United States Department of Agriculture

Compartment Fire Testing of a Two-Story Mass Timber Building

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Forest Service | Forest Products Laboratory | General Technical Report FPL–GTR–247 | May 2018

Abstract

Five full-scale fire experiments were conducted to observe the performance of a two-level apartment-style structure constructed of mass timber. Each level consisted of a one bedroom apartment, an L-shaped corridor, and a stairwell connecting the two levels. One of the primary variables considered in this test series was the amount and location of exposed mass timber. The amount of mass timber surface area protected by gypsum wallboard ranged from 100% to no protection. For each experiment, the fuel load was identical and the fire was initiated in a base cabinet in the kitchen. In the first three experiments, the fire reached flashover conditions, and subsequently underwent a cooling phase as the fuel load from combustible contents was consumed. The first three experiments were carried out for a duration of up to 4 h. In the fourth experiment, automatic fire sprinklers were installed. Sprinklers suppressed the fire automatically. In the fifth experiment, the activation of the automatic fire sprinklers was delayed by approximately 20 minutes beyond the sprinkler activation time in the fourth experiment to simulate responding fire service charging a failed sprinkler water system. A variety of instrumentation was used during the experiments, including thermocouples, bidirectional probes, optical density meters, heat flux transducers, directional flame thermometers, gas analyzers, a fire products collector, and residential smoke alarms. In addition, the experiments were documented with digital still photography, video cameras, and a thermal imaging camera.

The experiments were conducted in the large burn room of the Bureau of Alcohol, Tobacco, Firearms and Explosives Fire Research Laboratory located in Beltsville, Maryland, USA. This report provides details on how each experiment was set up, how the experiments were conducted, and the instrumentation used to collect the data. A brief summary of the test results is also included. Detailed results and full data for each test are included in separate appendices.

Keywords: fire, tall wood buildings, mass timber, compartment fire, fire dynamics

Most dimensional measurements were taken in American units and were later converted to metric units. Any inconsistencies between the two units are caused by rounding when converting from one system to the other.

Nominal lumber size (in.)	Standard lumber size (mm)
1 by 3	19 by 64
2 by 4	38 by 89
2 by 6	38 by 140
2 by 10	38 by 235

May 2018

Zelinka, Samuel L.; Hasburgh, Laura E.; Bourne, Keith J.; Tucholski, David R.; Ouellette, Jason P. 2018. Compartment fire testing of a two-story mass timber building. General Technical Report FPL-GTR-247. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 475 p.

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The Forest Products Laboratory is maintained in cooperation with the University of Wisconsin.

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This is a revised version. On page 16, 20 mm/min (0.50 gpm/ft^2) sprinkler flow rate was corrected to 2 mm/min (0.05 gpm/ft^2).

Compartment Fire Testing of a Two-Story Mass Timber Building

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Introduction

Because of advances in technology, new products, and building systems, the past decade has seen an increase in the ability and interest to build mid-rise and high-rise wood structures. However, the height of timber buildings permitted by prescriptive building codes the United States is six stories (ICC 2014). For mid- and high-rise wood buildings to be approved, they must follow a performance-based design or alternative solution approach, requiring that the design provides an equivalent or greater level of safety compared with the prescribed requirements. A limited number of these buildings have been approved for construction in the United States. Several tall wood buildings have been constructed internationally such as the 9-story Murray Grove building in London, the 10-story Forté Docklands in Melbourne, Australia, and the 18-story Brock Commons in Vancouver, Canada (Green and Karsh 2012, Lehmann 2012).

These buildings have been realized through the use of “mass timber” construction. Mass timber is a class of wood and wood composites that includes solid sawn timber, glue-laminated timber (glulam), structural composite lumber, and cross-laminated timber (CLT). CLT is made of dimensional lumber stacked in layers with each layer oriented 90° from the previous layer to form a massive panel. The panels range in size from approximately 50 to 500 mm (2 to 20 mm) thick and up to 18 m (60 ft) long and can be delivered to the jobsite with fenestrations precut (Mohammad and others 2012). The size, strength, and workability of CLT panels have allowed them to be used for both floor and wall systems in mass timber buildings.

To date, only a handful of tall (greater than six stories) mass timber buildings (tall wood buildings) have been constructed in North America. One reason for this is that current prescriptive provisions do not permit these buildings according to the height and area limitations set forth in the International Building Code (IBC). The International Code Council (ICC), which publishes the IBC, established an ad hoc committee (ICC-TWB) to study the issue of tall wood buildings and potential, future prescriptive provisions permitting tall wood buildings in the IBC. As part of this, a fire subgroup was established to examine possible issues pertaining to the fire safety of tall wood buildings and to perform research to address knowledge gaps in the fire performance of tall wood buildings.

In a previous research assessment, understanding the fire dynamics in compartments constructed with combustible materials was identified as one of the biggest research needs to achieve fire-safe, tall wood structures (Gerard and others 2013). In the research assessment, Gerard and others noted that in certain cases, a second flashover has been observed in wood structures. In general, second flashover occurs when passive fire protection falls off, thereby exposing a fresh, preheated surface of wood, which ignites and causes the heat release rate to rise (Osborne and others 2012, as cited in Brandon and Östman 2016). In CLT structures, a second flashover can occur when unburned wood is exposed to hot gases within the compartment if the gypsum wallboard falls off, if there is char fall-off from the CLT, or if there is delamination of a layer from the CLT. Whereas both char fall-off and delamination involve a portion of the charred CLT falling off and exposing a fresh surface, delamination is a term that is applied specially to failures that occur at the interlaminate interface (Osborne and others 2012, Brandon and Östman 2016). CLT delamination has been highlighted as an important research need because certain adhesives can fail at a temperature lower than the char temperature of wood (Frangi and others 2004, 2012; Craft and others 2008; König and others 2008; Tannert and others 2009; Clauß and others 2011a, 2011b; Klippel and others 2013; Lehringer and Gabriel 2014).

In response to the research needs assessment, Brandon and Östman (2016) conducted a literature review on compartment fires in mass timber structures, especially looking for what could be applied to better understand fire dynamics in tall wood buildings. They reviewed 41 different tests including compartments framed with light timber, light steel, and mass timber (including CLT). Of the 41 tests examined, 21 tests used some form of mass timber.

The largest tests performed had an area of 6.3 by 8.3 m (52.54 m^2) (20.7 by 27.2 ft (565.5 ft^2)) (Su and Lougheed 2014). The most extensive testing on CLT was in a series of tests performed at Carleton University (Ottawa, Ontario, Canada), which all used a compartment size of 3.5 by 4.5 m (15.75 m^2) (11.5 by 14.8 ft (169.5 ft^2)) (McGregor 2014, Medina Hevia 2014, Li and others 2015).

The tests performed at Carleton University examined the effects of passive protection on heat release rate and delamination of the CLT (McGregor 2014, Medina Hevia 2014, Li and others 2015). Importantly, it was determined that in a fully protected all-CLT compartment, the CLT does not contribute to the duration or intensity of the fire. When only one CLT wall was exposed (that is, not protected), the heat release rate was similar to that of a fully protected compartment and no second flashover occurred. When there were two exposed CLT walls, however, delamination and a second flashover occurred, regardless of whether the walls were adjacent or opposite of each other at 2.44 m (8 ft) apart. These tests give valuable insight into the potential contribution of exposed CLT surfaces to the fire dynamics of an all-CLT compartment. However, the compartment size tested was smaller than a typical apartment size, and therefore, the results need to be scaled to understand the fire dynamics in anticipated tall wood buildings.

Of the 41 tests examined in the literature review of Brandon and Östman (2016), only six used oxygen consumption calorimetry to determine the heat release rate, which is considered the most important variable used to evaluate fire hazard (Babrauskas and Peacock 1992). Li and others (2015) found that CLT compartments with passive fire protection had similar heat release characteristics to those of light-steel-framed compartments. Furthermore, in a completely unprotected all-CLT compartment (that is, all wall and ceiling CLT exposed), the total heat released was approximately double that of the encapsulated room, although the gas temperatures were similar to the encapsulated room.

In summary, the data on CLT compartments show that CLT does not contribute to the fire in fully protected compartments. Although there has been limited work exploring what happens when CLT surfaces are exposed, these tests have been performed on compartments that are smaller than traditional dwelling units and may or may not have had the heat release determined during the tests.

This report presents the results of five full-scale compartment fire tests performed under an oxygen calorimetry heat release rate hood on a two-story CLT building. The tests examined the effect of exposed walls and ceilings on a realistic, full-size apartment to better understand the contribution of CLT to a compartment fire, life safety of occupants, and firefighter safety. Additionally, two tests examined the effect of automatic sprinkler systems. The research was carried out in support of the mission of the ICC Ad Hoc Committee on Tall Wood Buildings.

Experiment Setup

Experiments were conducted inside of a structure designed to represent a two-story apartment building. The design was developed with the input and approval of the ICC Ad Hoc Committee on Tall Wood Buildings and was based on high-rise construction. Each apartment contained areas designated for a living room, kitchen, bedroom, bathroom, and utility–laundry room. A corridor ran along two sides of the apartment, with one end connecting to a stairwell and the other end opened to the laboratory space. The overall layout of each floor was identical, except for a doorway between the stairwell and the laboratory space on the first floor of the structure. Figure 1 is a plan view drawing of the test structure, illustrating the basic layout. Figure 2 is an elevation view of the front of the structure.

Each apartment was 9.14 m wide by 9.14 m deep by 2.74 m high (30 ft wide by 30 ft deep by 9 ft high). The L-shaped corridor was 1.52 m wide and 2.74 m high (5 ft wide and 9 ft high). The stairwell was 2.44 m wide by 4.88 m deep (8 ft wide by 16 ft deep).

Building Construction

An overview of the test structure is provided in this section. The test structure was built by Lendlease Corporation (Sydney, Australia) with industry-standard CLT construction methods and techniques according to the ICC Ad Hoc Committee on Tall Wood Buildings (TWB) proposed Type IV-A (test 1), IV-B (tests 2 and 3), and IV-C (test 4 and 5) construction. For the proposed Type IV-A, a 3-h fire resistance rating is required for primary structural frame and exterior bearing walls and a 2-h rating is required for floor construction. For proposed Type IV-B and IV-C, a 2-h fire resistance rating is required for the primary structural frame, exterior bearing walls, and floor construction.

Walls

The load-bearing walls of the test structure were made of CLT. The interior walls in the apartment were non-load-bearing walls and were constructed with metal studs, glulam columns, and gypsum wallboard. The walls of interest in this report are identified by the letters A through G, as illustrated in Figure 3. Walls A through F are CLT walls, and Wall G is an interior wall.

CLT Walls

The CLT structure was built with a balloon frame construction method, with the walls extending from the bottom of the first floor to the top of the second floor. Each complete wall was a series of CLT panels fastened together. Wall panels were connected together with half lap joints, with 152-mm- (6-in.-) long self-tapping screws at 203 mm

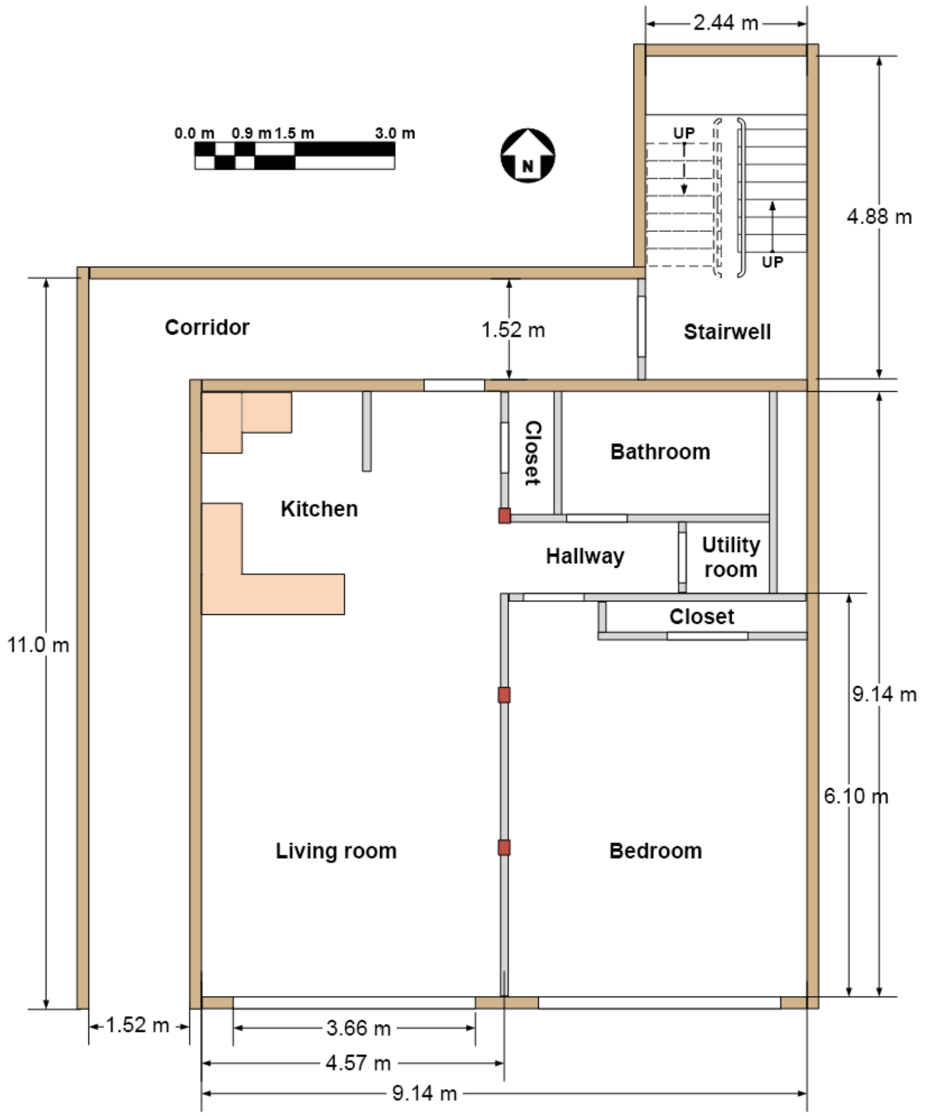


Figure 1. General plan view of cross-laminated timber test structure.

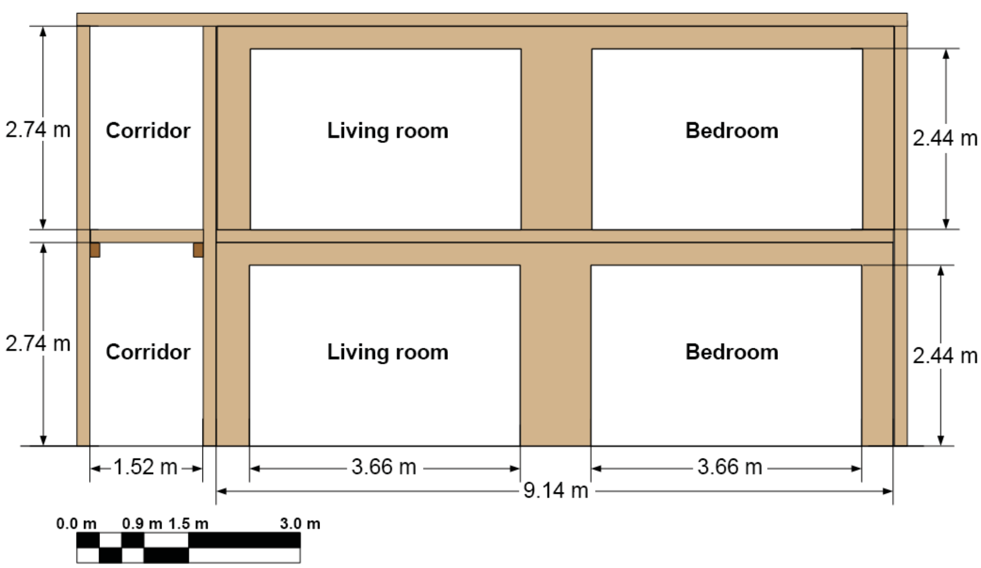


Figure 2. Elevation view of the front of the cross-laminated timber test structure.

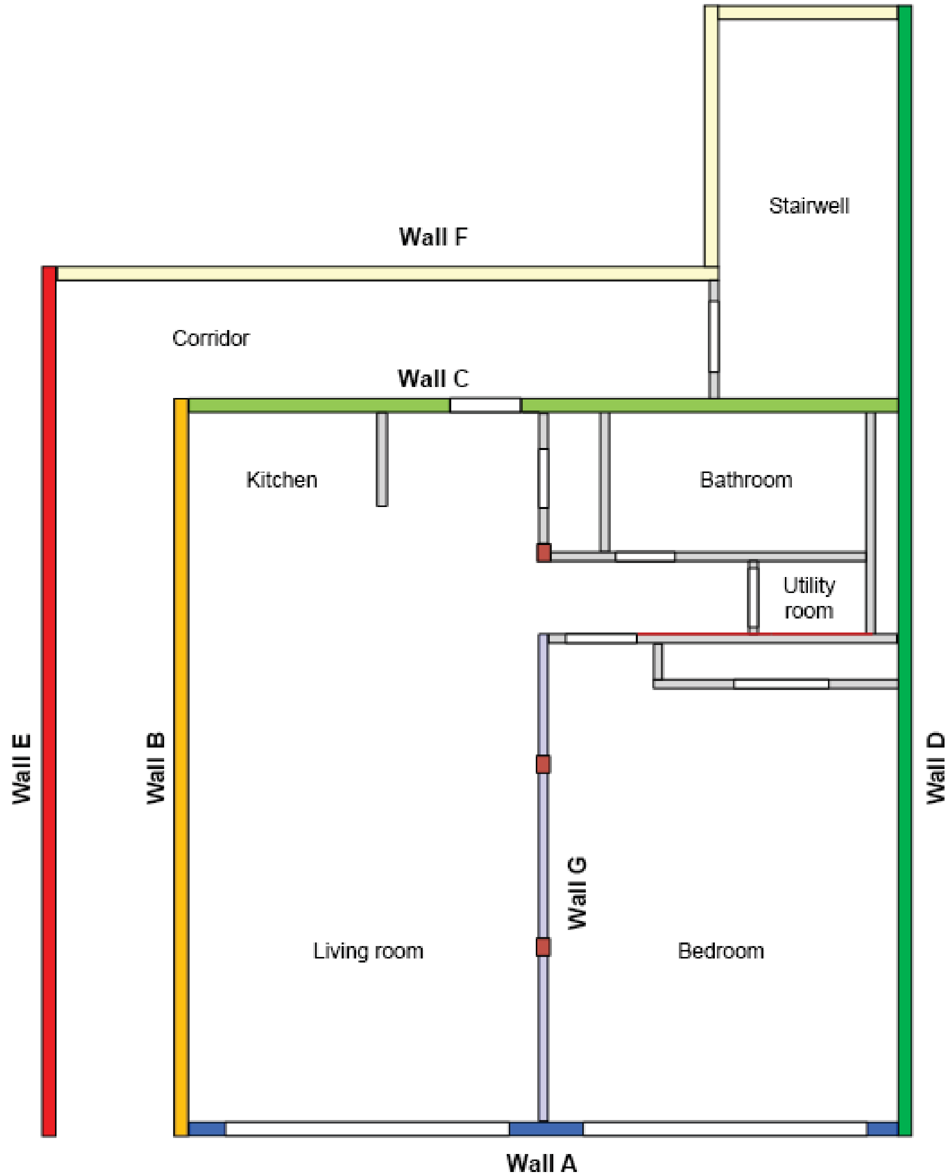


Figure 3. Letter designations for the walls.

(8 in.) on center along the joints. A continuous bead of intumescent caulk was applied at the panel interface along the half lap joints. The floor and roof panels were joined together with a spline joint. Self-tapping screws were installed at opposing 45° angles, 607 mm (24 in.) on center, and staggered on each side of the joint. The CLT wall panels ranged in size up to 2.44 m (8 ft) wide and approximately 5.79 m (19 ft) tall. The wall panels were installed using a crane and variable reach fork lift. Figure 4 shows one of the wall panels being installed.

The structure had six walls constructed of CLT. The walls consisted of five-ply CLT, resulting in a total thickness of approximately 175 mm (6.89 in.). The CLT was manufactured with Douglas Fir-Larch and a polyurethane adhesive. Figure 5 shows a cross section of a CLT panel.

Walls B, E, and F did not contain any fenestrations. Wall C contained an opening for the apartment door. Wall D contained a doorway from the stairwell to the laboratory space on the first floor (not shown in Fig. 3). Wall A contained two openings on each floor, and each opening measured 3.66 m wide by 2.44 m high (12 ft wide by 8 ft high). A large opening also existed in the corridor that was created between Walls B and E. The opening in the corridor measured approximately 1.52 m wide by 2.74 m high (5 ft wide by 9 ft high).

Interior Walls

Interior walls were used to define spaces within the apartment (Fig. 1). The interior walls were framed with steel studs and then covered with a single layer of 12.7-mm-(1/2-in.-) thick gypsum wallboard (UltraLight Brand

Figure 4. Installation of a cross-laminated timber wall panel.

Figure 5. Cross section of the five-ply cross-laminated timber panel.

Sheetrock, USG Corporation, Chicago, Illinois, USA) on each side of the metal studs. The wallboard seams and joints were taped and covered with joint compound. The walls were not painted.

Floor–Ceiling

First-Level Floor

The test structure was built directly on the concrete floor of the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) Fire Research Laboratory (FRL) large burn room. Therefore, no CLT floor assembly was present on the first floor of the structure. To protect the concrete floor during the tests, two layers of 12.7-mm- (1/2-in.-) thick cement board (Durock Brand Cement Board, USG Corporation) were placed on top of the concrete floor. The cement boards were staggered to overlap the seams.

Second-Level Floor

The second-level floor in the apartment and corridor was constructed of the same five-ply CLT as the CLT walls. The floor in the apartment was a series of CLT panels fastened together, and each panel spanned the width of the apartment from Wall B to D. Figure 6 shows one of the floor panels being installed. Each floor panel in the apartment was 9.14 m (30 ft) long and ranged up to 2.44 m (8 ft) wide.

Figure 6. Installation of a second-level floor panel.

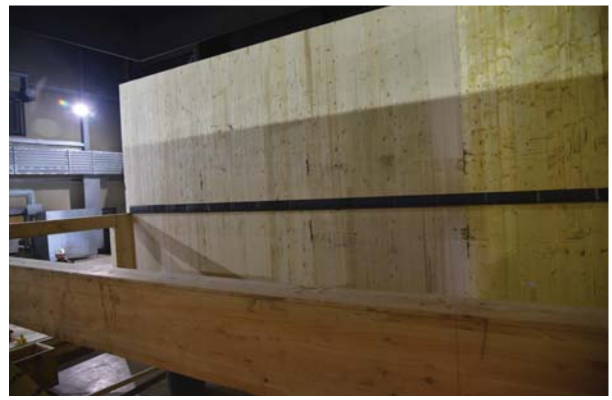


Figure 7. Steel angle located on Wall B to support the second-level floor in the apartment.

The floor in each corridor was a single CLT panel that was 1.52 m (5 ft) wide and ranged up to approximately 9.45 m (31 ft) long. The CLT floor assemblies were protected on top with two layers of 12.7-mm- (1/2-in.-) thick cement board (Durock Brand Cement Board, USG Corporation) to simulate the protection from a typical noncombustible subfloor layer such as gypsum concrete. The cement boards were staggered to overlap the seams.

The CLT used in the second-level floor was elevated 2.74 m (9 ft) above the first floor with a combination of support methods, including steel angles, glulam ledgers, and glulam beams and support columns.

Steel Angle

The second-level apartment floor was supported along Wall B with sections of steel angle (Fig. 7). The steel angle was 178 mm high by 102 mm wide by 9.5 mm thick (7 in. high by 4 in. wide by 3/8 in. thick). Each section of steel angle was 610 mm (24 in.) long.

As shown in Figure 8, the bottom of the CLT floor panel was notched, which allowed the CLT panel to be approximately flush with the bottom of the steel angle. After the second-level floor was installed, the bottom of the steel angle was protected with 2 by 10 dimension lumber (Fig. 9).

Figure 8. Cross-laminated timber floor panel on steel angle.

Figure 10. Ledger on Wall D to support second-level floor in the apartment.

Figure 9. Wood covering bottom of steel angle.

Figure 11. Second-level floor on top of the ledger.

The seams and joints along the 2 by 10 dimension lumber were sealed with an intumescent firestop sealant (FS-One Max, Hilti Corporation, Schaan, Liechtenstein), which can also be seen in Figure 9.

Ledger

The second-level apartment floor was supported along Wall D with a ledger (Fig. 10). The ledger consisted of five-ply glulam timber and was approximately 187 mm high by 130 mm wide (7-3/8 in. high by 5-1/8 in. wide). The bottom of the floor panel sat on top of the ledger (Fig. 11). The seams and joints along the ledger were sealed with an intumescent firestop sealant (FS-One Max).

The floor in the corridors was also supported with glulam ledgers. Ledgers were located on Walls E and B and on Walls F and C. Figure 12 shows the ledgers along Walls C and F.

Midspan Beam and Support Columns

The second-level apartment floor was supported midspan with glulam beams and support columns (Fig. 13). The midspan beam consisted of nine-ply glulam timber and was

Figure 12. Ledgers in the corridor along Walls C and F.

Figure 13. Original midspan beams and support columns on the first floor.

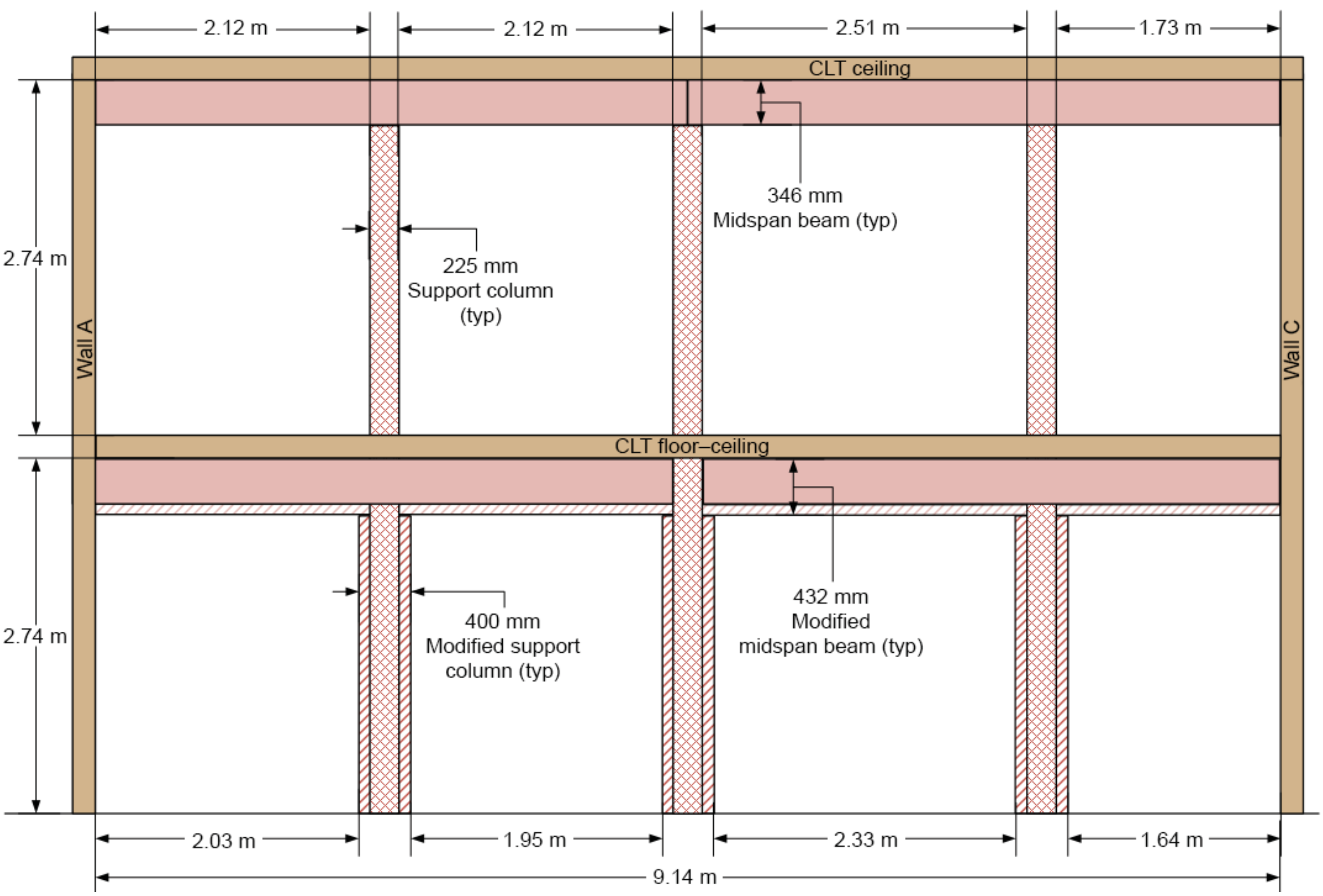


Figure 14. Cross-sectional view of apartment showing locations of support columns.

divided into two sections. Each section was approximately 4.46 m (14.7 ft) long, and the beam was 346 mm high by 171 mm wide (13-5/8 in. high by 6-3/4 in. wide). As illustrated in Figure 14, the first beam spanned from Wall A to the side of the middle support column and the second beam spanned from the side of the middle support column to Wall C. The three support columns consisted of six-ply glulam timber and were approximately 225 mm wide by 171 mm deep (8-7/8 in. wide by 6-3/4 in. deep). The middle column was 2.74 m (9 ft) tall, and the other two columns were approximately 2.41 m (7 ft 11 in.) tall. The seams and joints at connections between the beam and support columns were sealed with an intumescent firestop sealant (FS-One Max).

The beams and support columns on the first level were protected with additional wood cover to achieve a 2-h fire resistance rating, designed in accordance with Chapter 16 of the National Design Specification (NDS). Therefore, total depth of the beams on the first level was approximately 432 mm (17 in.) and total width was approximately 343 mm (13-1/2 in.). Support columns on the first level had a total width of approximately 400 mm (15-3/4 in.) and a depth of approximately 343 mm (13-1/2 in.). This additional wood protection was added to the beams and columns on the first level because they were exposed (that is, no gypsum wallboard protection) in Test 4 and Test 5. Figure 15 shows the wood protection added to the support columns and beams on the first level. Figure 16 shows the protected beams and support columns. Although not shown in Figure 16, the seams and joints formed by adding the additional material were sealed with an intumescent firestop sealant (FS-One Max).

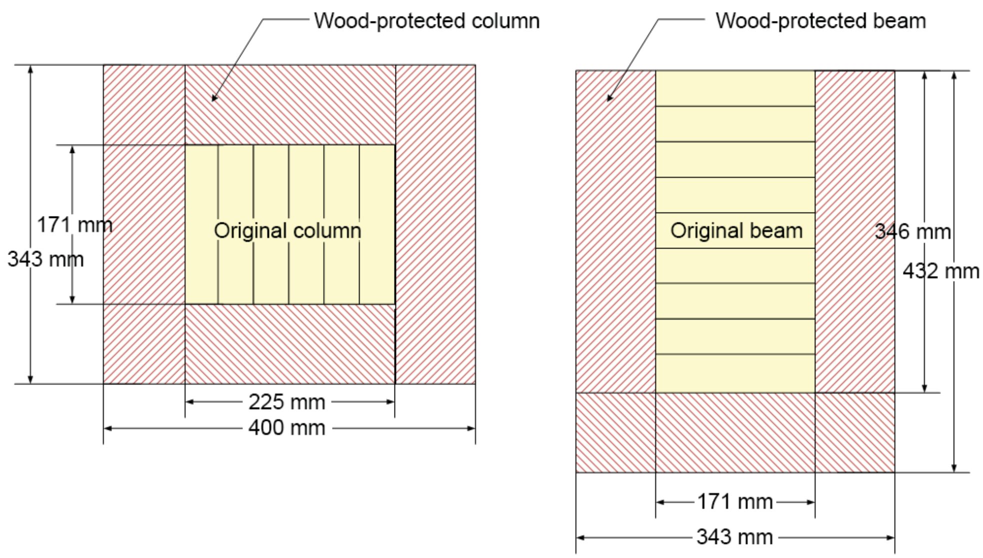


Figure 15. Cross-sectional view of a support column and midspan beam illustrating the wood protection added to achieve a 2-h fire resistance rating.

Figure 16. Wood-protected support columns and beams on first floor.

Second-Level Ceiling

The second-level ceiling was constructed of the same five-ply CLT as the CLT wall and floor assemblies. The ceiling was a series of CLT panels fastened together. Each panel spanned the entire width of the structure from Wall E to D. Figure 17 shows a ceiling panel being installed. The panels ranged up to approximately 11.3 m (37 ft) long and up to 2.44 m (8 ft) wide. The exterior surface of the CLT ceiling assembly (that is, the “roof” of the test structure) was protected with two layers of 12.7-mm- (1/2-in.-) thick cement board (Durock Brand Cement Board, USG Corporation) to simulate protection from a typical noncombustible subfloor layer such as gypsum concrete, which would generally be present on the level above in an actual tall wood building.

The CLT used in the second-level ceiling was elevated 2.74 m (9 ft) above the CLT floor. The ceiling panels were placed on top of the CLT walls; therefore, no additional supports were required at the edges of the ceiling panels. The seams and joints formed between the ceiling panels and the walls were sealed using an intumescent firestop sealant (FS-One Max). Figure 18 illustrates the interface between ceiling panels and the CLT wall. The ceiling was also supported midspan in the apartment by a support beam and columns (Fig. 19). The glulam support beam and columns were identical to the original ones discussed in the previous section. However, the beams and columns on the second level were protected with two layers of 15.9-mm (5/8-in.) Type X gypsum wallboard for each of the tests performed on that level. No additional wood protection was added to them. Figure 14 illustrates the location of the support columns on the second-level floor.

A 1.22-m- (4-ft-) high section of wall was constructed on the ceiling panel along Wall A (Fig. 20). This additional wall was built to simulate a portion of a third level. The wall was framed using standard dimensional 2 by 4 lumber and was sheathed with two layers of 15.9-mm- (5/8-in.-) thick fire-rated (Type X) gypsum wallboard.

Figure 17. A second-level ceiling panel being installed.

Figure 18. Second-level ceiling supported by Wall D.

Figure 19. Support beam and columns on the second floor.

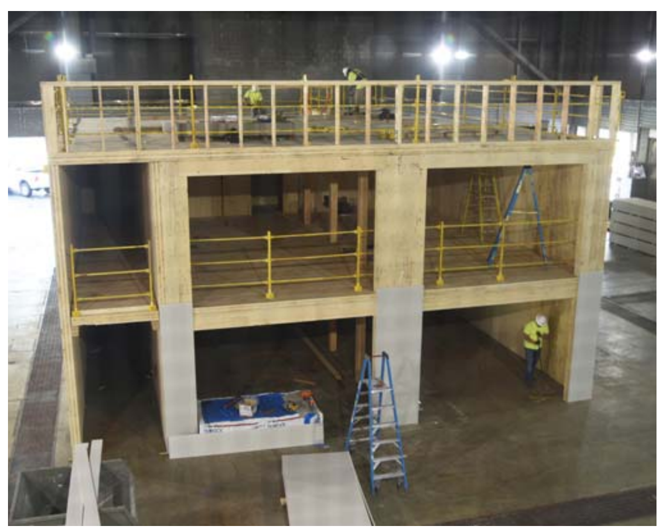


Figure 20. Partial wall constructed along the top of Wall A.

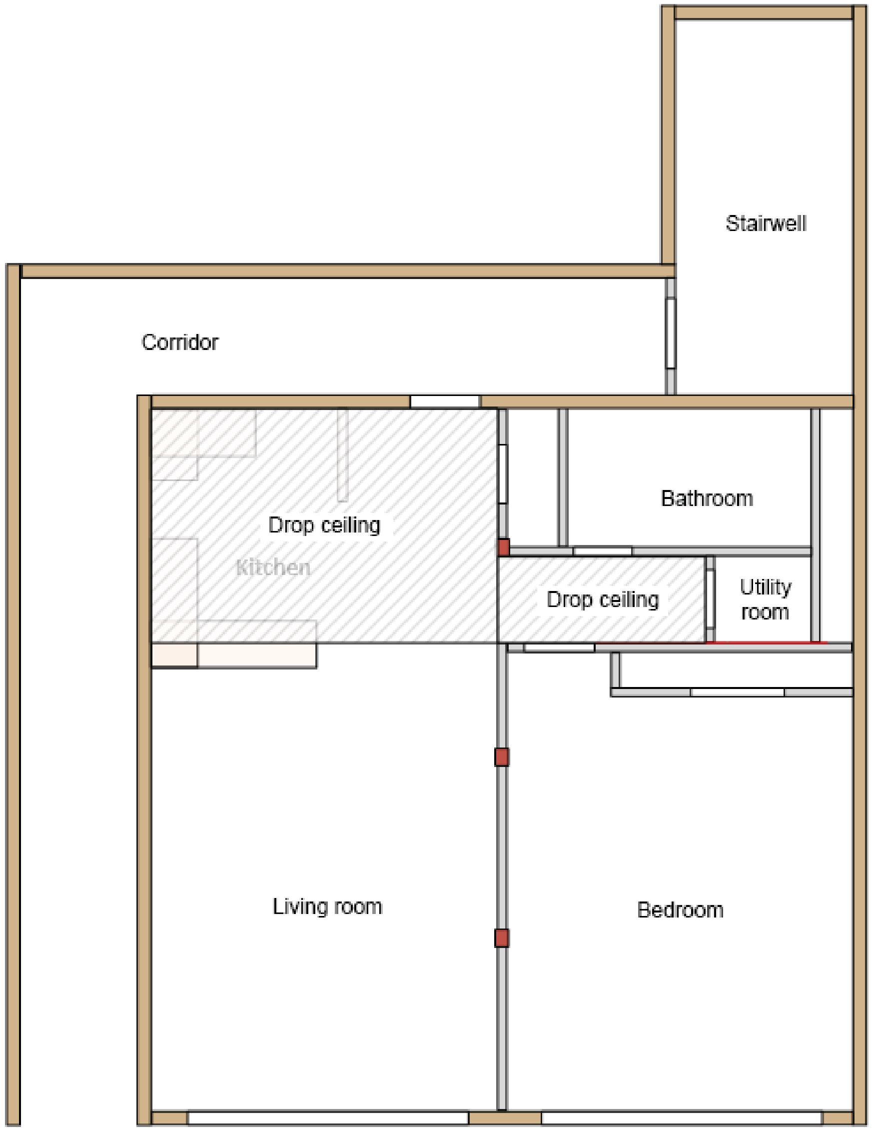


Figure 21. Drop ceiling locations.

Figure 22. Drop ceiling in the kitchen.

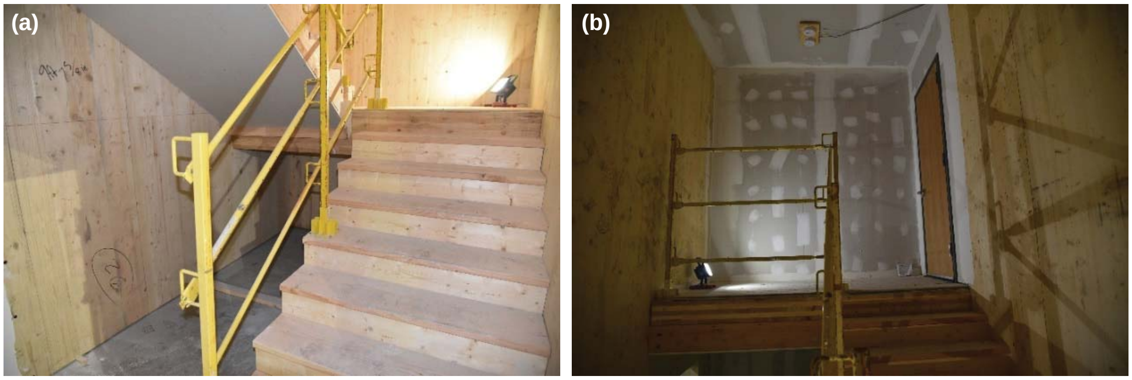


Figure 23. Stairwell: (a) first floor; (b) second floor.

Drop Ceiling

The nominal height between the floor and the CLT ceiling was 2.74 m (9 ft). The exception to this was in the kitchen area and in the hallway between the bedroom and the bathroom. As illustrated in Figure 21, these two areas had a drop ceiling. The drop ceiling was framed using metal studs and sheathed with a single layer of 12.7-mm- (1/2-in.-) thick gypsum wallboard. The nominal height between the floor and the drop ceiling was approximately 2.44 m (8 ft). Figure 22 shows the drop ceiling in the kitchen. The CLT above the drop ceiling was protected with two layers of 15.9-mm- (5/8-in.-) thick fire-resistant gypsum wallboard (Type X); the ICC code proposal states that all combustible surfaces within concealed spaces should be protected with noncombustible protection.

Stairwell

A stairwell was located on the northwest corner of the test structure and was connected to the corridor on each level. The stairwell was 2.44 m wide by 4.88 m long by approximately 5.79 m high (8 ft wide by 16 ft long by 19 ft high). Figure 23 shows the stairwell. A 0.9-m- (36-in.-) wide door with a fire protection rating of 90 min was located between the stairwell and the corridor. The door was hung in a metal frame and had an automatic door closer (Fig. 24). In addition to the fire door assembly, a doorway was located on the west wall (Wall D) of the stairwell on the first level, which opened to the laboratory space (Fig. 25).

Figure 24. Fire door assembly between corridor and stairwell.

Figure 25. Doorway in stairwell.

Doors

A fire door assembly was located between the apartment and the corridor (Fig. 26). The 914-mm- (36-in.-) wide door had a fire protection rating of 20 min. The door was hung in a metal frame, and it had an automatic door closer. This door was purposely propped open for Test 5 but left closed in all other tests.

In addition to the fire door assembly, the apartment had five standard, hollow-core interior doors. The bedroom and the bathroom each had a 0.9-m- (36-in.-) wide door. The closet near the apartment entrance and the utility room each had

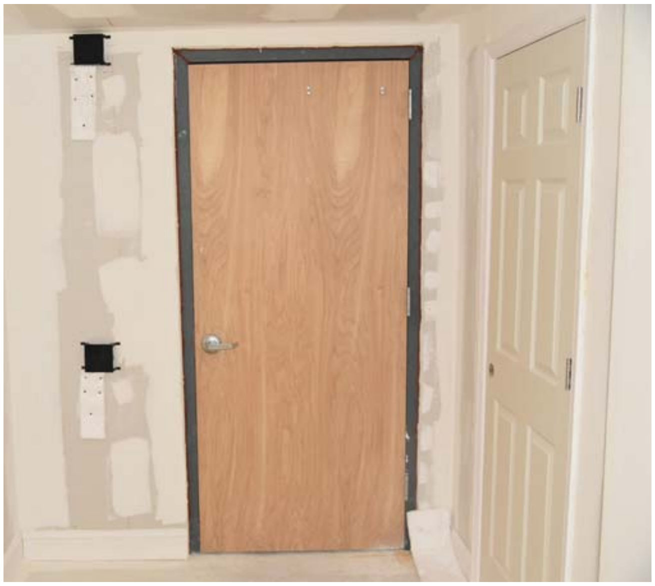


Figure 26. Fire door assembly in apartment.

Figure 27. Window installed in Wall A for Tests 4 and 5.

a 0.76-m- (30-in.-) wide door. The bedroom closet had a double door with an overall width of 1.2 m (48 in.).

Windows

Wall A had two large openings on each floor, one in the bedroom and one in the living room. Each opening measured 3.66 m wide by 2.44 m high (12 ft wide by 8 ft high). For Tests 4 and 5, tempered glass that was 6.35 mm (1/4 in.) thick was installed in each opening. A metal window frame with plastic trim was used to secure the glass. As shown in Figure 27, the window frame divided the opening into three sections. Each opening in the window frame was approximately 1.15 m (3.78 ft) wide by 2.34 m (7.67 ft) high.

HVAC, Electrical, and Plumbing Components

Although the test structure was designed to look like an apartment, it did not have functional utilities, such as electricity or water. However, for the first two tests, several components were included in the structure that were associated with a heating, ventilation, and air conditioning (HVAC) system, an electrical system, and a plumbing system.

HVAC System

Metal ducts were placed in the void space in the drop ceiling above the kitchen and in the hallway to simulate part of an HVAC system. Three sections of 203-mm- (8-in.-) diameter metal duct were used but were not connected to anything. Two ducts terminated at an opening into the living room, and one duct terminated at an opening to the bedroom. Each opening was covered with an air grille that was 254 by 254 mm (10 by 10 in.). Figure 28 shows the air grilles in the living room.

Figure 28. HVAC duct openings in drop ceiling.

Electrical System

To simulate electrical wiring in the apartment, metal conduit, electrical boxes, and receptacles were placed within Wall G and behind the baseboard along Walls B and D. Figure 29 shows the electrical components placed in Wall G between the living room and the bedroom. Figure 30 shows the electrical components placed behind the baseboard along Wall B in the living room.

Plumbing System

Several penetrations were made through the second level floor to simulate plumbing penetrations between the floors. For Tests 1 and 2, penetrations were made in the bathroom, utility room, and kitchen. Plumbing pipes were placed through the penetrations and were visible on the first and second floors (Figs. 31 and 32). In the kitchen, the plumbing pipes were not visible on the first floor because the pipes were hidden within the void space of the drop ceiling.

Figure 29. Electrical components in Wall G.

Figure 30. Electrical components along Wall B in the living room.

Figure 31. Plumbing penetrations in the utility room on second-floor level.

Figure 32. Plumbing penetrations in the utility room on the first-floor level.

Firestop plugs (CFS-PL 2”, Hilti) and firestop foam (Fire Foam CP620, Hilti) were used to seal the voids spaces around the pipes.

Passive Fire Protection

Fire-Resistant Gypsum Wallboard

Two layers of 15.9-mm- (5/8-in.-) thick fire-resistant gypsum wallboard (Sheetrock Brand Firecode X Type X, USG Corporation) were used as passive fire protection on various mass timber surfaces in each test. The gypsum wallboard was staggered during installation to overlap the seams. All drywall seams were taped and finished with joint compound.

Certain sections of mass timber within the test structure were protected with two layers of 15.9-mm- (5/8-in.) gypsum wallboard in all five tests. These sections included both the walls and ceiling in the kitchen, bathroom, utility room, and corridors and the ceiling in both the hallway and bedroom closet. Also, a portion of the stairwell was protected. Prior to the interior walls being constructed, the gypsum wallboard was installed on the CLT ceiling and walls in these areas. Passive protection of the other CLT wall and ceiling surfaces varied by experiment and is summarized in Table 1.

During Test 1, all mass timber surfaces were fully covered with passive protection. There were no exposed mass timber surfaces.

During Test 2, a portion of the ceiling in the living room and bedroom was exposed. Each exposed CLT section was 2.74 m wide by 3.05 m long (9 ft wide by 10 ft long), which represented 30% of the total ceiling in these areas. Figure 33 shows the exposed CLT on the living room ceiling. Also shown in Figure 33 is the wood trim that was used to protect the edge of the gypsum wallboard. As illustrated in Figure 34, the trim consisted of 2 by 4 dimension lumber that was placed along the edge of the gypsum wallboard. 2 by 6 dimension lumber was then placed on top, covering the 2 by 4 lumber and gypsum wallboard edge. The gaps

Table 1—Summary of cross-laminated timber wall and ceiling surfaces that were either exposed or protected with Type X gypsum wallboard during each experiment

Test	Wall A	Wall B	Wall C	Wall D	Ceiling
1	Protected	Protected	Protected	Protected	Protected
2	Protected	Protected	Protected	Protected	Partially exposed in living room and bedroom
3	Protected	Exposed in living room	Protected	Exposed in bedroom	Protected
4	Protected	Exposed in living room	Protected	Exposed in bedroom	Exposed in living room and bedroom
5	Protected	Exposed in living room	Protected	Exposed in bedroom	Exposed in living room and bedroom

Figure 33. Exposed cross-laminated timber ceiling in the living room for Test 2.

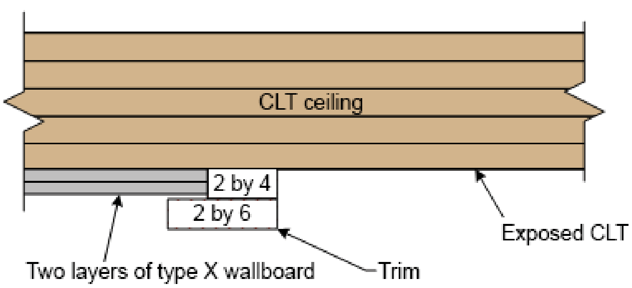


Figure 34. Trim added to exposed cross-laminated timber ceiling to protect edge of gypsum wallboard.

and seams around the trim, particularly the gap between the top edge of the 2 by 6 and the bottom surface of the gypsum wallboard, were sealed with an intumescent firestop sealant.

During Test 3, Wall B in the living room was exposed, as was Wall D in the bedroom. Figure 35 shows the exposed CLT wall in the living room (Wall B). The edge of the gypsum wallboards that ended at the exposed CLT wall was protected by placing a section of 2 by 4 dimension lumber or 2 by 6 dimension lumber there.

Figure 35. Exposed cross-laminated timber wall in the living room for Test 3.

Figure 36. Exposed cross-laminated timber ceiling and glulam support columns and beams in the living room for Tests 4 and 5.

Figure 37. Exposed ledger in the bedroom for Tests 4 and 5.

Figure 38. Exposed wood covering angle iron in the living room for Tests 4 and 5.

Figure 39. Wood trim placed along the edge of the gypsum wallboard on the ceiling.

Figure 40. Cross-laminated timber joints sealed with intumescent firestop sealant.

In Tests 4 and 5, all CLT walls and ceilings in the living room and bedroom were exposed. The glulam support columns and midspan beams were also exposed (Fig. 36). Although a portion of each column and beam was concealed by the steel stud infills of Wall G, the infills were unrated. In addition, the ledger and the wood covering the angle iron were also exposed, as shown in Figures 37 and 38, respectively.

Also in Tests 4 and 5, a small portion of the ceiling in the bedroom near the door and the closet were covered with gypsum wallboard. The edge of the wallboard next to the exposed CLT was protected with a section of dimensional 2 by 4 lumber that was placed along the edge of the wallboard (Fig. 39).

Firestop Sealants

Several different firestop sealants were used to inhibit the passage of smoke and flames through other penetrations in the CLT panels and between the CLT panel assemblies. An intumescent firestop sealant (FS-One Max) was used at various locations throughout the structure to fill any gaps formed between adjacent CLT assemblies and at other locations where hot gasses could otherwise pass through an assembly. Figure 40 shows an example of where the firestop sealant was applied. Firestop plugs (CFS-PL 2”, Hilti Corporation) and firestop foam (Fire Foam, CP620, Hilti Corporation) were also used to seal the annular spaces within penetrations such as those for the pipes supplying water to the fire suppression system.

Active Fire Protection

A fire sprinkler system was installed in the first floor apartment for Tests 4 and 5. The sprinklers were designed in accordance with National Fire Protection Association (NFPA) Standard 13, with a design area density of 2 mm/min (0.05 gpm/ft^2) (light hazard). This design density is less than that which would be required by code for this type of structure and can be conservatively applied to code-compliant tall mass timber construction. The sprinkler system was designed and installed by DC Fire Protection, LLC (Washington, DC, USA). Figure 41 provides the general layout of the sprinkler heads. Pendent-style sprinkler heads were placed in the interior areas of the apartment (kitchen, hallway, and utility room). Sidewall-type sprinkler heads were installed along the walls in the living room, bedroom, and bathroom. Details of the sprinkler heads are provided in Table 2.

The sidewall sprinklers in the living room were located approximately 0.25 m (99 in.) above the finished floor. The sidewall sprinklers in the bedroom were located approximately 0.24 m (94 in.) above the finished floor. The pendent sprinklers in the kitchen and the hallway were located approximately 50.8 mm (2 in.) below the drop ceiling or approximately 0.22 m (87 in.) above the finished floor. Although a drop ceiling was not present in the utility room, the pendent sprinkler was also located approximately 0.22 m (87 in.) above the finished floor.

A 102-mm- (4-in.-) diameter steel standpipe was located on the exterior of Wall D. Near the bottom of the standpipe was a shutoff valve and a connection for a fire hose. Near the top of the standpipe was a 38.1-mm (1-1/2-in.) steel pipe that connected the standpipe to the sprinkler circuit. The cross mains for the sprinkler circuit consisted of 38.1-mm- (1-1/2-in.-) diameter steel pipe, and the branch lines were 25.4-mm- (1-in.-) diameter steel pipe. All fittings were threaded.

The sprinkler system was connected to an isolated water supply (blue water) in the laboratory, which was separate from the municipal water supply. The standpipe on the test structure was connected to one of the blue water standpipes in the laboratory using two sections of 63.5-mm- (2-1/2-in.-) diameter fire hose, which were each 15.2 m (50 ft) long. The static water pressure in the blue water standpipe varied, based on the number of diesel pumps operating. Prior to sprinkler activation, the static pressure was approximately 1.1 MPa (160 lb/in^2).

For Test 4, the entire sprinkler system was charged with water prior to the start of the test. For Test 5, the entire system was not charged with water, to prevent the sprinklers from activating before the desired delay time had occurred. When it was time to activate the sprinklers during Test 5, a valve on the blue water standpipe was manually opened, allowing water to flow to the test structure.

Fuel Load

The fuel load for each experiment consisted of a variety of items and included furniture, kitchen cabinets, wood cribs, sheets of oriented strand board (OSB), and other miscellaneous items, such as books and plastic shelves. The calculated average fuel load provided by the furniture, books, cabinets, combustible flooring (OSB), and additional lumber and wood cribs was 550 MJ m^{-2}. If the additional fuel load of the paper on the gypsum wall board is included in the calculation, the total fuel load was 570 MJ m^{-2}. Thus, the specified fuel load of 550 MJ m^{-2}, as established by the ICC Ad Hoc Committee on Tall Wood Buildings, was met or exceeded in each test.

Furniture

Table 3 provides a summary of the furniture used in each experiment. Figure 42 is a sketch showing the general location of the furniture items in the apartment. For a given test, the exact location may have varied slightly, but the item would have still been in the same general location. Figures 43 and 44 show the furniture as positioned in the living room and bedroom, respectively, for Test 1.

Kitchen Cabinets

Cabinets were installed in the kitchen along Wall B, Wall C, and between the living room and kitchen. Details of the base cabinets and wall cabinets are provided in Table 4. The cabinets were obtained from two suppliers because of a lack of inventory at any one supplier. Therefore, information from both suppliers is provided in Table 4. The kitchen countertop for the base cabinets was simulated using 19.1-mm- (3/4-in.-) thick plywood.

Figure 45 shows the layout of the wall cabinets and the base cabinets. The bottom of the wall cabinets was installed approximately 0.46 m (18 in.) above the kitchen countertop, which resulted in a gap of approximately 0.25 m (10 in.) between the top of the cabinets and the drop ceiling. Figure 46 shows the cabinets as installed in the kitchen.

Additional Wood

Additional wood was added in the test structure to achieve the target fuel load specified by the ICC Ad Hoc Committee on Tall Wood Buildings. The additional wood included 20 sheets of 1.22-m-wide by 2.44-m-long by 11.1-mm-thick (4-ft-wide by 8-ft-long by 7/16-in.-thick) OSB. The OSB sheets, which were used to simulate a combustible floor covering by providing a similar amount of fuel load to that of hardwood flooring, were placed on top of the cement board, which made up the finished floor of the test structure. In addition, 300 pieces of 1 by 3 dimension lumber that was 2.44 m (8 ft) long were used. The 1 by 3 lumber was cut into smaller pieces and used for the wood slats in the bed frame and to make wood cribs. The wood cribs were placed

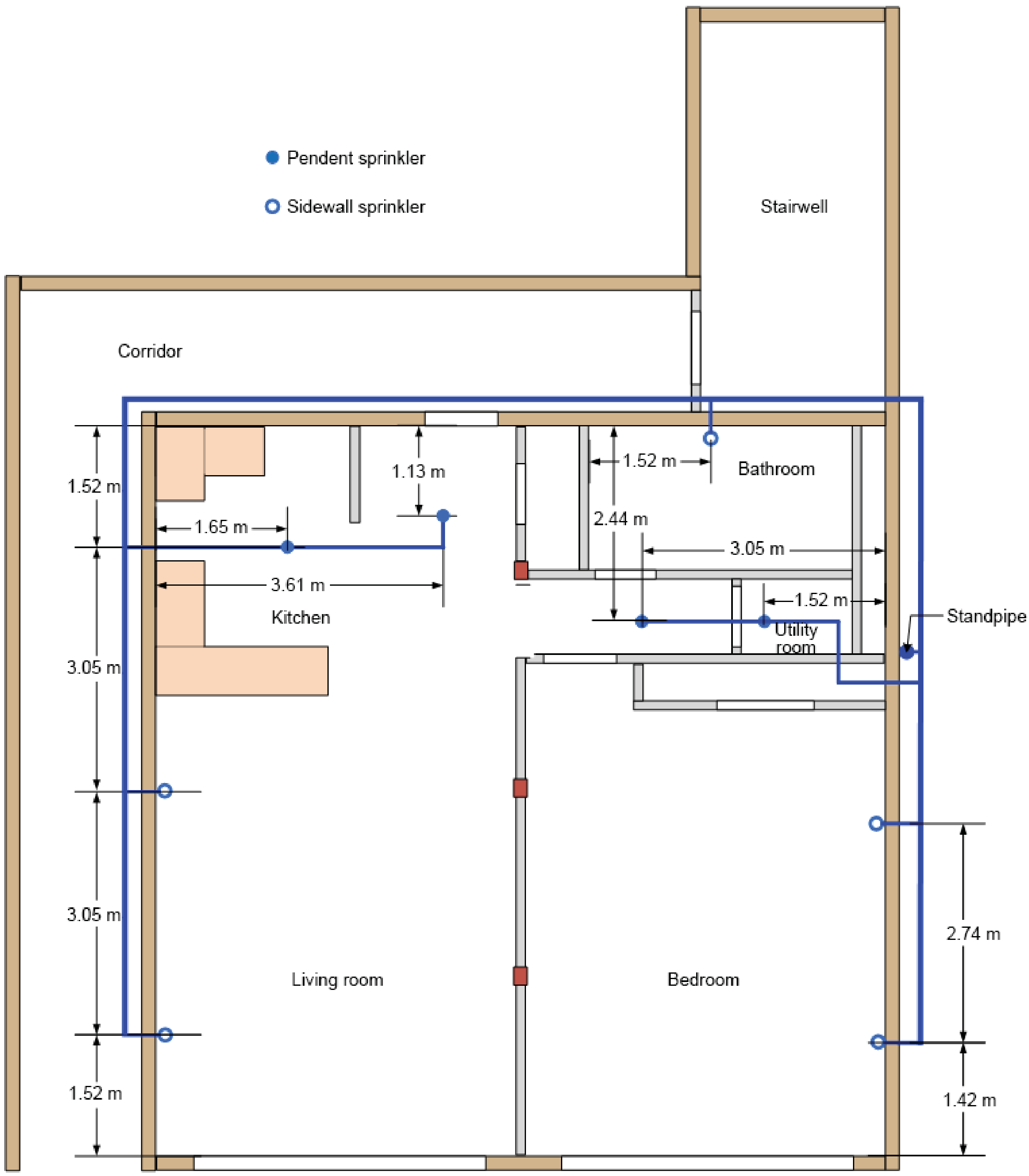


Figure 41. Sprinkler layout.

Table 2—Sprinkler head details

Type	Manufacturer	Model	K factor Lpm/bar$^{1/2}$ (gpm/psi$^{1/2}$)	Temperature °C (°F)	Quantity
Pendent	Globe[a]	GL3010	43.2 (3.0)	68.4 (155)	4
Sidewall	Tyco[b]	TY1334 Rapid Response	60.6 (4.2)	68.4 (155)	5

[a]Globe Fire Sprinkler Corporation, Standish, Michigan, USA.
[b]Tyco Fire Products, Lansdale, Pennsylvania, USA.

Table 3—Furniture

Description	Quantity	Supplier	Model	Item
Table	1	IKEA	Gamleby	602.470.27
Chairs	7	IKEA	Harry	201.058.31
Bookcases	4	IKEA	Billy	002.638.50
TV units	1	IKEA	Hemnes	702.970.45
8-drawer dresser	2	IKEA	Hemnes	003.185.98
Armchair frame	3	IKEA	Jennylund	300.475.48
Armchair cushions	3	IKEA	Jennylund	–
Sofa frame	2	IKEA	Ektorp	401.850.30
Sofa cushions	2	IKEA	Ektrop	–
Coffee table	1	IKEA	Hemnes	803.817.36
Night stands	7	IKEA	Tarva	502.196.09
Bed frame	2	IKEA	Hemnes	202.421.02
Mattress	2	IKEA	Morgedal	802.773.82
Desk	1	IKEA	Hemnes	502.821.44
Add-on unit for desk	1	IKEA	Hemnes	202.821.26

[a]IKEA, Leiden, The Netherlands.

Figure 42. General location of furniture.

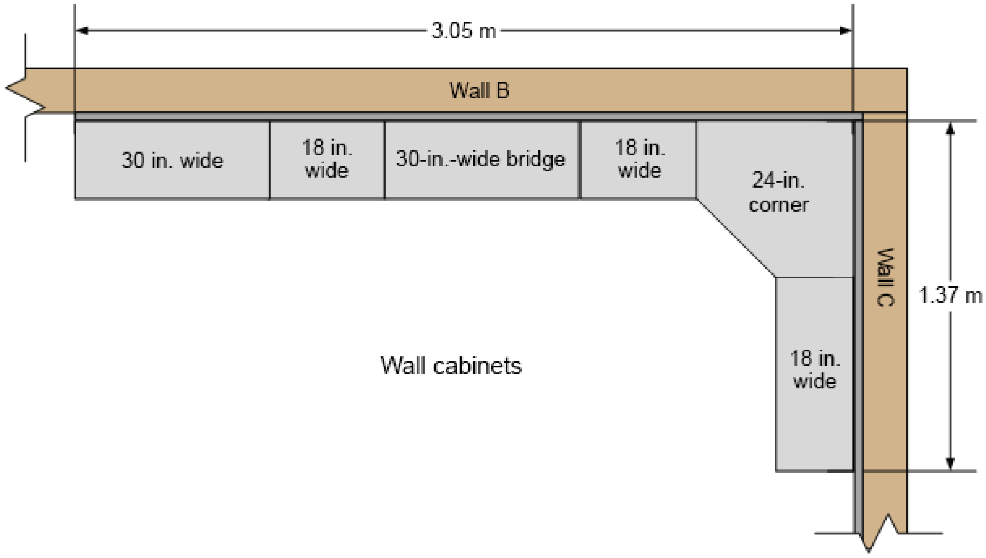
Table 4—Kitchen cabinets

Description	Quantity	Supplier	Model	Item number
12-in.-wide base cabinet 305 mm wide by 889 mm tall by 610 mm deep (12 in. wide by 35 in. high by 24 in. deep)	2	Lowe's and Home Depot[a]	33 B12R B12OHD	336303 235119
60-in.-wide sink base cabinet 1.52 m wide by 889 mm tall by 610 mm deep (60 in. wide by 35 in. high by 24 in. deep)	1	Lowe's and Home Depot	33 SB60B SB60OHD	365987 369062
30-in.-wide base cabinet 762 mm wide by 889 mm tall by 610 mm deep (30 in. wide by 35 in. high by 24 in. deep)	2	Lowe's and Home Depot	33 B30B B30OHD	336288 356528
30-in.-wide wall cabinet 762 mm wide by 762 mm high by 305 mm deep (30 in. wide by 30 in. high by 12 in. deep)	2	Lowe's and Home Depot	33 W3030B W30300HD	336276 379839
24-in.-wide corner wall cabinet 610 mm wide by 762 mm high by 305 mm deep (24 in. wide by 30 in. high by 12 in. deep)	1	Lowe's and Home Depot	33 DC2430R W2430OHD	336287 377881
30-in.-wide bridge cabinet 762 mm wide by 305 mm high by 305 mm deep (30 in. wide by 12 in. high by 12 in. deep)	1	Home Depot	W3012OHD	756067
18-in.-wide wall cabinet 457 mm wide by 762 mm high by 305 mm deep (18 in. wide by 30 in. high by 12 in. deep)	2	Home Depot	W1830OHD	377811

[a]Lowe's Companies, Inc., Mooresville, North Carolina, USA; The Home Depot, Inc., Atlanta, Georgia, USA

Figure 43. Furniture and wood cribs in living room.

Figure 44. Furniture and wood cribs in bedroom.



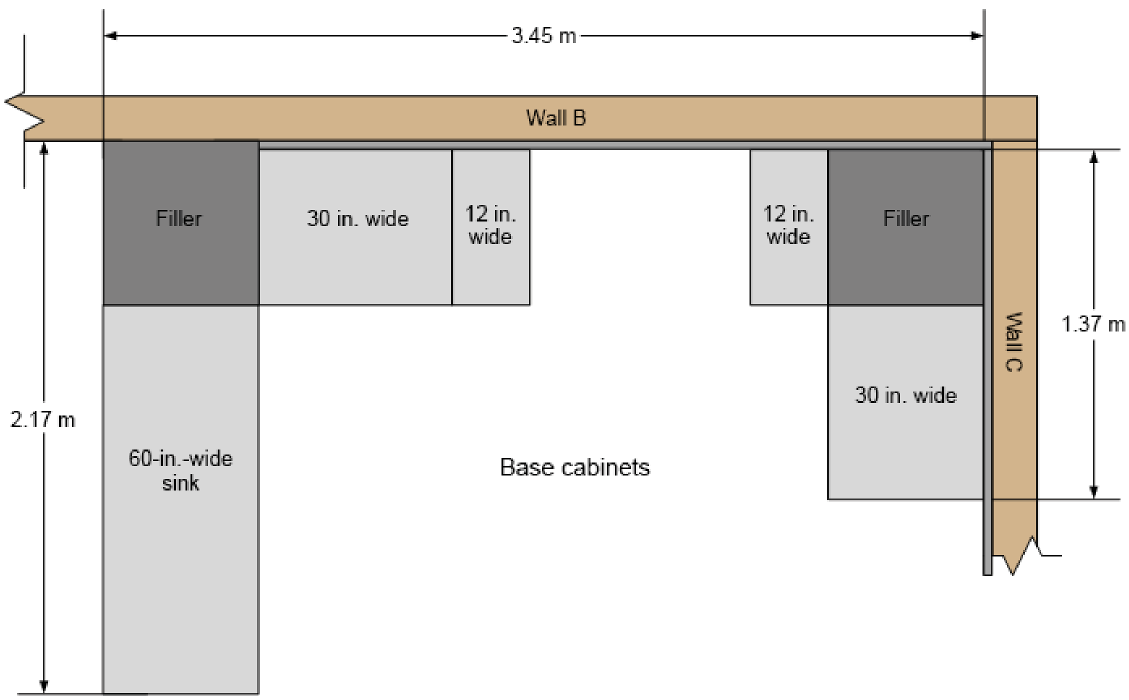


Figure 45. Plan view of wall cabinets and base cabinets in kitchen.

Figure 46. Kitchen cabinets and additional plywood covers.

Figure 47. Wood cribs and oriented strandboard added in the bedroom.

Figure 48. Plastic shelves and books in the bedroom.

Figure 49. Ignition package.

throughout the structure. Figure 47 shows several wood cribs that were added in the bedroom during Test 1. Also, sheets of OSB can be seen on the floor in Figure 47.

Miscellaneous Items

The overall fuel load in the structure was also increased by adding plastic shelves and paper books. Three plastic shelves were purchased from Walmart (Bentonville, Arkansas, USA) (Plano four-tier heavy duty, 1199594). Two plastic shelves were placed in the bedroom closet, and one shelf was placed in the utility room. In addition, 100 copies of the 2001 edition of the Wood Frame Construction Manual from the American Wood Council were added to the structure. The Wood Frame Construction Manuals added a total of 110 kg (243 lb) of paper books to the fuel load; 82 kg (181 lb) in the living room, and 28 kg (62 lb) in the bedroom. Figure 48 shows the plastic shelves in the closet and some books placed on the book shelf.

Ignition Package

The fire was initiated in a base kitchen cabinet along Wall C using an ignition package (Fig. 49). The ignition package was assembled by the FRL staff and consisted of a quart-size plastic bag that enclosed gasoline soaked paper towels and medical gauze rolled together.

The components of the ignition package consisted of rayon–polyester blend medical gauze (sterile premium rolled gauze, CVS Pharmacy, Woonsocket, Rhode Island, USA), ten sheets from a standard roll of paper towel, and a quart-size plastic Ziploc bag (S.C. Johnson & Son, Racine, Wisconsin, USA). The gauze had a listed unstretched length of 7.62 cm by 1.92 m (3 in. by 6.3 ft). Each sheet of paper towel measured 0.23 by 0.28 m (8-7/8 by 11 in.). The ignition packages were assembled by first unrolling the medical gauze and laying it out flat in the unstretched position. A continuous section of 10 paper towel sheets were then removed from the paper towel roll and folded width-wise in a trifold manner, such that the folded width of the continuous section of paper towels measured approximately

Table 5—Test matrix

Test number	Experiment ID	Amount and location of exposed cross-laminated timber (CLT)	Windows in Wall A	Fire sprinklers	Story
1	193825	None; all CLT surfaces encapsulated	No	No	1st
2	193871	Partially exposed CLT on ceiling in bedroom and living room	No	No	2nd
3	203923	Exposed CLT on walls in bedroom and living room	No	No	2nd
4	203924	Exposed CLT on ceiling and walls in bedroom and living room	Yes	Yes	1st
5	223940	Exposed CLT on ceiling and walls in bedroom and living room	Yes	Yes, but delayed	1st

73 mm (2-7/8 in.). The folded continuous section of paper towels were placed on top of the unstretched medical gauze. They were then rolled together such that the paper towels were on the inside and the medical gauze was on the outside of the roll. The roll was then placed inside the quart-sized plastic bag, and approximately 250 mL (8.5 fluid ounces) of gasoline was poured into the bag. For Test 2, approximately 225 mL (7.6 fluid ounces) of gasoline was unintentionally used instead of 250 mL.

End of Test Fire Suppression System

A deluge-type fire suppression system was used to extinguish the fire at the end of an experiment. The deluge system was separate from the fire suppression system installed in the apartment for Tests 4 and 5. The manually operated deluge system consisted of 11 fog hose type nozzles that were attached to steel pipes. Seven nozzles were positioned on the floor that was being tested and the remaining four nozzles were located on the other floor. The nozzles were elevated several feet above the floor using metal stands. The deluge system was connected to the blue water system in the laboratory. When not in use, the nozzles were covered with ceramic fiber to protect the nozzles during the fire. These nozzle covers blew off when the fire suppression system was activated. Figure 50 shows one of the nozzles positioned in the kitchen.

Figure 50. Deluge sprinkler system in the kitchen.

Experiment Details

Test Variables

Three variables were considered in this test series: (1) the amount and location of exposed mass timber surfaces, (2) the opening in Wall A (open or covered with glass), and (3) a fire sprinkler system (installed or not installed). Details related to each of these variables were discussed in previous sections.

Test Matrix

Five experiments were conducted to observe the performance of the mass timber structure when exposed to a fire in a multistory apartment-style building. Each experiment is summarized in Table 5. In Test 5, the sprinkler activation was delayed by approximately 20 min compared with the sprinkler activation time in Test 4.

Experimental Procedures

Each experiment followed the same general procedure. The ignition package was assembled and filled with approximately 250 mL of gasoline. The ignition package was then placed within the base kitchen cabinet along Wall C (Fig. 51). Inside the cabinet, 1 by 3 dimension lumber was placed that was either assembled into wood cribs or stacked randomly. A propane torch on a pole was then used to ignite the ignition package. After ignition, both cabinet doors were left in the open position and the test personnel exited the structure through either the opening in Wall A (Test 1) or the apartment door (Tests 2–5). After exiting through the apartment door, the test personnel verified that the door was closed. The exceptions to this were Tests 3 and 5. In Test 3, the automatic door closer was not attached to the door frame during the test and this was not noticed until after the test was complete. In Test 5, the door was intentionally left in the open position to increase ventilation and severity of the test scenario.

The experiment started when the ignition package was lit. The fire was then allowed to grow naturally. The experiment was terminated when either a predetermined time had elapsed (Tests 1–3) or after the fire sprinkler(s) activated

Figure 51. Ignition package located inside of kitchen cabinet.

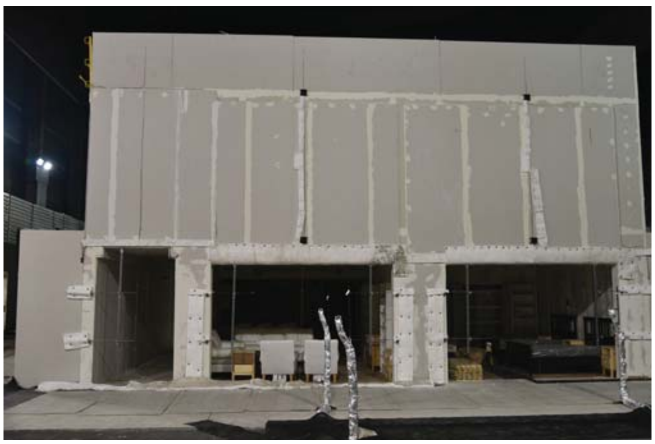


Figure 52. Second-level openings on Wall A covered with Type X wallboard for Test 1.

and had controlled the growth of the fire (Tests 4–5). ATF personnel then activated the deluge fire suppression system, and the fire was extinguished. The exception to this was Test 4, in which the fire was extinguished using a pressurized water fire extinguisher.

Additional Details

Test 1

During Test 1, all openings on the second floor of Wall A were enclosed with Type X gypsum wallboard (Fig. 52). The openings were covered to prevent the fire from spreading to the second level. Temporary walls were constructed in the wall openings using metal studs. In addition, most of the instrumentation on the second floor was active during Test 1, although the test was conducted on the first floor.

Test 2

For Test 2, a load was applied to the second floor's ceiling assembly using six vertical tanks filled with water. The polyethylene tanks were from Hastings Equity Manufacturing (Hastings, Nebraska, USA) (Model Nbr-T-0165-059). The tanks had a diameter of 0.79 m (31 in.), a height of 1.5 m (59 in.), and a dry weight of approximately 22.7 kg (50 lb). Each tank was filled with approximately 492 L (130 gallons) of water. The tanks were positioned to be centered along the width of each 2.44-m- (8-ft-) wide ceiling panel (Fig. 53). Three of the tanks were positioned to be centered over a line running parallel to and equidistant from Walls B and G over the living room and kitchen, whereas the other three were centered over a line running parallel to and equidistant from Walls D and G over the bedroom and hallway. The load resulted in the same maximum moment as would be induced by a 0.96 kPa (20 lb/ft^2) uniform load. This is equivalent to the induced moment used in the Fire Protection Research Foundation tests performed at the National Institute of Standards and Technology.

Figure 54 shows the water tanks on the ceiling assembly when viewed looking toward the front of the structure (Wall A). The water tanks were protected from the fire using gypsum wallboard (Fig. 54).

Test 3

The water tanks were reused for Test 3. However, prior to Test 3, two of the second floor ceiling panels were replaced because they had been partially exposed in Test 2. This required emptying the water from the tanks and moving them out of the way. After replacing the two ceiling panels, the tanks were positioned in their original locations. The day prior to Test 3, each tank was filled with approximately 492 L (130 gallons) of water. Upon arrival the following morning, ATF personnel discovered that one of the water tanks had leaked overnight (Fig. 55). Approximately 378.5 L (100 gallons) of water had leaked onto the ceiling assembly and then down into the structure through the joints between the CLT ceiling panels. A significant amount of water was found in the second level bedroom and living room. A wet vacuum was brought in to remove the standing water on the floor of the second level, and the wetted OSB sheets were replaced. Furthermore, both mattresses in the bedroom were replaced with dry ones that the FRL had on hand. Water stains were also visible on some of the exposed CLT wall panels. The moisture content of the CLT panels was measured using a reference (noncalibrated) moisture meter (Delmhorst J-2000, Delmhorst Instrument Company, Towaco, New Jersey, USA). The moisture content readings measured in the wetted areas of CLT were found to be as high as 27%, compared with 11% to 13% in areas unaffected by the water; however, this reading was most likely only a result of surface wetting as evidenced by the

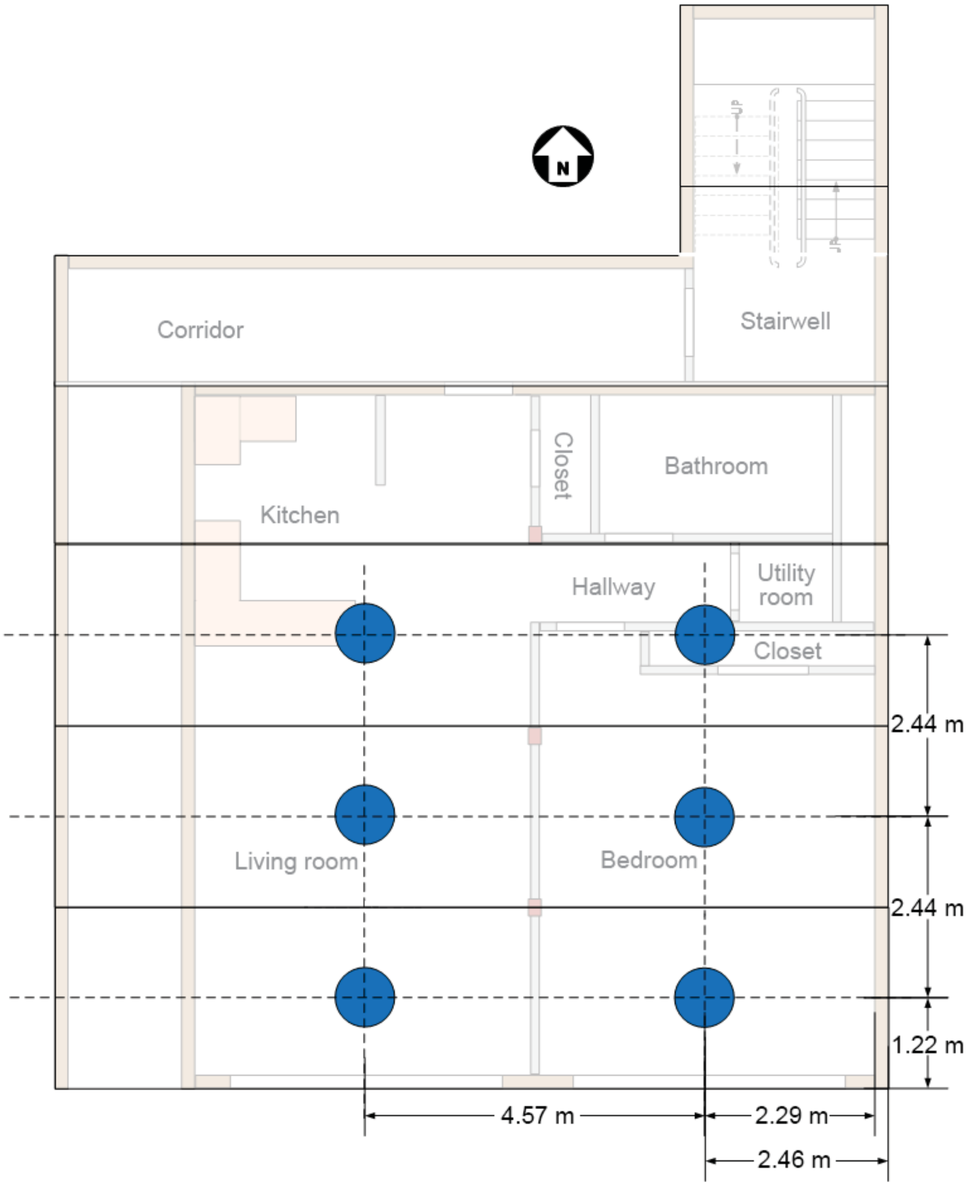


Figure 53. Location of water tanks on the second-level ceiling panel during Tests 2 and 3.

Figure 54. Water tanks on top of the second-level ceiling panels for Tests 2 and 3.

Figure 55. Water tank that leaked.

Figure 56. A plastic sheet placed over furniture during Test 4.

Figure 57. Apartment door propped open during Test 5.

lack of a char depth gradient between the wetted areas and unwetted areas following Test 3.

Test 4

A sheet of plastic was draped over some of the furniture in the living room to protect it from the water being discharged by the sprinkler head in the kitchen during the test (Fig. 56). The fire never spread beyond the cabinet, so the plastic had no effect on the fire growth.

Test 5

Prior to the start of Test 5, a decision was made to keep the apartment door open to allow for additional ventilation to feed fire grown. Therefore, the apartment door was propped open using a cement block (Fig. 57).

Restoration of Test Structure

Since Tests 2 and 3 were both performed on the second level, restoration of the interior was necessary between Tests 2 and 3. Figures 58 and 59 show the interior of the apartment after Tests 1 and 2, respectively. As part of the restoration, all of the gypsum wallboard was removed and then replaced in certain areas, based on the next test series. In addition, the unrated interior walls and drop ceiling were removed and replaced.

As part of the restoration, two of the second floor ceiling panels were also replaced. The ceiling panels were replaced because those two panels were the exposed CLT sections on the ceiling during Test 2. Figure 60 shows one of the ceiling panels as it was being removed.

The restoration of the test structure also involved repairing sections on the CLT wall assemblies that had sustained fire damage in the form of section loss caused by localized charring. Figure 61 is an example of the localized damage that occurred at the opening on Wall A on the second floor during Test 2. The wall was repaired by removing the damaged section (Fig. 62) and replacing it with equivalent

Figure 58. Interior view of apartment after Test 1.

Figure 59. Interior view of apartment after Test 2.

Figure 60. Second-level ceiling panel being removed after Test 2.

Figure 61. Localized section loss caused by charring on Wall A at the living room opening on the second floor.

Figure 62. Section of damaged cross-laminated timber removed from Wall A on second floor.

Figure 63. Localized section loss caused by charring around apartment door frame on the second floor.

Figure 64. Repair to damaged area around second-level apartment door.

Figure 65. Damage to support column and midspan beam.

material. In addition to the opening perimeters in Wall A, localized charring occurred around the apartment door frame during Tests 1, 2, and 3. Figure 63 illustrates some of the charring that occurred around the second-level door frame during Test 2. The damaged areas were removed, and the wall was repaired (Fig. 64).

Localized charring was also observed on the corners and intersections of support columns and midspan beams. An example of this charring is shown in Figure 65. The damage was limited to the corners and intersections of the wood that was added to the original support columns and beams. These damaged sections were removed and replaced with equivalent wood pieces.

Instrumentation

The ATF FRL uses a supervisory control and data acquisition (SCADA) system to collect and store data obtained from the various laboratory equipment. Data are collected at a rate of 1 hertz (1 sample per second). A variety of instrumentation was used during this test series and included thermocouples for temperature measurement, bidirectional probes for velocity measurement, optical density meters (ODM) to measure the optical density of the smoke, heat flux transducers and directional flame thermometers (DFT) to measure heat flux, gas analyzers to measure the concentrations of oxygen, carbon monoxide, and carbon dioxide within the test structure, a fire product collector to measure the heat release rate from the fire, and instrumentation to measure the atmospheric conditions in the laboratory. Smoke detectors were also used to determine smoke detector activation times in various parts of the test structure. In addition, the experiments were documented using a still camera, video cameras, and an infrared camera. The following sections discuss each of the instruments in more detail.

Thermocouples

Thermocouples are temperature measurement sensors that consist of two dissimilar metals joined at one end (a junction), which produces a small thermoelectrical voltage when the wire is heated. The change in voltage is interpreted as a change in temperature (Anon. 2000). There are many configurations of thermocouples, which affects the temperature range, ruggedness, and response time. Table 6 provides the information required to identify these factors for the thermocouples that were used during the experiments conducted for this test series. Thermocouples used during this test series were used in accordance with the method defined in FRL “Laboratory Instruction LI001 — Thermocouple” (Anon. n.d.-b).

Thermocouples were used in both a tree configuration (multiple thermocouples in a vertical line) and as single point measurements. The thermocouple trees had a thermocouple spaced every 0.6 m (2 ft), in addition to one placed at approximately floor level and one at the ceiling. Thermocouple trees that were 2.44 m (8 ft) tall and 2.74 m (9 ft) tall were both used because of the different ceiling heights in the test structure.

Figure 66 illustrates the location of the thermocouple trees in the test structure. One 2.44-m- (8-ft-) tall tree was located in the kitchen, and two trees were positioned inside of Wall G. Two 2.74-m- (9-ft-) tall thermocouple trees were located in the living room and bedroom, and three thermocouple trees were located in the corridor.

Temperature measurements were obtained at the ceiling in the living room and bedroom (Fig. 67). For Tests 1 and 3, two layers of Type X gypsum wallboard covered the CLT ceiling. For these two tests, two additional thermocouples were added at each measurement location on the ceiling. One thermocouple was located on the outermost layer of the gypsum wallboard, and one was placed between the two layers of the wallboard (Fig. 68).

In addition to the surface thermocouples at Location B on the living room ceiling, there were seven thermocouples embedded within the CLT. Holes of varying depth were drilled into the exterior of the CLT assembly. The holes were spaced evenly around a 50.8-mm- (2-in.-) diameter circle. After the holes were drilled, Type K thermocouples (30 American wire gauge (AWG)) were placed into the holes. As illustrated in Figure 69, the thermocouples were positioned at the following depths relative to the interior of the test structure: 12 mm (0.472 in.), 23 mm (0.906 in.), 35 mm (1.38 in.), 47 mm (1.85 in.), 58 mm (2.28 in.), 70 mm (2.76 in.), and 105 mm (4.13 in.).

Embedded thermocouples were also located along Walls B and D (Fig. 70). The thermocouples were placed 1.52 m (5 ft) above the finished floor. Surface thermocouples were also located at these same locations. If the CLT was encapsulated with gypsum wallboard, then two additional surface thermocouples were used (Fig. 68). The thermocouples located along Wall B were spaced evenly apart, every 2.29 m (7 ft 6 in.). However, this spacing resulted in the thermocouples at the third location (C) being placed behind a wall cabinet.

Table 6—Thermocouple details

Description	Manufacturer	Model	AWG No.	Insulation	Accuracy specification
Wire	Omega[a]	GG-K-24-SLE	24	Glass	Special limits of error
Extension wire	Omega	EXPP-K-24-SLE	24	Polyvinyl	Special limits of error

[a]Omega, Stamford, Connecticut, USA.

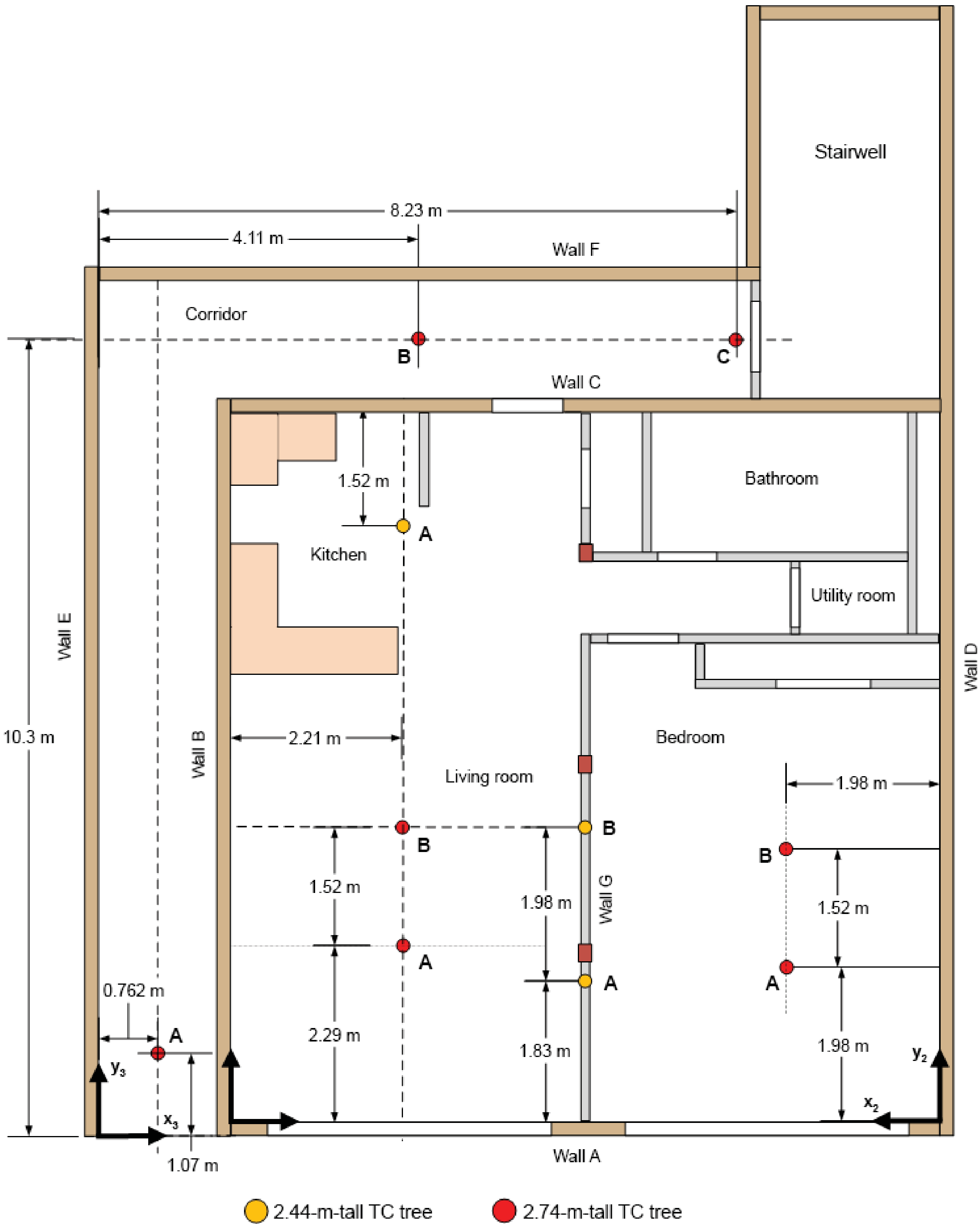


Figure 66. Location of thermocouple (TC) trees.

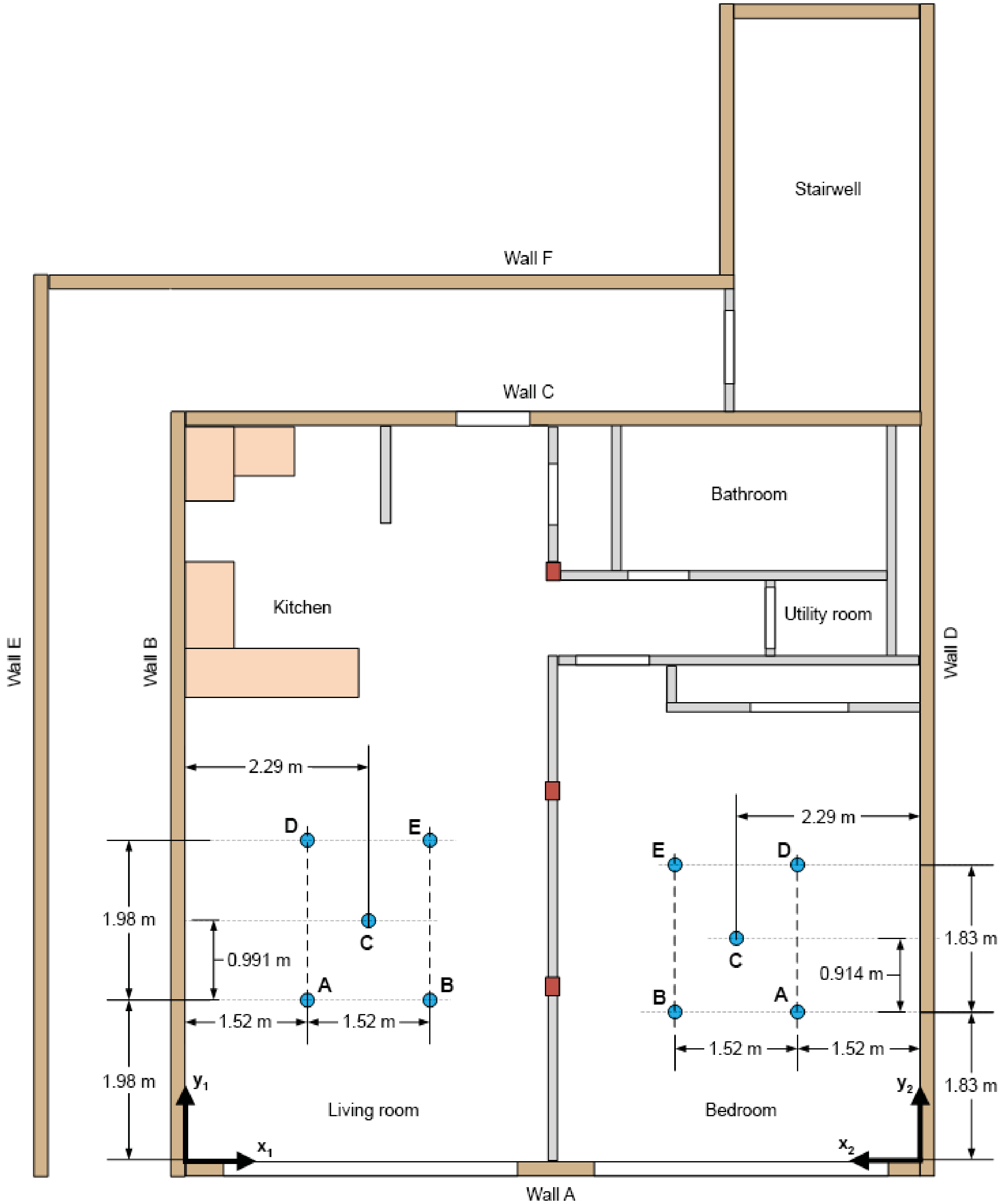


Figure 67. Location of ceiling thermocouples (blue circles).

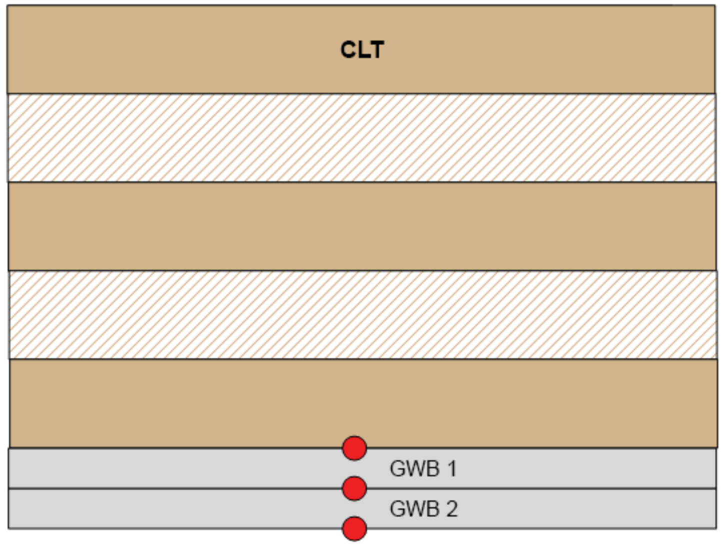


Figure 68. Additional surface thermocouples when the cross-laminated timber (CLT) was encapsulated (GWB, gypsum wallboard).

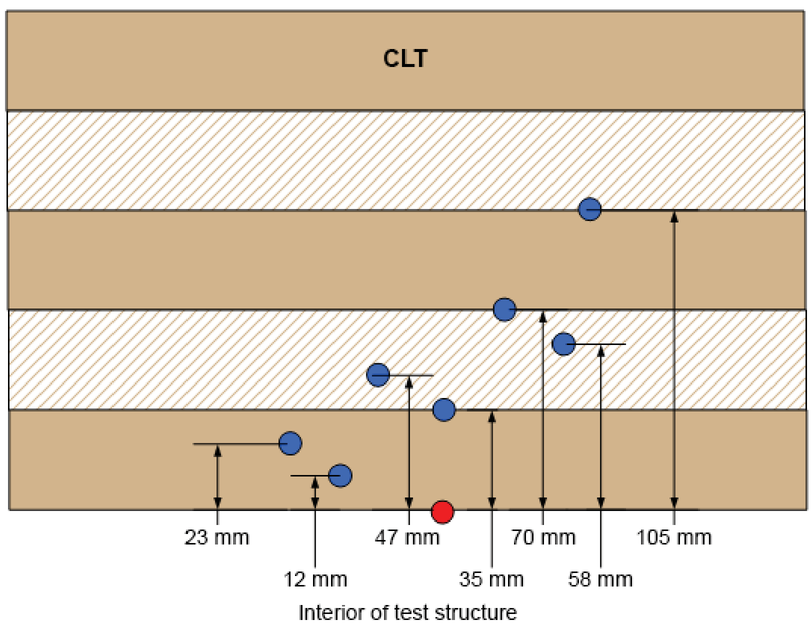


Figure 69. Location of embedded thermocouples in the cross-laminated timber (CLT).

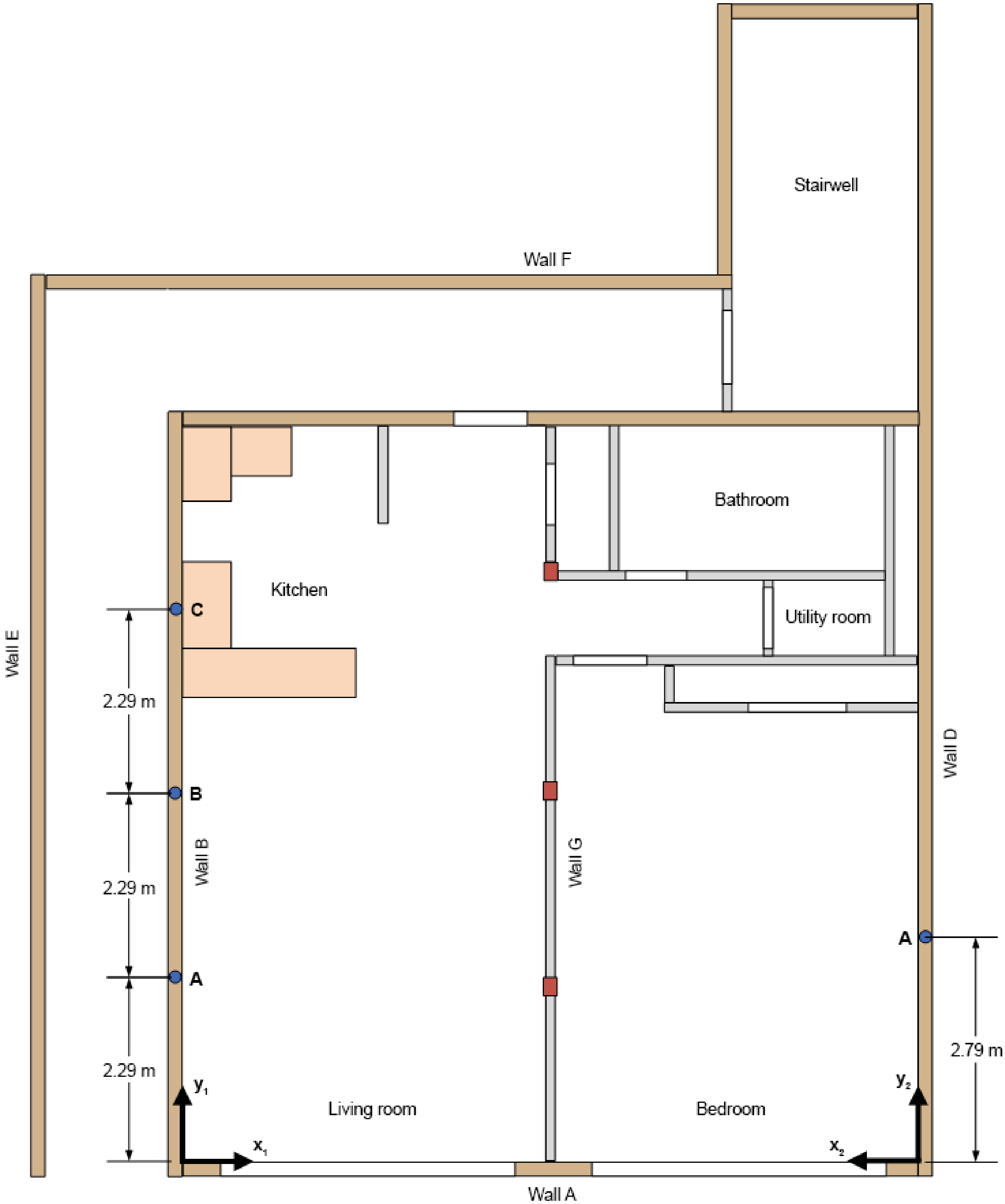


Figure 70. Location of embedded and surface wall thermocouples (blue circles) (thermocouples located 1.52 m above the finished floor).

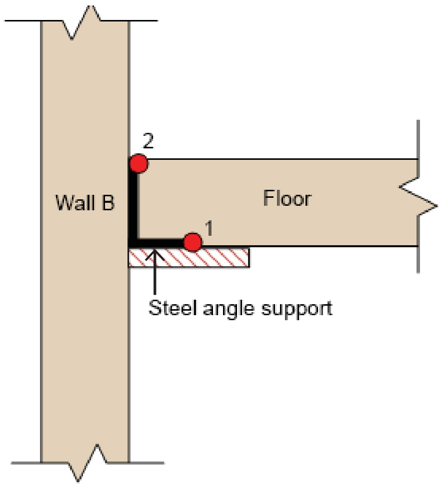


Figure 71. Joint temperature measurement at the steel angle–floor interface.

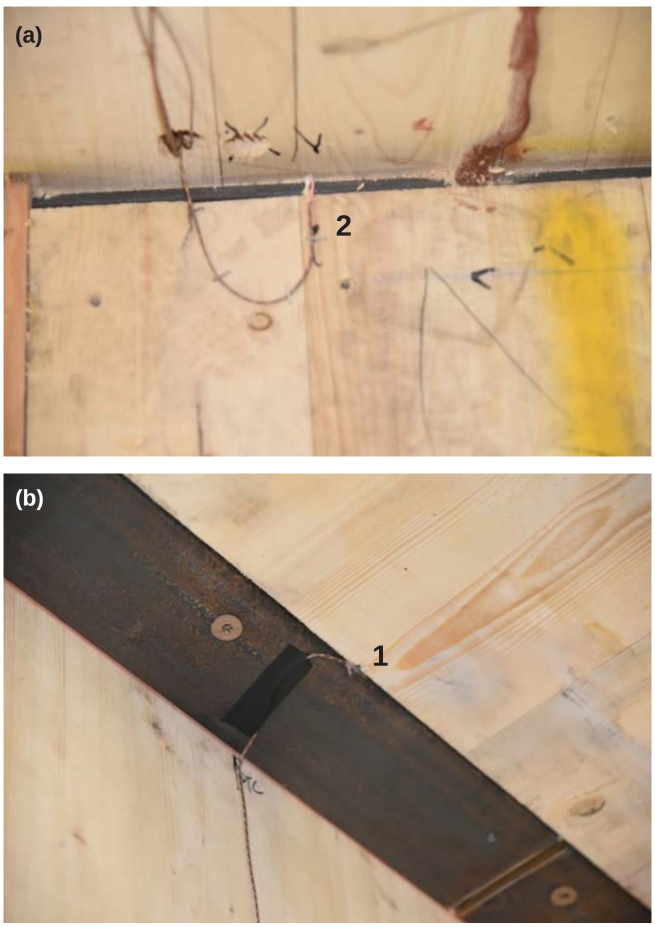


Figure 72. Thermocouples placed between the steel angle and the cross-laminated timber floor assembly to measure the joint temperatures: (a) top view; (b) bottom view (numbers correspond to locations shown in Fig. 71).

Temperature measurements were also obtained at the joints created between the CLT assemblies and their associated supports. Figures 71 and 72 show the joint temperature measurement location for the steel angle and floor assembly. The numbers shown in Figure 72 correspond to the thermocouples shown in Figure 71. The photographs were taken prior to the gaps being filled in with an intumescent fire caulk.

Figures 73 and 74 show the location of the joint temperature measurements for the ledger and floor assembly. The photograph in Figure 74 was taken prior to the floor assembly being installed. The numbers shown in Figure 74 correspond to the thermocouples shown in Figure 73.

Figures 75 and 76 show the location of the joint temperature measurement between the wall assembly and the ceiling assembly. The photograph was taken prior to the ceiling assembly being installed.

The locations for the joint temperature measurements along Walls B and D are shown in Figure 77. Joint temperatures were obtained every 1.14 m (3 ft 9 in.) along Wall B, in both the living room and the kitchen. Joint temperatures along Wall D were obtained every 1.14 m (3 ft 9 in.) in the bedroom.

Temperature measurements were also obtained at each opening in Wall A using 2.74-m- (9-ft-) tall thermocouple trees (Fig. 78). In addition, single thermocouples were used to measure temperatures above the second-level opening. The height of each thermocouple was measured relative to the finished floor for that particular floor level (1st, 2nd, or 3rd).

For Test 4, a single thermocouple was added near the fire sprinkler head in the kitchen (Fig. 79). This temperature measurement was used to determine sprinkler activation time. The thermocouple remained in the test structure for Test 5.

Bidirectional Probes

Velocity is commonly measured by application of the principal of conservation of mechanical energy through conservation of fluid velocity to pressure (head). If the fluid is forced to change its velocity, a change in pressure will occur (Avallone and Baumeister III 1996). Bernoulli’s equation (Munson and others 2006) uses differential pressure and density measurements of a fluid to calculate the fluid’s velocity. Differential pressure is the difference between the dynamic and static pressure measurements of the fluid and is measured using a differential pressure probe and differential pressure transducer. The density of the fluid is typically calculated from the fluid temperature.

There are various types of differential pressure and temperature probes that can be used to record the measurements necessary to calculate a fluid’s velocity. The characteristics of the various types of pressure and

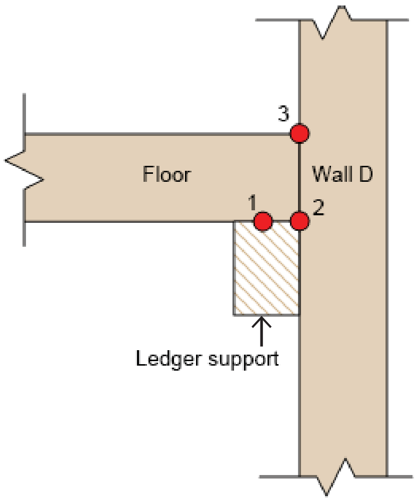


Figure 73. Ledger–floor joint temperature measurement loctions.

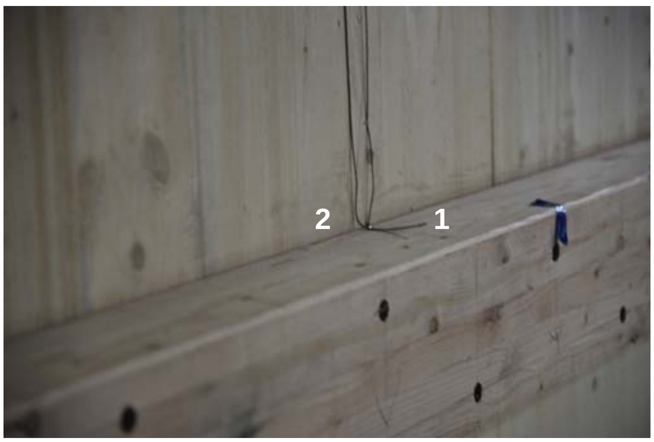


Figure 74. Thermocouples placed on the ledger to measure the temperature at the ledger–floor interface (numbers correspond to locations shown in Fig. 73).

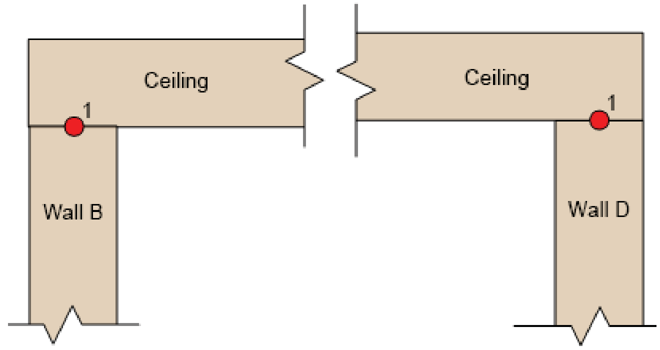


Figure 75. Ceiling–wall joint temperature measurement locations (second floor).

Figure 76. Thermocouple placed on wall to measure temperature at ceiling–wall joint interface on the second floor.

temperature probes affect the response and sensitivity of the measurements. All devices used to calculate velocity were used in accordance with the method defined in FRL "Laboratory Instruction LI009 —External Velocity Differential Pressure Probes" (Anon. n.d.-d).

The air velocity through the openings in Wall A was measured using bidirectional probes (Fig. 80). Each bidirectional probe was connected to a differential pressure manometer (MKS Type 220DD-00001B2B) that had a pressure full range of 133 Pa (1 Torr). The air temperature near each probe was measured using a Type K thermocouple (24 AWG, glass insulated).

Figure 81 illustrates the location of velocity measurements. When tests were conducted on the second level, the bidirectional probes were elevated and placed at equivalent locations relative to the second-level floor. Figure 82 shows the bidirectional probes mounted by the living room.

Heat Flux Transducers

A heat flux transducer is a device that measures the rate of absorbed incident energy and expresses it on a per unit area basis. The operating principle of the Schmidt–Boelter heat flux transducers used during this test series is based on one-dimensional heat conduction through a solid. Temperature sensors are placed on a thin, thermally conductive sensor element, and applying heat establishes a temperature gradient across the element. The heat flux is proportional to the temperature difference across the element according to Fourier's Law (Barnes 1999).

There are many configurations of heat flux transducers that affect range, size, mode, and sensitivity. The information required to identify these factors for the heat flux transducers that were used during the experiments conducted for this test series is provided in Table 7. Heat flux transducers were used in accordance with the method defined in FRL "Laboratory Instruction LI002 Heat Flux

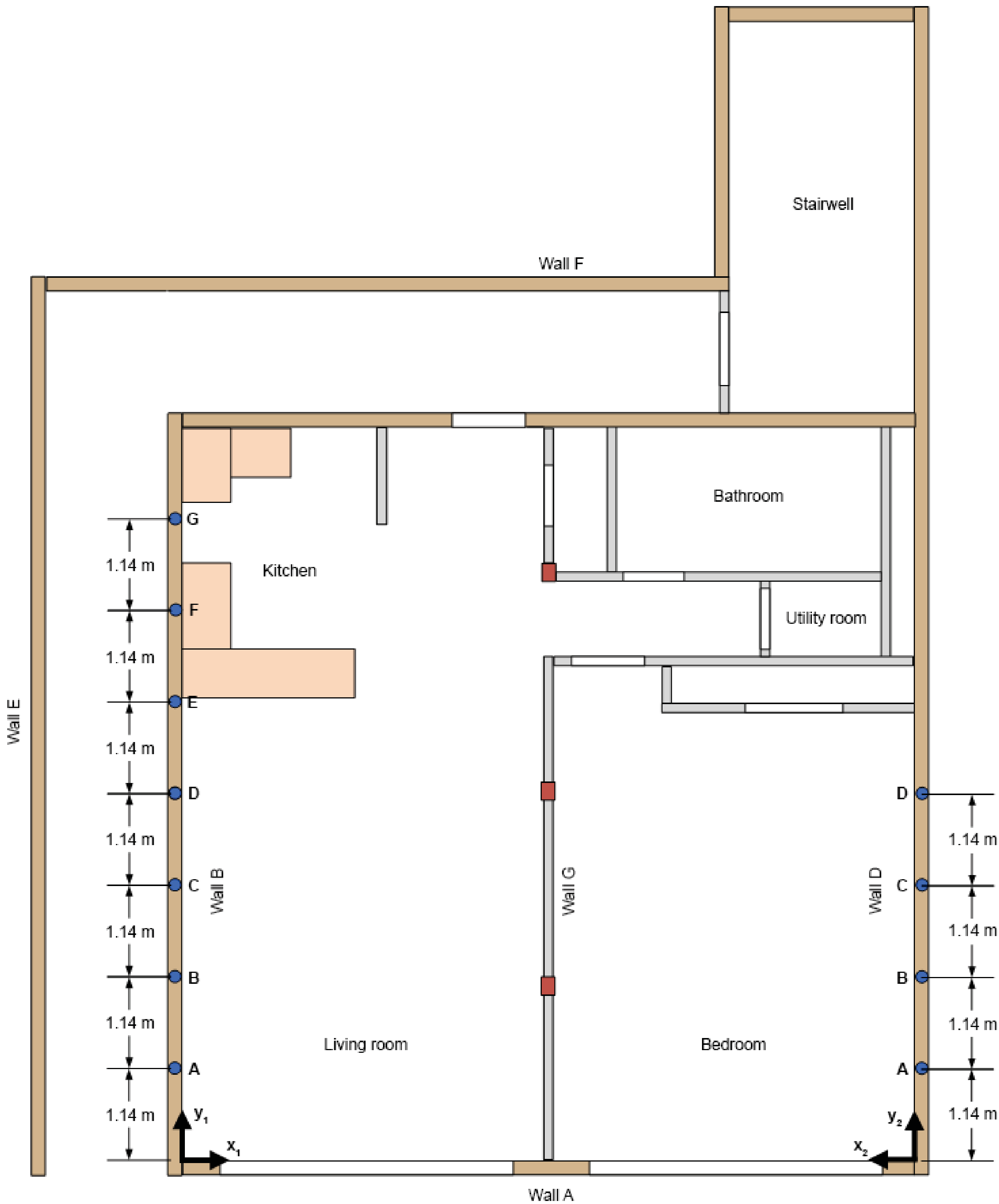


Figure 77. Locations of joint temperature measurements (blue circles).

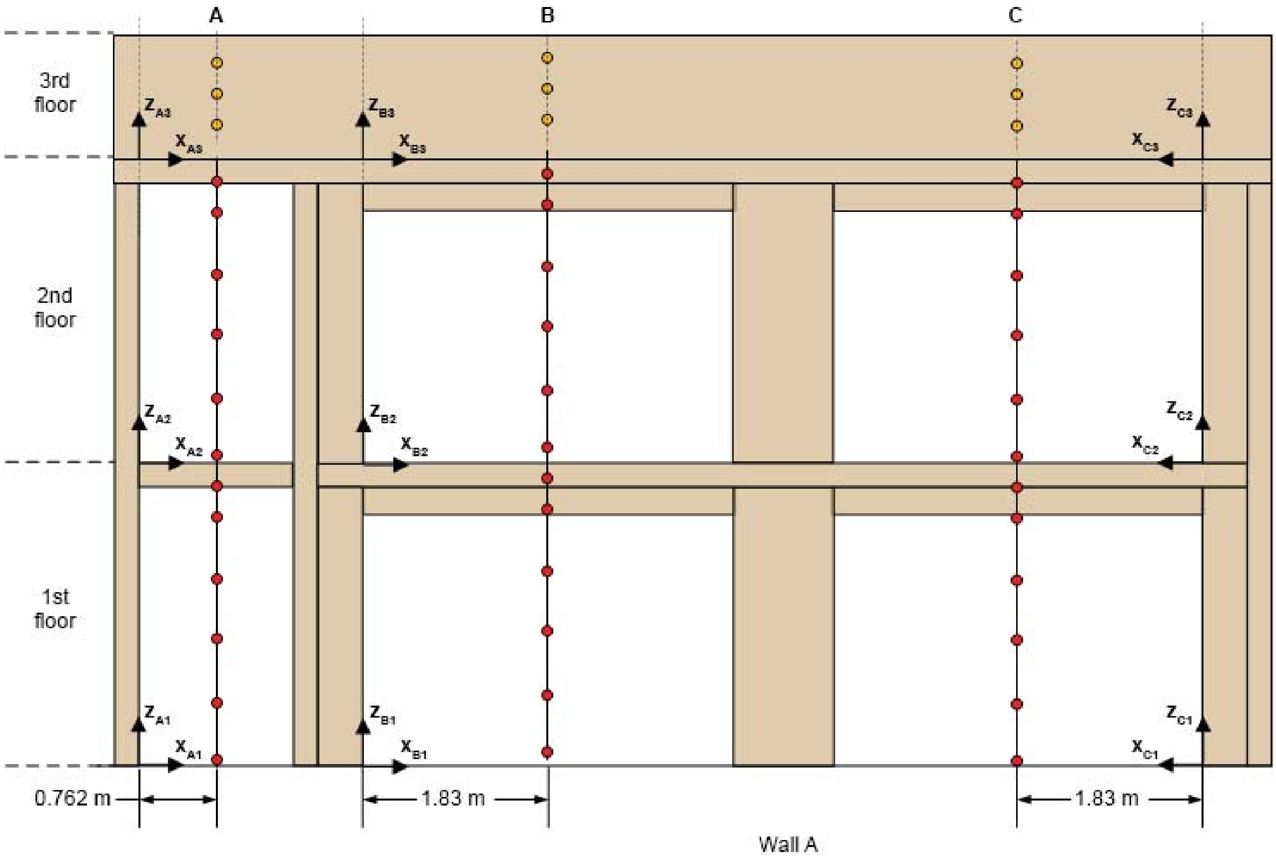


Figure 78. Location of thermocouples on Wall A (red and yellow circles).

Figure 79. Thermocouple placed near sprinkler head in kitchen for Test 4.

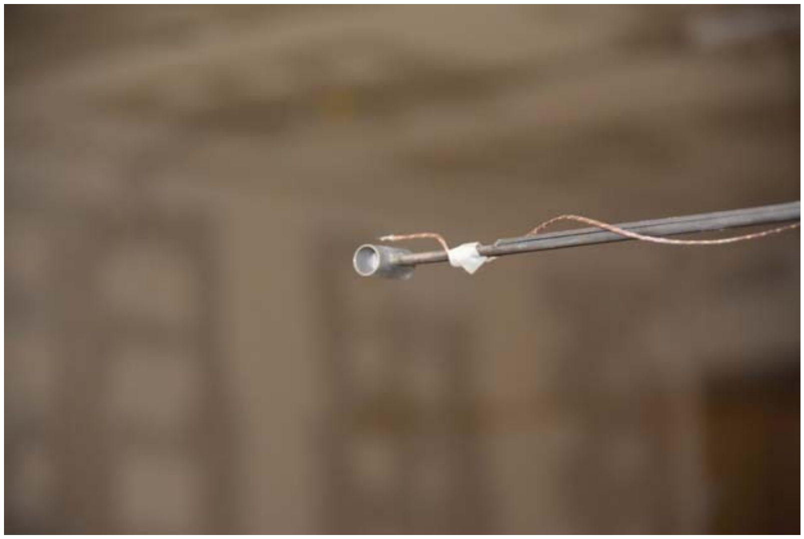


Figure 80. Bidirectional probe.

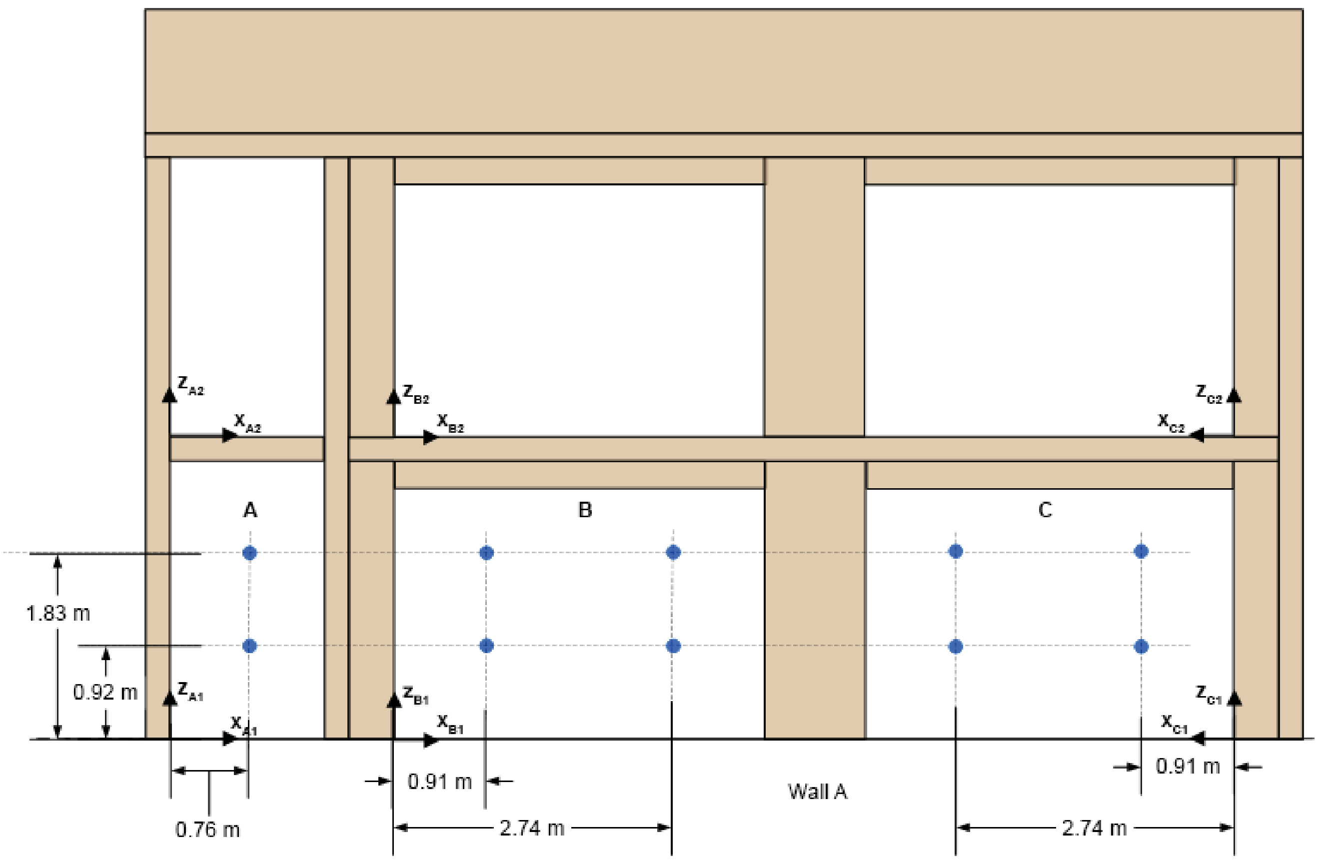


Figure 81. Location of bidirectional probes (blue circles).

Figure 82. Bidirectional probes mounted at the opening in Wall A.

Table 7—Description of heat flux transducers

Manufacturer	Model	Heat flux mode	Full-scale range (kW/m²)	Maximum over range (kW/m²)
Medtherm[a]	64-2.5-20	Total	25	37.5
Medtherm	64-5SB-20	Total	50	75
Medtherm	64-10SB-20	Total	100	150

[a]Medtherm Corporation, Huntsville, Alabama, USA.

Transducer" (Anon. n.d.-c). Figure 83 shows the location of the heat flux transducers. One transducer was positioned in the corridor across from the apartment door and was mounted 0.914 m (3 ft) above the finished floor. Four other heat flux transducers were located in front of Wall A (two in front of each opening), and they were located 1.52 m (5 ft) above the floor. When experiments were conducted on the second floor, the heat flux transducers were elevated and placed at equivalent locations relative to the second-level finished floor.

Directional Flame Thermometers

DFTs are another type of device to measure heat flux (ASTM 2016). A DFT consists of two metal plates separated by an insulating material and a thermocouple attached to each plate to measure the temperature of the plate. A thermal model is then used to calculate the heat flux, based on the temperature profiles and the temperature-dependent properties of the metal plates and insulating material.

The DFTs used in this test series were provided by the USDA Forest Service, Forest Products Laboratory (FPL). Figure 84 shows a DFT mounted on the ceiling. Only the temperature data from the DFTs are included in this report.

DFTs were mounted on both the walls and ceiling of the test structure. Figure 85 shows the location of the DFTs on the interior walls. The DFTs located on Walls B and D were mounted 1.52 m (5 ft) above the finished floor. Two DFTs were also mounted next to the apartment door on Wall C (Fig. 86). These DFTs were located 0.914 m (3 ft) and 2.18 m (7 ft 2 in.) above the finished floor.

Two DFTs were also mounted on the ceiling, one in the bedroom and one in the living room. Figure 87 shows the location of the DFTs on the ceiling.

For Test 1, four additional DFTs were mounted on the exterior of Wall A (Fig. 88). The location of each DFT is shown in Figure 89.

Optical Density Meter

ODMs were used to measure the smoke obscuration during the experiments. The ODM consists of two parts: a light source and a photo transducer, which responds to the intensity of light from the light source. The photo transducer produces an output voltage that is linear with the amount of light received from the light source. An increase in intensity of light results in an increase in output voltage, and a decrease in intensity of light results in a decrease in output

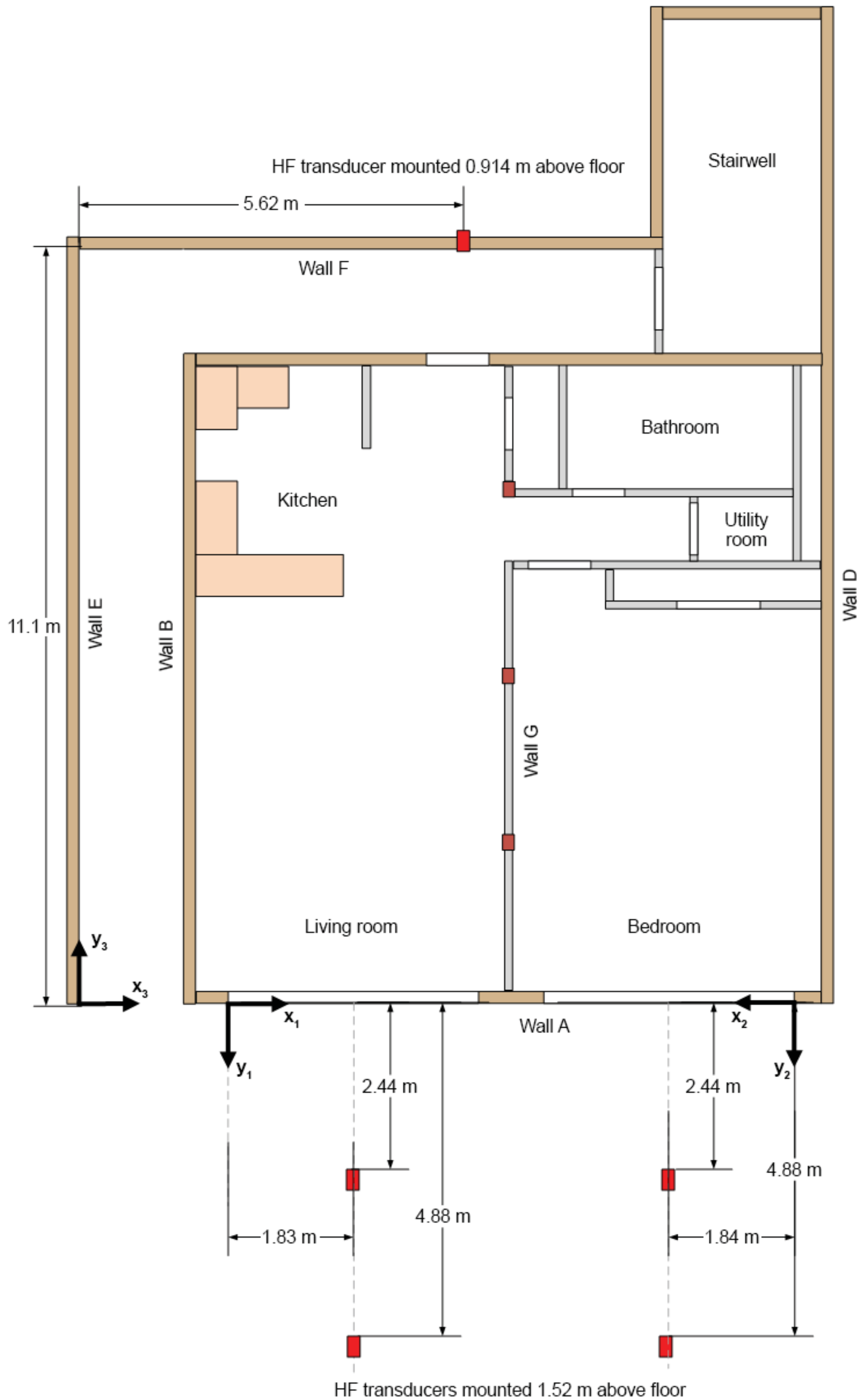


Figure 83. Location of heat flux (HF) transducers (red rectangles).

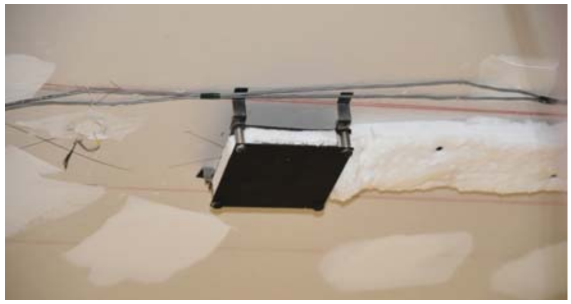


Figure 84. Directional flame thermometer mounted on ceiling.

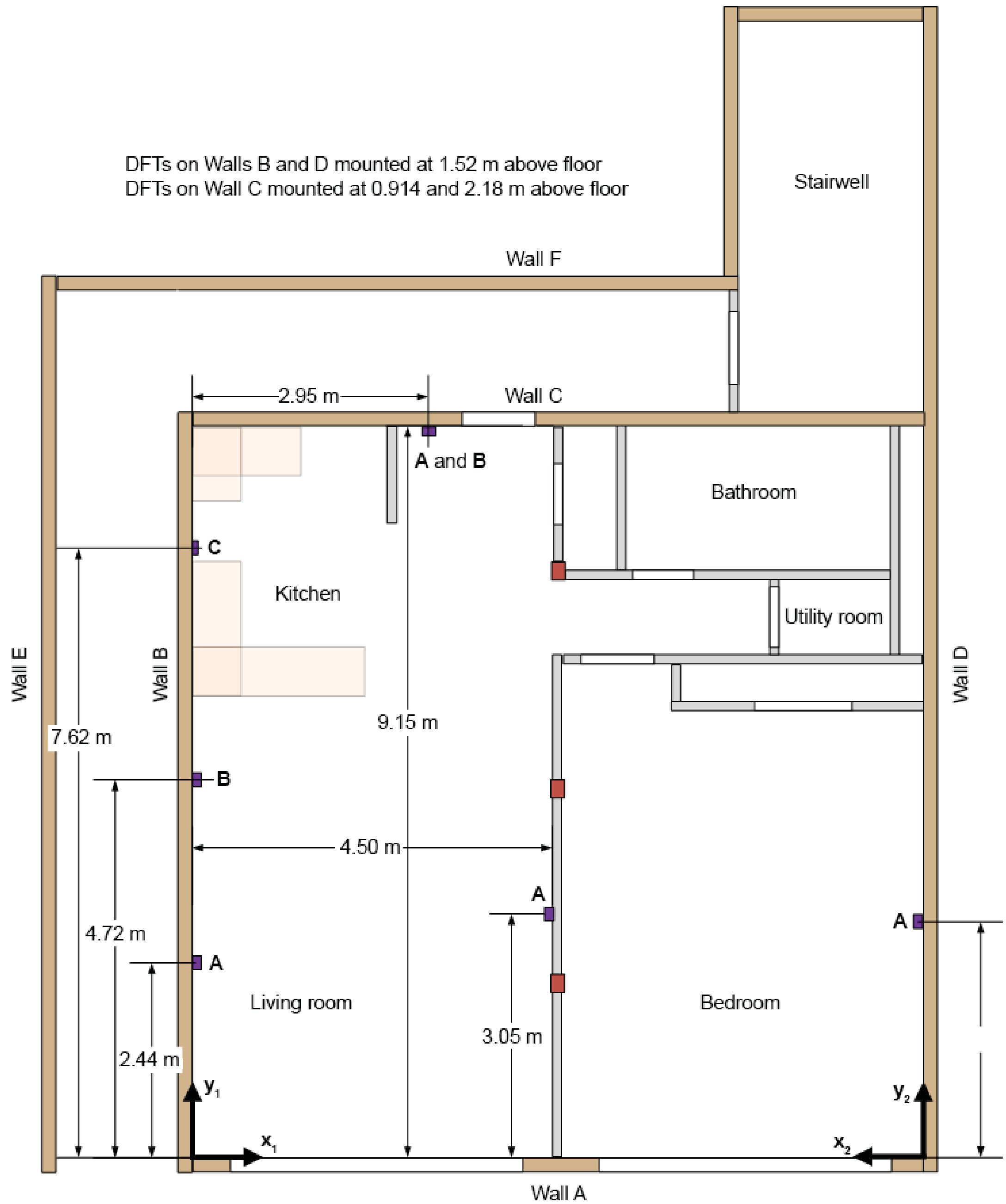


Figure 85. Location of directional flame thermometers (DFTs) on interior walls (purple rectangles).

Figure 86. Directional flame thermometers mounted on Wall C near the apartment door.

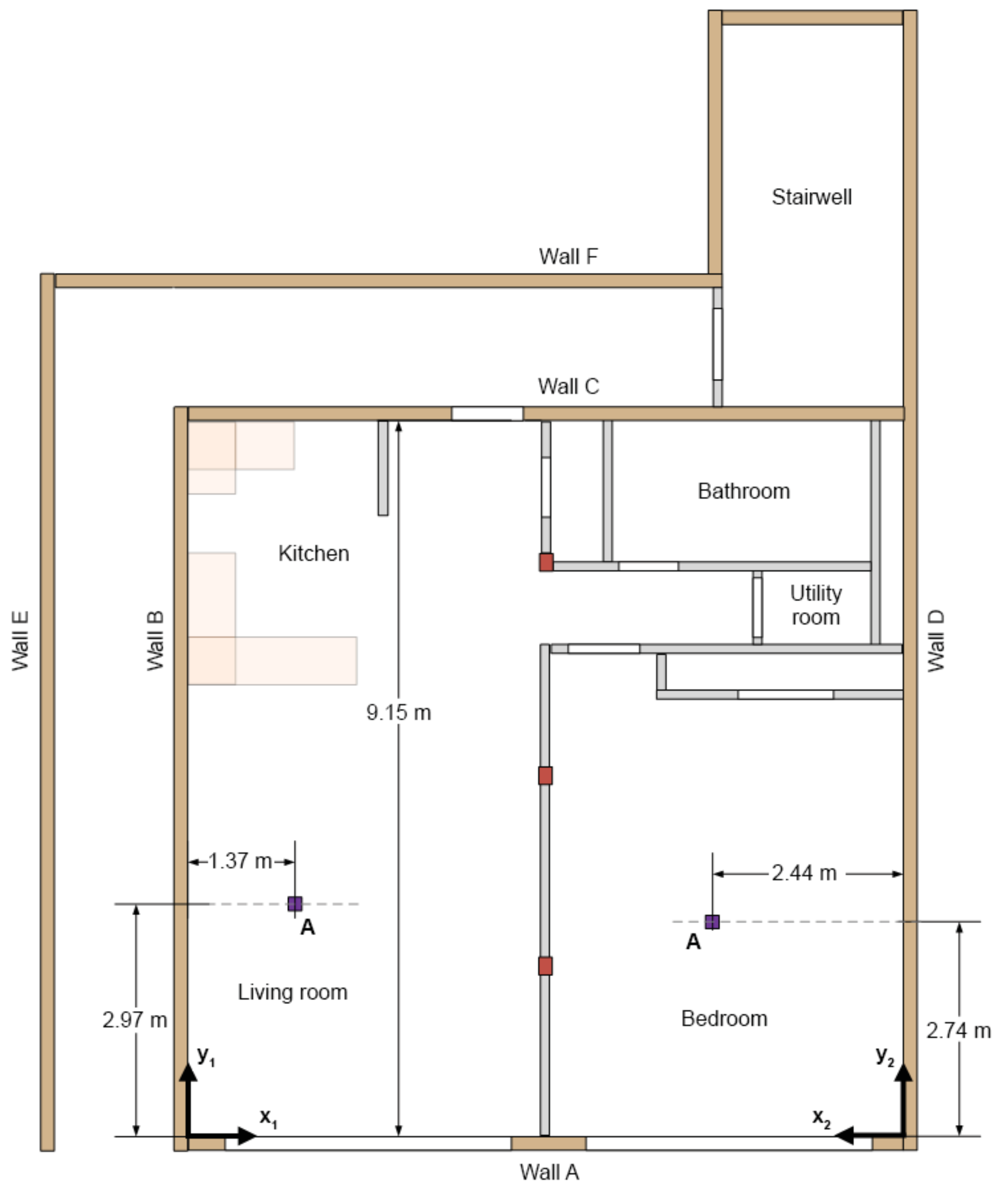


Figure 87. Location of directional flame thermometers on ceilings (purple squares).

Figure 88. Directional flame thermometers mounted on the exterior of Wall A.

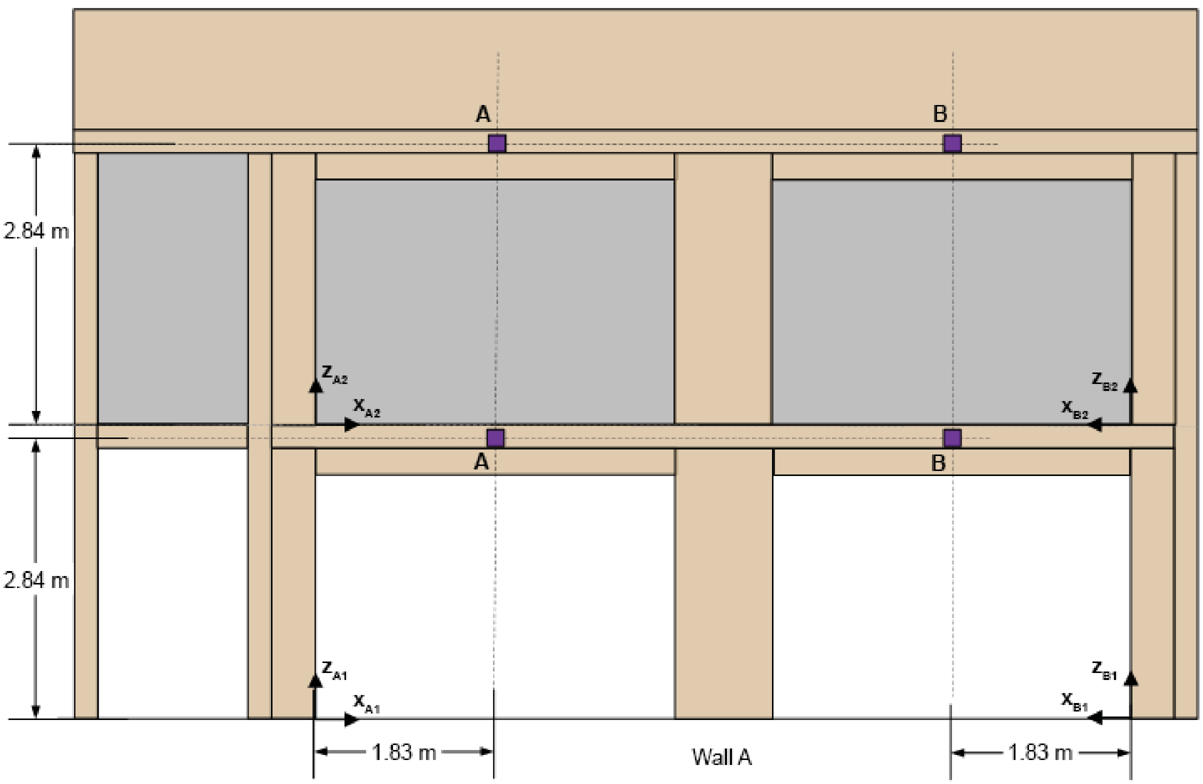


Figure 89. Location of directional flame thermometers on Wall A (purple squares) (see also photograph in Fig. 52).

voltage. Prior to the start of each test series, each optical density meter was functionally verified using neutral density filters.

The white light source for the ODM used in this test series was a GE model PAR 24671 incandescent lamp (General Electric Company, Boston, Massachusetts, USA). The light receiver was a Huygen 856 RRV photovoltaic cell (Huygen Corporation, Crystal Lake, Illinois, USA). It had a maximum operating temperature of 60°C (140°F). The light intensity was set using a Texio model PD18-30AD power supply (Texio Technology Corporation, Yokohama, Japan). The light receiver was located 0.914 m (3 ft) from the light source. Figure 90 shows the ODM mounted in the corridor. The ODM housing was protected from high air temperatures using a ceramic fiber blanket. A thermocouple was mounted near the ODM to monitor the air temperature. If the air temperature exceeded 60°C (140°F), the ODM was taken out of service. The ODM was not placed back into service until it had been functionally verified using the neutral density filters.

Figure 91 shows the location of the ODM, which was in the corridor near the apartment door. The ODM was mounted 1.52 m (5 ft) above the floor.

Smoke Detectors

Smoke detectors are devices used to activate an alarm in the presence of smoke. Smoke detectors send notifications in the form of audible, visible, and/or electrical responses. For this test series, interconnected-type smoke detectors were selected because detector activation could be determined by monitoring the electrical output produced by each detector. Table 8 provides a description of the smoke detectors used in the experiments. Figure 92 shows the smoke detectors as mounted to the ceiling. At each location, two smoke detectors were used, an ionization smoke detector and a photoelectric smoke detector. Figure 93 shows the location of smoke detectors in the test structure.

Oxygen Gas Analyzer

A gas analyzer was used to measure the oxygen (O_2) concentration at one or more point measurement locations. The oxygen analyzer operates according to the paramagnetic alternating pressure principal. The resolution of the oxygen transducer's output signal is less than 0.1% of the respective output signal span value. The analyzer was zeroed and calibrated prior to each test. Nitrogen was used as the zero gas, and dried ambient air, which is assumed to have an oxygen concentration of 20.95%, was used as the span gas. The gas concentration point measurements were conducted in accordance with the method defined in FRL "Laboratory Instruction LI016 — Point Source Gas Analysis" (Anon. n.d.-f). Table 9 provides a description of the oxygen gas analyzer used in this test series.

Figure 90. Optical density meters located in the corridor.

For each experiment, gas samples were taken outside of the apartment door in the corridor at a height of 1.52 m (5 ft) above the finished floor. For Tests 4 and 5, gas samples were also taken in the living room at a height of 1.52 m (5 ft) above the finished floor. Figure 94 shows the location of the gas samples in the test structure.

CO–CO_2 Gas Analyzer

A gas analyzer was used to measure both the carbon monoxide (CO) and carbon dioxide (CO_2) concentrations at one or more point measurement locations. The CO–CO_2 gas analyzer utilizes two separate nondispersive infrared (NDIR) type transducers to measure the concentration of each gas. The resolution of each transducer's output signal is less than 0.1% of the respective output signal span value. The span value is defined as the input value used to test the upper range of the analyzer. The analyzer was zeroed and spanned prior to each test. Nitrogen was used as the zero gas, and a premixed calibration gas with known concentrations of CO and CO_2 was used as the span gas. The gas concentration point measurements were conducted in accordance with the method defined in FRL "Laboratory Instruction LI016 — Point Source Gas Analysis" (Anon. n.d.-f). Table 10 provides a description of the CO–CO_2 gas analyzer used in this test series. The CO–CO_2 gas samples were obtained at the same locations in the test structure as the O_2 gas samples, which are shown in Figure 94.

Fire Products Collector

A fire products collector (FPC) measures several characteristics of a fire based on the measured properties of the fire plume. An FPC consists of a collection hood connected to an exhaust duct placed over a fire (Fig. 95). The primary fire characteristics calculated from an FPC include heat release rate (HRR), convective heat release rate (CHRR), gas species production, and smoke production. HRR measurements are based on the principle of oxygen

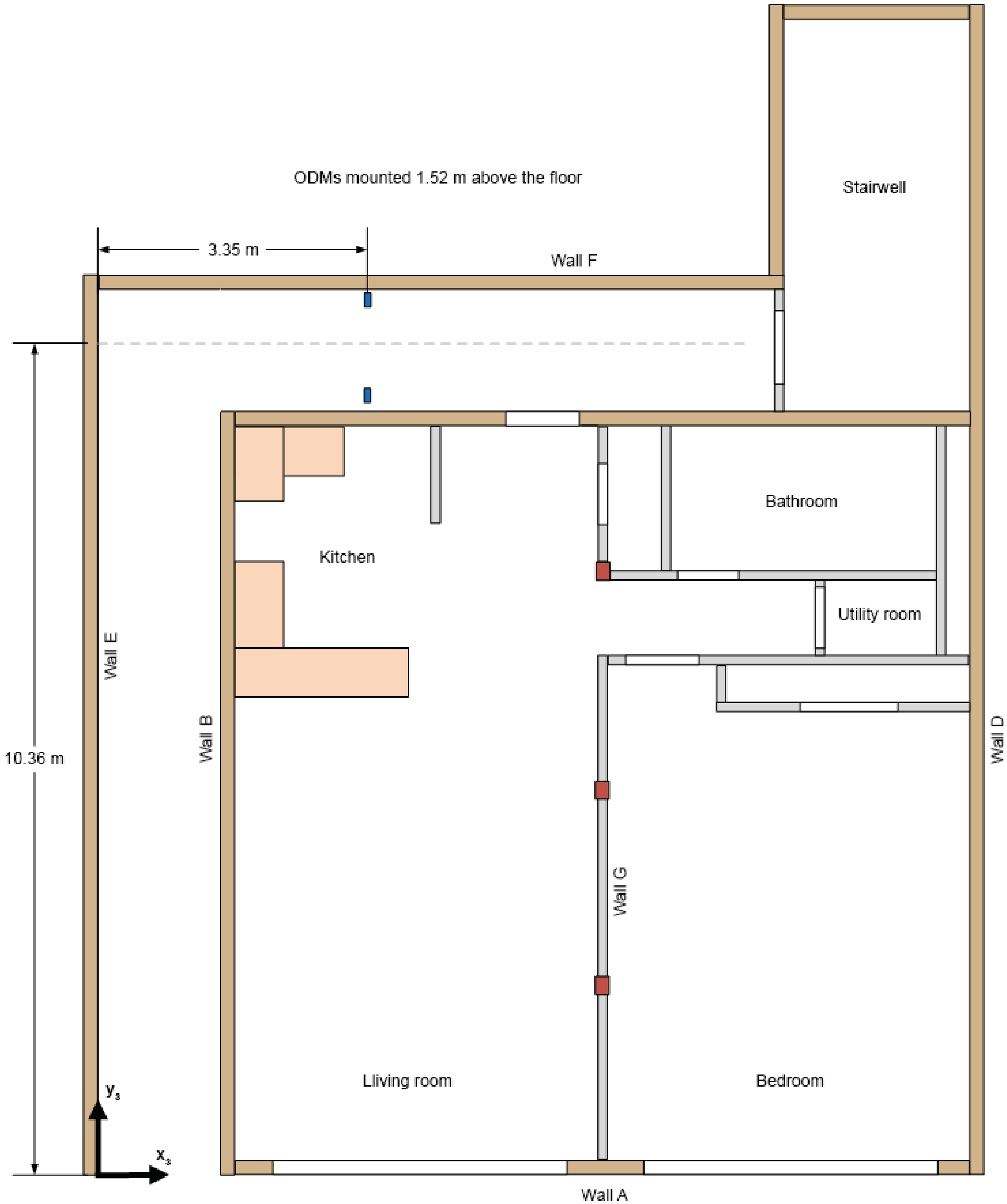


Figure 91. Location of optical density meters (ODMs) (blue rectangles).

Table 8—Smoke detector summary

Manufacturer	Model	Detector type	Sensor type	Nominal sensitivity (% obs/m)
Kidde[a]	p12040	Smoke	Ionization	3.94–11.0
Kidde	i12080	Smoke	Photoelectric	1.64–2.79

[a]Kidde, Inc., Mebane, North Carolina, USA.

Figure 92. Smoke detectors.

consumption calorimetry. CHRR is calculated as the enthalpy rise of gases flowing through the FPC. Gas species production is calculated based on the measured gas concentrations flowing through the FPC. Smoke production is quantified based on optical smoke measurements, which measure the attenuation of light as it passes through the smoke and fire gases in the FPC. The FPC was used in accordance with the method defined in FRL "Laboratory Instruction LI011 — Fire Products Collectors" (Anon. n.d.-e).

Experiments were conducted using the FRL's nominally rated 14-megawatt (MW) FPC (Fig. 96). The 14-MW FPC has a square apron that is 18.5 by 18.5 m (60.7 by 60.7 ft). The bottom of the apron is 9.14 m (30 ft) above the surface of the laboratory floor. The FPC can be operated above 14 MW for a period of time, as long as the safety of the FPC and its instrumentation is maintained.

Table 11 includes a description of the FPC, as well as the calibration factor (C factor) and E value, which are used to calculate the HRR during an experiment. The C factor is based on data from a fire with a known HRR. The net heat released per unit of oxygen consumed, E, is a property of the fuel being burned.

Laboratory Conditions

The ambient laboratory temperature, barometric pressure, and relative humidity were measured during the experiments. The laboratory conditions were measured using an industrial probe and microserver. The probe measured the ambient conditions using capacitive digital sensors. The sensor probe has surface-mounted circuitry, which responds to changes in the environment and outputs a digital signal. The laboratory conditions were measured in accordance with the method defined in FRL "Laboratory Instruction LI017 — Laboratory Conditions" (Anon. n.d.-g). Table 12 provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Experiment Photographs

Digital cameras are used within the FRL to record digital still photographs during experiments. Digital cameras used during this test series were used in accordance with the method defined in FRL "Laboratory Instruction LI003 — Digital Cameras" (Anon. n.d.-a).

Video Cameras

Video cameras were used to document the experiments. Both high definition (HD) video cameras and standard definition (SD) video cameras were used. During an experiment, up to five HD video cameras (NEX-FS100UK, Sony, Tokyo, Japan) were positioned outside of the structure and seven SD video cameras (VTC-206F03-4, Bosch, Gerlingen, Germany) were located inside of the structure. Figure 97 shows the general layout of the video cameras. The camera for the water pressure was only used during Tests 4 and 5.

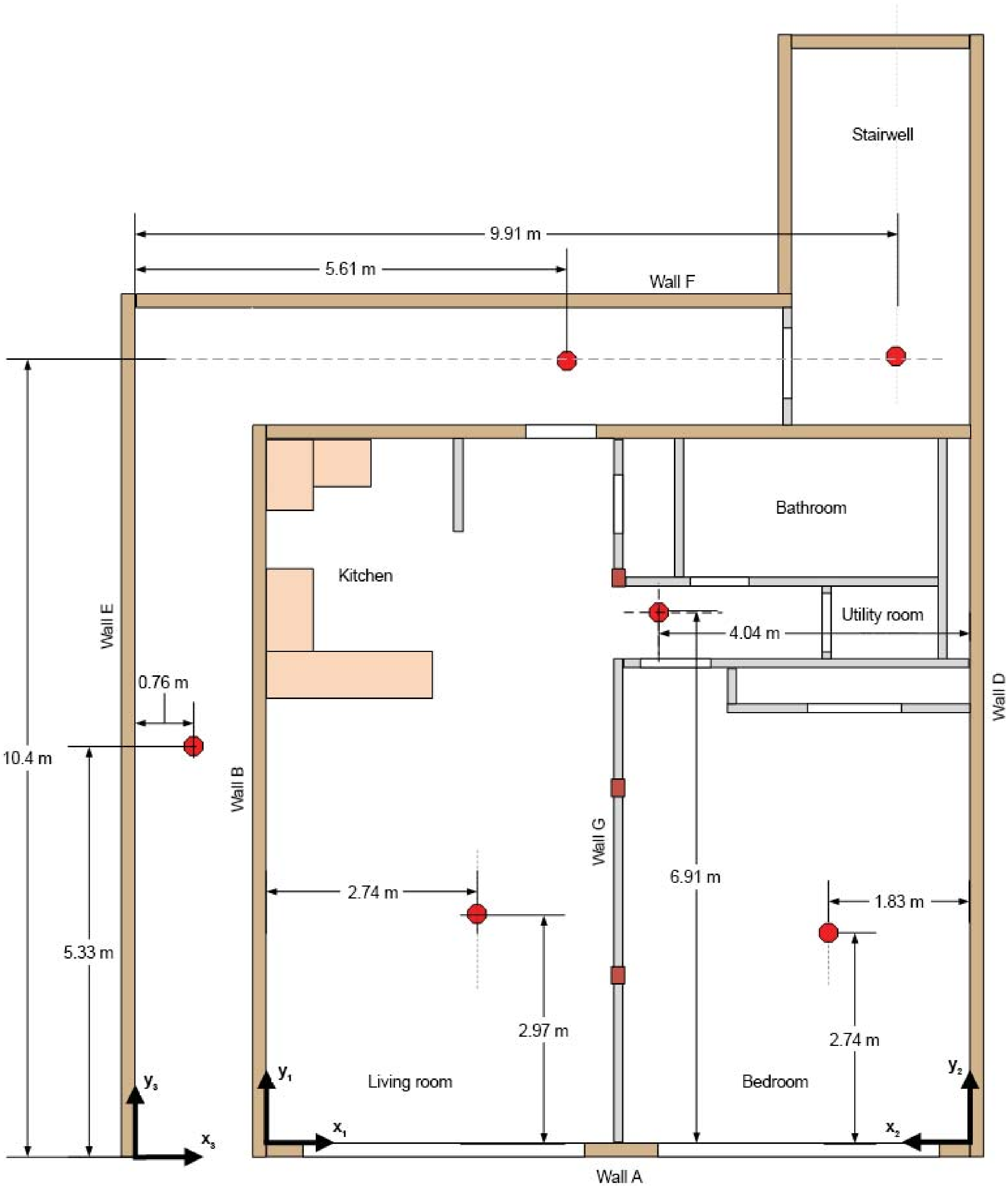


Figure 93. Location of smoke detectors (red octagons).

Table 9—Oxygen gas analyzer summary

Manufacturer	Model	Detector type	Range (%)
Siemens[a]	Oxymat 61	Paramagnetic	0–25

[a]Siemens AG, Munich, Germany.

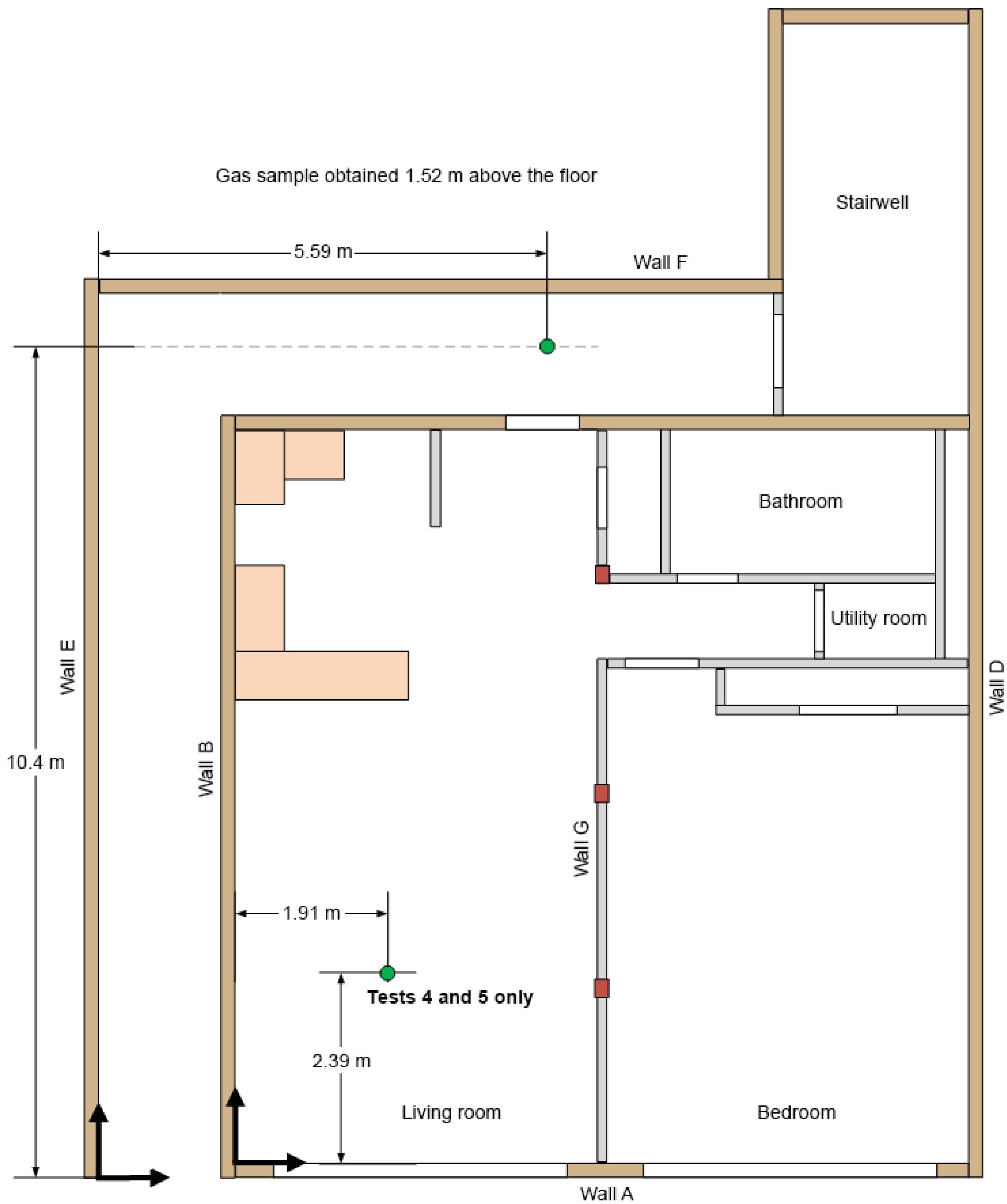


Figure 94. Gas sample locations (green octagons).

Table 10—CO–CO_2 gas analyzer summary

Manufacturer	Model	Gas	Detector type	Range (%)
Siemens[a]	Ultramat 23	CO_2	NDIR[b]	0–25
		CO	NDIR	0–5

[a]Siemens AG, Munich, Germany.
[b]NDIR, nondispersive infrared.

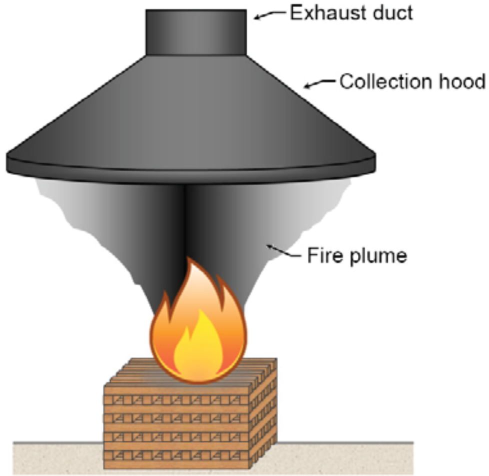


Figure 95. Schematic of a fire product collector.

Figure 96. 14-MW fire product collector at the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) Fire Research Laboratory.

Table 11—Fire products collector description

Description	C factor	E factor (kJ/kg)
14 MW	1.128	13,100

Table 12—Laboratory conditions description

Description	Manufacturer	Model
LBR_01	Omega[a]	IBTHP-5

[a]Omega Engineering, Stamford, Connecticut, USA.

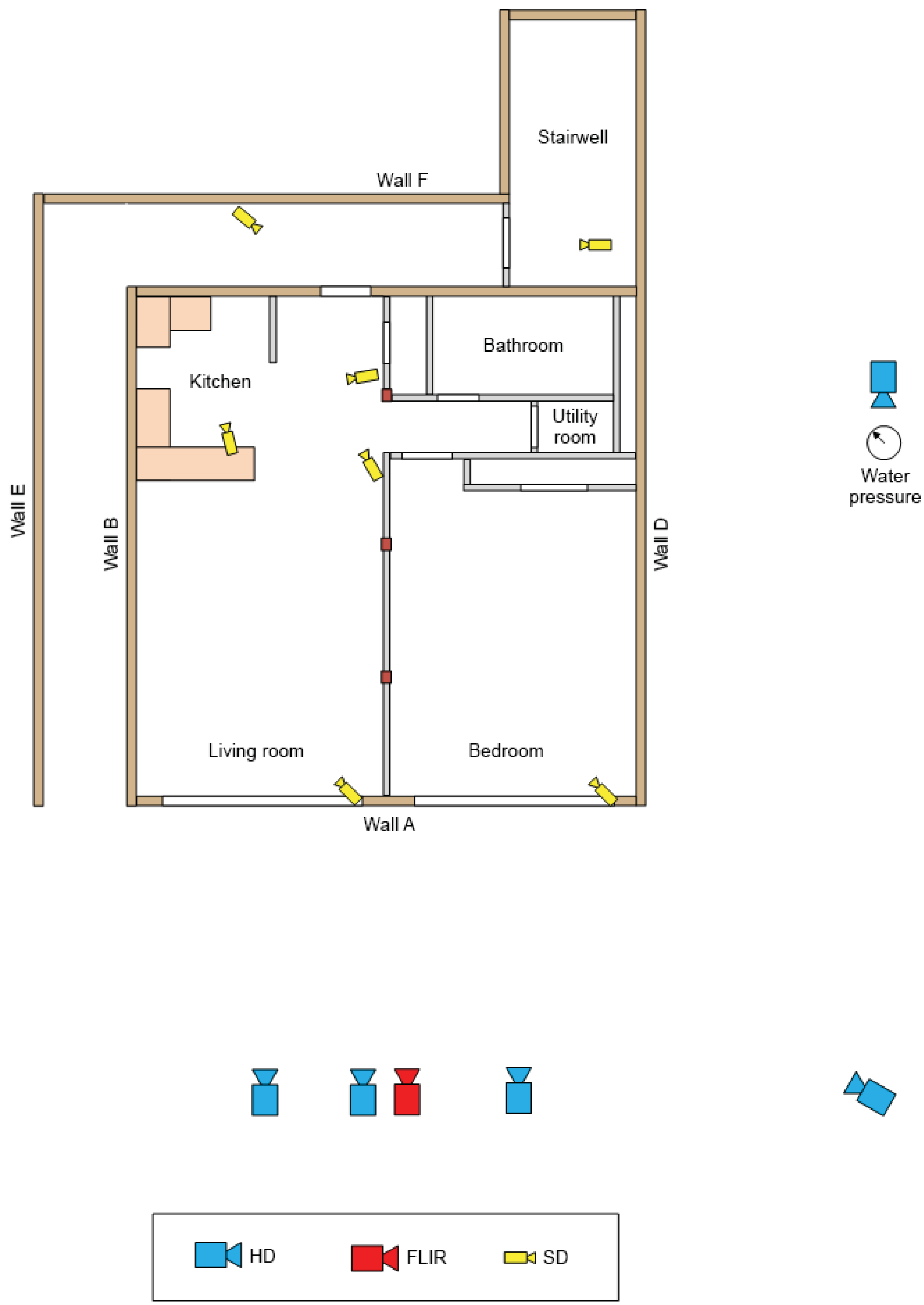


Figure 97. Layout of video cameras (HD, high definition; FLIR, forward looking infrared radiometer; SD, standard definition).

Thermal Imaging Camera

A FLIR ThermaCam SC640 thermal imaging camera (FLIR Systems, Inc., Wilsonville, Oregon, USA) was used during the test series. The infrared camera was used only to show differences in temperatures; it was not used to measure the actual temperature. The FLIR camera recorded videos in standard definition and was positioned looking toward Wall A (Fig. 97).

Summary of Results

The following is a brief summary of the results. Full results including photographs for each individual test are given in Appendices 1 through 5.

Events

Table 13 lists selected events that occurred during each experiment. These events include flashover in the living room and bedroom, visible flames in the corridor, complete failure of the apartment door, and sprinkler activation. The time (after ignition) at which each of these events occurred is given.

Flashover can be defined as "the transition from a localized fire to general conflagration within the compartment when all fuel surfaces are burning" (Drysdale 2011). Visually, it is difficult to determine the exact time when all of the fuel surfaces are burning during a test. Therefore, flashover for this test series was based on the time the two thermocouples located at a height of 1.83 m (6 ft) above the floor in a room (bedroom or living room) reached at least 600°C (1,110°F). The times were then averaged for the two thermocouple readings, and this time was taken as the time flashover occurred. Based on this definition of flashover, flashover occurred in the first three tests. The time to flashover was relatively consistent for a given room, within ±13 s from the average of 17:13 mm:ss in the bedroom and within ±1 min from the average of 12:35 mm:ss in the living room. In Test 5, although flashover conditions were not reached in the bedroom and living room, based on this definition, the thermocouples at Location B in both the bedroom and living room (see Fig. 66) exceeded the 600°C (1,100°F) threshold for a brief time prior to manual sprinkler activation. Also, flashover conditions were reached in the kitchen at approximately 17 min after ignition and were sustained until manual activation of the sprinkler system.

The entrance door to the apartment from the corridor had a fire resistance (protection) rating of 20 min. For the first two tests, flames did not breach the entrance door until after 20 min. However, for Test 3, fire breached the apartment entrance door in approximately 13 min and the entire door failed within 30 min. Although the door was kept closed during Test 3, it failed earlier than for Tests 1 and 2. One possible reason that the fire breached the door quicker in Test 3 is that the automatic door closer was (inadvertently) not attached to the door frame during the test (Fig. 98). This was not noticed until after the test. Another possible reason for the relatively early door failure was that the door frame did not appear to be properly installed. As shown in Figure 99, large gaps were observed between the door frame and the wall. These gaps allowed the steel door frame to flex as the frame was heated. The door may have then opened automatically, if the frame rotated enough that the latch no longer kept the door closed. The fire protection rating of a fire door assembly is based on NFPA Standard 252 fire exposure, in which a door is exposed to a "standard fire" rather than the natural fire growth exposure of a compartment fire. The performance of the fire door assemblies within the compartment fires presented herein cannot be directly compared with performance under a standard fire exposure.

Table 13—Major events during the cross-laminated timber test series

	Time to event after ignition (mm:ss)				
Event	Test #1	Test #2	Test #3	Test #4	Test #5
Flashover in living room	13:27	11:42	12:37	N/A	N/A
Flashover in bedroom	17:20	17:20	17:00	N/A	N/A
Flames in corridor outside of apartment door	26:51	30:38	13:06	N/A	~9:00[a]
Failure of entire apartment door	57:46	63:59	29:42	N/A	N/A
Sprinkler activation	N/A	N/A	N/A	2:37	23:00[b]

[a]Apartment door was open at the start of the test.
[b]Sprinklers were manually activated.

Figure 98. Automatic door closer not attached for Test 3.

Figure 99. Gaps between door frame and wall.

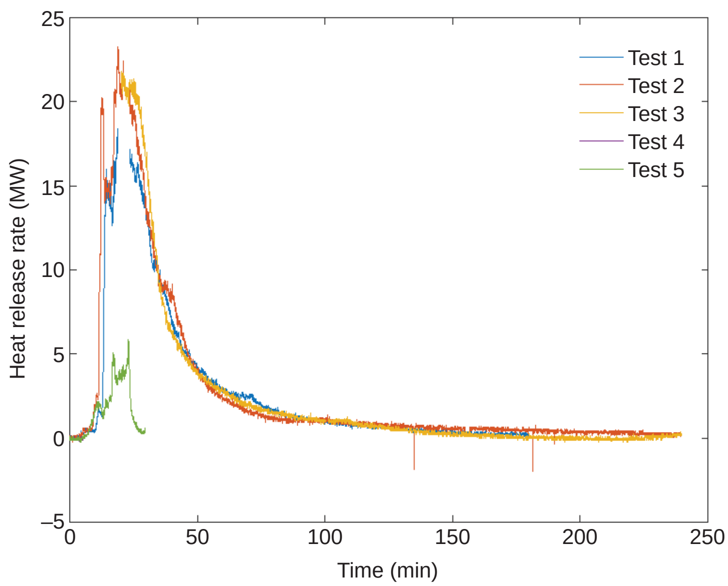


Figure 100. Heat release rate for each test.

Heat Release Rate

Figure 100 shows the heat release rate as a function of time for each test. In general, the first three tests had a similar profile. The heat release rate in Tests 4 and 5 was limited because of the use of fire sprinklers.

Table 14 provides a summary of the peak heat release rate and the total energy released for each test. These values may be less than the actual values because of several factors with the FPC. During Tests 1 and 2, the FPC was briefly taken offline to replace a gas filter. However, this occurred during a time in which the heat release rate may have been at its peak, based on the heat release rate curves shown in Figure 100. For Test 3, an issue with the FPC's gas sampling system resulted in the first 21 min of data not being collected. During Test 1, not all of the combustion products were captured by the FPC hood. This resulted in measured values of heat release rate and total energy released that were probably less than the actual values. To minimize this issue for subsequent tests, airflow through the hood was increased for Tests 2 through 5.

Temperatures

Figures 101 and 102 show the temperatures as a function of time for each test at 1.83 m (6 ft) above the finished floor at location B in the bedroom and living room, respectively. In general, the first three tests had similar temperature profiles at this location. The temperatures in Tests 4 and 5 were limited because of the use of fire sprinklers.

Figures 103 to 105 provide the temperatures of the embedded thermocouples located in the ceiling of the living room for Tests 2, 4, and 5, which all had exposed CLT. Charring, taken as a temperature of 300°C, occurred at

Table 14—Peak heat release rate (HRR) and total energy released

Test number	Peak HRR (MW)	Time of peak HRR (mm:ss)	Total energy released (MW)
1	18.5[a,b]	18:56	34,030[b]
2	23.3[a]	19:04	39,900
3	20.9[a]	20:37	29,150[c]
4	negligible	N/A	negligible
5	5.7	23:13	2,950

[a]Fire products collector (FPC) may have been offline when peak HRR occurred.
[b]Not all of the smoke was captured by the FPC hood.
[c]FPC was offline during the first 21 min of the test.

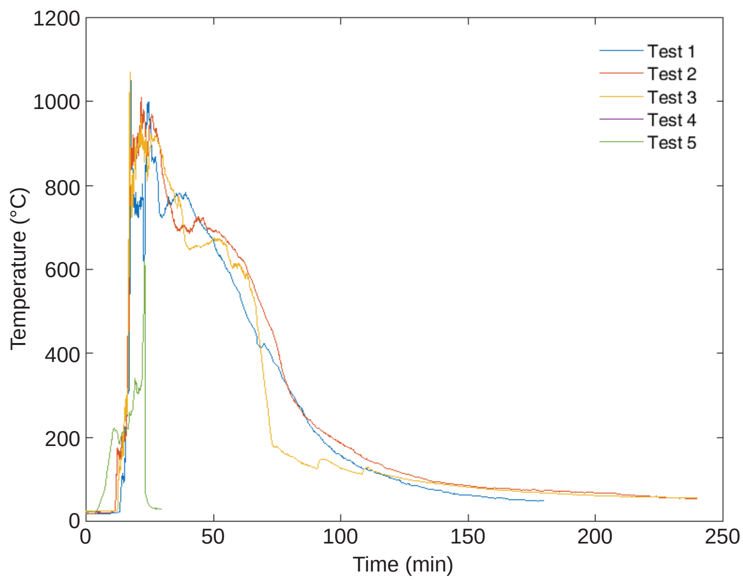


Figure 101. Bedroom air temperature at 1.83 m above finished floor at location B for each test.

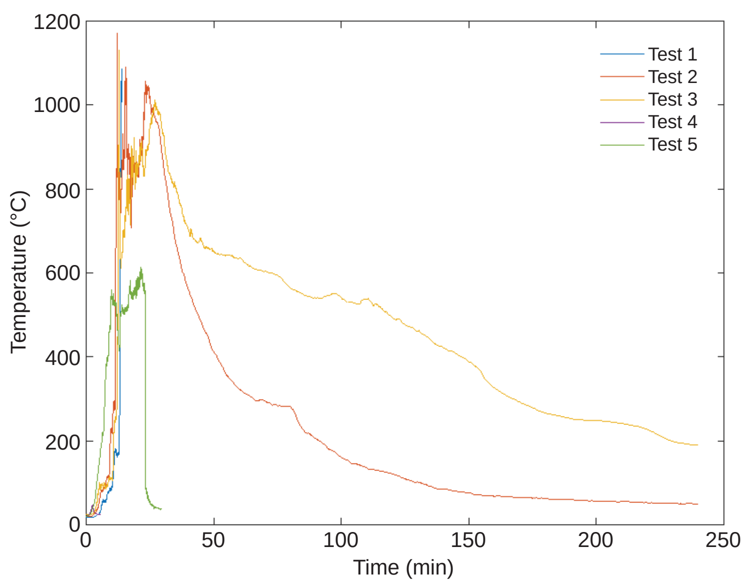


Figure 102. Living room air temperature at 1.83 m above finished floor at location B for each test.

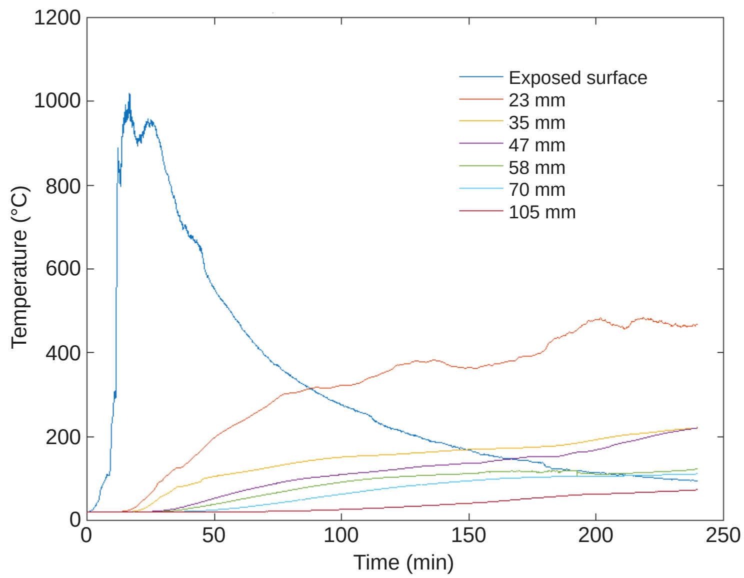


Figure 103. Embedded thermocouple temperatures in exposed cross-laminated timber portion of living room for Test 2.

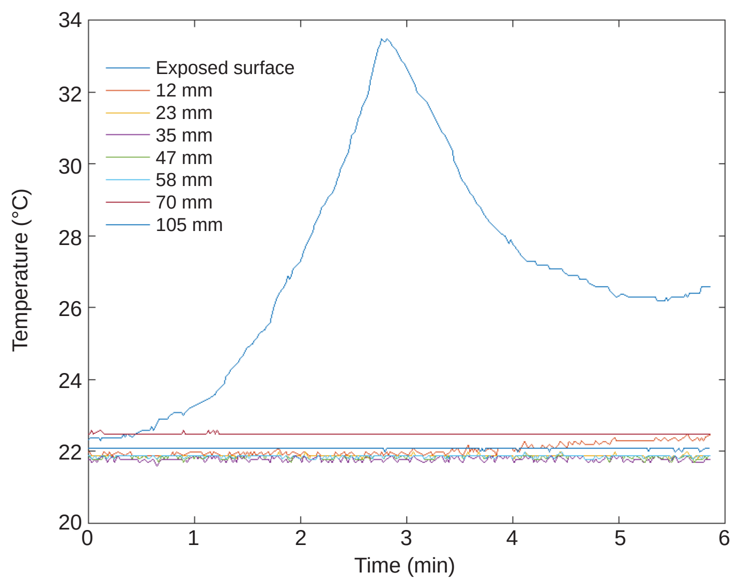


Figure 104. Embedded thermocouple temperatures in living room ceiling for Test 2.

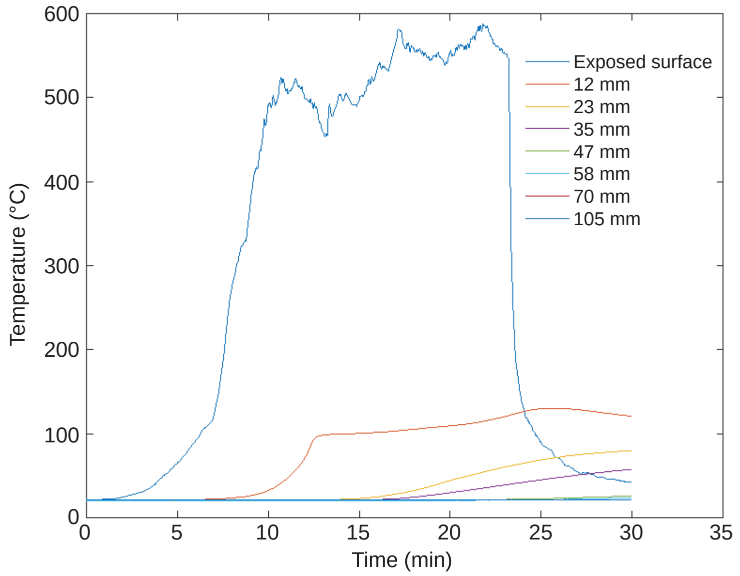


Figure 105. Embedded thermocouple temperatures in living room ceiling for Test 5.

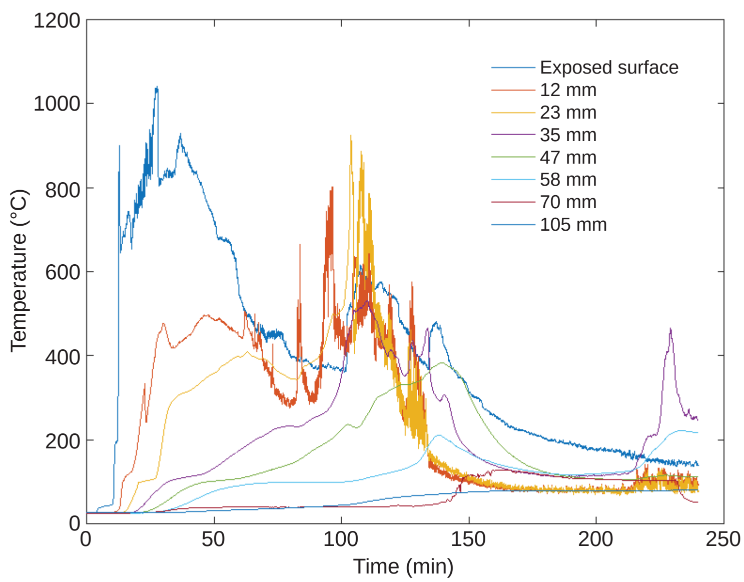


Figure 106. Embedded thermocouple temperatures in living room wall at location B for Test 3.

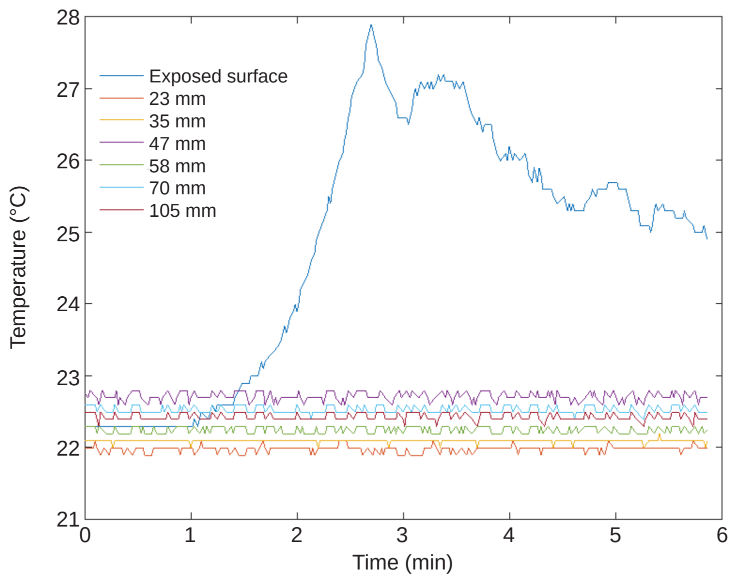


Figure 107. Embedded thermocouple temperatures in living room wall at Location B for Test 4.

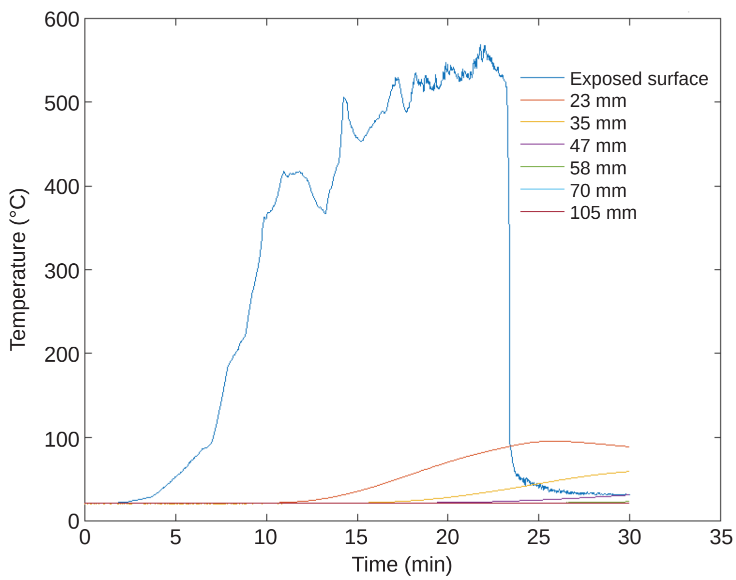


Figure 108. Embedded thermocouple temperatures in living room wall at Location B for Test 5.

depths 23 mm and less into the CLT for Test 2 and less than 12 mm for Test 5. Because of the rapid sprinkler activation in Test 4, charring did not occur in the living room ceiling.

Tests 3, 4, and 5 had exposed CLT on Wall B near the living room–dining area. The embedded thermocouple temperatures for these tests at Location B are provided in Figures 106 to 108. For Test 3, the surface temperature began to increase again around 100 min. Additionally, embedded thermocouple temperatures increased around the same time, with some noise occurring for the thermocouple at 12 mm (0.47 in.). This increase and noise were caused by localized delamination of the first layer of CLT near Location B.

Heat Flux

The heat flux meter in Wall F was positioned in the corridor across from the apartment door and was mounted 0.914 m (3 ft) above the finished floor. The heat flux for each test at this location is provided in Figure 109. The maximum heat flux at this location occurred in Tests 3 and 5, reaching 67 and 38 kW/m^2, respectively. In Test 3, the apartment door was improperly installed and failed earlier than it did in other tests. In Test 5, the apartment door remained open for the duration of the test. The heat flux for Tests 1, 2, and 4 all remained below 10 kW/m^2.

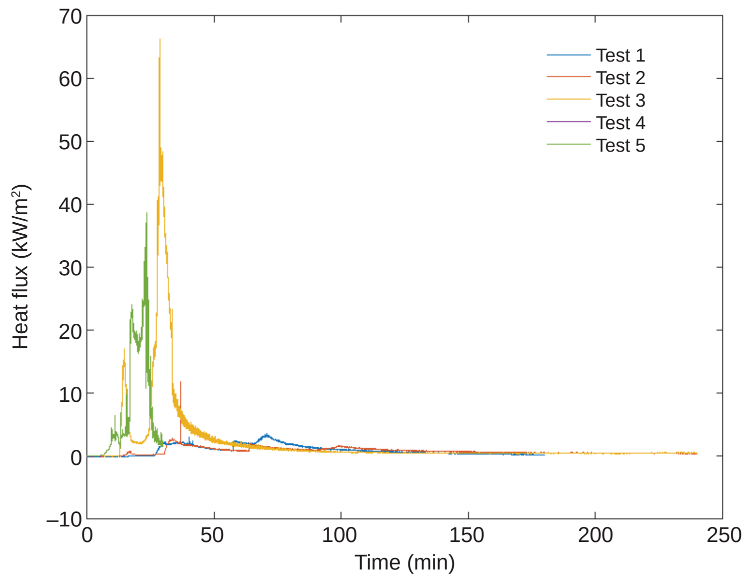


Figure 109. Heat flux in Wall F across from apartment door for each test.

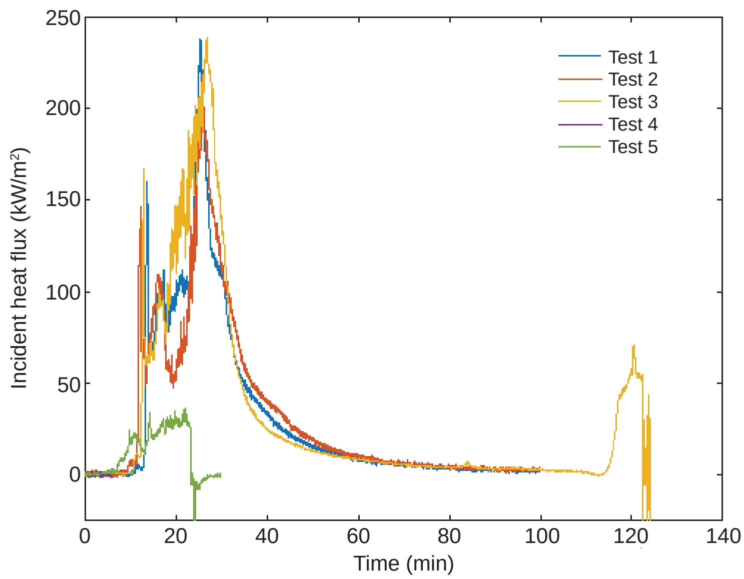


Figure 110. Directional flame thermometer incident heat flux estimates in Wall B, location B, for each test.

The heat flux was also measured throughout the apartment using DFTs. Figure 110 shows the incident heat fluxes to Wall B at Location B, which were estimated from the net heat flux measured by the DFT. The downward spike in Test 5 was most likely caused by water hitting the DFT.

The second spike in Test 3 around 115 min was from localized delamination and increased flaming in the immediate vicinity of the DFT. The DFT data for Test 3 then became noisy and was cut off; this occurred when the DFT fell off the wall.

Acknowledgments

The authors acknowledge contributions from the American Wood Council and the USDA Forest Service, State and Private Forestry. This research would not have been possible without contributions from the following staff of the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) Fire Research Laboratory (FRL): John Allen, Dr. David Sheppard, Dr. Stephen Paul Fuss, Jonathan Butta, Jason Dress, Joseph Bettenhausen, Biniyam Alemayehu, Adam Friedman, Scott Markward, James Zurenko, Steven Little Jr., Steven Little, Dennys Hernandez, Randy Markward, Kirk Markward, Mathew Rimland, Mark Wahl, and Robert Wulff. Also, the machine shop at the Forest Products Laboratory was extremely helpful in fabricating the differential flame thermometers.

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Anon. n.d.-c. Laboratory instruction LI002 – heat flux transducer. Beltsville, MD: Bureau of Alcohol, Tobacco, Firearms and Explosives – Fire Research Laboratory.

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Appendix 1—Cross-Laminated Timber Project Test 1 Results

U. S. Department of Justice

Fire Research Laboratory
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES
6000 Ammendale Road
Beltsville, MD 20705-1250
Phone: 202-648-6200

Test Record

ASCLD/LAB–*International* Testing Accreditation Certificate ALI-217-T

Title	CLT Project - Test 1 Results		
Test Type	Custom		
Lab Number	17OA0001-1	**Author**	David R. Tucholski
Test Date	5/23/17	**Test Number**	1 of 5

Introduction

The following provides the data for the first test of the CLT Project. The test was conducted on the first floor of the test structure. All CLT surfaces were encapsulated with two layers of (5/8 inch) Type X gypsum wallboard. The two large openings in Wall A were not covered with glass and remained opened. Fire sprinklers were not installed. The test duration was 3 hours. Additional details related to the test structure, instrumentation, and experimental procedures are provided in the main CLT Project report [1].

Table of Contents

Instrumentation Location

The following figure describes the nomenclature used to identify the various instrumentation and their locations.

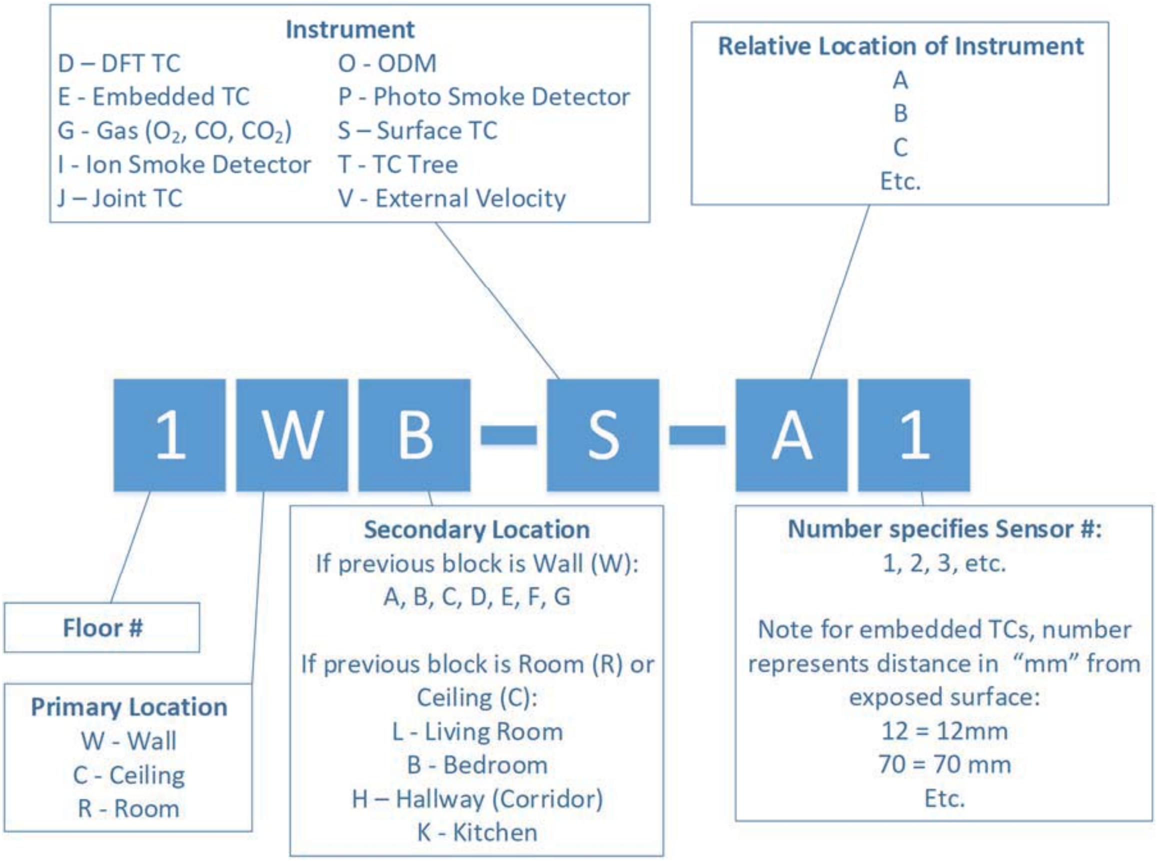

Figure 1. Nomenclature of Instrumentation Location

The example shown in Figure 1 is for a thermocouple located on the surface of Wall B on the first floor. It is the first thermocouple at location A. The exact location of each instrument is based on a Cartesian coordinate system (X, Y, Z). Location X and Location Y are located in the horizontal plane. Location Z is the vertical distance from the floor to the centerline of the instrument. Drawings showing the instrumentation locations and the associated coordinate systems are provided in the main CLT Project report [1].

Results for Test 1 (ID 193825)

Construction and Setup Photographs

The following photographs show the test structure being built and the setup for the experiment.

Figure 2. 193825_779775

Figure 3. 193825_779776

Figure 4. 193825_779777

Figure 5. 193825_779778

Figure 6. 193825_779779

Figure 7. 193825_779780

Figure 8. 193825_779781

Figure 9. 193825_779782

Figure 10. 193825_779783

Figure 11. 193825_779784

Figure 12. 193825_779785

Figure 13. 193825_779786

Figure 14. 193825_779787

Figure 15. 193825_779788

Figure 16. 193825_779789

Figure 17. 193825_779790

Figure 18. 193825_779791

Figure 19. 193825_779792

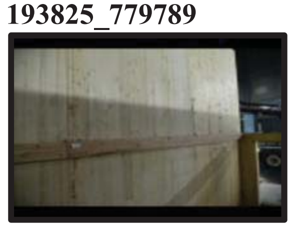

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Figure 21. 193825_779794


Figure 22. 193825_779795


Figure 23. 193825_779796


Figure 24. 193825_779797


Figure 25. 193825_779798


Figure 26. 193825_779799


Figure 27. 193825_779800


Figure 28. 193825_779801


Figure 29. 193825_779802


Figure 30. 193825_779803


Figure 31. 193825_779804


Figure 32. 193825_779805


Figure 33. 193825_779806


Figure 34. 193825_779807


Figure 35. 193825_779808


Figure 36. 193825_779809


Figure 37. 193825_779810


Figure 38. 193825_779811


Figure 39. 193825_779812


Figure 40. 193825_779813


Figure 41. 193825_779814


Figure 42. 193825_779815


Figure 43. 193825_779816


Figure 44. 193825_779817


Figure 45. 193825_779818

Figure 46.
193825_779819

Figure 47.
193825_779820

Figure 48.
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Figure 49.
193825_779822

Figure 50.
193825_779823

Figure 51.
193825_779824

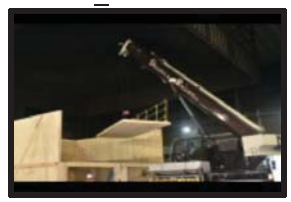

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Figure 53.
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Figure 54.
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Figure 55.
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Figure 56.
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Figure 57.
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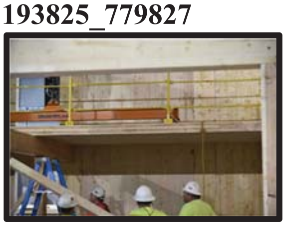

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Figure 59.
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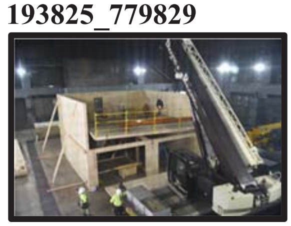

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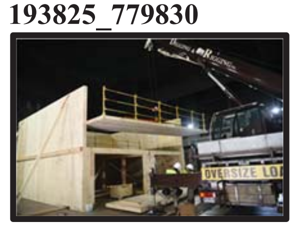

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Figure 62.
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Figure 63.
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Figure 64.
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Figure 65.
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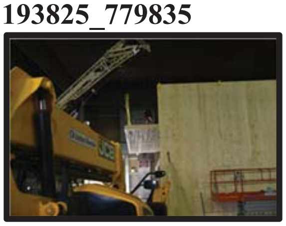

Figure 66.
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Figure 67.
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Figure 68.
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Figure 69.
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Figure 70.
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Figure 71.
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Figure 72.
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Figure 73.
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Figure 74.
193825_779850

Figure 75.
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Figure 79.
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Figure 80.
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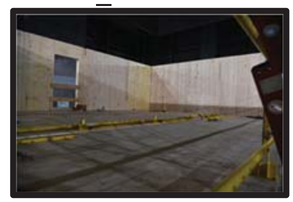

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Figure 82.
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Figure 83.
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Figure 84.
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Figure 85.
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Figure 86.
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Figure 87.
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Figure 88.
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Figure 90.
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Figure 98.
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Figure 99.
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Figure 100.
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Figure 101.
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Figure 102.
193825_779878

Figure 103.
193825_779879

Figure 104.
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Figure 105.
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Figure 106.
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Figure 107.
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Figure 108.
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Figure 109.
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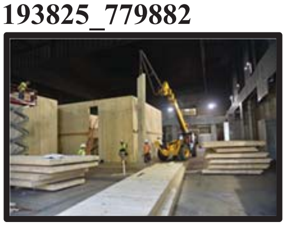

Figure 110.
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Figure 111.
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Figure 113.
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Figure 114.
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Figure 115.
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Figure 116.
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Figure 117.
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Figure 118.
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Figure 119.
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Figure 120.
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Figure 121.
193825_779908

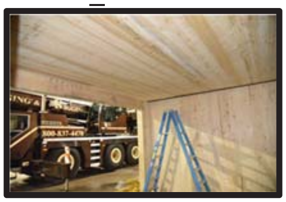
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Figure 124.
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Figure 125.
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Figure 127.
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Figure 128.
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Figure 129.
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Figure 130.
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Figure 131.
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Figure 132.
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Figure 133.
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Figure 134.
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Figure 135.
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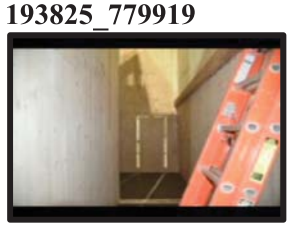
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Figure 137.
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Figure 138.
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Figure 140.
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Figure 141.
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Figure 142.
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Figure 143.
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Figure 144.
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Figure 145.
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Figure 146.
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Figure 147.
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Figure 148.
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Figure 149.
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Figure 150.
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Figure 151.
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Figure 152.
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Figure 153.
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Figure 154.
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Figure 155.
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Figure 156.
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Figure 157.
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Figure 158.
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Figure 159.
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Figure 160.
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Figure 161.
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Figure 162.
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Figure 163.
193825_779960

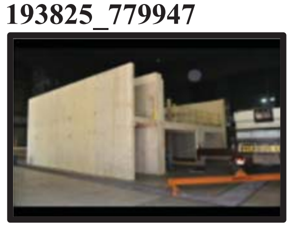

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Figure 165.
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Figure 166. 193825_779963


Figure 167. 193825_779964


Figure 168. 193825_779965


Figure 169. 193825_779966


Figure 170. 193825_779967


Figure 171. 193825_779968


Figure 172. 193825_779969


Figure 173. 193825_779970


Figure 174. 193825_779972


Figure 175. 193825_779973


Figure 176. 193825_779974


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Figure 180. 193825_779978


Figure 181. 193825_779979

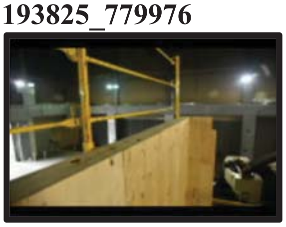
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Figure 183. 193825_779981


Figure 184. 193825_779982


Figure 185. 193825_779983


Figure 186. 193825_779984


Figure 187. 193825_779985

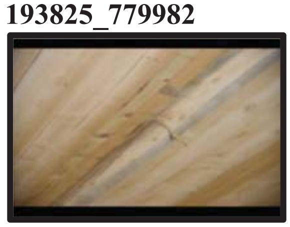
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Figure 189. 193825_779987


Figure 190.
193825_779988


Figure 191.
193825_779989


Figure 192.
193825_779990


Figure 193.
193825_779991


Figure 194.
193825_779992


Figure 195.
193825_779993


Figure 196.
193825_779994


Figure 197.
193825_779995

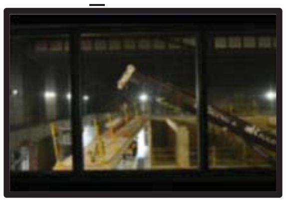
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Figure 199.
193825_779997


Figure 200.
193825_779998


Figure 201.
193825_779999


Figure 202.
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Figure 203.
193825_780001


Figure 204.
193825_780002


Figure 205.
193825_780005

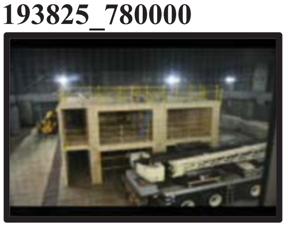
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Figure 207.
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Figure 209.
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Figure 210.
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Figure 211.
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Figure 212.
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Figure 213.
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Figure 214.
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Figure 215.
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Figure 216.
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Figure 217.
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Figure 218.
193825_780018

Figure 219.
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Figure 220.
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Figure 221.
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Figure 222.
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Figure 223.
193825_780023

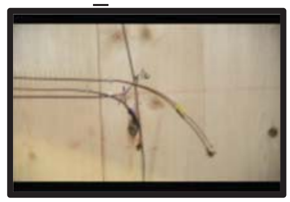

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Figure 225.
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Figure 226.
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Figure 227.
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Figure 228.
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Figure 229.
193825_780029

Figure 230.
193825_780030

Figure 231.
193825_780031

Figure 232.
193825_780032

Figure 233.
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Figure 234.
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Figure 235.
193825_780035

Figure 236.
193825_780036

Figure 237.
193825_780037


Figure 238.
193825_780038


Figure 239.
193825_780039


Figure 240.
193825_780040


Figure 241.
193825_780041


Figure 242.
193825_780042


Figure 243.
193825_780043


Figure 244.
193825_780044


Figure 245.
193825_780045


Figure 246.
193825_780046


Figure 247.
193825_780047


Figure 248.
193825_780048


Figure 249.
193825_780049


Figure 250.
193825_780050


Figure 251.
193825_780051


Figure 252.
193825_780052


Figure 253.
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Figure 254.
193825_780054


Figure 255.
193825_780055


Figure 256.
193825_780056

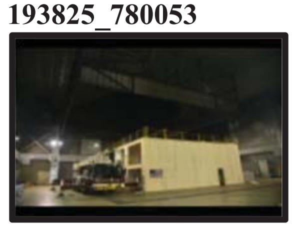
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Figure 258.
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Figure 259.
193825_780059

Figure 260.
193825_780060

Figure 261.
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Figure 262.
193825_780062

Figure 263.
193825_780063

Figure 264.
193825_780064

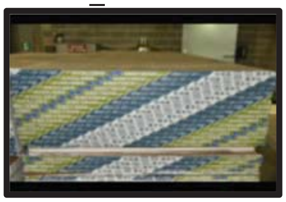

Figure 265.
193825_780065


Figure 266.
193825_780066


Figure 267.
193825_780067


Figure 268.
193825_780068


Figure 269.
193825_780069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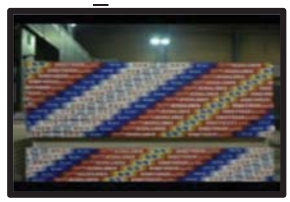
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Figure 273.
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Figure 274.
193825_780074


Figure 275.
193825_780075


Figure 276.
193825_780076


Figure 277.
193825_780077


Figure 278.
193825_780078


Figure 279.
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Figure 280.
193825_780080


Figure 281.
193825_780081


Figure 282.
193825_780082


Figure 283.
193825_780083

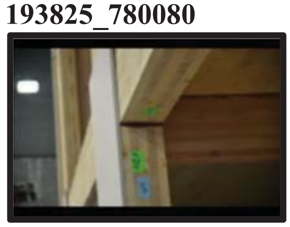
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Figure 285.
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Figure 287.
193825_780087


Figure 288.
193825_780088


Figure 289.
193825_780089

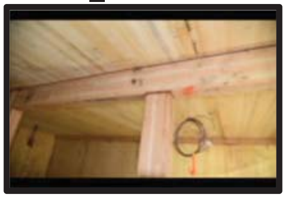
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Figure 295.
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Figure 296.
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Figure 297.
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Figure 298.
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Figure 299.
193825_780099


Figure 300.
193825_780100


Figure 301.
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Figure 302.
193825_780102


Figure 303.
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Figure 304.
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Figure 305.
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Figure 306.
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Figure 307.
193825_780107


Figure 308.
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Figure 309.
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Figure 310.
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Figure 311.
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Figure 312.
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Figure 313.
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Figure 314.
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Figure 315.
193825_780115

Figure 316.
193825_780116

Figure 317.
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Figure 318.
193825_780118

Figure 319.
193825_780119

Figure 320.
193825_780120

Figure 321.
193825_780121

Figure 322.
193825_780122

Figure 323.
193825_780123

Figure 324.
193825_780124

Figure 325.
193825_780125

Figure 326.
193825_780126

Figure 327.
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Figure 328.
193825_780128

Figure 329.
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Figure 330.
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Figure 331.
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Figure 332.
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Figure 333.
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Figure 334.
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Figure 335.
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Figure 336.
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Figure 337.
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Figure 338.
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Figure 339.
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Figure 340.
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Figure 341.
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Figure 342.
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Figure 343.
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Figure 344.
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Figure 345.
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Figure 346.
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Figure 347.
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Figure 348.
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Figure 349.
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Figure 350.
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Figure 351.
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Figure 352.
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Figure 353.
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Figure 356.
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Figure 357.
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Figure 358. 193825_780158


Figure 359. 193825_780159


Figure 360. 193825_780160


Figure 361. 193825_780161


Figure 362. 193825_780162


Figure 363. 193825_780163


Figure 364. 193825_780164


Figure 365. 193825_780165


Figure 366. 193825_780166


Figure 367. 193825_780167


Figure 368. 193825_780168


Figure 369. 193825_780169


Figure 370. 193825_780170


Figure 371. 193825_780171


Figure 372. 193825_780172


Figure 373. 193825_780173


Figure 374. 193825_780174


Figure 375. 193825_780175

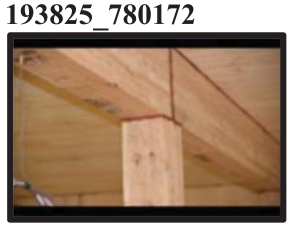
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Figure 380. 193825_780180


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Figure 382. 193825_780182


Figure 383. 193825_780183


Figure 384. 193825_780184


Figure 385. 193825_780185


Figure 386. 193825_780186


Figure 387. 193825_780187


Figure 388. 193825_780188


Figure 389. 193825_780189


Figure 390. 193825_780190

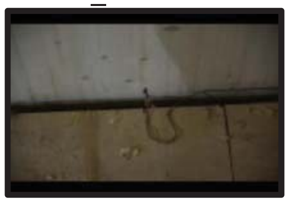
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Figure 397. 193825_780197


Figure 398. 193825_780198


Figure 399. 193825_780199


Figure 400. 193825_780200


Figure 401. 193825_780201


Figure 402. 193825_780202


Figure 403. 193825_780203


Figure 404. 193825_780204


Figure 405. 193825_780205


Figure 406.
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Figure 407.
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Figure 408.
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Figure 409.
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Figure 411.
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Figure 412.
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Figure 413.
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Figure 414.
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Figure 415.
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Figure 416.
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Figure 417.
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Figure 418.
193825_780218

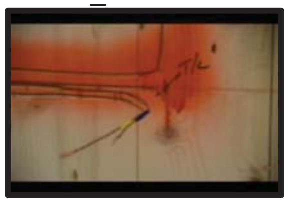
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Figure 424.
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Figure 425.
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Figure 426.
193825_780226


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Figure 428.
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Figure 429.
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Figure 430. 193825_780230


Figure 431. 193825_780231

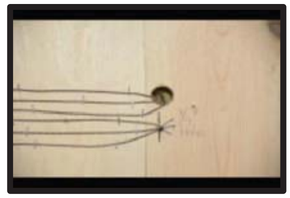
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Figure 436. 193825_780238


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Figure 438. 193825_780240


Figure 439. 193825_780241


Figure 440. 193825_780242


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Figure 442. 193825_780244


Figure 443. 193825_780245


Figure 444. 193825_780246


Figure 445. 193825_780247

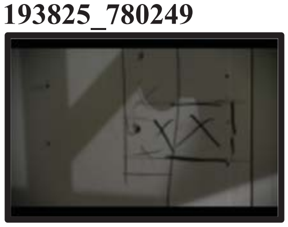

Figure 446. 193825_780248


Figure 447. 193825_780249


Figure 448. 193825_780250


Figure 449. 193825_780251


Figure 450. 193825_780252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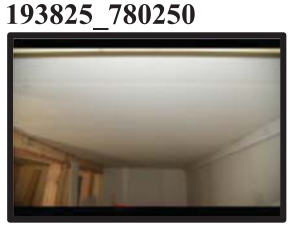
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Figure 455. 193825_780257


Figure 456. 193825_780258


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Figure 458. 193825_780260


Figure 459. 193825_780261


Figure 460. 193825_780262


Figure 461. 193825_780263


Figure 462. 193825_780264


Figure 463. 193825_780265


Figure 464. 193825_780266


Figure 465. 193825_780267


Figure 466. 193825_780268


Figure 467. 193825_780269


Figure 468. 193825_780270


Figure 469. 193825_780271


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Figure 471. 193825_780273


Figure 472. 193825_780274


Figure 473. 193825_780275


Figure 474. 193825_780276


Figure 475. 193825_780277

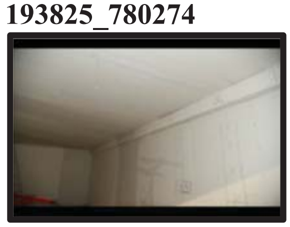
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Figure 482.
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Figure 484.
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Figure 489.
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Figure 490.
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Figure 493.
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Figure 494.
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Figure 495.
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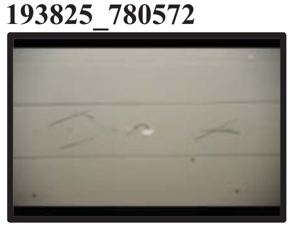

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Figure 497.
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Figure 498.
193825_780578

Figure 499.
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Figure 501.
193825_780581


Figure 502. 193825_780582


Figure 503. 193825_780583


Figure 504. 193825_780584


Figure 505. 193825_780585


Figure 506. 193825_780586


Figure 507. 193825_780587

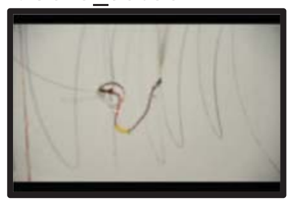
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Figure 511. 193825_780591

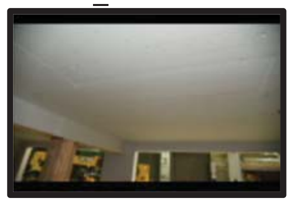
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Figure 516. 193825_780596


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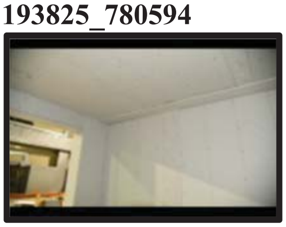
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Figure 524. 193825_780604


Figure 525. 193825_780605


Figure 526.
193825_780606


Figure 527.
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Figure 528.
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Figure 529.
193825_780609


Figure 530.
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Figure 531.
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Figure 532.
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Figure 533.
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Figure 534.
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Figure 535.
193825_780615


Figure 536.
193825_780624


Figure 537.
193825_780625


Figure 538.
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Figure 539.
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Figure 540.
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Figure 541.
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Figure 542.
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Figure 543.
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Figure 544.
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Figure 545.
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Figure 546.
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Figure 547.
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Figure 548.
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Figure 549.
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Figure 550.
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Figure 551.
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Figure 552.
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Figure 555.
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Figure 557.
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Figure 558.
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Figure 559.
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Figure 560.
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Figure 561.
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Figure 562.
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Figure 563.
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Figure 564.
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Figure 565.
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Figure 566.
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Figure 567.
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Figure 568.
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Figure 569.
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Figure 571.
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Figure 572.
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Figure 573.
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Figure 579.
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Figure 580.
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Figure 581.
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Figure 582.
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Figure 583.
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Figure 584.
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Figure 585.
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Figure 586.
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Figure 587.
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Figure 588.
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Figure 589.
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Figure 590.
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Figure 591.
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Figure 593.
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Figure 595.
193825_780696

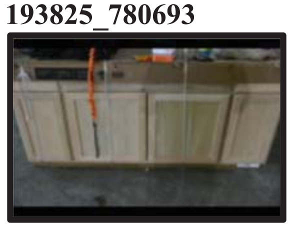

Figure 596.
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Figure 597.
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Figure 598.
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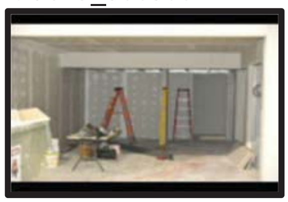
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Figure 608.
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Figure 609.
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Figure 610.
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Figure 611.
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Figure 612.
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Figure 613.
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Figure 614.
193825_780715


Figure 615.
193825_780716


Figure 616.
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Figure 617.
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Figure 618.
193825_780719


Figure 619.
193825_780720


Figure 620.
193825_780721


Figure 621.
193825_780722


Figure 622. **193825_780723**


Figure 623. **193825_780724**


Figure 624. **193825_780725**


Figure 625. **193825_780726**


Figure 626. **193825_780727**


Figure 627. **193825_780728**


Figure 628. **193825_780729**


Figure 629. **193825_780730**


Figure 630. **193825_780731**


Figure 631. **193825_780732**


Figure 632. **193825_780733**


Figure 633. **193825_780734**


Figure 634. **193825_780735**


Figure 635. **193825_780736**


Figure 636. **193825_780739**


Figure 637. **193825_780740**


Figure 638. **193825_780741**

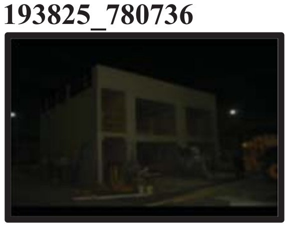
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Figure 640. **193825_780743**


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Figure 643. **193825_780746**


Figure 644. **193825_780747**


Figure 645. **193825_780748**

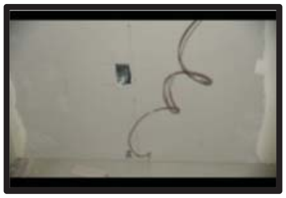

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Figure 647.
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193825_780751

Figure 649.
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Figure 650.
193825_780753

Figure 651.
193825_780754

Figure 652.
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Figure 653.
193825_780756

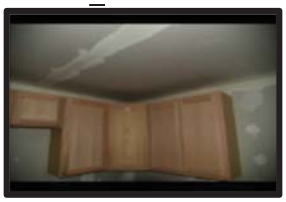

Figure 654.
193825_780757

Figure 655.
193825_780758

Figure 656.
193825_780759

Figure 657.
193825_780760

Figure 658.
193825_780761

Figure 659.
193825_780762

Figure 660.
193825_780763

Figure 661.
193825_780764

Figure 662.
193825_780765

Figure 663.
193825_780766

Figure 664.
193825_780767

Figure 665.
193825_780768

Figure 666.
193825_780769

Figure 667.
193825_780770

Figure 668.
193825_780771

Figure 669.
193825_780772

Figure 670. 193825_780773

Figure 671. 193825_780774

Figure 672. 193825_780775

Figure 673. 193825_780776

Figure 674. 193825_780777

Figure 675. 193825_780778

Figure 676. 193825_780779

Figure 677. 193825_780780

Figure 678. 193825_780781

Figure 679. 193825_780782

Figure 680. 193825_780783

Figure 681. 193825_780784

Figure 682. 193825_780785

Figure 683. 193825_780786

Figure 684. 193825_780787

Figure 685. 193825_780788

Figure 686. 193825_780789

Figure 687. 193825_780790

Figure 688. 193825_780791

Figure 689. 193825_780792

Figure 690. 193825_780793

Figure 691. 193825_780794

Figure 692. 193825_780795

Figure 693. 193825_780796

Figure 694.
193825_780797

Figure 695.
193825_780798

Figure 696.
193825_780799

Figure 697.
193825_780800

Figure 698.
193825_780801

Figure 699.
193825_780802

Figure 700.
193825_780803

Figure 701.
193825_780804

Figure 702.
193825_780805

Figure 703.
193825_780806

Figure 704.
193825_780807

Figure 705.
193825_780808

Figure 706.
193825_780809

Figure 707.
193825_780810

Figure 708.
193825_780811

Figure 709.
193825_780814

Figure 710.
193825_780815

Figure 711.
193825_780816

Figure 712.
193825_780817

Figure 713.
193825_780818

Figure 714.
193825_780819

Figure 715.
193825_780820

Figure 716.
193825_780821

Figure 717.
193825_780812


Figure 718. **193825_780813**


Figure 719. **193825_780822**


Figure 720. **193825_780823**


Figure 721. **193825_780824**


Figure 722. **193825_780825**


Figure 723. **193825_780826**


Figure 724. **193825_780827**


Figure 725. **193825_780828**


Figure 726. **193825_780829**


Figure 727. **193825_780830**

Figure 728. **193825_780831**


Figure 729. **193825_780832**


Figure 730. **193825_780836**


Figure 731. **193825_780837**


Figure 732. **193825_780838**


Figure 733. **193825_780839**


Figure 734. **193825_780840**


Figure 735. **193825_780841**


Figure 736. **193825_780842**


Figure 737. **193825_780843**


Figure 738. **193825_780844**


Figure 739. **193825_780845**


Figure 740. **193825_780846**


Figure 741. **193825_780847**


Figure 742. 193825_780848


Figure 743. 193825_780849


Figure 744. 193825_780850


Figure 745. 193825_780851


Figure 746. 193825_780852


Figure 747. 193825_780853


Figure 748. 193825_780854


Figure 749. 193825_780855


Figure 750. 193825_780856


Figure 751. 193825_780857


Figure 752. 193825_780858


Figure 753. 193825_780859


Figure 754. 193825_780860


Figure 755. 193825_780861


Figure 756. 193825_780862


Figure 757. 193825_780863


Figure 758. 193825_780864


Figure 759. 193825_780865


Figure 760. 193825_780866


Figure 761. 193825_780867


Figure 762. 193825_780868


Figure 763. 193825_780869


Figure 764. 193825_780870


Figure 765. 193825_780871


Figure 766. 193825_780872


Figure 767. 193825_780873


Figure 768. 193825_780887


Figure 769. 193825_780888


Figure 770. 193825_780889


Figure 771. 193825_780890


Figure 772. 193825_780891


Figure 773. 193825_780892


Figure 774. 193825_780893


Figure 775. 193825_780894


Figure 776. 193825_780895


Figure 777. 193825_780896


Figure 778. 193825_780897


Figure 779. 193825_780898


Figure 780. 193825_780899


Figure 781. 193825_780900


Figure 782. 193825_780901


Figure 783. 193825_780902


Figure 784. 193825_780903


Figure 785. 193825_780904


Figure 786. 193825_780905


Figure 787. 193825_780906


Figure 788. 193825_780907


Figure 789. 193825_780908


Figure 790.
193825_780909


Figure 791.
193825_780910


Figure 792.
193825_780911


Figure 793.
193825_780912


Figure 794.
193825_780913


Figure 795.
193825_780914


Figure 796.
193825_780915


Figure 797.
193825_780916


Figure 798.
193825_780917


Figure 799.
193825_781893


Figure 800.
193825_781894


Figure 801.
193825_781895


Figure 802.
193825_781896


Figure 803.
193825_781897


Figure 804.
193825_781898


Figure 805.
193825_781899


Figure 806.
193825_781900


Figure 807.
193825_781901

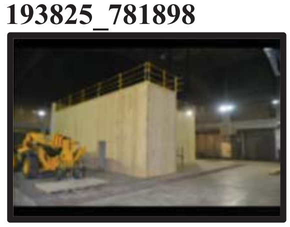
Figure 808.
193825_781903


Figure 809.
193825_781904


Figure 810.
193825_781905


Figure 811.
193825_781906


Figure 812.
193825_781907


Figure 813.
193825_781908


Figure 814. **193825_781909**


Figure 815. **193825_781910**


Figure 816. **193825_781911**


Figure 817. **193825_781912**


Figure 818. **193825_781913**


Figure 819. **193825_781914**


Figure 820. **193825_781915**


Figure 821. **193825_781916**


Figure 822. **193825_781917**


Figure 823. **193825_781918**


Figure 824. **193825_781919**


Figure 825. **193825_781920**


Figure 826. **193825_781921**


Figure 827. **193825_781922**


Figure 828. **193825_781923**


Figure 829. **193825_781924**


Figure 830. **193825_781925**


Figure 831. **193825_781926**


Figure 832. **193825_781927**


Figure 833. **193825_781928**


Figure 834. **193825_781929**


Figure 835. **193825_781930**


Figure 836. **193825_781931**


Figure 837. **193825_781932**

Figure 838. 193825_781933

Figure 839. 193825_781934

Figure 840. 193825_781935

Figure 841. 193825_781936

Figure 842. 193825_781937

Figure 843. 193825_781938

Figure 844. 193825_781939

Figure 845. 193825_781940

Figure 846. 193825_781941

Figure 847. 193825_781942

Figure 848. 193825_781943

Figure 849. 193825_781944

Figure 850. 193825_781945

Figure 851. 193825_781946

Figure 852. 193825_781947

Figure 853. 193825_781948

Figure 854. 193825_781949

Figure 855. 193825_783174

Figure 856. 193825_783175

Figure 857. 193825_783176

Figure 858. 193825_783177

Figure 859. 193825_783178

Figure 860. 193825_783179

Figure 861. 193825_783180


Figure 862. 193825_783181


Figure 863. 193825_783182


Figure 864. 193825_783183


Figure 865. 193825_783184


Figure 866. 193825_783186


Figure 867. 193825_783187


Figure 868. 193825_783188


Figure 869. 193825_783189


Figure 870. 193825_783190


Figure 871. 193825_783191


Figure 872. 193825_783192


Figure 873. 193825_783193


Figure 874. 193825_783194


Figure 875. 193825_783195

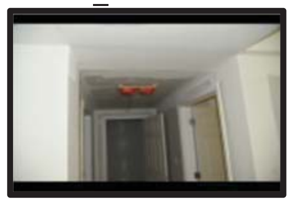
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Figure 877. 193825_783197

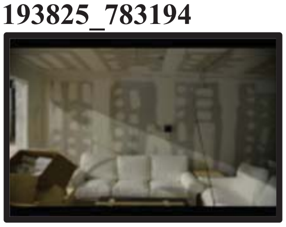
Figure 878. 193825_783198


Figure 879. 193825_783199


Figure 880. 193825_783200


Figure 881. 193825_783201


Figure 882. 193825_783202


Figure 883. 193825_783203

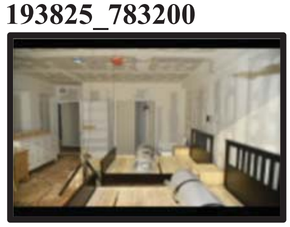
Figure 884. 193825_783204


Figure 885. 193825_783205


Figure 886. 193825_783206


Figure 887. 193825_783207


Figure 888. 193825_783208


Figure 889. 193825_783209


Figure 890. 193825_783210


Figure 891. 193825_783211


Figure 892. 193825_783212


Figure 893. 193825_783213


Figure 894. 193825_783214


Figure 895. 193825_783215


Figure 896. 193825_783216


Figure 897. 193825_783217


Figure 898. 193825_783218


Figure 899. 193825_783219


Figure 900. 193825_783220


Figure 901. 193825_783221


Figure 902. 193825_783222


Figure 903. 193825_783223


Figure 904. 193825_783224


Figure 905. 193825_783225


Figure 906. 193825_783226


Figure 907. 193825_783227


Figure 908. 193825_783228

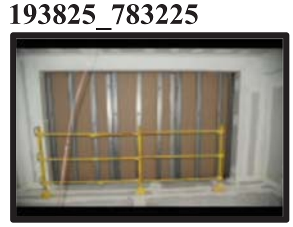
Figure 909. 193825_783229


Figure 910. 193825_783230


Figure 911. 193825_783231


Figure 912. 193825_783232


Figure 913. 193825_783233


Figure 914. 193825_783234


Figure 915. 193825_783235


Figure 916. 193825_783236

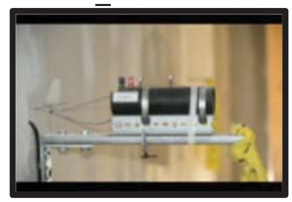
Figure 917. 193825_783237


Figure 918. 193825_783238


Figure 919. 193825_783239


Figure 920. 193825_783241


Figure 921. 193825_783242


Figure 922. 193825_783243

Experiment Events

The following table lists selected events that occurred during the experiment.

Table 1. Experiment Events

Description	Time (s)	Time (hh:mm:ss)
Flashover Living Room	807	00:13:27
Flashover Bedroom	1040	00:17:20
FPC Offline	1145	00:19:05
FPC Online	1424	00:23:44
Flames in Hallway at Apartment Door	1611	00:26:51
Apartment Door Fails Completely	3474	00:57:54

Laboratory Conditions

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 2. Lab Conditions Description

Description	Manufacturer	Model
LBR_01	OMEGA	IBTHP-5

The following table provides a summary of the initial conditions at the start of the experiment. The 'Description' column shows the location of the measurements.

Table 3. Ambient Laboratory Condition Summary

Description	Initial (C)	Initial (kPa)	Initial (%)
LBR_01	19	101	68

Thermocouples

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement.   The "Z" location is the height of the thermocouple above the floor. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 4. Thermocouple Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WB-S-A1	0.032	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A035	0.035	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A012	0.012	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A058	0.058	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A023	0.023	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A105	0.105	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A047	0.047	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-A070	0.070	2.286	1.524	Type K, Glass Ins., 24 AWG wire
1WB-S-B1	0.032	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-S-B2	0.016	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-S-B3	0.000	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B035	0.035	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B058	0.058	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B023	0.023	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B105	0.105	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B047	0.047	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B070	0.070	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-S-C1	0.032	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-S-C2	0.016	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-S-C3	0.000	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C035	0.035	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C012	0.012	6.858	1.524	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WB-E-C058	0.058	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C023	0.023	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C105	0.105	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C047	0.047	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C070	0.070	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-J-A1	0.102	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-A2	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-B1	0.102	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-B2	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-C1	0.102	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-C2	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-D1	0.102	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-D2	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-E1	0.102	5.715	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F1	0.102	6.858	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F2	0.000	6.858	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-G1	0.102	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-G2	0.000	8.001	2.921	Type K, Glass Ins., 24 AWG wire
2WB-S-A1	0.032	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-A2	0.016	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-A3	0.000	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A035	0.035	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A012	0.012	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A058	0.058	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A023	0.023	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A105	0.105	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A070	0.070	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-B1	0.032	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-B2	0.016	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-B3	0.000	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B035	0.035	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B012	0.012	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B058	0.058	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B023	0.023	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B105	0.105	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B047	0.047	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B070	0.070	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-C1	0.032	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-C2	0.016	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-C3	0.000	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C035	0.035	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C012	0.012	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C058	0.058	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C023	0.023	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C105	0.105	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C047	0.047	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C070	0.070	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-E1	0.088	5.715	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-F1	0.088	6.858	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-G1	0.088	8.001	2.743	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WD-S-A1	0.032	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-S-A2	0.016	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-S-A3	0.000	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A105	0.105	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A012	0.012	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A070	0.070	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A023	0.023	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A058	0.058	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A035	0.035	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A047	0.047	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-J-A1	0.076	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A2	0.000	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A3	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-B1	0.076	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B2	0.000	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B3	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-C1	0.076	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C2	0.000	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C3	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-D1	0.076	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D2	0.000	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D3	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
2WD-S-A1	0.025	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-S-A2	0.025	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-S-A3	0.000	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A105	0.105	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A012	0.012	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A070	0.070	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A023	0.023	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A058	0.058	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A035	0.035	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A047	0.047	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-A1	1.524	1.981	2.711	Type K, Glass Ins., 24 AWG wire
1CL-S-A2	1.524	1.981	2.727	Type K, Glass Ins., 24 AWG wire
1CL-S-A3	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-B1	3.048	1.981	2.711	Type K, Glass Ins., 24 AWG wire
1CL-S-B2	3.048	1.981	2.727	Type K, Glass Ins., 24 AWG wire
1CL-S-B3	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-C1	2.286	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CL-S-C2	2.286	2.972	2.727	Type K, Glass Ins., 24 AWG wire
1CL-S-C3	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-D1	1.524	3.962	2.711	Type K, Glass Ins., 24 AWG wire
1CL-S-D2	1.524	3.962	2.727	Type K, Glass Ins., 24 AWG wire
1CL-S-E1	3.048	3.962	2.711	Type K, Glass Ins., 24 AWG wire
1CL-S-E2	3.048	3.962	2.727	Type K, Glass Ins., 24 AWG wire
1CL-S-E3	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-A1	3.048	1.829	2.711	Type K, Glass Ins., 24 AWG wire
1CB-S-A2	3.048	1.829	2.727	Type K, Glass Ins., 24 AWG wire
1CB-S-A3	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-B1	1.524	1.829	2.711	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1CB-S-B2	1.524	1.829	2.727	Type K, Glass Ins., 24 AWG wire
1CB-S-B3	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-C1	2.286	2.743	2.711	Type K, Glass Ins., 24 AWG wire
1CB-S-C2	2.286	2.743	2.727	Type K, Glass Ins., 24 AWG wire
1CB-S-C3	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-D1	3.048	3.658	2.711	Type K, Glass Ins., 24 AWG wire
1CB-S-D2	3.048	3.658	2.727	Type K, Glass Ins., 24 AWG wire
1CB-S-D3	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-E1	1.524	3.658	2.711	Type K, Glass Ins., 24 AWG wire
1CB-S-E2	1.524	3.658	2.727	Type K, Glass Ins., 24 AWG wire
1CB-S-E3	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-A1	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-B1	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-C1	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-D1	1.524	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-E1	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-A1	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-B1	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-C1	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-D1	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-E1	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire
1RL-T-A0	2.210	2.286	0.152	Type K, Glass Ins., 24 AWG wire
1RL-T-A2	2.210	2.286	0.610	Type K, Glass Ins., 24 AWG wire
1RL-T-A4	2.210	2.286	1.219	Type K, Glass Ins., 24 AWG wire
1RL-T-A6	2.210	2.286	1.829	Type K, Glass Ins., 24 AWG wire
1RL-T-A8	2.210	2.286	2.438	Type K, Glass Ins., 24 AWG wire
1RL-T-A9	2.210	2.286	2.718	Type K, Glass Ins., 24 AWG wire
1RL-T-B0	2.210	3.810	0.152	Type K, Glass Ins., 24 AWG wire
1RL-T-B2	2.210	3.810	0.610	Type K, Glass Ins., 24 AWG wire
1RL-T-B4	2.210	3.810	1.219	Type K, Glass Ins., 24 AWG wire
1RL-T-B6	2.210	3.810	1.829	Type K, Glass Ins., 24 AWG wire
1RL-T-B8	2.210	3.810	2.438	Type K, Glass Ins., 24 AWG wire
1RL-T-B9	2.210	3.810	2.718	Type K, Glass Ins., 24 AWG wire
1RK-T-A0	2.210	7.620	0.152	Type K, Glass Ins., 24 AWG wire
1RK-T-A2	2.210	7.620	0.610	Type K, Glass Ins., 24 AWG wire
1RK-T-A4	2.210	7.620	1.219	Type K, Glass Ins., 24 AWG wire
1RK-T-A6	2.210	7.620	1.829	Type K, Glass Ins., 24 AWG wire
1RK-T-A8	2.210	7.620	2.362	Type K, Glass Ins., 24 AWG wire
1RB-T-A0	1.981	1.981	0.152	Type K, Glass Ins., 24 AWG wire
1RB-T-A2	1.981	1.981	0.610	Type K, Glass Ins., 24 AWG wire
1RB-T-A4	1.981	1.981	1.219	Type K, Glass Ins., 24 AWG wire
1RB-T-A6	1.981	1.981	1.829	Type K, Glass Ins., 24 AWG wire
1RB-T-A8	1.981	1.981	2.438	Type K, Glass Ins., 24 AWG wire
1RB-T-A9	1.981	1.981	2.718	Type K, Glass Ins., 24 AWG wire
1RB-T-B0	1.981	3.505	0.152	Type K, Glass Ins., 24 AWG wire
1RB-T-B2	1.981	3.505	0.610	Type K, Glass Ins., 24 AWG wire
1RB-T-B4	1.981	3.505	1.219	Type K, Glass Ins., 24 AWG wire
1RB-T-B6	1.981	3.505	1.829	Type K, Glass Ins., 24 AWG wire
1RB-T-B8	1.981	3.505	2.438	Type K, Glass Ins., 24 AWG wire
1RB-T-B9	1.981	3.505	2.718	Type K, Glass Ins., 24 AWG wire
1WG-T-A0	4.572	1.829	0.152	Type K, Glass Ins., 24 AWG wire
1WG-T-A2	4.572	1.829	0.610	Type K, Glass Ins., 24 AWG wire
1WG-T-A4	4.572	1.829	1.219	Type K, Glass Ins., 24 AWG wire
1WG-T-A6	4.572	1.829	1.829	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WG-T-A8	4.572	1.829	2.286	Type K, Glass Ins., 24 AWG wire
1WG-T-B0	4.572	3.810	0.152	Type K, Glass Ins., 24 AWG wire
1WG-T-B2	4.572	3.810	0.610	Type K, Glass Ins., 24 AWG wire
1WG-T-B4	4.572	3.810	1.219	Type K, Glass Ins., 24 AWG wire
1WG-T-B6	4.572	3.810	1.829	Type K, Glass Ins., 24 AWG wire
1WG-T-B8	4.572	3.810	2.286	Type K, Glass Ins., 24 AWG wire
1RH-T-A0	0.762	1.067	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-A2	0.762	1.067	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-A4	0.762	1.067	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-A6	0.762	1.067	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-A8	0.762	1.067	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-A9	0.762	1.067	2.718	Type K, Glass Ins., 24 AWG wire
1RH-T-B0	4.115	10.363	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-B2	4.115	10.363	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-B4	4.115	10.363	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-B6	4.115	10.363	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-B8	4.115	10.363	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-B9	4.115	10.363	2.718	Type K, Glass Ins., 24 AWG wire
1RH-T-C0	8.230	10.363	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-C2	8.230	10.363	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-C4	8.230	10.363	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-C6	8.230	10.363	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-C8	8.230	10.363	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-C9	8.230	10.363	2.718	Type K, Glass Ins., 24 AWG wire
2RL-T-A0	2.210	2.286	0.152	Type K, Glass Ins., 24 AWG wire
2RL-T-A2	2.210	2.286	0.610	Type K, Glass Ins., 24 AWG wire
2RL-T-A4	2.210	2.286	1.219	Type K, Glass Ins., 24 AWG wire
2RL-T-A6	2.210	2.286	1.829	Type K, Glass Ins., 24 AWG wire
2RL-T-A8	2.210	2.286	2.438	Type K, Glass Ins., 24 AWG wire
2RL-T-A9	2.210	2.286	2.718	Type K, Glass Ins., 24 AWG wire
2RL-T-B0	2.210	3.810	0.152	Type K, Glass Ins., 24 AWG wire
2RL-T-B2	2.210	3.810	0.610	Type K, Glass Ins., 24 AWG wire
2RL-T-B4	2.210	3.810	1.219	Type K, Glass Ins., 24 AWG wire
2RL-T-B6	2.210	3.810	1.829	Type K, Glass Ins., 24 AWG wire
2RL-T-B8	2.210	3.810	2.438	Type K, Glass Ins., 24 AWG wire
2RL-T-B9	2.210	3.810	2.718	Type K, Glass Ins., 24 AWG wire
2RK-T-A0	2.210	7.620	0.152	Type K, Glass Ins., 24 AWG wire
2RK-T-A2	2.210	7.620	0.610	Type K, Glass Ins., 24 AWG wire
2RK-T-A4	2.210	7.620	1.219	Type K, Glass Ins., 24 AWG wire
2RK-T-A6	2.210	7.620	1.829	Type K, Glass Ins., 24 AWG wire
2RK-T-A8	2.210	7.620	2.413	Type K, Glass Ins., 24 AWG wire
2RB-T-A0	1.981	1.981	0.152	Type K, Glass Ins., 24 AWG wire
2RB-T-A2	1.981	1.981	0.610	Type K, Glass Ins., 24 AWG wire
2RB-T-A4	1.981	1.981	1.219	Type K, Glass Ins., 24 AWG wire
2RB-T-A6	1.981	1.981	1.829	Type K, Glass Ins., 24 AWG wire
2RB-T-A8	1.981	1.981	2.438	Type K, Glass Ins., 24 AWG wire
2RB-T-A9	1.981	1.981	2.718	Type K, Glass Ins., 24 AWG wire
2RB-T-B0	1.981	3.505	0.152	Type K, Glass Ins., 24 AWG wire
2RB-T-B2	1.981	3.505	0.610	Type K, Glass Ins., 24 AWG wire
2RB-T-B4	1.981	3.505	1.219	Type K, Glass Ins., 24 AWG wire
2RB-T-B6	1.981	3.505	1.829	Type K, Glass Ins., 24 AWG wire
2RB-T-B8	1.981	3.505	2.438	Type K, Glass Ins., 24 AWG wire
2RB-T-B9	1.981	3.505	2.718	Type K, Glass Ins., 24 AWG wire
2WG-T-A0	4.572	1.829	0.152	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2WG-T-A2	4.572	1.829	0.610	Type K, Glass Ins., 24 AWG wire
2WG-T-A4	4.572	1.829	1.219	Type K, Glass Ins., 24 AWG wire
2WG-T-A6	4.572	1.829	1.829	Type K, Glass Ins., 24 AWG wire
2WG-T-A8	4.572	1.829	2.286	Type K, Glass Ins., 24 AWG wire
2WG-T-B0	4.572	3.810	0.152	Type K, Glass Ins., 24 AWG wire
2WG-T-B4	4.572	3.810	1.219	Type K, Glass Ins., 24 AWG wire
2WG-T-B6	4.572	3.810	1.829	Type K, Glass Ins., 24 AWG wire
2WG-T-B8	4.572	3.810	2.286	Type K, Glass Ins., 24 AWG wire
2RH-T-A0	0.762	1.067	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-A2	0.762	1.067	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-A4	0.762	1.067	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-A6	0.762	1.067	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-A8	0.762	1.067	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-A9	0.762	1.067	2.718	Type K, Glass Ins., 24 AWG wire
2RH-T-B0	4.115	10.363	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-B2	4.115	10.363	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-B4	4.115	10.363	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-B6	4.115	10.363	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-B8	4.115	10.363	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-B9	4.115	10.363	2.718	Type K, Glass Ins., 24 AWG wire
2RH-T-C0	8.230	10.363	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-C2	8.230	10.363	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-C4	8.230	10.363	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-C6	8.230	10.363	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-C8	8.230	10.363	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-C9	8.230	10.363	2.718	Type K, Glass Ins., 24 AWG wire
1WB-D-A1	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-A2	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-B1	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-B2	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-C1	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-C2	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-A1	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-A2	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WD-D-A1	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
1WD-D-A2	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
2WD-D-A1	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
2WD-D-A2	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
1CL-D-A1	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CL-D-A2	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CB-D-A1	2.438	2.743	2.711	Type K, Glass Ins., 24 AWG wire
1CB-D-A2	2.438	2.743	2.711	Type K, Glass Ins., 24 AWG wire
2CL-D-A1	1.372	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-D-A2	1.372	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CB-D-A1	2.438	2.743	2.743	Type K, Glass Ins., 24 AWG wire
2CB-D-A2	2.438	2.743	2.743	Type K, Glass Ins., 24 AWG wire
1WC-D-A1	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
1WC-D-A2	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
1WC-D-B1	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
1WC-D-B2	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
2WC-D-A1	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
2WC-D-A2	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
2WC-D-B1	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
2WC-D-B2	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WA-D-A1	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
1WA-D-A2	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
1WA-D-B1	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
1WA-D-B2	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
2WA-D-A1	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
2WA-D-A2	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
2WA-D-B1	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
2WA-D-B2	1.829	0.000	2.845	Type K, Glass Ins., 24 AWG wire
1WA-T-A0	0.762	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-A4	0.762	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-A6	0.762	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-A8	0.762	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-A9	0.762	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WA-T-B0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-B4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-B6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-B8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-B9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WA-T-C0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-C4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-C6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-C8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-C9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-A0	0.762	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-A4	0.762	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-A6	0.762	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-A8	0.762	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-A9	0.762	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-B0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-B4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-B6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-B8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-B9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-C0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-C4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-C6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-C8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-C9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
3WA-S-A3	0.762	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-A1	0.762	0.000	0.305	Type K, Glass Ins., 24 AWG wire
3WA-S-B3	1.829	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-B1	1.829	0.000	0.305	Type K, Glass Ins., 24 AWG wire
3WA-S-C3	1.829	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-C1	1.829	0.000	0.305	Type K, Glass Ins., 24 AWG wire
1CL-E-C105	2.286	2.972	0.105	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1CL-E-C012	2.286	2.972	0.012	Type K, Glass Ins., 24 AWG wire
1CL-E-C070	2.286	2.972	0.070	Type K, Glass Ins., 24 AWG wire
1CL-E-C023	2.286	2.972	0.023	Type K, Glass Ins., 24 AWG wire
1CL-E-C058	2.286	2.972	0.058	Type K, Glass Ins., 24 AWG wire
1CL-E-C035	2.286	2.972	0.035	Type K, Glass Ins., 24 AWG wire
1CL-E-C047	2.286	2.972	0.047	Type K, Glass Ins., 24 AWG wire

The following table provides a summary of the temperature results. The "Initial" column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the "Max" column. The remaining columns provide the calculated maximum average temperatures.

Table 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-S-A1	19.0	1150.3	1104.0	1084.2	1018.4	967.7
1WB-E-A035	19.9	59.7	59.7	59.7	59.7	59.7
1WB-E-A012	19.4	76.9	76.9	76.9	76.8	76.8
1WB-E-A058	20.2	47.8	47.7	47.7	47.6	47.5
1WB-E-A023	19.5	66.9	66.9	66.9	66.9	66.9
1WB-E-A105	19.9	28.8	28.8	28.7	28.6	28.5
1WB-E-A047	19.6	51.9	51.8	51.8	51.8	51.7
1WB-E-A070	19.8	42.1	42.0	42.0	41.8	41.5
1WB-S-B1	18.3	1248.7	1204.0	1167.6	1028.6	950.8
1WB-S-B2	18.9	372.6	372.5	372.4	368.4	356.9
1WB-S-B3	19.3	109.1	109.1	109.1	109.0	109.0
1WB-E-B035	19.7	61.8	61.8	61.8	61.8	61.8
1WB-E-B058	19.9	48.2	48.2	48.1	48.0	47.9
1WB-E-B023	19.6	67.7	67.5	67.5	67.5	67.5
1WB-E-B105	19.9	28.1	28.1	28.0	27.8	27.7
1WB-E-B047	20.2	53.3	53.2	53.2	53.1	52.9
1WB-E-B070	20.0	40.5	40.4	40.4	40.2	40.0
1WB-S-C1	19.5	1105.6	1071.7	1061.9	979.3	866.7
1WB-S-C2	19.9	218.4	218.3	218.3	217.3	214.8
1WB-S-C3	20.5	97.2	97.2	97.1	96.7	95.2
1WB-E-C035	19.6	52.1	52.1	52.1	52.0	51.8
1WB-E-C012	20.0	68.1	68.1	68.0	68.0	68.0
1WB-E-C058	19.6	38.1	38.1	38.1	37.9	37.7
1WB-E-C023	19.9	60.7	60.6	60.6	60.6	60.6
1WB-E-C105	19.6	24.9	24.8	24.8	24.7	24.5
1WB-E-C047	19.9	44.8	44.8	44.8	44.6	44.5
1WB-E-C070	19.8	30.2	30.2	30.2	30.0	29.8
1WB-J-A1	21.3	93.8	93.2	92.8	92.3	92.2
1WB-J-A2	21.6	83.5	83.4	83.4	83.1	82.5
1WB-J-B1	21.6	67.9	67.8	67.8	67.8	67.8
1WB-J-B2	21.6	37.5	37.5	37.4	37.3	37.2
1WB-J-C1	20.9	51.9	51.9	51.9	51.8	51.7
1WB-J-C2	21.9	38.4	38.4	38.3	38.2	37.9
1WB-J-D1	20.9	84.9	83.9	83.4	75.4	68.4
1WB-J-D2	22.0	56.3	56.3	56.3	56.3	56.2

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-J-E1	20.9	89.1	89.1	89.0	88.9	88.8
1WB-J-F1	21.1	92.4	92.3	92.3	91.1	90.1
1WB-J-F2	21.3	76.1	75.9	75.9	75.9	75.7
1WB-J-G1	21.5	50.6	50.6	50.6	50.4	49.9
1WB-J-G2	21.5	31.6	31.5	31.5	31.4	31.2
2WB-S-A1	22.0	26.8	26.6	26.6	26.6	26.5
2WB-S-A2	22.3	25.7	25.6	25.5	25.5	25.5
2WB-S-A3	22.4	25.3	25.1	25.1	25.1	25.1
2WB-E-A035	22.9	23.8	23.7	23.7	23.7	23.7
2WB-E-A012	22.2	24.3	24.2	24.2	24.1	24.1
2WB-E-A058	22.3	22.7	22.6	22.6	22.6	22.6
2WB-E-A023	22.2	23.6	23.6	23.6	23.5	23.5
2WB-E-A105	22.2	22.3	22.2	22.2	22.2	22.2
2WB-E-A070	22.2	22.4	22.3	22.3	22.3	22.3
2WB-S-B1	22.3	27.3	27.2	27.2	27.1	27.1
2WB-S-B2	22.6	25.7	25.6	25.6	25.6	25.6
2WB-S-B3	22.3	24.8	24.7	24.7	24.7	24.7
2WB-E-B035	22.3	23.2	23.1	23.1	23.1	23.1
2WB-E-B012	22.5	24.2	24.2	24.2	24.1	24.1
2WB-E-B058	22.5	22.9	22.8	22.8	22.8	22.8
2WB-E-B023	22.6	23.7	23.6	23.6	23.6	23.6
2WB-E-B105	22.7	22.8	22.7	22.7	22.7	22.7
2WB-E-B047	22.9	23.3	23.3	23.3	23.2	23.2
2WB-E-B070	22.9	23.0	23.0	23.0	22.9	22.9
2WB-S-C1	22.3	24.1	24.0	24.0	24.0	24.0
2WB-S-C2	22.3	23.7	23.6	23.6	23.6	23.6
2WB-S-C3	22.3	23.4	23.3	23.3	23.3	23.3
2WB-E-C035	22.9	23.0	22.9	22.9	22.9	22.9
2WB-E-C012	23.7	24.3	24.2	24.2	24.2	24.1
2WB-E-C058	22.9	22.9	22.9	22.9	22.8	22.8
2WB-E-C023	23.3	23.6	23.5	23.5	23.5	23.5
2WB-E-C105	22.9	23.0	22.9	22.9	22.9	22.8
2WB-E-C047	23.2	23.2	23.2	23.2	23.1	23.1
2WB-E-C070	23.0	23.0	23.0	23.0	22.9	22.9
2WB-J-A1	22.3	22.7	22.5	22.5	22.5	22.4
2WB-J-B1	22.3	22.8	22.6	22.6	22.6	22.5
2WB-J-C1	22.0	22.3	22.3	22.3	22.3	22.3
2WB-J-D1	22.2	22.5	22.4	22.4	22.3	22.3
2WB-J-E1	22.1	22.6	22.5	22.5	22.5	22.5
2WB-J-F1	22.3	22.6	22.6	22.6	22.6	22.6
2WB-J-G1	22.5	22.7	22.6	22.6	22.6	22.6
1WD-S-A1	18.6	1132.4	1090.3	1074.6	918.7	845.8
1WD-S-A2	19.5	293.1	293.1	293.0	290.8	285.5
1WD-S-A3	20.0	98.3	98.2	98.2	98.2	98.2
1WD-E-A105	19.4	24.5	24.5	24.4	24.3	24.2
1WD-E-A012	19.4	72.6	72.5	72.5	72.5	72.5
1WD-E-A070	19.6	34.4	34.4	34.4	34.2	34.0
1WD-E-A023	19.5	59.7	59.7	59.7	59.7	59.7
1WD-E-A058	19.6	39.0	38.9	38.9	38.8	38.6
1WD-E-A035	19.6	50.0	50.0	50.0	49.9	49.9
1WD-E-A047	19.6	44.6	44.6	44.5	44.5	44.4
1WD-J-A1	21.1	37.5	37.4	37.4	37.3	37.3

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WD-J-A2	21.5	26.0	26.0	25.9	25.8	25.7
1WD-J-A3	21.3	22.8	22.8	22.7	22.7	22.7
1WD-J-B1	20.5	42.1	42.0	42.0	41.9	41.8
1WD-J-B2	20.9	22.6	22.5	22.5	22.4	22.3
1WD-J-B3	21.2	22.4	22.3	22.3	22.3	22.3
1WD-J-C1	20.6	90.3	90.2	90.0	84.6	79.5
1WD-J-C2	20.8	31.4	31.4	31.3	31.3	31.1
1WD-J-C3	21.4	23.2	23.1	23.0	23.0	23.0
1WD-J-D1	20.8	87.3	86.4	85.0	71.2	70.9
1WD-J-D2	21.0	42.9	42.8	42.8	42.8	42.8
1WD-J-D3	22.0	69.2	69.1	69.1	69.0	68.4
2WD-S-A1	21.9	25.8	25.8	25.8	25.8	25.8
2WD-S-A2	21.9	25.1	25.0	25.0	25.0	25.0
2WD-S-A3	21.9	24.8	24.7	24.7	24.6	24.6
2WD-E-A105	20.8	21.6	21.6	21.6	21.6	21.6
2WD-E-A012	22.6	24.6	24.4	24.4	24.4	24.3
2WD-E-A070	21.3	21.8	21.7	21.7	21.7	21.6
2WD-E-A023	22.2	23.6	23.5	23.5	23.5	23.5
2WD-E-A058	21.6	22.1	22.0	22.0	21.9	21.9
2WD-E-A035	21.9	23.0	22.9	22.9	22.9	22.9
2WD-E-A047	21.7	22.5	22.4	22.3	22.3	22.3
2WD-J-A1	21.6	22.3	22.3	22.3	22.3	22.3
2WD-J-B1	21.3	22.1	21.9	21.9	21.9	21.9
2WD-J-C1	21.1	22.1	22.1	22.1	22.1	22.0
2WD-J-D1	21.2	22.1	22.1	22.0	22.0	22.0
1CL-S-A1	18.7	1202.9	1167.8	1143.4	1096.2	1082.0
1CL-S-A2	19.2	415.8	415.8	415.7	414.1	411.8
1CL-S-A3	19.6	129.1	128.9	128.9	128.4	128.3
1CL-S-B1	18.9	1153.1	1136.2	1121.8	1070.9	1061.8
1CL-S-B2	19.4	301.0	300.3	298.9	293.6	291.8
1CL-S-B3	20.1	99.1	99.0	99.0	98.6	98.3
1CL-S-C1	18.7	1192.2	1164.9	1160.5	1079.7	1070.2
1CL-S-C2	19.3	332.7	330.9	328.3	306.9	287.0
1CL-S-C3	19.6	108.8	108.7	108.7	108.7	108.6
1CL-S-D1	19.0	1082.7	1054.1	1048.4	1022.4	1006.4
1CL-S-D2	19.4	481.1	479.0	477.9	457.3	434.1
1CL-S-E1	19.2	1371.5	1247.0	1235.5	1175.4	1044.5
1CL-S-E2	19.7	312.3	309.8	309.6	309.0	303.5
1CL-S-E3	20.3	123.0	122.9	122.9	122.9	122.7
1CB-S-A1	18.8	1090.3	1062.8	1050.9	1032.1	1013.6
1CB-S-A2	19.1	212.1	212.1	212.0	210.9	208.3
1CB-S-A3	19.5	104.4	104.3	104.3	104.0	103.7
1CB-S-B1	18.9	1160.4	1136.5	1118.1	1080.0	1044.8
1CB-S-B2	19.4	244.8	243.0	240.6	222.6	208.3
1CB-S-B3	19.9	185.5	185.4	184.6	165.8	135.8
1CB-S-C1	19.6	1110.8	1080.6	1070.7	1058.4	1042.3
1CB-S-C2	19.3	270.3	269.8	268.7	247.0	198.3
1CB-S-C3	19.6	99.0	98.9	98.9	98.2	97.3
1CB-S-D1	18.8	1379.9	1336.5	1311.8	1142.8	1044.0
1CB-S-D2	19.2	688.1	682.0	678.7	660.6	652.7
1CB-S-D3	19.6	185.2	185.2	185.1	185.0	184.9
1CB-S-E1	18.9	1074.3	1066.0	1063.2	1033.8	967.9

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1CB-S-E2	19.4	261.7	260.6	259.4	249.6	229.5
1CB-S-E3	19.9	263.9	258.0	245.2	170.3	139.0
2CL-S-A1	21.9	27.2	27.1	27.1	27.1	27.1
2CL-S-B1	21.7	29.4	29.3	29.3	29.2	29.2
2CL-S-C1	22.4	25.7	25.6	25.6	25.6	25.6
2CL-S-D1	21.9	27.1	27.0	27.0	26.9	26.9
2CL-S-E1	21.9	26.9	26.9	26.9	26.8	26.8
2CB-S-A1	21.6	29.0	28.9	28.8	28.7	28.6
2CB-S-B1	21.6	28.9	28.8	28.7	28.6	28.5
2CB-S-C1	21.9	25.3	25.2	25.2	25.2	25.2
2CB-S-D1	21.9	28.3	28.0	28.0	27.9	27.8
2CB-S-E1	22.1	30.1	29.7	29.6	29.5	29.3
1RL-T-A0	18.2	1079.7	1073.7	1067.4	999.4	967.1
1RL-T-A2	17.8	1103.6	1072.8	1068.2	999.7	962.5
1RL-T-A4	17.7	1327.1	840.9	588.5	153.8	89.0
1RL-T-A6	17.8	1176.8	1084.0	1074.5	998.6	968.1
1RL-T-A8	18.1	1368.0	952.1	850.9	376.2	252.2
1RL-T-A9	18.8	1307.7	1071.1	1060.4	1001.2	967.1
1RL-T-B0	17.8	979.0	969.7	964.5	936.1	923.8
1RL-T-B2	17.7	993.9	982.3	979.0	941.5	926.4
1RL-T-B4	17.6	1088.0	987.3	984.5	943.6	926.7
1RL-T-B6	17.7	1236.2	897.1	651.3	237.5	142.7
1RL-T-B8	17.9	1094.1	1006.8	821.5	346.0	235.2
1RL-T-B9	18.2	1117.3	933.1	779.4	355.9	245.1
1RK-T-A0	17.8	930.6	866.7	754.2	597.6	578.9
1RK-T-A2	17.8	905.3	848.5	745.2	625.2	588.6
1RK-T-A4	21.0	934.9	884.0	770.0	715.2	714.0
1RK-T-A6	19.0	924.1	885.6	796.5	628.6	627.5
1RK-T-A8	19.6	983.1	915.5	873.0	620.0	567.6
1RB-T-A0	17.7	989.4	977.1	974.4	902.6	896.9
1RB-T-A2	17.6	1031.0	984.9	977.7	901.4	888.8
1RB-T-A4	17.6	1042.3	972.7	963.9	923.0	910.2
1RB-T-A6	17.8	1278.4	1018.8	980.9	921.0	895.9
1RB-T-A8	18.0	1379.3	814.4	713.9	425.4	234.1
1RB-T-A9	18.0	1352.5	856.4	774.0	458.1	253.0
1RB-T-B0	17.5	1007.8	997.5	991.0	900.1	827.8
1RB-T-B2	17.2	980.9	972.6	965.9	883.2	828.1
1RB-T-B4	17.5	1035.4	987.3	977.9	892.0	837.6
1RB-T-B6	18.6	1057.9	992.5	985.5	897.5	828.0
1RB-T-B8	18.5	1042.2	966.3	953.8	872.3	819.2
1RB-T-B9	18.6	1003.5	982.3	975.0	894.5	830.4
1WG-T-A0	18.7	1016.6	1006.6	1003.1	965.0	944.5
1WG-T-A2	18.4	991.2	982.4	979.8	949.7	935.4
1WG-T-A4	18.5	978.0	964.4	959.8	930.1	918.6
1WG-T-A6	18.5	1012.2	998.3	994.8	946.6	930.3
1WG-T-A8	18.9	997.4	985.5	982.4	957.7	935.2
1WG-T-B0	18.0	967.2	956.3	950.5	923.7	884.0
1WG-T-B2	17.9	975.5	963.9	959.4	929.2	887.7
1WG-T-B4	18.1	978.9	965.9	960.1	922.5	888.3
1WG-T-B6	18.2	911.3	894.9	892.1	876.4	858.0
1WG-T-B8	18.7	968.5	958.6	956.3	928.6	889.3
1RH-T-A0	17.1	31.4	30.9	30.7	30.1	29.3

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1RH-T-A2	17.1	35.9	35.4	34.9	34.1	32.8
1RH-T-A4	17.2	34.7	34.0	33.6	32.8	31.6
1RH-T-A6	17.8	68.3	65.5	63.4	57.2	56.5
1RH-T-A8	18.9	140.3	139.5	139.3	135.5	128.4
1RH-T-A9	19.1	101.5	100.9	100.7	97.8	96.8
1RH-T-B0	18.9	30.5	30.3	30.2	29.6	29.1
1RH-T-B2	18.8	42.0	40.7	40.2	39.0	38.6
1RH-T-B4	18.8	64.8	62.8	62.1	56.9	56.3
1RH-T-B6	18.9	118.7	116.9	115.1	112.6	107.4
1RH-T-B8	19.3	283.2	281.7	280.7	263.3	244.1
1RH-T-B9	19.4	341.7	337.0	329.8	296.1	267.7
1RH-T-C0	17.8	38.2	37.7	36.9	34.7	33.7
1RH-T-C2	17.9	39.9	39.1	38.4	36.5	35.0
1RH-T-C4	18.8	78.6	72.9	71.8	59.1	57.8
1RH-T-C6	18.8	138.7	137.2	136.1	132.9	130.5
1RH-T-C8	19.2	215.7	212.7	210.6	200.7	194.7
1RH-T-C9	19.4	220.7	217.2	215.0	195.9	190.4
2RL-T-A0	21.7	26.6	26.4	26.4	26.4	26.3
2RL-T-A2	21.8	27.1	27.0	26.9	26.9	26.9
2RL-T-A4	21.7	27.6	27.4	27.4	27.3	27.3
2RL-T-A6	21.8	28.3	28.2	28.2	28.1	28.1
2RL-T-A8	21.7	31.3	31.2	31.1	31.1	31.0
2RL-T-A9	21.6	27.6	27.5	27.5	27.5	27.4
2RL-T-B0	21.7	26.0	26.0	26.0	26.0	26.0
2RL-T-B2	21.8	26.6	26.5	26.5	26.4	26.4
2RL-T-B4	21.8	27.2	27.1	27.1	27.0	27.0
2RL-T-B6	22.0	28.1	28.0	28.0	27.9	27.9
2RL-T-B8	22.4	30.8	30.7	30.6	30.6	30.5
2RL-T-B9	22.1	29.9	29.9	29.8	29.7	29.7
2RK-T-A0	22.6	26.2	26.1	26.1	26.1	26.1
2RK-T-A2	22.5	26.5	26.3	26.3	26.3	26.3
2RK-T-A4	22.3	27.1	27.0	27.0	26.9	26.9
2RK-T-A6	22.3	28.2	28.0	28.0	27.9	27.9
2RK-T-A8	22.3	26.9	26.8	26.7	26.6	26.6
2RB-T-A0	21.8	26.4	26.4	26.4	26.3	26.3
2RB-T-A2	21.8	26.9	26.8	26.7	26.7	26.7
2RB-T-A4	21.8	27.4	27.3	27.3	27.3	27.3
2RB-T-A6	21.8	28.2	28.1	28.1	28.1	28.0
2RB-T-A8	21.8	30.4	30.2	30.2	30.0	29.9
2RB-T-A9	21.7	28.4	28.4	28.4	28.3	28.3
2RB-T-B0	21.6	26.0	26.0	26.0	26.0	26.0
2RB-T-B2	21.6	26.4	26.3	26.3	26.3	26.3
2RB-T-B4	21.6	26.9	26.9	26.8	26.8	26.8
2RB-T-B6	21.6	28.0	27.9	27.8	27.7	27.7
2RB-T-B8	21.9	30.0	29.9	29.8	29.7	29.6
2RB-T-B9	22.3	27.7	27.6	27.6	27.6	27.6
2WG-T-A0	22.2	26.3	26.3	26.3	26.3	26.3
2WG-T-A2	21.9	27.3	27.3	27.3	27.3	27.3
2WG-T-A4	21.9	27.6	27.5	27.5	27.5	27.5
2WG-T-A6	21.8	27.8	27.7	27.7	27.7	27.7
2WG-T-A8	21.8	27.0	26.9	26.9	26.9	26.9
2WG-T-B0	21.9	26.1	26.0	26.0	26.0	25.9

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2WG-T-B4	21.9	26.8	26.7	26.7	26.6	26.6
2WG-T-B6	21.9	27.1	27.0	27.0	27.0	27.0
2WG-T-B8	21.9	27.1	26.9	26.9	26.9	26.9
2RH-T-A0	22.3	23.4	23.3	23.3	23.3	23.3
2RH-T-A2	22.2	23.5	23.5	23.4	23.4	23.4
2RH-T-A4	22.2	23.4	23.3	23.3	23.3	23.3
2RH-T-A6	22.0	23.5	23.5	23.4	23.4	23.4
2RH-T-A8	22.0	24.9	24.7	24.7	24.7	24.6
2RH-T-A9	21.9	24.4	24.3	24.3	24.2	24.1
2RH-T-B0	22.3	22.6	22.6	22.6	22.6	22.6
2RH-T-B2	22.2	22.7	22.7	22.7	22.7	22.6
2RH-T-B4	22.1	22.8	22.8	22.8	22.7	22.7
2RH-T-B6	22.1	22.9	22.9	22.8	22.8	22.8
2RH-T-B8	22.2	23.3	23.3	23.3	23.3	23.2
2RH-T-B9	22.1	23.2	23.1	23.1	23.1	23.0
2RH-T-C0	22.1	22.7	22.6	22.6	22.6	22.6
2RH-T-C2	22.0	22.7	22.7	22.6	22.6	22.6
2RH-T-C4	22.1	22.8	22.7	22.7	22.7	22.6
2RH-T-C6	22.3	23.2	23.1	23.1	23.0	23.0
2RH-T-C8	22.9	23.7	23.6	23.6	23.6	23.6
2RH-T-C9	22.5	22.9	22.9	22.9	22.9	22.8
1WB-D-A1	18.1	1084.6	1076.6	1071.2	1049.7	1024.5
1WB-D-A2	18.1	1009.0	1007.3	1004.2	962.9	921.4
1WB-D-B1	18.1	1129.4	1124.6	1115.7	1019.9	957.0
1WB-D-B2	18.2	1014.1	1013.3	1009.8	948.8	886.5
1WB-D-C1	18.2	1114.2	1112.1	1106.5	1016.8	907.5
1WB-D-C2	18.3	1013.8	1012.8	1010.6	942.3	848.4
2WB-D-A1	22.0	27.6	27.4	27.4	27.4	27.4
2WB-D-A2	22.1	26.7	26.6	26.6	26.6	26.6
1WD-D-A1	18.3	1114.4	1112.1	1105.6	1034.8	938.7
1WD-D-A2	18.9	980.1	977.9	974.4	919.6	829.7
2WD-D-A1	21.7	26.9	26.8	26.8	26.8	26.8
2WD-D-A2	21.9	26.4	26.3	26.3	26.3	26.3
1CL-D-A1	18.2	1241.1	1151.3	1146.7	1063.8	1024.1
1CL-D-A2	17.1	25.0	24.9	24.9	24.6	24.4
1CB-D-A1	18.4	1103.3	1077.7	1070.8	1040.7	936.5
1CB-D-A2	18.6	1143.5	1110.4	1106.2	1061.1	945.3
2CL-D-A1	21.6	28.8	28.7	28.7	28.7	28.6
2CL-D-A2	21.6	28.8	28.6	28.6	28.6	28.6
2CB-D-A1	21.6	32.1	32.0	32.0	31.9	31.4
2CB-D-A2	21.7	28.4	28.3	28.3	28.3	28.2
1WC-D-A1	18.8	1024.9	1023.6	1021.7	974.8	886.2
1WC-D-A2	18.8	916.2	915.6	914.3	882.0	817.4
1WC-D-B1	18.6	986.6	985.1	983.1	947.9	873.0
1WC-D-B2	18.9	804.2	804.1	803.9	791.4	760.6
2WC-D-A1	22.2	26.0	26.0	26.0	25.9	25.9
2WC-D-A2	22.0	26.3	26.2	26.2	26.1	26.1
2WC-D-B1	22.0	26.6	26.6	26.6	26.6	26.6
2WC-D-B2	22.1	26.0	26.0	26.0	26.0	26.0
1WA-D-A1	18.9	843.2	840.5	838.2	813.2	808.3
1WA-D-A2	16.8	21.7	21.7	21.7	21.6	21.5
1WA-D-B1	18.8	977.8	972.1	965.7	892.5	773.1

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WA-D-B2	18.5	840.5	837.6	831.6	746.8	643.5
2WA-D-A1	18.7	644.1	640.6	635.2	577.0	546.5
2WA-D-A2	18.4	537.0	535.4	533.9	503.9	481.8
2WA-D-B1	18.6	717.5	710.1	699.8	622.6	514.9
2WA-D-B2	18.8	593.0	590.2	588.0	518.4	444.1
1WA-T-A0	17.5	58.6	54.7	54.4	52.1	49.2
1WA-T-A2	17.3	68.7	64.3	62.7	59.5	55.9
1WA-T-A4	17.8	89.4	87.0	86.7	81.8	78.3
1WA-T-A6	18.1	88.8	85.3	84.2	80.2	76.3
1WA-T-A8	18.6	136.2	133.3	130.4	127.9	124.6
1WA-T-A9	18.7	135.6	125.5	119.4	100.6	98.8
1WA-T-B0	17.9	577.7	567.2	563.6	549.5	535.0
1WA-T-B2	17.7	599.0	574.6	568.0	552.5	540.2
1WA-T-B4	17.7	763.6	663.5	646.6	610.2	549.4
1WA-T-B6	17.9	1096.9	1067.4	1058.7	1027.2	987.7
1WA-T-B8	20.2	860.4	535.0	479.5	279.5	151.6
1WA-T-B9	18.8	1122.2	1098.3	1048.0	909.2	900.0
1WA-T-C0	18.3	535.7	523.8	520.4	492.2	465.3
1WA-T-C2	18.3	424.8	409.9	404.5	367.6	324.1
1WA-T-C4	18.1	735.5	660.8	637.9	611.0	548.6
1WA-T-C6	17.9	1122.4	1072.6	1060.7	1029.2	977.4
1WA-T-C8	18.3	1288.8	1216.7	1207.1	1115.3	949.2
1WA-T-C9	18.5	1282.6	1207.3	1167.5	1041.5	847.3
2WA-T-A0	18.7	127.3	119.5	113.3	97.2	94.0
2WA-T-A2	18.2	128.5	122.3	117.8	105.7	102.4
2WA-T-A4	17.9	124.9	115.2	110.1	96.8	92.7
2WA-T-A6	17.9	128.1	122.5	116.6	104.0	98.8
2WA-T-A8	19.4	111.4	109.3	108.6	102.6	96.0
2WA-T-A9	19.4	122.0	119.9	118.9	112.6	104.2
2WA-T-B0	18.5	751.1	696.3	647.6	616.1	607.4
2WA-T-B2	18.1	966.0	856.1	824.7	711.0	697.1
2WA-T-B4	17.8	952.6	859.6	799.4	703.6	684.5
2WA-T-B6	17.8	940.2	854.8	799.8	696.4	654.9
2WA-T-B8	17.8	888.9	816.4	776.9	665.5	612.1
2WA-T-B9	17.6	880.5	800.5	763.0	645.8	590.7
2WA-T-C0	19.3	849.3	833.5	821.7	744.6	642.1
2WA-T-C2	17.8	1116.6	1014.3	968.6	829.3	708.7
2WA-T-C4	18.0	1125.4	974.8	927.1	796.4	664.2
2WA-T-C6	18.1	1160.0	966.3	910.6	781.1	631.4
2WA-T-C8	18.1	1142.9	951.2	878.2	743.9	589.8
2WA-T-C9	17.9	1243.0	979.3	890.1	728.6	571.5
3WA-S-A3	19.9	106.0	101.9	101.1	94.6	87.4
3WA-S-A2	19.3	98.7	96.6	95.6	89.8	82.1
3WA-S-A1	19.0	91.5	88.7	87.1	82.3	75.1
3WA-S-B3	18.9	714.6	652.8	619.3	495.5	445.2
3WA-S-B2	18.1	774.1	714.2	672.5	544.8	483.3
3WA-S-B1	18.8	764.4	717.5	684.0	555.9	494.7
3WA-S-C3	19.1	660.8	627.7	599.1	516.9	409.2
3WA-S-C2	18.5	726.3	680.0	649.3	556.2	442.1
3WA-S-C1	18.8	751.0	705.7	676.6	589.1	469.1
1CL-E-C105	21.6	27.7	27.6	27.6	27.4	27.2
1CL-E-C012	20.1	96.7	96.6	96.6	96.6	96.6

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1CL-E-C070	21.6	40.3	40.2	40.2	40.0	39.7
1CL-E-C023	20.3	80.2	80.1	80.1	80.1	80.0
1CL-E-C058	20.9	47.2	47.2	47.2	47.0	46.7
1CL-E-C035	20.4	64.5	64.4	64.4	64.4	64.3
1CL-E-C047	20.6	56.9	56.8	56.7	56.6	56.5

The following table shows which thermocouples were taken out of service during the experiment.

Table 6. Out of Service Times

Description	Time out of service time (s)	Time out of service time (hh:mm:ss)	Out of service reason
1RL-T-B8	843	0:14:03	Exceeded Max Allowable Temp
1RL-T-B9	843	0:14:03	Exceeded Max Allowable Temp
1RL-T-B6	844	0:14:04	Exceeded Max Allowable Temp
1RL-T-A8	854	0:14:14	Exceeded Max Allowable Temp
1RL-T-A4	857	0:14:17	Exceeded Max Allowable Temp
1RB-T-A8	1058	0:17:38	Thermocouple stopped working
1RB-T-A9	1058	0:17:38	Thermocouple stopped working
1WA-T-B8	1142	0:19:02	Thermocouple stopped working
1CL-S-E1	2440	0:40:40	Exceeded Max Allowable Temp
1CB-S-D1	3878	1:04:38	Exceeded Max Allowable Temp
1CL-D-A1	8578	2:22:58	Exceeded Max Allowable Temp

The following charts present a time-dependent representation of the instantaneous temperatures measured during the experiment.

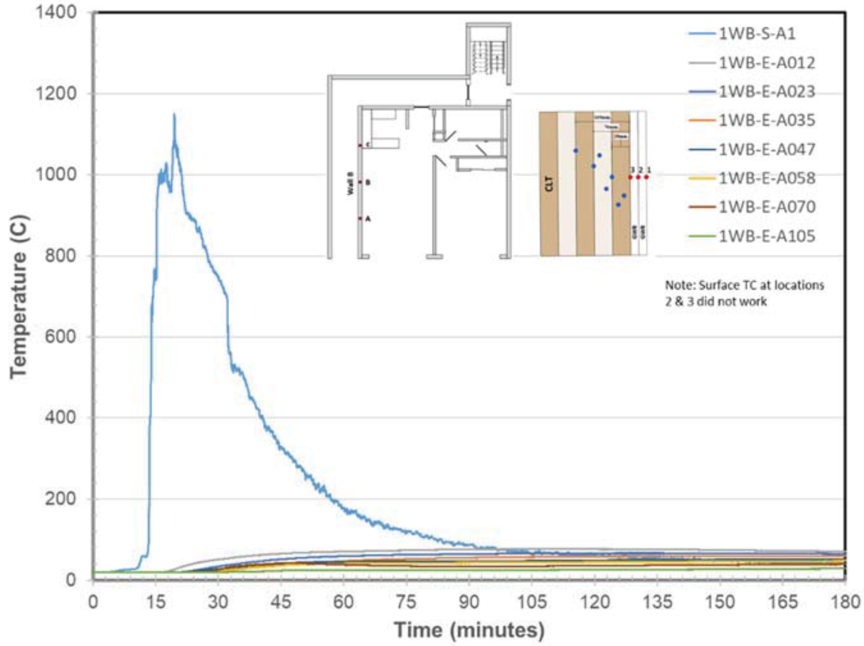

Figure 923. Wall B Embedded & Surface Temperatures at Location A

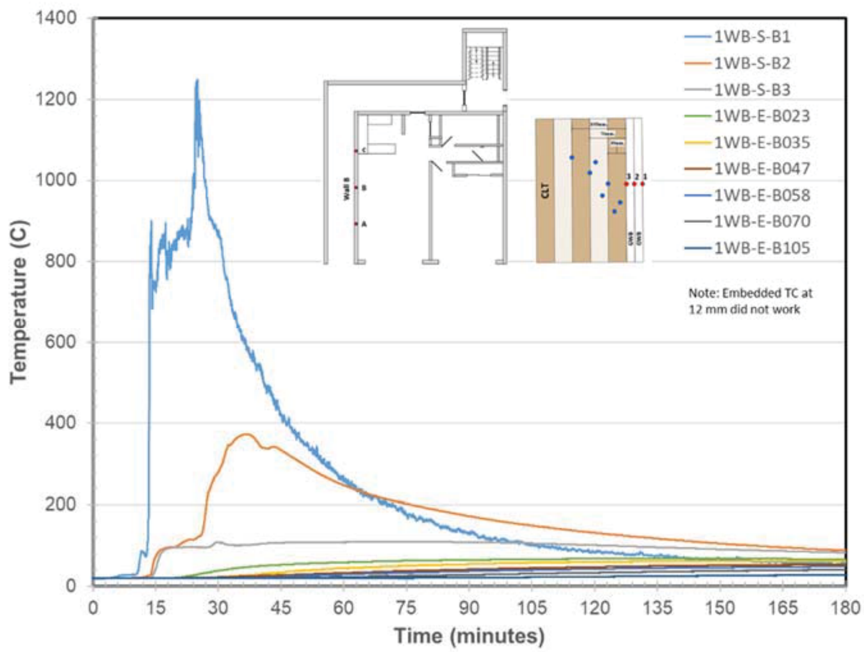

Figure 924. Wall B Embedded & Surface Temperatures at Location B

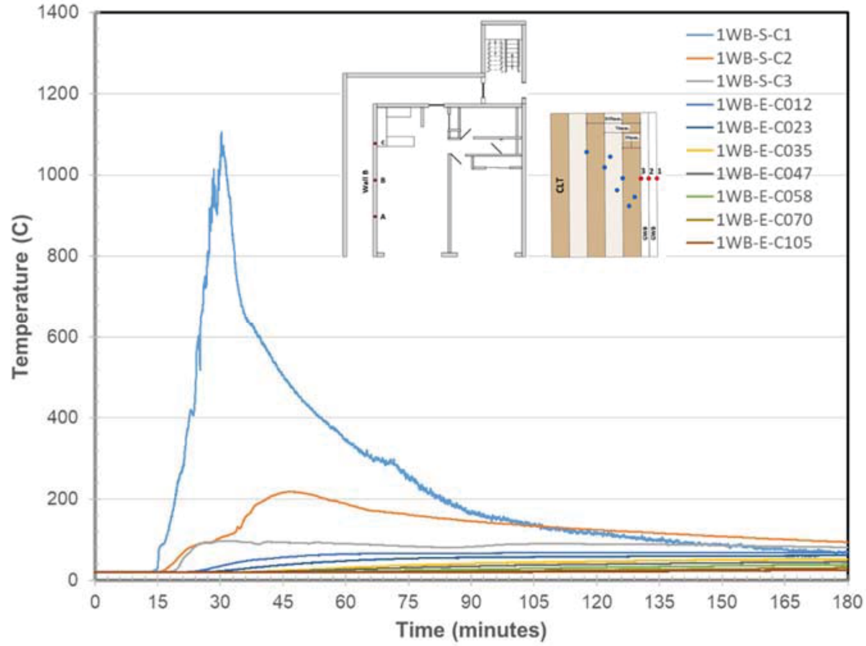

Figure 925. Wall B Embedded & Surface Temperatures at Location C

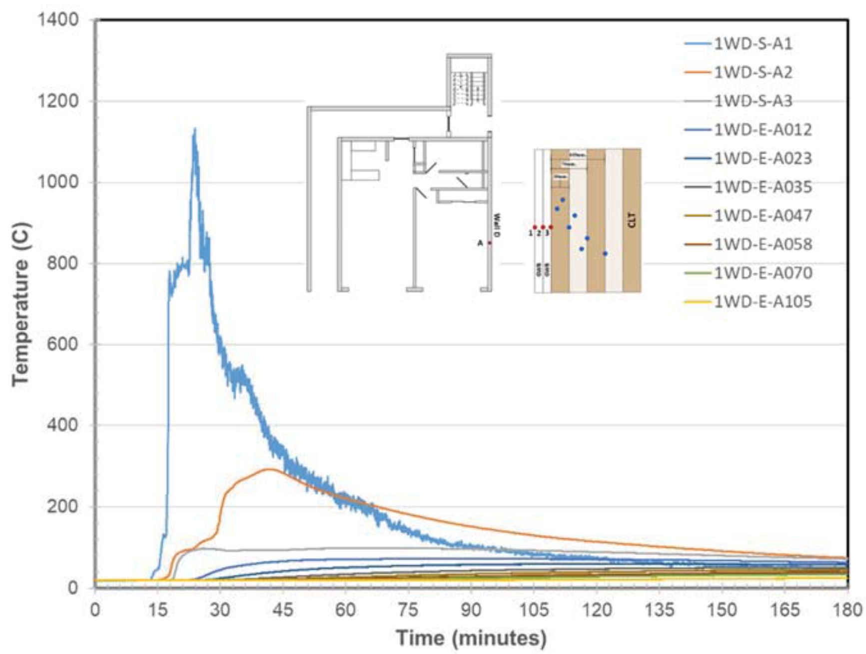

Figure 926. Wall D Embedded & Surface Temperatures at Location A

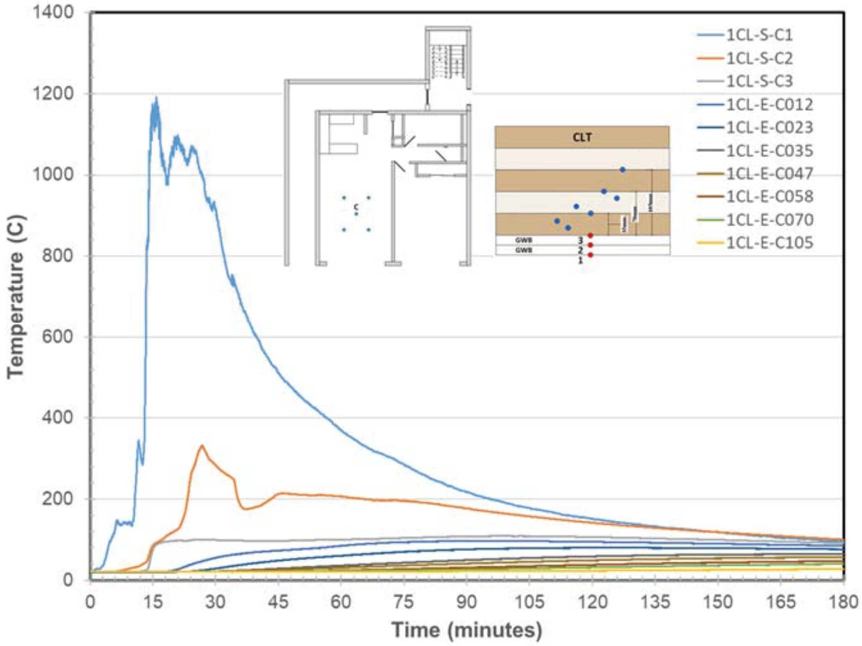

Figure 927. Living Room Ceiling Embedded & Surface Temperatures at Location C

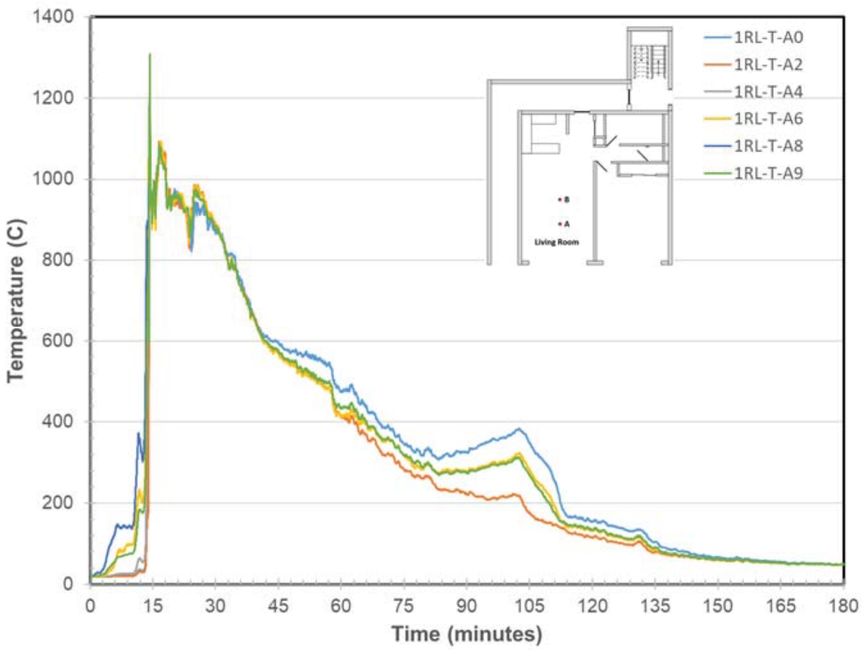

Figure 928. Living Room Temperature at Location A

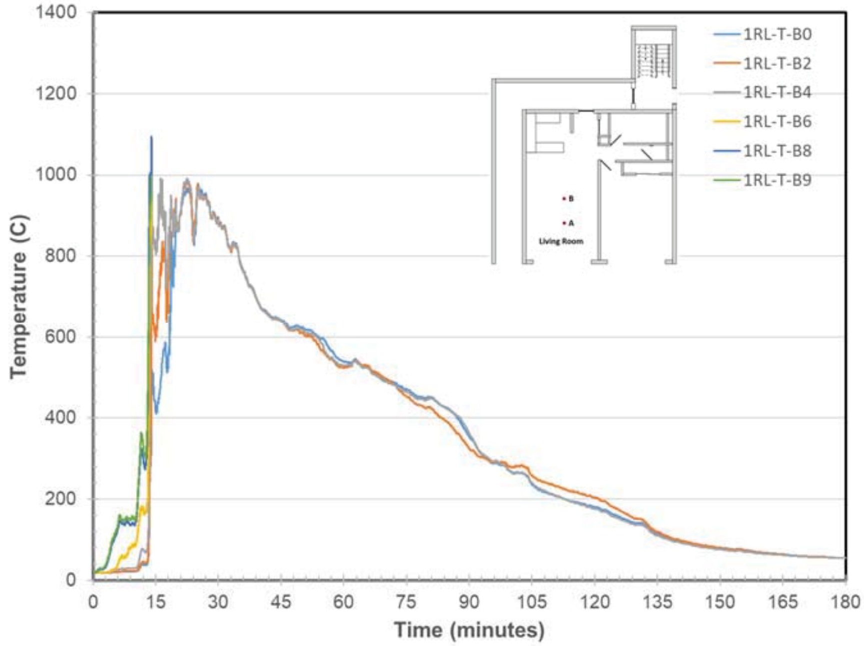

Figure 929. Living Room Temperature at Location B

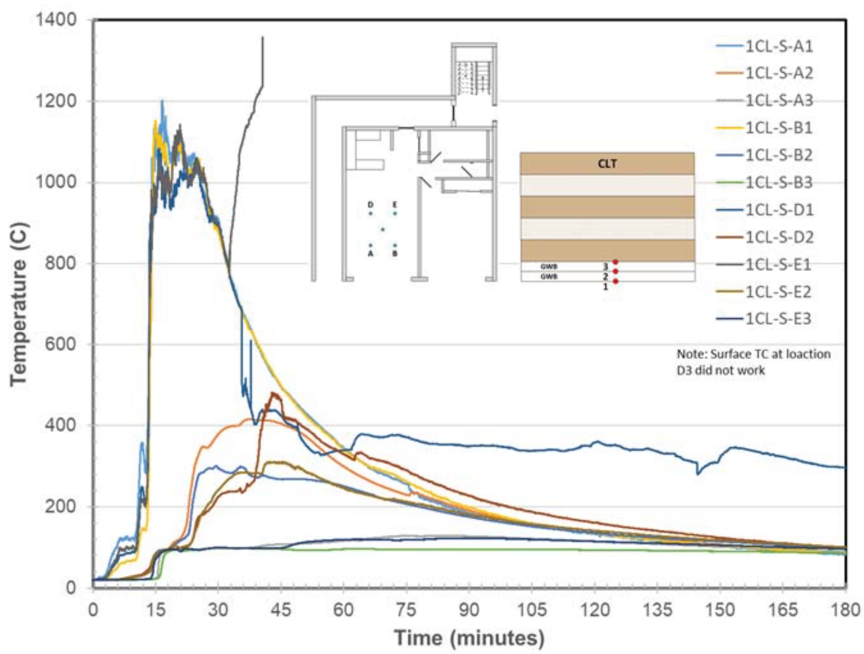

Figure 930. Living Room Ceiling Surface Temperatures at Location A, B, D, & E

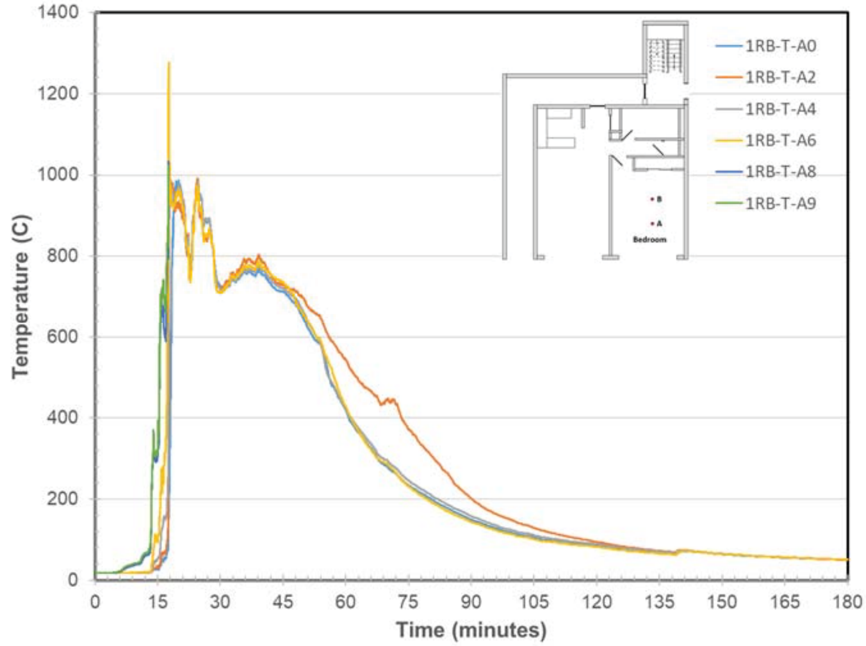

Figure 931. Bedroom Temperature at Location A

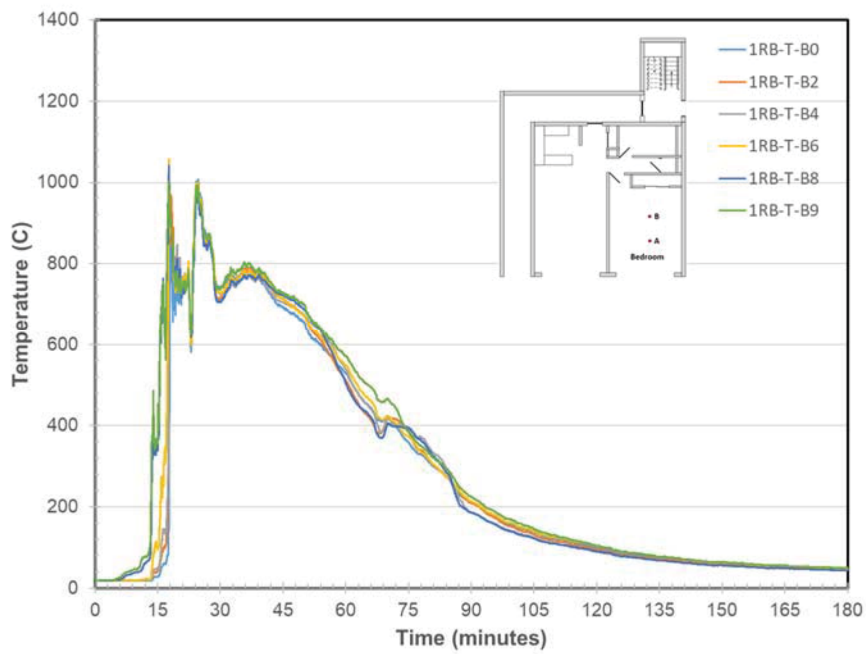

Figure 932. Bedroom Temperature at Location B

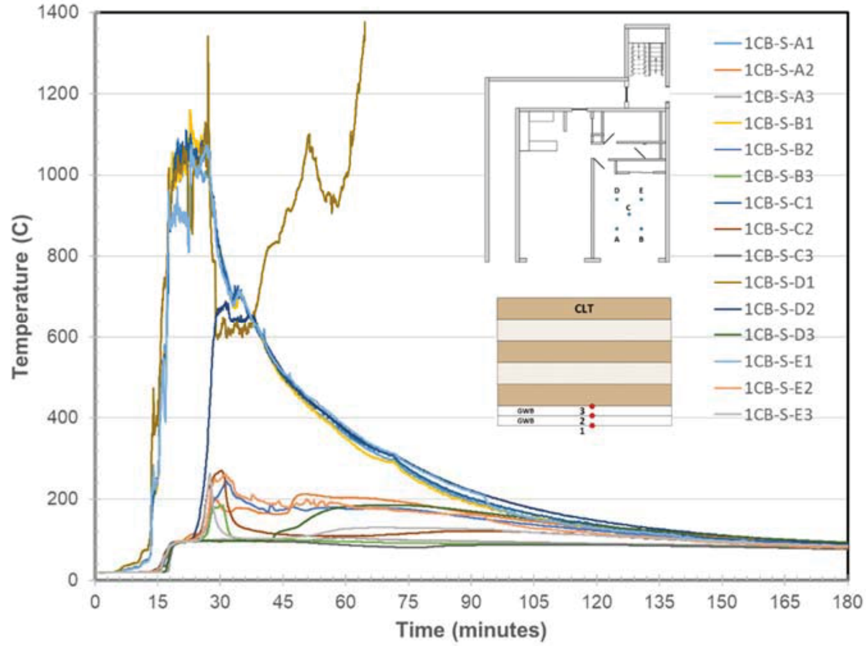

Figure 933. Bedroom Ceiling Surface Temperatures at Locations A through E

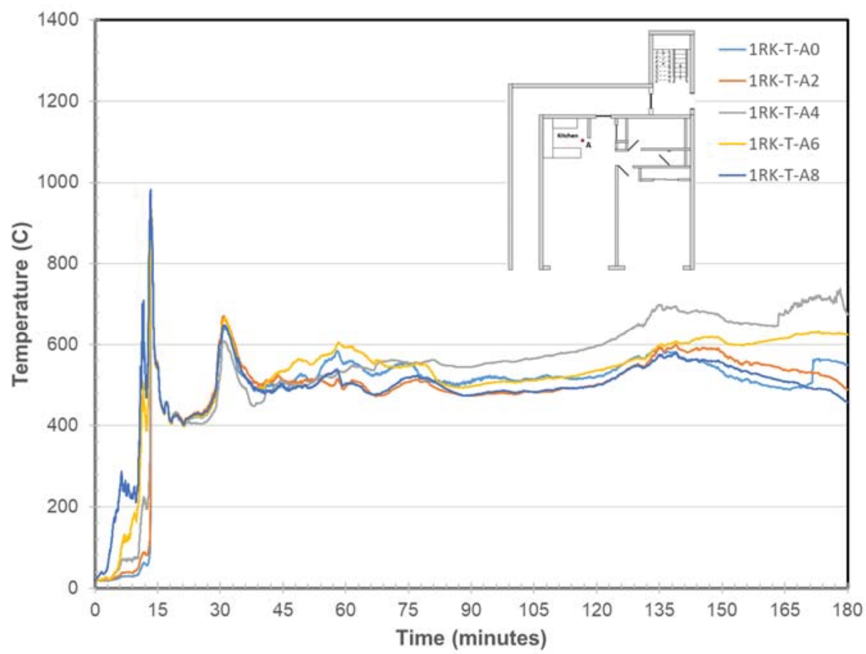

Figure 934. Kitchen Temperatures at Location A

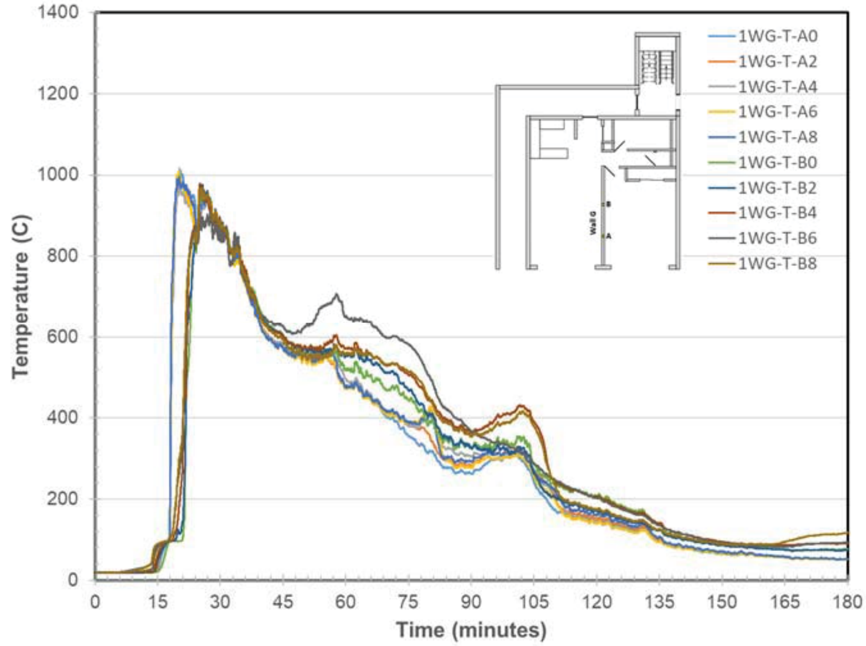

Figure 935. Wall G Temperatures at Locations A & B

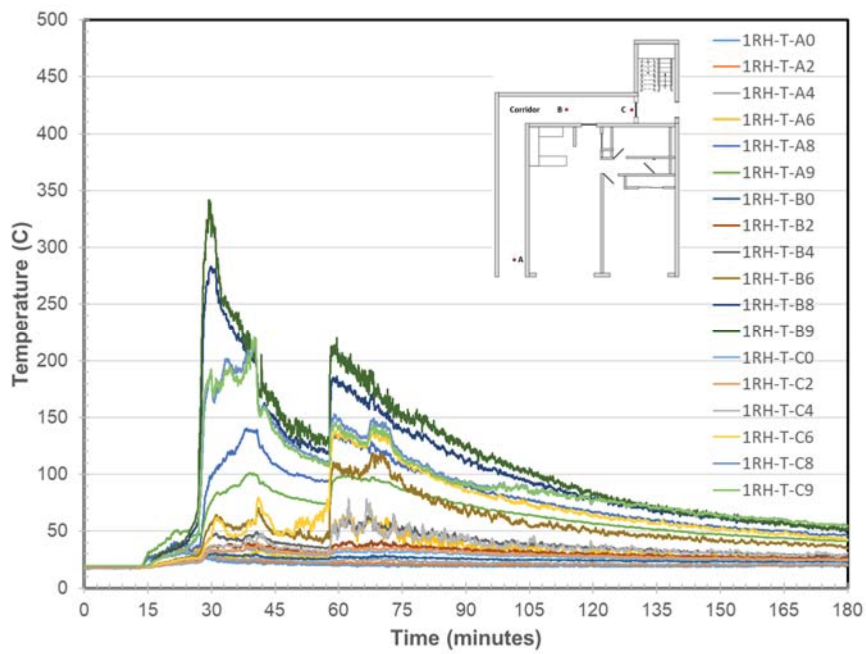

Figure 936. Corridor Temperatures at Locations A, B, & C

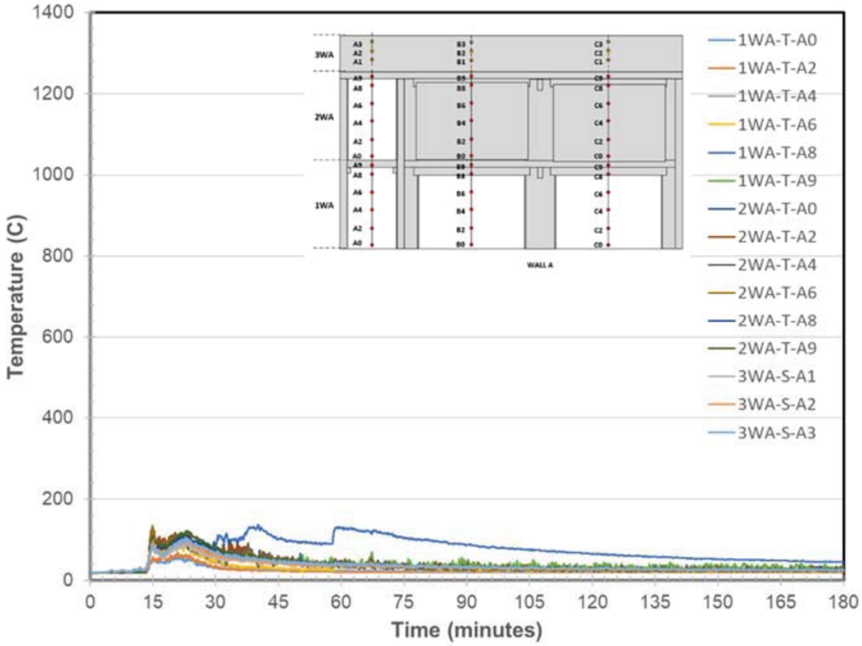

Figure 937. Wall A Temperatures at Location A

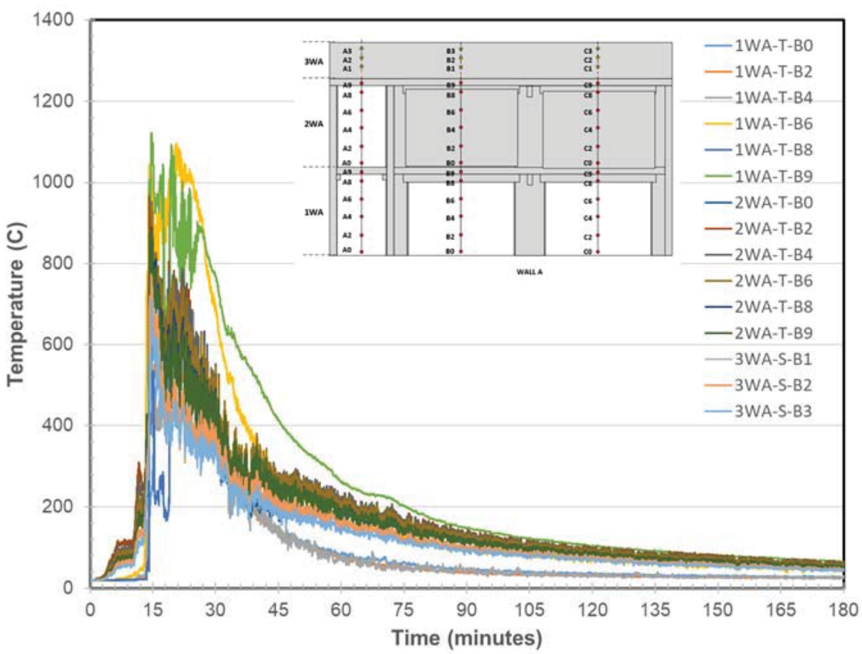

Figure 938. Wall A Temperatures at Locations B

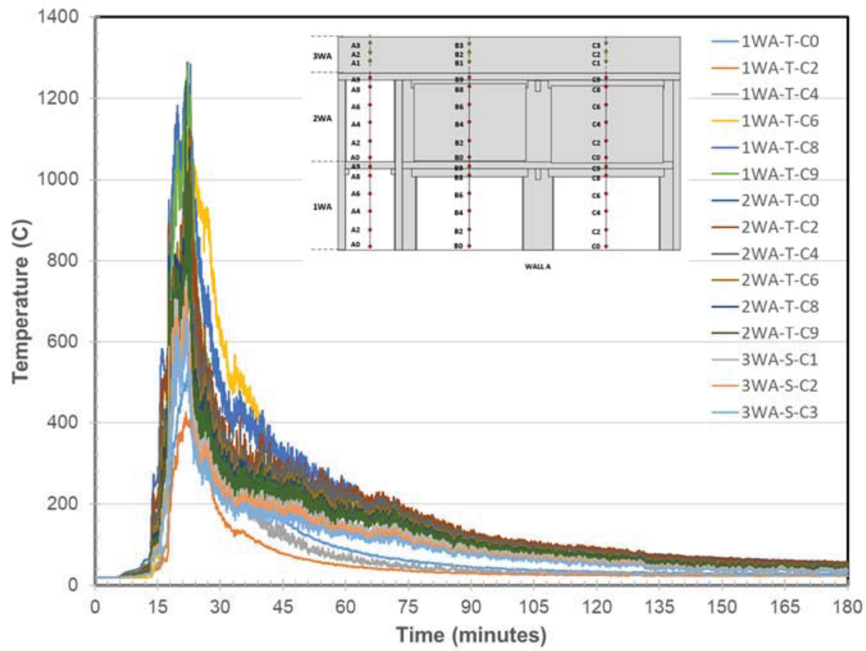

Figure 939. Wall A Temperatures at Locations C

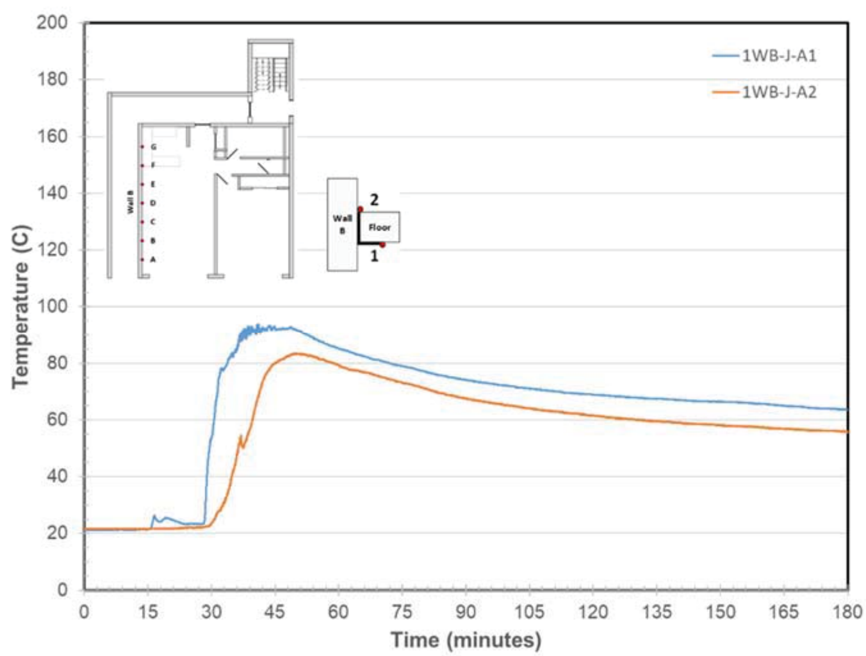

Figure 940. Wall B/Steel Angle Joint Temperatures at Location A

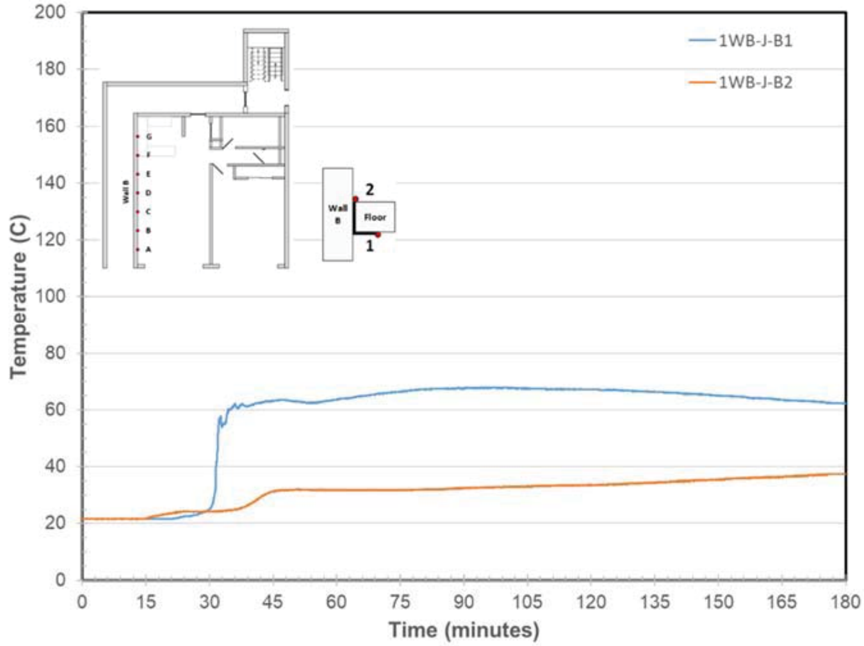

Figure 941. Wall B/Steel Angle Joint Temperatures at Location B

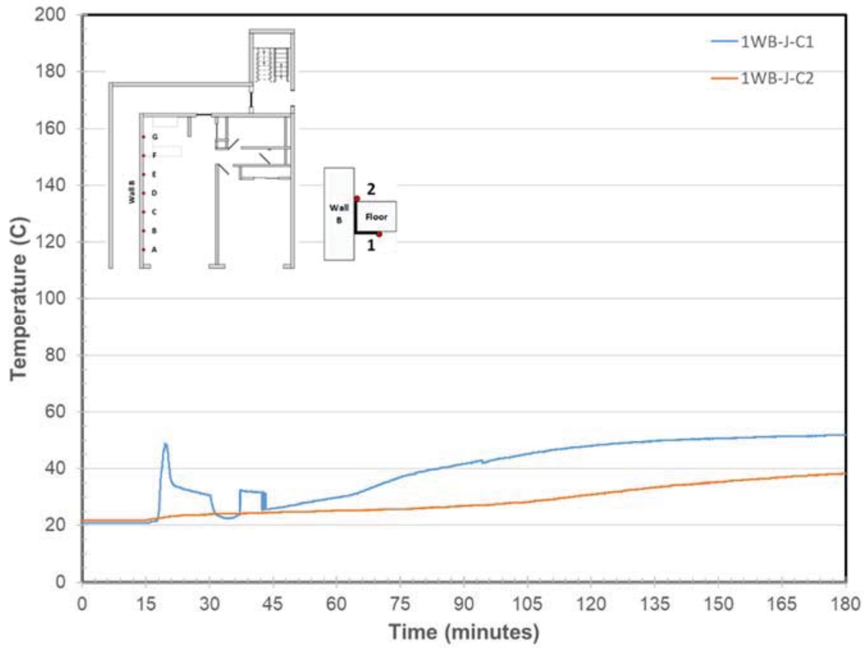

Figure 942. Wall B/Steel Angle Joint Temperatures at Location C

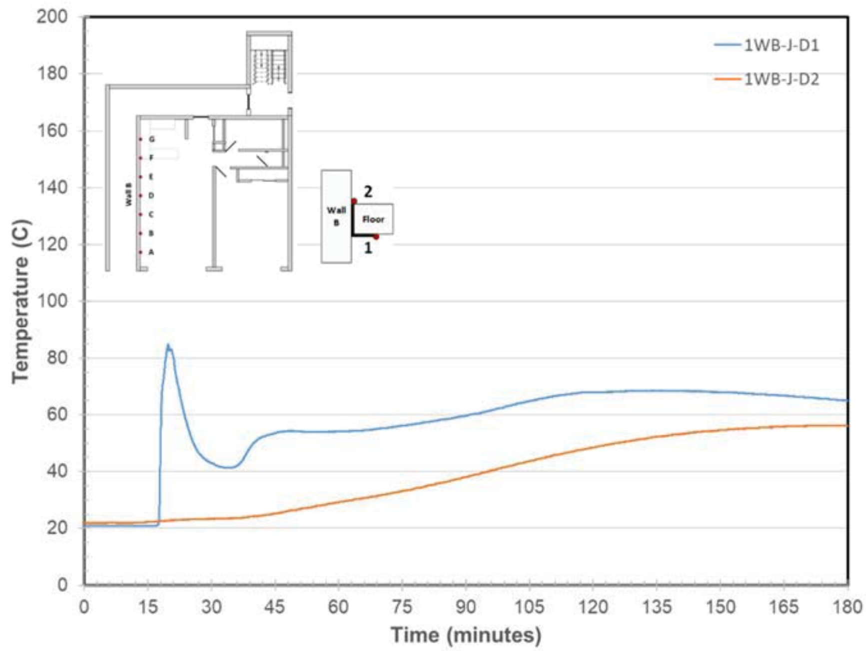

Figure 943. Wall B/Steel Angle Joint Temperatures at Location D

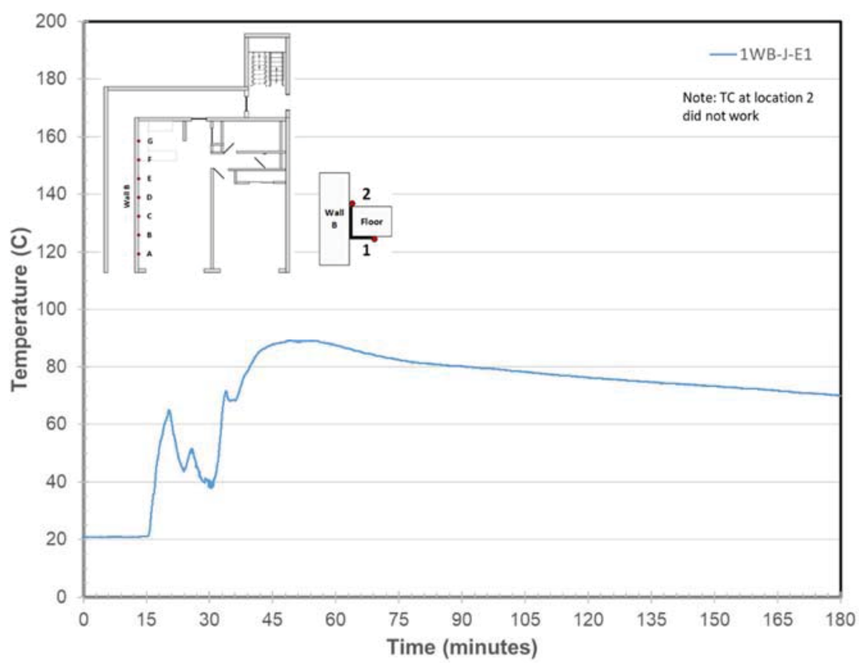

Figure 944. Wall B/Steel Angle Joint Temperatures at Location E

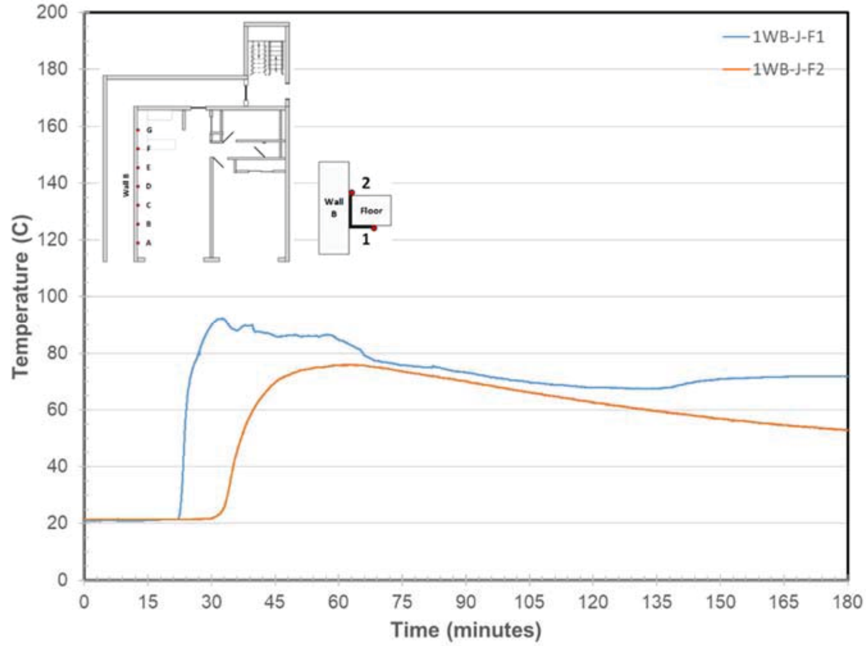

Figure 945. Wall B/Steel Angle Joint Temperatures at Location F

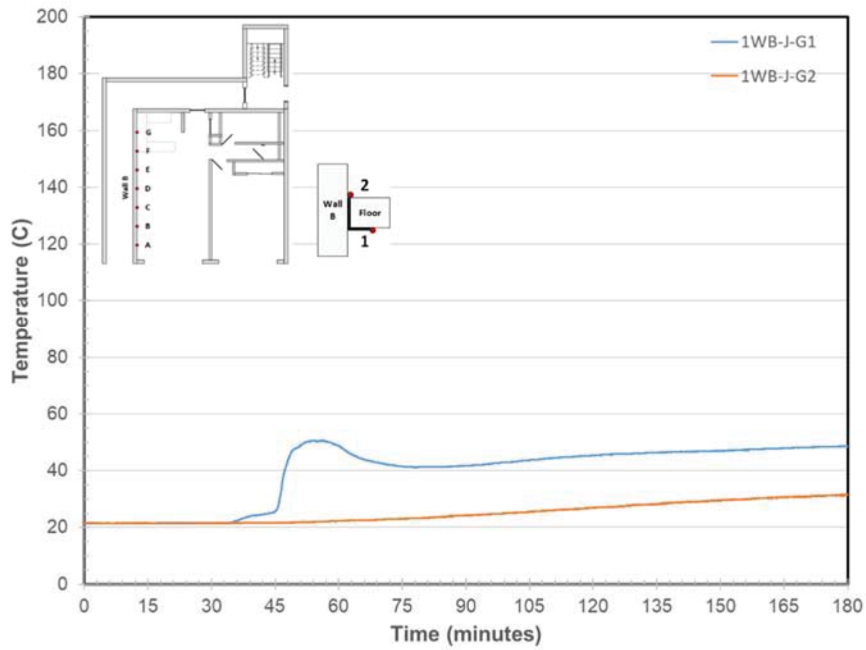

Figure 946. Wall B/Steel Angle Joint Temperatures at Location G

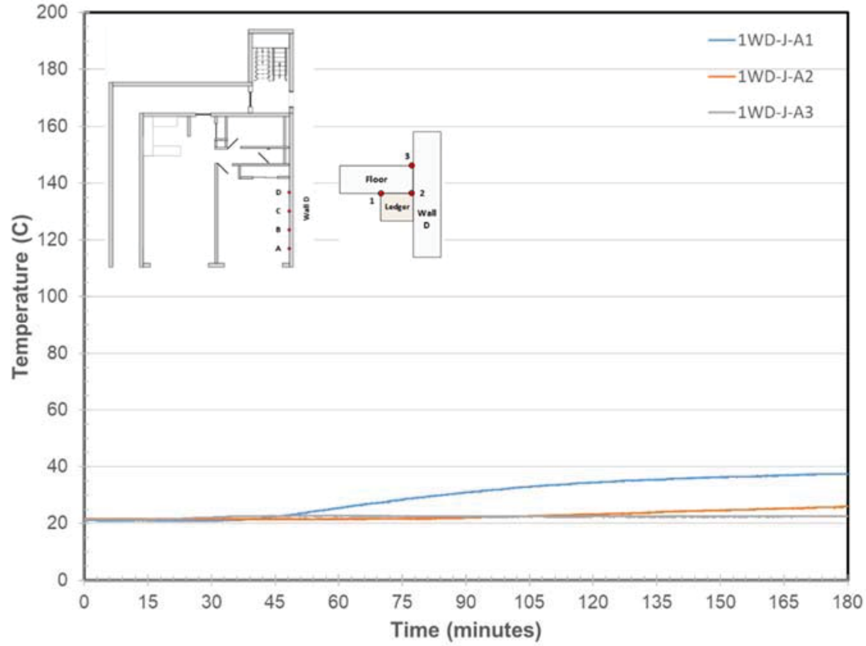

Figure 947. Wall D/Ledger Joint Temperatures at Location A

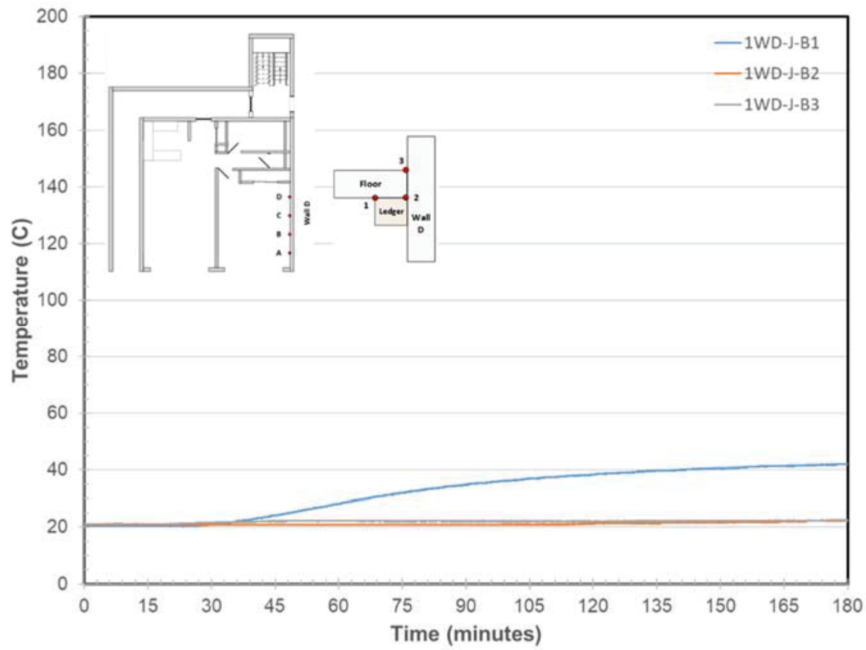

Figure 948. Wall D/Ledger Joint Temperatures at Location B

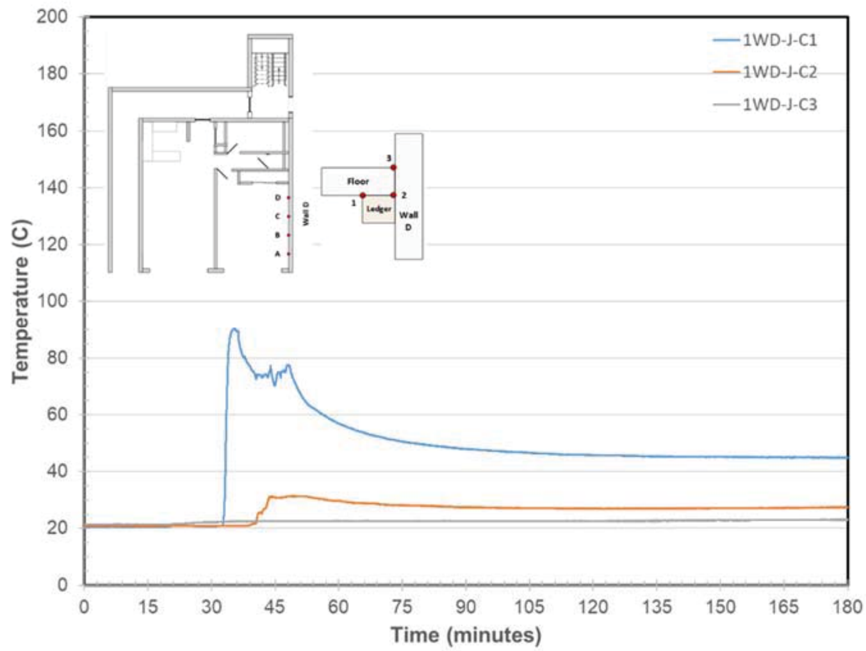

Figure 949. Wall D/Ledger Joint Temperatures at Location C

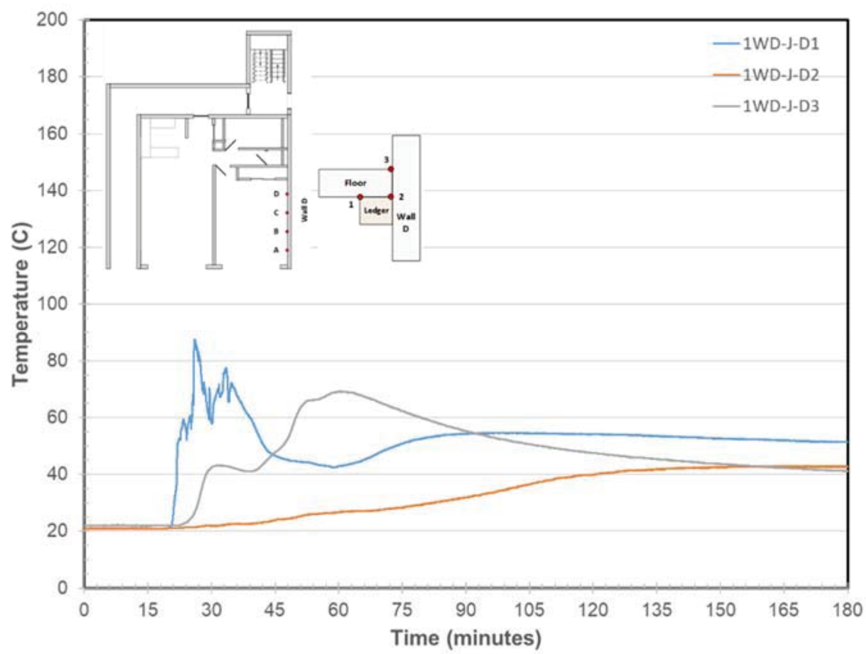

Figure 950. Wall D/Ledger Joint Temperatures at Location D

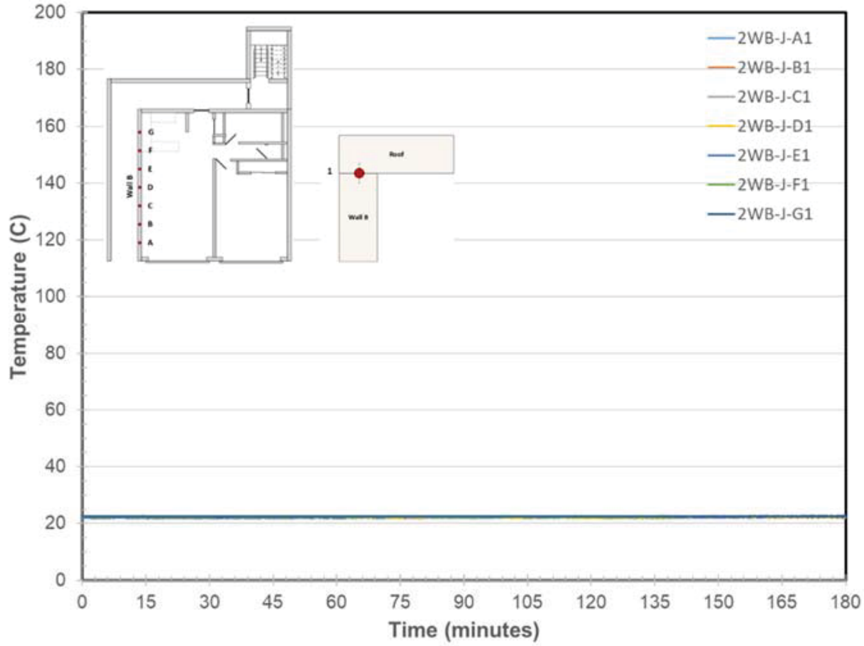

Figure 951. Ceiling/Wall B Joint Temperatures at Locations A-G

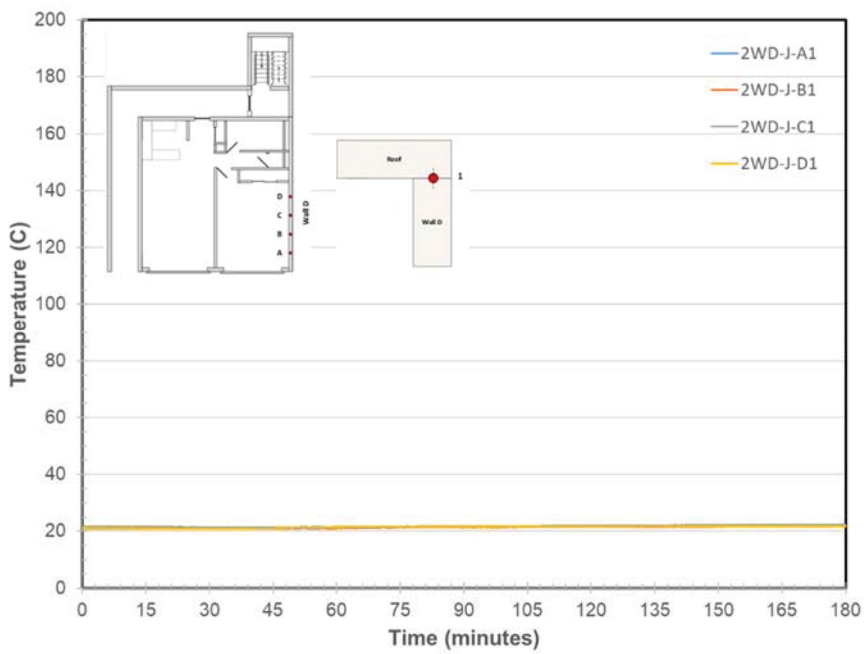

Figure 952. Ceiling/Wall B Joint Temperatures at Locations A-D

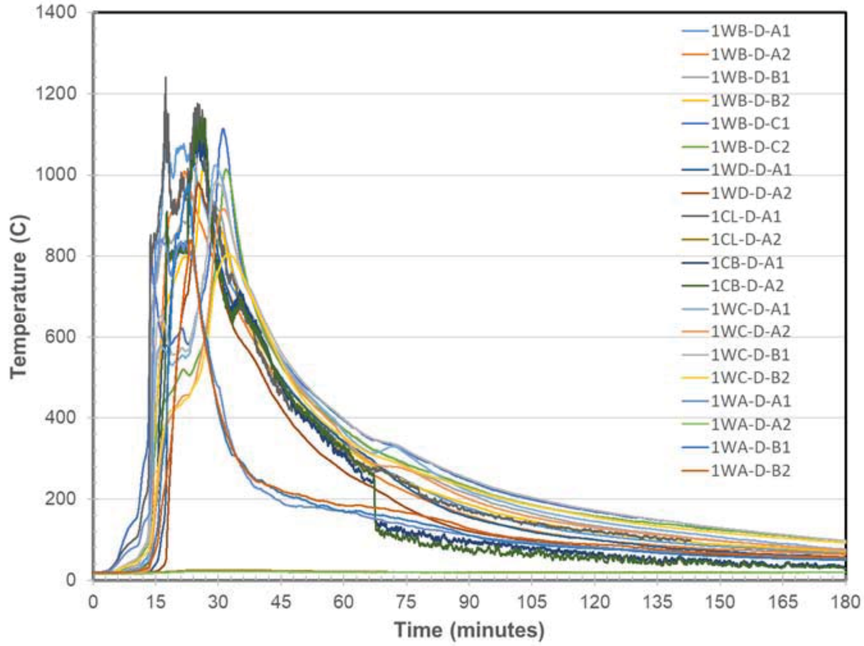

Figure 953. DFT Temperatures at each Location on 1st floor

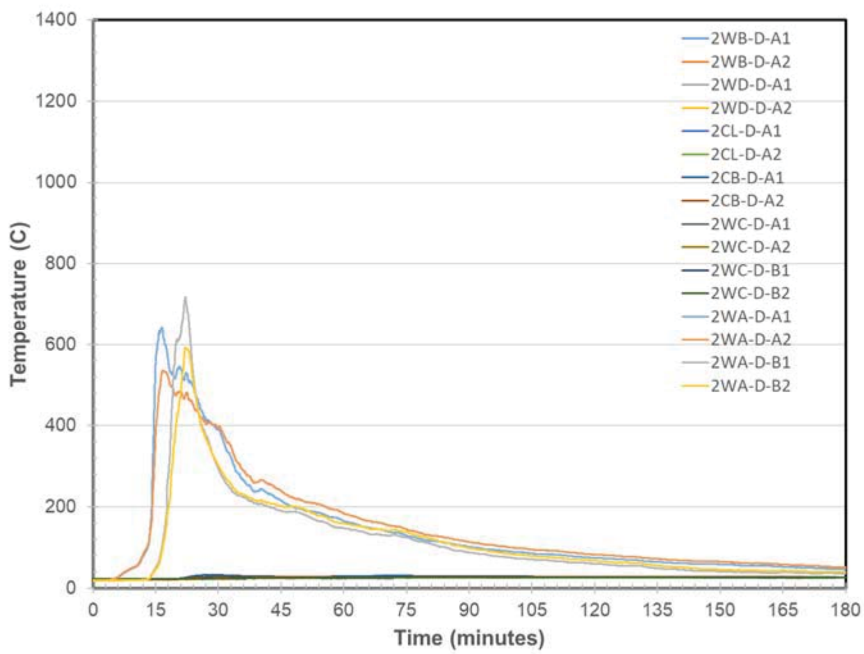

Figure 954. DFT Temperatures at each Location on 2nd floor

Velocity

The following table provides a description of the instrumentation used to collect velocity measurements during the experiments. Velocity is calculated from pressure and temperature measurements.

Table 7. Velocity Measurement Description

Description	Probe Description	Thermocouple Type	Location X (m)	Location Y (m)	Location Z (m)	Orientation
1WA-V-A1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.76	0.00	0.91	horizontal
1WA-V-A2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.76	0.00	1.83	horizontal
1WA-V-B1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	0.91	horizontal
1WA-V-B2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	1.83	horizontal
1WA-V-B3	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	0.91	horizontal
1WA-V-B4	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	1.83	horizontal
1WA-V-C1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	0.91	horizontal
1WA-V-C2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	1.83	horizontal
1WA-V-C3	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	0.91	horizontal
1WA-V-C4	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	1.83	horizontal

The following table provides a summary of the temperatures measured at the velocity probe.

Table 8. Velocity Temperature Summary

Description	Initial (C)	Maximum (C)	30 Second Maximum Average (C)	60 Second Maximum Average (C)	300 Second Maximum Average (C)	600 Second Maximum Average (C)
1WA-V-A1	17	55	53	52	49	47
1WA-V-A2	18	87	78	74	69	66
1WA-V-B1	17	308	214	207	179	174
1WA-V-B2	18	1074	1043	1040	960	921
1WA-V-B3	17	237	223	213	196	189
1WA-V-B4	18	1102	1092	1085	1023	930
1WA-V-C1	17	508	443	436	393	325
1WA-V-C2	17	1147	1112	1106	982	884
1WA-V-C3	18	485	402	383	359	328
1WA-V-C4	18	1068	1043	1038	992	931

The following table summarizes the minimum and maximum velocity values and the times at which they occurred.

Table 9. Velocity Minimum and Maximum

Description	Initial (m/s)	Maximum (m/s)	5 Second Maximum Average (m/s)	10 Second Maximum Average (m/s)	30 Second Maximum Average (m/s)	60 Second Maximum Average (m/s)
1WA-V-A1	-0.07	0.67	0.24	0.18	0.04	0.00
1WA-V-A2	0.13	1.35	0.97	0.89	0.70	0.65

Description	Initial (m/s)	Maximum (m/s)	5 Second Maximum Average (m/s)	10 Second Maximum Average (m/s)	30 Second Maximum Average (m/s)	60 Second Maximum Average (m/s)
1WA-V-B1	-0.10	1.22	0.18	0.16	0.10	0.06
1WA-V-B2	0.15	7.30	6.75	6.61	6.33	6.25
1WA-V-B3	-0.16	0.97	0.39	0.22	-0.04	-0.11
1WA-V-B4	0.07	7.83	7.24	7.06	6.96	6.94
1WA-V-C1	-0.13	1.13	0.82	0.61	0.20	0.17
1WA-V-C2	-0.14	7.09	6.14	6.11	5.86	5.71
1WA-V-C3	-0.15	3.49	2.42	2.21	1.71	1.22
1WA-V-C4	0.33	9.29	7.57	7.37	7.24	7.19

The following charts present a time dependent representation of the instantaneous velocities measured during the experiment.

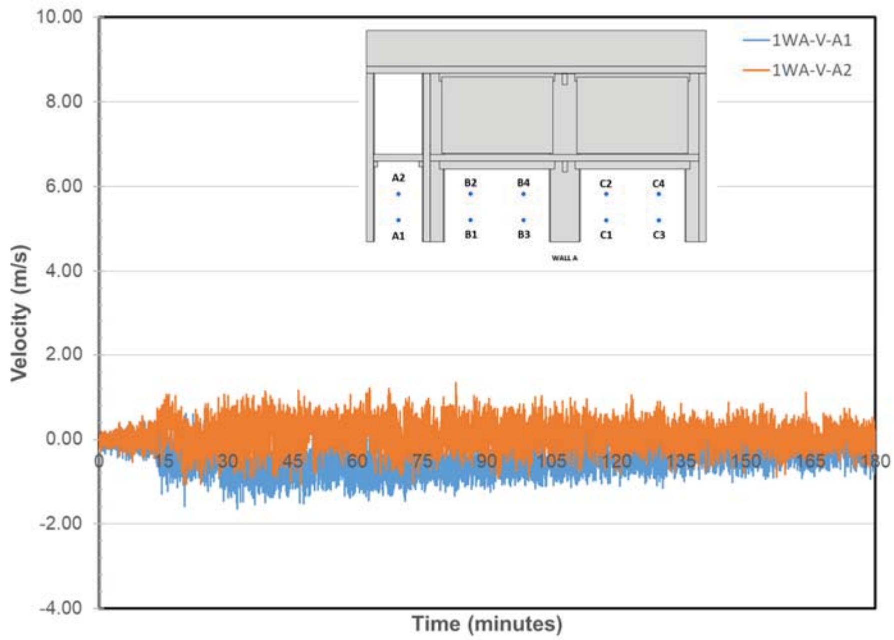

Figure 955. Velocity at Location A on Wall A

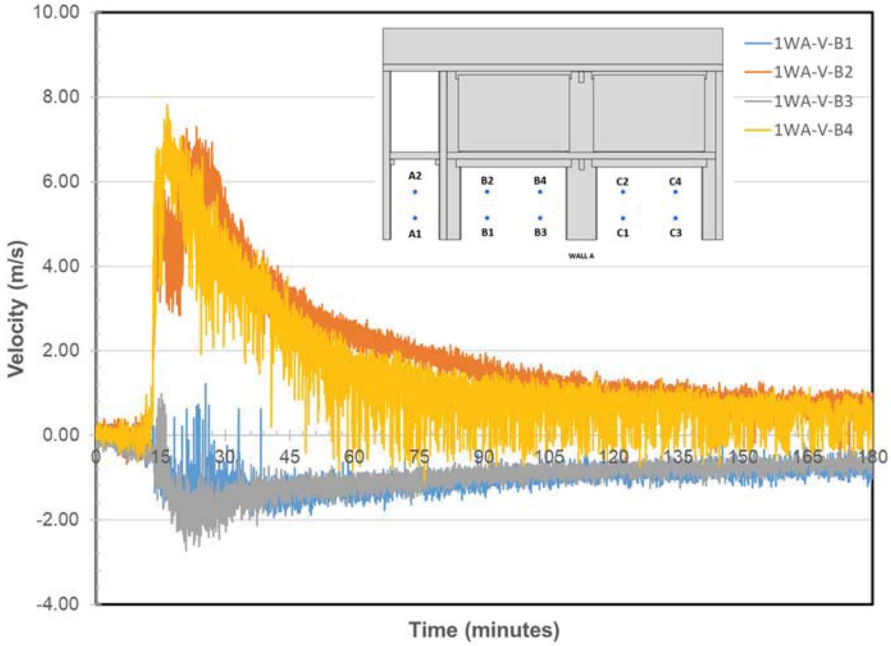

Figure 956. Velocity at Location B on Wall A

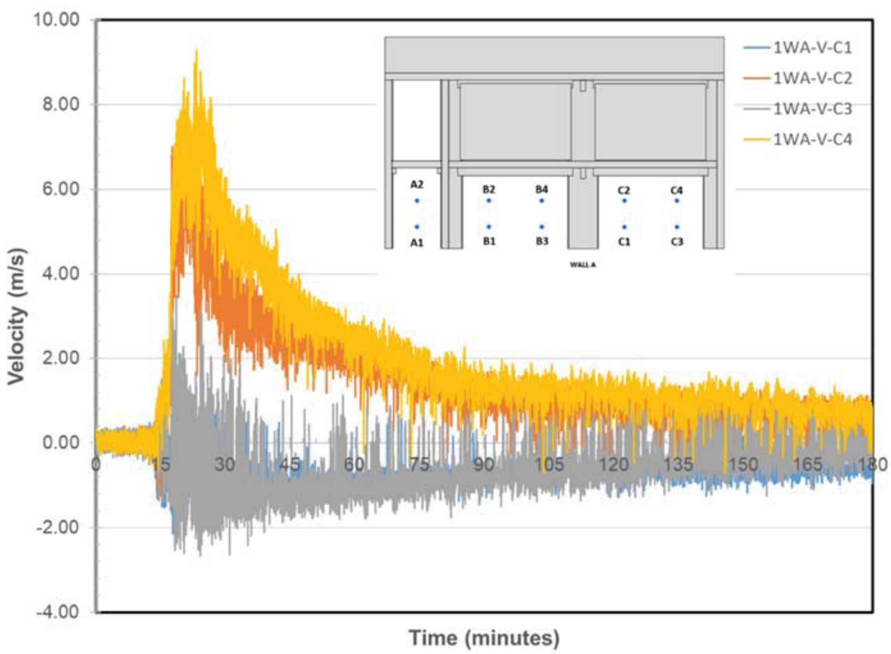

Figure 957. Velocity at Location C on Wall A

Heat Flux Transducers

The following table provides a description of the transducer used to collect heat flux measurements during the experiment. The "Description" column typically describes the location of the heat flux transducer. Location X and Location Y are Cartesian coordinates generally located in a horizontal plane. Location Z is the distance from the floor to the centerline of the transducer. Heat flux mode indicates whether the total heat flux was measured or just the radiation fraction. Heat flux over range is the maximum measured value reported for this transducer.

Table 10. Heat Flux Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Orientation	Heat Flux Mode	Heat Flux Over Range (kW/m²)
1WF-H-A1	5.59	11.16	0.91	horizontal	Total	150
1WA-H-A1	1.83	2.44	1.52	horizontal	Total	75
1WA-H-A2	1.83	4.88	1.52	horizontal	Total	37.5
1WA-H-B1	1.83	2.44	1.52	horizontal	Total	75
1WA-H-B2	1.83	4.88	1.52	horizontal	Total	37

The following table provides a summary of the heat flux results. A “SC” in the table indicates that the values did not change sufficiently for this value to be calculated. The “Description” column typically describes the location of the heat flux transducer. The time at which the heat flux first changes by a pre-determined amount is provided in the “Time of Initial Change” column. The pre-determined amount of change in heat flux is provided in the “Initial Change Amount” column. The maximum heat flux recorded during the test is provided in the “Maximum” column. The “Maximum Average” columns are calculated over four pre-determined time spans. Exceeded maximum instrument operating range and was taken out of service for the remainder of the test

Table 11. Heat Flux Result Summary

Description	Time of Initial Change (s)	Initial Change Value (kW/m²)	Maximum Heat Flux (kW/m²)	Heat Flux 10 second maximum average (kW/m²)	Heat Flux 30 second maximum average (kW/m²)	Heat Flux 60 second maximum average (kW/m²)	Heat Flux 300 second maximum average (kW/m²)	Heat Flux 600 second maximum average (kW/m²)
1WF-H-A1	SC	5	3.7	3.5	3.4	3.3	3.1	2.8
1WA-H-A1	802	5	74.6	73.4	71.9	69.8	45.1	22.8
1WA-H-A2	810	5	32.5	31.7	31.4	31.2	29.5	26.9
1WA-H-B1	939	5	65.8	64.1	63.4	61.6	41.8	21.9
1WA-H-B2	926	5	29.1	28.5	28.0	27.5	24.9	21.3

The following table shows which heat flux transducers were taken out of service during the experiment. The “Description” column typically describes the location of the heat flux transducer. If the heat flux measurement has to be discontinued during a test the “Out of Service Time” and “Out of Service Reason” columns report the test time and reason why the heat flux measurement was removed, respectively.

Table 12. Out of Service Times

Description	Out of Service Time (s)	Out of Service Time (hh:mm:ss)	Out of service reason
1WA-H-A1	1045	00:17:25	Over Range
1WA-H-B1	1295	00:21:35	Issue with data connection

The following charts show a time dependent representation of the instantaneous heat flux measured during the experiment.

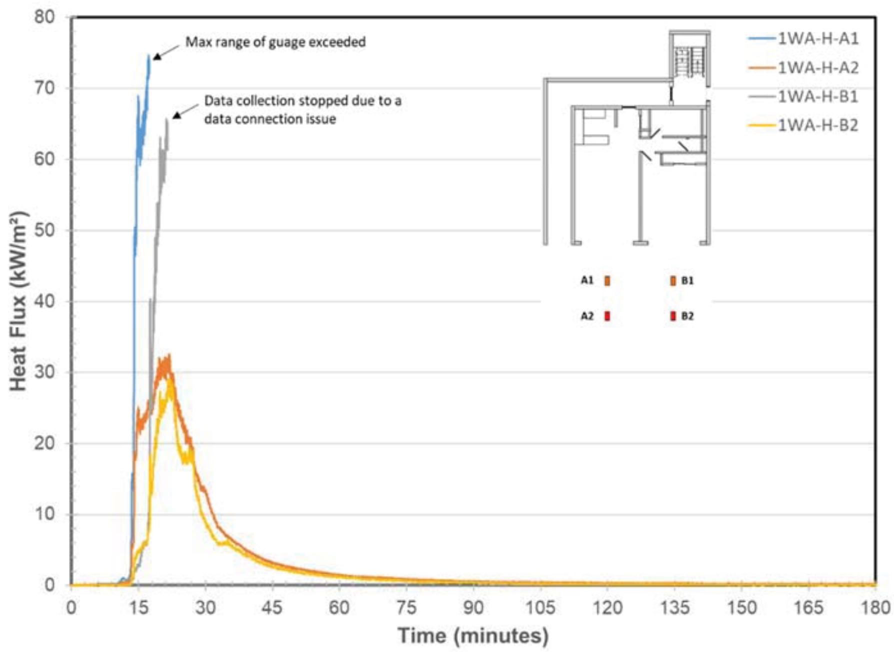

Figure 958. Heat Flux in Front of Wall A

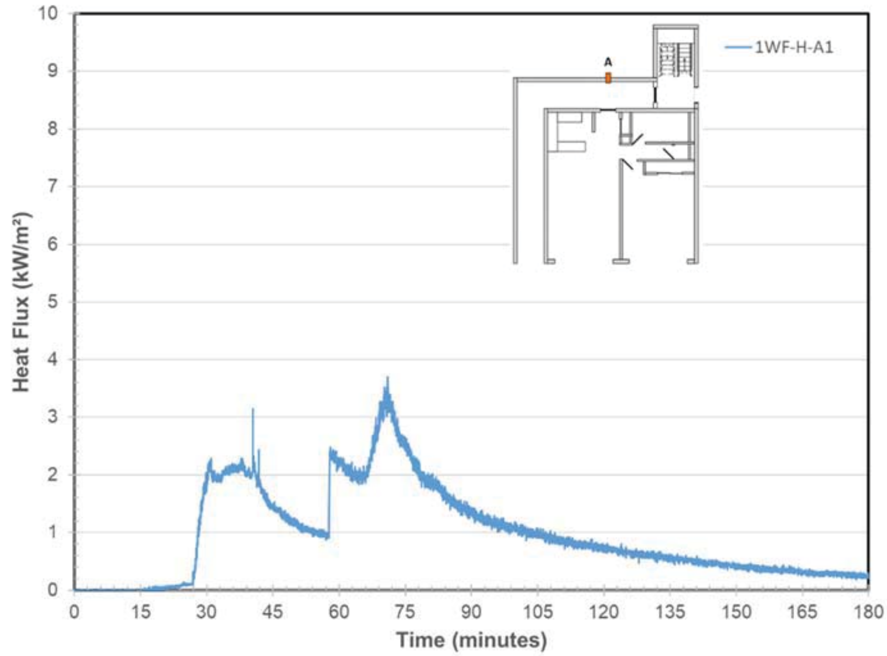

Figure 959. Heat Flux on Wall F across from Apartment Door

Optical Density Meter

The following table provides a description of the optical density meters used in the experiment. The extinction beam path length is the distance measured from the light source to the lens of the photo transducer.

Table 13. Optical Density Meter Description

Description	Light Source Type	X (m)	Y (m)	Z (m)	Extinction Beam Path Length (m)
1RH-O-A1	White light	3.353	10.363	1.524	0.914
2RH-O-A1	White light	3.353	10.363	1.524	0.914

The following chart shows the obscuration during the experiment.

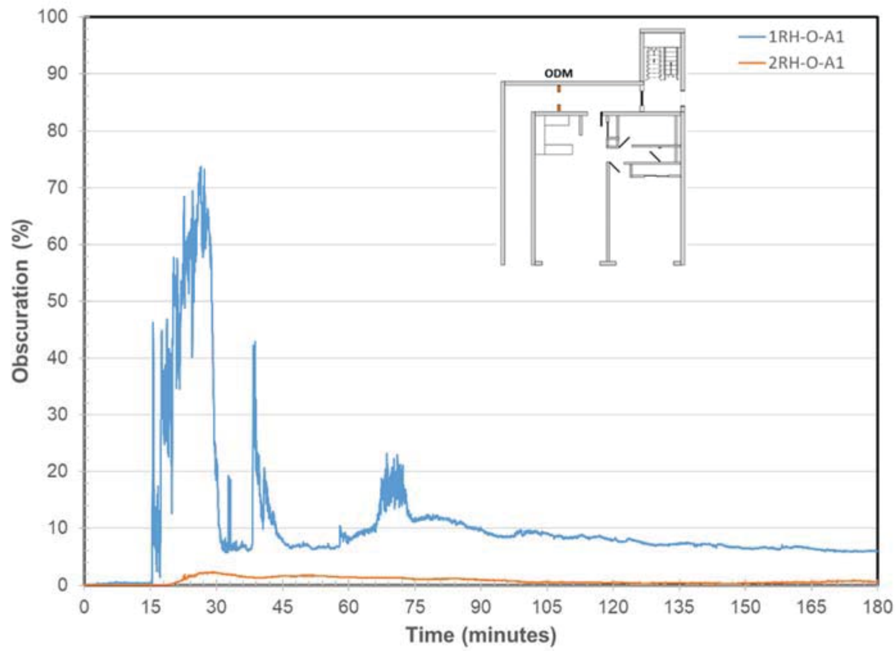

Figure 960. Obscuration in Corridors

The following chart shows the obscuration per unit length during the experiment.

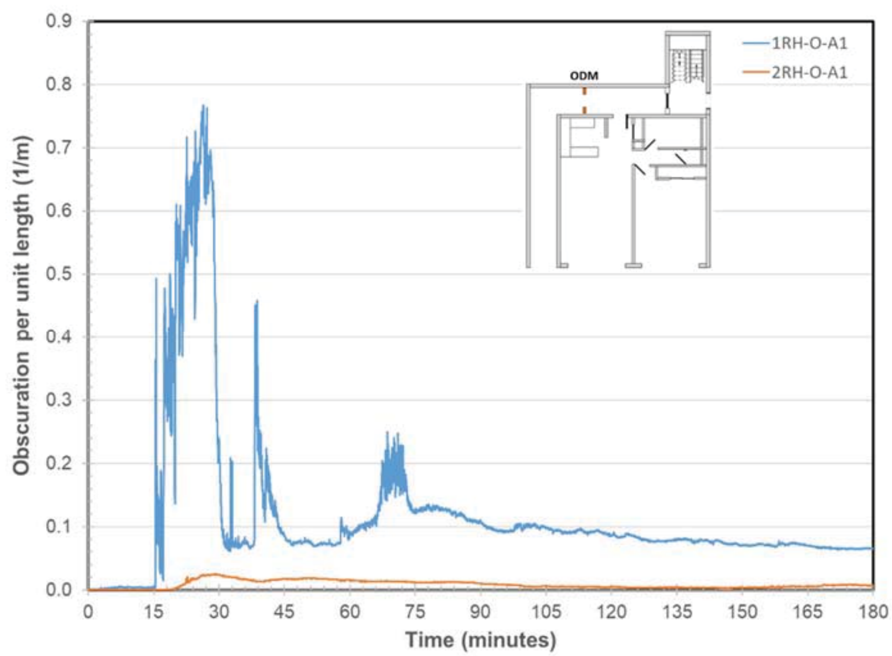

Figure 961. Obscuration per unit Length in Corridor

Smoke Detectors

The following table provides a description of the detectors used in the experiment. All detectors were mounted on the ceiling.

Table 14. Detectors Summary

Description	Location	Distance below ceiling (m)	Manufacturer	Model	Detector Type	Sensor Type
1CL-I-A1	1st Floor Living Room	0.00	Kidde	p12040	smoke	ionization
1CL-P-A1	1st Floor Living Room	0.00	Kidde	i12080	smoke	photoelectric
1CB-I-A1	1st Floor Bed Room	0.00	Kidde	i12080	smoke	ionization
1CB-P-A1	1st Floor Bed Room	0.00	Kidde	p12040	smoke	photoelectric
1CB-I-B1	1st Floor Hallway Outside of Bedroom	0.00	Kidde	i12080	smoke	ionization
1CB-P-B1	1st Floor Hallway Outside of Bedroom	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-A1	1st Floor Corridor near Wall A	0.00	Kidde	i12080	smoke	ionization
1CH-P-A1	1st Floor Corridor near Wall A	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-B1	1st Floor Corridor by Apartment Door	0.00	Kidde	i12080	smoke	ionization
1CH-P-B1	1st Floor Corridor by Apartment Door	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-C1	1st Floor Stairwell	0.00	Kidde	i12080	smoke	ionization
1CH-P-C1	1st Floor Stairwell	0.00	Kidde	p12040	smoke	photoelectric
2CL-I-A1	2nd Floor Living Room	0.00	Kidde	i12080	smoke	ionization
2CL-P-A1	2nd Floor Living Room	0.00	Kidde	p12040	smoke	photoelectric
2CB-I-A1	2nd Floor Bed Room	0.00	Kidde	i12080	smoke	ionization
2CB-P-A1	2nd Floor Bed Room	0.00	Kidde	p12040	smoke	photoelectric
2CB-I-B1	2nd Floor Hallway Outside of Bedroom	0.00	Kidde	i12080	smoke	ionization
2CB-P-B1	2nd Floor Hallway Outside of Bedroom	0.00	Kidde	p12040	smoke	photoelectric
2CH-I-A1	2nd Floor Corridor near Wall A	0.00	Kidde	i12080	smoke	ionization
2CH-P-A1	2nd Floor Corridor near Wall A	0.00	Kidde	p12040	smoke	photoelectric
2CH-I-B1	2nd Floor Corridor by Apartment Door	0.00	Kidde	p12040	smoke	ionization
2CH-P-B1	2nd Floor Corridor by Apartment Door	0.00	Kidde	i12080	smoke	photoelectric
2CH-I-C1	2nd Floor Stairwell	0.00	Kidde	i12080	smoke	ionization
2CH-P-C1	2nd Floor Stairwell	0.00	Kidde	p12040	smoke	ionization

The following table provides a summary of activation times for all smoke detectors in all experiments.

Table 15. Smoke Detector Activation Summary

Description	Location	Activation Time (s)	Activation Time (hh:mm:ss)
1CL-I-A1	1st Floor Living Room	36	00:00:36
1CL-P-A1	1st Floor Living Room	41	00:00:41
1CB-I-B1	1st Floor Hallway Outside of Bedroom	42	00:00:42
1CB-I-A1	1st Floor Bed Room	189	00:03:09
1CB-P-A1	1st Floor Bed Room	191	00:03:11
1CB-P-B1	1st Floor Hallway Outside of Bedroom	787	00:13:07
1CH-P-B1	1st Floor Corridor by Apartment Door	865	00:14:25
2CB-I-B1	2nd Floor Hallway Outside of Bedroom	872	00:14:32
1CH-I-B1	1st Floor Corridor by Apartment Door	873	00:14:33
2CB-P-B1	2nd Floor Hallway Outside of Bedroom	874	00:14:34
2CB-I-A1	2nd Floor Bed Room	1012	00:16:52
2CL-P-A1	2nd Floor Living Room	1028	00:17:08

Description	Location	Activation Time (s)	Activation Time (hh:mm:ss)
2CB-P-A1	2nd Floor Bed Room	1054	00:17:34
1CH-P-A1	1st Floor Corridor near Wall A	1081	00:18:01
1CH-I-A1	1st Floor Corridor near Wall A	1310	00:21:50
2CL-I-A1	2nd Floor Living Room	1369	00:22:49
1CH-I-C1	1st Floor Stairwell	3573	00:59:33

Fire Products Collector

The following table provides a description of the FPC used in the experiment. The table includes a description of the FPC, as well as the Calibration factor (C Factor) and the net heat released per unit of oxygen consumed (E Factor), which are used to calculate the het release rate (HRR) during an experiment. The C Factor is based on data from a fire with a known HRR. The E Factor is a property of the fuel being burned.

Table 16. Fire Products Collector Description

Description	C Factor	E Factor (kJ/kg)
14 MW	1.128	13100

The following table shows when the FPC was taken out of service during the experiment. A time is also provided when the FPC was placed back into service.

Table 17. FPC Event Times

Description	Time (s)	Time (hh:mm:ss)
FPC Offline to change gas filter	1145	00:19:05
FPC Online	1424	00:23:44

The following chart shows the heat release rate of the fire during the experiment. The heat release rate is calculated based on the principle of oxygen consumption calorimetry.

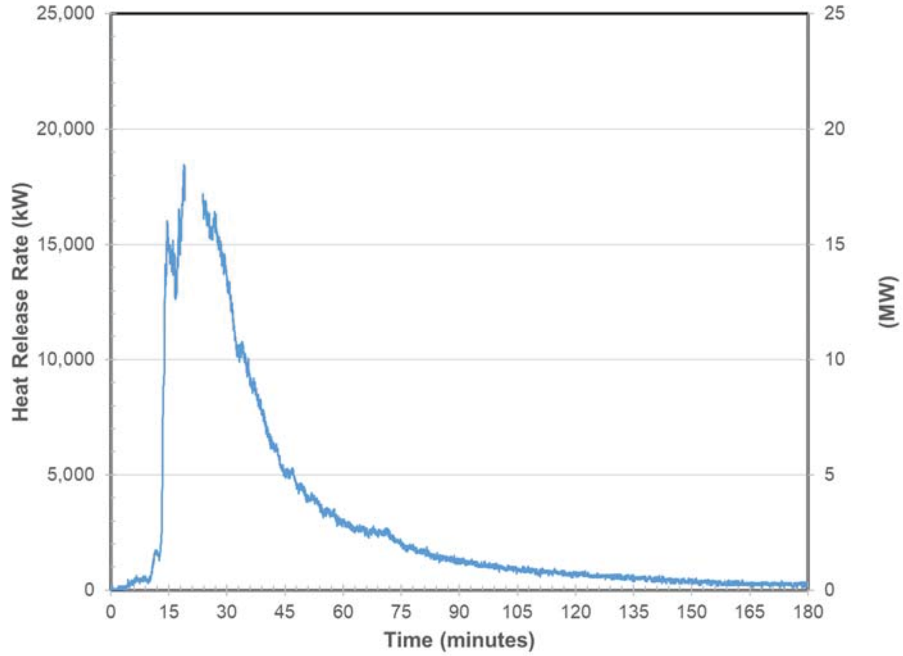

Figure 962. Heat Release Rate

The following chart shows the total heat released from the fire during the experiment. The total heat released is calculated by integrating the heat release rate over time.

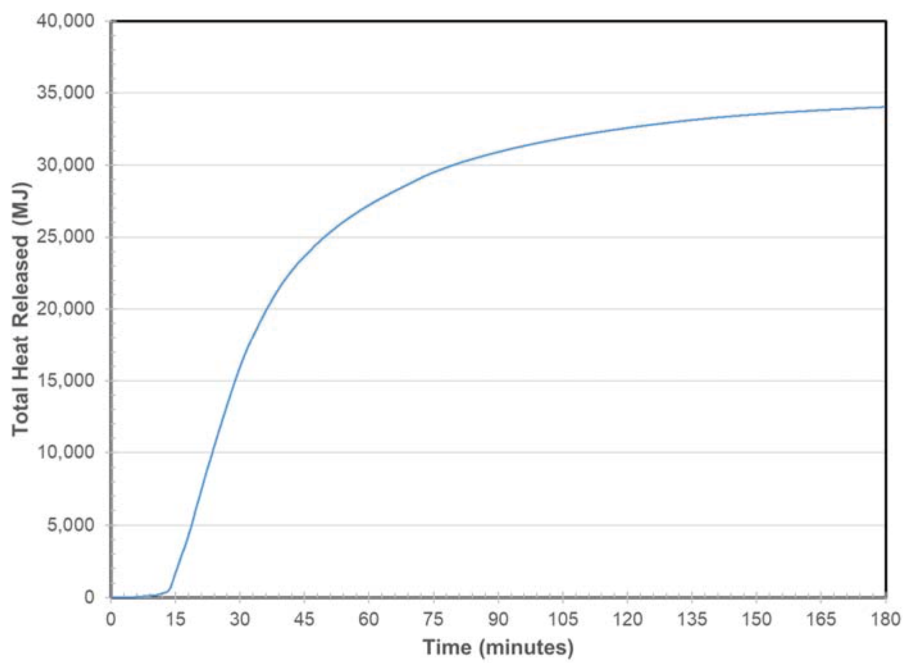

Figure 963. Total Heat Released

Gas Analyzer-Paramagnetic-O_2

The following table provides information about the oxygen sampling locations and the operating parameters of the oxygen analyzers. The "O2 delay time" is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample bypass and analyzer exhaust lines are returned to during the experiment.

Table 18. Oxygen measurement descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	O2 Delay Time (s)	Exhaust Return
1RH-G-A1	5.59	10.36	1.52	11	To Ambient Laboratory
2RH-G-A1	5.59	10.36	1.52	13	To Ambient Laboratory

The following table provides a summary of the oxygen measurement results.

Table 19. Oxygen Measurement Results

Description	O2 Analyzer Full Scale Range (%)	Oxygen Peak Minimum (%)	Oxygen-Average (%)
1RH-G-A1	25.00	19.86	20.48
2RH-G-A1	25.00	20.42	20.65

The following chart presents the oxygen concentrations measured during the test.

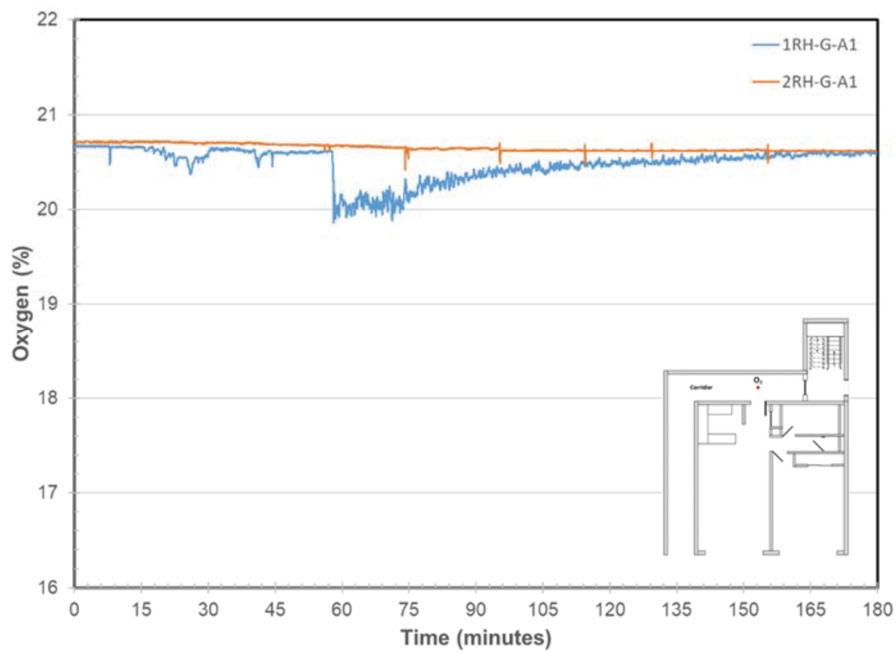

Figure 964. Oxygen Concentration in the Corridor on each Floor

Gas Analyzer-NDIR-CO/CO_2

The following table provides information about the carbon monoxide and carbon dioxide sampling locations and the operating parameters of the analyzers. The "CO/CO2 delay time" is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample by-pass and analyzer exhaust lines are returned to during the experiment.

Table 20. CO and CO2 Measurement Descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	CO/CO2 Delay Time (s)	Exhaust Return
1RH-G-A1	5.59	10.36	1.52	12	To Ambient Laboratory
2RH-G-A1	5.59	10.36	1.52	14	To Ambient Laboratory

The following table provides a summary of the carbon monoxide gas measurement results.

Table 21. CO Measurement Results

Description	CO Analyzer Full Scale Range (mol/mol)	CO Span Gas Value (mol/mol)	Maximum CO Gas Concentration (mol/mol)	CO- Average (mol/mol)
1RH-G-A1	0.05	0.05	0.0004	-0.0001
2RH-G-A1	0.05	0.05	-0.0002	-0.0002

The following table provides a summary of the carbon dioxide gas measurement results.

Table 22. CO2 Measurement Results

Description	CO2 Analyzer Full Scale Range (mol/mol)	CO2 Span Gas Value (mol/mol)	Maximum CO2 Gas Concentration (mol/mol)	CO2- Average (mol/mol)
1RH-G-A1	0.25	0.22	0.0068	0.0011
2RH-G-A1	0.25	0.22	0.0011	0.0008

The following chart shows the carbon monoxide concentration(s) measured during the experiment.

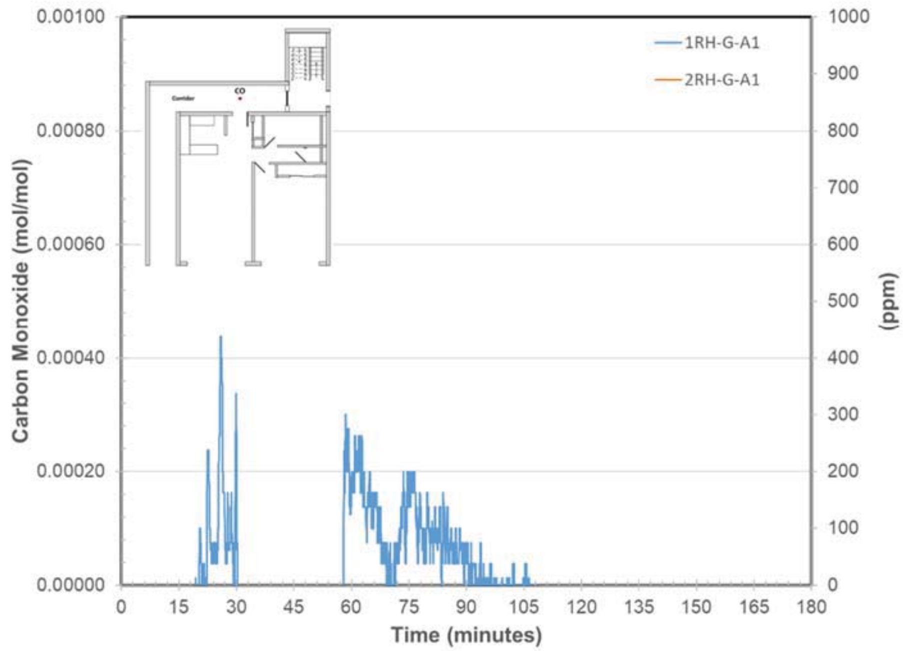

Figure 965. Carbon Monoxide Concentrations in the Corridor on each Floor

The following chart shows the carbon dioxide concentrations measured during the experiment.

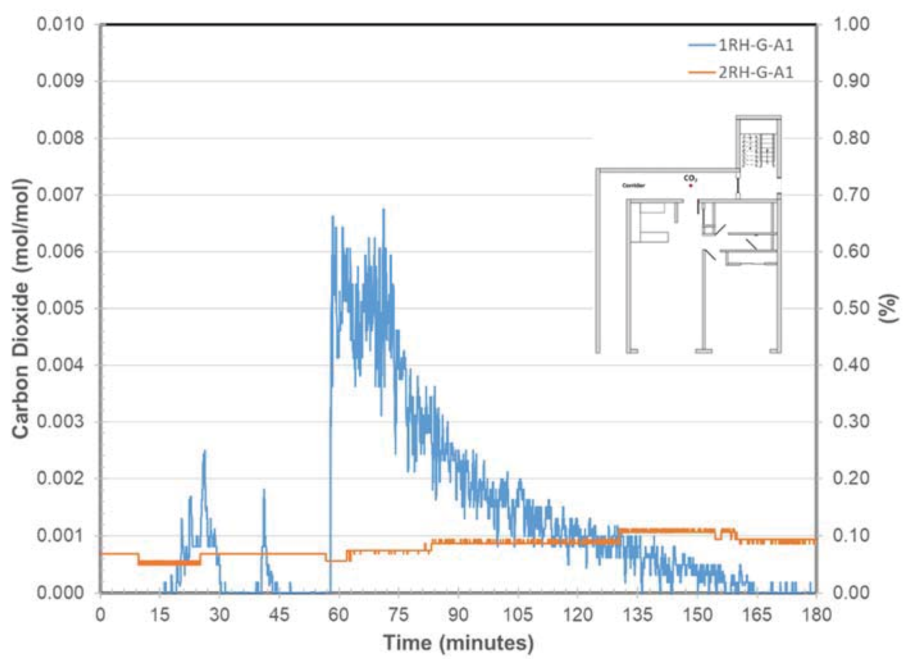

Figure 966. Carbon Dioxide Concentrations in the corridor on each Floor

Videos

The following table provides a description of the videos taken during this experiment.

Table 23. Video Log

Description	Start Time	Video Duration (s)	Filename
IGNITION	09:40:33	10857	193825_20170523_094033_1.mov
LIVING ROOM	09:40:35	10856	193825_20170523_094035_2.mov
BEDROOM	09:40:37	10855	193825_20170523_094037_3.mov
DOOR / KITCHEN	09:40:38	10855	193825_20170523_094038_4.mov
KITCHEN / LIVING ROOM	09:40:40	10854	193825_20170523_094040_5.mov
HALLWAY	09:40:42	10858	193825_20170523_094042_6.mov
STAIRWELL	09:40:43	10858	193825_20170523_094043_7.mov
FLIR	09:40:45	10857	193825_20170523_094045_8.mov
FRONT VIEW HD	09:40:46	10857	193825_20170523_094046_9.mov
LIVING ROOM HD	09:40:48	10856	193825_20170523_094048_10.mov
BEDROOM HD	09:40:50	10855	193825_20170523_094050_11.mov
FRONT VIEW HD_USDA			193825_949698.MOV
LIVING ROOM HD_USDA			193825_949700.MOV
BEDROOM HD_USDA			193825_949702.MOV
IGNITION_USDA			193825_949703.MOV
LIVING ROOM_USDA			193825_949704.MOV
BEDROOM_USDA			193825_949705.MOV
DOOR / KITCHEN_USDA			193825_949706.MOV
KITCHEN / LIVING ROOM_USDA			193825_949707.MOV
HALLWAY_USDA			193825_949708.MOV
STAIRWELL_USDA			193825_949709.MOV
FLIR_USDA			193825_949710.MOV
193825_Master_USDA			193825_949793.MOV

Experiment Photographs

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 967. Pre test 2:24 hr:min, (193825_790372)

Figure 968. Pre test 2:24 hr:min (193825_790373)

Figure 969. Pre test 2:23 hr:min (193825_790374)

Figure 970. Pre test 2:23 hr:min (193825_790375)

Figure 971. Pre test 2:23 hr:min (193825_790376)

Figure 972. Pre test 2:23 hr:min (193825_790377)

Figure 973. Pre test 2:23 hr:min (193825_790378)

Figure 974. Pre test 2:22 hr:min (193825_790379)

Figure 975. Pre test 2:22 hr:min (193825_790380)

Figure 976. Pre test 2:22 hr:min (193825_790381)

Figure 977. Pre test 2:22 hr:min (193825_790382)

Figure 978. Pre test 2:22 hr:min (193825_790383)

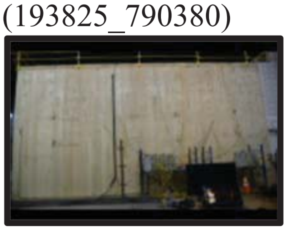

Figure 979. Pre test 2:22 hr:min (193825_790384)

Figure 980. Pre test 2:21 hr:min (193825_790385)

Figure 981. Pre test 2:21 hr:min (193825_790386)

Figure 982. Pre test 2:21 hr:min (193825_790387)


Figure 983. Pre test 2:21 hr:min (193825_790388)


Figure 984. Pre test 2:21 hr:min (193825_790389)


Figure 985. Pre test 2:21 hr:min (193825_790390)


Figure 986. Pre test 2:19 hr:min (193825_790391)

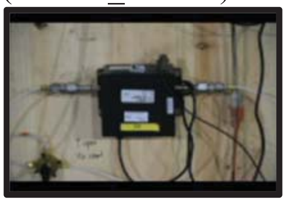
Figure 987. Pre test 2:19 hr:min (193825_790392)


Figure 988. Pre test 2:18 hr:min (193825_790393)


Figure 989. Pre test 2:18 hr:min (193825_790394)

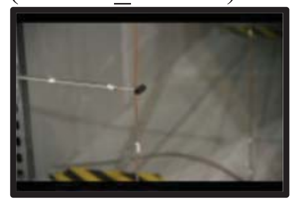
Figure 990. Pre test 2:18 hr:min (193825_790395)


Figure 991. Pre test 2:18 hr:min (193825_790396)

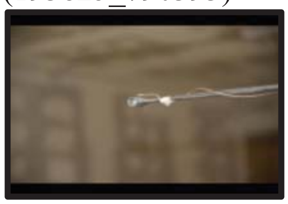
Figure 992. Pre test 2:18 hr:min (193825_790397)


Figure 993. Pre test 2:18 hr:min (193825_790398)

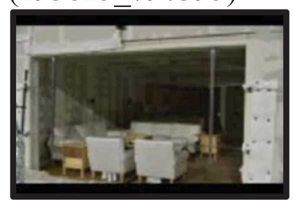
Figure 994. Pre test 2:18 hr:min (193825_790399)


Figure 995. Pre test 2:18 hr:min (193825_790400)


Figure 996. Pre test 2:17 hr:min (193825_790401)


Figure 997. Pre test 2:17 hr:min (193825_790402)

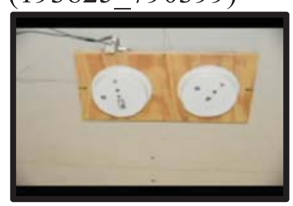
Figure 998. Pre test 2:17 hr:min (193825_790403)


Figure 999. Pre test 2:17 hr:min (193825_790404)


Figure 1000. Pre test 2:17 hr:min (193825_790405)


Figure 1001. Pre test 2:17 hr:min (193825_790406)


Figure 1002. Pre test 2:17 hr:min (193825_790407)


Figure 1003. Pre test 2:17 hr:min (193825_790408)


Figure 1004. Pre test 2:17 hr:min (193825_790409)


Figure 1005. Pre test 2:17 hr:min (193825_790410)


Figure 1006. Pre test 2:17 hr:min (193825_790411)


Figure 1007. Pre test 2:16 hr:min (193825_790412)


Figure 1008. Pre test 2:16 hr:min (193825_790413)


Figure 1009. Pre test 2:16 hr:min (193825_790414)


Figure 1010. Pre test 2:16 hr:min (193825_790415)


Figure 1011. Pre test 2:16 hr:min (193825_790416)

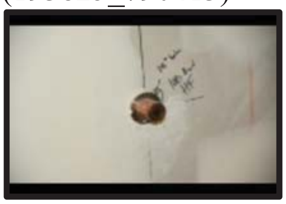
Figure 1012. Pre test 2:16 hr:min (193825_790417)


Figure 1013. Pre test 2:16 hr:min (193825_790418)


Figure 1014. Pre test 2:16 hr:min (193825_790419)


Figure 1015. Pre test 2:16 hr:min (193825_790420)


Figure 1016. Pre test 2:16 hr:min (193825_790421)


Figure 1017. Pre test 2:15 hr:min (193825_790422)


Figure 1018. Pre test 2:13 hr:min (193825_790423)


Figure 1019. Pre test 2:13 hr:min (193825_790424)


Figure 1020. Pre test 2:13 hr:min (193825_790425)


Figure 1021. Pre test 2:13 hr:min (193825_790426)


Figure 1022. Pre test 2:13 hr:min (193825_790427)


Figure 1023. Pre test 2:12 hr:min (193825_790428)


Figure 1024. Pre test 2:12 hr:min (193825_790429)


Figure 1025. Pre test 2:12 hr:min (193825_790430)


Figure 1026. Pre test 2:12 hr:min (193825_790431)


Figure 1027. Pre test 2:12 hr:min (193825_790432)


Figure 1028. Pre test 2:12 hr:min (193825_790433)


Figure 1029. Pre test 2:12 hr:min (193825_790434)


Figure 1030. Pre test 2:12 hr:min (193825_790435)


Figure 1031. Pre test 2:12 hr:min (193825_790436)


Figure 1032. Pre test 2:12 hr:min (193825_790437)


Figure 1033. Pre test 2:12 hr:min (193825_790438)


Figure 1034. Pre test 2:11 hr:min (193825_790439)


Figure 1035. Pre test 2:11 hr:min (193825_790440)


Figure 1036. Pre test 2:11 hr:min (193825_790441)


Figure 1037. Pre test 2:11 hr:min (193825_790442)


Figure 1038. Pre test 2:11 hr:min (193825_790443)


Figure 1039. Pre test 2:11 hr:min (193825_790444)


Figure 1040. Pre test 2:11 hr:min (193825_790445)


Figure 1041. Pre test 2:11 hr:min (193825_790446)


Figure 1042. Pre test 2:11 hr:min (193825_790447)


Figure 1043. Pre test 2:11 hr:min (193825_790448)


Figure 1044. Pre test 2:11 hr:min (193825_790449)


Figure 1045. Pre test 2:08 hr:min (193825_790450)


Figure 1046. Pre test 2:08 hr:min (193825_790451)

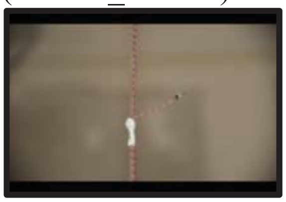
Figure 1047. Pre test 2:08 hr:min (193825_790452)


Figure 1048. Pre test 2:08 hr:min (193825_790453)


Figure 1049. Pre test 2:08 hr:min (193825_790454)


Figure 1050. Pre test 2:08 hr:min (193825_790455)


Figure 1051. Pre test 2:08 hr:min (193825_790456)


Figure 1052. Pre test 2:07 hr:min (193825_790457)


Figure 1053. Pre test 2:07 hr:min (193825_790458)


Figure 1054. Pre test 2:07 hr:min (193825_790459)

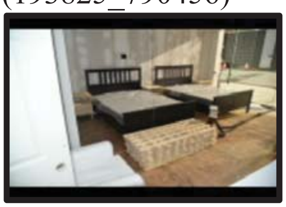
Figure 1055. Pre test 2:07 hr:min (193825_790460)


Figure 1056. Pre test 2:07 hr:min (193825_790461)


Figure 1057. Pre test 2:07 hr:min (193825_790462)


Figure 1058. Pre test 2:07 hr:min (193825_790463)


Figure 1059. Pre test 2:07 hr:min (193825_790464)


Figure 1060. Pre test 2:06 hr:min (193825_790465)


Figure 1061. Pre test 2:06 hr:min (193825_790466)


Figure 1062. Pre test 2:06 hr:min (193825_790467)

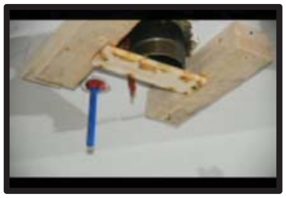
Figure 1063. Pre test 2:06 hr:min (193825_790468)


Figure 1064. Pre test 2:06 hr:min (193825_790469)


Figure 1065. Pre test 2:06 hr:min (193825_790470)


Figure 1066. Pre test 2:05 hr:min (193825_790471)

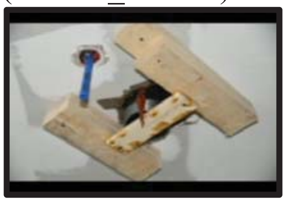
Figure 1067. Pre test 2:05 hr:min (193825_790472)


Figure 1068. Pre test 2:05 hr:min (193825_790473)

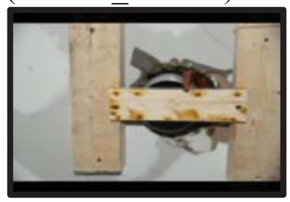
Figure 1069. Pre test 2:05 hr:min (193825_790474)


Figure 1070. Pre test 2:04 hr:min (193825_790475)


Figure 1071. Pre test 2:02 hr:min (193825_790476)


Figure 1072. Pre test 2:02 hr:min (193825_790477)

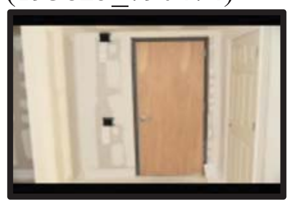
Figure 1073. Pre test 2:00 hr:min (193825_790478)


Figure 1074. Pre test 2:00 hr:min (193825_790479)


Figure 1075. Pre test 2:00 hr:min (193825_790480)


Figure 1076. Pre test 2:00 hr:min (193825_790481)


Figure 1077. Pre test 2:00 hr:min (193825_790482)


Figure 1078. Pre test 2:00 hr:min (193825_790483)


Figure 1079. Pre test 2:00 hr:min (193825_790484)


Figure 1080. Pre test 2:00 hr:min (193825_790485)


Figure 1081. Pre test 2:00 hr:min (193825_790486)


Figure 1082. Pre test 2:00 hr:min (193825_790487)


Figure 1083. Pre test 2:00 hr:min (193825_790488)


Figure 1084. Pre test 2:00 hr:min (193825_790489)


Figure 1085. Pre test 2:00 hr:min (193825_790490)


Figure 1086. Pre test 1:59 hr:min (193825_790491)

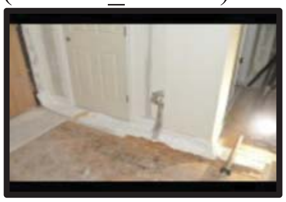
Figure 1087. Pre test 1:59 hr:min (193825_790492)


Figure 1088. Pre test 1:59 hr:min (193825_790493)


Figure 1089. Pre test 1:59 hr:min (193825_790494)


Figure 1090. Pre test 1:59 hr:min (193825_790495)


Figure 1091. Pre test 1:59 hr:min (193825_790496)


Figure 1092. Pre test 1:59 hr:min (193825_790497)


Figure 1093. Pre test 1:59 hr:min (193825_790498)

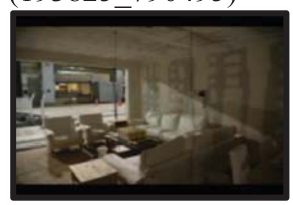
Figure 1094. Pre test 1:59 hr:min (193825_790499)


Figure 1095. Pre test 1:59 hr:min (193825_790500)


Figure 1096. Pre test 1:59 hr:min (193825_790501)

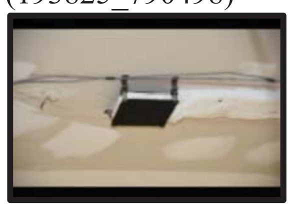
Figure 1097. Pre test 1:59 hr:min (193825_790502)


Figure 1098. Pre test 1:59 hr:min (193825_790503)


Figure 1099. Pre test 1:58 hr:min (193825_790504)


Figure 1100. Pre test 1:58 hr:min (193825_790505)


Figure 1101. Pre test 1:58 hr:min (193825_790506)

Figure 1102. Pre test 1:58 hr:min (193825_790507)


Figure 1103. Pre test 1:58 hr:min (193825_790508)


Figure 1104. Pre test 1:58 hr:min (193825_790509)


Figure 1105. Pre test 1:58 hr:min (193825_790510)


Figure 1106. Pre test 1:58 hr:min (193825_790511)


Figure 1107. Pre test 1:58 hr:min (193825_790512)


Figure 1108. Pre test 1:57 hr:min (193825_790513)


Figure 1109. Pre test 1:57 hr:min (193825_790514)


Figure 1110. Pre test 1:57 hr:min (193825_790515)


Figure 1111. Pre test 1:57 hr:min (193825_790516)


Figure 1112. Pre test 1:57 hr:min (193825_790517)


Figure 1113. Pre test 1:57 hr:min (193825_790518)


Figure 1114. Pre test 1:57 hr:min (193825_790519)


Figure 1115. Pre test 1:57 hr:min (193825_790520)


Figure 1116. Pre test 1:57 hr:min (193825_790521)


Figure 1117. Pre test 1:57 hr:min (193825_790522)


Figure 1118. Pre test 1:57 hr:min (193825_790523)


Figure 1119. Pre test 1:57 hr:min (193825_790524)


Figure 1120. Pre test 1:57 hr:min (193825_790525)


Figure 1121. Pre test 1:56 hr:min (193825_790526)


Figure 1122. Pre test 1:56 hr:min (193825_790527)


Figure 1123. Pre test 1:56 hr:min (193825_790528)


Figure 1124. Pre test 1:56 hr:min (193825_790529)


Figure 1125. Pre test 1:56 hr:min (193825_790530)


Figure 1126. Pre test 1:55 hr:min (193825_790531)


Figure 1127. Pre test 1:54 hr:min (193825_790532)

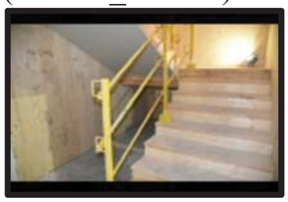
Figure 1128. Pre test 1:54 hr:min (193825_790533)


Figure 1129. Pre test 1:54 hr:min (193825_790534)


Figure 1130. Pre test 1:54 hr:min (193825_790535)

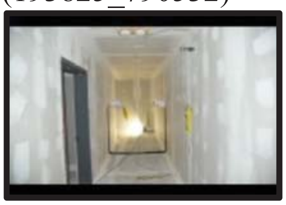
Figure 1131. Pre test 1:54 hr:min (193825_790536)


Figure 1132. Pre test 1:54 hr:min (193825_790537)


Figure 1133. Pre test 1:54 hr:min (193825_790538)


Figure 1134. Pre test 1:54 hr:min (193825_790539)


Figure 1135. Pre test 1:53 hr:min (193825_790540)

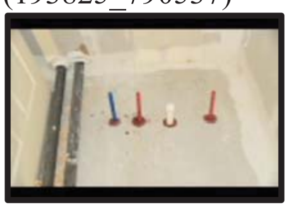
Figure 1136. Pre test 1:53 hr:min (193825_790541)


Figure 1137. Pre test 1:53 hr:min (193825_790542)


Figure 1138. Pre test 1:53 hr:min (193825_790543)


Figure 1139. Pre test 1:53 hr:min (193825_790544)


Figure 1140. Pre test 1:53 hr:min (193825_790545)


Figure 1141. Pre test 1:53 hr:min (193825_790546)

Figure 1142. Pre test 1:53 hr:min (193825_790547)


Figure 1143. Pre test 1:53 hr:min (193825_790548)


Figure 1144. Pre test 1:53 hr:min (193825_790549)


Figure 1145. Pre test 1:53 hr:min (193825_790550)


Figure 1146. Pre test 1:53 hr:min (193825_790551)


Figure 1147. Pre test 1:52 hr:min (193825_790552)


Figure 1148. Pre test 1:52 hr:min (193825_790553)


Figure 1149. Pre test 1:52 hr:min (193825_790554)


Figure 1150. Pre test 1:52 hr:min (193825_790555)


Figure 1151. Pre test 1:52 hr:min (193825_790556)


Figure 1152. Pre test 1:52 hr:min (193825_790557)


Figure 1153. Pre test 1:52 hr:min (193825_790558)

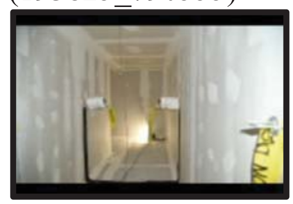
Figure 1154. Pre test 1:52 hr:min (193825_790559)


Figure 1155. Pre test 1:52 hr:min (193825_790560)


Figure 1156. Pre test 1:51 hr:min (193825_790561)


Figure 1157. Pre test 1:48 hr:min (193825_790562)


Figure 1158. Pre test 1:48 hr:min (193825_790563)

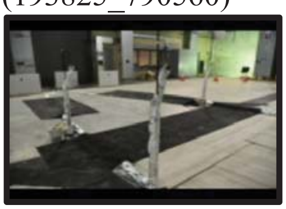
Figure 1159. Pre test 1:48 hr:min (193825_790564)


Figure 1160. Pre test 1:48 hr:min (193825_790565)


Figure 1161. Pre test 1:48 hr:min (193825_790566)


Figure 1162. Pre test 1:03 hr:min (193825_790567)


Figure 1163. Pre test 1:03 hr:min (193825_790568)


Figure 1164. Pre test 1:03 hr:min (193825_790569)


Figure 1165. Pre test 1:03 hr:min (193825_790570)


Figure 1166. Pre test 1:03 hr:min (193825_790571)


Figure 1167. Pre test 1:03 hr:min (193825_790572)


Figure 1168. Pre test 1:03 hr:min (193825_790573)


Figure 1169. Pre test 1:03 hr:min (193825_790574)


Figure 1170. Pre test 1:02 hr:min (193825_790575)


Figure 1171. Pre test 1:02 hr:min (193825_790576)


Figure 1172. Pre test 1:02 hr:min (193825_790577)

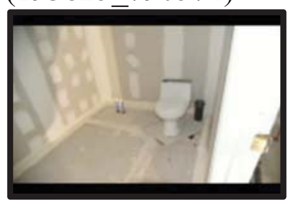
Figure 1173. Pre test 1:01 hr:min (193825_790578)


Figure 1174. Pre test 1:01 hr:min (193825_790579)


Figure 1175. Pre test 1:01 hr:min (193825_790580)


Figure 1176. Pre test 1:01 hr:min (193825_790581)


Figure 1177. Pre test 1:01 hr:min (193825_790582)


Figure 1178. Pre test 43 minutes (193825_790583)


Figure 1179. Pre test 43 minutes (193825_790584)


Figure 1180. Pre test 42 minutes (193825_790585)


Figure 1181. Pre test 42 minutes (193825_790586)


Figure 1182. Pre test 42 minutes (193825_790587)


Figure 1183. Pre test 42 minutes (193825_790588)


Figure 1184. Pre test 42 minutes (193825_790589)


Figure 1185. Pre test 42 minutes (193825_790590)


Figure 1186. Pre test 42 minutes (193825_790591)


Figure 1187. Pre test 42 minutes (193825_790592)


Figure 1188. Pre test 42 minutes (193825_790593)


Figure 1189. Pre test 42 minutes (193825_790594)


Figure 1190. Pre test 42 minutes (193825_790595)

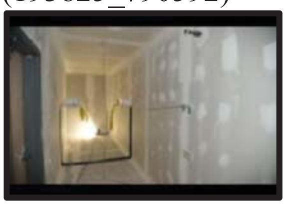
Figure 1191. Pre test 40 minutes (193825_790596)

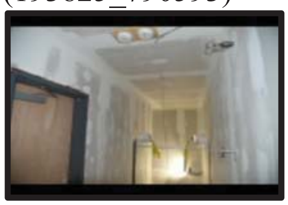
Figure 1192. Pre test 40 minutes (193825_790597)


Figure 1193. Pre test 40 minutes (193825_790598)


Figure 1194. Pre test 37 minutes (193825_790599)


Figure 1195. Pre test 37 minutes (193825_790600)


Figure 1196. Pre test 37 minutes (193825_790601)


Figure 1197. Pre test 37 minutes (193825_790602)


Figure 1198. Pre test 36 minutes (193825_790603)


Figure 1199. Pre test 36 minutes (193825_790604)


Figure 1200. Pre test 36 minutes (193825_790605)


Figure 1201. Pre test 36 minutes (193825_790606)


Figure 1202. Pre test 36 minutes (193825_790607)


Figure 1203. Pre test 35 minutes (193825_790608)


Figure 1204. Pre test 35 minutes (193825_790609)


Figure 1205. Pre test 35 minutes (193825_790610)


Figure 1206. Pre test 35 minutes (193825_790611)


Figure 1207. Pre test 35 minutes (193825_790612)


Figure 1208. Pre test 35 minutes (193825_790613)


Figure 1209. Pre test 35 minutes (193825_790614)


Figure 1210. Pre test 35 minutes (193825_790615)


Figure 1211. Pre test 34 minutes (193825_790616)

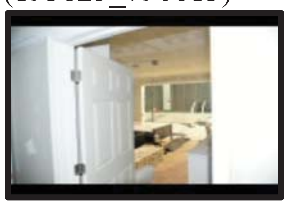
Figure 1212. Pre test 34 minutes (193825_790617)

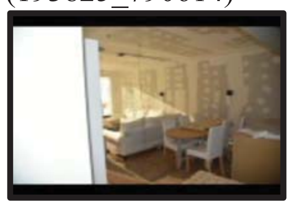
Figure 1213. Pre test 34 minutes (193825_790618)


Figure 1214. Pre test 34 minutes (193825_790619)


Figure 1215. Pre test 34 minutes (193825_790620)


Figure 1216. Pre test 33 minutes (193825_790621)


Figure 1217. Pre test 3 minutes (193825_790622)


Figure 1218. Pre test 3 minutes (193825_790623)


Figure 1219. Pre test 3 minutes (193825_790624)


Figure 1220. Pre test 9 seconds (193825_790625)

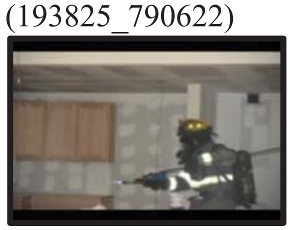
Figure 1221. Pre test 6 seconds (193825_790626)


Figure 1222. 0 seconds (193825_790627)


Figure 1223. 4 seconds (193825_790628)


Figure 1224. 12 seconds (193825_790629)


Figure 1225. 45 seconds (193825_790630)


Figure 1226. 50 seconds (193825_790181)


Figure 1227. 88 seconds (193825_790182)


Figure 1228. 92 seconds (193825_790183)


Figure 1229. 110 seconds (193825_790184)


Figure 1230. 128 seconds (193825_790185)


Figure 1231. 149 seconds (193825_790186)


Figure 1232. 153 seconds (193825_790187)


Figure 1233. 164 seconds (193825_790188)


Figure 1234. 167 seconds (193825_790189)


Figure 1235. 187 seconds (193825_790190)


Figure 1236. 200 seconds (193825_790191)


Figure 1237. 206 seconds (193825_790192)


Figure 1238. 229 seconds (193825_790193)


Figure 1239. 237 seconds (193825_790194)


Figure 1240. 283 seconds (193825_790195)


Figure 1241. 354 seconds (193825_790196)


Figure 1242. 360 seconds (193825_790197)


Figure 1243. 406 seconds (193825_790198)


Figure 1244. 410 seconds (193825_790199)


Figure 1245. 480 seconds (193825_790200)


Figure 1246. 484 seconds (193825_790201)


Figure 1247. 490 seconds (193825_790202)


Figure 1248. 555 seconds (193825_790203)


Figure 1249. 559 seconds (193825_790204)


Figure 1250. 625 seconds (193825_790205)


Figure 1251. 631 seconds (193825_790206)


Figure 1252. 636 seconds (193825_790207)


Figure 1253. 645 seconds (193825_790208)


Figure 1254. 648 seconds (193825_790209)


Figure 1255. 694 seconds (193825_790210)


Figure 1256. 697 seconds (193825_790211)


Figure 1257. 745 seconds (193825_790212)


Figure 1258. 774 seconds (193825_790213)


Figure 1259. 788 seconds (193825_790214)


Figure 1260. 800 seconds (193825_790215)


Figure 1261. 803 seconds (193825_790216)


Figure 1262. 807 seconds (193825_790217)


Figure 1263. 810 seconds (193825_790218)


Figure 1264. 818 seconds (193825_790219)


Figure 1265. 824 seconds (193825_790220)


Figure 1266. 830 seconds (193825_790221)


Figure 1267. 833 seconds (193825_790222)


Figure 1268. 845 seconds (193825_790223)


Figure 1269. 863 seconds (193825_790224)


Figure 1270. 866 seconds (193825_790225)


Figure 1271. 906 seconds (193825_790226)


Figure 1272. 912 seconds (193825_790227)


Figure 1273. 920 seconds (193825_790228)


Figure 1274. 925 seconds (193825_790229)


Figure 1275. 945 seconds (193825_790230)


Figure 1276. 953 seconds (193825_790231)


Figure 1277. 956 seconds (193825_790232)


Figure 1278. 963 seconds (193825_790233)


Figure 1279. 979 seconds (193825_790234)


Figure 1280. 994 seconds (193825_790235)


Figure 1281. 998 seconds (193825_790236)


Figure 1282. 1006 seconds (193825_790237)


Figure 1283. 1011 seconds (193825_790238)


Figure 1284. 1031 seconds (193825_790239)


Figure 1285. 1043 seconds (193825_790240)


Figure 1286. 1053 seconds (193825_790241)


Figure 1287. 1075 seconds (193825_790242)


Figure 1288. 1079 seconds (193825_790243)


Figure 1289. 1119 seconds (193825_790244)


Figure 1290. 1137 seconds (193825_790245)


Figure 1291. 1140 seconds (193825_790246)


Figure 1292. 1176 seconds (193825_790247)


Figure 1293. 1182 seconds (193825_790248)


Figure 1294. 1288 seconds (193825_790249)


Figure 1295. 1299 seconds (193825_790250)


Figure 1296. 1697 seconds (193825_790251)


Figure 1297. 1701 seconds (193825_790252)


Figure 1298. 1711 seconds (193825_790253)


Figure 1299. 1728 seconds (193825_790254)


Figure 1300. 1955 seconds (193825_790255)


Figure 1301. 1959 seconds (193825_790256)


Figure 1302. 1973 seconds (193825_790257)


Figure 1303. 1987 seconds (193825_790258)


Figure 1304. 1995 seconds (193825_790259)


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Figure 1309. 2069 seconds (193825_790264)


Figure 1310. 2073 seconds (193825_790265)


Figure 1311. 2111 seconds (193825_790266)


Figure 1312. 2334 seconds (193825_790267)


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Figure 1314. 2354 seconds (193825_790269)


Figure 1315. 2359 seconds (193825_790270)


Figure 1316. 2364 seconds (193825_790271)


Figure 1317. 2369 seconds (193825_790272)


Figure 1318. 2377 seconds (193825_790273)


Figure 1319. 2381 seconds (193825_790274)


Figure 1320. 2385 seconds (193825_790275)


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Figure 1322. 2395 seconds (193825_790277)


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Figure 1324. 2608 seconds (193825_790279)


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Figure 1331. 2720 seconds (193825_790286)


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Figure 1333. 2778 seconds (193825_790288)


Figure 1334. 2792 seconds (193825_790289)


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Figure 1337. 2828 seconds (193825_790292)


Figure 1338. 2851 seconds (193825_790293)


Figure 1339. 2881 seconds (193825_790294)


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Figure 1348. 3136 seconds (193825_790303)


Figure 1349. 3144 seconds (193825_790304)


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Figure 1351. 3165 seconds (193825_790371)


Figure 1352. 3165 seconds (193825_790756)


Figure 1353. 3182 seconds (193825_790306)


Figure 1354. 3221 seconds (193825_790307)


Figure 1355. 3237 seconds (193825_790308)


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Figure 1362. 3506 seconds (193825_790315)


Figure 1363. 3516 seconds (193825_790316)


Figure 1364. 3523 seconds (193825_790317)


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Figure 1366. 3539 seconds (193825_790319)


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Figure 1370. 5077 seconds (193825_790323)


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Figure 1373. 5097 seconds (193825_790326)


Figure 1374. 5108 seconds (193825_790327)


Figure 1375. 5111 seconds (193825_790328)


Figure 1376. 5136 seconds (193825_790329)


Figure 1377. 5138 seconds (193825_790330)


Figure 1378. 5308 seconds (193825_790331)


Figure 1379. 5311 seconds (193825_790332)


Figure 1380. 5314 seconds (193825_790333)


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Figure 1382. 6369 seconds (193825_790335)


Figure 1383. 6376 seconds (193825_790336)


Figure 1384. 6379 seconds (193825_790337)


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Figure 1386. 6386 seconds (193825_790339)


Figure 1387. 6431 seconds (193825_790340)


Figure 1388. 6435 seconds (193825_790341)


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Figure 1390. 6439 seconds (193825_790343)

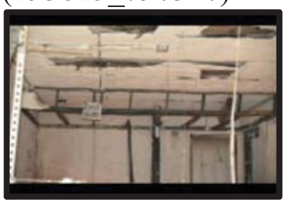
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Figure 1395. 6478 seconds (193825_790348)


Figure 1396. 6482 seconds (193825_790349)


Figure 1397. 6488 seconds (193825_790350)


Figure 1398. 6498 seconds (193825_790351)


Figure 1399. 6504 seconds (193825_790352)


Figure 1400. Post test 2 minutes (193825_790353)


Figure 1401. Post test 2 minutes (193825_790354)


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Figure 1403. Post test 2 minutes (193825_790356)


Figure 1404. Post test 2 minutes (193825_790357)


Figure 1405. Post test 2 minutes (193825_790358)


Figure 1406. Post test 2 minutes (193825_790359)


Figure 1407. Post test 2 minutes (193825_790360)


Figure 1408. Post test 2 minutes (193825_790361)


Figure 1409. Post test 2 minutes (193825_790362)


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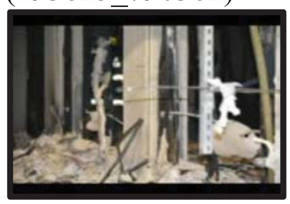
Figure 1412. Post test 3 minutes (193825_790365)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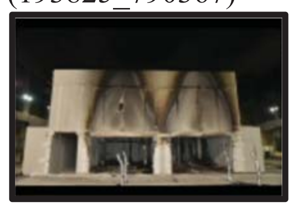
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Figure 1420. Post test 21 minutes (193825_790634)


Figure 1421. Post test 21 minutes (193825_790635)


Figure 1422. Post test 47 minutes (193825_790784)


Figure 1423. Post test 48 minutes (193825_790785)


Figure 1424. Post test 54 minutes (193825_790636)


Figure 1425. Post test 54 minutes (193825_790786)


Figure 1426. Post test 54 minutes (193825_790637)


Figure 1427. Post test 54 minutes (193825_790638)


Figure 1428. Post test 54 minutes (193825_790639)


Figure 1429. Post test 54 minutes (193825_790640)


Figure 1430. Post test 54 minutes (193825_790641)


Figure 1431. Post test 54 minutes (193825_790642)


Figure 1432. Post test 55 minutes (193825_790643)


Figure 1433. Post test 55 minutes (193825_790644)


Figure 1434. Post test 55 minutes (193825_790645)


Figure 1435. Post test 55 minutes (193825_790646)


Figure 1436. Post test 55 minutes (193825_790647)


Figure 1437. Post test 55 minutes (193825_790648)


Figure 1438. Post test 55 minutes (193825_790649)


Figure 1439. Post test 55 minutes (193825_790650)


Figure 1440. Post test 55 minutes (193825_790651)


Figure 1441. Post test 55 minutes (193825_790652)


Figure 1442. Post test 55 minutes (193825_790653)


Figure 1443. Post test 55 minutes (193825_790654)


Figure 1444. Post test 55 minutes (193825_790655)

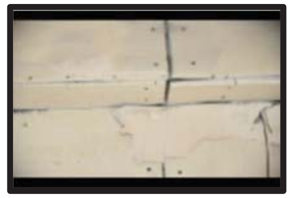
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Figure 1449. Post test 56 minutes (193825_790659)


Figure 1450. Post test 56 minutes (193825_790788)


Figure 1451. Post test 56 minutes (193825_790660)


Figure 1452. Post test 56 minutes (193825_790661)


Figure 1453. Post test 56 minutes (193825_790662)


Figure 1454. Post test 56 minutes (193825_790663)


Figure 1455. Post test 56 minutes (193825_790664)


Figure 1456. Post test 56 minutes (193825_790665)


Figure 1457. Post test 57 minutes (193825_790666)


Figure 1458. Post test 57 minutes (193825_790667)


Figure 1459. Post test 57 minutes (193825_790668)


Figure 1460. Post test 57 minutes (193825_790669)


Figure 1461. Post test 57 minutes (193825_790789)


Figure 1462. Post test 57 minutes (193825_790670)


Figure 1463. Post test 57 minutes (193825_790671)


Figure 1464. Post test 57 minutes (193825_790672)


Figure 1465. Post test 58 minutes (193825_790673)


Figure 1466. Post test 58 minutes (193825_790674)


Figure 1467. Post test 58 minutes (193825_790675)


Figure 1468. Post test 58 minutes (193825_790676)


Figure 1469. Post test 58 minutes (193825_790677)


Figure 1470. Post test 58 minutes (193825_790678)


Figure 1471. Post test 58 minutes (193825_790679)


Figure 1472. Post test 59 minutes (193825_790680)


Figure 1473. Post test 59 minutes (193825_790681)


Figure 1474. Post test 59 minutes (193825_790682)


Figure 1475. Post test 59 minutes (193825_790683)


Figure 1476. Post test 59 minutes (193825_790684)


Figure 1477. Post test 59 minutes (193825_790685)


Figure 1478. Post test 59 minutes (193825_790686)


Figure 1479. Post test 60 minutes (193825_790687)


Figure 1480. Post test 60 minutes (193825_790688)


Figure 1481. Post test 60 minutes (193825_790689)


Figure 1482. Post test 60 minutes (193825_790690)


Figure 1483. Post test 60 minutes (193825_790691)


Figure 1484. Post test 60 minutes (193825_790692)


Figure 1485. Post test 60 minutes (193825_790693)


Figure 1486. Post test 60 minutes (193825_790694)


Figure 1487. Post test 1:01 hr:min (193825_790695)


Figure 1488. Post test 1:01 hr:min (193825_790696)


Figure 1489. Post test 1:01 hr:min (193825_790697)


Figure 1490. Post test 1:01 hr:min (193825_790698)


Figure 1491. Post test 1:01 hr:min (193825_790699)


Figure 1492. Post test 1:01 hr:min (193825_790700)


Figure 1493. Post test 1:01 hr:min (193825_790701)


Figure 1494. Post test 1:02 hr:min (193825_790702)


Figure 1495. Post test 1:02 hr:min (193825_790703)

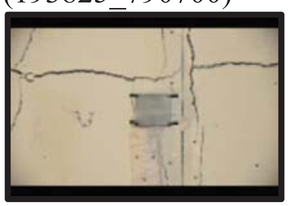
Figure 1496. Post test 1:02 hr:min (193825_790704)


Figure 1497. Post test 1:02 hr:min (193825_790705)


Figure 1498. Post test 1:02 hr:min (193825_790706)

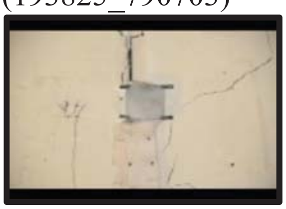
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Figure 1500. Post test 1:02 hr:min (193825_790708)


Figure 1501. Post test 1:02 hr:min (193825_790709)


Figure 1502. Post test 1:03 hr:min (193825_790710)

Figure 1503. Post test 1:03 hr:min (193825_790711)

Figure 1504. Post test 1:03 hr:min (193825_790712)

Figure 1505. Post test 1:03 hr:min (193825_790713)

Figure 1506. Post test 1:03 hr:min (193825_790714)

Figure 1507. Post test 1:04 hr:min (193825_790715)

Figure 1508. Post test 1:04 hr:min (193825_790716)

Figure 1509. Post test 1:04 hr:min (193825_790717)

Figure 1510. Post test 1:04 hr:min (193825_790718)

Figure 1511. Post test 1:04 hr:min (193825_790719)

Figure 1512. Post test 1:04 hr:min (193825_790720)

Figure 1513. Post test 1:04 hr:min (193825_790721)

Figure 1514. Post test 1:04 hr:min (193825_790722)

Figure 1515. Post test 1:04 hr:min (193825_790723)

Figure 1516. Post test 1:05 hr:min (193825_790724)

Figure 1517. Post test 1:05 hr:min (193825_790725)

Figure 1518. Post test 1:05 hr:min (193825_790726)

Figure 1519. Post test 1:05 hr:min (193825_790727)

Figure 1520. Post test 1:05 hr:min (193825_790728)

Figure 1521. Post test 1:05 hr:min (193825_790729)

Figure 1522. Post test 1:05 hr:min (193825_790730)


Figure 1523. Post test 1:05 hr:min (193825_790731)


Figure 1524. Post test 1:06 hr:min (193825_790732)


Figure 1525. Post test 1:06 hr:min (193825_790733)


Figure 1526. Post test 1:06 hr:min (193825_790734)


Figure 1527. Post test 1:06 hr:min (193825_790735)


Figure 1528. Post test 1:06 hr:min (193825_790736)


Figure 1529. Post test 1:06 hr:min (193825_790737)


Figure 1530. Post test 1:07 hr:min (193825_790738)


Figure 1531. Post test 1:07 hr:min (193825_790739)


Figure 1532. Post test 1:07 hr:min (193825_790740)


Figure 1533. Post test 1:07 hr:min (193825_790741)

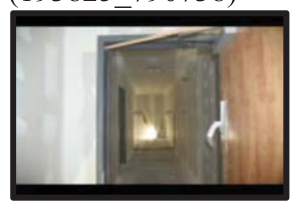
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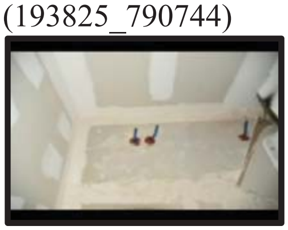
Figure 1535. Post test 1:08 hr:min (193825_790743)


Figure 1536. Post test 1:08 hr:min (193825_790744)


Figure 1537. Post test 1:08 hr:min (193825_790745)


Figure 1538. Post test 1:08 hr:min (193825_790746)


Figure 1539. Post test 1:08 hr:min (193825_790747)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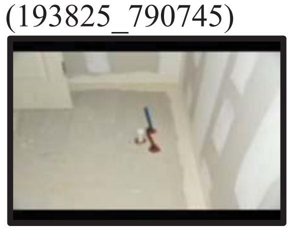
Figure 1541. Post test 1:08 hr:min (193825_790749)


Figure 1542. Post test 1:09 hr:min (193825_790750)


Figure 1543. Post test 1:09 hr:min (193825_790751)


Figure 1544. Post test 1:09 hr:min (193825_790752)


Figure 1545. Post test 1:09 hr:min (193825_790753)


Figure 1546. Post test 1:10 hr:min (193825_790754)


Figure 1547. Post test 1:10 hr:min (193825_790755)


Figure 1548. Post test 1:10 hr:min (193825_790757)


Figure 1549. Post test 1:10 hr:min (193825_790758)


Figure 1550. Post test 1:10 hr:min (193825_790759)


Figure 1551. Post test 1:11 hr:min (193825_790760)


Figure 1552. Post test 1:11 hr:min (193825_790761)


Figure 1553. Post test 1:11 hr:min (193825_790762)


Figure 1554. Post test 1:11 hr:min (193825_790763)


Figure 1555. Post test 1:11 hr:min (193825_790764)


Figure 1556. Post test 1:11 hr:min (193825_790765)


Figure 1557. Post test 1:11 hr:min (193825_790766)


Figure 1558. Post test 1:11 hr:min (193825_790767)


Figure 1559. Post test 1:11 hr:min (193825_790768)


Figure 1560. Post test 1:12 hr:min (193825_790769)


Figure 1561. Post test 1:12 hr:min (193825_790770)


Figure 1562. Post test 1:12 hr:min (193825_790771)


Figure 1563. Post test 1:12 hr:min (193825_790772)


Figure 1564. Post test 1:12 hr:min (193825_790773)


Figure 1565. Post test 1:12 hr:min (193825_790774)


Figure 1566. Post test 1:12 hr:min (193825_790775)


Figure 1567. Post test 1:12 hr:min (193825_790776)


Figure 1568. Post test 1:12 hr:min (193825_790777)


Figure 1569. Post test 1:12 hr:min (193825_790778)


Figure 1570. Post test 1:12 hr:min (193825_790779)


Figure 1571. Post test 1:12 hr:min (193825_790780)


Figure 1572. Post test 1:12 hr:min (193825_790781)


Figure 1573. Post test 1:12 hr:min (193825_790782)


Figure 1574. Post test 1:12 hr:min (193825_790783)


Figure 1575. Post test 1:40 hr:min (193825_790790)


Figure 1576. Post test 1:40 hr:min (193825_790791)


Figure 1577. Post test 1:40 hr:min (193825_790792)


Figure 1578. Post test 1:41 hr:min (193825_790793)


Figure 1579. Post test 1:41 hr:min (193825_790794)


Figure 1580. Post test 1:41 hr:min (193825_790795)


Figure 1581. Post test 1:42 hr:min (193825_790796)


Figure 1582. Post test 1:42 hr:min (193825_790797)

Figure 1583. Post test 1:43 hr:min (193825_790798)

Figure 1584. Post test 1:43 hr:min (193825_790799)

Figure 1585. Post test 1:44 hr:min (193825_790800)

References

1 ATF Fire Research Laboratory, CLT Project Report, 17OA0001 Sub 1, December 22, 2017

Appendix 2—Cross-Laminated Timber Project Test 2 Results

Fire Research Laboratory
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES
6000 Ammendale Road
Beltsville, MD 20705-1250
Phone: 202-648-6200

U. S. Department of Justice

Test Record

ASCLD/LAB–*International* Testing Accreditation Certificate ALI-217-T

Title	CLT Project - Test 2 Results		
Test Type	Custom		
Lab Number	17OA0001-1	**Author**	David R. Tucholski
Test Date	5/31/17	**Test Number**	2 of 5

Introduction

The following provides the data for the second test of the CLT Project. The test was conducted on the second floor of the test structure. A portion of the CLT ceiling in the bedroom and living room were exposed. All other CLT surfaces were encapsulated with two layers of (5/8 inch) Type X gypsum wallboard. The two large openings in Wall A were not covered with glass and remained opened. Fire sprinklers were not installed in the structure. The test duration was 4 hours. Additional details related to the test structure, instrumentation, and experimental procedures are provided in the main CLT Project report [1].

Table of Contents

Instrumentation Location

The following figure describes the nomenclature used to identify the various instrumentation and their locations.

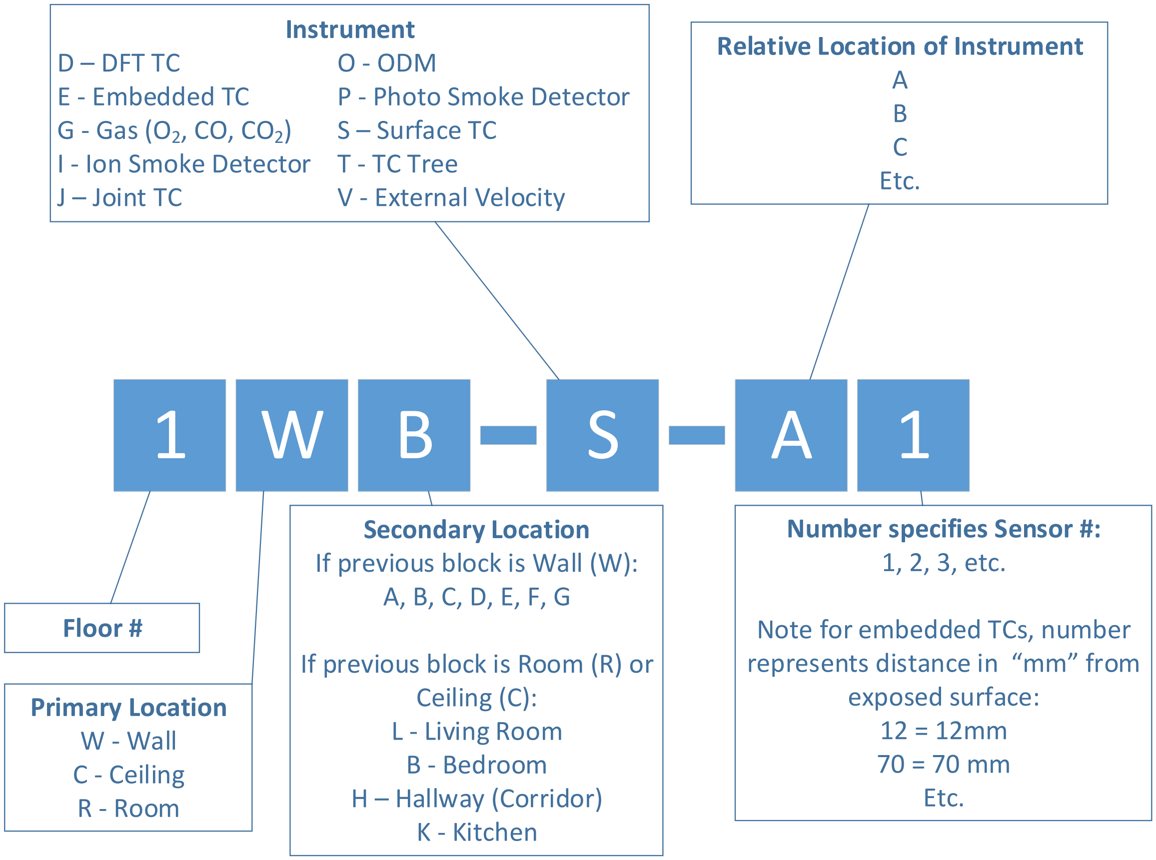

Figure 1. Nomenclature of Instrumentation Location

The example shown in Figure 1 is for a thermocouple located on the surface of Wall B on the first floor. It is the first thermocouple at location A. The exact location of each instrument is based on a Cartesian coordinate system (X, Y, Z). Location X and Location Y are located in the horizontal plane. Location Z is the vertical distance from the floor to the centerline of the instrument. Drawings showing the instrumentation locations and the associated coordinate systems are provided in the main CLT Project report [1].

Results for Test 2 (ID 193871)

Experiment Events

The following table lists selected events that occurred during the experiment.

Table 1. Experiment Events

Description	Time (s)	Time (hh:mm:ss)
Flashover Living Room	702	00:11:42
Flashover Bedroom	1040	00:17:20
FPC Offline	1267	00:21:07
FPC Online	1417	00:23:37
Flames In Hallway at Apartment Door	1838	00:30:38
Apartment Door Fails Completely	3839	01:03:59
FPC Offline	9315	02:35:15
FPC Online	9401	02:36:41
Gas Cart Offline	9508	02:38:28
Gas Cart Online	9583	02:39:43

Laboratory Conditions

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 2. Lab Conditions Description

Description	Manufacturer	Model
LBR_01	OMEGA	IBTHP-5

The following table provides a summary of the initial conditions at the start of the experiment(s).The 'Description' column shows the location of the measurements.

Table 3. Ambient Laboratory Condition Summary

Description	Initial (C)	Initial (kPa)	Initial (%)
LBR_01	21	101	80

Thermocouples

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement. The "Z" location is the height of the thermocouple above the floor. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 4. Thermocouple Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WB-J-A1	0.102	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-A2	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-B1	0.102	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-B2	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-C1	0.102	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-C2	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-D1	0.102	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-D2	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-E1	0.102	5.715	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F1	0.102	6.858	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F2	0.000	6.858	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-G1	0.102	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-G2	0.000	8.001	2.921	Type K, Glass Ins., 24 AWG wire
2WB-S-A1	0.032	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-A2	0.016	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-A3	0.000	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A035	0.035	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A012	0.012	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A058	0.058	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A023	0.023	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A105	0.105	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A070	0.070	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-B1	0.032	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-B2	0.016	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-B3	0.000	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B035	0.035	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B012	0.012	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B058	0.058	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B023	0.023	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B105	0.105	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B047	0.047	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B070	0.070	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-C1	0.032	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-C2	0.016	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-S-C3	0.000	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C035	0.035	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C012	0.012	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C058	0.058	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C023	0.023	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C105	0.105	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C047	0.047	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C070	0.070	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-E1	0.088	5.715	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-F1	0.088	6.858	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-G1	0.088	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A1	0.076	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A2	0.000	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A3	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WD-J-B1	0.076	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B2	0.000	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B3	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-C1	0.076	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C2	0.000	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C3	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-D1	0.076	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D2	0.000	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D3	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
2WD-S-A1	0.025	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-S-A2	0.025	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-S-A3	0.000	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A105	0.105	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A012	0.012	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A070	0.070	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A023	0.023	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A058	0.058	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A035	0.035	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A047	0.047	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-A1	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-B1	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-C1	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-D1	1.524	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-E1	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-A1	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-B1	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-C1	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-D1	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-E1	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2RL-T-A0	2.210	2.286	0.152	Type K, Glass Ins., 24 AWG wire
2RL-T-A2	2.210	2.286	0.610	Type K, Glass Ins., 24 AWG wire
2RL-T-A4	2.210	2.286	1.219	Type K, Glass Ins., 24 AWG wire
2RL-T-A6	2.210	2.286	1.829	Type K, Glass Ins., 24 AWG wire
2RL-T-A8	2.210	2.286	2.438	Type K, Glass Ins., 24 AWG wire
2RL-T-A9	2.210	2.286	2.718	Type K, Glass Ins., 24 AWG wire
2RL-T-B0	2.210	3.810	0.152	Type K, Glass Ins., 24 AWG wire
2RL-T-B2	2.210	3.810	0.610	Type K, Glass Ins., 24 AWG wire
2RL-T-B4	2.210	3.810	1.219	Type K, Glass Ins., 24 AWG wire
2RL-T-B6	2.210	3.810	1.829	Type K, Glass Ins., 24 AWG wire
2RL-T-B8	2.210	3.810	2.438	Type K, Glass Ins., 24 AWG wire
2RL-T-B9	2.210	3.810	2.718	Type K, Glass Ins., 24 AWG wire
2RK-T-A0	2.210	7.620	0.152	Type K, Glass Ins., 24 AWG wire
2RK-T-A2	2.210	7.620	0.610	Type K, Glass Ins., 24 AWG wire
2RK-T-A4	2.210	7.620	1.219	Type K, Glass Ins., 24 AWG wire
2RK-T-A6	2.210	7.620	1.829	Type K, Glass Ins., 24 AWG wire
2RK-T-A8	2.210	7.620	2.413	Type K, Glass Ins., 24 AWG wire
2RB-T-A0	1.981	1.981	0.152	Type K, Glass Ins., 24 AWG wire
2RB-T-A2	1.981	1.981	0.610	Type K, Glass Ins., 24 AWG wire
2RB-T-A4	1.981	1.981	1.219	Type K, Glass Ins., 24 AWG wire
2RB-T-A6	1.981	1.981	1.829	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2RB-T-A8	1.981	1.981	2.438	Type K, Glass Ins., 24 AWG wire
2RB-T-A9	1.981	1.981	2.718	Type K, Glass Ins., 24 AWG wire
2RB-T-B0	1.981	3.505	0.152	Type K, Glass Ins., 24 AWG wire
2RB-T-B2	1.981	3.505	0.610	Type K, Glass Ins., 24 AWG wire
2RB-T-B4	1.981	3.505	1.219	Type K, Glass Ins., 24 AWG wire
2RB-T-B6	1.981	3.505	1.829	Type K, Glass Ins., 24 AWG wire
2RB-T-B8	1.981	3.505	2.438	Type K, Glass Ins., 24 AWG wire
2RB-T-B9	1.981	3.505	2.718	Type K, Glass Ins., 24 AWG wire
2WG-T-A0	4.572	1.829	0.152	Type K, Glass Ins., 24 AWG wire
2WG-T-A2	4.572	1.829	0.610	Type K, Glass Ins., 24 AWG wire
2WG-T-A4	4.572	1.829	1.219	Type K, Glass Ins., 24 AWG wire
2WG-T-A6	4.572	1.829	1.829	Type K, Glass Ins., 24 AWG wire
2WG-T-A8	4.572	1.829	2.286	Type K, Glass Ins., 24 AWG wire
2WG-T-B0	4.572	3.810	0.152	Type K, Glass Ins., 24 AWG wire
2WG-T-B4	4.572	3.810	1.219	Type K, Glass Ins., 24 AWG wire
2WG-T-B6	4.572	3.810	1.829	Type K, Glass Ins., 24 AWG wire
2WG-T-B8	4.572	3.810	2.286	Type K, Glass Ins., 24 AWG wire
2RH-T-A0	0.762	1.067	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-A2	0.762	1.067	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-A4	0.762	1.067	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-A6	0.762	1.067	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-A8	0.762	1.067	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-A9	0.762	1.067	2.718	Type K, Glass Ins., 24 AWG wire
2RH-T-B0	4.115	10.363	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-B2	4.115	10.363	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-B4	4.115	10.363	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-B6	4.115	10.363	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-B8	4.115	10.363	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-B9	4.115	10.363	2.718	Type K, Glass Ins., 24 AWG wire
2RH-T-C0	8.230	10.363	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-C2	8.230	10.363	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-C4	8.230	10.363	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-C6	8.230	10.363	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-C8	8.230	10.363	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-C9	8.230	10.363	2.718	Type K, Glass Ins., 24 AWG wire
2WB-D-A1	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-A2	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-B1	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-B2	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-C1	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-C2	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
2WD-D-A1	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
2WD-D-A2	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
2CL-D-A1	1.372	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-D-A2	1.372	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2WC-D-A1	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
2WC-D-A2	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
2WC-D-B1	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
2WC-D-B2	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
2WG-D-A1	4.502	3.048	1.524	Type K, Glass Ins., 24 AWG wire
2WG-D-A2	4.502	3.048	1.524	Type K, Glass Ins., 24 AWG wire
2WA-T-A0	0.762	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-A4	0.762	0.000	1.219	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2WA-T-A6	0.762	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-A8	0.762	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-A9	0.762	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-B0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-B4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-B6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-B8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-B9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-C0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-C4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-C6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-C8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-C9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
3WA-S-A3	0.762	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-A1	0.762	0.000	0.305	Type K, Glass Ins., 24 AWG wire
3WA-S-B3	1.829	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-B1	1.829	0.000	0.305	Type K, Glass Ins., 24 AWG wire
3WA-S-C3	1.829	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-C1	1.829	0.000	0.305	Type K, Glass Ins., 24 AWG wire
2CL-E-C023	2.286	2.972	0.023	Type K, Glass Ins., 24 AWG wire
2CL-E-C035	2.286	2.972	0.035	Type K, Glass Ins., 24 AWG wire
2CL-E-C047	2.286	2.972	0.047	Type K, Glass Ins., 24 AWG wire
2CL-E-C058	2.286	2.972	0.058	Type K, Glass Ins., 24 AWG wire
2CL-E-C070	2.286	2.972	0.070	Type K, Glass Ins., 24 AWG wire
2CL-E-C105	2.286	2.972	0.105	Type K, Glass Ins., 24 AWG wire

The following table provides a summary of the temperature results. The “Initial” column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the “Max” column. The remaining columns provide the calculated maximum average temperatures.

Table 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-J-A1	19.9	36.9	36.9	36.9	36.8	36.8
1WB-J-A2	20.2	81.1	81.0	80.9	80.5	80.0
1WB-J-B1	20.2	37.7	37.7	37.7	37.6	37.6
1WB-J-B2	19.9	121.3	120.5	119.5	118.6	118.0
1WB-J-C1	19.7	46.3	46.2	46.2	46.2	46.2
1WB-J-C2	20.4	93.9	93.8	93.7	93.6	93.5
1WB-J-D1	19.7	34.3	34.3	34.2	34.1	34.0
1WB-J-D2	20.5	91.7	91.6	91.6	91.5	91.3
1WB-J-E1	19.7	42.4	42.4	42.3	42.3	42.3
1WB-J-F1	19.6	40.8	40.7	40.7	40.7	40.6

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-J-F2	19.6	208.5	208.4	208.4	208.4	208.4
1WB-J-G1	20.4	67.0	67.0	66.9	66.8	66.8
1WB-J-G2	19.9	320.7	320.6	320.5	319.3	316.8
2WB-S-A1	20.5	1083.0	1044.4	1036.3	992.2	923.9
2WB-S-A2	20.8	399.0	398.8	398.4	391.3	375.0
2WB-S-A3	20.9	114.6	114.5	114.5	114.5	114.4
2WB-E-A035	21.2	67.1	67.0	67.0	67.0	67.0
2WB-E-A012	20.7	85.2	85.1	85.1	85.1	85.1
2WB-E-A058	20.7	52.9	52.8	52.8	52.8	52.8
2WB-E-A023	20.6	73.5	73.4	73.4	73.4	73.4
2WB-E-A105	20.5	34.4	34.4	34.4	34.2	34.1
2WB-E-A070	20.5	45.1	45.1	45.1	45.0	44.9
2WB-S-B1	20.5	1107.3	1063.6	1034.3	987.3	920.1
2WB-S-B2	21.0	420.8	420.5	420.4	419.4	416.7
2WB-S-B3	20.6	130.7	130.7	130.6	130.5	130.4
2WB-E-B035	20.7	67.7	67.7	67.7	67.6	67.6
2WB-E-B012	20.8	91.6	91.5	91.5	91.5	91.5
2WB-E-B058	20.8	52.2	52.2	52.2	52.1	52.1
2WB-E-B023	20.8	79.2	79.1	79.1	79.1	79.1
2WB-E-B105	21.0	32.2	32.2	32.2	32.1	31.9
2WB-E-B047	21.0	58.3	58.3	58.3	58.2	58.2
2WB-E-B070	21.0	27.5	27.5	27.5	27.5	27.4
2WB-S-C1	20.6	1032.7	1021.4	1014.1	881.1	761.0
2WB-S-C2	20.6	183.7	183.4	182.6	175.4	174.0
2WB-S-C3	20.7	100.8	100.7	100.7	100.7	100.7
2WB-E-C035	20.9	57.9	57.8	57.8	57.7	57.7
2WB-E-C012	21.8	87.5	87.5	87.5	87.4	87.0
2WB-E-C058	20.9	45.1	45.0	45.0	44.9	44.7
2WB-E-C023	21.4	66.7	66.7	66.7	66.7	66.7
2WB-E-C105	21.0	29.9	29.9	29.8	29.7	29.6
2WB-E-C047	21.2	51.8	51.8	51.8	51.7	51.6
2WB-E-C070	21.0	38.1	38.0	37.9	37.9	37.7
2WB-J-A1	21.1	38.2	38.0	38.0	37.8	37.7
2WB-J-B1	21.0	92.9	92.6	92.5	89.1	81.4
2WB-J-C1	20.7	41.8	41.8	41.8	41.7	41.5
2WB-J-D1	20.8	48.1	48.0	48.0	48.0	47.9
2WB-J-E1	20.9	40.3	40.2	40.2	40.1	40.0
2WB-J-F1	21.0	90.2	90.0	89.8	87.6	81.5
2WB-J-G1	21.1	38.2	38.2	38.1	38.0	37.8
1WD-J-A1	20.0	23.2	23.1	23.1	23.0	22.9
1WD-J-A2	20.5	26.1	26.0	26.0	25.9	25.7
1WD-J-A3	20.0	135.1	135.0	134.8	134.0	133.8
1WD-J-B1	19.4	24.2	24.1	24.1	24.0	23.9
1WD-J-B2	19.7	66.6	66.5	66.5	66.5	66.4
1WD-J-B3	19.9	107.0	106.7	106.7	106.0	105.8
1WD-J-C1	19.4	35.3	35.3	35.3	35.1	34.9
1WD-J-C2	19.7	45.7	45.6	45.5	45.4	45.3
1WD-J-C3	20.2	128.8	128.7	128.6	128.1	127.2
1WD-J-D1	19.7	75.8	75.5	75.4	75.1	74.6
1WD-J-D2	20.0	79.2	79.2	79.2	78.9	78.6
1WD-J-D3	20.6	103.4	103.3	103.2	102.6	101.9
2WD-S-A1	20.3	1017.0	992.2	986.7	937.9	875.6

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2WD-S-A2	20.5	288.2	288.0	287.9	286.6	282.2
2WD-S-A3	20.6	143.2	143.2	143.2	141.6	135.4
2WD-E-A105	20.5	29.3	29.2	29.2	29.2	29.0
2WD-E-A012	21.3	78.7	78.6	78.6	78.6	78.6
2WD-E-A070	20.5	40.9	40.8	40.8	40.7	40.5
2WD-E-A023	21.0	69.1	69.0	68.9	68.9	68.9
2WD-E-A058	20.7	47.4	47.3	47.2	47.2	47.1
2WD-E-A035	20.8	60.3	60.3	60.2	60.2	60.2
2WD-E-A047	20.7	53.1	53.1	53.1	53.1	53.0
2WD-J-A1	21.0	39.8	39.7	39.7	39.6	39.6
2WD-J-B1	20.9	92.6	91.9	91.8	91.5	91.3
2WD-J-C1	20.8	32.7	32.6	32.6	32.5	32.4
2WD-J-D1	20.9	90.1	90.1	90.1	89.7	88.9
2CL-S-A1	20.3	1034.3	1019.2	1010.2	980.4	962.1
2CL-S-B1	20.1	1043.6	1025.6	1017.3	986.6	963.3
2CL-S-C1	21.0	1020.4	1001.3	991.2	961.5	942.9
2CL-S-D1	20.5	1038.7	1027.3	1025.9	998.7	968.4
2CL-S-E1	20.7	1024.2	1014.6	1012.5	987.1	958.2
2CB-S-A1	20.3	998.0	979.5	973.4	960.4	946.8
2CB-S-B1	20.3	989.9	974.7	969.9	959.7	945.7
2CB-S-C1	20.7	914.0	892.0	868.4	514.1	322.3
2CB-S-D1	20.4	1032.8	1019.5	1017.3	1004.8	968.4
2CB-S-E1	20.6	1029.0	1018.8	1017.4	1003.4	967.2
2RL-T-A0	20.1	1015.3	992.8	983.1	960.2	935.8
2RL-T-A2	20.1	1061.3	1008.3	1005.8	979.8	940.8
2RL-T-A4	20.0	1253.8	1040.7	1009.7	959.7	936.5
2RL-T-A6	20.0	1061.0	820.8	679.2	294.8	178.4
2RL-T-A8	20.1	934.7	887.7	793.9	397.8	252.3
2RL-T-A9	20.2	855.6	812.3	684.0	301.9	180.8
2RL-T-B0	20.0	1060.0	1049.4	1041.8	1004.8	951.6
2RL-T-B2	20.0	1040.3	1033.9	1024.3	993.4	952.0
2RL-T-B4	19.9	1043.9	1036.2	1029.0	994.6	945.5
2RL-T-B6	20.2	1172.7	1046.1	1037.5	1005.3	955.9
2RL-T-B8	20.7	1190.1	1051.0	1046.4	1012.9	959.1
2RL-T-B9	20.5	1084.2	1050.7	1045.5	1009.9	955.1
2RK-T-A0	21.0	910.2	842.9	838.4	795.9	724.5
2RK-T-A2	20.7	919.7	902.5	895.2	705.1	660.0
2RK-T-A4	20.8	981.4	943.3	904.9	737.7	718.1
2RK-T-A6	20.7	1097.7	1068.0	1021.5	781.9	630.0
2RK-T-A8	21.2	1086.0	1064.4	1005.6	878.9	856.5
2RB-T-A0	20.1	1112.5	1076.0	1051.8	1004.9	960.2
2RB-T-A2	20.0	1150.3	1119.9	1098.4	1013.8	957.6
2RB-T-A4	20.0	1275.0	1203.5	1162.6	1043.4	980.3
2RB-T-A6	20.0	1261.0	1205.8	1173.9	1042.9	978.1
2RB-T-A8	20.2	1377.5	1216.7	1161.1	1046.4	976.1
2RB-T-A9	20.2	1348.4	1158.5	1108.7	1020.1	963.5
2RB-T-B0	20.0	985.4	958.0	951.0	917.5	885.3
2RB-T-B2	19.9	1012.5	978.4	964.2	930.1	907.4
2RB-T-B4	19.8	990.3	976.7	970.2	939.2	922.5
2RB-T-B6	19.9	1010.3	981.5	968.8	940.1	925.3
2RB-T-B8	20.2	1012.1	983.5	970.0	935.1	923.9
2RB-T-B9	20.8	1007.3	982.9	966.4	935.0	919.8

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2WG-T-A0	20.6	947.4	944.4	942.4	901.4	834.8
2WG-T-A2	20.5	955.2	952.8	951.5	908.1	838.6
2WG-T-A4	20.5	945.5	941.0	938.5	900.5	842.8
2WG-T-A6	20.4	1037.5	1026.0	1012.8	942.3	919.3
2WG-T-A8	20.4	1060.2	1044.9	1024.9	935.8	916.8
2WG-T-B0	20.2	949.7	948.3	946.4	910.9	847.4
2WG-T-B4	20.2	959.0	954.8	952.5	913.7	856.1
2WG-T-B6	20.3	958.8	955.9	953.2	915.2	869.1
2WG-T-B8	20.3	981.9	950.4	935.3	904.1	872.8
2RH-T-A0	20.5	34.7	34.6	34.5	33.7	33.2
2RH-T-A2	20.3	34.9	34.6	34.3	33.8	33.2
2RH-T-A4	20.3	34.5	34.1	33.9	33.1	32.7
2RH-T-A6	20.4	70.2	69.4	68.2	66.2	63.9
2RH-T-A8	20.5	141.1	138.3	137.3	133.0	125.3
2RH-T-A9	20.5	143.4	142.2	141.6	135.6	127.4
2RH-T-B0	20.5	36.6	35.5	35.4	34.7	33.5
2RH-T-B2	20.5	46.1	45.6	45.4	43.7	41.4
2RH-T-B4	20.5	56.4	54.0	52.9	50.3	49.5
2RH-T-B6	20.5	95.4	93.1	92.5	90.9	88.5
2RH-T-B8	20.5	330.4	321.1	316.9	283.1	235.0
2RH-T-B9	20.5	366.5	352.9	343.7	297.8	242.4
2RH-T-C0	20.5	39.4	38.7	38.4	37.6	36.4
2RH-T-C2	20.5	43.5	42.0	41.7	40.5	39.1
2RH-T-C4	20.5	91.3	85.5	82.4	71.5	68.8
2RH-T-C6	20.8	120.0	119.0	117.9	114.5	110.3
2RH-T-C8	21.3	246.8	232.4	232.2	221.4	198.7
2RH-T-C9	21.0	231.6	215.0	213.4	206.6	187.1
2WB-D-A1	20.5	1066.7	1063.9	1060.4	1007.6	962.5
2WB-D-A2	20.4	947.3	945.6	942.9	898.1	878.0
2WB-D-B1	20.4	1083.0	1079.2	1074.9	1022.3	959.0
2WB-D-B2	20.2	1006.2	1005.4	1003.9	961.2	901.0
2WB-D-C1	20.2	1022.6	1020.2	1016.3	937.1	855.9
2WB-D-C2	20.1	932.0	931.1	929.2	875.8	804.4
2WD-D-A1	20.1	1041.9	1039.1	1036.9	997.5	930.5
2WD-D-A2	20.2	928.8	927.8	924.9	881.2	819.4
2CL-D-A1	19.9	1343.3	1227.3	1201.6	1052.4	1021.5
2CL-D-A2	20.0	1360.4	1287.6	1249.8	1066.9	1032.0
2WC-D-A1	20.4	838.5	837.7	835.5	794.6	734.1
2WC-D-A2	20.2	919.1	918.4	916.8	858.1	793.0
2WC-D-B1	20.4	933.7	932.7	930.5	884.9	830.1
2WC-D-B2	20.5	800.7	800.4	799.8	783.2	742.0
2WG-D-A1	20.1	1047.6	1042.5	1039.2	1009.3	950.3
2WG-D-A2	20.3	1046.4	1040.2	1036.3	1006.9	949.3
2WA-T-A0	20.2	68.3	64.5	63.0	58.8	55.0
2WA-T-A2	20.0	57.0	54.5	54.2	50.4	47.9
2WA-T-A4	20.0	73.3	69.8	66.4	58.4	54.7
2WA-T-A6	20.2	85.4	80.9	77.6	65.0	62.5
2WA-T-A8	20.3	115.8	106.4	97.5	87.4	85.3
2WA-T-A9	20.5	145.5	144.9	143.9	138.5	130.5
2WA-T-B0	19.7	106.9	98.1	94.0	83.1	77.7
2WA-T-B2	19.7	292.8	272.5	264.9	242.8	214.7
2WA-T-B4	19.8	408.3	374.8	368.6	347.3	302.8

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2WA-T-B6	19.8	896.4	824.1	821.7	796.4	789.0
2WA-T-B8	19.8	1323.9	1172.4	1158.1	996.4	908.5
2WA-T-B9	20.9	1170.3	1105.5	1050.8	857.3	832.2
2WA-T-C0	20.1	79.7	76.1	74.4	71.6	67.1
2WA-T-C2	19.9	253.8	225.3	219.1	206.1	193.6
2WA-T-C4	19.8	354.6	333.2	315.7	278.3	262.5
2WA-T-C6	19.8	845.3	765.0	752.3	707.3	641.9
2WA-T-C8	19.9	1156.1	1102.6	1075.4	1053.2	1008.2
2WA-T-C9	20.0	1242.6	1150.4	1094.5	1043.5	998.4
3WA-S-A3	21.4	147.9	139.9	128.1	96.2	86.5
3WA-S-A2	21.4	163.2	159.3	150.5	113.4	101.8
3WA-S-A1	21.2	178.1	175.1	164.8	119.8	106.1
3WA-S-B3	20.9	950.0	817.3	813.0	628.7	575.7
3WA-S-B2	20.7	947.4	818.9	798.8	623.8	574.8
3WA-S-B1	20.9	913.7	816.2	815.0	657.9	597.3
3WA-S-C3	21.5	929.5	849.5	784.8	728.3	635.9
3WA-S-C2	21.4	913.7	845.7	790.2	722.4	636.4
3WA-S-C1	21.1	917.9	841.8	784.1	732.4	640.5
2CL-E-C023	21.0	485.3	484.6	483.7	481.9	479.7
2CL-E-C035	21.0	221.4	221.2	221.1	220.3	219.1
2CL-E-C047	20.9	221.6	221.4	221.1	219.4	217.0
2CL-E-C058	20.8	124.0	123.6	123.4	121.8	120.6
2CL-E-C070	20.9	111.9	111.8	111.8	111.4	110.9
2CL-E-C105	20.9	74.0	73.9	73.8	73.0	72.2

The following table shows which thermocouples were taken out of service during the experiment.

Table 6. Out of Service Times

Description	Time out of service time (s)	Time out of service time (hh:mm:ss)	Out of service reason
2RL-T-A6	745	0:12:25	Exceeded Max Allowable Temp
2RL-T-A8	745	0:12:25	Exceeded Max Allowable Temp
2RL-T-A9	745	0:12:25	Exceeded Max Allowable Temp
2CB-S-C1	1133	0:18:53	Exceeded Max Allowable Temp
2CL-D-A2	1484	0:24:44	Exceeded Max Allowable Temp
2CL-D-A1	1488	0:24:48	Exceeded Max Allowable Temp
2RK-T-A6	3593	0:59:53	Exceeded Max Allowable Temp

The following charts present a time-dependent representation of the instantaneous temperatures measured during the experiment.

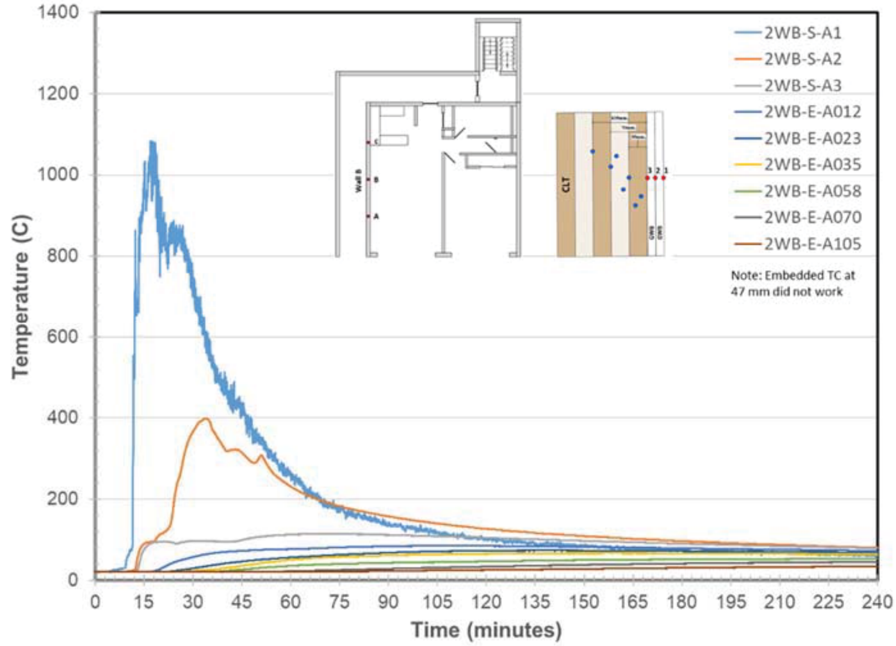

Figure 2. Wall B Embedded & Surface Temperatures at Location A

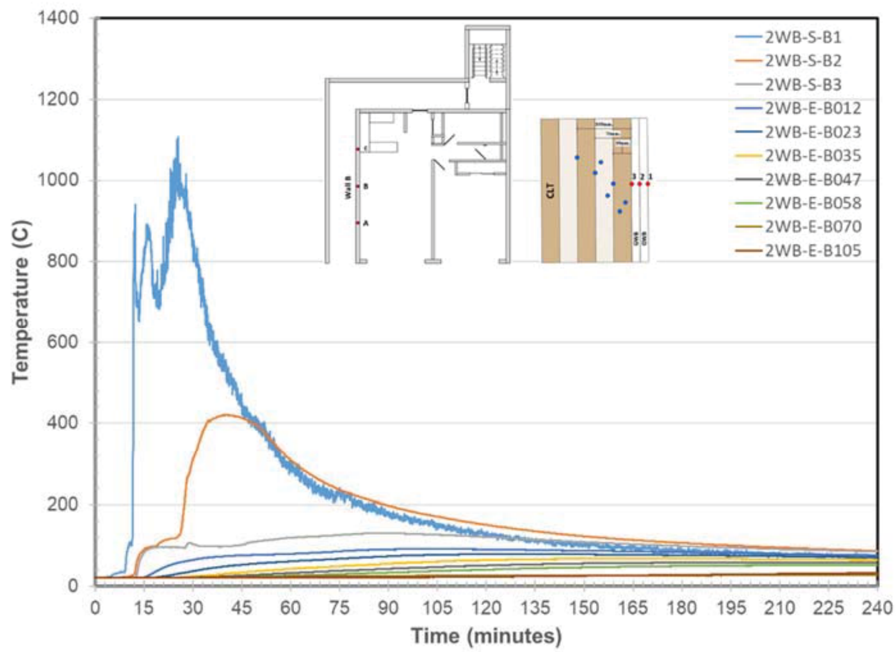

Figure 3. Wall B Embedded & Surface Temperatures at Location B

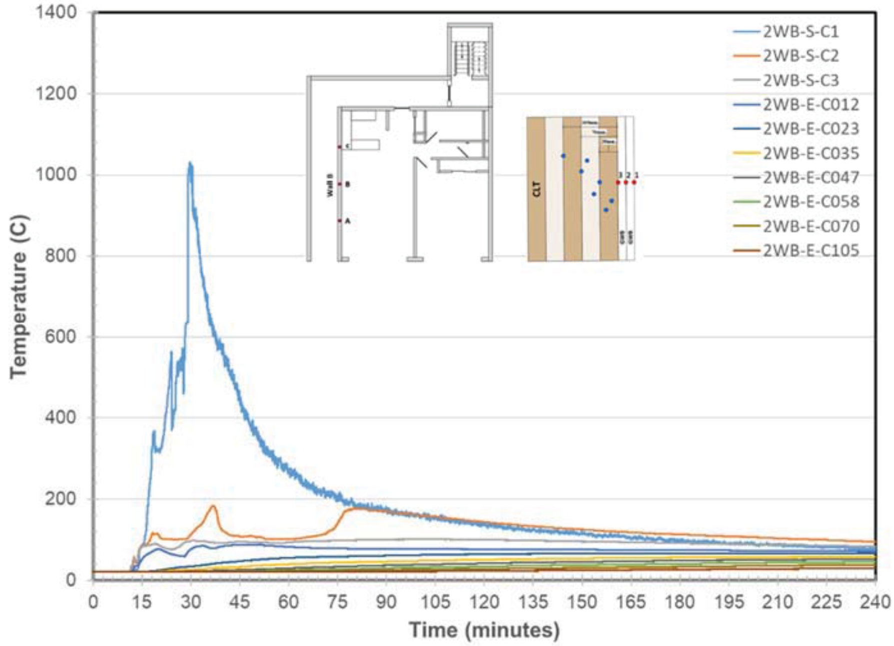

Figure 4. Wall B Embedded & Surface Temperatures at Location C

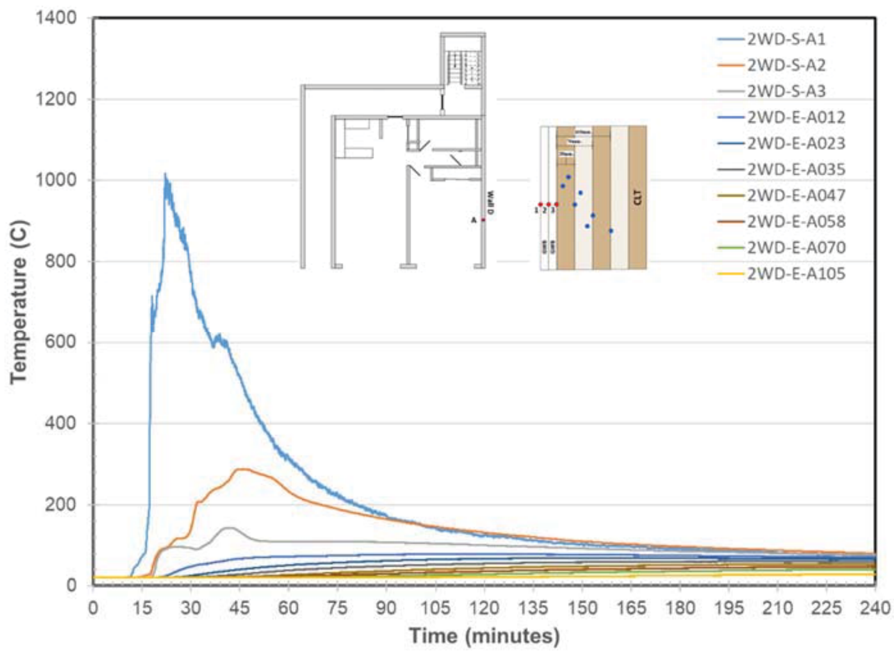

Figure 5. Wall D Embedded & Surface Temperatures at Location A

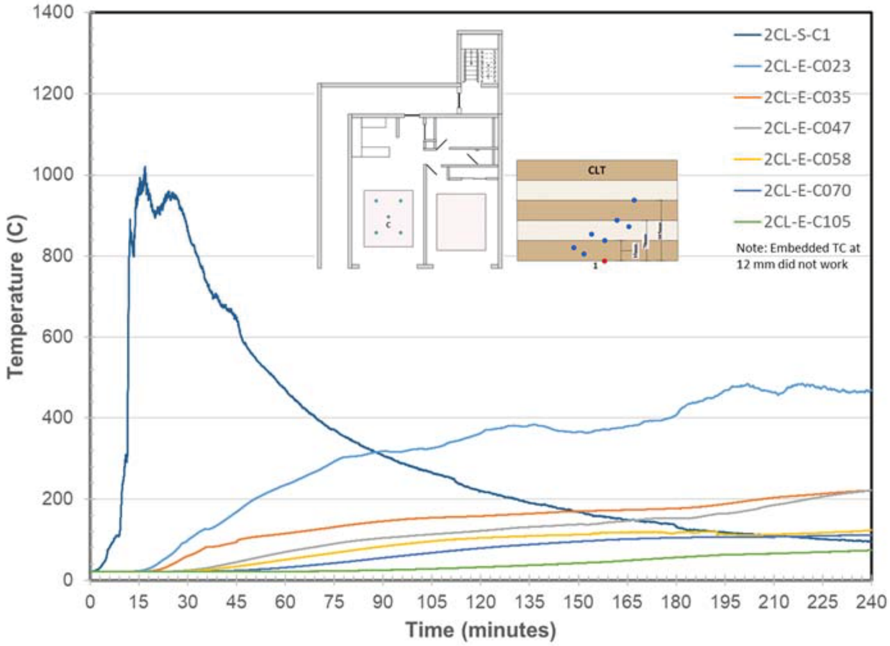

Figure 6. Living Room Ceiling Embedded & Surface Temperatures at Location C

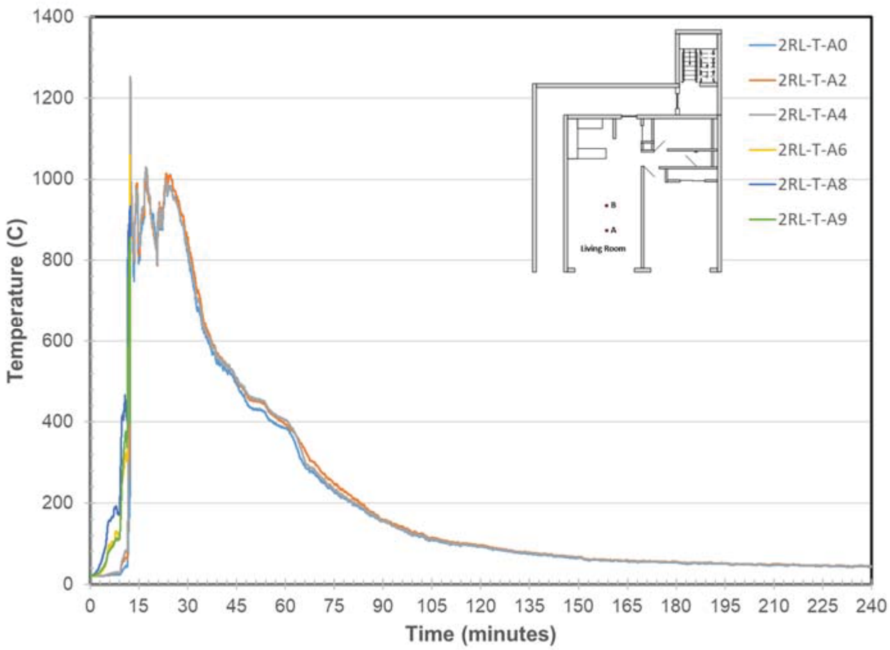

Figure 7. Living Room Temperature at Location A

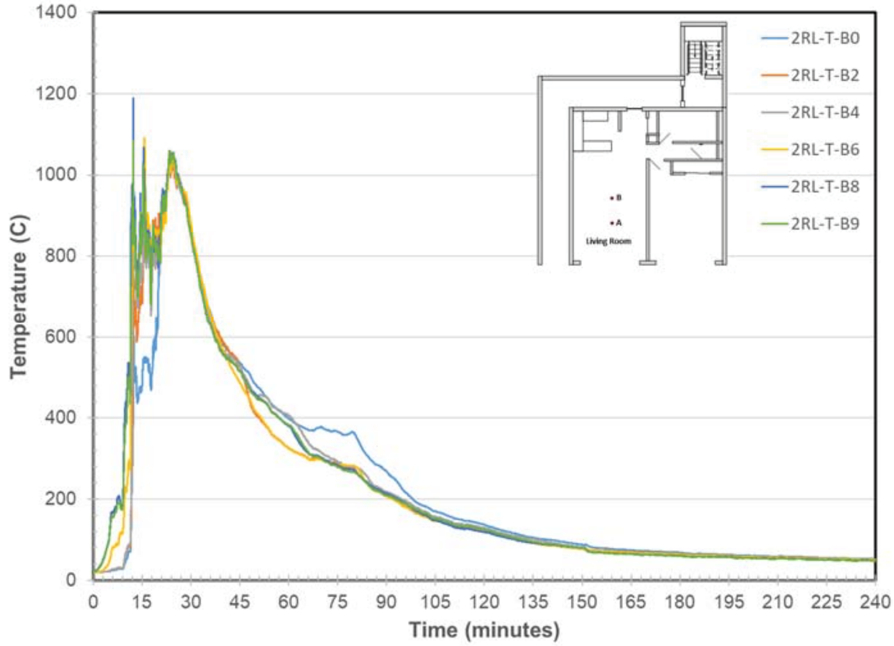

Figure 8. Living Room Temperature at Location B

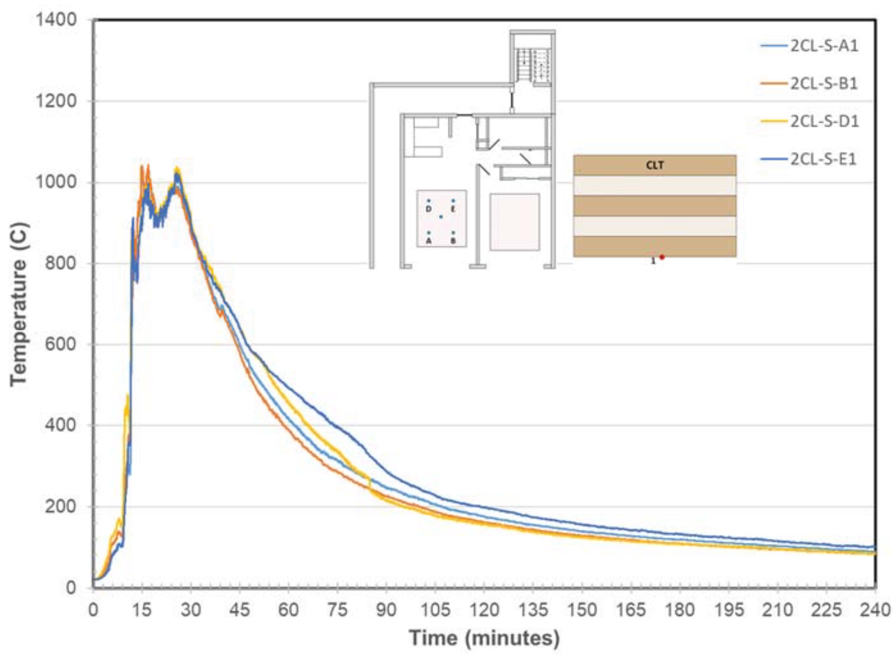

Figure 9. Living Room Ceiling Surface Temperatures at Location A, B, D, & E

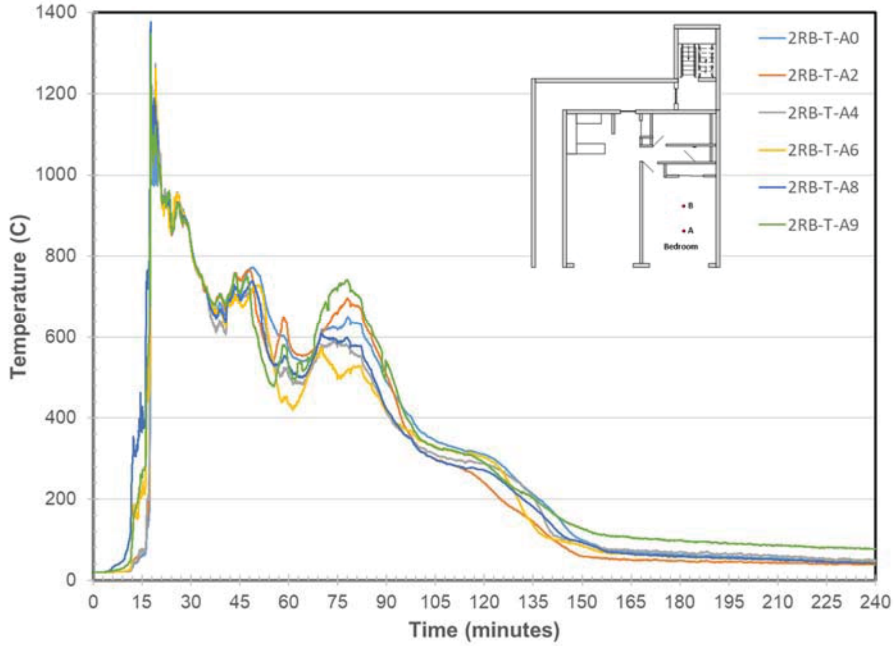

Figure 10. Bedroom Temperature at Location A

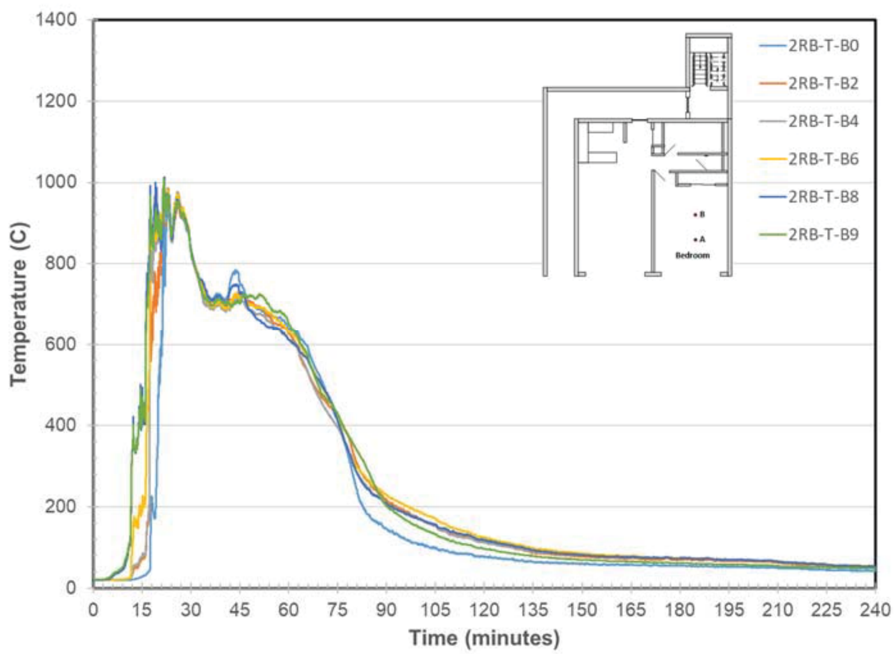

Figure 11. Bedroom Temperature at Location B

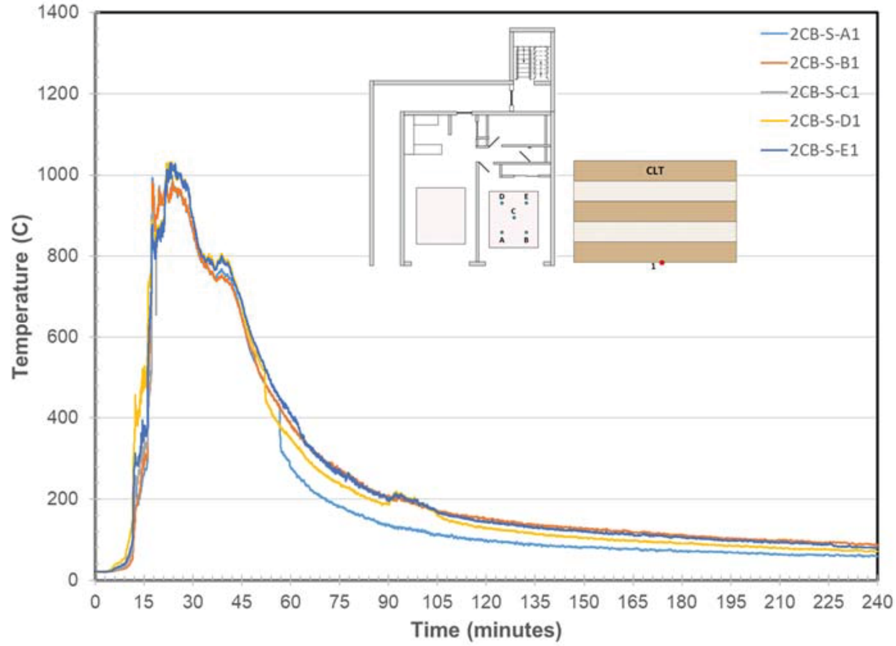

Figure 12. Bedroom Ceiling Surface Temperatures at Locations A through E

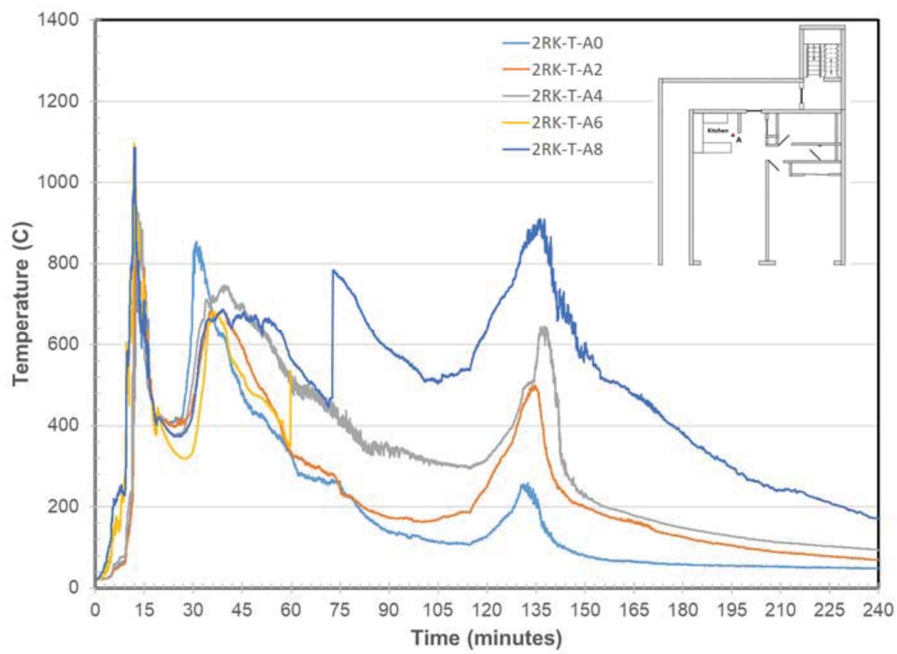

Figure 13. Kitchen Temperatures at Location A

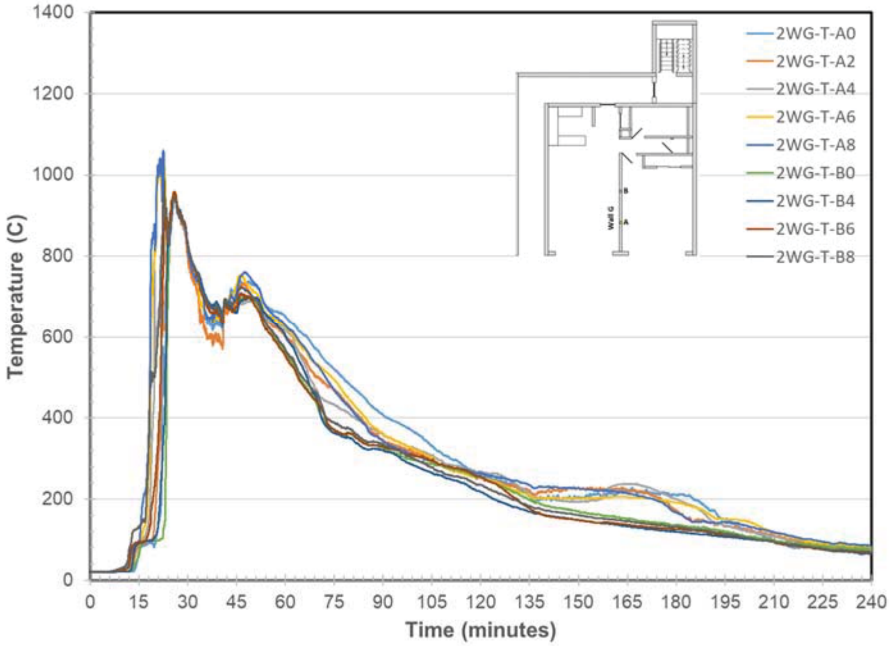

Figure 14. Wall G Temperatures at Locations A & B

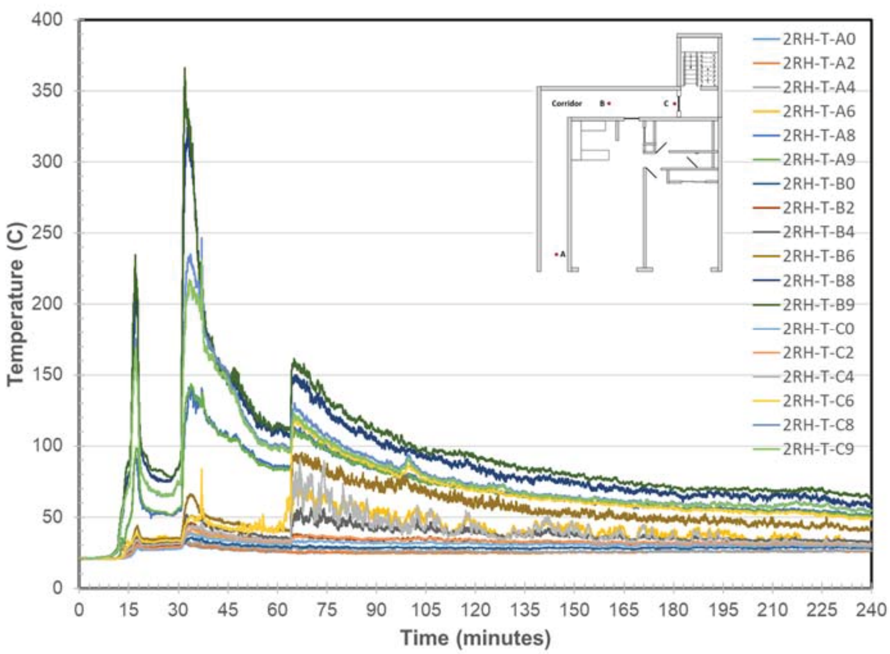

Figure 15. Corridor Temperatures at Locations A, B, & C

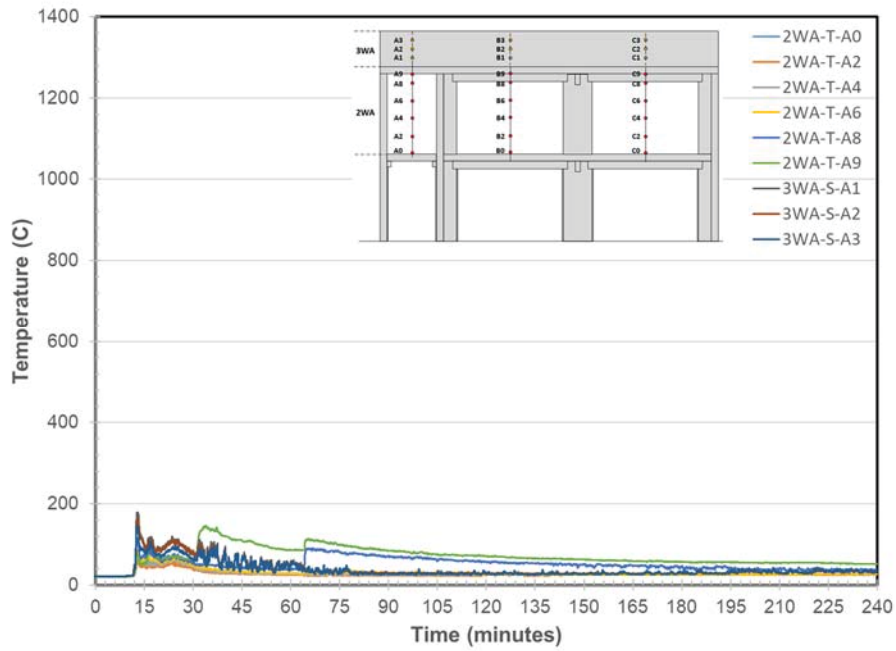

Figure 16. Wall A Temperatures at Location A

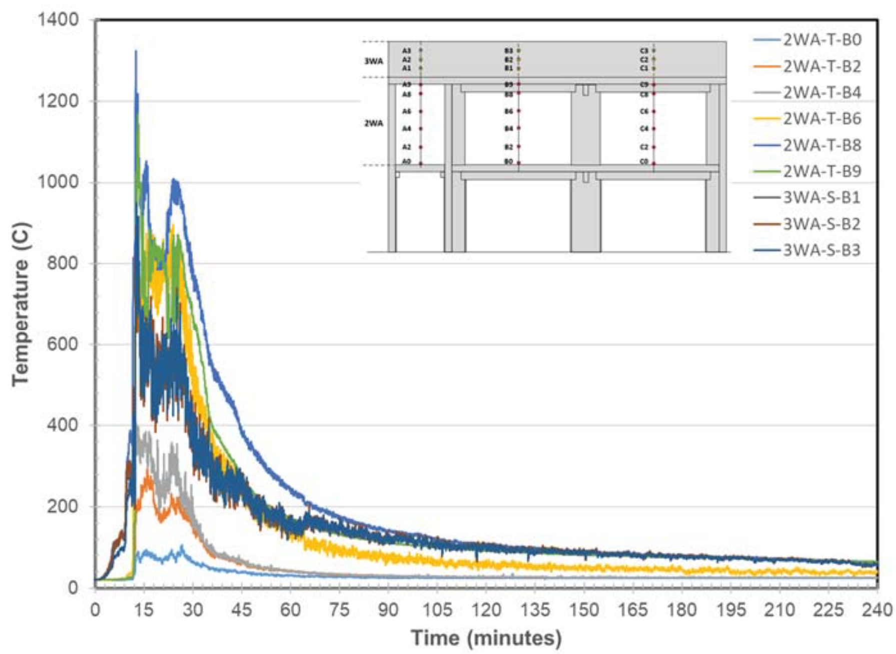

Figure 17. Wall A Temperatures at Locations B

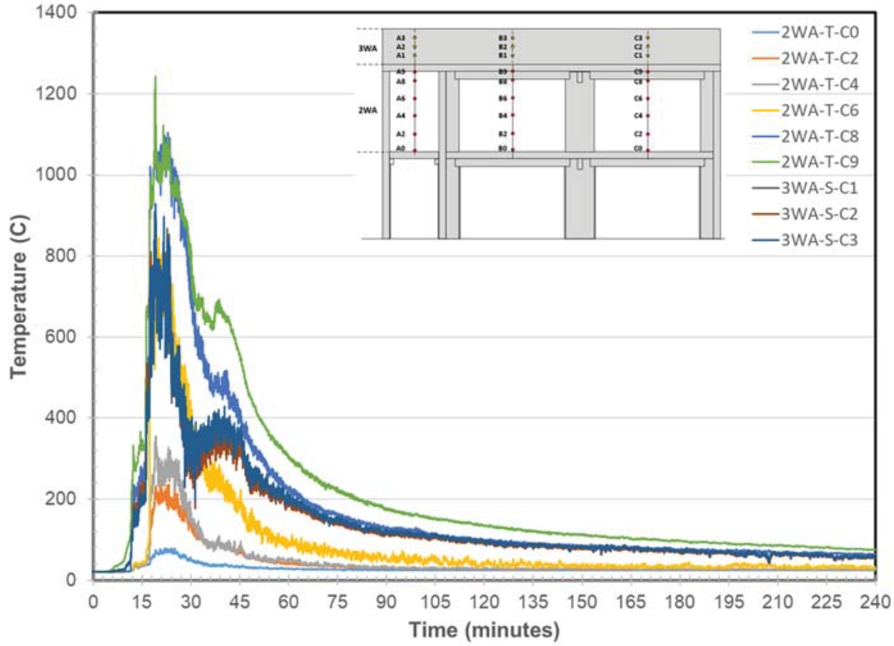

Figure 18. Wall A Temperatures at Locations C

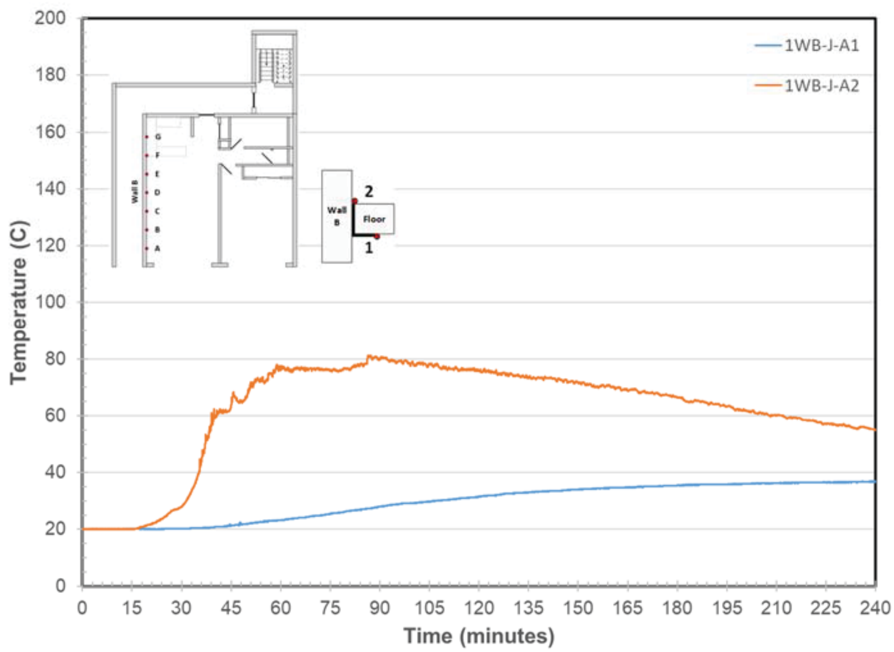

Figure 19. Wall B/Steel Angle Joint Temperatures at Location A

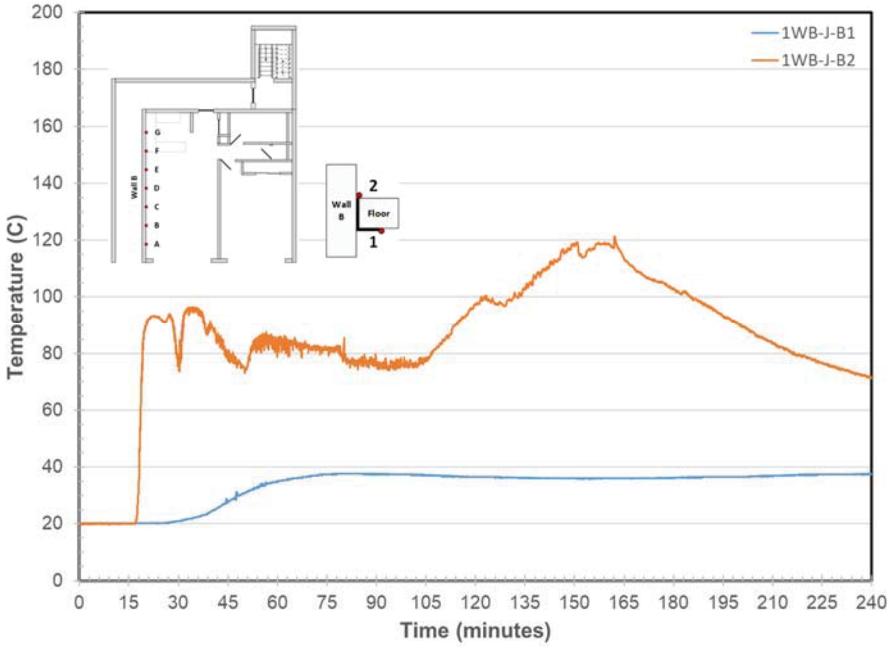

Figure 20. Wall B/Steel Angle Joint Temperatures at Location B

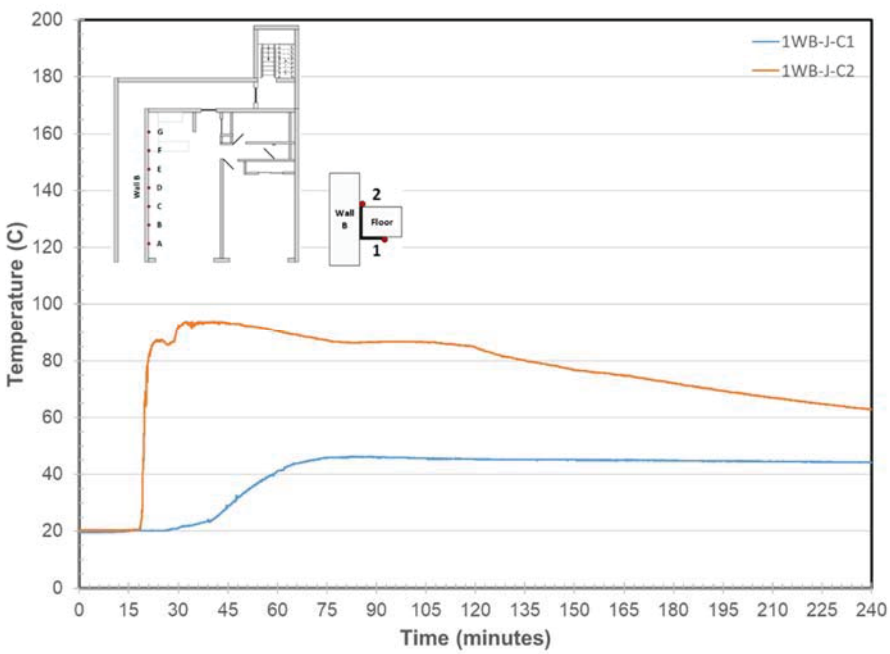

Figure 21. Wall B/Steel Angle Joint Temperatures at Location C

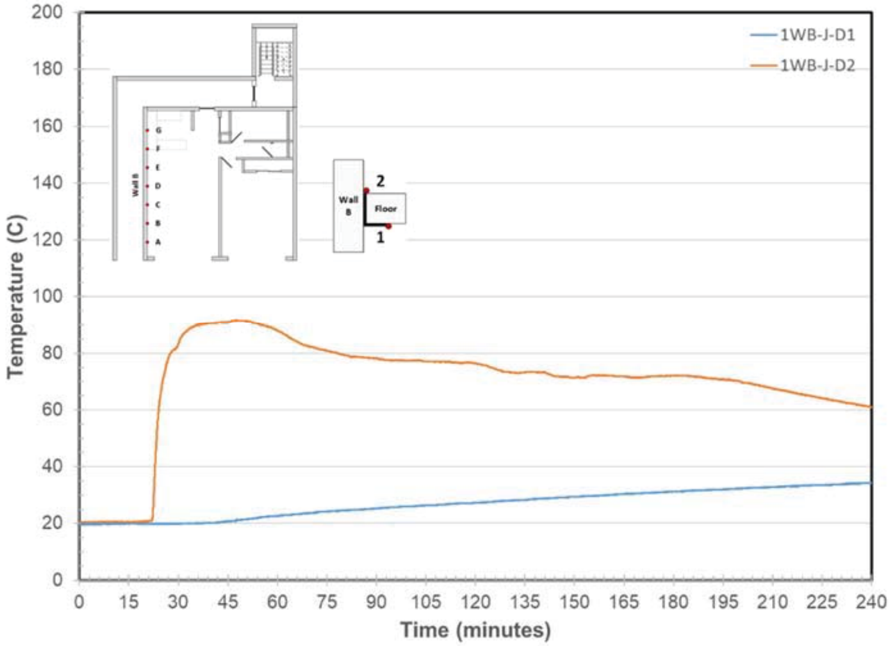

Figure 22. Wall B/Steel Angle Joint Temperatures at Location D

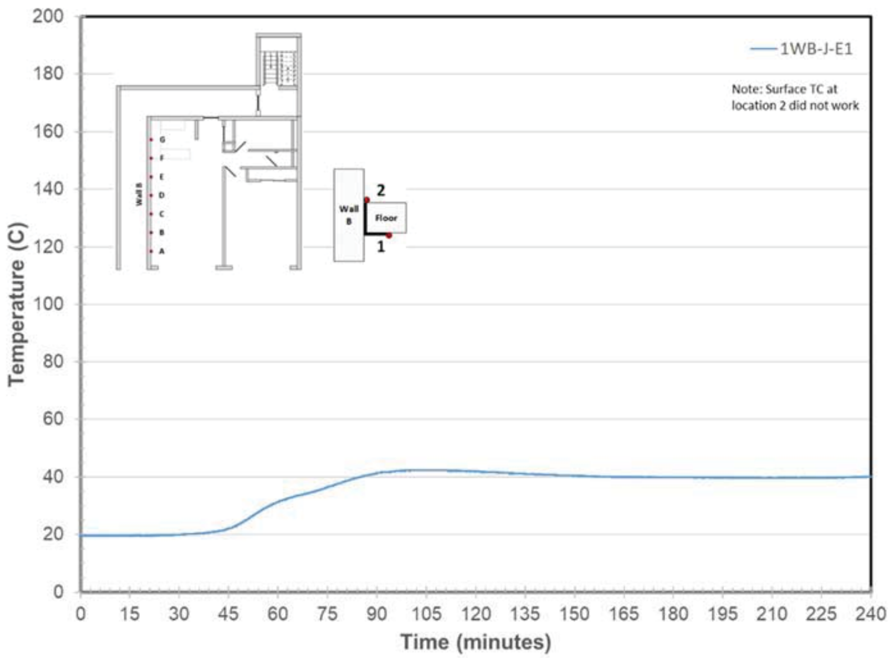

Figure 23. Wall B/Steel Angle Joint Temperatures at Location E

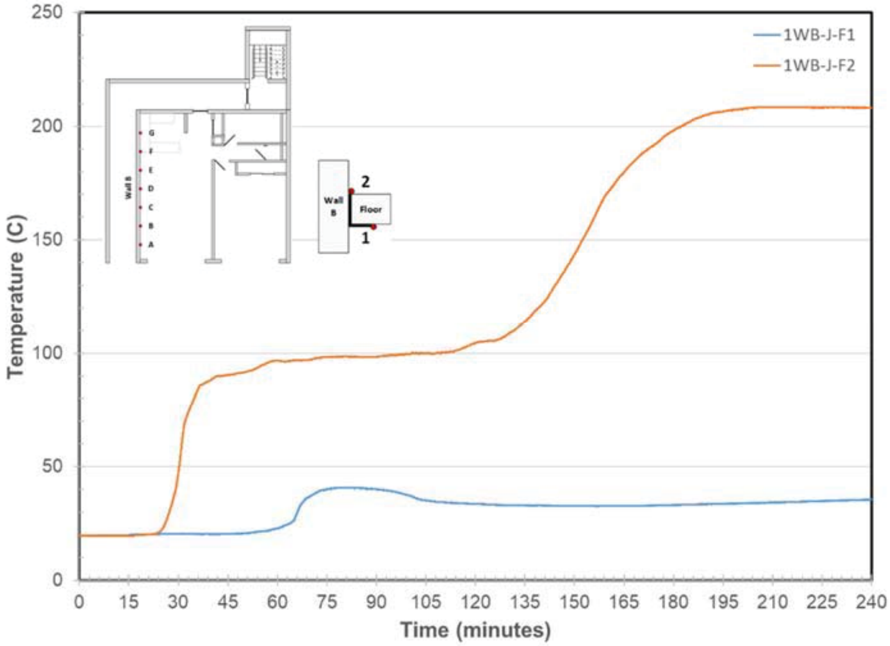

Figure 24. Wall B/Steel Angle Joint Temperatures at Location F

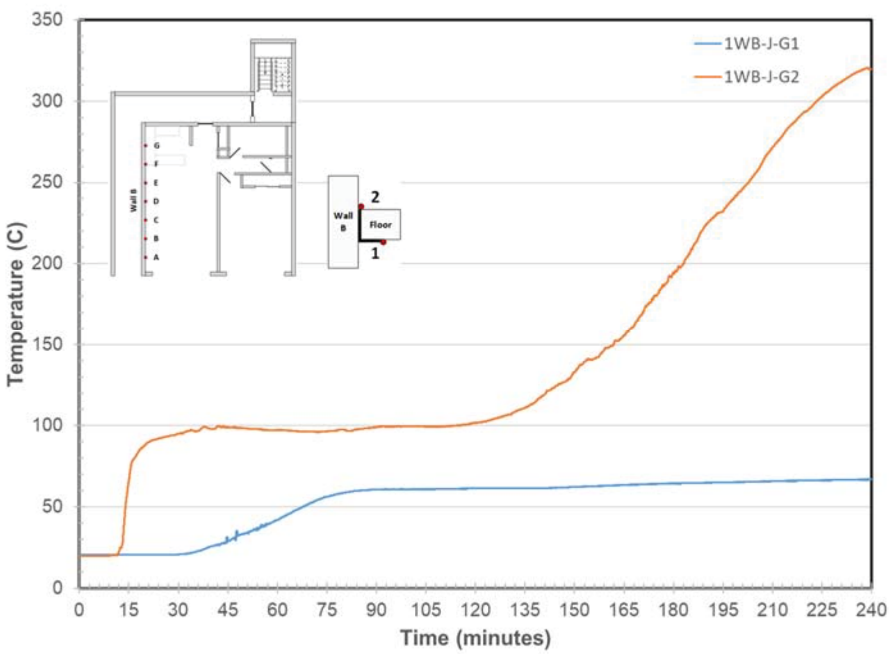

Figure 25. Wall B/Steel Angle Joint Temperatures at Location G

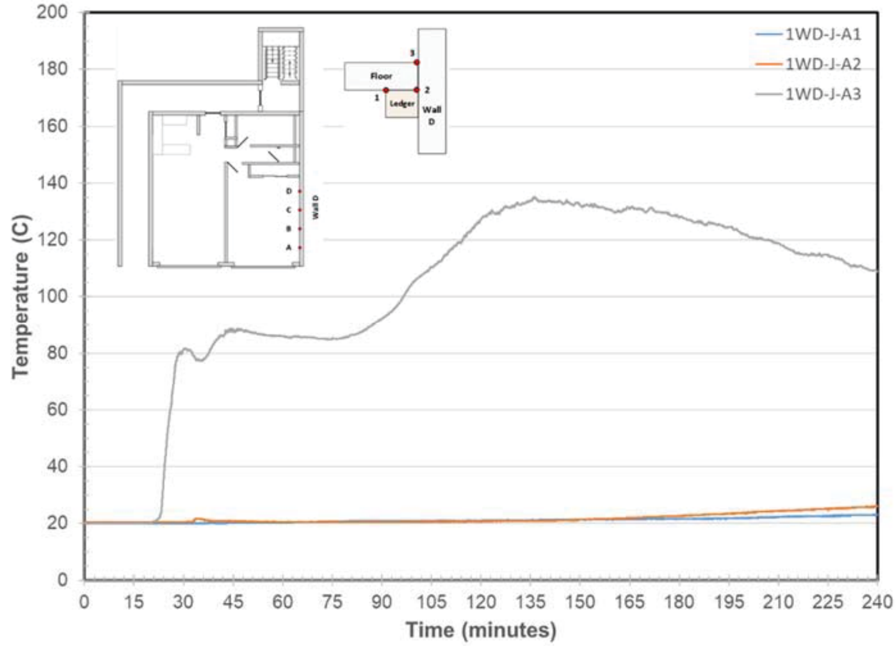

Figure 26. Wall D/Ledger Joint Temperatures at Location A

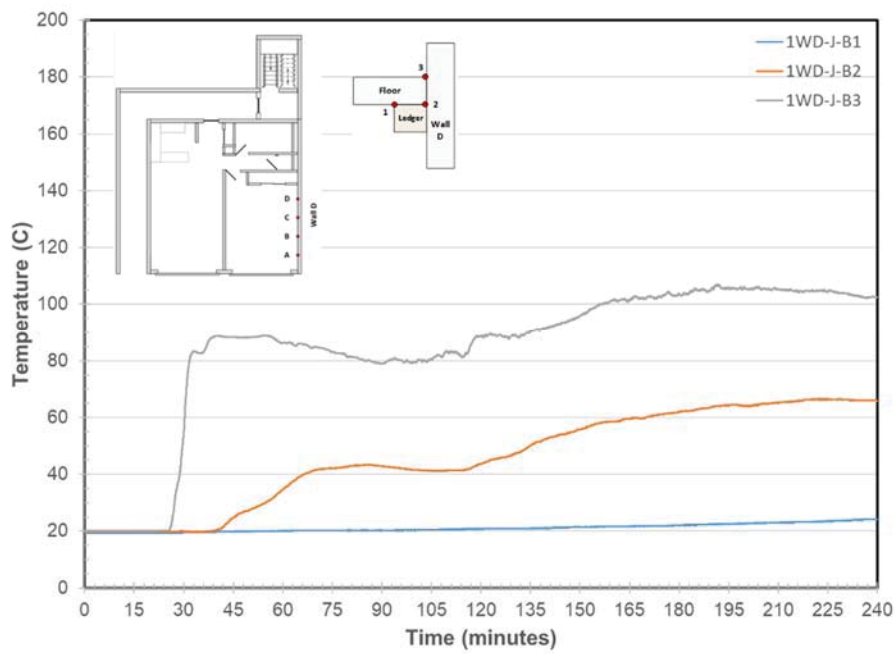

Figure 27. Wall D/Ledger Joint Temperatures at Location B

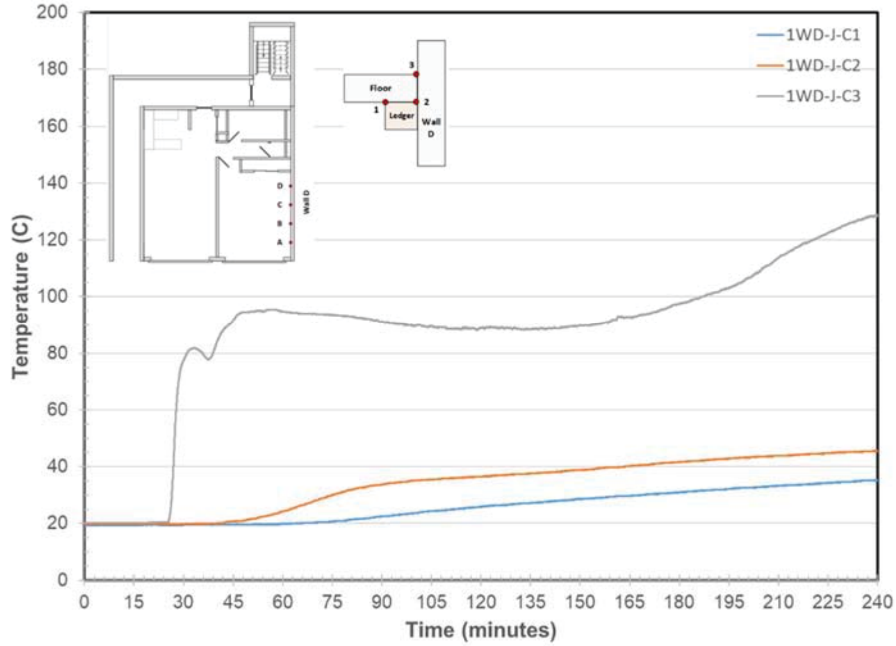

Figure 28. Wall D/Ledger Joint Temperatures at Location C

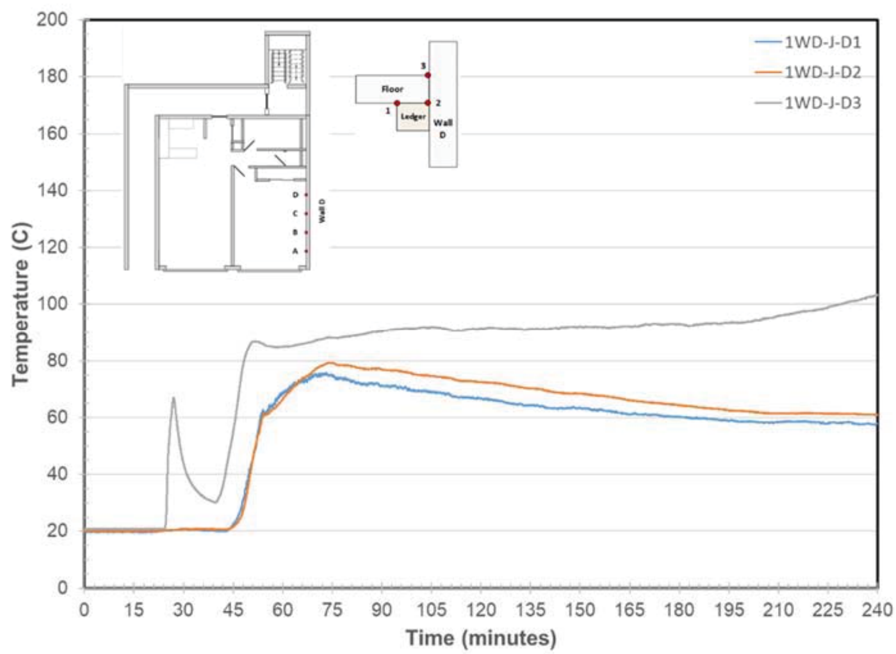

Figure 29. Wall D/Ledger Joint Temperatures at Location D

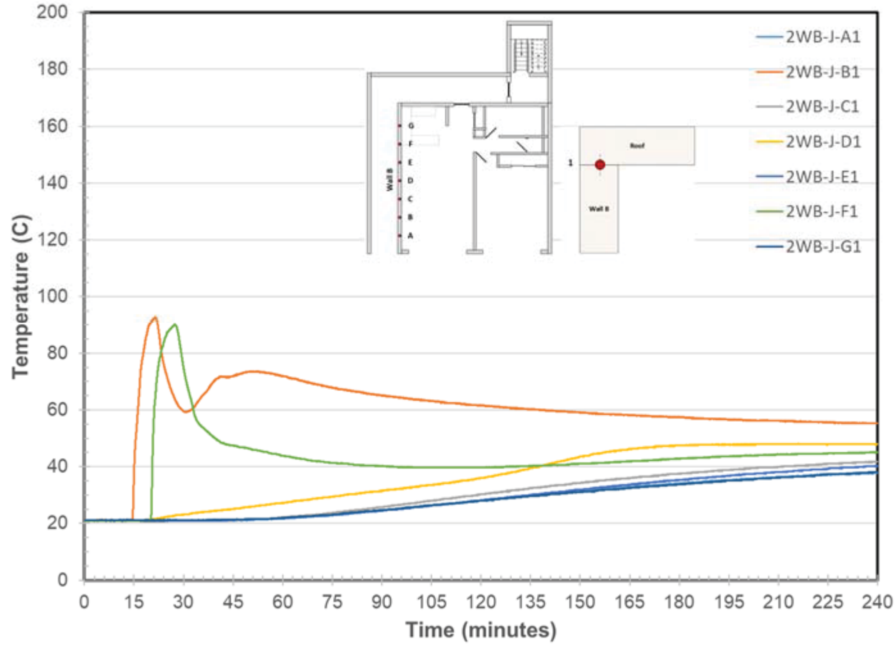

Figure 30. Ceiling/Wall B Joint Temperatures at Locations A-G

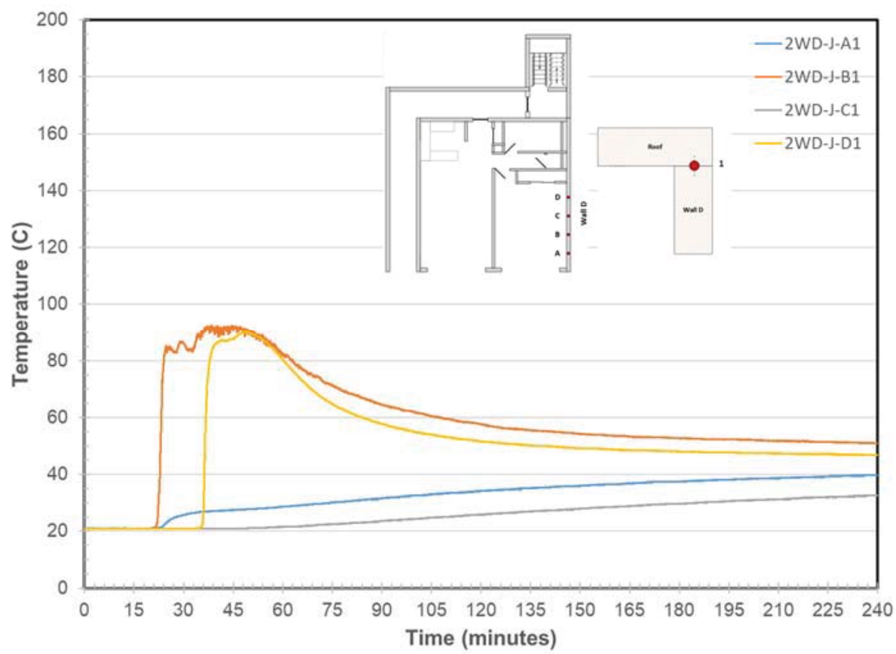

Figure 31. Ceiling/Wall B Joint Temperatures at Locations A-D

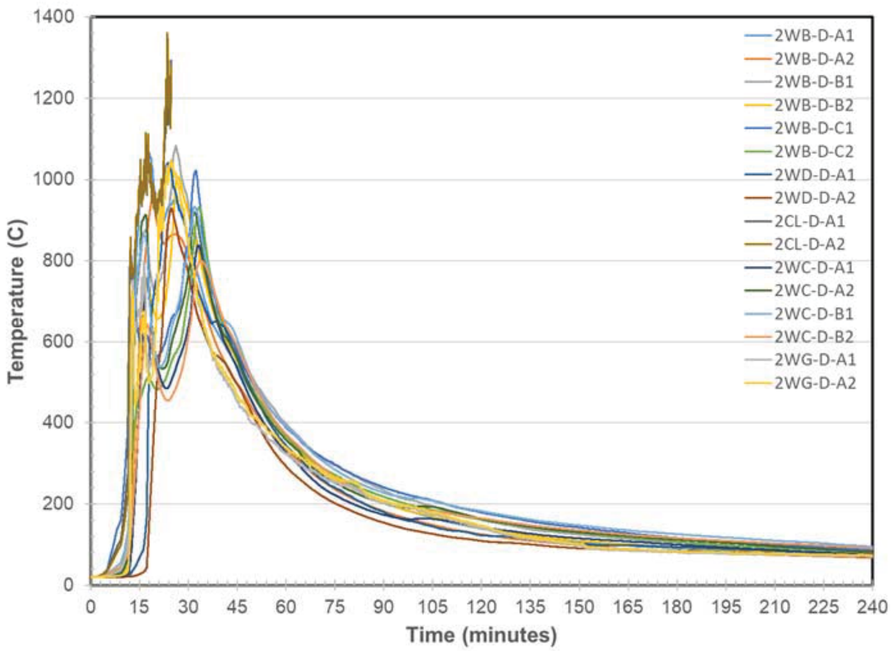

Figure 32. DFT Temperatures at each Location

Velocity

The following table provides a description of the instrumentation used to collect velocity measurements during the experiments. Velocity is calculated from pressure and temperature measurements.

Table 7. Velocity Measurement Description

Description	Probe Description	Thermocouple Type	Location X (m)	Location Y (m)	Location Z (m)	Orientation
1WA-V-A1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.76	0.00	0.91	horizontal
1WA-V-A2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.76	0.00	1.83	horizontal
1WA-V-B1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	0.91	horizontal
1WA-V-B2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	1.83	horizontal
1WA-V-B3	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	0.91	horizontal
1WA-V-B4	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	1.83	horizontal
1WA-V-C1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	0.91	horizontal
1WA-V-C2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	1.83	horizontal
1WA-V-C3	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	0.91	horizontal
1WA-V-C4	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	1.83	horizontal

The following table provides a summary of the temperatures measured at the velocity probe.

Table 8. Velocity Temperature Summary

Description	Initial (C)	Maximum (C)	30 Second Maximum Average (C)	60 Second Maximum Average (C)	300 Second Maximum Average (C)	600 Second Maximum Average (C)
1WA-V-A1	20	63	59	56	52	47
1WA-V-A2	20	97	92	90	84	80
1WA-V-B1	20	540	483	456	376	296
1WA-V-B2	20	968	948	930	893	838
1WA-V-B3	20	430	381	372	309	293
1WA-V-B4	20	1087	1025	1017	968	881
1WA-V-C1	20	475	428	390	331	308
1WA-V-C2	20	1051	1020	1014	975	871
1WA-V-C3	20	576	552	546	521	494
1WA-V-C4	20	1078	984	945	858	845

The following table summarizes the minimum and maximum velocity values and the times at which they occurred.

Table 9. Velocity Minimum and Maximum

Description	Initial (m/s)	Maximum (m/s)	5 Second Maximum Average (m/s)	10 Second Maximum Average (m/s)	30 Second Maximum Average (m/s)	60 Second Maximum Average (m/s)
1WA-V-A1	0.13	0.78	0.28	0.11	0.05	0.04
1WA-V-A2	0.06	0.97	0.52	0.36	0.17	0.14
1WA-V-B1	0.08	1.18	1.03	0.80	0.51	0.11
1WA-V-B2	-0.10	7.08	6.58	6.31	5.90	5.83
1WA-V-B3	0.09	1.22	1.00	0.98	0.86	0.69
1WA-V-B4	0.15	7.10	6.51	6.44	6.00	5.65
1WA-V-C1	-0.20	0.95	0.28	0.06	0.01	-0.04
1WA-V-C2	-0.12	7.20	6.77	6.56	6.07	5.68
1WA-V-C3	0.15	2.46	1.63	1.31	1.04	0.79
1WA-V-C4	0.26	8.13	7.18	7.00	6.78	6.74

The following charts present a time dependent representation of the instantaneous velocities measured during the experiment.

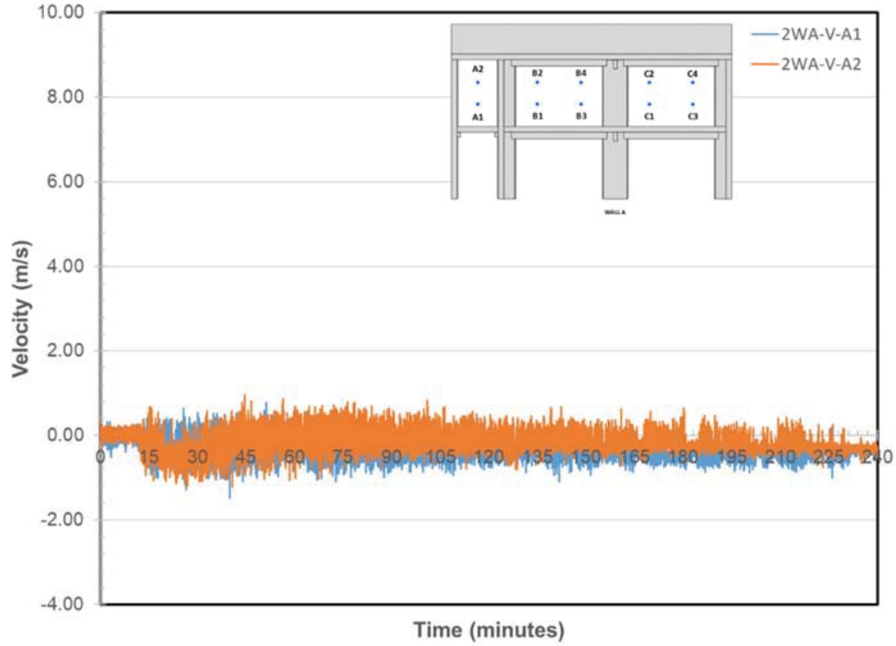

Figure 33. Velocity at Location A on Wall A

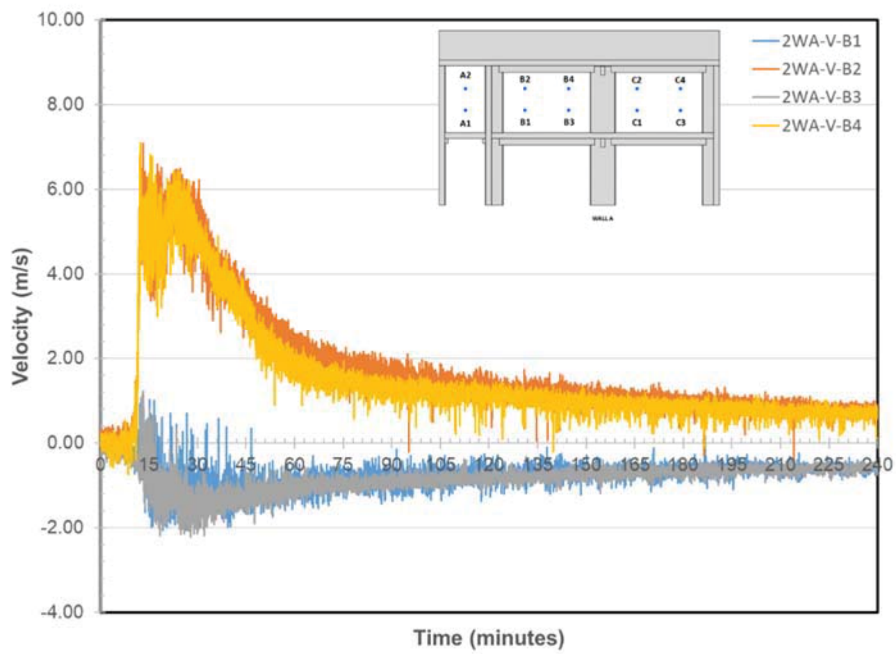

Figure 34. Velocity at Location B on Wall A

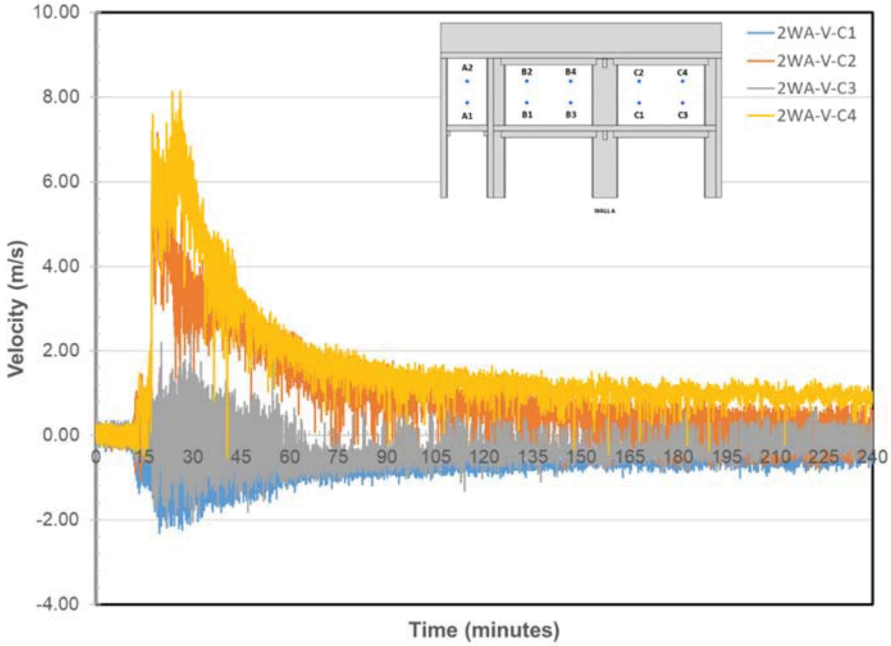

Figure 35. Velocity at Location C on Wall A

Heat Flux Transducers

The following table provides a description of the transducer used to collect heat flux measurements during the experiment. The "Description" column typically describes the location of the heat flux transducer. Location X and Location Y are Cartesian coordinates generally located in a horizontal plane. Location Z is the distance from the floor to the centerline of the transducer. Heat flux mode indicates whether the total heat flux was measured or just the radiation fraction. Heat flux over range is the maximum measured value reported for this transducer.

Table 10. Heat Flux Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Orientation	Heat Flux Mode	Heat Flux Over Range (kW/m²)
2WF-H-A1	5.62	11.18	0.91	horizontal	Total	150
2WA-H-A1	1.83	2.44	1.52	horizontal	Total	150
2WA-H-A2	1.83	4.88	1.52	horizontal	Total	75
2WA-H-B1	1.83	2.44	1.52	horizontal	Total	150
2WA-H-B2	1.83	4.88	1.52	horizontal	Total	75

The following table provides a summary of the heat flux results. The "Description" column typically describes the location of the heat flux transducer. The time at which the heat flux first changes by a pre-determined amount is provided in the "Time of Initial Change" column. The pre-determined amount of change in heat flux is provided in the "Initial Change Amount" column. The maximum heat flux recorded during the test is provided in the "Maximum" column. The "Maximum Average" columns are calculated over four pre-determined time spans.

Table 11. Heat Flux Result Summary

Description	Time of Initial Change (s)	Initial Change Value (kW/m²)	Maximum Heat Flux (kW/m²)	Heat Flux 10 second maximum average (kW/m²)	Heat Flux 30 second maximum average (kW/m²)	Heat Flux 60 second maximum average (kW/m²)	Heat Flux 300 second maximum average (kW/m²)	Heat Flux 600 second maximum average (kW/m²)
2WF-H-A1	2217	5	11.9	3.8	2.7	2.6	2.4	2.1
2WA-H-A1	697	5	62.8	60.8	59.1	56.4	53.3	27.8
2WA-H-A2	711	5	24.4	23.9	23.5	23.1	21.2	20.4
2WA-H-B1	746	5	64.1	61.1	59.2	56.7	52.4	47.2
2WA-H-B2	745	5	25.9	25.0	24.2	22.8	21.0	19.3

The following table shows which heat flux transducers were taken out of service during the experiment. The "Description" column typically describes the location of the heat flux transducer. If the heat flux measurement has to be discontinued during a test the "Out of Service Time" and "Out of Service Reason" columns report the test time and reason why the heat flux measurement was removed, respectively.

Table 12. Out of Service Times

Description	Out of Service Time (s)	Out of Service Time (hh:mm:ss)	Out of service reason
2WA-H-A1	1033	00:17:13	Issue with data connection

The following chart shows a time dependent representation of the instantaneous heat flux measured during the experiment.

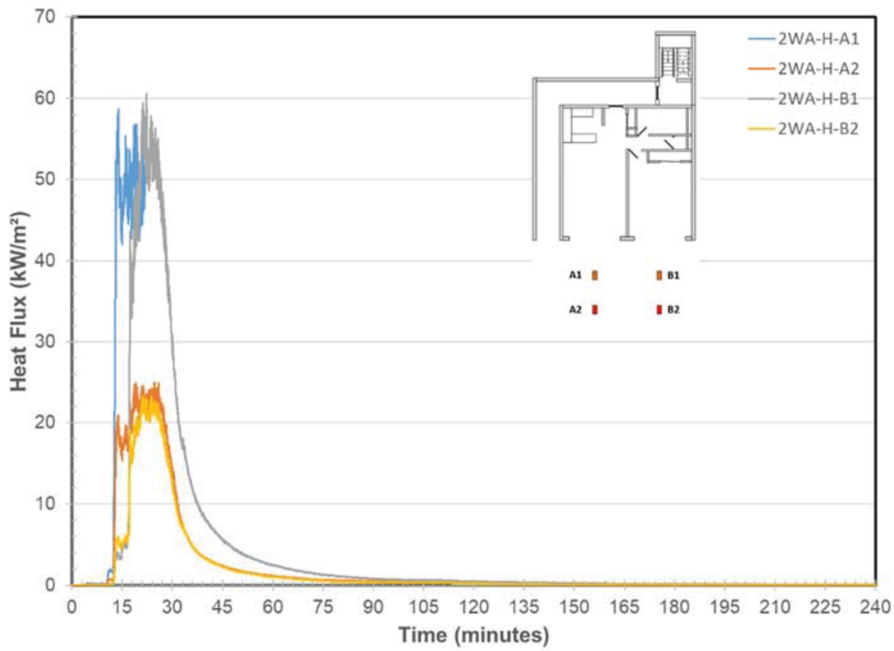

Figure 36. Heat Flux in Front of Wall A

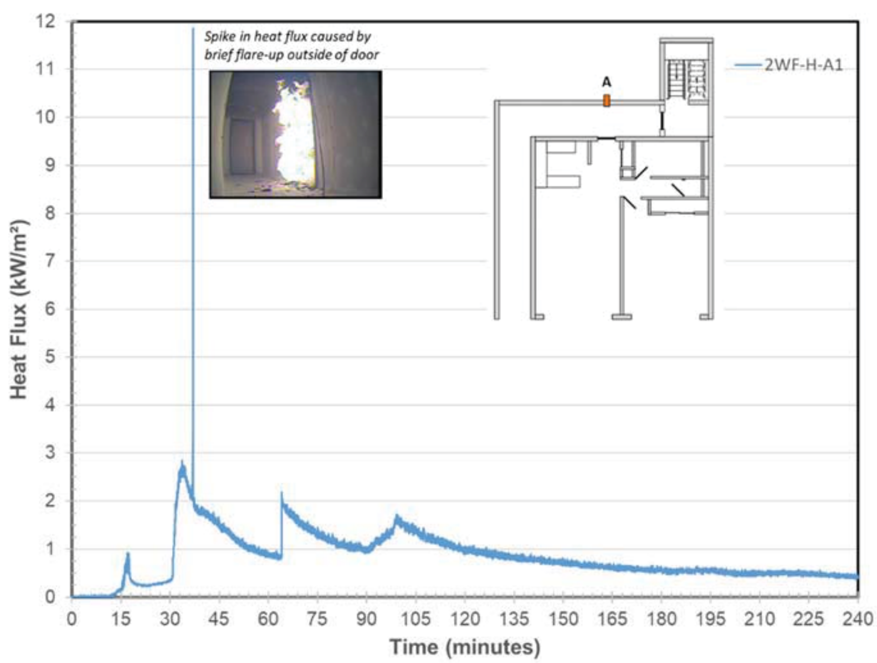

Figure 37. Heat Flux on Wall F across from Apartment Door

Optical Density Meter

The following table provides a description of the optical density meter used in the experiment. The extinction beam path length is the distance measured from the light source to the lens of the photo transducer.

Table 13. Optical Density Meter Description

Description	Light Source Type	X (m)	Y (m)	Z (m)	Extinction Beam Path Length (m)
2RH-O-A1	White light	3.353	10.363	1.524	0.914

The following chart shows the obscuration during the experiment.

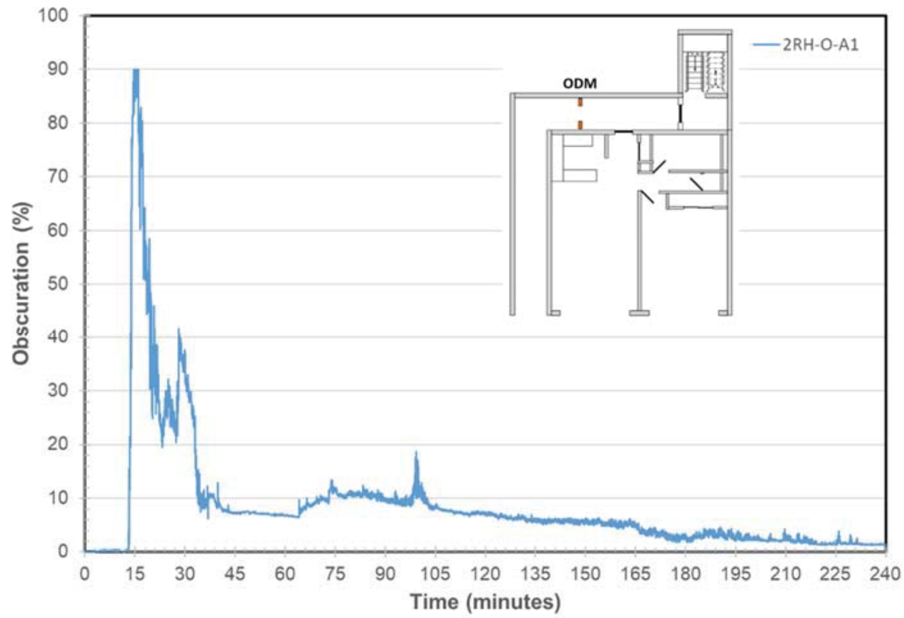

Figure 38. Obscuration in Corridor

The following chart shows the obscuration per unit length during the experiment.

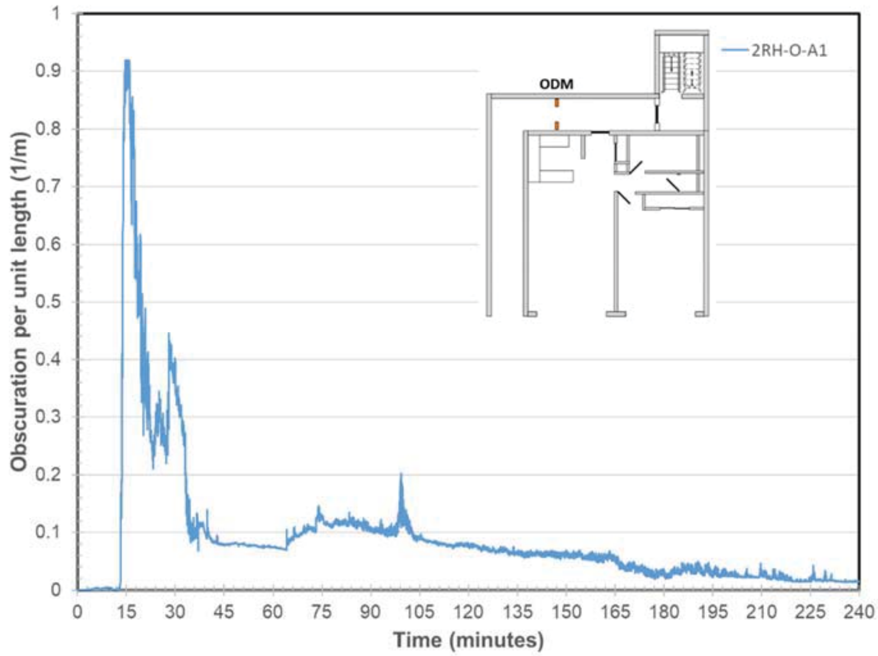

Figure 39. Obscuration per unit Length in Corridor

Smoke Detectors

The following table provides a description of the detectors used in the experiment. All detectors were mounted on the ceiling.

Table 14. Detectors Summary

Description	Location	Distance below ceiling (m)	Manufacturer	Model	Detector Type	Sensor Type
2CL-I-A1	2nd Floor Living Room	0.00	Kidde	i12080	smoke	ionization
2CL-P-A1	2nd Floor Living Room	0.00	Kidde	p12040	smoke	photoelectric
2CB-I-A1	2nd Floor Bed Room	0.00	Kidde	i12080	smoke	ionization
2CB-P-A1	2nd Floor Bed Room	0.00	Kidde	p12040	smoke	photoelectric
2CB-I-B1	2nd Floor Hallway Outside of Bedroom	0.00	Kidde	i12080	smoke	ionization
2CB-P-B1	2nd Floor Hallway Outside of Bedroom	0.00	Kidde	p12040	smoke	photoelectric
2CH-I-A1	2nd Floor Corridor near Wall A	0.00	Kidde	i12080	smoke	ionization
2CH-P-A1	2nd Floor Corridor near Wall A	0.00	Kidde	p12040	smoke	photoelectric
2CH-I-B1	2nd Floor Corridor by Apartment Door	0.00	Kidde	p12040	smoke	ionization
2CH-P-B1	2nd Floor Corridor by Apartment Door	0.00	Kidde	i12080	smoke	photoelectric
2CH-I-C1	2nd Floor Stairwell	0.00	Kidde	i12080	smoke	ionization
2CH-P-C1	2nd Floor Stairwell	0.00	Kidde	p12040	smoke	ionization

The following table provides a summary of activation times for all smoke detectors in all experiments.

Table 15. Smoke Detector Activation Summary

Test Number	Location	Activation Time (s)	Activation Time (hh:mm:ss)
2CL-I-A1	2nd Floor Living Room	46	00:00:46
2CL-P-A1	2nd Floor Living Room	51	00:00:51
2CB-P-B1	2nd Floor Hallway Outside of Bedroom	106	00:01:46
2CB-I-A1	2nd Floor Bed Room	202	00:03:22
2CH-I-B1	2nd Floor Corridor by Apartment Door	220	00:03:40
2CB-P-A1	2nd Floor Bed Room	223	00:03:43
2CH-I-A1	2nd Floor Corridor near Wall A	406	00:06:46
2CB-I-B1	2nd Floor Hallway Outside of Bedroom	600	00:10:00
2CH-P-A1	2nd Floor Corridor near Wall A	732	00:12:12
2CH-P-B1	2nd Floor Corridor by Apartment Door	1026	00:17:06
2CH-I-C1	2nd Floor Stairwell	3875	01:04:35

Fire Products Collector

The following table provides a description of the FPC used in the experiment. The table includes a description of the FPC, as well as the Calibration factor (C Factor) and the net heat released per unit of oxygen consumed (E Factor), which are used to calculate the het release rate (HRR) during an experiment. The C Factor is based on data from a fire with a known HRR. The E Factor is a property of the fuel being burned.

Table 16. Fire Products Collector Description

Description	C Factor	E Factor (kJ/kg)
14 MW	1.128	13100

The following table shows when the FPC was taken out of service during the experiment. A time is also provided when the FPC was placed back into service.

Table 17. FPC Event Times

Description	Time (s)	Time (hh:mm:ss)
FPC Offline to change gas filter	9315	02:35:15
FPC Online	9401	02:36:41

The following chart shows the heat release rate of the fire during the experiment. The heat release rate is calculated based on the principle of oxygen consumption calorimetry.

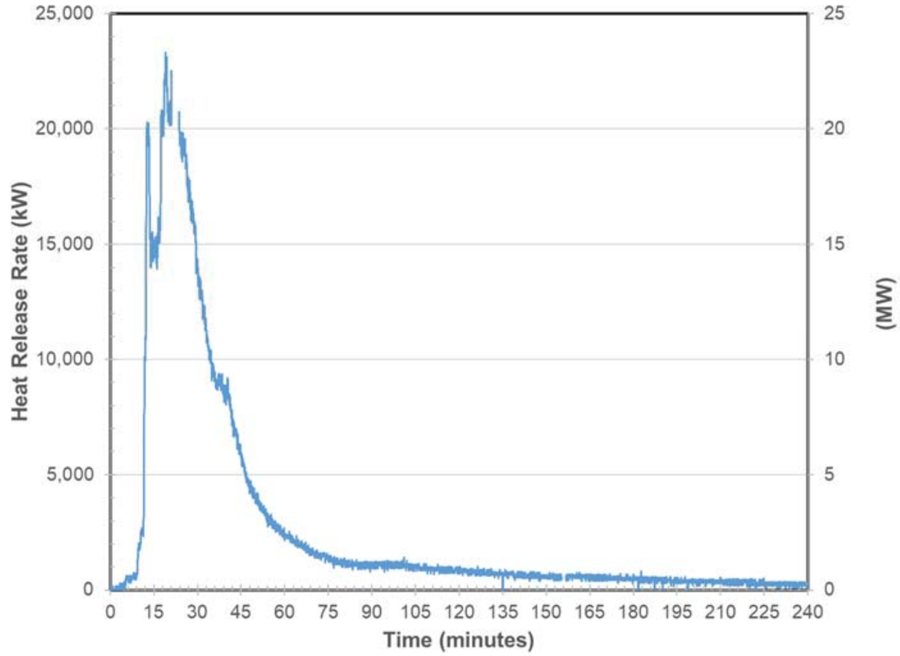

Figure 40. Heat Release Rate

The following chart shows the total heat released from the fire during the experiment. The total heat released is calculated by integrating the heat release rate over time.

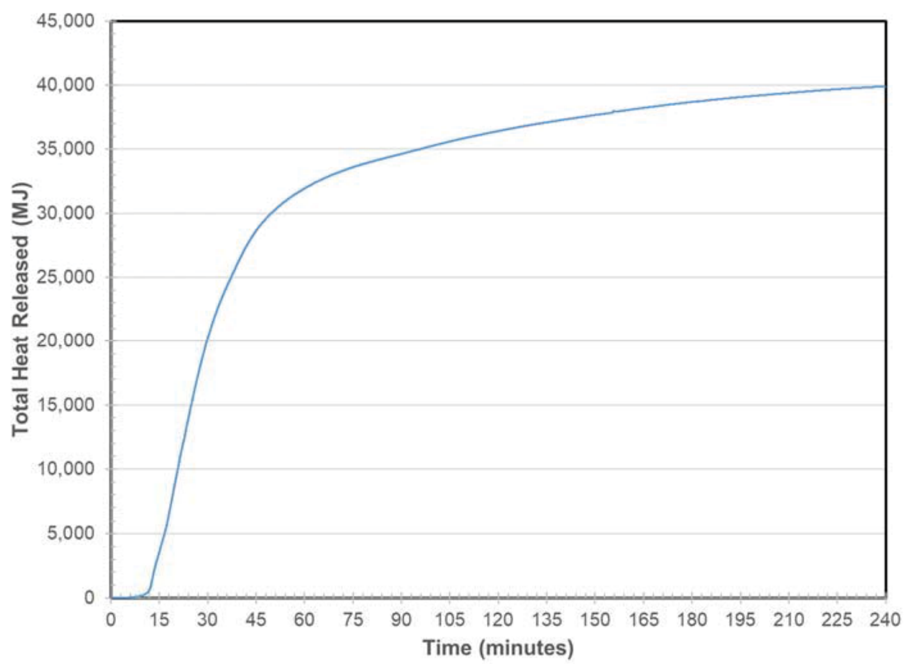

Figure 41. Total Heat Released

Gas Analyzer-Paramagnetic-O_2

A gas analyzer was used to measure the oxygen (O_2) concentration at one or more point The following table provides information about the oxygen sampling location(s) and the operating parameters of the oxygen analyzer. The “O2 delay time” is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample bypass and analyzer exhaust lines are returned to during the experiment.

Table 18. Oxygen measurement descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	O2 Delay Time (s)	Exhaust Return
2RH-G-A1	5.59	10.36	1.52	13	To Ambient Laboratory

The following table shows when the gas analyzer was taken out of service during the experiment. A time is also provided when the gas analyzer was placed back into service.

Table 19. Gas Analyzer Event Times

Description	Time (s)	Time (hh:mm:ss)
Gas Cart Off to change gas filter	9508	02:38:28
Gas Cart On	9583	02:39:43

The following table provides a summary of the oxygen measurement results.

Table 20. Oxygen Measurement Results

Description	O2 Analyzer Full Scale Range (%)	Oxygen Peak Minimum (%)	Oxygen-Average (%)
2RH-G-A1	25.00	1.87	20.43

The following chart presents the oxygen concentration measured during the test.

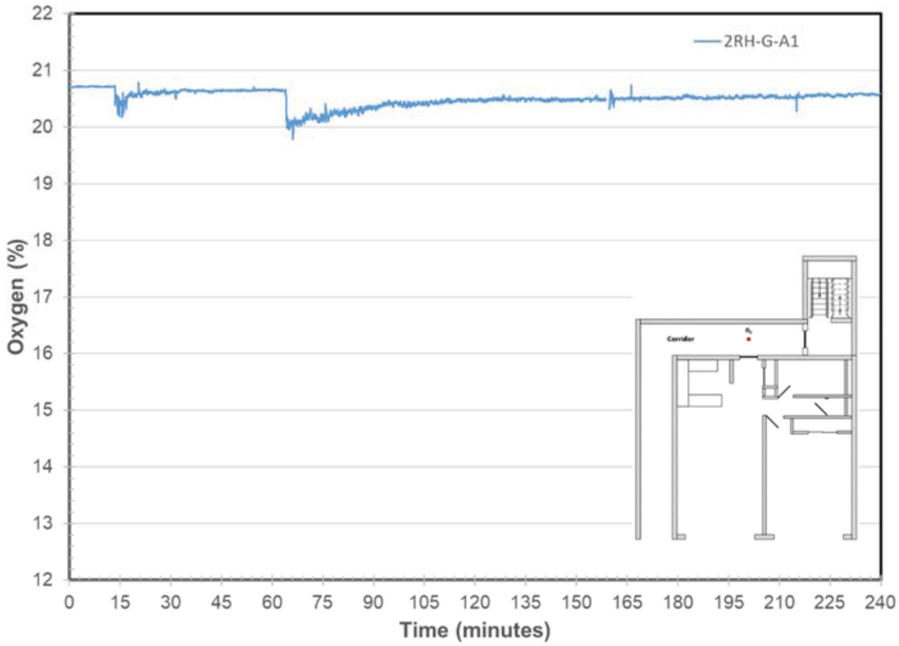

Figure 42. Oxygen Concentration in the Corridor

Gas Analyzer-NDIR-CO/CO_2

The following table provides information about the carbon monoxide and carbon dioxide sampling location and the operating parameters of the analyzer. The "CO/CO2 delay time" is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample by-pass and analyzer exhaust lines are returned to during the experiment.

Table 21. CO and CO2 Measurement Descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	CO/CO2 Delay Time (s)	Exhaust Return
2RH-G-A1	5.59	10.36	1.52	14	To Ambient Laboratory

The following table shows when the gas analyzer was taken out of service during the experiment. A time is also provided when the gas analyzer was placed back into service.

Table 22. Gas Analyzer Event Times

Description	Time (s)	Time (hh:mm:ss)
Gas Cart Off to change gas filter	9508	02:38:28
Gas Cart On	9583	02:39:43

The following table provides a summary of the carbon monoxide gas measurement results.

Table 23. CO Measurement Results

Description	CO Analyzer Full Scale Range (mol/mol)	CO Span Gas Value (mol/mol)	Maximum CO Gas Concentration (mol/mol)	CO- Average (mol/mol)
2RH-G-A1	0.05	0.05	-0.0001	-0.0002

The following table provides a summary of the carbon dioxide gas measurement results.

Table 24. CO2 Measurement Results

Description	CO2 Analyzer Full Scale Range (mol/mol)	CO2 Span Gas Value (mol/mol)	Maximum CO2 Gas Concentration (mol/mol)	CO2- Average (mol/mol)
2RH-G-A1	0.25	0.22	0.0061	0.0008

The following chart shows the carbon monoxide concentration(s) measured during the experiment.

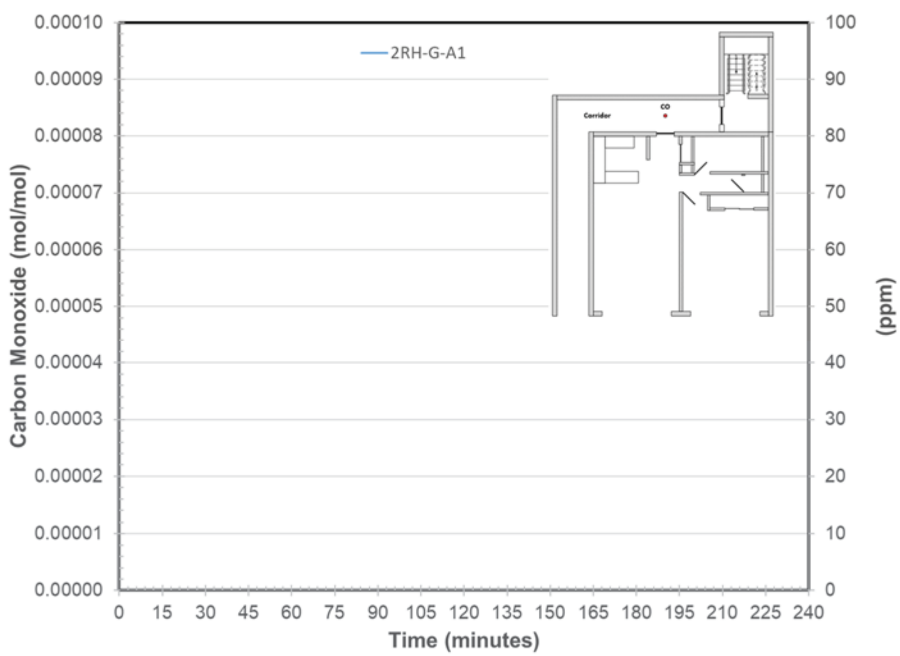

Figure 43. Carbon Monoxide Concentration in the Corridor

The following chart shows the carbon dioxide concentration(s) measured during the experiment.

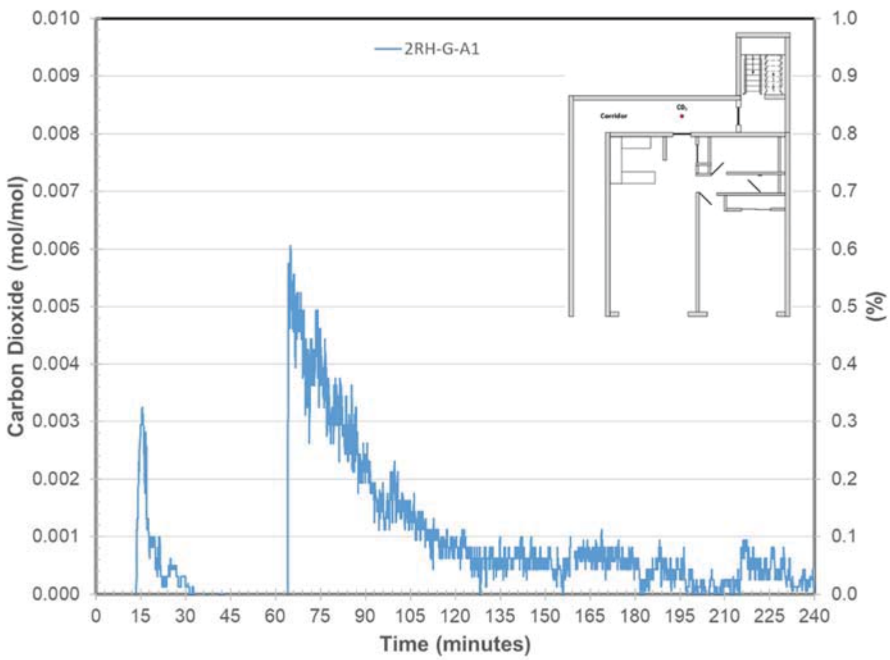

Figure 44. Carbon Dioxide Concentration in the Corridor

Videos

The following table provides a description of the videos taken during this experiment.

Table 25. Video Log

Description	Start Time	Video Duration (s)	Filename
IGNITION	09:23:57	14491	193871_20170531_092357_1.mov
LIVING ROOM	09:23:58	14491	193871_20170531_092358_2.mov
BEDROOM	09:24:00	14490	193871_20170531_092400_3.mov
DOOR / KITCHEN	09:24:02	14489	193871_20170531_092402_4.mov
KITCHEN / LIVING ROOM	09:24:08	14484	193871_20170531_092408_5.mov
HALLWAY	09:24:10	14483	193871_20170531_092410_6.mov
STAIRWELL	09:24:11	14488	193871_20170531_092411_7.mov
FLIR	09:24:13	14487	193871_20170531_092413_8.mov
FRONT VIEW HD	09:24:14	14487	193871_20170531_092414_9.mov
LIVING ROOM HD	09:24:15	14487	193871_20170531_092415_10.mov
BEDROOM HD	09:24:16	14487	193871_20170531_092416_11.mov
OVERALL	09:24:17	14486	193871_20170531_092417_12.mov
OVERALL_USDA			193871_949714.MOV
IGNITION_USDA			193871_949715.MOV
LIVING ROOM_USDA			193871_949716.MOV
BEDROOM_USDA			193871_949717.MOV
DOOR / KITCHEN_USDA			193871_949718.MOV
KITCHEN / LIVING ROOM_USDA			193871_949719.MOV
HALLWAY_USDA			193871_949720.MOV
STAIRWELL_USDA			193871_949721.MOV

Description	Start Time	Video Duration (s)	Filename
FLIR_USDA			193871_949722.MOV
FRONT VIEW HD			193871_949723.MOV
LIVING ROOM HD			193871_949724.MOV
BEDROOM HD			193871_949725.MOV
193871_Master_USDA			193871_949865.MOV

Experiment Photographs

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.


Figure 45. Pre test 1:21 hr:min, (193871_791799)


Figure 46. Pre test 1:20 hr:min (193871_791800)


Figure 47. Pre test 1:20 hr:min (193871_791801)


Figure 48. Pre test 1:20 hr:min (193871_791802)


Figure 49. Pre test 1:20 hr:min (193871_791803)


Figure 50. Pre test 1:20 hr:min (193871_791804)


Figure 51. Pre test 1:20 hr:min (193871_791805)

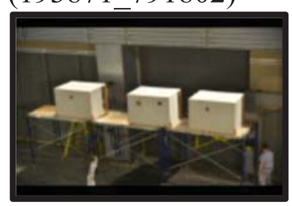
Figure 52. Pre test 1:20 hr:min (193871_791806)


Figure 53. Pre test 1:20 hr:min (193871_791807)


Figure 54. Pre test 1:20 hr:min (193871_791808)


Figure 55. Pre test 1:19 hr:min (193871_791809)


Figure 56. Pre test 1:19 hr:min (193871_791810)


Figure 57. Pre test 1:19 hr:min (193871_791811)


Figure 58. Pre test 48 minutes (193871_791812)


Figure 59. Pre test 48 minutes (193871_791813)


Figure 60. Pre test 48 minutes (193871_791814)


Figure 61. Pre test 47 minutes (193871_791815)


Figure 62. Pre test 47 minutes (193871_791816)


Figure 63. Pre test 47 minutes (193871_791817)


Figure 64. Pre test 47 minutes (193871_791818)


Figure 65. Pre test 47 minutes (193871_791819)


Figure 66. Pre test 47 minutes (193871_791820)


Figure 67. Pre test 47 minutes (193871_791821)


Figure 68. Pre test 47 minutes (193871_791822)


Figure 69. Pre test 46 minutes (193871_791823)


Figure 70. Pre test 46 minutes (193871_791824)

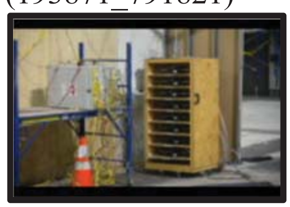
Figure 71. Pre test 46 minutes (193871_791825)


Figure 72. Pre test 46 minutes (193871_791826)


Figure 73. Pre test 46 minutes (193871_791827)


Figure 74. Pre test 46 minutes (193871_791828)


Figure 75. Pre test 46 minutes (193871_791829)


Figure 76. Pre test 45 minutes (193871_791830)


Figure 77. Pre test 45 minutes (193871_791831)


Figure 78. Pre test 45 minutes (193871_791832)


Figure 79. Pre test 45 minutes (193871_791833)


Figure 80. Pre test 45 minutes (193871_791834)


Figure 81. Pre test 45 minutes (193871_791835)


Figure 82. Pre test 45 minutes (193871_791836)

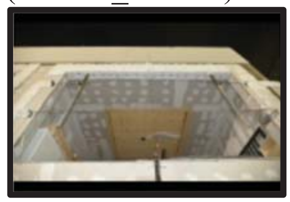
Figure 83. Pre test 45 minutes (193871_791837)


Figure 84. Pre test 44 minutes (193871_791838)

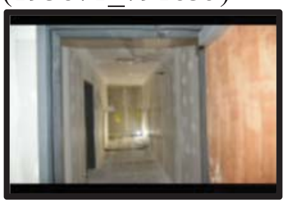
Figure 85. Pre test 44 minutes (193871_791839)

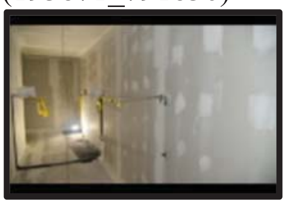
Figure 86. Pre test 44 minutes (193871_791840)

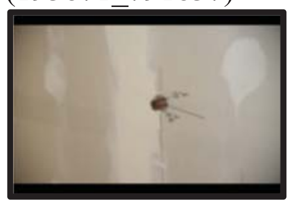
Figure 87. Pre test 44 minutes (193871_791841)

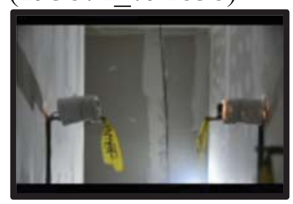
Figure 88. Pre test 44 minutes (193871_791842)


Figure 89. Pre test 44 minutes (193871_791843)


Figure 90. Pre test 44 minutes (193871_791844)


Figure 91. Pre test 44 minutes (193871_791845)

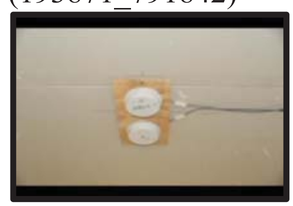
Figure 92. Pre test 43 minutes (193871_791846)


Figure 93. Pre test 43 minutes (193871_791847)


Figure 94. Pre test 43 minutes (193871_791848)


Figure 95. Pre test 43 minutes (193871_791849)


Figure 96. Pre test 43 minutes (193871_791850)


Figure 97. Pre test 43 minutes (193871_791851)


Figure 98. Pre test 42 minutes (193871_791852)


Figure 99. Pre test 42 minutes (193871_791853)


Figure 100. Pre test 42 minutes (193871_791854)


Figure 101. Pre test 42 minutes (193871_791855)


Figure 102. Pre test 42 minutes (193871_791856)


Figure 103. Pre test 42 minutes (193871_791857)


Figure 104. Pre test 42 minutes (193871_791858)


Figure 105. Pre test 42 minutes (193871_791859)


Figure 106. Pre test 42 minutes (193871_791860)


Figure 107. Pre test 42 minutes (193871_791861)


Figure 108. Pre test 42 minutes (193871_791862)


Figure 109. Pre test 42 minutes (193871_791863)


Figure 110. Pre test 42 minutes (193871_791864)


Figure 111. Pre test 42 minutes (193871_791865)


Figure 112. Pre test 41 minutes (193871_791866)


Figure 113. Pre test 41 minutes (193871_791867)


Figure 114. Pre test 41 minutes (193871_791868)


Figure 115. Pre test 41 minutes (193871_791869)


Figure 116. Pre test 41 minutes (193871_791870)


Figure 117. Pre test 41 minutes (193871_791871)


Figure 118. Pre test 41 minutes (193871_791872)


Figure 119. Pre test 41 minutes (193871_791873)


Figure 120. Pre test 41 minutes (193871_791874)


Figure 121. Pre test 41 minutes (193871_791875)


Figure 122. Pre test 41 minutes (193871_791876)


Figure 123. Pre test 41 minutes (193871_791877)


Figure 124. Pre test 41 minutes (193871_791878)

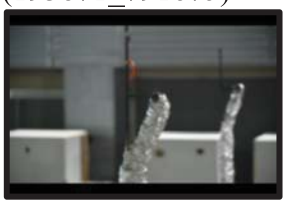
Figure 125. Pre test 41 minutes (193871_791879)

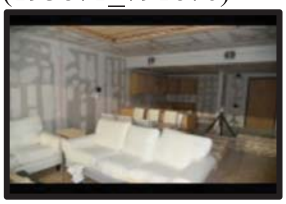
Figure 126. Pre test 41 minutes (193871_791880)


Figure 127. Pre test 40 minutes (193871_791881)


Figure 128. Pre test 40 minutes (193871_791882)


Figure 129. Pre test 40 minutes (193871_791883)


Figure 130. Pre test 40 minutes (193871_791884)


Figure 131. Pre test 40 minutes (193871_791885)


Figure 132. Pre test 40 minutes (193871_791886)


Figure 133. Pre test 40 minutes (193871_791887)


Figure 134. Pre test 40 minutes (193871_791888)


Figure 135. Pre test 40 minutes (193871_791889)


Figure 136. Pre test 40 minutes (193871_791890)


Figure 137. Pre test 40 minutes (193871_791891)


Figure 138. Pre test 40 minutes (193871_791892)


Figure 139. Pre test 39 minutes (193871_791893)


Figure 140. Pre test 39 minutes (193871_791894)


Figure 141. Pre test 39 minutes (193871_791895)


Figure 142. Pre test 39 minutes (193871_791896)


Figure 143. Pre test 39 minutes (193871_791897)


Figure 144. Pre test 39 minutes (193871_791898)


Figure 145. Pre test 39 minutes (193871_791899)


Figure 146. Pre test 39 minutes (193871_791900)

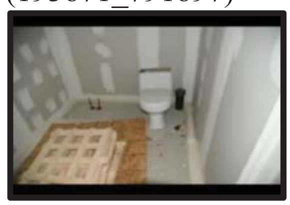
Figure 147. Pre test 38 minutes (193871_791901)

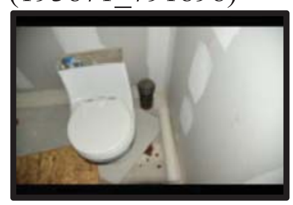
Figure 148. Pre test 38 minutes (193871_791902)


Figure 149. Pre test 38 minutes (193871_791903)


Figure 150. Pre test 38 minutes (193871_791904)


Figure 151. Pre test 38 minutes (193871_791905)


Figure 152. Pre test 38 minutes (193871_791906)


Figure 153. Pre test 38 minutes (193871_791907)


Figure 154. Pre test 37 minutes (193871_791908)


Figure 155. Pre test 37 minutes (193871_791909)


Figure 156. Pre test 37 minutes (193871_791910)


Figure 157. Pre test 37 minutes (193871_791911)


Figure 158. Pre test 37 minutes (193871_791912)


Figure 159. Pre test 37 minutes (193871_791913)


Figure 160. Pre test 37 minutes (193871_791914)


Figure 161. Pre test 37 minutes (193871_791915)


Figure 162. Pre test 36 minutes (193871_791916)


Figure 163. Pre test 36 minutes (193871_791917)


Figure 164. Pre test 36 minutes (193871_791918)


Figure 165. Pre test 36 minutes (193871_791919)


Figure 166. Pre test 36 minutes (193871_791920)


Figure 167. Pre test 36 minutes (193871_791921)


Figure 168. Pre test 36 minutes (193871_791922)


Figure 169. Pre test 35 minutes (193871_791924)


Figure 170. Pre test 35 minutes (193871_791925)


Figure 171. Pre test 35 minutes (193871_791926)


Figure 172. Pre test 35 minutes (193871_791927)


Figure 173. Pre test 35 minutes (193871_791928)


Figure 174. Pre test 35 minutes (193871_791929)


Figure 175. Pre test 35 minutes (193871_791930)


Figure 176. Pre test 35 minutes (193871_791931)


Figure 177. Pre test 35 minutes (193871_791932)


Figure 178. Pre test 35 minutes (193871_791933)


Figure 179. Pre test 34 minutes (193871_791934)


Figure 180. Pre test 34 minutes (193871_791935)


Figure 181. Pre test 34 minutes (193871_791936)


Figure 182. Pre test 34 minutes (193871_791937)


Figure 183. Pre test 34 minutes (193871_791938)


Figure 184. Pre test 34 minutes (193871_791939)

Figure 185. Pre test 34 minutes (193871_791940)


Figure 186. Pre test 34 minutes (193871_791941)

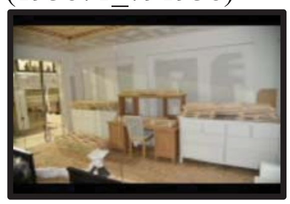
Figure 187. Pre test 33 minutes (193871_791942)


Figure 188. Pre test 33 minutes (193871_791943)


Figure 189. Pre test 33 minutes (193871_791944)


Figure 190. Pre test 33 minutes (193871_791945)


Figure 191. Pre test 33 minutes (193871_791946)


Figure 192. Pre test 33 minutes (193871_791947)


Figure 193. Pre test 33 minutes (193871_791948)


Figure 194. Pre test 33 minutes (193871_791949)


Figure 195. Pre test 32 minutes (193871_791950)


Figure 196. Pre test 32 minutes (193871_791951)


Figure 197. Pre test 32 minutes (193871_791952)


Figure 198. Pre test 32 minutes (193871_791953)


Figure 199. Pre test 32 minutes (193871_791954)


Figure 200. Pre test 32 minutes (193871_791955)


Figure 201. Pre test 32 minutes (193871_791956)

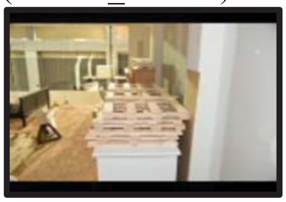
Figure 202. Pre test 32 minutes (193871_791957)


Figure 203. Pre test 31 minutes (193871_791958)


Figure 204. Pre test 31 minutes (193871_791959)


Figure 205. Pre test 31 minutes (193871_791960)


Figure 206. Pre test 31 minutes (193871_791961)


Figure 207. Pre test 31 minutes (193871_791962)

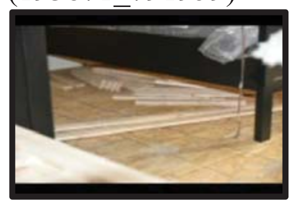
Figure 208. Pre test 31 minutes (193871_791963)


Figure 209. Pre test 31 minutes (193871_791964)


Figure 210. Pre test 31 minutes (193871_791965)


Figure 211. Pre test 30 minutes (193871_791966)


Figure 212. Pre test 30 minutes (193871_791967)


Figure 213. Pre test 21 minutes (193871_791968)


Figure 214. Pre test 21 minutes (193871_791969)


Figure 215. Pre test 20 minutes (193871_791970)


Figure 216. Pre test 19 minutes (193871_791971)

Figure 217. Pre test 19 minutes (193871_791972)

Figure 218. Pre test 19 minutes (193871_791973)

Figure 219. Pre test 19 minutes (193871_791974)

Figure 220. Pre test 19 minutes (193871_791975)

Figure 221. 8042 seconds (193871_791977)

Figure 222. 8045 seconds (193871_791978)

Figure 223. 8054 seconds (193871_791979)

Figure 224. 8062 seconds (193871_791980)

Figure 225. 8071 seconds (193871_791981)

Figure 226. 8074 seconds (193871_791982)

Figure 227. 8079 seconds (193871_791983)

Figure 228. 8085 seconds (193871_791984)

Figure 229. 10585 seconds (193871_791985)

Figure 230. 10591 seconds (193871_791986)

Figure 231. 10600 seconds (193871_791987)

Figure 232. 10603 seconds (193871_791988)

Figure 233. 10608 seconds (193871_791989)

Figure 234. 10615 seconds (193871_791990)

Figure 235. 10629 seconds (193871_791991)

Figure 236. 10631 seconds (193871_791992)

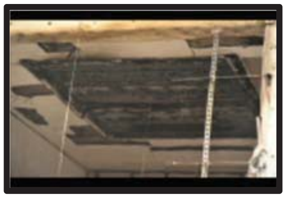
Figure 237. 10635 seconds (193871_791993)


Figure 238. 10641 seconds (193871_791994)


Figure 239. 12277 seconds (193871_791995)


Figure 240. 12283 seconds (193871_791996)


Figure 241. 12286 seconds (193871_791997)


Figure 242. 12294 seconds (193871_791998)


Figure 243. 12304 seconds (193871_791999)


Figure 244. 12314 seconds (193871_792000)


Figure 245. 12317 seconds (193871_792001)

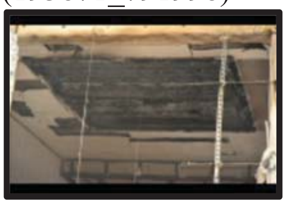
Figure 246. 12322 seconds (193871_792002)

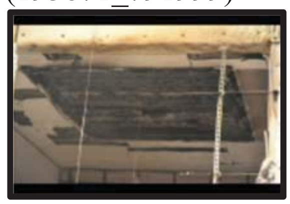
Figure 247. 12324 seconds (193871_792003)


Figure 248. 12332 seconds (193871_792004)


Figure 249. 14090 seconds (193871_792005)


Figure 250. 14095 seconds (193871_792006)


Figure 251. 14099 seconds (193871_792007)


Figure 252. 14105 seconds (193871_792008)

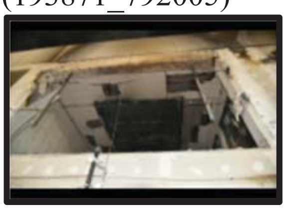
Figure 253. 14113 seconds (193871_792009)


Figure 254. 14116 seconds (193871_792010)


Figure 255. 14124 seconds (193871_792011)


Figure 256. 14136 seconds (193871_792012)


Figure 257. 14139 seconds (193871_792013)


Figure 258. 14143 seconds (193871_792014)


Figure 259. 14151 seconds (193871_792015)


Figure 260. 14158 seconds (193871_792016)


Figure 261. 14164 seconds (193871_792017)


Figure 262. 14173 seconds (193871_792018)


Figure 263. 14179 seconds (193871_792019)


Figure 264. 14191 seconds (193871_792020)


Figure 265. 14202 seconds (193871_792021)


Figure 266. 14208 seconds (193871_792022)

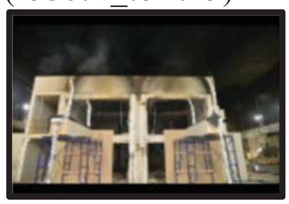
Figure 267. 14214 seconds (193871_792023)

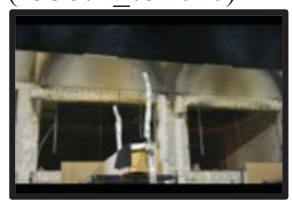
Figure 268. 14224 seconds (193871_792024)


Figure 269. Post test 16 minutes (193871_792025)


Figure 270. Post test 28 minutes (193871_792027)


Figure 271. Post test 28 minutes (193871_792028)


Figure 272. Post test 28 minutes (193871_792029)


Figure 273. Post test 28 minutes (193871_792030)


Figure 274. Post test 28 minutes (193871_792031)


Figure 275. Post test 28 minutes (193871_792032)


Figure 276. Post test 28 minutes (193871_792033)


Figure 277. Post test 29 minutes (193871_792034)


Figure 278. Post test 29 minutes (193871_792035)


Figure 279. Post test 29 minutes (193871_792036)


Figure 280. Post test 29 minutes (193871_792037)


Figure 281. Post test 29 minutes (193871_792038)


Figure 282. Post test 29 minutes (193871_792039)


Figure 283. Post test 29 minutes (193871_792040)


Figure 284. Post test 29 minutes (193871_792041)


Figure 285. Post test 29 minutes (193871_792042)


Figure 286. Post test 29 minutes (193871_792043)


Figure 287. Post test 29 minutes (193871_792044)


Figure 288. Post test 29 minutes (193871_792045)


Figure 289. Post test 29 minutes (193871_792046)


Figure 290. Post test 29 minutes (193871_792047)


Figure 291. Post test 30 minutes (193871_792048)


Figure 292. Post test 30 minutes (193871_792049)


Figure 293. Post test 30 minutes (193871_792050)


Figure 294. Post test 30 minutes (193871_792051)


Figure 295. Post test 30 minutes (193871_792052)


Figure 296. Post test 30 minutes (193871_792053)


Figure 297. Post test 30 minutes (193871_792054)


Figure 298. Post test 30 minutes (193871_792055)


Figure 299. Post test 30 minutes (193871_792056)


Figure 300. Post test 30 minutes (193871_792057)


Figure 301. Post test 31 minutes (193871_792058)


Figure 302. Post test 31 minutes (193871_792059)


Figure 303. Post test 31 minutes (193871_792060)


Figure 304. Post test 31 minutes (193871_792061)


Figure 305. Post test 31 minutes (193871_792062)


Figure 306. Post test 31 minutes (193871_792063)


Figure 307. Post test 31 minutes (193871_792064)


Figure 308. Post test 31 minutes (193871_792065)


Figure 309. Post test 32 minutes (193871_792066)


Figure 310. Post test 32 minutes (193871_792067)


Figure 311. Post test 32 minutes (193871_792068)


Figure 312. Post test 32 minutes (193871_792069)


Figure 313. Post test 32 minutes (193871_792070)


Figure 314. Post test 32 minutes (193871_792071)


Figure 315. Post test 32 minutes (193871_792072)


Figure 316. Post test 32 minutes (193871_792073)


Figure 317. Post test 32 minutes (193871_792074)


Figure 318. Post test 33 minutes (193871_792075)


Figure 319. Post test 33 minutes (193871_792076)


Figure 320. Post test 33 minutes (193871_792077)


Figure 321. Post test 33 minutes (193871_792078)


Figure 322. Post test 33 minutes (193871_792079)


Figure 323. Post test 33 minutes (193871_792080)


Figure 324. Post test 33 minutes (193871_792081)


Figure 325. Post test 34 minutes (193871_792082)


Figure 326. Post test 34 minutes (193871_792083)


Figure 327. Post test 34 minutes (193871_792084)


Figure 328. Post test 34 minutes (193871_792085)


Figure 329. Post test 34 minutes (193871_792086)


Figure 330. Post test 34 minutes (193871_792087)


Figure 331. Post test 34 minutes (193871_792088)


Figure 332. Post test 35 minutes (193871_792089)


Figure 333. Post test 35 minutes (193871_792090)


Figure 334. Post test 35 minutes (193871_792091)


Figure 335. Post test 35 minutes (193871_792092)


Figure 336. Post test 35 minutes (193871_792093)

Figure 337. Post test 35 minutes (193871_792094)

Figure 338. Post test 35 minutes (193871_792095)

Figure 339. Post test 35 minutes (193871_792096)

Figure 340. Post test 35 minutes (193871_792097)

Figure 341. Post test 36 minutes (193871_792098)

Figure 342. Post test 36 minutes (193871_792099)

Figure 343. Post test 36 minutes (193871_792100)

Figure 344. Post test 36 minutes (193871_792101)

Figure 345. Post test 36 minutes (193871_792102)

Figure 346. Post test 36 minutes (193871_792103)

Figure 347. Post test 36 minutes (193871_792104)

Figure 348. Post test 37 minutes (193871_792105)

Figure 349. Post test 37 minutes (193871_792106)

Figure 350. Post test 37 minutes (193871_792107)

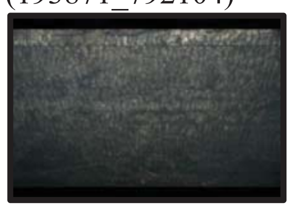

Figure 351. Post test 37 minutes (193871_792108)

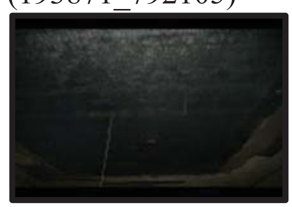

Figure 352. Post test 37 minutes (193871_792109)

Figure 353. Post test 37 minutes (193871_792110)

Figure 354. Post test 37 minutes (193871_792111)

Figure 355. Post test 37 minutes (193871_792112)

Figure 356. Post test 38 minutes (193871_792113)


Figure 357. Post test 38 minutes (193871_792114)


Figure 358. Post test 38 minutes (193871_792115)


Figure 359. Post test 38 minutes (193871_792116)


Figure 360. Post test 38 minutes (193871_792117)


Figure 361. Post test 38 minutes (193871_792118)


Figure 362. Post test 38 minutes (193871_792119)


Figure 363. Post test 39 minutes (193871_792120)


Figure 364. Post test 39 minutes (193871_792121)


Figure 365. Post test 39 minutes (193871_792122)


Figure 366. Post test 39 minutes (193871_792123)


Figure 367. Post test 39 minutes (193871_792124)


Figure 368. Post test 39 minutes (193871_792125)

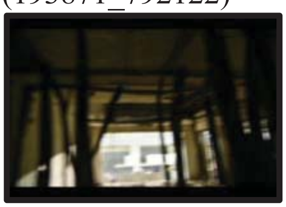
Figure 369. Post test 39 minutes (193871_792126)


Figure 370. Post test 39 minutes (193871_792127)


Figure 371. Post test 39 minutes (193871_792128)


Figure 372. Post test 40 minutes (193871_792129)


Figure 373. Post test 40 minutes (193871_792130)


Figure 374. Post test 40 minutes (193871_792131)


Figure 375. Post test 40 minutes (193871_792132)


Figure 376. Post test 40 minutes (193871_792133)


Figure 377. Post test 40 minutes (193871_792134)


Figure 378. Post test 40 minutes (193871_792135)


Figure 379. Post test 40 minutes (193871_792136)


Figure 380. Post test 41 minutes (193871_792137)


Figure 381. Post test 41 minutes (193871_792138)


Figure 382. Post test 41 minutes (193871_792139)


Figure 383. Post test 41 minutes (193871_792140)


Figure 384. Post test 41 minutes (193871_792141)


Figure 385. Post test 41 minutes (193871_792142)


Figure 386. Post test 41 minutes (193871_792143)


Figure 387. Post test 41 minutes (193871_792144)


Figure 388. Post test 42 minutes (193871_792145)


Figure 389. Post test 42 minutes (193871_792146)


Figure 390. Post test 42 minutes (193871_792147)


Figure 391. Post test 42 minutes (193871_792148)


Figure 392. Post test 42 minutes (193871_792149)


Figure 393. Post test 42 minutes (193871_792150)


Figure 394. Post test 43 minutes (193871_792151)


Figure 395. Post test 43 minutes (193871_792152)


Figure 396. Post test 43 minutes (193871_792153)


Figure 397. Post test 43 minutes (193871_792154)


Figure 398. Post test 43 minutes (193871_792155)


Figure 399. Post test 43 minutes (193871_792156)


Figure 400. Post test 43 minutes (193871_792157)


Figure 401. Post test 44 minutes (193871_792158)


Figure 402. Post test 44 minutes (193871_792159)


Figure 403. Post test 44 minutes (193871_792160)


Figure 404. Post test 44 minutes (193871_792161)


Figure 405. Post test 44 minutes (193871_792162)


Figure 406. Post test 44 minutes (193871_792163)


Figure 407. Post test 44 minutes (193871_792164)


Figure 408. Post test 44 minutes (193871_792165)


Figure 409. Post test 45 minutes (193871_792166)


Figure 410. Post test 45 minutes (193871_792167)


Figure 411. Post test 45 minutes (193871_792168)


Figure 412. Post test 45 minutes (193871_792169)


Figure 413. Post test 45 minutes (193871_792170)


Figure 414. Post test 45 minutes (193871_792171)


Figure 415. Post test 46 minutes (193871_792172)


Figure 416. Post test 46 minutes (193871_792173)


Figure 417. Post test 46 minutes (193871_792174)


Figure 418. Post test 46 minutes (193871_792175)


Figure 419. Post test 46 minutes (193871_792176)


Figure 420. Post test 46 minutes (193871_792177)


Figure 421. Post test 46 minutes (193871_792178)


Figure 422. Post test 46 minutes (193871_792179)


Figure 423. Post test 46 minutes (193871_792180)


Figure 424. Post test 47 minutes (193871_792181)


Figure 425. Post test 47 minutes (193871_792182)


Figure 426. Post test 47 minutes (193871_792183)


Figure 427. Post test 4 days (193871_792628)


Figure 428. Post test 4 days (193871_792629)

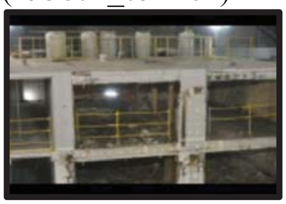
Figure 429. Post test 4 days (193871_792630)


Figure 430. Post test 4 days (193871_792631)


Figure 431. Post test 5 days (193871_792632)


Figure 432. Post test 5 days (193871_792633)


Figure 433. Post test 5 days (193871_792634)


Figure 434. Post test 5 days (193871_792635)


Figure 435. Post test 5 days (193871_792636)


Figure 436. Post test 5 days (193871_792637)


Figure 437. Post test 5 days (193871_792638)


Figure 438. Post test 5 days (193871_792639)


Figure 439. Post test 5 days (193871_792640)


Figure 440. Post test 5 days (193871_792641)


Figure 441. Post test 5 days (193871_792642)


Figure 442. Post test 5 days (193871_792643)


Figure 443. Post test 5 days (193871_792644)


Figure 444. Post test 5 days (193871_792645)


Figure 445. Post test 5 days (193871_792646)


Figure 446. Post test 5 days (193871_792647)


Figure 447. Post test 5 days (193871_792648)


Figure 448. Post test 5 days (193871_792649)


Figure 449. Post test 5 days (193871_792650)


Figure 450. Post test 5 days (193871_792651)


Figure 451. Post test 5 days (193871_792652)


Figure 452. Post test 5 days (193871_792653)


Figure 453. Post test 5 days (193871_792654)


Figure 454. Post test 5 days (193871_792655)


Figure 455. Post test 5 days (193871_792656)


Figure 456. Post test 5 days (193871_792657)


Figure 457. Post test 5 days (193871_792658)


Figure 458. Post test 5 days (193871_792659)


Figure 459. Post test 5 days (193871_792660)


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Figure 462. Post test 5 days (193871_792663)

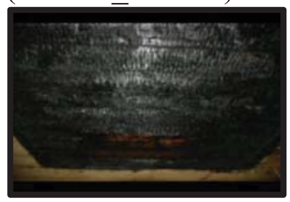
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Figure 467. Post test 5 days (193871_792668)


Figure 468. Post test 5 days (193871_792669)


Figure 469. Post test 5 days (193871_792670)


Figure 470. Post test 5 days (193871_792671)


Figure 471. Post test 5 days (193871_792672)


Figure 472. Post test 5 days (193871_792673)


Figure 473. Post test 5 days (193871_792674)


Figure 474. Post test 5 days (193871_792675)


Figure 475. Post test 5 days (193871_792676)


Figure 476. Post test 5 days (193871_792677)


Figure 477. Post test 5 days (193871_792678)


Figure 478. Post test 5 days (193871_792679)


Figure 479. Post test 5 days (193871_792680)


Figure 480. Post test 5 days (193871_792681)


Figure 481. Post test 5 days (193871_792682)


Figure 482. Post test 5 days (193871_792683)


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Figure 485. Post test 5 days (193871_792686)


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Figure 487. Post test 5 days (193871_792688)


Figure 488. Post test 5 days (193871_792689)


Figure 489. Post test 5 days (193871_792690)


Figure 490. Post test 5 days (193871_792691)


Figure 491. Post test 5 days (193871_792692)


Figure 492. Post test 5 days (193871_792693)


Figure 493. Post test 5 days (193871_792694)


Figure 494. Post test 5 days (193871_792695)


Figure 495. Post test 5 days (193871_792696)


Figure 496. Post test 5 days (193871_792697)


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Figure 498. Post test 5 days (193871_792699)


Figure 499. Post test 5 days (193871_792700)


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Figure 502. Post test 5 days (193871_792703)


Figure 503. Post test 5 days (193871_792704)


Figure 504. Post test 5 days (193871_792705)


Figure 505. Post test 5 days (193871_792706)


Figure 506. Post test 5 days (193871_792707)


Figure 507. Post test 5 days (193871_792708)


Figure 508. Post test 5 days (193871_792709)


Figure 509. Post test 5 days (193871_792710)


Figure 510. Post test 5 days (193871_792711)


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Figure 514. Post test 5 days (193871_792715)


Figure 515. Post test 5 days (193871_792716)


Figure 516. Post test 5 days (193871_792717)


Figure 517. Post test 5 days (193871_792718)


Figure 518. Post test 5 days (193871_792719)


Figure 519. Post test 5 days (193871_792720)


Figure 520. Post test 5 days (193871_792721)


Figure 521. Post test 5 days (193871_792722)


Figure 522. Post test 5 days (193871_792723)


Figure 523. Post test 5 days (193871_792724)


Figure 524. Post test 5 days (193871_792725)


Figure 525. Post test 5 days (193871_792726)


Figure 526. Post test 5 days (193871_792727)


Figure 527. Post test 5 days (193871_792728)


Figure 528. Post test 5 days (193871_792729)


Figure 529. Post test 5 days (193871_792730)


Figure 530. Post test 5 days (193871_792731)


Figure 531. Post test 5 days (193871_792732)


Figure 532. Post test 5 days (193871_792733)


Figure 533. Post test 5 days (193871_792734)


Figure 534. Post test 5 days (193871_792735)


Figure 535. Post test 5 days (193871_792736)


Figure 536. Post test 5 days (193871_792737)

Figure 537. Post test
5 days
(193871_792738)

References

1 ATF Fire Research Laboratory, CLT Project Report, 17OA0001 Sub 1, December 22, 2017

Appendix 3—Cross-Laminated Timber Project Test 3 Results

U. S. Department of Justice

Fire Research Laboratory
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES
6000 Ammendale Road
Beltsville, MD 20705-1250
Phone: 202-648-6200

Test Record

ASCLD/LAB–*International* Testing Accreditation Certificate ALI-217-T

Title	CLT Project - Test 3 Results		
Test Type	Custom		
Lab Number	17OA0001-1	**Author**	David R. Tucholski
Test Date	6/20/17	**Test Number**	3 of 5

Introduction

The following provides the data for the third test of the CLT Project. The test was conducted on the second floor of the test structure. The CLT walls in the bedroom and living room were exposed. All other CLT surfaces were encapsulated with two layers of (5/8 inch) Type X gypsum wallboard. The two large openings in Wall A where not covered with glass and remained opened. Fire sprinklers were not installed in the structure. The test duration was 4 hours. Additional details related to the test structure, instrumentation, and experimental procedures are provided in the main CLT Project report [1].

Table of Contents

Instrumentation Location

The following figure describes the nomenclature used to identify the various instrumentation and their locations.

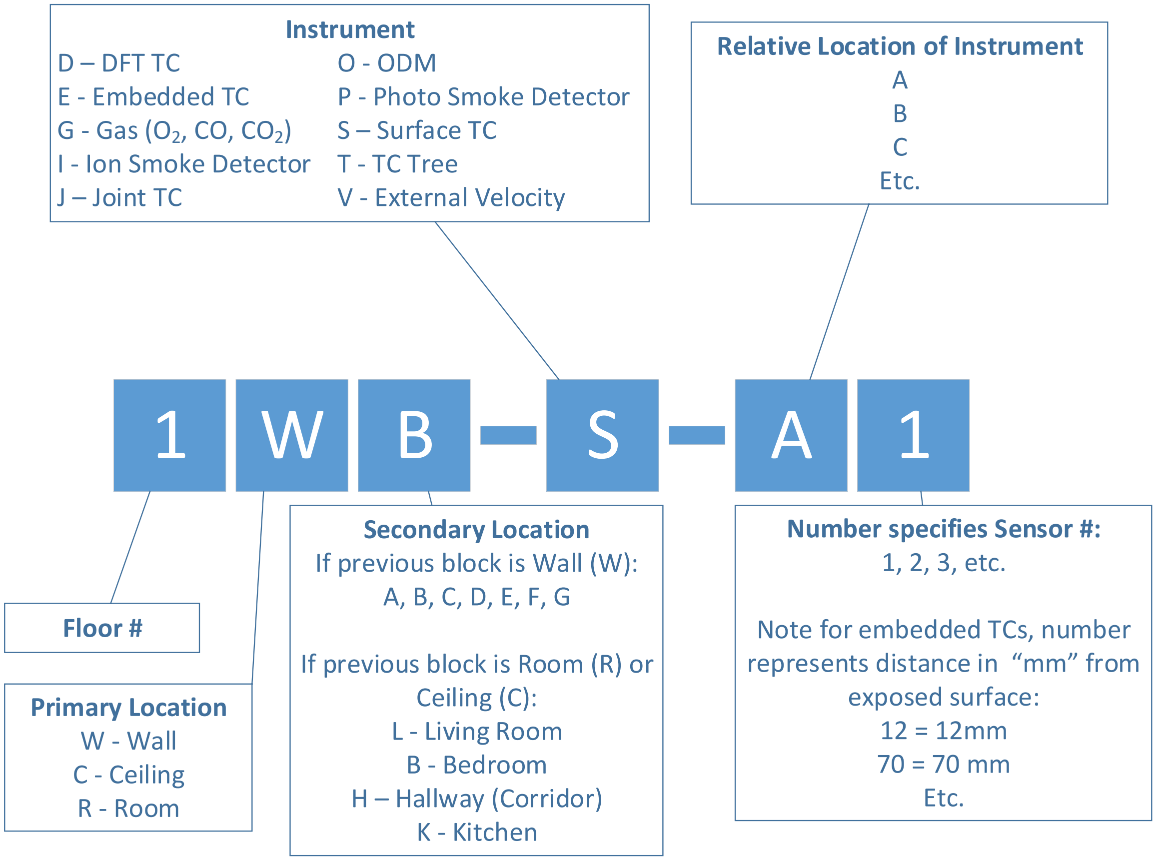


Figure 1. Nomenclature of Instrumentation Location

The example shown in Figure 1 is for a thermocouple located on the surface of Wall B on the first floor. It is the first thermocouple at location A. The exact location of each instrument is based on a Cartesian coordinate system (X, Y, Z). Location X and Location Y are located in the horizontal plane. Location Z is the vertical distance from the floor to the centerline of the instrument. Drawings showing the instrumentation locations and the associated coordinate systems are provided in the main CLT Project report [1].

Results for Test 3 (ID 203923)

Restoration of Test Structure and Setup Photographs

The following photographs show the restoration of the test structure after Test 2 and of the experiment setup.

Figure 2. 203923_825562

Figure 3. 203923_825563

Figure 4. 203923_825564

Figure 5. 203923_825565

Figure 6. 203923_825566

Figure 7. 203923_825567

Figure 8. 203923_825568

Figure 9. 203923_825569

Figure 10. 203923_825570

Figure 11. 203923_825571

Figure 12. 203923_825572

Figure 13. 203923_825573

Figure 14. 203923_825574

Figure 15. 203923_825575

Figure 16. 203923_825576

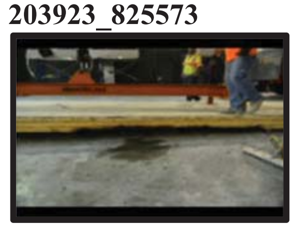


Figure 17. 203923_825577

Figure 18. 203923_825578

Figure 19. 203923_825579

Figure 20. 203923_825580

Figure 21. 203923_825581


Figure 22.
203923_825582


Figure 23.
203923_825583


Figure 24.
203923_825584


Figure 25.
203923_825585

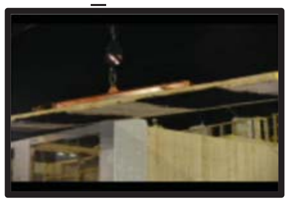

Figure 26.
203923_825586


Figure 27.
203923_825587


Figure 28.
203923_825588


Figure 29.
203923_825589


Figure 30.
203923_825590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203923_825591


Figure 32.
203923_825592


Figure 33.
203923_825593


Figure 34.
203923_825594


Figure 35.
203923_825595


Figure 36.
203923_825596


Figure 37.
203923_825597


Figure 38.
203923_825598


Figure 39.
203923_825599


Figure 40.
203923_825600


Figure 41.
203923_825601

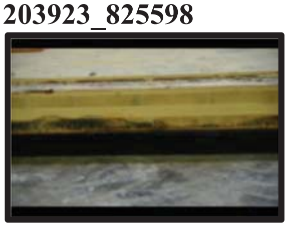
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Figure 43.
203923_825603


Figure 44.
203923_825604


Figure 45.
203923_825605

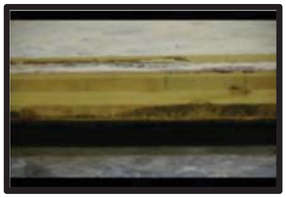
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Figure 47. 203923_825607


Figure 48. 203923_825608


Figure 49. 203923_825609


Figure 50. 203923_825610


Figure 51. 203923_825611


Figure 52. 203923_825612


Figure 53. 203923_825613


Figure 54. 203923_825614

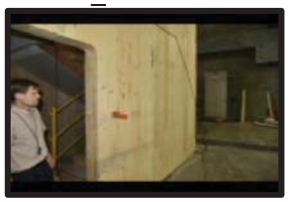
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Figure 58. 203923_825618


Figure 59. 203923_825619


Figure 60. 203923_825620


Figure 61. 203923_825621


Figure 62. 203923_825622


Figure 63. 203923_825623


Figure 64. 203923_825624


Figure 65. 203923_825625


Figure 66. 203923_825626


Figure 67. 203923_825627


Figure 68. 203923_825628


Figure 69. 203923_825629


Figure 70. 203923_825630


Figure 71. 203923_825631


Figure 72. 203923_825632


Figure 73. 203923_825633


Figure 74. 203923_825634


Figure 75. 203923_825635


Figure 76. 203923_825636


Figure 77. 203923_825637


Figure 78. 203923_825638


Figure 79. 203923_825639


Figure 80. 203923_825640


Figure 81. 203923_825641


Figure 82. 203923_825642


Figure 83. 203923_825643


Figure 84. 203923_825644


Figure 85. 203923_825645


Figure 86. 203923_825646


Figure 87. 203923_825647


Figure 88. 203923_825648


Figure 89. 203923_825649


Figure 90. 203923_825650


Figure 91. 203923_825651

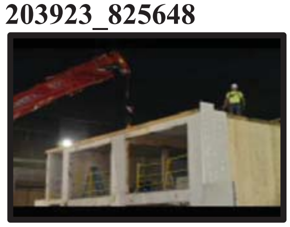
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Figure 95.
203923_825920

Figure 96.
203923_825921

Figure 97.
203923_825922

Figure 98.
203923_825923

Figure 99.
203923_825924

Figure 100.
203923_825925

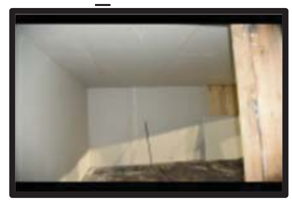

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Figure 102.
203923_825927

Figure 103.
203923_825654

Figure 104.
203923_825928

Figure 105.
203923_825929

Figure 106.
203923_825930

Figure 107.
203923_825931

Figure 108.
203923_825932

Figure 109.
203923_825933

Figure 110.
203923_825934

Figure 111.
203923_825935

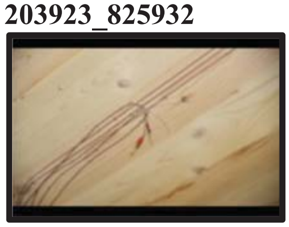

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Figure 114.
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Figure 115.
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Figure 116.
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Figure 117.
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Figure 121.
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Figure 122.
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Figure 123.
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Figure 124.
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Figure 125.
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Figure 126.
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Figure 127.
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Figure 129.
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Figure 130.
203923_825954


Figure 131.
203923_825955


Figure 132.
203923_825956


Figure 133.
203923_825957

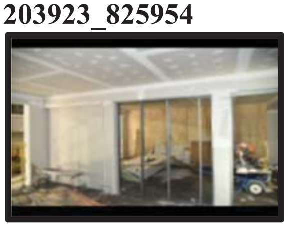
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Figure 135.
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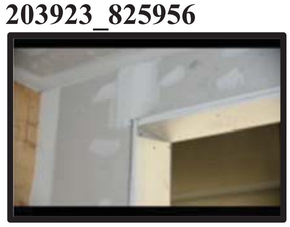
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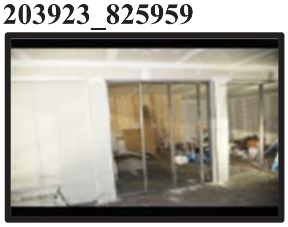
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Figure 140.
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Figure 142.
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Figure 143.
203923_825967


Figure 144.
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Figure 145.
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Figure 146.
203923_825970


Figure 147.
203923_825971


Figure 148.
203923_825972


Figure 149.
203923_825973


Figure 150.
203923_825974


Figure 151.
203923_825975


Figure 152.
203923_825976


Figure 153.
203923_825977


Figure 154.
203923_825978


Figure 155.
203923_825979


Figure 156.
203923_825980


Figure 157.
203923_825981


Figure 158.
203923_825982


Figure 159.
203923_825983


Figure 160.
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Figure 161.
203923_825893


Figure 162.
203923_825894


Figure 163.
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Figure 164.
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Figure 165.
203923_825897


Figure 166.
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Figure 167.
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Figure 168.
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Figure 169.
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Figure 170.
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Figure 171.
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Figure 172.
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Figure 173.
203923_825905


Figure 174.
203923_825906


Figure 175.
203923_825907


Figure 176.
203923_825908


Figure 177.
203923_825909

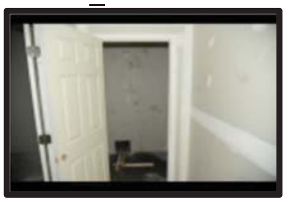
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Figure 181.
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Figure 182.
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Figure 183.
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Figure 184.
203923_825916


Figure 185.
203923_825917


Figure 186.
203923_825918


Figure 187.
203923_825655

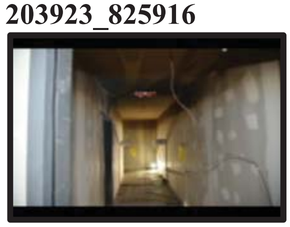
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Figure 192.
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Figure 193.
203923_825661


Figure 194.
203923_825662


Figure 195.
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Figure 196.
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Figure 197.
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Figure 198.
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Figure 199.
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Figure 200.
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Figure 201.
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Figure 202.
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Figure 203.
203923_825671


Figure 204.
203923_825672


Figure 205.
203923_825673


Figure 206.
203923_825674

Experiment Events

The following table lists selected events that occurred during the experiment.

Table 1. Experiment Events

Description	Time (s)	Time (hh:mm:ss)
FPC Offline Due to an Issue with Gas Filtration System	0	00:00:00
Flashover Living Room	757	00:12:37
Flashover Bedroom	1020	00:17:00
FPC Online	1219	00:20:19
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	4696	01:18:16
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	5673	01:34:33
FPC Offline	6023	01:40:23
FPC Online	6084	01:41:24
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	6421	01:47:01
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	6893	01:54:53
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	7682	02:08:02
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	8091	02:14:51
Wall D - Small flame in hole for data cables suppressed with water	8140	02:15:40
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	8191	02:16:31
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	8280	02:18:00
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	8703	02:25:03
Wall D - Small flame inside bedroom at ceiling panel/inner wall interface suppressed with water	8772	02:26:12
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	8794	02:26:34
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	8951	02:29:11
Wall D - Small flame in hole for data cables suppressed with water	9044	02:30:44
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	9340	02:35:40
Wall D - Small flame in hole for data cables suppressed with water	9376	02:36:16
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	9537	02:38:57
Wall D - Small flame in hole for data cables and ceiling panel/outer wall interface suppressed with water	9558	02:39:18
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	9591	02:39:51
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	10066	02:47:46
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	10540	02:55:40
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	10582	02:56:22
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	10884	03:01:24
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	10912	03:01:52
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	11048	03:04:08
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	11143	03:05:43
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	11215	03:06:55
Gas Cart Off	11416	03:10:16
Gas Cart On	11470	03:11:10
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	11673	03:14:33
Wall D - Small flame in hole for data cables and ceiling panel/outer wall interface suppressed with water	11707	03:15:07
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	12050	03:20:50
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	12191	03:23:11
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	12446	03:27:26
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	12689	03:31:29
Wall D - Small flame in hole for data cables and ceiling panel/outer wall interface suppressed with water	12826	03:33:46
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	12877	03:34:37
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	13003	03:36:43
Wall D - Small flame at ceiling panel/outer wall interface suppressed with water	13029	03:37:09

Description	Time (s)	Time (hh:mm:ss)
Wall D - Small flame in hole for data cables and ceiling panel/outer wall interface suppressed with water	13430	03:43:50
Wall B - Small flame at ceiling panel/outer wall interface suppressed with water	13600	03:46:40

Laboratory Conditions

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 2. Lab Conditions Description

Description	Manufacturer	Model
LBR_01	OMEGA	IBTHP-5

The following table provides a summary of the initial conditions at the start of the experiments. The 'Description' column shows the location of the measurements.

Table 3. Ambient Laboratory Condition Summary

Description	Initial (C)	Initial (kPa)	Initial (%)
LBR_01	26	101	59

Thermocouples

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement. The "Z" location is the height of the thermocouple above the floor. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 4. Thermocouple Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2RL-T-B0	2.210	3.810	0.152	Type K, Glass Ins., 24 AWG wire
2RL-T-B2	2.210	3.810	0.610	Type K, Glass Ins., 24 AWG wire
2RL-T-B4	2.210	3.810	1.219	Type K, Glass Ins., 24 AWG wire
2RL-T-B6	2.210	3.810	1.829	Type K, Glass Ins., 24 AWG wire
2RL-T-B8	2.210	3.810	2.438	Type K, Glass Ins., 24 AWG wire
2RL-T-B9	2.210	3.810	2.718	Type K, Glass Ins., 24 AWG wire
2RK-T-A0	2.210	7.620	0.152	Type K, Glass Ins., 24 AWG wire
2RK-T-A2	2.210	7.620	0.610	Type K, Glass Ins., 24 AWG wire
2RK-T-A4	2.210	7.620	1.219	Type K, Glass Ins., 24 AWG wire
2RK-T-A6	2.210	7.620	1.829	Type K, Glass Ins., 24 AWG wire
2RK-T-A8	2.210	7.620	2.413	Type K, Glass Ins., 24 AWG wire
2RB-T-A0	2.210	2.286	0.152	Type K, Glass Ins., 24 AWG wire
2RB-T-A2	2.210	2.286	0.610	Type K, Glass Ins., 24 AWG wire
2RB-T-A4	2.210	2.286	1.219	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2RB-T-A6	2.210	2.286	1.829	Type K, Glass Ins., 24 AWG wire
2RB-T-A8	2.210	2.286	2.438	Type K, Glass Ins., 24 AWG wire
2RB-T-A9	2.210	2.286	2.718	Type K, Glass Ins., 24 AWG wire
2RB-T-B0	1.981	3.505	0.152	Type K, Glass Ins., 24 AWG wire
2RB-T-B2	1.981	3.505	0.610	Type K, Glass Ins., 24 AWG wire
2RB-T-B4	1.981	3.505	1.219	Type K, Glass Ins., 24 AWG wire
2RB-T-B6	1.981	3.505	1.829	Type K, Glass Ins., 24 AWG wire
2RB-T-B8	1.981	3.505	2.438	Type K, Glass Ins., 24 AWG wire
2RB-T-B9	1.981	3.505	2.718	Type K, Glass Ins., 24 AWG wire
2WG-T-A0	4.572	1.829	0.152	Type K, Glass Ins., 24 AWG wire
2WG-T-A2	4.572	1.829	0.610	Type K, Glass Ins., 24 AWG wire
2WG-T-A4	4.572	1.829	1.219	Type K, Glass Ins., 24 AWG wire
2WG-T-A6	4.572	1.829	1.829	Type K, Glass Ins., 24 AWG wire
2WG-T-A8	4.572	1.829	2.286	Type K, Glass Ins., 24 AWG wire
2WG-T-B0	4.572	3.810	0.152	Type K, Glass Ins., 24 AWG wire
2WG-T-B4	4.572	3.810	1.219	Type K, Glass Ins., 24 AWG wire
2WG-T-B6	4.572	3.810	1.829	Type K, Glass Ins., 24 AWG wire
2WG-T-B8	4.572	3.810	2.286	Type K, Glass Ins., 24 AWG wire
2RH-T-A0	0.762	1.067	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-A2	0.762	1.067	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-A4	0.762	1.067	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-A6	0.762	1.067	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-A8	0.762	1.067	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-A9	0.762	1.067	2.718	Type K, Glass Ins., 24 AWG wire
2RH-T-B0	4.115	10.363	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-B2	4.115	10.363	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-B4	4.115	10.363	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-B6	4.115	10.363	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-B8	4.115	10.363	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-B9	4.115	10.363	2.718	Type K, Glass Ins., 24 AWG wire
2RH-T-C0	8.230	10.363	0.152	Type K, Glass Ins., 24 AWG wire
2RH-T-C2	8.230	10.363	0.610	Type K, Glass Ins., 24 AWG wire
2RH-T-C4	8.230	10.363	1.219	Type K, Glass Ins., 24 AWG wire
2RH-T-C6	8.230	10.363	1.829	Type K, Glass Ins., 24 AWG wire
2RH-T-C8	8.230	10.363	2.438	Type K, Glass Ins., 24 AWG wire
2RH-T-C9	8.230	10.363	2.718	Type K, Glass Ins., 24 AWG wire
2WB-D-A1	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-A2	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-B1	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-B2	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-C1	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
2WB-D-C2	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
2WD-D-A1	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
2WD-D-A2	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
2CL-D-A1	1.372	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-D-A2	1.372	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2WC-D-A1	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
2WC-D-A2	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
2WC-D-B1	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
2WC-D-B2	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
2WG-D-A1	0.000	3.048	1.524	Type K, Glass Ins., 24 AWG wire
2WG-D-A2	0.000	3.048	1.524	Type K, Glass Ins., 24 AWG wire
2WA-T-A0	0.762	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2WA-T-A4	0.762	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-A6	0.762	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-A8	0.762	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-A9	0.762	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-B0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-B4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-B6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-B8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-B9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
2WA-T-C0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
2WA-T-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
2WA-T-C4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
2WA-T-C6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
2WA-T-C8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
2WA-T-C9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
3WA-S-A3	0.762	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-A1	0.762	0.000	0.305	Type K, Glass Ins., 24 AWG wire
3WA-S-B3	1.829	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-B1	1.829	0.000	0.305	Type K, Glass Ins., 24 AWG wire
3WA-S-C3	1.829	0.000	0.914	Type K, Glass Ins., 24 AWG wire
3WA-S-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
3WA-S-C1	1.829	0.000	0.305	Type K, Glass Ins., 24 AWG wire
2CL-E-C023	2.286	2.972	0.023	Type K, Glass Ins., 30 AWG wire
2CL-E-C035	2.286	2.972	0.035	Type K, Glass Ins., 30 AWG wire
2CL-E-C047	2.286	2.972	0.047	Type K, Glass Ins., 30 AWG wire
2CL-E-C058	2.286	2.972	0.058	Type K, Glass Ins., 30 AWG wire
2CL-E-C070	2.972	2.972	0.070	Type K, Glass Ins., 30 AWG wire
2CL-E-C105	2.286	2.972	0.105	Type K, Glass Ins., 30 AWG wire
1WB-J-A1	0.102	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-A2	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-B1	0.102	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-B2	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-C1	0.102	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-C2	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-D1	0.102	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-D2	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-E1	0.102	5.715	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F1	0.102	6.858	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F2	0.000	6.858	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-G1	0.102	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-G2	0.000	8.001	2.921	Type K, Glass Ins., 24 AWG wire
2WB-S-A1	0.000	2.286	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-A035	0.035	2.286	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-A012	0.012	2.286	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-A058	0.058	2.286	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-A023	0.023	2.286	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-A105	0.105	2.286	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-A070	0.047	2.286	1.524	Type K, Glass Ins., 30 AWG wire
2WB-S-B1	0.000	4.572	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-B035	0.035	4.572	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-B012	0.012	4.572	1.524	Type K, Glass Ins., 30 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2WB-E-B058	0.058	4.572	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-B023	0.023	4.572	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-B105	0.105	4.572	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-B047	0.047	4.572	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-B070	0.070	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-S-C1	0.000	6.858	1.524	Type K, Glass Ins., 24 AWG wire
2WB-E-C035	0.035	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-C012	0.012	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-C058	0.058	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-C023	0.023	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-C105	0.105	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-C047	0.047	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-E-C070	0.076	6.858	1.524	Type K, Glass Ins., 30 AWG wire
2WB-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-E1	0.088	5.715	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-F1	0.088	6.858	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-G1	0.088	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A1	0.076	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A2	0.000	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A3	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-B1	0.076	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B2	0.000	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B3	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-C1	0.076	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C2	0.000	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C3	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-D1	0.076	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D2	0.000	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D3	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
2WD-S-A1	0.000	2.794	1.524	Type K, Glass Ins., 24 AWG wire
2WD-E-A105	0.035	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-E-A012	0.012	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-E-A070	0.058	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-E-A023	0.023	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-E-A058	0.105	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-E-A035	0.047	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-E-A047	0.070	2.794	1.524	Type K, Glass Ins., 30 AWG wire
2WD-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-A1	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-B1	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-C1	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-D1	1.524	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-E1	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-A1	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-B1	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-C1	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-D1	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-E1	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
2RL-T-A0	1.981	1.981	0.152	Type K, Glass Ins., 24 AWG wire
2RL-T-A2	1.981	1.981	0.610	Type K, Glass Ins., 24 AWG wire
2RL-T-A4	1.981	1.981	1.219	Type K, Glass Ins., 24 AWG wire
2RL-T-A6	1.981	1.981	1.829	Type K, Glass Ins., 24 AWG wire
2RL-T-A8	1.981	1.981	2.438	Type K, Glass Ins., 24 AWG wire
2RL-T-A9	1.981	1.981	2.718	Type K, Glass Ins., 24 AWG wire
2CL-S-A2	1.524	1.981	2.727	Type K, Glass Ins., 24 AWG wire
2CL-S-A3	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-B2	3.048	1.981	2.727	Type K, Glass Ins., 24 AWG wire
2CL-S-B3	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-C2	2.286	2.972	2.727	Type K, Glass Ins., 24 AWG wire
2CL-S-C3	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
2CL-S-D2	1.524	3.962	2.727	Type K, Glass Ins., 24 AWG wire
2CL-S-D3	1.524	3.962	2.711	Type K, Glass Ins., 24 AWG wire
2CL-S-E2	3.048	3.962	2.727	Type K, Glass Ins., 24 AWG wire
2CL-S-E3	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-A2	3.048	1.829	2.727	Type K, Glass Ins., 24 AWG wire
2CB-S-A3	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-B2	1.524	1.829	2.727	Type K, Glass Ins., 24 AWG wire
2CB-S-B3	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-C2	2.286	2.743	2.727	Type K, Glass Ins., 24 AWG wire
2CB-S-C3	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-D2	3.048	3.658	2.727	Type K, Glass Ins., 24 AWG wire
2CB-S-D3	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2CB-S-E2	1.524	3.658	2.727	Type K, Glass Ins., 24 AWG wire
2CB-S-E3	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire
2CB-D-A1	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
2CB-D-A2	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
2CL-E-C012	0.012	2.972	2.755	Type K, Glass Ins., 30 AWG wire

The following table provides a summary of the temperature results. The "Initial" column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the "Max" column. The remaining columns provide the calculated maximum average temperatures.

Table 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2RL-T-B0	24.8	1046.0	1029.3	1024.5	1000.0	952.9
2RL-T-B2	24.8	1000.5	990.1	986.2	964.9	923.3
2RL-T-B4	24.9	1055.8	1012.6	1008.2	984.2	939.2
2RL-T-B6	25.0	1132.3	1004.6	1000.4	977.7	934.8
2RL-T-B8	25.7	1222.6	1005.6	1003.7	976.6	933.4
2RL-T-B9	25.6	1232.9	975.9	972.0	953.1	916.4
2RK-T-A0	25.8	911.5	879.5	800.0	789.9	781.3
2RK-T-A2	25.3	925.8	884.0	786.5	780.1	773.4
2RK-T-A4	25.2	925.1	888.5	798.8	788.3	782.8
2RK-T-A6	25.1	912.8	878.6	805.8	797.7	789.9
2RK-T-A8	27.5	907.2	867.1	851.1	791.9	784.2
2RB-T-A0	24.6	979.7	969.0	942.4	930.8	911.4

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2RB-T-A2	24.6	993.6	985.9	952.5	929.0	914.1
2RB-T-A4	24.6	936.3	922.9	916.8	904.8	890.9
2RB-T-A6	24.6	1014.3	947.3	940.0	926.3	906.7
2RB-T-A8	24.6	1041.6	950.9	922.7	900.9	890.8
2RB-T-A9	25.1	979.6	914.1	912.9	901.2	884.5
2RB-T-B0	24.3	947.6	921.5	918.6	899.4	885.8
2RB-T-B2	24.3	972.7	936.4	923.1	901.1	895.8
2RB-T-B4	24.3	1014.6	942.3	931.9	901.5	897.9
2RB-T-B6	24.3	1071.9	935.7	922.7	903.7	898.8
2RB-T-B8	24.7	1331.3	1021.3	928.7	899.5	890.3
2RB-T-B9	25.3	1269.8	993.8	918.0	899.8	887.6
2WG-T-A0	24.9	949.7	940.5	939.9	925.2	903.9
2WG-T-A2	22.0	958.9	931.8	931.1	916.9	901.4
2WG-T-A4	24.9	939.1	934.2	933.6	919.3	898.2
2WG-T-A6	24.8	957.5	941.1	940.3	924.0	903.8
2WG-T-A8	25.4	942.2	927.8	924.2	911.9	894.3
2WG-T-B0	22.2	948.5	919.0	918.4	906.5	890.3
2WG-T-B4	24.0	957.1	926.1	917.3	893.1	881.7
2WG-T-B6	24.6	961.2	923.9	916.2	880.6	874.1
2WG-T-B8	24.9	956.8	939.8	923.7	879.5	873.2
2RH-T-A0	25.3	46.6	45.1	44.5	43.3	41.7
2RH-T-A2	25.2	49.4	48.2	47.3	45.9	44.1
2RH-T-A4	25.3	81.6	71.8	71.1	61.4	55.0
2RH-T-A6	25.3	300.0	281.8	279.7	258.8	215.3
2RH-T-A8	25.6	399.4	395.7	393.9	381.7	343.4
2RH-T-A9	25.8	389.8	386.5	384.8	374.1	340.8
2RH-T-B0	25.3	257.3	253.6	253.4	223.1	179.0
2RH-T-B2	25.3	332.5	321.8	320.4	274.5	215.7
2RH-T-B4	25.3	398.4	387.0	385.9	342.8	278.7
2RH-T-B6	25.3	779.6	703.0	688.1	591.9	485.3
2RH-T-B8	25.6	865.6	846.3	838.6	765.0	663.7
2RH-T-B9	25.8	872.8	857.0	850.8	792.0	688.0
2RH-T-C0	25.3	314.6	304.6	295.4	251.5	219.6
2RH-T-C2	25.4	341.3	332.1	326.7	287.5	238.5
2RH-T-C4	25.4	426.5	392.7	379.4	348.9	285.6
2RH-T-C6	25.8	821.4	766.0	741.2	605.9	512.8
2RH-T-C8	26.4	842.5	803.9	785.7	682.8	585.4
2RH-T-C9	26.2	890.0	853.0	831.5	683.9	582.1
2WB-D-A1	25.3	1096.4	1093.3	1091.0	1060.7	1045.5
2WB-D-A2	25.3	985.2	984.1	982.7	975.9	964.7
2WB-D-B1	25.0	1143.6	1139.9	1135.9	1093.9	1062.2
2WB-D-B2	25.1	990.4	989.2	987.7	967.5	934.0
2WB-D-C1	24.8	1077.4	1074.7	1068.8	993.5	895.8
2WB-D-C2	25.0	978.2	977.4	975.3	915.0	828.5
2WD-D-A1	24.5	1103.1	1100.6	1098.7	1078.7	1021.6
2WD-D-A2	24.2	1001.9	1001.0	1000.6	995.7	964.7
2CL-D-A1	24.9	1034.3	1019.3	1016.2	999.7	981.6
2CL-D-A2	25.2	1029.6	1016.1	1012.8	997.9	981.8
2WC-D-A1	25.1	996.3	990.4	979.3	807.1	693.3
2WC-D-A2	25.1	922.9	921.7	919.1	869.9	791.9
2WC-D-B1	25.3	955.2	944.2	940.3	820.2	735.0
2WC-D-B2	25.4	800.3	782.1	768.8	665.5	609.2

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2WG-D-A1	24.7	1003.8	995.9	991.3	969.8	938.7
2WG-D-A2	24.4	995.1	988.2	982.0	962.2	944.3
2WA-T-A0	24.8	66.7	61.4	60.1	57.9	56.7
2WA-T-A2	24.6	59.1	56.1	55.3	54.0	52.6
2WA-T-A4	24.8	82.1	77.2	73.2	68.8	68.3
2WA-T-A6	24.9	122.1	110.5	106.6	92.0	81.9
2WA-T-A8	25.1	344.8	336.5	335.1	321.8	281.0
2WA-T-A9	25.5	387.1	381.8	379.7	368.2	334.2
2WA-T-B0	24.6	302.0	270.4	261.6	233.5	217.4
2WA-T-B2	24.5	268.4	258.7	249.5	236.8	226.2
2WA-T-B4	24.6	514.7	444.5	424.9	396.7	387.3
2WA-T-B6	24.6	1119.8	1063.7	1040.3	919.4	892.9
2WA-T-B8	24.9	1346.6	1259.1	1197.1	1018.0	1003.6
2WA-T-B9	26.5	944.3	877.8	868.5	631.9	561.2
2WA-T-C0	24.9	350.2	330.3	321.1	314.0	296.1
2WA-T-C2	24.8	227.1	218.2	214.3	195.8	184.8
2WA-T-C4	24.8	640.9	536.4	507.7	485.0	460.1
2WA-T-C6	24.7	1053.4	986.1	979.1	937.6	895.2
2WA-T-C8	25.3	912.1	830.4	810.3	730.4	669.5
2WA-T-C9	26.7	309.9	269.6	250.9	153.1	124.9
3WA-S-A3	26.4	152.2	141.7	135.4	121.7	109.1
3WA-S-A2	26.2	156.0	132.2	119.7	113.5	102.4
3WA-S-A1	26.0	122.5	111.3	107.9	99.1	92.7
3WA-S-B3	25.3	947.9	846.1	805.1	647.6	636.4
3WA-S-B2	25.4	943.0	856.0	798.0	643.2	633.0
3WA-S-B1	25.6	908.6	843.9	787.5	628.1	621.7
3WA-S-C3	26.1	846.3	708.3	629.3	589.3	530.5
3WA-S-C2	25.8	881.4	706.5	632.7	586.8	526.1
3WA-S-C1	25.6	859.3	682.7	615.5	567.1	512.0
2CL-E-C023	26.4	94.0	93.9	93.9	93.9	93.8
2CL-E-C035	27.3	77.2	77.2	77.2	77.1	77.1
2CL-E-C047	27.2	71.8	71.7	71.7	71.7	71.7
2CL-E-C058	26.8	64.1	63.8	63.8	63.7	63.6
2CL-E-C070	27.3	58.3	58.2	58.2	58.1	58.0
2CL-E-C105	27.1	40.1	39.9	39.9	39.7	39.5
1WB-J-A1	25.7	38.0	37.9	37.9	37.9	37.9
1WB-J-A2	25.7	97.6	97.4	97.3	96.8	96.4
1WB-J-B1	26.0	40.3	40.2	40.2	40.1	40.1
1WB-J-B2	25.2	147.8	147.6	147.6	147.4	147.0
1WB-J-C1	25.3	42.6	42.6	42.6	42.5	42.4
1WB-J-C2	25.6	132.5	132.2	132.2	131.4	130.2
1WB-J-D1	25.4	47.5	47.4	47.4	47.2	46.9
1WB-J-D2	26.1	128.0	127.8	127.7	126.8	125.6
1WB-J-E1	25.1	42.5	42.5	42.5	42.4	42.2
1WB-J-F1	26.3	52.7	39.6	39.6	39.5	39.2
1WB-J-F2	25.7	90.4	90.3	90.3	90.3	90.2
1WB-J-G1	26.1	55.8	55.8	55.7	55.6	55.4
1WB-J-G2	25.1	99.1	99.0	99.0	99.0	99.0
2WB-S-A1	25.5	1045.5	1032.7	1026.2	988.7	985.3
2WB-E-A035	26.6	168.0	168.0	168.0	167.9	167.6
2WB-E-A012	25.5	568.3	567.8	566.7	549.7	525.8
2WB-E-A058	26.4	100.3	100.2	100.2	100.2	100.1

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2WB-E-A023	25.8	296.0	295.9	295.8	294.7	292.5
2WB-E-A105	26.5	68.6	68.5	68.5	68.4	68.2
2WB-E-A070	26.4	91.7	91.6	91.6	91.6	91.6
2WB-S-B3	25.2	1042.2	1035.4	1033.1	922.0	875.3
2WB-E-B035	26.2	533.2	532.3	531.3	520.0	509.2
2WB-E-B012	25.7	804.2	753.6	734.8	631.5	539.8
2WB-E-B058	26.6	222.9	222.8	222.8	221.9	220.4
2WB-E-B023	26.0	925.1	902.7	869.4	731.0	703.7
2WB-E-B105	27.0	81.5	81.4	81.4	81.2	80.9
2WB-E-B047	26.6	384.1	383.9	383.8	381.1	376.6
2WB-E-B070	26.3	129.4	129.2	129.1	128.6	127.4
2WB-S-C3	26.6	113.0	112.6	112.0	104.9	102.6
2WB-E-C035	27.2	59.4	59.3	59.3	59.2	59.2
2WB-E-C012	27.8	82.1	82.0	82.0	81.9	81.8
2WB-E-C058	27.3	49.7	49.7	49.6	49.5	49.4
2WB-E-C023	27.6	66.7	66.6	66.6	66.6	66.6
2WB-E-C105	27.2	38.9	38.8	38.8	38.6	38.5
2WB-E-C047	27.5	54.2	54.0	54.0	53.9	53.8
2WB-E-C070	27.4	44.0	43.9	43.9	43.7	43.6
2WB-J-A1	27.3	62.9	62.8	62.8	62.8	62.8
2WB-J-B1	26.7	89.4	89.2	89.2	89.2	89.2
2WB-J-C1	27.0	82.5	82.4	82.4	82.4	82.4
2WB-J-D1	27.1	100.3	100.3	100.3	100.1	99.9
2WB-J-E1	27.1	70.8	70.8	70.8	70.8	70.7
2WB-J-F1	27.0	44.5	44.5	44.5	44.4	44.3
2WB-J-G1	27.5	46.0	46.0	46.0	45.9	45.8
1WD-J-A1	25.9	732.2	729.5	728.6	717.6	689.5
1WD-J-A2	26.6	697.9	694.4	693.6	682.0	648.3
1WD-J-A3	25.2	656.6	653.8	652.9	643.8	615.2
1WD-J-B1	25.2	770.8	763.1	762.0	736.6	683.6
1WD-J-B2	26.1	462.2	457.3	456.6	416.5	318.1
1WD-J-B3	25.0	416.6	411.3	409.1	386.7	304.4
1WD-J-C1	25.3	536.6	534.5	531.0	481.5	419.7
1WD-J-C2	25.9	486.6	484.4	481.3	452.5	421.3
1WD-J-C3	25.1	643.7	642.2	638.6	604.0	575.1
1WD-J-D1	25.7	477.7	464.8	463.0	452.9	433.7
1WD-J-D2	26.3	312.0	305.3	304.2	291.6	274.1
1WD-J-D3	25.0	247.8	245.3	244.8	237.5	227.0
2WD-S-A1	24.8	1086.5	1074.7	1064.6	1055.6	1017.1
2WD-E-A105	25.6	70.9	70.8	70.8	70.8	70.8
2WD-E-A012	25.7	390.3	388.0	385.1	360.4	351.3
2WD-E-A070	26.0	99.8	99.7	99.7	99.7	99.6
2WD-E-A023	25.7	229.9	229.8	229.8	229.6	228.8
2WD-E-A058	25.9	103.8	103.8	103.8	103.8	103.7
2WD-E-A035	25.8	139.6	139.5	139.5	139.5	139.3
2WD-E-A047	25.9	119.9	119.9	119.9	119.8	119.6
2WD-J-A1	25.5	997.3	994.1	993.3	988.5	982.7
2WD-J-B1	26.6	96.4	96.3	96.3	96.0	95.9
2WD-J-C1	26.2	55.8	55.7	55.7	55.7	55.7
2WD-J-D1	26.3	876.9	869.4	867.4	854.1	842.4
2CL-S-A1	25.3	1117.9	1092.8	1075.5	992.6	949.1
2CL-S-B1	24.3	1373.2	1276.8	1228.5	1050.3	1015.4

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
2CL-S-C1	25.6	1073.0	1053.4	1052.2	1008.2	959.0
2CL-S-D1	26.2	1126.4	1111.0	1106.6	1025.4	880.4
2CL-S-E1	25.3	1117.2	1097.4	1095.7	1080.2	1055.7
2CB-S-A1	25.0	829.1	821.6	819.7	783.9	715.6
2CB-S-B1	24.3	959.6	945.7	938.3	913.7	892.9
2CB-S-C1	23.6	1015.6	1004.8	999.0	976.6	943.6
2CB-S-D1	23.3	900.4	893.0	889.0	873.3	843.2
2CB-S-E1	24.1	998.3	987.3	985.7	964.3	927.8
2RL-T-A0	24.8	1024.3	995.9	991.2	966.3	933.9
2RL-T-A2	24.9	1041.3	1006.9	1002.0	976.1	941.0
2RL-T-A4	24.9	1070.0	1019.1	1013.8	987.3	942.8
2RL-T-A6	24.9	1106.3	1008.2	1003.5	977.9	944.9
2RL-T-A8	25.1	1344.7	1044.9	1000.1	974.8	939.3
2RL-T-A9	25.2	1242.2	1019.4	1014.5	986.3	948.5
2CL-S-A2	25.5	1024.0	1013.6	1009.4	969.0	900.8
2CL-S-A3	25.6	361.6	358.7	358.2	355.9	353.3
2CL-S-B2	24.7	993.1	978.1	974.6	901.5	762.3
2CL-S-B3	25.1	262.1	237.1	230.6	221.2	218.5
2CL-S-C2	26.0	574.2	564.2	558.5	513.6	480.5
2CL-S-C3	26.6	148.8	148.7	148.7	148.5	148.3
2CL-S-D2	26.0	1038.7	1021.5	1019.4	938.6	806.6
2CL-S-D3	26.1	215.9	215.9	215.9	215.7	215.3
2CL-S-E2	25.9	919.7	859.0	830.9	677.8	574.2
2CL-S-E3	26.3	221.0	219.8	219.6	218.2	215.2
2CB-S-A2	24.9	714.6	712.9	710.8	659.5	535.4
2CB-S-A3	25.3	801.1	797.5	795.8	752.4	629.3
2CB-S-B2	24.6	739.2	737.6	735.3	689.1	592.2
2CB-S-B3	24.8	655.2	654.4	652.3	599.0	493.8
2CB-S-C2	24.3	596.3	595.7	594.3	542.2	443.8
2CB-S-C3	24.3	483.4	482.8	481.3	425.3	329.2
2CB-S-D2	24.0	793.8	791.8	790.3	756.4	663.1
2CB-S-D3	24.5	693.3	691.6	689.5	642.2	534.8
2CB-S-E2	24.5	816.7	813.3	811.5	767.3	669.2
2CB-S-E3	24.3	727.1	724.1	722.1	676.1	579.5
2CB-D-A1	24.6	1015.1	1003.7	1000.2	985.4	953.2
2CB-D-A2	24.8	1004.4	996.3	994.2	979.1	947.3
2CL-E-C012	26.6	106.6	106.5	106.4	106.4	106.4

The following table shows which thermocouples were taken out of service during the experiment.

Table 6. Out of Service Times

Description	Time out of service time (s)	Time out of service time (hh:mm:ss))	Out of service reason
2WC-D-B2	1720	00:28:40	Exceeded Max Allowable Temp
2WC-D-B1	1763	00:29:23	Exceeded Max Allowable Temp
2WC-D-A1	1793	00:29:53	Exceeded Max Allowable Temp
2CL-S-B1	2129	00:35:29	Exceeded Max Allowable Temp
2CL-D-A2	3282	00:54:42	Temperature went Negative
2CL-D-A1	3755	01:02:35	Temperature went Negative
2WD-D-A2	6514	01:48:34	Temperature went Negative

The following charts present a time-dependent representation of the instantaneous temperatures measured during the experiment.

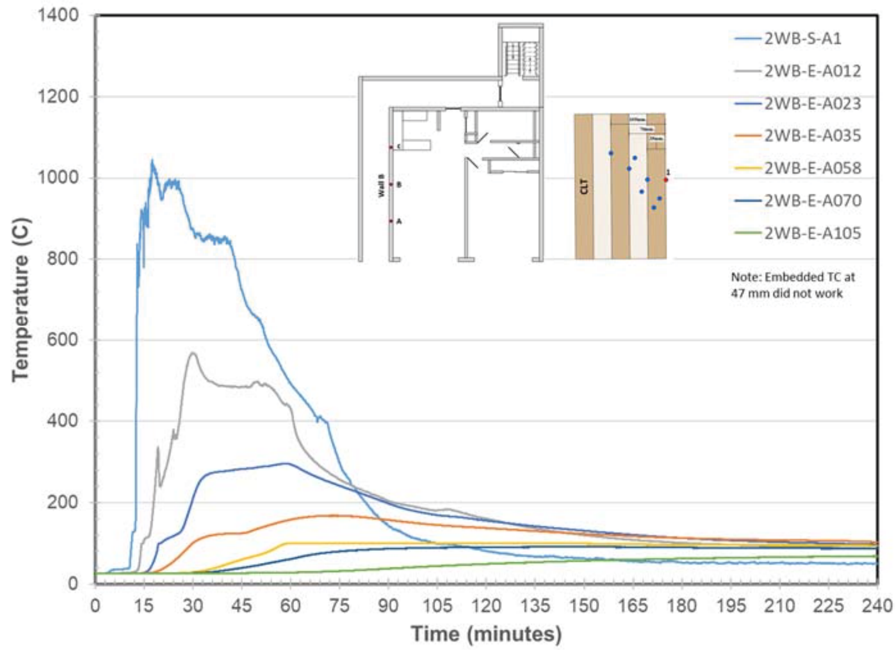

Figure 207. Wall B Embedded & Surface Temperatures at Location A

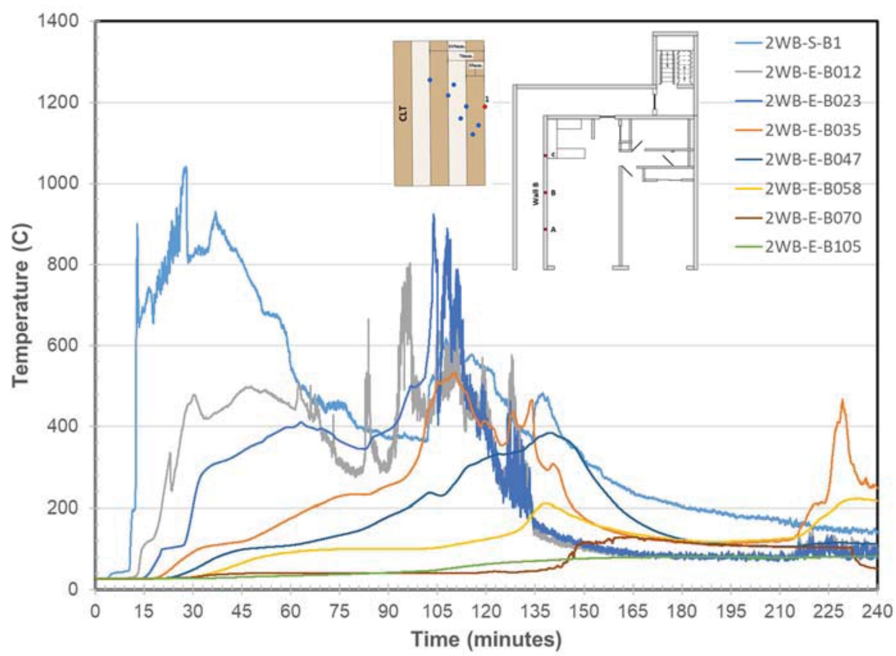

Figure 208. Wall B Embedded & Surface Temperatures at Location B

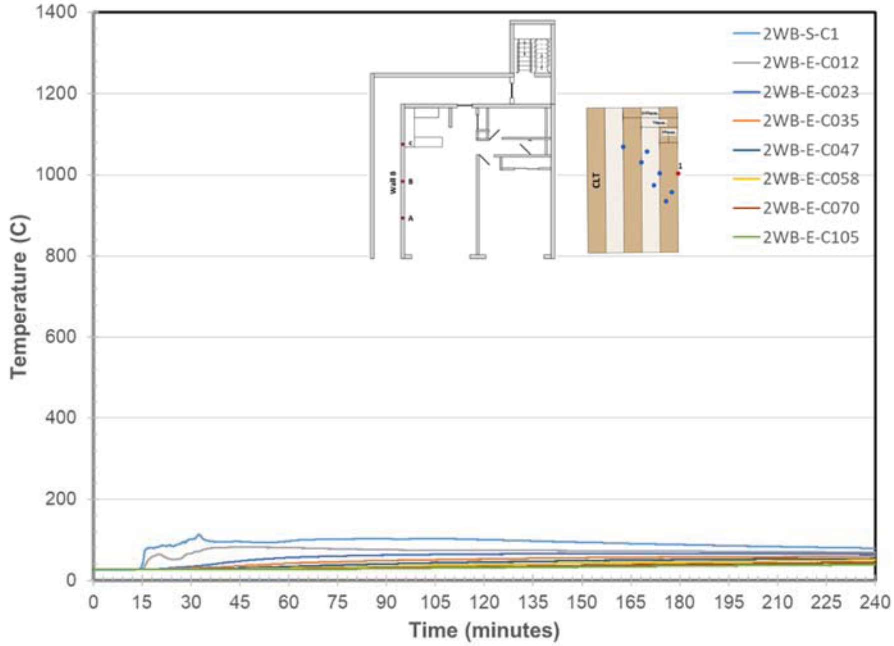

Figure 209. Wall B Embedded & Surface Temperatures at Location C

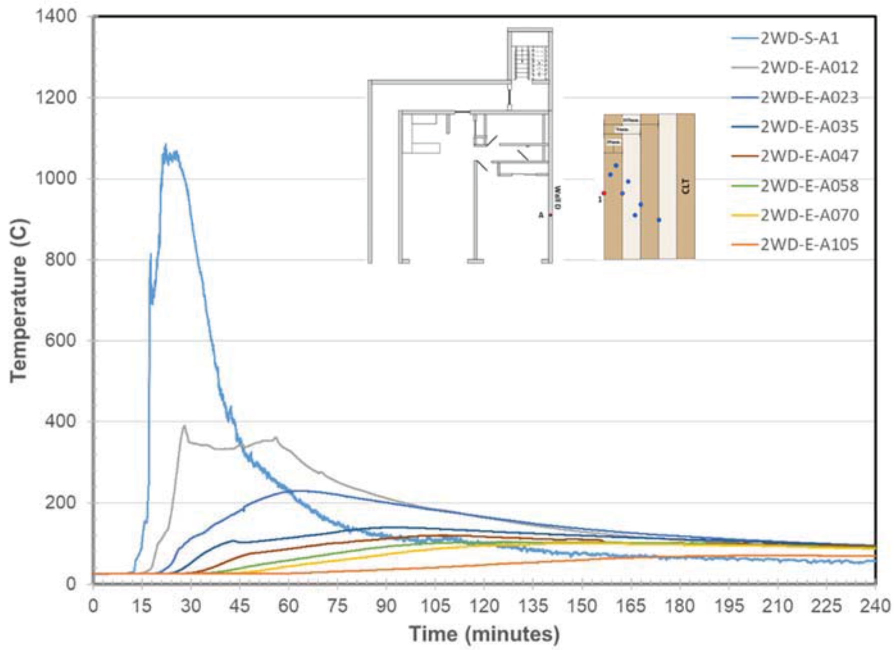

Figure 210. Wall D Embedded & Surface Temperatures at Location A

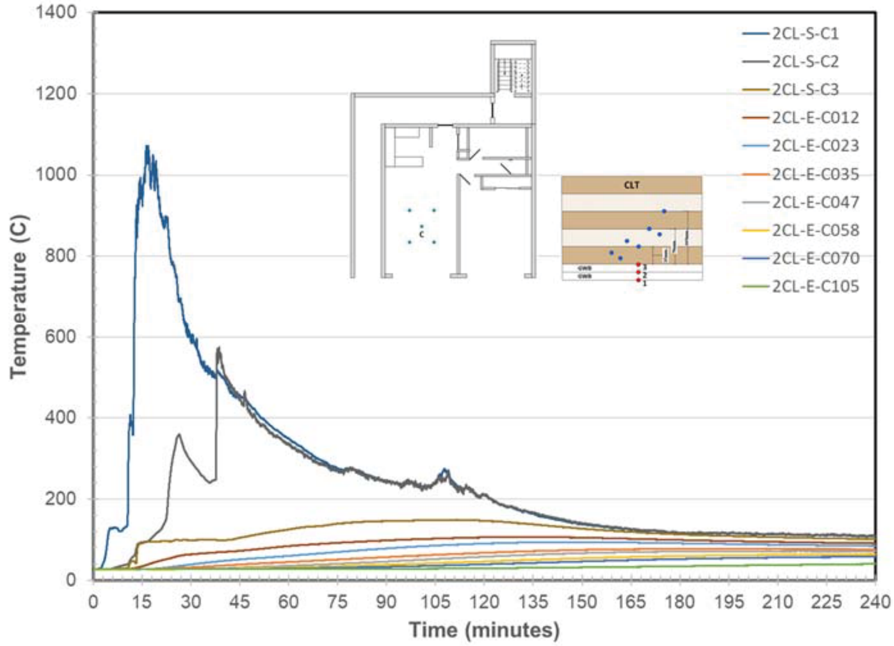

Figure 211. Living Room Ceiling Embedded & Surface Temperatures at Location C

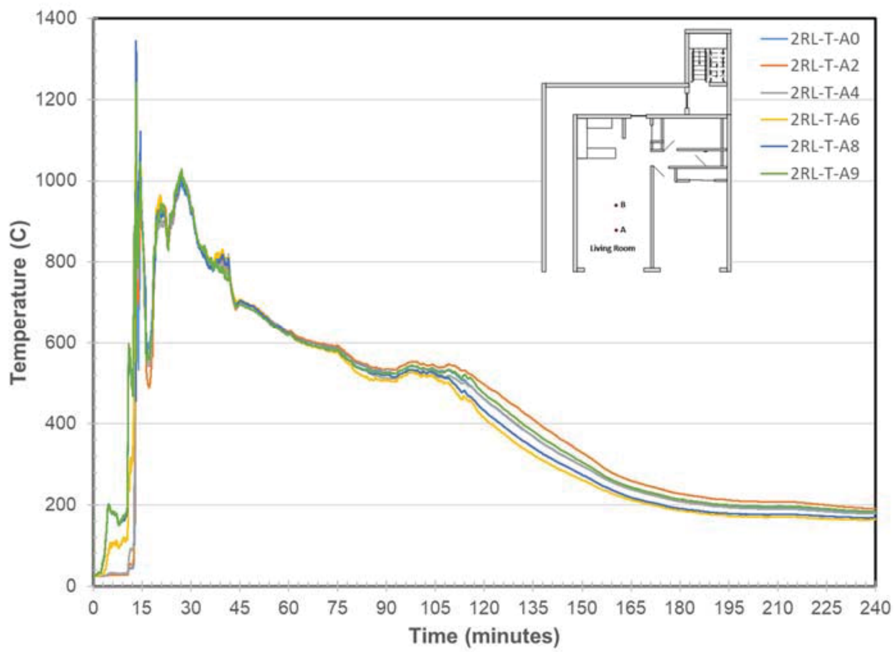

Figure 212. Living Room Temperature at Location A

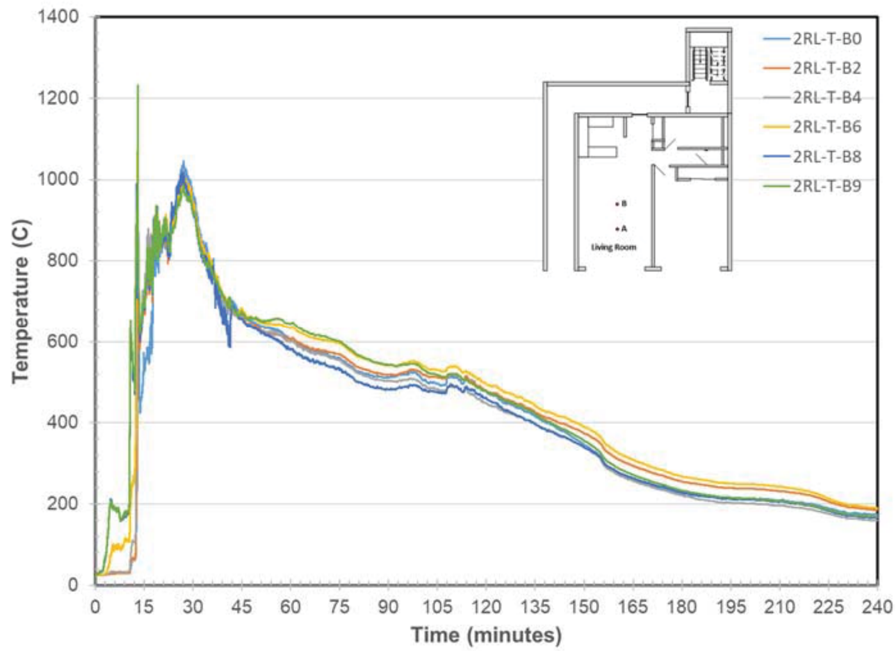

Figure 213. Living Room Temperature at Location B

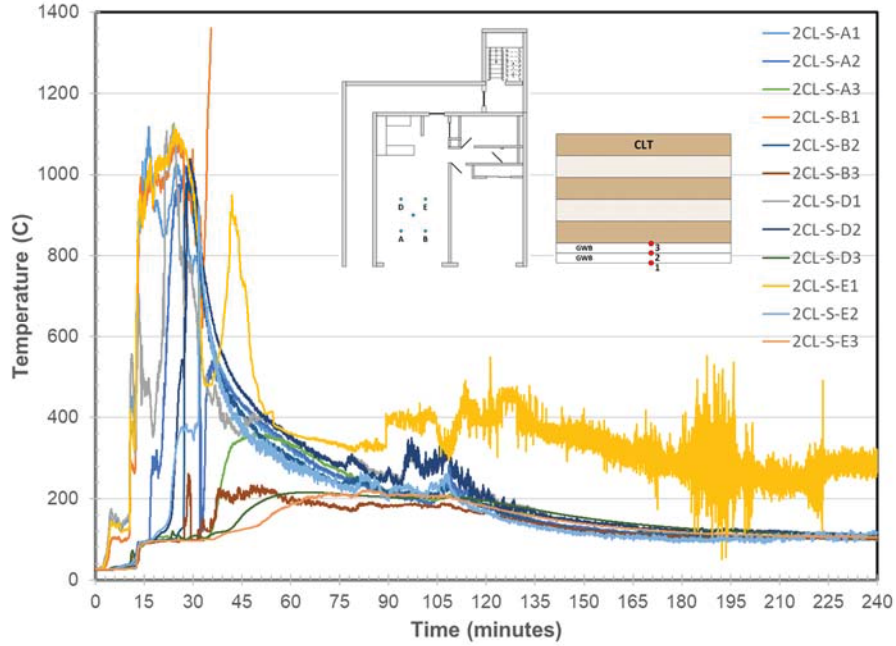

Figure 214. Living Room Ceiling Surface Temperatures at Location A, B, D, & E

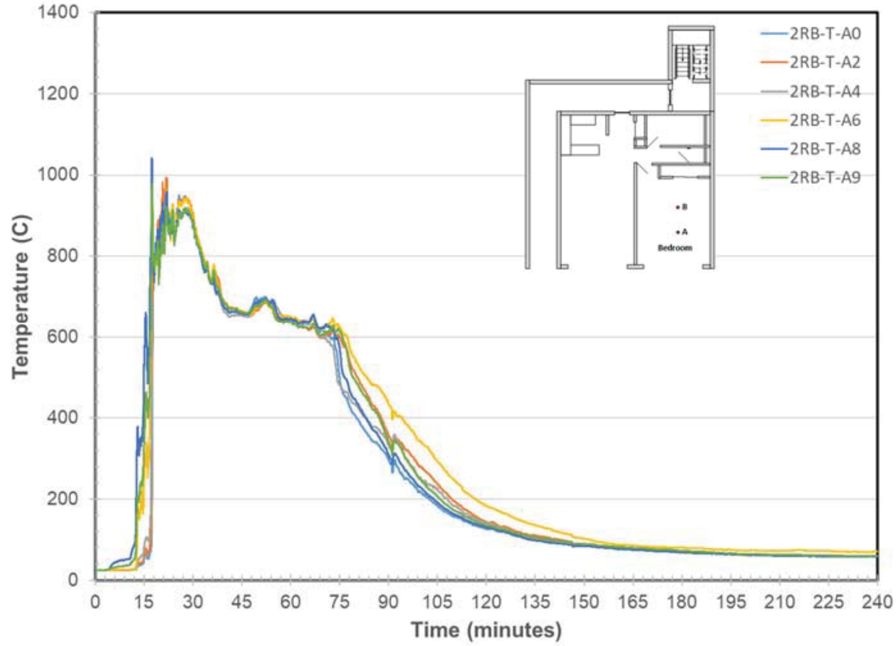

Figure 215. Bedroom Temperature at Location A

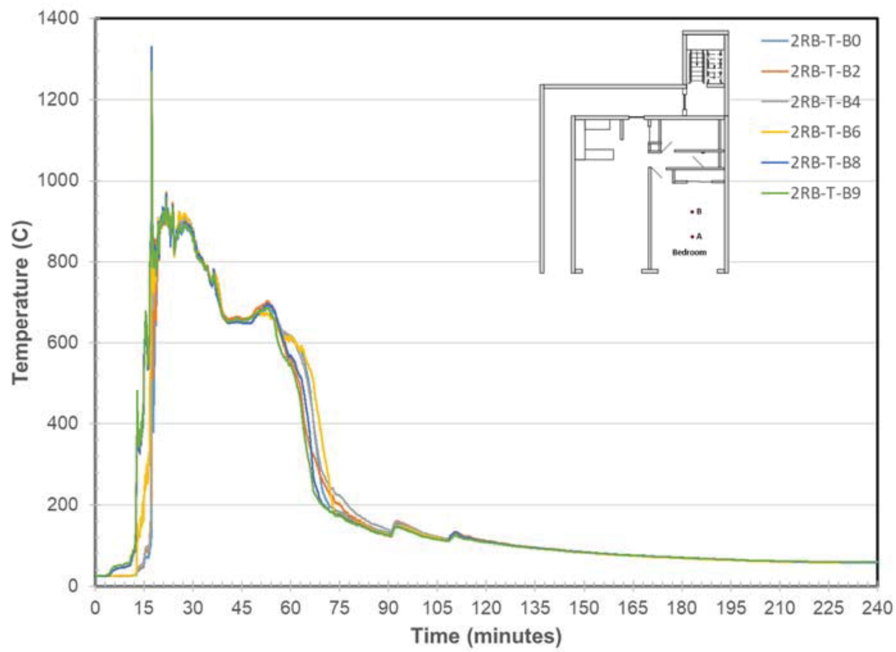

Figure 216. Bedroom Temperature at Location B

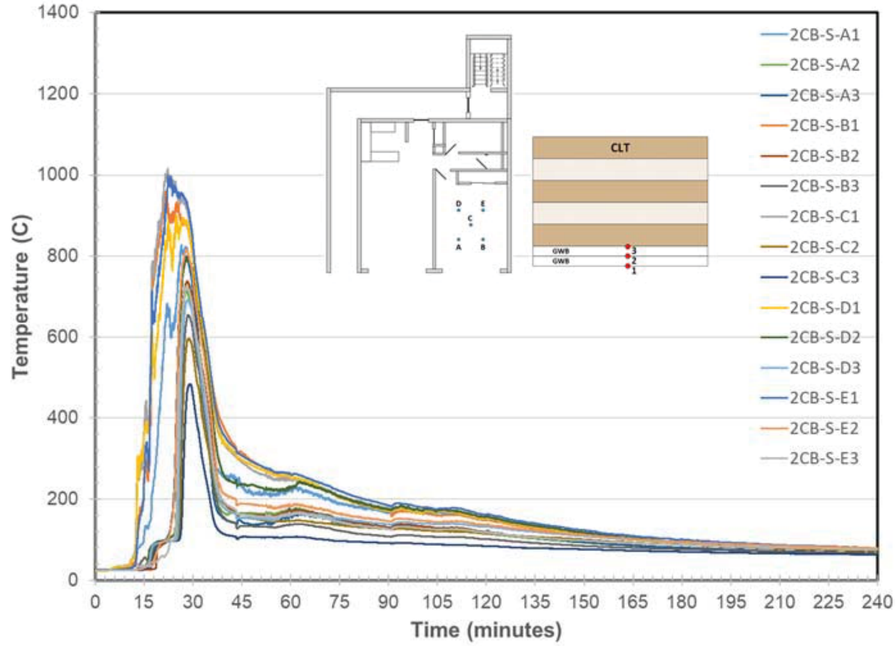

Figure 217. Bedroom Ceiling Surface Temperatures at Locations A through E

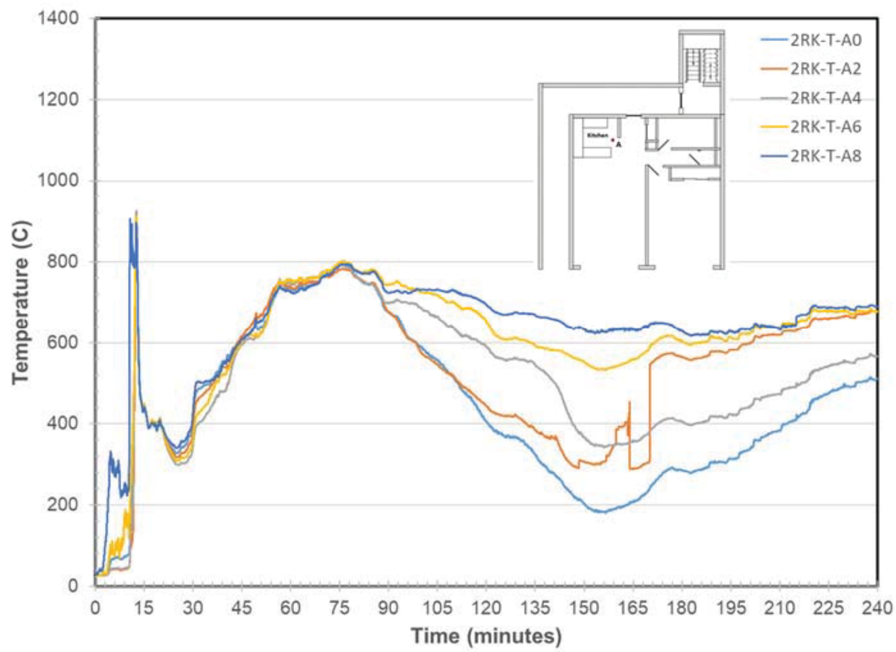

Figure 218. Kitchen Temperatures at Location A

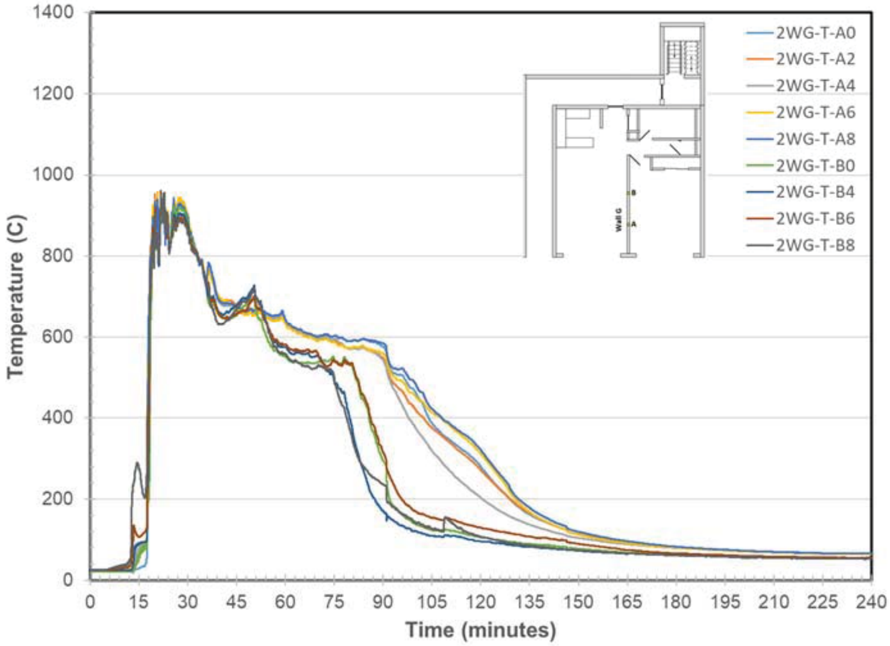

Figure 219. Wall G Temperatures at Locations A & B

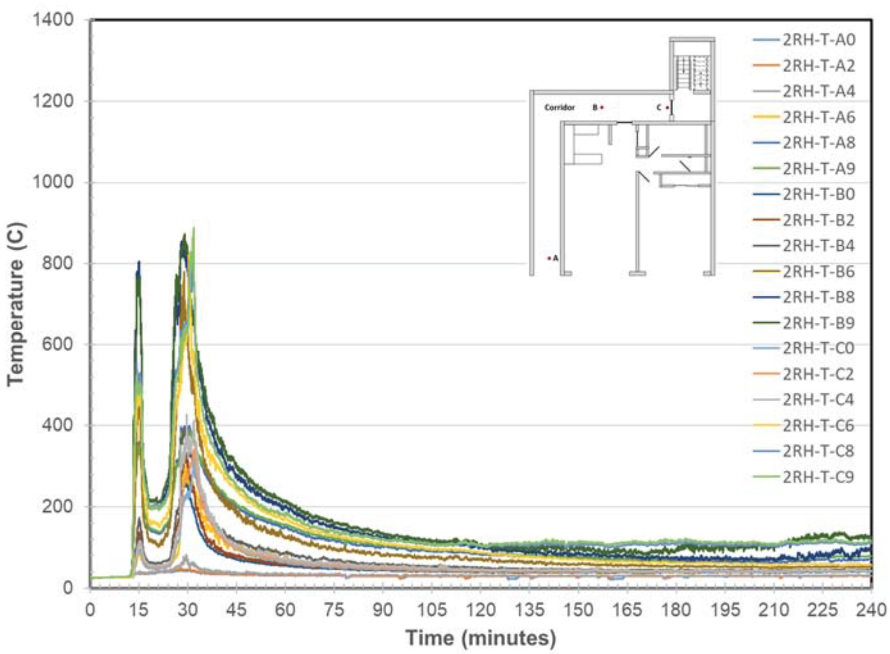

Figure 220. Corridor Temperatures at Locations A, B, & C

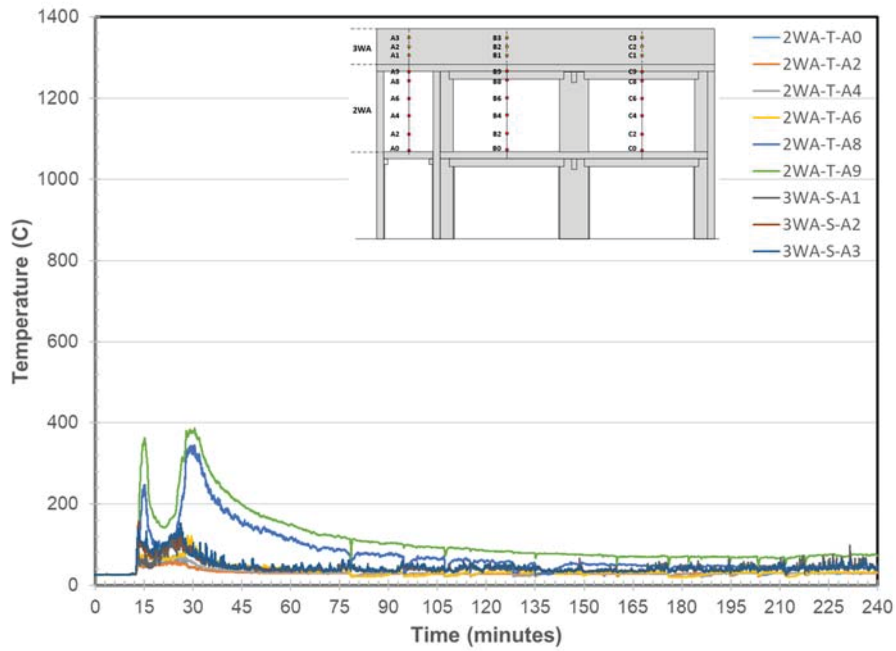

Figure 221. Wall A Temperatures at Location A

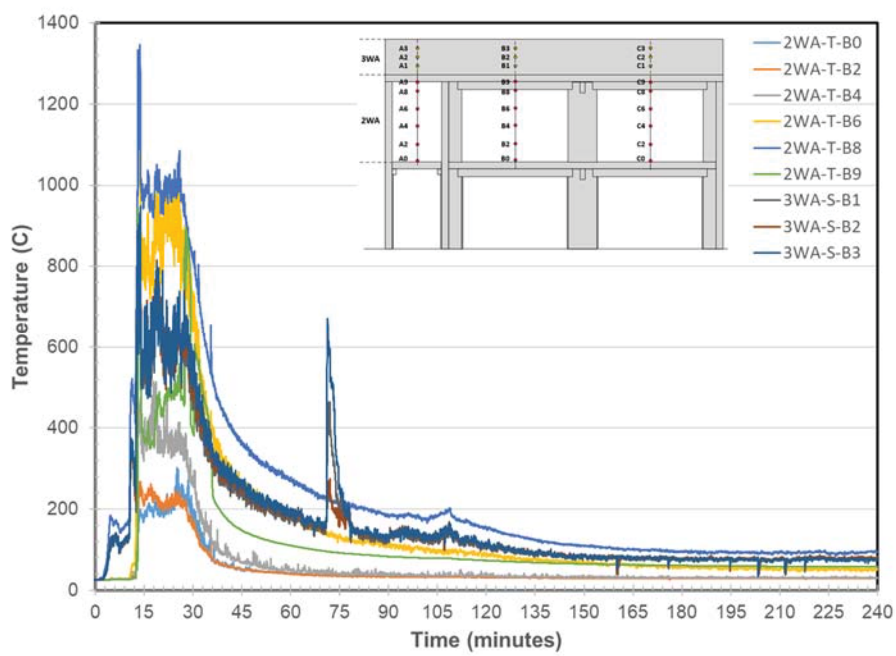

Figure 222. Wall A Temperatures at Locations B

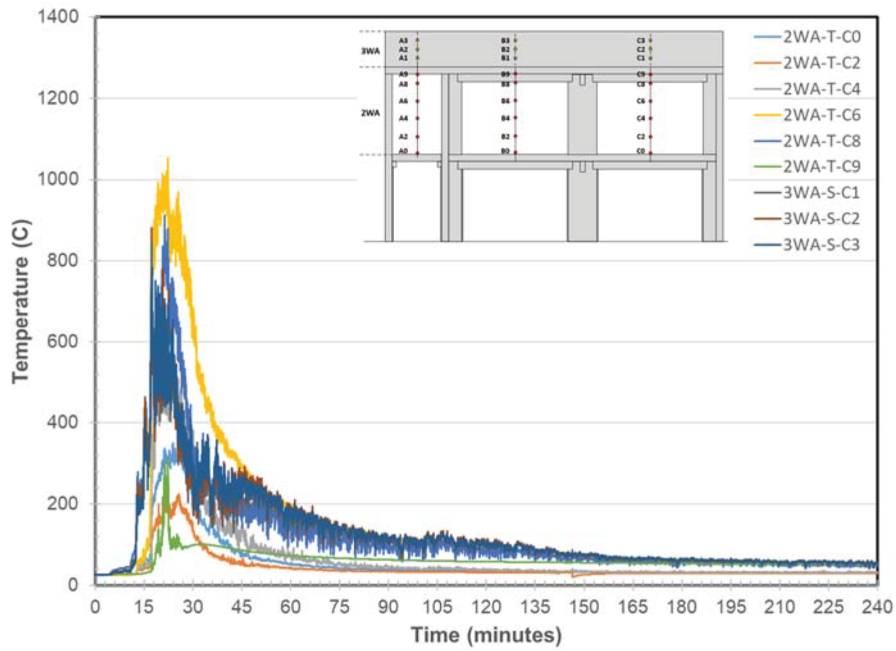

Figure 223. Wall A Temperatures at Locations C

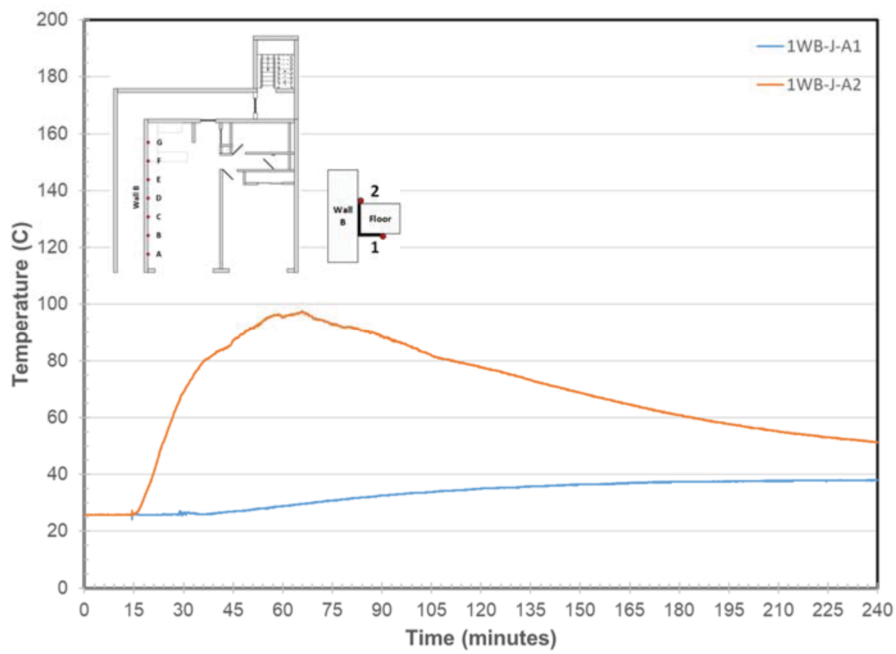

Figure 224. Wall B/Steel Angle Joint Temperatures at Location A

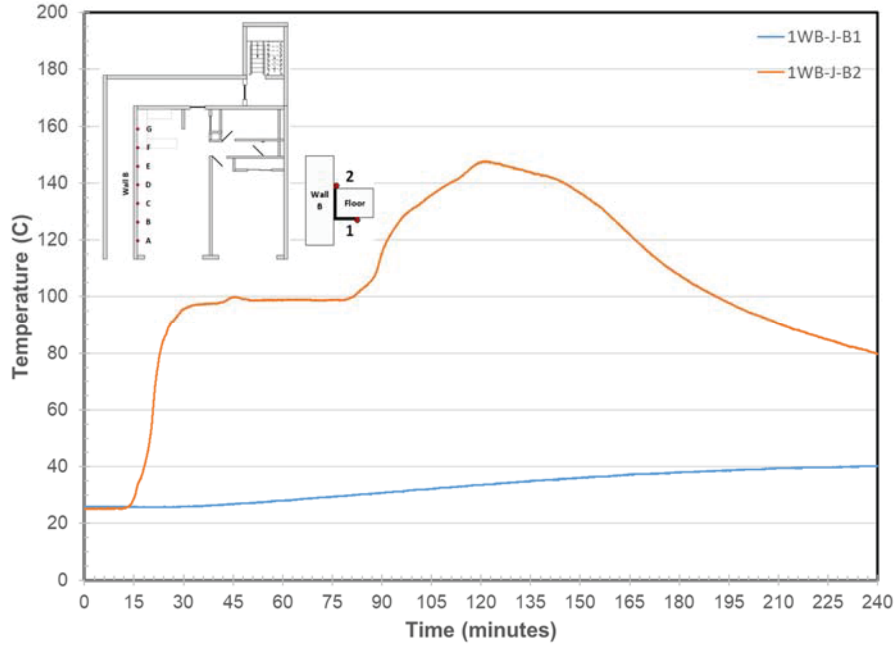

Figure 225. Wall B/Steel Angle Joint Temperatures at Location B

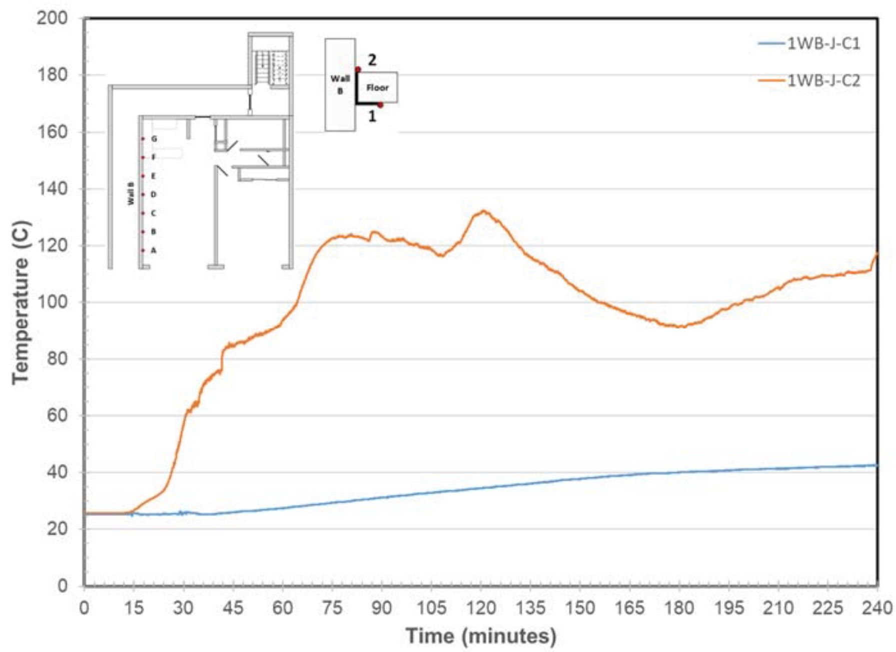

Figure 226. Wall B/Steel Angle Joint Temperatures at Location C

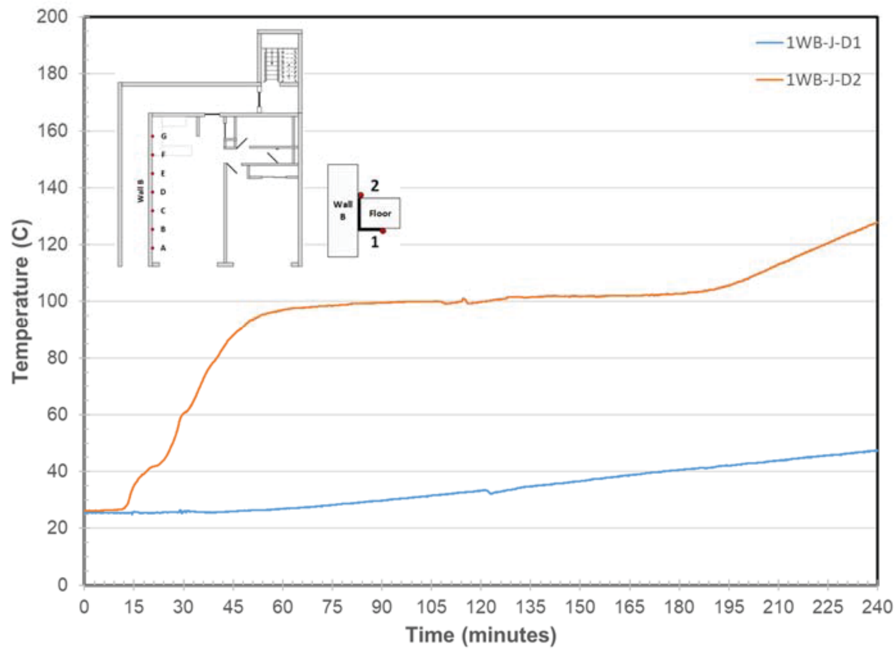

Figure 227. Wall B/Steel Angle Joint Temperatures at Location D

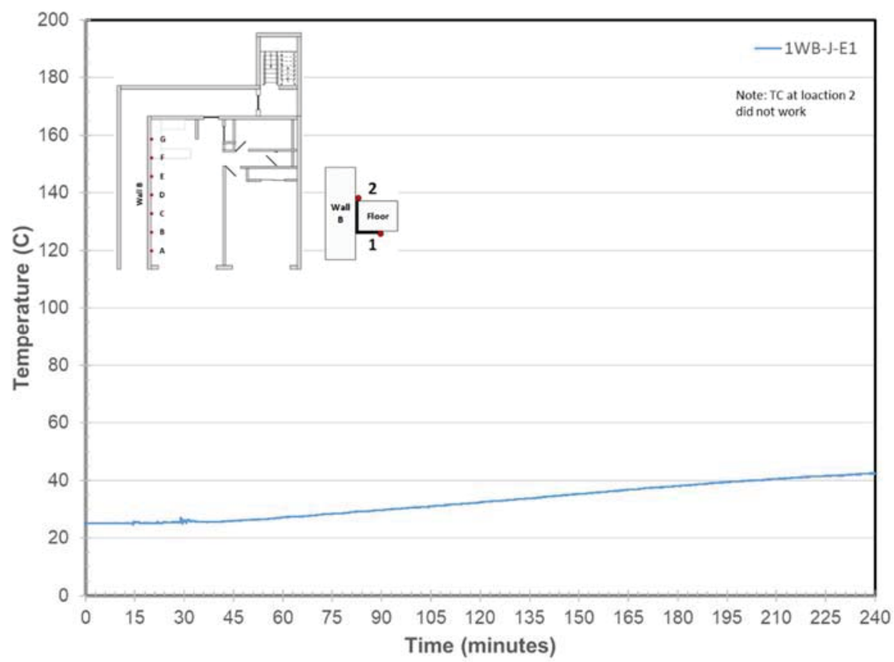

Figure 228. Wall B/Steel Angle Joint Temperatures at Location E

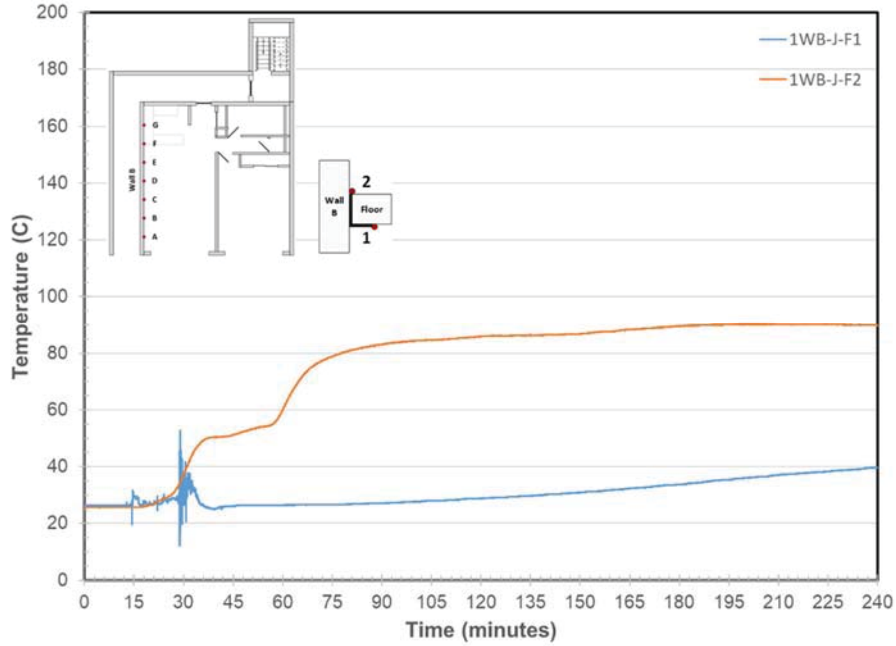

Figure 229. Wall B/Steel Angle Joint Temperatures at Location F

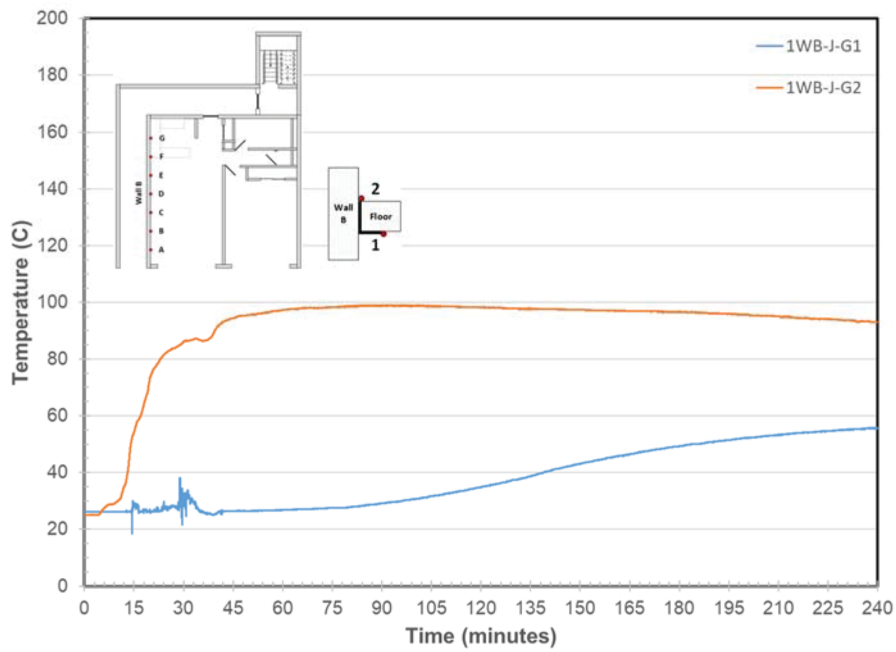

Figure 230. Wall B/Steel Angle Joint Temperatures at Location G

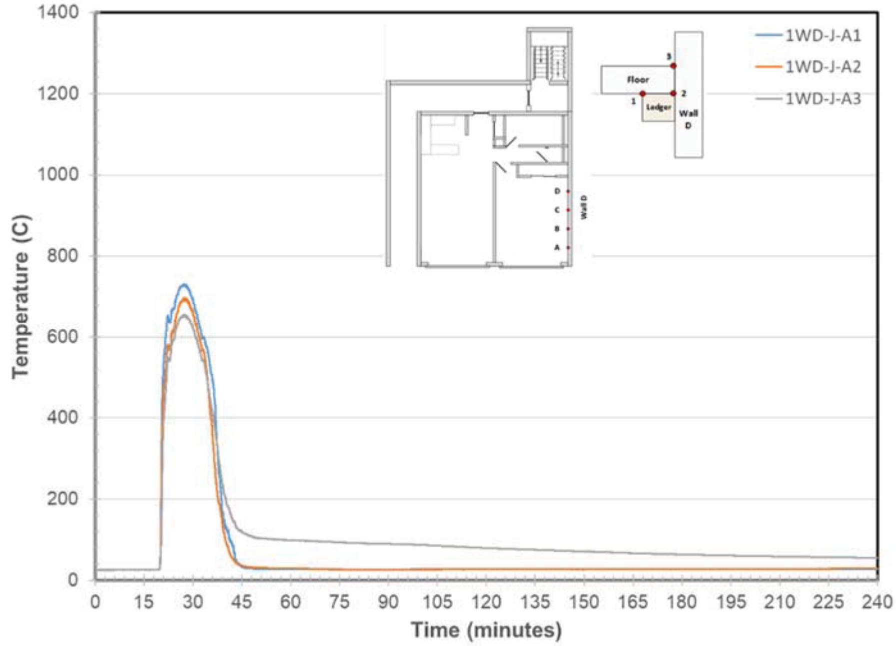

Figure 231. Wall D/Ledger Joint Temperatures at Location A

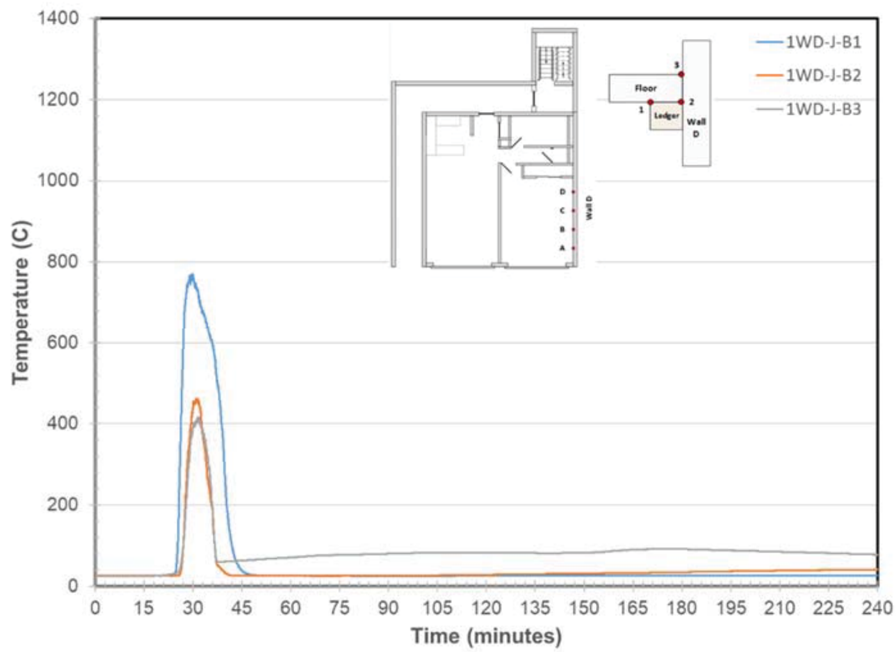

Figure 232. Wall D/Ledger Joint Temperatures at Location B

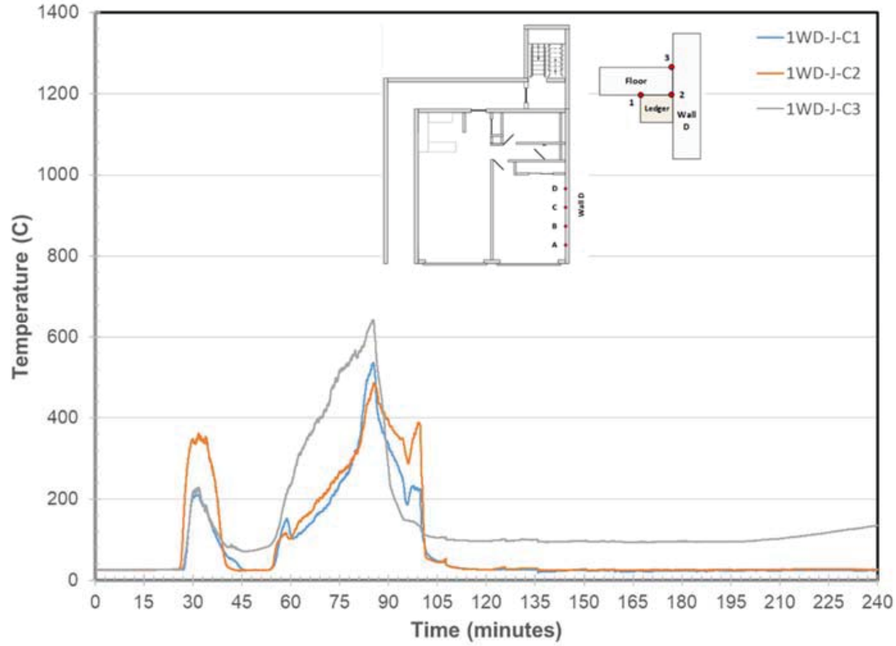

Figure 233. Wall D/Ledger Joint Temperatures at Location C

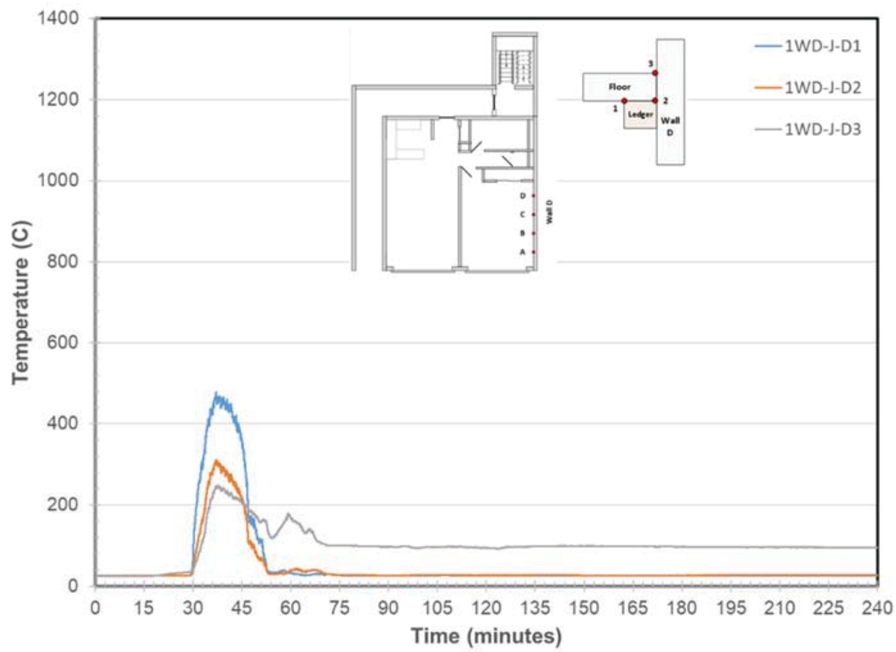

Figure 234. Wall D/Ledger Joint Temperatures at Location D

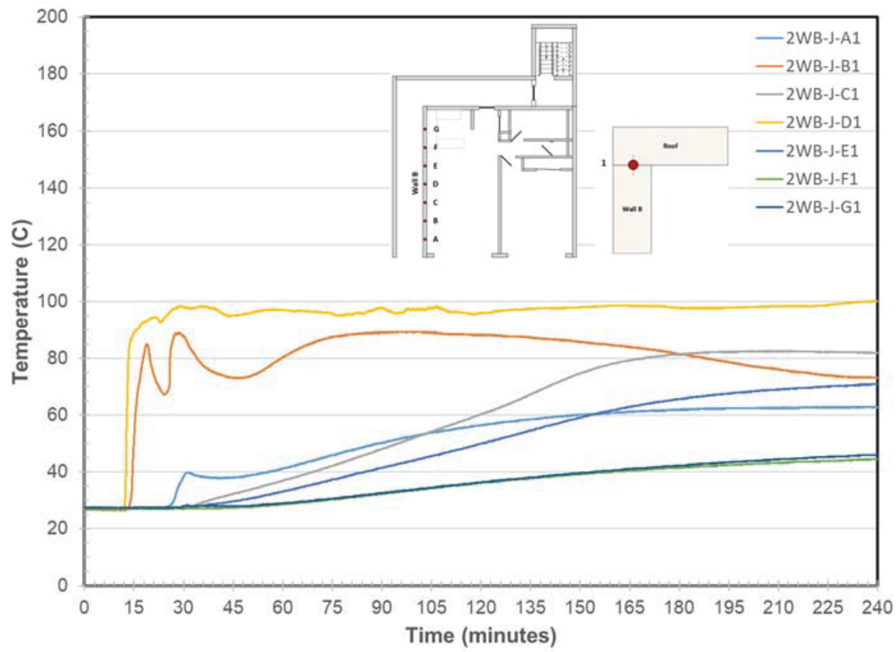

Figure 235. Ceiling/Wall B Joint Temperatures at Locations A-G

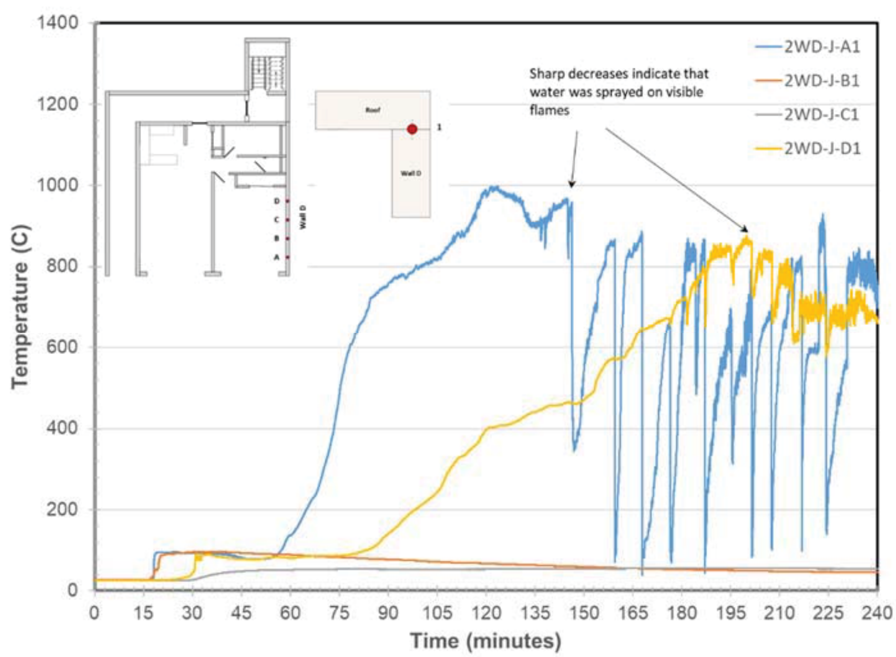

Figure 236. Ceiling/Wall B Joint Temperatures at Locations A-D

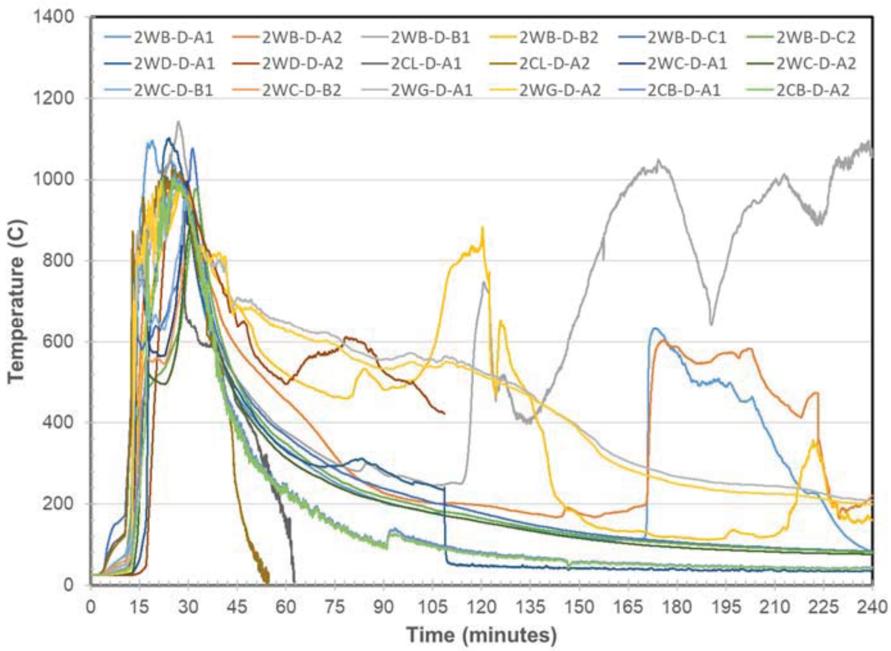

Figure 237. DFT Temperatures at each Location

Velocity

The following table provides a description of the instrumentation used to collect velocity measurements during the experiments. Velocity is calculated from pressure and temperature measurements.

Table 7. Velocity Measurement Description

Description	Probe Description	Thermocouple Type	Location X (m)	Location Y (m)	Location Z (m)	Orientation
1WA-V-A1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.76	0.00	0.91	horizontal
1WA-V-A2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.76	0.00	1.83	horizontal
1WA-V-B1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	0.91	horizontal
1WA-V-B2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	1.83	horizontal
1WA-V-B3	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	0.91	horizontal
1WA-V-B4	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	1.83	horizontal
1WA-V-C1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	0.91	horizontal
1WA-V-C2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.91	0.00	1.83	horizontal
1WA-V-C3	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	0.91	horizontal
1WA-V-C4	Bidirectional	Type K, Glass Ins., 24 ga wire	2.74	0.00	1.83	horizontal

The following table shows which velocity probe was taken out of service during the experiment. All calculated values reported for the instrument are prior to the out of service time.

Table 8. Out of Service Times

Description	Time out of service time (s)	Time out of service time (hh:mm:ss)	Out of service reason
1WA-V-A2	4698	01:18:18	Stream of water hit bi-directional probe while suppressing flames in corridor

The following table provides a summary of the temperatures measured at the velocity probe.

Table 9. Velocity Temperature Summary

Description	Initial (C)	Maximum (C)	30 Second Maximum Average (C)	60 Second Maximum Average (C)	300 Second Maximum Average (C)	600 Second Maximum Average (C)
1WA-V-A1	25	62	59	57	54	53
1WA-V-A2	25	187	175	172	154	124
1WA-V-B1	25	406	380	371	341	326
1WA-V-B2	25	1221	1156	1103	955	917
1WA-V-B3	24	441	413	403	380	357
1WA-V-B4	25	1026	979	964	895	888
1WA-V-C1	24	415	359	339	319	303
1WA-V-C2	24	1248	1101	1074	968	883
1WA-V-C3	25	425	380	359	344	324
1WA-V-C4	25	1094	1054	1049	1010	956

The following table summarizes the minimum and maximum velocity values and the times at which they occurred.

Table 10. Velocity Minimums and Maximums

Description	Initial (m/s)	Maximum (m/s)	5 Second Maximum Average (m/s)	10 Second Maximum Average (m/s)	30 Second Maximum Average (m/s)	60 Second Maximum Average (m/s)
1WA-V-A1	0.03	0.70	0.20	0.15	0.07	0.03
1WA-V-A2	0.09	2.18	1.65	1.57	1.18	1.09
1WA-V-B1	0.18	1.65	1.31	1.18	0.94	0.91
1WA-V-B2	0.25	6.55	6.26	6.09	5.84	5.56
1WA-V-B3	0.12	0.70	0.16	0.03	-0.03	-0.04
1WA-V-B4	0.37	7.37	6.84	6.82	6.54	6.49
1WA-V-C1	-0.13	3.71	3.64	3.56	3.27	2.87
1WA-V-C2	0.53	6.17	5.81	5.72	4.81	4.20
1WA-V-C3	-0.06	2.90	2.09	1.99	1.60	1.23
1WA-V-C4	-0.24	16.26	16.02	15.89	14.54	11.55

The following charts present a time dependent representation of the instantaneous velocities measured during the experiment.

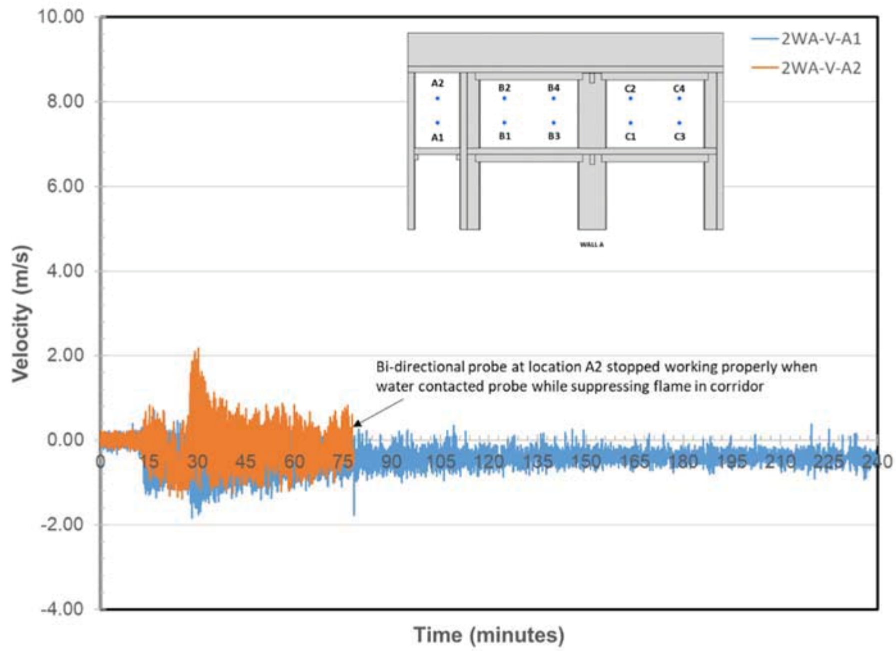

Figure 238. Velocity at Location A on Wall A

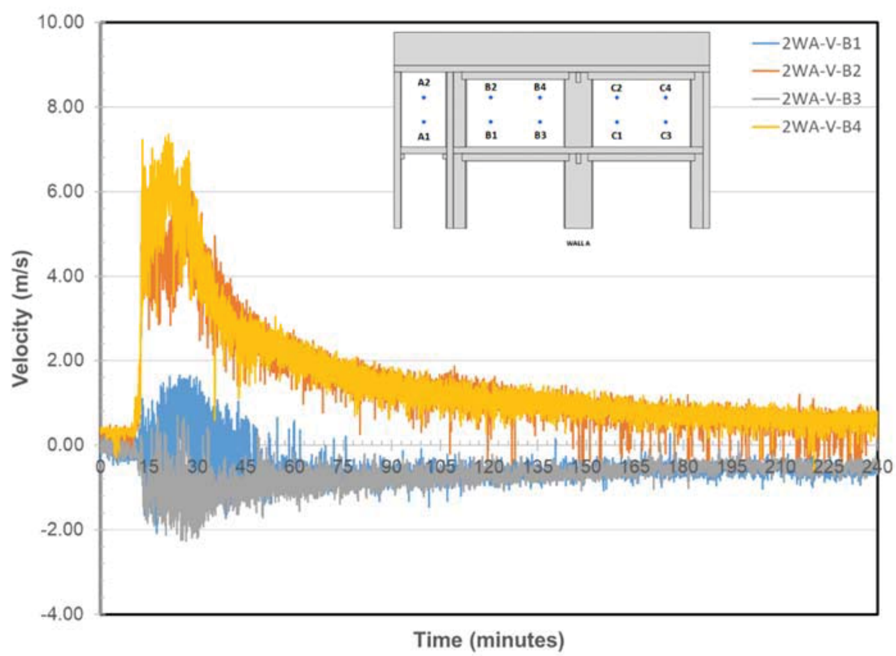

Figure 239. Velocity at Location B on Wall A

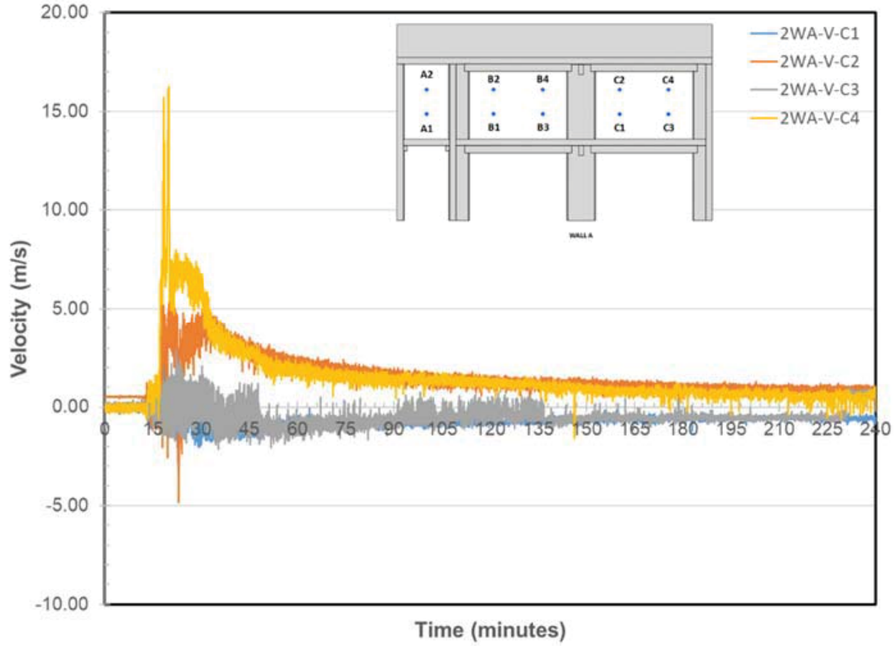

Figure 240. Velocity at Location C on Wall A

Heat Flux Transducers

The following table provides a summary of the heat flux results. The "Description" column typically describes the location of the heat flux transducer. The time at which the heat flux first changes by a pre-determined amount is provided in the "Time of Initial Change" column. The pre-determined amount of change in heat flux is provided in the "Initial Change Amount" column. The maximum heat flux recorded during the test is provided in the "Maximum" column. The "Maximum Average" columns are calculated over four pre-determined time spans.

Table 11. Heat Flux Result Summary

Description	Time of Initial Change (s)	Initial Change Value (kW/m²)	Maximum Heat Flux (kW/m²)	Heat Flux 10 second maximum average (kW/m²)	Heat Flux 30 second maximum average (kW/m²)	Heat Flux 60 second maximum average (kW/m²)	Heat Flux 300 second maximum average (kW/m²)	Heat Flux 600 second maximum average (kW/m²)
2WF-H-A1	817	5	66.4	58.4	51.0	48.5	37.9	26.2
2WA-H-A1	750	5	58.6	57.2	55.8	53.4	49.9	44.9
2WA-H-A2	758	5	25.0	24.3	23.9	23.6	23.0	22.5
2WA-H-B1	914	5	60.6	57.1	56.4	55.8	53.8	49.8
2WA-H-B2	784	5	23.3	22.6	22.3	22.1	21.7	20.4

The following table shows which heat flux transducer was taken out of service during the experiment. All calculated values reported for the instrument are prior to the out of service time.

Table 12. Out of Service Times

Description	Out of Service Time (s)	Out of Service Time (hh:mm:ss)	Out of service reason
2WA-H-A1	1310	00:21:50	Issue with data connection

The following charts show a time dependent representation of the instantaneous heat flux measured during the experiment.

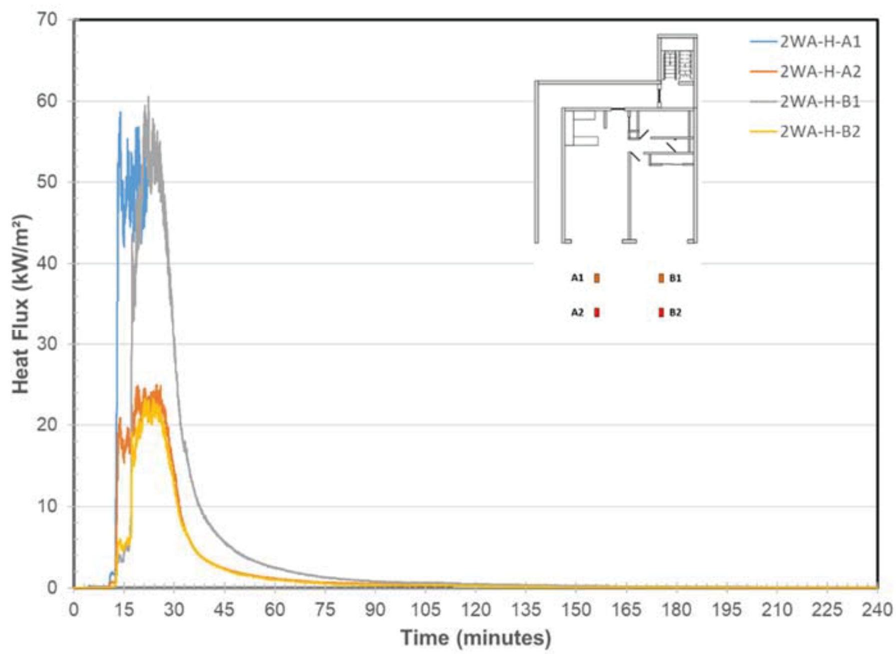

Figure 241. Heat Fluxes in Front of Wall A

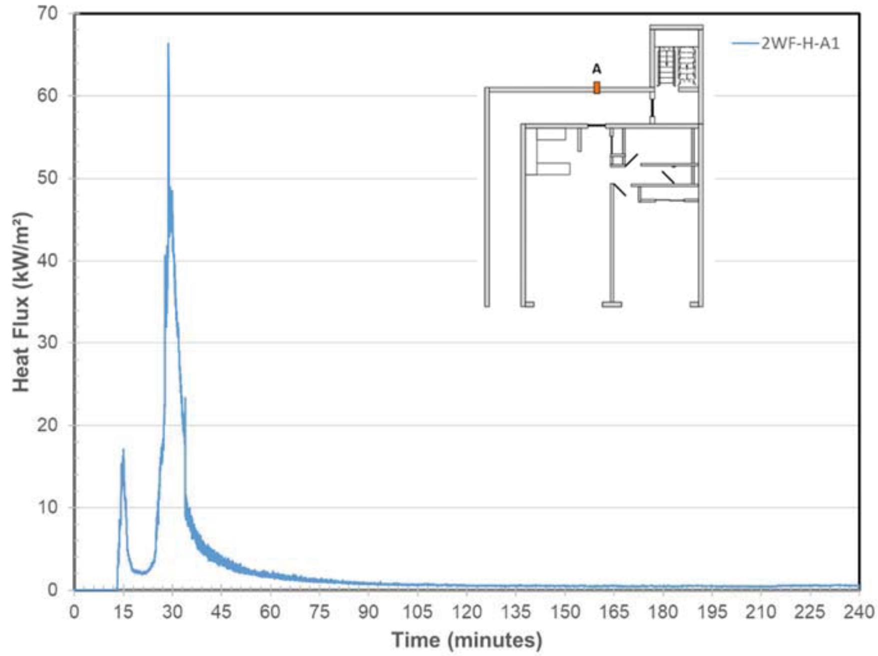

Figure 242. Heat Flux on Wall F across from Apartment Door

Optical Density Meter

The following table provides a description of the optical density meter used in the experiment. The extinction beam path length is the distance measured from the light source to the lens of the photo transducer.

Table 13. Optical Density Meter Description

Description	Light Source Type	X (m)	Y (m)	Z (m)	Extinction Beam Path Length (m)
2RH-O-A1	White light	3.353	10.363	1.524	0.914

The following table shows when the ODM was taken out of service during the experiment. All calculated values reported for the instrument are prior to the out of service time.

Table 14. Out of Service Times

Description	Out of Service Time (s)	Out of Service Time (hh:mm:ss)	Out of service reason
2RH-O-A1	864	00:14:24	Temperature exceeded operating range

The following chart shows the obscuration during the experiment.

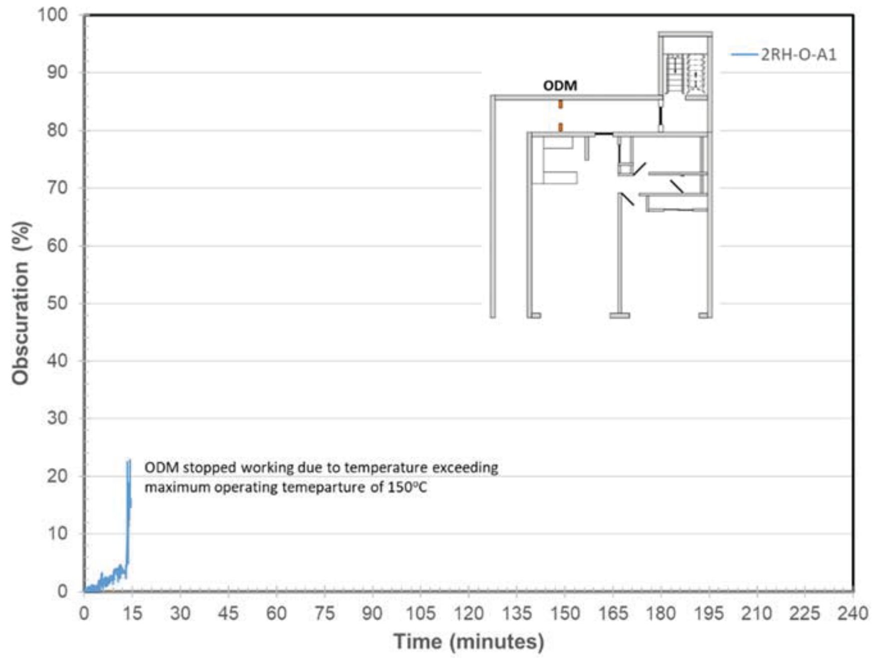

Figure 243. Obscuration in Corridor

The following chart shows the obscuration per unit length during the experiment.

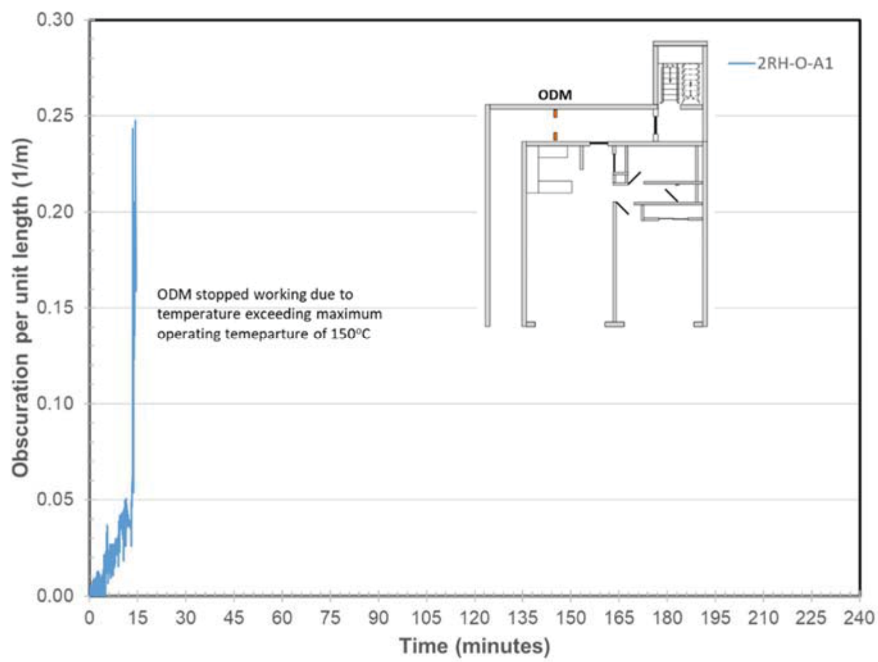

Figure 244. Obscuration per unit Length in Corridor

Smoke Detectors

The following table provides a description of the detectors used in the experiment. All detectors were mounted on the ceiling.

Table 15. Detectors Summary

Description	Location	Distance below ceiling (m)	Manufacturer	Model	Detector Type	Sensor Type
2CL-I-A1	2nd Floor Living Room	0.00	Kidde	i12080	smoke	ionization
2CL-P-A1	2nd Floor Living Room	0.00	Kidde	p12040	smoke	photoelectric
2CB-I-A1	2nd Floor Bed Room	0.00	Kidde	i12080	smoke	ionization
2CB-P-A1	2nd Floor Bed Room	0.00	Kidde	p12040	smoke	photoelectric
2CB-I-B1	2nd Floor Hallway Outside of Bedroom	0.00	Kidde	i12080	smoke	ionization
2CB-P-B1	2nd Floor Hallway Outside of Bedroom	0.00	Kidde	p12040	smoke	photoelectric
2CH-I-A1	2nd Floor Corridor near Wall A	0.00	Kidde	i12080	smoke	ionization
2CH-P-A1	2nd Floor Corridor near Wall A	0.00	Kidde	p12040	smoke	photoelectric
2CH-I-B1	2nd Floor Corridor by Apartment Door	0.00	Kidde	p12040	smoke	ionization
2CH-P-B1	2nd Floor Corridor by Apartment Door	0.00	Kidde	i12080	smoke	photoelectric
2CH-I-C1	2nd Floor Stairwell	0.00	Kidde	i12080	smoke	ionization
2CH-P-C1	2nd Floor Stairwell	0.00	Kidde	p12040	smoke	ionization

The following table provides a summary of activation times for all smoke detectors in all experiments.

Table 16. Smoke Detector Activation Summary

Description	Location	Activation Time (s)	Activation Time (hh:mm:ss)
2CL-I-A1	2nd Floor Living Room	49	00:00:49
2CB-I-B1	2nd Floor Hallway Outside of Bedroom	57	00:00:57
2CL-P-A1	2nd Floor Living Room	62	00:01:02
2CB-P-B1	2nd Floor Hallway Outside of Bedroom	80	00:01:20
2CB-I-A1	2nd Floor Bed Room	184	00:03:04
2CB-P-A1	2nd Floor Bed Room	218	00:03:38
2CH-P-B1	2nd Floor Corridor by Apartment Door	273	00:04:33
2CH-I-B1	2nd Floor Corridor by Apartment Door	300	00:05:00
2CH-I-A1	2nd Floor Corridor near Wall A	540	00:09:00
2CH-P-A1	2nd Floor Corridor near Wall A	788	00:13:08
2CH-P-C1	2nd Floor Stairwell	1604	00:26:44
2CH-I-C1	2nd Floor Stairwell	7045	01:57:25

Fire Products Collector

The following table provides a description of the FPC used in the experiment. The table includes a description of the FPC, as well as the Calibration factor (C Factor) and the net heat released per unit of oxygen consumed (E Factor), which are used to calculate the het release rate (HRR) during an experiment. The C Factor is based on data from a fire with a known HRR. The E Factor is a property of the fuel being burned.

Table 17. Fire Products Collector Description

Description	C Factor	E Factor (kJ/kg)
14 MW	1.128	13100

The following table shows when the FPC was taken out of service during the experiment. A time is also provided when the FPC was placed back into service.

Table 18. FPC Event Times

Description	Time (s)	Time (hh:mm:ss)
FPC Offline due to an issue with gas filtration system	0	00:00:00
FPC Online	1219	00:20:19
FPC Offline to replace gas filter	6023	01:40:23
FPC Online	6084	01:41:24

The following chart shows the heat release rate of the fire during the experiment. The heat release rate is calculated based on the principle of oxygen consumption calorimetry.

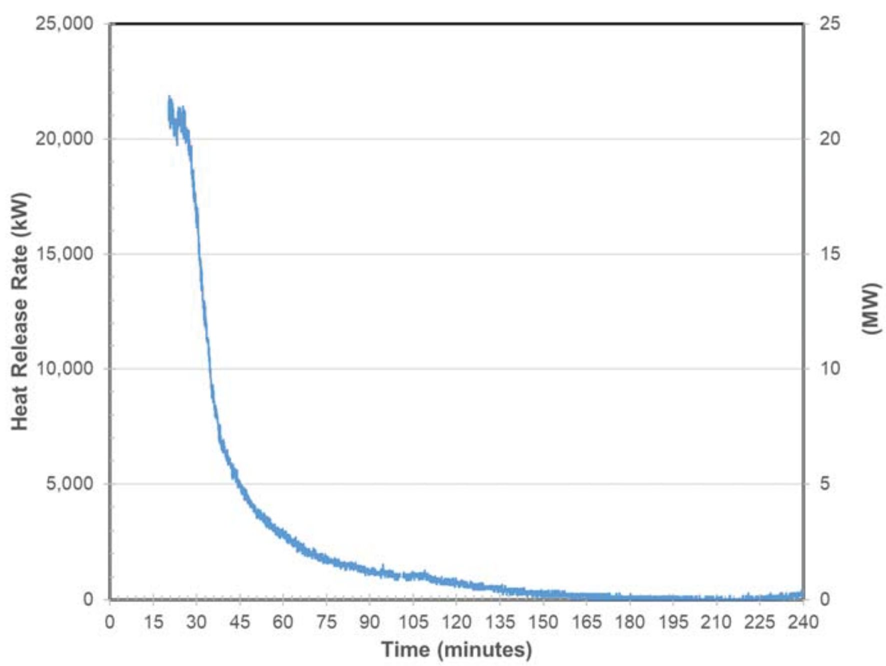

Figure 245. Heat Release Rate

The following chart shows the total heat released from the fire during the experiment. The total heat released is calculated by integrating the heat release rate over time. Note that because the FPC was offline during a portion of the experiment, the final value for the total heat released will be less than the actual value.

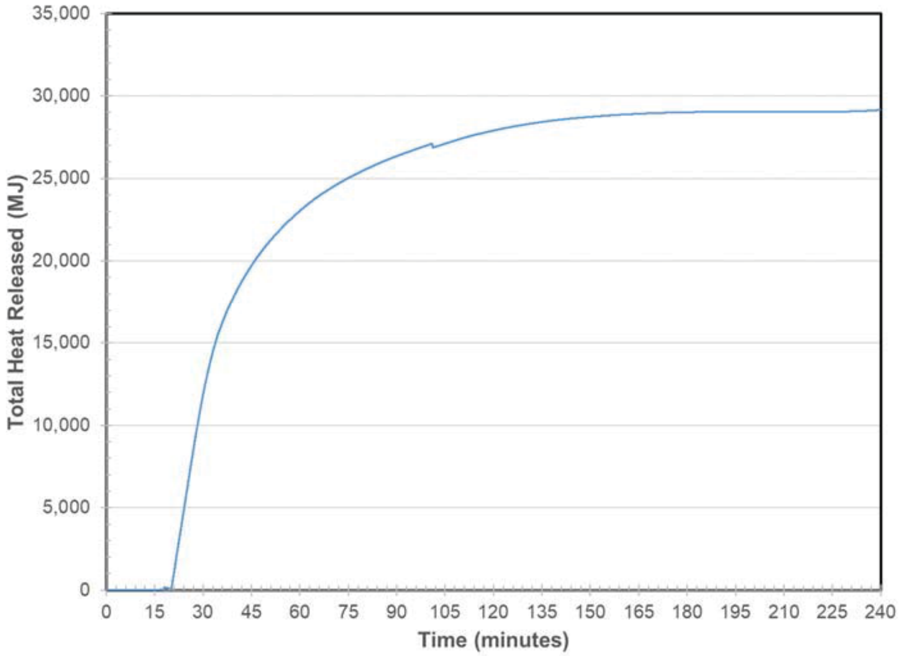

Figure 246. Total Heat Released

Gas Analyzer-Paramagnetic-O_2

The following table provides information about the oxygen sampling location and the operating parameters of the oxygen analyzer. The “O_2 delay time” is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample bypass and analyzer exhaust lines are returned to during the experiment.

Table 19. Oxygen measurement descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	O_2 delay time	Exhaust Return
2RH-G-A1	5.59	10.36	1.62	12	To Ambient Laboratory

The following table shows when the gas analyzer was taken out of service during the experiment. A time is also provided when the gas analyzer was placed back into service.

Table 20. Gas Analyzer Event Times

Description	Time (s)	Time (hh:mm:ss)
Gas Cart Off – due to filter change	11416	03:10:16
Gas Cart On	11470	03:11:10

The following table provides a summary of the oxygen measurement results.

Table 21. Oxygen Measurement Results

Description	Oxygen Analyzer Full Scale Range (%)	Oxygen Peak Minimum (%)	Oxygen-Average (%)
2RH-G-A1	25.00	0.869	20.10

The following chart presents the oxygen concentration measured during the test.

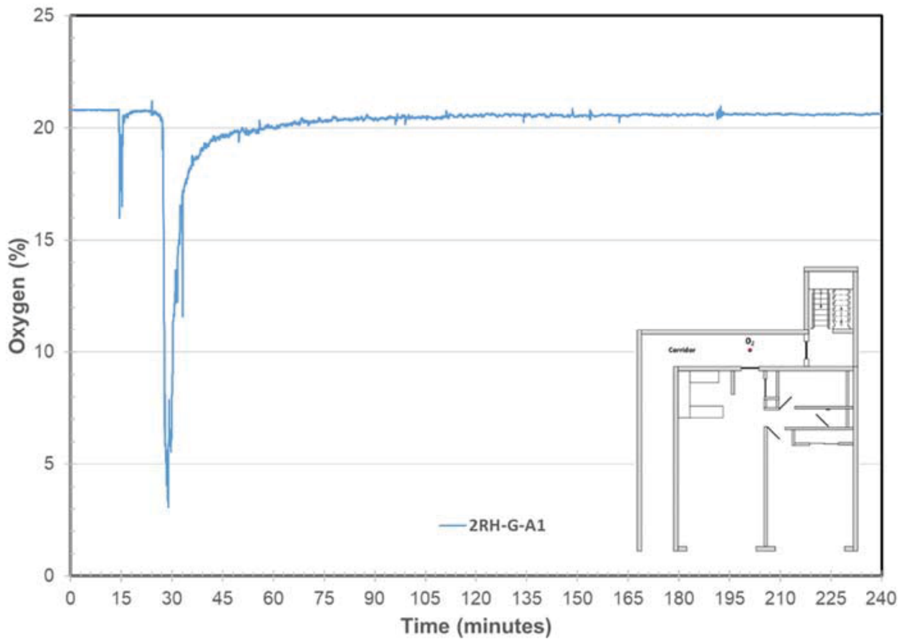

Figure 247. Oxygen Concentration in the Corridor

Gas Analyzer-NDIR-CO/CO₂

The following table provides information about the carbon monoxide and carbon dioxide sampling location(s) and the operating parameters of the analyzer(s). The "CO/CO2 delay time" is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample by-pass and analyzer exhaust lines are returned to during the experiment.

Table 22. CO and CO2 Measurement Descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	CO/CO2 Delay Time (s)	Exhaust Return
2RH-G-A1	5.59	10.36	1.52	12	To Ambient Laboratory

The following table shows when the gas analyzer was taken out of service during the experiment. A time is also provided when the gas analyzer was placed back into service.

Table 23. Gas Analyzer Event Times

Description	Time (s)	Time (hh:mm:ss)
Gas Cart Off to change gas filter	11416	03:10:16
Gas Cart On	11470	03:11:10

The following table provides a summary of the carbon monoxide gas measurement results.

Table 24. CO Measurement Results

Description	CO Analyzer Full Scale Range (mol/mol)	Maximum CO Gas Concentration (mol/mol)	CO- Average (mol/mol)
2RH-G-A1	0.05	0.0036	-0.0002

The following table provides a summary of the carbon dioxide gas measurement results.

Table 25. CO2 Measurement Results

Description	CO2 Analyzer Full Scale Range (mol/mol)	CO2 Span Gas Value (mol/mol)	Maximum CO2 Gas Concentration (mol/mol)	CO2- Average (mol/mol)
2RH-G-A1	0.25	0.22	0.1662	0.0053

The following chart shows the carbon monoxide concentration measured during the experiment.

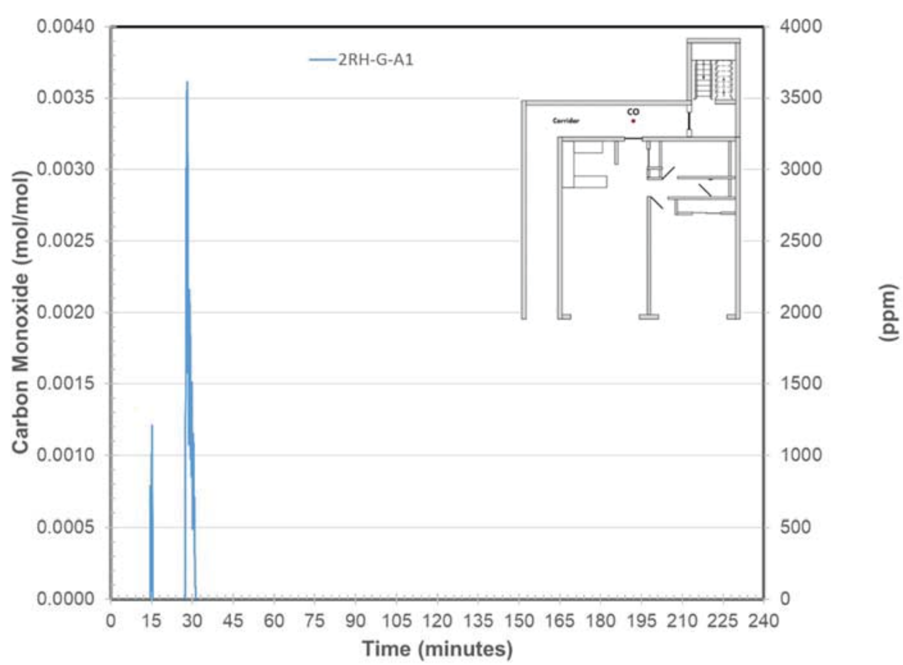

Figure 248. Carbon Monoxide Concentration in the Corridor

The following chart shows the carbon dioxide concentration measured during the experiment.

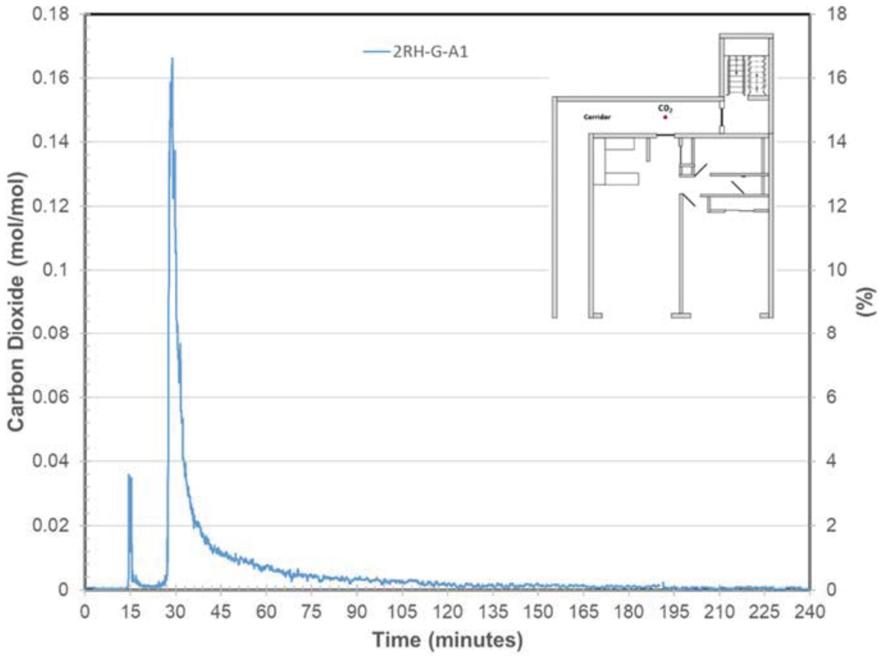

Figure 249. Carbon Dioxide Concentration in the Corridor

Video

The following table provides a description of the videos taken during this experiment.

Table 26. Video Log

Description	Start Time	Video Duration (s)	Filename
IGNITION	09:25:58	14494	203923_20170620_092558_1.mov
LIVING ROOM	09:25:59	14494	203923_20170620_092559_2.mov
BEDROOM	09:26:01	14493	203923_20170620_092601_3.mov
DOOR / KITCHEN	09:26:03	14492	203923_20170620_092603_4.mov
KITCHEN / LIVING ROOM	09:26:04	14492	203923_20170620_092604_5.mov
HALLWAY	09:26:06	14492	203923_20170620_092606_6.mov
STAIRWELL	09:26:07	14492	203923_20170620_092607_7.mov
FLIR	09:26:09	14496	203923_20170620_092609_8.mov
FRONT VIEW HD	09:26:11	14495	203923_20170620_092611_9.mov
LIVING ROOM HD	09:26:11	14496	203923_20170620_092611_10.mov
BEDROOM HD	09:26:12	14495	203923_20170620_092612_11.mov
OVERALL	09:26:13	14495	203923_20170620_092613_12.mov
FRONT VIEW HD_USDA			203923_949755.MOV
LIVING ROOM HD_USDA			203923_949756.MOV
BEDROOM HD_USDA			203923_949757.MOV
OVERALL_USDA			203923_949758.MOV
IGNITION_USDA			203923_949759.MOV
LIVING ROOM_USDA			203923_949760.MOV
BEDROOM_USDA			203923_949761.MOV

Description	Start Time	Video Duration (s)	Filename
DOOR / KITCHEN_USDA			203923_949762.MOV
KITCHEN / LIVING ROOM_USDA			203923_949763.MOV
HALLWAY_USDA			203923_949764.MOV
STAIRWELL_USDA			203923_949765.MOV
FLIR_USDA			203923_949766.MOV
203923_Master_USDA			203923_949846.MOV

Experiment Photographs

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 250. Pre test 1:39 hr:min, (203923_836035)

Figure 251. Pre test 1:39 hr:min (203923_836036)

Figure 252. Pre test 1:35 hr:min (203923_836037)

Figure 253. Pre test 1:35 hr:min (203923_836038)

Figure 254. Pre test 1:33 hr:min (203923_836039)

Figure 255. Pre test 1:33 hr:min (203923_836040)

Figure 256. Pre test 1:33 hr:min (203923_836041)

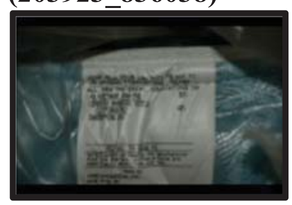

Figure 257. Pre test 1:33 hr:min (203923_836042)

Figure 258. Pre test 1:27 hr:min (203923_836043)

Figure 259. Pre test 1:27 hr:min (203923_836044)

Figure 260. Pre test 1:27 hr:min (203923_836045)

Figure 261. Pre test 1:27 hr:min (203923_836046)

Figure 262. Pre test 1:26 hr:min (203923_836047)

Figure 263. Pre test 1:26 hr:min (203923_836048)

Figure 264. Pre test 1:26 hr:min (203923_836049)

Figure 265. Pre test 1:26 hr:min (203923_836050)

Figure 266. Pre test 1:26 hr:min (203923_836051)

Figure 267. Pre test 1:26 hr:min (203923_836052)

Figure 268. Pre test 1:25 hr:min (203923_836053)

Figure 269. Pre test 1:25 hr:min (203923_836054)

Figure 270. Pre test 59 minutes (203923_836055)

Figure 271. Pre test 59 minutes (203923_836056)

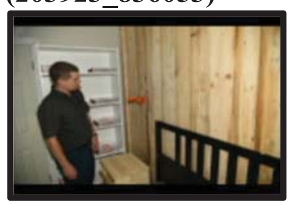

Figure 272. Pre test 56 minutes (203923_836057)

Figure 273. Pre test 56 minutes (203923_836058)

Figure 274. Pre test 56 minutes (203923_836059)

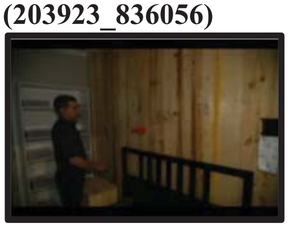

Figure 275. Pre test 56 minutes (203923_836060)

Figure 276. Pre test 55 minutes (203923_836061)

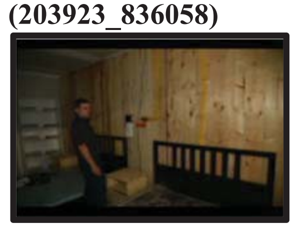

Figure 277. Pre test 55 minutes (203923_836062)

Figure 278. Pre test 55 minutes (203923_836063)

Figure 279. Pre test 55 minutes (203923_836064)

Figure 280. Pre test 50 minutes (203923_836065)

Figure 281. Pre test 49 minutes (203923_836066)

Figure 282. Pre test 49 minutes (203923_836067)

Figure 283. Pre test 49 minutes (203923_836068)

Figure 284. Pre test 49 minutes (203923_836069)

Figure 285. Pre test 48 minutes (203923_836070)

Figure 286. Pre test 48 minutes (203923_836071)

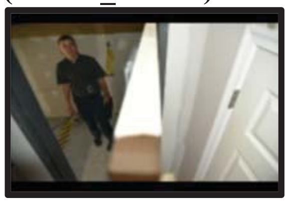

Figure 287. Pre test 44 minutes (203923_836072)

Figure 288. Pre test 44 minutes (203923_836073)

Figure 289. Pre test 42 minutes (203923_836074)

Figure 290. Pre test 42 minutes (203923_836075)

Figure 291. Pre test 42 minutes (203923_836076)

Figure 292. Pre test 41 minutes (203923_836077)

Figure 293. Pre test 41 minutes (203923_836078)

Figure 294. Pre test 41 minutes (203923_836079)

Figure 295. Pre test 41 minutes (203923_836080)

Figure 296. Pre test 41 minutes (203923_836081)

Figure 297. Pre test 40 minutes (203923_836082)

Figure 298. Pre test 40 minutes (203923_836083)

Figure 299. Pre test 40 minutes (203923_836084)

Figure 300. Pre test 40 minutes (203923_836085)

Figure 301. Pre test 39 minutes (203923_836086)

Figure 302. Pre test 39 minutes (203923_836087)

Figure 303. Pre test 39 minutes (203923_836088)

Figure 304. Pre test 39 minutes (203923_836089)

Figure 305. Pre test 39 minutes (203923_836090)

Figure 306. Pre test 39 minutes (203923_836091)

Figure 307. Pre test 39 minutes (203923_836092)

Figure 308. Pre test 38 minutes (203923_836093)

Figure 309. Pre test 38 minutes (203923_836094)

Figure 310. Pre test 38 minutes (203923_836095)

Figure 311. Pre test 38 minutes (203923_836096)

Figure 312. Pre test 38 minutes (203923_836097)

Figure 313. Pre test 38 minutes (203923_836098)

Figure 314. Pre test 38 minutes (203923_836099)

Figure 315. Pre test 37 minutes (203923_836100)

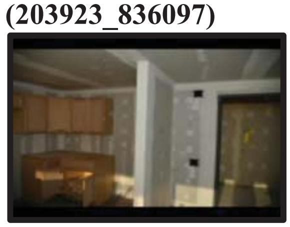

Figure 316. Pre test 37 minutes (203923_836101)

Figure 317. Pre test 37 minutes (203923_836102)

Figure 318. Pre test 37 minutes (203923_836103)

Figure 319. Pre test 37 minutes (203923_836104)

Figure 320. Pre test 37 minutes (203923_836105)

Figure 321. Pre test 37 minutes (203923_836106)


Figure 322. Pre test 37 minutes (203923_836107)


Figure 323. Pre test 37 minutes (203923_836108)


Figure 324. Pre test 37 minutes (203923_836109)


Figure 325. Pre test 37 minutes (203923_836110)


Figure 326. Pre test 37 minutes (203923_836111)


Figure 327. Pre test 37 minutes (203923_836112)


Figure 328. Pre test 37 minutes (203923_836113)


Figure 329. Pre test 37 minutes (203923_836114)


Figure 330. Pre test 37 minutes (203923_836115)


Figure 331. Pre test 36 minutes (203923_836116)


Figure 332. Pre test 36 minutes (203923_836117)

Figure 333. Pre test 36 minutes (203923_836118)

Figure 334. Pre test 36 minutes (203923_836119)


Figure 335. Pre test 36 minutes (203923_836120)


Figure 336. Pre test 36 minutes (203923_836121)


Figure 337. Pre test 36 minutes (203923_836122)


Figure 338. Pre test 36 minutes (203923_836123)


Figure 339. Pre test 36 minutes (203923_836124)


Figure 340. Pre test 36 minutes (203923_836125)


Figure 341. Pre test 36 minutes (203923_836126)


Figure 342. Pre test 36 minutes (203923_836127)


Figure 343. Pre test 36 minutes (203923_836128)

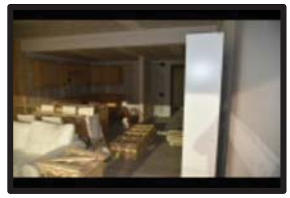
Figure 344. Pre test 36 minutes (203923_836129)


Figure 345. Pre test 35 minutes (203923_836130)


Figure 346. Pre test 35 minutes (203923_836131)


Figure 347. Pre test 35 minutes (203923_836132)


Figure 348. Pre test 35 minutes (203923_836133)


Figure 349. Pre test 35 minutes (203923_836134)


Figure 350. Pre test 35 minutes (203923_836135)


Figure 351. Pre test 35 minutes (203923_836136)


Figure 352. Pre test 35 minutes (203923_836137)


Figure 353. Pre test 35 minutes (203923_836138)


Figure 354. Pre test 35 minutes (203923_836139)


Figure 355. Pre test 35 minutes (203923_836140)


Figure 356. Pre test 35 minutes (203923_836141)


Figure 357. Pre test 35 minutes (203923_836142)


Figure 358. Pre test 35 minutes (203923_836143)


Figure 359. Pre test 35 minutes (203923_836144)


Figure 360. Pre test 33 minutes (203923_836145)


Figure 361. Pre test 33 minutes (203923_836146)


Figure 362. Pre test 33 minutes (203923_836147)


Figure 363. Pre test 33 minutes (203923_836148)


Figure 364. Pre test 33 minutes (203923_836149)


Figure 365. Pre test 33 minutes (203923_836150)


Figure 366. Pre test 33 minutes (203923_836151)


Figure 367. Pre test 33 minutes (203923_836152)


Figure 368. Pre test 33 minutes (203923_836153)


Figure 369. Pre test 33 minutes (203923_836154)

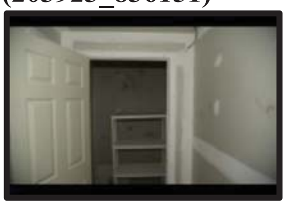
Figure 370. Pre test 33 minutes (203923_836155)


Figure 371. Pre test 33 minutes (203923_836156)


Figure 372. Pre test 33 minutes (203923_836157)

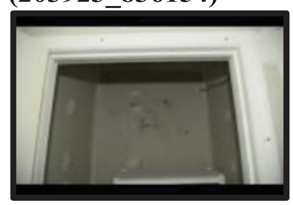
Figure 373. Pre test 33 minutes (203923_836158)


Figure 374. Pre test 33 minutes (203923_836159)


Figure 375. Pre test 33 minutes (203923_836160)

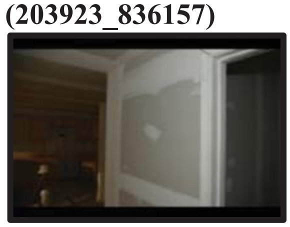
Figure 376. Pre test 33 minutes (203923_836161)

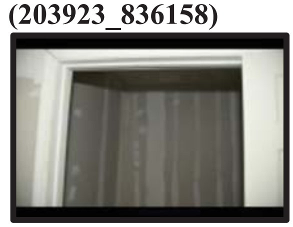
Figure 377. Pre test 33 minutes (203923_836162)


Figure 378. Pre test 32 minutes (203923_836163)

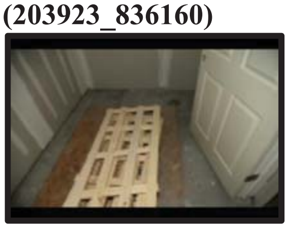
Figure 379. Pre test 32 minutes (203923_836164)


Figure 380. Pre test 32 minutes (203923_836165)


Figure 381. Pre test 32 minutes (203923_836166)

Figure 382. Pre test 32 minutes (203923_836167)

Figure 383. Pre test 32 minutes (203923_836168)

Figure 384. Pre test 32 minutes (203923_836169)

Figure 385. Pre test 32 minutes (203923_836170)

Figure 386. Pre test 32 minutes (203923_836171)

Figure 387. Pre test 32 minutes (203923_836172)

Figure 388. Pre test 31 minutes (203923_836173)

Figure 389. Pre test 31 minutes (203923_836174)

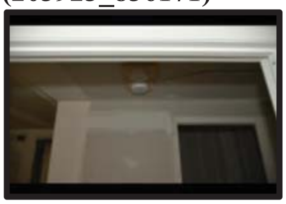

Figure 390. Pre test 31 minutes (203923_836175)

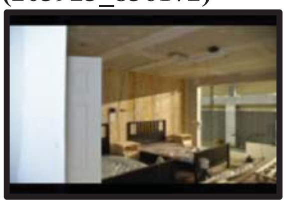

Figure 391. Pre test 31 minutes (203923_836176)

Figure 392. Pre test 31 minutes (203923_836177)

Figure 393. Pre test 31 minutes (203923_836178)

Figure 394. Pre test 31 minutes (203923_836179)

Figure 395. Pre test 31 minutes (203923_836180)

Figure 396. Pre test 31 minutes (203923_836181)

Figure 397. Pre test 31 minutes (203923_836182)

Figure 398. Pre test 31 minutes (203923_836183)

Figure 399. Pre test 31 minutes (203923_836184)

Figure 400. Pre test 31 minutes (203923_836185)

Figure 401. Pre test 31 minutes (203923_836186)

Figure 402. Pre test 30 minutes (203923_836187)

Figure 403. Pre test 30 minutes (203923_836188)

Figure 404. Pre test 30 minutes (203923_836189)

Figure 405. Pre test 30 minutes (203923_836190)

Figure 406. Pre test 30 minutes (203923_836191)

Figure 407. Pre test 30 minutes (203923_836192)

Figure 408. Pre test 30 minutes (203923_836193)

Figure 409. Pre test 30 minutes (203923_836194)

Figure 410. Pre test 30 minutes (203923_836195)

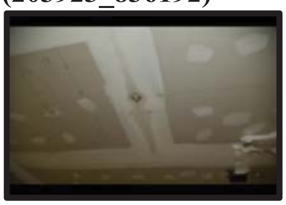

Figure 411. Pre test 30 minutes (203923_836196)

Figure 412. Pre test 30 minutes (203923_836197)

Figure 413. Pre test 30 minutes (203923_836198)

Figure 414. Pre test 29 minutes (203923_836199)

Figure 415. Pre test 29 minutes (203923_836200)

Figure 416. Pre test 29 minutes (203923_836201)

Figure 417. Pre test 29 minutes (203923_836202)

Figure 418. Pre test 29 minutes (203923_836203)

Figure 419. Pre test 29 minutes (203923_836204)

Figure 420. Pre test 29 minutes (203923_836205)

Figure 421. Pre test 29 minutes (203923_836206)


Figure 422. Pre test 29 minutes (203923_836207)


Figure 423. Pre test 29 minutes (203923_836208)


Figure 424. Pre test 29 minutes (203923_836209)


Figure 425. Pre test 29 minutes (203923_836210)


Figure 426. Pre test 29 minutes (203923_836211)


Figure 427. Pre test 29 minutes (203923_836212)


Figure 428. Pre test 28 minutes (203923_836213)


Figure 429. Pre test 28 minutes (203923_836214)


Figure 430. Pre test 28 minutes (203923_836215)


Figure 431. Pre test 28 minutes (203923_836216)


Figure 432. Pre test 28 minutes (203923_836217)


Figure 433. Pre test 28 minutes (203923_836218)


Figure 434. Pre test 28 minutes (203923_836219)


Figure 435. Pre test 21 minutes (203923_836220)


Figure 436. Pre test 21 minutes (203923_836221)


Figure 437. Pre test 21 minutes (203923_836222)


Figure 438. Pre test 20 minutes (203923_836223)


Figure 439. Pre test 20 minutes (203923_836224)


Figure 440. Pre test 20 minutes (203923_836225)


Figure 441. Pre test 20 minutes (203923_836226)


Figure 442. Pre test 20 minutes (203923_836227)


Figure 443. Pre test 19 minutes (203923_836228)


Figure 444. 23 seconds (203923_836229)


Figure 445. 39 seconds (203923_836230)


Figure 446. 61 seconds (203923_836231)


Figure 447. 93 seconds (203923_836232)


Figure 448. 163 seconds (203923_836233)


Figure 449. 189 seconds (203923_836234)


Figure 450. 217 seconds (203923_836235)


Figure 451. 227 seconds (203923_836236)


Figure 452. 261 seconds (203923_836237)


Figure 453. 297 seconds (203923_836238)


Figure 454. 333 seconds (203923_836239)


Figure 455. 337 seconds (203923_836240)


Figure 456. 405 seconds (203923_836241)


Figure 457. 411 seconds (203923_836242)


Figure 458. 421 seconds (203923_836243)


Figure 459. 595 seconds (203923_836244)


Figure 460. 633 seconds (203923_836245)


Figure 461. 637 seconds (203923_836246)


Figure 462. 639 seconds (203923_836247)


Figure 463. 643 seconds (203923_836248)


Figure 464. 647 seconds (203923_836249)


Figure 465. 653 seconds (203923_836250)


Figure 466. 661 seconds (203923_836251)


Figure 467. 677 seconds (203923_836252)


Figure 468. 683 seconds (203923_836253)


Figure 469. 699 seconds (203923_836254)


Figure 470. 717 seconds (203923_836255)


Figure 471. 735 seconds (203923_836256)


Figure 472. 753 seconds (203923_836257)


Figure 473. 755 seconds (203923_836258)


Figure 474. 757 seconds (203923_836259)


Figure 475. 761 seconds (203923_836260)


Figure 476. 767 seconds (203923_836261)


Figure 477. 773 seconds (203923_836262)


Figure 478. 775 seconds (203923_836263)


Figure 479. 783 seconds (203923_836264)


Figure 480. 797 seconds (203923_836265)


Figure 481. 803 seconds (203923_836266)

Figure 482. 809 seconds (203923_836267)

Figure 483. 821 seconds (203923_836268)

Figure 484. 839 seconds (203923_836269)

Figure 485. 845 seconds (203923_836270)

Figure 486. 873 seconds (203923_836271)

Figure 487. 897 seconds (203923_836272)

Figure 488. 915 seconds (203923_836273)

Figure 489. 929 seconds (203923_836274)

Figure 490. 935 seconds (203923_836275)

Figure 491. 957 seconds (203923_836276)

Figure 492. 985 seconds (203923_836277)

Figure 493. 997 seconds (203923_836278)

Figure 494. 1031 seconds (203923_836279)

Figure 495. 1041 seconds (203923_836280)

Figure 496. 1045 seconds (203923_836281)

Figure 497. 1049 seconds (203923_836282)

Figure 498. 1055 seconds (203923_836283)

Figure 499. 1067 seconds (203923_836284)

Figure 500. 1073 seconds (203923_836285)

Figure 501. 1093 seconds (203923_836286)


Figure 502. 1113 seconds (203923_836287)


Figure 503. 1119 seconds (203923_836288)


Figure 504. 1143 seconds (203923_836289)


Figure 505. 1163 seconds (203923_836290)


Figure 506. 1169 seconds (203923_836291)


Figure 507. 1177 seconds (203923_836292)


Figure 508. 1183 seconds (203923_836293)


Figure 509. 1377 seconds (203923_836294)


Figure 510. 1379 seconds (203923_836295)


Figure 511. 1383 seconds (203923_836296)


Figure 512. 1629 seconds (203923_836297)


Figure 513. 1637 seconds (203923_836298)


Figure 514. 1645 seconds (203923_836299)


Figure 515. 2155 seconds (203923_836300)


Figure 516. 2159 seconds (203923_836301)


Figure 517. 2179 seconds (203923_836302)


Figure 518. 2191 seconds (203923_836303)


Figure 519. 2989 seconds (203923_836304)


Figure 520. 2991 seconds (203923_836305)


Figure 521. 3005 seconds (203923_836306)


Figure 522. 3013 seconds (203923_836307)


Figure 523. 3101 seconds (203923_836308)


Figure 524. 3103 seconds (203923_836309)


Figure 525. 3109 seconds (203923_836310)


Figure 526. 3117 seconds (203923_836311)


Figure 527. 3129 seconds (203923_836312)


Figure 528. 3131 seconds (203923_836313)


Figure 529. 3131 seconds (203923_836314)


Figure 530. 3137 seconds (203923_836315)


Figure 531. 4353 seconds (203923_836316)


Figure 532. 4363 seconds (203923_836317)


Figure 533. 4369 seconds (203923_836318)


Figure 534. 4421 seconds (203923_836319)


Figure 535. 4423 seconds (203923_836320)


Figure 536. 4433 seconds (203923_836321)


Figure 537. 4435 seconds (203923_836322)


Figure 538. 4859 seconds (203923_836323)


Figure 539. 4871 seconds (203923_836324)


Figure 540. 4885 seconds (203923_836325)


Figure 541. 4887 seconds (203923_836326)

Figure 542. 4899 seconds (203923_836327)

Figure 543. 4901 seconds (203923_836328)

Figure 544. 4921 seconds (203923_836329)

Figure 545. 4923 seconds (203923_836330)

Figure 546. 6435 seconds (203923_836331)

Figure 547. 6441 seconds (203923_836332)

Figure 548. 6443 seconds (203923_836333)

Figure 549. 6447 seconds (203923_836334)

Figure 550. 6505 seconds (203923_836335)

Figure 551. 6507 seconds (203923_836336)

Figure 552. 6515 seconds (203923_836337)

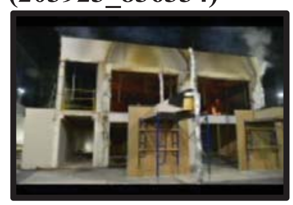

Figure 553. 6529 seconds (203923_836338)

Figure 554. 6531 seconds (203923_836339)

Figure 555. 6533 seconds (203923_836340)

Figure 556. 6539 seconds (203923_836341)

Figure 557. 12625 seconds (203923_836342)

Figure 558. 12629 seconds (203923_836343)

Figure 559. 12631 seconds (203923_836344)

Figure 560. 12639 seconds (203923_836345)

Figure 561. 12651 seconds (203923_836346)


Figure 562. 12657 seconds (203923_836347)


Figure 563. 12665 seconds (203923_836348)


Figure 564. 12671 seconds (203923_836349)


Figure 565. 12677 seconds (203923_836350)


Figure 566. 13681 seconds (203923_836351)


Figure 567. 13685 seconds (203923_836352)


Figure 568. 13703 seconds (203923_836353)


Figure 569. 13705 seconds (203923_836354)


Figure 570. 13713 seconds (203923_836355)

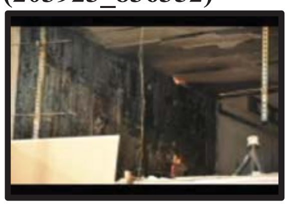
Figure 571. 13715 seconds (203923_836356)


Figure 572. 13723 seconds (203923_836357)


Figure 573. 13727 seconds (203923_836358)


Figure 574. 13731 seconds (203923_836359)


Figure 575. 13731 seconds (203923_836360)


Figure 576. 14183 seconds (203923_836361)


Figure 577. 14197 seconds (203923_836362)


Figure 578. 14205 seconds (203923_836363)


Figure 579. 14207 seconds (203923_836364)


Figure 580. 14217 seconds (203923_836365)


Figure 581. 14221 seconds (203923_836366)

Figure 582. 14227 seconds (203923_836367)

Figure 583. 14231 seconds (203923_836368)

Figure 584. 14239 seconds (203923_836369)

Figure 585. 14247 seconds (203923_836370)

Figure 586. 14251 seconds (203923_836371)

Figure 587. 14265 seconds (203923_836372)

Figure 588. 14273 seconds (203923_836373)

Figure 589. Post test 13 minutes (203923_836374)

Figure 590. Post test 13 minutes (203923_836375)

Figure 591. Post test 13 minutes (203923_836376)

Figure 592. Post test 13 minutes (203923_836377)

Figure 593. Post test 13 minutes (203923_836378)

Figure 594. Post test 14 minutes (203923_836379)

Figure 595. Post test 14 minutes (203923_836380)

Figure 596. Post test 15 minutes (203923_836381)

Figure 597. Post test 16 minutes (203923_836382)

Figure 598. Post test 18 minutes (203923_836383)

Figure 599. Post test 18 minutes (203923_836384)

Figure 600. Post test 18 minutes (203923_836385)

Figure 601. Post test 21 minutes (203923_836386)

Figure 602. Post test 21 minutes (203923_836387)

Figure 603. Post test 21 minutes (203923_836388)

Figure 604. Post test 21 minutes (203923_836389)

Figure 605. Post test 22 minutes (203923_836390)

Figure 606. Post test 22 minutes (203923_836391)

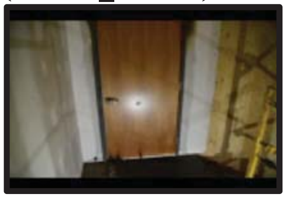

Figure 607. Post test 23 minutes (203923_836392)

Figure 608. Post test 23 minutes (203923_836393)

Figure 609. Post test 23 minutes (203923_836394)

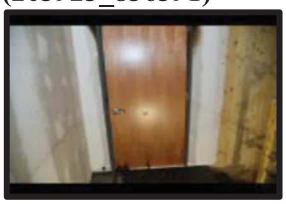

Figure 610. Post test 23 minutes (203923_836395)

Figure 611. Post test 23 minutes (203923_836396)

Figure 612. Post test 23 minutes (203923_836397)

Figure 613. Post test 23 minutes (203923_836398)

Figure 614. Post test 23 minutes (203923_836399)

Figure 615. Post test 23 minutes (203923_836400)

Figure 616. Post test 23 minutes (203923_836401)

Figure 617. Post test 23 minutes (203923_836402)

Figure 618. Post test 23 minutes (203923_836403)

Figure 619. Post test 23 minutes (203923_836404)

Figure 620. Post test 23 minutes (203923_836405)

Figure 621. Post test 24 minutes (203923_836406)


Figure 622. Post test 24 minutes (203923_836407)


Figure 623. Post test 24 minutes (203923_836408)


Figure 624. Post test 24 minutes (203923_836409)


Figure 625. Post test 24 minutes (203923_836410)


Figure 626. Post test 24 minutes (203923_836411)


Figure 627. Post test 24 minutes (203923_836412)


Figure 628. Post test 24 minutes (203923_836413)


Figure 629. Post test 24 minutes (203923_836414)


Figure 630. Post test 24 minutes (203923_836415)


Figure 631. Post test 24 minutes (203923_836416)


Figure 632. Post test 24 minutes (203923_836417)


Figure 633. Post test 24 minutes (203923_836418)


Figure 634. Post test 25 minutes (203923_836419)


Figure 635. Post test 25 minutes (203923_836420)


Figure 636. Post test 25 minutes (203923_836421)


Figure 637. Post test 25 minutes (203923_836422)

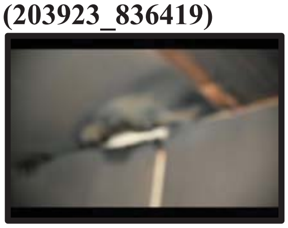
Figure 638. Post test 25 minutes (203923_836423)


Figure 639. Post test 25 minutes (203923_836424)


Figure 640. Post test 25 minutes (203923_836425)


Figure 641. Post test 25 minutes (203923_836426)

Figure 642. Post test 25 minutes (203923_836427)

Figure 643. Post test 25 minutes (203923_836428)

Figure 644. Post test 25 minutes (203923_836429)

Figure 645. Post test 25 minutes (203923_836430)

Figure 646. Post test 26 minutes (203923_836431)

Figure 647. Post test 26 minutes (203923_836432)

Figure 648. Post test 26 minutes (203923_836433)

Figure 649. Post test 26 minutes (203923_836434)

Figure 650. Post test 26 minutes (203923_836435)

Figure 651. Post test 26 minutes (203923_836436)

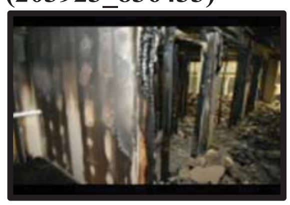

Figure 652. Post test 26 minutes (203923_836437)

Figure 653. Post test 26 minutes (203923_836438)

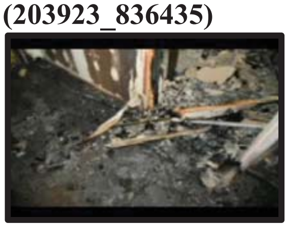

Figure 654. Post test 26 minutes (203923_836439)

Figure 655. Post test 26 minutes (203923_836440)

Figure 656. Post test 26 minutes (203923_836441)

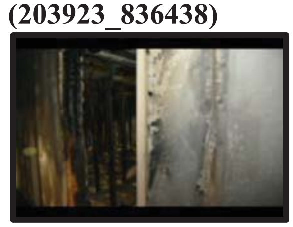

Figure 657. Post test 26 minutes (203923_836442)

Figure 658. Post test 26 minutes (203923_836443)

Figure 659. Post test 26 minutes (203923_836444)

Figure 660. Post test 27 minutes (203923_836445)

Figure 661. Post test 27 minutes (203923_836446)

Figure 662. Post test 27 minutes (203923_836447)

Figure 663. Post test 27 minutes (203923_836448)

Figure 664. Post test 27 minutes (203923_836449)

Figure 665. Post test 27 minutes (203923_836450)

Figure 666. Post test 27 minutes (203923_836451)

Figure 667. Post test 27 minutes (203923_836452)

Figure 668. Post test 27 minutes (203923_836453)

Figure 669. Post test 27 minutes (203923_836454)

Figure 670. Post test 27 minutes (203923_836455)

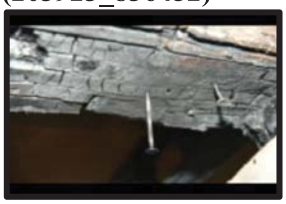

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Figure 672. Post test 27 minutes (203923_836457)

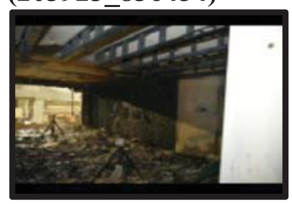

Figure 673. Post test 27 minutes (203923_836458)

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Figure 675. Post test 28 minutes (203923_836460)

Figure 676. Post test 28 minutes (203923_836461)

Figure 677. Post test 28 minutes (203923_836462)

Figure 678. Post test 28 minutes (203923_836463)

Figure 679. Post test 28 minutes (203923_836464)

Figure 680. Post test 28 minutes (203923_836465)

Figure 681. Post test 28 minutes (203923_836466)


Figure 682. Post test 28 minutes (203923_836467)


Figure 683. Post test 28 minutes (203923_836468)


Figure 684. Post test 28 minutes (203923_836469)


Figure 685. Post test 28 minutes (203923_836470)


Figure 686. Post test 28 minutes (203923_836471)


Figure 687. Post test 28 minutes (203923_836472)


Figure 688. Post test 28 minutes (203923_836473)


Figure 689. Post test 28 minutes (203923_836474)


Figure 690. Post test 28 minutes (203923_836475)

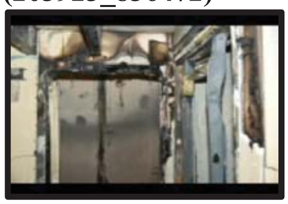
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Figure 692. Post test 28 minutes (203923_836477)


Figure 693. Post test 28 minutes (203923_836478)


Figure 694. Post test 28 minutes (203923_836479)


Figure 695. Post test 29 minutes (203923_836480)


Figure 696. Post test 29 minutes (203923_836481)


Figure 697. Post test 29 minutes (203923_836482)

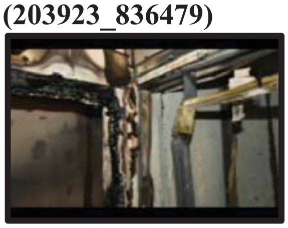


Figure 698. Post test 29 minutes (203923_836483)


Figure 699. Post test 29 minutes (203923_836484)


Figure 700. Post test 29 minutes (203923_836485)


Figure 701. Post test 29 minutes (203923_836486)


Figure 702. Post test 29 minutes (203923_836487)


Figure 703. Post test 29 minutes (203923_836488)


Figure 704. Post test 29 minutes (203923_836489)


Figure 705. Post test 29 minutes (203923_836490)


Figure 706. Post test 29 minutes (203923_836491)


Figure 707. Post test 29 minutes (203923_836492)


Figure 708. Post test 29 minutes (203923_836493)


Figure 709. Post test 29 minutes (203923_836494)


Figure 710. Post test 29 minutes (203923_836495)


Figure 711. Post test 29 minutes (203923_836496)


Figure 712. Post test 29 minutes (203923_836497)

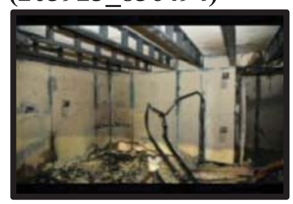


Figure 713. Post test 29 minutes (203923_836498)


Figure 714. Post test 29 minutes (203923_836499)


Figure 715. Post test 29 minutes (203923_836500)


Figure 716. Post test 29 minutes (203923_836501)


Figure 717. Post test 29 minutes (203923_836502)


Figure 718. Post test 30 minutes (203923_836503)


Figure 719. Post test 30 minutes (203923_836504)


Figure 720. Post test 30 minutes (203923_836505)


Figure 721. Post test 30 minutes (203923_836506)

Figure 722. Post test 30 minutes (203923_836507)

Figure 723. Post test 30 minutes (203923_836508)

Figure 724. Post test 30 minutes (203923_836509)

Figure 725. Post test 30 minutes (203923_836510)

Figure 726. Post test 30 minutes (203923_836511)

Figure 727. Post test 30 minutes (203923_836512)

Figure 728. Post test 30 minutes (203923_836513)

Figure 729. Post test 30 minutes (203923_836514)

Figure 730. Post test 30 minutes (203923_836515)

Figure 731. Post test 30 minutes (203923_836516)

Figure 732. Post test 30 minutes (203923_836517)

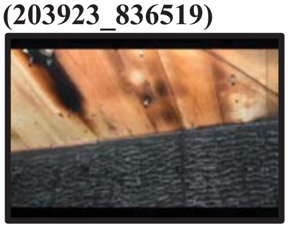
Figure 733. Post test 30 minutes (203923_836518)

Figure 734. Post test 30 minutes (203923_836519)

Figure 735. Post test 30 minutes (203923_836520)

Figure 736. Post test 31 minutes (203923_836521)

Figure 737. Post test 31 minutes (203923_836522)



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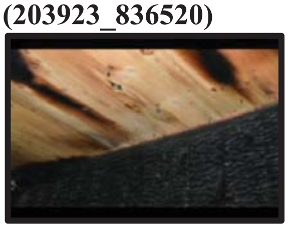

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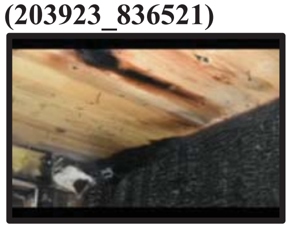


Figure 740. Post test 31 minutes (203923_836525)

Figure 741. Post test 31 minutes (203923_836526)


Figure 742. Post test 31 minutes (203923_836527)


Figure 743. Post test 31 minutes (203923_836528)


Figure 744. Post test 31 minutes (203923_836529)


Figure 745. Post test 31 minutes (203923_836530)


Figure 746. Post test 31 minutes (203923_836531)

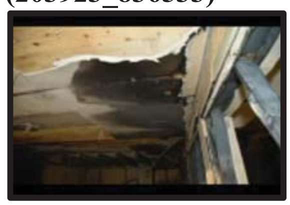

Figure 747. Post test 31 minutes (203923_836532)


Figure 748. Post test 32 minutes (203923_836533)


Figure 749. Post test 32 minutes (203923_836534)


Figure 750. Post test 32 minutes (203923_836535)


Figure 751. Post test 32 minutes (203923_836536)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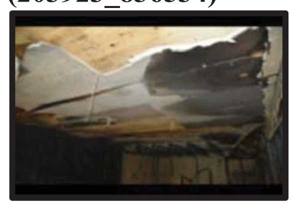
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Figure 754. Post test 32 minutes (203923_836539)


Figure 755. Post test 32 minutes (203923_836540)

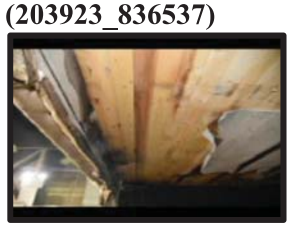
Figure 756. Post test 32 minutes (203923_836541)


Figure 757. Post test 32 minutes (203923_836542)


Figure 758. Post test 32 minutes (203923_836543)


Figure 759. Post test 32 minutes (203923_836544)


Figure 760. Post test 32 minutes (203923_836545)

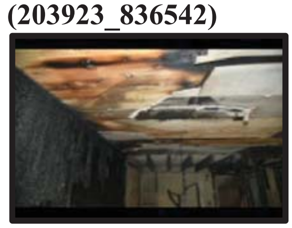
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Figure 762. Post test 32 minutes (203923_836547)

Figure 763. Post test 32 minutes (203923_836548)

Figure 764. Post test 32 minutes (203923_836549)

Figure 765. Post test 32 minutes (203923_836550)

Figure 766. Post test 32 minutes (203923_836551)

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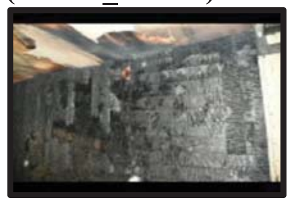

Figure 768. Post test 32 minutes (203923_836553)

Figure 769. Post test 32 minutes (203923_836554)

Figure 770. Post test 33 minutes (203923_836555)

Figure 771. Post test 33 minutes (203923_836556)

Figure 772. Post test 33 minutes (203923_836557)

Figure 773. Post test 33 minutes (203923_836558)

Figure 774. Post test 33 minutes (203923_836559)

Figure 775. Post test 33 minutes (203923_836560)

Figure 776. Post test 33 minutes (203923_836561)

Figure 777. Post test 33 minutes (203923_836562)

Figure 778. Post test 33 minutes (203923_836563)

Figure 779. Post test 33 minutes (203923_836564)

Figure 780. Post test 33 minutes (203923_836565)

Figure 781. Post test 33 minutes (203923_836566)

Figure 782. Post test 33 minutes (203923_836567)

Figure 783. Post test 33 minutes (203923_836568)

Figure 784. Post test 33 minutes (203923_836569)

Figure 785. Post test 33 minutes (203923_836570)

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Figure 788. Post test 33 minutes (203923_836573)

Figure 789. Post test 33 minutes (203923_836574)

Figure 790. Post test 33 minutes (203923_836575)

Figure 791. Post test 33 minutes (203923_836576)

Figure 792. Post test 34 minutes (203923_836577)

Figure 793. Post test 34 minutes (203923_836578)

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Figure 796. Post test 34 minutes (203923_836581)

Figure 797. Post test 34 minutes (203923_836582)

Figure 798. Post test 34 minutes (203923_836583)

Figure 799. Post test 34 minutes (203923_836584)

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Figure 802. Post test 34 minutes (203923_836587)

Figure 803. Post test 34 minutes (203923_836588)

Figure 804. Post test 34 minutes (203923_836589)

Figure 805. Post test 34 minutes (203923_836590)

Figure 806. Post test 34 minutes (203923_836591)

Figure 807. Post test 34 minutes (203923_836592)

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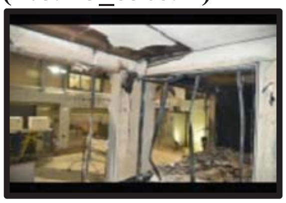
Figure 809. Post test 34 minutes (203923_836594)

Figure 810. Post test 34 minutes (203923_836595)



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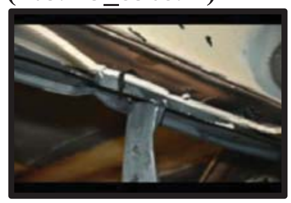

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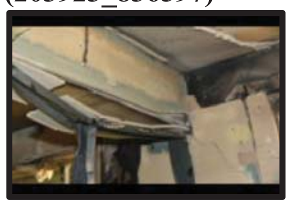

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Figure 817. Post test 35 minutes (203923_836602)

Figure 818. Post test 35 minutes (203923_836603)

Figure 819. Post test 35 minutes (203923_836604)

Figure 820. Post test 35 minutes (203923_836605)

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Figure 822. Post test 35 minutes (203923_836607)


Figure 823. Post test 35 minutes (203923_836608)


Figure 824. Post test 35 minutes (203923_836609)


Figure 825. Post test 35 minutes (203923_836610)


Figure 826. Post test 35 minutes (203923_836611)


Figure 827. Post test 36 minutes (203923_836612)


Figure 828. Post test 36 minutes (203923_836613)


Figure 829. Post test 36 minutes (203923_836614)


Figure 830. Post test 36 minutes (203923_836615)


Figure 831. Post test 36 minutes (203923_836616)


Figure 832. Post test 36 minutes (203923_836617)


Figure 833. Post test 36 minutes (203923_836618)


Figure 834. Post test 36 minutes (203923_836619)


Figure 835. Post test 36 minutes (203923_836620)


Figure 836. Post test 36 minutes (203923_836621)


Figure 837. Post test 36 minutes (203923_836622)


Figure 838. Post test 36 minutes (203923_836623)


Figure 839. Post test 36 minutes (203923_836624)


Figure 840. Post test 36 minutes (203923_836625)


Figure 841. Post test 36 minutes (203923_836626)

Figure 842. Post test 36 minutes (203923_836627)

Figure 843. Post test 36 minutes (203923_836628)

Figure 844. Post test 37 minutes (203923_836629)

Figure 845. Post test 37 minutes (203923_836630)

Figure 846. Post test 37 minutes (203923_836631)

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Figure 850. Post test 37 minutes (203923_836635)

Figure 851. Post test 37 minutes (203923_836636)

Figure 852. Post test 37 minutes (203923_836637)

Figure 853. Post test 37 minutes (203923_836638)

Figure 854. Post test 37 minutes (203923_836639)

Figure 855. Post test 37 minutes (203923_836640)

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Figure 864. Post test 37 minutes (203923_836649)


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Figure 866. Post test 37 minutes (203923_836651)


Figure 867. Post test 38 minutes (203923_836652)


Figure 868. Post test 38 minutes (203923_836653)


Figure 869. Post test 38 minutes (203923_836654)


Figure 870. Post test 38 minutes (203923_836655)


Figure 871. Post test 38 minutes (203923_836656)


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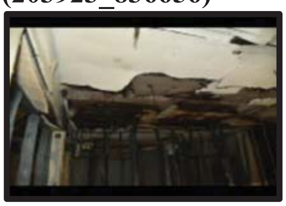
Figure 873. Post test 38 minutes (203923_836658)


Figure 874. Post test 38 minutes (203923_836659)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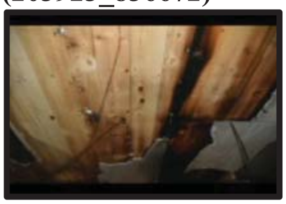

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Figure 894. Post test 39 minutes (203923_836679)

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Figure 897. Post test 39 minutes (203923_836682)

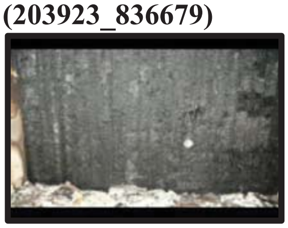

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Figure 899. Post test 39 minutes (203923_836684)

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Figure 902. Post test 39 minutes (203923_836687)

Figure 903. Post test 39 minutes (203923_836688)

Figure 904. Post test 39 minutes (203923_836689)

Figure 905. Post test 39 minutes (203923_836690)

Figure 906. Post test 40 minutes (203923_836691)

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Figure 908. Post test 40 minutes (203923_836693)

Figure 909. Post test 40 minutes (203923_836694)

Figure 910. Post test 40 minutes (203923_836695)

Figure 911. Post test 40 minutes (203923_836696)

Figure 912. Post test 40 minutes (203923_836697)

Figure 913. Post test 40 minutes (203923_836698)

Figure 914. Post test 40 minutes (203923_836699)

Figure 915. Post test 40 minutes (203923_836700)

Figure 916. Post test 40 minutes (203923_836701)

Figure 917. Post test 40 minutes (203923_836702)

Figure 918. Post test 40 minutes (203923_836703)

Figure 919. Post test 40 minutes (203923_836704)

Figure 920. Post test 40 minutes (203923_836705)

Figure 921. Post test 40 minutes (203923_836706)

Figure 922. Post test 40 minutes (203923_836707)

Figure 923. Post test 41 minutes (203923_836708)

Figure 924. Post test 41 minutes (203923_836709)

Figure 925. Post test 41 minutes (203923_836710)

Figure 926. Post test 41 minutes (203923_836711)

Figure 927. Post test 41 minutes (203923_836712)

Figure 928. Post test 41 minutes (203923_836713)

Figure 929. Post test 41 minutes (203923_836714)

Figure 930. Post test 42 minutes (203923_836715)

Figure 931. Post test 42 minutes (203923_836716)

Figure 932. Post test 42 minutes (203923_836717)

References

1 ATF Fire Research Laboratory, CLT Project Report, 17OA0001 Sub 1, December 22, 2017

Appendix 4—Cross-Laminated Timber Project Test 4 Results

U. S. Department of Justice

Fire Research Laboratory
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES
6000 Ammendale Road
Beltsville, MD 20705-1250
Phone: 202-648-6200

Test Record

ASCLD/LAB–*International* Testing Accreditation Certificate ALI-217-T

Title	CLT Project - Test 4 Results		
Test Type	Custom		
Lab Number	17OA0001-1	**Author**	David R. Tucholski
Test Date	6/27/17	**Test Number**	4 of 5

Introduction

The following provides the data for the fourth test of the CLT Project. The test was conducted on the first floor of the test structure. The CLT ceiling and walls in the bedroom and living room were exposed, as were portions of the support columns and mid-span beams. All other CLT surfaces were encapsulated with two layers of (5/8 inch) Type X gypsum wallboard. The two large openings in Wall A were covered with glass. Fire sprinklers were installed throughout the structure and were allowed to activate automatically. The test duration was 5 minutes and 52 seconds. Details related to the test structure, instrumentation, and experimental procedures are provided in the main CLT Project report [1].

Table of Contents

Instrumentation Location

The following figure describes the nomenclature used to identify the various instrumentation and their locations.

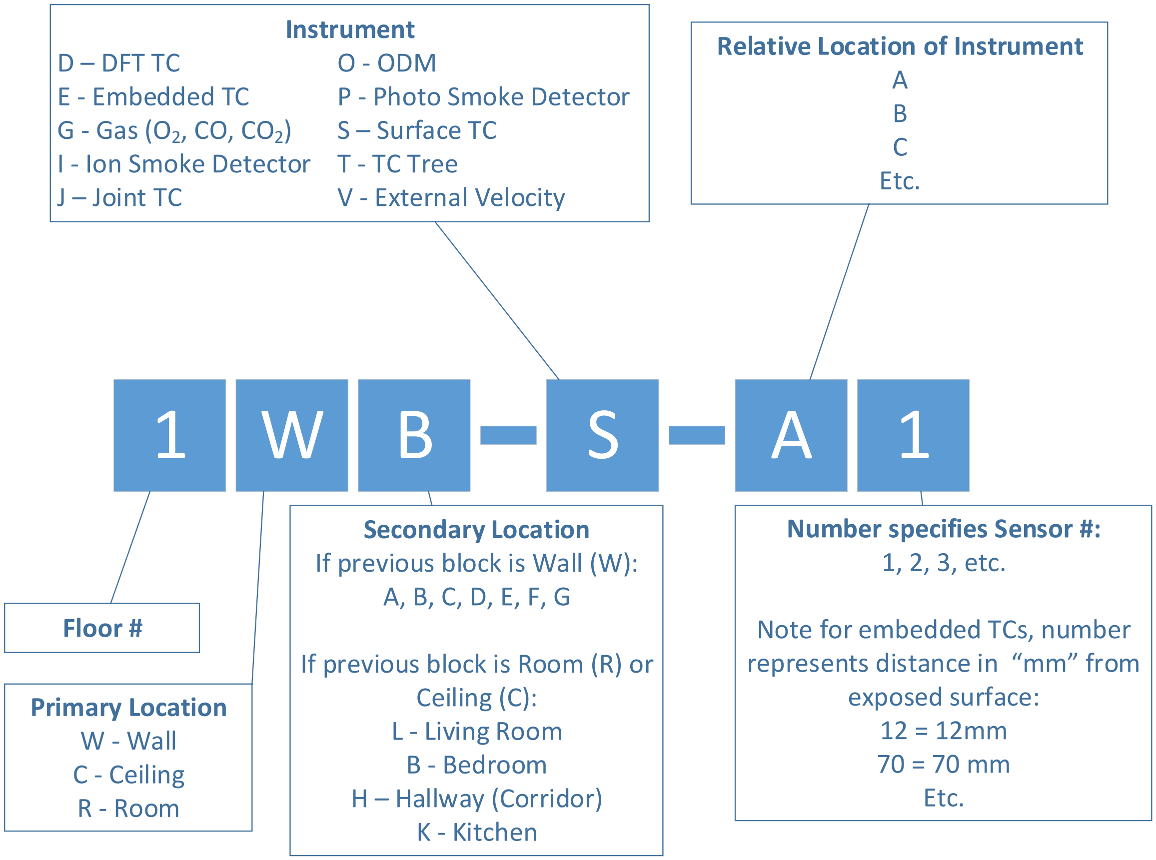

Figure 1. Nomenclature of Instrumentation Location

The example shown in Figure 1 is for a thermocouple located on the surface of Wall B on the first floor. It is the first thermocouple at location A. The exact location of each instrument is based on a Cartesian coordinate system (X, Y, Z). Location X and Location Y are located in the horizontal plane. Location Z is the vertical distance from the floor to the centerline of the instrument. Drawings showing the instrumentation locations and the associated coordinate systems are provided in the main CLT Project report [1].

Results for Test 4 (ID 203924)

Restoration of Test Structure and Setup Photographs

The following photographs show the restoration of the test structure after Test 2 and of the experiment setup.


Figure 2. 203924_825771


Figure 3. 203924_825772


Figure 4. 203924_825773


Figure 5. 203924_825774


Figure 6. 203924_825775


Figure 7. 203924_825776


Figure 8. 203924_825777


Figure 9. 203924_825778


Figure 10. 203924_825779


Figure 11. 203924_825780


Figure 12. 203924_825781


Figure 13. 203924_825782


Figure 14. 203924_825783


Figure 15. 203924_825784


Figure 16. 203924_825785

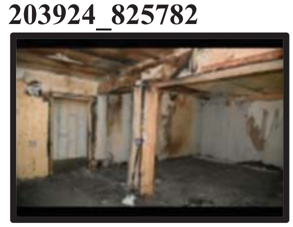
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Figure 18. 203924_825787


Figure 19. 203924_825788


Figure 20. 203924_825789


Figure 21. 203924_825790


Figure 22.
203924_825791


Figure 23.
203924_825792


Figure 24.
203924_825793


Figure 25.
203924_825794


Figure 26.
203924_825795


Figure 27.
203924_825796


Figure 28.
203924_825797


Figure 29.
203924_825798


Figure 30.
203924_825799


Figure 31.
203924_825800


Figure 32.
203924_825801


Figure 33.
203924_825802


Figure 34.
203924_825803


Figure 35.
203924_825804


Figure 36.
203924_825805


Figure 37.
203924_825806


Figure 38.
203924_825807


Figure 39.
203924_825808


Figure 40.
203924_825809


Figure 41.
203924_825810


Figure 42.
203924_825811


Figure 43.
203924_825812

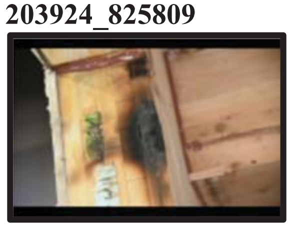
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Figure 45.
203924_825814


Figure 46.
203924_825815


Figure 47.
203924_825816


Figure 48.
203924_825817


Figure 49.
203924_825818


Figure 50.
203924_825819


Figure 51.
203924_825820


Figure 52.
203924_825821


Figure 53.
203924_825822


Figure 54.
203924_825823


Figure 55.
203924_825824


Figure 56.
203924_825825


Figure 57.
203924_825826

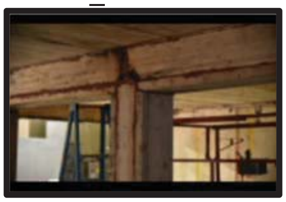
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Figure 59.
203924_825828


Figure 60.
203924_825829


Figure 61.
203924_825830


Figure 62.
203924_825831


Figure 63.
203924_825832


Figure 64.
203924_825833


Figure 65.
203924_825834


Figure 66.
203924_825835


Figure 67.
203924_825836


Figure 68.
203924_825837


Figure 69.
203924_825838


Figure 70.
203924_825839


Figure 71.
203924_825840


Figure 72.
203924_825841


Figure 73.
203924_825842


Figure 74.
203924_825843


Figure 75.
203924_825844


Figure 76.
203924_825845


Figure 77.
203924_825846


Figure 78.
203924_825847


Figure 79.
203924_825848


Figure 80.
203924_825849


Figure 81.
203924_825850


Figure 82.
203924_825851


Figure 83.
203924_825852


Figure 84.
203924_825853

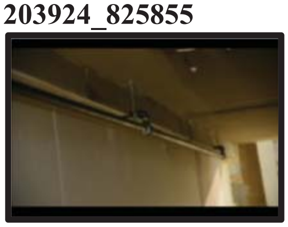

Figure 85.
203924_825854


Figure 86.
203924_825855


Figure 87.
203924_825856


Figure 88.
203924_825857


Figure 89.
203924_825858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203924_825862

Figure 94.
203924_825863

Figure 95.
203924_825864

Figure 96.
203924_825865

Figure 97.
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Figure 98.
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Figure 99.
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Figure 100.
203924_825869

Figure 101.
203924_825870

Figure 102.
203924_825871

Figure 103.
203924_825872

Figure 104.
203924_825873

Figure 105.
203924_825874

Figure 106.
203924_825875

Figure 107.
203924_825876

Figure 108.
203924_825877

Figure 109.
203924_825878

Figure 110.
203924_825879

Figure 111.
203924_825880

Figure 112.
203924_825881

Figure 113.
203924_825882

Figure 114.
203924_825883

Figure 115.
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Figure 116.
203924_825885

Figure 117.
203924_825886

Figure 118. 203924_825887

Figure 119. 203924_825888

Figure 120. 203924_825889

Figure 121. 203924_825890

Figure 122. 203924_825891

Figure 123. 203924_825985

Figure 124. 203924_825986

Figure 125. 203924_825987

Figure 126. 203924_825988

Figure 127. 203924_825989

Figure 128. 203924_825737

Figure 129. 203924_825738

Figure 130. 203924_825739

Figure 131. 203924_825740

Figure 132. 203924_825741

Figure 133. 203924_825742

Figure 134. 203924_825892

Figure 135. 203924_825990

Figure 136. 203924_825743

Figure 137. 203924_825744

Figure 138. 203924_825745

Figure 139. 203924_825746

Figure 140. 203924_825747

Figure 141. 203924_825748


Figure 142.
203924_825749


Figure 143.
203924_825750


Figure 144.
203924_825751


Figure 145.
203924_825752


Figure 146.
203924_825753


Figure 147.
203924_825754


Figure 148.
203924_825755


Figure 149.
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Figure 150.
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Figure 151.
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Figure 152.
203924_825759


Figure 153.
203924_825760


Figure 154.
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Figure 155.
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Figure 156.
203924_825763


Figure 157.
203924_825764

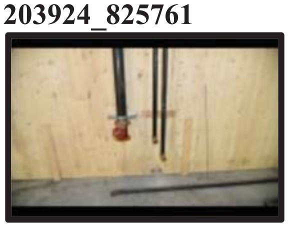
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Figure 159.
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Figure 160.
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Figure 161.
203924_825768


Figure 162.
203924_825769


Figure 163.
203924_825770


Figure 164.
203924_825675


Figure 165.
203924_825676


Figure 166.
203924_825677


Figure 167.
203924_825678


Figure 168.
203924_825679


Figure 169.
203924_825680


Figure 170.
203924_825681


Figure 171.
203924_825682


Figure 172.
203924_825683


Figure 173.
203924_825684


Figure 174.
203924_825685


Figure 175.
203924_825686


Figure 176.
203924_825687


Figure 177.
203924_825688


Figure 178.
203924_825689


Figure 179.
203924_825690


Figure 180.
203924_825691


Figure 181.
203924_825692


Figure 182.
203924_825693


Figure 183.
203924_825694


Figure 184.
203924_825695


Figure 185.
203924_825696


Figure 186.
203924_825697


Figure 187.
203924_825698


Figure 188.
203924_825699


Figure 189.
203924_825700


Figure 190. 203924_825701


Figure 191. 203924_825702

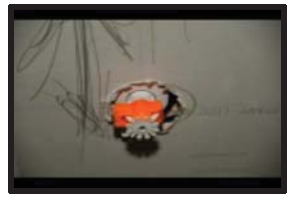
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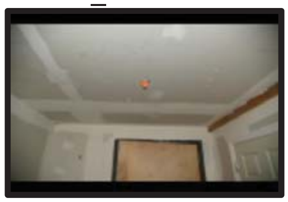
Figure 194. 203924_825705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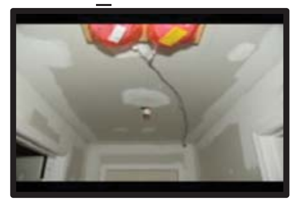
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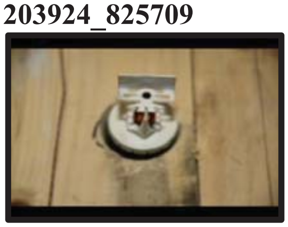
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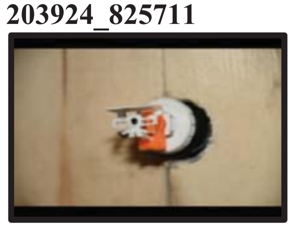
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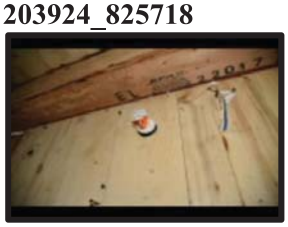
Figure 208. 203924_825719


Figure 209. 203924_825720


Figure 210. 203924_825721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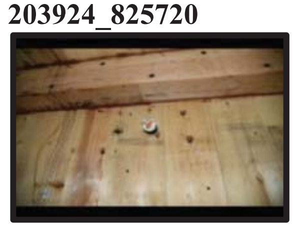
Figure 213. 203924_825724

Figure 214.
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Figure 216.
203924_825727

Figure 217.
203924_825728

Figure 218.
203924_825729

Figure 219.
203924_825730

Figure 220.
203924_825731

Figure 221.
203924_825732

Figure 222.
203924_825991

Figure 223.
203924_825992

Figure 224.
203924_825993

Figure 225.
203924_825994

Figure 226.
203924_825995

Figure 227.
203924_825996

Figure 228.
203924_825997

Figure 229.
203924_825998

Figure 230.
203924_825999

Experiment Events

The following table lists selected events that occurred during the experiment.

Table 1. Experiment Events

Description	Time (s)	Time (hh:mm:ss)
Sprinkler Activation	157	00:02:37
Water Off	286	00:04:46
Apartment Door Opened & Manual Suppression of Remaining Fire	296	00:04:56

Laboratory Conditions

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 2. Lab Conditions Description

Description	Manufacturer	Model
LBR_01	OMEGA	IBTHP-5

The following table provides a summary of the initial conditions at the start of the experiment. The 'Description' column shows the location of the measurements.

Table 3. Ambient Laboratory Condition Summary

Description	Initial (C)	Initial (kPa)	Initial (%)
LBR_01	24	101	45

Thermocouples

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement. The "Z" location is the height of the thermocouple above the floor. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 4. Thermocouple Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WD-J-D3	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
2WD-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-A1	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-B1	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-C1	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-E1	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-A1	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1CB-S-B1	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-C1	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-D1	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-E1	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire
1RL-T-A0	2.210	2.286	0.152	Type K, Glass Ins., 30 AWG wire
1RL-T-A2	2.210	2.286	0.610	Type K, Glass Ins., 24 AWG wire
1RL-T-A4	2.210	2.286	1.219	Type K, Glass Ins., 24 AWG wire
1RL-T-A6	2.210	2.286	1.829	Type K, Glass Ins., 24 AWG wire
1RL-T-A8	2.210	2.286	2.438	Type K, Glass Ins., 24 AWG wire
1RL-T-A9	2.210	2.286	2.718	Type K, Glass Ins., 24 AWG wire
1RL-T-B0	2.210	3.810	0.152	Type K, Glass Ins., 24 AWG wire
1RL-T-B2	2.210	3.810	0.610	Type K, Glass Ins., 24 AWG wire
1RL-T-B4	2.210	3.810	1.219	Type K, Glass Ins., 24 AWG wire
1RL-T-B6	2.210	3.810	1.829	Type K, Glass Ins., 24 AWG wire
1RL-T-B8	2.210	3.810	2.438	Type K, Glass Ins., 24 AWG wire
1RL-T-B9	2.210	3.810	2.718	Type K, Glass Ins., 24 AWG wire
1RK-T-A0	2.210	7.620	0.152	Type K, Glass Ins., 24 AWG wire
1RK-T-A2	2.210	7.620	0.610	Type K, Glass Ins., 24 AWG wire
1RK-T-A4	2.210	7.620	1.219	Type K, Glass Ins., 24 AWG wire
1RK-T-A6	2.210	7.620	1.829	Type K, Glass Ins., 24 AWG wire
1RK-T-A8	2.210	7.620	2.362	Type K, Glass Ins., 24 AWG wire
1RB-T-A0	1.981	1.981	0.152	Type K, Glass Ins., 24 AWG wire
1RB-T-A2	1.981	1.981	0.610	Type K, Glass Ins., 24 AWG wire
1RB-T-A4	1.981	1.981	1.219	Type K, Glass Ins., 24 AWG wire
1RB-T-A6	1.981	1.981	1.829	Type K, Glass Ins., 24 AWG wire
1RB-T-A8	1.981	1.981	2.438	Type K, Glass Ins., 24 AWG wire
1RB-T-A9	1.981	1.981	2.718	Type K, Glass Ins., 24 AWG wire
1RB-T-B0	1.981	3.505	0.152	Type K, Glass Ins., 24 AWG wire
1RB-T-B2	1.981	3.505	0.610	Type K, Glass Ins., 24 AWG wire
1RB-T-B4	1.981	3.505	1.219	Type K, Glass Ins., 24 AWG wire
1RB-T-B6	1.981	3.505	1.829	Type K, Glass Ins., 24 AWG wire
1RB-T-B8	1.981	3.505	2.438	Type K, Glass Ins., 24 AWG wire
1RB-T-B9	1.981	3.505	2.718	Type K, Glass Ins., 24 AWG wire
1WG-T-A0	4.572	1.829	0.152	Type K, Glass Ins., 24 AWG wire
1WG-T-A2	4.572	1.829	0.610	Type K, Glass Ins., 24 AWG wire
1WG-T-A4	4.572	1.829	1.219	Type K, Glass Ins., 24 AWG wire
1WG-T-A6	4.572	1.829	1.829	Type K, Glass Ins., 24 AWG wire
1WG-T-A8	4.572	1.829	2.286	Type K, Glass Ins., 24 AWG wire
1WG-T-B0	4.572	3.810	0.152	Type K, Glass Ins., 24 AWG wire
1WG-T-B2	4.572	3.810	0.610	Type K, Glass Ins., 24 AWG wire
1WG-T-B4	4.572	3.810	1.219	Type K, Glass Ins., 24 AWG wire
1WG-T-B6	4.572	3.810	1.829	Type K, Glass Ins., 24 AWG wire
1WG-T-B8	4.572	3.810	2.286	Type K, Glass Ins., 24 AWG wire
1RH-T-A0	0.762	1.067	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-A2	0.762	1.067	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-A4	0.762	1.067	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-A6	0.762	1.067	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-A8	0.762	1.067	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-A9	0.762	1.067	2.718	Type K, Glass Ins., 24 AWG wire
1RH-T-B0	4.115	10.363	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-B2	4.115	10.363	0.610	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1RH-T-B4	4.115	10.363	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-B6	4.115	10.363	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-B8	4.115	10.363	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-B9	4.115	10.363	2.718	Type K, Glass Ins., 24 AWG wire
1RH-T-C0	8.230	10.363	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-C2	8.230	10.363	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-C4	8.230	10.363	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-C6	8.230	10.363	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-C8	8.230	10.363	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-C9	8.230	10.363	2.718	Type K, Glass Ins., 24 AWG wire
1WB-D-A1	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-A2	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-B1	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-B2	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-C1	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-C2	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
1WD-D-A1	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
1WD-D-A2	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
1CL-D-A1	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CL-D-A2	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CB-D-A1	2.438	2.743	2.711	Type K, Glass Ins., 24 AWG wire
1CB-D-A2	2.438	2.743	2.711	Type K, Glass Ins., 24 AWG wire
1WC-D-A1	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
1WC-D-A2	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
1WC-D-B1	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
1WC-D-B2	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
1WA-T-A0	0.762	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-A4	0.762	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-A6	0.762	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-A8	0.762	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-A9	0.762	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WA-T-B0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-B4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-B6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-B8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-B9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WA-T-C0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-C4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-C6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-C8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-C9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WB-E-A035	0.035	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A012	0.012	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A058	0.058	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A023	0.023	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A105	0.105	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A047	0.047	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A070	0.070	2.286	1.524	Type K, Glass Ins., 30 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WB-S-B1	0.000	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B035	0.035	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B058	0.058	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B023	0.023	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B105	0.105	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B047	0.047	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B070	0.070	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-S-C1	0.000	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C035	0.035	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C012	0.012	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C058	0.058	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C023	0.023	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C105	0.105	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C047	0.047	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C070	0.070	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-J-A1	0.102	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-A2	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-B1	0.102	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-B2	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-C1	0.102	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-C2	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-D1	0.102	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-D2	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-E1	0.102	5.715	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F1	0.102	6.858	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F2	0.000	6.858	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-G1	0.102	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-G2	0.000	8.001	2.921	Type K, Glass Ins., 24 AWG wire
2WB-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-E1	0.088	5.715	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-F1	0.088	6.858	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-G1	0.088	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WD-S-A1	0.000	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A105	0.105	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A012	0.012	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A070	0.070	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1CL-E-C105	2.286	2.972	0.105	Type K, Glass Ins., 30 AWG wire
1CL-E-C012	2.286	2.972	0.012	Type K, Glass Ins., 30 AWG wire
1CL-E-C070	2.286	2.972	0.070	Type K, Glass Ins., 30 AWG wire
1CL-E-C023	2.286	2.972	0.023	Type K, Glass Ins., 30 AWG wire
1CL-E-C058	2.286	2.972	0.058	Type K, Glass Ins., 30 AWG wire
1CL-E-C035	2.286	2.972	0.035	Type K, Glass Ins., 30 AWG wire
1CL-E-C047	2.286	2.972	0.047	Type K, Glass Ins., 30 AWG wire
1WD-E-A023	0.023	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A058	0.058	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A035	0.035	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A047	0.047	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-J-A1	0.076	1.143	2.743	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WD-J-A2	0.000	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A3	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-B1	0.076	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B2	0.000	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B3	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-C1	0.076	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C2	0.000	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C3	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-D1	0.076	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D2	0.000	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WG-D-A1	4.502	3.048	1.524	Type K, Glass Ins., 24 AWG wire
1WG-D-A2	4.502	3.048	1.524	Type K, Glass Ins., 24 AWG wire
Sprinkler	1.655	7.620	2.230	Type K, Glass Ins., 24 AWG wire
1CL-S-D1	1.524	3.962	2.743	Type K, Glass Ins., 24 AWG wire
1WB-S-A1	0.000	2.286	1.524	Type K, Glass Ins., 24 AWG wire

The following table provides a summary of the temperature results. The "Initial" column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the "Max" column. The remaining columns provide the calculated maximum average temperatures.

Table 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WD-J-D3	22.6	22.6	22.6	22.6	22.6	22.6
2WD-J-A1	23.0	23.2	23.1	23.0	23.0	23.0
2WD-J-B1	23.6	23.7	23.6	23.6	23.6	23.6
2WD-J-C1	23.9	24.0	23.9	23.9	23.9	23.9
2WD-J-D1	23.0	23.2	23.0	23.0	23.0	23.0
1CL-S-A1	22.0	40.1	39.3	37.6	29.7	25.9
1CL-S-B1	22.5	46.8	45.2	43.1	31.8	27.2
1CL-S-C1	22.3	33.5	32.8	32.0	27.7	25.1
1CL-S-E1	23.1	43.2	41.9	39.9	30.8	27.0
1CB-S-A1	22.2	23.1	22.9	22.9	22.7	22.4
1CB-S-B1	22.5	23.3	23.2	23.1	22.8	22.7
1CB-S-C1	22.0	24.5	24.3	24.0	22.9	22.4
1CB-S-D1	22.1	27.9	27.2	26.2	23.8	22.9
1CB-S-E1	22.5	23.2	23.1	23.1	22.8	22.6
1RL-T-A0	22.3	24.1	24.0	23.9	23.1	22.7
1RL-T-A2	22.3	26.3	25.6	25.5	24.1	23.2
1RL-T-A4	22.2	27.7	27.1	26.9	25.7	24.0
1RL-T-A6	22.3	52.1	48.2	44.3	31.4	26.9
1RL-T-A8	22.3	67.5	62.8	58.8	38.2	30.4
1RL-T-A9	21.9	38.7	38.1	36.8	29.6	25.8
1RL-T-B0	21.8	25.8	25.5	25.4	23.7	22.8
1RL-T-B2	22.4	26.3	26.1	26.1	24.5	23.4
1RL-T-B4	22.0	30.4	29.4	28.7	26.0	24.0
1RL-T-B6	22.1	48.4	45.6	42.2	30.5	26.3

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1RL-T-B8	22.1	68.2	63.4	59.5	37.7	30.1
1RL-T-B9	21.9	36.5	35.3	34.2	28.8	25.4
1RK-T-A0	21.3	30.1	29.1	28.6	25.6	23.5
1RK-T-A2	21.7	32.8	29.8	29.2	26.1	23.9
1RK-T-A4	21.9	30.2	28.4	28.1	26.3	24.1
1RK-T-A6	22.0	51.0	39.5	35.9	29.0	25.6
1RK-T-A8	22.2	93.0	83.4	73.1	39.9	31.6
1RB-T-A0	22.0	22.3	22.3	22.2	22.1	22.1
1RB-T-A2	22.0	22.4	22.4	22.3	22.2	22.1
1RB-T-A4	22.1	22.9	22.8	22.7	22.3	22.2
1RB-T-A6	22.2	23.4	23.3	23.3	22.8	22.5
1RB-T-A8	22.1	25.0	24.9	24.7	23.4	22.7
1RB-T-A9	21.9	24.9	24.7	24.5	23.1	22.5
1RB-T-B0	21.4	21.7	21.6	21.6	21.5	21.4
1RB-T-B2	21.6	21.9	21.9	21.8	21.7	21.6
1RB-T-B4	21.9	22.6	22.6	22.5	22.1	22.0
1RB-T-B6	22.8	24.0	24.0	24.0	23.4	23.1
1RB-T-B8	22.6	25.2	25.1	25.0	23.9	23.2
1RB-T-B9	22.4	27.5	27.0	26.3	24.2	23.3
1WG-T-A0	23.2	23.3	23.2	23.2	23.2	23.2
1WG-T-A2	21.5	21.6	21.6	21.6	21.5	21.5
1WG-T-A4	23.1	23.5	23.4	23.3	23.2	23.1
1WG-T-A6	22.8	24.3	24.2	24.2	23.4	23.1
1WG-T-A8	23.3	24.3	24.3	24.2	23.8	23.5
1WG-T-B0	21.3	21.3	21.3	21.3	21.2	21.2
1WG-T-B2	21.9	22.3	22.3	22.2	22.0	22.0
1WG-T-B4	21.9	22.2	22.2	22.1	22.0	21.9
1WG-T-B6	22.2	22.9	22.9	22.8	22.4	22.3
1WG-T-B8	21.9	23.0	22.9	22.9	22.4	22.2
1RH-T-A0	21.6	21.9	21.8	21.7	21.6	21.6
1RH-T-A2	21.9	22.1	22.0	21.9	21.9	21.9
1RH-T-A4	22.2	22.3	22.1	22.1	22.0	22.1
1RH-T-A6	22.3	22.5	22.4	22.4	22.2	22.3
1RH-T-A8	22.7	22.9	22.7	22.7	22.6	22.6
1RH-T-A9	22.3	22.6	22.5	22.4	22.4	22.3
1RH-T-B0	22.7	23.0	22.9	22.7	22.5	22.6
1RH-T-B2	22.6	22.9	22.8	22.6	22.5	22.6
1RH-T-B4	22.5	22.8	22.7	22.6	22.5	22.5
1RH-T-B6	22.6	22.9	22.7	22.7	22.6	22.6
1RH-T-B8	22.4	23.4	22.9	22.7	22.5	22.5
1RH-T-B9	22.3	24.6	23.3	23.0	22.6	22.4
1RH-T-C0	21.6	21.7	21.6	21.6	21.2	21.4
1RH-T-C2	22.0	22.2	22.0	21.9	21.6	21.8
1RH-T-C4	22.8	23.4	22.9	22.9	22.6	22.7
1RH-T-C6	22.5	22.9	22.6	22.6	22.4	22.4
1RH-T-C8	22.2	23.9	23.2	22.7	22.3	22.3
1RH-T-C9	22.1	23.4	22.9	22.5	22.1	22.1
1WB-D-A1	21.9	24.6	24.6	24.6	23.4	22.7
1WB-D-A2	21.8	24.0	23.9	23.8	22.9	22.4
1WB-D-B1	21.5	25.0	24.9	24.8	23.4	22.5

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-D-B2	21.5	24.3	24.1	24.0	22.8	22.1
1WB-D-C1	21.5	28.7	28.6	28.6	25.7	23.6
1WB-D-C2	21.5	27.2	27.2	27.2	24.2	22.9
1WD-D-A1	22.3	22.4	22.4	22.4	22.3	22.3
1WD-D-A2	22.9	23.0	23.0	22.9	22.9	22.9
1CL-D-A1	21.5	29.2	29.0	28.9	26.8	24.2
1CL-D-A2	21.6	27.3	27.3	27.2	25.7	23.7
1CB-D-A1	22.1	22.5	22.4	22.4	22.3	22.2
1CB-D-A2	24.7	25.0	25.0	24.9	24.8	24.7
1WC-D-A1	22.4	25.4	25.3	25.2	23.6	23.0
1WC-D-A2	22.1	24.8	24.7	24.6	23.1	22.6
1WC-D-B1	21.9	25.6	25.5	25.4	23.9	22.9
1WC-D-B2	22.2	25.2	25.1	25.0	23.7	22.9
1WA-T-A0	21.8	22.3	22.2	22.2	22.0	21.9
1WA-T-A2	22.3	22.5	22.4	22.4	22.3	22.3
1WA-T-A4	22.9	23.0	22.9	22.9	22.8	22.8
1WA-T-A6	22.6	22.9	22.9	22.8	22.6	22.6
1WA-T-A8	22.7	22.9	22.9	22.8	22.6	22.7
1WA-T-A9	22.6	22.8	22.8	22.7	22.6	22.6
1WA-T-B0	22.9	23.0	22.8	22.8	22.7	22.8
1WA-T-B2	22.9	23.0	22.8	22.8	22.6	22.7
1WA-T-B4	22.9	23.0	22.9	22.9	22.7	22.8
1WA-T-B6	23.2	24.4	24.3	24.3	23.8	23.5
1WA-T-B8	23.2	23.4	23.3	23.3	23.2	23.2
1WA-T-B9	22.9	23.0	23.0	23.0	22.9	22.9
1WA-T-C0	22.8	22.9	22.8	22.8	22.7	22.7
1WA-T-C2	23.5	23.7	23.6	23.6	23.5	23.5
1WA-T-C4	23.3	23.5	23.4	23.4	23.3	23.3
1WA-T-C6	23.0	23.3	23.1	23.1	23.0	23.0
1WA-T-C8	22.9	23.1	23.0	23.0	22.8	22.9
1WA-T-C9	22.9	23.0	22.9	22.9	22.7	22.8
1WB-E-A035	22.5	22.5	22.4	22.4	22.4	22.4
1WB-E-A012	22.1	22.4	22.3	22.3	22.2	22.1
1WB-E-A058	22.8	22.9	22.8	22.8	22.8	22.8
1WB-E-A023	22.1	22.2	22.1	22.1	22.1	22.1
1WB-E-A105	22.6	22.6	22.5	22.5	22.5	22.5
1WB-E-A047	22.2	22.3	22.2	22.2	22.2	22.2
1WB-E-A070	22.3	22.3	22.3	22.3	22.3	22.3
1WB-S-B1	22.3	27.9	27.2	27.1	25.3	23.8
1WB-E-B035	22.1	22.2	22.1	22.1	22.1	22.1
1WB-E-B058	22.3	22.3	22.3	22.3	22.3	22.3
1WB-E-B023	22.0	22.1	22.0	22.0	22.0	22.0
1WB-E-B105	22.5	22.5	22.5	22.4	22.4	22.5
1WB-E-B047	22.8	22.8	22.7	22.7	22.7	22.7
1WB-E-B070	22.6	22.6	22.6	22.5	22.5	22.6
1WB-S-C1	22.9	23.0	23.0	23.0	22.9	22.9
1WB-E-C035	22.1	22.3	22.1	22.1	22.1	22.1
1WB-E-C012	22.5	22.6	22.5	22.5	22.5	22.5
1WB-E-C058	22.3	22.3	22.3	22.3	22.3	22.3
1WB-E-C023	22.5	22.6	22.5	22.5	22.4	22.5

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-E-C105	22.3	22.4	22.3	22.3	22.3	22.3
1WB-E-C047	22.4	22.6	22.5	22.4	22.4	22.4
1WB-E-C070	22.4	22.5	22.4	22.4	22.4	22.4
1WB-J-A1	22.9	22.9	22.9	22.9	22.9	22.9
1WB-J-A2	23.8	24.0	23.7	23.7	23.7	23.7
1WB-J-B1	22.9	22.9	22.9	22.9	22.9	22.9
1WB-J-B2	21.4	21.6	21.4	21.4	21.4	21.4
1WB-J-C1	22.1	22.3	22.2	22.2	22.2	22.2
1WB-J-C2	22.2	22.4	22.3	22.3	22.3	22.3
1WB-J-D1	22.3	22.4	22.3	22.3	22.3	22.3
1WB-J-D2	22.5	22.6	22.6	22.6	22.6	22.6
1WB-J-E1	21.8	22.0	22.0	22.0	21.9	21.9
1WB-J-F1	21.8	21.9	21.9	21.9	21.9	21.8
1WB-J-F2	21.2	21.3	21.3	21.2	21.2	21.2
1WB-J-G1	22.2	22.4	22.3	22.3	22.3	22.2
1WB-J-G2	21.2	21.3	21.3	21.2	21.2	21.2
2WB-J-A1	23.9	24.0	24.0	23.9	23.9	23.9
2WB-J-B1	23.5	23.5	23.4	23.4	23.4	23.4
2WB-J-C1	24.0	24.0	24.0	24.0	24.0	24.0
2WB-J-D1	22.3	22.3	22.3	22.3	22.3	22.3
2WB-J-E1	24.3	24.4	24.4	24.4	24.3	24.3
2WB-J-F1	23.4	23.5	23.4	23.4	23.4	23.4
2WB-J-G1	23.4	23.5	23.5	23.5	23.5	23.4
1WD-S-A1	23.1	23.6	23.5	23.5	23.2	23.2
1WD-E-A105	22.8	22.9	22.8	22.8	22.8	22.8
1WD-E-A012	22.6	22.6	22.6	22.6	22.6	22.6
1WD-E-A070	22.7	22.8	22.8	22.8	22.7	22.7
1CL-E-C105	22.1	22.1	22.1	22.1	22.1	22.1
1CL-E-C012	22.0	22.5	22.4	22.3	22.1	22.0
1CL-E-C070	22.5	22.6	22.5	22.5	22.5	22.5
1CL-E-C023	21.9	22.0	21.9	21.9	21.9	21.9
1CL-E-C058	21.9	22.0	21.9	21.9	21.9	21.9
1CL-E-C035	21.8	21.9	21.8	21.8	21.8	21.8
1CL-E-C047	21.9	21.9	21.9	21.9	21.9	21.9
1WD-E-A023	22.6	22.7	22.6	22.6	22.6	22.6
1WD-E-A058	22.7	22.8	22.7	22.7	22.7	22.7
1WD-E-A035	22.6	22.8	22.7	22.7	22.6	22.6
1WD-E-A047	22.7	22.8	22.7	22.7	22.7	22.7
1WD-J-A1	23.3	23.6	23.4	23.4	23.3	23.3
1WD-J-A2	23.9	24.2	24.0	24.0	24.0	23.9
1WD-J-A3	22.3	22.4	22.3	22.3	22.3	22.3
1WD-J-B1	22.7	22.9	22.8	22.7	22.7	22.7
1WD-J-B2	23.0	23.1	23.0	23.0	23.0	23.0
1WD-J-B3	22.6	22.6	22.6	22.6	22.6	22.6
1WD-J-C1	22.5	22.6	22.5	22.5	22.5	22.5
1WD-J-C2	22.9	23.0	22.9	22.9	22.9	22.9
1WD-J-C3	21.8	21.9	21.8	21.8	21.8	21.8
1WD-J-D1	22.9	23.0	22.9	22.9	22.9	22.9
1WD-J-D2	23.4	23.6	23.4	23.4	23.4	23.4
1WG-D-A1	23.0	25.5	25.4	25.3	24.5	23.7

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WG-D-A2	23.1	25.2	25.1	25.0	24.3	23.7
Sprinkler	23.6	97.6	85.0	74.9	39.8	32.0
1CL-S-D1	22.8	58.0	53.7	49.7	35.0	29.0
1WB-S-A1	23.1	32.4	31.0	30.1	26.8	24.9

The following charts present a time-dependent representation of the instantaneous temperatures measured during the experiment.

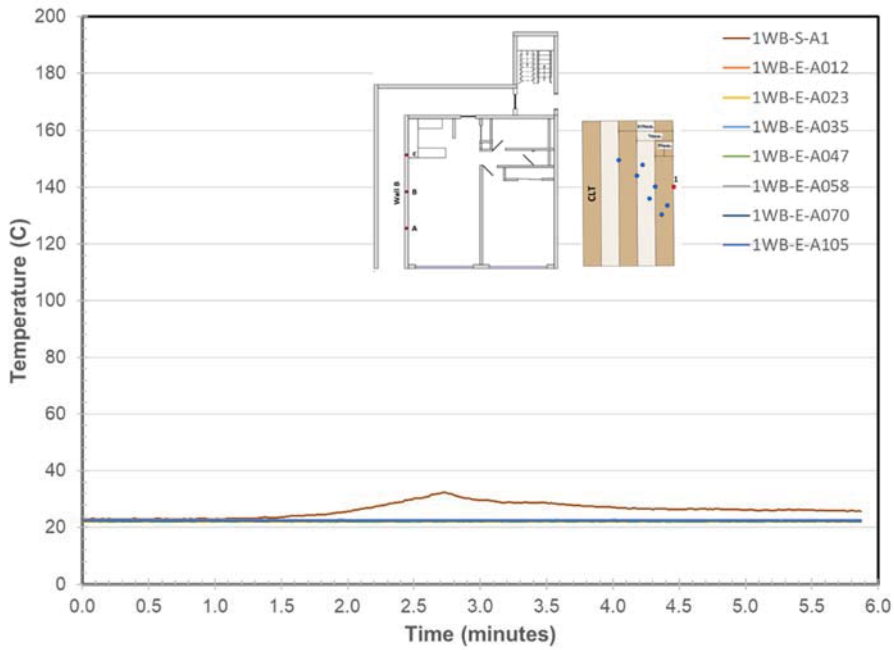

Figure 231. Wall B Embedded & Surface Temperatures at Location A

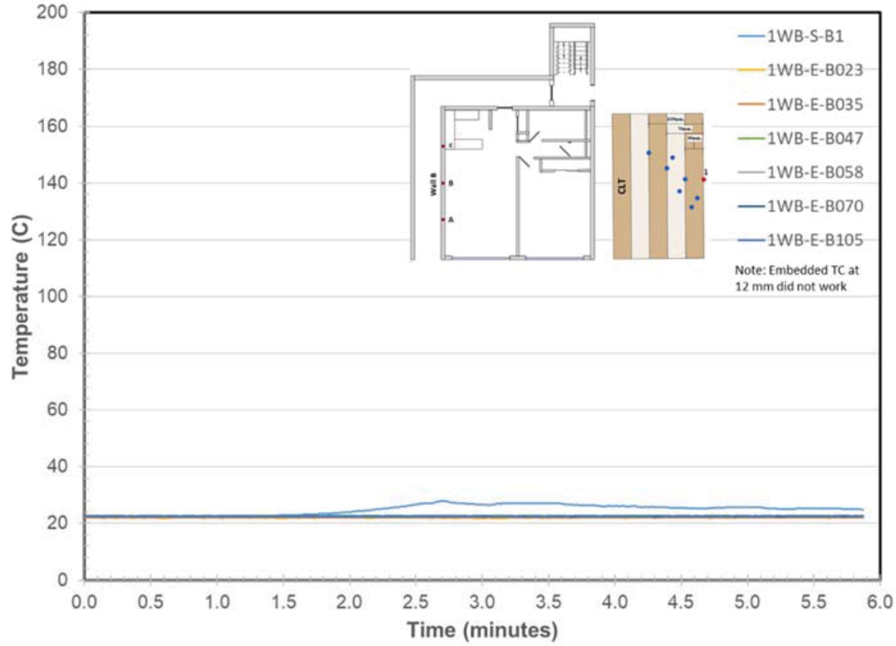

Figure 232. Wall B Embedded & Surface Temperatures at Location B

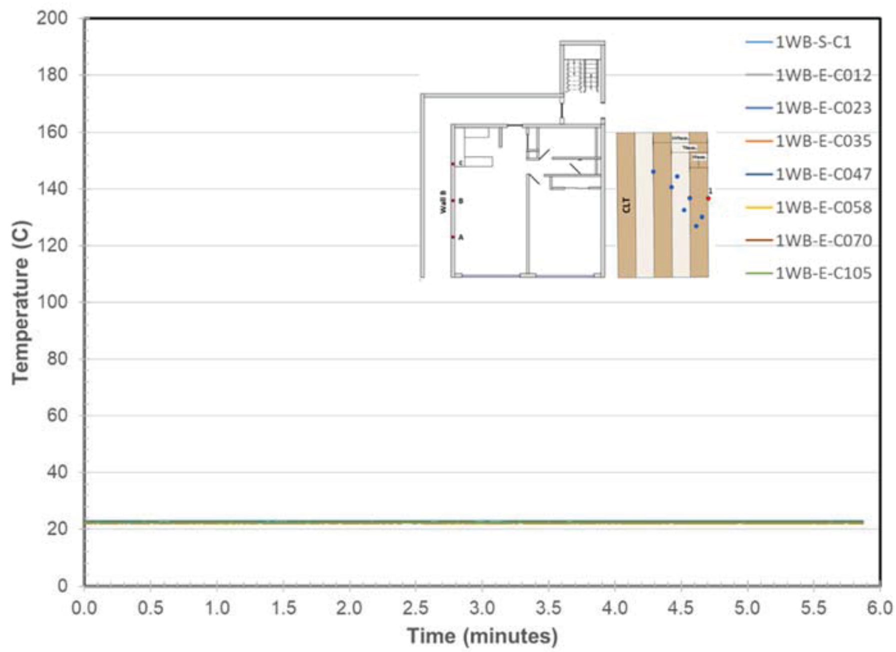

Figure 233. Wall B Embedded & Surface Temperatures at Location C

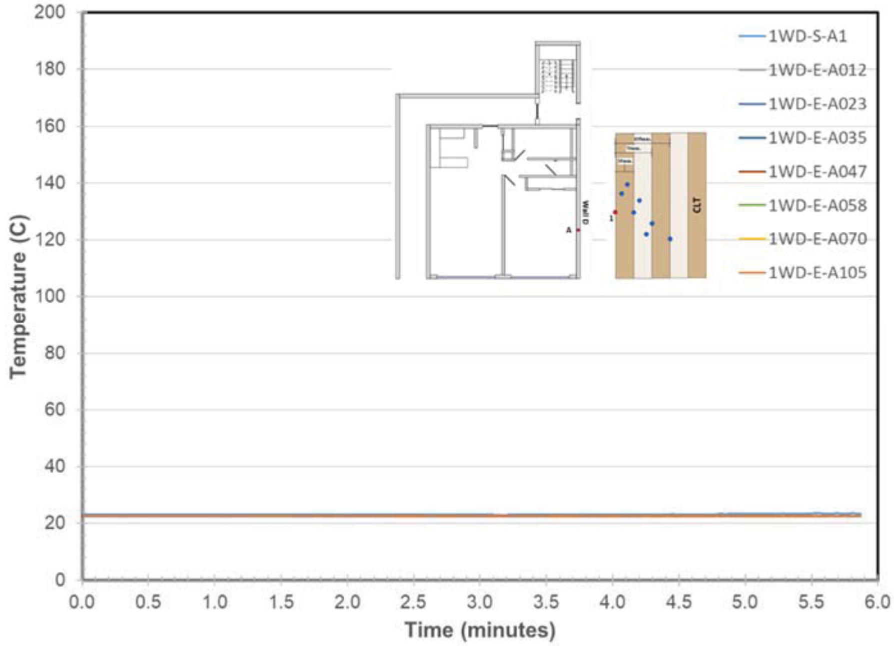

Figure 234. Wall D Embedded & Surface Temperatures at Location A

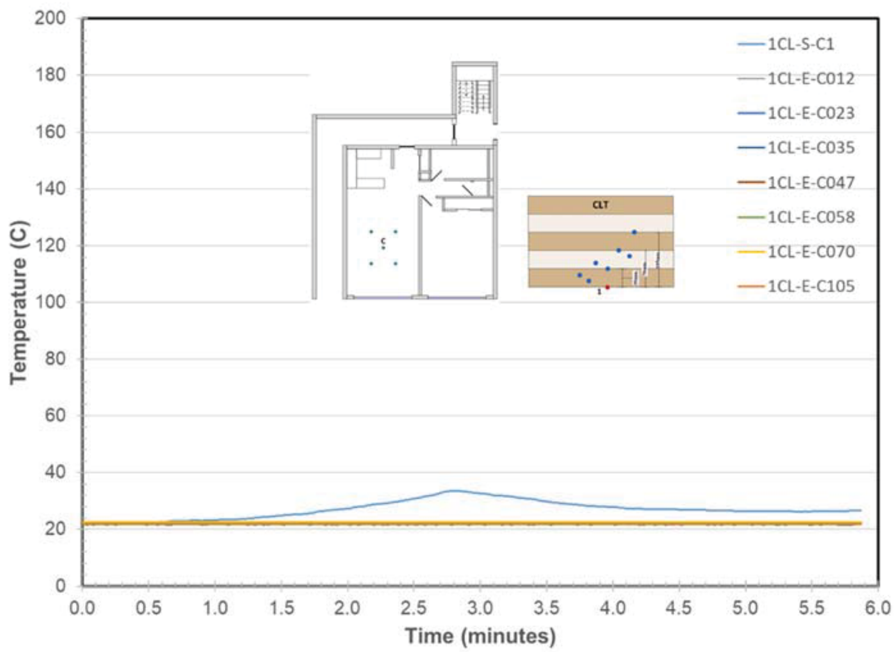

Figure 235. Living Room Ceiling Embedded & Surface Temperatures at Location C

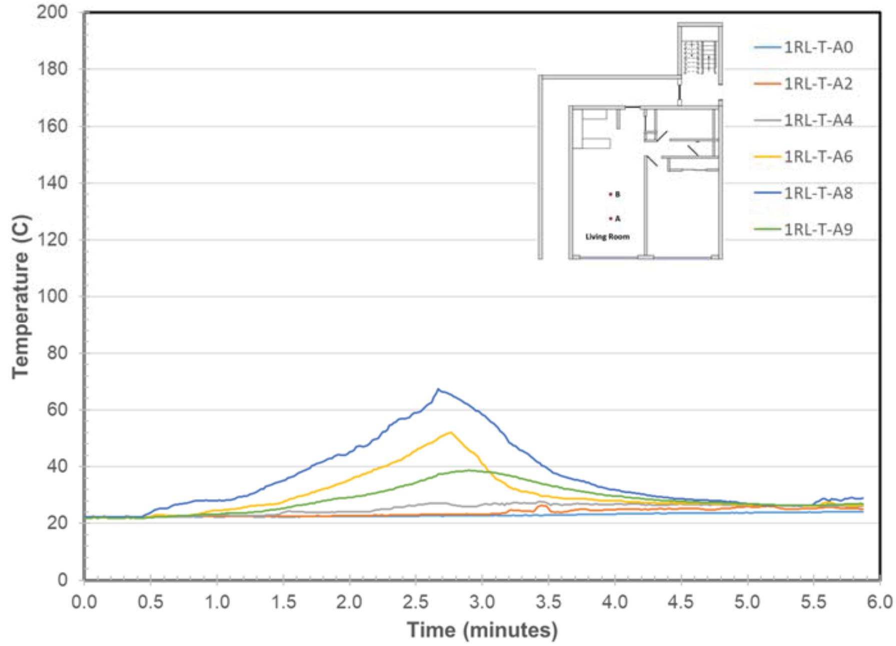

Figure 236. Living Room Temperature at Location A

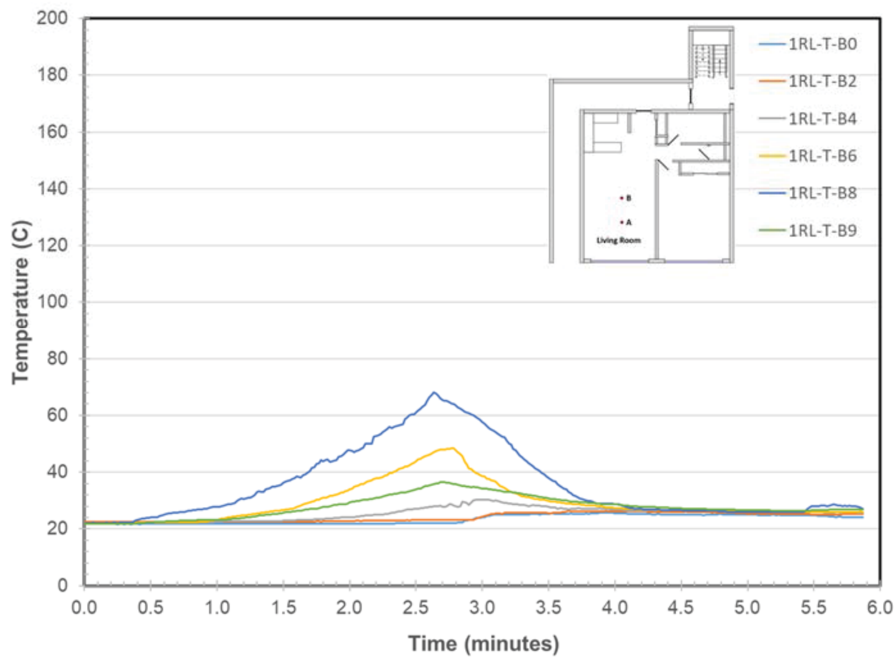

Figure 237. Living Room Temperature at Location B

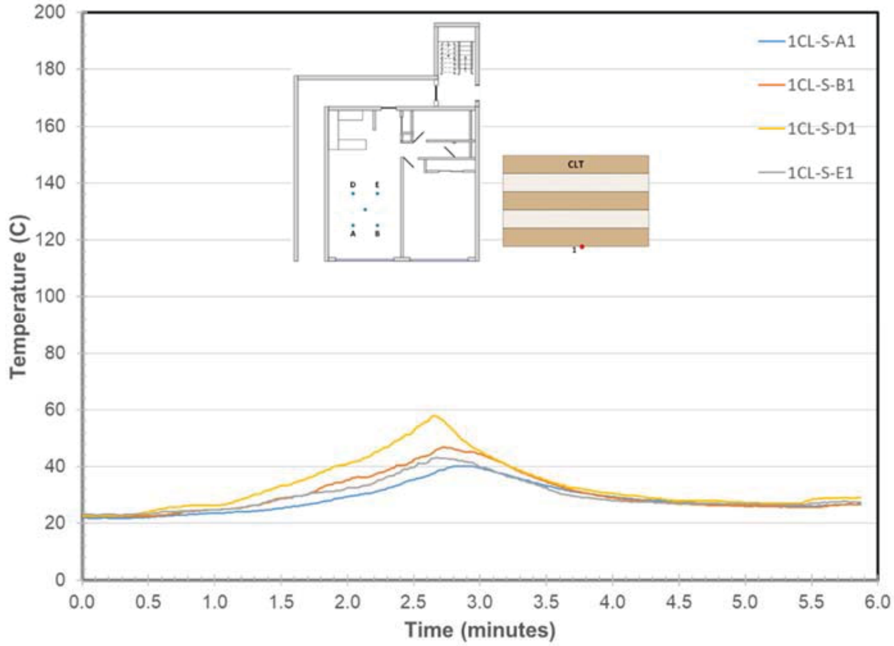

Figure 238. Living Room Ceiling Surface Temperatures at Location A, B, D, & E

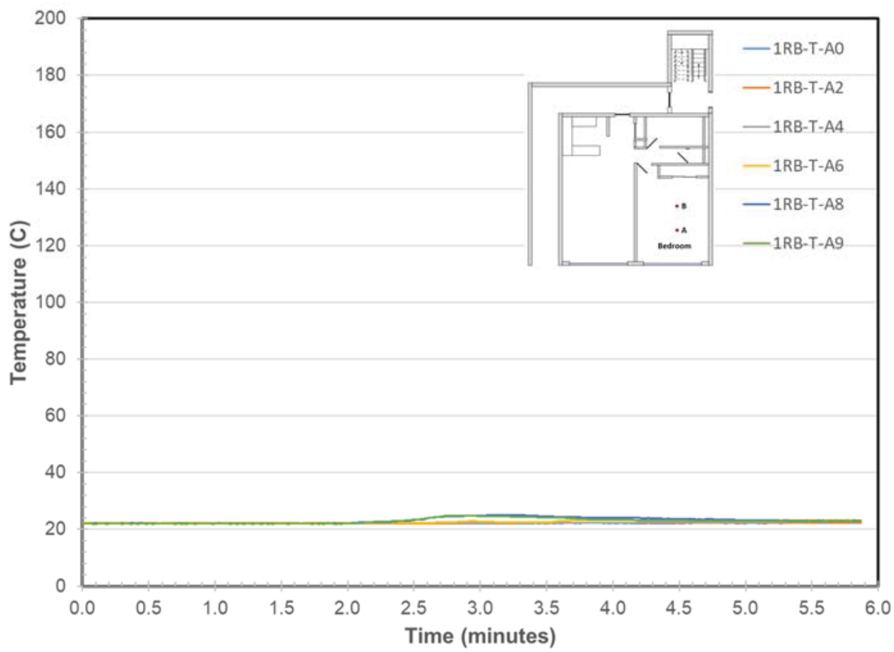

Figure 239. Bedroom Temperature at Location A

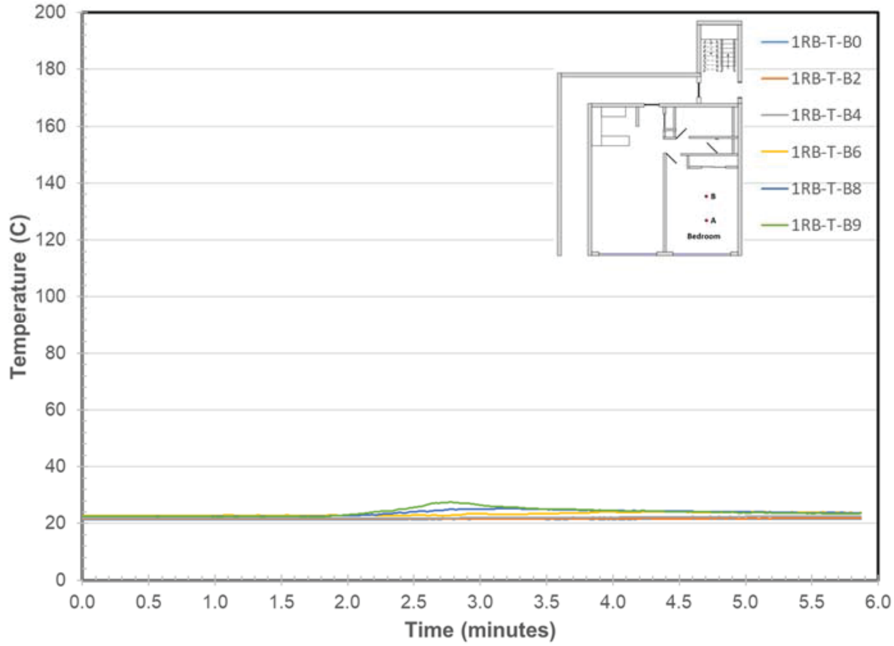

Figure 240. Bedroom Temperature at Location B

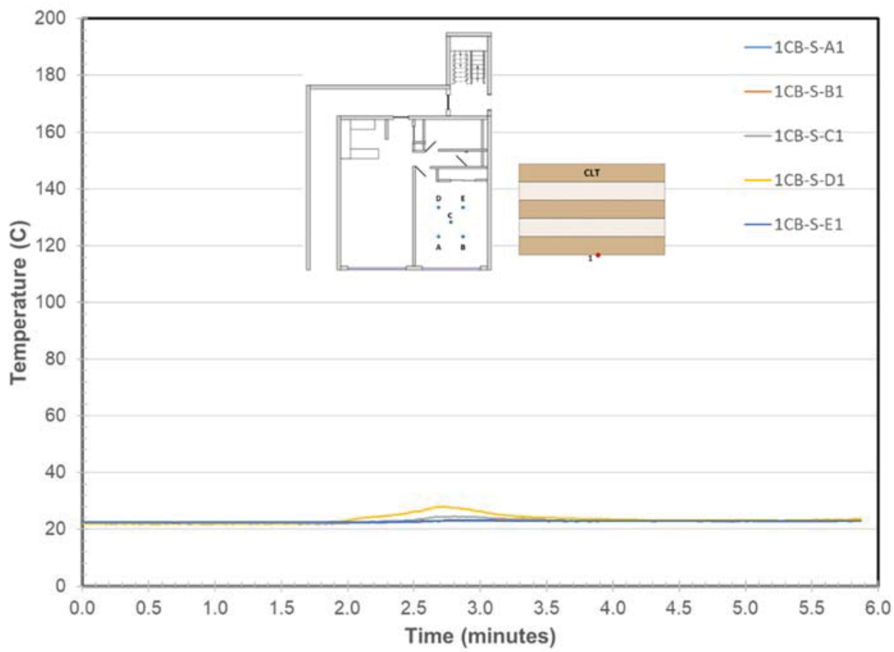

Figure 241. Bedroom Ceiling Surface Temperatures at Locations A through E

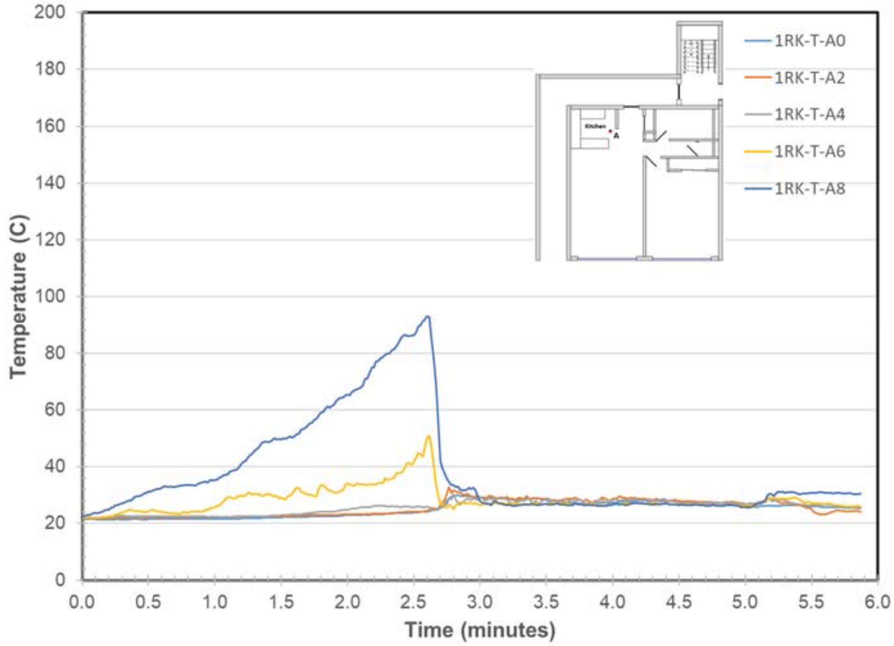

Figure 242. Kitchen Temperatures at Location A

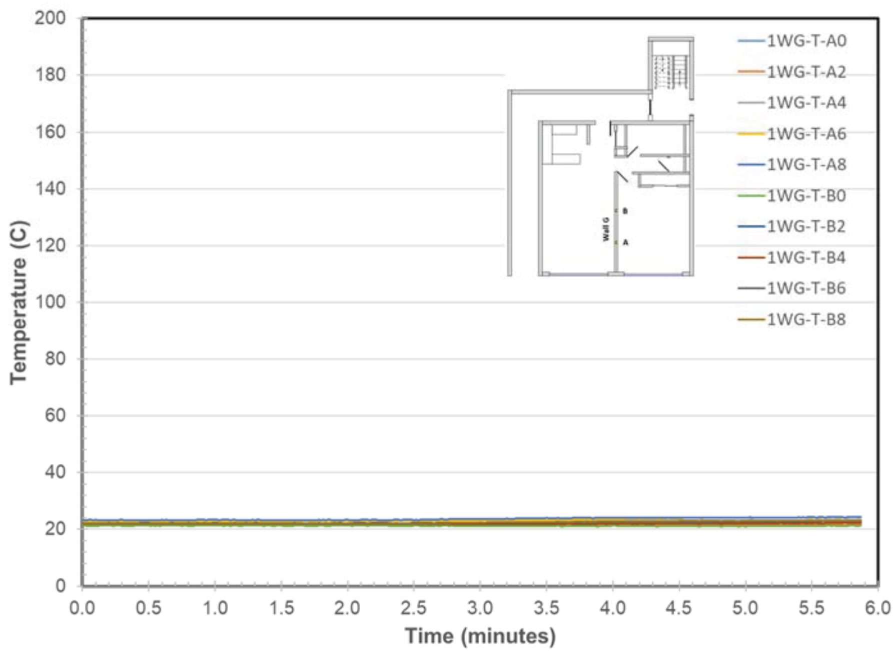

Figure 243. Wall G Temperatures at Locations A & B

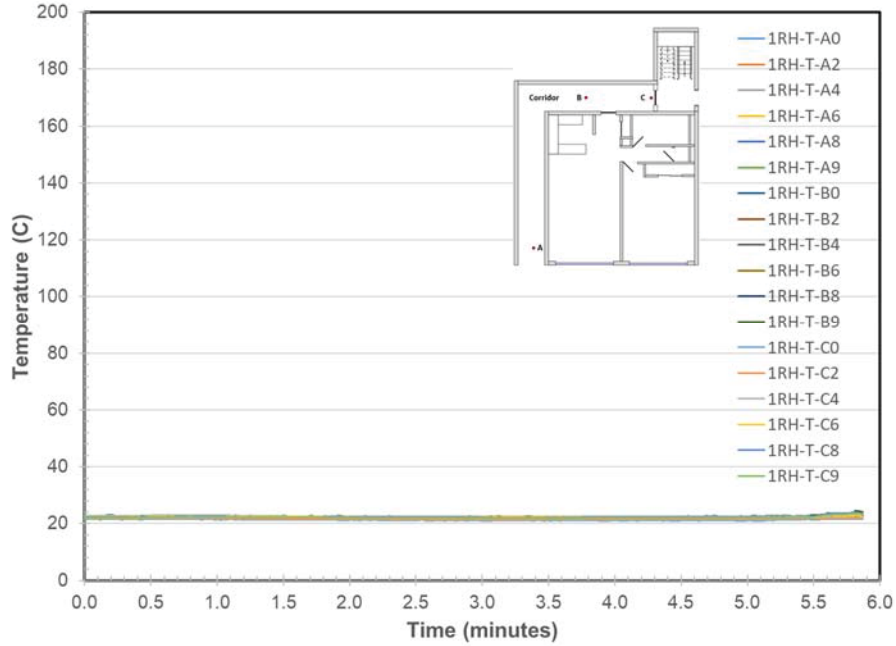

Figure 244. Corridor Temperatures at Locations A, B, & C

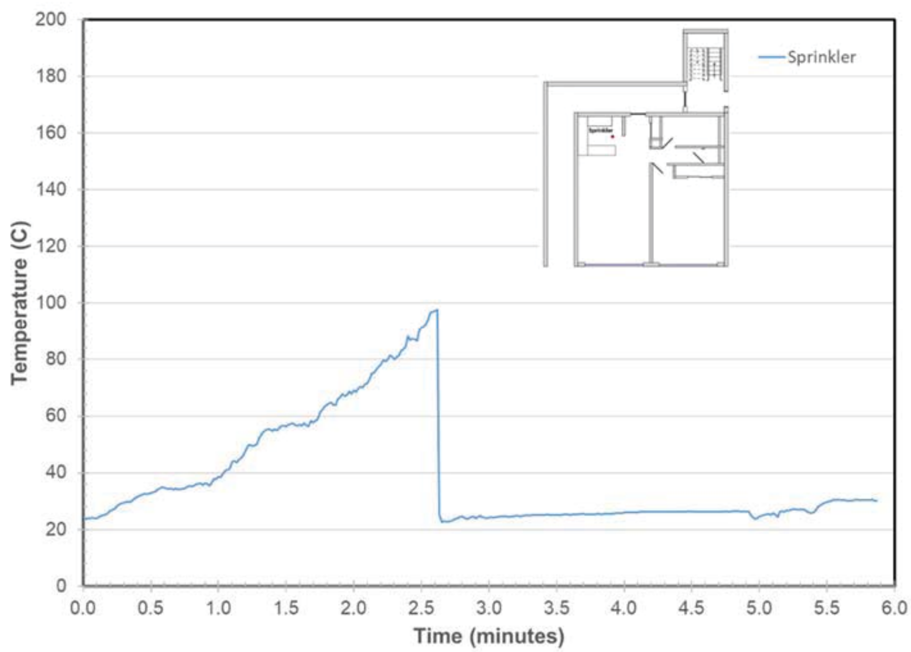

Figure 245. Sprinkler Head Temperature in Kitchen

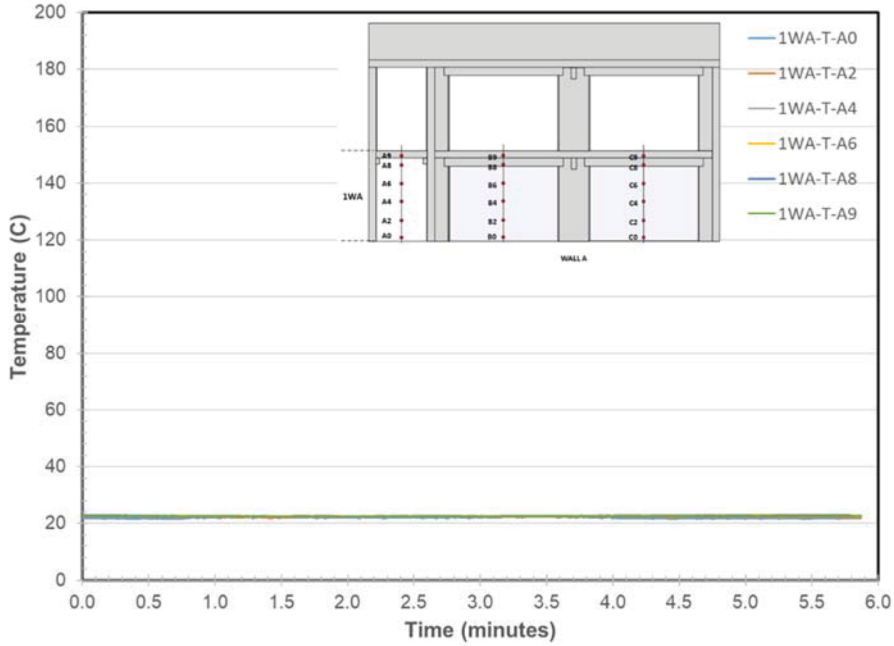

Figure 246. Wall A Temperatures at Location A

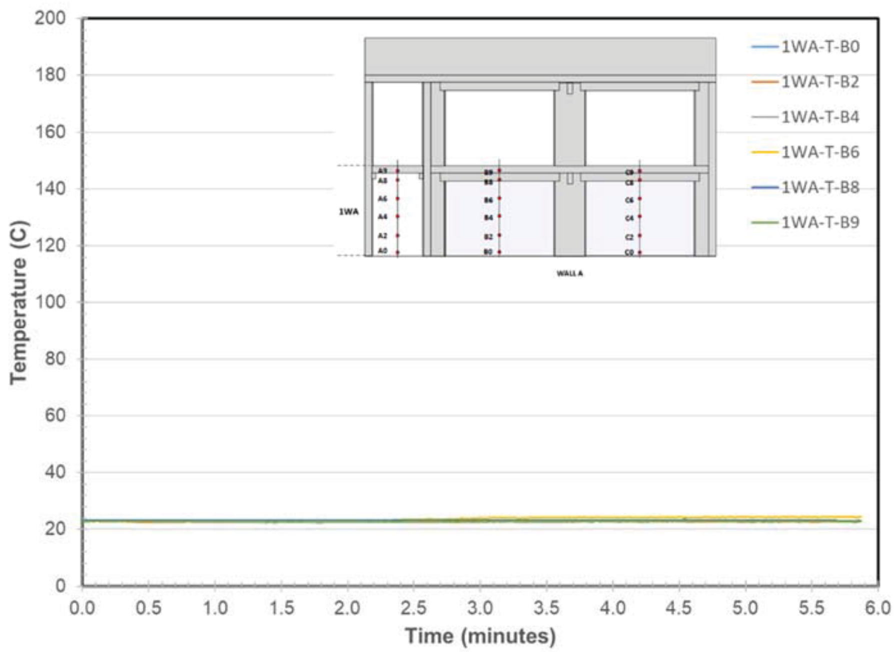

Figure 247. Wall A Temperatures at Locations B

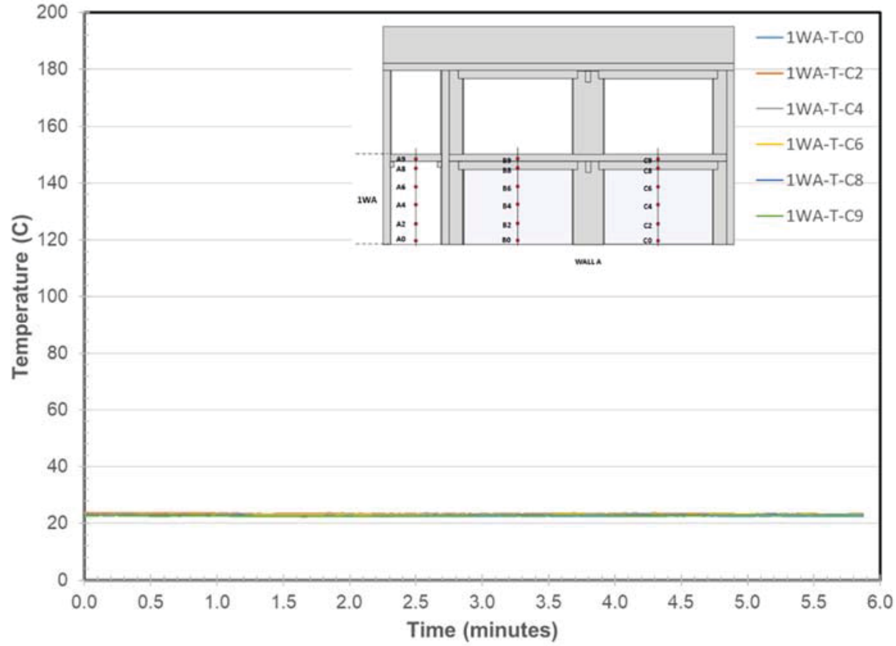

Figure 248. Wall A Temperatures at Locations C

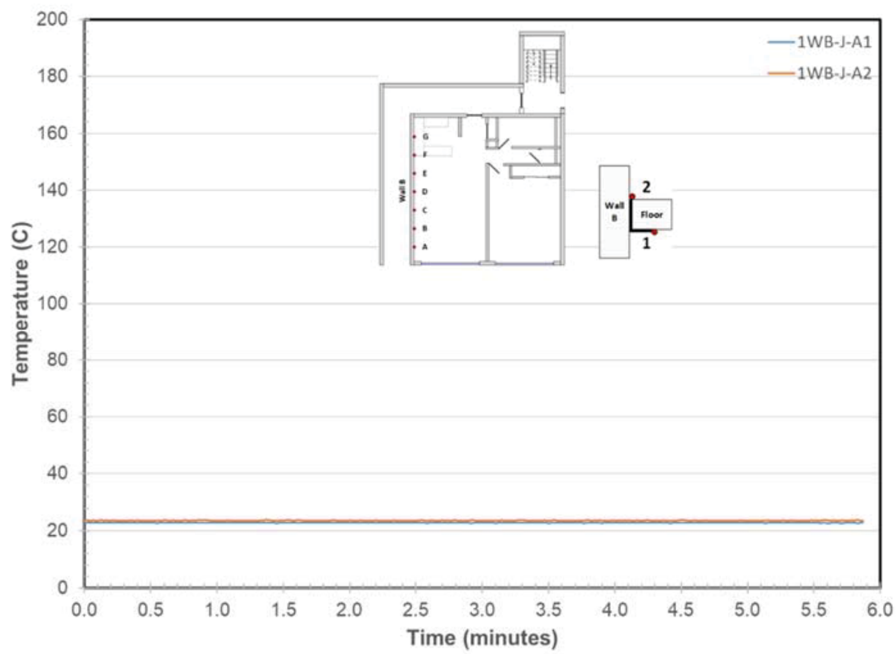

Figure 249. Wall B/Steel Angle Joint Temperatures at Location A

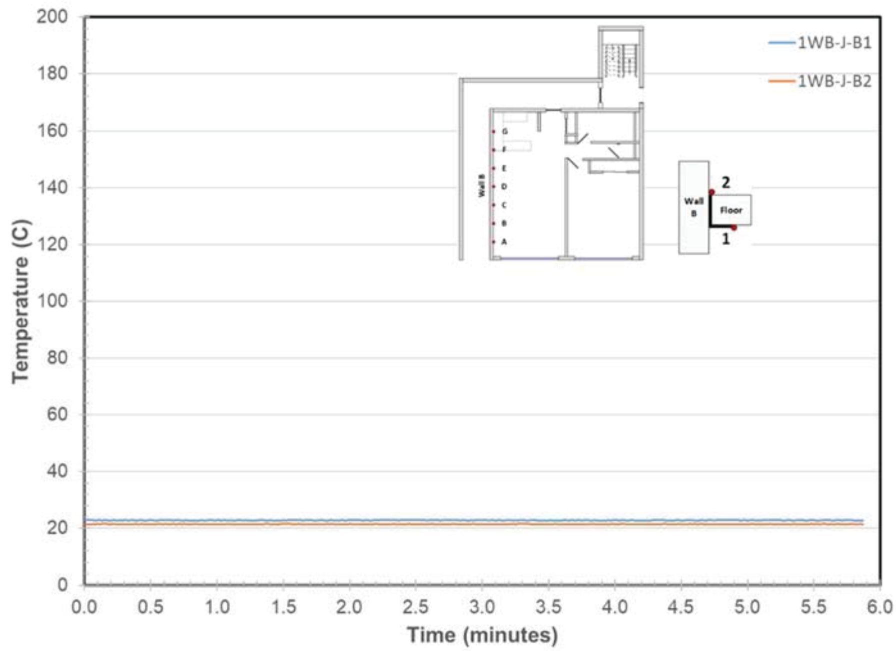

Figure 250. Wall B/Steel Angle Joint Temperatures at Location B

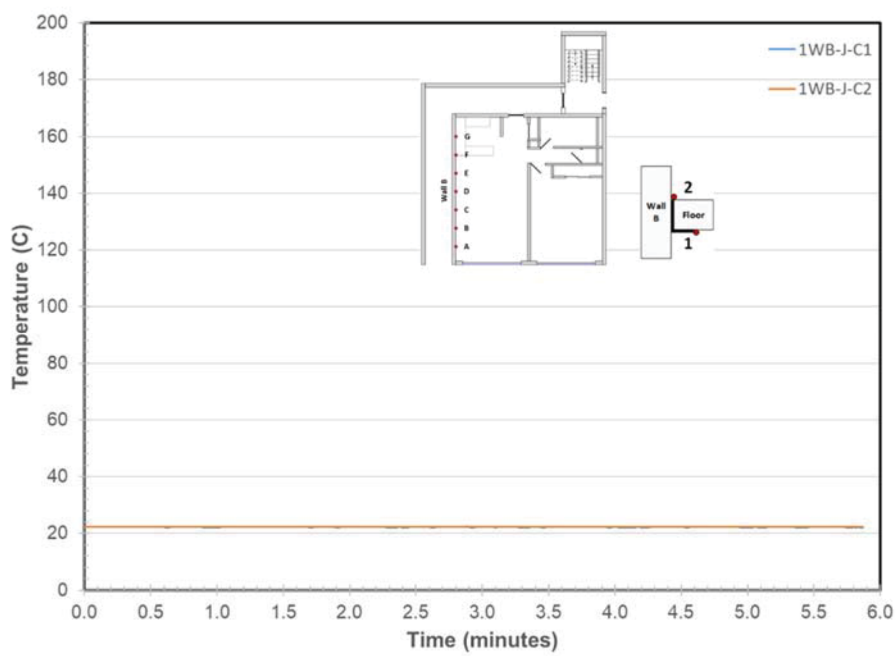

Figure 251. Wall B/Steel Angle Joint Temperatures at Location C

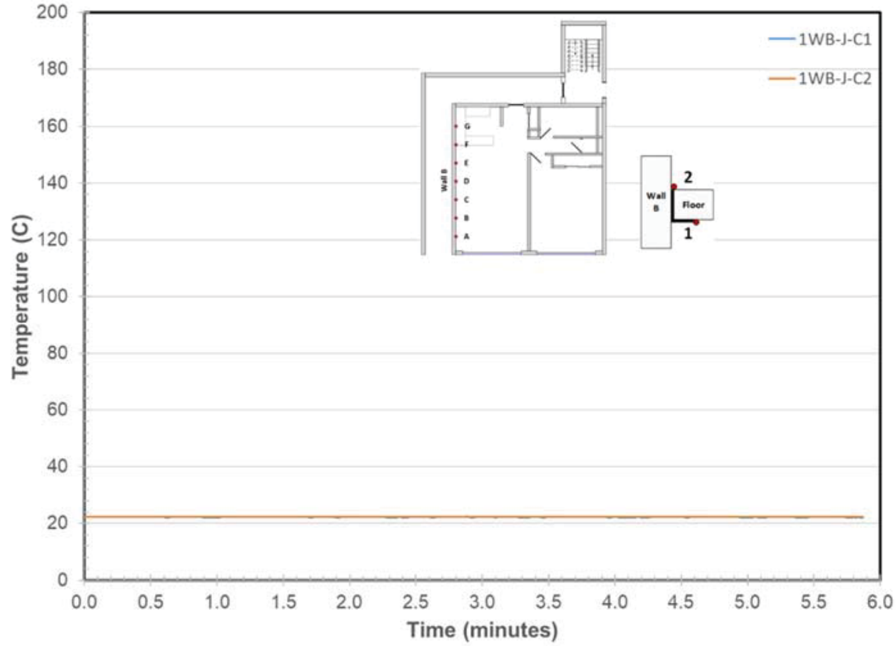

Figure 252. Wall B/Steel Angle Joint Temperatures at Location D

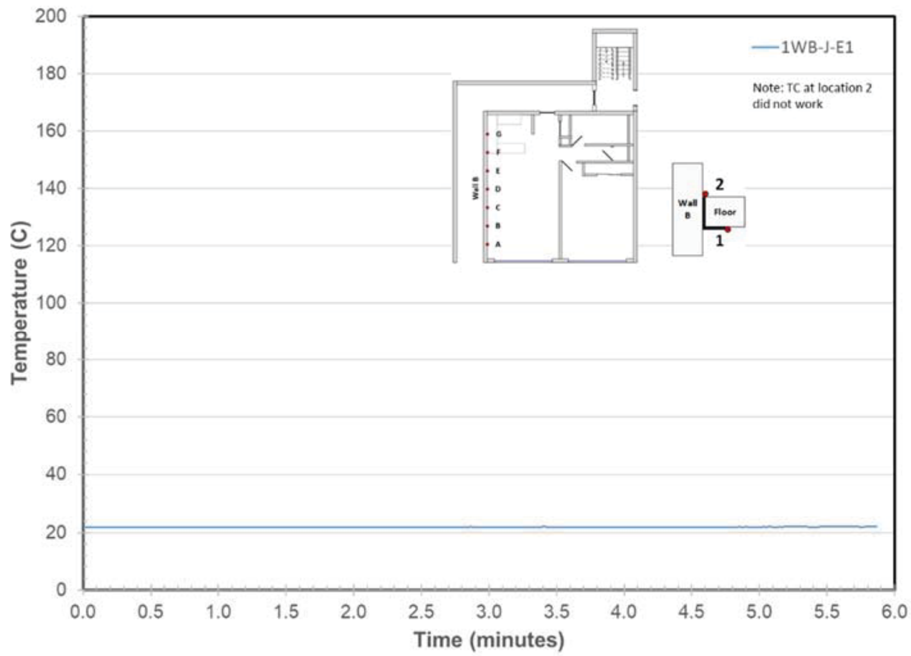

Figure 253. Wall B/Steel Angle Joint Temperatures at Location E

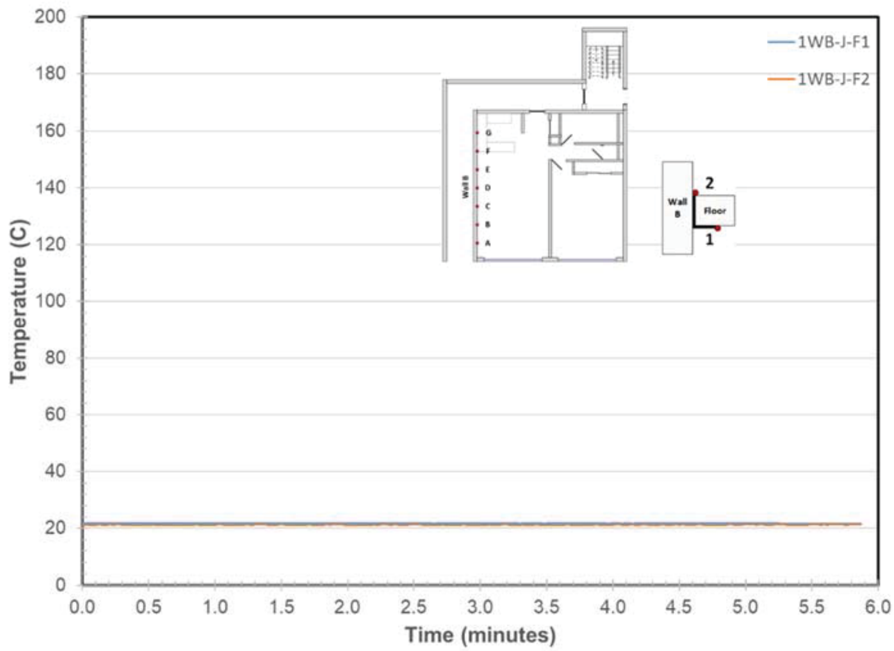

Figure 254. Wall B/Steel Angle Joint Temperatures at Location F

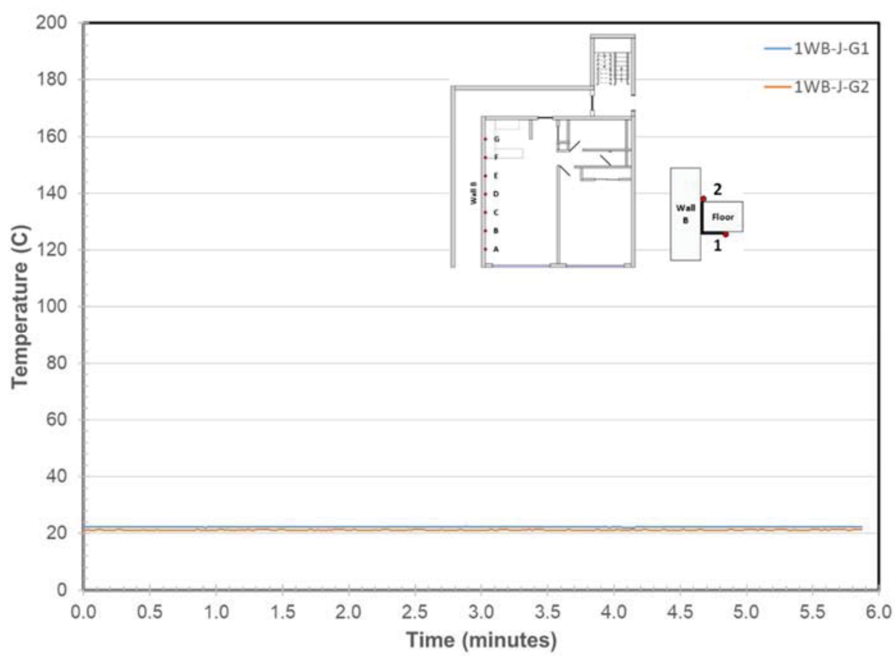

Figure 255. Wall B/Steel Angle Joint Temperatures at Location G

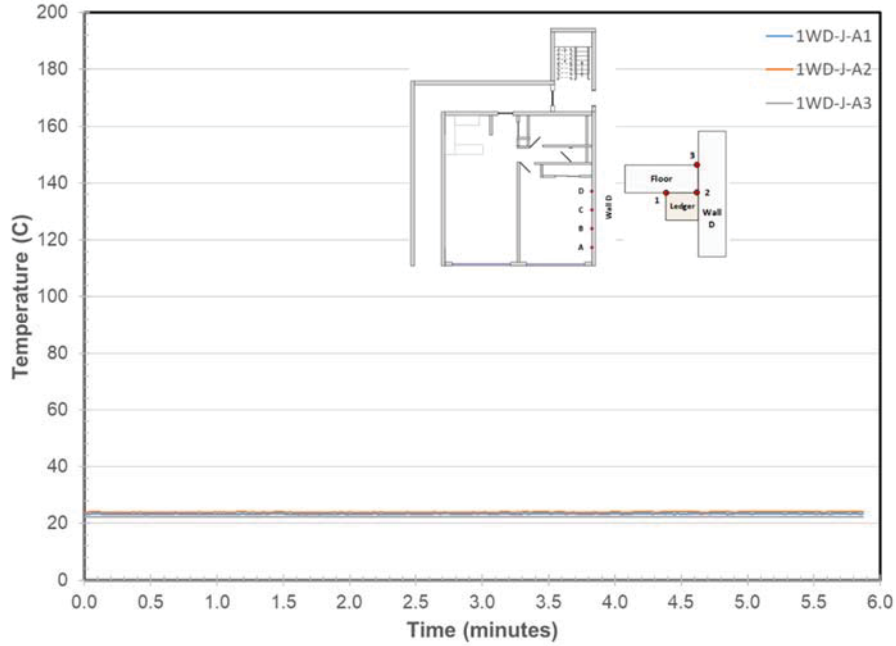

Figure 256. Wall D/Ledger Joint Temperatures at Location A

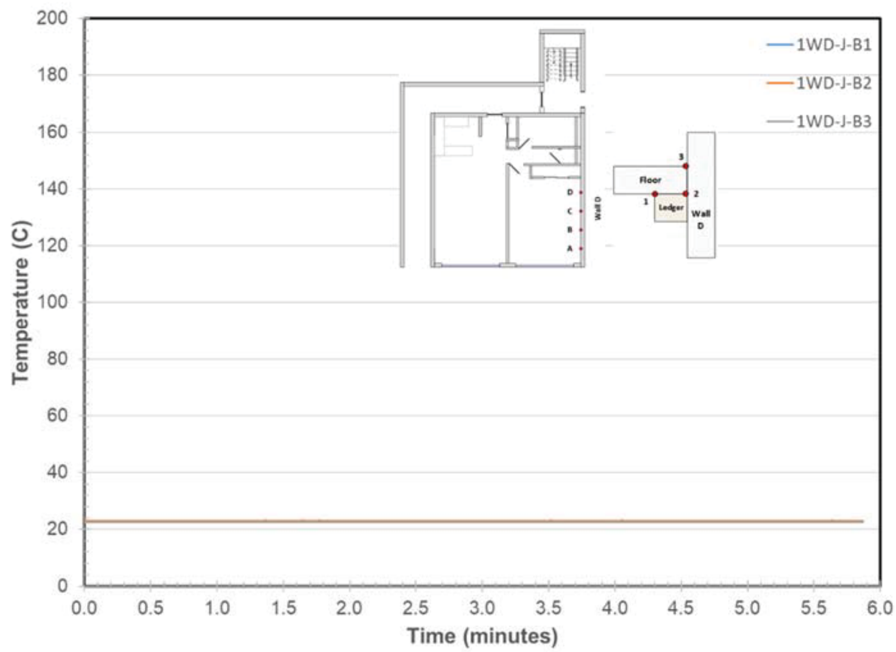

Figure 257. Wall D/Ledger Joint Temperatures at Location B

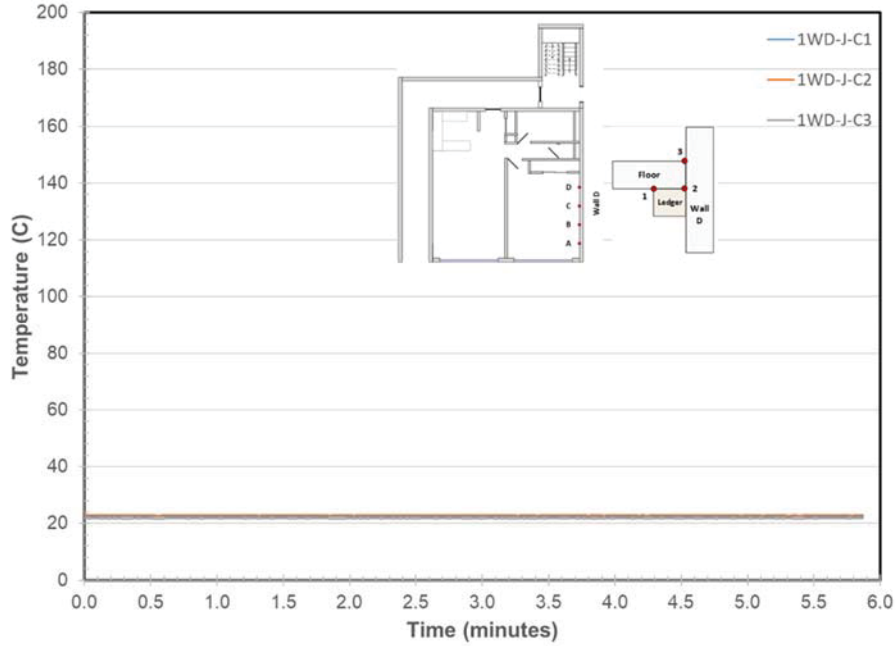

Figure 258. Wall D/Ledger Joint Temperatures at Location C

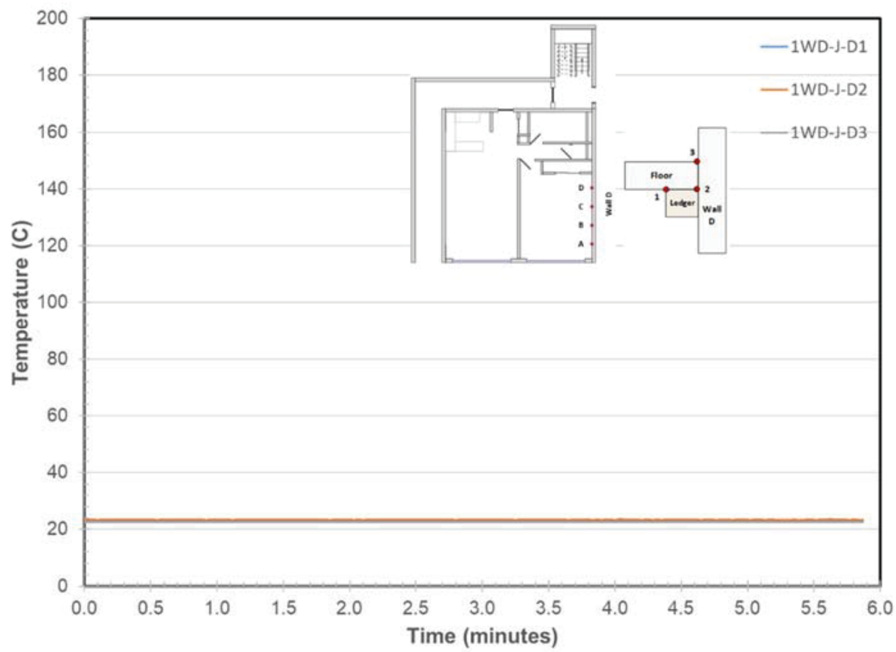

Figure 259. Wall D/Ledger Joint Temperatures at Location D

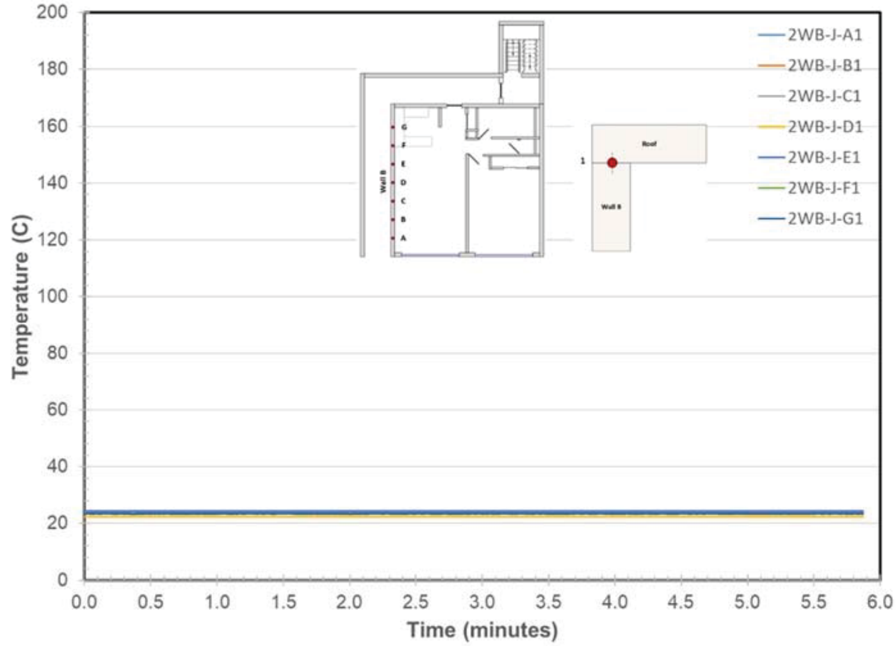

Figure 260. Ceiling/Wall B Joint Temperatures at Locations A-G

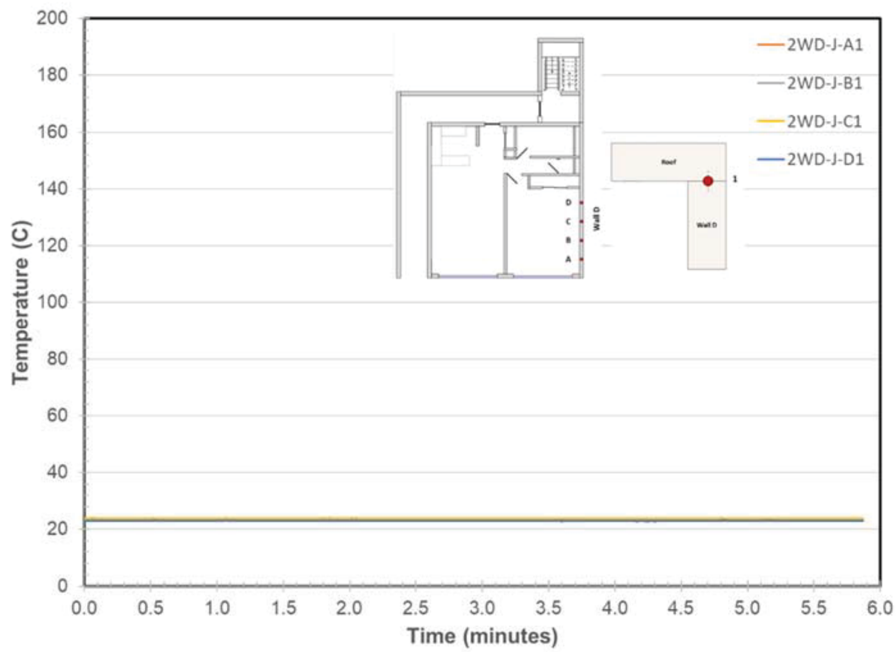

Figure 261. Ceiling/Wall B Joint Temperatures at Locations A-D

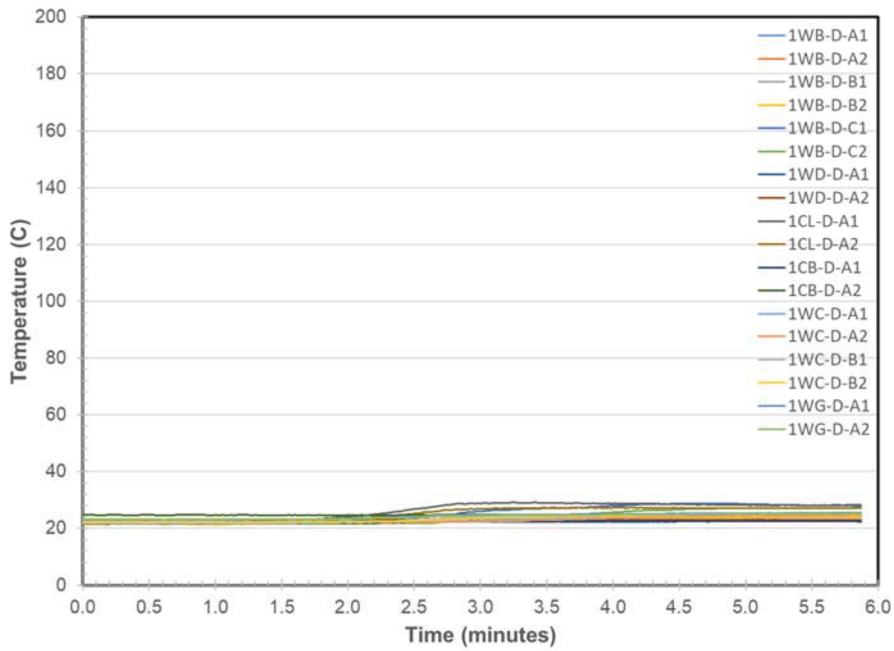

Figure 262. DFT Temperatures at Each Location

Velocity

The following table provides a description of the instrumentation used to collect velocity measurements during the experiments. Velocity is calculated from pressure and temperature measurements.

Table 6. Velocity Measurement Description

Description	Probe Description	Thermocouple Type	Location X (m)	Location Y (m)	Location Z (m)	Orientation
1WA-V-A1	BIDIRECTIONAL	Type K, Glass Ins., 24 ga wire	0.76	0.00	0.91	horizontal
1WA-V-A2	BIDIRECTIONAL	Type K, Glass Ins., 24 ga wire	0.76	0.00	1.83	horizontal

The following table provides a summary of the temperatures measured at the velocity probe.

Table 7. Velocity Temperature Summary

Description	Initial (C)	Maximum (C)	30 Second Maximum Average (C)	60 Second Maximum Average (C)	300 Second Maximum Average (C)	600 Second Maximum Average (C)
1WA-V-A1	22	23	23	23	22	22
1WA-V-A2	23	23	23	23	23	23

The following table summarizes the minimum and maximum velocity values and the times at which they occurred.

Table 8. Velocity Minimum and Maximum

Description	Initial (m/s)	Maximum (m/s)	5 Second Maximum Average (m/s)	10 Second Maximum Average (m/s)	30 Second Maximum Average (m/s)	60 Second Maximum Average (m/s)
1WA-V-A1	0.03	0.23	0.12	0.07	0.04	0.02
1WA-V-A2	0.04	0.18	0.10	0.07	-0.01	-0.02

The following chart present a time dependent representation of the instantaneous velocities measured during the experiment.

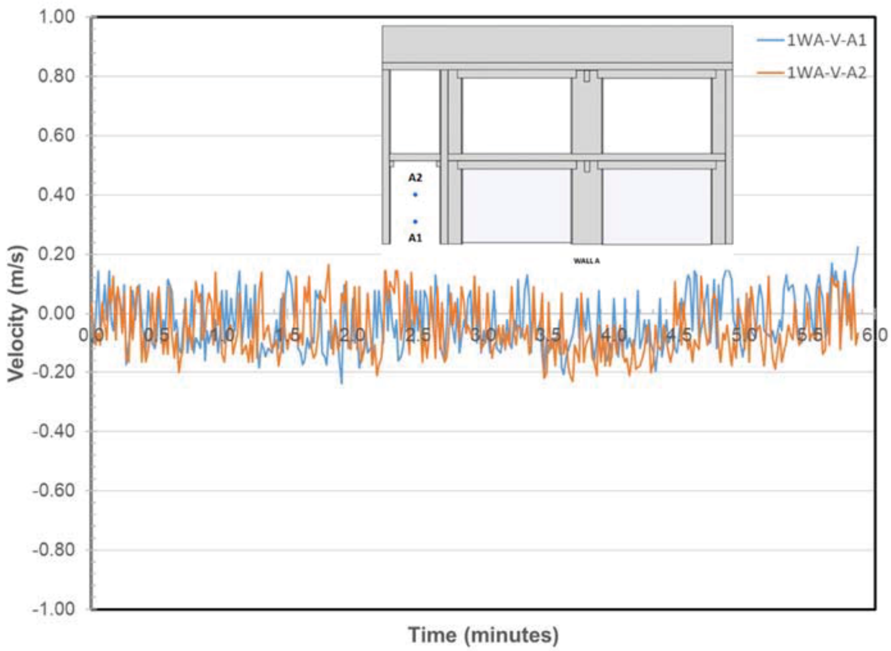

Figure 263. Velocity at Location A on Wall A

Heat Flux Transducers

The following table provides a description of the transducer used to collect heat flux measurements during the experiment. The "Description" column typically describes the location of the heat flux transducer. Location X and Location Y are Cartesian coordinates generally located in a horizontal plane. Location Z is the distance from the floor to the centerline of the transducer. Heat flux mode indicates whether the total heat flux was measured or just the radiation fraction. Heat flux over range is the maximum measured value reported for this transducer.

Table 9. Heat Flux Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Orientation	Heat Flux Mode	Heat Flux Over Range (kW/m²)
1WF-H-A1	5.56	11.15	0.91	horizontal	Total	150
1WA-H-A1	1.83	2.44	1.52	horizontal	Total	150
1WA-H-A2	1.83	4.88	1.52	horizontal	Total	75
1WA-H-B1	1.83	2.44	1.52	horizontal	Total	150
1WA-H-B2	1.83	4.88	1.52	horizontal	Total	75

The following table provides a summary of the heat flux results. A "SC" in the table indicates that the values did not change sufficiently for this value to be calculated. The "Description" column typically describes the location of the heat flux transducer. The time at which the heat flux first changes by a pre-determined amount is provided in the "Time of Initial Change" column. The pre-determined amount of change in heat flux is provided in the "Initial Change Amount" column. The maximum heat flux recorded during the test is provided in the "Maximum" column. The "Maximum Average" columns are calculated over four pre-determined time spans. Exceeded maximum instrument operating range and was taken out of service for the remainder of the test

Table 10. Heat Flux Result Summary

Description	Time of Initial Change (s)	Initial Change Value (kW/m²)	Maximum Heat Flux (kW/m²)	Heat Flux 10 second maximum average (kW/m²)	Heat Flux 30 second maximum average (kW/m²)	Heat Flux 60 second maximum average (kW/m²)	Heat Flux 300 second maximum average (kW/m²)	Heat Flux 600 second maximum average (kW/m²)
1WF-H-A1	SC	5	0.0	0.0	0.0	0.0	0.0	0.0
1WA-H-A1	SC	5	0.2	0.2	0.2	0.2	0.2	0.2
1WA-H-A2	SC	5	0.2	0.2	0.2	0.2	0.2	0.2
1WA-H-B1	SC	5	0.3	0.3	0.3	0.2	0.2	0.2
1WA-H-B2	SC	5	0.3	0.3	0.3	0.3	0.3	0.3

The following chart shows a time dependent representation of the instantaneous heat flux measured during the experiment.

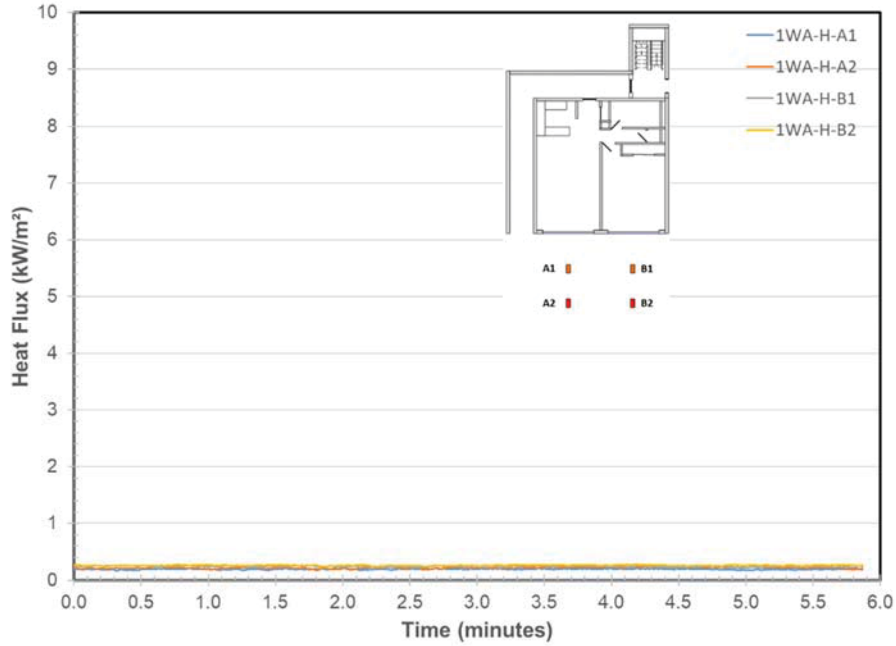

Figure 264. Heat Fluxes in Front of Wall A

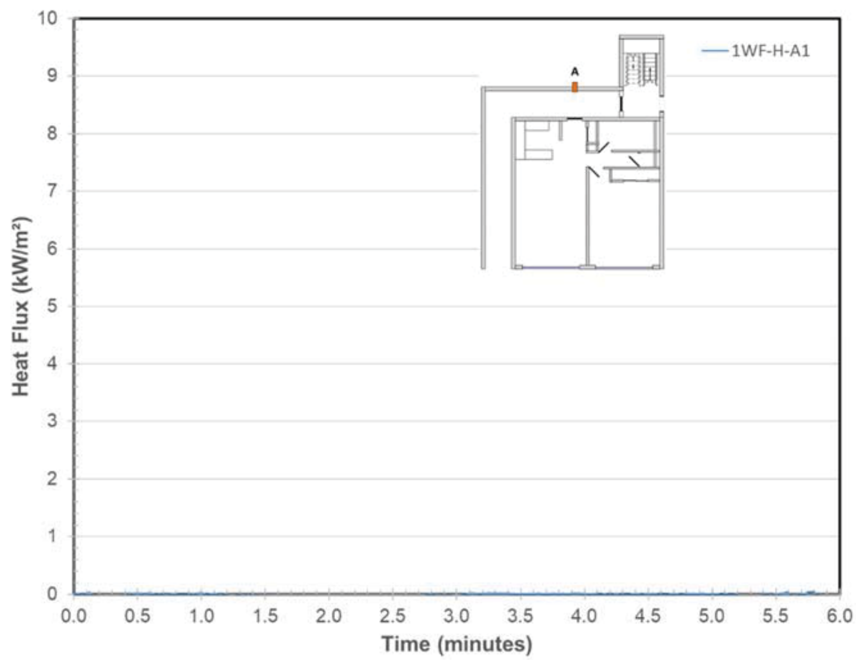

Figure 265. Heat Flux on Wall F across from Apartment Door

Optical Density Meter

The following table provides a description of the optical density meter used in the experiment. The extinction beam path length is the distance measured from the light source to the lens of the photo transducer.

Table 11. Optical Density Meter Description

Description	Light Source Type	X (m)	Y (m)	Z (m)	Extinction Beam Path Length (m)
1RH-O-A1	White light	3.353	10.363	1.524	0.914

The following chart shows the obscuration during the experiment.

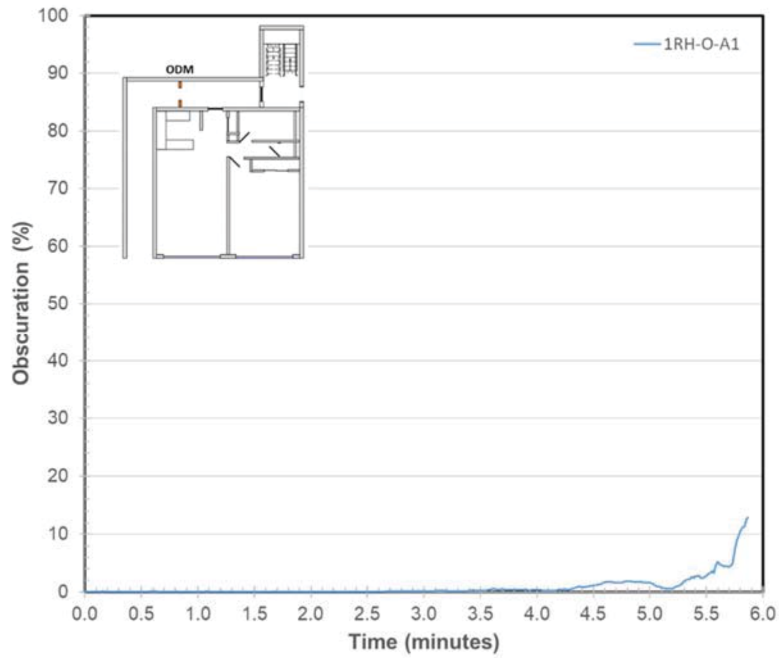

Figure 266. Obscuration in Corridor

The following chart shows the obscuration per unit length during the experiment.

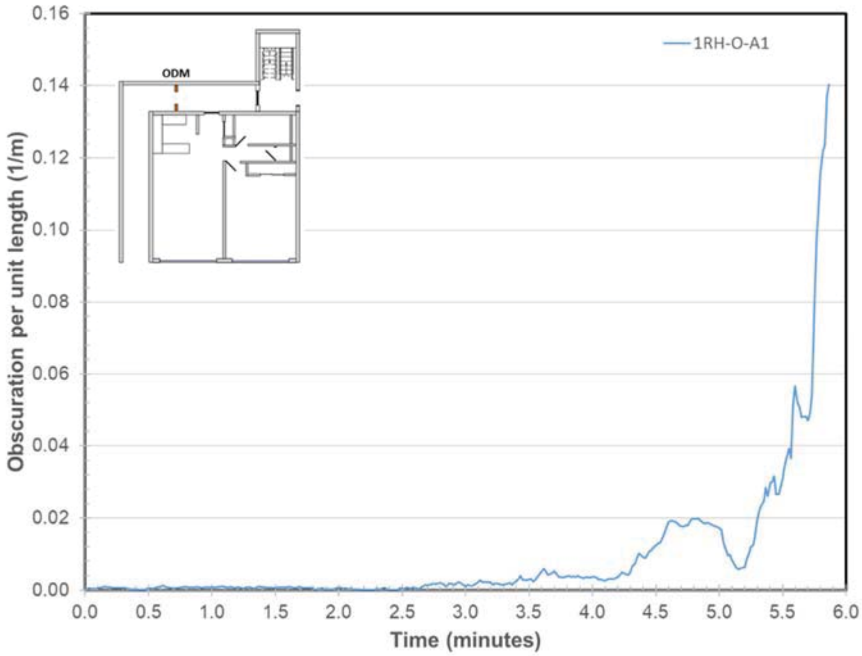

Figure 267. Obscuration per unit Length in Corridor

Smoke Detectors

The following table provides a description of the detectors used in the experiment. All detectors were mounted on the ceiling.

Table 12. Detector Summary

Description	Location	Distance below ceiling (m)	Manufacturer	Model	Detector Type	Sensor Type
1CH-I-A1	1st Floor Corridor near Wall A	0.00	Kidde	i12080	smoke	ionization
1CH-P-A1	1st Floor Corridor near Wall A	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-B1	1st Floor Corridor by Apartment Door	0.00	Kidde	i12080	smoke	ionization
1CH-P-B1	1st Floor Corridor by Apartment Door	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-C1	1st Floor Stairwell	0.00	Kidde	i12080	smoke	ionization
1CH-P-C1	1st Floor Stairwell	0.00	Kidde	p12040	smoke	photoelectric
1CL-I-A1	1st Floor Living Room	0.00	Kidde	p12040	smoke	ionization
1CL-P-A1	1st Floor Living Room	0.00	Kidde	i12080	smoke	photoelectric
1CB-I-A1	1st Floor Bedroom	0.00	Kidde	i12080	smoke	ionization
1CB-P-A1	1st Floor Bedroom	0.00	Kidde	p12040	smoke	photoelectric
1CB-I-B1	1st Floor Hallway Outside of Bedroom	0.00	Kidde	i12080	smoke	ionization
1CB-P-B1	1st Floor Hallway Outside of Bedroom	0.00	Kidde	p12040	smoke	photoelectric

The following table provides a summary of activation times for all smoke detectors in all experiments.

Table 13. Smoke Detector Activation Summary

Test Number	Location	Activation Time (s)	Activation Time (hh:mm:ss))
1CL-I-A1	1st Floor Living Room	33	00:00:33
1CB-I-B1	1st Floor Hallway Outside of Bedroom	36	00:00:36
1CB-P-B1	1st Floor Hallway Outside of Bedroom	39	00:00:39
1CL-P-A1	1st Floor Living Room	44	00:00:44
1CB-P-A1	1st Floor Bedroom	140	00:02:20
1CH-I-B1	1st Floor Corridor by Apartment Door	332	00:05:32
1CH-P-B1	1st Floor Corridor by Apartment Door	339	00:05:39

Fire Products Collector

The following table provides a description of the FPC used in the experiment. The table includes a description of the FPC, as well as the Calibration factor (C Factor) and the net heat released per unit of oxygen consumed (E Factor), which are used to calculate the het release rate (HRR) during an experiment. The C Factor is based on data from a fire with a known HRR. The E Factor is a property of the fuel being burned.

Table 14. Fire Products Collector Description

Description	C Factor	E Factor (kJ/kg)
14 MW	1.128	13100

The following chart shows the heat release rate of the fire during the experiment. The heat release rate is calculated based on the principle of oxygen consumption calorimetry.

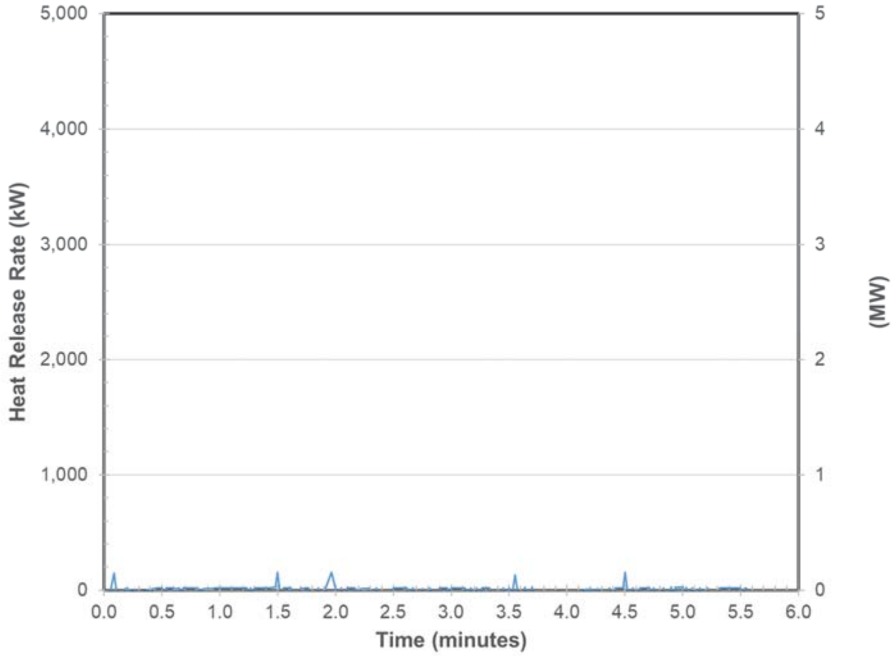

Figure 268. Heat Release Rate

The following chart shows the total heat released from the fire during the experiment. The total heat released is calculated by integrating the heat release rate over time.

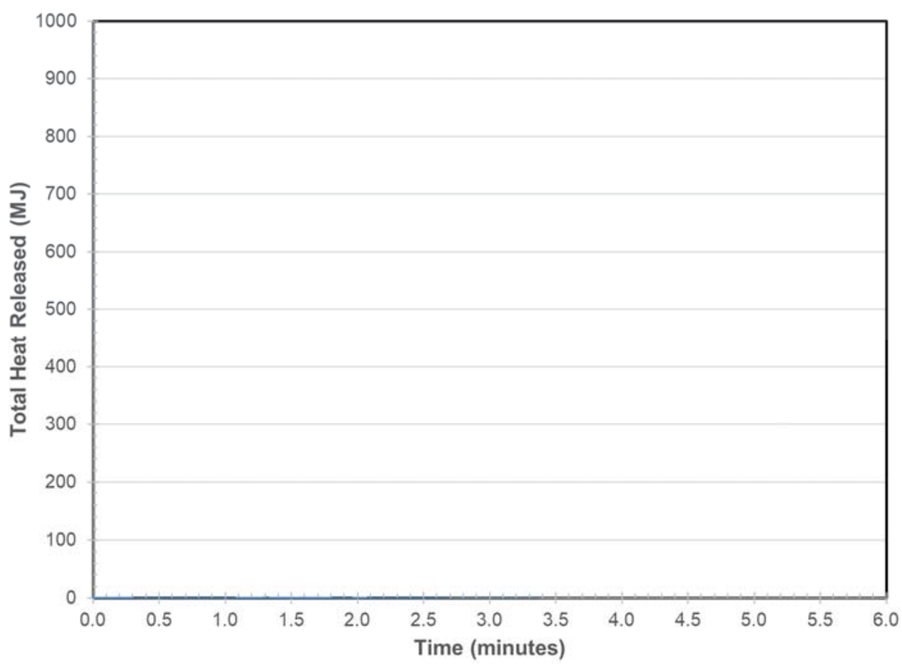

Figure 269. Total Heat Released

Gas Analyzer-Paramagnetic-O_2

The following table provides information about the oxygen sampling location(s) and the operating parameters of the oxygen analyzers. The “O2 delay time” is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample bypass and analyzer exhaust lines are returned to during the experiment.

Table 15. Oxygen measurement descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	O2 Delay Time (s)	Exhaust Return
1RH-G-A1	5.59	10.36	1.52	10	To Ambient Laboratory
1RL-G-A1	1.90	2.39	1.52	21	To Ambient Laboratory

The following chart presents the oxygen concentration(s) measured during the test.

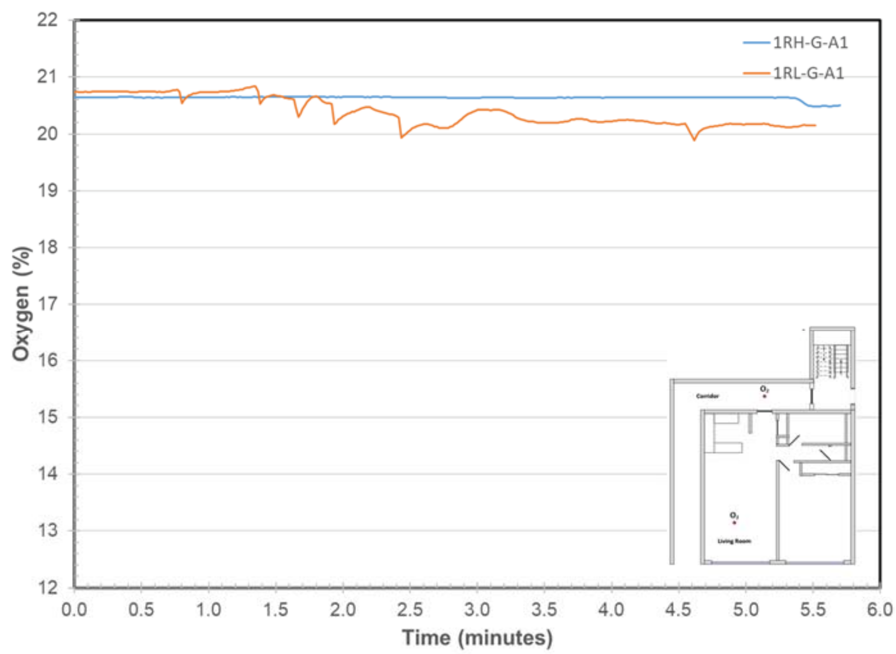

Figure 270 Oxygen Concentrations in the Corridor and Living Room

Gas Analyzer-NDIR-CO/CO_2

The following table provides information about the carbon monoxide and carbon dioxide sampling locations and the operating parameters of the analyzer(s). The “CO/CO2 delay time” is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample by-pass and analyzer exhaust lines are returned to during the experiment.

Table 16. CO and CO2 Measurement Descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	Delay Time CO/CO2 (s)	Exhaust Return
1RH-G-A1	5.59	10.36	1.52	10	To Ambient Laboratory
1RL-G-A1	1.90	2.39	1.52	21	To Ambient Laboratory

The following table provides a summary of the carbon monoxide gas measurement results.

Table 17. CO Measurement Results

Description	CO Analyzer Full Scale Range (mol/mol)	CO Span Gas Value (mol/mol)	Maximum CO Gas Concentration (mol/mol)	CO-Average (mol/mol)
1RH-G-A1	0.05	0.05	0.0000	-0.0002
1RL-G-A1	0.05	0.05	-0.0001	-0.0002

The following table provides a summary of the carbon dioxide gas measurement results.

Table 18. CO_2 Measurement Results

Description	CO2 Analyzer Full Scale Range (mol/mol)	CO2 Span Gas Value (mol/mol)	Maximum CO2 Gas Concentration (mol/mol)	CO2-Average (mol/mol)
1RH-G-A1	0.25	0.22	0.0010	-0.0003
1RL-G-A1	0.25	0.22	0.0066	0.0039

The following chart shows the carbon monoxide concentrations measured during the experiment.

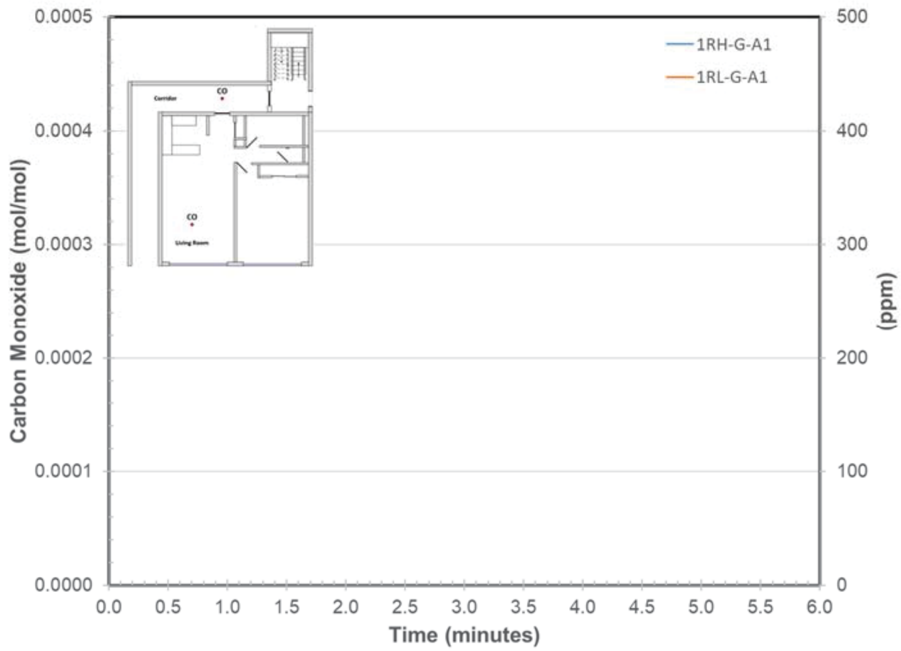

Figure 271. Carbon Monoxide Concentrations in the Corridor and Living Room

The following chart shows the carbon dioxide concentrations measured during the experiment.

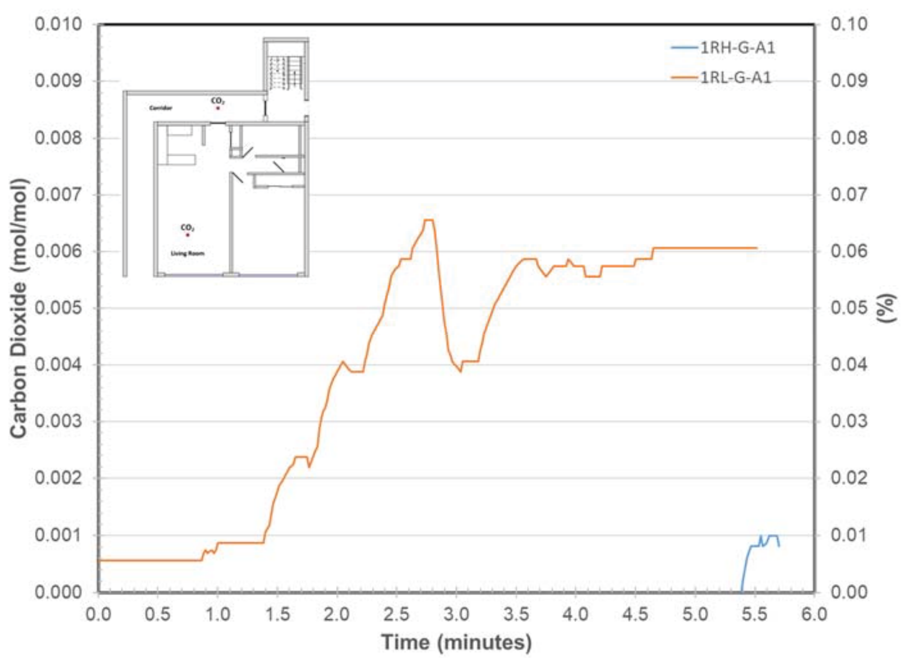

Figure 272. Carbon Dioxide Concentration in the Corridor and Living Room

Videos

The following table provides a description of the videos taken during this experiment.

Table 19. Video Log

Description	Start Time	Video Duration (s)	Filename
IGNITION	09:22:54	398	203924_20170627_092254_1.mov
LIVING ROOM	09:22:56	398	203924_20170627_092256_2.mov
BEDROOM	09:22:57	398	203924_20170627_092257_3.mov
DOOR / KITCHEN	09:22:59	397	203924_20170627_092259_4.mov
KITCHEN / LIVING ROOM	09:23:01	396	203924_20170627_092301_5.mov
HALLWAY	09:23:02	396	203924_20170627_092302_6.mov
STAIRWELL	09:23:04	395	203924_20170627_092304_7.mov
FLIR	09:23:05	395	203924_20170627_092305_8.mov
FRONT VIEW HD	09:23:07	394	203924_20170627_092307_9.mov
LIVING ROOM HD	09:23:08	394	203924_20170627_092308_10.mov
BEDROOM HD	09:23:09	398	203924_20170627_092309_11.mov
OVERALL HD	09:23:09	399	203924_20170627_092309_12.mov
SPRINKLER PRESSURE HD	09:23:10	399	203924_20170627_092310_13.mov
IGNITION_USDA			203924_949767.MOV
LIVING ROOM_USDA			203924_949768.MOV
BEDROOM_USDA			203924_949769.MOV
DOOR / KITCHEN_USDA			203924_949770.MOV
KITCHEN / LIVING ROOM_USDA			203924_949771.MOV
HALLWAY_USDA			203924_949772.MOV
STAIRWELL_USDA			203924_949773.MOV
FLIR_USDA			203924_949774.MOV
FRONT VIEW HD_USDA			203924_949775.MOV
LIVING ROOM HD_USDA			203924_949776.MOV
BEDROOM HD_USDA			203924_949777.MOV
OVERALL HD_USDA			203924_949778.MOV
SPRINKLER PRESSURE HD_USDA			203924_949779.MOV
203924_Master_USDA			203924_949863.MOV

Experiment Photographs

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 273. Pre test 2:09 hr:min, (203924_856767)

Figure 274. Pre test 2:09 hr:min (203924_856768)

Figure 275. Pre test 2:09 hr:min (203924_856769)

Figure 276. Pre test 2:08 hr:min (203924_856770)

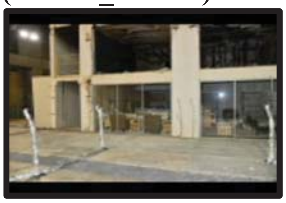

Figure 277. Pre test 2:08 hr:min (203924_856771)

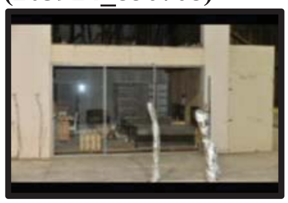

Figure 278. Pre test 2:08 hr:min (203924_856772)

Figure 279. Pre test 2:08 hr:min (203924_856773)

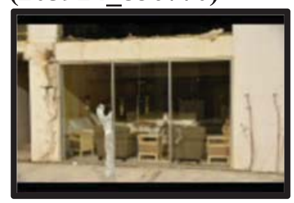

Figure 280. Pre test 2:08 hr:min (203924_856774)

Figure 281. Pre test 2:08 hr:min (203924_856775)

Figure 282. Pre test 2:08 hr:min (203924_856776)

Figure 283. Pre test 2:07 hr:min (203924_856777)

Figure 284. Pre test 2:07 hr:min (203924_856778)

Figure 285. Pre test 2:07 hr:min (203924_856779)

Figure 286. Pre test 2:07 hr:min (203924_856780)

Figure 287. Pre test 2:07 hr:min (203924_856781)

Figure 288. Pre test 2:07 hr:min (203924_856782)


Figure 289. Pre test 2:07 hr:min (203924_856783)


Figure 290. Pre test 2:07 hr:min (203924_856784)


Figure 291. Pre test 2:06 hr:min (203924_856785)

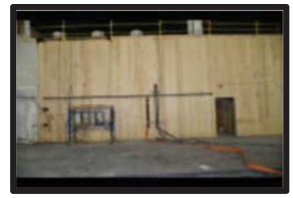
Figure 292. Pre test 2:05 hr:min (203924_856787)


Figure 293. Pre test 2:05 hr:min (203924_856788)


Figure 294. Pre test 2:05 hr:min (203924_856789)

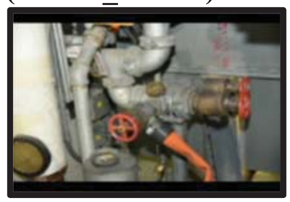
Figure 295. Pre test 2:04 hr:min (203924_856790)


Figure 296. Pre test 2:04 hr:min (203924_856791)


Figure 297. Pre test 2:04 hr:min (203924_856792)


Figure 298. Pre test 2:02 hr:min (203924_856793)

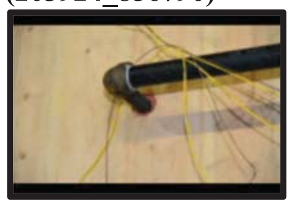
Figure 299. Pre test 2:02 hr:min (203924_856794)

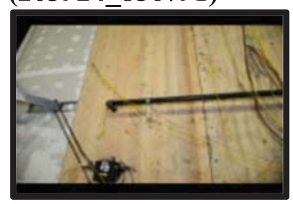
Figure 300. Pre test 2:02 hr:min (203924_856795)


Figure 301. Pre test 2:02 hr:min (203924_856796)

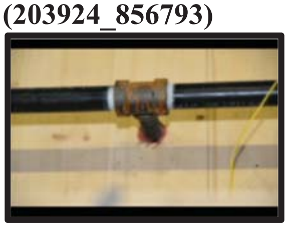
Figure 302. Pre test 2:02 hr:min (203924_856797)


Figure 303. Pre test 2:02 hr:min (203924_856798)


Figure 304. Pre test 2:02 hr:min (203924_856799)


Figure 305. Pre test 2:02 hr:min (203924_856800)


Figure 306. Pre test 2:02 hr:min (203924_856801)


Figure 307. Pre test 2:01 hr:min (203924_856802)


Figure 308. Pre test 2:01 hr:min (203924_856803)


Figure 309. Pre test 2:01 hr:min (203924_856804)


Figure 310. Pre test 2:01 hr:min (203924_856805)


Figure 311. Pre test 2:01 hr:min (203924_856806)


Figure 312. Pre test 2:01 hr:min (203924_856807)


Figure 313. Pre test 2:01 hr:min (203924_856808)


Figure 314. Pre test 2:01 hr:min (203924_856809)


Figure 315. Pre test 2:01 hr:min (203924_856810)


Figure 316. Pre test 2:01 hr:min (203924_856811)


Figure 317. Pre test 2:01 hr:min (203924_856812)


Figure 318. Pre test 2:00 hr:min (203924_856813)


Figure 319. Pre test 2:00 hr:min (203924_856814)


Figure 320. Pre test 2:00 hr:min (203924_856815)


Figure 321. Pre test 2:00 hr:min (203924_856816)


Figure 322. Pre test 2:00 hr:min (203924_856817)


Figure 323. Pre test 2:00 hr:min (203924_856818)

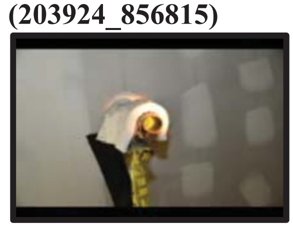
Figure 324. Pre test 2:00 hr:min (203924_856819)


Figure 325. Pre test 2:00 hr:min (203924_856820)


Figure 326. Pre test 2:00 hr:min (203924_856821)


Figure 327. Pre test 2:00 hr:min (203924_856822)


Figure 328. Pre test 2:00 hr:min (203924_856823)


Figure 329. Pre test 2:00 hr:min (203924_856824)


Figure 330. Pre test 2:00 hr:min (203924_856825)


Figure 331. Pre test 2:00 hr:min (203924_856826)


Figure 332. Pre test 1:59 hr:min (203924_856827)


Figure 333. Pre test 1:59 hr:min (203924_856828)


Figure 334. Pre test 1:59 hr:min (203924_856829)


Figure 335. Pre test 1:59 hr:min (203924_856830)


Figure 336. Pre test 1:59 hr:min (203924_856831)


Figure 337. Pre test 1:59 hr:min (203924_856832)

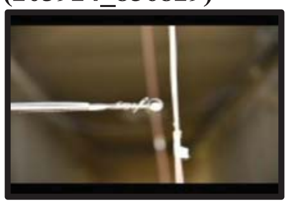
Figure 338. Pre test 1:59 hr:min (203924_856833)

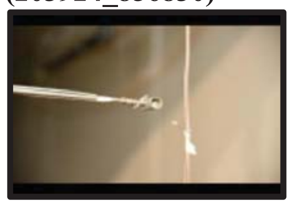
Figure 339. Pre test 1:59 hr:min (203924_856834)


Figure 340. Pre test 1:58 hr:min (203924_856835)


Figure 341. Pre test 1:58 hr:min (203924_856836)


Figure 342. Pre test 1:58 hr:min (203924_856837)


Figure 343. Pre test 1:58 hr:min (203924_856838)


Figure 344. Pre test 1:58 hr:min (203924_856839)


Figure 345. Pre test 1:58 hr:min (203924_856840)


Figure 346. Pre test 1:58 hr:min (203924_856841)


Figure 347. Pre test 1:58 hr:min (203924_856842)


Figure 348. Pre test 1:58 hr:min (203924_856843)


Figure 349. Pre test 1:58 hr:min (203924_856844)


Figure 350. Pre test 1:57 hr:min (203924_856845)


Figure 351. Pre test 1:57 hr:min (203924_856846)


Figure 352. Pre test 1:56 hr:min (203924_856847)


Figure 353. Pre test 1:56 hr:min (203924_856848)


Figure 354. Pre test 1:56 hr:min (203924_856849)


Figure 355. Pre test 1:56 hr:min (203924_856850)


Figure 356. Pre test 1:56 hr:min (203924_856851)


Figure 357. Pre test 1:47 hr:min (203924_856852)


Figure 358. Pre test 1:47 hr:min (203924_856853)


Figure 359. Pre test 1:46 hr:min (203924_856854)


Figure 360. Pre test 1:46 hr:min (203924_856855)


Figure 361. Pre test 1:46 hr:min (203924_856856)


Figure 362. Pre test 1:46 hr:min (203924_856857)


Figure 363. Pre test 1:46 hr:min (203924_856858)


Figure 364. Pre test 1:46 hr:min (203924_856859)


Figure 365. Pre test 1:46 hr:min (203924_856860)


Figure 366. Pre test 1:46 hr:min (203924_856861)


Figure 367. Pre test 1:46 hr:min (203924_856864)


Figure 368. Pre test 1:46 hr:min (203924_856866)

Figure 369. Pre test 1:45 hr:min (203924_856867)

Figure 370. Pre test 1:45 hr:min (203924_856868)

Figure 371. Pre test 1:45 hr:min (203924_856869)

Figure 372. Pre test 1:45 hr:min (203924_856870)

Figure 373. Pre test 1:45 hr:min (203924_856871)

Figure 374. Pre test 1:45 hr:min (203924_856872)

Figure 375. Pre test 1:45 hr:min (203924_856873)

Figure 376. Pre test 1:45 hr:min (203924_856874)

Figure 377. Pre test 1:45 hr:min (203924_856875)

Figure 378. Pre test 1:45 hr:min (203924_856876)

Figure 379. Pre test 1:45 hr:min (203924_856877)

Figure 380. Pre test 1:44 hr:min (203924_856878)

Figure 381. Pre test 1:44 hr:min (203924_856879)

Figure 382. Pre test 1:44 hr:min (203924_856880)

Figure 383. Pre test 1:44 hr:min (203924_856881)

Figure 384. Pre test 1:44 hr:min (203924_856882)

Figure 385. Pre test 1:44 hr:min (203924_856883)

Figure 386. Pre test 1:44 hr:min (203924_856884)

Figure 387. Pre test 1:44 hr:min (203924_856885)

Figure 388. Pre test 1:44 hr:min (203924_856886)

Figure 389. Pre test 1:44 hr:min (203924_856887)

Figure 390. Pre test 1:44 hr:min (203924_856888)

Figure 391. Pre test 1:44 hr:min (203924_856889)

Figure 392. Pre test 1:44 hr:min (203924_856890)

Figure 393. Pre test 1:44 hr:min (203924_856891)

Figure 394. Pre test 1:44 hr:min (203924_856892)

Figure 395. Pre test 1:44 hr:min (203924_856893)

Figure 396. Pre test 1:44 hr:min (203924_856894)

Figure 397. Pre test 1:44 hr:min (203924_856895)

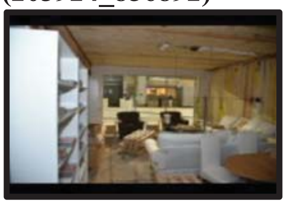

Figure 398. Pre test 1:44 hr:min (203924_856896)

Figure 399. Pre test 1:44 hr:min (203924_856897)

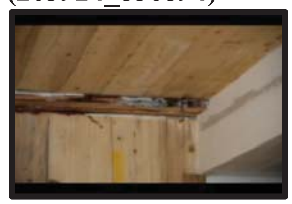

Figure 400. Pre test 1:44 hr:min (203924_856898)

Figure 401. Pre test 1:43 hr:min (203924_856899)

Figure 402. Pre test 1:43 hr:min (203924_856900)

Figure 403. Pre test 1:43 hr:min (203924_856901)

Figure 404. Pre test 1:43 hr:min (203924_856902)

Figure 405. Pre test 1:43 hr:min (203924_856903)

Figure 406. Pre test 1:43 hr:min (203924_856904)

Figure 407. Pre test 1:43 hr:min (203924_856905)

Figure 408. Pre test 1:43 hr:min (203924_856906)

Figure 409. Pre test 1:43 hr:min (203924_856907)

Figure 410. Pre test 1:43 hr:min (203924_856908)

Figure 411. Pre test 1:43 hr:min (203924_856909)

Figure 412. Pre test 1:43 hr:min (203924_856910)

Figure 413. Pre test 1:43 hr:min (203924_856911)

Figure 414. Pre test 1:43 hr:min (203924_856912)

Figure 415. Pre test 1:43 hr:min (203924_856913)

Figure 416. Pre test 1:43 hr:min (203924_856914)

Figure 417. Pre test 1:42 hr:min (203924_856915)

Figure 418. Pre test 1:42 hr:min (203924_856916)

Figure 419. Pre test 1:42 hr:min (203924_856917)

Figure 420. Pre test 1:42 hr:min (203924_856918)

Figure 421. Pre test 1:42 hr:min (203924_856919)

Figure 422. Pre test 1:42 hr:min (203924_856920)

Figure 423. Pre test 1:42 hr:min (203924_856921)

Figure 424. Pre test 1:42 hr:min (203924_856922)

Figure 425. Pre test 1:42 hr:min (203924_856923)

Figure 426. Pre test 1:42 hr:min (203924_856924)

Figure 427. Pre test 1:41 hr:min (203924_856925)

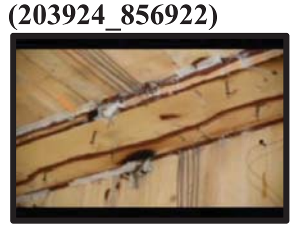

Figure 428. Pre test 1:41 hr:min (203924_856926)


Figure 429. Pre test
1:41 hr:min
(203924_856927)


Figure 430. Pre test
1:41 hr:min
(203924_856928)


Figure 431. Pre test
1:41 hr:min
(203924_856929)


Figure 432. Pre test
1:41 hr:min
(203924_856930)


Figure 433. Pre test
1:41 hr:min
(203924_856931)

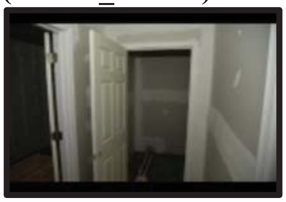
Figure 434. Pre test
1:41 hr:min
(203924_856932)


Figure 435. Pre test
1:41 hr:min
(203924_856933)


Figure 436. Pre test
1:41 hr:min
(203924_856934)


Figure 437. Pre test
1:41 hr:min
(203924_856935)

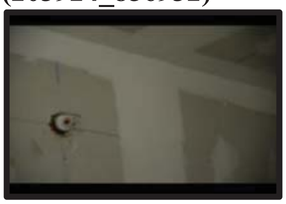
Figure 438. Pre test
1:40 hr:min
(203924_856936)

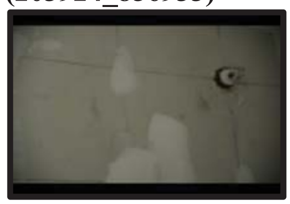
Figure 439. Pre test
1:40 hr:min
(203924_856937)

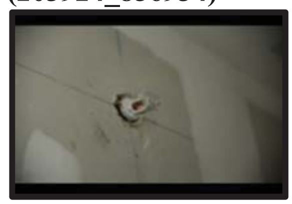
Figure 440. Pre test
1:40 hr:min
(203924_856938)


Figure 441. Pre test
1:40 hr:min
(203924_856939)


Figure 442. Pre test
1:40 hr:min
(203924_856940)

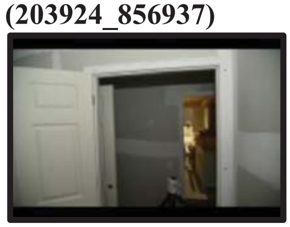
Figure 443. Pre test
1:40 hr:min
(203924_856941)


Figure 444. Pre test
1:40 hr:min
(203924_856942)


Figure 445. Pre test
1:40 hr:min
(203924_856943)


Figure 446. Pre test
1:40 hr:min
(203924_856944)


Figure 447. Pre test
1:40 hr:min
(203924_856945)

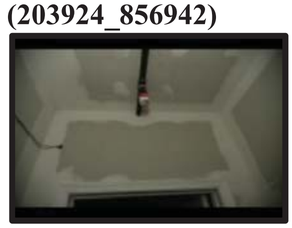
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Figure 449. Pre test 1:40 hr:min (203924_856947)

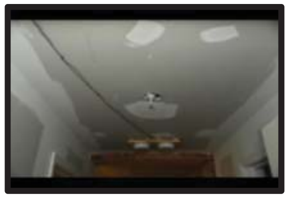
Figure 450. Pre test 1:40 hr:min (203924_856948)


Figure 451. Pre test 1:39 hr:min (203924_856949)


Figure 452. Pre test 1:38 hr:min (203924_856950)

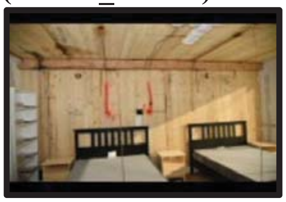
Figure 453. Pre test 1:38 hr:min (203924_856951)


Figure 454. Pre test 1:38 hr:min (203924_856952)


Figure 455. Pre test 1:38 hr:min (203924_856953)

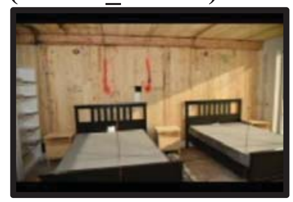
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Figure 457. Pre test 1:38 hr:min (203924_856955)


Figure 458. Pre test 1:38 hr:min (203924_856956)


Figure 459. Pre test 1:38 hr:min (203924_856957)


Figure 460. Pre test 1:38 hr:min (203924_856958)


Figure 461. Pre test 1:38 hr:min (203924_856959)


Figure 462. Pre test 1:38 hr:min (203924_856960)


Figure 463. Pre test 1:38 hr:min (203924_856961)


Figure 464. Pre test 1:37 hr:min (203924_856962)


Figure 465. Pre test 1:37 hr:min (203924_856963)


Figure 466. Pre test 1:37 hr:min (203924_856964)


Figure 467. Pre test 1:37 hr:min (203924_856965)


Figure 468. Pre test 1:37 hr:min (203924_856966)


Figure 469. Pre test 1:37 hr:min (203924_856967)


Figure 470. Pre test 1:37 hr:min (203924_856968)


Figure 471. Pre test 1:37 hr:min (203924_856969)


Figure 472. Pre test 1:37 hr:min (203924_856970)


Figure 473. Pre test 1:37 hr:min (203924_856971)


Figure 474. Pre test 1:37 hr:min (203924_856972)


Figure 475. Pre test 1:37 hr:min (203924_856973)


Figure 476. Pre test 1:37 hr:min (203924_856974)


Figure 477. Pre test 1:37 hr:min (203924_856975)


Figure 478. Pre test 1:37 hr:min (203924_856976)


Figure 479. Pre test 1:37 hr:min (203924_856977)


Figure 480. Pre test 1:37 hr:min (203924_856978)


Figure 481. Pre test 1:36 hr:min (203924_856979)


Figure 482. Pre test 1:36 hr:min (203924_856980)


Figure 483. Pre test 1:36 hr:min (203924_856981)


Figure 484. Pre test 1:36 hr:min (203924_856982)


Figure 485. Pre test 1:36 hr:min (203924_856983)


Figure 486. Pre test 1:33 hr:min (203924_856984)


Figure 487. Pre test 1:33 hr:min (203924_856985)


Figure 488. Pre test 1:33 hr:min (203924_856986)


Figure 489. Pre test 1:33 hr:min (203924_856987)


Figure 490. Pre test 1:33 hr:min (203924_856988)

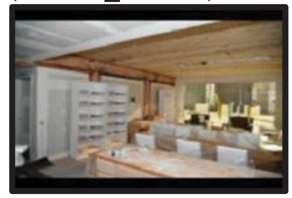

Figure 491. Pre test 1:33 hr:min (203924_856989)


Figure 492. Pre test 1:33 hr:min (203924_856990)


Figure 493. Pre test 1:33 hr:min (203924_856991)


Figure 494. Pre test 1:32 hr:min (203924_856992)


Figure 495. Pre test 1:32 hr:min (203924_856993)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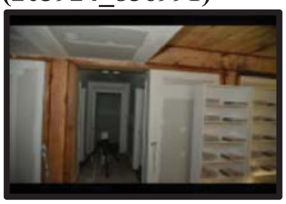
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Figure 498. Pre test 1:32 hr:min (203924_856996)

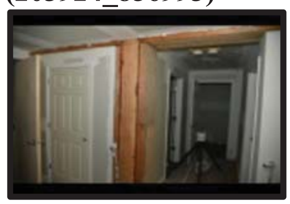
Figure 499. Pre test 1:31 hr:min (203924_856997)


Figure 500. Pre test 1:30 hr:min (203924_856998)


Figure 501. Pre test 1:30 hr:min (203924_856999)


Figure 502. Pre test 1:29 hr:min (203924_857000)


Figure 503. Pre test 1:29 hr:min (203924_857001)


Figure 504. Pre test 1:28 hr:min (203924_857002)


Figure 505. Pre test 1:09 hr:min (203924_857003)


Figure 506. Pre test 1:09 hr:min (203924_857004)


Figure 507. Pre test 1:07 hr:min (203924_857005)


Figure 508. Pre test 1:07 hr:min (203924_857006)


Figure 509. Pre test 1:05 hr:min (203924_857007)


Figure 510. Pre test 1:05 hr:min (203924_857008)


Figure 511. Pre test 1:05 hr:min (203924_857009)


Figure 512. Pre test 1:05 hr:min (203924_857011)


Figure 513. Pre test 1:04 hr:min (203924_857012)


Figure 514. Pre test 1:04 hr:min (203924_857013)


Figure 515. Pre test 1:02 hr:min (203924_857014)


Figure 516. Pre test 1:02 hr:min (203924_857015)


Figure 517. Pre test 1:02 hr:min (203924_857016)


Figure 518. Pre test 1:02 hr:min (203924_857017)


Figure 519. Pre test 1:01 hr:min (203924_857018)


Figure 520. Pre test 1:01 hr:min (203924_857019)


Figure 521. Pre test 1:01 hr:min (203924_857020)


Figure 522. Pre test 1:01 hr:min (203924_857021)


Figure 523. Pre test 1:01 hr:min (203924_857022)


Figure 524. Pre test 1:01 hr:min (203924_857023)


Figure 525. Pre test 31 minutes (203924_857024)


Figure 526. Pre test 31 minutes (203924_857025)


Figure 527. Pre test 31 minutes (203924_857026)


Figure 528. Pre test 31 minutes (203924_857027)


Figure 529. Pre test 31 minutes (203924_857028)


Figure 530. Pre test 30 minutes (203924_857029)


Figure 531. Pre test 30 minutes (203924_857030)


Figure 532. Pre test 30 minutes (203924_857031)


Figure 533. Pre test 30 minutes (203924_857032)


Figure 534. Pre test 19 minutes (203924_857033)

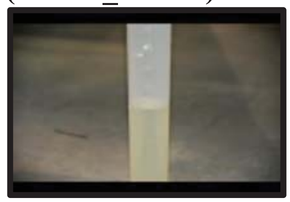
Figure 535. Pre test 19 minutes (203924_857034)


Figure 536. Pre test 19 minutes (203924_857035)


Figure 537. Pre test 18 minutes (203924_857036)


Figure 538. Pre test 18 minutes (203924_857037)


Figure 539. Pre test 18 minutes (203924_857038)


Figure 540. Pre test 17 minutes (203924_857039)


Figure 541. Pre test 17 minutes (203924_857040)

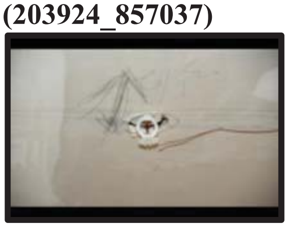
Figure 542. Pre test 17 minutes (203924_857041)


Figure 543. Pre test 17 minutes (203924_857042)


Figure 544. Pre test 42 seconds (203924_857043)


Figure 545. Pre test 32 seconds (203924_857044)


Figure 546. Pre test 16 seconds (203924_857045)


Figure 547. Pre test 6 seconds (203924_857046)


Figure 548. 2 seconds (203924_857047)

Figure 549. 8 seconds (203924_857048)

Figure 550. 16 seconds (203924_857049)

Figure 551. 30 seconds (203924_857050)

Figure 552. 50 seconds (203924_857051)

Figure 553. 76 seconds (203924_857052)

Figure 554. 84 seconds (203924_857053)

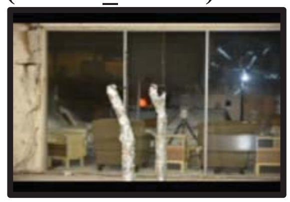

Figure 555. 94 seconds (203924_857054)

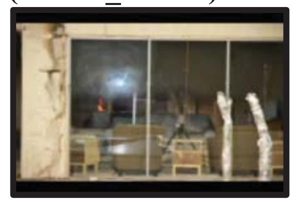

Figure 556. 106 seconds (203924_857055)

Figure 557. 130 seconds (203924_857056)

Figure 558. 146 seconds (203924_857057)

Figure 559. 156 seconds (203924_857058)

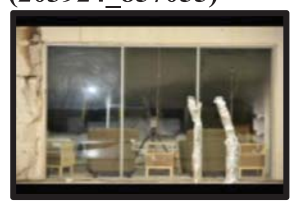

Figure 560. 166 seconds (203924_857059)

Figure 561. 166 seconds (203924_857060)

Figure 562. 188 seconds (203924_857061)

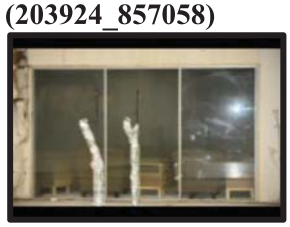

Figure 563. 206 seconds (203924_857062)

Figure 564. 216 seconds (203924_857063)

Figure 565. 234 seconds (203924_857064)

Figure 566. 238 seconds (203924_857065)

Figure 567. 284 seconds (203924_857066)

Figure 568. 290 seconds (203924_857067)


Figure 569. 294 seconds (203924_857068)


Figure 570. 296 seconds (203924_857069)


Figure 571. 308 seconds (203924_857070)

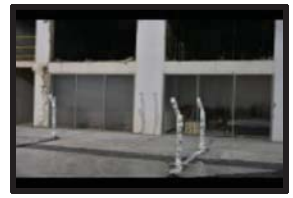
Figure 572. 318 seconds (203924_857071)


Figure 573. 342 seconds (203924_857072)


Figure 574. Post test 0 minutes (203924_857073)


Figure 575. Post test 0 minutes (203924_857074)


Figure 576. Post test 1 minutes (203924_857075)


Figure 577. Post test 1 minutes (203924_857076)


Figure 578. Post test 1 minutes (203924_857077)


Figure 579. Post test 31 minutes (203924_857078)


Figure 580. Post test 31 minutes (203924_857079)


Figure 581. Post test 31 minutes (203924_857080)


Figure 582. Post test 31 minutes (203924_857081)


Figure 583. Post test 32 minutes (203924_857082)


Figure 584. Post test 32 minutes (203924_857083)


Figure 585. Post test 32 minutes (203924_857084)


Figure 586. Post test 32 minutes (203924_857085)


Figure 587. Post test 32 minutes (203924_857086)


Figure 588. Post test 32 minutes (203924_857087)

Figure 589. Post test 32 minutes (203924_857088)

Figure 590. Post test 32 minutes (203924_857089)

Figure 591. Post test 32 minutes (203924_857090)

Figure 592. Post test 32 minutes (203924_857091)

Figure 593. Post test 32 minutes (203924_857092)

Figure 594. Post test 32 minutes (203924_857093)

Figure 595. Post test 32 minutes (203924_857094)

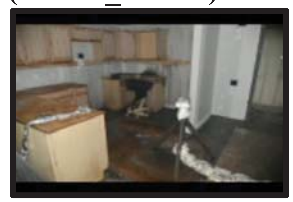

Figure 596. Post test 32 minutes (203924_857095)

Figure 597. Post test 32 minutes (203924_857096)

Figure 598. Post test 32 minutes (203924_857097)

Figure 599. Post test 32 minutes (203924_857098)

Figure 600. Post test 33 minutes (203924_857099)

Figure 601. Post test 33 minutes (203924_857100)

Figure 602. Post test 33 minutes (203924_857101)

Figure 603. Post test 33 minutes (203924_857102)

Figure 604. Post test 33 minutes (203924_857103)

Figure 605. Post test 33 minutes (203924_857104)

Figure 606. Post test 33 minutes (203924_857105)

Figure 607. Post test 33 minutes (203924_857106)

Figure 608. Post test 33 minutes (203924_857107)

Figure 609. Post test 34 minutes (203924_857108)

Figure 610. Post test 34 minutes (203924_857109)

Figure 611. Post test 34 minutes (203924_857110)

Figure 612. Post test 34 minutes (203924_857111)

Figure 613. Post test 34 minutes (203924_857112)

Figure 614. Post test 34 minutes (203924_857113)

Figure 615. Post test 34 minutes (203924_857114)

Figure 616. Post test 34 minutes (203924_857115)

Figure 617. Post test 35 minutes (203924_857116)

Figure 618. Post test 35 minutes (203924_857117)

Figure 619. Post test 35 minutes (203924_857118)

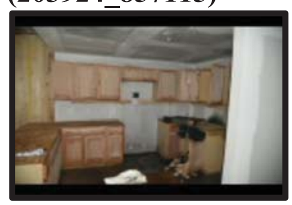

Figure 620. Post test 35 minutes (203924_857119)

Figure 621. Post test 37 minutes (203924_857120)

Figure 622. Post test 37 minutes (203924_857121)

Figure 623. Post test 37 minutes (203924_857122)

Figure 624. Post test 37 minutes (203924_857123)

Figure 625. Post test 37 minutes (203924_857124)

Figure 626. Post test 37 minutes (203924_857125)

Figure 627. Post test 37 minutes (203924_857126)

Figure 628. Post test 37 minutes (203924_857127)


Figure 629. Post test 37 minutes (203924_857128)


Figure 630. Post test 37 minutes (203924_857129)


Figure 631. Post test 38 minutes (203924_857130)


Figure 632. Post test 38 minutes (203924_857131)


Figure 633. Post test 38 minutes (203924_857132)


Figure 634. Post test 38 minutes (203924_857133)


Figure 635. Post test 38 minutes (203924_857134)


Figure 636. Post test 38 minutes (203924_857135)


Figure 637. Post test 38 minutes (203924_857136)


Figure 638. Post test 38 minutes (203924_857137)


Figure 639. Post test 38 minutes (203924_857138)


Figure 640. Post test 38 minutes (203924_857139)


Figure 641. Post test 38 minutes (203924_857140)


Figure 642. Post test 38 minutes (203924_857141)


Figure 643. Post test 38 minutes (203924_857142)


Figure 644. Post test 38 minutes (203924_857143)


Figure 645. Post test 38 minutes (203924_857144)


Figure 646. Post test 39 minutes (203924_857145)


Figure 647. Post test 39 minutes (203924_857146)


Figure 648. Post test 39 minutes (203924_857147)


Figure 649. Post test 39 minutes (203924_857148)


Figure 650. Post test 39 minutes (203924_857149)


Figure 651. Post test 39 minutes (203924_857150)


Figure 652. Post test 39 minutes (203924_857151)


Figure 653. Post test 39 minutes (203924_857152)


Figure 654. Post test 39 minutes (203924_857153)


Figure 655. Post test 39 minutes (203924_857154)


Figure 656. Post test 39 minutes (203924_857155)


Figure 657. Post test 39 minutes (203924_857156)


Figure 658. Post test 39 minutes (203924_857157)


Figure 659. Post test 39 minutes (203924_857158)


Figure 660. Post test 39 minutes (203924_857159)


Figure 661. Post test 40 minutes (203924_857160)


Figure 662. Post test 40 minutes (203924_857161)


Figure 663. Post test 40 minutes (203924_857162)


Figure 664. Post test 40 minutes (203924_857163)

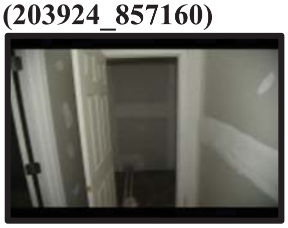
Figure 665. Post test 40 minutes (203924_857164)


Figure 666. Post test 40 minutes (203924_857165)


Figure 667. Post test 40 minutes (203924_857166)


Figure 668. Post test 40 minutes (203924_857167)

Figure 669. Post test 40 minutes (203924_857168)

References

1 ATF Fire Research Laboratory, CLT Project Report, 17OA0001 Sub 1, December 22, 2017

Appendix 5—Cross-Laminated Timber Project Test 5 Results

U. S. Department of Justice

Fire Research Laboratory
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES
6000 Ammendale Road
Beltsville, MD 20705-1250
Phone: 202-648-6200

Test Record

ASCLD/LAB–*International* Testing Accreditation Certificate ALI-217-T

Title	CLT Project - Test 5 Results		
Test Type	Custom		
Lab Number	17OA0001-1	**Author**	David R. Tucholski
Test Date	6/29/17	**Test Number**	5 of 5

Introduction

The following provides the data for the fifth test of the CLT Project. The test was conducted on the first floor of the test structure. The CLT ceiling and walls in the bedroom and living room were exposed, as were portions of the support columns and mid-span beams. All other CLT surfaces were encapsulated with two layers of (5/8 inch) Type X gypsum wallboard. The two large openings in Wall A were covered with glass. Fire sprinklers were installed throughout the structure. However, the fire suppression system was prevented from operating automatically in order to observe how the suppression system would perform under a delayed response. The sprinklers where activated 23 minutes post ignition, which was approximately 20 minutes longer than the suppression system required to activate during Test 4. The apartment door also remained opened during the entire test. The test duration was 30 minutes. Additional details related to the test structure, instrumentation, and experimental procedures are provided in the main CLT Project report [1].

Table of Contents

Instrumentation Location

The following figure describes the nomenclature used to identify the various instrumentation and their locations.

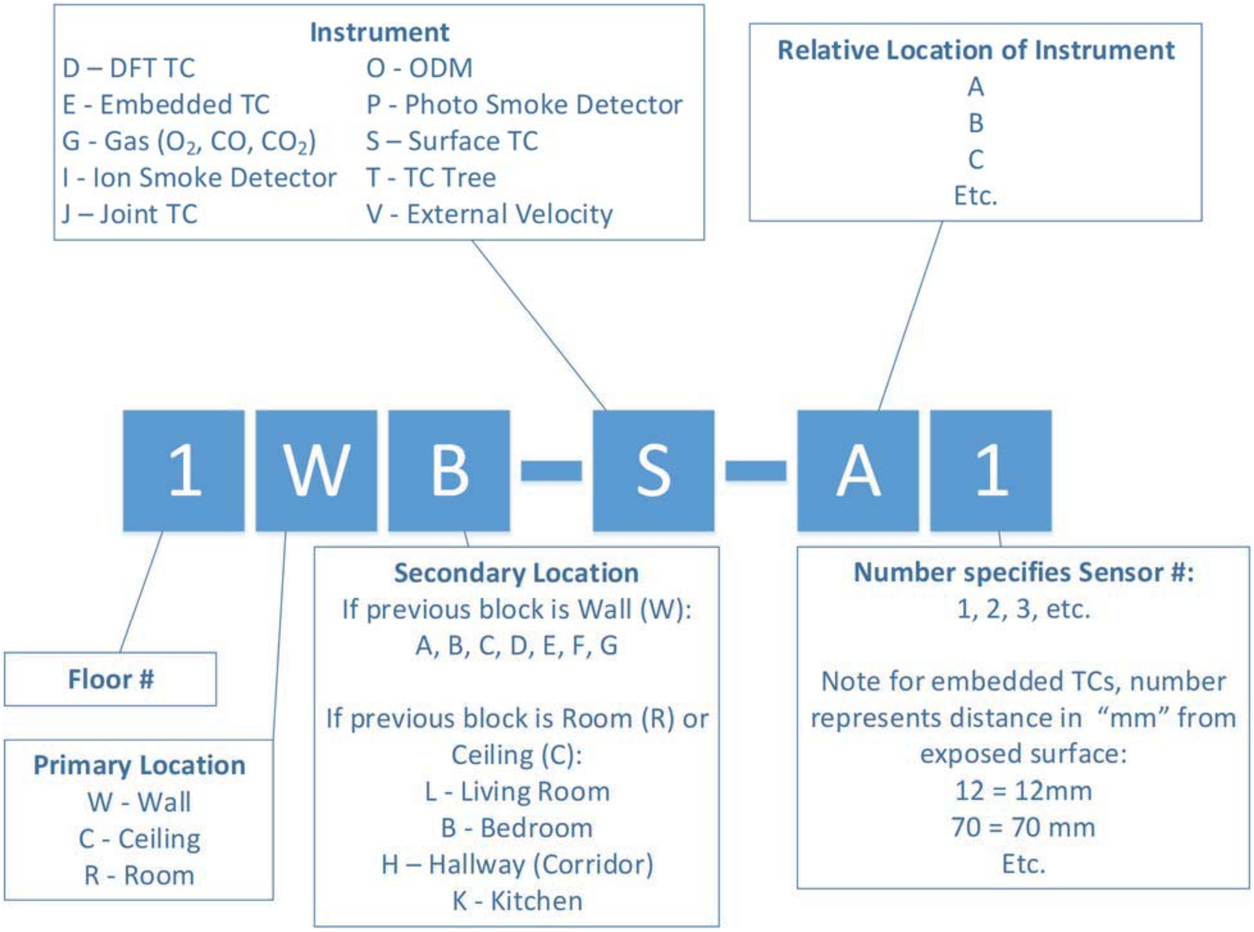

Figure 1. Nomenclature of Instrumentation Location

The example shown in Figure 1 is for a thermocouple located on the surface of Wall B on the first floor. It is the first thermocouple at location A. The exact location of each instrument is based on a Cartesian coordinate system (X, Y, Z). Location X and Location Y are located in the horizontal plane. Location Z is the vertical distance from the floor to the centerline of the instrument. Drawings showing the instrumentation locations and the associated coordinate systems are provided in the main CLT Project report [1].

Results for Test 5 (ID 223940)

Experiment Events

The following table lists selected events that occurred during the experiment.

Table 1. Experiment Events

Description	Time (s)	Time (hh:mm:ss)
Manually Broke Window in Bedroom	991	00:16:31
Manually Activated Sprinkles	1380	00:23:00

Laboratory Conditions

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 2. Lab Conditions Description

Description	Manufacturer	Model
LBR_01	OMEGA	IBTHP-5

The following table provides a summary of the initial conditions at the start of the experiment. The 'Description' column shows the location of the measurements.

Table 3. Ambient Laboratory Condition Summary

Description	Initial (C)	Initial (kPa)	Initial (%)
LBR_01	25	101	54

Thermocouples

The following table provides a description of the instrumentation used to collect the temperature measurements during the experiments. The "Description" column describes the location of the temperature measurement. The "Z" location is the height of the thermocouple above the floor. The "Thermocouple Type" describes the characteristics of the thermocouple used.

Table 4. Thermocouple Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WD-J-D3	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
2WD-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WD-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-A1	1.524	1.981	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-B1	3.048	1.981	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-C1	2.286	2.972	2.743	Type K, Glass Ins., 24 AWG wire
1CL-S-E1	3.048	3.962	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-A1	3.048	1.829	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-B1	1.524	1.829	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-C1	2.286	2.743	2.743	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1CB-S-D1	3.048	3.658	2.743	Type K, Glass Ins., 24 AWG wire
1CB-S-E1	1.524	3.658	2.743	Type K, Glass Ins., 24 AWG wire
1RL-T-A0	2.210	2.286	0.152	Type K, Glass Ins., 24 AWG wire
1RL-T-A2	2.210	2.286	0.610	Type K, Glass Ins., 24 AWG wire
1RL-T-A4	2.210	2.286	1.219	Type K, Glass Ins., 24 AWG wire
1RL-T-A6	2.210	2.286	1.829	Type K, Glass Ins., 24 AWG wire
1RL-T-A8	2.210	2.286	2.438	Type K, Glass Ins., 24 AWG wire
1RL-T-A9	2.210	2.286	2.718	Type K, Glass Ins., 24 AWG wire
1RL-T-B0	2.210	3.810	0.152	Type K, Glass Ins., 24 AWG wire
1RL-T-B2	2.210	3.810	0.610	Type K, Glass Ins., 24 AWG wire
1RL-T-B4	2.210	3.810	1.219	Type K, Glass Ins., 24 AWG wire
1RL-T-B6	2.210	3.810	1.829	Type K, Glass Ins., 24 AWG wire
1RL-T-B8	2.210	3.810	2.438	Type K, Glass Ins., 24 AWG wire
1RL-T-B9	2.210	3.810	2.718	Type K, Glass Ins., 24 AWG wire
1RK-T-A0	2.210	7.620	0.152	Type K, Glass Ins., 24 AWG wire
1RK-T-A2	2.210	7.620	0.610	Type K, Glass Ins., 24 AWG wire
1RK-T-A4	2.210	7.620	1.219	Type K, Glass Ins., 24 AWG wire
1RK-T-A6	2.210	7.620	1.829	Type K, Glass Ins., 24 AWG wire
1RK-T-A8	2.210	7.620	2.362	Type K, Glass Ins., 24 AWG wire
1RB-T-A0	1.981	1.981	0.152	Type K, Glass Ins., 24 AWG wire
1RB-T-A2	1.981	1.981	0.610	Type K, Glass Ins., 24 AWG wire
1RB-T-A4	1.981	1.981	1.219	Type K, Glass Ins., 24 AWG wire
1RB-T-A6	1.981	1.981	1.829	Type K, Glass Ins., 24 AWG wire
1RB-T-A8	1.981	1.981	2.438	Type K, Glass Ins., 24 AWG wire
1RB-T-A9	1.981	1.981	2.718	Type K, Glass Ins., 24 AWG wire
1RB-T-B0	1.981	3.505	0.152	Type K, Glass Ins., 24 AWG wire
1RB-T-B2	1.981	3.505	0.610	Type K, Glass Ins., 24 AWG wire
1RB-T-B4	1.981	3.505	1.219	Type K, Glass Ins., 24 AWG wire
1RB-T-B6	1.981	3.505	1.829	Type K, Glass Ins., 24 AWG wire
1RB-T-B8	1.981	3.505	2.438	Type K, Glass Ins., 24 AWG wire
1RB-T-B9	1.981	3.505	2.718	Type K, Glass Ins., 24 AWG wire
1WG-T-A0	4.572	1.829	0.152	Type K, Glass Ins., 24 AWG wire
1WG-T-A2	4.572	1.829	0.610	Type K, Glass Ins., 24 AWG wire
1WG-T-A4	4.572	1.829	1.219	Type K, Glass Ins., 24 AWG wire
1WG-T-A6	4.572	1.829	1.829	Type K, Glass Ins., 24 AWG wire
1WG-T-A8	4.572	1.829	2.286	Type K, Glass Ins., 24 AWG wire
1WG-T-B0	4.572	3.810	0.152	Type K, Glass Ins., 24 AWG wire
1WG-T-B2	4.572	3.810	0.610	Type K, Glass Ins., 24 AWG wire
1WG-T-B4	4.572	3.810	1.219	Type K, Glass Ins., 24 AWG wire
1WG-T-B6	4.572	3.810	1.829	Type K, Glass Ins., 24 AWG wire
1WG-T-B8	4.572	3.810	2.286	Type K, Glass Ins., 24 AWG wire
1RH-T-A0	0.762	1.067	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-A2	0.762	1.067	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-A4	0.762	1.067	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-A6	0.762	1.067	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-A8	0.762	1.067	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-A9	0.762	1.067	2.718	Type K, Glass Ins., 24 AWG wire
1RH-T-B0	4.115	10.363	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-B2	4.115	10.363	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-B4	4.115	10.363	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-B6	4.115	10.363	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-B8	4.115	10.363	2.438	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1RH-T-B9	4.115	10.363	2.718	Type K, Glass Ins., 24 AWG wire
1RH-T-C0	8.230	10.363	0.152	Type K, Glass Ins., 24 AWG wire
1RH-T-C2	8.230	10.363	0.610	Type K, Glass Ins., 24 AWG wire
1RH-T-C4	8.230	10.363	1.219	Type K, Glass Ins., 24 AWG wire
1RH-T-C6	8.230	10.363	1.829	Type K, Glass Ins., 24 AWG wire
1RH-T-C8	8.230	10.363	2.438	Type K, Glass Ins., 24 AWG wire
1RH-T-C9	8.230	10.363	2.718	Type K, Glass Ins., 24 AWG wire
1WB-D-A1	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-A2	0.000	2.438	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-B1	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-B2	0.000	4.724	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-C1	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
1WB-D-C2	0.000	7.620	1.524	Type K, Glass Ins., 24 AWG wire
1WD-D-A1	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
1WD-D-A2	0.000	2.946	1.524	Type K, Glass Ins., 24 AWG wire
1CL-D-A1	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CL-D-A2	1.372	2.972	2.711	Type K, Glass Ins., 24 AWG wire
1CB-D-A1	2.438	2.743	2.711	Type K, Glass Ins., 24 AWG wire
1CB-D-A2	2.438	2.743	2.711	Type K, Glass Ins., 24 AWG wire
1WC-D-A1	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
1WC-D-A2	2.950	9.144	0.914	Type K, Glass Ins., 24 AWG wire
1WC-D-B1	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
1WC-D-B2	2.950	9.144	2.184	Type K, Glass Ins., 24 AWG wire
1WA-T-A0	0.762	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-A2	0.762	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-A4	0.762	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-A6	0.762	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-A8	0.762	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-A9	0.762	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WA-T-B0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-B2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-B4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-B6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-B8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-B9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WA-T-C0	1.829	0.000	0.152	Type K, Glass Ins., 24 AWG wire
1WA-T-C2	1.829	0.000	0.610	Type K, Glass Ins., 24 AWG wire
1WA-T-C4	1.829	0.000	1.219	Type K, Glass Ins., 24 AWG wire
1WA-T-C6	1.829	0.000	1.829	Type K, Glass Ins., 24 AWG wire
1WA-T-C8	1.829	0.000	2.438	Type K, Glass Ins., 24 AWG wire
1WA-T-C9	1.829	0.000	2.743	Type K, Glass Ins., 24 AWG wire
1WB-E-A035	0.035	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A012	0.012	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A058	0.058	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A023	0.023	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A105	0.105	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A047	0.047	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-A070	0.070	2.286	1.524	Type K, Glass Ins., 30 AWG wire
1WB-S-B1	0.000	4.572	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-B035	0.035	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B058	0.058	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B023	0.023	4.572	1.524	Type K, Glass Ins., 30 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WB-E-B105	0.105	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B047	0.047	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-B070	0.070	4.572	1.524	Type K, Glass Ins., 30 AWG wire
1WB-S-C1	0.000	6.858	1.524	Type K, Glass Ins., 24 AWG wire
1WB-E-C035	0.035	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C012	0.012	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C058	0.058	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C023	0.023	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C105	0.105	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C047	0.047	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-E-C070	0.070	6.858	1.524	Type K, Glass Ins., 30 AWG wire
1WB-J-A1	0.102	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-A2	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-B1	0.102	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-B2	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-C1	0.102	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-C2	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-D1	0.102	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-D2	0.000	4.572	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-E1	0.102	5.715	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F1	0.102	6.858	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-F2	0.000	6.858	2.921	Type K, Glass Ins., 24 AWG wire
1WB-J-G1	0.102	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WB-J-G2	0.000	8.001	2.921	Type K, Glass Ins., 24 AWG wire
2WB-J-A1	0.088	1.143	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-B1	0.088	2.286	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-C1	0.088	3.429	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-D1	0.088	4.572	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-E1	0.088	5.715	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-F1	0.088	6.858	2.743	Type K, Glass Ins., 24 AWG wire
2WB-J-G1	0.088	8.001	2.743	Type K, Glass Ins., 24 AWG wire
1WD-S-A3	0.000	2.794	1.524	Type K, Glass Ins., 24 AWG wire
1WD-E-A105	0.105	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A012	0.012	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A070	0.070	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1CL-E-C105	2.286	2.972	0.105	Type K, Glass Ins., 30 AWG wire
1CL-E-C012	2.286	2.972	0.012	Type K, Glass Ins., 30 AWG wire
1CL-E-C070	2.286	2.972	0.070	Type K, Glass Ins., 30 AWG wire
1CL-E-C023	2.286	2.972	0.023	Type K, Glass Ins., 30 AWG wire
1CL-E-C058	2.286	2.972	0.058	Type K, Glass Ins., 30 AWG wire
1CL-E-C035	2.286	2.972	0.035	Type K, Glass Ins., 30 AWG wire
1CL-E-C047	2.286	2.972	0.047	Type K, Glass Ins., 30 AWG wire
1WD-E-A023	0.023	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A058	0.058	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A035	0.035	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-E-A047	0.047	2.794	1.524	Type K, Glass Ins., 30 AWG wire
1WD-J-A1	0.076	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A2	0.000	1.143	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-A3	0.000	1.143	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-B1	0.076	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B2	0.000	2.286	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-B3	0.000	2.286	2.921	Type K, Glass Ins., 24 AWG wire

Description	Location X (m)	Location Y (m)	Location Z (m)	Thermocouple type
1WD-J-C1	0.076	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C2	0.000	3.429	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-C3	0.000	3.429	2.921	Type K, Glass Ins., 24 AWG wire
1WD-J-D1	0.076	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WD-J-D2	0.000	4.572	2.743	Type K, Glass Ins., 24 AWG wire
1WG-D-A1	4.502	3.048	1.524	Type K, Glass Ins., 24 AWG wire
1WG-D-A2	4.502	3.048	1.524	Type K, Glass Ins., 24 AWG wire
Sprinkler	1.655	7.620	2.230	Type K, Glass Ins., 24 AWG wire
1CL-S-D1	1.524	3.962	2.743	Type K, Glass Ins., 24 AWG wire
1WB-S-A1	0.000	2.286	1.524	Type K, Glass Ins., 24 AWG wire

The following table provides a summary of the temperature results. The “Initial” column provides the measured temperature at the beginning of the test. The maximum temperature recorded during the test is provided in the “Max” column. The remaining columns provide the calculated maximum average temperatures.

Table 5. Temperature Value Result Summary

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WD-J-D3	21.9	22.0	21.9	21.9	21.9	21.9
2WD-J-A1	24.6	27.1	26.9	26.8	26.4	26.1
2WD-J-B1	23.3	23.3	23.3	23.3	23.2	23.2
2WD-J-C1	23.6	23.6	23.6	23.6	23.6	23.6
2WD-J-D1	23.8	43.6	40.7	39.6	36.2	34.0
1CL-S-A1	21.4	585.6	572.7	568.7	555.0	546.2
1CL-S-B1	21.9	568.2	561.6	556.8	544.3	525.8
1CL-S-C1	21.9	588.3	584.3	580.6	561.0	542.7
1CL-S-E1	22.3	679.4	669.4	652.6	619.3	610.0
1CB-S-A1	21.7	600.1	544.3	502.0	353.3	277.6
1CB-S-B1	21.8	610.4	558.2	513.0	354.4	277.1
1CB-S-C1	21.5	663.2	621.1	580.4	443.2	357.4
1CB-S-D1	21.9	708.9	679.7	648.2	521.6	428.7
1CB-S-E1	21.9	573.5	521.1	472.0	350.1	287.0
1RL-T-A0	21.7	305.4	301.8	300.8	291.0	237.0
1RL-T-A2	21.9	426.2	418.3	415.1	399.1	346.9
1RL-T-A4	21.7	517.3	513.0	510.2	498.1	470.3
1RL-T-A6	21.9	576.7	562.9	559.4	543.4	527.8
1RL-T-A8	21.8	668.8	632.3	623.8	585.3	580.7
1RL-T-A9	21.3	542.4	539.3	536.2	517.9	502.0
1RL-T-B0	21.3	304.9	294.0	293.0	275.3	218.2
1RL-T-B2	22.2	429.1	424.4	424.2	414.0	363.2
1RL-T-B4	21.6	547.9	521.6	520.5	504.4	474.3
1RL-T-B6	21.9	616.1	601.4	599.0	572.5	548.0
1RL-T-B8	21.9	767.6	736.1	721.6	657.6	641.8
1RL-T-B9	21.4	621.2	617.5	613.9	589.6	572.1
1RK-T-A0	19.9	557.9	551.2	534.0	471.4	377.2
1RK-T-A2	21.2	630.2	594.5	568.3	479.8	396.5
1RK-T-A4	21.4	922.3	845.2	787.0	740.4	623.6
1RK-T-A6	21.6	957.6	864.3	825.9	736.9	686.2
1RK-T-A8	21.9	887.6	873.0	859.5	823.1	751.4

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1RB-T-A0	21.7	130.4	114.3	99.8	77.7	69.4
1RB-T-A2	21.6	155.4	137.2	135.7	128.4	105.8
1RB-T-A4	22.0	521.5	375.4	320.7	217.4	194.0
1RB-T-A6	21.7	686.9	599.5	541.5	370.0	299.5
1RB-T-A8	21.8	758.9	707.9	665.8	466.7	373.6
1RB-T-A9	21.6	696.0	646.0	607.0	444.8	359.0
1RB-T-B0	20.9	113.8	103.1	91.6	72.5	66.2
1RB-T-B2	21.0	166.0	136.8	127.2	120.0	99.7
1RB-T-B4	21.3	433.3	345.6	302.3	211.1	193.5
1RB-T-B6	22.2	623.8	547.4	490.0	349.4	287.0
1RB-T-B8	22.0	767.7	699.6	642.8	471.1	386.3
1RB-T-B9	21.8	708.6	652.9	605.1	457.7	379.0
1WG-T-A0	22.7	72.5	67.4	63.5	48.7	43.3
1WG-T-A2	21.6	188.8	187.9	186.7	180.9	159.6
1WG-T-A4	22.3	123.4	122.6	121.7	116.2	110.2
1WG-T-A6	22.1	151.7	151.1	150.2	139.9	130.9
1WG-T-A8	22.8	142.5	141.9	141.5	134.3	124.6
1WG-T-B0	21.1	89.9	88.1	87.6	84.7	76.4
1WG-T-B2	21.6	26.9	25.8	25.0	22.7	22.1
1WG-T-B4	21.9	111.7	110.7	109.9	105.4	100.6
1WG-T-B6	21.5	149.0	145.8	143.3	135.8	125.3
1WG-T-B8	21.2	259.6	254.9	249.9	215.7	180.9
1RH-T-A0	22.0	33.0	31.6	30.9	29.3	28.7
1RH-T-A2	22.3	36.6	34.5	34.1	31.9	31.3
1RH-T-A4	22.5	56.4	46.9	44.7	40.2	38.1
1RH-T-A6	22.7	310.5	286.1	278.9	235.7	207.9
1RH-T-A8	23.0	568.1	517.6	480.9	401.0	346.1
1RH-T-A9	22.7	522.5	483.5	452.5	383.8	334.7
1RH-T-B0	22.6	114.9	109.7	105.7	87.1	75.0
1RH-T-B2	22.7	195.0	184.3	174.9	145.7	117.5
1RH-T-B4	22.7	387.8	340.9	318.6	270.5	232.0
1RH-T-B6	23.0	805.5	756.0	701.5	529.8	431.1
1RH-T-B8	23.3	846.9	833.4	828.0	739.5	623.1
1RH-T-B9	23.3	864.5	840.5	832.6	766.5	660.2
1RH-T-C0	22.0	184.0	177.4	171.2	138.4	112.1
1RH-T-C2	23.1	198.6	191.9	185.6	155.0	124.6
1RH-T-C4	24.0	559.3	546.6	526.7	429.7	359.7
1RH-T-C6	24.0	633.3	624.8	614.7	568.2	480.5
1RH-T-C8	23.3	673.5	659.6	650.7	611.8	529.8
1RH-T-C9	23.1	645.7	626.1	621.1	579.3	501.8
1WB-D-A1	21.2	509.2	509.0	508.4	495.3	465.2
1WB-D-A2	21.0	439.8	439.1	437.7	417.6	381.6
1WB-D-B1	20.9	576.4	575.5	574.4	559.2	527.4
1WB-D-B2	20.9	512.3	512.0	511.3	492.1	437.3
1WB-D-C1	21.0	946.0	939.9	930.5	812.1	787.5
1WB-D-C2	21.0	802.8	800.6	796.0	727.2	689.8
1WD-D-A1	21.6	368.9	356.2	341.7	268.3	215.9
1WD-D-A2	22.3	253.6	247.7	237.8	190.9	155.8
1CL-D-A1	21.0	591.1	590.3	588.6	576.8	559.5
1CL-D-A2	21.0	555.5	555.2	554.5	547.3	526.0

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1CB-D-A1	21.3	562.2	538.8	512.0	411.0	332.3
1CB-D-A2	27.4	389.7	380.4	367.9	311.2	254.5
1WC-D-A1	21.9	718.4	712.8	705.8	654.6	527.6
1WC-D-A2	21.6	605.4	600.0	590.8	498.8	360.1
1WC-D-B1	21.6	824.7	821.7	817.9	781.1	686.3
1WC-D-B2	21.6	710.8	708.6	703.4	667.2	586.1
1WA-T-A0	21.9	30.5	29.2	28.3	27.0	26.7
1WA-T-A2	22.9	30.5	29.9	29.7	28.3	27.8
1WA-T-A4	23.3	41.3	37.8	37.5	33.8	32.8
1WA-T-A6	23.1	110.2	90.0	87.0	75.5	71.4
1WA-T-A8	23.3	451.1	425.2	402.0	342.3	297.3
1WA-T-A9	23.3	524.4	479.4	448.9	381.0	331.2
1WA-T-B0	23.2	85.4	64.0	58.8	40.4	34.7
1WA-T-B2	23.3	49.3	46.6	45.1	41.2	36.7
1WA-T-B4	22.9	74.8	60.3	59.6	57.4	52.2
1WA-T-B6	23.0	86.8	64.6	62.7	60.6	57.1
1WA-T-B8	23.5	203.0	197.2	193.7	165.3	128.3
1WA-T-B9	23.0	184.0	175.6	169.9	142.1	111.5
1WA-T-C0	23.8	35.5	32.9	31.2	28.3	27.3
1WA-T-C2	24.8	40.4	37.9	36.2	31.9	30.7
1WA-T-C4	24.4	40.2	38.2	37.7	34.4	32.7
1WA-T-C6	24.4	50.9	45.7	43.0	36.5	33.4
1WA-T-C8	24.0	137.6	103.7	94.5	64.0	53.2
1WA-T-C9	23.4	117.2	96.7	84.4	63.1	52.6
1WB-E-A035	21.5	38.7	38.2	37.7	33.8	30.0
1WB-E-A012	21.3	121.8	121.7	121.6	119.3	115.2
1WB-E-A058	21.8	22.7	22.6	22.6	22.3	22.1
1WB-E-A023	21.3	77.9	77.6	77.3	73.4	64.7
1WB-E-A105	21.6	21.7	21.7	21.7	21.7	21.6
1WB-E-A047	21.3	28.9	28.5	28.3	26.6	24.8
1WB-E-A070	21.3	21.7	21.7	21.6	21.5	21.5
1WB-S-B1	21.4	569.4	559.3	555.1	535.5	506.0
1WB-E-B035	21.2	59.5	59.0	58.6	53.2	44.7
1WB-E-B058	21.3	23.4	23.3	23.2	22.5	22.0
1WB-E-B023	21.2	95.8	95.7	95.7	94.1	89.0
1WB-E-B105	21.5	21.7	21.6	21.6	21.6	21.6
1WB-E-B047	21.7	31.6	31.2	30.8	28.3	26.0
1WB-E-B070	21.5	21.9	21.9	21.9	21.7	21.7
1WB-S-C1	21.8	95.6	95.4	95.1	92.4	87.9
1WB-E-C035	21.0	21.4	21.3	21.3	21.2	21.1
1WB-E-C012	21.3	46.9	46.6	46.3	42.0	34.3
1WB-E-C058	21.0	21.3	21.3	21.3	21.3	21.2
1WB-E-C023	21.3	27.6	27.3	27.0	24.8	23.2
1WB-E-C105	21.3	21.4	21.3	21.3	21.3	21.3
1WB-E-C047	21.3	21.4	21.4	21.4	21.3	21.3
1WB-E-C070	21.3	21.4	21.3	21.3	21.3	21.3
1WB-J-A1	21.8	32.2	31.6	31.5	30.4	28.6
1WB-J-A2	23.3	23.3	23.2	23.2	23.1	23.1
1WB-J-B1	21.7	38.7	38.0	37.6	34.1	31.4
1WB-J-B2	21.0	21.5	21.3	21.3	21.3	21.2

Description	Initial (C)	Max (C)	30 second max average (C)	1 minute max average (C)	5 minute max average (C)	10 minute max average (C)
1WB-J-C1	21.3	80.5	78.0	75.7	64.8	54.9
1WB-J-C2	21.6	22.3	22.3	22.2	22.2	22.1
1WB-J-D1	21.0	474.0	450.7	421.6	378.1	322.9
1WB-J-D2	21.5	21.7	21.7	21.6	21.6	21.6
1WB-J-E1	20.9	797.8	786.0	766.4	686.2	658.6
1WB-J-F1	20.7	20.8	20.6	20.6	20.6	20.5
1WB-J-F2	20.2	20.3	20.2	20.2	20.2	20.2
1WB-J-G1	21.3	27.6	24.2	24.2	22.9	22.3
1WB-J-G2	20.2	20.3	20.2	20.2	20.2	20.2
2WB-J-A1	23.2	23.4	23.2	23.2	23.2	23.2
2WB-J-B1	23.0	23.3	23.1	23.0	23.0	23.0
2WB-J-C1	23.2	23.9	23.7	23.7	23.7	23.6
2WB-J-D1	22.0	22.1	22.1	22.1	22.0	22.0
2WB-J-E1	23.4	23.9	23.9	23.9	23.8	23.7
2WB-J-F1	22.9	23.0	23.0	23.0	23.0	22.9
2WB-J-G1	23.1	23.3	23.3	23.2	23.2	23.2
1WD-S-A3	22.6	508.4	464.6	418.9	291.7	237.8
1WD-E-A105	22.2	22.3	22.3	22.3	22.2	22.2
1WD-E-A012	21.8	96.6	96.5	96.3	90.9	83.9
1WD-E-A070	21.9	22.0	22.0	22.0	21.9	21.9
1CL-E-C105	21.3	21.4	21.4	21.3	21.3	21.3
1CL-E-C012	21.2	130.8	130.7	130.6	128.5	123.1
1CL-E-C070	21.6	21.9	21.9	21.9	21.8	21.7
1CL-E-C023	21.1	80.2	79.9	79.6	75.9	66.8
1CL-E-C058	21.0	24.1	23.9	23.8	22.8	22.1
1CL-E-C035	21.0	58.0	57.5	57.0	52.3	45.1
1CL-E-C047	21.0	26.7	26.4	26.2	24.7	23.4
1WD-E-A023	21.9	55.2	55.1	55.1	52.2	44.9
1WD-E-A058	21.9	22.3	22.3	22.3	22.1	22.0
1WD-E-A035	21.9	30.8	30.5	30.3	28.2	26.2
1WD-E-A047	21.9	24.1	24.0	23.9	23.3	22.8
1WD-J-A1	22.3	23.0	23.0	23.0	22.7	22.6
1WD-J-A2	22.6	23.0	22.8	22.7	22.7	22.7
1WD-J-A3	21.6	21.8	21.8	21.8	21.8	21.7
1WD-J-B1	21.6	24.5	24.4	24.3	23.4	22.8
1WD-J-B2	21.9	21.9	21.9	21.9	21.9	21.8
1WD-J-B3	21.7	21.9	21.9	21.9	21.8	21.8
1WD-J-C1	21.2	23.9	23.7	23.6	22.8	22.3
1WD-J-C2	21.5	21.7	21.7	21.6	21.6	21.6
1WD-J-C3	20.7	20.9	20.8	20.8	20.8	20.8
1WD-J-D1	21.7	22.6	22.6	22.5	22.3	22.1
1WD-J-D2	22.3	22.3	22.3	22.3	22.3	22.3
1WG-D-A1	23.0	554.7	554.3	553.1	534.4	500.7
1WG-D-A2	22.6	480.9	480.5	479.3	452.8	410.7
Sprinkler	23.3	906.3	896.2	888.7	849.6	786.3
1CL-S-D1	21.9	694.3	688.1	673.0	633.8	620.8
1WB-S-A1	22.4	515.6	507.7	503.1	489.0	459.0

The following table shows which thermocouples were taken out of service during the experiment.

Table 6. Out of Service Times

Description	Time out of service time (s)	Time out of service time (hh:mm:ss)	Out of service reason
1WG-T-B2	611	0:10:11	Temperature went Negative
1RB-T-A4	1410	0:23:30	Temperature went Negative
1CB-D-A2	1475	0:24:35	Temperature went Negative

The following charts present a time-dependent representation of the instantaneous temperatures measured during the experiment.

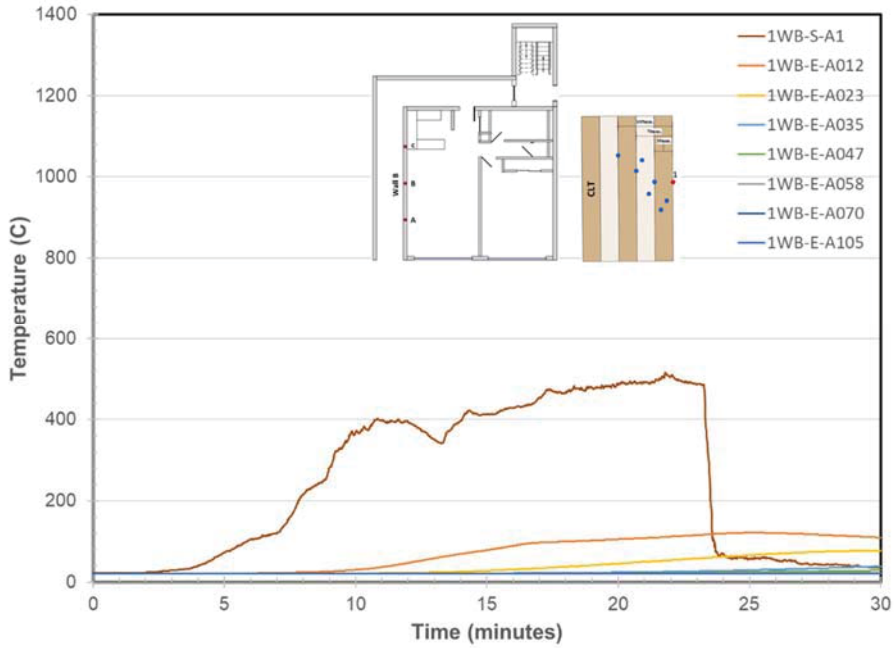

Figure 2. Wall B Embedded & Surface Temperatures at Location A

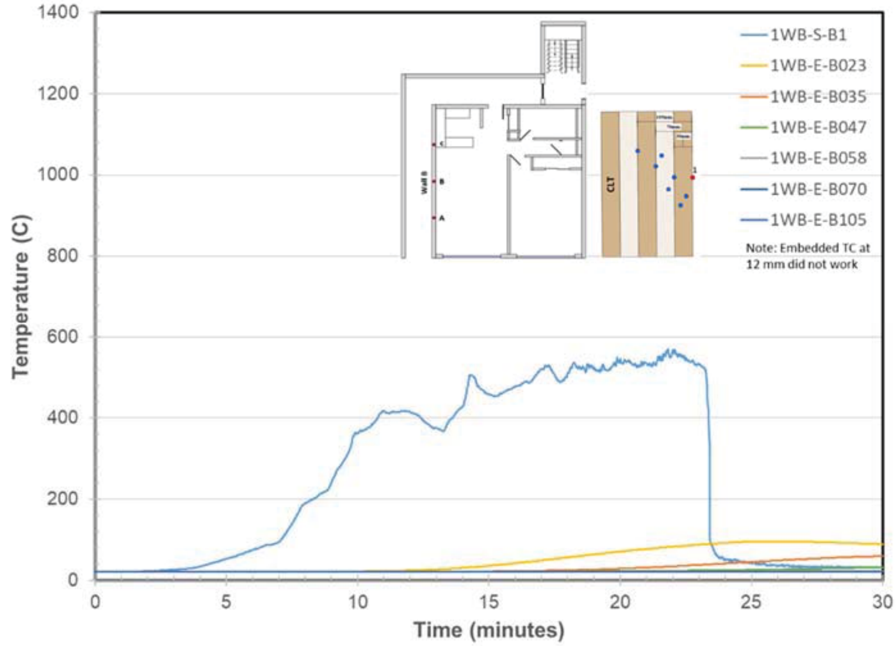

Figure 3. Wall B Embedded & Surface Temperatures at Location B

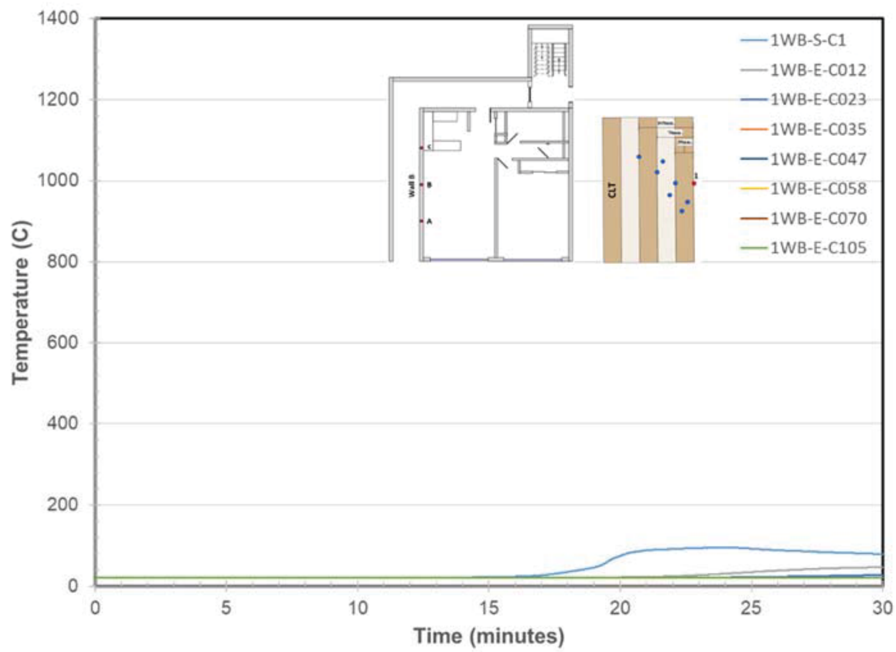

Figure 4. Wall B Embedded & Surface Temperatures at Location C

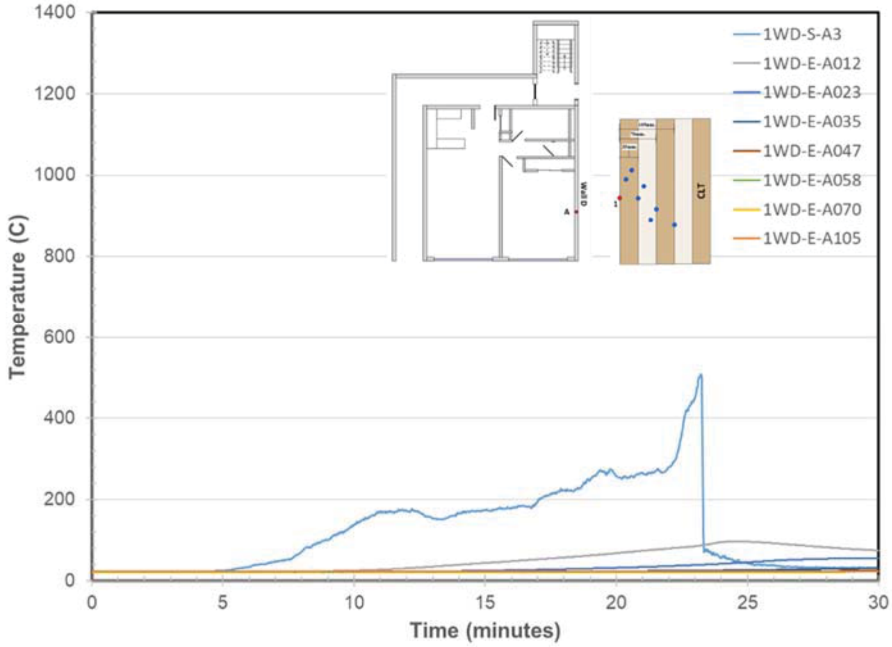

Figure 5. Wall D Embedded & Surface Temperatures at Location A

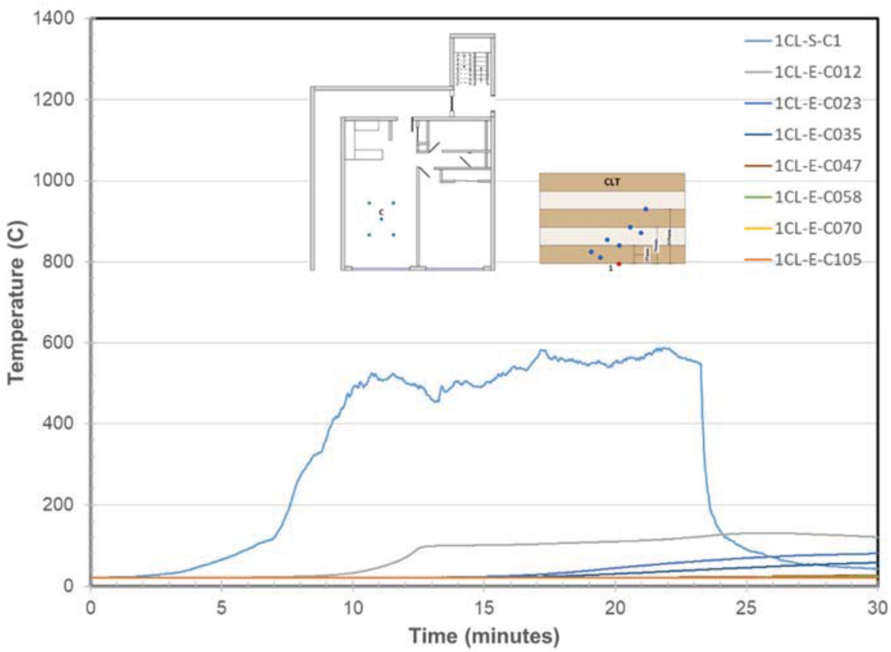

Figure 6. Living Room Ceiling Embedded & Surface Temperatures at Location C

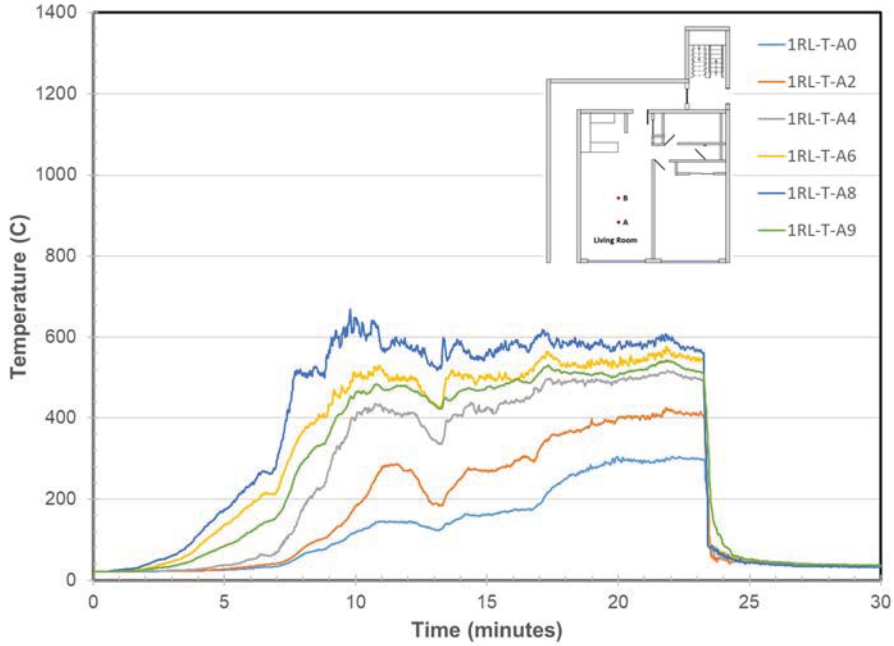

Figure 7. Living Room Temperature at Location A

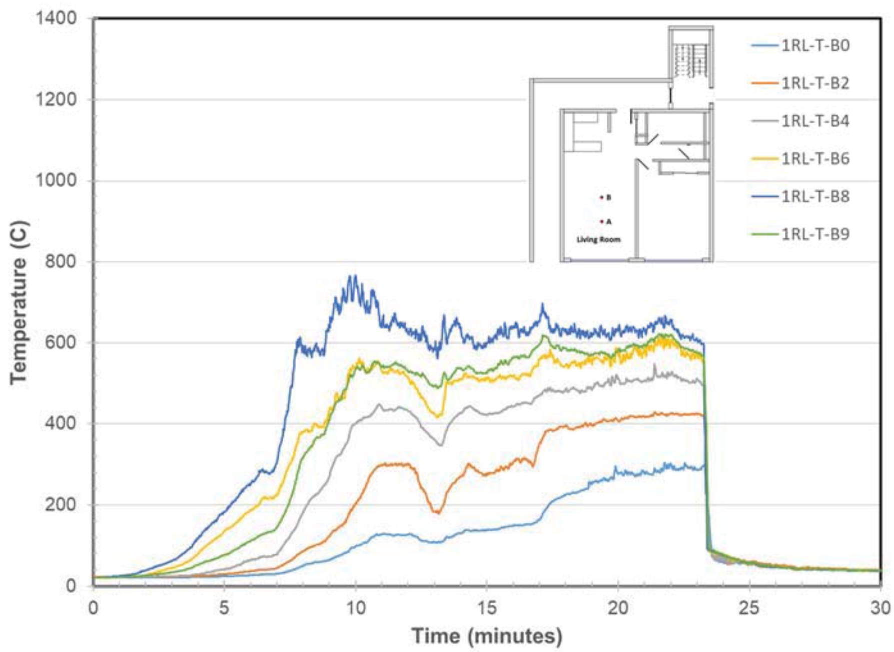

Figure 8. Living Room Temperature at Location B

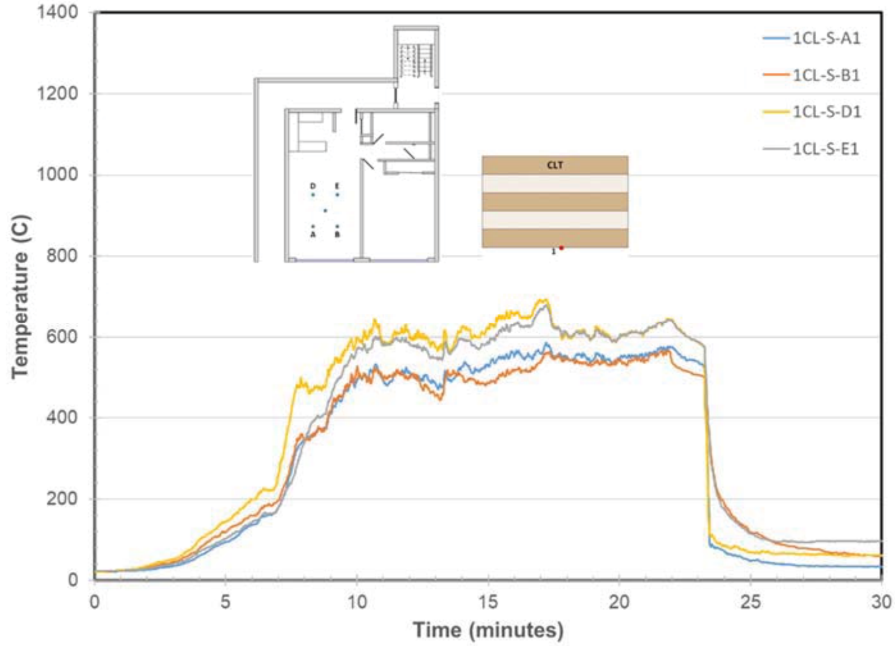

Figure 9. Living Room Ceiling Surface Temperatures at Location A, B, D, & E

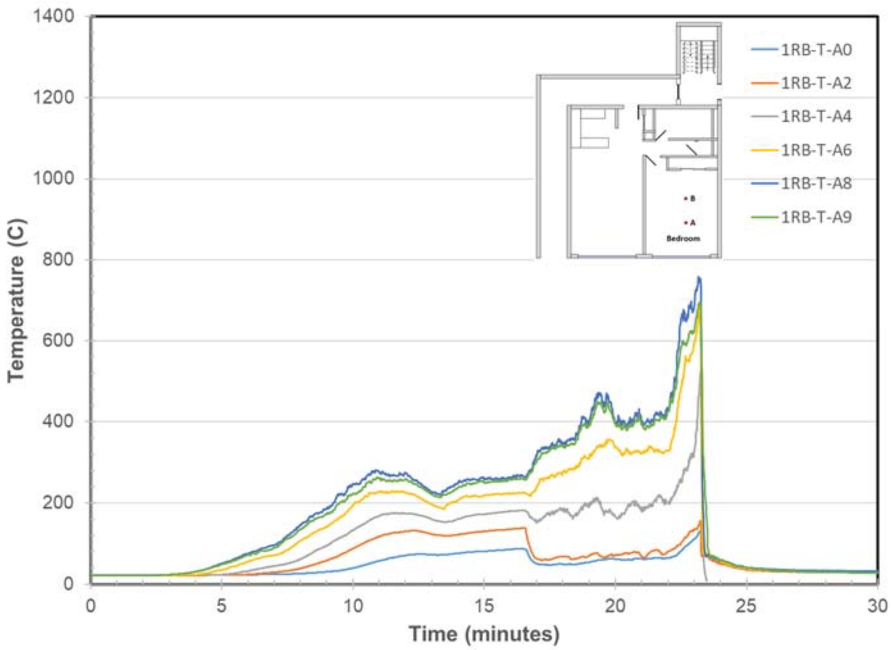

Figure 10. Bedroom Temperature at Location A

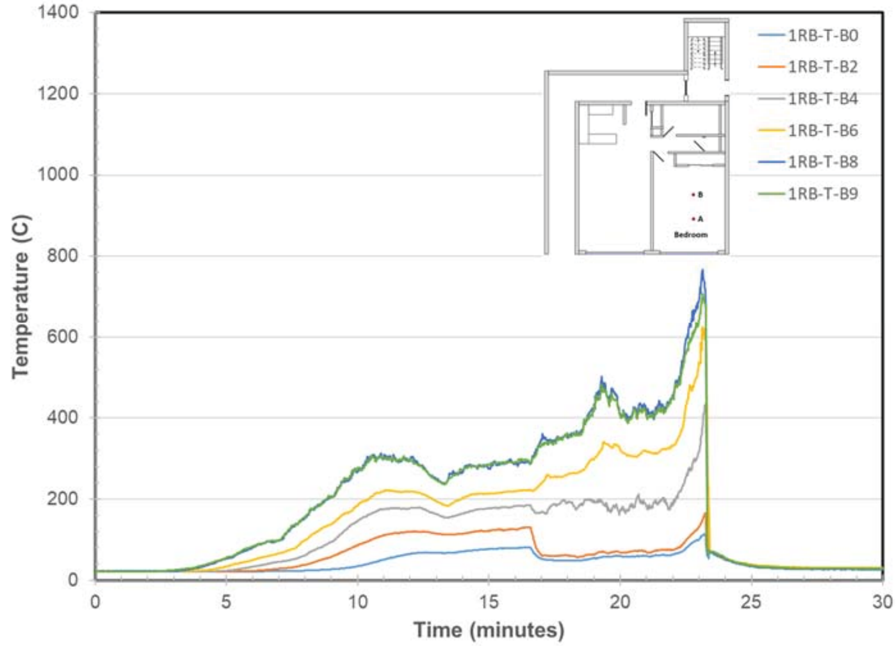

Figure 11. Bedroom Temperature at Location B

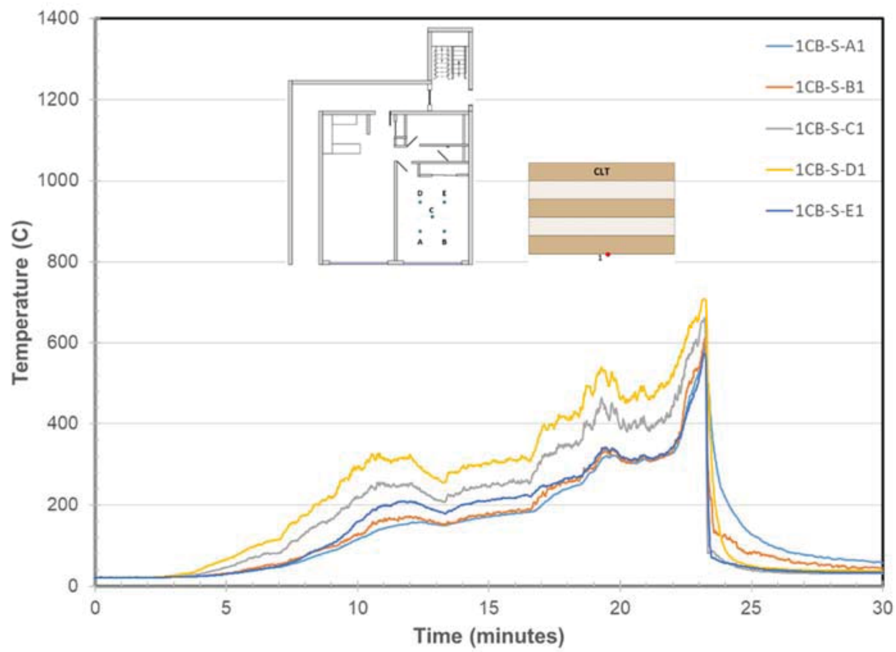

Figure 12. Bedroom Ceiling Surface Temperatures at Locations A through E

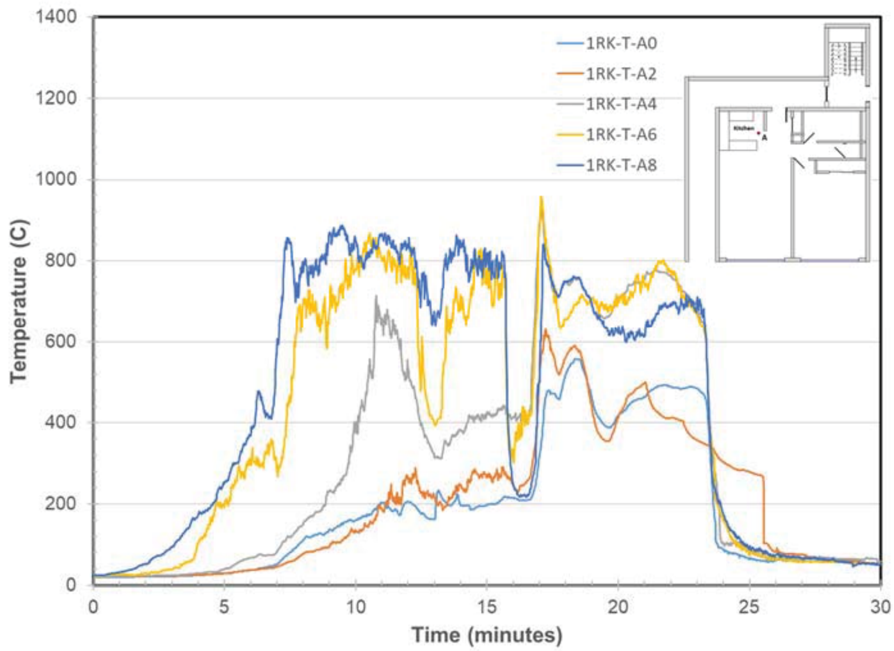

Figure 13. Kitchen Temperatures at Location A

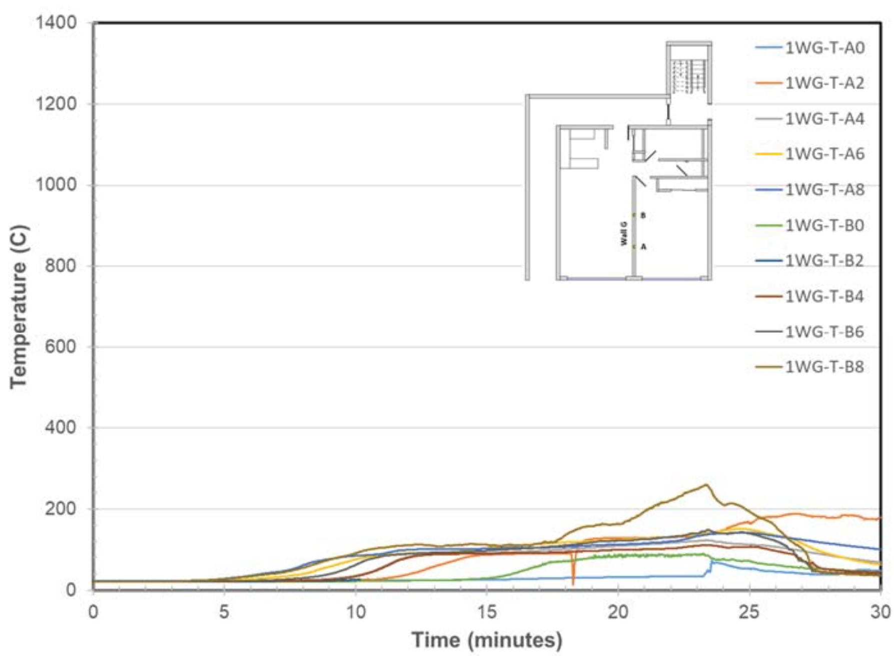

Figure 14. Wall G Temperatures at Locations A & B

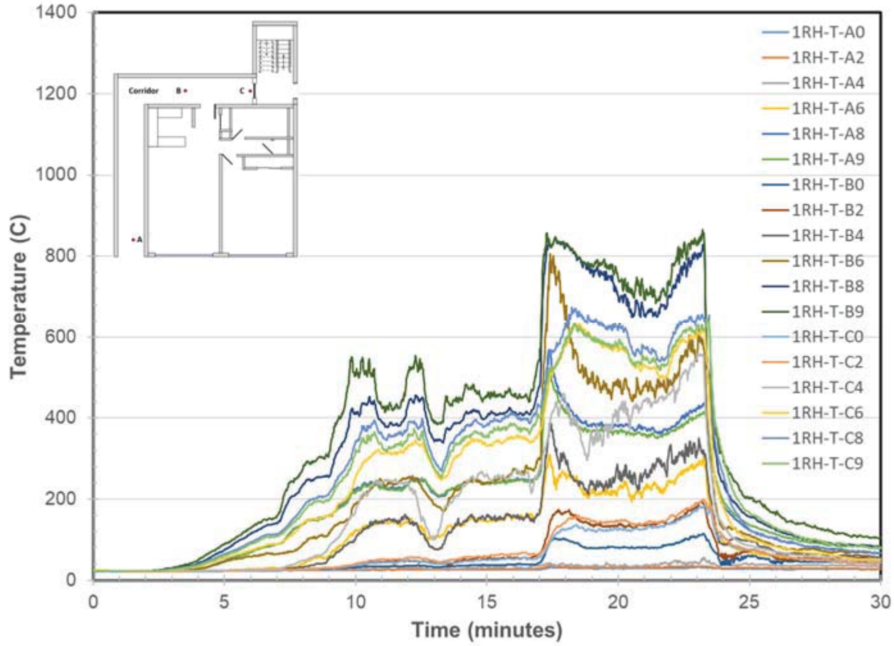

Figure 15. Corridor Temperatures at Locations A, B, & C

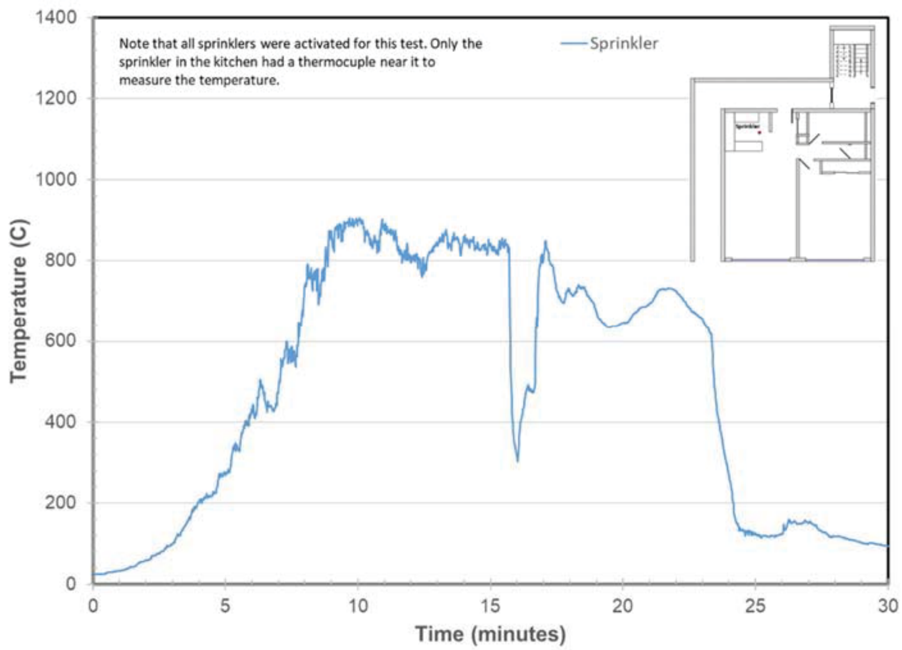

Figure 16. Sprinkler Head Temperature in Kitchen

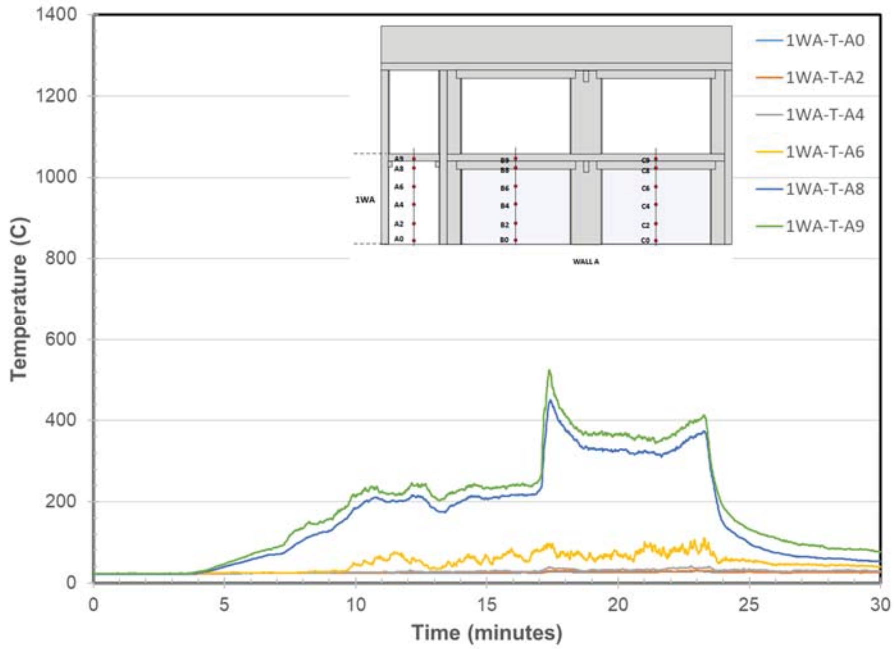

Figure 17. Wall A Temperatures at Location A

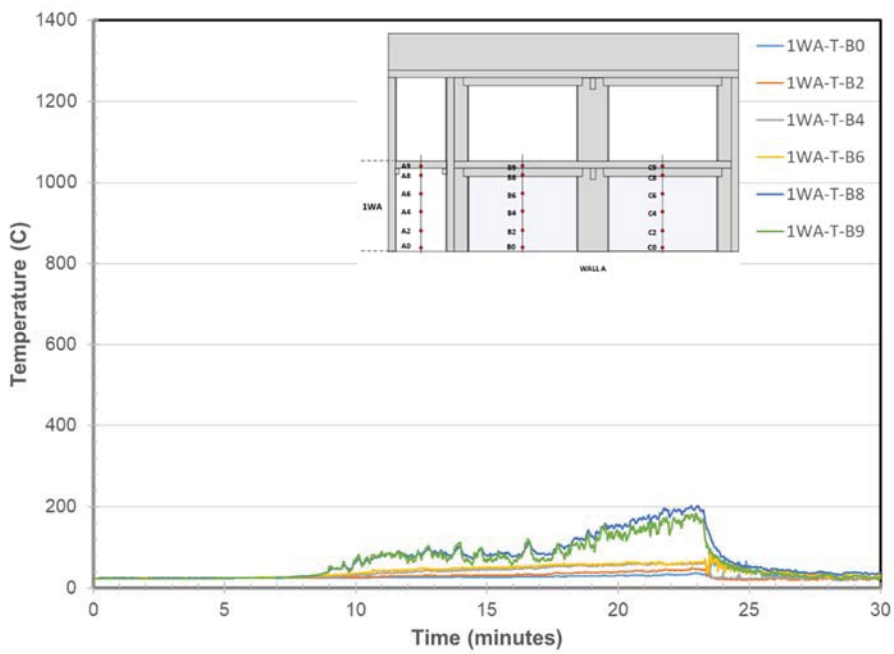

Figure 18. Wall A Temperatures at Locations B

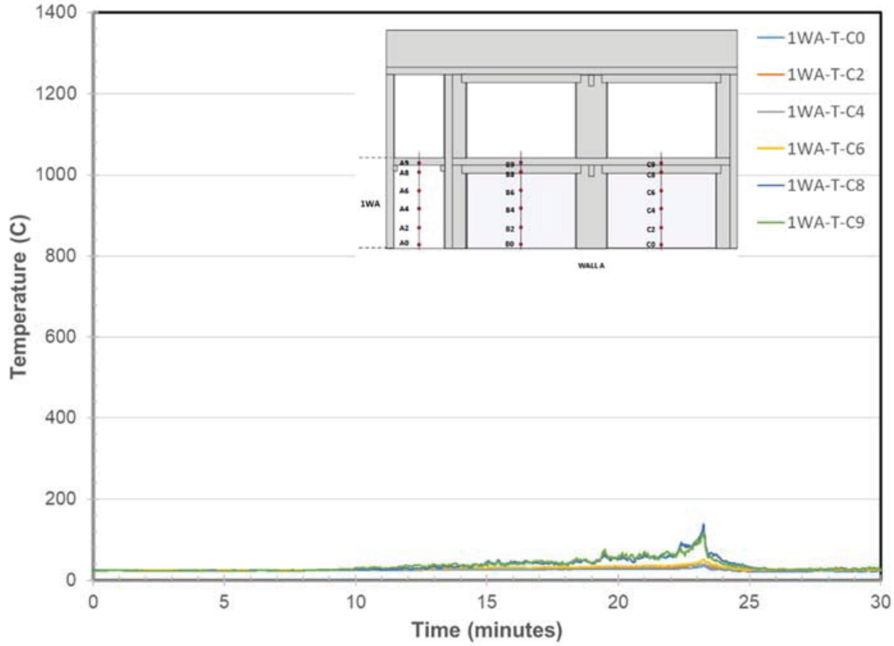

Figure 19. Wall A Temperatures at Locations C

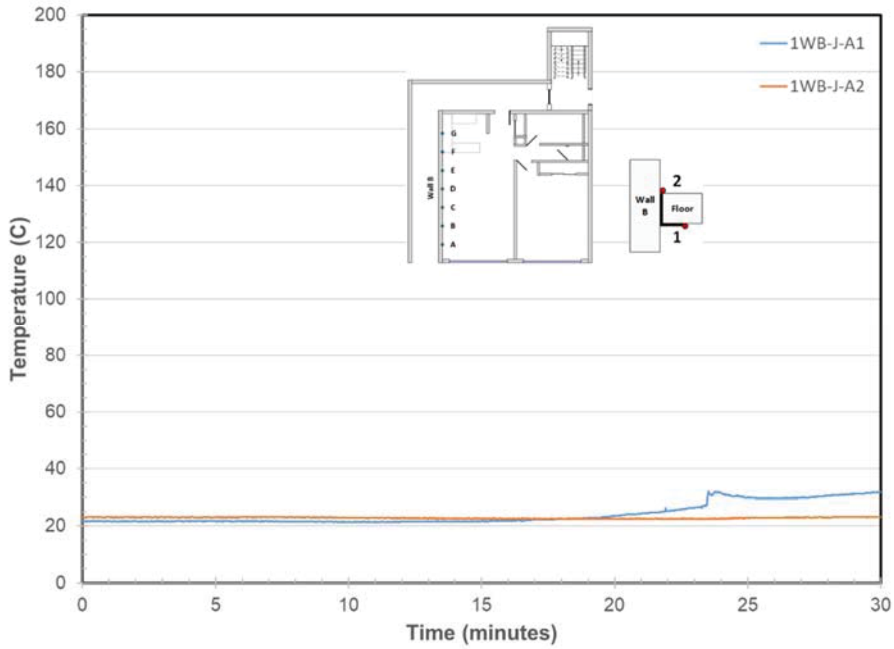

Figure 20. Wall B/Steel Angle Joint Temperatures at Location A

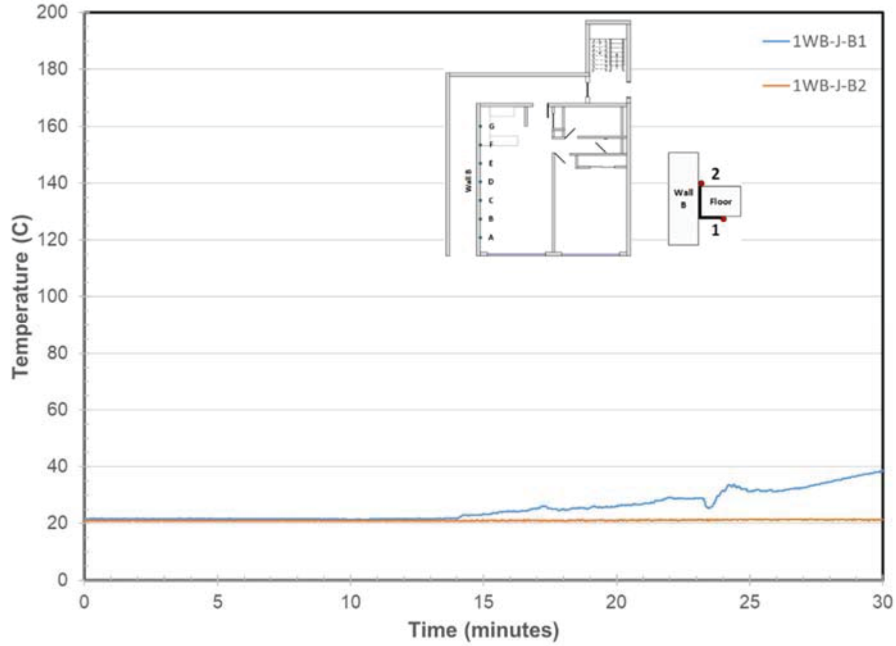

Figure 21. Wall B/Steel Angle Joint Temperatures at Location B

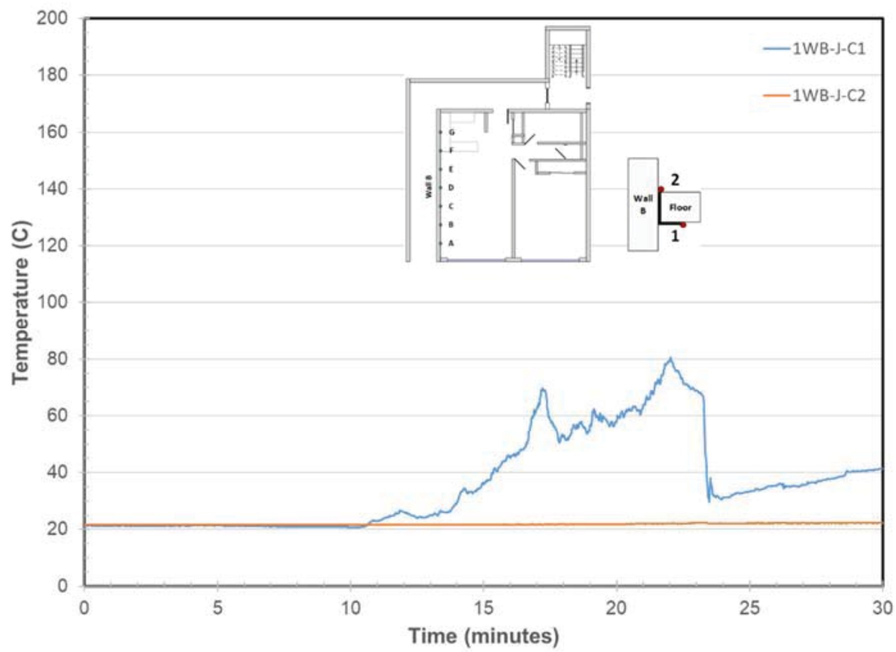

Figure 22. Wall B/Steel Angle Joint Temperatures at Location C

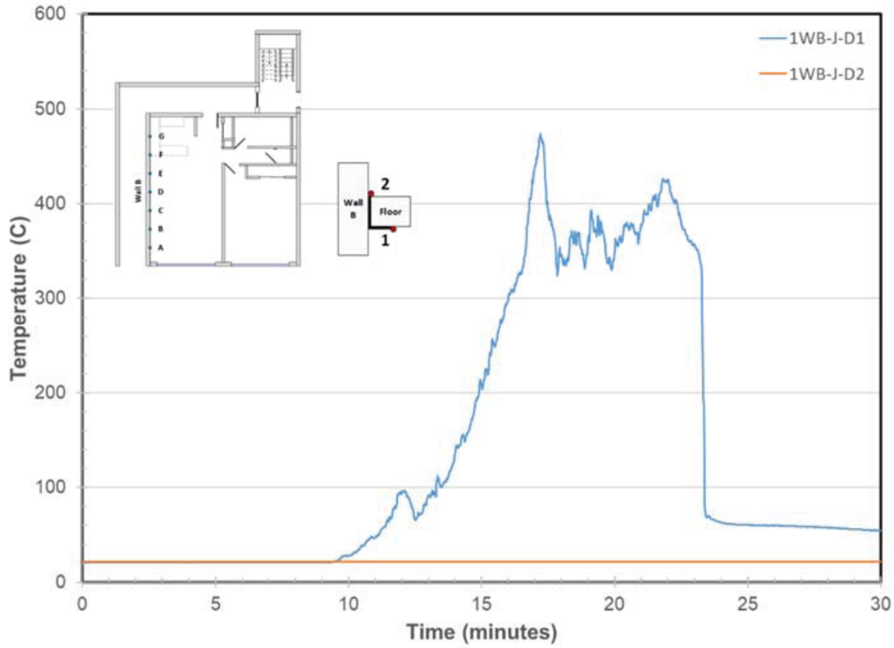

Figure 23. Wall B/Steel Angle Joint Temperatures at Location D

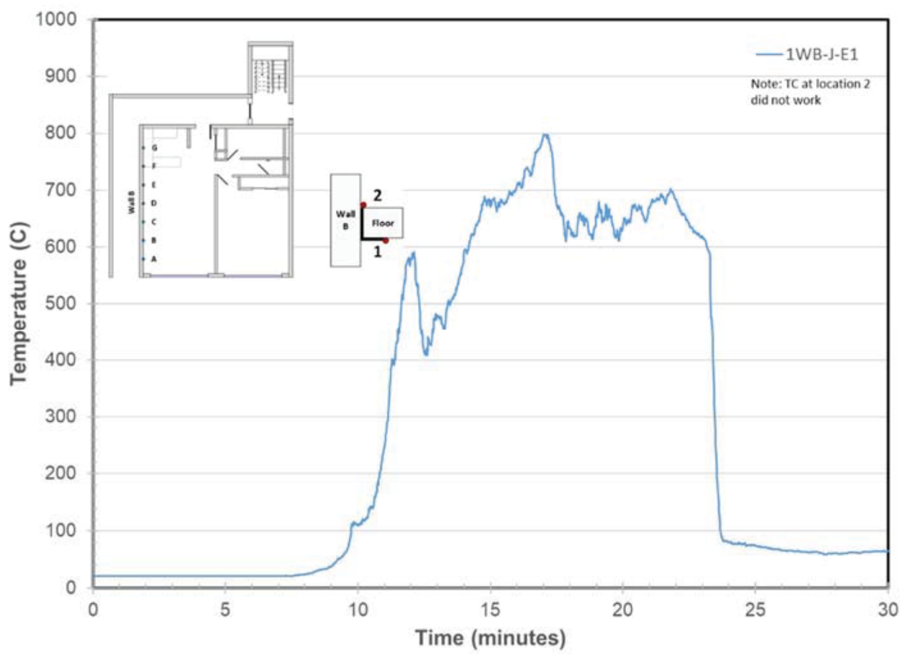

Figure 24. Wall B/Steel Angle Joint Temperatures at Location E

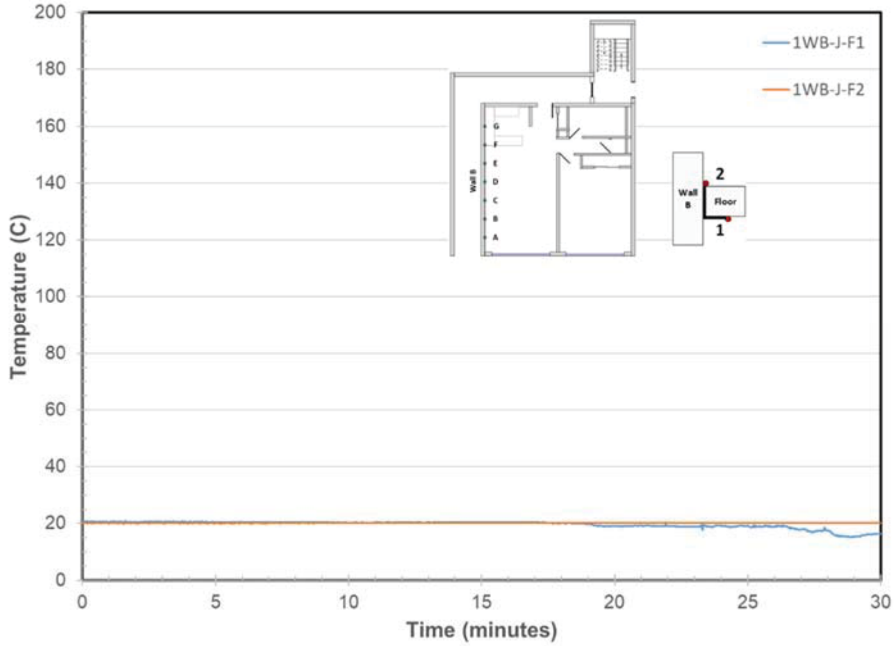

Figure 25. Wall B/Steel Angle Joint Temperatures at Location F

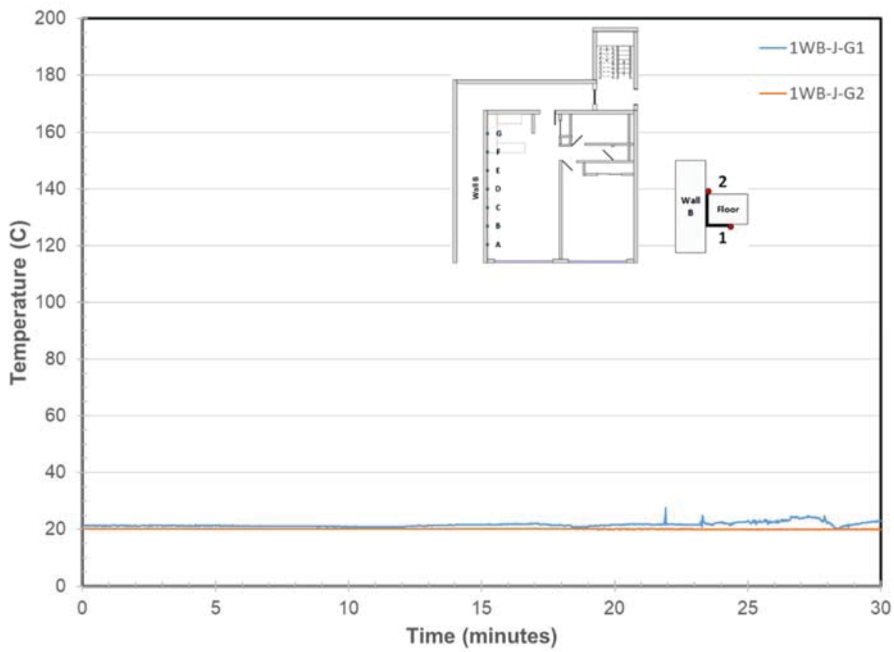

Figure 26. Wall B/Steel Angle Joint Temperatures at Location G

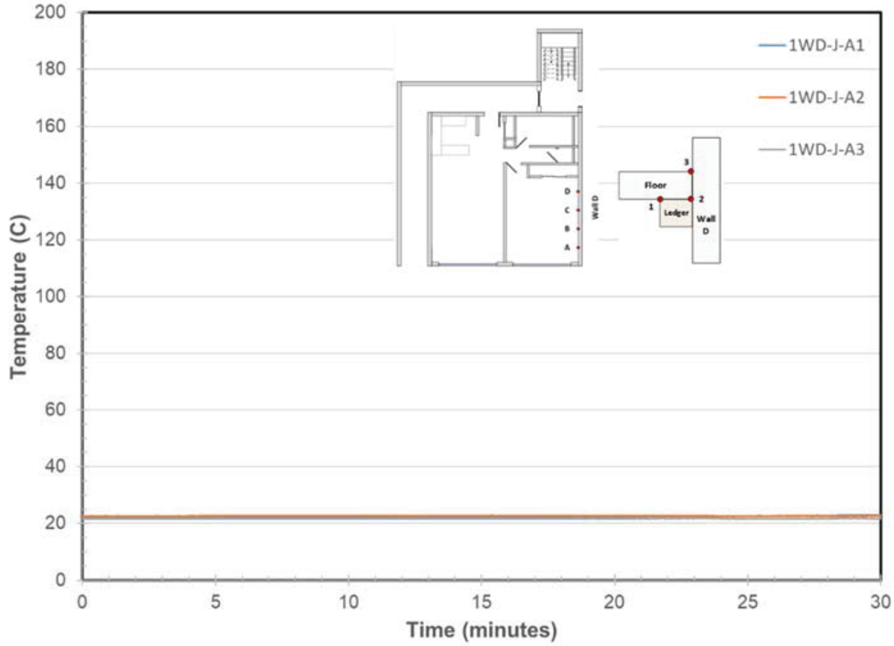

Figure 27. Wall D/Ledger Joint Temperatures at Location A

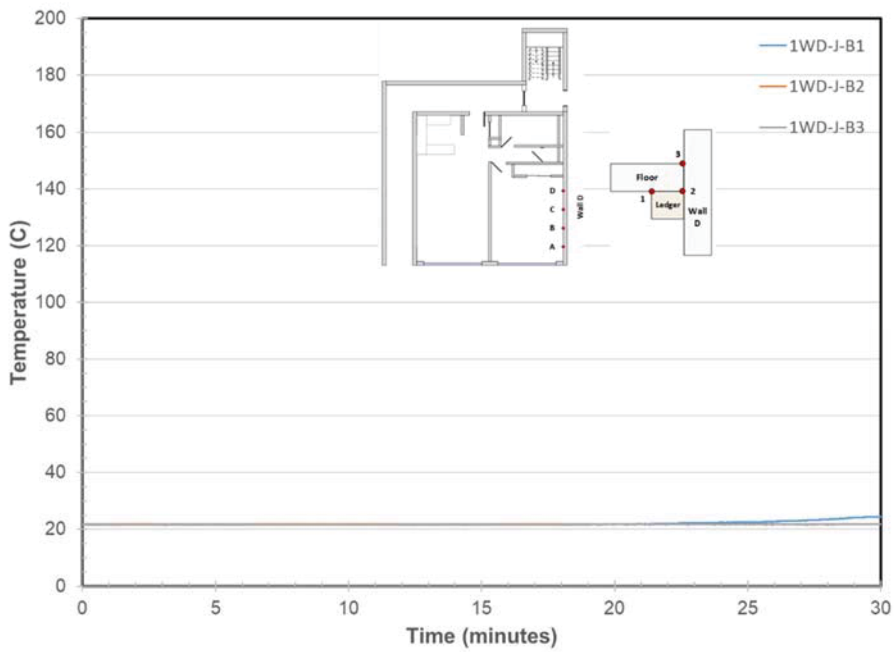

Figure 28. Wall D/Ledger Joint Temperatures at Location B

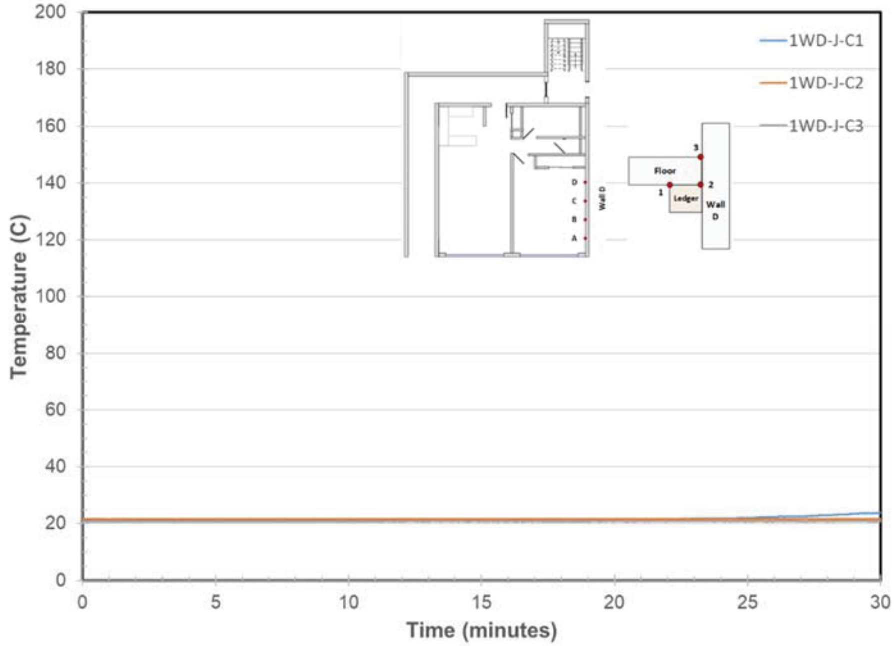

Figure 29. Wall D/Ledger Joint Temperatures at Location C

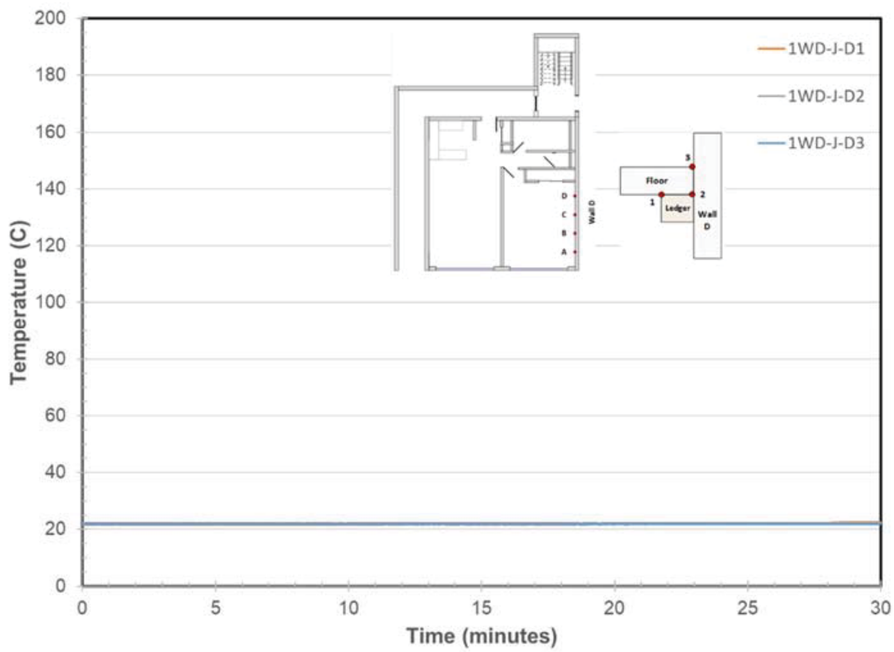

Figure 30. Wall D/Ledger Joint Temperatures at Location D

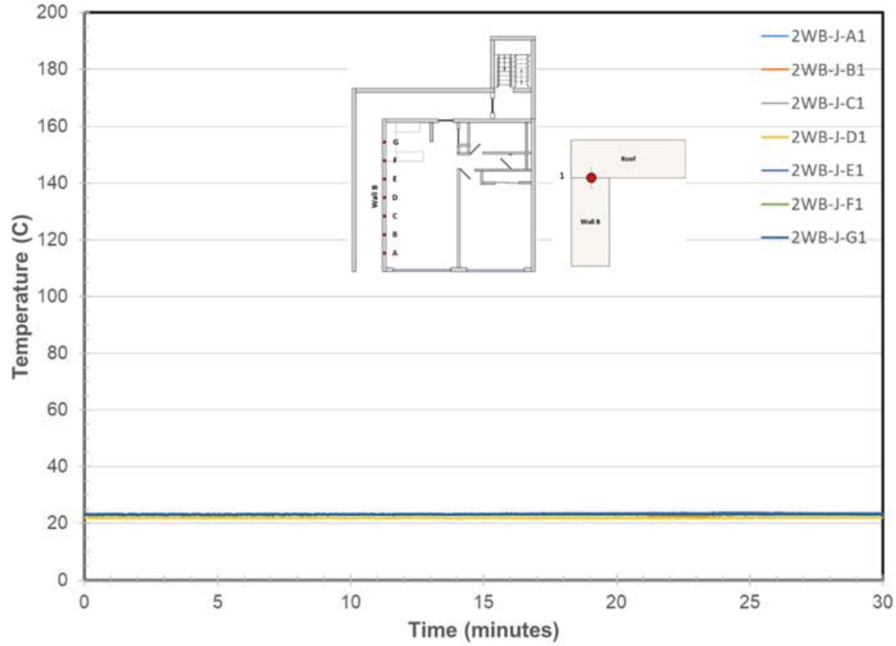

Figure 31. Ceiling/Wall B Joint Temperatures at Locations A-G

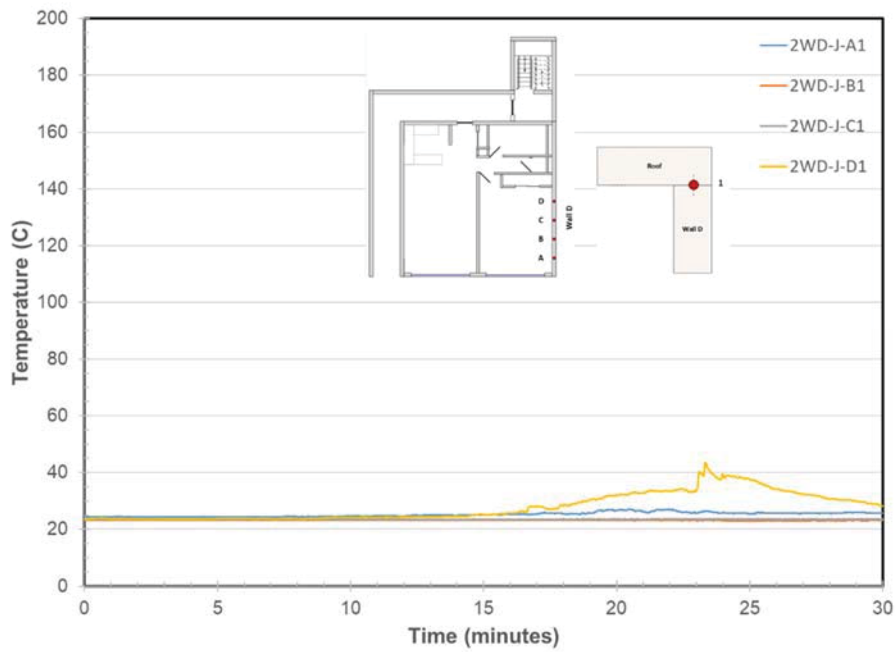

Figure 32. Ceiling/Wall B Joint Temperatures at Locations A-D

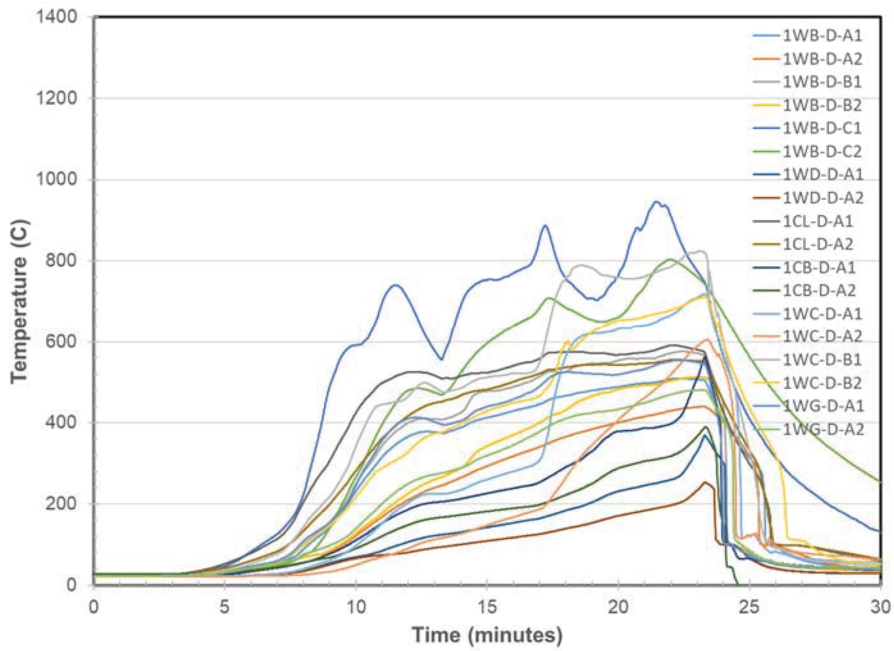

Figure 33. DFT Temperatures at Each Location

Velocity

The following table provides a description of the instrumentation used to collect velocity measurements during the experiments. Velocity is calculated from pressure and temperature measurements.

Table 7. Velocity Measurement Description

Description	Probe Description	Thermocouple Type	Location X (m)	Location Y (m)	Location Z (m)	Orientation
1WA-V-A1	Bidirectional	Type K, Glass Ins., 24 ga wire	0.79	0.00	0.91	horizontal
1WA-V-A2	Bidirectional	Type K, Glass Ins., 24 ga wire	0.79	0.00	1.83	horizontal
1WA-V-B1	Bidirectional	Type K, Glass Ins., 24 ga wire	1.37	0.00	0.91	horizontal
1WA-V-B2	Bidirectional	Type K, Glass Ins., 24 ga wire	1.37	0.00	1.83	horizontal
1WA-V-B3	Bidirectional	Type K, Glass Ins., 24 ga wire	3.14	0.00	0.91	horizontal
1WA-V-B4	Bidirectional	Type K, Glass Ins., 24 ga wire	3.14	0.00	1.83	horizontal
1WA-V-C1	Bidirectional	Type K, Glass Ins., 24 ga wire	1.37	0.00	0.91	horizontal
1WA-V-C2	Bidirectional	Type K, Glass Ins., 24 ga wire	1.37	0.00	1.83	horizontal
1WA-V-C3	Bidirectional	Type K, Glass Ins., 24 ga wire	3.14	0.00	0.91	horizontal
1WA-V-C4	Bidirectional	Type K, Glass Ins., 24 ga wire	3.14	0.00	1.83	horizontal

The following table provides a summary of the temperatures measured at the velocity probe.

Table 8. Velocity Temperature Summary

Description	Initial (C)	Maximum (C)	30 Second Maximum Average (C)	60 Second Maximum Average (C)	300 Second Maximum Average (C)	600 Second Maximum Average (C)
1WA-V-A1	23	34	31	31	29	28
1WA-V-A2	23	135	112	111	96	89
1WA-V-B1	23	85	61	60	55	49
1WA-V-B2	23	93	85	83	80	72
1WA-V-B3	24	71	70	69	64	56
1WA-V-B4	24	95	89	82	66	57
1WA-V-C1	24	60	56	52	46	39
1WA-V-C2	24	43	41	41	38	36
1WA-V-C3	24	89	76	69	50	42
1WA-V-C4	24	564	465	444	343	227

The following table summarizes the minimum and maximum velocity values and the times at which they occurred.

Table 9. Velocity Minimum and Maximum

Description	Initial (m/s)	Maximum (m/s)	5 Second Maximum Average (m/s)	10 Second Maximum Average (m/s)	30 Second Maximum Average (m/s)	60 Second Maximum Average (m/s)
1WA-V-A1	0.02	0.76	0.35	0.12	0.07	0.03
1WA-V-A2	0.16	2.25	1.74	1.42	1.34	1.29
1WA-V-B1	0.12	1.51	0.41	0.28	0.08	0.04
1WA-V-B2	0.17	3.33	1.99	1.63	0.92	0.65
1WA-V-B3	-0.12	3.44	2.64	1.87	0.82	0.65
1WA-V-B4	0.14	6.89	6.38	5.58	2.97	2.79
1WA-V-C1	0.08	2.20	1.56	1.31	0.64	0.36
1WA-V-C2	-0.06	2.00	1.17	0.83	0.58	0.48
1WA-V-C3	-0.15	1.19	1.05	0.87	0.16	0.12
1WA-V-C4	-0.15	10.24	10.20	10.16	8.63	7.24

The following charts present a time dependent representation of the instantaneous velocities measured during the experiment.

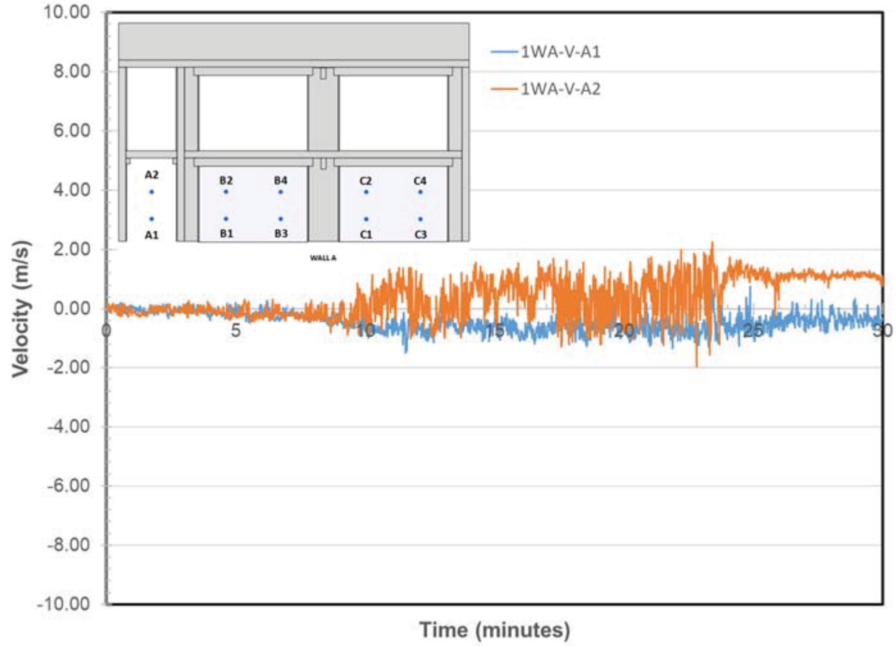

Figure 34. Velocity at Location A on Wall A

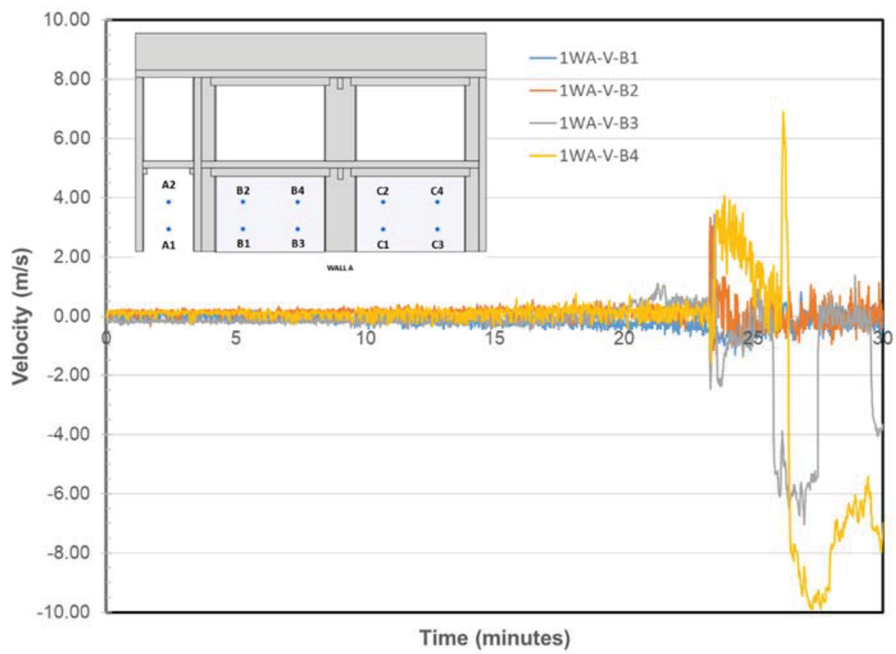

Figure 35. Velocity at Location B on Wall A

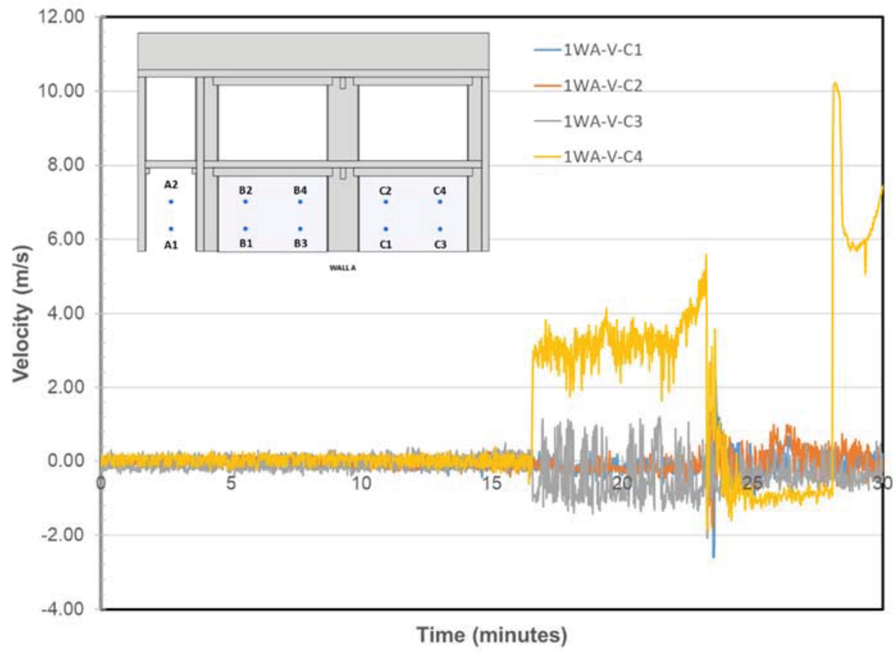

Figure 36. Velocity at Location C on Wall A

Heat Flux Transducers

The following table provides a description of the transducer used to collect heat flux measurements during the experiment. The "Description" column typically describes the location of the heat flux transducer. Location X and Location Y are Cartesian coordinates generally located in a horizontal plane. Location Z is the distance from the floor to the centerline of the transducer. Heat flux mode indicates whether the total heat flux was measured or just the radiation fraction. Heat flux over range is the maximum measured value reported for this transducer.

Table 10. Heat Flux Measurement Description

Description	Location X (m)	Location Y (m)	Location Z (m)	Orientation	Heat Flux Mode	Heat Flux Over Range (kW/m²)
1WF-H-A1	5.56	11.15	0.91	horizontal	Total	150
1WA-H-A1	1.83	2.44	1.52	horizontal	Total	150
1WA-H-A2	1.83	4.88	1.52	horizontal	Total	75
1WA-H-B1	1.83	2.44	1.52	horizontal	Total	150
1WA-H-B2	1.83	4.88	1.52	horizontal	Total	75

The following table provides a summary of the heat flux results. A "SC" in the table indicates that the values did not change sufficiently for this value to be calculated. The "Description" column typically describes the location of the heat flux transducer. The time at which the heat flux first changes by a pre-determined amount is provided in the "Time of Initial Change" column. The pre-determined amount of change in heat flux is provided in the "Initial Change

Amount" column. The maximum heat flux recorded during the test is provided in the "Maximum" column. The "Maximum Average" columns are calculated over four pre-determined time spans. Exceeded maximum instrument operating range and was taken out of service for the remainder of the test

Table 11. Heat Flux Result Summary

Description	Time of Initial Change (s)	Initial Change Value (kW/m²)	Maximum Heat Flux (kW/m²)	Heat Flux 10 second maximum average (kW/m²)	Heat Flux 30 second maximum average (kW/m²)	Heat Flux 60 second maximum average (kW/m²)	Heat Flux 300 second maximum average (kW/m²)	Heat Flux 600 second maximum average (kW/m²)
1WF-H-A1	666	5	38.8	27.5	26.3	25.2	20.6	17.0
1WA-H-A1	SC	5	1.1	1.0	0.9	0.9	0.8	0.7
1WA-H-A2	SC	5	0.7	0.6	0.5	0.5	0.4	0.3
1WA-H-B1	SC	5	5.0	3.4	2.3	1.8	0.9	0.6
1WA-H-B2	SC	5	1.0	0.7	0.5	0.4	0.3	0.2

The following chart shows a time dependent representation of the instantaneous heat flux measured during the experiment.

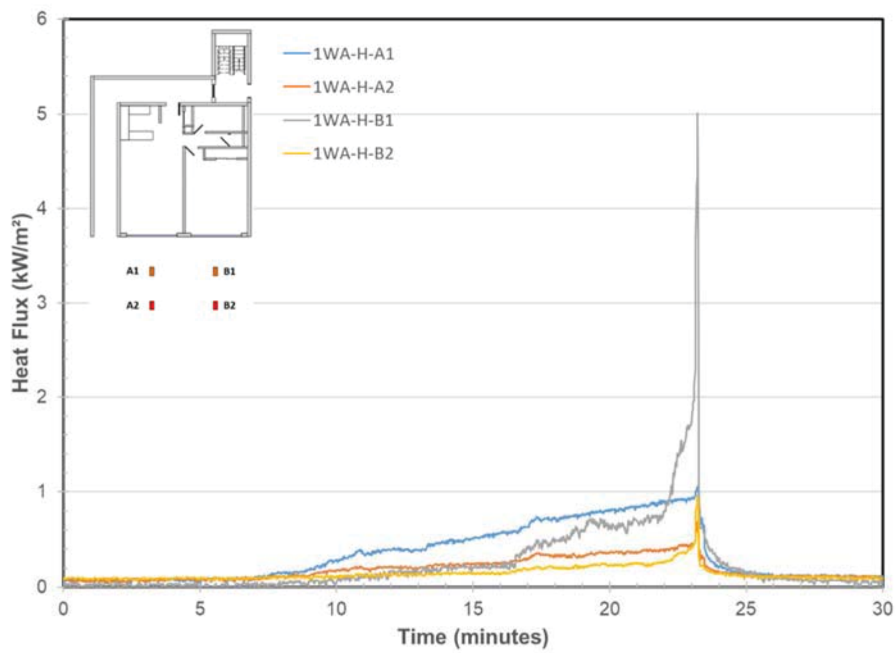

Figure 37. Heat Fluxes in Front of Wall A

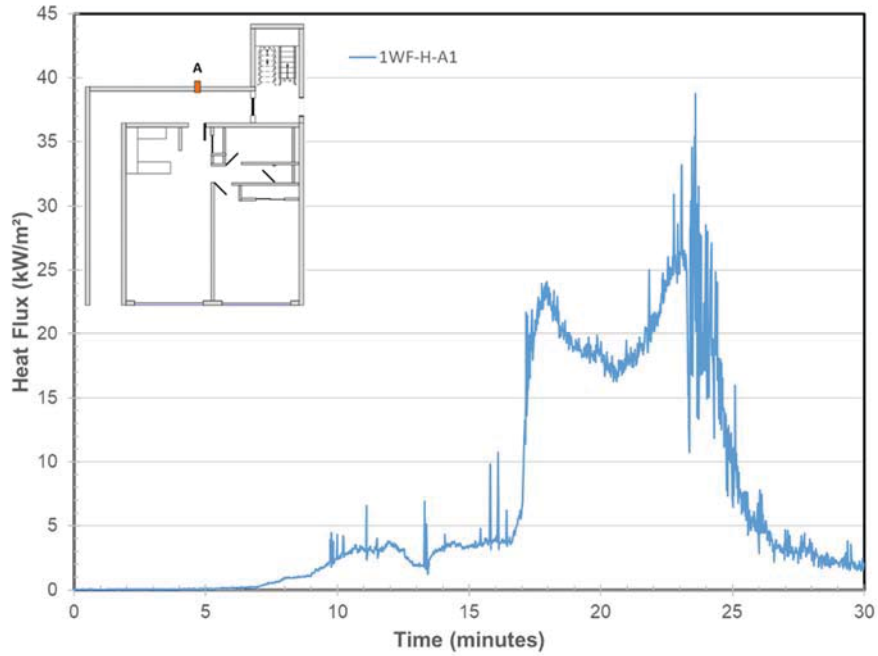

Figure 38. Heat Flux on Wall F across from Apartment Door

Optical Density Meter

The following table provides a description of the optical density meter used in the experiment. The extinction beam path length is the distance measured from the light source to the lens of the photo transducer.

Table 12. Optical Density Meter Description

Description	Light Source Type	X (m)	Y (m)	Z (m)	Extinction Beam Path Length (m)
1RH-O-A1	White light	3.353	10.363	1.524	0.914

The following table shows when the ODM was taken out of service during the experiment. All calculated values reported for the instrument are prior to the out of service time.

Table 13. Out of Service Times

Description	Out of Service Time (s)	Out of Service Time (hh:mm:ss)	Out of service reason
1RH-O-A1	613	00:10:13	Temperature exceeded operating range

The following chart shows the obscuration during the experiment.

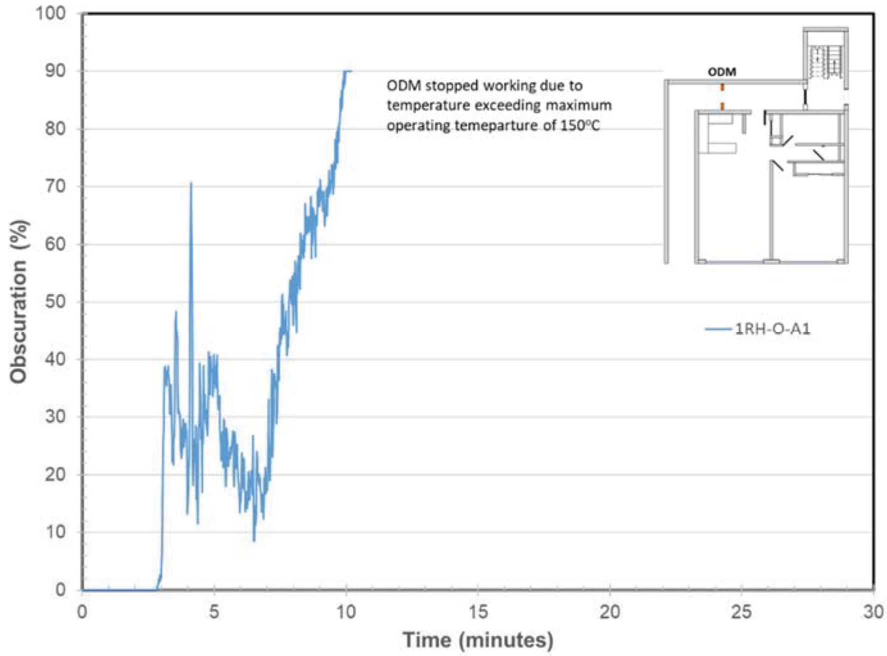

Figure 39. Obscuration in Corridor

The following chart shows the obscuration per unit length during the experiment.

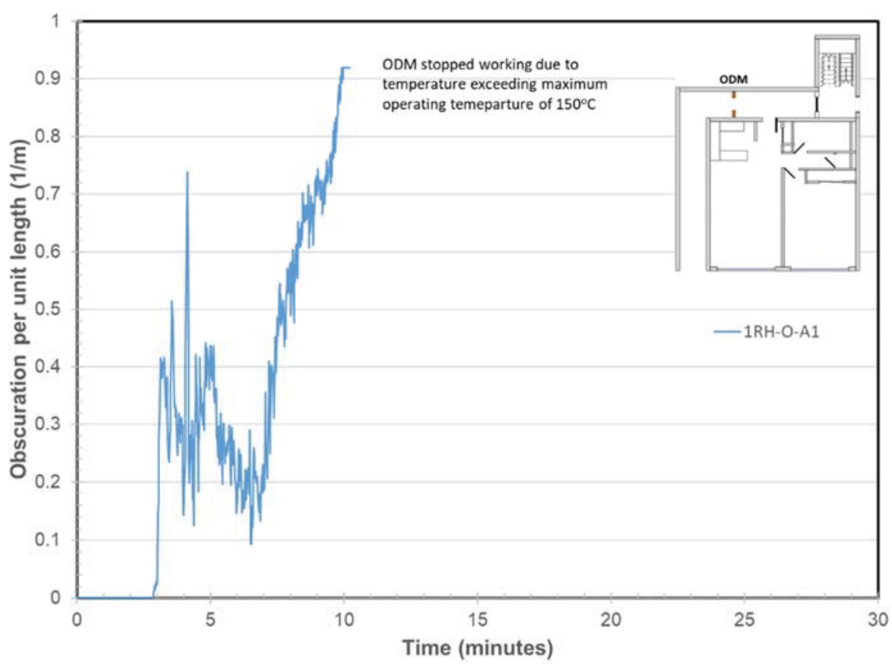

Figure 40. Obscuration per unit Length in Corridor

Smoke Detectors

The following table provides a description of the detectors used in the experiment. All detectors were mounted on the ceiling.

Table 14. Detector(s) Summary

Description	Location	Distance below ceiling (m)	Manufacturer	Model	Detector Type	Sensor Type
1CH-I-A1	1st Floor Corridor near Wall A	0.00	Kidde	i12080	smoke	ionization
1CH-P-A1	1st Floor Corridor near Wall A	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-B1	1st Floor Corridor by Apartment Door	0.00	Kidde	i12080	smoke	ionization
1CH-P-B1	1st Floor Corridor by Apartment Door	0.00	Kidde	p12040	smoke	photoelectric
1CH-I-C1	1st Floor Stairwell	0.00	Kidde	i12080	smoke	ionization
1CH-P-C1	1st Floor Stairwell	0.00	Kidde	p12040	smoke	photoelectric
1CL-I-A1	1st Floor Living Room	0.00	Kidde	p12040	smoke	ionization
1CL-P-A1	1st Floor Living Room	0.00	Kidde	i12080	smoke	photoelectric
1CB-I-A1	1st Floor Bedroom	0.00	Kidde	i12080	smoke	ionization
1CB-P-A1	1st Floor Bedroom	0.00	Kidde	p12040	smoke	photoelectric
1CB-I-B1	1st Floor Hallway Outside of Bedroom	0.00	Kidde	i12080	smoke	ionization
1CB-P-B1	1st Floor Hallway Outside of Bedroom	0.00	Kidde	p12040	smoke	photoelectric

The following table provides a summary of activation times for all smoke detectors in the experiment.

Table 15. Smoke Detector Activation Summary

Description	Location	Activation Time (s)	Activation Time (hh:mm:ss)
1CL-I-A1	1st Floor Living Room	43	00:00:43
1CB-I-B1	1st Floor Hallway Outside of Bedroom	49	00:00:49
1CH-P-B1	1st Floor Corridor by Apartment Door	116	00:01:56
1CH-I-B1	1st Floor Corridor by Apartment Door	118	00:01:58
1CB-P-A1	1st Floor Bedroom	158	00:02:38
1CH-P-A1	1st Floor Corridor near Wall A	195	00:03:15
1CH-I-A1	1st Floor Corridor near Wall A	200	00:03:20
1CB-P-B1	1st Floor Hallway Outside of Bedroom	395	00:06:35
1CL-P-A1	1st Floor Living Room	443	00:07:23
1CB-I-A1	1st Floor Bedroom	577	00:09:37
1CH-I-C1	1st Floor Stairwell	597	00:09:57
1CH-P-C1	1st Floor Stairwell	618	00:10:18

Fire Products Collector

The following table provides a description of the FPC used in the experiment. The table includes a description of the FPC, as well as the Calibration factor (C Factor) and the net heat released per unit of oxygen consumed (E Factor), which are used to calculate the het release rate (HRR) during an experiment. The C Factor is based on data from a fire with a known HRR. The E Factor is a property of the fuel being burned.

Table 16. Fire Products Collector Description

Description	C Factor	E Factor (kJ/kg)
14 MW	1.128	13100

The following chart shows the heat release rate of the fire during the experiment. The heat release rate is calculated based on the principle of oxygen consumption calorimetry.

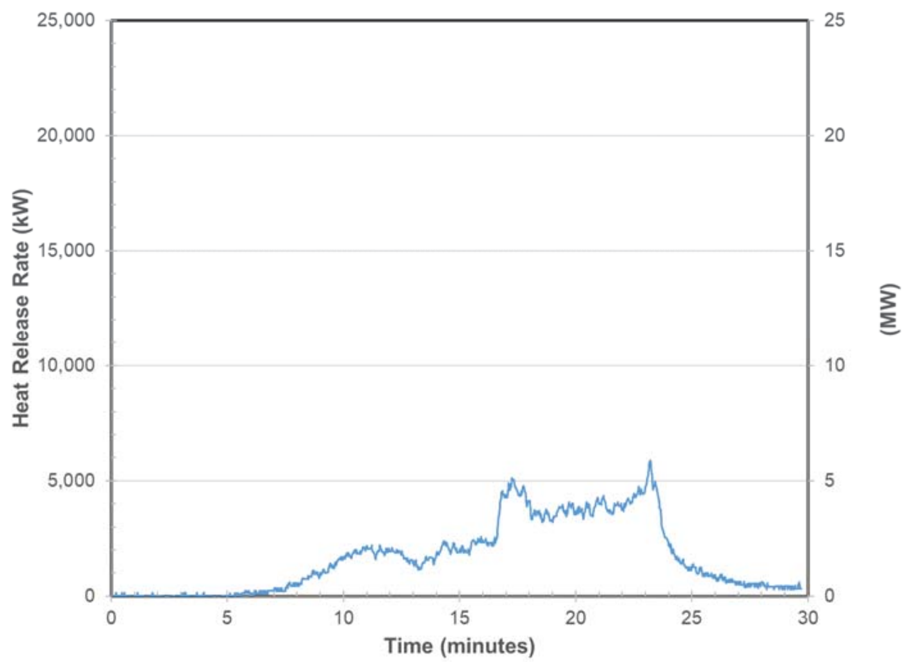

Figure 41. Heat Release Rate

The following chart shows the total heat released from the fire during the experiment. The total heat released is calculated by integrating the heat release rate over time.

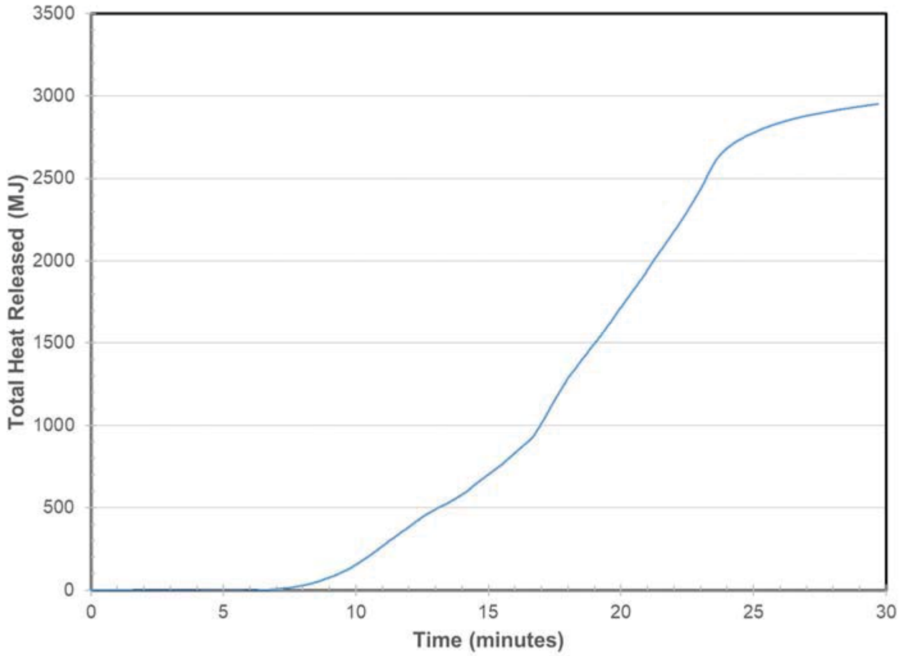

Figure 42. Total Heat Released

Gas Analyzer-Paramagnetic-O_2

The following table provides information about the oxygen sampling location and the operating parameters of the oxygen analyzer(s). The "O2 delay time" is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample bypass and analyzer exhaust lines are returned to during the experiment.

Table 17. Oxygen measurement descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	O2 Delay Time (s)	Exhaust Return
1RH-G-A1	5.59	10.36	1.52	10	To Ambient Laboratory
1RL-G-A1	1.90	2.39	1.52	21	To Ambient Laboratory

Table 18. Oxygen Measurement Results

Description	O2 Analyzer Full Scale Range (%)	Oxygen Peak Minimum (%)	Oxygen-Average (%)
1RH-G-A1	25.00	2.99	17.26
1RL-G-A1	25.00	-0.01	10.06

The following chart presents the oxygen concentration(s) measured during the test.

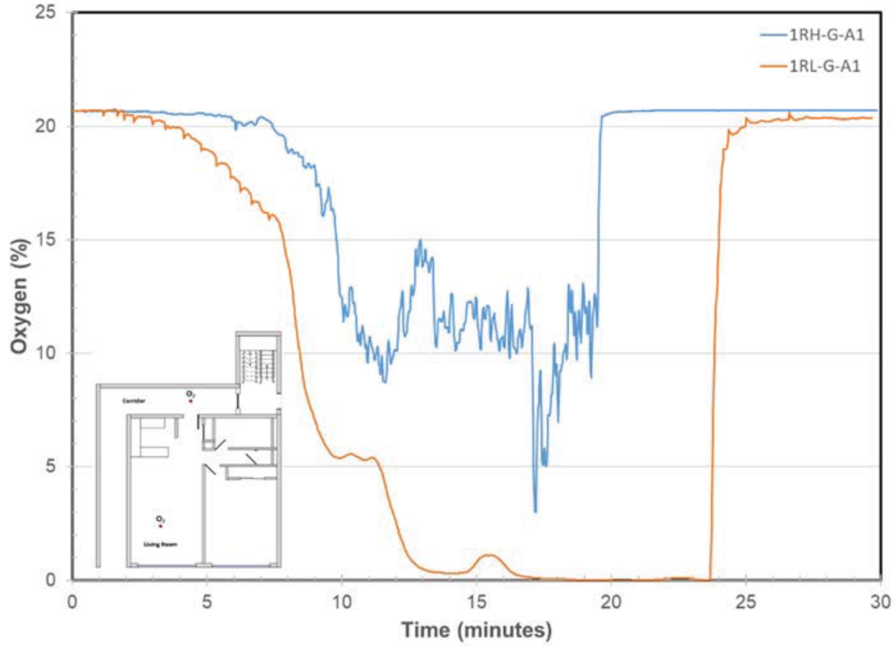

Figure 43. Oxygen Concentrations in the Corridor and Living Room

Gas Analyzer-NDIR-CO/CO₂

The following table provides information about the carbon monoxide and carbon dioxide sampling locations and the operating parameters of the analyzer). The "CO/CO_2 delay time" is the time required for the gas analyzer output to adjust when subjected to a known gas concentration change at the measurement location. The "Exhaust Return" states where the gas sample by-pass and analyzer exhaust lines are returned to during the experiment.

Table 19. CO and CO2 Measurement Descriptions

Description	Location X (m)	Location Y (m)	Location Z (m)	CO/CO2 Delay Time (s)	Exhaust Return
1RH-G-A1	5.59	10.36	1.52	10	To Ambient Laboratory
1RL-G-A1	1.90	2.39	1.52	21	To Ambient Laboratory

The toxic gas species measured during the experiments were carbon monoxide (CO) and carbon dioxide (CO_2). The mass production rates of these species were calculated from the gas concentrations measured in the exhaust duct of the Fire Products Collector during the experiment. The following table provides a summary of the maximum mass production rates of these species. The "Maximum Average" values, which are calculated from average values of species production rates over the specified time periods, provide a means to compare the severity of the toxic gas production over these time spans.

The following table provides a summary of the carbon monoxide gas measurement results.

Table 20. CO Measurement Results

Description	CO Analyzer Full Scale Range (mol/mol)	CO Span Gas Value (mol/mol)	Maximum CO Gas Concentration (mol/mol)	CO- Average (mol/mol)
1RH-G-A1	0.05	0.05	0.0390	0.0059
1RL-G-A1	0.05	0.05	0.0178	0.0046

The following table provides a summary of the carbon dioxide gas measurement results.

Table 21. CO_2 Measurement Results

Description	CO_2 Analyzer Full Scale Range (mol/mol)	CO_2 Span Gas Value (mol/mol)	Maximum CO2 Gas Concentration (mol/mol)	CO2- Average (mol/mol)
1RH-G-A1	0.25	0.22	0.1569	0.0303
1RL-G-A1	0.25	0.22	0.1933	0.0906

The following chart shows the carbon monoxide concentrations measured during the experiment.

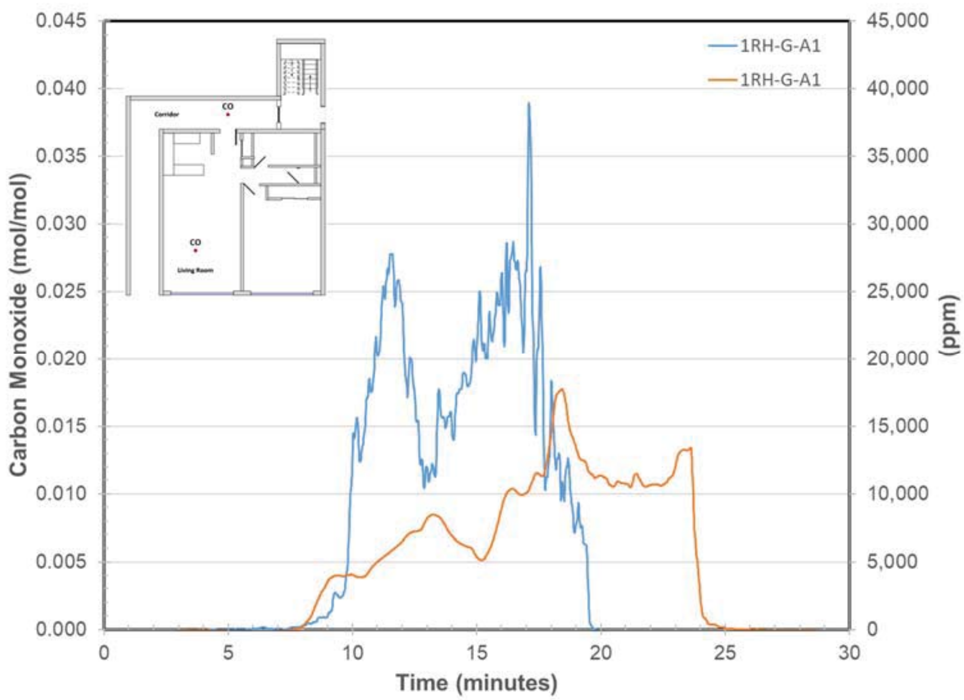

Figure 44. Carbon Monoxide Concentrations in the Corridor and Living Room

The following chart shows the carbon dioxide concentrations measured during the experiment.

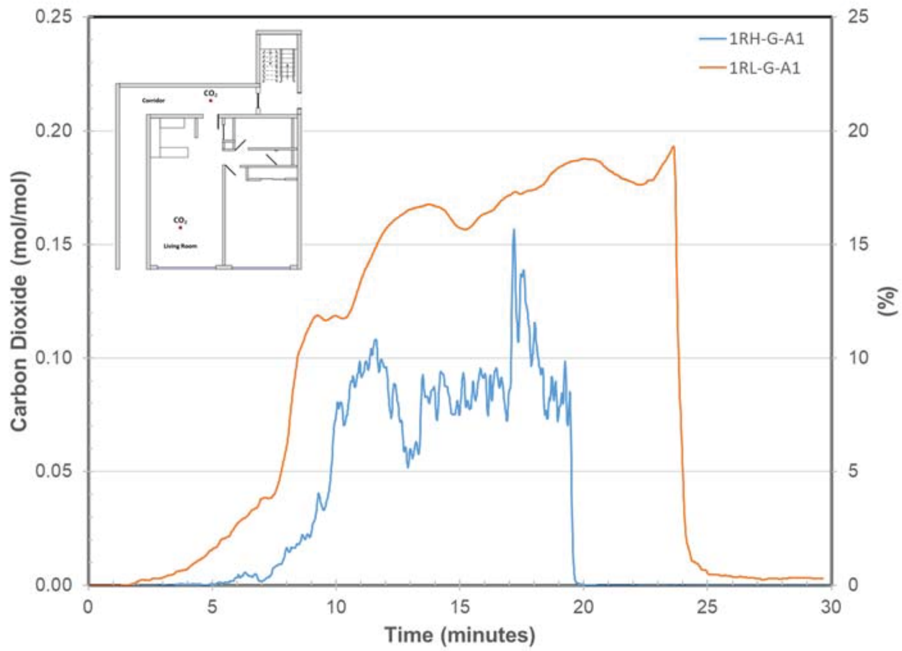

Figure 45. Carbon Dioxide Concentrations in the Corridor and Living Room

Videos

The following table provides a description of the video(s) taken during this experiment.

Table 22. Video Log

Description	Start Time	Video Duration (s)	Filename
IGNITION	09:24:38	1845	223940_20170629_092438_1.mov
LIVING ROOM	09:24:39	1845	223940_20170629_092439_2.mov
BEDROOM	09:24:41	1844	223940_20170629_092441_3.mov
DOOR / KITCHEN	09:24:42	1844	223940_20170629_092442_4.mov
KITCHEN / LIVING ROOM	09:24:44	1843	223940_20170629_092444_5.mov
HALLWAY	09:24:45	1848	223940_20170629_092445_6.mov
STAIRWELL	09:24:47	1847	223940_20170629_092447_7.mov
FLIR	09:24:49	1846	223940_20170629_092449_8.mov
FRONT VIEW HD	09:24:50	1846	223940_20170629_092450_9.mov
LIVING ROOM HD	09:24:51	1846	223940_20170629_092451_10.mov
BEDROOM HD	09:24:52	1846	223940_20170629_092452_11.mov
OVERALL HD	09:24:53	1846	223940_20170629_092453_12.mov
SPRINKLER PRESSURE HD	09:24:53	1846	223940_20170629_092453_13.mov
FLIR_USDA			223940_949780.MOV
FRONT VIEW HD_USDA			223940_949781.MOV
LIVING ROOM HD_USDA			223940_949782.MOV
BEDROOM HD_USDA			223940_949783.MOV
OVERALL HD_USDA			223940_949784.MOV
SPRINKLER PRESSURE HD_USDA			223940_949785.MOV
IGNITION_USDA			223940_949786.MOV
LIVING ROOM_USDA			223940_949787.MOV
BEDROOM_USDA			223940_949788.MOV

Description	Start Time	Video Duration (s)	Filename
DOOR / KITCHEN_USDA			223940_949789.MOV
KITCHEN / LIVING ROOM_USDA			223940_949790.MOV
HALLWAY_USDA			223940_949791.MOV
STAIRWELL_USDA			223940_949792.MOV
203940_Master_USDA			223940_949864.MOV

Experiment Photographs

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 46. Pre test 1:16 hr:min, (223940_857484)

Figure 47. Pre test 1:16 hr:min (223940_857485)

Figure 48. Pre test 1:16 hr:min (223940_857486)

Figure 49. Pre test 1:16 hr:min (223940_857487)

Figure 50. Pre test 1:16 hr:min (223940_857488)

Figure 51. Pre test 1:16 hr:min (223940_857489)

Figure 52. Pre test 1:15 hr:min (223940_857490)

Figure 53. Pre test 1:15 hr:min (223940_857491)

Figure 54. Pre test 1:15 hr:min (223940_857492)

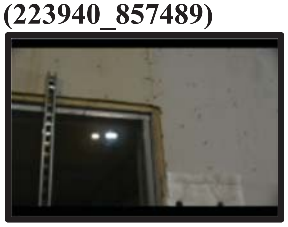

Figure 55. Pre test 1:15 hr:min (223940_857493)

Figure 56. Pre test 1:15 hr:min (223940_857494)

Figure 57. Pre test 1:15 hr:min (223940_857495)

Figure 58. Pre test 1:14 hr:min (223940_857496)

Figure 59. Pre test 1:14 hr:min (223940_857497)

Figure 60. Pre test 1:14 hr:min (223940_857498)

Figure 61. Pre test 1:14 hr:min (223940_857499)


Figure 62. Pre test 1:14 hr:min (223940_857500)


Figure 63. Pre test 1:14 hr:min (223940_857501)


Figure 64. Pre test 1:14 hr:min (223940_857502)


Figure 65. Pre test 1:13 hr:min (223940_857504)


Figure 66. Pre test 1:13 hr:min (223940_857505)


Figure 67. Pre test 1:13 hr:min (223940_857506)


Figure 68. Pre test 1:11 hr:min (223940_857507)


Figure 69. Pre test 1:11 hr:min (223940_857508)

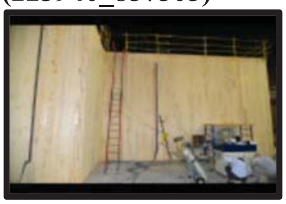
Figure 70. Pre test 1:10 hr:min (223940_857509)


Figure 71. Pre test 1:10 hr:min (223940_857510)


Figure 72. Pre test 1:10 hr:min (223940_857511)


Figure 73. Pre test 1:10 hr:min (223940_857512)

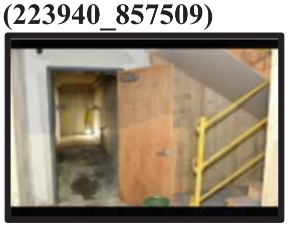
Figure 74. Pre test 51 minutes (223940_857513)


Figure 75. Pre test 51 minutes (223940_857514)


Figure 76. Pre test 51 minutes (223940_857515)


Figure 77. Pre test 50 minutes (223940_857516)


Figure 78. Pre test 50 minutes (223940_857517)


Figure 79. Pre test 50 minutes (223940_857518)


Figure 80. Pre test 50 minutes (223940_857519)


Figure 81. Pre test 50 minutes (223940_857520)


Figure 82. Pre test 50 minutes (223940_857521)


Figure 83. Pre test 50 minutes (223940_857522)


Figure 84. Pre test 50 minutes (223940_857523)


Figure 85. Pre test 50 minutes (223940_857524)


Figure 86. Pre test 50 minutes (223940_857525)


Figure 87. Pre test 50 minutes (223940_857526)


Figure 88. Pre test 50 minutes (223940_857527)


Figure 89. Pre test 49 minutes (223940_857528)


Figure 90. Pre test 49 minutes (223940_857529)

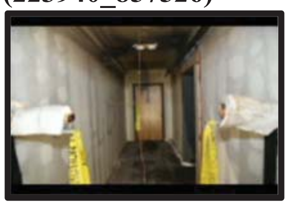
Figure 91. Pre test 49 minutes (223940_857530)

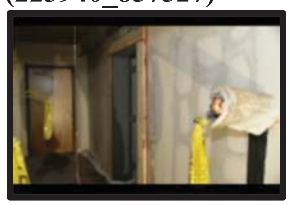
Figure 92. Pre test 49 minutes (223940_857531)


Figure 93. Pre test 49 minutes (223940_857532)


Figure 94. Pre test 49 minutes (223940_857533)


Figure 95. Pre test 49 minutes (223940_857534)

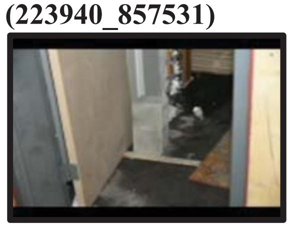
Figure 96. Pre test 49 minutes (223940_857535)


Figure 97. Pre test 49 minutes (223940_857536)


Figure 98. Pre test 48 minutes (223940_857537)


Figure 99. Pre test 48 minutes (223940_857538)


Figure 100. Pre test 48 minutes (223940_857539)


Figure 101. Pre test 48 minutes (223940_857540)


Figure 102. Pre test 48 minutes (223940_857541)


Figure 103. Pre test 48 minutes (223940_857542)


Figure 104. Pre test 48 minutes (223940_857543)


Figure 105. Pre test 48 minutes (223940_857544)


Figure 106. Pre test 48 minutes (223940_857545)

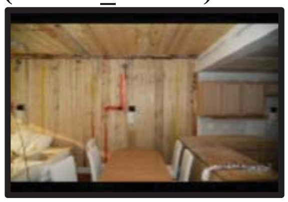
Figure 107. Pre test 48 minutes (223940_857546)


Figure 108. Pre test 48 minutes (223940_857547)


Figure 109. Pre test 47 minutes (223940_857548)


Figure 110. Pre test 47 minutes (223940_857549)

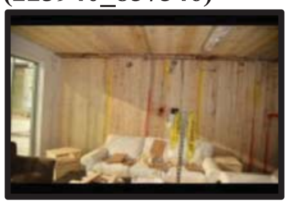
Figure 111. Pre test 47 minutes (223940_857550)

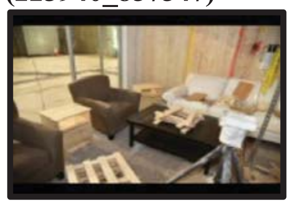
Figure 112. Pre test 47 minutes (223940_857551)

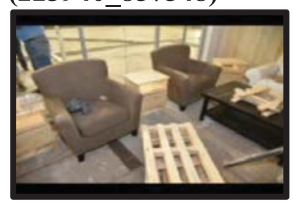
Figure 113. Pre test 47 minutes (223940_857552)


Figure 114. Pre test 47 minutes (223940_857553)


Figure 115. Pre test 47 minutes (223940_857554)


Figure 116. Pre test 47 minutes (223940_857555)


Figure 117. Pre test 47 minutes (223940_857556)


Figure 118. Pre test 47 minutes (223940_857557)


Figure 119. Pre test 47 minutes (223940_857558)


Figure 120. Pre test 47 minutes (223940_857559)


Figure 121. Pre test 47 minutes (223940_857560)


Figure 122. Pre test 47 minutes (223940_857561)


Figure 123. Pre test 47 minutes (223940_857562)


Figure 124. Pre test 47 minutes (223940_857563)


Figure 125. Pre test 47 minutes (223940_857564)


Figure 126. Pre test 47 minutes (223940_857565)


Figure 127. Pre test 47 minutes (223940_857566)


Figure 128. Pre test 47 minutes (223940_857567)


Figure 129. Pre test 47 minutes (223940_857568)


Figure 130. Pre test 47 minutes (223940_857569)


Figure 131. Pre test 46 minutes (223940_857570)

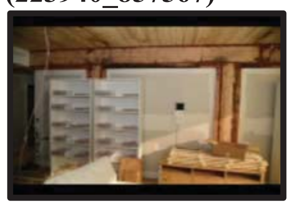
Figure 132. Pre test 46 minutes (223940_857571)


Figure 133. Pre test 46 minutes (223940_857572)


Figure 134. Pre test 46 minutes (223940_857573)


Figure 135. Pre test 46 minutes (223940_857574)


Figure 136. Pre test 46 minutes (223940_857575)


Figure 137. Pre test 46 minutes (223940_857576)


Figure 138. Pre test 46 minutes (223940_857577)


Figure 139. Pre test 46 minutes (223940_857578)


Figure 140. Pre test 46 minutes (223940_857579)


Figure 141. Pre test 46 minutes (223940_857580)

Figure 142. Pre test 46 minutes (223940_857581)

Figure 143. Pre test 46 minutes (223940_857582)

Figure 144. Pre test 45 minutes (223940_857583)

Figure 145. Pre test 45 minutes (223940_857584)

Figure 146. Pre test 45 minutes (223940_857585)

Figure 147. Pre test 45 minutes (223940_857586)

Figure 148. Pre test 45 minutes (223940_857587)

Figure 149. Pre test 45 minutes (223940_857588)

Figure 150. Pre test 45 minutes (223940_857589)

Figure 151. Pre test 45 minutes (223940_857590)

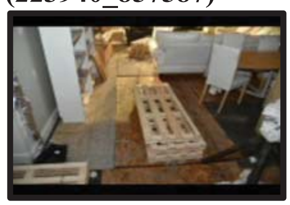

Figure 152. Pre test 45 minutes (223940_857591)

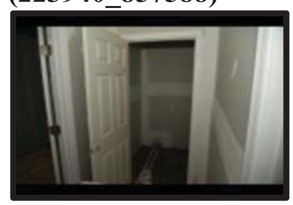

Figure 153. Pre test 45 minutes (223940_857592)

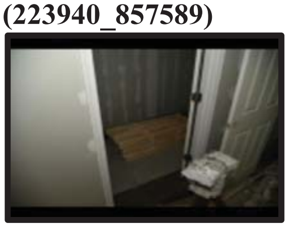

Figure 154. Pre test 45 minutes (223940_857593)

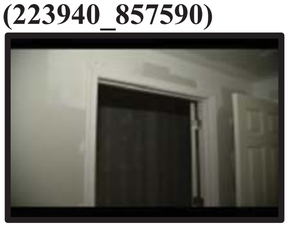

Figure 155. Pre test 45 minutes (223940_857594)

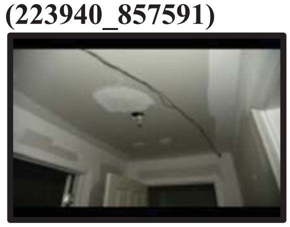

Figure 156. Pre test 45 minutes (223940_857595)

Figure 157. Pre test 45 minutes (223940_857596)

Figure 158. Pre test 45 minutes (223940_857597)

Figure 159. Pre test 45 minutes (223940_857598)

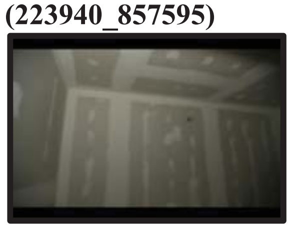

Figure 160. Pre test 45 minutes (223940_857599)

Figure 161. Pre test 44 minutes (223940_857600)

Figure 162. Pre test 44 minutes (223940_857601)

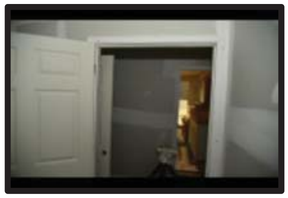

Figure 163. Pre test 44 minutes (223940_857602)

Figure 164. Pre test 44 minutes (223940_857603)

Figure 165. Pre test 44 minutes (223940_857604)

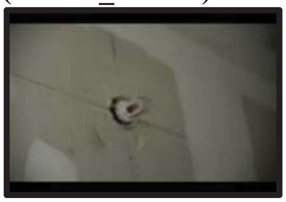

Figure 166. Pre test 44 minutes (223940_857605)

Figure 167. Pre test 44 minutes (223940_857606)

Figure 168. Pre test 44 minutes (223940_857607)

Figure 169. Pre test 42 minutes (223940_857608)

Figure 170. Pre test 42 minutes (223940_857609)

Figure 171. Pre test 42 minutes (223940_857610)

Figure 172. Pre test 42 minutes (223940_857611)

Figure 173. Pre test 42 minutes (223940_857612)

Figure 174. Pre test 41 minutes (223940_857613)

Figure 175. Pre test 41 minutes (223940_857614)

Figure 176. Pre test 41 minutes (223940_857615)

Figure 177. Pre test 41 minutes (223940_857616)

Figure 178. Pre test 41 minutes (223940_857617)

Figure 179. Pre test 41 minutes (223940_857618)

Figure 180. Pre test 41 minutes (223940_857619)

Figure 181. Pre test 41 minutes (223940_857620)


Figure 182. Pre test 41 minutes (223940_857621)


Figure 183. Pre test 41 minutes (223940_857622)


Figure 184. Pre test 41 minutes (223940_857623)


Figure 185. Pre test 41 minutes (223940_857624)


Figure 186. Pre test 41 minutes (223940_857625)


Figure 187. Pre test 41 minutes (223940_857626)

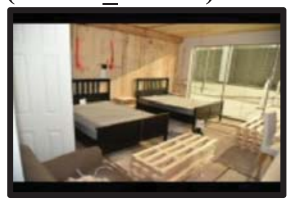
Figure 188. Pre test 41 minutes (223940_857627)


Figure 189. Pre test 41 minutes (223940_857628)

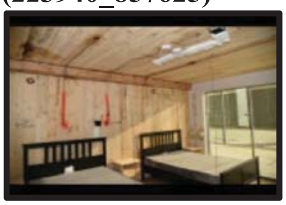
Figure 190. Pre test 41 minutes (223940_857629)


Figure 191. Pre test 40 minutes (223940_857630)


Figure 192. Pre test 40 minutes (223940_857631)


Figure 193. Pre test 40 minutes (223940_857632)


Figure 194. Pre test 40 minutes (223940_857633)


Figure 195. Pre test 40 minutes (223940_857634)


Figure 196. Pre test 40 minutes (223940_857635)

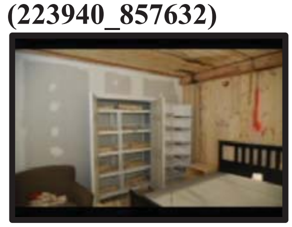
Figure 197. Pre test 40 minutes (223940_857636)


Figure 198. Pre test 40 minutes (223940_857637)


Figure 199. Pre test 40 minutes (223940_857638)


Figure 200. Pre test 40 minutes (223940_857639)

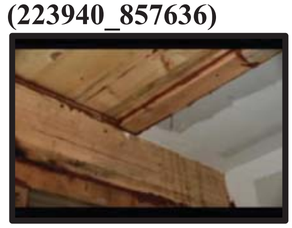
Figure 201. Pre test 40 minutes (223940_857640)


Figure 202. Pre test 40 minutes (223940_857641)


Figure 203. Pre test 40 minutes (223940_857642)


Figure 204. Pre test 40 minutes (223940_857643)


Figure 205. Pre test 40 minutes (223940_857644)


Figure 206. Pre test 40 minutes (223940_857645)


Figure 207. Pre test 40 minutes (223940_857646)


Figure 208. Pre test 39 minutes (223940_857647)


Figure 209. Pre test 39 minutes (223940_857648)


Figure 210. Pre test 39 minutes (223940_857649)


Figure 211. Pre test 39 minutes (223940_857650)


Figure 212. Pre test 39 minutes (223940_857651)


Figure 213. Pre test 39 minutes (223940_857652)

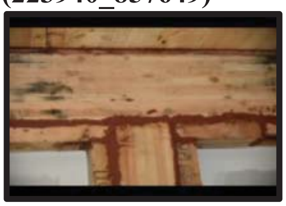
Figure 214. Pre test 39 minutes (223940_857653)


Figure 215. Pre test 39 minutes (223940_857654)


Figure 216. Pre test 39 minutes (223940_857655)


Figure 217. Pre test 39 minutes (223940_857656)


Figure 218. Pre test 39 minutes (223940_857657)


Figure 219. Pre test 39 minutes (223940_857658)


Figure 220. Pre test 39 minutes (223940_857659)


Figure 221. Pre test 39 minutes (223940_857660)


Figure 222. Pre test 39 minutes (223940_857661)


Figure 223. Pre test 39 minutes (223940_857662)


Figure 224. Pre test 39 minutes (223940_857663)


Figure 225. Pre test 38 minutes (223940_857664)

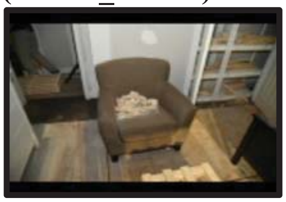
Figure 226. Pre test 38 minutes (223940_857665)


Figure 227. Pre test 38 minutes (223940_857666)


Figure 228. Pre test 38 minutes (223940_857667)


Figure 229. Pre test 38 minutes (223940_857668)


Figure 230. Pre test 38 minutes (223940_857669)


Figure 231. Pre test 38 minutes (223940_857670)


Figure 232. Pre test 38 minutes (223940_857671)


Figure 233. Pre test 38 minutes (223940_857672)


Figure 234. Pre test 38 minutes (223940_857673)


Figure 235. Pre test 38 minutes (223940_857674)


Figure 236. Pre test 38 minutes (223940_857675)


Figure 237. Pre test 38 minutes (223940_857676)


Figure 238. Pre test 38 minutes (223940_857677)


Figure 239. Pre test 37 minutes (223940_857678)


Figure 240. Pre test 37 minutes (223940_857679)


Figure 241. Pre test 37 minutes (223940_857680)

Figure 242. Pre test 37 minutes (223940_857681)

Figure 243. Pre test 37 minutes (223940_857682)

Figure 244. Pre test 37 minutes (223940_857683)

Figure 245. Pre test 37 minutes (223940_857684)

Figure 246. Pre test 37 minutes (223940_857685)

Figure 247. Pre test 37 minutes (223940_857686)

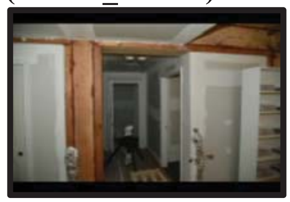

Figure 248. Pre test 37 minutes (223940_857687)

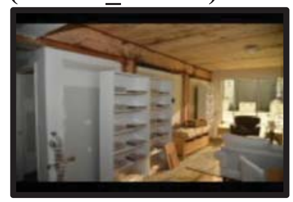

Figure 249. Pre test 37 minutes (223940_857688)

Figure 250. Pre test 37 minutes (223940_857689)

Figure 251. Pre test 37 minutes (223940_857690)

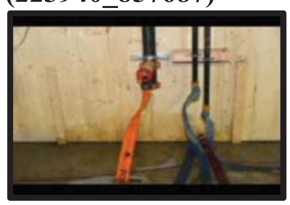

Figure 252. Pre test 36 minutes (223940_857691)

Figure 253. Pre test 36 minutes (223940_857692)

Figure 254. Pre test 36 minutes (223940_857693)

Figure 255. Pre test 36 minutes (223940_857694)

Figure 256. Pre test 36 minutes (223940_857695)

Figure 257. Pre test 15 minutes (223940_857696)

Figure 258. Pre test 15 minutes (223940_857697)

Figure 259. Pre test 15 minutes (223940_857698)

Figure 260. Pre test 13 minutes (223940_857699)

Figure 261. Pre test 13 minutes (223940_857700)


Figure 262. Pre test 13 minutes (223940_857701)


Figure 263. Pre test 12 minutes (223940_857702)


Figure 264. Pre test 12 minutes (223940_857703)


Figure 265. Pre test 12 minutes (223940_857704)


Figure 266. Pre test 12 minutes (223940_857705)

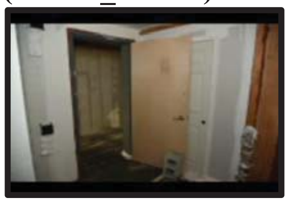
Figure 267. Pre test 12 minutes (223940_857706)


Figure 268. 183 seconds (223940_857707)


Figure 269. 195 seconds (223940_857708)


Figure 270. 219 seconds (223940_857709)

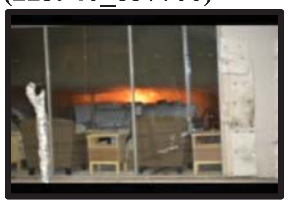
Figure 271. 239 seconds (223940_857710)


Figure 272. 249 seconds (223940_857711)


Figure 273. 263 seconds (223940_857712)


Figure 274. 315 seconds (223940_857713)

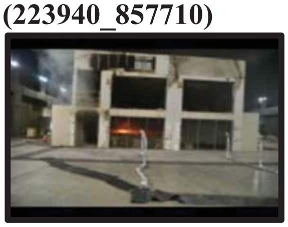
Figure 275. 381 seconds (223940_857714)

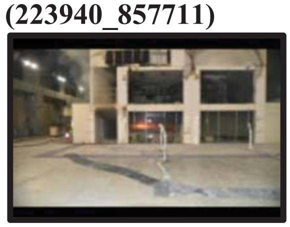
Figure 276. 387 seconds (223940_857715)

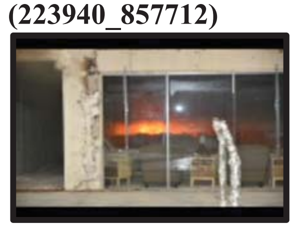
Figure 277. 397 seconds (223940_857716)

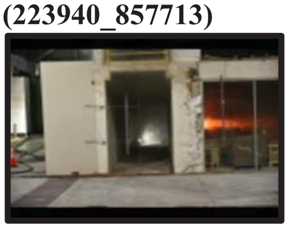
Figure 278. 407 seconds (223940_857717)


Figure 279. 419 seconds (223940_857718)


Figure 280. 435 seconds (223940_857719)


Figure 281. 461 seconds (223940_857720)


Figure 282. 483 seconds (223940_857721)


Figure 283. 515 seconds (223940_857722)


Figure 284. 537 seconds (223940_857723)


Figure 285. 561 seconds (223940_857724)


Figure 286. 579 seconds (223940_857725)


Figure 287. 619 seconds (223940_857726)


Figure 288. 635 seconds (223940_857727)


Figure 289. 653 seconds (223940_857728)

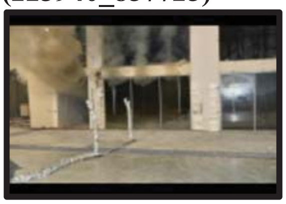
Figure 290. 669 seconds (223940_857729)


Figure 291. 695 seconds (223940_857730)


Figure 292. 755 seconds (223940_857731)


Figure 293. 829 seconds (223940_857732)


Figure 294. 1017 seconds (223940_857733)


Figure 295. 1023 seconds (223940_857734)


Figure 296. 1035 seconds (223940_857735)


Figure 297. 1047 seconds (223940_857736)


Figure 298. 1087 seconds (223940_857737)

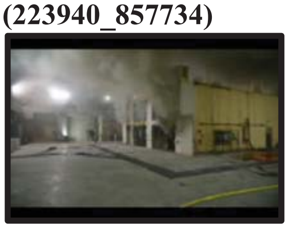
Figure 299. 1127 seconds (223940_857738)


Figure 300. 1191 seconds (223940_857739)


Figure 301. 1199 seconds (223940_857740)


Figure 302. 1267 seconds (223940_857741)


Figure 303. 1293 seconds (223940_857742)


Figure 304. 1299 seconds (223940_857743)


Figure 305. 1319 seconds (223940_857744)


Figure 306. 1329 seconds (223940_857745)


Figure 307. 1345 seconds (223940_857746)


Figure 308. 1371 seconds (223940_857747)


Figure 309. 1377 seconds (223940_857748)

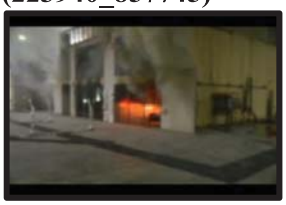
Figure 310. 1385 seconds (223940_857749)


Figure 311. 1391 seconds (223940_857750)

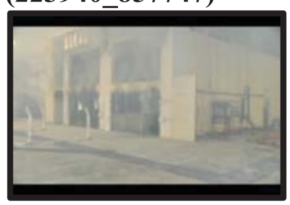
Figure 312. 1395 seconds (223940_857751)


Figure 313. 1401 seconds (223940_857752)


Figure 314. 1403 seconds (223940_857753)


Figure 315. 1409 seconds (223940_857754)


Figure 316. 1417 seconds (223940_857755)


Figure 317. 1453 seconds (223940_857756)


Figure 318. 1479 seconds (223940_857757)


Figure 319. 1493 seconds (223940_857758)

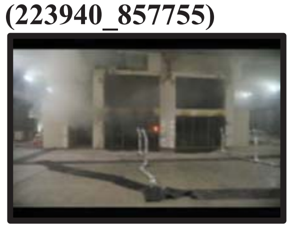
Figure 320. 1529 seconds (223940_857759)


Figure 321. 1535 seconds (223940_857760)


Figure 322. 1541 seconds (223940_857761)


Figure 323. 1627 seconds (223940_857762)


Figure 324. 1631 seconds (223940_857763)


Figure 325. 1701 seconds (223940_857764)


Figure 326. 1705 seconds (223940_857765)


Figure 327. 1725 seconds (223940_857766)


Figure 328. 1733 seconds (223940_857767)


Figure 329. 1777 seconds (223940_857768)


Figure 330. 1791 seconds (223940_857769)


Figure 331. Post test 0 minutes (223940_857770)


Figure 332. Post test 0 minutes (223940_857771)


Figure 333. Post test 0 minutes (223940_857772)


Figure 334. Post test 0 minutes (223940_857773)


Figure 335. Post test 45 minutes (223940_857774)


Figure 336. Post test 45 minutes (223940_857775)


Figure 337. Post test 46 minutes (223940_857776)


Figure 338. Post test 46 minutes (223940_857777)


Figure 339. Post test 46 minutes (223940_857778)


Figure 340. Post test 46 minutes (223940_857779)


Figure 341. Post test 46 minutes (223940_857780)

Figure 342. Post test 46 minutes (223940_857781)

Figure 343. Post test 46 minutes (223940_857782)

Figure 344. Post test 46 minutes (223940_857783)

Figure 345. Post test 47 minutes (223940_857784)

Figure 346. Post test 47 minutes (223940_857785)

Figure 347. Post test 47 minutes (223940_857786)

Figure 348. Post test 47 minutes (223940_857787)

Figure 349. Post test 47 minutes (223940_857788)

Figure 350. Post test 47 minutes (223940_857789)

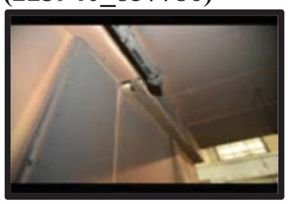

Figure 351. Post test 47 minutes (223940_857790)

Figure 352. Post test 47 minutes (223940_857791)

Figure 353. Post test 48 minutes (223940_857792)

Figure 354. Post test 48 minutes (223940_857794)

Figure 355. Post test 48 minutes (223940_857795)

Figure 356. Post test 48 minutes (223940_857796)

Figure 357. Post test 48 minutes (223940_857797)

Figure 358. Post test 48 minutes (223940_857798)

Figure 359. Post test 48 minutes (223940_857799)

Figure 360. Post test 48 minutes (223940_857800)

Figure 361. Post test 48 minutes (223940_857801)

Figure 362. Post test 48 minutes (223940_857802)

Figure 363. Post test 48 minutes (223940_857803)

Figure 364. Post test 48 minutes (223940_857804)

Figure 365. Post test 48 minutes (223940_857805)

Figure 366. Post test 48 minutes (223940_857806)

Figure 367. Post test 48 minutes (223940_857807)

Figure 368. Post test 48 minutes (223940_857808)

Figure 369. Post test 48 minutes (223940_857809)

Figure 370. Post test 48 minutes (223940_857810)

Figure 371. Post test 48 minutes (223940_857811)

Figure 372. Post test 49 minutes (223940_857812)

Figure 373. Post test 49 minutes (223940_857813)

Figure 374. Post test 49 minutes (223940_857814)

Figure 375. Post test 49 minutes (223940_857815)

Figure 376. Post test 49 minutes (223940_857816)

Figure 377. Post test 49 minutes (223940_857817)

Figure 378. Post test 49 minutes (223940_857818)

Figure 379. Post test 49 minutes (223940_857819)

Figure 380. Post test 49 minutes (223940_857820)

Figure 381. Post test 49 minutes (223940_857821)


Figure 382. Post test 49 minutes (223940_857822)


Figure 383. Post test 49 minutes (223940_857823)


Figure 384. Post test 49 minutes (223940_857824)


Figure 385. Post test 49 minutes (223940_857825)


Figure 386. Post test 49 minutes (223940_857826)


Figure 387. Post test 49 minutes (223940_857827)


Figure 388. Post test 49 minutes (223940_857828)


Figure 389. Post test 49 minutes (223940_857829)


Figure 390. Post test 49 minutes (223940_857830)


Figure 391. Post test 49 minutes (223940_857831)


Figure 392. Post test 50 minutes (223940_857832)


Figure 393. Post test 50 minutes (223940_857833)


Figure 394. Post test 50 minutes (223940_857834)


Figure 395. Post test 50 minutes (223940_857835)


Figure 396. Post test 50 minutes (223940_857836)


Figure 397. Post test 50 minutes (223940_857837)


Figure 398. Post test 50 minutes (223940_857838)


Figure 399. Post test 50 minutes (223940_857839)


Figure 400. Post test 50 minutes (223940_857840)


Figure 401. Post test 50 minutes (223940_857841)

Figure 402. Post test 50 minutes (223940_857842)

Figure 403. Post test 51 minutes (223940_857843)

Figure 404. Post test 51 minutes (223940_857844)

Figure 405. Post test 51 minutes (223940_857845)

Figure 406. Post test 51 minutes (223940_857846)

Figure 407. Post test 51 minutes (223940_857847)

Figure 408. Post test 51 minutes (223940_857848)

Figure 409. Post test 52 minutes (223940_857849)

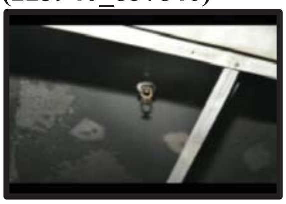

Figure 410. Post test 52 minutes (223940_857850)

Figure 411. Post test 52 minutes (223940_857851)

Figure 412. Post test 52 minutes (223940_857852)

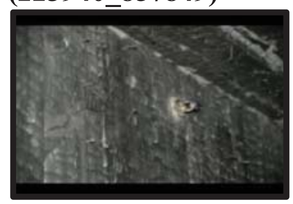

Figure 413. Post test 52 minutes (223940_857853)

Figure 414. Post test 53 minutes (223940_857854)

Figure 415. Post test 53 minutes (223940_857855)

Figure 416. Post test 53 minutes (223940_857856)

Figure 417. Post test 53 minutes (223940_857857)

Figure 418. Post test 53 minutes (223940_857858)

Figure 419. Post test 54 minutes (223940_857859)

Figure 420. Post test 54 minutes (223940_857860)

Figure 421. Post test 54 minutes (223940_857861)

Figure 422. Post test 54 minutes (223940_857862)

Figure 423. Post test 54 minutes (223940_857863)

Figure 424. Post test 54 minutes (223940_857864)

Figure 425. Post test 54 minutes (223940_857865)

Figure 426. Post test 54 minutes (223940_857866)

Figure 427. Post test 54 minutes (223940_857867)

Figure 428. Post test 54 minutes (223940_857868)

Figure 429. Post test 54 minutes (223940_857869)

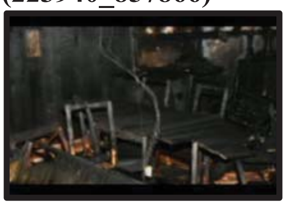

Figure 430. Post test 54 minutes (223940_857870)

Figure 431. Post test 54 minutes (223940_857871)

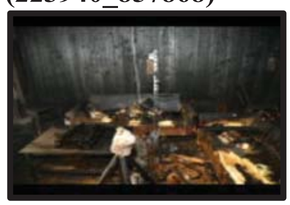

Figure 432. Post test 54 minutes (223940_857872)

Figure 433. Post test 54 minutes (223940_857873)

Figure 434. Post test 54 minutes (223940_857874)

Figure 435. Post test 54 minutes (223940_857875)

Figure 436. Post test 54 minutes (223940_857876)

Figure 437. Post test 55 minutes (223940_857877)

Figure 438. Post test 55 minutes (223940_857878)

Figure 439. Post test 55 minutes (223940_857879)

Figure 440. Post test 55 minutes (223940_857880)

Figure 441. Post test 55 minutes (223940_857881)


Figure 442. Post test 55 minutes (223940_857882)


Figure 443. Post test 55 minutes (223940_857883)


Figure 444. Post test 55 minutes (223940_857884)


Figure 445. Post test 55 minutes (223940_857885)


Figure 446. Post test 55 minutes (223940_857886)


Figure 447. Post test 55 minutes (223940_857887)


Figure 448. Post test 55 minutes (223940_857888)


Figure 449. Post test 55 minutes (223940_857889)


Figure 450. Post test 55 minutes (223940_857890)


Figure 451. Post test 56 minutes (223940_857891)


Figure 452. Post test 56 minutes (223940_857892)


Figure 453. Post test 56 minutes (223940_857893)


Figure 454. Post test 56 minutes (223940_857894)


Figure 455. Post test 56 minutes (223940_857895)


Figure 456. Post test 56 minutes (223940_857896)


Figure 457. Post test 56 minutes (223940_857897)


Figure 458. Post test 56 minutes (223940_857898)


Figure 459. Post test 56 minutes (223940_857899)


Figure 460. Post test 56 minutes (223940_857900)


Figure 461. Post test 56 minutes (223940_857901)


Figure 462. Post test 56 minutes (223940_857902)


Figure 463. Post test 56 minutes (223940_857903)


Figure 464. Post test 57 minutes (223940_857904)


Figure 465. Post test 57 minutes (223940_857905)


Figure 466. Post test 57 minutes (223940_857906)


Figure 467. Post test 57 minutes (223940_857907)


Figure 468. Post test 57 minutes (223940_857908)


Figure 469. Post test 57 minutes (223940_857909)


Figure 470. Post test 57 minutes (223940_857910)


Figure 471. Post test 57 minutes (223940_857911)


Figure 472. Post test 57 minutes (223940_857912)


Figure 473. Post test 57 minutes (223940_857913)


Figure 474. Post test 57 minutes (223940_857914)


Figure 475. Post test 58 minutes (223940_857915)


Figure 476. Post test 58 minutes (223940_857916)


Figure 477. Post test 58 minutes (223940_857917)


Figure 478. Post test 58 minutes (223940_857918)


Figure 479. Post test 58 minutes (223940_857919)


Figure 480. Post test 58 minutes (223940_857920)


Figure 481. Post test 58 minutes (223940_857921)

Figure 482. Post test 58 minutes (223940_857922)

Figure 483. Post test 58 minutes (223940_857923)

Figure 484. Post test 58 minutes (223940_857924)

Figure 485. Post test 58 minutes (223940_857925)

Figure 486. Post test 58 minutes (223940_857926)

Figure 487. Post test 58 minutes (223940_857927)

Figure 488. Post test 58 minutes (223940_857928)

Figure 489. Post test 59 minutes (223940_857929)

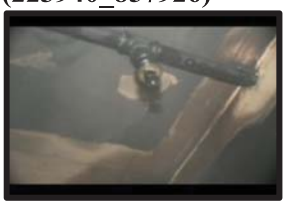

Figure 490. Post test 59 minutes (223940_857930)

Figure 491. Post test 59 minutes (223940_857931)

Figure 492. Post test 59 minutes (223940_857932)

Figure 493. Post test 59 minutes (223940_857933)

Figure 494. Post test 59 minutes (223940_857934)

Figure 495. Post test 59 minutes (223940_857935)

Figure 496. Post test 59 minutes (223940_857936)

Figure 497. Post test 59 minutes (223940_857937)

Figure 498. Post test 59 minutes (223940_857938)

Figure 499. Post test 59 minutes (223940_857939)

Figure 500. Post test 59 minutes (223940_857940)

Figure 501. Post test 59 minutes (223940_857941)


Figure 502. Post test 59 minutes (223940_857942)


Figure 503. Post test 59 minutes (223940_857943)


Figure 504. Post test 60 minutes (223940_857944)


Figure 505. Post test 60 minutes (223940_857945)


Figure 506. Post test 60 minutes (223940_857946)


Figure 507. Post test 60 minutes (223940_857947)


Figure 508. Post test 60 minutes (223940_857948)

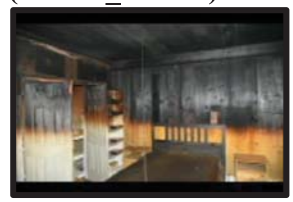
Figure 509. Post test 60 minutes (223940_857949)


Figure 510. Post test 60 minutes (223940_857950)


Figure 511. Post test 60 minutes (223940_857951)


Figure 512. Post test 60 minutes (223940_857952)


Figure 513. Post test 60 minutes (223940_857953)


Figure 514. Post test 60 minutes (223940_857954)


Figure 515. Post test 60 minutes (223940_857955)


Figure 516. Post test 60 minutes (223940_857956)


Figure 517. Post test 1:01 hr:min (223940_857957)


Figure 518. Post test 1:01 hr:min (223940_857958)


Figure 519. Post test 1:01 hr:min (223940_857959)


Figure 520. Post test 1:01 hr:min (223940_857960)


Figure 521. Post test 1:01 hr:min (223940_857961)


Figure 522. Post test 1:01 hr:min (223940_857962)


Figure 523. Post test 1:01 hr:min (223940_857963)


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Figure 525. Post test 1:01 hr:min (223940_857965)


Figure 526. Post test 1:01 hr:min (223940_857966)


Figure 527. Post test 1:01 hr:min (223940_857967)


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Figure 530. Post test 1:01 hr:min (223940_857970)


Figure 531. Post test 1:01 hr:min (223940_857971)


Figure 532. Post test 1:01 hr:min (223940_857972)


Figure 533. Post test 1:01 hr:min (223940_857973)


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Figure 535. Post test 1:01 hr:min (223940_857975)


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Figure 538. Post test 1:02 hr:min (223940_857978)


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Figure 540. Post test 1:02 hr:min (223940_857980)


Figure 541. Post test 1:02 hr:min (223940_857981)


Figure 542. Post test 1:02 hr:min (223940_857982)


Figure 543. Post test 1:02 hr:min (223940_857983)


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Figure 550. Post test 1:02 hr:min (223940_857990)


Figure 551. Post test 1:02 hr:min (223940_857991)


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Figure 558. Post test 1:03 hr:min (223940_857998)


Figure 559. Post test 1:03 hr:min (223940_857999)


Figure 560. Post test 1:03 hr:min (223940_858000)


Figure 561. Post test 1:03 hr:min (223940_858001)

Figure 562. Post test 1:03 hr:min (223940_858002)

Figure 563. Post test 1:03 hr:min (223940_858003)

Figure 564. Post test 1:03 hr:min (223940_858004)

Figure 565. Post test 1:04 hr:min (223940_858005)

Figure 566. Post test 1:04 hr:min (223940_858006)

Figure 567. Post test 1:04 hr:min (223940_858007)

Figure 568. Post test 1:04 hr:min (223940_858008)

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Figure 570. Post test 1:04 hr:min (223940_858010)

Figure 571. Post test 1:04 hr:min (223940_858011)

Figure 572. Post test 1:04 hr:min (223940_858012)

Figure 573. Post test 1:04 hr:min (223940_858013)

Figure 574. Post test 1:04 hr:min (223940_858014)

Figure 575. Post test 1:04 hr:min (223940_858015)

Figure 576. Post test 1:04 hr:min (223940_858016)

Figure 577. Post test 1:04 hr:min (223940_858017)

Figure 578. Post test 1:04 hr:min (223940_858018)

Figure 579. Post test 1:04 hr:min (223940_858019)

Figure 580. Post test 1:07 hr:min (223940_858020)

Figure 581. Post test 1:07 hr:min (223940_858021)


Figure 582. Post test 1:07 hr:min (223940_858022)


Figure 583. Post test 1:07 hr:min (223940_858023)


Figure 584. Post test 1:07 hr:min (223940_858024)


Figure 585. Post test 1:07 hr:min (223940_858025)


Figure 586. Post test 1:07 hr:min (223940_858026)


Figure 587. Post test 1:07 hr:min (223940_858027)


Figure 588. Post test 1:07 hr:min (223940_858028)


Figure 589. Post test 1:07 hr:min (223940_858029)


Figure 590. Post test 1:11 hr:min (223940_858030)


Figure 591. Post test 1:11 hr:min (223940_858031)


Figure 592. Post test 1:11 hr:min (223940_858032)


Figure 593. Post test 1:11 hr:min (223940_858033)


Figure 594. Post test 1:11 hr:min (223940_858034)


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Figure 598. Post test 1:11 hr:min (223940_858038)


Figure 599. Post test 1:11 hr:min (223940_858039)


Figure 600. Post test 1:11 hr:min (223940_858040)


Figure 601. Post test 1:11 hr:min (223940_858041)


Figure 602. Post test 1:12 hr:min (223940_858042)


Figure 603. Post test 1:12 hr:min (223940_858043)


Figure 604. Post test 1:12 hr:min (223940_858044)


Figure 605. Post test 1:12 hr:min (223940_858045)


Figure 606. Post test 1:12 hr:min (223940_858046)


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Figure 608. Post test 1:12 hr:min (223940_858048)


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Figure 610. Post test 1:12 hr:min (223940_858050)


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Figure 616. Post test 1:12 hr:min (223940_858056)


Figure 617. Post test 1:12 hr:min (223940_858057)


Figure 618. Post test 1:13 hr:min (223940_858058)


Figure 619. Post test 1:13 hr:min (223940_858059)


Figure 620. Post test 1:13 hr:min (223940_858060)


Figure 621. Post test 1:14 hr:min (223940_858061)

Figure 622. Post test 1:14 hr:min (223940_858062)