AMERICAN WOOD COUNCIL

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Errata

to the 2015/2018 Edition of the Structural Wood Design Examples

Replace page 72 with the following page:

Determine Bending Stress from Out-of-Plane MWFRS Wind Pressures

Moment

$$w_{windBWW} := \frac{(16)}{12} \cdot ft \cdot p_{mwfrsBWW}$$

Load Combination 5a includes the MWFRS Wind Load

$$w_{windBWW} = -19.65 \cdot plf$$

$$M_{mwfrsBWW} := \frac{w_{windBWW} \cdot L^2}{8} \cdot 12 \cdot \frac{in}{ft}$$

Bending moment from out-of-plane MWFRS wind loads

$$M_{mwfrsBWW} = -10642 \cdot in \cdot lbf$$

Determine Reference and Adjusted Bending Design Values for Load Combination 5a

$$C_L := 1.0$$

Depth to breadth (d/b) ratio 2<d/b≤4 End restraints for the beam-column satisfy NDS 4.4.1.2 (b) and sheathing/gypsum wall board nailing provides lateral support for the compression edges NDS 4.4.1.2 (c)

$$F'_{b5a} := F_b \cdot C_{D5} \cdot C_M \cdot C_L \cdot C_t \cdot C_F \cdot C_i \cdot C_r$$

F'_{b5a} is adjusted bending design value for Load Combination 5a

$$F'_{b5a} = 1850\,psi$$

Compare Actual Bending Stress with Adjusted Bending Design Values for Load Combination 5a

$$f_{b5a} := \frac{\left|M_{mwfrsBWW}\right|}{S_x} \qquad f_{b5a} = 810 \cdot psi \qquad F'_{b5a} = 1850\,psi$$

Bending stress resulting from out-of-plane MWFRS wind loads

$$\frac{f_{b5a}}{F'_{b5a}} = 0.44$$

Ok. Actual bending stress f_{b5a} is less than adjusted bending design value F'_{b5a}. Ratio of actual bending stress to adjusted bending design value < 1

Check Combined Uniaxial Bending and Axial Compression

$$\left(\frac{f_{c5a}}{Fc'_{5a}}\right)^2 + \frac{f_{b5a}}{F'_{b5a} \cdot \left[1 - \left(\frac{f_{c5a}}{F_{cE}}\right)\right]} = 0.5$$

< 1.0 ok (NDS 3.9-3)

$$f_{c5a} = 44\,psi \qquad F_{cE} = 424\,psi$$

Actual compression stress f_{c5a} does not exceed adjusted compression design value in plane of lateral support for edgewise bending F_{cE}. OK

Replace pages 74-78 with the following:

Determine Bending Stress from Out-of-Plane MWFRS Wind Pressures

Moment

$$w_{windBWW} := 0.75 \cdot \frac{(16)}{12} \cdot ft \cdot p_{mwfrsBWW}$$

Load Combination 6a1 includes 75% of the MWFRS Wind Load

$$w_{windBWW} = -14.74 \cdot plf$$

$$M_{mwfrsBWW} := \frac{w_{windBWW} \cdot L^2}{8} \cdot 12 \cdot \frac{in}{ft}$$

Bending moment from out-of-plane MWFRS wind loads

$$M_{mwfrsBWW} = -7982 \cdot in \cdot lbf$$

Determine Reference and Adjusted Bending Design Values for Load Combination 6a1

$$C_L := 1.0$$

Depth to breadth (d/b) ratio 2<d/b<4 End restraints for the beam-column satisfy NDS 4.4.1.2 (b) and sheathing/gypsum wall board nailing provides lateral support for the compression edges NDS 4.4.1.2 (c)

$$F'_{b6a1} := F_b \cdot C_{D6} \cdot C_M \cdot C_L \cdot C_t \cdot C_F \cdot C_i \cdot C_r$$

$$F'_{b6a1} = 1850\,psi$$

F'_{b6a1} is adjusted bending design value for Load Combination 6a1

Compare Actual Bending Stress with Adjusted Bending Design Values for Load Combination 6a1

$$f_{b6a1} := \frac{\left|M_{mwfrsBWW}\right|}{S_x} \qquad f_{b6a1} = 607 \cdot psi \qquad F'_{b6a1} = 1850\,psi$$

Bending stress resulting from out-of-plane MWFRS wind loads

$$\frac{f_{b6a1}}{F'_{b6a1}} = 0.33$$

Ok. Actual bending stress f_{b6a1} is less than adjusted bending design value F'_{b6a1}. Ratio of actual bending stress to adjusted bending design value < 1

Check Combined Uniaxial Bending and Axial Compression

$$\left(\frac{f_{c6a1}}{Fc'_{6a1}}\right)^2 + \frac{f_{b6a1}}{F'_{b6a1} \cdot \left[1 - \left(\frac{f_{c6a1}}{F_{cE}}\right)\right]} = 0.5$$

< 1.0 ok (NDS 3.9-3)

$$f_{c6a1} = 102\,psi \quad F_{cE} = 424\,psi$$

Actual compression stress f_{c6a1} does not exceed adjusted compression design value in plane of lateral support for edgewise bending F_{cE}. OK

Load Case 6a2: D + 0.75L + 0.75 W (wind perpendicular to ridge)

Determing compression load in framing for load combination 6a2

$P_{6a2} := \frac{(16)}{12} \cdot ft \cdot \left(P_{dist_{10}}\right)$ $P_{6a2} = 716 \cdot lbf$

Determine Reference and Adjusted Compression Design Values for Load Combination 6a2

$C_{D6} := 1.6$

Wind load duration factor C_D controls for Load Combination 6a - NDS Appendix B Section B.2

$F_{c6a2*} := F_c \cdot C_{D6} \cdot C_M \cdot C_t \cdot C_F \cdot C_i$

$F_{c6a2*} = 2160\,psi$

F_{c6a2}* is reference compression design value adjusted with all adjustment factors except the column stability factor $C_{P,}$. The following calculations determine the column stabilty factor C_P:

Determine Column Stability Factor C_p for Load Combination 6a2

$$C_{P6} := \frac{1 + \left(\frac{F_{cE}}{F_{c6a2*}}\right)}{2 \cdot c} - \sqrt{\left[\frac{1 + \left(\frac{F_{cE}}{F_{c6a2*}}\right)}{2 \cdot c}\right]^2 - \frac{\left(\frac{F_{cE}}{F_{c6a2*}}\right)}{c}}$$

$C_{P6} = 0.188$

Column Stability Factor for Load Combination 6a2 (NDS 3.7-1)

Determine Adjusted Compression Design Value for Load Combination 6a2

$Fc'_{6a2} := F_{c6a2*} \cdot C_{P6}$ $Fc'_{6a2} = 405 \cdot psi$

Adjusted compression design value for Load Combination 6a

Compare Actual Compression Stress with Adjusted Compression Design Value

$f_{c6a2} := \frac{P_{6a2}}{A_g}$

$f_{c6a2} = 66 \cdot psi$

$Fc'_{6a2} = 405 \cdot psi$

$\frac{f_{c6a2}}{Fc'_{6a2}} = 0.16$

Actual compression stress f_{c6a2} does not exceed adjusted compression design value F'_{c6a2}. Ratio of actual compression stress to adjusted compression design value < 1. OK

Determine Bending Stress from Out-of-Plane MWFRS Wind Pressures

Moment

$w_{windAWW} := 0.75 \cdot \frac{(16)}{12} \cdot ft \cdot p_{mwfrsAWW}$

$w_{windAWW} = 17.31 \cdot plf$

Load Combination 6a2 includes 75% of the MWFRS Wind Load

$M_{mwfrsAWW} := \frac{w_{windAWW} \cdot L^2}{8} \cdot 12 \cdot \frac{in}{ft}$

$M_{mwfrsAWW} = 9375 \cdot in \cdot lbf$

Bending moment from out-of-plane MWFRS wind loads

Determine Reference and Adjusted Bending Design Values for Load Combination 6a2

$C_L := 1.0$

Depth to breadth (d/b) ratio 2<d/b<4 End restraints for the beam-column satisfy NDS 4.4.1.2 (b) and sheathing/gypsum wall board nailing provides lateral support for the compression edges NDS 4.4.1.2 (c)

$F'_{b6a2} := F_b \cdot C_{D6} \cdot C_M \cdot C_L \cdot C_t \cdot C_F \cdot C_i \cdot C_r$

$F'_{b6a2} = 1850\,psi$

F'_{b6a2} is adjusted bending design value for Load Combination 6a2

Compare Actual Bending Stress with Adjusted Bending Design Values for Load Combination 6a2

$f_{b6a2} := \frac{|M_{mwfrsAWW}|}{S_x}$ $\quad f_{b6a2} = 713 \cdot psi$ $\quad F'_{b6a2} = 1850\,psi$

Bending stress resulting from out-of-plane MWFRS wind loads

$\frac{f_{b6a2}}{F'_{b6a2}} = 0.39$

Ok. Actual bending stress f_{b6a2} is less than adjusted bending design value F'_{b6a2}. Ratio of actual bending stress to adjusted bending design value < 1

Check Combined Uniaxial Bending and Axial Compression

$$\left(\frac{f_{c6a2}}{Fc'_{6a2}}\right)^2 + \frac{f_{b6a2}}{F'_{b6a2} \cdot \left[1 - \left(\frac{f_{c6a2}}{F_{cE}}\right)\right]} = 0.48$$

< 1.0 ok (NDS 3.9-3)

$f_{c6a2} = 66\,psi$ $\quad F_{cE} = 424\,psi$

Actual compression stress f_{c6a2} does not exceed adjusted compression design value in plane of lateral support for edgewise bending F_{cE}. OK

<u>Load Case 7a: 0.6 D + 0.6 W (wind parallel to ridge)</u>

Determing compression load in framing for load combination 7a

$P_{7a} := \frac{(16)}{12} \cdot ft \cdot \left(P_{dist_{12}}\right)$ $\quad P_{7a} = 323 \cdot lbf$

Note: by inspection, Load Case 5a controls and calculations will not be repeated for Load Case 7a.

Load Case 7b: 0.6 D + 0.6 W (wind perpendicular to ridge)

Determing axial load in framing for load combination 7b

$P_{7b} := \frac{(16)}{12} \cdot ft \cdot \left(P_{dist_{13}}\right)$ $\quad P_{7b} = -199 \cdot lbf$

Determine Adjusted Tension Design Value for Load Combination 7b

$C_{D7} := 1.6$

Wind load duration factor C_D controls for Load Combination 7b - NDS Appendix B Section B.2

$F'_{t7b} := F_t \cdot C_{D7} \cdot C_M \cdot C_t \cdot C_F \cdot C_i$

F'_{t7b} is adjusted tension design value

$F'_{t7b} = 880\ psi$

Compare Actual Tension Stress with Adjusted Tension Design Value

$f_{t7b} := \frac{P_{7b}}{A_g}$ $\quad f_{t7b} = -18 \cdot psi$

$F'_{t7b} = 880\ psi$

$\frac{f_{t7b}}{F'_{t7b}} = -0.02$

Actual tension stress f_{t7b} does not exceed adjusted tension design value F'_{t7b}. Ratio of actual tension stress to adjusted tension design value < 1. OK

Determine Bending Stress from Out-of-Plane MWFRS Wind Pressures

Moment

$w_{windAWW} := \frac{(16)}{12} \cdot ft \cdot p_{mwfrsAWW}$

Load Combination 7b includes the MWFRS Wind Load

$w_{windAWW} = 23.08 \cdot plf$

$M_{mwfrsAWW} := \frac{w_{windAWW} \cdot L^2}{8} \cdot 12 \cdot \frac{in}{ft}$

Bending moment from out-of-plane MWFRS wind loads

$M_{mwfrsAWW} = 12500 \cdot in \cdot lbf$

Determine Reference and Adjusted Bending Design Values for Load Combination 7b

$C_L := 1.0$

Depth to breadth (d/b) ratio 2<d/b<4 End restraints for the beam-column satisfy NDS 4.4.1.2 (b) and sheathing/gypsum wall board nailing provides lateral support for the compression edges NDS 4.4.1.2 (c)

$F'_{b7b} := F_b \cdot C_{D7} \cdot C_M \cdot C_L \cdot C_t \cdot C_F \cdot C_i \cdot C_r$

F'_{b7b} is adjusted bending design value for Load Combination 7b

$F'_{b7b} = 1850\ psi$

Compare Actual Bending Stress with Adjusted Bending Design Values for Load Combination 7b

$$f_{b7b} := \frac{|M_{mwfrsAWW}|}{S_x} \qquad f_{b7b} = 951 \cdot psi \qquad F'_{b7b} = 1850\,psi$$

Bending stress resulting from out-of-plane MWFRS wind loads

$$\frac{f_{b7b}}{F'_{b7b}} = 0.51$$

Ok. Actual bending stress f_{b7b} is less than adjusted bending design value F'_{b7b}. Ratio of actual bending stress to adjusted bending design value < 1

Check Combined Uniaxial Bending and Axial Tension

$$\frac{f_{t7b}}{F'_{t7b}} + \frac{f_{b7b}}{F'_{b7b}} = 0.493$$

< 1.0 ok (NDS 3.9-1)

$$\frac{f_{b7b} - f_{t7b}}{F'_{b7b}} = 0.524$$

< 1.0 ok (NDS 3.9-2)

Load Combination	Applied Stress/ Allowable Stress
5a	0.50
6a1	0.50
6a2	0.48
7b	0.52

Table comparing ratio of applied stress to allowable stresses for combined bending and axial load combinations. By inspection and comparison to gravity load combinations analyzed earlier, Load Combination 7b controls so far with combined dead plus MWFRS loads perpendicular to ridge.

Check Adequacy of Framing to Resist Components and Cladding (C&C) loads

Calculate C&C Pressures on Wall

$$C_{DCC} := 1.6$$

C_D for C&C loading

Determine External C&C Pressure Coefficient

$$EWA := \frac{L^2}{3} \cdot \frac{1}{ft^2} \qquad EWA = 120$$

Note: "EWA" is used for Effective Wind Area since "A" is a previously defined variable. Per ASCE 7 Chapter 26, EWA need not be less than $(L)^2/3$

$$GC_p(EWA) := -0.8 - 0.3 \cdot \left(\frac{\log\left(\frac{EWA}{500}\right)}{\log\left(\frac{10}{500}\right)} \right)$$

The south wall is in Zone 4. ASCE 7-10 Figure 30.4-1 / ASCE 7-16 Figure 30.3-1. The equation for GC_p for Zone 4 for 10 ft^2 < EWA < 500 ft^2

$$GC_p(EWA) = -0.909$$

External pressure coefficient for full height studs in Foyer wall

$$p_{CC}(EWA) := q_h \cdot \left[GC_p(EWA) - \left(GC_{pi}\right) \right]$$

Equation for C&C pressures for framing in the Foyer wall

$$q_h = 23.4 \cdot psf$$

$$\left[GC_p(EWA) - \left(GC_{pi}\right) \right] = -1.089$$

By observation negative external pressure coefficients (GC_p) are greater than positive external pressure coefficients. So negative external pressures and positive internal pressures (windward) create the greatest C&C pressures