AGENDA

UBC COMMISSION
STRUCTURAL ADVISORY COMMITTEE

December 4, 2014 3:00 pm
Heber M Wells Building Room 475
160 E 300 S Salt Lake City, UT
This agenda is subject to change up to 24 hours prior to the meeting.

1. Approval of the minutes from October 2, 2014
2. Review current amendments for Section 1904.2 and 1905.1.11
3. Review Chapters 21 through 24 of 2015 IBC and current amendments

INFO ITEMS

a. IEBC Amendment Status Log

Next Scheduled Meeting: January 8, 2015

Please call Sharon at 530-6163 or email ssmalley@utah.gov if you do not plan on attending this meeting.

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MINUTES

UTAH
UNIFORM BUILDING CODE COMMISSION
STRUCTURAL ADVISORY COMMITTEE
MEETING

October 2, 2014

Room 475 – 4th Floor 3:00
Heber M Wells Building
160 East 300 South
Salt Lake City UT 84111

STAFF:
Dan Jones, Bureau Manager
Sharon Smalley, Board Secretary

COMMITTEE MEMBERS:
Justin Naser
Jerel Newman (excused)
Mark Urry (excused)
Peter McDonough
Michael Buehner
Josh Blazzard
Jerry Thompson

VISITORS:
Jerod Johnson, SEAU
Marc Maguire, Utah State University
Scott Russell, NUCOR Building Systems

MINUTES

A motion was made by Michael Buehner to approve the minutes from the September 4, 2014 meeting as written. The motion was seconded by Josh Blazzard and passed unanimously.

DISCUSS REVIEWING THE CURRENT SNOW LOAD AMENDMENTS

Jerod Johnson, Scott Russell and Marc Maguire spoke to the committee in connection with the review of the current snow load amendment. Those present discussed the possibility of having a project funded to do a new study to develop a methodology for snow load calculations. A motion was made by Peter McDonough that this committee recognizes the value of this study and to endorse further development of a snow load study. The motion was seconded by Josh Blazzard. During the discussion, Dan Jones suggested that the motion should also be that a study should be accomplished to update the snow load without endorsement of a specific provider. Both the first and seconded

IEBC AMENDMENT STATUS LOG
PENDING

Section to Amend	Proponent & Agency	Approved/Denied by Committee	Commission Appr/Deny for Hearing	Published	Public Hearing	Commission Appr/Deny Amendment	Effective Date

~~(3) In IBC, Section 1904.2, a new exception 1 is added as follows and the current exception is modified to be number 2.~~

~~Exceptions:~~

~~"1. In ACI Table 4.2.1, for Exposure Class F1, change Maximum w/cm from 0.45 to 0.5 and Minimum f'c from 4,500 psi to 3,000 psi."~~

Table 19.3.2.1 Now allows up to 0.55

(4) A new IBC, Section 1905.1.~~4~~9 is added as follows: "1905.1.~~4~~9 ACI 318, Table 19.3.1.1 ~~4.2.1~~." Modify ACI 318, Table 4.2.1 to read as follows: In the portion of the table designated as "Condition~~s~~", the Exposure categorie~~s~~ and classe~~s~~ ~~are~~ deleted and replaced with the following: "F0: Concrete ~~elements~~ not exposed to freezing and thawing cycles to include footing and foundation elements that are completely buried in soil.

~~F1: Concrete elements exposed to freezing and thawing cycles and are not likely to be saturated or exposed to deicing chemicals.~~

~~F2: Concrete elements exposed to freezing and thawing cycles and are likely to be saturated, but not exposed to deicing chemicals.~~

~~F3: Concrete elements exposed to freezing and thawing cycles and are likely to be saturated and exposed to deicing chemicals.~~"

llowing

following

CODE

Table 19.3.1.1—Exposure categories and classes

Category	Class	Condition	
Freezing and thawing (F)	F0	Concrete not exposed to freezing-and-thawing cycles	
	F1	Concrete exposed to freezing-and-thawing cycles with limited exposure to water	
	F2	Concrete exposed to freezing-and-thawing cycles with frequent exposure to water	
	F3	Concrete exposed to freezing-and-thawing cycles with frequent exposure to water and exposure to deicing chemicals	
Sulfate (S)		Water-soluble sulfate (SO_4^{2-}) in soil, percent by mass[1]	Dissolved sulfate (SO_4^{2-}) in water, ppm[2]
	S0	$SO_4^{2-} < 0.10$	$SO_4^{2-} < 150$
	S1	$0.10 \le SO_4^{2-} < 0.20$	$150 \le SO_4^{2-} < 1500$ or seawater
	S2	$0.20 \le SO_4^{2-} \le 2.00$	$1500 \le SO_4^{2-} \le 10{,}000$
	S3	$SO_4^{2-} > 2.00$	$SO_4^{2-} > 10{,}000$
In contact with water (W)	W0	Concrete dry in service Concrete in contact with water and low permeability is not required	
	W1	Concrete in contact with water and low permeability is required	
Corrosion protection of reinforcement (C)	C0	Concrete dry or protected from moisture	
	C1	Concrete exposed to moisture but not to an external source of chlorides	
	C2	Concrete exposed to moisture and an external source of chlorides from deicing chemicals, salt, brackish water, seawater, or spray from these sources	

[1]Percent sulfate by mass in soil shall be determined by ASTM C1580.

[2]Concentration of dissolved sulfates in water, in ppm, shall be determined by ASTM D516 or ASTM D4130.

COMMENTARY

the water freezes and expands. The entire member need not be saturated to be susceptible to damage. For example, if the top 3/8 in. of a slab or outer 1/4 in. of a wall is saturated, those portions are vulnerable to damage from freezing and thawing, regardless of how dry the interior may be.

For any portion of a member to be resistant to freezing and thawing, that portion of the concrete needs to have sufficient entrained air and adequate strength. Adequate strength is obtained by requiring a low *w/cm*, which also reduces the pore volume and increases resistance to water penetration. Entrained air makes it more difficult for the concrete to become saturated and allows for expansion of the water when it freezes.

Exposure class varies with degree of exposure to water, as this will influence the likelihood that any portion of the concrete will be saturated when exposed to cyclic freezing and thawing. Conditions that increase the potential for saturation include longer-duration or more-frequent contact with water without intervening drainage or drying periods. The likelihood that concrete in a member will be saturated depends on project location, member location and orientation in the structure, and climate. Records of performance of similar members in existing structures in the same general location can also provide guidance in assigning exposure classes.

Exposure Category F is subdivided into four exposure classes:

(a) Exposure Class F0 is assigned to concrete that will not be exposed to cycles of freezing and thawing.

(b) Exposure Class F1 is assigned to concrete that will be exposed to cycles of freezing and thawing and that will have limited exposure to water. Limited exposure to water implies some contact with water and water absorption; however, it is not anticipated that the concrete will absorb sufficient water to become saturated. The licensed design professional should review the exposure conditions carefully to support the decision that the concrete is not anticipated to become saturated before freezing. Even though concrete in this exposure class is not expected to become saturated, a minimum entrained air content of 3.5 to 6 percent is required to reduce the potential for damage in case portions of the concrete member become saturated.

(c) Exposure Class F2 is assigned to concrete that will be exposed to cycles of freezing and thawing and that will have frequent exposure to water. Frequent exposure to water implies that some portions of the concrete will absorb sufficient water such that over time they will have the potential to be saturated before freezing. If there is doubt about whether to assign Exposure Classes F1 or F2 to a member, the more conservative choice, F2, should be selected. Exposure Classes F1 and F2 are conditions where exposure to deicing chemicals is not anticipated.

(d) Exposure Class F3 is assigned to concrete that will be exposed to cycles of freezing and thawing with the same degree of exposure to water as Exposure Class F2. Addi-

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CODE

COMMENTARY

tionally, concrete in Exposure Class F3 is anticipated to be exposed to deicing chemicals. Deicing chemicals can increase water absorption and retention (Spragg et al. 2011), which would enable the concrete to become saturated more readily.

Table R19.3.1 provides examples of concrete members for each of these exposure classes.

Table R19.3.1—Examples of structural members in Exposure Category F

Exposure class	Examples
F0	• Members in climates where freezing temperatures will not be encountered • Members that are inside structures and will not be exposed to freezing • Foundations not exposed to freezing • Members that are buried in soil below the frost line
F1	• Members that will not be subject to snow and ice accumulation, such as exterior walls, beams, girders, and slabs not in direct contact with soil • Foundation walls may be in this class depending upon their likelihood of being saturated
F2	• Members that will be subject to snow and ice accumulation, such as exterior elevated slabs • Foundation or basement walls extending above grade that have snow and ice buildup against them • Horizontal and vertical members in contact with soil
F3	• Members exposed to deicing chemicals, such as horizontal members in parking structures • Foundation or basement walls extending above grade that can experience accumulation of snow and ice with deicing chemicals

Exposure Category S is subdivided into four exposure classes:

(a) Exposure Class S0 is assigned for conditions where the water-soluble sulfate concentration in contact with concrete is low and injurious sulfate attack is not a concern.
(b) Exposure Classes S1, S2, and S3 are assigned for structural concrete members in direct contact with soluble sulfates in soil or water. The severity of exposure increases from Exposure Class S1 to S3 based on the more critical value of measured water-soluble sulfate concentration in soil or the concentration of dissolved sulfate in water. Seawater exposure is classified as Exposure Class S1.

Exposure Category W is subdivided into two exposure classes:

(a) Members are assigned to Exposure Class W0 if they are dry in service or in contact with water, but there are no specific requirements for low permeability.
(b) Members are assigned to Exposure Class W1 if there is need for concrete with low permeability to water and the penetration of water into concrete might reduce the durability of the member. An example is a foundation wall below the water table.

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CODE COMMENTARY

Table 19.3.2.1—Requirements for concrete by exposure class

Exposure class	Maximum *w/cm*[1]	Minimum f_c', psi	Additional requirements: Air content			Limits on cementitious materials
F0	N/A	2500	N/A			N/A
F1	0.55	3500	Table 19.3.3.1			N/A
F2	0.45	4500	Table 19.3.3.1			N/A
F3	0.40[2]	5000[2]	Table 19.3.3.1			26.4.2.2(b)
			Cementitious materials[3] — Types			Calcium chloride admixture
			ASTM C150	ASTM C595	ASTM C1157	
S0	N/A	2500	No type restriction	No type restriction	No type restriction	No restriction
S1	0.50	4000	II[4][5]	Types IP, IS, or IT with (MS) designation	MS	No restriction
S2	0.45	4500	V[5]	Types IP, IS, or IT with (HS) designation	HS	Not permitted
S3	0.45	4500	V plus pozzolan or slag cement[6]	Types IP, IS, or IT with (HS) designation plus pozzolan or slag cement[6]	HS plus pozzolan or slag cement[6]	Not permitted
W0	N/A	2500	None			
W1	0.50	4000	None			
			Maximum water-soluble chloride ion (Cl^-) content in concrete, percent by weight of cement[7]			
			Nonprestressed concrete	Prestressed concrete	Additional provisions	
C0	N/A	2500	1.00	0.06	None	
C1	N/A	2500	0.30	0.06		
C2	0.40	5000	0.15	0.06	Concrete cover[8]	

[1]The maximum *w/cm* limits in Table 19.3.2.1 do not apply to lightweight concrete.

[2]For plain concrete, the maximum *w/cm* shall be 0.45 and the minimum f_c' shall be 4500 psi.

[3]Alternative combinations of cementitious materials to those listed in Table 19.3.2.1 are permitted when tested for sulfate resistance and meeting the criteria in 26.4.2.2(c).

[4]For seawater exposure, other types of portland cements with tricalcium aluminate (C_3A) contents up to 10 percent are permitted if the *w/cm* does not exceed 0.40.

[5]Other available types of cement such as Type I or Type III are permitted in Exposure Classes S1 or S2 if the C_3A contents are less than 8 percent for Exposure Class S1 or less than 5 percent for Exposure Class S2.

[6]The amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount that has been determined by service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag cement to be used shall be at least the amount tested in accordance with ASTM C1012 and meeting the criteria in 26.4.2.2(c).

[7]Water-soluble chloride ion content that is contributed from the ingredients including water, aggregates, cementitious materials, and admixtures shall be determined on the concrete mixture by ASTM C1218 at age between 28 and 42 days.

[8]Concrete cover shall be in accordance with 20.6.

19.3.3 *Additional requirements for freezing-and-thawing exposure*

19.3.3.1 Normalweight and lightweight concrete subject to freezing-and-thawing Exposure Classes F1, F2, or F3 shall be air entrained. Except as permitted in 19.3.3.3, air content shall conform to Table 19.3.3.1.

R19.3.3 *Additional requirements for freezing-and-thawing exposure*

R19.3.3.1 A table of required air contents for concrete to resist damage from cycles of freezing and thawing is included in the Code, based on guidance provided for proportioning concrete mixtures in ACI 211.1. Entrained air will not protect concrete containing coarse aggregates that undergo disruptive volume changes when frozen in a saturated condition.

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CODE

Table 19.3.3.1—Total air content for concrete exposed to cycles of freezing and thawing

Nominal maximum aggregate size, in.	Target air content, percent	
	F1	F2 and F3
3/8	6	7.5
1/2	5.5	7
3/4	5	6
1	4.5	6
1-1/2	4.5	5.5
2	4	5
3	3.5	4.5

19.3.3.2 Concrete shall be sampled in accordance with ASTM C172, and air content shall be measured in accordance with ASTM C231 or ASTM C173.

19.3.3.3 For f_c' exceeding 5000 psi, reduction of air content indicated in Table 19.3.3.1 by 1.0 percentage point is permitted.

19.3.3.4 The maximum percentage of pozzolans, including fly ash and silica fume, and slag cement in concrete assigned to Exposure Class F3, shall be in accordance with 26.4.2.2(b).

19.3.4 *Alternative combinations of cementitious materials for sulfate exposure*

19.3.4.1 Alternative combinations of cementitious materials to those listed in 19.3.2 are permitted when tested for sulfate resistance. Testing and acceptance criteria shall conform to Table 26.4.2.2(c).

19.4—Grout durability requirements

19.4.1 Water-soluble chloride ion content of grout for bonded tendons shall not exceed 0.06 percent when tested in accordance with ASTM C1218, measured by mass of chloride ion to mass of cement.

COMMENTARY

R19.3.3.2 The sampling of fresh concrete for acceptance based on air content is usually performed as the concrete is discharged from a mixer or a transportation unit (for example, a ready mixed concrete truck) to the conveying equipment used to transfer the concrete to the forms. ASTM C172 primarily covers sampling of concrete as it is discharged from a mixer or a transportation unit, but recognizes that specifications may require sampling at other points such as discharge from a pump. Table 19.3.3.1 was developed for testing as-delivered concrete. ASTM C231 is applicable to normalweight concrete and ASTM C173 is applicable to normalweight or lightweight concrete.

If the licensed design professional requires measurement of air content of fresh concrete at additional sampling locations, such requirements should be stated in the construction documents, including the sampling protocol, test methods to be used, and the criteria for acceptance.

R19.3.3.3 This section permits a 1.0 percentage point lower air content for concrete with f_c' greater than 5000 psi. Such higher-strength concretes, which have a lower *w/cm* and porosity, have greater resistance to cycles of freezing and thawing.

R19.3.3.4 This provision is intended for application during concrete mixture proportioning. The provision has been duplicated in 26.4.2.2(b). Additional commentary information is presented in Chapter 26.

R19.3.4 *Alternative combinations of cementitious materials for sulfate exposure*

R19.3.4.1 This provision is intended for application during concrete mixture proportioning. The provision has been duplicated in 26.4.2.2(c). Additional commentary information is presented in Chapter 26.

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2015 IBC CHANGES

SECTIONS 2001-2002

There are no changes to these sections.

SECTIONS 2101- 2113

2101.2- 2101.3 This is a complete re-write. Reference to section 21 06 and 2107 removed. See Section 2107 in new code .Reference to ASCE 5 regarding masonry veneer removed. Paragraph on "special inspections" added.

2102.1 "anchor", "autoclaved aerated concrete" and "thin bed mortar" removed from defined terms.

2103.1 Number of reference standards reduced. Old paragraphs 2103.3 through 2103.7 combined in new 2103.1

2103.2.1 New paragraph on masonry mortar. Replaces old 2103.9

2103.2.4 New paragraph replacing old 2103.12, with new references.

2104.1 New reference to paragraph 2104.1.2. Old wording "through 2104.4" removed.

OLD PARAGRAPHS 2104.3 AND 2104.4 REMOVED (REGARDING COLD AND HOT WEATHER CONSTRUCTION)

2105.1 Added word "approved" construction documents. Added reference to TMS602

2108.3 Removed reference to "special moment frames".

2111.2 Old paragraph 2101.3.1

2111.4 Old paragraph 2111.3

2111.5 Old paragraph 2111.4

2112.2 "labeled" in *italic* in new code

2112.5 Metric conversion correction in first sentence. Different section of NFPA 211 referenced.

2113.1 Paragraph re-worded.

2113.3 Anchorage specified for design category E and F.

2113.4 Re-wording

2015 CHANGES TO THE 2012 Chapter 23 Code

2301.2 Ex 3 changed to item #4

2303.1.4 Is new, reference for glu-lams is ANSI/AITC a 190.1

2303.4.13 Engineered rim board new section

2303.4.13 add language and minor text change

2303.5 added reference for joist hangars ASTM D7147

2304.6 added word "Exterior" to wall sheathing and reworded entire section, changed reference from 2609 to table 2304.6.1

2304.10.5.3 New section see 2304.9.5.2(2012)

2304.10.6 New section formerly 2304.9.6 also changed thickness for clips from 0.040 to 0.0329

Table 2304.10.1 has changed sequence and changed attachments blocking between ceiling joists rafters and truss and top plates removed (3) 10d nails

2304.12 changed from 2304.11 protection from decay

2304.12.1 was formerly 2304.11.2

2304.12.1 To 12.5 same except removed girder ends and added to 12.1.1

2304.12.2.2 Formerly 2304.11.4.1 post or columns added to naturally durable

2304.12.2.3 Removed language for commodity specs A and F

2304.12.2.5 Cleaned up excessive test to say members that exposed to weather, concrete masonry (slabs)??? Must be a typo, what is a masonry slab?

2304.12.3.1 No apparent sig change

2304.12.5 Removed words for commodity use

2305.3 changed deflection reference to AWC SDPWS which was formerly AF & PA ASPWS

Need to maintain 2306.15 amendment?

2308.2 limitations chanbe to new code section

Table 2308.2.1 added table for clarity

2308.2.3 Changed loads to new wind speed

2308.2.6 Removed seismic zone F?

2308.3.1 Added additi9nal clarification of anchorage and increased spacing to 6 feet of

Table 2308.4.2.1(1) floor joist spans for common southern pine 1, 2, 3 all spans reduced

Maintain amendment to 2308.6?

2308.4.4.1 Openings in floor and roof sheathing is new

2308.4.4.2 renamed vertical offsets in floor diaphragms in seismic category D&E which clarified from 2012 offsets that are designed by accepted engineering practice

2308.4.6 Clarified depth ratio of framing to not less than 5:1, 6:1 etc...

2308.4.7 Changed code reference

2308.4.8 Also changed code reference

May consider an amendment in 2308.5.3.2 reference table 2304.10.1 item 13 and add a 2" wide mechanical connection face nailed each side of joint per item #13?

2308.5.4 Studs changed spacing max to 24" of from 28" of

Added utility grade studs cannot be used in walls that exceed 10' and parallel to wall dimension

2308.5.5 To 2308.5.11 openings in walls and partitions expanded this section for clarity

2308.6 was moved from 2012 2308.9.3

2308.6.5 Alternate bracing formerly 2308.9.3.1 prescriptive design methods

2308.6.7 To 6.8 braced wall connection to top plate and truss/rafter connections are new.

New Eng "out" 2308.8.1 Elements of buildings that exceed values of 2308.2 pg. 491 are allowed to be designed with common engineering standards and this code

2309.1 Structural design in accordance with AWQC WFCM 2015

2012 WFCM Changes

John "Buddy" Showalter, P.E., Bradford K. Douglas, P.E.,
Philip Line, P.E., Peter J. Mazikins, P.Eng., and Loren Ross, E.I.T.

Introduction

The 2001 Edition of the *Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings (ANSI/AF&PA WFCM-2001)* was recently updated. The updated standard designated *ANSI/AWC WFCM-2012* was approved November 29, 2011 (Figure 1). The *2012 WFCM* was developed by the American Wood Council's (AWC) Wood Design Standards Committee and is referenced in the *2012 International Residential Code (IRC)* and *2012 International Building Code (IBC)*.

Primary changes to the *2012 WFCM* are listed here and are subsequently covered in more detail:

- Design load provisions are updated per *ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures*
- Wood structural panels are permitted to resist wind uplift
- Shear wall story offset provisions are clarified
- Design values for lumber, structural glued laminated timber, and fasteners are in accordance with the *2012 National Design Specification® (NDS®) for Wood Construction* and *2012 NDS Supplement: Design Values for Wood Construction*
- Engineering design of horizontal diaphragm assemblies and vertical wall assemblies are in accordance with *Special Design Provisions for Wind and Seismic, ANSI/AWC SDPWS-2008*
- Wind exposure categories B and C are incorporated together in Chapter 3 prescriptive provisions
- Header tables include both "dropped" and "raised" header conditions

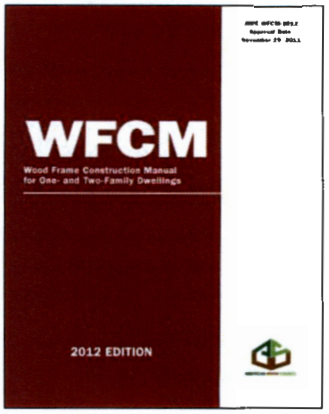

Figure 1. *Wood Frame Construction Manual (WFCM) for One- and Two-Family Dwellings, 2012 Edition*

ASCE 7-10 Load Provisions

Tabulated engineered and prescriptive design provisions in *WFCM* Chapters 2 and 3, respectively are based on the following loads from *ASCE 7-10*:

- 0-70 psf ground snow loads
- 110-195 mph 700-year return period 3-second gust basic wind speeds
- Seismic Design Categories A-D

Ground snow loads in the *WFCM* take into account both balanced and unbalanced snow load conditions. Unbalanced snow load provisions were revised in *ASCE 7-05* which resulted in reduced loads (O'Rourke 2006). Those provisions are relatively unchanged in *ASCE 7-10*, resulting in net reductions to snow loads where unbalanced cases govern.

All seismic-related tables in the *2012 WFCM* are updated to new *ASCE 7-10* seismic provisions. New risk-based maps generally reduce areas of highest seismic risk along the New Madrid fault and in the Charleston, SC area. Revised map contours will influence Seismic Design Categories of some geographic areas.

All wind-related tables in the *2012 WFCM* are updated to 700-year return, 3-second gust wind speeds. Revised wind speed maps are on a "strength design" basis. Wind speeds are higher, but load factors for design are also adjusted so that the net effect will be a reduction of wind pressures in some regions (Line 2011). There are separate wind speed maps for each Risk Category in the code, and Exposure D will become applicable again in hurricane prone regions.

When basic wind speeds from *ASCE 7-05* are used, the value shall be converted to the *ASCE 7-10* basis using Table 1.

Table 1. Wind Speed Conversion

ASCE 7-05 Basic Wind Speeds based on 50 yr. return period 3 second gust (mph)							
85	90	100	110	120	130	140	150
Equivalent ASCE 7-10 Basic Wind Speeds based on 700 yr. return period 3 second gust (mph)							
110	116	129	142	155	168	181	194

While the 90 mph wind speed zone from *ASCE 7-05* and the *2012 IRC* covers approximately the same geographical area as the 115 mph wind speed zone in *ASCE 7-10*, Table 1 shows a slight difference of 116 mph versus 115 mph due to rounding in the direct conversion from the *ASCE 7-05* basis to the *ASCE 7-10* basis. The local authority having jurisdiction should be consulted to determine whether conversion to a 115 mph basis is permissible.

Wood Structural Panels Resisting Wind Uplift

Wood structural panels can be used to resist uplift alone or simultaneously resist uplift and shear from wind forces. These provisions were adapted from *the 2008 SDPWS* (Coats 2010). Section 3.2.3 of the *2012 WFCM* now contains provisions for the use of certain wood structural panel shear walls, with a list of requirements for installation and illustrations for nailing. Capacities are based on provisions in the *2005 NDS* and have been verified by full scale testing.

The primary characteristic of this method is increased nailing of panels to framing to provide a continuous load path and enabling uplift loads to be transferred to existing wall anchorage at the foundation. A desire to investigate the inherent uplift capacity of nailed wood structural panel shear walls was the impetus for development of this design method. In the last two decades, as design standards have evolved to address losses associated with high-wind events, designers and home builders have been challenged by the substantially "beefed up" methods and equipment required to resist wind forces. Among the concerns is the number of tie-downs required for shear walls, which can present both cost increases and practical construction challenges. Traditional methods of providing for uplift resistance with additional tie-downs at shear walls can be cumbersome and expensive.

An integral Appendix of the *2012 WFCM* still contains uplift strap and ridge strap capacity tables for those wishing to maintain that option.

Shear Wall Story Offsets

Shear wall story offset provisions were clarified in the *2012 WFCM*. Shear wall segments are permitted to be offset out-of-plane from the story below by a maximum distance equal to the depth, **d**, of the floor joists (Figure 2) where all of the following conditions are met:

- Upper and lower story shear wall segments are attached to the floor diaphragm through wall plate-to blocking connection and wall plate-to band joist connections
- Floor diaphragm wood structural panel sheathing is nailed to blocking and band joist at 6" o.c.
- Allowable unit shear capacity for the shear wall above does not exceed 436 plf for wind or 239 plf for seismic
- Floor joists supporting the shear wall are nominal 2x8 or larger, tripled at ends of shear walls, and provide support for loads from roof and ceiling only
- Continuous load path is provided for uplift and overturning.

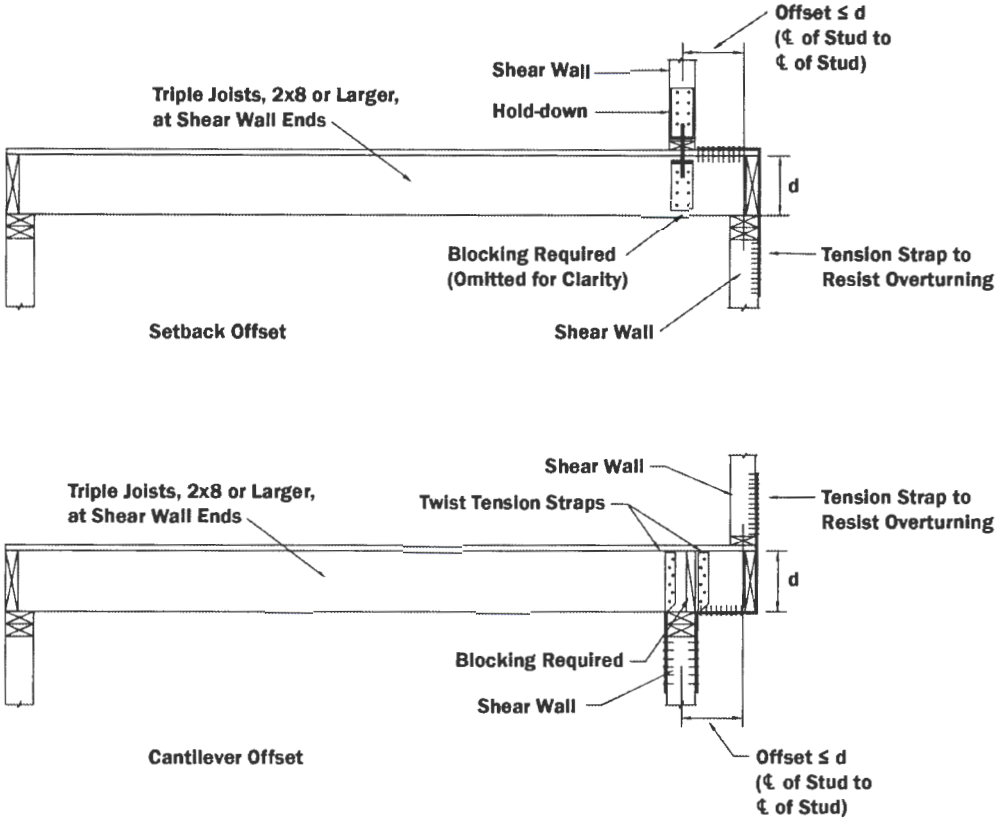

Figure 2. Shear Wall Story Offset Limits.

Design Values

Design values for structural lumber, structural glued laminated (glulam) timber, and fasteners were incorporated in the integral Supplement of the *2001 WFCM*. The *2012 WFCM* now references the *2012 NDS Supplement* for lumber and glulam design values. For fastener design values, the *2012 NDS* is the reference standard.

Shear Wall and Diaphragm Design

Design properties for horizontal diaphragms and shear walls were incorporated in the integral Supplement of the *2001 WFCM*. The *2012 WFCM* now references the *2008 SDPWS* for engineered design of shear walls and diaphragms. Prescriptive tables in *WFCM* Chapter 3 still contain shear wall and diaphragm tables similar to the *2001 WFCM*.

Wind Exposure B and C Tables

Wind Exposure C tables were incorporated in a separate Appendix in the *2001 WFCM*. The *2012 WFCM* now integrates Exposure B and C tables together in the prescriptive provisions of Chapter 3.

More Details

A comprehensive table listing section by section changes to the *WFCM*, including modifications to Supplement and Appendix material, is included as an appendix to this document.

WFCM Availability

The *2012 WFCM* is currently available for purchase in electronic format (PDF) only. Once the *WFCM Commentary* is updated (which is to be included with the *WFCM*) printed copies will be available for purchase. Check the AWC website (www.awc.org) for status updates on the *2012 WFCM*. Once the

WFCM Commentary is complete, those who purchased electronic versions of the *2012 WFCM* will receive the *WFCM Commentary* in electronic format at no additional charge.

Conclusion

The *2012 WFCM* represents the state-of-the-art for design of one- and two-family dwellings for high wind, high seismic, and high snow loads. Its reference in the *2012 IBC* and *2012 IRC* will allow for its use in those jurisdictions adopting the latest building code. However, building officials are also apt to accept designs prepared in accordance with newer reference standards even if the latest building code has not been adopted in their jurisdiction. *IBC* 104.11 and *IRC* R104.11 for alternate materials and design provides the authority having jurisdiction with that leeway.

Authors

John "Buddy" Showalter, P.E. is Vice President of Technology Transfer, Bradford K. Douglas, P.E. is Vice President of Engineering, Philip Line, P.E. is Director of Structural Engineering, Peter J. Mazikins is Senior Manager of Engineering Standards, and Loren Ross is Manager of Engineering Research with the American Wood Council. Contact Mr. Showalter (bshowalter@awc.org) with questions.

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Appendix – 2012 WFCM Summary of Changes

Section	Description
Chapter 1	1) Replaced reference to 2000 IBC with reference to ASCE 7-10 for all loading conditions addressed in the WFCM. All tabulated values adjusted to new loading requirements. 2) Added ASCE 7-10 Wind Map for Category II (Residential) structures. 3) Moved mean roof height (MRH) adjustments for building heights and exposure conditions from Chapter 1 to Chapter 2. These adjustments only apply to Chapter 2 and were moved to avoid misapplication to Chapter 3 tables and provisions. 4) Removed provision for separate check of minimum vertical projected area load for MWFRS as this provision has been reduced from 10 psf to 5 psf roof/10 psf wall in ASCE 7-10 and is now directly checked in the affected WFCM tables. 5) Added provision to clarify that special design requirements for torsional load cases have not been checked. WFCM assumes that the lateral force resisting system is in the exterior envelop of the building. 6) Added provision to clarify that sliding snow requirements have not been checked since loading condition will be building specific. 7) Deleted building aspect ratio limits to avoid confusion with diaphragm aspect ratio limits in Chapters 2 and 3. 8) Moved limitations on floor, wall, and roof assemblies and coordinated with specific limitations in Chapters 2 and 3 to avoid confusion. 9) Added provision to clarify that design of ancillary structures such as decks, balconies, carports, and porches are not addressed in this standard. 10) Updated reference standards. 11) Updated definitions to be consistent with the 2012 NDS, 2008 SDPWS, and ASCE 7-10 standards. 12) Revised notation to match variable names used in this versions of the standard. 13) Moved figures describing Chapter 2 and 3 applicability limits from Chapter 1 to respective chapters and updated references to all figures.
Chapter 2	1) Moved mean roof height (MRH) adjustments for building heights and exposure conditions from Chapter 1 to Chapter 2. These adjustments only apply to Chapter 2 and were moved to avoid misapplication to Chapter 3 tables and provisions. Added column for Exposure B to clarify that the MRH adjustment is 1.0 for all cases up to 33 feet. 2) Added provisions that require additional loading from habitable attics to be considered in design. 3) Deleted shear walls from all floor joist cantilever and setback limits in 2.1.3.2c and 2.1.3.2d to clarify that these provisions are for gravity design only. Offsets

Section	Description
	for shear walls are covered in 2.1.3.3d. 4) Modified shear wall offset provisions to prohibit upper story shear wall segments from being offset in-plane or out-of-plane from lower story shear wall segments unless designed (2.1.3.3.d). 5) Replaced shear wall aspect ratio limit with reference to SDPWS to incorporate sheathing-type specific limits. 6) Replaced lumber, glulam, and SCL design provisions and WFCM Supplement design values with reference to 2012 NDS and 2012 NDS Design Value Supplement, respectively, to ensure proper design and that framing design values are current. 7) Replaced shear wall and diaphragm design provisions and WFCM Supplement design values with reference to 2008 SDPWS to ensure proper design and that shear wall and diaphragm design values are current. 8) Replaced nail design provisions and WFCM Supplement design values with reference to 2012 NDS to ensure proper design and that fastener design values are current. 9) Updated Tables 2.5A and 2.5B for wind perpendicular and parallel to ridge respectively, and Table 2.6 for seismic motion to meet new provisions in ASCE 7-10. 10) Replaced reference to TPI's *Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses, HIB-91* with SBCA/TPI's *Building Component Safety Information (BCSI) – Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.* 11) Clarified that rafter spans in Tables 2.14A-D are based on horizontal projected length. 12) Moved figures describing Chapter 2 applicability limits from Chapter 1 to Chapter 2 and updated references to all figures. 13) Updated tables to use new design loads per ASCE 7-10.
Chapter 3	1) Limited prescriptive designs in Chapter 3 to Wind Exposures B and C only. Tables for both exposures are now included in Chapter 3. 2) Replaced provision that required an attic to be considered a separate story when the roof slope is greater than 6 in 12 with a) new requirement that habitable attics be considered an additional floor for purposes of determining gravity and seismic loads, and b) new footnotes to all lateral wind design tables (diaphragm, shear wall, and shear connection tables) that adjust bracing requirements for increased roof slopes and eave-to-ridge heights. 3) Deleted shear walls from all floor joist cantilever and setback limits in 3.1.3.2c and 3.1.3.2d to clarify that these provisions are for gravity design only. Offsets for shear walls are covered in 3.1.3.3d. 4) Clarified provisions in 3.1.3.3c for shear wall line offsets exceeding 4 feet. Added language to exception providing guidance on distribution of shear loads

Section	Description
	into shear wall lines proportional to the diaphragm area tributary to each shear wall line or by other accepted engineering practice. 5) Modified shear wall offset provision to prohibit upper story shear wall segments from being offset in-plane or out-of-plane from lower story shear wall segments (3.1.3.3.d) with an exception that permits out-of-plane offsets up to the floor joist depth when designed in accordance with specific limits. 6) Moved prescriptive uplift strap connection table (3.4B), which is based on generic steel strapping values, to the appendix (A-3.4). 7) Added provisions requiring roof-to-top plate connections to be on the same side of the wall as top plate to stud connections unless other methods are used to prevent twisting of the top plate due to eccentric loading. 8) Added provisions permitting wood structural panels (WSPs) to be used to resist uplift when designed in accordance with a new section (3.2.3) on design of WSPs to resist uplift. The provisions of and figures in the new WSP uplift section were taken directly from the 2008 SDPWS standard. 9) Moved prescriptive ridge strap connection table (3.6A), which is based on generic steel strapping values, to the appendix (A-3.6). 10) Moved stud height limit from Tables 3.23A-B footnote to a new Table 3.23C and referenced the table directly in the provisions. 11) Revised the reference shear wall configuration to wall studs spaced at a maximum of 16" o.c., sheathed with 3/8 inch wood structural panels on the exterior attached with 8d common nails at 6 inch o.c. at panel edges and 12 inches o.c. in the field, and 1/2 inch gypsum wallboard on the interior attached with 5d cooler nails at 7 inches o.c. at panel edges and 10 inches o.c. in the field. All affected tables revised. 12) Deleted requirement for adding an extra story to the building design when the bottom floor is elevated above grade. The new seismic shear wall, diaphragm and connection tables have been increased by the loads from the out-of-plane foundation walls. The foundations are assumed to be rigid and not contribute to the vertical redistribution of forces in the structure. 13) Replaced complicated interior shear wall geometry requirements with simpler provisions that require the structure to be designed as separate structures attached in the plane of the interior shear wall and clarifying that the shear wall length of the shared wall (interior shear wall) shall be the sum of the lengths required for the shear wall of each attached structure. 14) Added clarification that the shear wall length requirements in both Tables 3.17A and 3.17C must be multiplied by the appropriate full-height sheathing length adjustment factors in Table 3.17E. 15) Added clarification that hold-down capacities in Table 3.17F must be divided by the appropriate length adjustment factor in Table 3.17D. 16) Clarified that rafter spans in Tables 3.26A-H are based on horizontal projected length. 17) Moved figures describing Chapter 3 applicability limits from Chapter 1 to

Section	Description
	Chapter 3 and updated references to all figures. 18) Updated tables to use new design loads per ASCE 7-10 and resistances per 2012 NDS and 2008 SDPWS. Specific revisions to tables include the following: 1. All lateral wind bracing tables (diaphragm, shear wall, and shear connection tables) have been calculated assuming an eave-to-ridge height of 10 feet and a wall height of 10'. Tabulated requirements are based on the wind perpendicular to ridge condition (worst case) rather than providing separate tables for parallel and perpendicular to ridge removing need to specify parallel and perpendicular to ridge directionality and addressing effects of dormers, Dutch hips, etc. New footnotes to all lateral wind design tables adjust bracing requirements for increased roof slopes and eave-to-ridge heights. 2. All lateral seismic bracing tables (diaphragm, shear wall, and shear connection tables) have been calculated assuming a reference condition with the following dead load assumptions: a. Roof/Ceiling Assembly = 15 psf b. Floor Assembly = 12 psf c. Exterior Wall Assembly = 18 psf d. Partition Wall = 8 psf Adjustment factors are used to adjust for various combinations of other dead load conditions: a. Roof/Ceiling Assembly = 25 psf b. Floor Assembly = 20 psf c. Exterior Wall Assembly = 11 psf 3. New table added (Table 3.4A) that provides maximum roof spans for each wind speed that can utilize wood structural panels to resist uplift. 4. Roof sheathing attachment requirements for wind loads (Table 3.10) has been expanded to address two specific gravity ranges directly in tabular values rather than in complicated footnotes. 5. Shear wall design values and adjustment factors for various shear wall configurations were updated for consistency with 2008 SDPWS. 6. Exterior stud design tables (Table 3.20A&B) for wind were modified to cover h/180, h/240, and h/360 deflection limits as required in current model codes for flexible finishes (with gypsum wallboard on the interior), brittle finishes, and very brittle finishes (plaster or stucco), respectively. The 2001 WFCM limited deflection to h/120, previously the only code-required wall deflection limit for wind. After review of test data and analysis, it was determined that the Wall Stud Repetitive Member factor (C_r) for wind design from 2008 SDPWS is applicable to wall studs up to 24" o.c. and that a composite action factor at least equal to the C_r factor is applicable to bending stiffness calculations. These changes were incorporated into the new tables. 7. Header tables were expanded to include single-ply headers consistent with

Section	Description
	new energy code provisions, spans up to 20' to accommodate double-car garage doors, and new glulam header sizes. Also, header tables were calculated for dropped headers and raised header support conditions. 8. Rafter live load span tables were separated from rafter snow load span tables to clarify that design for wind loading of rafters can be addressed by adjusting the live load tables with simple factors covered in the footnotes.
Appendix	1) Removed Exposure C prescriptive wind design tables from Appendix since they are now included in Chapter 3. 2) Moved prescriptive uplift strap connection table (3.4B), which is based on generic steel strapping values, to the appendix (A-3.4). 3) Moved prescriptive ridge strap connection table (3.6A), which is based on generic steel strapping values, to the appendix (A-3.6).
Supplement	WFCM design value supplement tables were previously based on the 2001 NDS or other sources. With direct reference to these standards, this duplication is no longer necessary or warranted. Only those tables which are not referenced in the 2012 NDS or 2008 SDPWS are included in the WFCM Supplement section. These tables include: 1) Table S-1 Maximum Spans and Allowable Total Uniform Loads for Floor Sheathing 2) Table S-2 Maximum Spans and Allowable Total Uniform Loads for Roof Sheathing (live and snow loads) 3) Table S-3 Shear Capacities for Horizontal Diaphragm Assemblies (for gypsum wallboard ceiling diaphragms)