WOOD-OVER-PODIUM DESIGN TIPS
Lateral Design and Detailing for Wood-over-Podium Construction

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Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.
WHAT IS A PODIUM?

IBC 510.2 – HORIZONTAL BUILDING SEPARATION ALLOWANCE

A BUILDING SHALL BE CONSIDERED AS SEPARATE AND DISTINCT BUILDINGS FOR THE PURPOSE OF DETERMINING AREA LIMITATION, CONTINUITY OF FIRE WALLS, LIMITATION OF NUMBER OF STORIES AND TYPE OF CONSTRUCTION WHERE ALL OF THE FOLLOWING CONDITIONS ARE MET:

1. THE BUILDINGS ARE SEPARATED WITH A HORIZONTAL ASSEMBLY HAVING A FIRE-RESISTANCE RATING OF NOT LESS THAN 3 HOURS
2. THE BUILDING BELOW THE HORIZONTAL ASSEMBLY IS OF TYPE IA CONSTRUCTION.
3. AND MORE....SEE IBC!

MAX PODIUM STORIES?

IBC 2012 (AND PREVIOUS VERSIONS) A PODIUM WAS LIMITED TO 1-STORY IN HEIGHT. 4-ON-1 AND 5-ON-1

STARTING IN IBC 2015, THIS LIMIT WAS REMOVED ALLOWING FOR PODIUMS TALLER THAN ONE STORY. NOW THE MAX OVERALL BUILDING HEIGHT OF THE MORE RESTRICTIVE CONSTRUCTION TYPE WILL LIMIT THE PODIUM HEIGHT. 4-ON-2 AND 5-ON-2, 5-ON-3
## WOOD OVER-PODIUM: HOW TALL?

### MAX BUILDING SIZES DEPENDING ON CONSTR. TYPE

<table>
<thead>
<tr>
<th>MAX STORIES</th>
<th>TYPE IIIA</th>
<th>TYPE IIIB</th>
<th>TYPE VA</th>
<th>TYPE VB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVEL 6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>LEVEL 5</td>
<td>85 FT</td>
<td>75 FT</td>
<td>70 FT</td>
<td>60 FT</td>
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</tbody>
</table>

- Assumes residential use Type R-2
- Assumes automatic sprinklers
- Based on IBC 2015

### MAX BUILDING HEIGHT

- Represents wood construction Type IIIa
- Represents steel/concrete (Type I) podium construction

**LEVEL 8**
- MAX BUILDING HEIGHT: 85 FT

**LEVEL 7**
- MAX BUILDING HEIGHT: 70 FT

**LEVEL 6**
- MAX BUILDING HEIGHT: 75 FT

**LEVEL 5**
- MAX BUILDING HEIGHT: 85 FT

**LEVEL 4**
- MAX BUILDING HEIGHT: 85 FT

**LEVEL 3**
- MAX BUILDING HEIGHT: 70 FT
WOOD OVER-PODIUM: HOW TALL?

MAX HEIGHT = 70 FT (ASSUMES NFPA 13)

TYPE V A - 4 STORIES MAX

DELINEATION OF 3-HOUR FIRE RATED PODIUM

L2
L3
L4
L5
L6
UNIT
CORRIDOR
UNIT

L1
PARKING
RESIDENTIAL

L2
PARKING
CORRIDOR
UNIT

L1
PARKING
RESIDENTIAL

MAX HEIGHT = 85 FT (ASSUMES NFPA 13)

TYPE III A - 5 STORIES MAX

DELINEATION OF 3-HOUR FIRE RATED PODIUM

L2
UNIT
CORRIDOR
UNIT

L3
UNIT
CORRIDOR
UNIT

L4
UNIT
CORRIDOR
UNIT

L5
UNIT
CORRIDOR
UNIT

L6
UNIT
CORRIDOR
UNIT

L7
UNIT
CORRIDOR
UNIT

L2
PARKING
CORRIDOR
UNIT

L1
PARKING
RESIDENTIAL

L2
PARKING
CORRIDOR
UNIT

L1
PARKING
RESIDENTIAL
1. OPEN WEB FLOOR TRUSSES
2. CORRIDOR FRAMING 2X10@16” o.c.
3. ¾” SUBFLOOR + ACOUSTIC MAT + GYPCRETE
4. TRUSSES TYPICALLY RUN PARALLEL TO CORRIDOR
   1. MAXIMIZES DEAD LOAD ON SHEAR WALLS
   2. REDUCES LOAD LANDING ON SLAB EDGE
   3. EXTERIOR WALL HEADERS NON-BEARING
5. DOUBLE PARTITION WALL
GRAVITY – HIGH AXIAL LOADS

1. GRAVITY LOADS BECOME SUBSTANTIAL AT THE LOWER LEVELS
   1. EXPECT BEARING WALLS TO HAVE BUILT UP STUDS AT LOWER LEVELS, (3)-2X6 @ 24" O.C. FOR EXAMPLE
   2. DOUBLE PARTITION WALLS CAN BE DOUBLE 2X4 WALLS
   3. AT NON-DOUBLE PARTITION WALLS, IF POSSIBLE, USE 2X6 WALLS AT BEARING WALLS, NOT 2X4

2. STACKING WOOD POSTS BECOME LARGE. AVOID LARGE BEAM SPANS WHERE POSSIBLE.
3. THE CONTROLLING FACTOR FOR POST AND STUD SIZING IS OFTEN THE SILL/TOP PLATES LOADED PERPENDICULAR TO THE GRAIN
GRAVITY – SHRINKAGE CONSIDERATIONS

• BE AWARE OF SHRINKAGE
• LOOK FOR:
  • MASONRY SHAFTS
  • MASONRY VENEERS
  • PLUMBING RUNS
  • CHANGES IN VERTICAL MATERIAL CONSTRUCTION TYPES
• DETAIL TO MINIMIZE SHRINKAGE
• NOTIFY CONTRACTOR OF THIS

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>ROOF</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL SHRINKAGE</td>
<td>1/4”/3”</td>
<td>5/8”/3”</td>
<td>1”/3”</td>
<td>1 1/2”/3”</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:

1. THE VALUES ABOVE ARE AN ESTIMATE OF THE TOTAL SHRINKAGE A GIVEN FLOOR WILL EXPERIENCE FROM THE INITIAL WOOD INSTALLATION TO THE POINT OF FINAL COMPLETION. THE ESTIMATED SHRINKAGES SHOWN IN THIS TABLE ARE BASED ON VARIOUS ASSUMPTIONS SUCH AS STARTING MOISTURE CONTENT OF MATERIAL, ACTUAL CURRER, AND ENVIRONMENTAL CONDITIONS. THEY REFLECT ACTUAL SHRINKAGE WHICH WERE ATTEMPTED TO DETERMINE BY PROVIDING A RANGE TO THE SHRINKAGE ESTIMATE.

2. ALL PLUMBING HOLES SHOULD BE INSTALLED AND DETAINED TO BE ABLE TO ACCOMMODATE THIS MOVEMENT. EXISTING USE FLEXIBLE COUPLING OR VERTIALLY PLUMBING RUNS BETWEEN FLOORS AND TRUSS JOISTS FROM A RISER OR PERVIOUS WALL. THESE JOISTS ARE INTENDED TO ALLOW THE SHEAR MASONRY TO COMPENSATE FOR THE APPLICABLE MOVEMENTS. THE DESIGN AND SPECIFICATION FOR THESE SYSTEMS SHOULDS BE PROVIDED BY THE PLUMBING ENGINEER.

3. AT TRUSS WITH SWEEK, UNDER THE RIMBOARDS ISSUE SHOUO BE CONSIDERED IN ADDITION TO THE WINDOW ENTRANCE. THE WINDOW ENTRANCE WILL MOVE WITH THE WOOD WALL. THEREFORE IT WILL MOVE DOPHILATE AS THE WOOD SHRINKS. CONSEQUENTLY, THE BRICK VENEER WUA NOT SHRINK. IN FACT IT WILL EXPAND AS IT ABSORBS MOISTURE FROM THE ATMOSPHERE. THIS DIFFERENTIAL MOVEMENT NEEDS TO BE ACCOMMODATED IN THE DETAILING OF THE WINDOW HEAD AND SILL. WE RECOMMEND THAT THE DS OR OWNER OFFER AN ALLOWANCE TO FRAME ALL WINDOWS PERMITTING A BRICK VENEER AN ABSORPTION TYPICALLY AT THE INSULATION ANNO THE MAJORITY OF THE WOOD SHRINKAGE, WILL HAVE OCCURRED.

NO RIM BOARDS
USE FLEXIBLE COUPLING
GRAVITY – TYPE IIIA DETAILING

- **EXTERIOR BEARING WALLS** NEED TO BE 2 HOUR RATED
- **EXTERIOR WALLS** NEED TO USE FIRE TREATED LUMBER
- **TRANSFERS OF EXTERIOR BEARING WALLS** (THINK BUILDING STEPS) NEED TO MAINTAIN THE 2-HR RATING TO THE PODIUM

**FIRE RATED SHEATHING**

**LEDGER THRU DRYWALL**

**SIMPSON DGHF FIRE HANGER**

**TOP CHORD BEARING TRUSS**
LATERAL – ANALYSIS CONSIDERATIONS

1. WIND
2. SEISMIC
   1. 2-STAGE SEISMIC ANALYSIS (NEXT SLIDE)
3. STRENGTH DESIGN
   1. NAILING PATTERN
   2. HOLD-DOWN SIZING
4. DRIFT DESIGN
   1. LONGER WALLS
   2. INCREASED NAILING
   3. LARGER HOLD DOWN

\[ \delta_{sw} = \frac{8\nu h^3}{EAb} + \frac{\nu h}{1000G_a} + \frac{h\Delta_a}{b} \]

- SHEAR DEFORMATION
- FLEXURAL DEFORMATION
- HOLD DOWN ELONGATION

PHOTO BY SIMPSON
1. TREAT WOOD LEVELS AS STAND-ALONE
2. AMPLIFY SEISMIC COMPONENT ONTO PODIUM
   1. $R=6.5$ @ WOOD SHEAR WALLS
   2. $R\sim3$ @ PODIUM

ASCE 7-10 SECTION 12.2.3.2 – TWO STAGE ANALYSIS PROCEDURE

A two-stage equivalent lateral force procedure is permitted to be used for structures having a flexible upper portion above a rigid lower portion, provided the design of the structure complies with all of the following:

a. The stiffness of the lower portion shall be at least 10 times the stiffness of the upper portion.
b. The period of the entire structure shall not be greater than 1.1 times the period of the upper portion considered as a separate structure supported at the transition from the upper to the lower portion.
c. The upper portion shall be designed as a separate structure using the appropriate values of $R$ and $p$.
d. The lower portion shall be designed as a separate structure using the appropriate values of $R$ and $p$. The reactions from the upper portion shall be those determined from the analysis of the upper portion amplified by the ratio of the $R/p$ of the upper portion over $R/p$ of the lower portion. This ratio shall not be less than 1.0.
e. The upper portion is analyzed with the equivalent lateral force or modal response spectrum procedure, and the lower portion is analyzed with the equivalent lateral force procedure.
LATERAL – SHEAR WALL TYPES

1. SEGMENTED
   1. IDEAL!
2. PERFORATED
   1. EMPIRICAL
   2. WATCH OUT FOR UNIFORM UPLIFT ALONG LENGTH OF WALL
   3. AMPLIFIES HOLD DOWN FORCES
3. FTAO – FORCE TRANSFER AROUND OPENING
   1. CONTRACTORS MAY NOT PREFER
   2. ADDITIONAL ANALYSIS
LATERAL – SHEAR WALL LAYOUTS

- FLEXIBLE VS RIGID DIAPHRAGM
- OPEN FRONT STRUCTURE
  - 35 FT MAX CANTILEVER
  - L/W < 1.5:1
- IDEALLY USE SOLID WALLS
- LONGER WALLS ARE BETTER!
LATERAL – SHEAR WALLS

TOP CHORD BEARING TRUSSES

BOTTOM CHORD BEARING TRUSSES
LATERAL – SHEAR WALL DETAILING

HOW TO PASS SHEAR THROUGH FLOORS?

1. TOP CHORD BEARING – EASY
2. BOTTOM CHORD BEARING
   1. TRUSS BLOCKS
   2. SITE INSTALLED OSB BLOCKS
LATERAL – HOLD DOWN OPTIONS

1. COIL STRAPS
   1. CHEAPEST OPTION
   2. CANNOT ACCOMMODATE SHRINKAGE
   3. IF USED, NAIL TOP PORTION AS LATER AS POSSIBLE
   4. MORE COMMON IN SHORTER WOOD BUILDINGS

2. HOLD DOWNS
   1. MIDDLE GROUND
   2. CANNOT ACCOMMODATE SHRINKAGE AUTOMATICALLY
   3. CAN ALWAYS TIGHTEN THE NUT AFTER SHRINKAGE HAS OCCURRED
   4. DIRECT GC TO RETIGHTEN ALL HOLD DOWN NUTS PRIOR TO INSTALLING DRYWALL

3. CONTINUOUS ROD SYSTEMS
   1. AUTOMATICALLY COMPENSATES FOR SHRINKAGE
   2. CAN ACHIEVE HIGHER CAPACITIES
   3. SIMPSON ATS (ANCHOR TIE-DOWN SYSTEM)
   4. CLP (CONTINUOUS LOAD PATH)
   5. SUPPLIERS WILL DESIGN THE SYSTEM...EOR TO PROVIDE LOADS
1. NEED TO TRANSFER LARGE UPLIFT LOADS TO THE PODIUM
2. TRY TO KEEP THE HOLD DOWNS AWAY FROM SLAB EDGES
3. PROVIDE CONSTRUCTION TOLERANCE IN THESE DETAILS
   1. THIS IS WHERE MANY TRADES MEET
4. DRILL AND EPOXY ANCHORS……..MAYBE
   1. ONLY FOR LOW LOAD CONDITIONS
   2. AT POST-TENSIONED SLABS TRY TO AVOID DRILLING
5. ALWAYS HAVE RETROFIT SOLUTIONS IN MIND!

BAD LOCATION FOR HOLD DOWN

AVOID SLAB EDGES

LESS TOLERANCE

MORE TOLERANCE

RETOFIT SOLUTION
QUESTIONS?

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