Raise the Roof:
A Look at How your Roof Supports Your Walls and Other Uncommon Knowledge
2014 WINDSTORM INSURANCE CONFERENCE  
Workshop Presentation

Title

Raise the Roof: A Look at How Your Roof Supports Your Walls and Other Uncommon Knowledge

Summary Description

This presentation will focus on wind damages to buildings, individual components and structural systems, and the relationship of the building envelope with respect to the integrity of the structure during a high wind event. The presentation will discuss the load path concept engineers utilize in design and discuss how the failure of one component in the load path can lead to catastrophic failure of an entire system. A discussion on construction considerations, International Building Code and Florida Building Code upgrades, and repair protocols/methods will be included. The presentation will include graphical demonstrations outlining the multiple roles building components play in a structure and the affects of their individual failures.

Description

This presentation focuses on wind damages to buildings, the relationship of the building envelope with respect to the integrity of the structure, and the relationship of individual building components with respect to a structural system during a high wind event. The different types of individual building envelope components that will be discussed include doors, sliding glass doors, skylights, overhead/garage doors, and windows. The presentation will outline the roles of individual components with respect to various structural systems. This will include timber framing in roof truss, wall systems, and floor systems; sheathing in wall, roof, and floor systems; and concrete masonry units (CMU) in wall and shear construction. The presentation will utilize graphical demonstrations to present the concept of load path in the design of a structure as well as to discuss how the stability of an individual component affects the global stability of the structure. The presentation will focus on the interdependent relationship between supported systems and their respective load bearing system (i.e. roofs and walls, sheathing and trusses, sheathing and walls, floors and walls, etc.). This information will be then help to further explain how the failure of a supported system can lead to the failure of the load bearing system. A simplified explanation of building enclosures and exposures as well as the design considerations necessary for each condition will be included. A discussion on anticipated International Building Code and Florida Building Code required upgrades and repair protocol will be included.
Speakers

Clayton L. Prescott, P.E., S.E., RRC; Principal Structural Engineer
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Biographies

Clayton L. Prescott, PE, SE is a Principal Structural Engineer with Biller Reinhart Structural Group, Inc. Mr. Prescott earned a BS in Civil Engineering from The University of South Florida and is a Licensed Professional Engineer (PE) registered in the State of Florida. He has over a decade of experience in the field of structural engineering design for both new and existing structures, repairs of existing structures, consultation, assessments and inspections. Mr. Prescott has also earned his Registered Roof Consultant (RRC) designation from RCI, Inc. and has extensive knowledge of the building envelope and roof systems; providing unbiased expertise on roofing standards, regulations, applications, products and systems, for design, analysis, restoration and repair, quality assurance and expert testimony. Additionally, Mr. Prescott, is a FEMA certified structures specialist and heavy equipment and rigging specialist for the Urban Search and Rescue. Mr. Prescott is a member of the Tampa Bay Area Urban Search and Rescue Team – FL Task Force-3. Mr. Prescott has been deployed on multiple occasions to participate in operations to aid states affected by hurricanes, natural disasters and other catastrophic events.

David L. Compton, PE is a Senior Project Engineer at Bracken Engineering, Inc. Mr. Compton earned a Master of Engineering and a BS in Civil Engineering from the University of South Florida. Mr. Compton is a Licensed Professional Engineer registered in a number of states including the State of Florida. Mr. Compton’s structural engineering experience includes the design and analysis of proposed and existing structures, retrofitting existing structures for increased loading conditions, construction inspection and investigative and forensic evaluations of residential and commercial structures for damage and structural failures. Additionally, Mr. Compton is an Advanced Structures Specialist - STS2 and a member of the Southwest Florida Urban Search & Rescue Team - FL Task Force-6.
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**Topic Outline**

I. Factors Considered when Analyzing Wind Pressure

A. Main Wind Force-Resisting System (MFRS) v Components and Cladding

B. Variables Included in Wind Pressure Calculation

1. Building and Site Exposure
2. Surrounding Topography
3. Wind Direction
4. Structure Risk Category
5. Structure Occupancy Type
6. Wind Speed
II. **Code Required Anticipated Wind Speeds**

A. Wind speed map of Country; with focus on Florida and Gulf Coast

B. Extent of High Velocity Winds from Various Hurricanes

C. **SAFFIR-SIMPSON Scale** (*Qualitative assessment tool*)
   1. 3 second gust
   2. 1 minute average wind speed

<table>
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<th>Hurricane Category</th>
<th>Sustained Wind Speed (1)</th>
<th>Central Barometric Pressure</th>
<th>Storm Surge</th>
<th>Damage Potential</th>
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<td>inches of mercury</td>
<td>millibars</td>
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<td>5</td>
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<td>&lt;27.17</td>
<td>&lt;920</td>
<td>&gt;18</td>
</tr>
</tbody>
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1000 millibars = 100 kPa
(1) 1-minute average wind speed at 33 ft (10 m) above open water

D. **Debris Impact Zones (Small and Large Missiles)**

E. 2005 wind speeds vs. 2010 wind speeds
III. Wind Pressure Distribution on Structures

A. Wind Pressure Zones on Roofs *(Including Photographic Examples)*
   a. Outline of how various roof geometry affects wind loading

B. Wind Pressure Zones on Walls *(Including Photographic Examples)*

C. Internal Building Pressures
   1. Open
   2. Partially Enclosed
   3. Enclosed
IV. Building Envelope and Structural Components

A. Roof
   a. Timber Framed
   b. Light Gauge Metal Framing
   c. Commercial Construction Systems (steel beam and steel bar joist)
   d. Hip vs Gable Roof and their respective bracing requirements
   e. Deck types (OSB, Plywood, Corrugated Metal Deck, Nailable Insulation, Composite Systems, etc.)
   f. Roof membrane coverings
   g. Affects of fastening patterns
   h. Load Path for vertical and lateral loads

B. Walls
   a. Timber Framing/Light Gauge Metal Framing
   b. CMU construction
   c. Sheathing types (OSB, Plywood, Densglass)
   d. Affects of fastening patterns
   e. Load path for vertical and lateral loads

C. Floors
   a. Timber Framed (truss, sawn lumber, engineered lumber)
   b. Commercial Construction Systems (steel beam and steel bar joist)
c. Deck types (OSB, Plywood, Corrugated Metal Deck, Concrete, Composite Systems, etc.)

d. Affects of fastening patterns

e. Load Path for vertical and lateral loads

D. Openings

a. Window

b. Doors

c. Protection of openings

E. Product Approval and NOA Approvals
V. Wind Related Damages and Effects on Buildings

A. Wall Component Failure
   1. Large Missile Impact
   2. Small Missile Impact
   3. Window Anchoring and modes of failure
   4. Door anchoring and modes of failure
   5. Door anchoring and modes of failure

B. Roof Component Failure
   1. Large Missile Impact
   2. Skylight Failure
   3. Membrane Failure
   4. Decking Failure
C. System Failure
1. Component failure leads to system failure
2. Role of redundancy in design of systems
3. Effects on internal pressure once building envelope has failed
4. Graphic demonstration showing changes in internal pressure pre and post failure of building envelope
5. Common domino effect of failure components

D. Storm Surge

E. Scouring

F. Wind Driven Rain

G. Moisture Intrusion through components and systems

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V. Construction Considerations

A. Following the load path

B. The interdependent relationship of supported and load bearing systems

C. The affects of bracing on components and how it is utilized.

D. Strapping (roof, floor, wall, foundation)

E. Structure Shear Walls (timber framed and CMU)

F. Building Diaphragms (floor and roof)
VI. Code Requirements/Upgrades

A. *Florida Building Code* 25% Area Based Rule

B. *Florida Building Code* Hurricane Mitigation Rule
   1. Secondary Water Barrier
   2. Roof Deck Fastening
   3. Supplemental Strapping Requirements
   4. Supplemental Bracing Requirements (Gable and Hip Roof)
   5. Prioritization Code Requirements

C. FEMA 50% Value Based Elevation
   Requirements for Structures in Flood Zones

D. New Door and Window Installation Requirements

E. Reinstallation of Windows and Doors