RESIDENTIAL SUBMITTAL SEMINAR

November 18, 2004

Purpose of Today's Seminar

- Review code requirements for residential submittal.
- Present SEAU's position on minimum requirements for a non-conventional residential submittal.
- Review the common missed design and detailing items in a residential submittal.
- Provide a panel of design professionals and building officials to answer questions on residential design.

Overview of Home Design

- Modern homes are some of the most complex structures that a building department will see. Even for the engineer, they are among the most difficult to analyze properly.

- With multi-pitched and stepped roofs, stepped floors, clear stories, large window openings and floors with large openings, the conventional design requirements of IBC 2308 or the minimum requirements of the IRC do not apply to most of the homes being designed in our area.

Code Requirements

- The IRC and section 2308 of the IBC are similar in their requirements and define homes that can be designed under the heading of “conventional construction”.
- Some of the basic requirements that must be met for a home to fall under the conventional construction requirements are:

- Three stories or less above grade
  - Two stories for SDC D or E (D_1 and D_2 in the IRC)
- Bearing and foundation wall floor to floor heights < 10’
- Roof dead loads < 15 psf
  - 25 psf allowed if shearwall elements spaced closer together
- Floor dead loads < 15 psf
- Ground snow load < 50/70 psf (35/40 psf design snow loads)
- Wind load < 100 mph (110 mph per IRC if exposure A or B)
- Truss span < 40’

- Irregular structures are not allowed including:
  - Shearwalls not aligning vertically*
  - Shearwalls staggered horizontally over openings*
  - Shearwalls missing on one or more sides
  - Shearwalls sitting on cantilevered joist ends*
  - Vertical offset in floor lines
  - Shearwalls not perpendicular to each other
  - Large openings in exterior walls or floor diaphragms
    - 12' openings or 50% of least dimension
    - 25% of floor or roof area between orthogonal braces
  - Masonry/concrete shearwalls are not allowed in combination with sheathed shearwalls in the IRC

TABLE 2308.12.4
WALL BRACING IN SEISMIC DESIGN CATEGORIES D AND E
(Minimum Length of Wall Bracing per each 25 Linear Feet of Braced Wall Line)

Story Location	Sheathing Type	$0.50 \le S_{DS} < 0.75$	$0.75 \le S_{DS} < 1.0$	$1.0 < S_{DS}$
Top or only story	S-W	8 feet 0 inches	9 feet 4 inches	12 feet 0 inches
Story below top story	S-W	13 feet 4 inches	17 feet 4 inches	21 feet 4 inches
Bottom story of three story	S-W	Not Permitted	Not Permitted	Not Permitted

- Because of the limits on Conventional Construction most homes will require design based on the IBC/ASCE-7 requirements with design based on accepted engineering practice.

Code Requirements for Submittal

- IRC Section R106
  - R106.1.1 Information on the construction documents…Construction documents shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show IN DETAIL that it will conform to the provisions of this code and relevant laws, ordinances, rules and regulations, as determined by the building official.

- R106.3 Examination of documents. The building official shall examine or cause to be examined the accompanying construction documents and shall ascertain by such examinations whether the construction indicated and described is in accordance with the requirements of this code and other pertinent laws or ordinances.

- IBC Section 1603
  - 1603.1 General. Construction documents shall show the size, section and relative locations of structural members with floor levels, columns centers and offsets fully dimensioned. The design loads and other information pertinent to the structural design required by Sections 1603.1.1 through 1603.1.8 shall be clearly indicated on the construction documents for parts of the building or structure.

- 1603.1.1 Floor live load. The uniformly distributed, concentrated and impact floor live loads used in the design shall be indicated for floor areas. Live load reduction of the uniformly distributed floor live loads, if used in the design, shall be indicated.

- 1603.1.2 Roof live load. The roof live load used in the design shall be indicated for roof areas.
- 1603.1.3 Roof snow load. The ground snow load, P_g, shall be indicated. ...the following additional information shall also be provided...
  - Flat-roof snow load, P_f
  - Snow exposure factor, C_e
  - Snow load importance factor, I_s
  - Thermal factor, C_t

- 1603.1.4 Wind design data. The following information related to wind loads shall be shown...
  - Basic wind speed (3-second gust), mph
  - Wind importance factor, I_w, and building category
  - Wind exposure...
  - The applicable internal pressure coefficient
  - Component and cladding, design wind pressure...used for the design

- 1603.1.5 Earthquake design data. The following information related to the seismic loads shall be shown, regardless of whether seismic loads govern the design of the lateral-force-resisting system of the building:

- Seismic importance factor I_E
- Seismic use group
- Mapped spectral response accelerations S_s and S_1
- Spectral response coefficients S_{DS} and S_{D1}
- Seismic design category
- Basic seismic-force-resisting system(s)
- Design base shear
- Seismic response coefficient(s), C_s
- Response modification factor(s), R
- Analysis procedure used

- 1603.1.6 Flood Load
  - Typically not an issue – See code
- 1603.1.7 Special loads. Special loads that are applicable to the design of the building, structure or portions thereof shall be indicated along with the specified section of this code that addresses the special loading condition.

- 1603.1.8 System and components requiring special inspections for seismic resistance. Construction documents or specifications shall be prepared for those systems and components requiring special inspection for seismic resistance as specified in Section 1707.1 by the registered design professional responsible for the design and shall be submitted for approval in accordance with Section 106.1. Reference to seismic standards in lieu of detailed drawings is acceptable.

- 1603.2 Restrictions on loading. It shall be unlawful to place, or cause to permit to be placed, on any floor or roof of a building, structure or portion thereof, a load greater than is permitted by these requirements.
- 1603.3 Live loads posted.
  - Does not apply to residential construction.
- 1603.4 Occupancy permits for changed loads.
  - Does not apply to residential construction.

- State Amendment R156
  - No changes to section 1603.

SEAU Recommended Minimum Requirements for Residential Submittal

- Footing & Foundation Plan
  - Footing thickness, width and reinforcement
  - Hold-down sizes and locations
  - Sill plate anchorage
  - Foundation wall thickness and reinforcing

- Floor Framing Plans
  - Beam & joist sizes and spacing
  - Column sizes
  - Lateral bracing element (shearwall) size or scheduled callout and locations
  - Uplift floor ties (hold-downs)
  - Connection callout or detail reference
  - Collectors and struts
  - Design loads

- Roof Framing Plans
  - Beam & joist size and spacing
  - Column sizes
  - Lateral bracing element (shearwall) size or scheduled callout and locations
  - Connection callouts or detail references
  - Collectors and struts
  - Assumed truss layout if applicable and truss collectors, struts and chords
  - Design loads; including unbalanced snow and drift loads

- Details
  - General structural notes denoting material strengths/grades and general structural requirements
  - Shearwall schedules (or show information on details i.e. A35 anchors, uplift anchors, shearwall sheathing and nailing, sill plate nailing and anchorage)
  - Basic shear transfer details from horizontal to vertical diaphragms

- Connections including
  - Beam to beam (hangers to be scheduled or called out on the plans)
  - Beam to column
  - Columns or beams to foundation system
  - Lateral straps and ties
- Non-standard details
  - Steel, concrete or masonry material connections
  - Special design (i.e. perforated shearwalls, moment frames)

- Calculations
  - General
    - Code or Standard used in the design
    - Load calculations used in the design (LRFD, ASD, Alternate ASD)
    - If the IRC or IBC conventional construction is used in the design, the design professional must justify and "prove" that the minimum design standards are met based on the appropriate code. It is not enough to state that the design is per the IRC or IBC section 2308, justify the design as part of the calculations.

- Gravity Design
  - Footing design and soil requirements or assumptions used in the design
  - Foundation wall reinforcement
  - Columns
  - Beams. headers and joists
  - Drift, sliding, eave and unbalanced snow loading
  - Exterior stud walls if h>10’ or heavily loaded

- Lateral Design
  - Determination of redundancy ρ
  - Seismic base shear calculations
  - Wind base shear calculation
  - Shearwall design based on controlling lateral force including connections and force transfer if perforated shearwall method used
  - Collector and diaphragm design
  - Hold-down design at foundation and intermediate floor lines including foundation resisting dead load
  - Shear transfer design between horizontal and vertical diaphragms
  - Shear transfer design to foundation system
  - Provide design and input criteria along with key plans as needed for computer analysis along with the appropriate output

- Calculations must be wet stamped, signed and dated by the engineer of record. Computer generated stamp is allowed with an original signature. Computer generated or copied signatures are not allowed.
- The structural drawings shall be wet stamped, signed and dated by the design professional as required by the local Building Department.
- Non-conventional lateral construction should designed by a licensed engineer.

Design and detailing that is often missing on a residential submittal

- Gravity
  - Footing and column design
  - Drift, sliding, eave and unbalanced snow loading
  - Tall bearing wall stud design for axial plus bending
  - Non standard loading (heavy shingles or concrete toppings on floors not accounted for)
  - Connection
  - Truss layout

- Lateral
  - Calculation for redundancy ρ
  - Height/width ratio of shear panels exceeded or incorrect use of perforated shearwall design
  - Incorrect use of foundation hold-down strap allowable loads where applied over a rim joist
  - 3x sill plate and panel edge requirements for high shear elements
  - Hold-down design where wind and seismic loading are similar (2/3 wind reduction vs .9 seismic)
  - Resisting dead load at hold-down locations

- Details
  - Connections
  - Basic shear transfer detailing
  - General structural notes
  - Veneer support

- "Estimates of damage to single-family dwellings in the San Fernando earthquake ranged from $58 million to $114 million. The damage to residences – mostly of modern design and construction – was of greater dollar value than damage to any other building category in the private sector."

ATC 4A Methodology for Seismic Design and Construction of Single-Family Dwellings.

- Building Department Comments
  - Anne vonWeller – Chief Building Official Murray City
- Importance of plan/pier review
  - Scott Marsell – Chief Building Official Sandy City

- Question & answer and panel discussion
  - Ron Ivie – Head Building Official Park City
  - Gilbert Gonzales – Plans Examiner Murray City
  - Jon DeGray – Jonathan DeGray Architect P.C.
  - Chris Jensen – Principal JSA Architects
  - Craig Lym – Project Manager JM Williams
  - Matthew Roblez – Head of Structural Department McNeil Engineering
  - Carl Eriksson – Kearns Improvement District