# IBC 2006 & ASCE 7-05 Structural Provisions

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# Schedule of Adoption

- 2006 IBC, ASCE 7-05 and material standard documents are available now.
- 2007 CBC will be published by ICC on or before July 1, 2007.
- 2007 CBC/2006 IBC will become law on Jan.1, 2008.
- From July 1 to Jan. 1 interval is “optional” to designers & building officials

# What Books do I need..?

| Book | Typ. Member Price |
|---|---|
| 2006 IBC | $73 |
| SEI/ASCE 7-05 | $94 |
| Material Standards: | |
| AISC Manual | $175 |
| AISC Seismic | $20 |
| ACI 318-05 | $98 |
| MSJC Std. (ACI 530/ASCE5/TMS 402) | $72 |
| AF&PA - NDS & SDPWS | $40 |
| Approx. total | $572 |
| Plus: SEAOC Design Manuals! | $130 for 3 vol. set |
| NEHRP 450-1&2 | Free! |

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# Changes to Load Combinations Strength (LRFD) Design

| <u>1997 UBC</u> | <u>2006 IBC</u> |
|---|---|
| 1.4 D | 1.4 D |
| $1.2D + 1.6L + 0.5(L_r)$ | $1.2D + 1.6\,L + 0.5(L_r$ or $R)$ |
| $1.2D + 1.6(L_r) + (f_1L$ or $0.8W)$ | $1.2D + 1.6(L_r$ or $R) + (f_1L$ or $0.8W)$ |
| $1.2D + \mathbf{1.3W} + f_1L + 0.5(L_r)$ | $1.2D + \mathbf{1.6W} + f_1L + 0.5(L_r$ or $R)$ |
| $1.2D \pm E + f_1L$ | $1.2D + E + f_1L$ |
| $0.9D \pm (\rho \mathbf{E_h}$ or $\mathbf{1.3W})$ | $0.9D + \mathbf{1.6W}$ |
| | $0.9D + \mathbf{E}$ |

where $E = \rho E_h \pm E_V$

$E_V$ = no longer includes Importance Factor

S,H,F,T combinations not shown

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# Changes to Load Combinations Basic (ASD) Design

## 1997 UBC

$D$

$D + L + L_R$

$D + (W \text{ or } \mathbf{E/1.4})$

$D + 0.75[L + L_R + (W \text{ or } E/1.4)]$

$\mathbf{0.9D} \pm \mathbf{E/1.4}$

$E_V = 0$

## 2006 IBC

$D$

$D + L$

$D + (L_R \text{ or } R)$

$D + 0.75(L) + 0.75(L_R \text{ or } R)$

$D + (W \text{ or } \mathbf{0.7E})$

$D + 0.75[L + (L_R \text{ or } R) + (W \text{ or } 0.7E)]$

$\mathbf{0.6D + W}$

$\mathbf{0.6D} + \mathbf{0.7E}$

for this set of load combinations,
$E = \rho E_h \pm E_V$ where $E_V = 0.14S_{DS}D$

S,H,F,T combinations not shown

# Changes to Load Combinations Alternate (ASD) Design (IBC1605.3.2)

<u>1997 UBC</u>

$D + L + (L_R)$

D + L + **W**

D + L + E/1.4

0.9D ± E/1.4

$E_V = 0$

1/3 stress increase is permitted w/ W or E

<u>2006 IBC</u>

$D + L + (L_R$ or $R)$

D + L + **1.3W**

**Use 2/3D to counteract Wind uplift**

D + L + E/1.4

0.9D ± E/1.4

$E_V = 0$

1/3 stress increase is permitted w/ W or E

The 25% reduction in E overturning from ASCE 7 Sect. 12.3.4 is <u>not</u> permitted with Alt. ASD comb.

S (snow) combinations not shown

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# Wind Design (ASCE 7-05)

- Simplified UBC wind method no longer exists;
  - Efforts ongoing to re-introduce a simplified method
- Even "simplest" ASCE 7 method is lengthy and complex, but may not often govern within LA area.
- W load cases include
  - direct lateral force in each direction
  - 0.75 force + wind "torsion" component
  - (at least 4 W conditions to consider)

# IBC seismic provisions

# IBC Section 1613

- Scope *(next slide)*
- Definitions needed to determine Site Class (soil type).
- Definitions needed to determine Seismic Design Category (SDC).
- A few alternatives to ASCE 7.
- Copies of Ground Motion maps

# IBC Section 1613.1 Scope.

"Every structure, and portion thereof, including nonstructural components that are permanently attached to structures and their supports at attachments, shall be designed and constructed in accordance with ASCE 7, excluding Chapter 14 and Appendix 11A. The seismic design category for a structure is permitted to be determined in accordance with Section 1613 or ASCE 7."

(*IBC then lists 4 exceptions for some residential, prescriptive, agricultural shed and undefined construction)*

*(ASCE 7 Ch 14 contains exceptions to Material standards)*
*(ASCE 7 App 11A contains QA/QC Provisions)*
Both are replaced by similar (not identical) IBC Provisions

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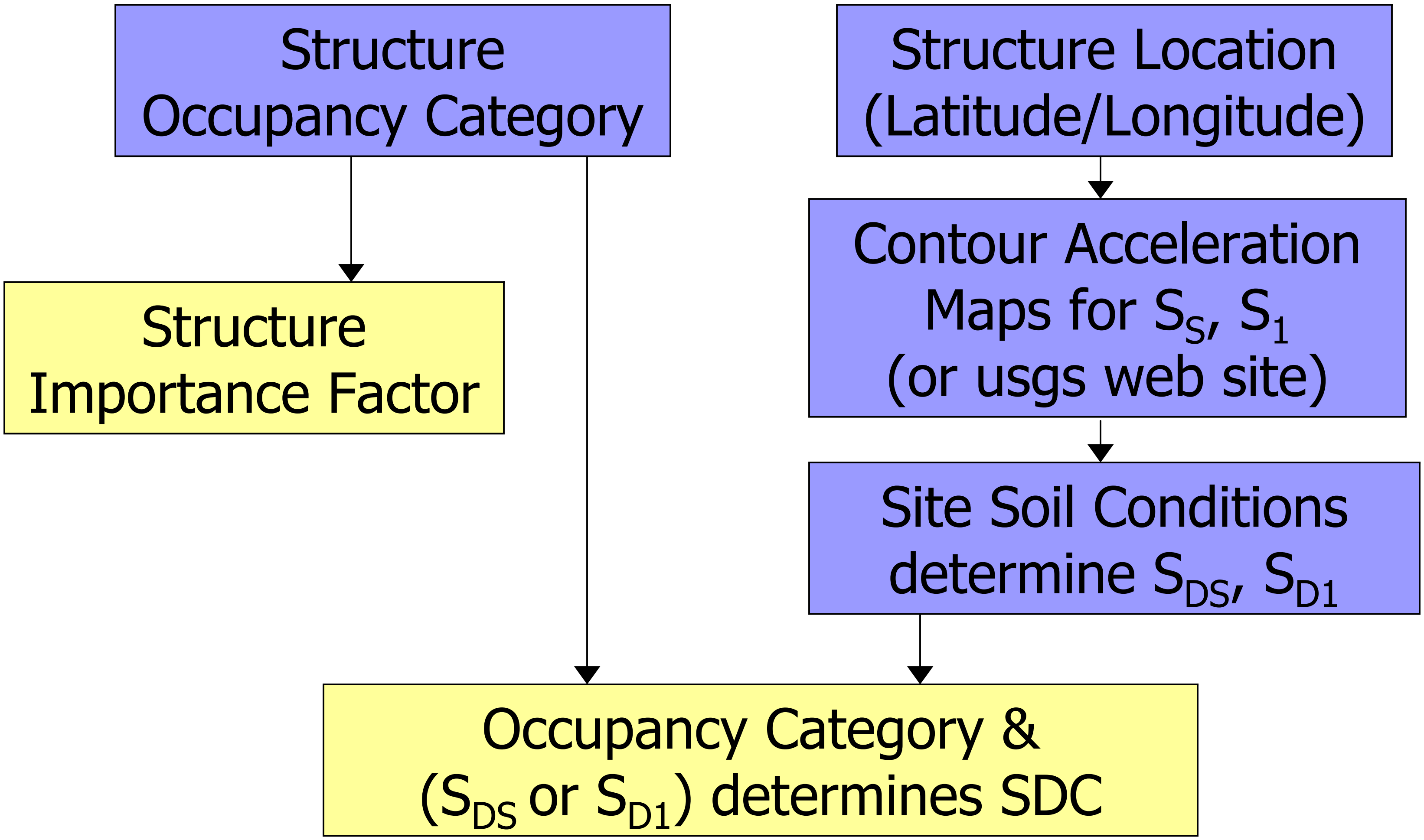
# Seismic Design Category (SDC)

## Replaces Seismic “Zones”

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## IBC Table 1604.5
## Occupancy Category (Partial List)

| Occupancy Category | Nature of Occupancy |
|---|---|
| I | Minor storage, agricultural & temporary facilities |
| II | Normal Buildings |
| III | ■Schools<br>■Public assembly >300 occupants<br>■Jails & detention facilities<br>■Some types of healthcare > 50 occup.<br>■Power-generation, water-treatment facilities<br>■Any building > 5,000 occupants<br>■Hazardous occupancies |
| IV | Hospitals, Fire, rescue, & police stations<br>Emergency preparedness centers, & more |

# Seismic Importance Factors

| Occupancy Category | *I* - Factor |
|---|---|
| I or II | 1.0 |
| III | 1.25 |
| IV | 1.5 |

# Definition of $S_S$,$S_1$,$S_{MS}$,$S_{M1}$,$S_{DS}$and $S_{D1}$

- Traditional 10%/50 yr (475-year event) is history in building codes.
- ASCE 7-05 uses 2/3 of the 2%/50 yr (2,500 year event)
- $S_S$ and $S_1$ = map values of 2,500 year event.
  - Maps assume Type B (rock) soil conditions
  - Default soil is Type D
- $S_{MS}$ and $S_{M1}$ are 2,500 year values adjusted for design soil conditions by coefficients $F_a$ and $F_v$.
- $S_{DS}$ = 2/3 $S_{MS}$ and $S_{D1}$ = 2/3 $S_{M1}$ = DESIGN VALUES
- Equiv. recurrence interval of the $S_{DS}$, $S_{D1}$ in Calif. will vary depending on fault creep rate & characteristic interval.
  - Some sites < 300 years, others perhaps 750 years.

# Deterministic "Cap" on $S_S$, $S_1$

- In near-fault zones, purely probabilistic acceleration contours become close and $S_S$, $S_1$ for 2,500 year event could become VERY large.
- $S_S$, $S_1$ values invisibly transition from a 2,500-year "probabilistic" event to a "deterministic" event defined as "150% of the median accelerations of the characteristic event."
- Magnitude of Characteristic event is defined as equal to the maximum magnitude capable of occurring on the fault, but not less than the largest magnitude that has historically occurred on the fault.

# Every structure must be assigned to a Seismic Design Category (SDC)

Determination of SDC uses two tables Based on $S_{DS}$ and $S_{D1}$

SDC Based on Short-Period Response $S_{DS}$

| Value of $S_{DS}$ | Occupancy Category | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{DS} < 0.167g$ | A | A | A |
| $0.167g < S_{DS} < 0.33g$ | B | B | C |
| $0.33g < S_{DS} < 0.5g$ | C | C | D |
| $0.5g \le S_{DS}$ | D | D | D |
| → mapped $S_1 \geq 0.75g$ | E | E | F |

Many near-fault sites have $S_1 \geq 0.75g$

# Seismic Design Category (SDC) Basic Method Cont'd

SDC Based on 1-Second Response Period

| Value of $S_{D1}$ | Occupancy Category | | |
|---|---|---|---|
| | I or II | III | IV |
| $S_{D1} < 0.067g$ | A | A | A |
| $0.067g < S_{D1} < 0.133g$ | B | B | C |
| $0.133g < S_{D1} < 0.2g$ | C | C | D |
| $0.2g \leq S_{D1}$ | D | D | D |
| mapped $S_1 \geq 0.75g$ | E | E | F |

Many near-fault sites have $S_1 \geq 0.75g$

# Example Problem; Calculation of design accelerations $S_{DS}$ & $S_{D1}$

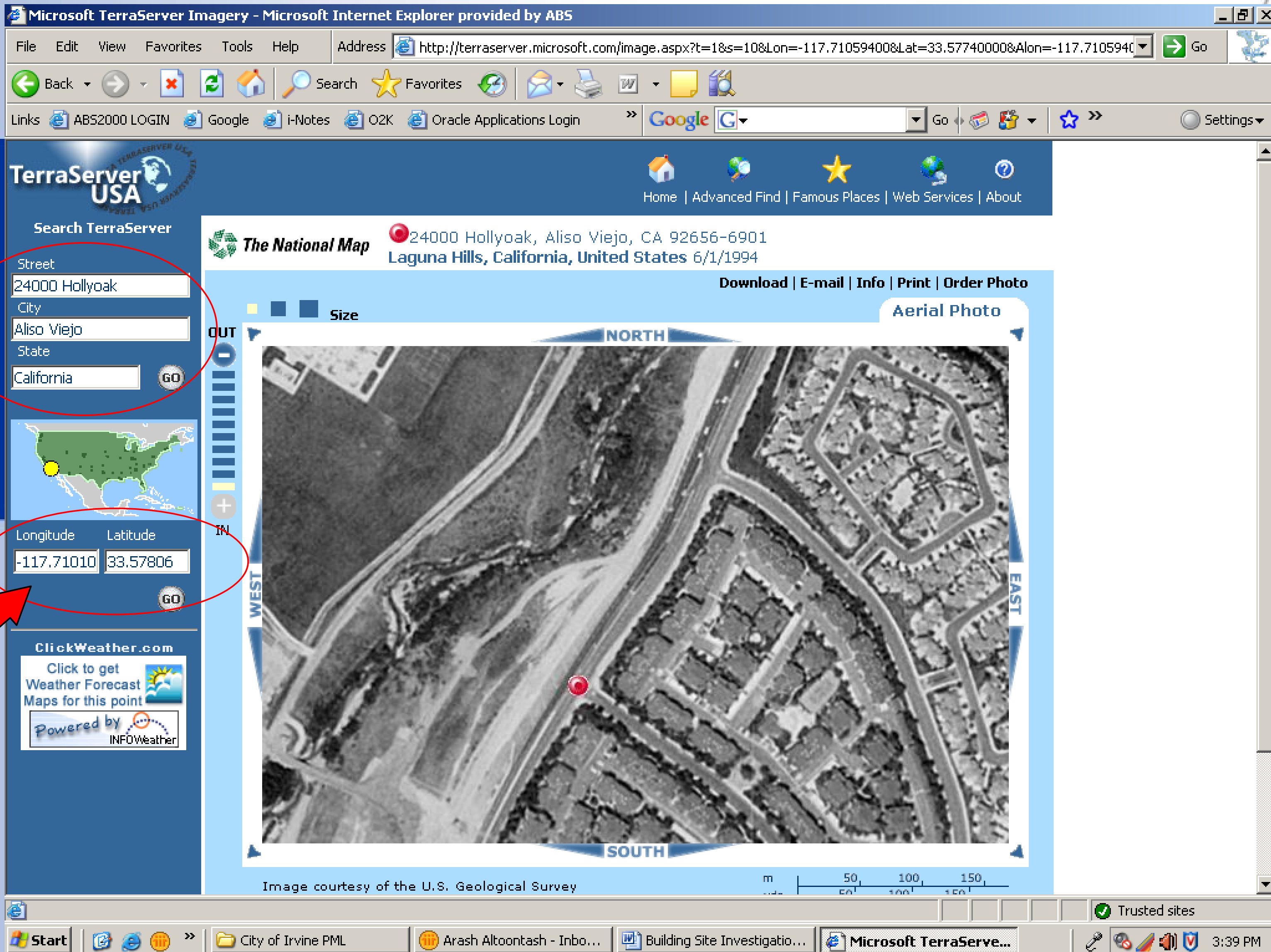
## Site Data

Site Location: 24000 Hollyoak
Aliso Viejo, California

- Use “Terraserver” or other software to find:
  - Latitude = 33.57806
  - Longitude = -117.71010

- Site Class D (Per Soils Report or by default)

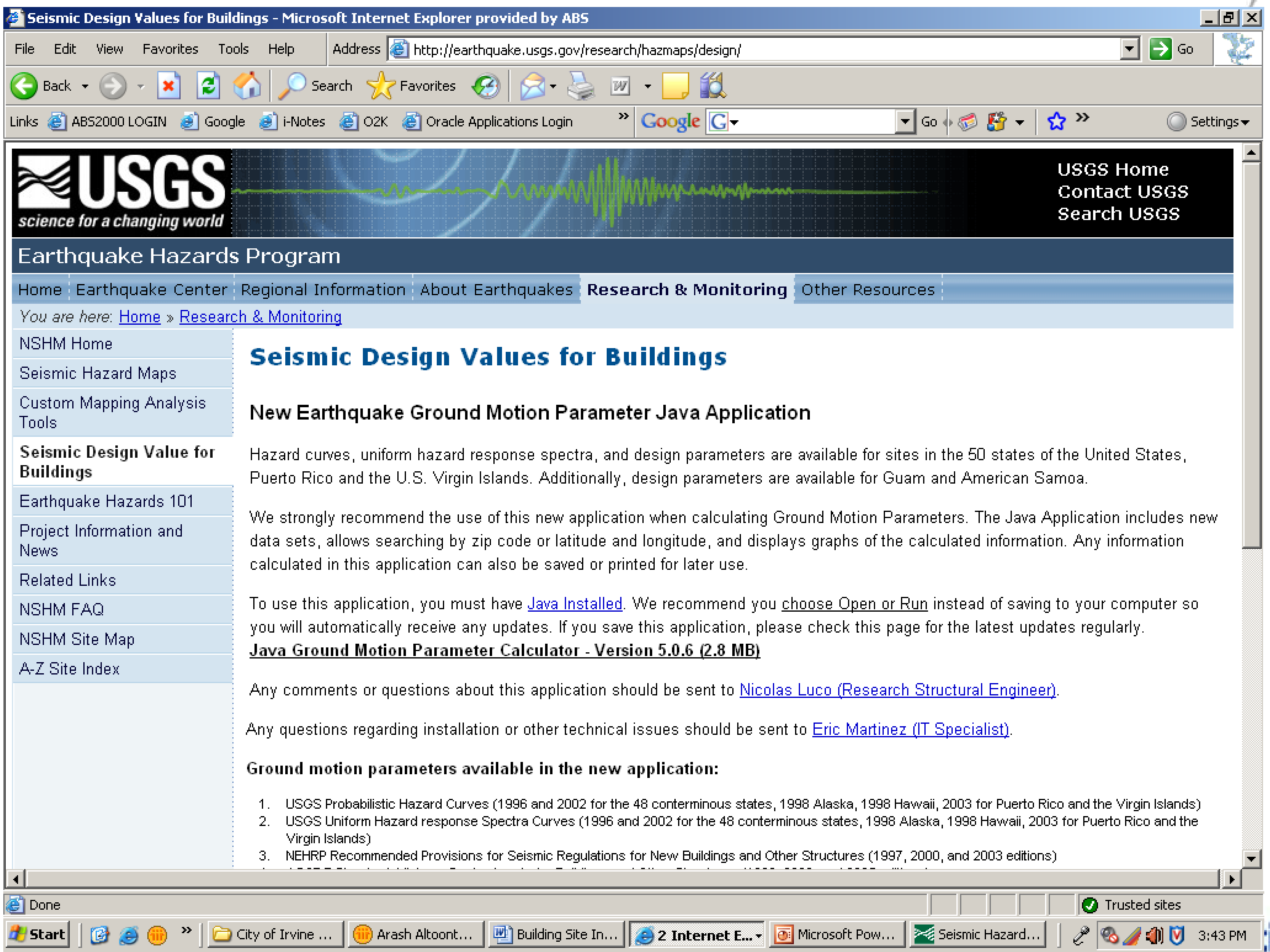
# www.terraserver.microsoft.com



# Ground Motion

- Using USGS ground motion JAVA application:
  - $S_S = 1.462$
  - $S_1 = 0.516$
- MCE for Site Class D
  - $S_{MS} = 1.462 \times 1.0 = 1.462$
  - $S_{M1} = 0.516 \times 1.5 = 0.774$
- DBE for Site Class D
  - $S_{DS} = 0.975$
  - $S_{D1} = 0.516 < 0.75$

# http://earthquake.usgs.gov

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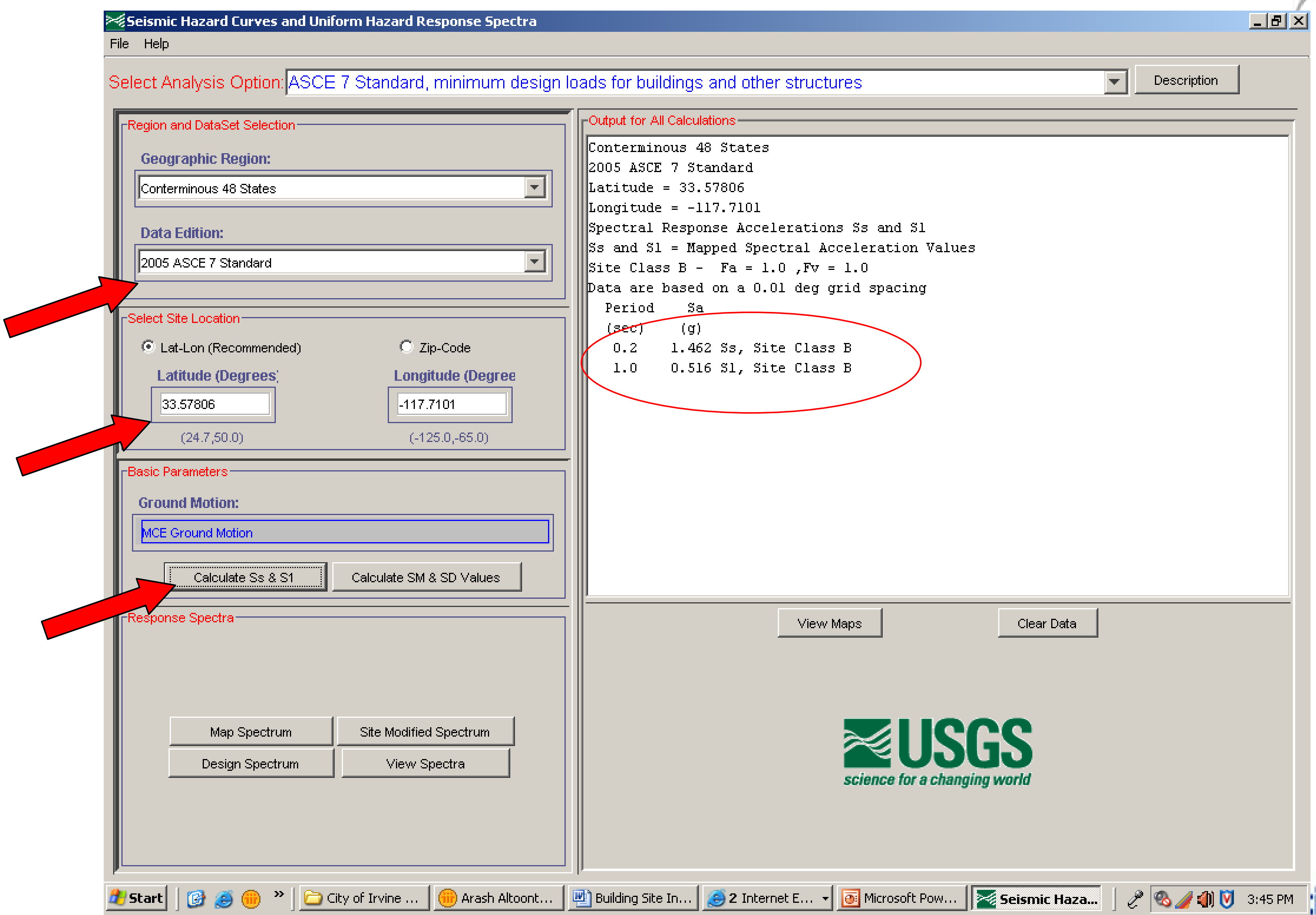
# Calculate $S_s$ and $S_1$

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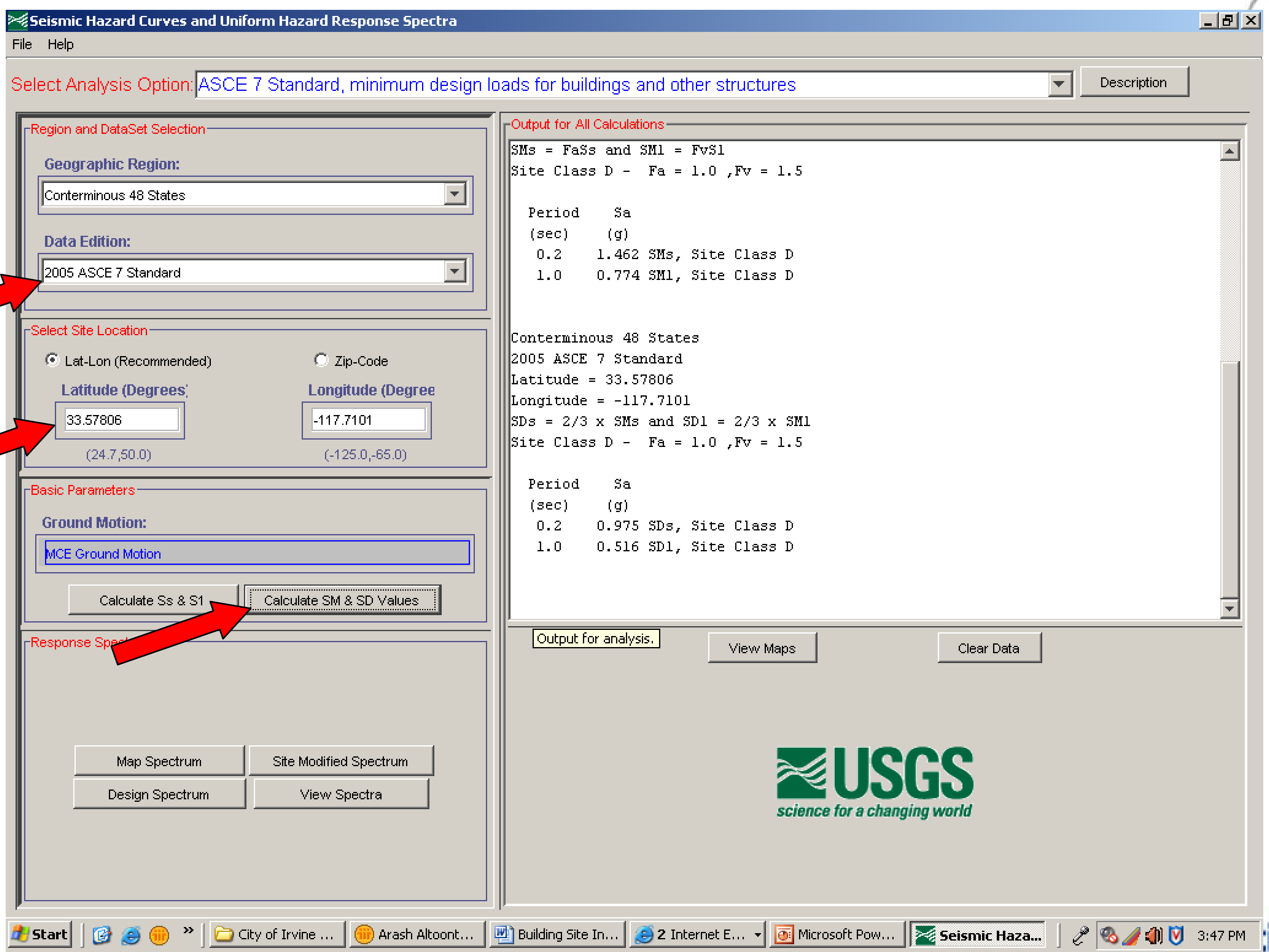
# Calculate $S_M$ and $S_D$

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# "SDC" A–F vs. "Site Class" A-F

- Will cause confusion
- Site Class = Soil Type
  - Default site class = D
- Seismic Design Category = SDC
  - Defines material structure detailing requirements
  - Limits permissible structural irregularities
  - Replaces Zone-dependent detailing
    - Traditional "Zone 4 detailing" similar to "SDC D detailing"

## IBC 1613.5.6.1 defines an alternate method to determine Seismic Design Category

- Permitted to be used where $S_1$ is less than 0.75
- Four conditions must ALL be met
  - Rigid diaphragms
  - Approx. Fundamental Period $T_a < 0.8T_s$
  - Fundamental Period used to calculate story drift is less than $T_s$
  - Seismic Response Coeff. $C_s$ calculated using ASCE 7-05 Eqn 12.8-2.
- Permits SDC to be determined using $S_{D1}$ ONLY.
- ~~Not likely within So.Cal. area~~

# IBC Section 1613.6
# contains other alternatives to ASCE 7-05

- 1613.6.1 Assumption of Flexible Diaphragm – w/ wood structural panels or untopped steel decking permitted to be idealized as flexible
  - Concrete or similar wood topping permitted only as nonstructural no greater than 1.5 inch thick
  - Each line of resistance complies with allowable story drift
  - Vertical LFRS elements limited to light-framed walls w/ wood panel or steel sheet shear panels
  - (modifies IBC 2305.2.5) Parts of diaphragm in rotation limited to 25 ft & *length/width* of diaph.<1 for 1-story or 0.67 for 2+-story
- 1613.6.2 Use of OCBF's and OMF's is permitted in seismically isolated structures (w/conditions).

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# IBC Chapter 17,
## "Structural Tests and Special Inspections"

- Much more extensive than 1997 UBC
  - 1997 UBC = 3 pages
  - 2006 IBC = 16 pages!!!
- Provides useful tables separated by basic material types, defining verification and inspection requirements, with reference standards and IBC section references.
- 1705.1 Requires "statement of special inspections" in construction documents
  - SDC D+ Includes significant special inspection for non-structural components such as cladding, ceilings and storage racks
- 1708.5 Seismic Qualification of mechanical and electrical equipment. "The registered design professional in responsible charge shall state the applicable seismic qualification requirements for designated seismic systems on the construction documents."
- 1709 will require structural observation visits (with written statement) for SDC D+ or in high-wind regions for some Occupancy Categories, when height > 75 ft, or when building official requires.

# Overview of
# ASCE 7-05 Seismic Provisions

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# ASCE 7-05 Seismic Provisions

**Table of Contents**



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# ASCE 7 Table of Contents, Continued

**Ch. 16 and up contains rarely-used material**

- Ch 16 Seismic Response History Procedures
  (i.e., time-history seismic analysis)
- Ch 17 Seismic Design Requirements for Seismically Isolated Structures (base isolation)
- Ch 18 Seismic Design Requirements for Structures with Damping Systems (such as viscous dampers)
- Ch 19 Soil Structure Interaction for Seismic Design
  (not commonly used)
- Ch 20 Site Classification Procedure for Seismic Design
  (definitions for soil types A-F)

# ASCE 7 Table of Contents, Continued

- Ch 21 Site-Specific Ground Motion Procedures
- Ch 22 Seismic Ground Motion and Long Period Transition Maps
  (use http://earthquake.usgs.gov/research/hazmaps/design/ instead.)
- Ch 23 Reference Documents
- App. 11A Quality Assurance Provisions
  (not used w/IBC)
- App. 11B Existing Building Provisions
  (replaced by IBC Ch. 34)

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# ASCE 7 Chapter Detail: Ch. 11 Design Criteria

- Ch. 11 contains
  - List of Definitions
  - Defines $S_S$,$S_1$ etc. ground motion factors
  - Defines site coefficients, $F_a$, $F_v$
  - Defines Importance Factors, SDC's
  - Presents a simplified procedure for SDC A
  - Contains requirements for geotechnical investigation reports (depending on SDC)

# Chapter Detail: Chapter 12

**“Seismic Design Requirements for Building Structures”**

- Most ordinary buildings will only use this chapter & Ch. 13 (nonstructural components) & material stds.
- R-Factor and Ht. Limit tables (3 pages!)
- Definitions of Irregularity types
- Rules for Horizontal & Vertical combinations of structural systems
- Definitions of Rigid & Flexible Diaphragms
  - Introduces semi-rigid diaphragms
- Special Load Combinations incl. new redundancy-factor
- ELF & Response Spectrum Procedures
- More….

# R-Factors

- Table is 3 pages long (vs. 1 in UBC)
- New Structural Systems
  - Unbonded bracing systems
  - Steel Plate Shear Walls
  - Precast Concrete Systems
  - Prestressed Masonry Shear Walls (not in SDC C-F)

# New Precast Concrete Systems

- Special Precast Shear Wall
  - Based on UCSD Research
- Intermediate Precast Shear Wall
  - Traditional Tilt-Up Construction
  - SDC D-F Limited to 40 ft. height, except one-story warehouses to 45 ft.

*Note!*

- Ordinary Precast Shear Wall
  - Other types of precast

# Changes to R-Factors

| Bearing Wall Systems | 97 UBC<br>*R* | ASCE 7-05<br>*R* |
|---|---|---|
| Light-framed walls w/ wood structural panels or steel sheets | 5.5 | 6.5 |
| Light Framed walls,<br>using flat strap bracing<br>other shear panel types | <br>4.5<br>4.5 | <br>4<br>2 |
| CIP Concrete Shear Walls | 4.5 | 5 |
| Tilt-Up Concrete Shear Walls (Intermediate Precast) | 4.5 | 4 |
| Masonry Shear Walls | 4.5 | 5 |

# Changes to R-Factors, Cont'd.

| Building Frame Systems | 97 UBC *R* | ASCE 7-05 *R* |
|---|---|---|
| Steel EBF | 7 | 7, w/o MF<br>8, w/ MF |
| Steel Ordinary Braced Frames | 5.6<br>(160' ht. limit) | 5<br>(35' ht. limit) |
| Steel Special Concentric Braced Frames | 6.4 | 6 |
| CIP Concrete Shear Walls | 5.5 | 6 |
| Masonry Shear Walls | 5.5 | 5.5 |

# Changes to R-Factors, Cont'd.

| Moment Frame Systems | 97 UBC *R* | ASCE 7-05 *R* |
|---|---|---|
| Special Steel MRF | 8.5 | 8 |
| UBC: Ordinary Steel MRF<br>Now: Intermediate Steel MRF | 4.5 | 4.5<br>(plus height & weight limits) |
| Special Concrete MRF | 8.5 | 8 |
| | | |
| Cantilevered Column Elements | 2.2 | Varies<br>1 to 2.5 |

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# Diaphragm Flexibility

- 12.3.1 "Unless a diaphragm can be idealized as either flexible or rigid …, the structural analysis shall explicitly include consideration of the stiffness of the diaphragm.
  - 12.3.1.1 **Flexible Diaphragm Condition**. Diaphragms constructed of untopped steel decking or wood structural panels shall be permitted to be idealized as flexible in structures in which the vertical elements are steel braced frames, or concrete, masonry or steel shear walls.

    Diaphragms of wood structural panels or untopped steel decks in one and two-family residential buildings of light-frame construction shall also be permitted to be idealized as flexible."
  - 12.3.1.2 **Rigid Diaphragm Condition**. Etc.…

# Irregularity Tables

- Three new irregularity types
  - Extreme Torsional Irregularity
  - Extreme Soft Story Irregularity
  - Extreme Weak Story Irregularity
- Some changes in how irregularities are defined
  - Intended to simplify calculation checks

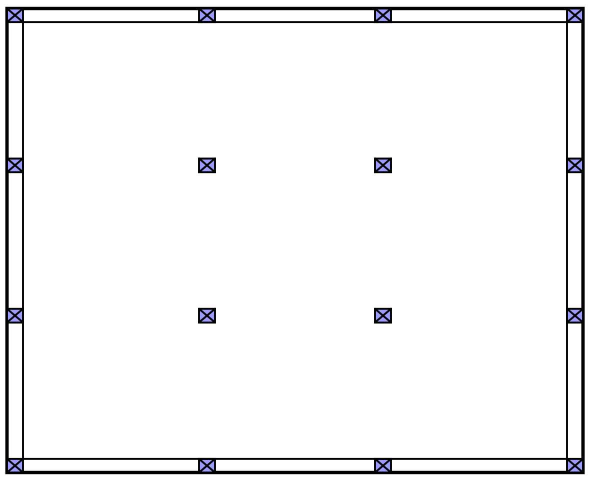
# Example Problem

Vertical distribution of seismic lateral design forces

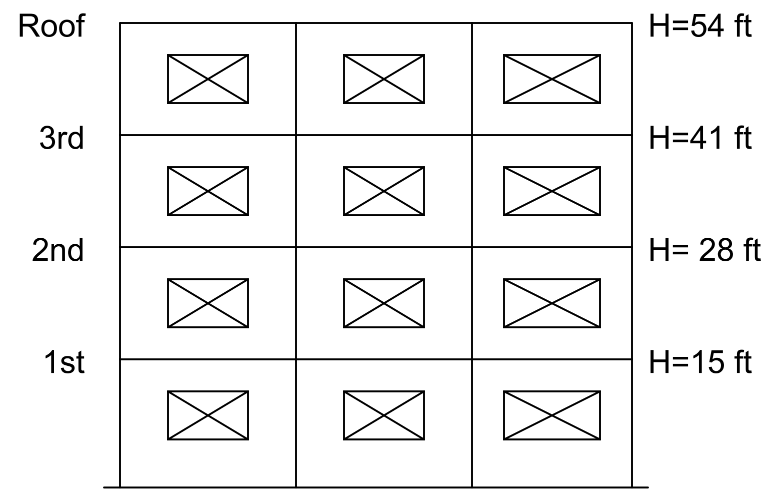
## Seismic Design Criteria

- DBE for Site Class D
  - $S_{DS}$ =0.975
  - $S_{D1}$ =0.516
- Four Story Residential Building
- Occupancy Category II (Table 1-1)
- Importance Factor I = 1.0 (Table 11.5-1)
- Seismic Design Group: D (Table 11.6-1&2)

# Building Information



Plan




Elevation

## Seismic Participating Weight

| Level | | Seismic weight (kips) | Height (ft) |
|---|---|---|---|
| Roof | $W_r$ | 131 | 54 |
| 3rd | $W_3$ | 326 | 41 |
| 2nd | $W_2$ | 326 | 28 |
| 1st | $W_1$ | 326 | 15 |
| Total | $W_{tot}$ | 1110 | |

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# Design Coefficients

- Light Framed Walls Sheathed with Wood Panels

  R = 6.5 (Table12.2-1- bearing wall system)

  $\Omega_0$ = 3

  $C_d$ = 4

- Approximate Period
  - $T = C_t h^x{}_n$
  - $C_t$ = 0.02 (Table 12.8-2)
  - x = 0.75
  - $h_n$ = 54 ft
  - T = 0.40 s (Eqn.12.8-7)

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# Equivalent Lateral Force Procedure

Base Shear $$V = C_S W = 0.15 \times W$$ (12.8-1)

Where: $$C_S = \frac{S_{DS}}{\left(\frac{R}{I}\right)} = 0.15$$ (12.8-2)

Not more than: $$C_S = \frac{S_{D1}}{T\left(\frac{R}{I}\right)} = 0.2$$ (12.8-3) for T<$T_L$ = 8 (s)

Not less than: $$C_S = \frac{0.5 S_1}{\left(\frac{R}{I}\right)} = 0.04$$ (12.8-6)

# Load Distribution

- V = 0.15xW = 166 kips (12.8-1)
- T ≤ 0.5 s : ⟶ k = 1.0 (12.8.3)

$$F_x = C_{vx} V$$

$$C_{vx} = \frac{w_x h_x^k}{\sum w_i h_i^k}$$

| Level | $W_i$ | $h_i$ | $W_i h^k_i$ | $C_{vx}$ | $F_x$ |
|---|---|---|---|---|---|
| Roof | 131 | 54 | 7,076 | 0.21 | 35 |
| 3rd | 326 | 41 | 13,373 | 0.39 | 65 |
| 2nd | 326 | 28 | 9,132 | 0.26 | 43 |
| 1st | 326 | 15 | 4,892 | 0.14 | 23 |
| Total | 1,110 | | 34,474 | 1.00 | 166 |

# Chapter Detail: Ch. 12 Continued

- 12.10 & 11 - Diaphragms, chords, collectors, wall anchorage.
- 12.12 - Drift & Bldg separations
- 12.13 - Foundation design
- 12.14 - Simplified Alternative Criteria
  - Self Contained
  - Must meet 12 conditions
    - Intimidating for rigid diaphragm structures
    - Not so bad for flexible diaphragm or "flexible diaphragm permitted" structures

# 12.14 Simplified Alternative Design

- 6½ -pages long (incl. tables & figures)
- Stands alone, other than Material Std. Requirements
  - Separate Load Combinations, R-Factor Table, etc.
  - Limited to 3 stories & less.
  - Wood diaphragms permitted to be considered flexible
- No redundancy factor
  (but must meet 12 conditions in 12.14.1.1)
- Force penalty for method
  - 1.0 for single-story
  - 1.1 for two story
  - 1.2 for three story
- Separate R-Factor Table
  - Only bearing wall & building frame systems permitted (no moment frames)

# Example Problem

Flexible Diaphragm Structure checks to use simplified alternative criteria

# Condition checks for flexible diaphragm structures

1. Occupancy Category I or II only
2. Site Class not E or F (*i.e.*, no soft-soil sites)
3. Structure not exceeding 3 stories
4. Only bearing wall or building frame systems (no Moment frames)
5. At least 2 lines of resistance in each direction
6. At least 1 line of resistance on each side of center of mass in each direction
7. Maximum diaphragm overhang = 20% depth
8. (n/a – rigid diaphragm only)
9. Lines of resistance skewed no more than 15°
10. Simplified Method must be used for Both directions
11. In-Plane & Out-of-Plane irregularity types not permitted (Exception for light-frame structures)
12. Each story strength = at least 80% of story above

# 12.3.4 Redundancy Factor, ρ

- Still arbitrary
- Limited to SDC D-F.
- Separate ρ-factor is determined for each direction.
- ρ equal to either 1.0 or 1.3 – nothing in between.
- ρ = 1 if loss or removal of any one element would not result in more than a 33 percent reduction in story strength, for any story resisting more than 35 percent of the base shear (see also Table 12.3-3).
- Some specific calculations where ρ of 1 is permitted to be used (see section 12.3.4.1).
- Otherwise, ρ = 1.3

# 12.12 Drift and Deformation

- Drift limits in ASCE 7-05 reduced for Occupancy Category III and IV structures
- Permissible drift a function of building type & stories, not period
- Permissible drift varies from 0.025 to 0.010
- Note: $\rho$ applied to drift limit of MRF in Design Category D-F! (12.12.1.1)
- Design story drift (Sec 12.8.6) $\delta_x = \dfrac{C_d \delta_{xe}}{I}$
- Minimum building separation
  - ASCE 12.12.3 "…distance sufficient to avoid damaging contact.."
  - Versus UBC $\Delta_{MT} = \sqrt{(\Delta_{M1})^2 + (\Delta_{M2})^2}$

# Table 12.12-1 Allowable Story Drift

| Structure | Occupancy Category | | |
|---|---|---|---|
| | I or II | III | IV |
| Structures, other than masonry shear wall structures, 4 stories or less (etc.) | $0.025h_{sx}$ | $0.020h_{sx}$ | $0.015h_{sx}$ |
| Masonry cantilever shear wall structures | $0.010h_{sx}$ | $0.010h_{sx}$ | $0.010h_{sx}$ |
| Other masonry shear wall structures | $0.007h_{sx}$ | $0.007h_{sx}$ | $0.007h_{sx}$ |
| All other structures | $0.020h_{sx}$ | $0.015h_{sx}$ | $0.010h_{sx}$ |

Note: $0.015 \times 1.5 = 0.0225$

$0.010 \times 1.5 = 0.015$

# Chapter Detail: Chapter 13

**"Seismic Design Requirements for Nonstructural Components"**

| 1997 UBC | 2006 IBC |
|---|---|
| $F_p = 4.0 C_a I_p W_p$ | $F_p = 1.6 S_{DS} I_p W_p$ |
| $F_p = \frac{a_p C_a I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right) W_p$ | $F_p = \frac{0.4 a_p S_{DS} W_p}{\left(\frac{R_p}{I_p}\right)}\left(1 + 2\frac{z}{h}\right)$ |
| $0.7 C_a I_p W_p \geq F_p \leq 4 C_a I_p W_p$ | $0.3 S_{DS} I_p W_p \geq F_p \leq 1.6 S_{DS} I_p W_p$ |

Note that $\frac{0.7}{0.3} \approx \frac{4.0}{1.6} = 2.5$

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# Chapter Detail: Chapter 13 Continued

Comparing $R_p$ values for selected nonstructural elements

| | 1997 UBC | 2006 IBC |
|---|---|---|
| Interior Partitions<br>URM<br>other | <br>(not defined)<br>3.0 | <br>1.5<br>2.5 |
| Exterior Wall Element | 3.0 | 2.5 |
| Cantilever Parapet | 3.0 | 2.5 |
| Penthouses | 4.0 | 3.5 |

Summary: Although the $F_p$ "z/h" coefficient was reduced from 3 to 2, $R_p$ was also reduced, so that the net change is less.

# Chapter Detail:
# Chapter 15 Nonbuilding Structures

- Far more extensive scope than ever before
  - Tanks, Vessels, Racks, Boilers, Spheres
- New type of R-Factor Table
  - Less Ductile Systems are permitted in high-seismicity areas, when lower R is used

# Example from Ch. 15
## Non-Building Structure R-Factor Table

| Structure Type | R | $\Omega_o$ | $C_d$ | SDC C | SDC D | SDC E | SDC F |
|---|---|---|---|---|---|---|---|
| Ordinary Steel Concentrically Braced Frame | $3^1/_4$ | 2 | $3^1/_4$ | NL | 35’ | 35’ | NP |
| With permitted height increase | $2^1/_2$ | 2 | $2^1/_2$ | NL | 160’ | 160’ | 100’ |
| With unlimited height | 1.5 | 1 | 1.5 | NL | NL | NL | NL |

Compared to Ch. 12 Values for Buildings:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| OCBF | $3^1/_4$ | 2 | $3^1/_4$ | NL | 35’ | 35’ | NP |

# Other

- $T_L$ Maps
  - Very long period – 8 or 12 sec.
    - Tank sloshing

## Warning: ASCE Supplement 2

- ASCE main committee is currently balloting a Supplement 2 change to seismic provisions.
- Would re-institute 2nd minimum base shear equation.
  - $V = 0.44\, S_{DS}\, IW$
- ATC 63 preliminary finding that very tall buildings may need more min. lateral strength
- Bonus: would also result in compliance with Calif. 1933 Field Act (3% min. x 1.4)

# Warning: Structure separations

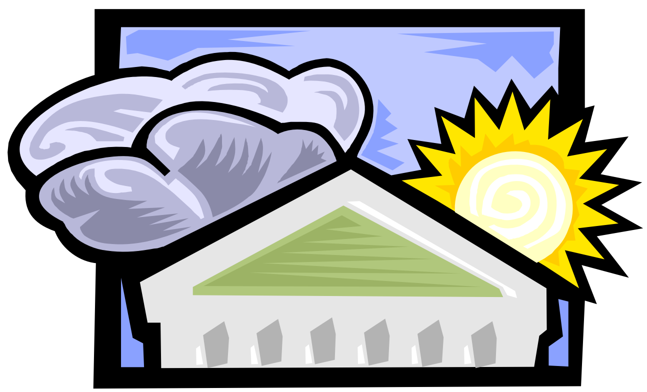
- Traditional minimum separation requirement is vague in IBC & ASCE 7.
  - Vague limitation vs. UBC "SRSS" equation
- Existing UBC "SRSS" equation being submitted as correction for next cycle of ASCE 7-10.

# ASCE 7-05 Errata

- Updated periodically and posted on www.SEInstitute.org
- Look in the "Publications" tab at the top of the page, under "Errata"
- Most recent posting May 3, 2007
  - 24 pages total!!

# *End of Presentation*

*Thank You*
*for*
*Staying Awake*



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