PENGARUH KONDISI LOKAL DAN GEMPA RENCANA

Pendahuluan

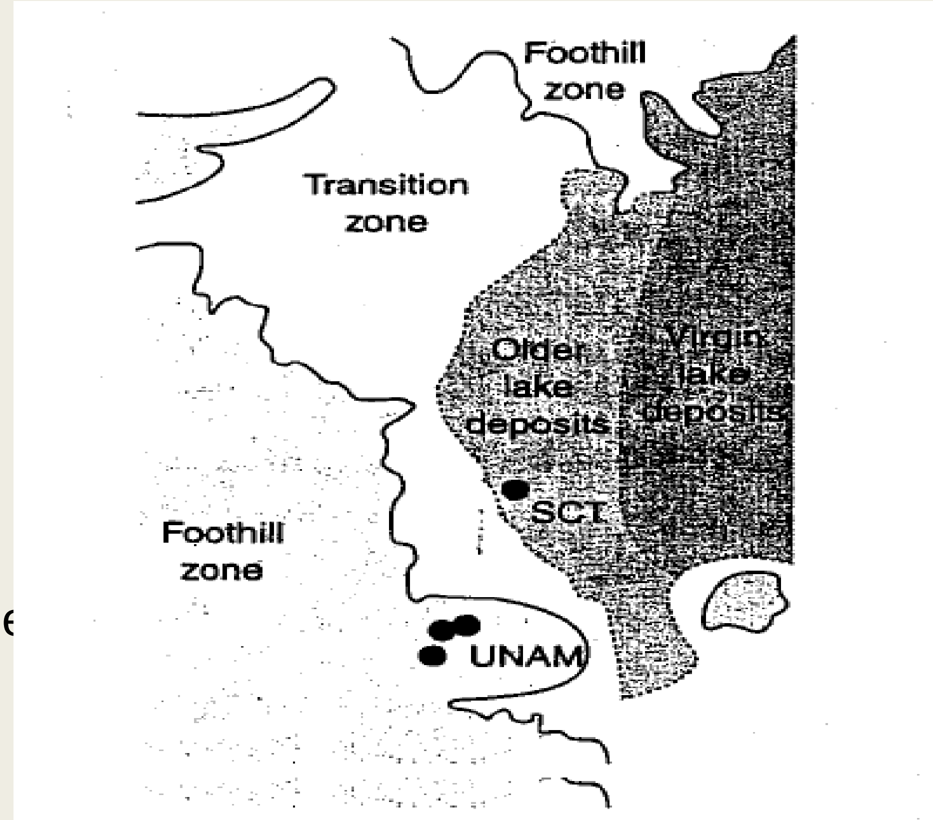
- *Intensitas gempa dapat dipengaruhi oleh kondisi setempat / kondisi lokal. Dengan demikian amplitudo, frekuensi dan lamanya gempa harus direncanakan berdasarkan lokasi dimana konstruksi bangunan akan dilaksanakan.*

BUKTI bahwa kondisi local sangat memepengaruhi pengukuran intensitas gempa : Gempa Mexico City, 1985

Earthquake Description

September, 1985 Gempa Michoacan (M_s=8.1), 350 Km dari Mexico city

Kondisi Geologi



Foothill Zone: Shallow, compact deposits of mostly granular soils.

Lake Zone: Thick deposits of very soft soils. Ground water was located at depth of 2m.

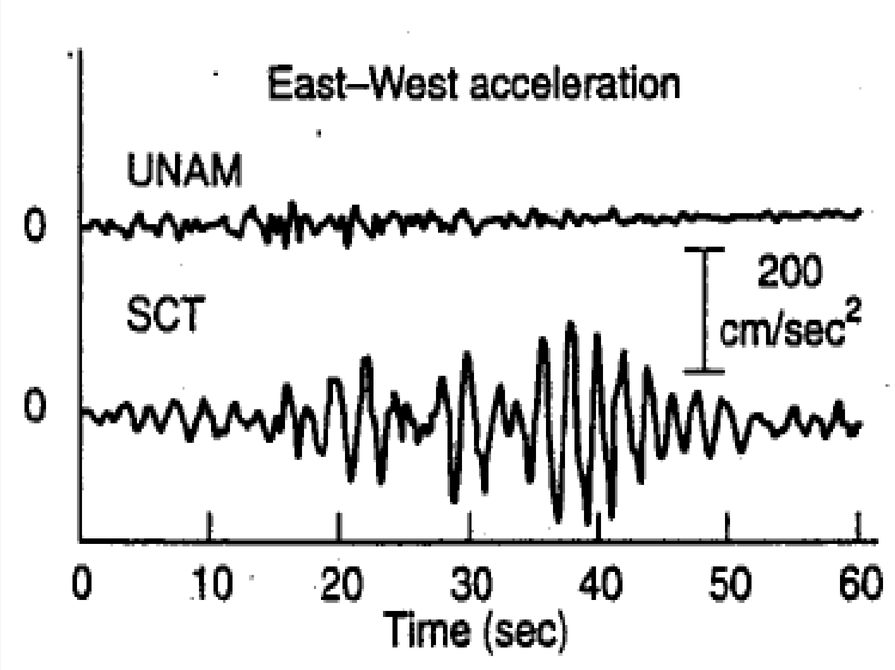
Transition Zone: Located between Foothill and Lake Zone and comprise of thin soft soil deposits.

Lokasi Seismographs

UNAM: University National Autonoma de Mexico (Foothill Zone)

SCT: Secretary of Communications and Transportation (Lake Zone)

Hasil Pengukuran seismograph (BERBEDA)



Perbandingan hasil pengukuran

Peak Accelerations: At SCT site were up to five times greater than those at UNAM. (0.03g-0.04g at UNAM site)

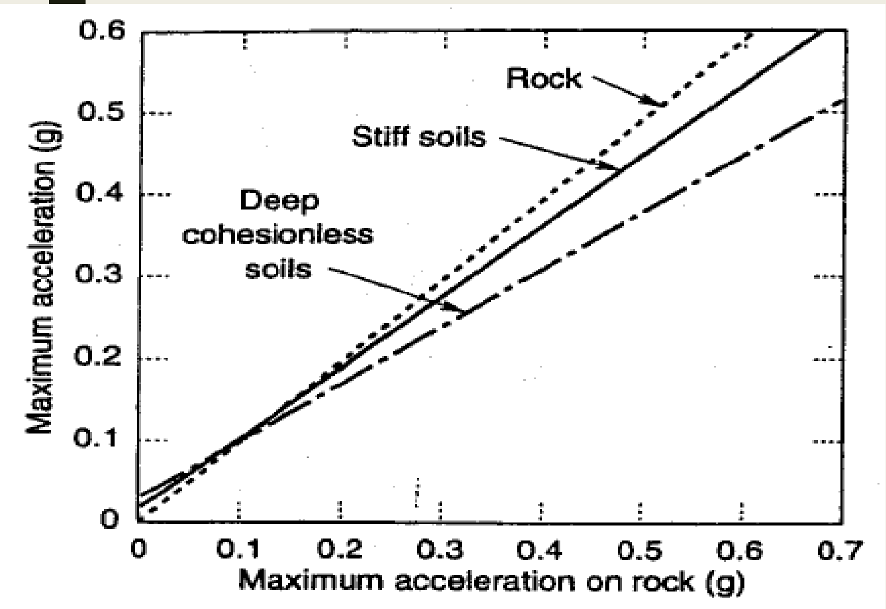
Spectral Acceleration: Response spectra computed from recorded motions for SCT site were about 10 times greater than at UNAM.

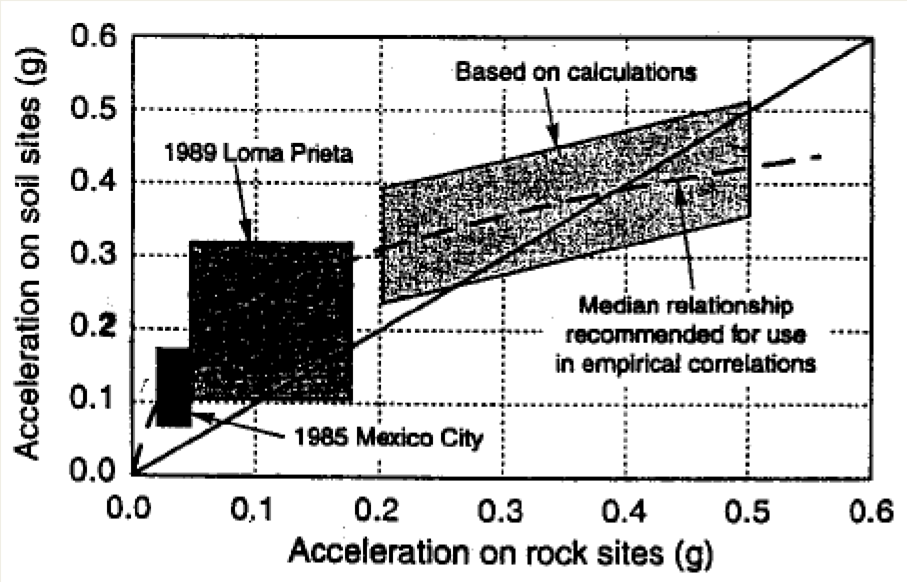
Damages at SCT site: The characteristic site period for SCT site was estimated to be around 2 sec. Most buildings (5-20 storey high) with almost the same fundamental period were damaged. (Resonance effect)

Pengaruh kondisi tanah

Pada percepatan gempa yang rendah, peak acceleration pada lokasi dengan tanah lunak LEBIH BESAR daripada pada lokasi dengan tanah keras atau batuan.

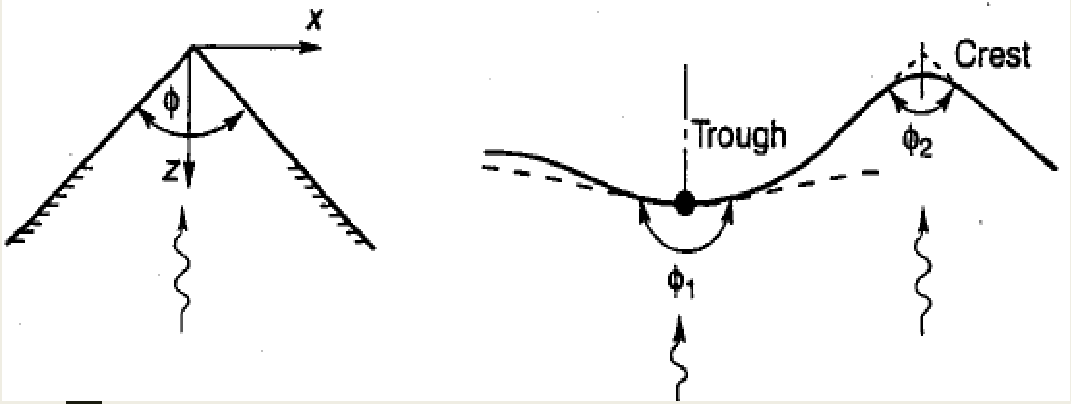
Pada percepatan gempa yang tinggi Peak acceleration LEBIH Besar pada kondisis batuan dari pada kondisi lokasi dengan deposit tanah lunak atau lempung karena modulus yang lebih rendah serta kondisi tidak homogen

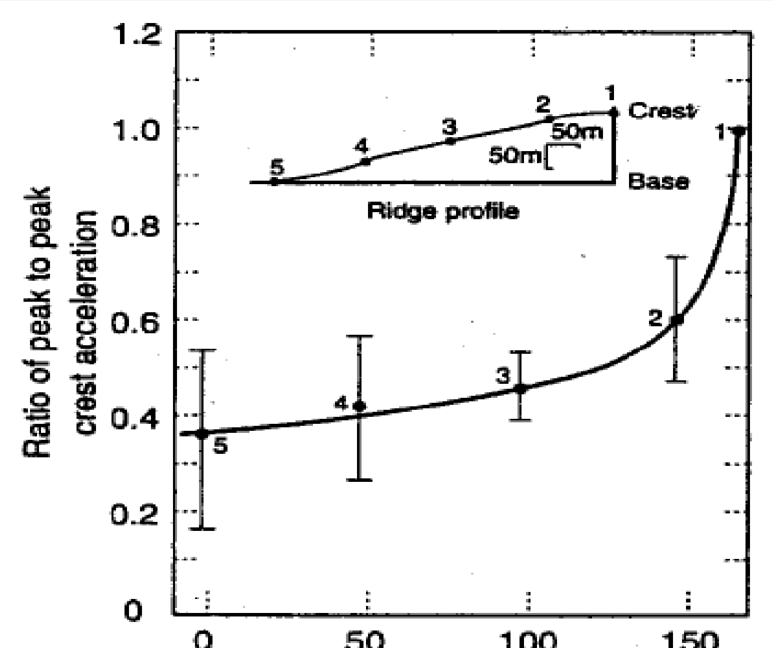




Pengaruh topografi

Accelerasi gempa di daerah bukit lebih tinggi dari pada di daerah lembah, terutama lebah yang terdiri dari tanah lunak; di Japan ($a_{crest} = 2.5\ a_{base}$*)*





Design Ground Motion

Design ground motions are the motions that reflect the levels of strong motion amplitude ($a_{h(max)}$, $v_{h(max)}$), frequency content, and duration that a structure or facility at a particular site should be designed for.

I. Design Parameters
  - ➢ *Design Earthquakes*
  - ➢ *Design Spectra*

II. Development of Design Parameters
  - ➢ *Site-Specific Development*
  - ➢ *Code-Based Development*

Design Earthquake

- *Design earthquake have been associated with two-level design, at first level, remain operational, and to avoid catastrophic failure for more severe level.*

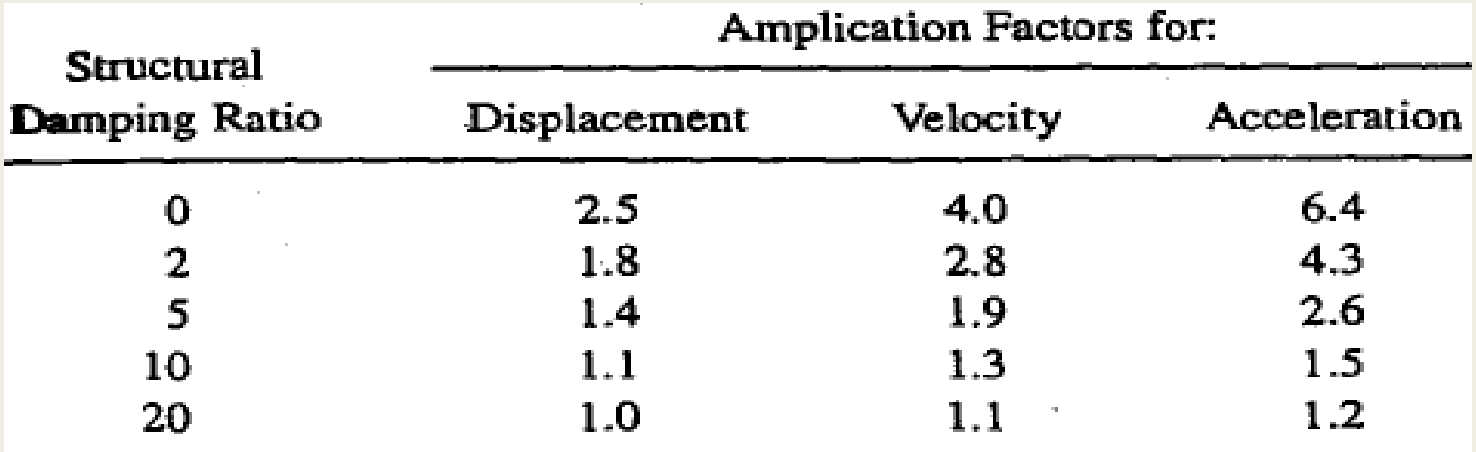
- *The Maximum Credible Earthquake (MCE): Is usually defined as the largest earthquake that can reasonably be expected.*

- *Operating Basis Earthquake (OBE): It is an earthquake that should be expected during the life of a structure.*

- *Safe Shutdown Earthquake (SSE): The earthquake that produces the maximum peak horizontal acceleration for the following case:(SSE is used in design of nuclear power plants*

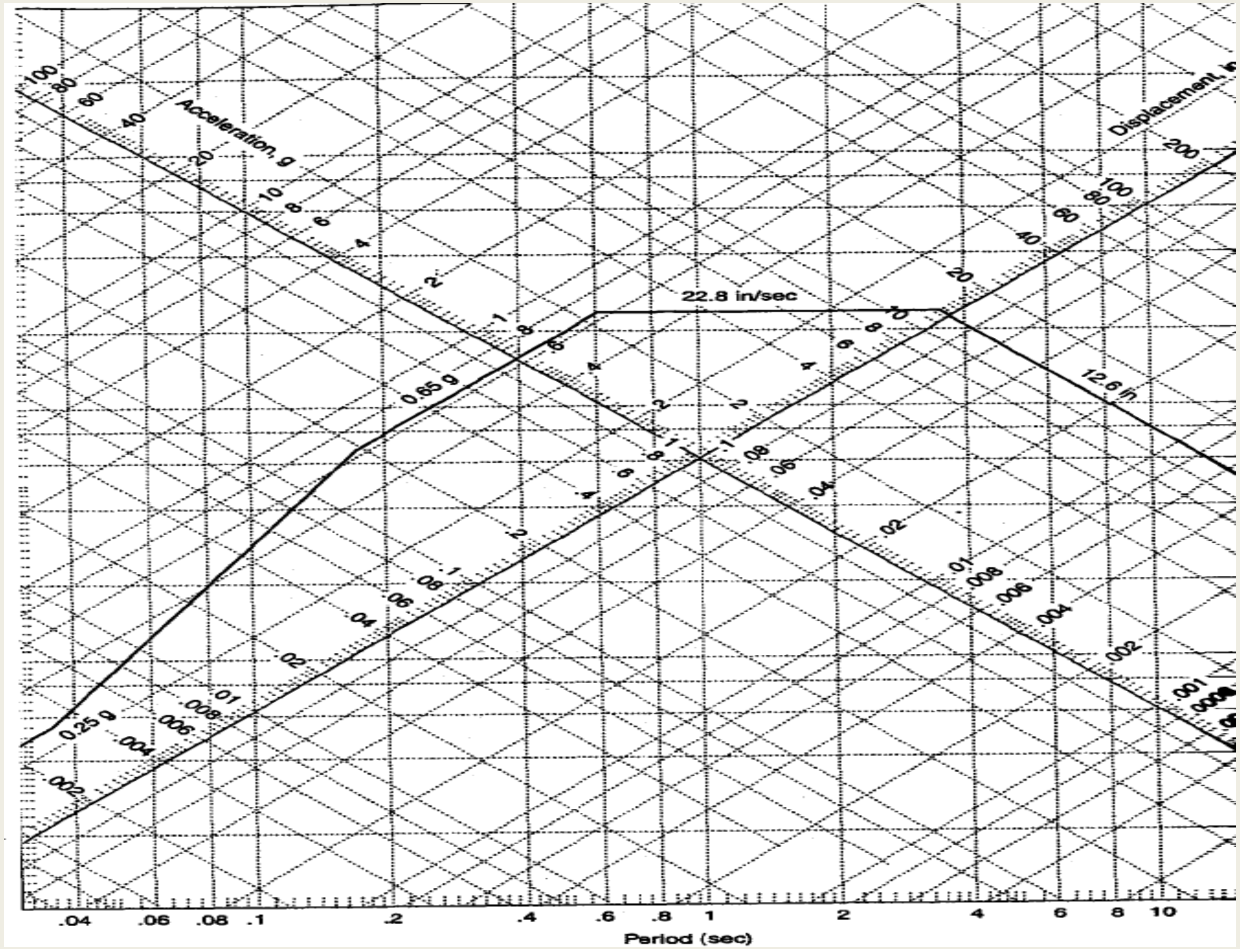
Design Spectra

- *Response spectra are often used to represent seismic loading for the dynamic analysis of structures. As a result, design ground motions are often expressed in terms of design spectra.*
- *Newmark and Hall, for example, recommended that design response spectra be developed from a series of straight lines on a tripartie plot.*
- *A Newmark-Hall design spectrum is obtained by multiplying the peak ground acceleration, velocity, and displacement values by amplification factors given for different structural damping ratios.*



Structural Damping Ratio	Amplication Factors for:		
	Displacement	Velocity	Acceleration
0	2.5	4.0	6.4
2	1.8	2.8	4.3
5	1.4	1.9	2.6
10	1.1	1.3	1.5
20	1.0	1.1	1.2

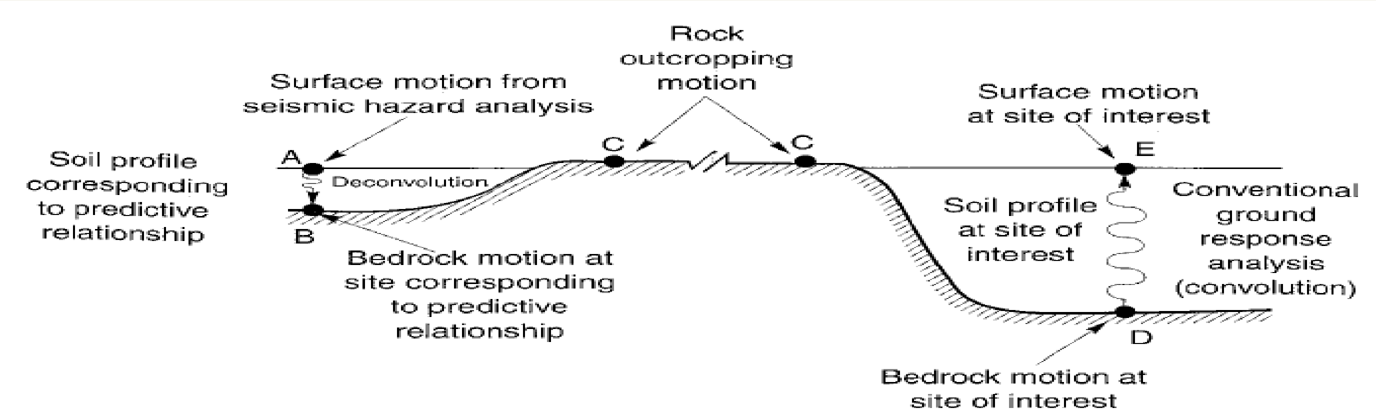
Design Spectra



Development of Design Parameters

- *Site-Specific Development: Site-specific design ground motions reflect the detailed effects of the particular subsurface conditions at the site of interest. The usual process for developing site-specific ground motions involves a seismic hazard analysis and a ground response analysis. The procedure is as follows:*

- *Seismic hazard analysis that produce ground motion at the surface (point A)*
- *Deconvolution through the soil profile to determine bedrock motion (point B)*
- *This is the bedrock motion at the base (point D) of the soil profile at the site.*
- *A conventional ground response analysis is then performed to predict the motion at the surface of the soil profile of interest (point E)*



Development of Design Parameters

- *Code-Based Development:*

  The purpose of these codes is to produce minimum standards to safeguard life, health, property, and public welfare during an earthquake by regulating and controlling the design, construction, quality of materials and etc…

- *The UBC and NEHRP are the most influential contemporary documents that describe minimum standards for earthquake-resistant design of buildings in the United States.*

Uniform Building Code (UBC)

The UBC building code is not intended to eliminate earthquake damage completely, In general, structures designed based on this code is able to:

1. *Resist a minor level of earthquake ground motion without damage.*
2. *Resist a moderate level of earthquake ground motion without structural damage, but possibly experience some non-structural damage.*
3. *Resist a major level of earthquake ground motion having an intensity equal to the strongest either experienced or forecast for the building site, without collapse, but possibly with some structural as well as non-structural damage.*

Uniform Building Code (UBC)

- *The UBC allows two basic approaches to the earthquake-resistant design of a building:*
- *Static Approach*
- *Dynamic Approach*

Uniform Building Code (UBC)

- *Static Approach:*

This approach is based on determination of a *design base shear force*, which is then distributed in a specific form over the height of the structure for structural resistance of lateral load resistance.

(The effect of ground motions are represented by static lateral force)

$$V = \frac{ZIC}{R_w} W$$

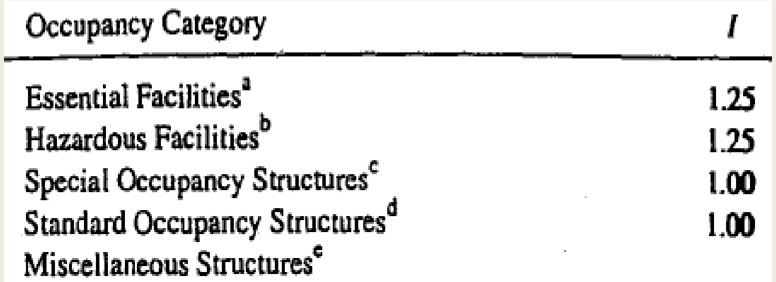
Structure Ductility coefficient

Seismic dead load

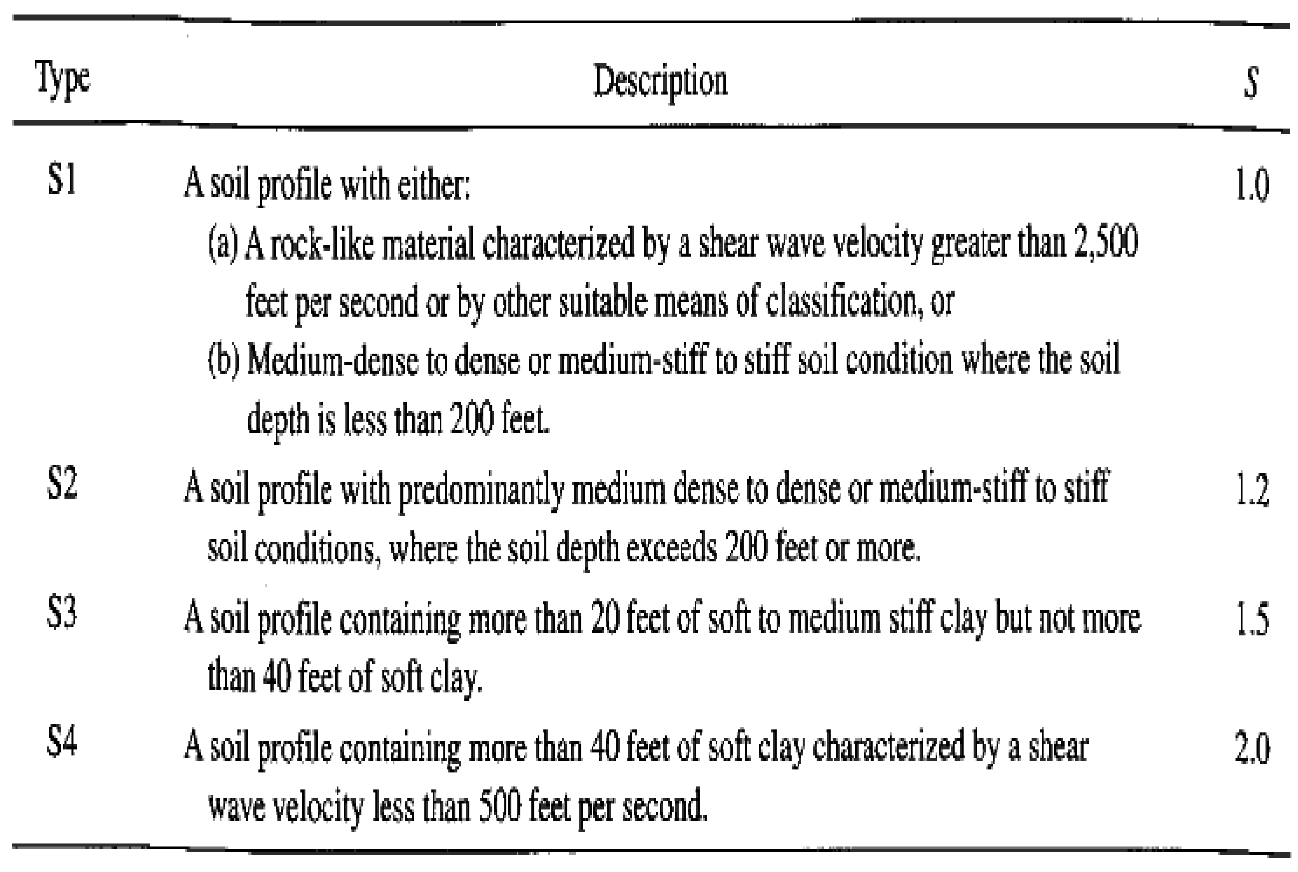
Z: Seismic Zone Factor
I: Importance Factor
S: Soil Coefficient
T: Fundamental Period

$$C = \frac{1.25S}{T^{2/3}} \leq 2.75$$

Uniform Building Code (UBC)



Occupancy Category	*I*
Essential Facilities[a]	1.25
Hazardous Facilities[b]	1.25
Special Occupancy Structures[c]	1.00
Standard Occupancy Structures[d]	1.00
Miscellaneous Structures[e]	



Type	Description	*S*
S1	A soil profile with either: (a) A rock-like material characterized by a shear wave velocity greater than 2,500 feet per second or by other suitable means of classification, or (b) Medium-dense to dense or medium-stiff to stiff soil condition where the soil depth is less than 200 feet.	1.0
S2	A soil profile with predominantly medium dense to dense or medium-stiff to stiff soil conditions, where the soil depth exceeds 200 feet or more.	1.2
S3	A soil profile containing more than 20 feet of soft to medium stiff clay but not more than 40 feet of soft clay.	1.5
S4	A soil profile containing more than 40 feet of soft clay characterized by a shear wave velocity less than 500 feet per second.	2.0

Uniform Building Code (UBC)

- *Dynamic Approach:*

  This approach allows the response of the structure to be determined by response spectrum analysis or by time-history analysis which are obtained by site-specific ground response analysis or from smooth, normalized spectral shapes.