APPENDIX A
LIST OF PARTICIPANTS

NCEER Workshop on Seismic Hazard Mapping

October 24-25, 1991

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APPENDIX B
PRELIMINARY AGENDA

Thursday 24 October

7:30-8:15 AM	Shuttle from Marriott to UB Ketter Hall
8.00 AM	Continental Breakfast - Room 140
8:30 AM	Opening remarks by Organizer: objectives, format (Whitman)
8:40 AM	SEAOC's new committee and its plans (Singh)
8:50 AM	Next revision cycle for BSSC (Israelson and others)
9:00 AM	Presentation and explanation of results from questionnaire, plus results from SHAKE analyses (Whitman, Taylor)
9.30 AM	Split into two discussion groups. Quiet time for perusing background material. Discussion of question: Are there corrections/improvements that should be made within present code format? More categories, different S-factors, more quantitative description of site categories, etc.? Specific advice regarding additional research, if needed. Rooms 140 and 236

Coffee available from 10:00 AM

11:30 AM	Reconvene entire Workshop to discuss preliminary conclusions of groups regarding above questions. Room 140
12:00 NOON	Informal Buffet Lunch - outside Room 140
12.45 PM	Entire Workshop: Organizer's latest marching orders
1:00 PM	Reconvene two discussion groups for continued discussion and formulation of recommendations.

Refreshments available from 2:00 PM

2:30 PM	Reconvene entire Workshop to discuss conclusions of groups regarding above questions. Agree on at least preliminary conclusions.
3:30 PM	Split into two (probably different) discussion groups Discussion of questions: (a) Should there be an entirely different code format (use of site periods?) in the near future?, and (b) How should site effects be considered (in building code context, remember) if time-histories are to be selected as input to dynamic analysis (a longer range question)?
4.30 PM	Tours of Seismic Simulator Laboratory - Room 103 Ketter Hall and Information Service - Room 304 Capen Hall
4:30-5:45 PM	Buses return to hotel
7:00 PM	Informal Cash Bar at Marriott

7:30 PM	Dinner - Salon A
8:30 PM	Informal presentation concerning NCEER's organization and plans for second half-decade (Buckle).

Friday 25 October

7:30-8:15 AM	Shuttle from Marriott to UB Ketter Hall - Room 140
8:00 AM	Continental Breakfast
8:30 AM	Latest marching orders from Organizer
8:45 AM	Back to discussion groups, with updated assignments. One additional question: Should, and if so how, topographic site features be included in building codes?

Coffee available from 10:00 AM

10:30 AM	Reconvene Workshop as a whole. Discussion, conclusions.
12:00 NOON	Informal Buffet Lunch - outside Room 140
12:45 PM	Entire Workshop; Organizer's latest marching orders.
1:00 PM	Entire Workshop, or special working groups as needed: Finalize conclusions and recommendations.
2:30 PM	Concluding session
3:00 PM	Adjournment Transportation to Airport/Hotel as needed.

APPENDIX C
SUMMARY OF RESPONSES TO PRE-WORKSHOP QUESTIONNAIRES

The Third NCEER Workshop on mapping of seismic shaking hazard for building code purposes, will investigate the adequacy for the workshop, a questionnaire was sent to 35 researchers and professionals in the seismic engineering field during July and August of 1991.

The purpose of the questionnaire was to collect information on the use of current site categories, to investigate the kinds of problems experienced, and to obtain suggestions for improvement. A copy of the questionnaire is included in Appendix 1.

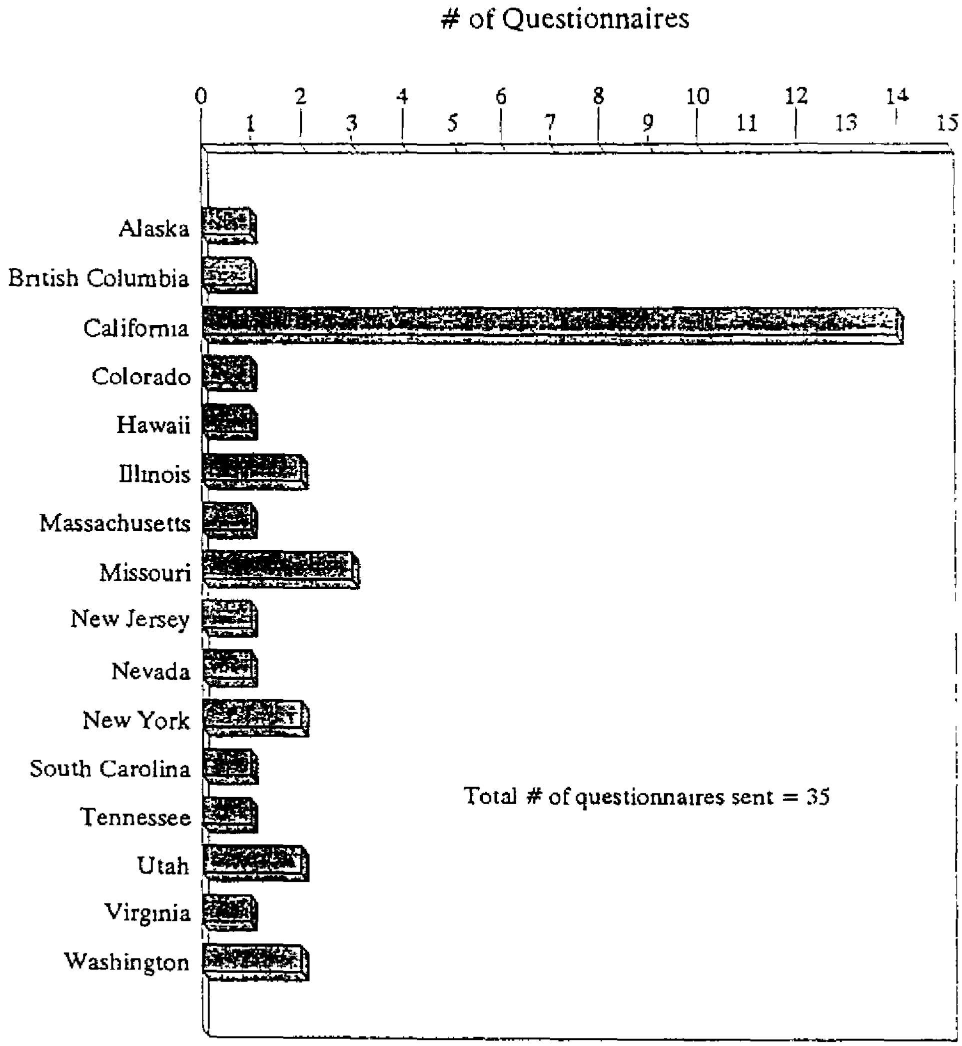
Responses were received for 9 different metropolitan areas or regions: Anchorage, AK; Vancouver, BC; San Francisco, CA; New England; St. Louis, MO; Portland, OR, Memphis, TN; Salt Lake City, UT; and Seattle WA. Fourteen people replied and one person provided details for three different metropolitan areas, thus making a total of 16 responses. A summary of results, presented in factual format in graphs and tables in included in Appendix 2.

In addition to the questionnaire, information on typical soil profiles for use in site response analysis was provided, together with references to professional papers concerning analysis of site responses.

Many thanks to those who responded.

SITE CATEGORIES QUESTIONNAIRE

Geographical Distribution of Questionnaires Sent



SITE CATEGORIES QUESTIONNAIRE

From_______________

Organization_______________

Metropolitan Area_______________

If you have experience in more than one metropolitan area, please xerox this sheet and complete these tables for each area.

1. TYPICAL SITE CONDITIONS -I

Within the metropolitan area where you have the most experience, how often are sites encountered that fall into?:

	Never	Very Seldom	Fairly Often	Often	Always
S1	____	____	____	____	____
S2	____	____	____	____	____
S3	____	____	____	____	____
S4	____	____	____	____	____

Please check the appropriate box on each line.

How often do you encounter serious difficulties in deciding which site category to assign to a site?:

Never	Very Seldom	Fairly Often	Often	Always
____	____	____	____	____

Please describe the types of sites that give difficulties.

2. What peak ground acceleration is now typically assumed for design of projects in your area? Does this acceleration apply atop rock (how hard?) or atop soil (what category of soil?)

3. How common is it to perform site-specific response analyses in your area?:

Never	Very Seldom	Fairly Often	Often	Always
____	____	____	____	____

4. Can you suggest better definitions for standard site categories?

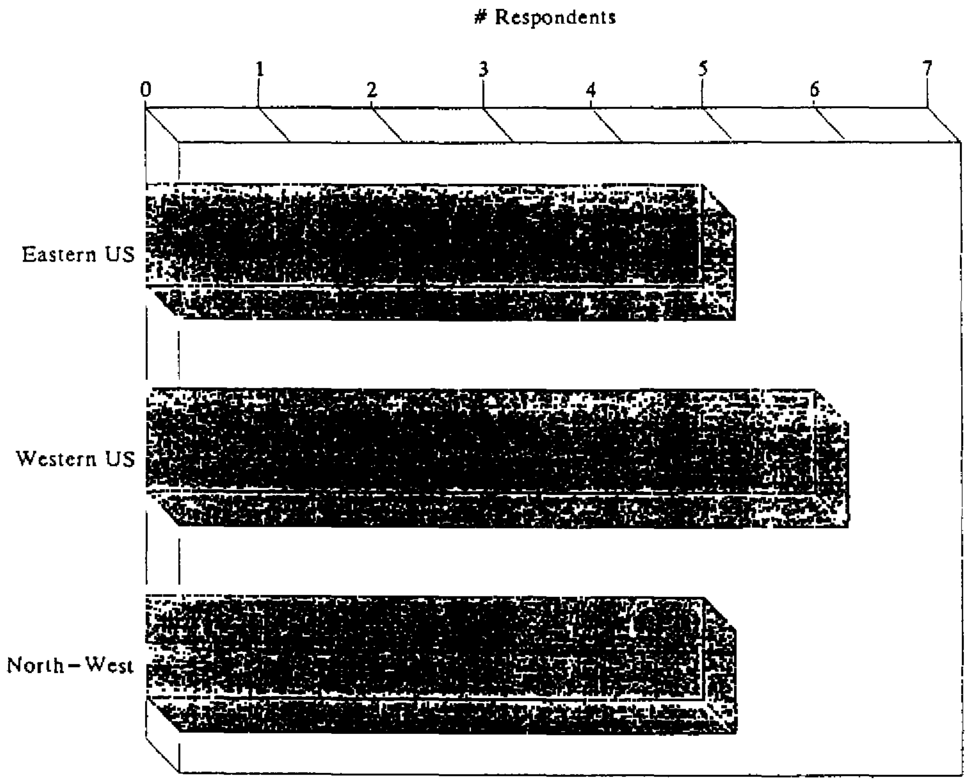
5. Do you feel that the relative soil factors assigned to the current categories are reasonable? If not, what would you suggest?

2. TYPICAL SITE CONDITIONS -I I

Could you please supply a set of soil profiles typical of those encountered in your practice? Copies of boring logs or profiles from reports or papers will suffice. Naturally we are interested in quantitative descriptions of the stiffness of the soils - blow counts, shear wave velocities, etc. - and also data for unit weight, PI, etc., if they are readily available. If you prefer, you may indicate typical profile conditions using the following sheet.

RESULTS OF SITE CATEGORIES QUESTIONNAIRE

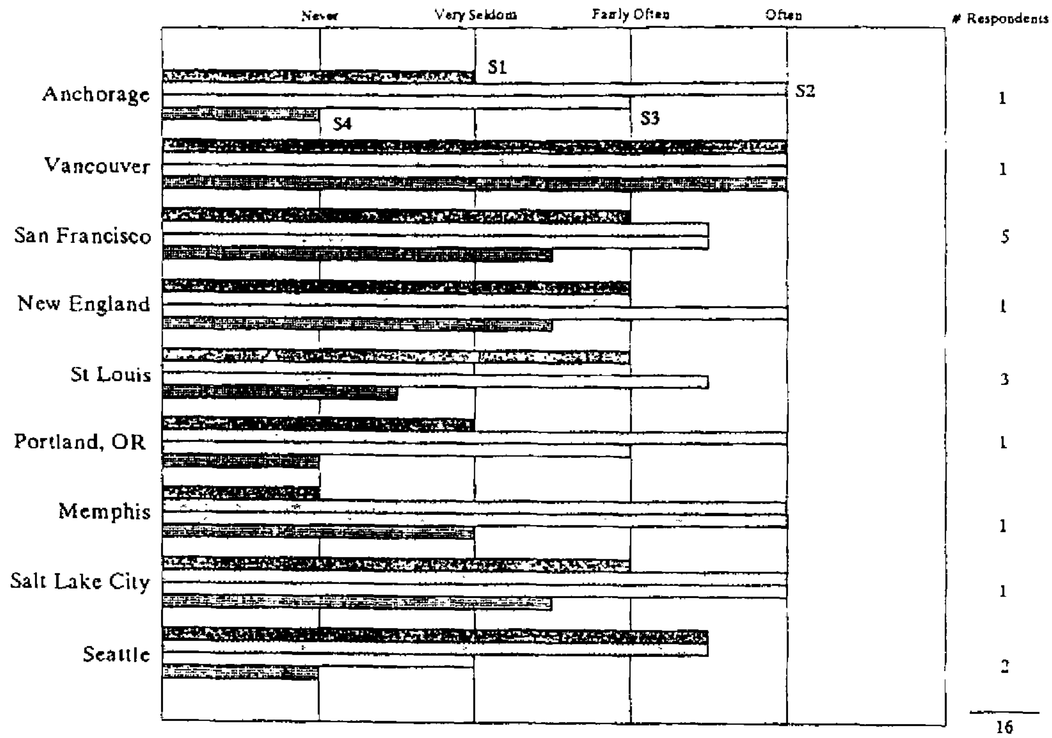
Geographical Distribution of Responses

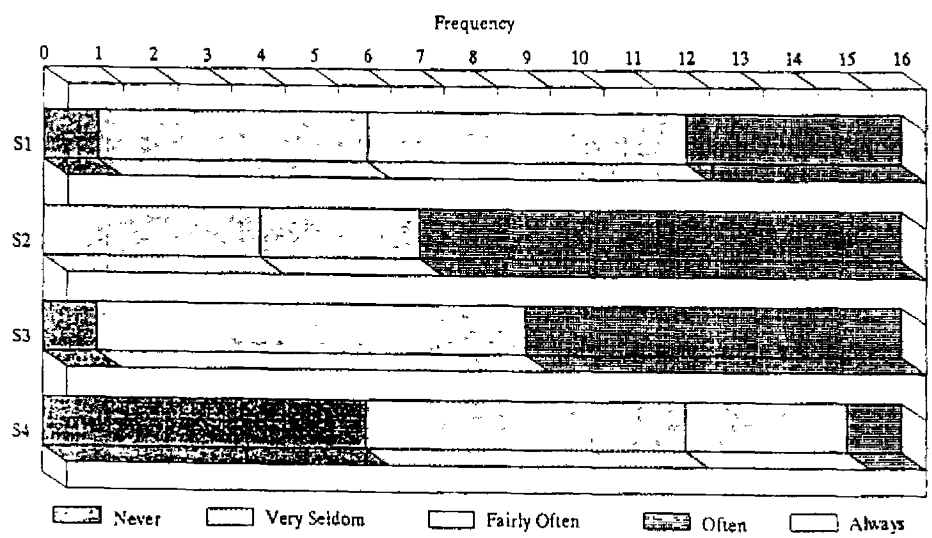


Total # Respondents = 16

RESULTS OF SITE CATEGORIES QUESTIONNAIRE

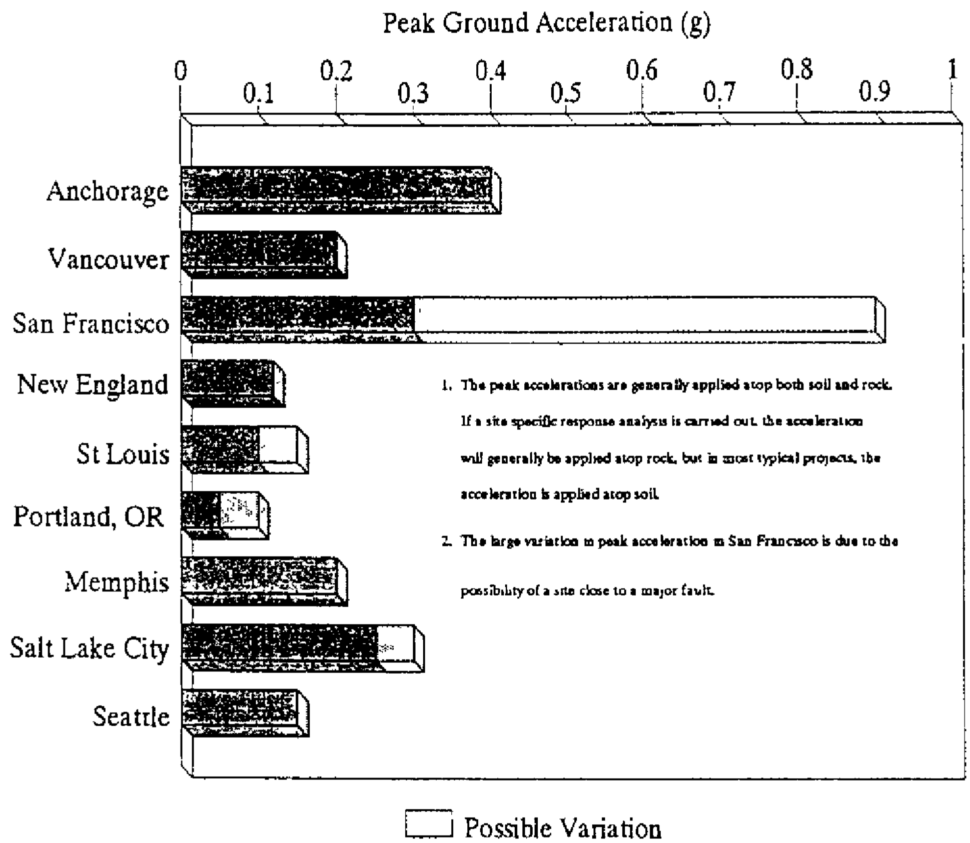
Q. How Often Do Sites Fall into the Current Code Categories ?





RESULTS OF SITE CATEGORIES QUESTIONNAIRE

Q. What Peak Acceleration is Typically Used in Design Projects ?



Q. How Common Is It to Perform Site Specific Response Analyses in Your Area?

- In general, site specific reponses are very rarely carried out.
- In the Western US and Northwest, particularly since the Loma Prieta Earthquake, it is becoming fairly common to carry out site specific response analyses for high rise buildings, highway bridges and other major public works projects
- Liquefaction studies are carried out fairly often, particularly in San Francisco

RESULTS OF SITE CATEGORIES QUESTIONNAIRE

Q. Can You Suggest Better Definitions for Standard Site Categories?

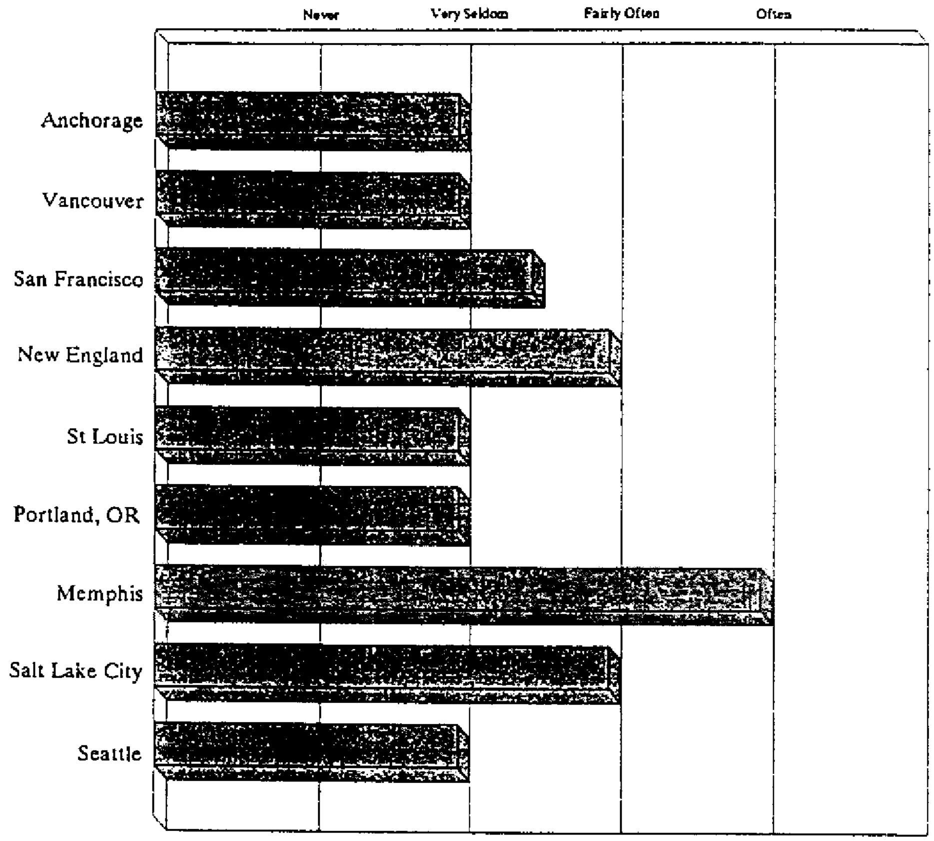
- The soil period could be incorporated into the construction of response spectra
- Profiles could be a function of shear wave velocity, depth and velocity contrast
- Clearer definitions of loose, stiff etc. are required, possibly by using SPT N60
- There could be a separate category for rock instead of including it with shallow stiff soils
- The S2 site category should have an upper limit of the soil profile depth
- The definition for clay in S4 should include a plasticity index or factor
- S4 should be changed to include thickness of clay > 10 feet
- S5 could be added to include Clay thickness > 40 feet
- Soft clay in S4 should have shear wave velocity defined between 200 and 250 fps, instead of 500 fps as currently
- The confusion arising from different definitions in different codes needs to be cleared up
- The site category could be tied to peak bedrock acceleration as well as to soil type and thickness
- Since amplification is non-linear in zones of high seismicity (high pga), and soft sites attenuate or "limit" accelerations, simple rules for limiting pga as a function of soil strength could be introduced

Q. Are the Relative Soil Factors for Current Categories Reasonable ?

- The current ratios are satisfactory
- The response spectrum shape should be included instead of just a factor
- For the eastern US, the peak ground acceleration is evaluated for hard rock condition while site categories use soft rock as reference site.
- The factor for rock is probably too high in the longer period range, because it is lumped in with shallow stiff soils
- There is a lot of uncertainty about the factors for soft soil sites, S3 and S4, and these should be revised as more information becomes available
- The current ratios for S4, particularly in the 0.5 to 2.0 second period range, underestimate spectral accelerations, which may provide a dis-incentive to carry out site specific response analyses.
- The factor for S4 should be increased to 2.5

RESULTS OF SITE CATEGORIES QUESTIONNAIRE

Q. How Often Are Problems Encountered in Assigning Sites to Site Categories ?



Q. What Types of Sites Cause Difficulties ?

- Very deep but stable deposits, such as stiff alluvium, which can be classified as S2 or S3, or hard glacial till or residual soils which can be S1 or S2
- Some sand deposits which may be prone to liquefaction and are strictly not classified as S3 or S4
- Sites with variable layering, particularly unstable soft deposits interbedded with stiffer layers
- Soft relatively unstable deposits underlain by very deep stiffer material

RESULTS OF SITE CATEGORIES QUESTIONNAIRE

List of People Who Responded to the Questionnaire

Name	Organization	Area	State
W. Paul Grant	Shannon and Wilson Inc.	Anchorage	AK
W.D. Liam Finn	University of British Columbia	Vancouver	BC
Roger D. Borcherdt	U.S. Geological Survey	San Francisco	CA
Neville C. Donovan	Dames and Moore	San Francisco	CA
Maurice S. Power	Geomatrix Consultants	San Francisco	CA
Robert Pyke	Consulting Engineer	San Francisco	CA
Raymond B. Seed	University of California at Berkeley	San Francisco	CA
Cetin Soydemir	Haley and Aldrich, Inc.	New England	MA
Duane Atchley	Sverdrup Corporation	St. Louis	MO
Tom Cooling	Woodward Clyde Consultants	St. Louis	MO
Stephen L. McCaskie	Sverdrup Corporation	St. Louis	MO
W. Paul Grant	Shannon and Wilson, Inc.	Portland	OR
Howard H.M. Hwang	Memphis State University	Memphis	TN
Kyle M. Rollins	Brigham Young University	Salt Lake City	UT
C.B. Crouse	Dames and Moore	Seattle	WA
W. Paul Grant	Shannon and Wilson, Inc.	Seattle	WA

APPENDIX D
SUMMARY OF PRE-WORKSHOP SHAKE ANALYSES

List of Soil Profiles Analyzed:

Metropolitan Area	Site Category
Boston #1	S1
Boston #2	S1
Memphis #1	S2
Memphis #2	S2
St. Louis #1	S1
San Francisco #1	S4
San Francisco #2	S2
San Francisco #3	S3/S4
Seattle #1	S2

APPENDIX E
PROPOSED FRENCH CODE PROVISIONS FOR TOPOGRAPHIC EFFECTS

The following figures and text come from the French Association for Earthquake Engineering[3] for a topographic site factor. The first figure plots the factor τ' vs. the slope *i*. Subsequent figures show the application of this factor to various situations.

[3] The material shown on pages E-2 through E-5 is used by permission from the French Association for Earthquake Engineering.

C.5.33.

Both theory and experiment show that certain particularities of the surface or underground topography are liable to induce amplifications of the seismic motion in certain frequency ranges. These amplifications may locally reach sizeable values. In the present state of knowledge, it is not possible to establish general rules giving more than a very poor approximation of the place and magnitude that can be foreseen for these amplifications.

Empirical coefficients given in the article on the opposite page should be considered as design coefficients intended on reducing the mean risk and on deterring from choosing settlements of which it has been proven by experience that they might be liable to be dangerous. The whole article 5.33 should be considered as provisional.

C.5.331.2.

In order to estimate τ, relief elements that should be taken into account are those that affect the general site configuration, as shown for example by topographical surveys and vertical sections used for the general site investigations, at the scale and with the density of points of measurement generally admitted for this type of investigation. Purely local relief accidents shall be considered as having no effect on the seismic motion.

It is reminded that lines of largest slope and contour lines are orthogonal (property retained in horizontal projections). Therefore, if P is on a more or less horizontal shelf, it shall be considered that lines of largest slope coming from or going to P are defined by the lines originating in P and normal to the contour line(s) delimiting the shelf (Figure 5.331.2a).

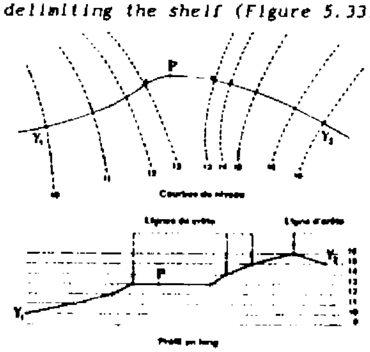


Figure 5.331.2a

5.33. SITE RESPONSE FACTOR

5.331. GENERALITIES AND DEFINITIONS

5.331.1.

Except if the effect of the topography on the seismic motion is directly taken into account using a dynamic calculation based on a proper idealization of the relief, a multiplying coefficient τ called site response factor or topography factor will be used.

5.331.2.

The coefficient τ relative to a given point P of the site will be conventionally determined from certain characteristics of the longitudinal section of the steepest gradient line going to P (Figure 5.331.2a).

In the particular cases when it is possible to define several steepest gradient lines going to P (spurs, peaks), the association of partial sections most unfavourable for point P will be considered (Figure 5.331.2.b).

Section drawings will represent great mass excavations if the latter are large enough to justify this or make it necessary.

C.5.331 2. (Continued)

Situations at the foot of a cirque or on a spur or peak are represented in the following drawings :

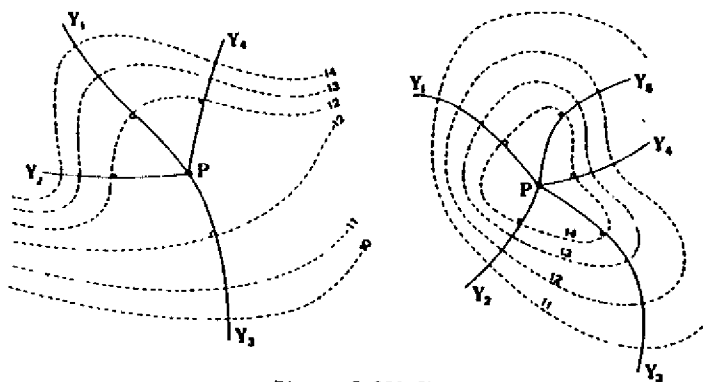


Figure 5.331.2b

The section to consider is the most unfavourable of composite sections Y_1 P Y_j.

C.5.331.3.

A ridge line or watershed line means a line of changing slope corresponding to a convexity of the relief, both slopes going in the same direction (or one of them being horizontal) in the first case, in opposite directions in the second case.

5.331.3.

When the section has been schematically broken up into successive parts within which the slope may be considered as uniform, relative to the scale of the relief, relief elements that play a role in calculating τ are

- ridge ledges close to point P, under certain conditions (article 5.332),
- the possible closeness of watershed ledges (article 5 333) or of spurs and peaks (article 5.334).

5 331 4.

The value of τ to retain in order to determine the design seismic motion to apply to a construction will be the most unfavourable value obtained on the bearing surface of the construction

5.332. RIDGE LEDGES

5.332.1.

If one considers a ridge C delimiting a downhill slope of gradient I (tangent of the slope angle) and an uphill slope of gradient i, and if :

- $H \geq 10$ m (H being the height of the ridge above the base of the relief)
- $i \leq I/3$

Coefficient τ :

- takes the value :

$\tau = 1$	for $I-i \leq 0.40$
$\tau = 1 + 0.8\,(I-i-0.4)$	for $0.40 \leq I-i \leq 0.90$
$\tau = 1.40$	for $I-i \geq 0.90$

On segment CB of the uphill slope defined by length b of its horizontal projection (expressed in meters) :

$$b = \text{minimum of} \begin{cases} 20\ 1 \\ \dfrac{H + 10}{4} \end{cases}$$

- is given by a linear relation connecting the values 1 and τ along segments AC and BD, of length :

$$\begin{cases} a = AC = H/3 \\ c = bd = H/4 \end{cases}$$

- takes value 1 downhill from point A and uphill from point D.

C.5.332.1.

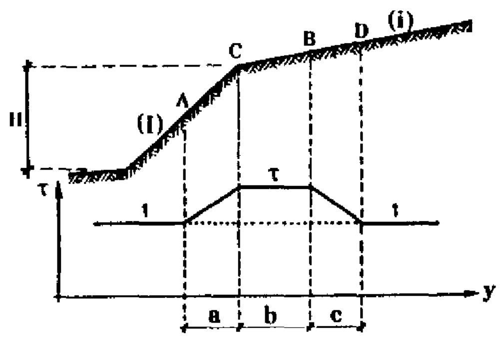
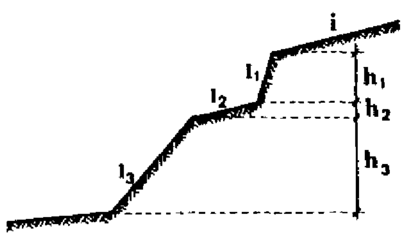


Figure 5.332.1a

The determination of H leaves a large latitude to self-judgment. As an example, one may consider as base of the relief the point above which the general slope of the site becomes inferior to 0.4 again.

The determination of I may also set a few problems if the segment of slope I is of small length. In a situation like the one of figure 5.332.1b, it may be replaced by the weighted average :



$$I_m = \frac{\sum h_i I_i}{\sum h_i}$$

Figure 5.332.1b

These remarks also apply to further articles.

C.5.332.2

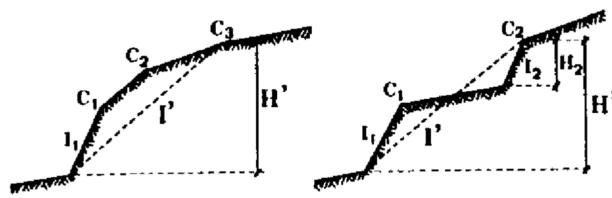


Figure 5.332.2

C.5.333

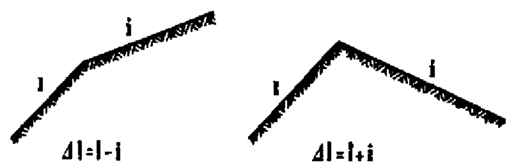


Figure 5.333

C.5 334

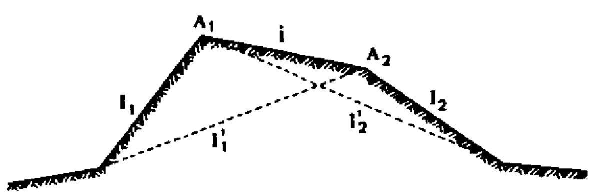


Figure 5 334

5.332.2

In the case of several successive ridge lines C1, C2 , one will consider, beside individual effects of these ridges or changes of slope, the fictitious ridges of slope l' defined in figure 5 332.2.

5.333. WATERSHED LEDGES

The situation of watershed ledges (slopes l and i in opposite directions) will be treated in the same manner as that of ridge ledges, terms (l-i) being replaced by (l+i) in formulas of article 5.332.1.

5.334. SPURS AND PEAKS.

In the case when the relief includes two sides of opposite slopes l1 and l2 separated by intermediary ridges or crests, one will consider, beside individual effects of these changes of slope, the effects of fictitious ridges defined in figure 5 334 and take the envelope of the results

APPENDIX F
EXCERPT FROM PROPOSED NEW GREEK SEISMIC CODE[4]

The following table, with the quantities B and D defined in the figures, gives a "Foundation Coefficient" that multiplies the usual base shear coefficient, which is already a function of site conditions. Site categories A, B, and C correspond roughly to S1, S2 and S3/S4, respectively.

The new Greek Seismic Code is to be finalized in early 1992. The proposed Eurocode (EC8) contains similar provisions; it is under review and should be ready by 1993.

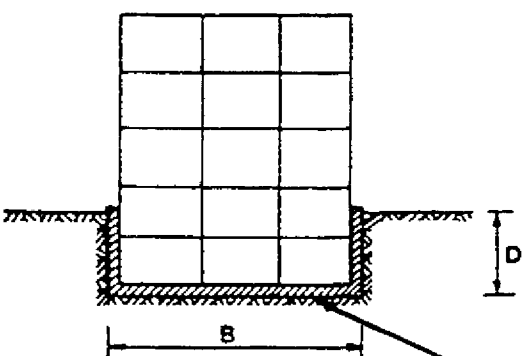
[4] As interpreted by Professor George Gazetas

TABLE F-I Foundation Coefficient (ϑ) (multiplies the base shear coefficient)

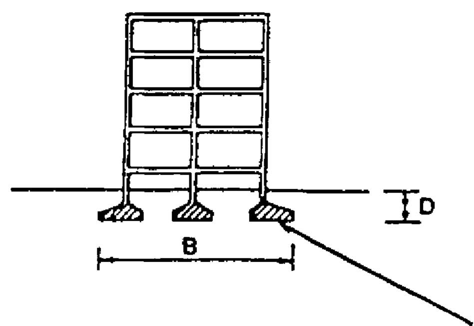
RELATIVE STIFFNESS	RELATIVE DEPTH	SOIL CATEGORY A	B	C
Small	small* (D/B < 0.10)	1.0	1.1	1.2
	large (D/B $\geq$ 0.40)	0.85	0.9	1.0
Large	small (D/B < 0.10)	0.85	0.9	1.0
	large (D/B $\geq$ 0.10)	0.7	0.8	0.9

* for intermediate depths: interpolate

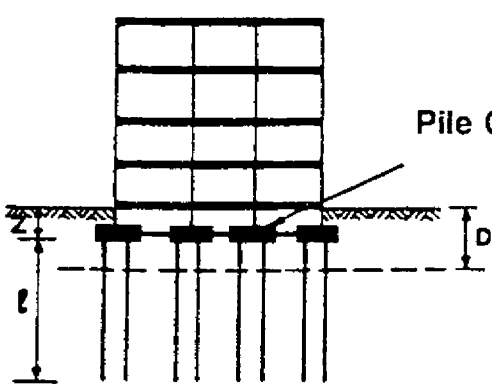
The following sketches explain the meaning of symbols D and B in Table F-I:



Rigid Box Foundation



Isolated Footings



Pile Caps Connected with Tie Beams

$$D \leq z + l/5$$

NATIONAL CENTER FOR EARTHQUAKE ENGINEERING RESEARCH
LIST OF TECHNICAL REPORTS

The National Center for Earthquake Engineering Research (NCEER) publishes technical reports on a variety of subjects related to earthquake engineering written by authors funded through NCEER. These reports are available from both NCEER's Publications Department and the National Technical Information Service (NTIS). Requests for reports should be directed to the Publications Department, National Center for Earthquake Engineering Research, State University of New York at Buffalo, Red Jacket Quadrangle, Buffalo, New York 14261. Reports can also be requested through NTIS, 5285 Port Royal Road, Springfield, Virginia 22161. NTIS accession numbers are shown in parenthesis, if available.

NCEER-87-0001 "First-Year Program in Research, Education and Technology Transfer," 3/5/87, (PB88-134275/AS)

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