Appendix

I	**:**	**Seismic Resistant Design Standard for Buildings（SNI-1726-2002）in Indonesia**
II	**:**	**Design of Structures for Earthquake Resistance (TCXDVN 375:2006) in Vietnam**
III	**:**	**National structural Code of Philippines(NSCP), Volume1Fourth Edition 1992, Fifth Edition 2001, Sixth Edition 2010**
IV	**:**	**Summary of Seismic design code for Petroleum Refinery and Petrochemical Plant in Japan**
V	**:**	**Comparison of seismic loads among three countries**
VI	**:**	**Comparison of Disaster Management Plan for Three Countries and Japan**
VII	**:**	**Local Survey Schedule**
VIII	**:**	**Outline of the educational seminar**

Appendix I : Seismic Resistant Design Standard for Buildings (SNI-1726-2002) in Indonesia

This attached document is a summary of the reference 1).

1. Introduction

This standard has taken into account as far as possible the latest development of earthquake engineering in the world, particularly what has been reported by the National Earthquake Hazards Reduction Program (NEHRP), USA, in its report titled "NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures" (February 1998), but on the other hand maintains as close as possible the format of the previous Indonesian standard "Rules for Earthquake Resistant Design of Houses and Buildings" (SNI 03-1726-1989).

In general this standard is sufficient to be used as the basis for the modern design of seismic resistant building structures, particularly high-rise buildings.

In order that the building engineering community understands what the basic principles are of this standard, in this paper their background are explained. More detailed explanations can be found in the commentary of the respective clauses, which is an integral part of the standard.

2. Design Earthquake and Seismic Zoning Map of Indonesia

On the Seismic Zoning Map of Indonesia (Figure 1) it can be seen, that Indonesia is divided into 6 seismic zones, Seismic Zone 1 being the least and Seismic Zone 6 the most severe seismic zone. The mean peak base acceleration for each zone starting from Seismic Zone 1 to 6 are respectively as follows: 0.03 g, 0.10 g, 0.15 g, 0.20 g, 0.25 g and 0.30 g (see Figure 1 and Table 2).

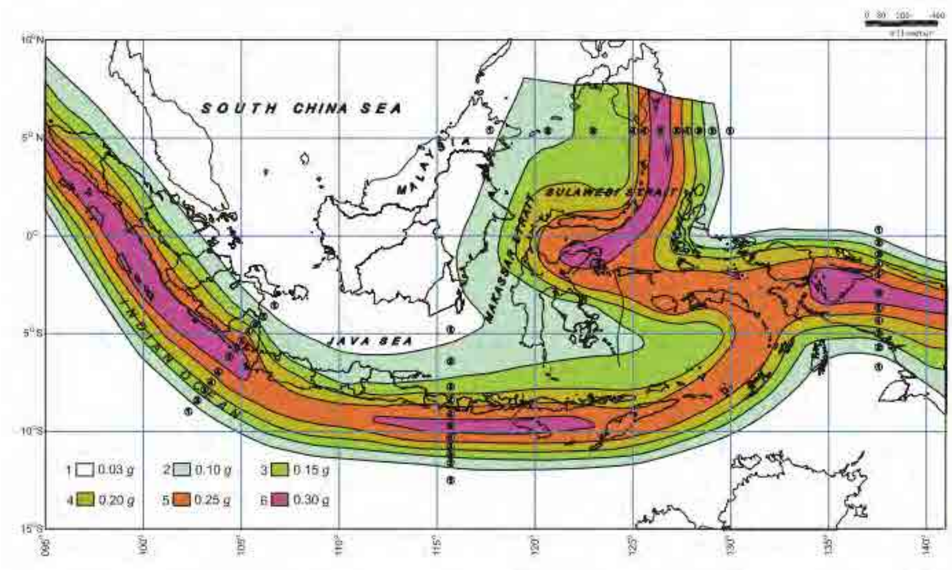


Figure 1. The Seismic Zoning Map of Indonesia with peak base acceleration with a return period of 500 years.

3. Local Soil Category and Peak Ground Acceleration

The soil on top of the base rock generally consists of several layers, each with different values of the soil parameters. Therefore, to determine the category of the soil, the weighted average of the soil parameter must be computed using the thickness of each soil layer as the weighing factor. The weighted average shear wave velocity $\overline{v}_s$, Standard Penetration Test value $\overline{N}$ and undrained shear strength $\overline{S}_u$, can be computed from the following equations :

$$\overline{v}_s = \frac{\sum_{i=1}^{m} t_i}{\sum_{i=1}^{m} t_i / v_{si}} \qquad \text{.......... (1)}$$

$$\overline{N} = \frac{\sum_{i=1}^{m} t_i}{\sum_{i=1}^{m} t_i / N_i} \qquad \text{.......... (2)}$$

$$\overline{S}_u = \frac{\sum_{i=1}^{m} t_i}{\sum_{i=1}^{m} t_i / S_{ui}} \qquad \text{.......... (3)}$$

where

$\overline{v}_s$: weighted average shear wave velocity

$\overline{N}$: weighted average Standard Penetration Test

$\overline{S}_u$: weighted average undrained shear strength

t_i : thickness of layer i

v_{si} : shear wave velocity of layer i

N_i : Standard Penetration Test value of layer i

S_{ui} : undrained shear strength of layer i

So, using the weighted average of soil parameters according to equations (1), (2) and (3) for a total depth of not more than 30 m, the definition of Hard Soil, Medium Soil and Soft Soil is shown in Table 1.

Table 1 Soil Categories

Soil Category	Average shear wave velocity $\overline{v}_s$ (m/sec)	Average Standard Penetration $\overline{N}$	Average undrained shear strength $\overline{S}_u$ (kPa)
Hard Soil	$\overline{v}_s \geq 350$	$\overline{N} \geq 50$	$\overline{S}_u \geq 100$
Medium Soil	$175 \leq \overline{v}_s < 350$	$15 \leq \overline{N} < 50$	$50 \leq \overline{S}_u < 100$
Soft Soil	$\overline{v}_s < 175$	$\overline{N} < 15$	$\overline{S}_u < 50$
	Or, any soil profile with more than 3m of soft clays with PI > 20, $w_n \geq 40\%$ and $S_u < 25$ kPa.		
Special Soil	Site specific evaluation required.		

For the soil categories defined in Table 1, the peak ground acceleration A_0 for each seismic zone is shown in Table 2.

Table 2 Peak Base Acceleration and Peak Ground Acceleration A_0

Seismic Zone	Peak Base Acceleration ('g)	Peak Ground Acceleration A_o ('g')			
		Hard Soil	Medium Soil	Soft Soil	Special Soil
1	0.03	0.04	0.05	0.08	Site specific evaluation required.
2	0.10	0.12	0.15	0.20	
3	0.15	0.18	0.23	0.30	
4	0.20	0.24	0.28	0.34	
5	0.25	0.28	0.32	0.36	
6	0.30	0.33	0.36	0.38	

4. Response Spectra of the Design Earthquake and Modal Analysis

In this standard the maximum response acceleration of the SDOF system due to the Design Earthquake is expressed in the gravity acceleration (g) and is called the Seismic Response Factor C (non-dimensional).

・Seismic response factor

$$T \le 0.2 \;:\; C(T) = A_0 + (A_m - A_0)\frac{T}{0.2}$$

$$0.2 \le T \le T_C \;:\; C(T) = A_m$$

$$T_C \le T \;:\; C(T) = A_m \cdot \frac{T_C}{T}$$

・Method of modal analysis

・SRSS (Square Root of the Sum of Squares)

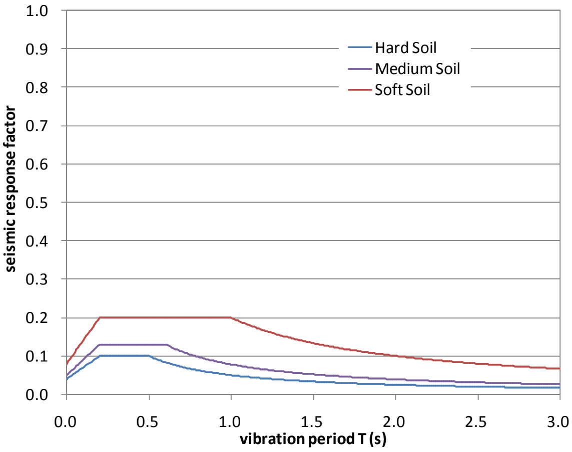
・CQC (Complete Quadratic Combination)

・Vertical effect of earthquakes

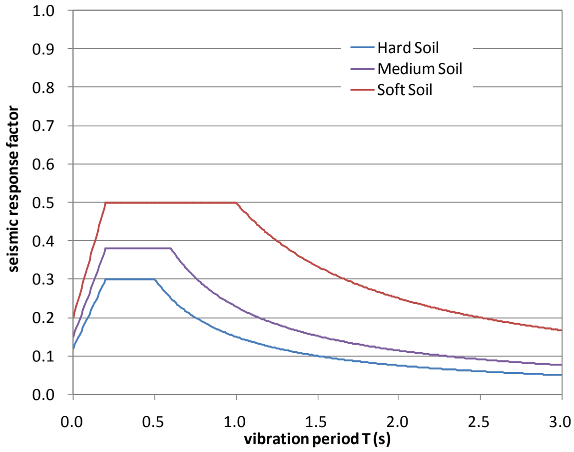
$$A_v = \psi \cdot A_0$$

Table 3 Response Spectra of the Design Earthquake

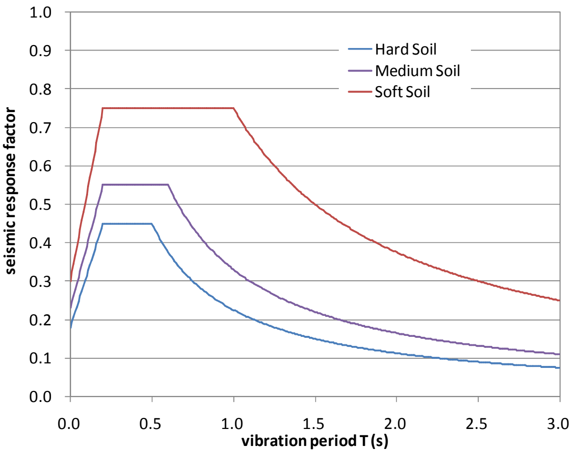
Seismic Zone	Hard Soil T_c = 0.5 sec.			Medium Soil T_c = 0.6 sec.			Soft Soil T_c = 1.0 sec.		
	A_o	A_m	A_r	A_o	A_m	A_r	A_o	A_m	A_r
1	0.04	0.10	0.05	0.05	0.13	0.08	0.08	0.20	0.20
2	0.12	0.30	0.15	0.15	0.38	0.23	0.20	0.50	0.50
3	0.18	0.45	0.23	0.23	0.55	0.33	0.30	0.75	0.75
4	0.24	0.60	0.30	0.28	0.70	0.42	0.34	0.85	0.85
5	0.28	0.70	0.35	0.32	0.83	0.50	0.36	0.90	0.90
6	0.33	0.83	0.42	0.36	0.90	0.54	0.38	0.95	0.95



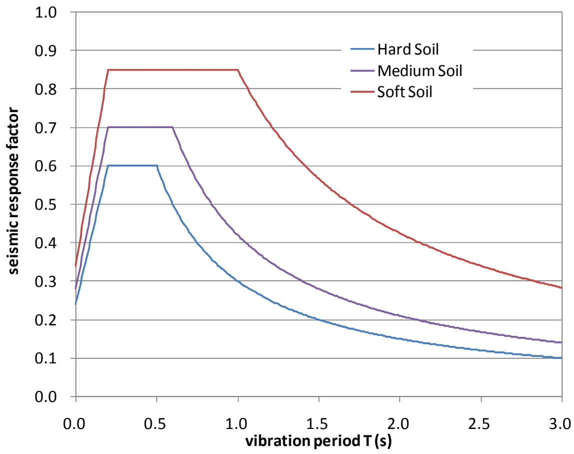
Seismic Zone 1



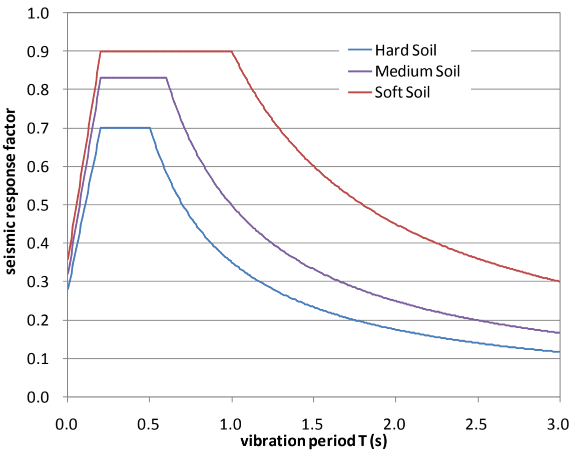
Seismic Zone 2



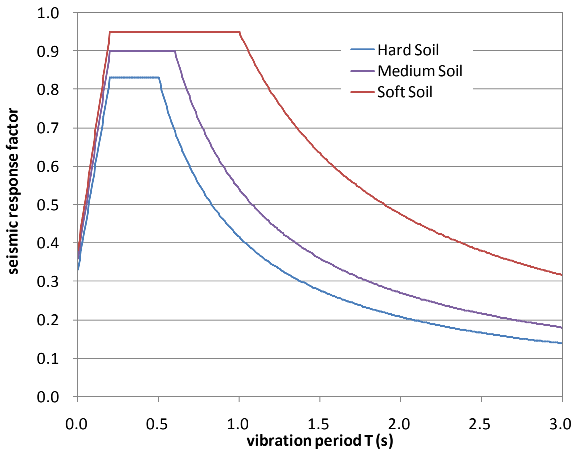
Seismic Zone 3



Seismic Zone 4



Seismic Zone 5



Seismic Zone 6

Figure 2.a Design Response Spectra

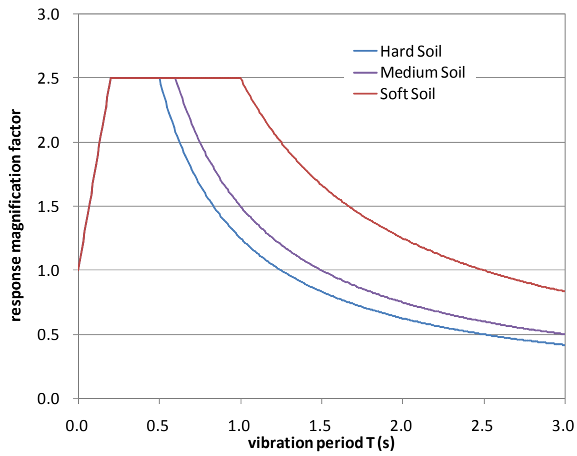


Figure 2.b Response Magnification Spectra of Design Earthquake

Table 4 Coefficient to compute the vertical acceleration of the Design Earthquake

Seismic Zone	Coefficient ψ
1	0.5
2	0.5
3	0.5
4	0.6
5	0.7
6	0.8

5. Ductility, Over-strength and the Effect of the Design Earthquake on the Building Structure

The load-deflection diagram of a building structure designed to remain elastic and designed to possess a certain level of ductility, based on the constant maximum displacement concept may be visualized as shown in Figure 3, whereby δm =constant. In this figure the load is represented by the base shear load V resisted by the structure, and the deflection is represented by the top floor deflection δ of the building structure. Furthermore, the level of ductility according to this standard is expressed by a factor called ductility factor μ, which is the ratio between the maximum deflection δm and the deflection at first yield δy (at which the first plastic hinge develops), so that :

$$1 \le \mu = \frac{\delta_m}{\delta_y} \le \mu_m \qquad \text{..} (4)$$

μ : ductility factor

δ_y : deflection at first yield

δ_m : maximum deflection

μ_m : maximum ductility factor

μ_m=5.3 for full ductile structure

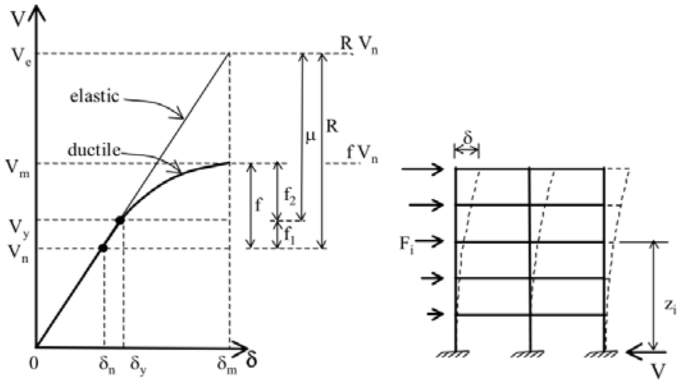


Figure 3. Load deflection diagram (V-δ diagram) of a building structure.

If the elastic load V_e of a building structure in its elastic condition is known, for example from the result of a response spectrum modal analysis as described in section 4, and the building structure is to be designed to have a certain ductility factor μ, which according to this standard may be chosen by the designer or the building owner, then from Figure 3 it can be seen, that the seismic load producing first yield is:

$$V_y = \frac{V_e}{\mu} \qquad \text{..............................} (5)$$

V_y : first yield load

V_e : elastic load in elastic condition

At the seismic load level V_y, the first plastic hinge begins to develop at the most critical section of the structure. To design the strength of that critical section based on the Load and Resistance Factor Design method as required by this standard, the seismic load to be considered, called the nominal seismic load V_n, must be taken lower that V_y, to accommodate the strength margin required to cope with overload on the structure and under-strength of the material.

$$V_n = \frac{V_y}{f_1} = \frac{V_e}{R} \qquad \text{..............................} (6)$$

$$R = \mu\, f_1 \qquad \text{..............................} (7)$$

f_1 : over-strength factor

V_n : nominal seismic load

R : seismic reduction factor

Theoretically the minimum value of f_1 is the product of the load factor and the material factor used in the Load and Resistance Factor Design, namely f_1 = 1.05 x 1.15 = 1.2. The material factor is the inverse of the capacity reduction factor (= 1/φ). In reality there will always be oversized steel sections or excessive concrete reinforcements in structural members, so that in general f_1 > 1,2. According to this standard the over-strength factor is assumed to be constant namely f_1 = 1.6. Therefore, equations (6) and (7) becomes

$$V_n = \frac{V_y}{1.6} = \frac{V_e}{R} \qquad \text{......} \quad (8)$$

$$1.6 \leq R = 1.6\,\mu \leq R_m \qquad \text{......} \quad (9)$$

R_m : maximum seismic reduction factor

R_m =1.6×5.3=8.5 for full ductile structure

$$V_m = f_2\ V_y \qquad \text{......} \quad (10)$$

f_2 : over-strength factor

largest value : f_2 =1.75 for full ductile structure

smallest value : f_2 =1.0 for full elastic structure

$$f_2 = 0.83 + 0.17\,\mu \qquad \text{......} \quad (11)$$

$$V_m = f\ V_n \qquad \text{......} \quad (12)$$

$$f = f_1\ f_2 = 1.6\ f_2 \qquad \text{......} \quad (13)$$

Table 5 Ductility parameters of building structures

Performance level	μ	R eq.(7)	f_2 eq.(11)	f eq.(13)
Full elastic	1.0	1.6	1.00	1.6
Partially ductile	1.5	2.4	1.09	1.7
	2.0	3.2	1.17	1.9
	2.5	4.0	1.26	2.0
	3.0	4.8	1.35	2.2
	3.5	5.6	1.44	2.3
	4.0	6.4	1.51	2.4
	4.5	7.2	1.61	2.6
	5.0	8.0	1.70	2.7
Full ductile	5.3	8.5	1.75	2.8

The deflection of the building structure δ_n due to the nominal seismic load V_n, can also be used to calculate deflections of the building structure at various conditions under the effect of the Design Earthquake, such as the deflection at first yielding :

$$\delta_y = f_1 \ \delta_n = 1.6 \ \delta_n \qquad \text{(14)}$$

δ_n: deflection of the building structure due to the nominal seismic load V_n,

$$\delta_m = R \ \delta_n \qquad \text{(15)}$$

6. The Analysis of 3D Structures

6.1 General

If in the direction of a coordinate axis the R value is not known yet, its value must be computed as the weighted average of the R value of all structural subsystems present in that direction, using the seismic base shear Vs resisted by each subsystem as the weighing factor. In this case the R value of each subsystem in that direction must be known, for example R = 8.5 for an open frame and R = 5.3 for a shear wall, which are their maximum values according to this standard. For each x-axis and y-axis direction, the weighted average R value may be computed as follows :

$$R_x = \frac{\Sigma V_{xs}}{\Sigma V_{xs}/R_{xs}} = \frac{V_x^o}{\Sigma V_{xs}/R_{xs}} \qquad \text{(16)}$$

$$R_y = \frac{\Sigma V_{ys}}{\Sigma V_{ys}/R_{ys}} = \frac{V_y^o}{\Sigma V_{ys}/R_{ys}} \qquad \text{(17)}$$

R_x , R_y : the weighted average R values for the x, y-axis direction

V_{xs} , V_{ys} : the base shear for the x, y-axis direction

V_x^0 , V_y^0 : the weighing factors for the x, y-axis direction

The representative value of the overall seismic reduction factor R of the 3D building structure, is then computed as the weighted average of Rx and Ry, using V_x^o and V_y^o as the weighing factors :

$$R = \frac{V_x^o + V_y^o}{V_x^o/R_x + V_y^o/R_y} \qquad \text{(18)}$$

The fundamental vibration period must satisfy the following requirement:

$$T_1 < \zeta \ n \qquad \text{(19)}$$

T_1 : fundamental vibration period

n : number of stories

ζ : coefficient depending on the seismic zone

Table 6. The ζ coefficient for the limitation of T_1

Seismic Zone	ζ
1	0.20
2	0.19
3	0.18
4	0.17
5	0.16
6	0.15

For various categories of buildings, the importance factor I according to this standard is formulated as follows :

$$I = I_1 \, I_2 \quad \text{.........................} \, (20)$$

I : importance factor

I_1 : importance factor to adjust the return period of the Design Earthquake related to the adjustment of its occurrence probability

I_2 : importance factor to adjust the return period of the Design Earthquake related to the adjustment of the life time of the building

Table 7 Importance Factor for several building categories

Building Category	Importance Factor		
	I_1	I_2	I
General buildings such as for residential, commercial and office use	1.0	1.0	1.0
Monuments and monumental buildings	1.0	1.6	1.6
Post earthquake important buildings such as hospital, clean water installation, power plant, emergency and rescue center, radio and television facilities	1.4	1.0	1.4
Buildings for storing dangerous goods such as gas, oil products, acid, toxic materials	1.6	1.0	1.6
Chimneys, elevated tanks	1.5	1.0	1.5
Note: For all building structures, which usage permit is issued prior to the enforcement date of this standard, the importance factor I may be multiplied by 0.8.			

6.2 The Irregular Building Structure

Based on the fundamental period T_1, the nominal static equivalent base shear due to the Design Earthquake is computed as follows :

$$V_1 = \frac{C_1 I}{R} W_t \qquad \text{..........................} (21)$$

V_1 : nominal static equivalent base shear due to the Design Earthquake

C_1 : Seismic Response Factor obtained from the response spectra of the Design Earthquake

I : importance factor of the building

R : representative seismic reduction factor of the building structure

W_t : total weight of the building, including an appropriate portion of the live load

The base shear V_1 is a reference quantity for the total nominal base shear V_t obtained from the result of a response spectrum modal analysis as described in section 4, whereby the response spectrum used is that of the Design Earthquake shown on Figure 2, its ordinates being multiplied by I/R. The following requirement must be satisfied :

$$V_t \geq 0.8 \ V_1 \qquad \text{..........................} (22)$$

To satisfy the requirement expressed by eq.(22), the nominal story shears obtained from the result of the response spectrum modal analysis, must be multiplied by a scaling factor as follows :

$$\text{Scaling Factor} = \frac{0{,}8 \ V_1}{V_t} \geq 1 \qquad \text{..........................} (23)$$

Visually the result of the above described scaling, is shown on Figure 4, where the CQC curve is the nominal story shear distribution obtained from the result of the response spectrum modal analysis.

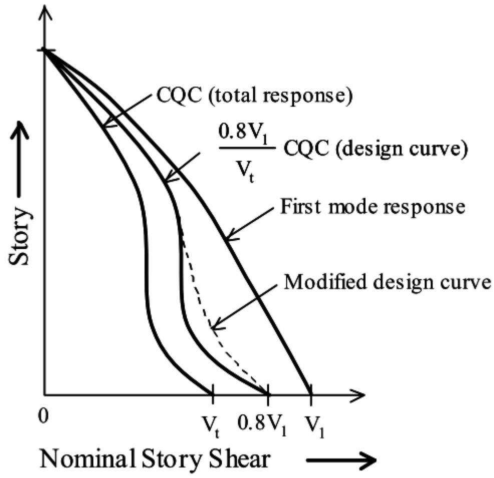


Figure 4. The nominal story shear diagrams along the height of the building structure

6.3 The Regular Building Structure

The nominal static equivalent base shear V at the base of the building structure induced by the effect of the Design Earthquake is

$$V = \frac{C_1\ I}{R} W_t \qquad \text{.............................. (24)}$$

The nominal base shear according to eq.(24) may be distributed along the height of the building structure into nominal static equivalent seismic loads F_i acting at the center of mass of floor i according to the following expression :

$$F_1 = \frac{W_i\ z_i}{\sum_{i=1}^{n} W_i\ z_i} V \qquad \text{..............................(25)}$$

where W_i : weight of floor i, including an appropriate portion of the live load

Z_i : height of floor i measured from the level of its lateral restraint at the base

n : top floor number.

Hence, for regular building structures dynamic analyses are not at all necessary. Even to compute its fundamental period T_1 no free vibration analysis is necessary, because as mentioned in section 6.1, to determine its value the well-known Rayleigh's formula of a 2D structure may be used :

$$T_1 = 2\pi \sqrt{\frac{\sum_{i=1}^{n} W_i \, d_i^2}{g \sum_{i=1}^{n} F_i \, d_i}} \qquad \text{.............................(26)}$$

where d_i : horizontal static deflection of floor i from the result of a static analysis

g : gravity acceleration.

7. Reference

1) “Seismic Resistance Design Standard for Buildings SNI–02-1726-2002”, Wiratman Wangsadinata, Chairman SNI-1726-2002 Committee

2) “Standar Perencanaan Ketahanan Gempa Untuk Struktur Bangunan Gedung SNI-1726-2002”, Standar Nasional Indonesia

Appendix II　: Design of Structures for Earthquake Resistance (TCXDVN 375:2006) in Vietnam

1. Design spectrum for elastic analysis

The design spectrum $S_d(T)$ for the natural period T of the buildings (Figure 2) can be determined by the following formula:

$$0 \le T \le T_B : \; S_d(T) = a_g \cdot S \cdot \left[\frac{2}{3} + \frac{T}{T_B} \cdot \left(\frac{2.5}{q} - \frac{2}{3} \right) \right]$$

$$T_B \le T \le T_C : \; S_d(T) = a_g \cdot S \cdot \frac{2.5}{q}$$

$$T_C \le T \le T_D : \; S_d(T) = a_g \cdot S \cdot \frac{2.5}{q} \left(\frac{T_C}{T} \right)$$

$$\ge \beta \cdot a_g$$

$$T_D \le T \quad : \; S_d(T) = a_g \cdot S \cdot \frac{2.5}{q} \left(\frac{T_C \cdot T_D}{T^2} \right)$$

$$\ge \beta \cdot a_g$$

where

$S_d(T)$: design spectrum

a_g : design ground acceleration on type A ground

$a_g = a_{gR}\gamma_I$

a_{gR} : reference peak ground acceleration on type A ground, determined form Vietnam Seismic map.
for the damage limitation states, value of PGA is taken by 0.585agR.

γ_I : importance factor, equal to 1.25, 1.0, 0.75 and 0.0 for building of class I, II, III and IV.

T : natural period of the buildings

T_B, T_C, T_D : turning points of the period, determined from Table 1

S : soil factor, determined form Table 1.

η : damping correction factor with a reference value of $\eta = 1$ for 5% viscous damping, as follows.

$$\eta = \sqrt{\frac{10}{5+\xi}} \ge 0.55$$

ξ : viscous damping　ratio of the structure (%)

q : behavior factor taking into account for the non-linear response of the structure, associated with the material, the structural system and the design procedures.

β : lower bound factor for the horizontal design spectrum, recommended value is 0.2

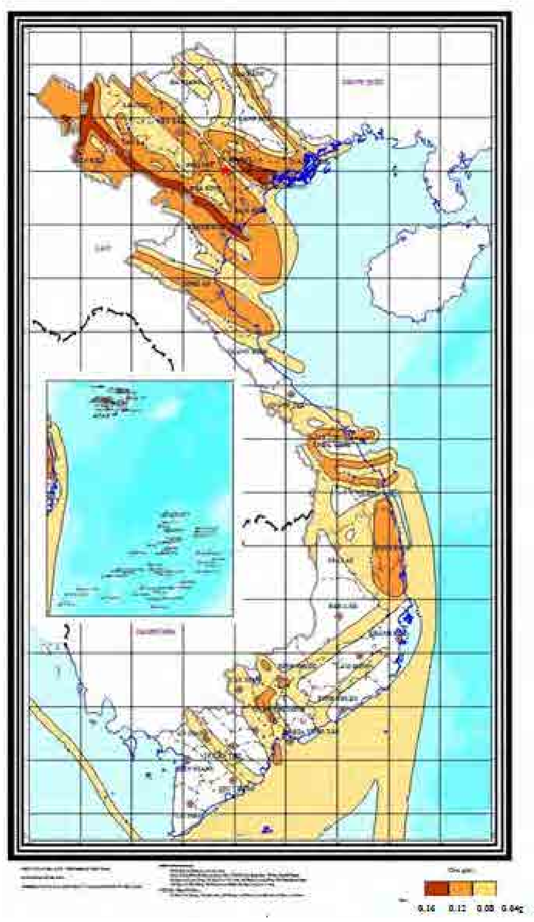


Figure 1 Ground acceleration zone map of Vietnam (Return period:500years, Ground type: A)

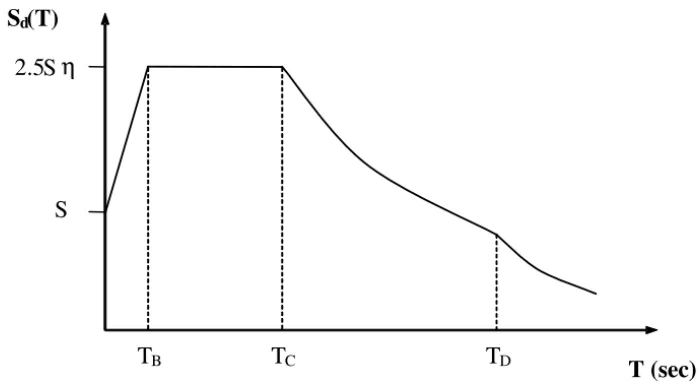


Figure 2 Design response spectrum

Table 1 Values of S, T_B, T_C and T_D

Ground Type	S	T_B (s)	T_C (s)	T_D (s)
A	1.00	0.15	0.4	2.0
B	1.20	0.15	0.5	2.0
C	1.15	0.20	0.6	2.0
D	1.35	0.20	0.8	2.0
E	1.40	0.15	0.5	2.0

Table 2 Ground types

Ground type	Description of stratigraphic profile	Parameters		
		$v_{s,30}$ (m/s)	N_{SPT} (blows/30cm)	c_u (kPa)
A	Rock or other rock-like geological formation, including at most 5 m of weaker material at the surface.	> 800	_	_
B	Deposits of very dense sand, gravel, or very stiff clay, at least several tens of metres in thickness, characterised by a gradual increase of mechanical properties with depth.	360 – 800	> 50	> 250
C	Deep deposits of dense or medium-dense sand, gravel or stiff clay with thickness from several tens to many hundreds of metres.	180 – 360	15 - 50	70 - 250
D	Deposits of loose-to-medium cohesionless soil (with or without some soft cohesive layers), or of predominantly soft-to-firm cohesive soil.	< 180	< 15	< 70
E	A soil profile consisting of a surface alluvium layer with v_s values of type C or D and thickness varying between about 5 m and 20 m, underlain by stiffer material with v_s > 800 m/s.			
S_1	Deposits consisting, or containing a layer at least 10 m thick, of soft clays/silts with a high plasticity index (PI > 40) and high water content	< 100 (indicative)	_	10 - 20
S_2	Deposits of liquefiable soils, of sensitive clays, or any other soil profile not included in types A – E or S_1			

Table 3 Importance classes and importance factor (TCXDVN 375:2006)

Importance classes		Buildings	Importance factor γ_I
Special	Buildings of extreme importance, no damages are allowed during an earthquake event	- Concrete dams with hydraulic pressure of greater than 100m; - Nuclear power plants; - Research centres for test production of extremely toxically biological products, bacteria, natural or man-made germs (cholera, typhoid, etc.); - Tower structures with heights of greater than 300 m; - Multi-storey buildings (60 storeys or higher).	Maximum possible value of acceleration shall be used for design
I	Buildings of vital importance for civil protection; remain functioning during an earthquake event	- Buildings of high occupancy: as described in I-2.a[1], I-2.b, I-2.d, I-2.h, I-2.k, I-2.l, I-2.m with number of storeys, spans, floor areas and capacities belong to Class I; - Buildings remain functioning after an earthquake event: public buildings I-2.c with total floor areas belong to Class I; - Buildings as described in II-9.a, II-9.b; V-1.a, V-1.b belong to Class I; - Storage facilities or pipeline for toxic, inflammable, explosive materials: as described in II-5.a, II-5.b, II-5.c belong to Classes I, II; - High-rise buildings of between 20 storeys and 60 storeys, tower structures with height of between 200m and 300m.	1.25
II	Buildings whose seismic resistance is of importance in view of the consequences associated with a collapse and adverse impacts on human lives and properties.	- Buildings of high occupancy: as described in I-2.a, I-2.b, I-2.d, I-2.h, I-2.k, I-2.l, I-2.m with number of storeys, spans, floor areas and capacities belong to Class II; - Administrative buildings, provincial government buildings: as described in I-2.d, I-2.g, I-2.h with spans and floor areas belong to Classes I, II; - Industrial buildings of high importance house valuable equipments: as described in II-1 to II-4, from II-6 to II-8; from II-10 to II-12; energy buildings as described in II-9.a, II-9.b; traffic structures as shown in III-3, III-5; irrigation structures as described in IV-2; underground structures as shown in III-4; water supply and drainage facilities as described in V-1; all structures belong to Classes I, II; - Buildings for national defence and security; - Buildings of between 9 stories and 19 stories, tower structures with height of between 100m and 200m.	1.00
III	Buildings not belonging in the other categories.	- Residential buildings as shown in I-1, office buildings as described in I-2 (fifth), expo centres, cultural halls, clubs, performance halls, theatres, cinema, circus halls belong to Class III; - Industrial buildings as described in II-1 to II-4, from II-6 to II-8; from II-10 to II-12 belong to Class III with floor areas of between 1000 m^2 and 5000 m^2; - Buildings having 4 stories to 8 stories, tower structures of height of between 50m and 100m; - Walls with height of greater than 10 m.	0.75
IV	Buildings of minor importance in view of the consequences on human lives	- Temporary houses with less than 3 stories; - One-storey cattle farms; - Storages with floor area of 1000 m^2; - Workshops, small industrial buildings: in II-1 to II-4, from II-6 to II-8; from II-10 to II-12 belong to Class IV; - Buildings of which damages cause no harms to people and equipments.	Seismic resistance design not required

Note:
- [1] Refer to Decree 209/2004/ND-CP dated 16/12/2004 of the Government for type of building (e.g.: I-2.a, I-2.b etc.).
- For buildings which house dangerous installations or materials, the importance factor should be established in accordance with the criteria set forth in relevant Standards.

Table 4 Importance classes and importance factors (BS EN 1998-1-2004)

Importance class	Buildings	Importance factor
I	Buildings of minor importance for public safety, e.g. agricultural buildings, etc.	0.8
II	Ordinary buildings, not belonging in the other categories.	1.0
III	Buildings whose seismic resistance is of importance in view of the consequences associated with a collapse, e.g. schools, assembly halls, cultural institutions etc.	1.2
IV	Buildings whose integrity during earthquakes is of vital importance for civil protection, e.g. hospitals, fire stations, power plants, etc.	1.4

Table 5 Design concepts, structural ductility classes and upper limit reference values of the behavior factors

Design concept	Structural ductility class	Range of the reference values of the behaviour factor q
Concept a) Low dissipative structural behaviour	DCL (Low)	≤ 1,5 - 2
Concept b) Dissipative structural behaviour	DCM (Medium)	≤ 4 also limited by the values of Table 6.2
	DCH (High)	only limited by the values of Table 6.2

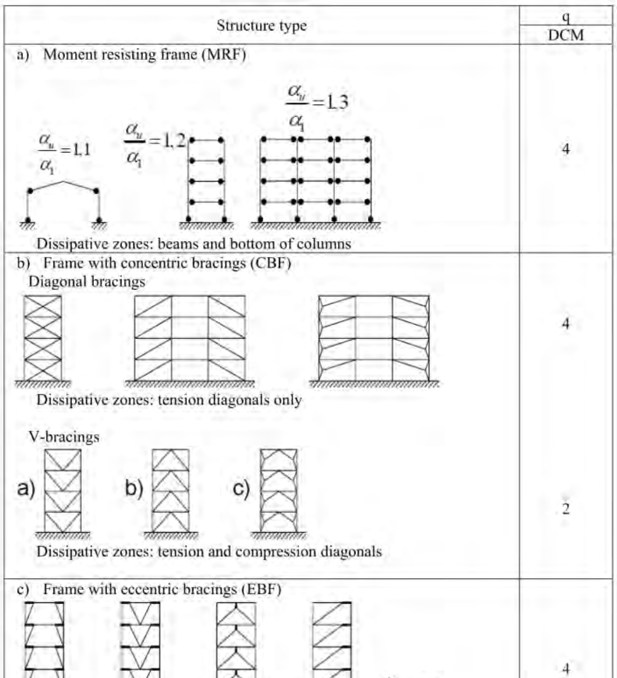


Figure3a Behavior Factor (q) of steel structure

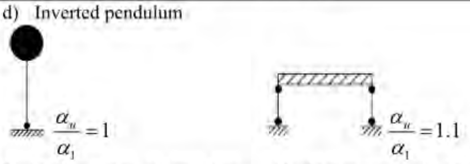
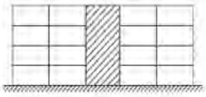
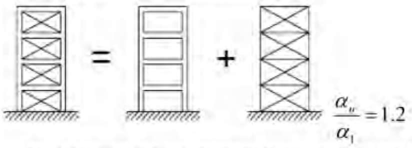
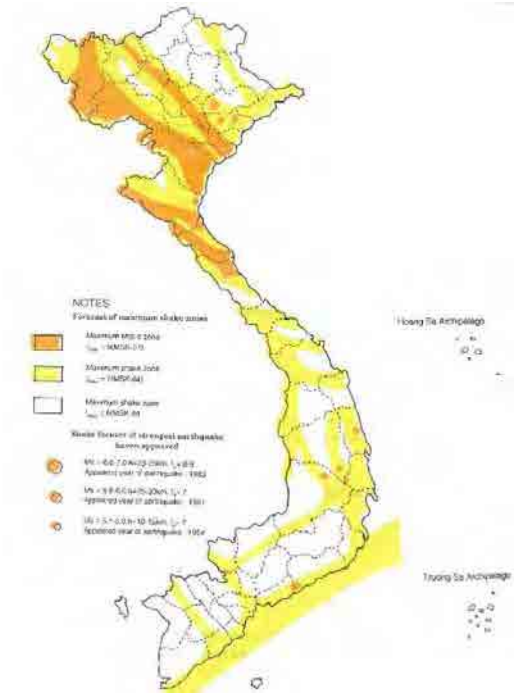
Structure Type	q DCM
d) Inverted pendulum  $\frac{\alpha_u}{\alpha_1}=1$ Dissipative zones: column base $\frac{\alpha_u}{\alpha_1}=1.1$ Dissipative zones: in columns $N_{Sd} / N_{Pl,Rd} > 0.3$	2
e) Structures with concrete cores or concrete walls 	Refer to q of concrete structure
f) Dual structures Moment frame with concentric bracing  $\frac{\alpha_u}{\alpha_1}=1.2$ Dissipative zones: in moment frame and in tension diagonals	4
g) Mixed structures (steel moment resisting frames with infills) 	
Unconnected concrete or masonry infills, in contact with the frame	2
Connected reinforced concrete infills	Refer to cls. 7 of EN 1998-1
Infills isolated from moment frame → see moment frames	4

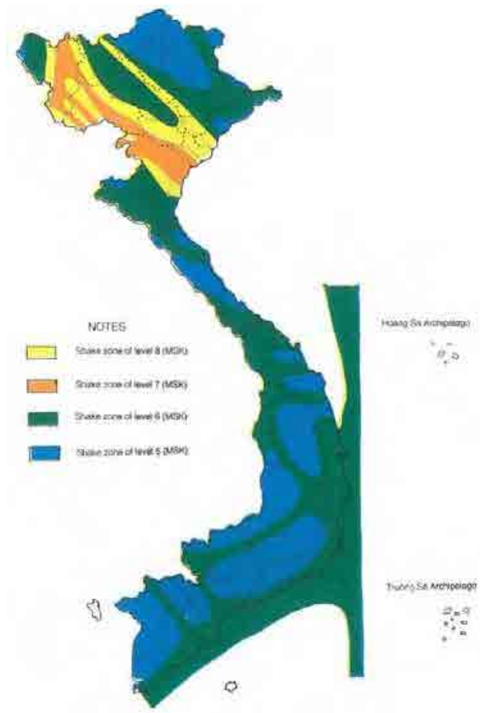
Figure3b Behavior Factor (q) of steel structure

2. Building Code of Vietnam 1997

1) Zone map



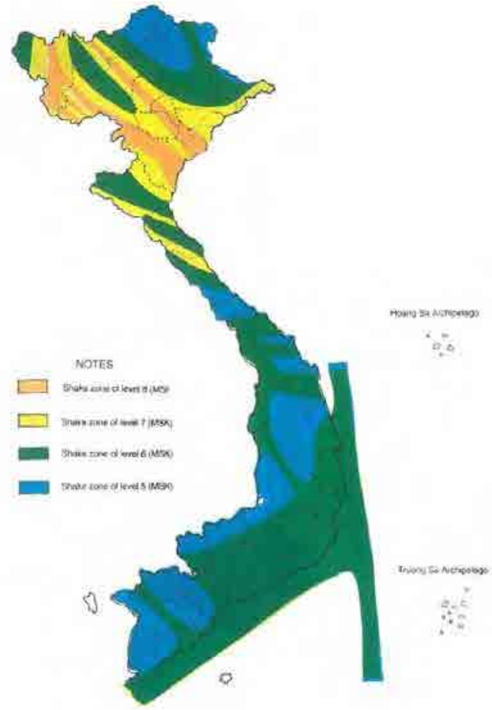
Map of strong earthquake originated zones and maximum shake zoning



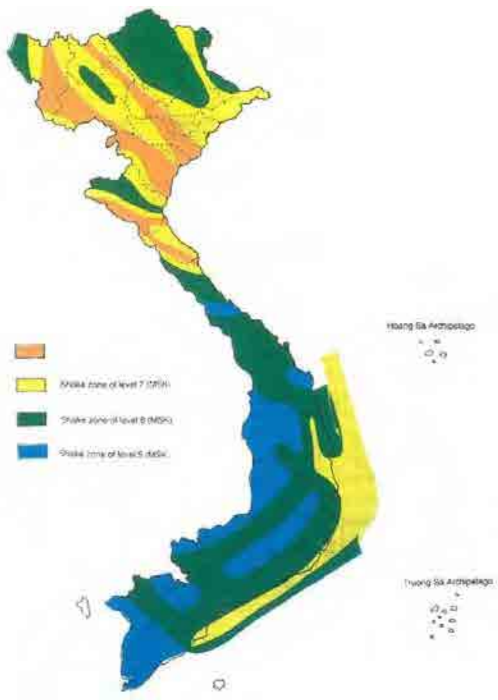
Repeated frequency B1≥0.005, cycle T1≤200years

(probability P≥0.1 within the time of 20 years)

Figure4a Shake zoning map



Repeated frequency B1≥0.002, cycle T1≤500years
(probability P≥0.1 within the time of 50 years)



Repeated frequency B1≥0.001, cycle T1≤1000years
(probability P≥0.1 within the time of 100 years)

Figure4b Shake zoning map

2) Designing for earthquake
   Design calculation for earthquake resistance must be in accordance with the relevant standards.

   Note: As Vietnamese standards on Earthquake Resistance are not available, designers can apply those existing standards of industrially developed countries, which are accepted by the Ministry of Construction.

Appendix III : National structural Code of Philippines(NSCP), Volume1
Fourth Edition 1992, Fifth Edition 2001, Sixth Edition 2010

1. Introduction

National structural Code of Philippines (NSCP) was established with referring UBC fundamentally. The outline of descriptions for the seismic design procedures in the latest edition (2010;sixth edition) is shown as follows, and the history of revising is shown finally.

2. Static Force Procedure

2.1 Design Lateral Force on Buildings and Building-like Structures

・Design base shear

Total design base shear in a given direction shall be determined from the following equation.

$$V = \frac{CvI}{RT}W \qquad (3.1) \quad \text{(Ref. Eq. 208-4 of NSCP)}$$

Total design base shear need not exceed the following.

$$V = \frac{2.5CaI}{R}W \qquad (3.2) \quad \text{(Ref. Eq. 208-5 of NSCP)}$$

Total design base shear shall not be less than the following.

$$V = 0.11CaIW \qquad (3.3) \quad \text{(Ref. Eq. 208-6 of NSCP)}$$

In addition, for Seismic Zone 4, the total base shear shall also not be less than the following.

$$V = \frac{0.80ZN_V I}{R}W \qquad (3.4) \quad \text{(Ref. Eq. 208-7 of NSCP)}$$

where V : total design lateral force of shear at the base

Z : seismic zone factor (refer to Figure 1, Table 1)

I : importance factor(refer to Figure 2, Table 3)

C_a : seismic coefficient(refer to Figure 1, Table 4,5)

C_v : seismic coefficient(refer to Figure 1, Table 4,6)

N_a : near-source factor(refer to Table 7,9)

N_v : near-source factor(refer to Table 8,9)

R : response modification coefficient (refer to Table 10)

T : fundamental period of the building

$$T = C_t (h_n)^{3/4}$$

C_t : numerical coefficient

C_t =0.0853 for steel moment-resisting frames.

C_t =0.0731 for reinforced concrete moment-resisting frames and eccentrically braced frames

C_t =0.0488 for all other buildings

h_n : height above the base

W : total seismic dead load

2.2 Design Lateral Force on Elements of Structures, Nonstructural Components and Equipment Supported by Structures

・Total design lateral seismic force

The total design lateral seismic force, Fp shall be determined from the following equation.

$$F_p = 4.0\, C_a I_p W_p$$

Alternatively, Fp may be calculated using the following equation.

$$F_p = \frac{a_p C_a I_p}{R_p}\left(1 + 3\frac{h_x}{h_r}\right)W_p \qquad (3.6) \quad \text{- (Ref. Eq. 208-19 of NSCP)}$$

Except that Fp shall not be less than the following equation,

$$F_p = 0.70\, C_a I_p W_p$$

and need not be more than the following equation.

$$F_p = 4.0\, C_a I_p W_p$$

where F_p : total design lateral seismic force

I_p : weight of element or component

W_p : weight of element or component

a_p : in-structure component amplification factor

R_p : component response modification factor

h_x : element or component attachment elevation

h_r : structure roof elevation

2.3 Design Lateral Force on Non-building Structures

1) Rigid structures

Rigid structures those with period T less than 0.06s and their anchorages shall be designed for the lateral force obtained from following equation.

$$V = 0.7 C_a\, I\, W \qquad (3.7) \quad \text{(Eq. 208-22 NSCP)}$$

The force V shall be distributed according to the distribution of mass and shall be assumed to act in any horizontal direction.

2) Flat bottom tanks or other tanks with supported bottoms

Flat bottom tanks or other tanks with supported bottoms, founded at or below grade, shall be designed to resist the seismic forces calculated using the procedures in 2.2 for rigid structures considering the entire weigh of the tank and its contents. Alternatively, such tanks may be designed using one of the two procedures described below.

a) A response spectrum analysis that includes consideration of the actual ground motion anticipated at the site and the inertial effects of the contained fluid.

b) A design basis prescriber for the particular type of tank by an approved national standard, provided that the seismic zones and occupancy categories shall be in conformance with the provisions of Sections 208.4.4 and 208.4.2, respectively.

3) Other non-building structure

Non-building structures that are not covered by Sections 208.9.3 and 208.9.4 shall be designed to resist design seismic forces not less than those determined in accordance with the provisions in Section 208.5 with the following additions and exceptions.

a) The factors R and Ω0 shall be as set forth in Table 208-13. The total design base shear determined in accordance with Section 208.5.2 shall not be less than the following.

$$V = 0.56\, C_a\ I\, W \qquad (3.8) \quad \text{(Eq. 208-23 NSCP)}$$

Additionally, for Seismic Zone 4, the total base shear shall also not be less than the following.

$$V = \frac{1.60\, ZN_V\ I}{R} W \qquad (3.9) \quad \text{(Eq. 208-24 NSCP)}$$

b) The vertical distribution of the design seismic forces in structures covered by this section may be determined by using the provisions of Section 208.5.5 or by using the procedures of Section 208.6.

2.4 Vertical Distribution of Earthquake Load

The total force shall be distributed over the height of the structure in conformance with following equations.

$$V = F_t + \sum_{i=1}^{n} F_i \qquad (3.10) \quad \text{(Eq. 208-13 NSCP)}$$

The concentrated force Ft at the top, which is in addition to Fn shall be determined from the equation.

$$F_t = 0.07TV \qquad (3.11) \quad \text{(Eq. 208-14 NSCP)}$$

$$F_t = 0 \ \text{ in case } \ T \le 0.70$$

$$F_t \ \text{ need not exceed } \ 0.25V$$

$$Fx = \frac{(V - F_t) w_x h_x}{\sum_{i=1}^{n} w_i h_i} \qquad (3.12) \quad \text{(Eq. 208-15 NSCP)}$$

where F_t : concentrated force at the top

F_i, F_x : Design Seismic Force applied to Level i or x, respectively

w_i, w_x : that portion of W located at or assigned to Level i or x, respectively

h_i, h_x : height in meter above the base to Level i or x, respectively

3 Dynamic Analysis Procedure

3.1 Ground Motion

The ground motion representation shall, as a minimum, be one having a 10-percent probability of being exceed in 50 years, shall not be reduced by the quantity and may be one of the following.

1) An elastic design response spectrum constructed in accordance with Figure 2, using the value of C_a and C_v consistent with the specific site. The design acceleration ordinates shall be multiplied by the acceleration of gravity, 9.815m/s^2.
2) A site-specific elastic design response spectrum based in the geologic, tectonic, seismologic and soil characteristics associated with the specific site. The spectrum shall be developed fir a damping ratio of 0.05, unless a different value is shown to be consistent with the anticipated structural behavior at the intensity if shaking established for the site.
3) Ground motion time histories developed for the specific site shall be representative of actual earthquake motions. Response spectra from time histories, either individually or in combination, shall approximate the site design spectrum conforming to Item 2).
4) For structures on Soil Profile Type SF, the following requirements shall apply when required by Section 208.4.8.3, Item 4
   4-1) The ground motion representation shall be developed in accordance with Item 2 and 3.
   4-2) Possible amplification of building response due to the effects of soil-structure interaction and lengthening of building period caused by inelastic behavior shall be considered.
5) The vertical component of ground motion may be defined by scaling corresponding horizontal accelerations by a factor of two-thirds. Alternative factors may be used when substantiated by site-specific data. Where the Near Source Factor N_v, is greater than 1.0, site-specific vertical response spectra shall be used in lieu if the factor of two-thirds.

4 Figures and Tables

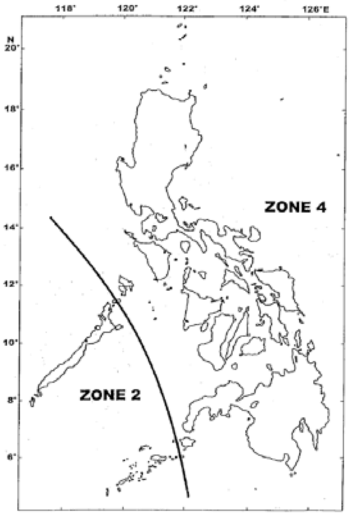


Figure1 Referenced Seismic Map of the Philippines

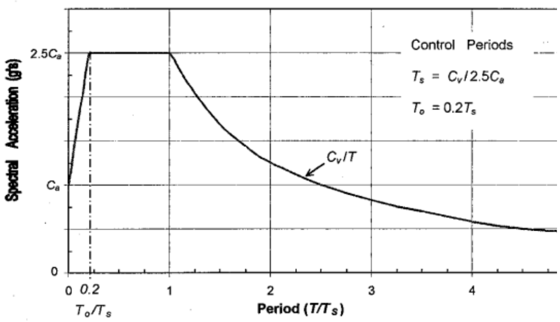


Figure 2 Design Response Spectra

Table 1 Seismic Zone Factor Z

ZONE	2	4
Z	0.20	0.40

Table 2 Occupancy Category

OCCUPANCY CATEGORY	OCCUPANCY OR FUNCTIONS OF STRUCTURE
I. Essential Facilities	Occupancies having surgery and emergency treatment areas, Fire and Police Stations, Garages and shelters for emergency vehicles and emergency aircraft, Structures and shelters in emergency preparedness centers, Aviation control towers, Structures and equipment in communication centers and other facilities required for emergency response, Standby power-generating equipment for Category I facilities, Tanks or other structures containing housing or supporting water or other fire-suppression material or equipment required for the protection of Category I, II, or III structures.
II. Hazardous Facilities	Occupancies and structures therein housing or supporting toxic or explosive chemicals or substances, Nonbuilding structures, housing, supporting or containing quantities of toxic or explosive substances.
III. Special Occupancy Structures	Buildings with an assembly room with an occupant capacity of 1,000 or more, Educational buildings with a capacity of 300 or more students, Buildings used for college or adult education with a capacity of 500 or more students, Institutional buildings with 50 or more incapacitated patients, but not included in Category I, Mental hospitals, sanitariums, jails, prison and other buildings where personal liberties of inmates are similarly restrained,
	All structures with an occupancy 5,000 or more persons, Structures and equipment in power-generating stations, and other public utility facilities not included in Category I or Category II for continued operation.
IV. Standard Occupancy Structures	All structures housing occupancies or having functioned not listed in Category I, II, or III and Category V below.
V. Miscellaneous Structures	Private garages, carports, sheds, agricultural buildings, and fence over 1.8 meters high.

Table 3 Seismic Importance Factor

Occupancy Category[1]	Seismic Importance Factor, I	Seismic Importance[2] Factor, I_p
I. Essential Facilities[3]	1.25	1.50
II. Hazardous Facilities	1.25	1.50
III. Special Occupancy Structures[4]	1.00	1.00
IV. Standard Occupancy Structures[4]	1.00	1.00
V. Miscellaneous Structures	1.00	1.00

Table 4 Soil Profile Types

Soil Profile Type	Soil Profile Name/Generic Description	Average Soil Properties for Top 30m of Soil Profile		
		Shear Wave Velocity, V_s (m/s)	SPT, N (blows / 300mm)	Undrained Shear Strength, (kPa)
S_A	Hard Rock	> 1,500		
S_B	Rock	760 to 1,500		
S_C	Very Dense Soil and Soft Rock	360 to 760	> 50	> 100
S_D	Stiff Soil Profile	180 to 360	15 to 50	50 to 100
S_E[1]	Soft Soil Profile	< 180	< 15	< 50
S_F	Soil requiring Site-specific Evaluation. See Section 208.4.3.1			

Table 5 Seismic Coefficient C_a

Soil Profile type	Seismic Zone Factor, Z	
	Z = 0.2	Z = 0.4
S_A	0.16	$0.32N_a$
S_B	0.20	$0.40N_a$
S_C	0.24	$0.40N_a$
S_D	0.28	$0.44N_a$
S_E	0.34	$0.36N_a$
S_F	See Footnote 1 of Table 208-8	

Table 6 Seismic Coefficient C_v

Soil Profile Type	Seismic Zone Factor, Z	
	Z = 0.2	Z = 0.4
S_A	0.16	$0.32N_V$
S_B	0.20	$0.40N_V$
S_C	0.32	$0.56N_V$
S_D	0.40	$0.64N_V$
S_E	0.64	$0.96N_V$
S_F	*See Footnote 1*	

Table 7 Near-Source Factor *Na*

Seismic Source Type	Closest Distance To Known Seismic Source[2]	
	≤ 5km	≥ 10km
A	1.2	1.0
B	1.0	1.0
C	1.0	1.0

Table 8 Near-Source Factor *Nv*

Seismic Source Type	Closest Distance To Known Seismic Source[2]		
	≤ 5km	10km	≥ 15km
A	1.6	1.2	1.0
B	1.2	1.0	1.0
C	1.0	1.0	1.0

Table 9 Seismic Source Types

Seismic Source Types	Seismic Source Descriptions	Seismic Source Definitions
		Maximum Moment Magnitude, M
A	Faults that are capable of producing large magnitude events and that have a high rate of seismic activity	$M \geq 7.0$
B	All faults other than Types A and C	$6.5 \leq M < 7.0$
C	Faults that are not capable of producing large magnitude earthquakes and that have relatively low rate of seismic activity	$M < 6.5$

Table 10 Earthquake-Force-Resisting Structural System of Steel

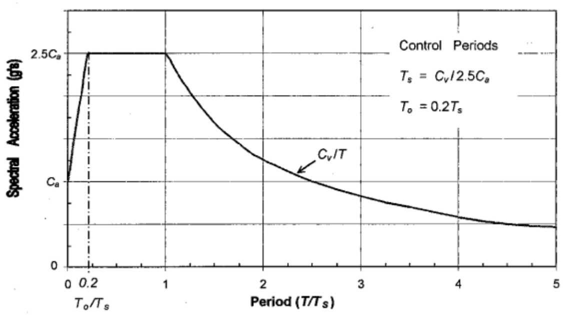
Basic Structural System[2]	Lateral-Force-Resisting System Description	R	Ω_o	Height Limit for Zones 4 (m)
1. Bearing wall System	1. Light-Framed Walls with Shear Panels			
	a. Wood structural panel walls for structures three stories or less	5.5	2.8	20
	b. All other light-framed walls	4.5	2.8	20
	2. Shear Walls			
	a. Concrete	4.5	2.8	50
	b. Masonry	4.5	2.8	50
	3. Light Steel-Framed Bearing Walls with tension-only bracing	2.8	2.2	20
	4. Braced Frames where Bracing Carries Gravity Load			
	a. Steel	4.4	2.2	50
	b. Concrete[3]	2.8	2.2	--
	c. Heavy timber	2.8	2.2	20
2. Building Frame Systems	1. Steel Eccentricially Braced Frame (EBF)	7.0	2.8	75
	2. Light-Framed Walls with Shear Panels			
	a. Wood structural panel walls for structures three stories or less	6.5	2.8	20
	b. All other light-framed walls	5.0	2.8	20
	3. Shear Walls			
	a. Concrete	5.5	2.8	75
	b. Masonry	5.5	2.8	50
	4. Ordinary Braced Frames			
	a. Steel	5.6	2.2	50
	b. Concrete[3]	5.6	2.2	--
	c. Heavy timber	5.6	2.2	20
	5. Special Concentrically Braced Frames			
	a. Steel	6.4	2.2	75
3. Moment-Resisting Frame Systems	1. Special Moment-Resisting Frame (SMRF)			
	a. Steel	8.5	2.8	N.L
	b. Concrete[4]	8.5	2.8	N.L
	2. Masonry Moment-Resisting Wall Frame (MMRWF)	6.5	2.8	50
	3. Concrete Intermediate Moment-Resisting Frame (IMRF)[5]	5.5	2.8	--
	4. Ordinary Moment-Resisting Frame (OMRF)			
	a. Steel[6]	4.5	2.8	50
	b. Concrete[7]	3.5	2.8	--
	5. Special Truss Moment Frames of Steel (STMF)	6.5	2.8	75
4. Dual Systems	1. Shear Walls			
	a. Concrete with SMRF	8.5	2.8	N.L
	b. Concrete with steel OMRF	4.2	2.8	50
	c. Concrete with concrete IMRF[5]	6.5	2.8	50
	d. Masonry with SMRF	5.5	2.8	50
	e. Masonry with steel OMRF	4.2	2.8	50
	f. Masonry with concrete IMRF[3]	4.2	2.8	--
	g. Masonry with masonry MMRWF	6.0	2.8	50
	2. Steel Eccentrically Braced Frame (EBF)			
	a. With steel SMRF	8.5	2.8	N.L
	b. With steel OMRF	4.2	2.8	50
	3. Ordinary Braced Frames			
	a. Steel with steel SMRF	6.5	2.8	N.L
	b. Steel with steel OMRF	4.2	2.8	50
	c. Concrete with concrete SMRF[3]	6.5	2.8	--
	d. Concrete with concrete IMRF[3]	4.2	2.8	--
	4. Special Concentrically Braced Frames			
	a. Steel with steel SMRF	7.5	2.8	N.L
	b. Steel with steel OMRF	4.2	2.8	50
5. Cantilevered Column Building Systems	Cantilevered column elements	2.2	2.0	10[6]
6. Shear-Wall-Frame Interaction Systems	Concrete[7]	5.5	2.8	50

Table 11 Horizontal Force Factors, a_p and R_p for Elements of Structures and Nonstructural Components and Equipment

Category	Element or Component	a_p	R_p	Footnote
1. Elements of Structures	1. Walls including the following			
	a. Unbraced (cantilevered) parapets.	2.5	3.0	
	b. Exterior walls at or above ground floor and parapets	1.0	3.0	2
	c. All interior-bearing and non-bearing walls	1.0	3.0	2
	2. Penthouse (except when framed by an extension of the structural frame)	2.5	4.0	
	3. Connections for prefabricated structural elements other walls. See also Section 208.7.2	1.0	3.0	3
2. Nonstructural Components	1. Exterior and interior ornamentation and appendages.	2.5	3.0	
	2. Chimneys, stacks, and trussed towers supported on or projecting above the roof.			
	a. Laterally braced or anchored to the structural frame at a point below their centers of mass.	2.5	3.0	
	b. Laterally braced or anchored to the structural frame at or above their centers of mass.	1.0	3.0	
	3. Signs and billboards	2.5	3.0	
	4. Storage racks (include contents) over 1.8 meters tall.	2.5	4.0	4
	5. Permanent floor supported cabinets and book stocks more than 1.8 meters height (include contents)	1.0	3.0	5
	6. Anchorage and lateral bracing for suspended ceilings and light fixtures.	1.0	3.0	3, 6, 7, 8
	7. Access floor systems.	1.0	3.0	4, 5, 9
	8. Masonry or concrete fences over 1.8 meters high.	1.0	3.0	
	9. Partitions.	1.0	3.0	
3. Equipment	1. Tanks and vessels (include contents), including support systems.	1.0	3.0	
	2. Electrical, Mechanical, and plumbing equipment and associated conduit and ductwork and piping.	1.0	3.0	5, 10, 11, 12, 13, 14, 15, 16
	3. Any flexible equipment laterally braced and anchored to the structural frame at a point below their center of mass.	2.5	3.0	5, 10, 14, 15, 16
	4. Anchorage of emergency power supply systems and essential communication equipment. Anchorage and support systems for battery racks and fuel tanks necessary for operation of emergency equipment. See also Section 208.7.2	1.0	3.0	17, 18
	5. Temporary containers with flammable or hazardous materials.	1.0	3.0	19
4. Other Components	1. Rigid components with ductile material and attachments.	1.0	3.0	1
	2. Rigid components with nonductile material or attachments.	1.0	1.5	1
	3. Flexible components with ductile material and attachments.	2.5	3.0	1
	4. Flexible components with nonductile material or attachments.	2.5	1.5	1

Table 12 R and Ωo Factors for Non-building Structures

STRUCTURE TYPE	R	Ω_o
1. Vessels, including tanks and pressurized spheres, on braced or unbraced legs.	2.2	2.0
2. Cast-in-place concrete silos and chimneys having walls continuous to the foundations.	3.6	2.0
3. Distributed mass cantilever structures such as stacks, chimneys, silos and skirt-supported vertical vessels.	2.9	2.0
4. Trussed towers (freestanding or guyed), guyed stacks and chimneys.	2.9	2.0
5. Cantilevered column-type structures.	2.2	2.0
6. Cooling towers.	3.6	2.0
7. Bins and hoppers on braced or unbraced legs.	2.9	2.0
8. Storage racks.	3.6	2.0
9. Signs and billboards.	3.6	2.0
10. Amusement structures and monuments	2.2	2.0
11. All other self-supporting structures not otherwise covered.	2.9	2.0



5 History of revising

5.1 Revising points from Fourth Edition 1992 to Fifth Edition 2001

1) Seismic zoning and seismic zone factor were not revised.
2) Importance factor was not revised.
3) Number of Soil profile types increased from four to five, and the values of Ca and C_v factors in the Fifth Edition are similar to the values if S factor in the Fourth Edition.
4) The values of reduction factors in the Fifth Edition decreased from those in the Fourth Edition.

Table 13 Comparison of R factors

	Fourth Edition 1992 R_w	Fifth Edition 2001 R
Steel Eccentric Braced Frame	10	7.0
Steel Concentrically Braced Frame	8	6.4
Steel Special Moment Resisting Space Frame	12	8.5
Concrete Special Moment Resisting Space Frame	10	8.5

5) The equations of static design base shear were revised. Those in the Fourth Edition are as follows.

$$V = \frac{ZIC}{R_w} W \quad (2\text{-}1)$$

$$C = \frac{1.25\ S}{T^{2/3}} \quad (2\text{-}2)$$

6) Although the category of soil profile type was revised, the shapes and the values of the design response spectrum are similar.

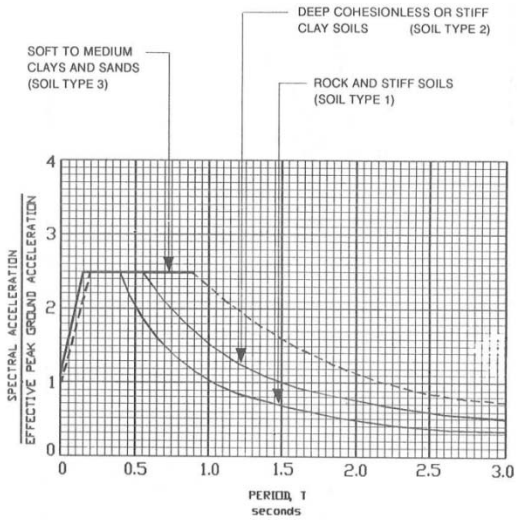


Figure 3 Normal Response Spectral Shapes in Fourth Edition 1992

5.2 Revising points from Fifth Edition 2001 to Sixth Edition 2010

1) Values of "Table 3 Seismic Importance Factors" and "Table 5 Seismic Coefficient" were changed a little.
2) Category of "Table 10 Earthquake-Force-Resisting Structural System of Steel" was revised and the values were changed a little.

6 Reference

1) "National Structural Code of Philippines (NSCP), Volume 1, Fourth Edition 1992", The Board of Civil Engineering of the Professional Regulation Commission
2) "National Structural Code of Philippines 2001 Volume 1 Buildings, Towers and

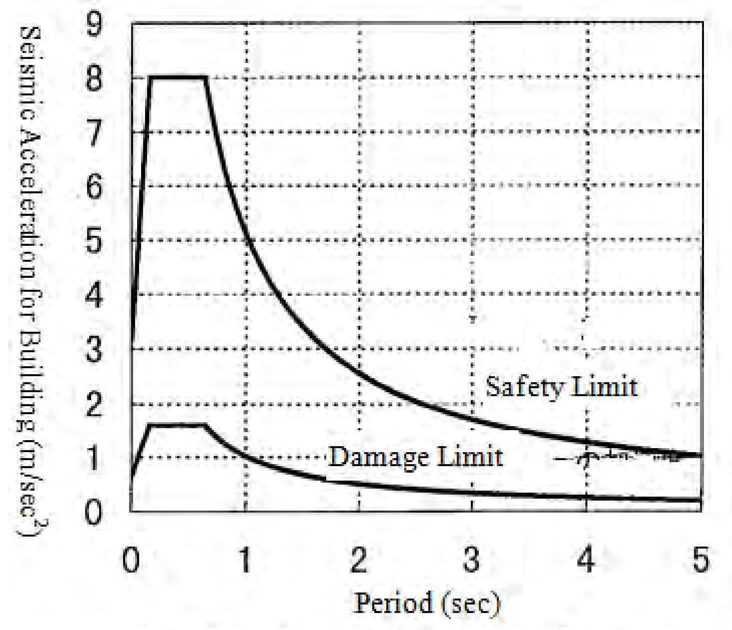
Other Vertical Structures Fifth Edition" , Association of Structural Engineers of Philippines

3) "National Structural Code of Philippines 2010 Volume 1 Buildings, Towers and Other Vertical Structures Sixth Edition", Association of Structural Engineers of Philippines

4) "ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures", American Society of Civil Engineer

Appendix IV　: Summary of Seismic design code for Petroleum Refinery and Petrochemical Plant in Japan

Item	Seismic Design Code of the High Pressure Gas Facilities	Notification for the specifics of the technical standards on hazardous materials	Building Standard Act
Structures to be applied seismic design code	1. Pressure Vessel and Column（Ref. “Guidelines on Seismic Design for High Pressure Gas Facilities”） According to the type of high-pressure gas, determined by the following rules (1) Safetu Regulation for Refrigiration (2) Safety Regulation for Liquified Petroleum Gas (3) Safety Regulation for petroleum Industries Complexes and Other Petroleum Facilities (4) Regulation of trading and safety for Liquefied Petroleum Gas 2. Piping (see Appendix for details) Piping stipulated in article 1 and 2 of the Notification. 3. Structures and structures to support Foundation (Ref. “Guidelines on Seismic Design for High Pressure Gas Facilities” for details) Structures and Foundations supporting for the above 1. and 2.	1. Large Outdoor Storage Tank Storage tank with capacity 1,000kl and more. 2. Medium-size Outdoor Storage Tank Storage tank with capacity 500kl and more and less than 1,000kl. 3. Storage tank other than Category 1,2 Storage capacity less than 500kl. 4. Piping on transfer facility	1. Category I Building（Height 60m over） 2. Category II Building　（large-sized） 3. Category III Building　（medium-sized）
Earthquakes to be Considered	The following earthquakes shall be considered; 1.「Level 1 Earthquake」 Probable strong earthquake in the service life of the facilities 2.「Level 2 Earthquake」 Possible strongest earthquake with extremely low probability of occurrence	(1) Large Outdoor Storage Tank　（Notification Article 4-20） $Kh_1=0.15*\nu_1 * \nu_2 * \nu_3$ $Kh_2=0.15*\nu_1 * \nu_4 * \nu_5$ Kh_1 : Design Seismic Intensity ν_1 : Seismic Zone Factor (1.00,0.85,0.75) ν_2 : Ground Factor (1.50,1.67,1.83,2.00) ν_3 : Response factor considering the natural period of the Large Outdoor Storage Tank ν_4 : Response factor considering the natural period of sloshing ν_5 : Factor considering the local long period earthquake (2) Medium-size Outdoor Storage Tank　（Notification Article 4-22-10） $Kh_1=0.15*\nu_1 * \nu_2 * \nu_3$ Kh_1 : Design Seismic Intensity ν_1 : Seismic Zone Factor (1.00,0.85,0.75) ν_2 : Ground Factor (1.50,1.67,1.83,2.00) ν_3 : Response factor considering the natural period of the Large Outdoor Storage Tank	For the building height less than 60m 1. Largest load / force (force / load very rarely occurs) Seismic force equivalent to standard shear force coefficient of 1.0 or higher, or equivalent acceleration response spectrum 2. Medium load / force (force / load rarely occurs) Seismic force equivalent to standard shear force coefficient of at least 0.3, or equivalent acceleration response spectrum For the building height 60m and over 1. Largest load / force (force / load very rarely occurs) Seismic force is based on the acceleration response spectrum as shown in Figure 2.5 - 1 if it is in safety limit (5x of seismic force of the right) 2. Medium load / force (force / load rarely occurs) Damage limits shown in Figure 2.5 - 1 if acceleration response spectrum on the seismic force

Item	Seismic Design Code of the High Pressure Gas Facilities	Notification for the specifics of the technical standards on hazardous materials	Building Standard Act
		(3) Storage tank other than Category 1,2 （Notification Article 4-23） $Kh'_1=0.15*\nu_1*\nu_2$ Kh'_1 : Design Seismic Intensity ν_1 : Seismic Zone Factor (1.00,0.85,0.75) ν_2 : Ground Factor (1.50,1.67,1.83,2.00) (4) Piping on transfer facility $Kh_1=\nu_2*\nu_4*K_{OH}$ $K_{OH}=0.15*\nu_1*\nu_2*\nu_7$ Kh_1 : Design Seismic Intensity K_{OH} : Design Seismic Intensity at Baseplate ν_1 : Seismic Zone Factor (1.00,0.85,0.75) ν_2 : Ground Factor ν_3 : Importance Factor （as 1.0） ν_4 : Seismic intensity distribution factor（as 1.0） ν_7 : Land utilization factor	 Fig 2.5-1 Acceleration Response Spectrum
Seismic Performance to be provided	1.「Level 1 Earthquake」 The term detrimental deformation, etc. without residual for the Level 1 Earthquake and hold the relevant Seismic Design Structures in High Pressure Gas tightness. 2.「Level 2 Earthquake」 Level 2Seismic Performance as pertaining to importance categories 1 and I against the ground displacement due to liquefaction of the ground and Level 2 Earthquake Seismic Design Structures in High Pressure Gas tightness is retained.	1. Large Outdoor Storage Tank（regulation Article 20- 4） The major load, influence of temperature changes, pertaining to the Large Outdoor Storage Tank pressure and snow load, wind load, according loads and impact of the earthquake should be safe for the deformation and stress. And that stress in conjunction with major load and major load and therefore load combination tank, which is below the allowable stress each provided for in public notice. -The ultimate horizontal strength due to seismic horizontal load-carrying capacity unnecessarily. -In floating roof should be, having a structure without causing damage to the sloshing. 2.Medium-size Outdoor Storage Tankregulation Article 20- 4－2） 3. Storage tank other than Category 1,2（Notification Article 423） ・Not overturning when fully filled ・Not sliding whenever empty or fully filled	1. Largest load / force (force / load very rarely occurs) Building will never collapse or failure (safety limit) 2. Medium load / force (force / load rarely occurs) No damage for the major structural parts of building (damage limit)）
Response Analysis Method（Seismic Design Procedure）	<u>1. Category 1 Design base Earthquake Level 1</u> Calculate the seismic force cause parts of the said seismic design facilities in earthquake response analysis pertaining to Category 1 Design base Earthquake on seismic design facilities in normal operating conditions. Modified seismic coefficient method (article 6 of the notice) method replaces the seismic	1. Large Outdoor Storage Tank Modified seismic coefficient method Ultimate strength design method 2. Medium-size Outdoor Storage Tank Modified seismic coefficient method（exclude the deformation type earthquake）	

Item	Seismic Design Code of the High Pressure Gas Facilities	Notification for the specifics of the technical standards on hazardous materials	Building Standard Act
	design facilities static seismic coefficient method (article 5 of the notice) by a static response analysis method and subject to seismic force calculating method with the appropriate vibration model analysis, dynamic analysis, Modal analysis method (article 7 of the notice), and time history a response analysis method (article 8 of the notice). 2. Category 2 earthquake Level 1 Calculate the seismic force cause parts of the facilities of the seismic design response analysis pertaining to Category 2 earthquake acting on cylindrical storage tank with flat bottom in normal operating conditions. response analysis methods, i.e., the seismic force calculating how have method determined in the notification under article 13, time history response analysis method or other appropriate methods. the time history response analysis in proper seismic waves using, replace the cylindrical storage tank with flat bottom and fluid with the appropriate vibration model, conduct and second is to be calculated based seismic force for design earthquake, this matter has become for METI inquiries. In addition, defined and proper way with three wave resonance method using sine wave directive. 3. Category 1 Design base Earthquake Level 2 Response analysis pertaining to Category 1 Design base earthquake usually acting on seismic design facilities in operating conditions cause, each part of the seismic design facilities in calculating deformation elasto-plastic response. Response analysis method considering non-linear behavior of elasto-plastic deformation as time history modal analysis method with equivalent linear model element and elasto-plastic element model by modified seismic coefficient method of nonlinear single-mass model response analysis method is mentioned. Selecting the appropriate response analysis method from these depending on the nonlinear dynamical characteristics of seismic design facilities. 4. Second consider against vertical earthquake response analysis is carried out according to vertical earthquake of Level 1 Earthquake response analysis for Level 2 Earthquake and severe vertical directions forces such as for damage	Ultimate strength design method 3. Storage tank other than Category 1,2 Seismic intensity method 4. Piping on transfer facility （Above ground piping） Seismic intensity method （Underground piping） Seismic deformation method	

Item	Seismic Design Code of the High Pressure Gas Facilities	Notification for the specifics of the technical standards on hazardous materials	Building Standard Act
	depending on the morphology of the various seismic design facilities and failure mode of the seismic design of vibration Level 2 normal driving conditions calculating plastic deformations and elastic pertaining to interact with design facilities in Level 2 horizontal earthquake response analysis due to all parts of the seismic design facilities during an earthquake. response analysis considering elasto-plasticity is sine wave three wave resonance nonlinear single-mass model.		
Evaluation Method （Evaluation items, Judging Criteria）	1．Level 1 Earthquake Seismic design allowable stress calculation of stress of all, etc. that corresponds to less performance evaluation is not passed. 2．Level 2 Earthquake As Level 2Seismic Performance evaluation is a pass that acceptable ductility factor of under response ductility factor all earthquake on seismic design facilities such important members.	1. Large Outdoor Storage Tank -The main load of tank and the stress of major load and the combination of other load, which is below the allowable stress each provided for in public notice. ・Potential horizontal force＞Required horizontal force ・Prescribed by the floating roof that has a structure without causing damage to the sloshing. 2. Medium-size Outdoor Storage Tank ・The stress provided in the side plate of tank should be below the allowable stress in axial compression stress during an earthquake. ・Potential horizontal force＞Required horizontal force 3．Storage tank other than Category 1,2 ・Resistance moment＞Overturning moment ・μ（1 －Kv）＞Kh μ ：Friction factor between baseplate and foundation of tank Kh ：Design Seismic Intensity Kv ：Design vertical seismic intensity	1. Largest load / force (force / load very rarely occurs) Impair structural strength shall not exceed the strength of force caused a major part based on requests for material strength. (Article 82 5 No. 2) that is under water horizontal strength. (Ripening article 82 3)-do not exceed the strength of each floor based on the requested material or spiritual power of acting on each floor of the buildings by acceleration due to the earthquake. (Masal 82 Kume 5 No. 5) 2. Medium load / force (force / load rarely occurs) That caused financial status on a major part of the short-term stress does not exceed the allowable stress of the short. (Ripening article 82 No. 1 ~ climbs 82 item of article 5 1, no. 3), roofing component, to provide safe and wind. (Ripening article 82 and ripening of 82 article 4 5 No. 7) (If article 82 No. 1 ~ No. 3), eyebrows angle is 1 / 200 (deformation caused seriously damage portion of the building if the non-sign 1 / 120) within. (If article 82 2)-angle between the eyebrows and do not exceed the damage limit means floor seismic force acting on each floor of the building on the ground based on the requests for short-term stress tolerance is 1 / 200 (without risk of damages due to deformation of the buildings at 1 / 120) within. (If article 82 5 No. 3)-by earthquake underground part of the building's structural strength on the force main that caused part of the stress does not exceed the allowable stress of the short. (Ripening article 82 5 No. 4), roofing materials are in accordance with standards specified by the Minister to ensure safety. (If article 82 5, no. 7), conducting safety confirmation structure calculation with x. washing ≥ 0.6, eccentricity is less than 0.15, prescribed by the Minister. (Filling of 82 article 6, no. 2)

Appendix V : Comparison of seismic loads among three countries

1. Introduction

   To compare the design seismic loads specified by seismic design codes of three countries, calculation models of a tall tower (pressure vessel) and a steel structure, which are typical ones in refineries and petro-chemical plants, are made and design seismic loads are calculated in accordance with the seismic design code of each countries.

   Design seismic lords in accordance with the seismic design standard for high pressure gas facilities (in Japan) are calculated for a reference.

2. Sample calculation model

   Sample calculation model for a tower is shown on Figure 1.

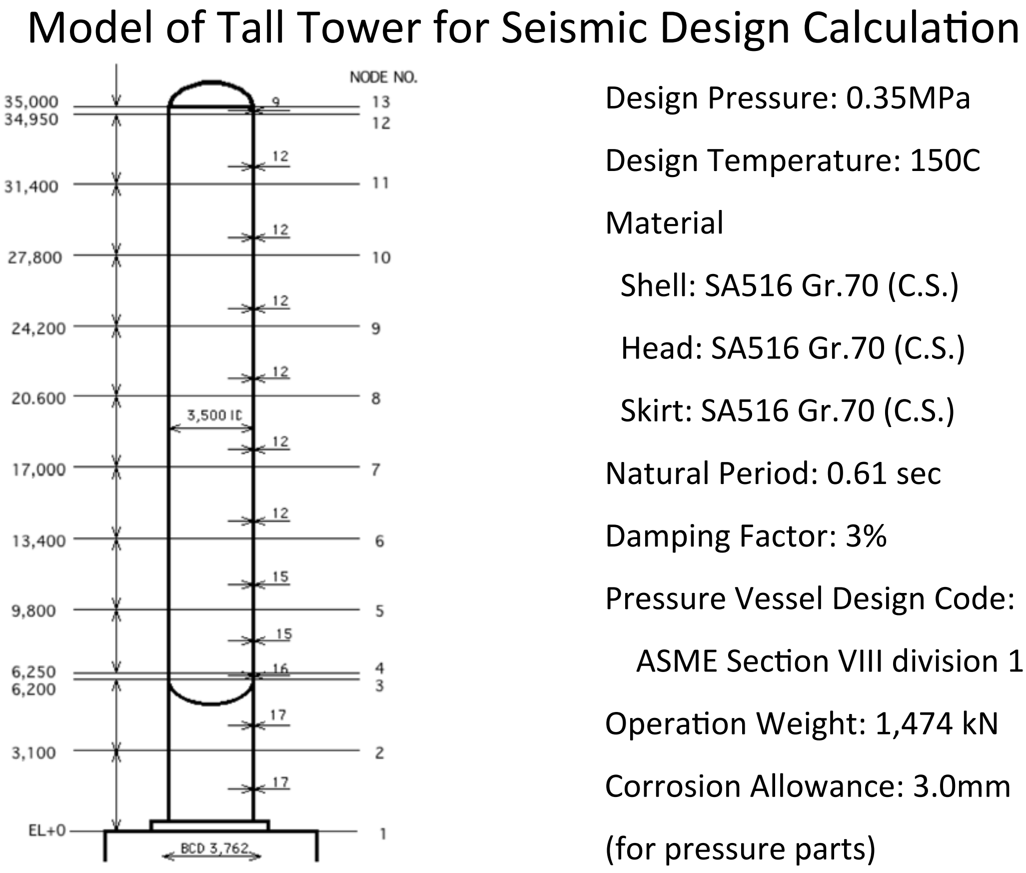
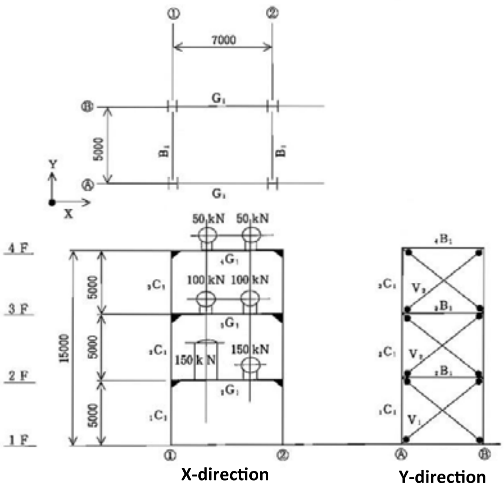


Figure 1 Calculation model for tower

Calculation model for a steel structure is shown on Figure 2.

A Sample Calculation Model of a Structure



Member list（material：SN400）

symbol	member (JIS)
$_1C_1$	H-588x300x12x20
$_2C_1$	H-390x300x10x16
$_3C_1$	H-340x250x9x14
$_2G_1$	H-588x300x12x20
$_3G_1$	H-440x300x11x18
$_4G_1$	H-400x200x8x13
V_1	$2L_S$-90x90x7
V_2	$2L_S$-65x65x6
V_3	L-65x65x6
$_2B_1$	H-350x175x7x11
$_3B_1$	H-300x150x6.5x9
$_4B_1$	H-300x150x6.5x9

Structure Type
- X-direction : ordinary moment frame
- Y-direction : ordinary concentrically braced frame

Vibration Period
- X-direction : 0.54 s
- Y-direction : 0.36 s

Weight (kN)

	DL	LL	EL	Total
4F	66	35	100	201
3F	66	35	200	301
2F	66	35	300	401

DL : dead load , LL : live load , EL : equipment load

Figure 2 Sample calculation model for a structure

3. Assumptions for calculation

Seismic design codes of all three countries can be applied to the steel structure. However, seismic design codes of Indonesia and Vietnam cannot be applied to the tower. Because the importance factor and the reduction factor (Behavior factor in Vietnam) are not specified on their design codes. Therefore, the importance factor of 1.0 is assumed for Indonesia and Vietnam. And the Reduction Factor of 2.9 for tower, which is the same value as specified by UBC, is assumed for Indonesia. UBC is de-facto standard in Indonesia. For Vietnam the Behavior Factor of 2.0, which is the same factor specified for silo by Vietnamese seismic design code, is assumed.

It is also assumed that the tower and the structure are constructed in the zone where the design horizontal seismic acceleration is the highest and that they are on the soil whose seismic response is the highest to their natural periods.

4. Results of calculations

4.1 Vietnam

Design horizontal elastic response in Vietnam is shown on Figure 3.

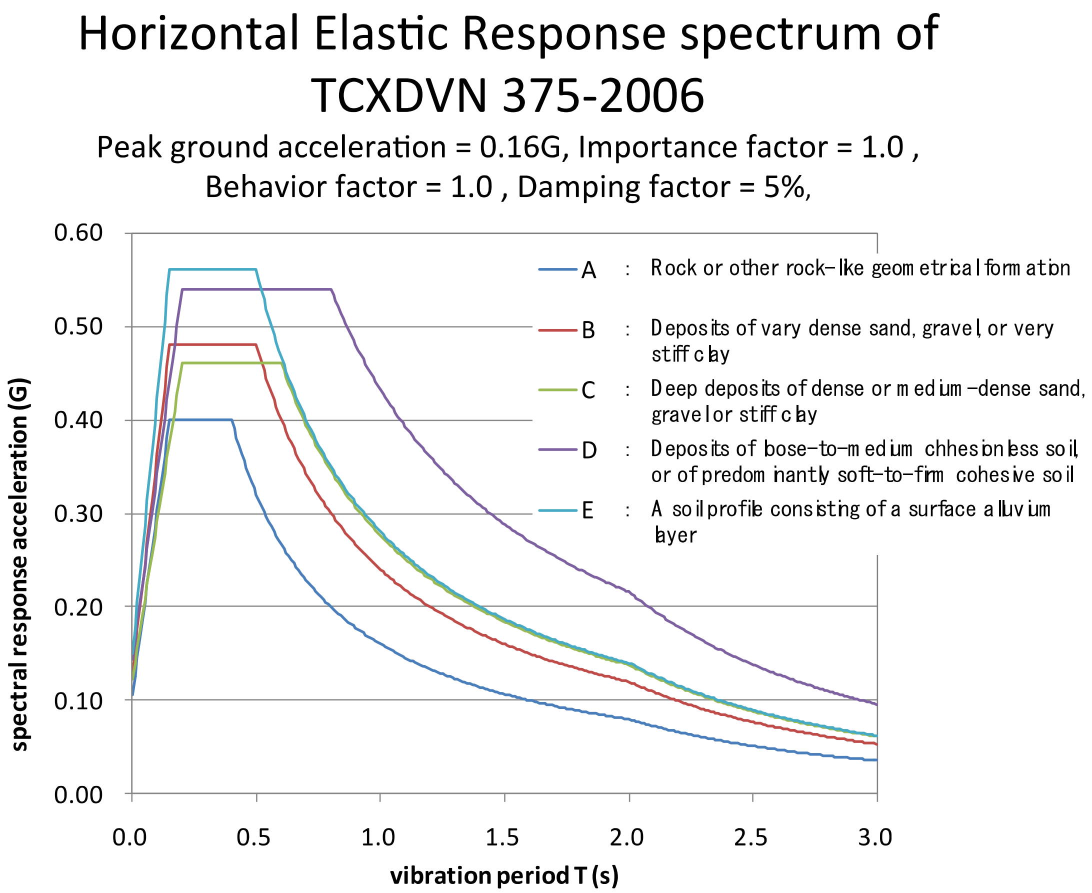


Figure 3 Horizontal elastic response spectrum in Vietnam

Distribution of seismic shear forces and bendinding moments on the sample modele of tower are show on Figure 4.

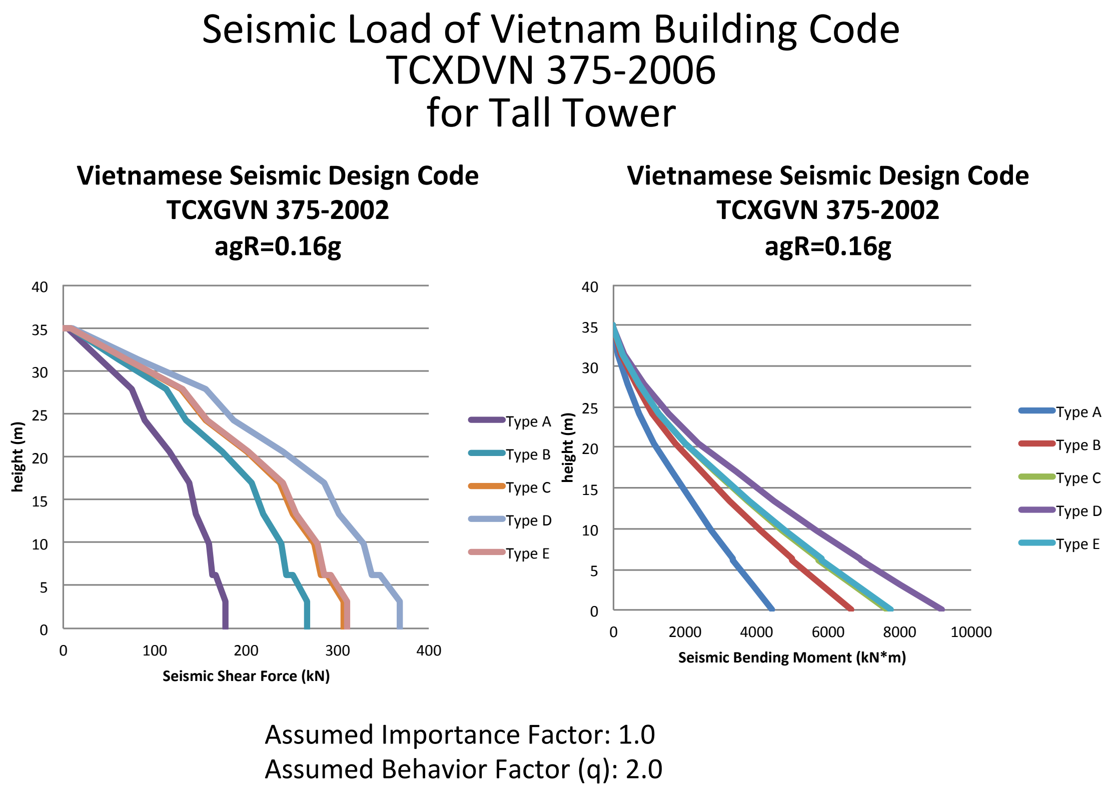


Figure 4 Distribution of seismic shear forces and bendinding moments in Vietnam

Distribution of horizontal seismic force and horizontal shear forces on the sample modele of steel structure are show on Figure 5.

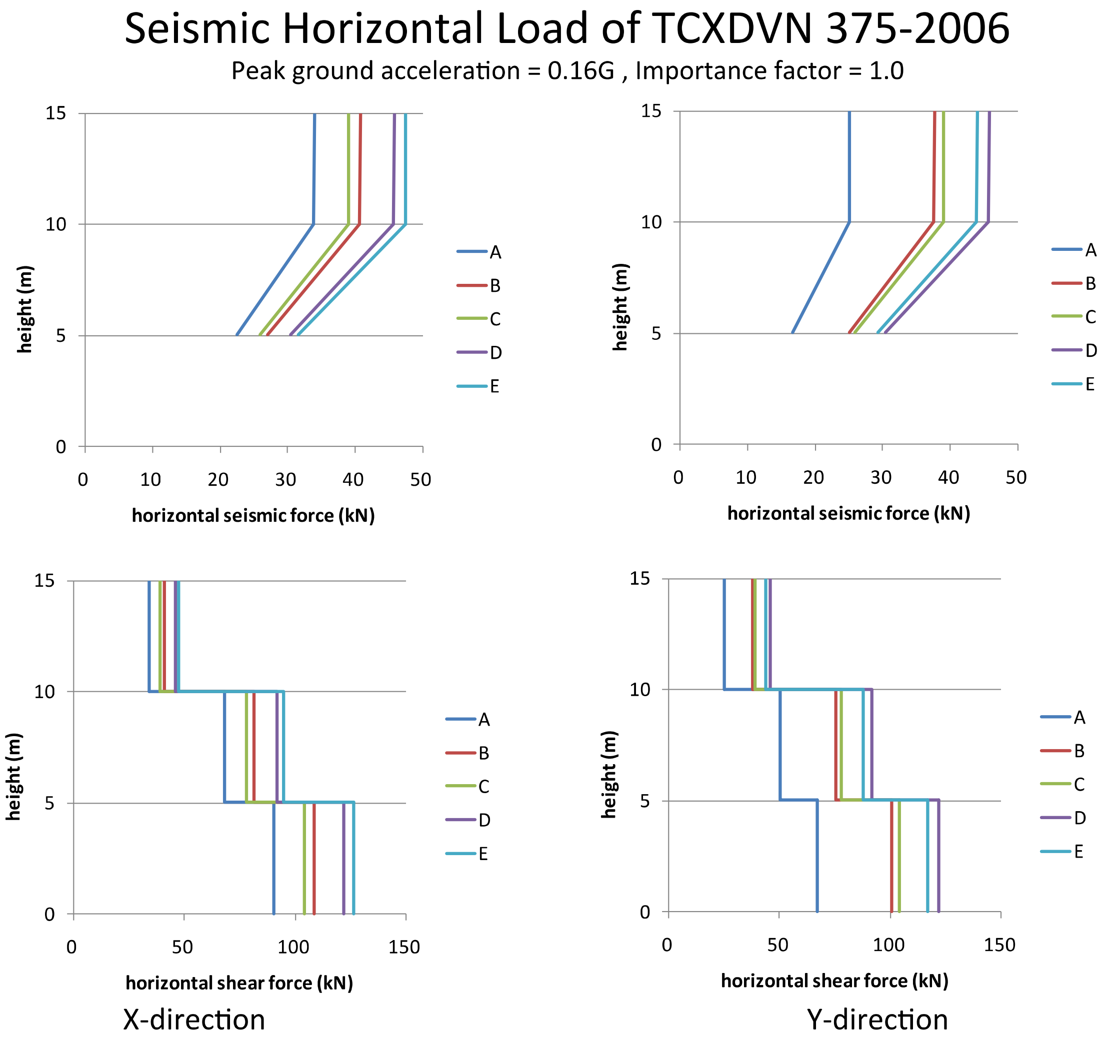


Figure 5 Distribution of horizontal seismic force and horizontal shear forces in Vietnam

4.2 Indonesia

Design horizontal elastic response in Vietnam is shown on Figure 3.

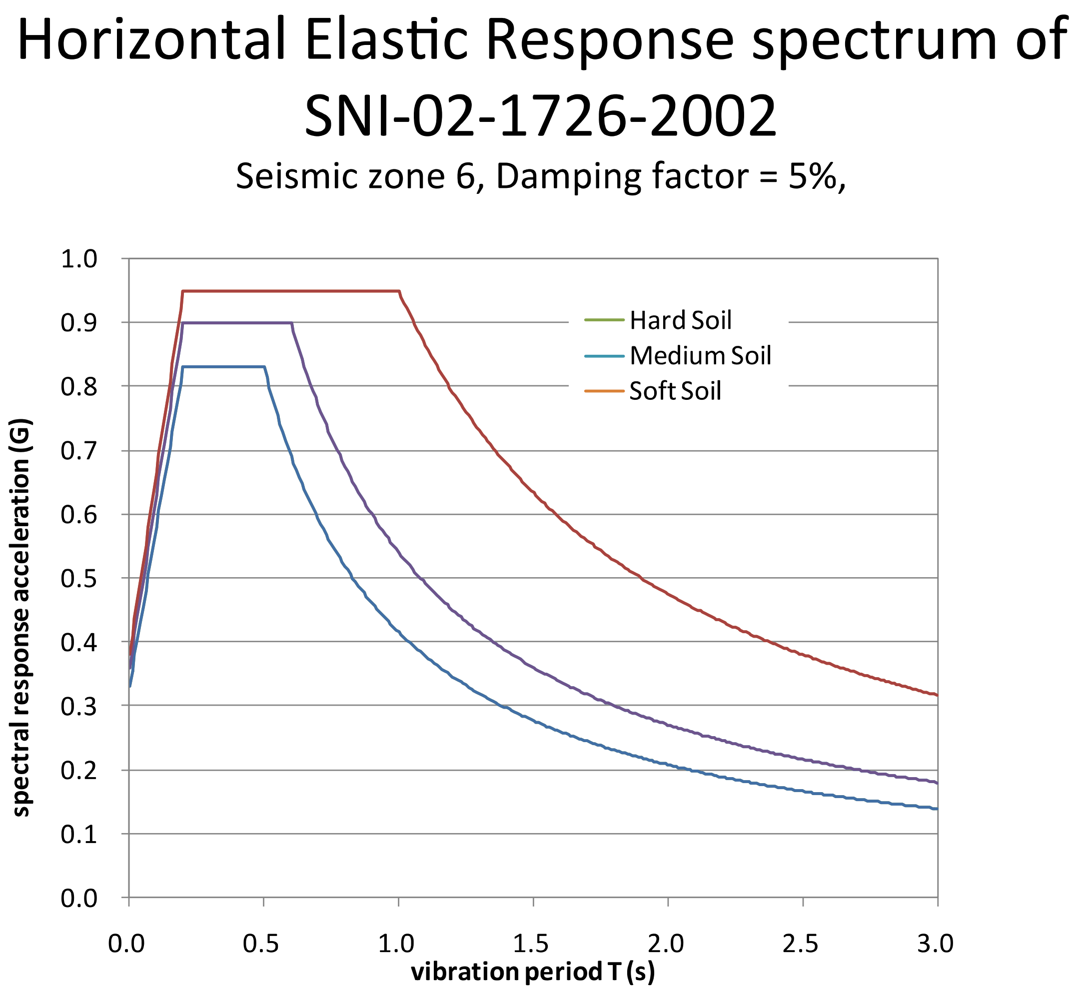


Figure 6 Horizontal elastic response spectrum in Indonesia

Distribution of seismic shear forces and bendinding moments on the sample modele of tower are show on Figure 7.

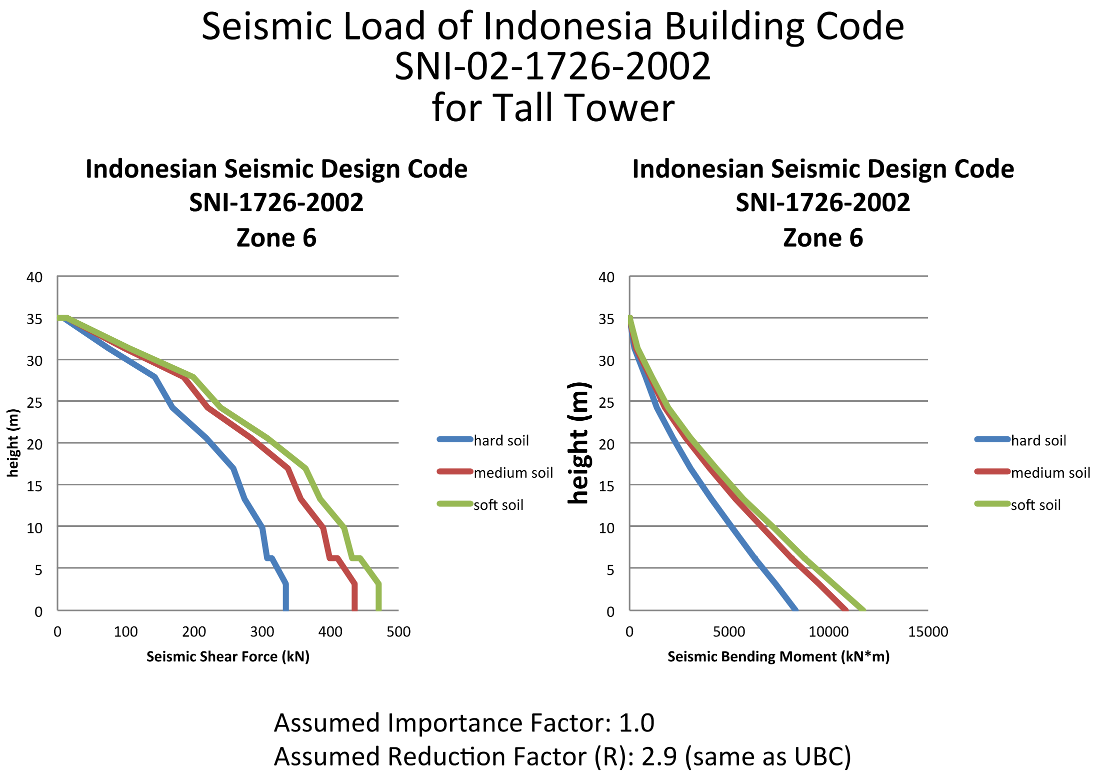


Figure 7 Distribution of seismic shear forces and bendinding moments in Indonesia

Distribution of horizontal seismic force and horizontal shear forces on the sample modele of steel structure are show on Figure 8.

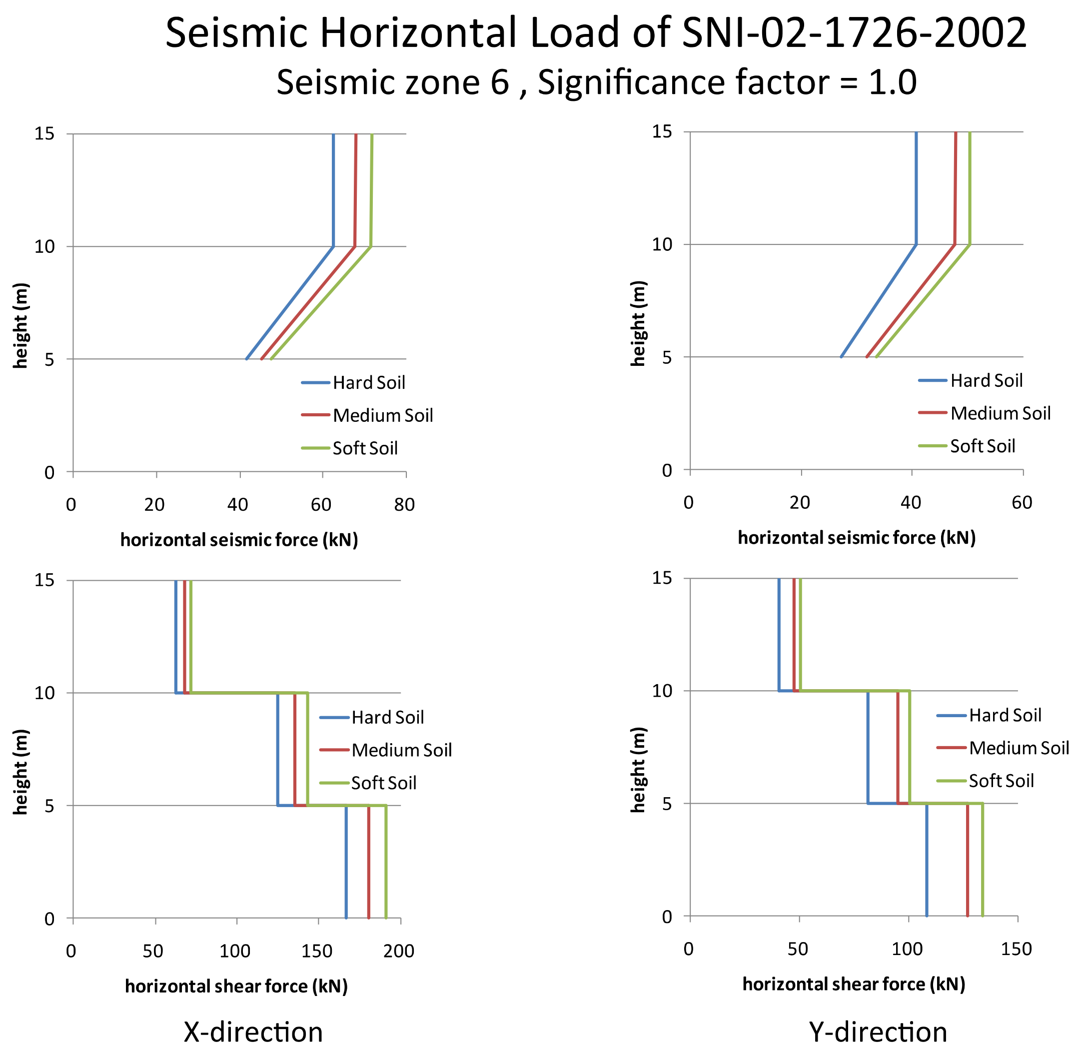


Figure 8 Distribution of horizontal seismic force and horizontal shear forces in Indonesia

4.3 Philippines

Design horizontal elastic response in Philippines is shown on Figure 9.

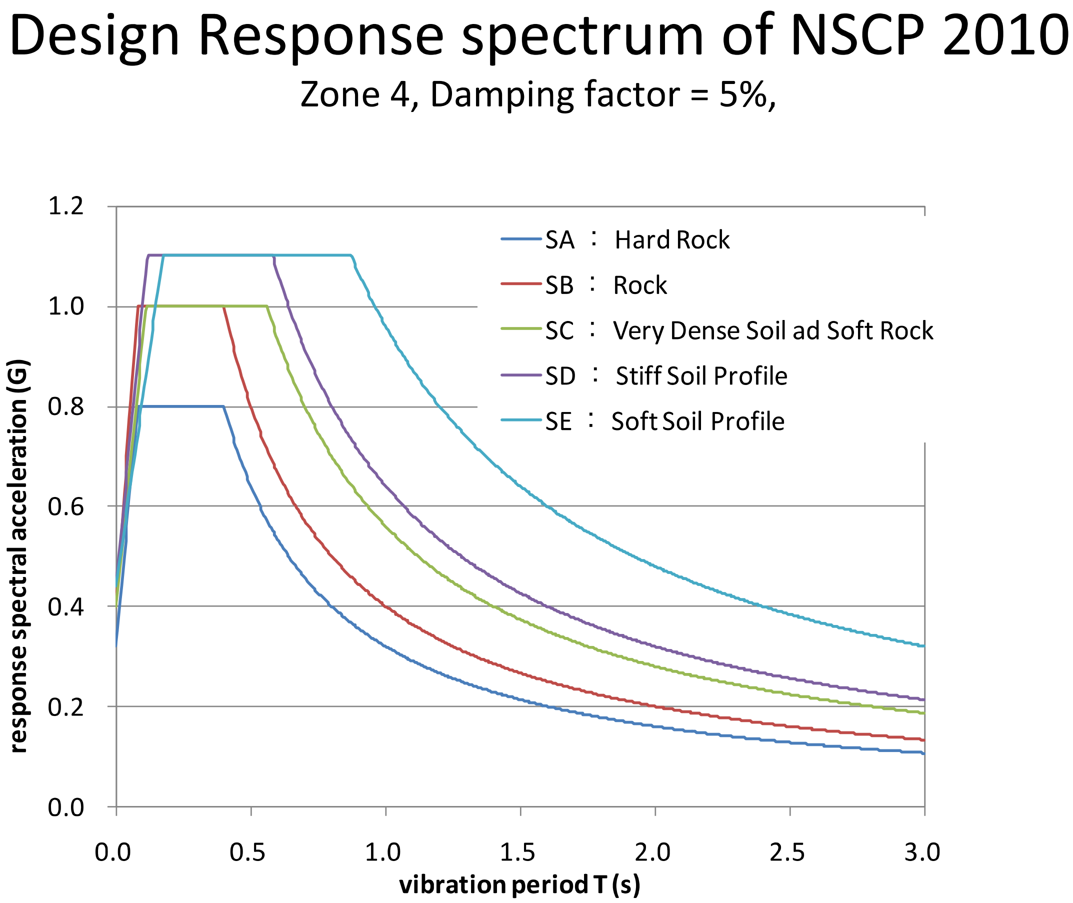


Figure 9 Horizontal elastic response spectrum in Philippines

Distribution of seismic shear forces and bendinding moments on the sample modele of tower are show on Figure 10.

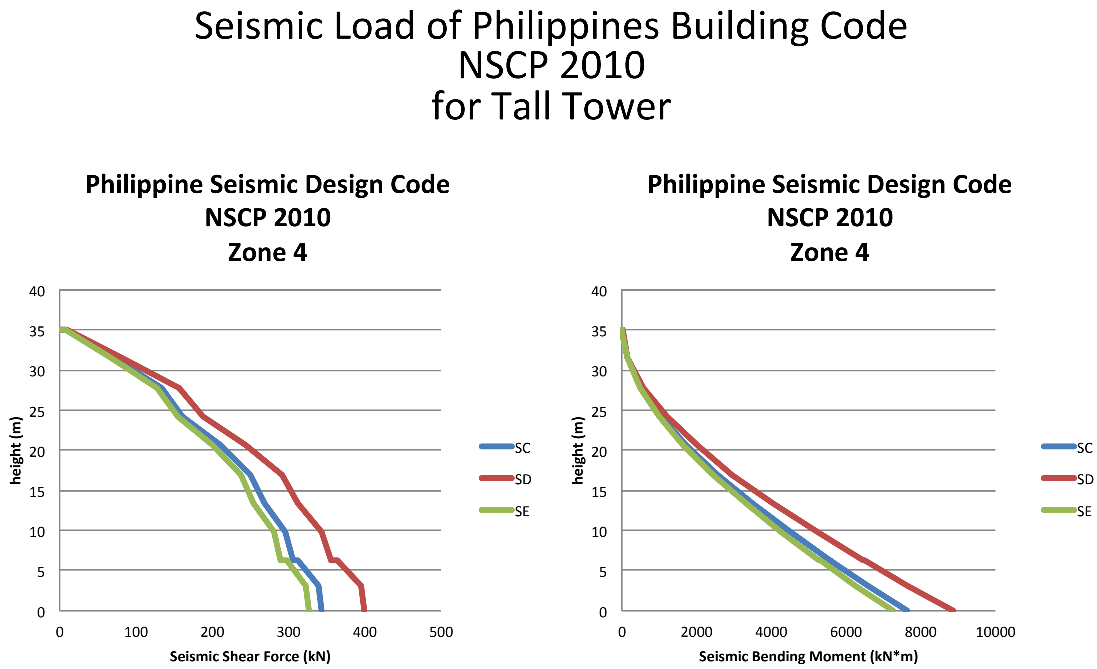


Figure 10 Distribution of seismic shear forces and bendinding moments in Philippines

Distribution of horizontal seismic force and horizontal shear forces on the sample modele of steel structure are show on Figure 11.

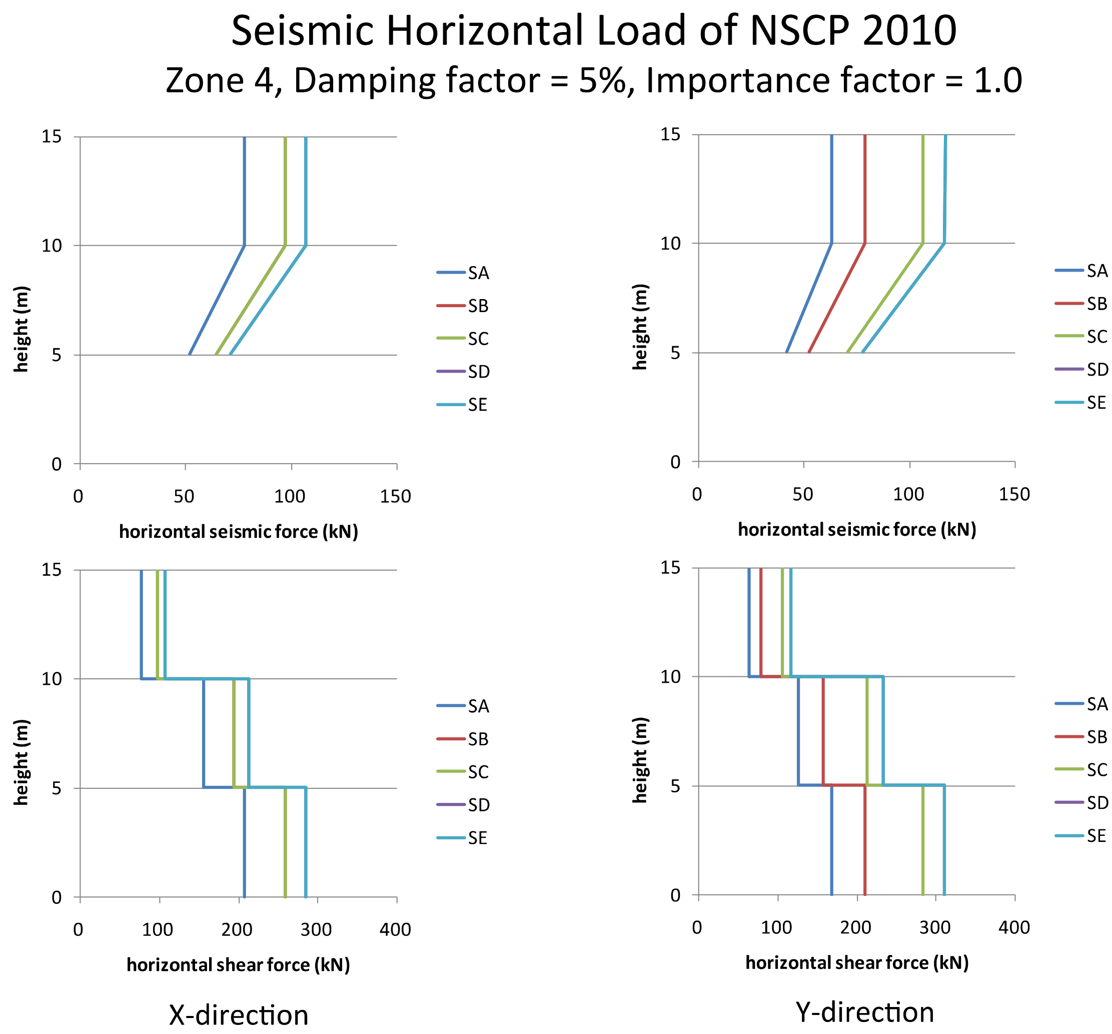


Figure 11 Distribution of horizontal seismic force and horizontal shear forces in Philippines

4.4 Japan

Design horizontal elastic response in Japan is shown on Figure 12.

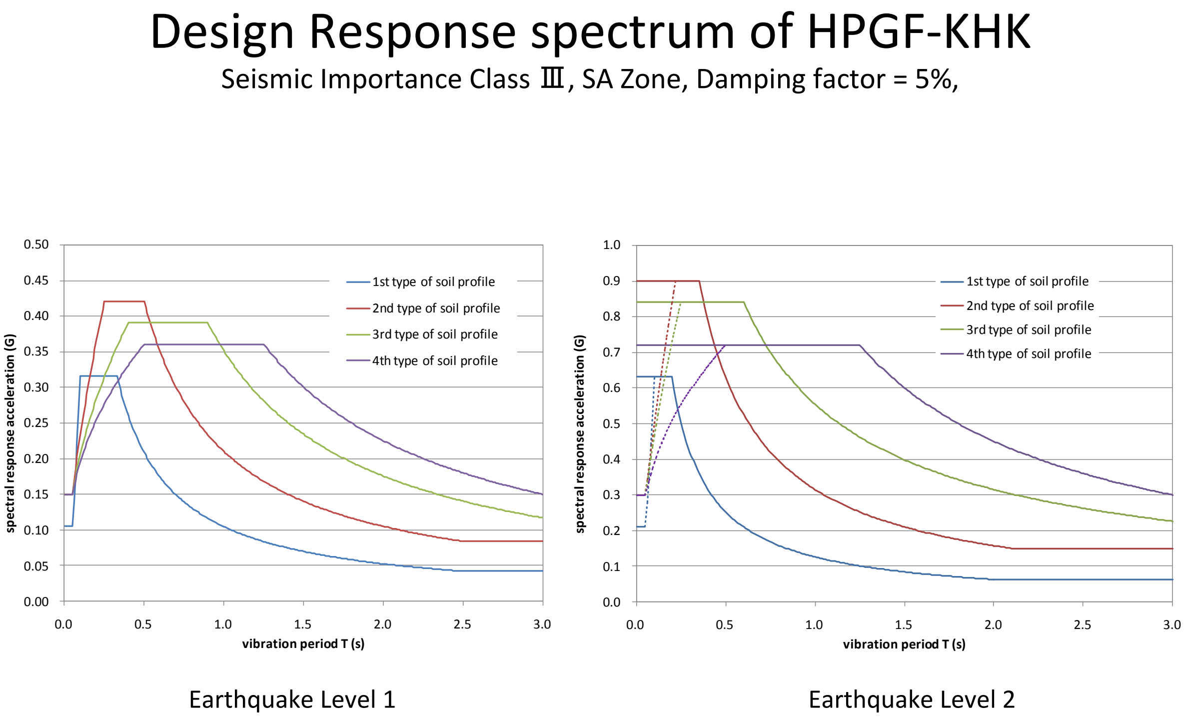


Figure 12 Horizontal elastic response spectrum in Japan

Distribution of seismic shear forces and bendinding moments on the sample modele of tower are show on Figure 13.

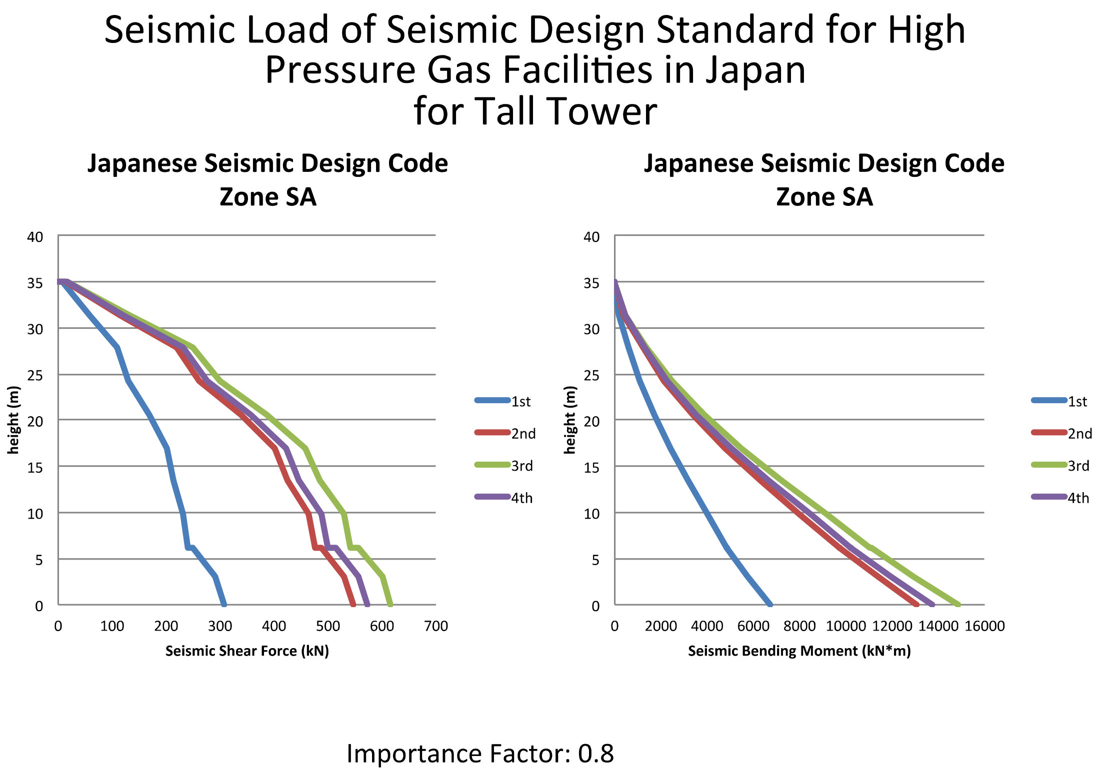


Figure 13 Distribution of seismic shear forces and bendinding moments in Japan

Distribution of horizontal seismic force and horizontal shear forces on the sample modele of steel structure are show on Figure 14, 15, 16 and 17.

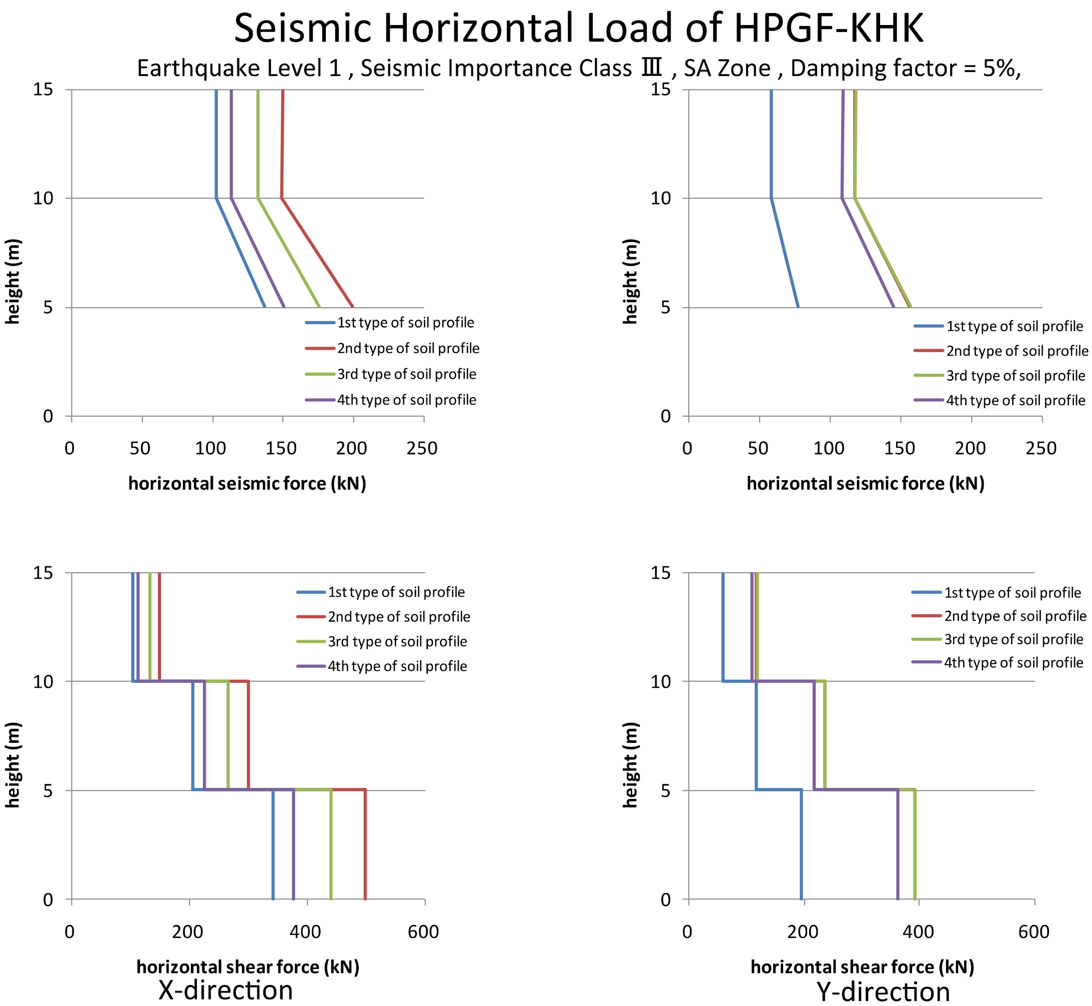


Figure 14 Distribution of horizontal seismic force and horizontal shear forces in Japan (Lvel 1 Earthquake, Importance class III)

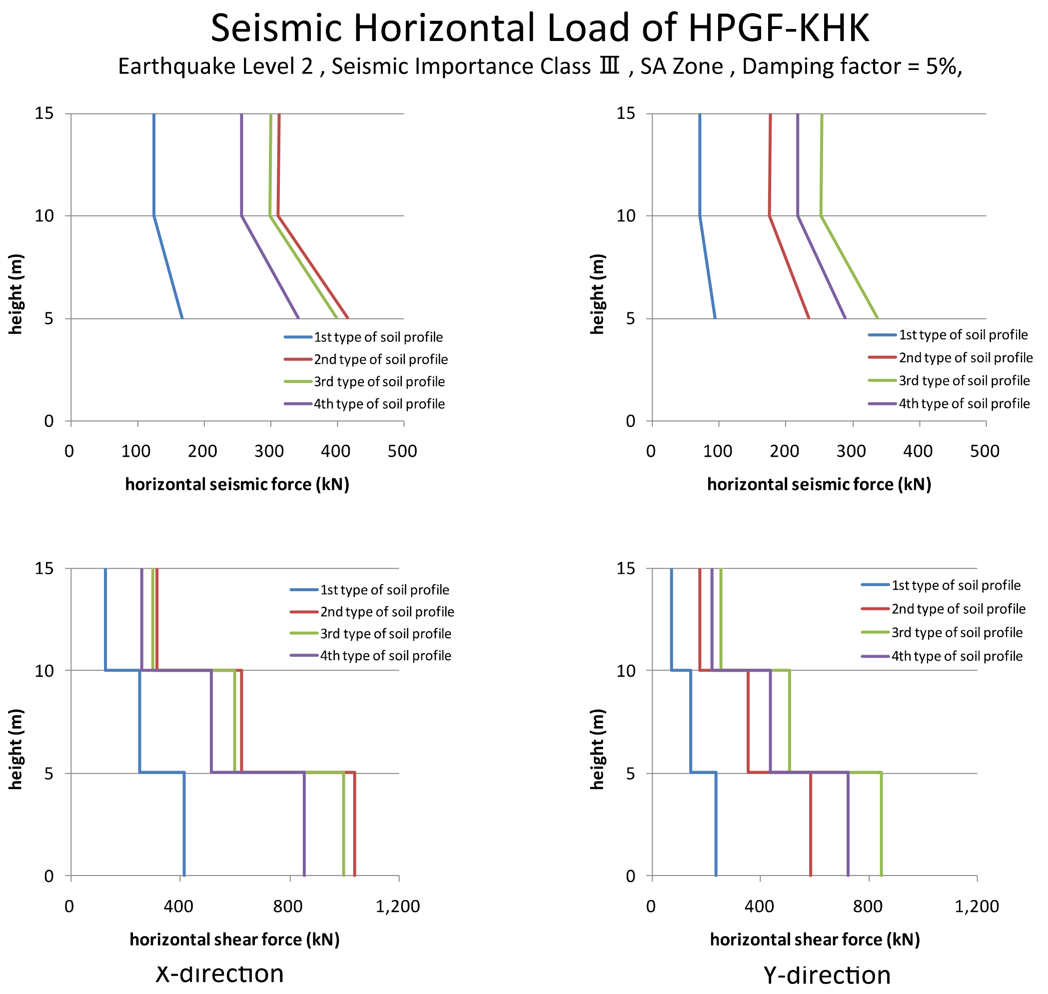


Figure 15 Distribution of horizontal seismic force and horizontal shear forces in Japan (Lvel 2 Earthquake, Importance class III)

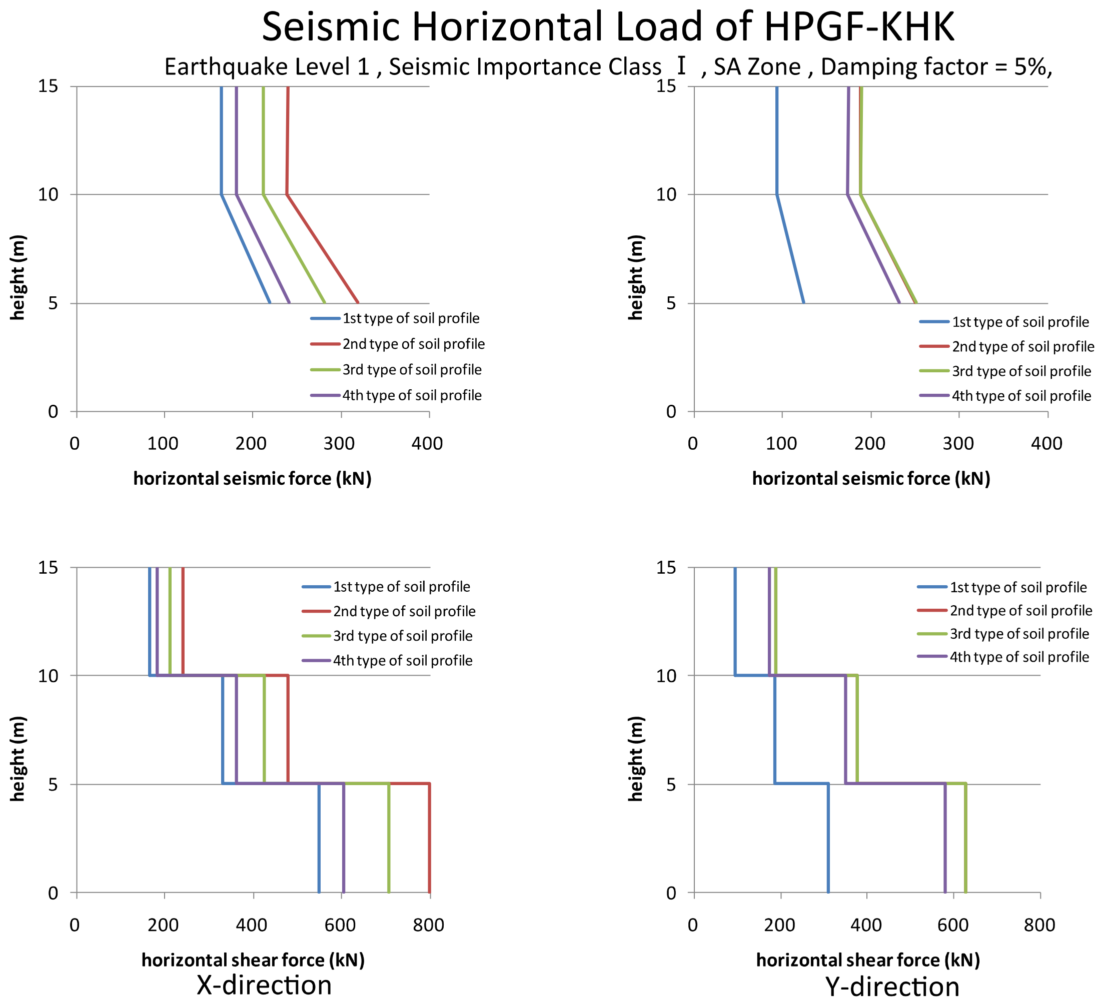


Figure 16 Distribution of horizontal seismic force and horizontal shear forces in Japan (Lvel 1 Earthquake, Importance class I)

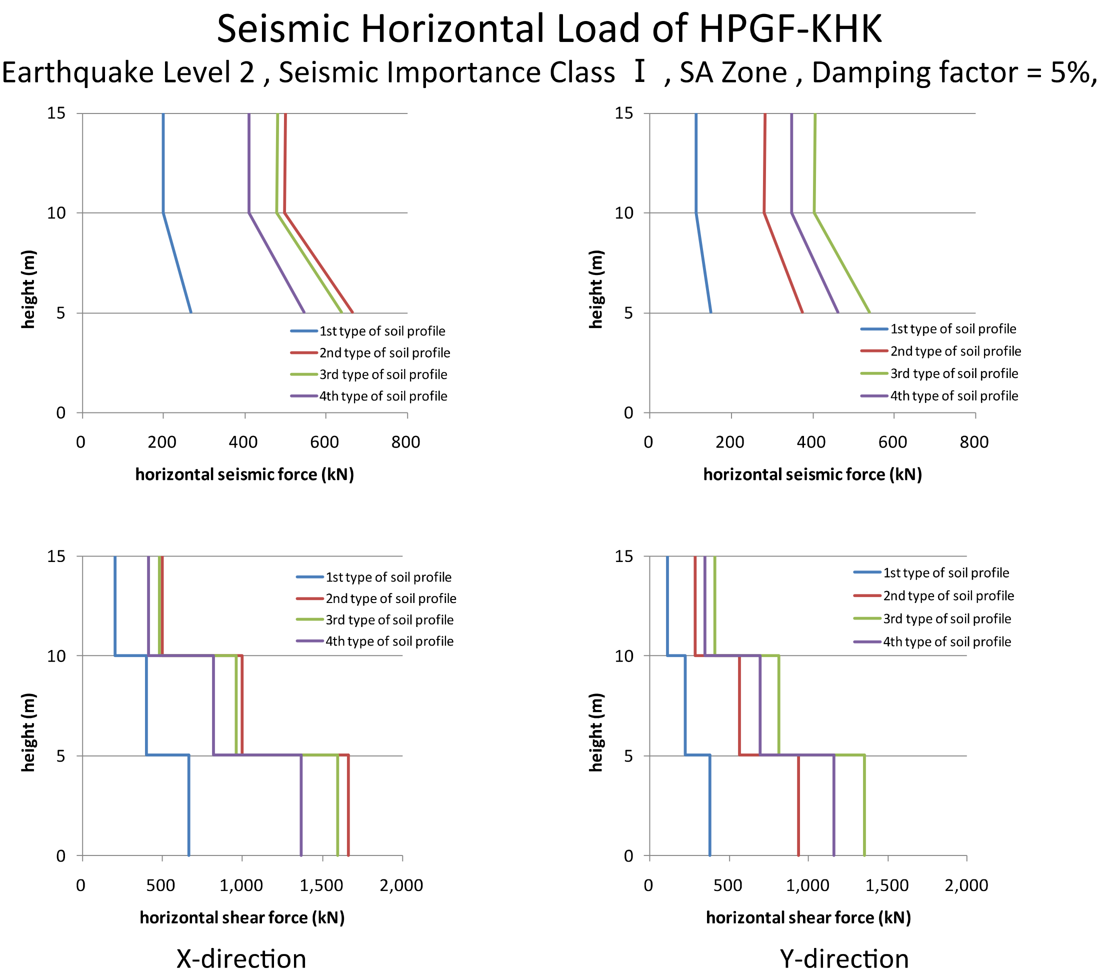


Figure 17 Distribution of horizontal seismic force and horizontal shear forces in Japan (Lvel 2 Earthquake, Importance class I)

Appendix VI : Comparison of Disaster Management Plan for Three Countries and Japan

Item	Indonesia	Vietnam	Philippine	Japan
Name of Disaster Plan	National Disaster Management Plan 2010-2014	NATIONAL STRATEGY FOR NATURAL DISASTER PREVENTION, RESPONSE AND MITIGATION TO 2020	Strategic National Action Plan 2009－2019	Basic Disaster Management Plan
Preparation				1963
Latest Version	12 January 2010	16 November 2007	20 April 2009	27 December 2011
Prepared by	National Agency for Disaster Management (BNPB)	THE PRIME MINISTER	National Disaster Coordinating Council	Central Disaster Management Council
Basic Act	Law No. 24 Year 2007 on Disaster Management The preparation of the National DM Plan also refers to Law Number 32 Year 2009 on the Protection and Management of the Environment, Law Number 22 Year 2001 on Oil and Gas, Law Number 7 Year 2004 on Water Resources, Law Number 32 Year 2004 on Local Government, Law Number 27 Year 2007 on the Management of Coastal Areas and Small Islands, Law Number 26 Year 2007 on Spatial Planning, Law Number 4 Year 2009 on Mineral and Coal Mining and other related prevailing government regulations	Law on Organization of Government dated 25th December 2001; Law on Water Resource dated 20th May 1998; Law on Dyke dated 29th November 2006; Ordinance on Flood and Storm Control dated 20th March 1993 amended and revised Ordinance on Flood and Storm Control dated 24th August 2000; Decree 86/2003/NĐ-CP dated 18th July 2003 of the Government stipulating functions, duties, authority and organizational structure of the Ministry of Agriculture and Rural Development;	Disaster Risk Management (DRM) Act. Strengthen the country's legal, institutional and policy framework for disaster risk reduction (DRR). Multi-Stakeholder Dialogues on DRR. Strengthen partnerships and build alliances for enhanced DRR advocacy. Institutionalization of Disaster Management Office (DMO). Sustain disaster management programs and projects, particularly at the local levels. Enhancing Capacity Development for Local Disaster Coordinating Councils (LDCCs). Enhance capacity of LDCCs so that they will become self-reliant and capable of fully implementing the disaster management program. Mainstreaming DRR into the Peace Process. Develop trust and confidence of the communities to the government agencies involved in the peacekeeping process; protect and preserve life and property (internally displaced persons (IDPs), protection of the rights of women and children).	Disaster Countermeasures Basic Act
Natural Disaster	Earthquake Tsunami Volcanic Eruption Land Mass Movement Flood	Flash-flood Draught Earthquake and tsunami Storm and storm surge Erosion in river bank or seaside	typhoons, floods, earthquakes, epidemics, fires and other major calamities	Earthquake Disaster, Storm and Flood Volcano Disaster Snow Disaster

Item	Indonesia	Vietnam	Philippine	Japan
	Drought Forest and land Fire Erosion Extreme Wave and Abrasion Extreme Weather			
Accidental Disaster	Building and House Fire Technological Failure			Maritime Disaster Aviation Disaster Railroad Disaster Road Disaster Nuclear Disaster Hazardous Materials Disaster Large-scale Fire Disaster Forest Fire Disaster
Other Disaster	Epidemics and Disease Outbreaks Social conflict			
Contents	Integrated disaster management and enhancement of training Research, education and training Capacity building and improvement of people's and stakeholders' participation in DRR. Disaster prevention and mitigation Early warning system Early warning system Preparedness Emergency response		All of the 18 programs/projects are considered essential to achieve the goal of disaster resilience at the community and country level.	Disaster Prevention and Preparedness Disaster Emergency Response Disaster Recovery and Rehabilitation

Appendix VII : Local Survey Schedule

Seminar in Indonesia

Seminar in Vietnam

Seminar in Philippines

The first local survey

1) The team visited appropriate organizations and explained the purpose and outlines of JICA study, and collected data and documents as much as possible.
2) To conduct the 2nd local survey effectively, the team settled the expected counterparts (offices and factories to be visited) and rough schedule.
3) The team found partners for the coming seminar in the 2nd local survey.
4) The team asked related persons to attend the seminar.

The team member:
Takashi SATO, Leader/Plant Engineering
Masami OSHIMA, Seismic Technologies
Tetsuya SUGITA, Coordinator
Schedule: April 8, 2012 – April 21, 2012
Itinerary :

Date		Schedule
April 8	Sun	Leave Tokyo, Arrive at Hanoi
April 9	Mon	IBST, DSTE, VAST Sism Labo, JICA Vietnam office
April 10	Tue	DMC/ Ministry Agriculture, VAST Physical Global Institute
April 11	Wed	Petrovietnam Head office
April 12	Thu	Leave Hanoi, Arrive at Jakarta
April 13	Fri	PUSKIM
April 14	Sat	Internal meeting
April 15	Sun	Internal meeting
April 16	Mon	Rekayasa, JICA Indonesia office, Petrochina, BMKG
April 17	Tue	PT Wiratman & Associates, BNPB, BPPT
April 18	Wed	Leave Jakarta, Arrive at Manila
April 19	Thu	ASEP, OCD
April 20	Fri	Petron, Philvolcs, JICA Philippines office
April 21	Sat	Leave Manila, Arrive at Tokyo

The second local survey

1）The seminar was held.
2）The team visited plants and made simplified factory assesment.
3）The team asked related persons to attend the next seminar.
4）The team collected further data and information.

The team member:
Takashi SATO, Leader/Plant Engineering
Masami OSHIMA, Seismic Technologies
Takashi NOTO, Seismic Institution
Toshio ISHIGURO, petro refinery
Moritaka KATO, Petrochemical/Chemical
Schedule: June 3, 2012 – July 7
Itinerary:

Date		Schedule
June 3	Sun	Leave Tokyo, Arrive at Hanoi
June 4	Mon	JICA Vietnam office, IBST
June 5	Tue	Preparation for seminar
June 6	Wed	Seminar
June 7	Thu	Review seminar and making report, examination for the next seminar
June 8	Fri	PPC power station and simplified factory assesment
June 9	Sat	Internal meeting
June 10	Sun	Leave Hanoi, Arrive at Quang Ngai
June 11	Mon	Petrovietnam Dung Quat refinery and simplified factory assesment
June 12	Tue	Leave Quang Ngai, Arrive at Danang
June 13	Wed	Leave Danang, Arrive at Ho Chi Minh
June 14	Thu	Make report
June 15	Fri	Pvgas
June 16	Sat	PVgas factory and simplified factory assesment
June 17	Sun	Leave Ho Chi Minh, Arrive at Jakarta
June 18	Mon	JICA Indonesia office, BPPT Office
June 19	Tue	Preparation for seminar
June 20	Wed	Seminar
June 21	Thu	Rekayasa
June 22	Fri	Make report
June 23	Sat	Internal meeting
June 24	Sun	Internal meeting
June 25	Mon	A group : Move from Jakarta to Jambi

Date		Schedule
		Petrochina Betara Gas Complex (BGC) Plant and simplified factory assesment B group : Internal meeting, make report
June 26	Tue	B group : Mitsubishi Chemical and simplified factory assesment A group : Move from Jambi to Jakarta
June 27	Wed	Internal meeting
June 28	Thu	Leave Jakarta, Arrive at Manila
June 29	Fri	JICA Philippines office
June 30	Sat	Internal meeting
July 1	Sun	Internal meeting
July 2	Mon	Make report and preparation for the next seminar
July 3	Tue	ASEP, preparation for the next seminar
July 4	Wed	Move from Manila to Bataan Petron Bataan Refinery and simplified factory assesment
July 5	Thu	Petron Bataan Refinery and simplified factory assesment Move from Bataan to Manila
July 6	Fri	Internal meeting, Chiyoda Philippines
July 7	Sat	Leave Manila, Arrive at Tokyo

The third local survey

(1) The seminars were held.
(2) The team exchanged opinions for their requirements and needs in each countries.
(3) The team had detailed discussions for making suggestion.

The team member:
Takashi SATO, Leader/Plant Engineering
Masami OSHIMA, Seismic Technologies
Takashi NOTO, Seismic Institution
Toshio ISHIGURO, petro refinery
Moritaka KATO, Petrochemical/Chemical
Schedule: April 19, 2012 – September 8, 2012
Itinerary:

Date		Schedule
August 19	Sun	Leave Tokyo, Arrive at Hanoi
August 20	Mon	JICA Vietnam office, IBST
August 21	Tue	Preparation for seminar, IBST
August 22	Wed	Seminar
August 23	Thu	Review seminar and making report
August 24	Fri	Review seminar and making report
August 25	Sat	Internal meeting
August 26	Sun	Internal meeting
August 27	Mon	Leave Hanoi, Arrive at Manila
August 28	Tue	JICA Philippines office, ASEP
August 29	Wed	Seminar
August 30	Thu	Review seminar and making report
September 1	Fri	Internal meeting
September 2	Sat	Leave Manila, Arrive at Jakarta
September 3	Sun	Internal meeting
September 4	Mon	JICA Indonesia office, BPPT, Preparation for seminar
September 5	Tue	Ministry of Public Works (Mr. Kinoshita, JICA Expert)
September 6	Wed	PUSKIM
September 7	Thu	Seminar, Review seminar and making report Leave Jakarta
September 8	Fri	Arrive at Tokyo

Appendix VIII: Outline of the educational seminar

The first seminar

1)	Vietnam	Date: June 6, 2012
2)	Indonesia	Date: June 20, 2012

The second seminar

1)	Vietnam	Date: August 22, 2012
2)	Philippines	Date: August 29, 2012
	(In Philippines, only one seminar was held.)	
3)	Indonesia	Date: September 7, 2012

Program of the first seminar held in Vietnam

SEMINAR PROGRAMME


Promotion of Earthquake Resistant Technologies and relevant Laws and Codes for Petroleum Refinery and Petrochemicals Plant

Hanoi Viet Nam, June 6, 2012

08:30 – 08:50	**Registration**
08:50 – 09:00	**Welcome Remarks by Dr. Nguyen Quang Minh(MOC)D**
09:00 – 09:10	**Opening Statement by Mr. T. Sato (JICA Team)**
09:10 – 09:20	**Opening Statement by Dr. Tran Ba Viet (IBST)**
09.20 – 09:45	***COFFEE BREAK & GROUP PHOTO SESSION***
09:45 – 11:30	**Session 1 :** **Seismic Technologies 、 Codes and Seismic Observations : Outline & Achievements**
09:45 – 10:30	**Presentation by JICA & Vietnam Side** **1) Outline and Plan of JICA Project by T. Sato (JICA Team)** **2) Outline and Achievements Seismic Technologies by Dr. Nguyen Dai Minh (IBST))**
10:30 – 12:00	3) Overview of Japanese Seismic Technologies by Dr. M. Oshima (JICA Team) 4) Seismic Observation in Vietnam by Dr.Nguyen Hong Phuong(VAST, Earthquake Information and Tsunami Warning Centre)
12:00-13:00	***LUNCH***
13:00-13:45	*5)* Japanese Seismic Laws and Codes for Plant Engineering by Mr. T. Noto (JICA Team)
13:45 – 15:30	**Session 2 :** **"Disaster Prevention Plan and Management in Vietnam & Japan "**
13:45 – 14:30	**Disaster Management in Japan by Ishiguro (JICA Team)**
14:30–14:50	**COFFEE BREAK**
14:50 – 15:30	**Session 3 : Summary & Question/Answer**

The answer of questionnaire for the first seminar in Vietnam

Summary of questionnaire

Question 1: Time/length of the seminar

Short	9.1	%
Acceptable	81.8	%
Long	9.1	%

Question 2: Would you satisfy with the presentation?

Satisfactory	54.5	%
Acceptable	45.5	%
Not satisfactory	0.0	%

Question 3: Do you expect to attend the future cooperation to JICA/JICA training in Vietnam or Japan

Yes	100.0	%
No	0.0	%

Opinions in the answer of questionnaire

Participant's opinions:

1. Specialist A

- If the purpose of the seminar is introduction of earthquake resistant technology for nonstructural components Petroleum Refinery and Petrochemicals Plant, then the content of presentation is not concentrated and clear. It is better to introduce specified technology for pipe, tanks, building…
- It is necessary to introduce design code, not only design procedure.
- One of objectives of JICA Team is Investigation, therefore it is better to have comment about earthquake resistant technology for Petroleum Refinery and Petrochemicals Plant in Vietnam.

2. Consultant B

- The printed document should be distributed earlier to participant
- The content of presentation is general and only suitable for Japan, and do not similar to Vietnamese codes or EU code.

- The seminar should be longer, so that there is more time to discuss and prepare document.

3. Specialist C

If there are more photos, video example of effect of earthquake on Petroleum Refinery and Petrochemicals Plant in Vietnam and on World, the presentation will be more interesting with participant.

The list of attendees in the first seminar in Vietnam

List of Actual Attendees

6 June, 2012, Viet Nam

Organization	Number
Vietnam Institute for Building Science and Technology (IBST)	19
Petrovietnam	7
Ministry of Construction	4
Institute of Urban and Rural Architecture and Planning	4
Vietnam National Construction Consultants Corporation (VNCC)	4
Hanoi Transport and Communication University	3
National University of Civil Engineering	2
CONINCO	2
VietNam Consultant Corporation (VCC)	2
Vietnam Oil and Gas Group, PV Gas	2
Viet Nam Academy of Science and Technology, Institute of Geophysics	1
Hanoi Architecture University	1
Ministry of Science and Technology	1
THIKECO	1
Petro Vietnam Construction Company (PVC)	1
Vina Consult (Vinaconex)	1
Viện KHCN & Kinh tế Xây dựng – Sở XD HN	1
CDC	1
Vietnam Oil and Gas Group, Construction Division	1
TOTAL	58

Program of the first seminar held in Indonsia

SEMINAR PROGRAM

Promotion of Earthquake Resistant Technologies and relevant Laws and Codes for Petroleum Refinery and Petrochemicals Plant

Jakarta Indonesia, **June 20, 2012**

08:30 – 08:50	**Registration**
08:50 – 09:00	**Welcome Remarks by Ir. Isman Justanto, MSCE. (BPPT, Director)**
09:00 – 09:10	**Opening Statement by Mr. S. Tanaka (JICA Indonesia Office)**
09.10 – 09:30	***GROUP PHOTO & COFFEE BREAK***
09:30 – 12:05	**Session 1 :** **Seismic Technologies, Codes, and Seismic Observation : Outline & Achievements**
09:30– 10:45	**Presentation by JICA & Indonesia** **1) Outline and Plan of JICA Project - *by Mr. T. Sato (JICA Team)*** **2) Outline of Seismic Technologies and Codes *by Mr. Maryoko Hadi (PUSKIM)*** **3) Indonesian National Codes for Petroleum Refinery and Chemical Plant *by Mr. Y. Kristianto Widiwardono (BSN)***
10:45 –12:05	**4) Overview of Japanese Seismic Technologies *by Dr. M. Oshima (JICA Team)*** **5) Seismic Observation in Indonesia *by Mr. Budi Waluyo (BMKG)*** **6) Japanese Seismic Laws and Codes for Plant Engineering *by Mr. T. Noto (JICA Team)***
12:05 -13:15	***LUNCH***
13:15 – 14:30	**Session 2 :** **"Disaster Prevention Plan and Management in Indonesia & Japan**
13:15 –14:30	1) Earthquake and Tsunami Disaster Potential Study for LPG Terminal Site Determination *by Dr. Iwan G. Tejakusuma (BPPT)* 2) Disaster Management in Japan *by Mr. Kato & Mr. Ishiguro (JICA Team)*
14:30 -14:45	***COFFEE BREAK***
14:45 – 15:15	**Session 3 : Summary** **Closing**

The answer of questionnaire for the first seminar in Indonesia

RESULTS OF QUESTIONNAIRE

SEMINAR ON Promotion of Earthquake Resistant Technologies and relevant Laws and Codes for Petroleum Refinery and Petrochemicals Plant

Komisi Utama Room, Building 2, BPPT, June 20, 2012

No	Content of Seminar				Length of Seminar			Request to JICA Seismic Technology Project			
	Satisfactory	Acceptable	Unsatisfied	Reason	Too long	Too short	Reasonable	More often Seminar	Dispatch JICA Experts	Seismic Technology Engineer Resource Development Plant	Other request
1		1					1			1	
2			1	1. The seminar content is only 30% related to the tittle, too much introduction. 2. Please add more examples of cases related to the topic.		1				1	
3			1	Petroleum & Petrochemical aspect about earthquake disater potential not clear and not explained to decrease earthquake disaster potential in petroleum & petrochemicals aspect.		1				1	More aplicable technology to petroleum & petrochemicals aspect to decrease/ prevent earthquake disaster potential topic & matery presentation not deep/clear.
4		1					1			1	
5		1		1. Geotechnical aspect was not deeply discussed 2. good other knowledge sharing.			1			1	Field equipment to evaluate ground response/condition in petroleum refrinery plant to earthquake shaking or ground deformation.
6		1		If possible give more detail background of the project to the audience.			1	1	1		
7		1		Unfocus topic	1						Cooperation in technical project in Indonesia.
8		1		Updated and learned			1	1			
9	1			A lot of new information		1			1		
10	1						1		1	1	
11	1			Get knowledge and information to prevent damage due to earthquake, if we implement disaster management laws.			1	1			
12		1		Should have relevant experiences that can be implemented in Indonesia.			1			1	As disaster resource partnership is a new invitiative of public private partnership of government and 10 construction and engineering companies in Indonesia, DRP would like to explore more how could benefit from JICA in term of expertise and experience of seismic technologies that are relevant to contruction and engineering sector.
13	1			Very much advantages due to one of our bussines.		1		1			
14	1			It is very advance lecture.			1			1	Practical Training
15	1			It's a relleable with Indonesia with Indonesia.			1	1			Training in Japan
16	1			Sharing of information and design practices.			1	1	1	1	
17	1			Informative and Complete			1	1			
18			1				1	1			Earth/Seismic Technology in Sunda Strait
19		1		One of important thing for seismic structure resistant design.		1		1		1	
20	1			Suitable with my work			1			1	More seminar in other disaster topics
21		1					1	1			
22	1			Disaster mitigation technology and management of japan experience to share.			1	1		1	
23	1			New knowledges.		1				1	
	11	9	3		1	6	16	11	4	13	

The list of attendees in the first seminar in Indonesia

List of Actual Attendees

20 June, 2012, Indonesia

Organization	Number
Bandan Pengkajian dan Penerapan Teknologi, The Agency for the Assessment and Application of Technology (BPPT)	34
Meteorological, Climatological and Geophysical Agency (BMKG)	3
Pertamina	3
Badan Standardisasi Nasional, National Standardization Agency of Indonesia (BSN)	2
PT. Surya Daya Mandiri	2
WIRATMAN & Associates	1
Kementerian Riset dan Teknologi, The State Ministry of Research and Technology (RISTEK)	1
PTL	1
Badan Pengelolaan Lingkungan Hidup Daerah (BPLHD)	1
PT. WIKA	1
Puslit Geoteknologi, LIPI	1
Research Institute for Human Settlements, Agency for Research and Development, Ministry of Public Works (PUSKIM)	1
PT. Adhi Karya	1
Indonesia Iron and Steel Industry Association	1
PT. Jababeka	1
PT Rekayasa Industri	1
PT Chandra Asri Petrochemical	1
Disaster Research Partnership	1
Japan International Cooperation Agency (JICA)	1
N. A.	2
TOTAL	60

Program of the second seminar held in Vietnam

SEMINAR PROGRAM


Promotion of Practical Seismic Technologies

for Petroleum Refinery and Petrochemicals Plant

Hanoi Vietnam, August 22, 2012

08:30 – 08:50	Registration
08:50 – 09:00	Welcome Remarks by Dr. Nguyen Trung Hoa (MOC)
09:00 – 09:10	Opening Statement by Mr. Nagase (JICA Vietnam Office)
09:10 – 09:20	Opening Statement by Dr. Trinh Viet Cuong (IBST)
09:20 – 12:00	Session 1: Experiences and Examples of Plants Seismic Design and Codes :
09:20 – 9:55 09:55 – 10:30	1) Insight about JICA Seismic Technology Survey Project (Result and Outcome) by T. Sato (JICA Team) 2) Experimental Study on Seismic Performance of Precast Concrete Frame Building by Prof. Dr. Tran Chung (IBST)
10:30 – 10:50	*COFFEE BREAK & GROUP PHOTO SESSION*
10:50 – 11:25 11:25– 12:00	3) Report of Survey Results and Introduction of Seismic Assessment Methods for Existing Plant Facilities in Japan by Dr. M. Oshima (JICA Team) 4) Application of Vietnamese seismic design code to plant facilities by Mr. T. Noto (JICA Team)
12:00-13:00	*LUNCH*
13:00 – 15:05	Session 2 :“Disaster Prevention System and Management in Vietnam & Japan “
13:00-13:35	1) Study on Earthquke Ground Motion Prediction in Vietnam by Dr. Tran Viet Hung (University of Transport and Communication)
13:35 – 14:10	2) Disaster Prevention System of Refineries in Japan by Mr. Kato & Ishiguro (JICA Team)
14:10 – 14:30	*COFFEE BREAK*
14:30 – 15:00	Session 3 : Summary & Question/Answer

The answer of questionnaire for the second seminar in Vietnam

Questionnaires of JICA Seminar

Date

1. About Program Contents (e.g. Topics of this Seminar, Level of Contents, Presentation, Time, etc.

a) Good	12
b) Fair	1
c) points to be improved	
d) Other Comments	

2. About JICA Seminar.

a) To be continued	8
b) To be more frequent	6
c) Other comments	

3. Type of Technical Cooperation (in terms of Capacity Buildings) from JICA in the Future.

a) For example, Expert Dispatch of Seismic Code & Standards.	8
b) Seismic Design Technology.	8
c) Seismic Assesment Technology.	5
d) Other field.	

The list of attendees in the second seminar in Vietnam

List of Actual Attendees

22 August, 2012, Viet Nam

Organization	Number
Vietnam Institute for Building Science and Technology (IBST)	26
National University of Civil Engineering	13
Hanoi Architecture University	8
Hanoi Transport and Communication University	6
Water Resources University	6
Vietnam Soil Mechanics and Geotechnical Association	3
Ministry of Construction	2
Institute of Geophysics	2
SF Consultant Company	2
Vietnam Big Dam Association	2
Water Resource General Department	1
Electric Consultant Company No3	1
Academy of Army Technology	1
TOTAL	73

<u>**Program of the second seminar held in Philippines (only one seminar held in Philippines)**</u>

SEMINAR PROGRAMME

Promotion of Practical Seismic Technologies for Petroleum Refinery and Petrochemicals Plant

Metropolitan Club, Makati City, August 29, 2012

08:30 – 08:50	**Registration**
08:50 – 09:00	**Welcome Remarks by Engr. Miriam Lusica-Tamayo, ASEP President**
09:00 – 09:10	**Opening Statement by Mr. Hayato NAKAMURA, Project Formulation Advisor on Disaster Risk Reduction, JICA Philippine Office**
09.10 – 09:30	**COFFEE BREAK & GROUP PHOTO SESSION**
Session 1 : Experiences and Examples of Plants Seismic Design and Codes	
09:30–10:30	**Presentation by JICA & PHIVOLCS** **1) Insight about JICA Seismic Technology Survey Project (Result and Outcome) by T. Sato (JICA Team)** **2) Seismic Observation in Philippines by Mr. Ishmael Narag (PHIVOLCS)**
10:30–12:00	**3) Overview of Japanese Seismic Technology and Introduction of Seismic Assessment Methods for Existing Plant Facilities in Japan by Dr. M. Oshima (JICA Team)** **4) Philippine Codes and Practice for Petroleum Refineries by Engr. Carlos M. Villaraza (ASEP)**
12:00 -13:00	***LUNCH***
13:00–13:45	**5) Comparison of seismic design results based on various national codes by Mr. T. Noto (JICA Team)**
Session 2 : "Disaster Prevention Plan and Management in Philippines & Japan	
13:45 –14:25	**1) Disaster Prevention Plan and Management in Philippines by Ms. Shelby A. Ruiz (Office of Civil Defense)**
14:25 -15:00	***COFFEE BREAK***
15:00 – 15:40	**2) Disaster Prevention System of Refineries in Japan by Mr. Ishiguro (JICA Team)**
Session 3 : Summary & Question/Answer	
15:40 – 16:30	**Open Forum and Recap**

The answer of questionnaire for the second seminar in Philippines

JAPANESE INTERNATIONAL COOPERATION AGENCY (JICA) and
ASSOCIATION OF STRUCTURAL ENGINEERS OF THE PHILIPPINES, INC.
"Promotion of Practical Seismic Technologies for Petroleum Refinery and Petrochemicals Plants
Metropolitan Club, Makati City / August 29, 2012 / 8:00AM to 5:00 PM

SUMMARY OF SEMINAR EVALUATION

Number of Participants	44	
Number of Evaluation Sheets	29	66% replied

BREAKDOWN OF PARTICIPANTS WHO FILLED UP EVALUATION SHEET

5	ACADEME	17%
18	DESIGN ENGINEER / CONSULTANCY FIRM	62%
5	PRODUCTION, PETROCHEM PLANT	17%

1	GOV'T AGENCY		1%
	OTHERS		

ABOUT THE SEMINAR ORGANIZATION/ PREPARATION

	(Average rating, 10 is the highest)
1 Venue of the Seminar	8.50
2 Projection and Sound Quality	8.92
3 Food and Drinks	7.73
4 Handouts/Seminar Materials	7.70

ABOUT THE TOPICS

		Based on the Number of Respondents (= 29)									
		Relevant and Useful		May be useful in the future		Practical Application is Limited		Nice to know but not important to me		No Answer	
1-1	Insight about the JICA Seismic Technology Survey Project (Result and Outcome)	23	79%	6	21%		0%		0%		0%
1-2	Experiences and Examples of Plants Seismic Design and Codes	20	69%	8	28%		0%		0%	1	3%
1-3	Overview of Japanese Seismic Technology and Introduction of Seismic Assessment Methods for Existing Plant Facilities in Japan	20	69%	9	31%		0%		0%		0%
1-4	Philippine Codes and Practice for Petroleum Refineries	20	69%	8	28%		0%	1	3%		0%
1-5	Comparison of Seismic Design results based on various national codes	22	76%	6	21%		0%	1	3%		
2-1	Disaster Prevention Plan and Management in the Philippines	18	62%	7	24%	2	7%		0%	2	7%
2-2	Disaster Prevention Plan and Management in Japan	15	52%	12	41%		0%		0%	2	7%

COMMENTS/RECOMMENDATIONS/OBSERVATIONS

1	Pls. Include DOE representative in the next seminar on similar topics. They are now preparing finalizing Phil. National standards DOE for pipe line and depots. They used insights in the critical design activity involved in depots/terminal/ pipeline conceptualization and design.
2	There is a clear language barrier when our friends from JICA are presenting. A better alternative would be to allow translators to present.
3	It is expected from ASEP to initiate a long term plan on how to realize the establishment of Philippine design code specific to oil & gas industries. Please invite Chiyoda Philippines for similar event in the future. Thank you to JICA and ASEP.
4	Panel discussion on seismic design should be programmed in the next occasion.
5	Good presentation by each presenter. Very informative I wish JICA would sponsor a training on seismic design to our engineers.
6	This is very informative seminar and great help in my research. It would be much appreciated to anticipated a future seminar/workshop about a similar one but about transportation lifelines, eng. Pipe system, LRT, MRT.
7	Collaboration or globalizationof seismic codes specifically for petroleum refinery of petrochemicals plant.
8	Doesn't talk really about prevention, it pointed more on response.
9	Modern equipment in monitoring seismic activities all over the Philippines (Digital Technology)
10	I've seen many references/design guides/manuals when I was in Japan.The problem is it is in Japanese can make thier more accessibly translating to English, it will be very helpful to us engineer.
11	The seminar it very interesting congratulations. Hope to have similar seminars in the future. Maybe JICA can also offer seminars on Performance Based Design of buildings & Bridges.
12	Philippine needs for code development for plant facilities. JICA to recommend a milestone/way forward for the development of code in the Philippines.

The list of attendees in the second seminar in Philippines

List of Actual Attendees

29 August, 2012, Philippine

Organization	Number
Petron Corporation	5
Chiyoda Philippines	5
Philippine Institute of Volcanology and Seismology (PHIVOLCS)	4
AAE+C	3
Association of Structural Engineers, Philippines (ASEP)	3
JGC Philippines, Inc.	2
BB Engineers Co.	2
FEU-East Asia College	2
UP Diliman (Institute of Civil Engineering)	2
Makati – Office of the Building Official)	2
EM2A Partners & Co.	2
JFE Techno Manila	1
Department of Public Works and Highway	1
CC Pabalan & Associates	1
National Research Institute for Earth Science and Disaster Prevention (NIED)	1
DCCD Engineering Corporation	1
Total Philippines	1
Pamantasan ng Lungsod ng Maynila	1
Office of Civil Defense (OCD)	1
RS Ison & Associates	1
TandeM Engg Consultancy	1
GEOSEED	1
Japan International Cooperation Agency (JICA)	1
TOTAL	44

Program of the second seminar held in Indonesia

SEMINAR PROGRAM

Promotion of Practical Seismic Technologies for Petroleum Refinery and Petrochemicals Plant

Main Commission Room, 3rd Floor, Building 2

Agency for the Assessment and Application of Technology (BPPT)

Jakarta, Indonesia September 7th, 2012

08:30 – 08:50	Registration
08:50 – 09:00	Welcome Remarks by Ir. Isman Justanto (Director, BPPT)
09:00 – 09:10	Opening Statement by Mr. H. Katayama (JICA Indonesia Office)
09.10 – 09:30	*COFFEE BREAK & GROUP PHOTO SESSION*
09:30 – 10:50	Session 1 : Experiences and Examples of Plants Seismic Design and Codes
09:30– 10:10	1) Insight about JICA Seismic Technology Survey Project (Result and Outcome) by T. Sato (JICA Team) 2) Seismic Factor in the Design of Existing and Future Facilities in PERTAMINA by Joko Susilo (Vice President HSSE, PT PERTAMINA (PERSERO))
10:10 –10:50	3) Proposal of Seismic Design Methods for Plant Facilities in Indonesia and Introduction of Seismic Assessment Methods for Existing Plant Facilities in Japan by Dr. M. Oshima (JICA Team) 4) Comparison of seismic design results based on various national codes by Mr. T. Noto (JICA Team)
10:50 – 11:30	Session 2 : Disaster Prevention Plan and Management in Indonesia & Japan
10:50 –11:10	3) Disaster Prevention Plan and Management in Petrochemical Industry by R. Tjiptoputro (General Manager - HSE, Chandra Asri Petrochemical)
11:10 – 11:30	4) Disaster Prevention System of Refineries in Japan by Mr. Kato & Ishiguro (JICA Team)
11:30 – 11:45	Session 3 : Summary
11:45 -13:30	*LUNCH*

The answer of questionnaire for the first seminar in Indonesia

RESULTS OF QUESTIONNAIRE
SEMINAR ON Promotion of Practical Seismic Technologies for Petroleum Refinery and Petrochemicals Plant
Komisi Utama Room, Building 2, BPPT, September 7, 2012

No	Content of Seminar				Length of Seminar			Request to JICA Seismic Technology Project			
	Satisfactory	Acceptable	Unsatisfied	Reason	Too long	Too short	Reasonable	More often Seminar	Dispatch JICA Experts	Seismic Technology Engineer Resource Development Plant	Other request
1		1					1		1	1	
2		1					1	1			
3	1						1	1			
4		1					1			1	
5		1					1			1	
6		1				1			1		
7			1					1			Training and Scholarship
8	1			The materials are very usefull and informative			1	1		1	
9		1		adequate informations			1	1			
10	1					1		1			
11	1					1		1			
12		1		That's important for disaster mitigation, to Industrial hazard and non natural hazard		1				1	
13		1		not enough time for discussion			1			1	
14		1		This is a new issue to be discussed. I am interested with this issue.		1		1			
15		1		Good Speakers			1			1	
16		1				1				1	
17		1				1				1	
18		1					1	1			
19		1				1		1		1	
20		1					1			1	
21	1						1				Cooperation with BPPT
22		1				1				1	
23		1					1			1	
24		1		for JICA team 2 speakers enough	1						Seismic technology project cooperation with indonesian experts/scientist
25		1					1				Training of practical seismic technologies for petroleum refinery and petrochemicals plant
26	1					1				1	Training
27		1				1		1			
28		1		they gave me new knowledge		1				1	
	6	21	1		1	12	14	11	2	15	

The list of attendees in the first seminar in Indonesia

List of Actual Attendees

7 September, 2012, Indonesia

Organization	Number
Bandan Pengkajian dan Penerapan Teknologi, The Agency for the Assessment and Application of Technology (BPPT)	52
PT Chandra Asri Petrochemical	3
Pertamina	2
Badan Standardisasi Nasional, National Standardization Agency of Indonesia (BSN)	2
Universitas Bakrie	1
Research Institute for Human Settlements, Agency for Research and Development, Ministry of Public Works (PUSKIM)	1
National Agency for Disaster Management (BNPB)	1
Japan International Cooperation Agency (JICA)	2
N. A.	1
TOTAL	65