THE PREPARATORY STUDY
ON
DISASTER MANAGEMENT PROGRAM
FOR
INDONESIA

FINAL REPORT

SUPPLEMENT REPORT

- FINDINGS FROM WEST SUMATRA EARTHQUAKE -
- 30 SEPTEMBER 2009 -

MARCH 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

THE PREPARATORY STUDY
ON
DISASTER MANAGEMENT PROGRAM
FOR
INDONESIA

FINAL REPORT

SUPPLEMENT REPORT
- FINDINGS FROM WEST SUMATRA EARTHQUAKE -
- 30 SEPTEMBER 2009 -

MARCH 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

APPENDICES

CONTENTS

Appendix-1

Survey sheets for large scale reinforced concrete building

Survey sheet for large scale reinforced concrete building

Reference no. __01__   Research date __Dec. 8 ~12__   (AM·PM) 9:00 __ ~

1. Outline of building

1	Building Name	BPKP
2	Building Address	Jl. Rasuna Said. No.69, Padang
3	Owner(Contact)	BPKP (Badan Pemeriksa Keuangan dan Pembangunan) (Pak Sugeng: 07519815734)
4	Building Usage	1.Condominium 2.Multipurpose house 3.Store, Shop ④.Office 5.Guesthouse, Hotel 6.Public Facilities 7.Hospital, Clinic 8.Nursery 9.Facility 12.Warehouse 13.School 14.Gymnasium 15.Theater, Amusement Places 16.Others( )
5	Structure	①.Reinforced Concrete 2.Others( )
6	Wall Structure	1.Reinforced Concrete ②.Others(Brick)
7	Basement St.	1.Spread Foundation ②.Pile Foundation(Type:Mini Pile?) 3.Unclear
8	Framing	①.Rigid Frame 2.Wall 3.Others( )
9	Storey	Ground __5__ storey、Basement __－__ storey
10	Building Size	1F measurement approx.__42__ m × __24__ m
11	Topography	①.Flat land 2.Sloping land 3.Plateau 4.Hollow 5.Others
12	Surrounding	1.from Cliff _____ m ②.from River, (Sea,) Lake, Pond __1,200__ m
13	Exterior Finish	1.Concrete ②Mortar ③.Stone ④.Tile 5.Others( )
14	Drawings	Drawing (Yes) No Structural statement (Yes) No Construction record:Yes (No)
15	Completed	1.(2003)year 2.Unclear

2. Investigation   method: (1.Exterior investigation only ②.Exterior and Interior investigation)

2. 1 Risk is judged to be at a glance.(Judge dangerous that putting is "○", Completed a survey to determine overall)

1. The entire building or a part of collapse and falling floor	2. Remarkable base destruction & gap with upper-structure
3. The entire building or a part of remarkable inclination	④.Others(Non structural wall: fall off)

2. 2 Judgment by subsidence and inclination of the entire building

Pile Damage	1.Yes 2.No ③.Unclear	Liquidizing	1.Yes 2.No ③.Unclear

2. 2. 1 Judgment by subsidence of the entire building ①Maximum amount of subsidence S=_____ m

①.No Damage(S=0m) 2.Small Damage(0m＜S≦0.2m) 3.Medium Damage(0.2m＜S≦1.0m) 4.Large Damage(1.0m＜S)

2. 2. 2 Judgment by inclination of the entire building

① Inclination for X θ_x = _____N.A_____ radian

② Inclination for Y θ_y = _____N.A_____ radian

③ Maximum Inclination $\theta = \sqrt{\theta_x^2 + \theta_y^2}$ = _____N.A_____ radian

At most severe story:

Columns: D5 = East 1° North 5°

E5 = South 2°,   E4 = East 2°, F4 = East 2°

1.No Damage(θ=0) 2.Small Damage(0＜θ≦0.0) 3.Medium Damage(0.01＜θ≦0.03) 4.Large Damage(0.03＜θ≦0.06) 5.Collapse(0.06＜θ)

2. 2. 3 Judgment by damage ratio of structure

① The most severe damage _____3rd_____ Floor

					Brick wall	RC Wall
② Total No. of Column Ao	= __36__ pcs		Total No. of Wall	= _____	=_____ pcs	=_____ pcs
③ Investigated No. of Column A	= __36__ pcs		Investigated No. of Wall	= _____	=_____ pcs	=_____ pcs
④ Investigate Ratio A/Ao	= __100__ %		Investigate Ratio	= _____	=_____ %	=_____ %
⑤ No. of Column of each damage level Bi						
Damage level Ⅴ	B5	= __7__ pcs	Damage level Ⅴ		=_____ pcs	=_____ pcs
Damage level Ⅳ	B4	= __10__ pcs	Damage level Ⅳ		=_____ pcs	=_____ pcs
Damage level Ⅲ	B3	= __10__ pcs	Damage level Ⅲ		=_____ pcs	=_____ pcs
Damage level Ⅱ	B2	= __3__ pcs	Damage level Ⅱ		=_____ pcs	=_____ pcs
Damage level Ⅰ	B1	= __3__ pcs	Damage level Ⅰ		=_____ pcs	=_____ pcs
Damage level Ο	B0	= __2__ pcs	Damage level Ο		=_____ pcs	=_____ pcs

⑥ Calculation of D_i for damage level of column

Damage level Ⅴ	$D_5 =$ min(1000B_5／7A	=	28	, 50)=	28
Damage level Ⅳ	$D_4 =$ min(100B_4／A	=	28	, 50)=	28
Damage level Ⅲ	$D_3 =$ min(60B_3／A	=	17	, 30)=	17
Damage level Ⅱ	$D_2 =$ min(26B_2／A	=	2	, 13)=	2
Damage level Ⅰ	$D_1 =$ min(10B_1／A	=	0.8	, 5)=	0.8
		$D = \Sigma(D_1 \sim D_5) =$			75.8

1.No Damage（D ＝0) 2.Minor Damage（D ≦5) 3.Small Damage（5＜D ≦10) 4.Medium Damage（10＜D ≦50)
⑤Large Damage（50＜D) 6.Collapse（D_5 ＝50)

3. Damage of finish and attached structure

①Window frame and pane	1. No Damage	2. Distortion, cracks	③Dangerous of fall
②Exterior Wet type	1. No Damage	2. Partial cracks, gaps	③Significant cracking, peeling
③Exterior Dry type	1. Cracks in the joint	2. Gaps in the boards	③ Significant deviation joint destruction plate
④Signboard and equipment	1. No Inclination	2. Slight Inclination	3. Dangerous of fall
⑤Penthouse	1. No Damage	2. Damage（	）
⑥Exterior Stairs	1. No Damage	2. Damage（	）
⑦Rooftop Chimney	1. No Damage	2. Damage（	）
⑧Extending passage	1. No Damage	2. Damage（	）
⑨Exp.Joint	1. No Damage	2. Damage（	）
⑩Others（ ）	1. No Damage	2. Damage（	）

※At the time of the damage having. Note a specified dangerous location and treatment necessity.

4. Results determine degree classification affected

「2.2.1」、「2.2.2」、「2.2.3」The highest degree of victims affected by the degree of division

| 1.No Damage | 2.Minor Damage | 3.Small Damage | 4.Medium Damage | ⑤Large Damage | 6.Collapse |

Comment （Note whether a structural building frame etc. are dangerous or the falling object etc. are dangerous, etc.）

Floor plate above the third floor shows deflection due to significant damage of columns at third floor. If the building is to be retained/repaired, then it is advisable to remove the forth and fifth floors (floors above third floor). So that the seismic demand becomes lower.

Standard of damage level classification for RC Columns and Shear Walls

Damage level for Columns & Shear Walls	Content of damage
Ⅰ	much less visible cracks（crack width of 0.2mm or less）
Ⅱ	Cracks clearly visible（crack width of 0.2～1mm）
Ⅲ	The relatively large cracks are occurring, chipped concrete is negligible（crack width of around 1～2mm）。
Ⅳ	Large cracks (crack width of 2mm over) caused a large number are also heavily exposed considerably chipped concrete reinforcement.
Ⅴ	Bend the steel, concrete collapsed inside the pillar at a glance (shear walls), which shows that the deformation occurring in the height direction. The observed characteristics of the subsidence and slope. There has been a sometimes rupture of steel.

Survey sheet for large scale reinforced concrete building

Reference no. __002__   Research date ___Dec.11~14.___

1. Outline of building

1	Building Name	PU (Pekerjaan Umum: Public Works)
2	Building Address	Jl. Batang Arau No.86, Padang
3	Owner(Contact)	PU (Mr. Zulmadi: 0812 678 7292)
4	Building Usage	1.Condominium 2.Multipurpose house 3.Store, Shop ④Office 5.Guesthouse, Hotel 6.Public Facilities 7.Hospital, Clinic 8.Nursery 9.Facility 12.Warehouse 13.School 14.Gymnasium 15.Theater, Amusement Places 16.Others ( )
5	Structure	①Reinforced Concrete 2.Others ( )
6	Wall Structure	1.Reinforced Concrete ②Others ( )
7	Basement St.	1.Spread Foundation 2.Pile Foundation (Type) ③Unclear
8	Framing	①Rigid Frame 2.Wall 3.Others ( )
9	Storey	Ground __4__ storey、Basement __–__ storey
10	Building Size	1F measurement approx. __36__ m × __12.5__ m
11	Topography	①Flat land 2.Sloping land 3.Plateau 4.Hollow 5.Others
12	Surrounding	1.from Cliff _____ m ②from River, Sea, Lake, Pond __30__ m
13	Exterior Finish	1.Concrete ②Mortar 3.Stone 4.Tile 5.Others ( )
14	Drawings	Drawing：Yes ⨀No Structural statement：Yes ⨀No Construction record：Yes ⨀No
15	Completed	1.(1970)year 2.Unclear

2. Investigation   method：(1.Exterior investigation only ②Exterior and Interior investigation)

2. 1 Risk is judged to be at a glance. (Judge dangerous that putting is "○", Completed a survey to determine overall)

1. The entire building or a part of collapse and falling floor	2. Remarkable base destruction & gap with upper-structure
③The entire building or a part of remarkable inclination	4.Others ( )

2. 2 Judgment by subsidence and inclination of the entire building

Pile Damage	1.Yes 2.No ③Unclear	Liquidizing	1.Yes 2.No ③Unclear

2. 2. 1 Judgment by subsidence of the entire building ①Maximum amount of subsidence S＝_____ m

1.No Damage (S=0m) ②Small Damage (0m＜S≦0.2m) 3.Medium Damage (0.2m＜S≦1.0m) 4.Large Damage (1.0m＜S)

3. Damage of finish and attached structure

①Window frame and pane	1. No Damage	②Distortion, cracks	3. Dangerous of fall
②Exterior Wet type	1. No Damage	②Partial cracks, gaps	3. Significant cracking, peeling
③Exterior Dry type	1. Cracks in the joint	2. Gaps in the boards	3. Significant deviation joint destruction plate
④Signboard and equipment	1. No Inclination	2. Slight Inclination	3. Dangerous of fall
⑤Penthouse	1. No Damage	2. Damage ( )	
⑥Exterior Stairs	1. No Damage	②Damage Distortion,cracken. crack)	
⑦Rooftop Chimney	1. No Damage	2. Damage ( )	
⑧Extending passage	1. No Damage	2. Damage ( )	
⑨Exp.Joint	1. No Damage	2. Damage ( )	
⑩Others ( )	1. No Damage	2. Damage ( )	

※At the time of the damage having. Note a specified dangerous location and treatment necessity.

Comment (Note whether a structural building frame etc. are dangerous or the falling object etc. are dangerous, etc.)

Although the results from 2.2.1 is "Small Damage", in reality, the first story showed soft story mechanism which were very dangerous.

Survey sheet for large scale reinforced concrete building

Reference no.____O03____ Research date____Dec. 12~____

1. Outline of building

1	Building Name	UNP
2	Building Address	Jl. Belibis (enter from Jl, Hamka), Padang
3	Owner(Contact)	UNP (Universitas Negri Padang)　(Rusnardi　0812 662 860 78)
4	Building Usage	1.Condominium 2.Multipurpose house 3.Store, Shop 4.Office 5.Guesthouse, Hotel 6.Public Facilities 7.Hospital, Clinic 8.Nursery 9.Facility 12.Warehouse ⑬School 14.Gymnasium 15.Theater, Amusement Places 16.Others(　　　　　　　)
5	Structure	①Reinforced Concrete 2.Others(　　　　　　　　　　　　　　　)
6	Wall Structure	1.Reinforced Concrete ②Others(Brick　　　　　　　　　　　　)
7	Basement St.	1.Spread Foundation 2.Pile Foundation(Type　　　　　　　) ③Unclear
8	Framing	①Rigid Frame 2.Wall 3.Others(　　　　　　　　　　　　)
9	Storey	Ground____5____storey、Basement____−____storey
10	Building Size	1F measurement approx._____m×_____m
11	Topography	①Flat land 2.Sloping land 3.Plateau 4.Hollow 5.Others
12	Surrounding	1.from Cliff_____m ②from River, Sea, Lake, Pond____400____m
13	Exterior Finish	1.Concrete ②Mortar 3.Stone 4.Tile ⑤Others(Metal Panel　　　)
14	Drawings	Drawing：Yes ⑩o　Structural statement：Yes ⑩o　Construction record：Yes ⑩o
15	Completed	1.(　2006　)year 2.Unclear　　(According UNP staff: completed 1998)

2. Investigation method：(1.Exterior investigation only ②Exterior and Interior investigation)

2. 1 Risk is judged to be at a glance.(Judge dangerous that putting is "○", Completed a survey to determine overall)

1. The entire building or a part of collapse and falling floor	2. Remarkable base destruction & gap with upper-structure
3. The entire building or a part of remarkable inclination	4.Others(　　　　　　　　　)

2. 2 Judgment by subsidence and inclination of the entire building

Pile Damage	1.Yes 2.No ③Unclear	Liquidizing	1.Yes 2.No ③Unclear

2. 2. 1 Judgment by subsidence of the entire building ①Maximum amount of subsidence S＝_____m

1.No Damage(S=0m) 2.Small Damage(0m＜S≦0.2m) 3.Medium Damage(0.2m＜S≦1.0m) 4.Large Damage(1.0m＜S)

3. Damage of finish and attached structure

①Window frame and pane	1. No Damage	2. Distortion, cracks	③Dangerous of fall
②Exterior　Wet type	1. No Damage	2.Partial cracks, gaps	③Significant cracking, peeling
③Exterior　Dry type	1. Cracks in the joint	②Gaps in the boards	3. Significant deviation joint destruction plate
④Signboard and equipment	1. No Inclination	2. Slight Inclination	3. Dangerous of fall
⑤Penthouse	1. No Damage	2. Damage(　　　　　　　)	
⑥Exterior Stairs	1. No Damage	2. Damage(　　　　　　　)	
⑦Rooftop Chimney	1. No Damage	2. Damage(　　　　　　　)	
⑧Extending passage	1. No Damage	2. Damage(　　　　　　　)	
⑨Exp.Joint	1. No Damage	2. Damage(　　　　　　　)	
⑩Others(　　　)	1. No Damage	2. Damage(　　　　　　　)	

※At the time of the damage having. Note a specified dangerous location and treatment necessity.

Comment （Note whether a structural building frame etc. are dangerous or the falling object etc. are dangerous, etc.)

From 2.2.3, the damage level is Medium Damage. However, from reality it seems the building showed small damage (structurally).

Survey sheet for large scale reinforced concrete building

Reference no.＿＿＿004＿＿＿　Research date＿Dec. 16＿＿　AM・PM＿＿＿＿＿＿＿＿＿　〜 AM・PM＿＿＿＿＿＿＿＿

Researcher＿＿＿＿＿＿　　　Research＿＿＿＿＿＿time

1. Outline of building

1	Building Name	BAPPEDA
2	Building Address	Jl. Khotib Sulaiman No.1
3	Owner（Contact）	BAPPEDA （　　　　　　　　　　　　　）
4	Building Usage	1.Condominium　2.Multipurpose　house　3.Store,　Shop　④.Office　5.Guesthouse,　Hotel　6.Public　Facilities　7.Hospital,　Clinic　8.Nursery　9.Facility　12.Warehouse　13.School　14.Gymnasium　15.Theater, Amusement Places　16.Others（　　　　　　　　　　　）
5	Structure	①Reinforced Concrete　2.Others（　　　　　　　　　　　　　　　　　　　　　　　　）
6	Wall Structure	①Reinforced Concrete　②.Others（　　　　　　　　　　　　　　　　　　　　　　　）
7	Basement St.	1.Spread Foundation　2.Pile Foundation（Type　　　　　　　　　　　　　　　　）　③Unclear
8	Framing	①Rigid Frame　2.Wall　3.Others（　　　　　　　　　　　　　　　　　　　　　）
9	Storey	Ground＿＿＿＿＿＿＿3＿storey、Basement＿＿＿＿＿＿＿＿＿storey
10	Building Size	1F measurement　approx.＿＿30＿m×＿＿＿30＿m
11	Topography	①Flat land　2.Sloping land　3.Plateau　4.Hollow　5.Others
12	Surrounding	1.from Cliff＿＿＿＿＿＿＿＿＿＿m　②from River, Sea, Lake, Pond＿＿＿＿1,200＿＿＿m
13	Exterior Finish	①.Concrete　②.Mortar　3.Stone　4.Tile　5.Others（　　　　　　　　　　　　）
14	Drawings	Drawing：Yes ⓃO　　Structural statement：Yes Ⓝo　　Construction record：Yes Ⓝo
15	Completed	1.（　　　　　　　）year　2.Unclear

2. Investigation　　method：（①.Exterior investigation only　2.Exterior and Interior investigation）

2. 1　Risk is judged to be at a glance.（Judge dangerous that putting is "○", Completed a survey to determine overall）

①.The entire building or a part of collapse and falling floor	2.　Remarkable　base　destruction　&　gap　with　upper-structure
3. The entire building or a part of remarkable inclination	4.Others（　　　　　　　　　　　　　　　）

2. 2　Judgment by subsidence and inclination of the entire building

Pile Damage	1.Yes　2.No　③Unclear	Liquidizing	1.Yes　2.No　③Unclear

2. 2. 1 Judgment by subsidence of the entire building　①Maximum amount of subsidence　S＝＿＿＿＿＿＿＿m

1.No Damage（S＝0m）2.Small Damage（0m＜S≦0.2m）3.Medium Damage（0.2m＜S≦1.0m）④Large Damage（1.0m＜S）

3. Damage of finish and attached structure

①Window frame and pane	1. No Damage	2. Distortion, cracks	③.Dangerous of fall
②Exterior　Wet type	1. No Damage	2. Partial cracks, gaps	③. Significant cracking, peeling
③Exterior　Dry type	1. Cracks in the joint	2. Gaps in the boards	3.　Significant　deviation　joint　destruction plate
④Signboard and equipment	1. No Inclination	2. Slight Inclination	3. Dangerous of fall
⑤Penthouse	1. No Damage	2. Damage（　　　　　　　　　　　）	
⑥Exterior Stairs	1. No Damage	2. Damage（　　　　　　　　　　　）	
⑦Rooftop Chimney	1. No Damage	2. Damage（　　　　　　　　　　　）	
⑧Extending passage	1. No Damage	2. Damage（　　　　　　　　　　　）	
⑨Exp.Joint	1. No Damage	2. Damage（　　　　　　　　　　　）	
⑩Others（　　　　　）	1. No Damage	2. Damage（　　　　　　　　　　　）	

※At the time of the damage having. Note a specified dangerous location and treatment necessity.

Comment （Note whether a structural building frame etc. are dangerous or the falling object etc. are dangerous, etc.）

Survey sheet for large scale reinforced concrete building

Reference no.＿＿005＿＿　Research date＿Dec. 16＿　AM･PM＿＿＿＿＿＿＿　～ AM･PM＿＿＿＿＿＿＿

Researcher＿＿＿＿＿＿　　Research ＿＿＿＿＿time

1. Outline of building

1	Building Name	DEPARTMEN KEUANGAN
2	Building Address	Jl. Knotib Sulaiman
3	Owner(Contact)	( )
4	Building Usage	1.Condominium 2.Multipurpose house 3.Store, Shop ④.Office 5.Guesthouse, Hotel 6.Public Facilities 7.Hospital, Clinic 8.Nursery 9.Facility 12.Warehouse 13.School 14.Gymnasium 15.Theater, Amusement Places 16.Others( )
5	Structure	①.Reinforced Concrete 2.Others( )
6	Wall Structure	1.Reinforced Concrete ②.Others( )
7	Basement St.	1.Spread Foundation 2.Pile Foundation(Type) ③.Unclear
8	Framing	①.Rigid Frame 2.Wall 壁式 3.Others( )
9	Storey	Ground＿＿2＿storey、Basement＿＿＿＿＿＿＿＿＿＿storey
10	Building Size	1F measurement approx.＿＿＿＿＿m×＿＿＿＿＿m
11	Topography	①.Flat land 2.Sloping land 3.Plateau 4.Hollow 5.Others
12	Surrounding	1.from Cliff＿＿＿＿＿＿m ②.from River, Sea, Lake, Pond＿＿1,200＿m
13	Exterior Finish	1.Concrete ②.Mortar 3.Stone 4.Tile 5.Others( )
14	Drawings	Drawing：Yes ⓝo Structural statement：Yes ⓝo Construction record：Yes ⓝo
15	Completed	1.( )year ②.Unclear

2. Investigation   method：(1.Exterior investigation only   2.Exterior and Interior investigation)

2．1 Risk is judged to be at a glance.(Judge dangerous that putting is "○", Completed a survey to determine overall)

①.The entire building or a part of collapse and falling floor	2. Remarkable base destruction & gap with upper-structure
3. The entire building or a part of remarkable inclination	4.Others( )

2．2 Judgment by subsidence and inclination of the entire building

Pile Damage	1.Yes 2.No ③.Unclear	Liquidizing	1.Yes 2.No ③.Unclear

2．2．1 Judgment by subsidence of the entire building ①Maximum amount of subsidence S=＿＿＿＿＿＿m

1.No Damage(S=0m) 2.Small Damage(0m＜S≦0.2m) 3.Medium Damage(0.2m＜S≦1.0m) ④.Large Damage(1.0m＜S)

3. Damage of finish and attached structure

①Window frame and pane	1. No Damage	2. Distortion, cracks	③.Dangerous of fall
②Exterior Wet type	1. No Damage	2. Partial cracks, gaps	3. Significant cracking, peeling
③Exterior Dry type	1. Cracks in the joint	2. Gaps in the boards	3. Significant deviation joint destruction plate
④Signboard and equipment	1. No Inclination	2. Slight Inclination	3. Dangerous of fall
⑤Penthouse	1. No Damage	2. Damage( )	
⑥Exterior Stairs	1. No Damage	2. Damage( )	
⑦Rooftop Chimney	1. No Damage	2. Damage( )	
⑧Extending passage	1. No Damage	2. Damage( )	
⑨Exp.Joint	1. No Damage	2. Damage( )	
⑩Others( )	1. No Damage	2. Damage( )	

※At the time of the damage having. Note a specified dangerous location and treatment necessity.

Comment （Note whether a structural building frame etc. are dangerous or the falling object etc. are dangerous, etc.）

Survey sheet for large scale reinforced concrete building

Reference no.__006__ Research date____Dec. 11____ AM・PM_____ ～ AM・PM_____

Researcher_____ Research _____time

1. Outline of building

1	Building Name	DPRD （Parliament house)
2	Building Address	Jl. Khatib Sulaiman
3	Owner（Contact）	（ ）
4	Building Usage	1.Condominium 2.Multipurpose house 3.Store, Shop 4.Office 5.Guesthouse, Hotel ⑥Public Facilities 7.Hospital, Clinic 8.Nursery 9.Facility 12.Warehouse 13.School 14.Gymnasium 15.Theater, Amusement Places 16.Others（ ）
5	Structure	①Reinforced Concrete 2.Others（ ）
6	Wall Structure	1.Reinforced Concrete ②Others（Brick ）
7	Basement St.	1.Spread Foundation 2.Pile Foundation（Type ）③Unclear
8	Framing	①Rigid Frame 2.Wall 3.Others（ ）
9	Storey	Ground_____3___storey、Basement_____－__storey
10	Building Size	1F measurement approx.____60_m×_____65_m
11	Topography	①Flat land 2.Sloping land 3.Plateau 4.Hollow 5.Others
12	Surrounding	1.from Cliff_____m ②from River, Sea, Lake, Pond_____250__m
13	Exterior Finish	1.Concrete ②Mortar 3.Stone 4.Tile 5.Others（ ）
14	Drawings	Drawing：Yes No Structural statement：Yes ⑩ Construction record：Yes ⑩
15	Completed	1.（ 1995 ）year 2.Unclear

2. Investigation method: (1.Exterior investigation only ②Exterior and Interior investigation)

2. 1 Risk is judged to be at a glance. (Judge dangerous that putting is "○", Completed a survey to determine overall)

1. The entire building or a part of collapse and falling floor	2. Remarkable base destruction & gap with upper−structure
3. The entire building or a part of remarkable inclination	4.Others（ ）

2. 2 Judgment by subsidence and inclination of the entire building

Pile Damage	1.Yes 2.No ③Unclear	Liquidizing	1.Yes 2.No ③Unclear

2. 2. 1 Judgment by subsidence of the entire building ①Maximum amount of subsidence S＝_____m

①No Damage（S=0m）2.Small Damage（0m＜S≦0.2m）3.Medium Damage（0.2m＜S≦1.0m）4.Large Damage（1.0m＜S）

3. Damage of finish and attached structure

①Window frame and pane	①No Damage	2. Distortion, cracks	3. Dangerous of fall
②Exterior Wet type	①No Damage	2. Partial cracks, gaps	3. Significant cracking, peeling
③Exterior Dry type	1. Cracks in the joint	2. Gaps in the boards	3. Significant deviation joint destruction plate
④Signboard and equipment	1. No Inclination	2. Slight Inclination	3. Dangerous of fall
⑤Penthouse	1. No Damage	2. Damage（ ）	
⑥Exterior Stairs	1. No Damage	2. Damage（ ）	
⑦Rooftop Chimney	1. No Damage	2. Damage（ ）	
⑧Extending passage	1. No Damage	2. Damage（ ）	
⑨Exp.Joint	1. No Damage	2. Damage（ ）	
⑩Others（ ）	1. No Damage	2. Damage（ ）	

※At the time of the damage having. Note a specified dangerous location and treatment necessity.

Comment （Note whether a structural building frame etc. are dangerous or the falling object etc. are dangerous, etc.）

Appendix-2

Structural Analysis of Surveyed Building

BAPPEDA MAIN BUILDING

The survey was carried out on 16 December 2009.

I.   INTRODUCTION

(a)

(b)

(c)

BAPPEDA Main Building View (a) Front Left (b) Back Left (c) Front Right

The first story height was reduced due to the earthquake (most severely was the front part)

BAPPEDA Main Building is located at Jalan Khotib Sulaiman No.1, Padang City, West Sumatra Province, Republic of Indonesia.

In 2009 earthquake, damage was so severe that the first story (front part) was practically disappeared. The back part dropped as well but not as severe as the front part.

Dimension of bays measured at site:
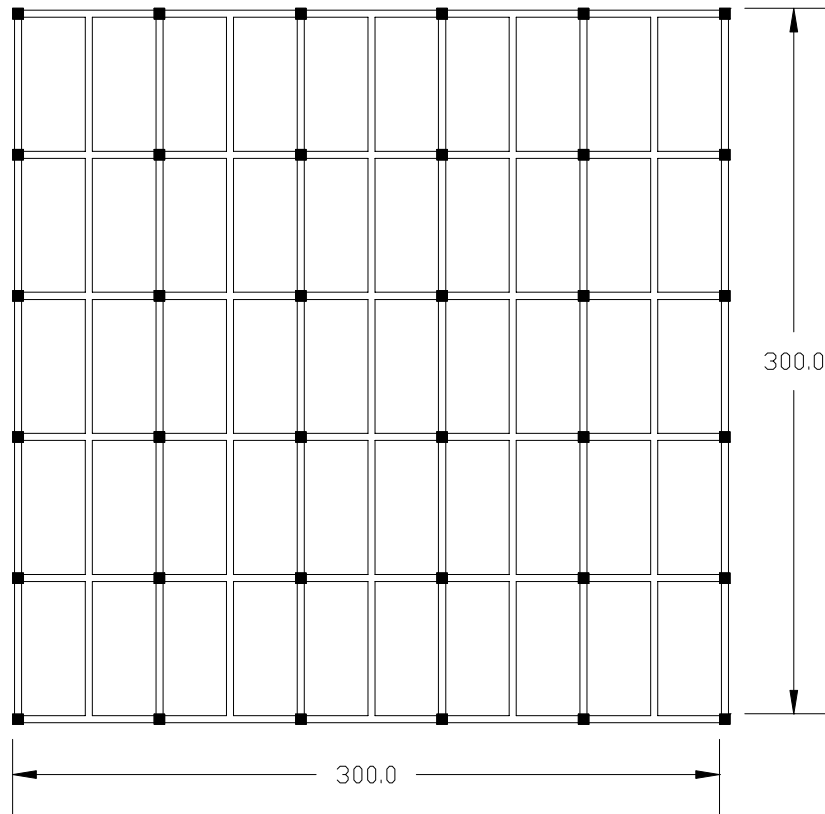
Plan of BAPPEDA Building at Floor-1 up to Floor-3
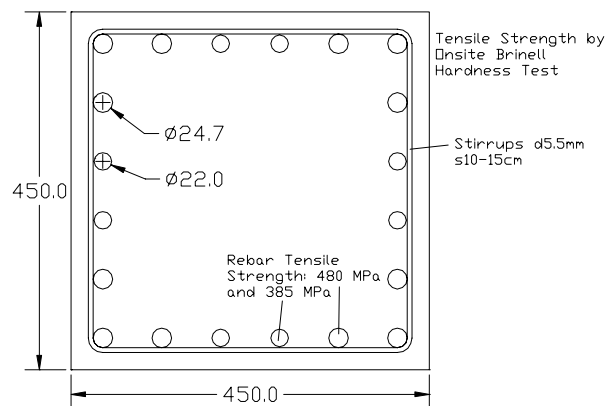
Dimension of First Floor Columns (Upper Floor Columns is assumed to be the same)

The beam dimension was h = 500 mm and b = 300 mm.

The first floor height was measured based on height of standing stairways at the back part of the building. The steel stairways was not connected to the main building so that it was not broken by the drop of the building. The height of first story is found to be 4.4 meter. The second and third story height was measured at 3.8 meter.

Original height of second floor at the back part is shown by the height of stairways

Roof is made of wood frame and thin steel. Therefore the weight is asumed to be relatively light.

Roof is made thin steel and wood frame structure

Other floors has the same plan pattern. Floor thickness was assumed to be 12 cm. The building has balustrade around the building (see photo of the building). This balustrade added extra weight to the structure. The FEM model and the eigenvalue analysis of the building (100% of column stiffness) is shown below.
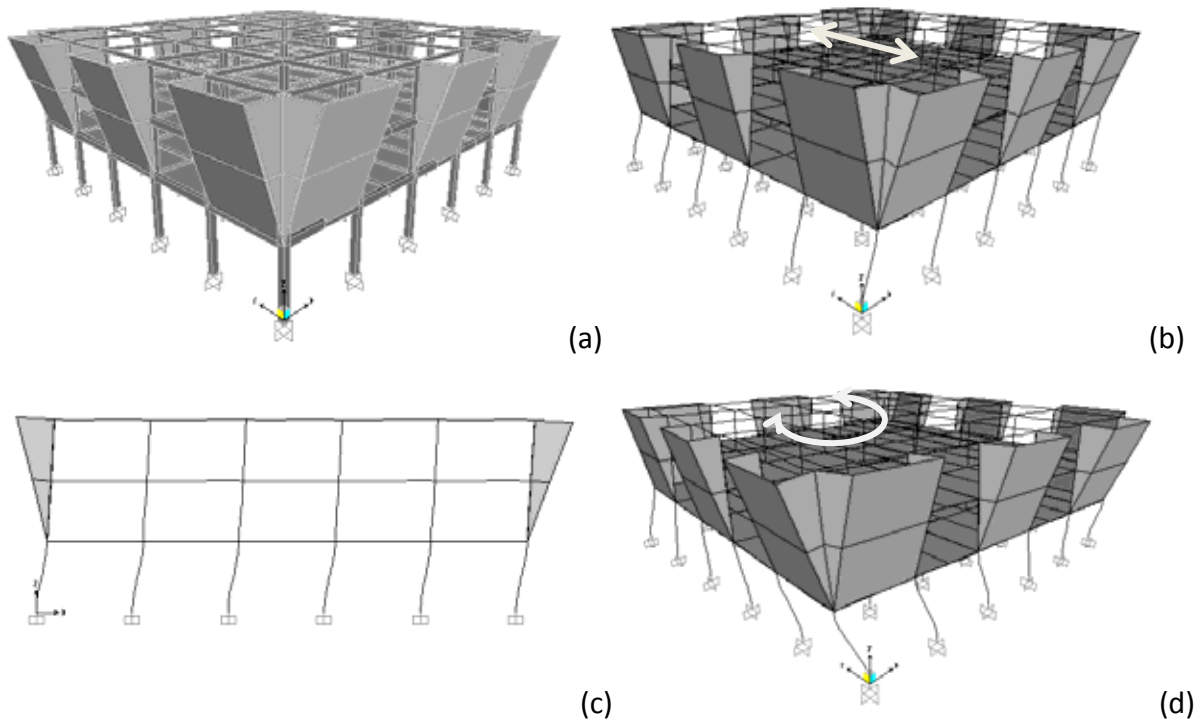
FEM Model (a) Undeformed (b) First Mode, Sway Y, T1 = 0.483 s

(c) First Mode, Side View (d) Third Mode, Torsion Z, T3 = 0.423 s

Based on the dimension of the column, beam, ballustrade, and plate, and also mass density (2400 kg/m^3) of reinforced concrete material, the weight of perimeter wall, and life load of 200 kg/m2, the weigth of the structure is found to be 11138 kN (without ballustrade) and 12568 kN (with ballustrade). So, the ballustrade itself weighs 1430 kN ($\approx$146 tons).

From the weight, and SNI-03-1726-2002, the distribution of the static equivalent force is shown below (for the structure with ballustrade).
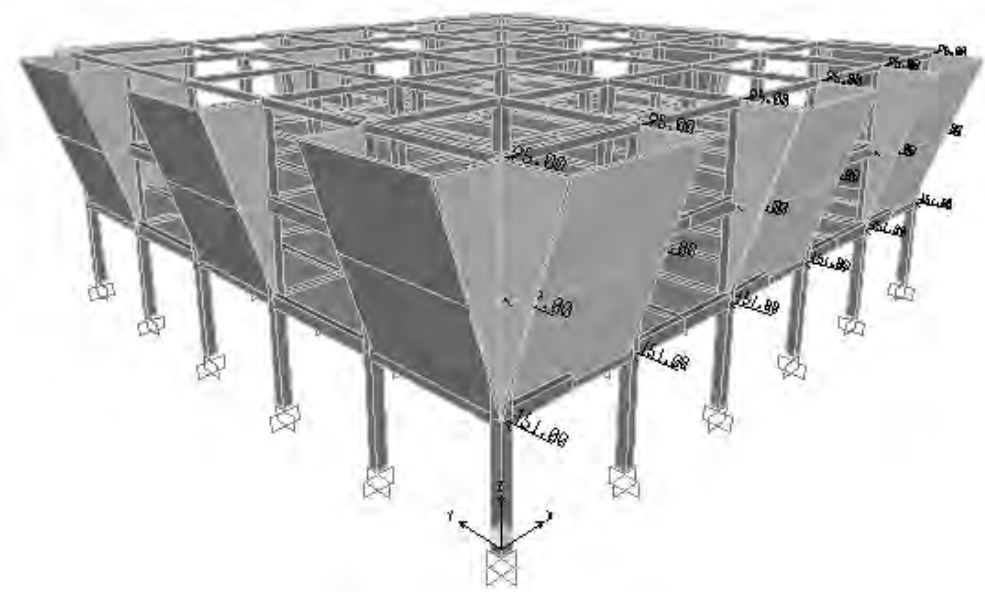
Seismic Equivalent Static Loading (method to calculate is at the end this report)
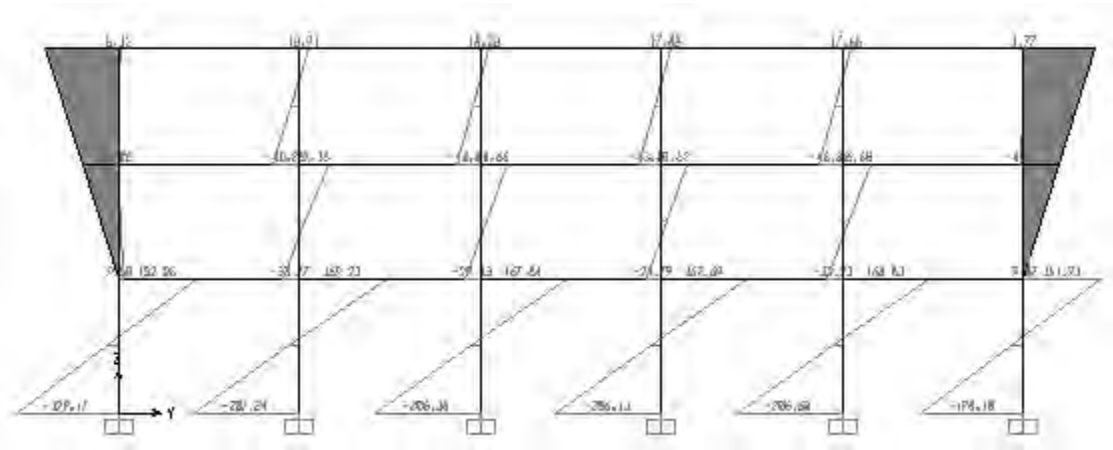
Maximum Moment (206 kN.m) at Column Base

Under Seismic Equivalent Static Loading (SNI-03-1726-2002)

From the dimension, the capacity of the column is calculated. The results are shown below.

P-M Interaction Diagram
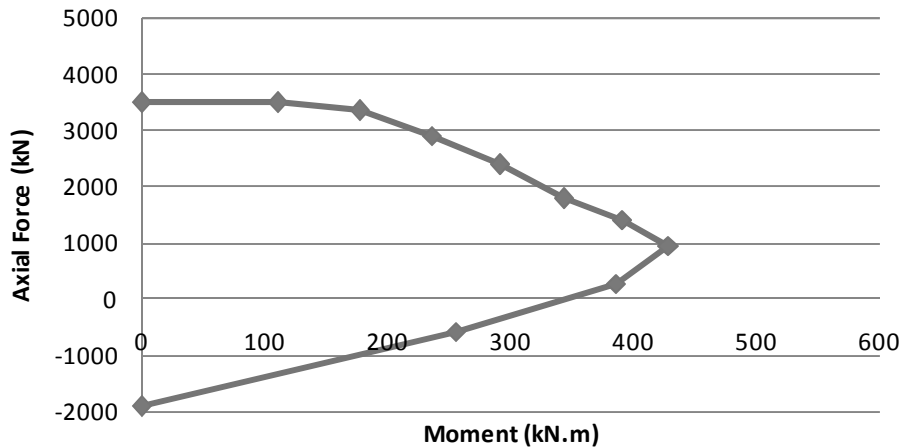
Interaction Diagram of Column at BAPPEDA Building

With the load at column Floor-1 at 403 kN by the Dead Load, the moment capacity of the base of column at longitudinal direction is around 400 kN.m.
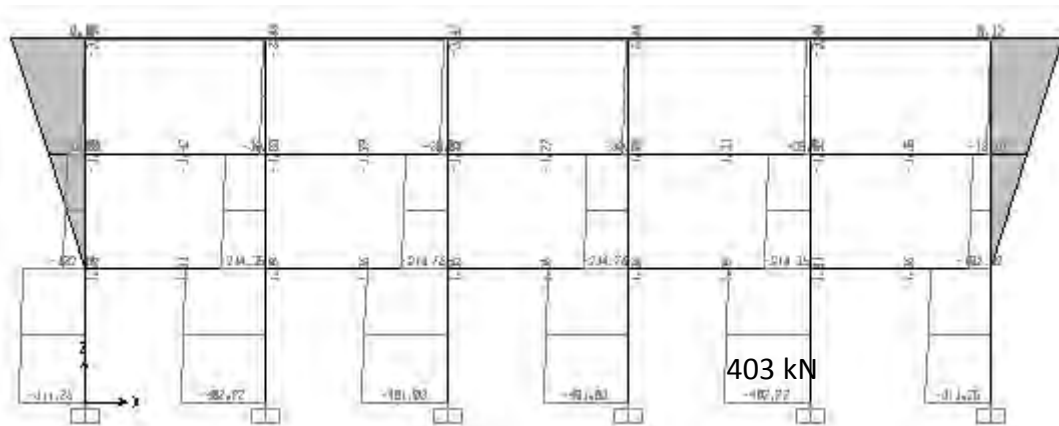
403 kN

Axial Force Diagram at Column under Dead Load (largest axial force is 403 kN)

The demand of 206 kN.m at the base at one column under seismic static loading is still below the moment capacity of column at Floor-1 (400 kN.m). From the survey, the column shows heavy damage at the first floor so that soft-story mechaniscm occured.

Photo of column damage at Floor-1.

Damaged Columns (a) building side view (b) zoom view

Discussion

Although the calculated capacity of the column is larger than the code seismic demand, the reinforcement was badly arranged. The overlappings of rebars were at the large moment area, the rebars were the smooth type, and the stirrups were too small ($\varnothing$5.5 mm). Thereofore, the column could not develope full strength capacity of moment. The column collapse because of pull out of rebars.

Concluding Remarks

The results show that the damage of columns at Floor-1 is due to column rebars were overlapped at maximum moment region, smooth type of rebars, and too-small stirrups. Therefore real capacity is lower than the calculated capacity.

Compressive Stress of Columns

It is important to calculate the compressive stress of one column:

The dimension of columns at Floor-G is measured as 45 x 45 cm^2. The area is 0.2025 m^2.

The largest axial force due to dead load at one column is 403 kN. Therefore the compressive stress at one column is: 0.403 MN / 0.3025 m^2 = 1.33 MPa.

Equivalent Seismic Force

In SNI-03-1726-2002, the nominal static equivalent base shear force V is calculated based on:

$$V = \frac{C_1 I}{R} W_t$$

Where C_1 is obtained from the figure below using first natural period T_1, and W_t is total weight of building, included an appropriate life load.

In this case, T_1 = 0.483 second. Therefore, based on the figure and soft soil (Tanah lunak) condition, C_1 = 0.9.

I is importance factor, taken as 1.0 for office building.
R is seismic reduction factor. For a normal moment resisting frame, *R* is taken as 3.5.
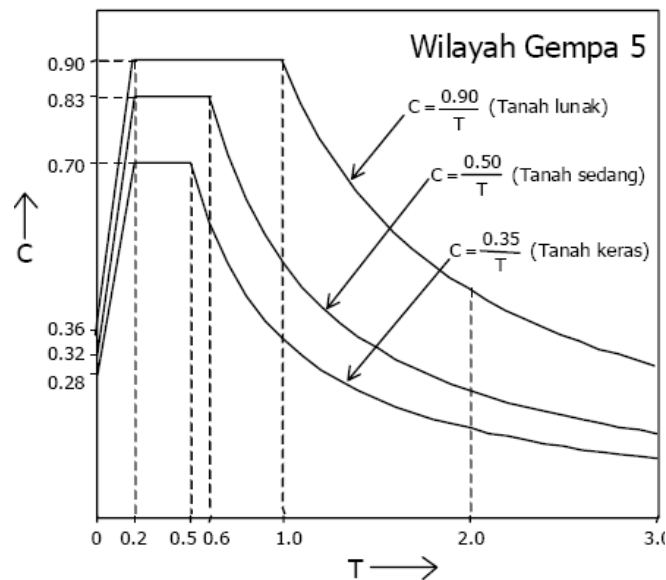
Response Spectrum of Design Earthquake for Zone 5 (Padang City)

Therefore:

$$V = 0.257\ W_t$$

Base shear V should be distributed along the height of the structure to become F_i that is working on mass center at floor -i according to:

$$F_i = \frac{W_i \ z_i}{\sum\limits_{i=1}^{n} W_i \ z_i} \ V$$

Where W_i is weight of floor -i, included appropriate life load, z_i is height of floor -i, and n is total number of story.

In this case, the weight is assumed to be by:

1. structural members (columns, beams, and plates): YES

2. perimeter wall: YES

3. life load of 200 kg/m^2 (for office): YES

Therefore W_t = 12568 kN.

So that V = 3232 kN

Using the formula for distributing forces above, the force distribution is shown in table below.

Distribution of equivalent seismic static force.

Floor Name	Height (m)	Weight (kN)	Force per floor* (kN)
Floor-3	12	1283	95
Floor-2	8.2	5749	292
Floor-1	4.4	5525	151

*In the FEM model, the force per floor should be divided by the amount of nodes per floor to apply the force at each node.

Capacity of the Building

Under the seismic code loading, the building is able to resist the force. Therefore it is interesting to know how strong the building is.

1. The moment capacity of column at Floor-1 is 400 kN.m and the demand is 206 kN.m. Therefore the capacity is 400/206 = 194 % of the seismic code demand.

2. However, one must be careful in looking at the capacity, since the real column capacity was lower than that of calculated one, because the column rebars were overlapped at maximum moment region, smooth type of rebars, and too small size of stirrups.

BPKP BUILDING

Finite Element Model and Analysis

The survey was carried out between 7 to 12 December 2009.

I.   INTRODUCTION

BPKP stands for Badan Pemeriksa Keuangan dan Pembangunan (Financial and Development Supervisory Board). BPKP Building was located at Jalan Rasuna Said No. 69, Padang City, West Sumatra Province, Republic of Indonesia.

BPKP Building (Photo shows damage at the back side of the building)

The building was started to be built in 2003. At that time the only ground and first floor was used. Other floors were built but only column, beam, and floor plates. In 2006 all the five floors were used (see figure below for the opening placard).

Opening placard at the entrance of BPKP building showing date of 03 May 2006

In 2007 earthquake (two years before the 2009 earthquake), the roof top was falling down. Therefore, the roof was altered from terracotta roof to lighter thin-steel roof (see Figure below).

Roof of BPKP Building

Also in 2007 earthquake, there were some minor damage at the column at Floor-3 (Floor-4 at Japanese floor-numbering system: No ground floor). The column was repaired. There were some marks of repair on column when the team inspected the column (see figure below).

Photo of repaired column at Floor-3.

From direct measurement on site of column dimension, floor height, beam dimension, and plate thickness, FEM model was developed. The model is shown below.

(a)

(b)

(c)

(d)
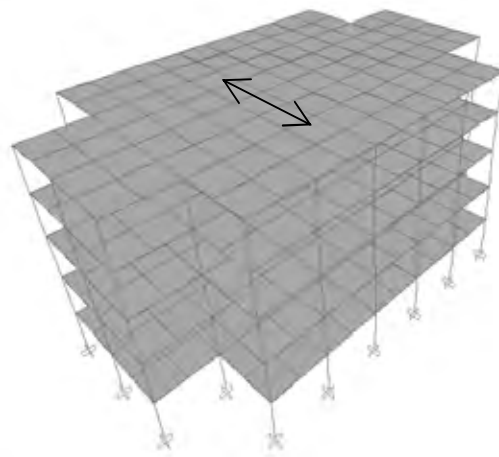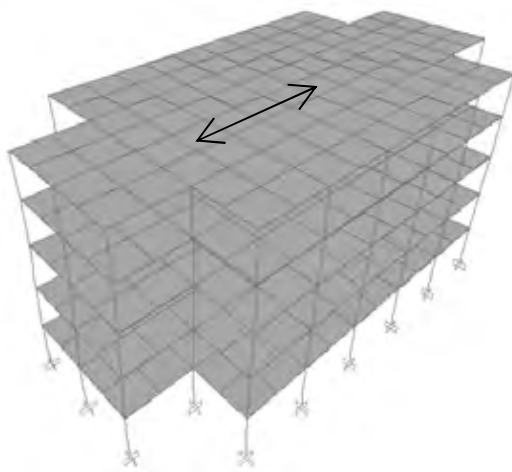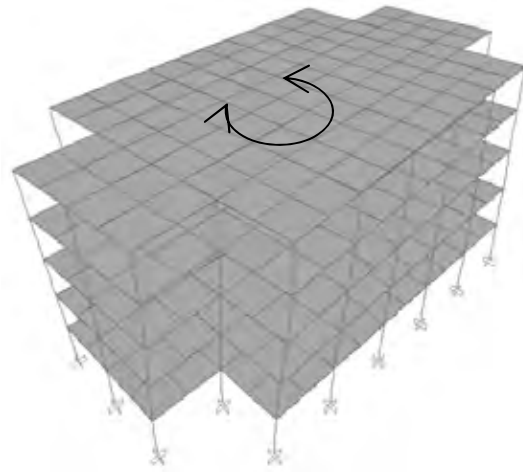
FEM Model (a) Undeformed (b) First Mode, Sway X, T1 = 1.02 s
(c) Second Mode, Sway Y, T2 = 1.00 s (d) Third Mode, Torsion Z, T3 = 0.91 s

The mass of perimeter wall surrounding the building is included in the floor plate mass. Half wall mass above and below the floor plate is added to the plate mass. The stiffness of columns and beams are 100% of original.

Dimensions of columns were directly measured at site:
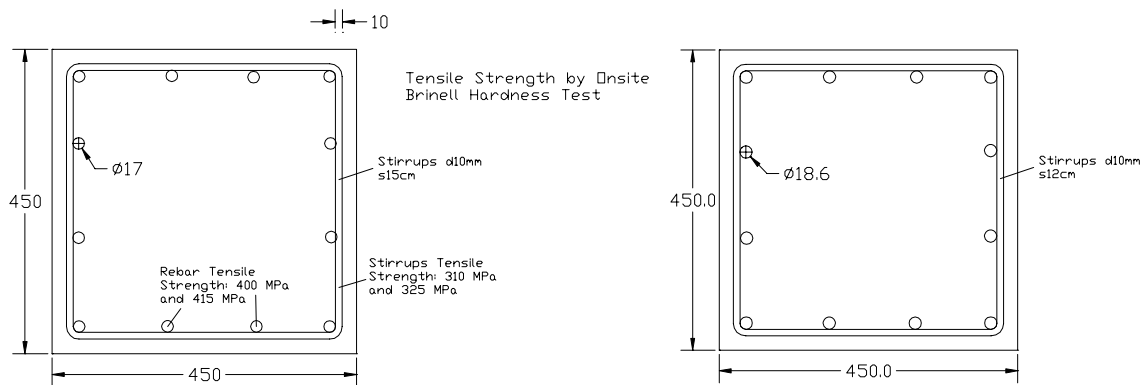
(a)   (b)

Dimension of Column (a) Floor-2 C-2 (b) Floor 2 E-5

Columns at Floor-2 up to Floor-4 are basically the same in dimension (450x450 mm^2) and number of rebars (12 bars with $\varnothing$17.2mm and $\varnothing$18.6mm).
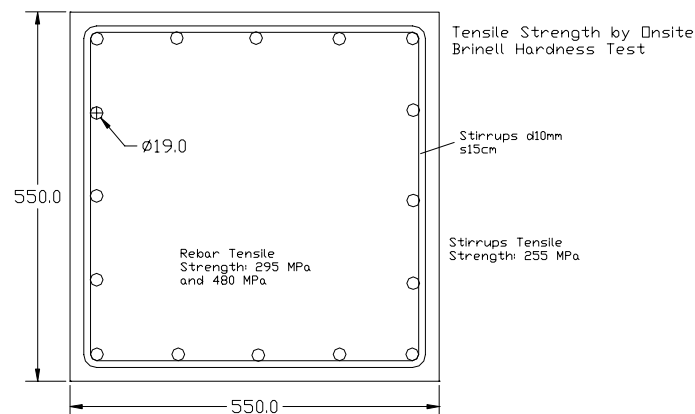
Dimension of Column Floor-G E-5

Columns at Floor-G up to Floor-1 are basically the same in dimension (550x550 mm^2) and number of rebars (16 bars with $\varnothing$19mm).

Using the property of concrete and steel obtained from survey, the axial force and moment capacity (P-M interaction diagram) of columns at Floor-G up to Floor-1 and columns at Floor-2 up to Floor-4 were calculated.

P-M Interaction Diagram
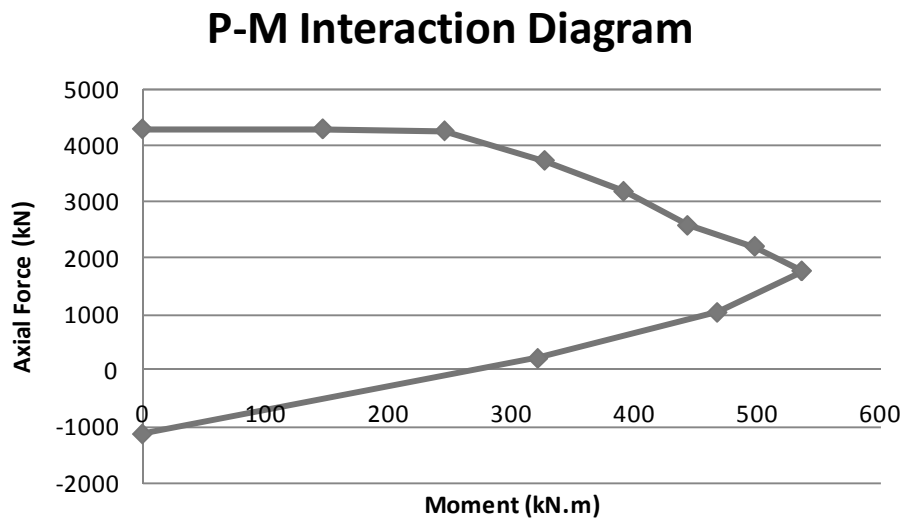
P-M Interaction Diagram of Column at Floor-G up to Floor-1

The distribution of equivalent static seismic loading based on SNI-03-1726-2002 (recent seismic code used in Indonesia) is shown below. The weight is assumed to be by structural members (columns, beams, and plates) , perimeter wall, and life load of 200 kg/m^2 (for office).
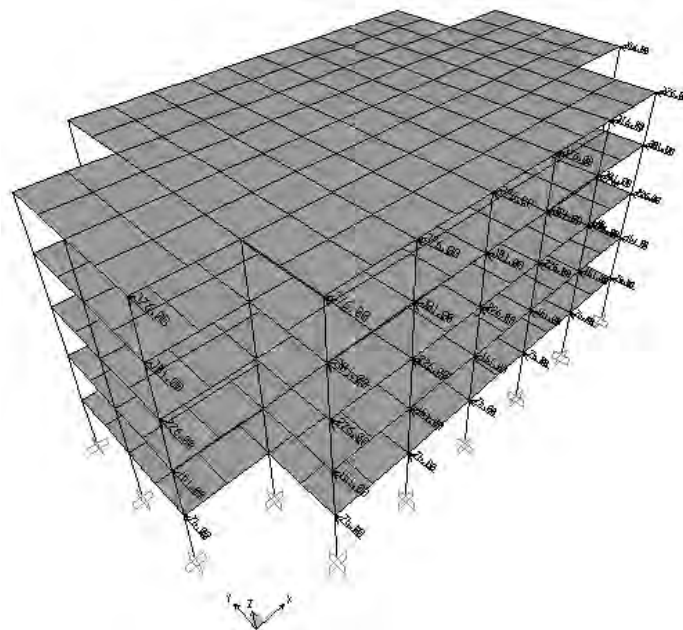
Seismic Equivalent Static Loading (method to calculate is at the end this report)

The moment demand at columns due to equivalent static seismic loading is shown below.
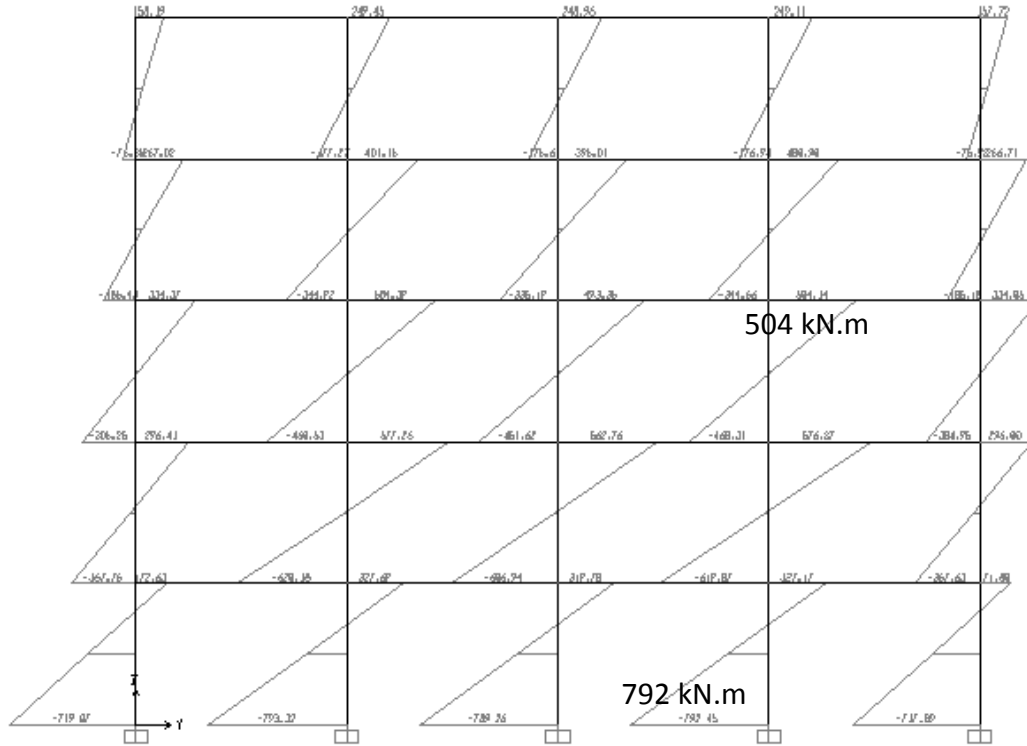
Moment of 792 kN.m at Column Base and 504 kN.m at upper Column Floor-2

Under Seismic Equivalent Static Loading (SNI-03-1726-2002)

The axial load to the columns under dead load is shown below.
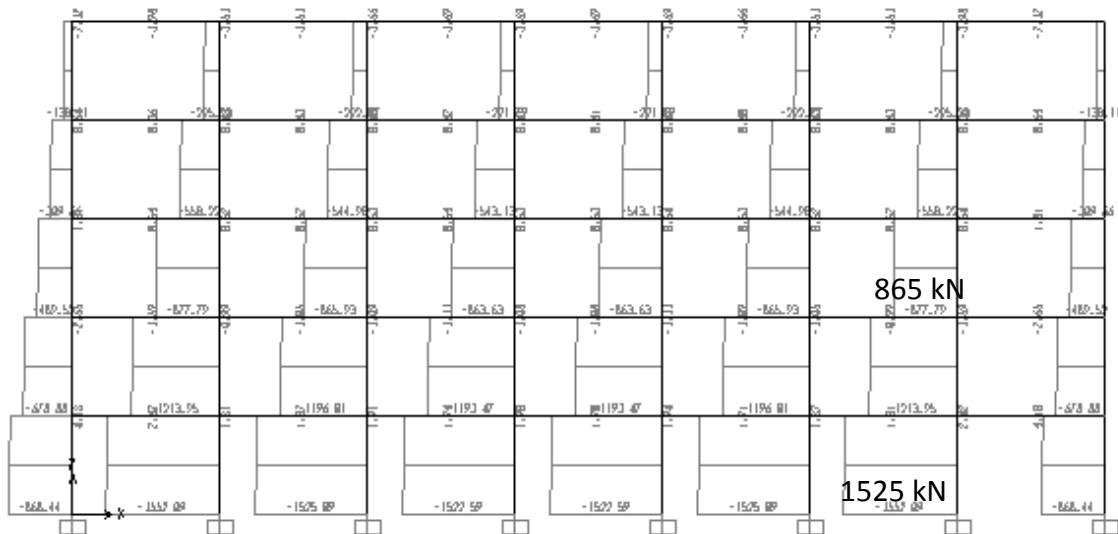
Axial Force Diagram at Column under Dead Load

With the dead load at column Floor-G load of 1525 kN, the moment capacity of the base of column is around 515 kN.m (based on interaction diagram of column Floor-G).

Therefore the demand of 792 kN.m at the base at one column by the seismic static loading is beyond the moment capacity of 515 kN.m at the base column. From the survey, the column shows little damage at the base floor (see figure below).

Photo of Column at Floor-G

With the dead load of 865 kN at column Floor-2, the moment capacity of the column at Floor-2 is 230 kN.m.

Therefore the demand of 504 kN.m at upper part of columns at Floor-2 by the seismic static loading is beyond the moment capacity (230 kN.m) of the column at Floor-2. From the survey, the column shows severe damage at upper part of column.

P-M Interaction Diagram
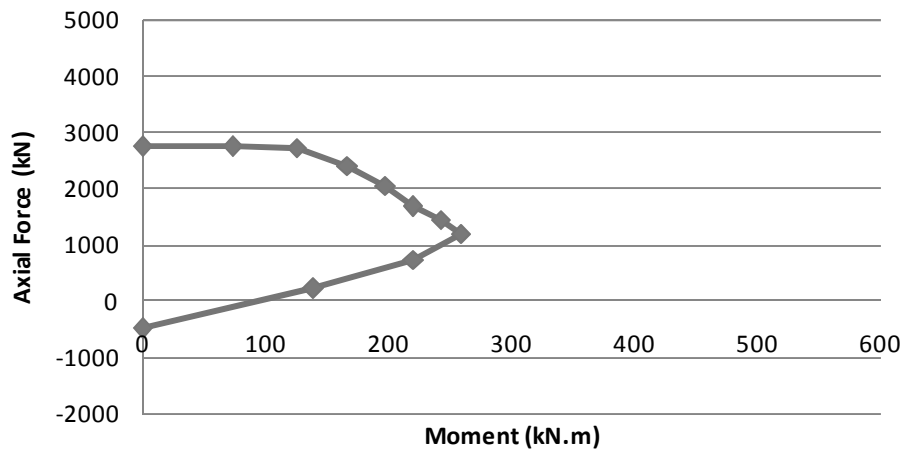
P-M Interaction Diagram of Column at Floor-2

Photo of upper part column damage at Floor-2.

Concluding Remarks

The results show that the damage of columns at Floor-2 is due to the "too early" reduction of column size at Floor-2. The seismic moment demand is higher than the capacity of columns at Floor-2.

The reduction of column size should be at Floor-3 (as it is specified in the design drawing) where the seismic demand is smaller.

Compressive Stress of Columns

It is important to calculate the compressive stress of one column:

The dimension of columns at Floor-G is measured as 55 x 55 cm^2. The area is 3025 cm^2 or 0.3025 m^2.

The largest axial force due to dead load at one column is 1525 kN. Therefore the compressive stress at one column is: 1.525 MN / 0.3025 m^2 = 5.04 MPa.

Equivalent Seismic Force

In SNI-03-1726-2002, the nominal static equivalent base shear force V is calculated based on:

$$V = \frac{C_1 I}{R} W_t$$

Where C_1 is obtained from the figure below using first natural period T_1, and W_t is total weight of building, included an appropriate life load.

In the BPKP case, $T_1 = 1.11$ second. Therefore, based on the figure and soft soil (Tanah lunak) condition, $C_1 = 0.9/T_1 = 0.9/1.11 = 0.811$.

I is importance factor, taken as 1.0 for office building.

R is seismic reduction factor. For a normal moment resisting frame, R is taken as 3.5.
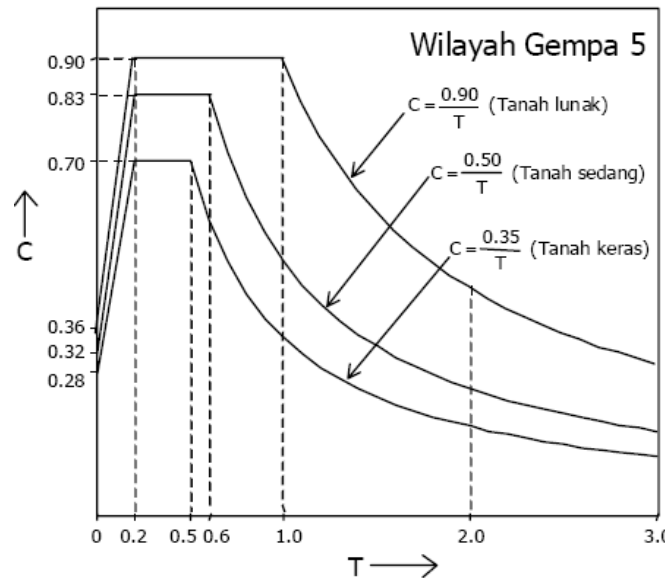
Response Spectrum of Design Earthquake for Zone 5 (Padang City)

Therefore with $C_1 = 0.811$, $I = 1.0$, and $R = 3.5$:

$$V = 0.232 \, W_t$$

Base shear V should be distributed along the height of the structure to become F_i that is working on mass center at floor -i according to:

$$F_i = \frac{W_i \, z_i}{\sum_{i=1}^{n} W_i \, z_i} \, V$$

Where W_i is weight of floor -i, included appropriate life load, z_i is height of floor -i, and n is total number of story.

In the case of BPKP, the weight is assumed to be by structural members (columns, beams, and plates), perimeter wall, and life load of 200 kg/m^2 (for office). Therefore $W_t = 39005$ kN.

So that V = 0.232 x 39005 = 9036 kN

Using the formula for distributing forces above, the force distribution is shown in table below.

Distribution of equivalent seismic static force.

Floor Name	Height (m)	Weight (kN)	Force per floor* (kN)
Floor-4	20	4847	3012
Floor-3	16	8540	2410
Floor-2	12	8540	1807
Floor-1	8	8540	1205
Floor-G	4	8540	602

*In the FEM model, the force per floor should be divided by the amount of nodes per floor to apply the force at each node.

Capacity of the Building

Under the seismic code loading, the building is not able to resist the force. Therefore it is interesting to know how strong the building is.

1. The moment capacity of column at Floor-G is 515 kN.m and the demand is 792 kN.m. Therefore the capacity is 515/792 = 65.0 % of the seismic code demand.

2. The moment capacity of column at Floor-2 is 230 kN.m and the demand is 504 kN.m. Therefore the capacity is 230/504 = 45.6 % of the seismic code demand.

The total capacity is determined by the columns at Floor-2. Therefore the capacity of the building is 45.6% of the seismic code demand.

However, the survey showed that the damage was concentrated at Floor-2. This is show that the September 2009 earthquake is lower than that specified in the seismic design code.

Therefore, because columns at Floor-G showed minor damage, the seismic demand of the September 2009 earthquake is around the capacity of these columns, that is 65.0 % of the seismic code demand.

<center>**PU (Public Works) BUILDING**</center>

The survey was carried out between 11 to 14 December 2009.

I.   INTRODUCTION

<center>PU Building</center>

PU building was located at Jalan Batang Arau No. 86, Padang City, West Sumatra Province, Republic of Indonesia.

In 2007 earthquake, cracks were developed on non structural parts.

In 2009 earthquake, the first columns could not sustained the lateral force. They are inclined in the longitudinal direction. (See Figure)

The building was built in 1970's.

Dimension of bays measured on site:

Longitudinal Beam: h=300mm, b=300mm
Lateral Beam: h=700mm, b=300mm
Column Dimension 300×700 mm2
Floor Height: 3500mm
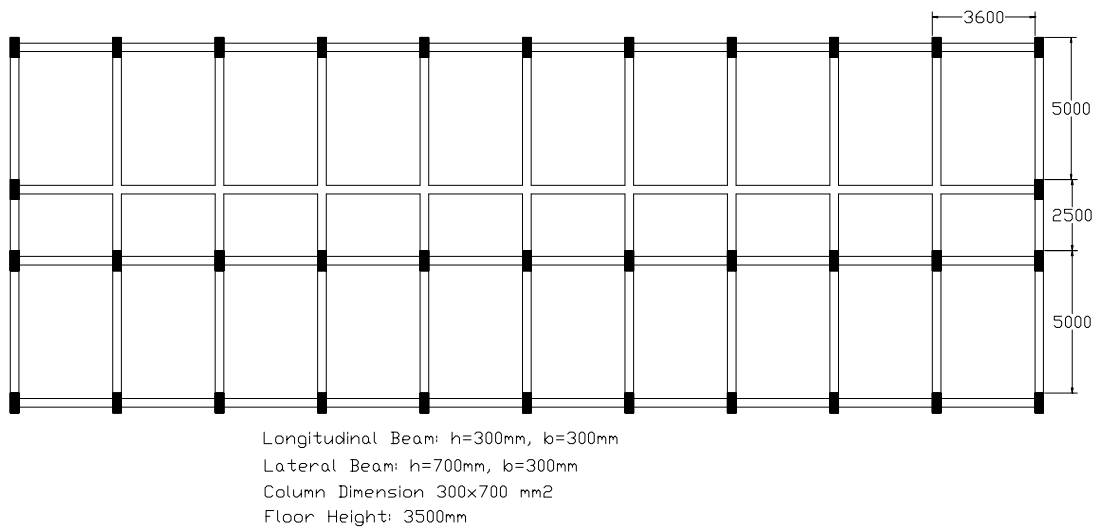
Plan of PU Building at Floor-4

Roof is made of wood frame and thin steel. Therefore the weight is relatively light.

Other floors has the same plan pattern as that of Floor-4. Floor thickness is 12 cm. The FEM model of the building is shown below. Floor height is 3500 mm for floor 2 to 4. Floor 1 is 4400 mm.

(a)   (b)

(c)   (d)
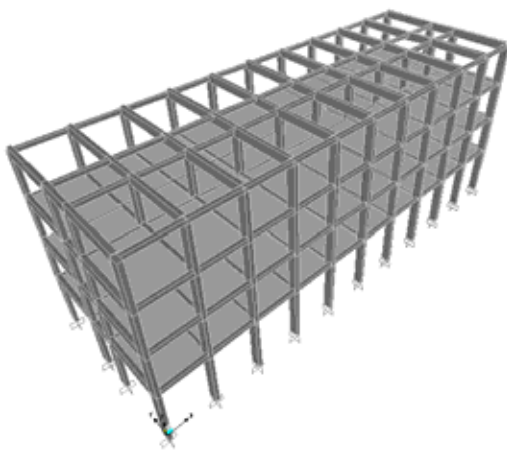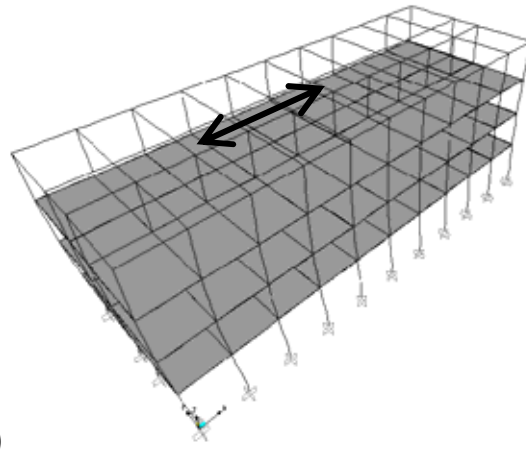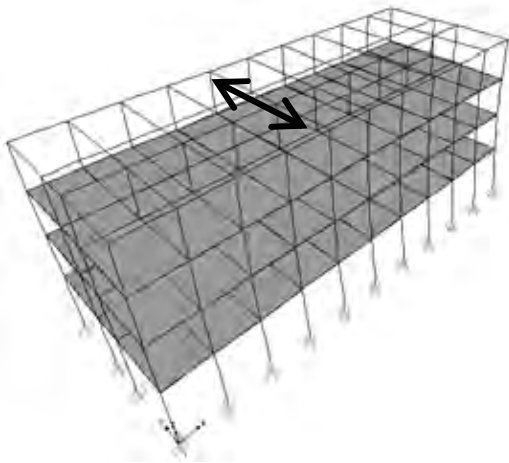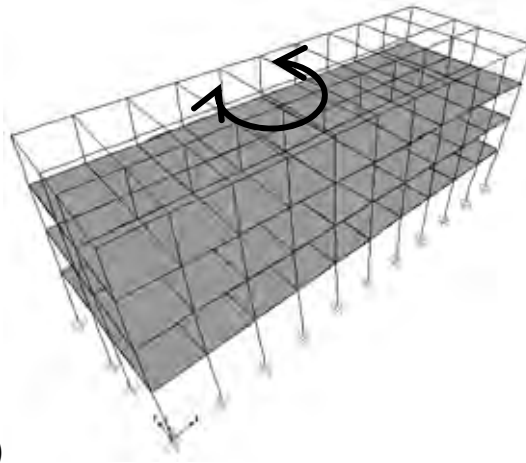
FEM Model (a) Undeformed (b) First Mode, Sway Y, T1 = 0.81 s

(c) Second Mode, Sway X, T2 = 0.38 s (d) Third Mode, Torsion Z, T3 = 0.37 s
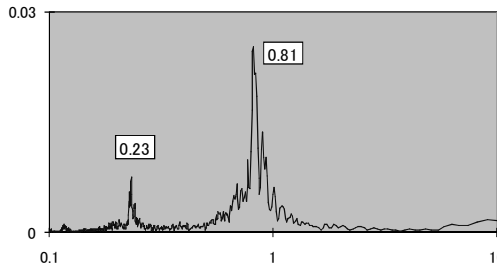
(a)
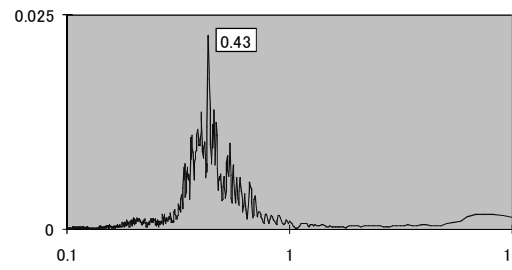
(b)
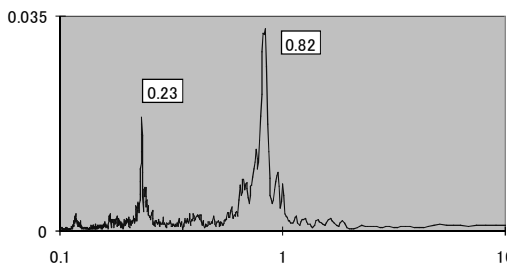
(c)
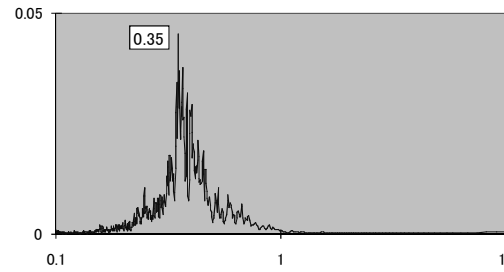
(d)

(e)
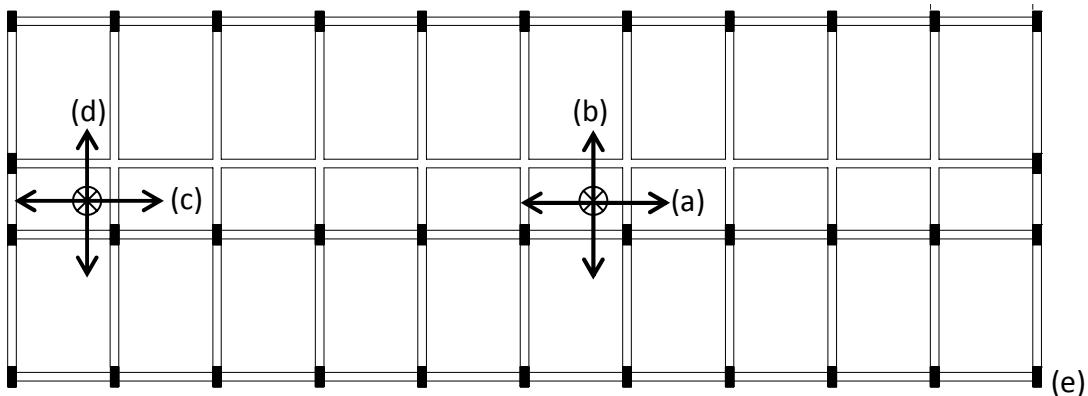
Natural Period of PU Building using Microtremor Test at Fifth Floor at (a) Center, Longitudinal, (b) Center, Lateral, (c) West, Longitudinal, (d) West, Lateral

Micrtotremor test was also carried out at PU Building to check the natural period of the building. The results shows that the first natural period is 0.81 and 0.82 second. The second natural period is 0.43 and 0.35 second.

Based on the dimension of the column, beam, plate and mass density (2400 kg/m^3) of reinforced concrete material, the weight of the structure is found to be 10341 kN.

From the weight, and SNI, the distribution of the static equivalent force is shown below.
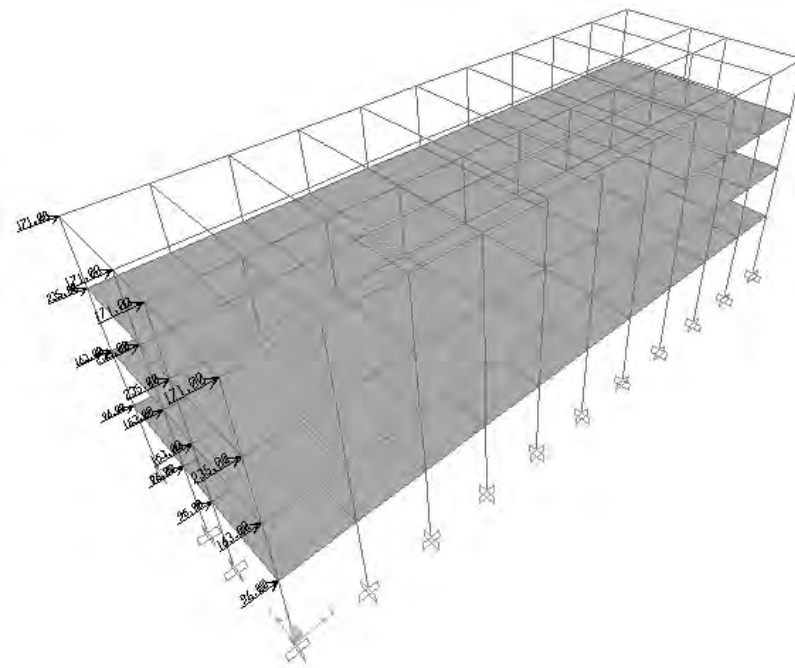
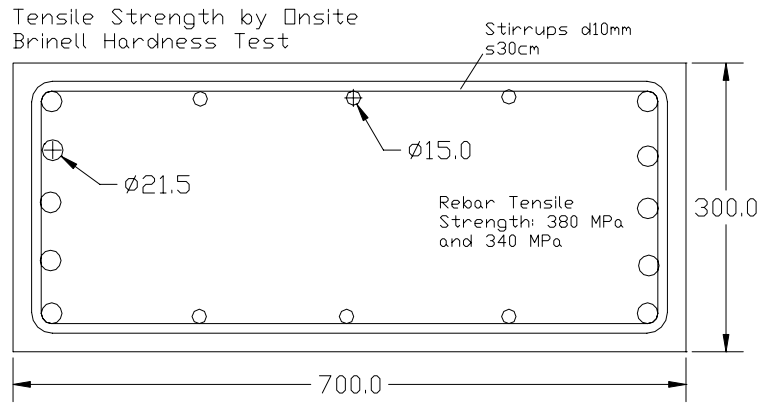Seismic Equivalent Static Loading (SNI-03-1726-2002)
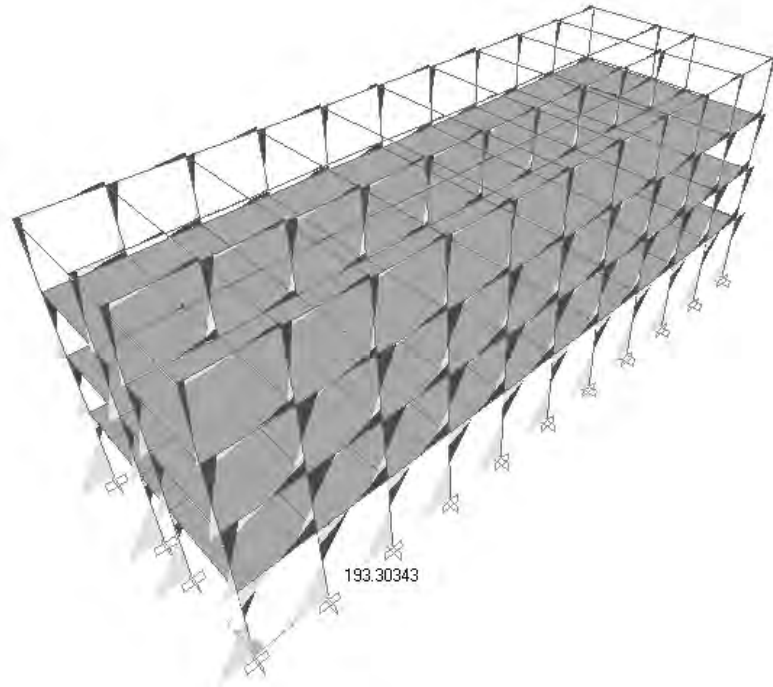
Maximum Moment (193 kN.m) at Column Base (front)

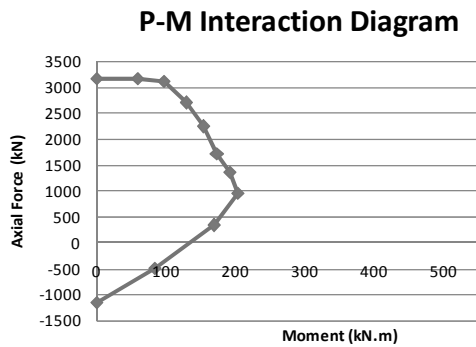Under Seismic Equivalent Static Loading (SNI-03-1726-2002)
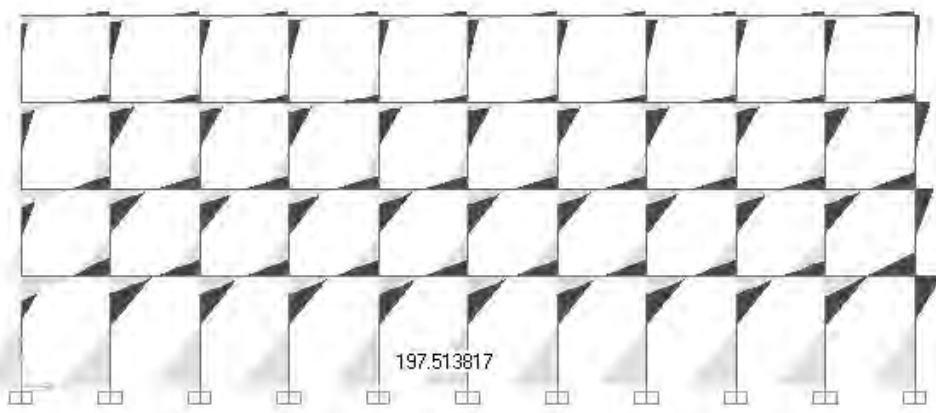
Maximum Moment (198 kN.m) at Column Base (middle)

Under Seismic Equivalent Static Loading (SNI-03-1726-2002)
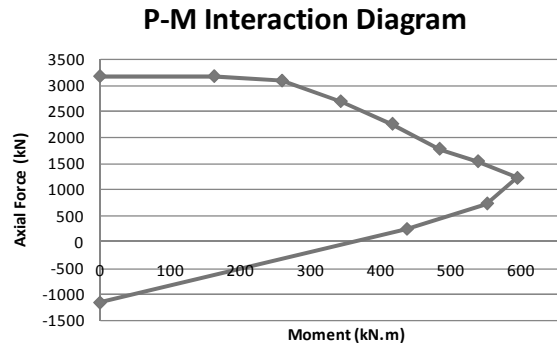
The dimension of column is as shown below.

Dimension of Column at PU Building

From the dimension, the capacity of the column is calculated. The results are shown below.
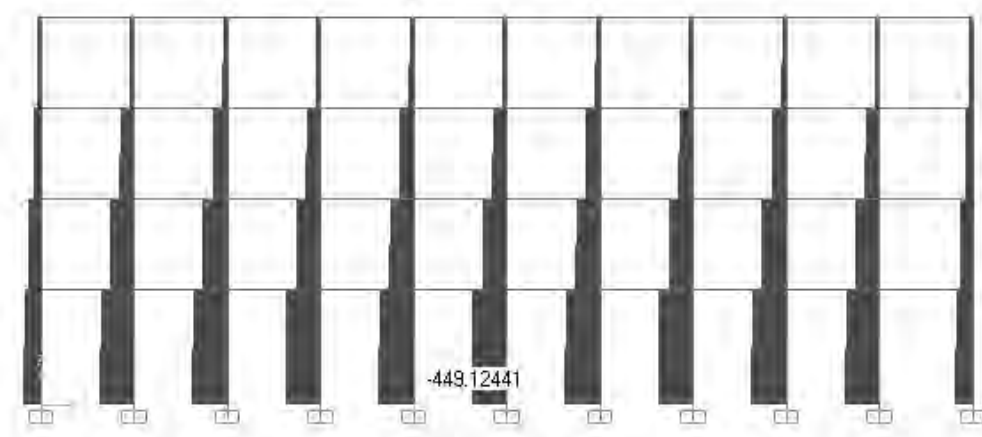

Interaction Diagram of Column (a) Longitudinal Direction (b) Lateral Direction

With the load at column Floor-1 at 450 kN by the Dead Load, the moment capacity of the base of column at longitudinal direction is around 180 kN.m.

Axial Force Diagram at Column under Dead Load

Therefore the demand of 198 kN.m at the base at one column under seismic static loading is beyond the moment capacity of column at Floor-1 (180 kN.m). From the survey, the column shows heavy damage at the first floor so that soft-story mechaniscm occured.

Photo of damage at Floor-1.

(a)   (b)
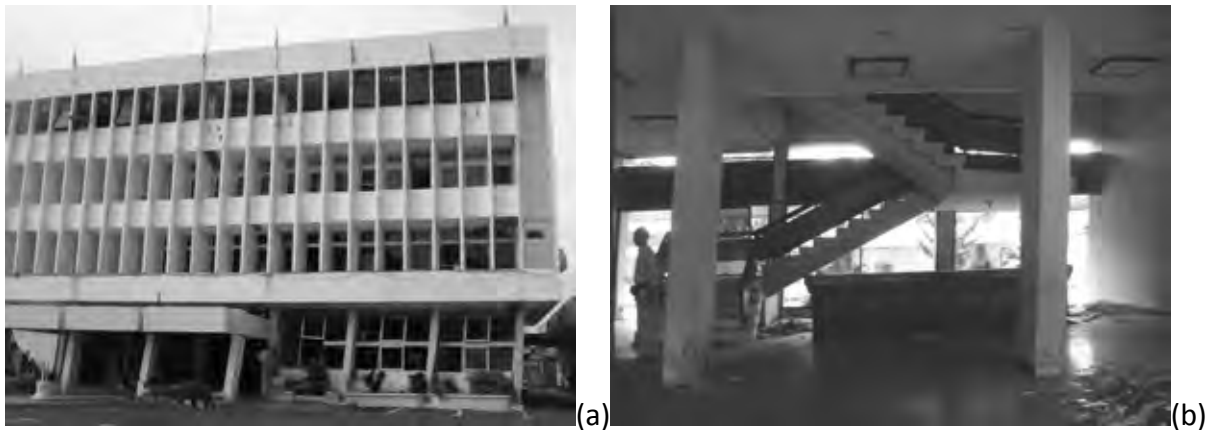
Damaged Columns (a) Outside View (b) Inside View

The inclination of inner columns is 4 degree (longitudinal direction)

Things to know:

With the column height of 4.4 meter and column inclination of 4° (0.07 radian), the moment caused by the weight of building is 10341x0.07x4.4 = 3185 kN.m.

The total moment capacity of 35 columns are 35x180 = 6300 kN.m.

Therefore, the building can stand at this tilting position because the demand moment (caused by P-delta effect) is half the capacity of the columns.

The building theoretically starts to collapse when the tilting degree becomes 6300/(10341x4.4) = 0.138 radian (or 7.9°).

Note: The weight is by structural component only. The weight may increase (by about 50%) due to existence of masonry walls and life loads.

Appendix-3

Result of Questionnaire survey of Seismic intensity

AREA 1

AREA 5

AREA 2

AREA 7

AREA 3

AREA 6

AREA 4

AREA 1