Recovery Cooperation for Padang Earthquake Damage by Seismic Isolation Buildings Design

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Time-history of the Cooperation

1) Sep. 2009  Padang earthquake occurred.
2) Oct. 2009  Earthquake damage research
   By association team of EWBJ (Engineers without Boarder, Japan), JSCE (Japan Society of Civil Engineers), JSAEE (Japan Association for Earthquake Engineering)
3) Dec. 2009  2nd cooperation for earthquake damage recovery
   EWBJ members of architectural team (Teramoto & Okohsi) and civil team. Symposums at Padang and Jakarta were held.
4) Apr. 2010  3rd cooperation for earthquake damage recovery
   The EWBJ members hold a symposiums at Padang for seismic isolation buildings.
   Local government requested design cooperation of 5 seismic isolation buildings.
5) May and June 2010  Design of No.1 building (Governor office)
6) March to June 2011  Design of No.2 building (Public works office)
7) Now  Under construction of two buildings
   Japanese isolators were imported from Japan.
2 Padang earthquake and official building damages

2.1 Outline of the earthquake

(Main shock)
• Time : 30th September 2009 about 19:16
• Epicenter : Offshore of Padang, west Sumatra, Indonesia
• Depth : 80 km
• Magnitude : M7.6
• Dead persons: 1,100

(After shock)
• Time : 1st October about 10:52
• Epicenter : Offshore west Sumatra, Indonesia
• Depth : 15 km
• Magnitude : M6.6
2.2 World earthquake environment

Map of world epicenters

Map of the plates

M4以上の地震の震源

プレートの境界

(1993年、深さ100Km以浅)
2.3 Epicenter of the Padang earthquake

Epicentre
Magnitude: 7.6
Date: 30 Sep 2009
Time: 17:16 Local Time

Medan, Malaysia
Sumatera
Padang, Indonesia
Palembang, Indonesia
Jakarta, Indonesia

100 km
Padang city is at the flat alluvium plane. The mountains are so far about 15km. Tsunami refuge buildings are requested for the city area.
2.3 Earthquake damage of official buildings

Landscape of Padang city/ Roofs are imaged from water buffalo horns.
3.1 Building damage 1 / Board of audit (BPKP)

Reinforced concrete rigid frame structure of 6-story with brick wall
3.1 Building damage 1 / Board of audit (BPKP)

Damage of exterior brick wall and curtain wall

November 2012  US–Japan Workshop
3.2 Building damage 3/ Public works office

Reinforced concrete rigid frame of 4-story with brick wall

November 2012  US–Japan Workshop
3.2 Building damage 3/ Public works office

Shear-crack of reinforced concrete beams connected to the outer columns
3.3 Building damage 10/ State government office

Historical reinforced concrete rigid frame with brick wall
3.3 Building damage 10/ State government office

Brick wall with curtain wall and confliction of exp. joint
3.4 Building damage/ Andalas university

Falling-down of brick wall, they started to repair using the same method.
1) Requirement
The building design was completed and foundations are under construction. The governor required more seismicity and redesign with seismic isolation was required for EWBJ with no or less payment.

2) Outline of building
Reinforced concrete rigid frame of 4-story with brick wall, pile foundation. Governor office from 1st to 3rd story, tsunami refuge area from 4th to roof.

3) Seismic isolation members
Natural rubber isolators 500φ, 35 sets  Lead rubber isolators  600 φ , 18 sets

4) Design works
Isolators, 1st floor structural members, column base and mat-slab were designed by Japanese standard. Upper structures are examined by local engineers using Indonesian code. Dynamic analysis was Japanese style of 50 cm/sec seismic input using Padang wave.

5) Final document by English
Structural drawings, specification, analysis documents and architectural sketches

November 2012  US–Japan Workshop
No.1 building perspective

Governor office (1F～3F) Tsunami refuge space (4F～RF)
Seismic isolation structure/ Construction stopped at mat slab.

Governor work space
Completed seismic structure

November 2012   US–Japan Workshop
No.1 building model

Existing building
Mat slab is under construction. Governor work space has completed already.
1) Requirement
   Rough structural design was done following No.1 building. EWBJ was required to design seismic isolation details with payment of minimum expenses.

2) Outline of building
   Reinforced concrete rigid frame of 4-story with brick wall, pile foundation. Public works, tsunami refuge area on the roof.

3) Seismic isolation members
   Natural rubber isolators 500φ - 29 sets
   Lead rubber isolators 600 φ - 22 sets, 650 φ - 3 sets

4) Design works
   Upper structure was designed for base-shear 0.15 by local engineers, and 1st floor members, column base and mat-slab were designed by Japanese standard.
   Dynamic analysis was Japanese style of 50 cm/sec seismic input as No.1 building.

5) Final document by English
   Structural drawings, specification, analysis documents and “Seismic isolation buildings construction standard” by JSSI translated by Okoshi & Teramoto.
6.1 No.2 building architectural perspectives

Public works office (1F-4F), Tsunami refuge space (Roof)

/ Seismic isolation structure
6.2 No.2 building structural drawing
6.2 No.2 building construction site photograph

Construction site/
Re-bar arrangement of isolator base at 5th May, 2011

Construction site/
Re-bar arrangement of 300mm mat slab at 6th June, 2011
Cooperation system

EWBJ wanted to contract with the state government but not realized. Finally, we cooperated with Andalas university staffs without the contract. Consultant fee was transferred from unknown somebody.
Evaluation of the cooperation project (1)

(1) No project manager (Who is responsible for final decision?)
Responsibility for architecture, structure, equipment and construction?

(2) Very rough architectural design (there are only rough planning and perspective.)
Detailed architectural design may be arranged by the client and contractor at the construction stage.
For the design change requested by EWBJ, no one reply and no response from the client. (The cost should be responsible for someone replied.??)

(2) No one keep the schedule
4F-concrete-casting of No1 building should be completed until December 2010. But only mat slab was completed at June 2011, and no one was worried about for this. (Project did not smoothly advanced, but was not gone back.)

(4) Consultant fee
We got some minimum consulting fee for these two buildings. The payment are for structural analysis, structural drawings and the business trip expenses. The balance of the budget of EWBJ is about zero with the aid of JSSI.
(5) First seismic isolation building of Indonesia
One experimental building was constructed before, these buildings are the first seismic isolation buildings in Indonesia.

(6) Cooperation was possible only by Non-Profit-Organization
The client request was very irregular one which was impossible to manage by a usual design office. (No payment assurance, short and hard design schedule and less response by client and local engineers.)

(7) Good relationship between the state government, Andalas university and EWBJ
EWBJ made up good relationship between the state government and Andalas university. When they visited Japan, Professor Hamada of EWBJ, Professor Wada of Tokyo Institute of Technology and Dr. Kani of JSSI were helped us so much.

(8) Japanese products exportation
Japanese isolators and base-plates were exported to Indonesia at the first time. This project may be useful for the generalization of seismic isolation techniques for South-east Asia.