Introduction of National Center for Research on Earthquake Engineering (NCREE)

Prof. Kuo-Chun Chang

Director, NCREE

Professor, National Taiwan University, Taipei, Taiwan

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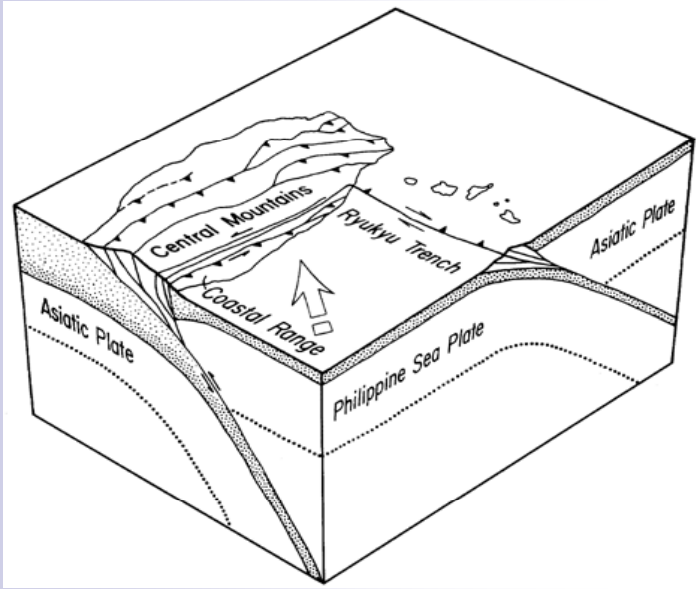
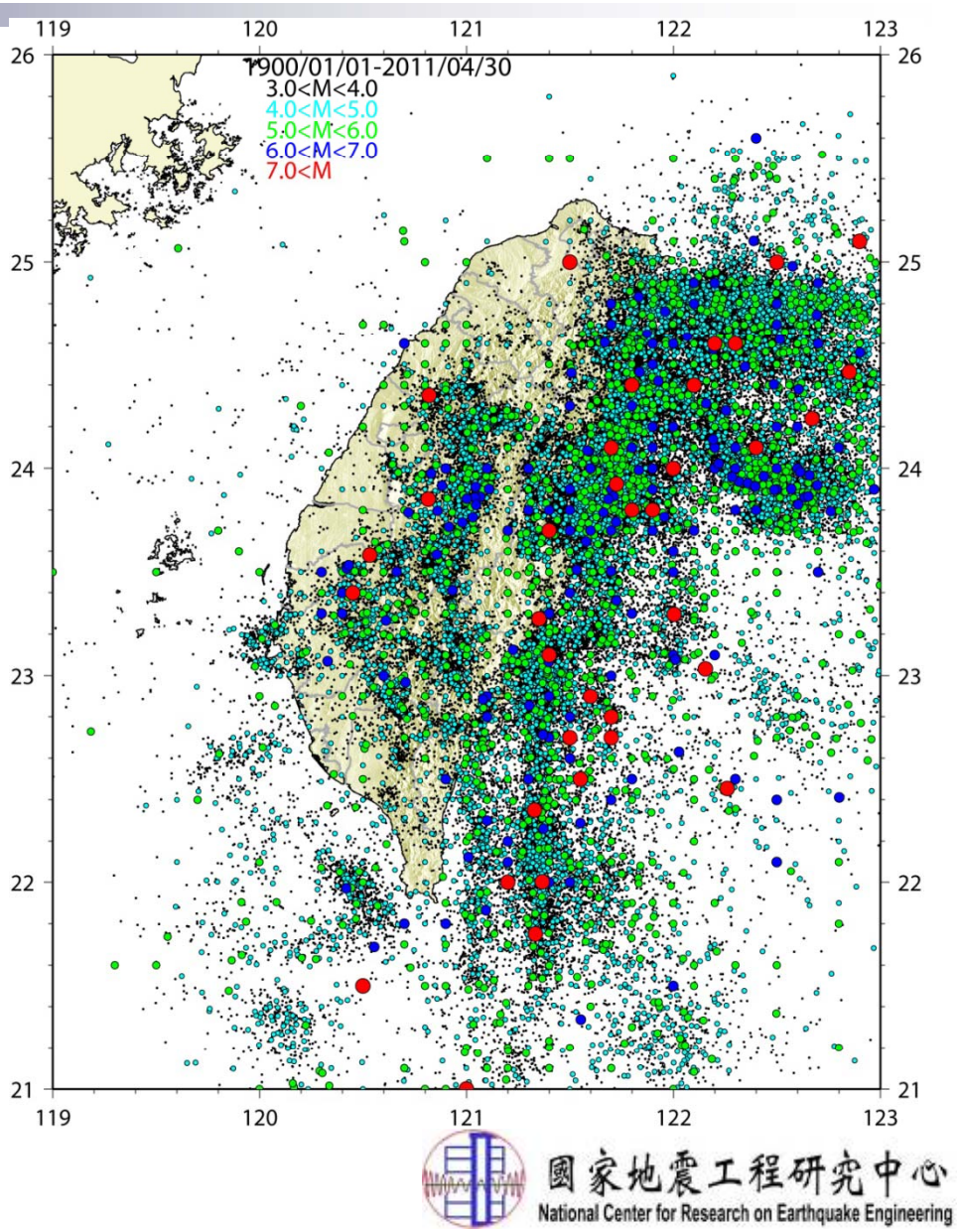
Seismicity in Taiwan (1900-2011)



Tectonics of Taiwan



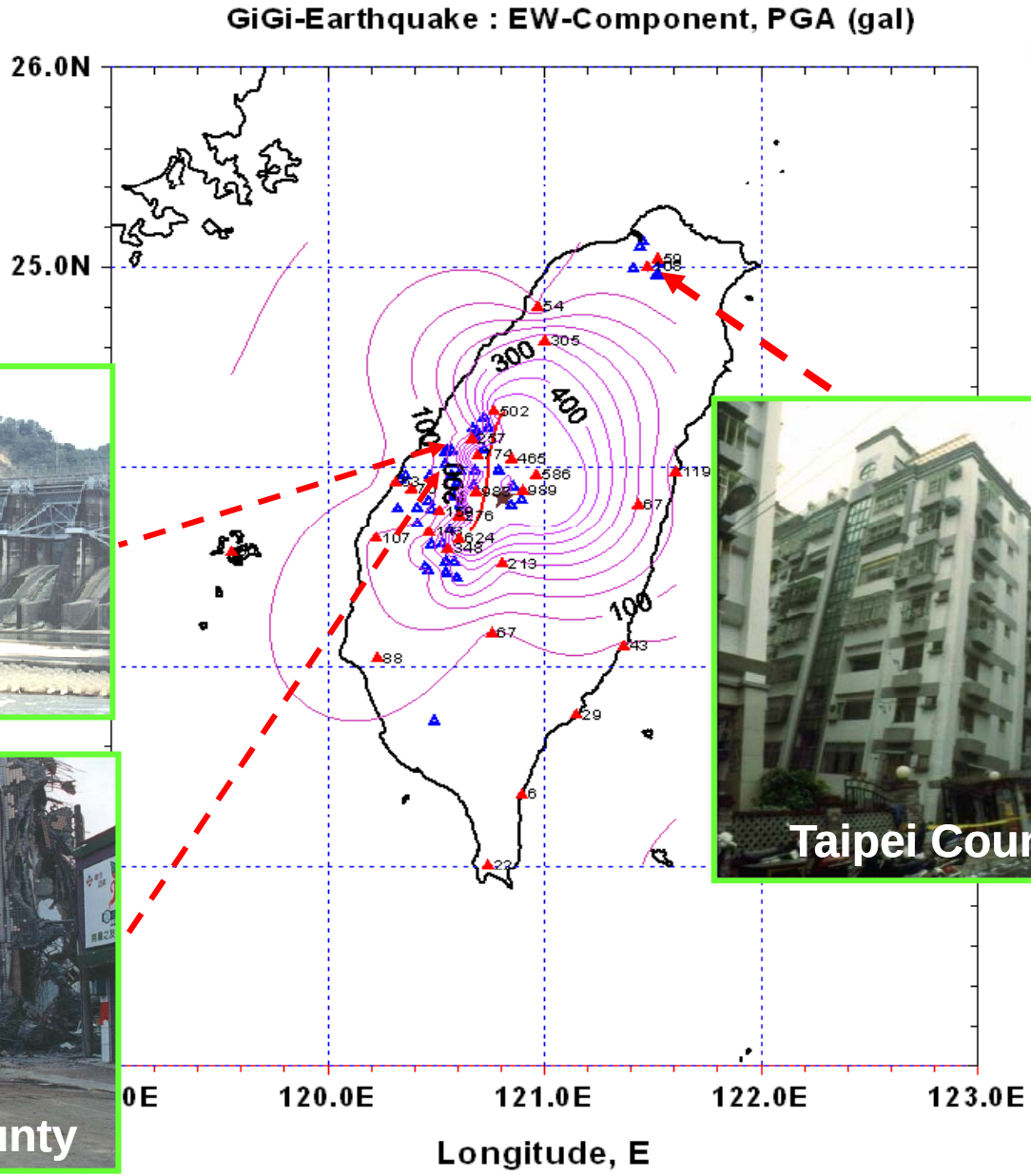
Earthquake Distribution of Taiwan (A.D.1900-2011)

國家地震工程研究中心
National Center for Research on Earthquake Engineering

1999 Chi-Chi Earthquake

Ml=7.3

Sept. 21, 1999



Evolution of NCREE

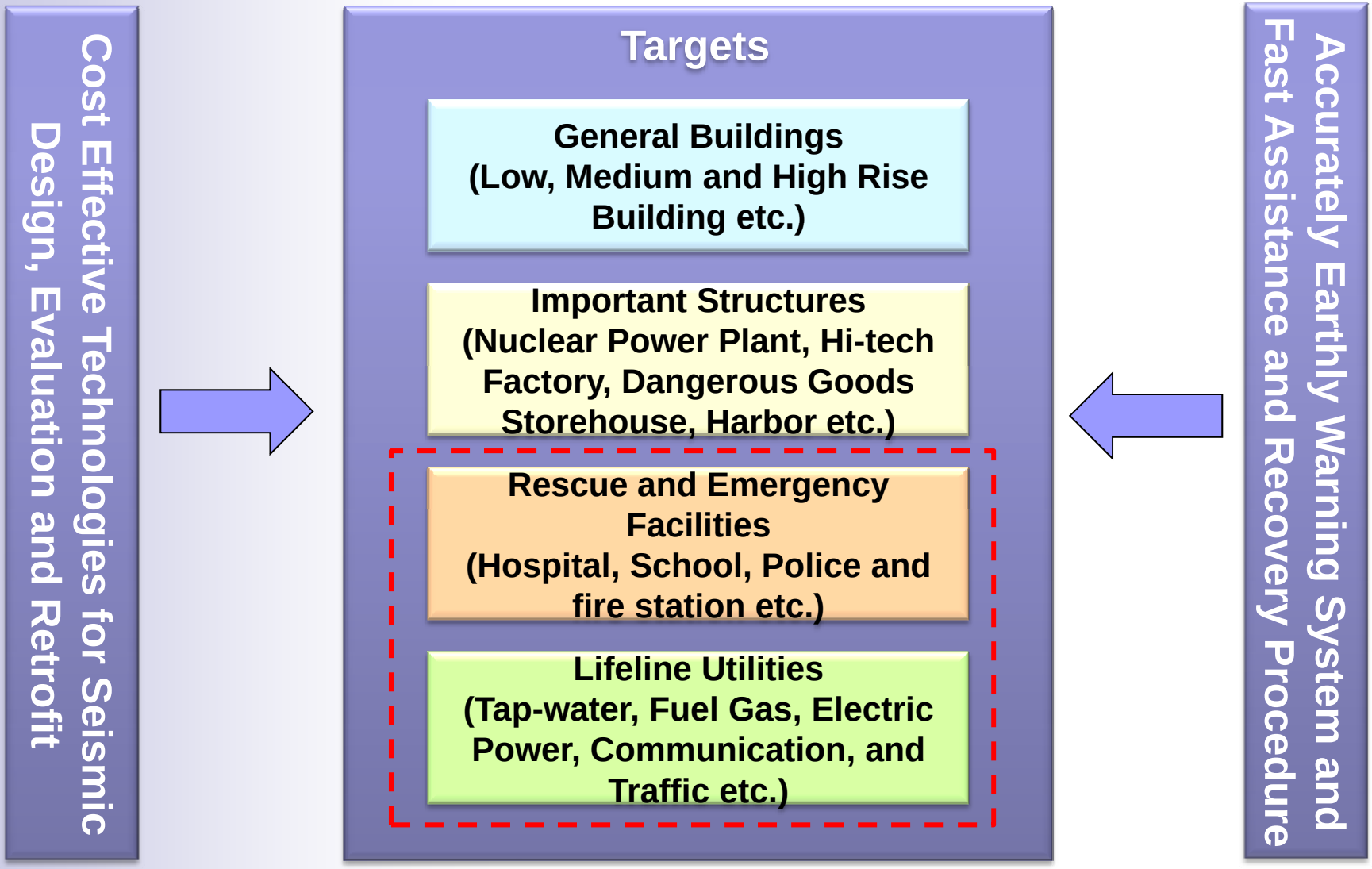
- Project awarded by NSC to NTU in 1990
- Merged into NARL as one of the Centers in 2003
- Major experimental facilities have been in operation since 1997 when the construction of the lab was completed

Vision and Mission

- Pre-quake preparation, emergency response and post-quake recovery
- Integrate research capacities of various earthquake engineering research institutes in Taiwan to enhance the research capability of the nation
- Promote international research cooperation for earthquake hazard mitigation, and play a key role in the earthquake engineering research community of the world

Vision - Recoverable and Sustainable Communities

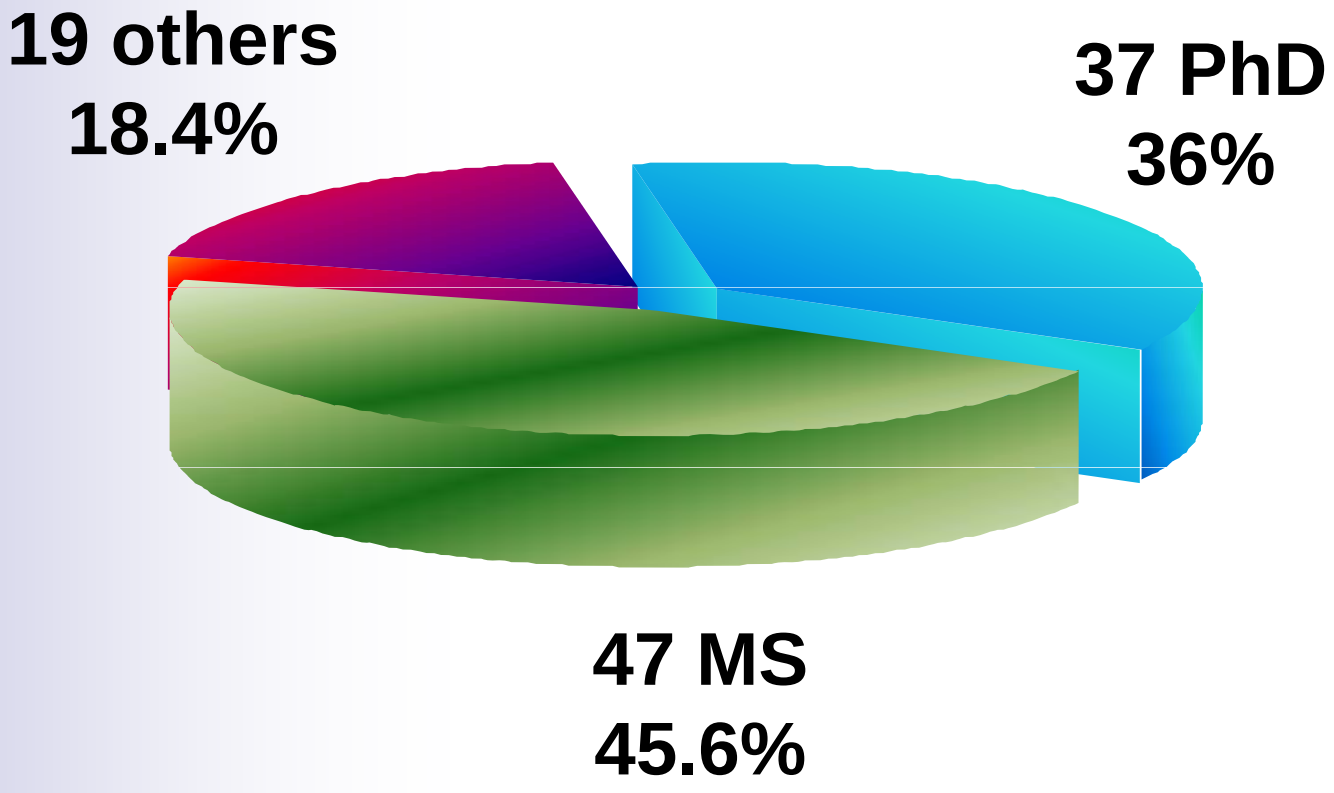
Medium-term: Enhancing Community Resilience



Improving Seismic Resistance of Specific Structures

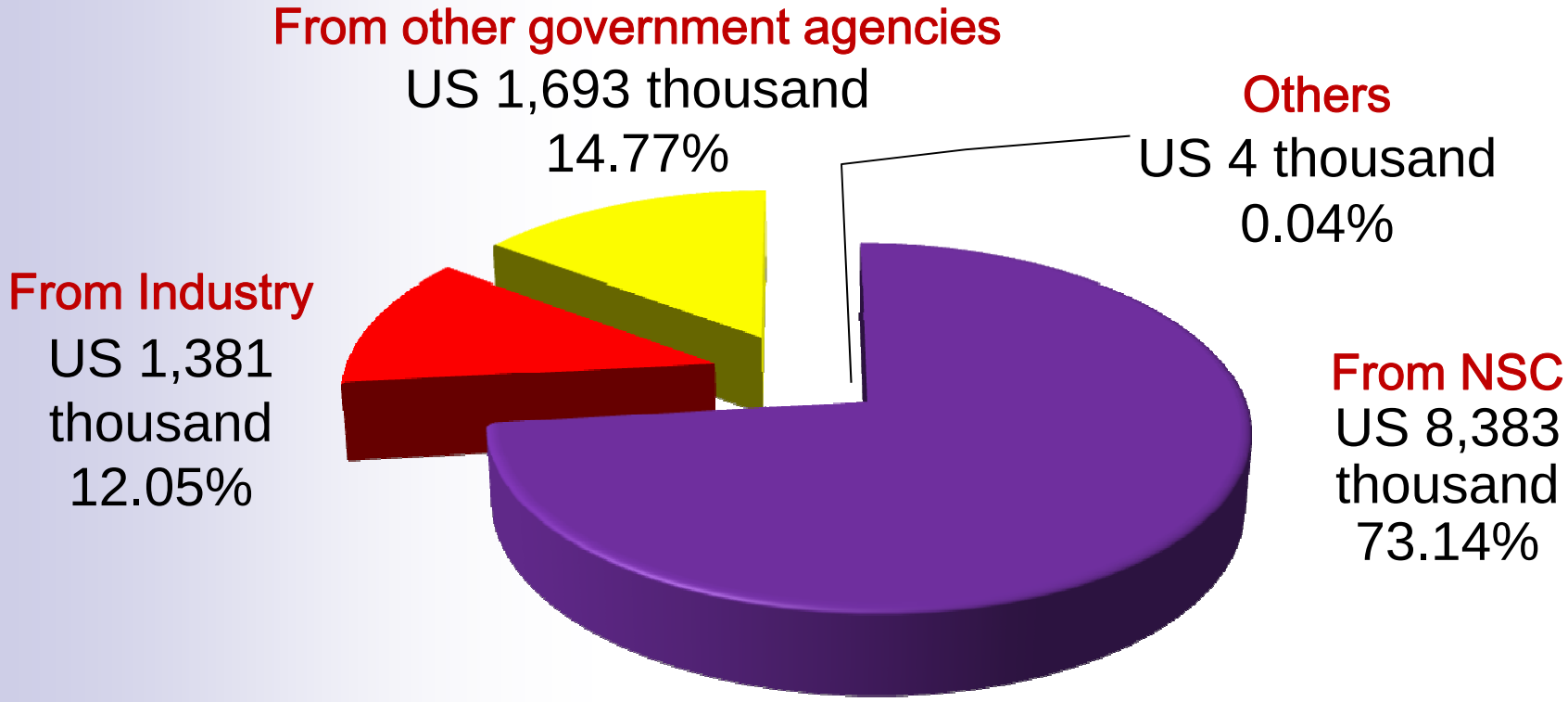
Personnel (2012)

A total of 103 employees



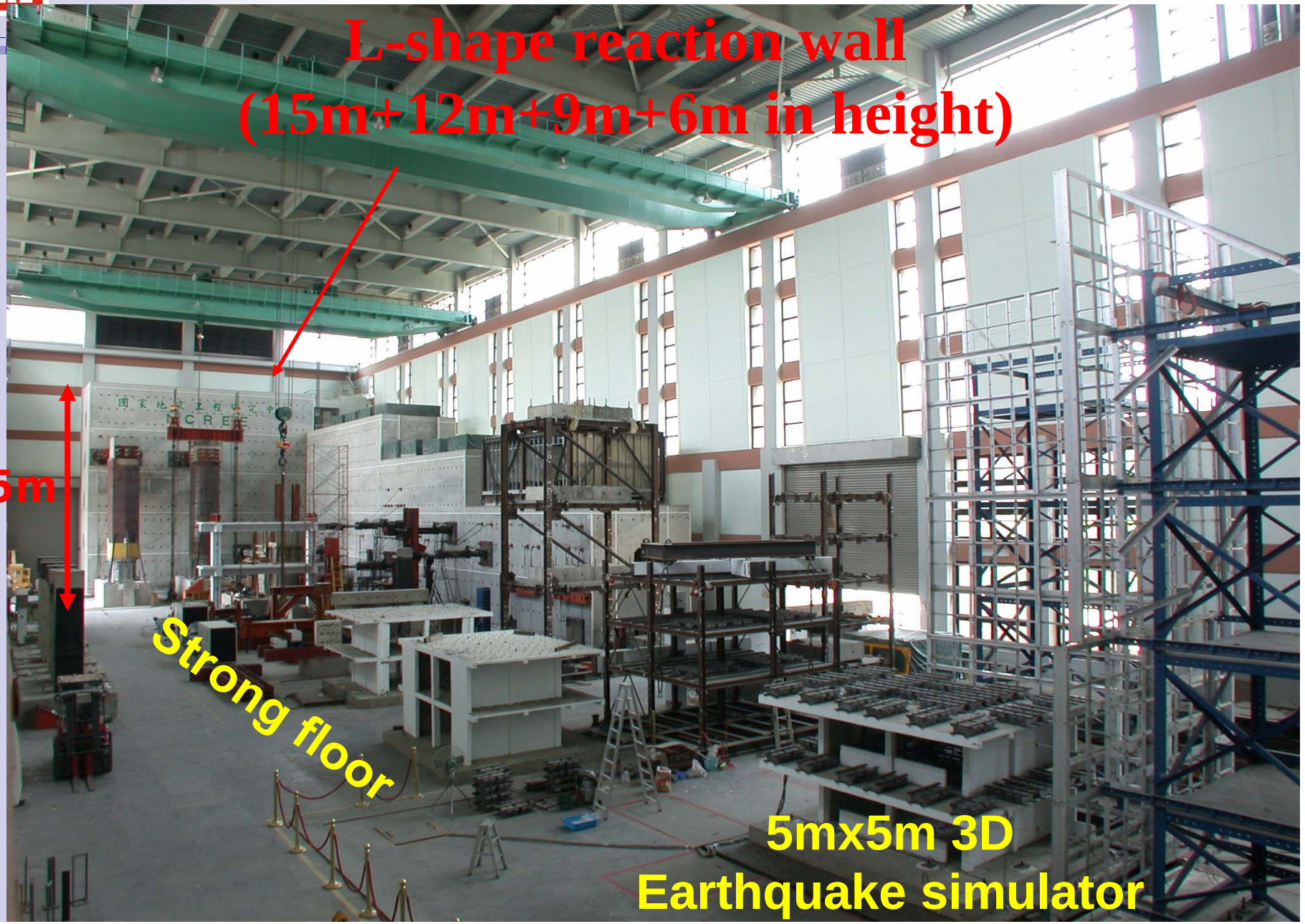
Revenue in 2011

(11.46 million US dollars for 2011)



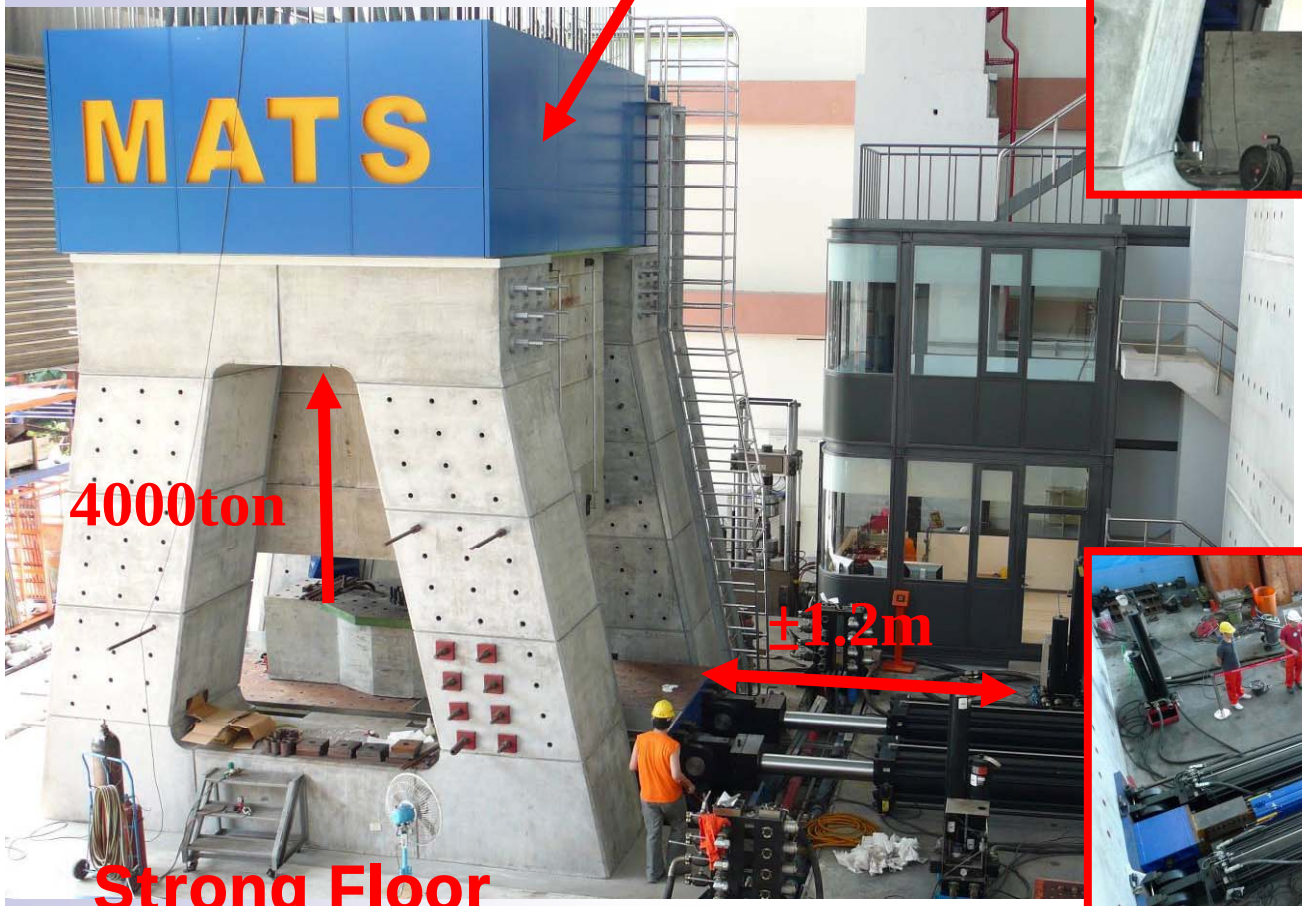
(8.38 million US dollars from NSC)

Experimental Facilities

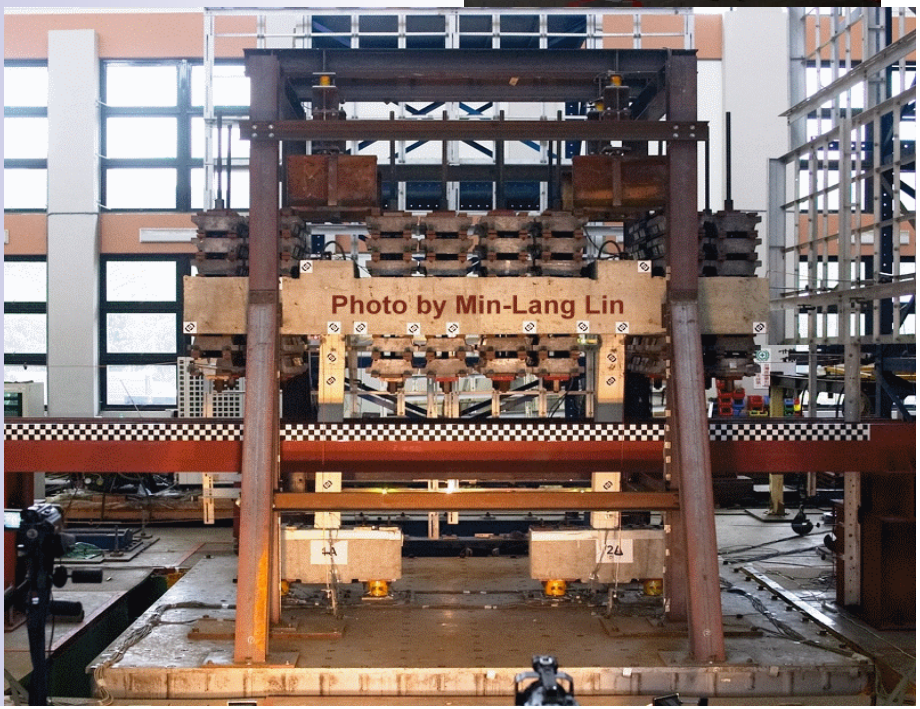


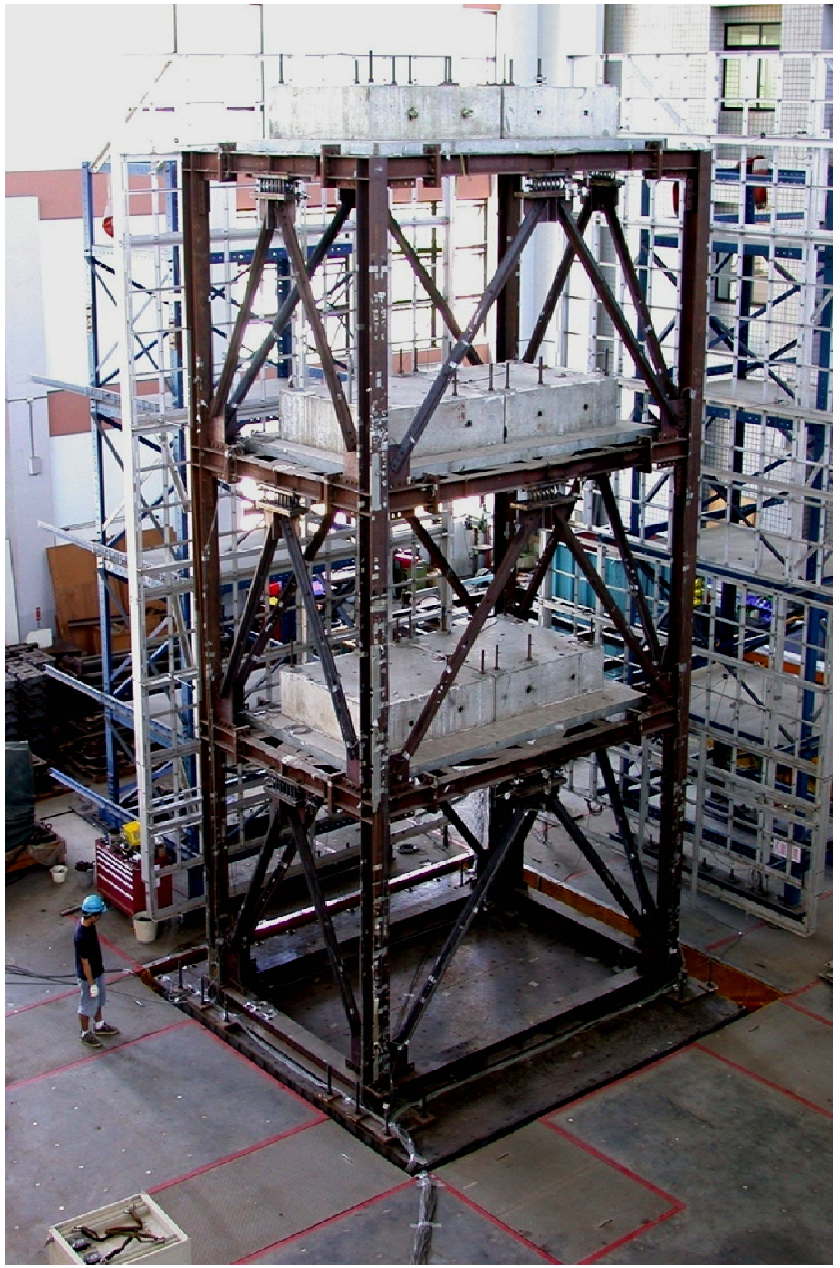
Experimental Facilities

Multi-Axial Testing System (MATS)



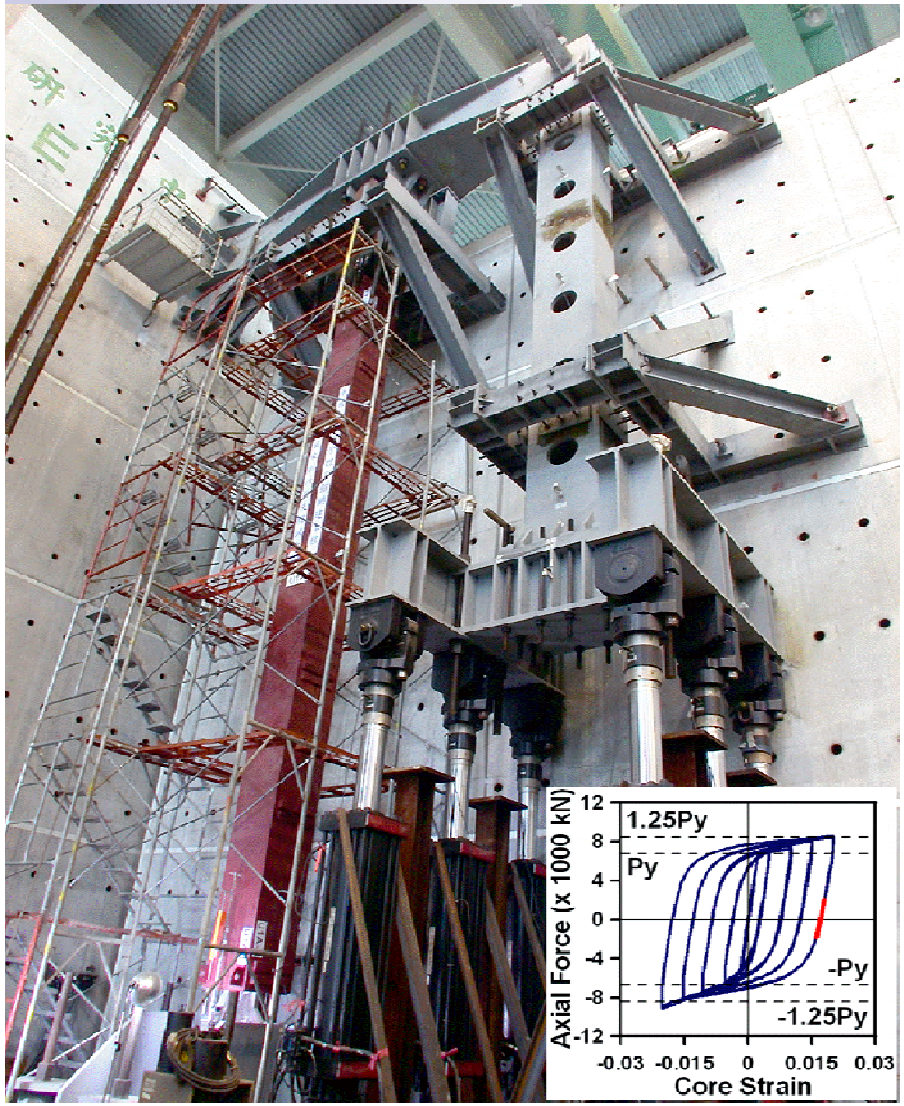
Shaking Table Tests





Reaction Wall Tests - Full Scale Structural Element Tests

World-Largest BRB Test



Major Research and Contributions

- **Development of seismic design, evaluation and retrofit technologies**
- **Development and application of earthquake loss estimation technologies**
- **Development of innovative seismic technologies and systems**
- Advancement of experimental and numerical simulation technologies
- Development of geotechnical and strong ground motion research
- **Dissemination of earthquake engineering knowledge to enhance earthquake awareness**

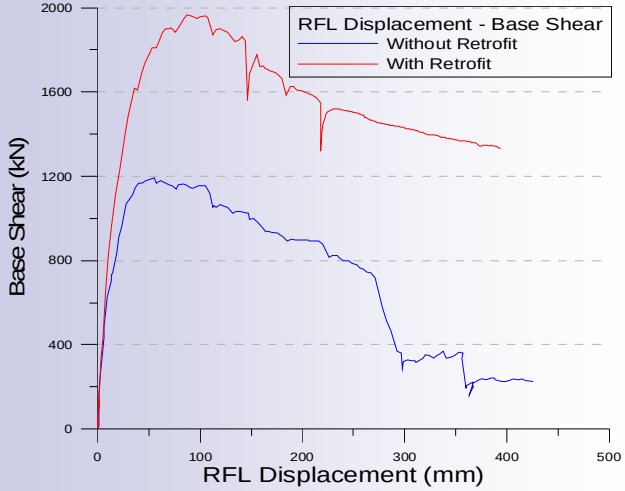
1. Seismic Design and Retrofit Codes

- Building structures
- Highway bridges
- Railway bridges
- Seismic isolation and energy dissipation design
- Qualification for seismic isolation and energy dissipation devices

2. Seismic Evaluation and Retrofit of School Buildings (1/4)

- Strategy was proposed.
- Methods for simple survey, preliminary evaluation, detailed evaluation and retrofit design were developed.
- US$ 587 million was allocated for seismic upgrading of elementary and secondary school buildings in four years, from 2009 to 2011.

In Situ Pushover Test



Effectiveness of Retrofit

In Situ
Pseudo Dynamic Test

Laboratory
Full Scale Cyclic Test

2. In Situ Experiment on Seismic Performance of School Buildings (2/4)

Kouhu Elementary School (2005)

2. 20100304 Jia-Xian Earthquake Location of Yu-Jing Junior High School (Grades 7-9) and Yu-Jing Vocational School (Grades 10-12) (3/4)

Distance between two schools 1.2 km

Yu-Jing Junior High School

Yu-Jing Vocational School

30 km from epicenter

31 km from epicenter

Serious Damage

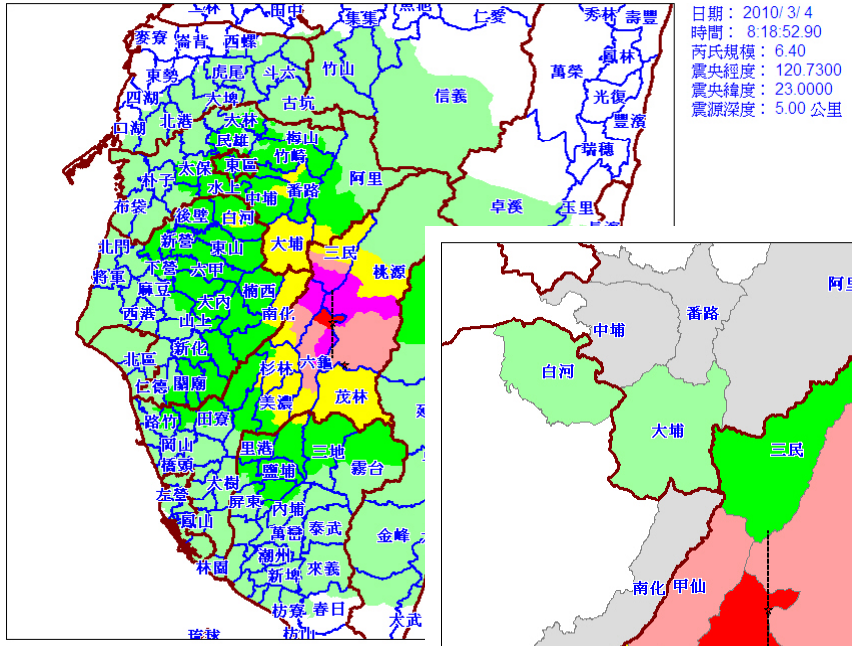
No Damage

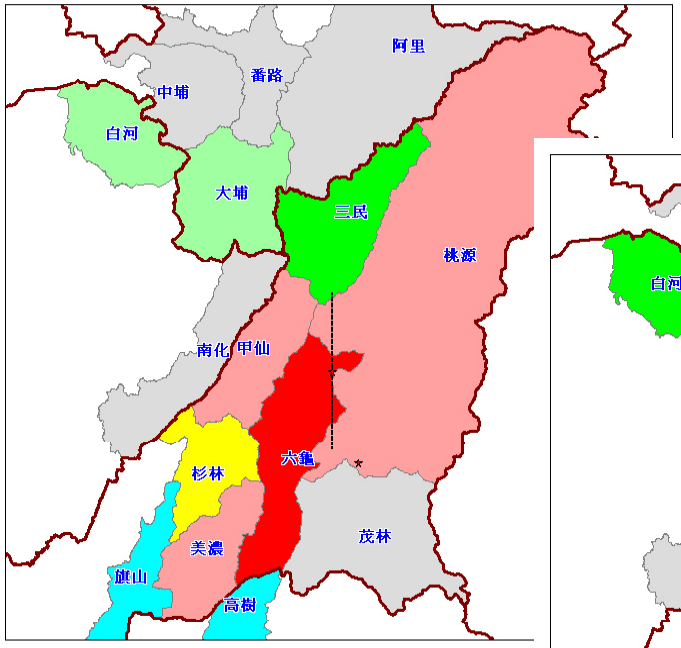
The school buildings were NOT retrofitted.

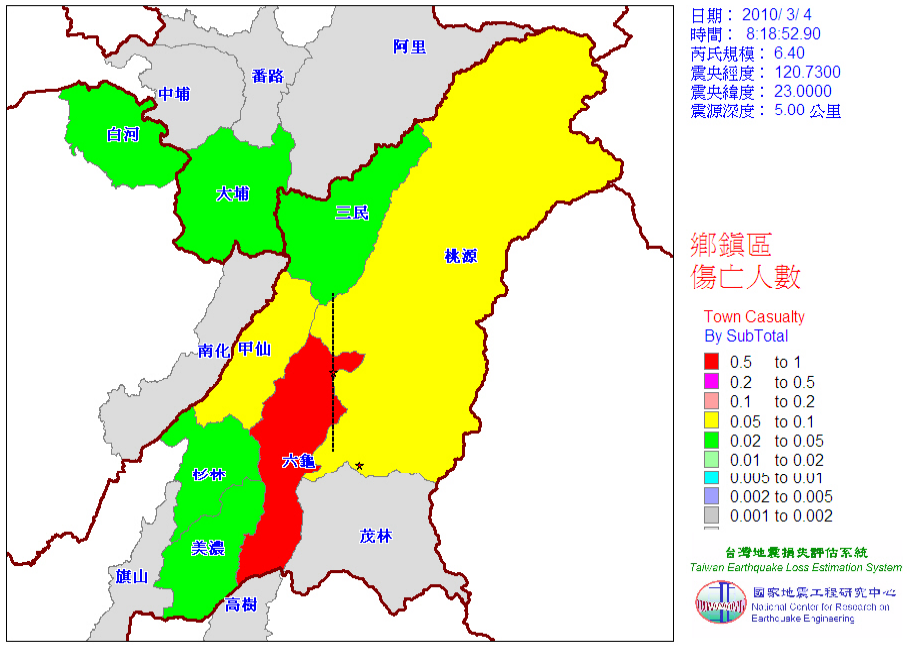
The school buildings were retrofitted.

3.Taiwan Earthquake Loss Estimation System (1/2)

Complete loss assessment within short time after receiving mail from CWB and automatically send messages to emergency response persons to assist in initiation and management of CEOC







3.Taiwan Earthquake Loss Estimation System (2/2)

- Improving the efficiency of emergency responses
- Providing useful data (PME, rescue & medical resources, etc.) for disaster reduction plans
- Already applied in TREIF-ERA to study insurance policy and to update risk measures
- Already applied in prioritization of retrofit sequence of major bridges under administration of DGH, MOTC

4. On-site Earthquake Early Warning System

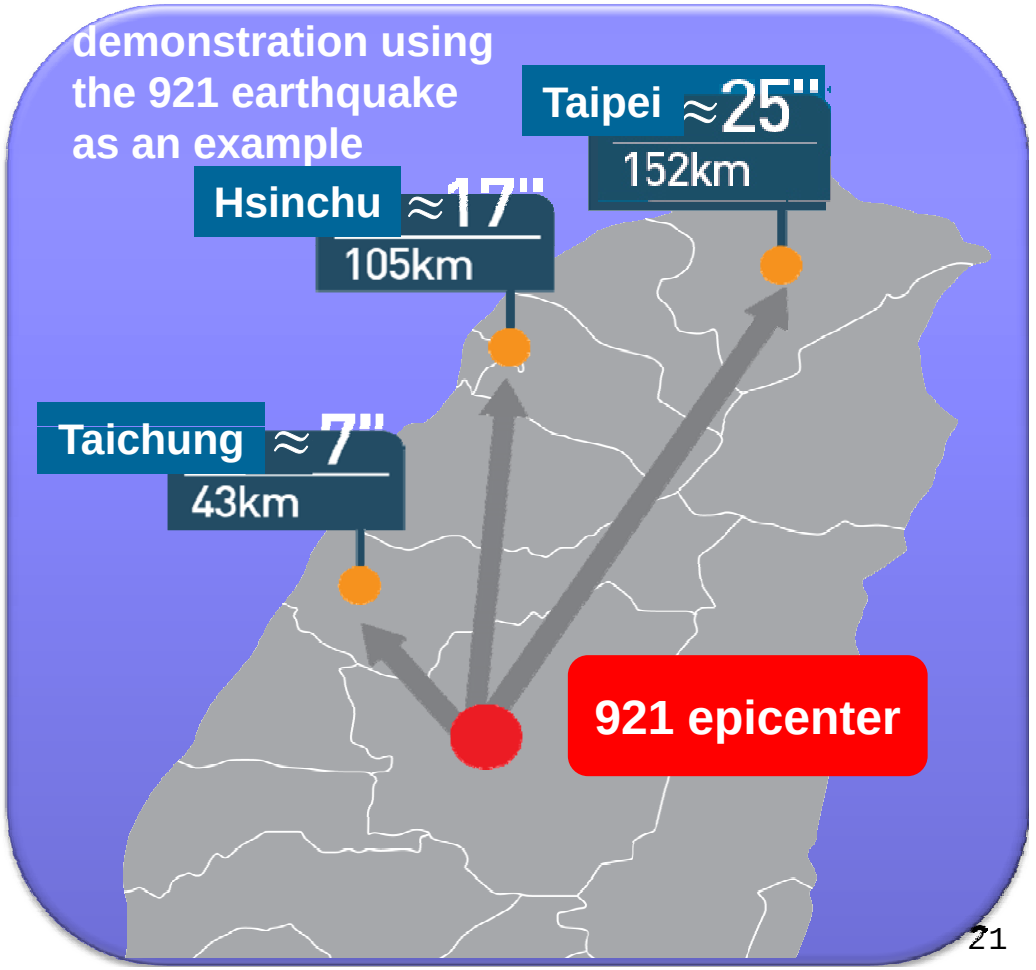
- The on-site EEWS demonstration stations have been established at 9 places, including Fanghe Junior High School, Yilan Elementary School, Taiwan SECOM, etc.
- EEWS could be applied to schools, hospitals, transportation systems and security companies.

On-site EEWS

Seismic sensor

On-line EEW calculation System

Automatic Control → **Earthquake Warning**

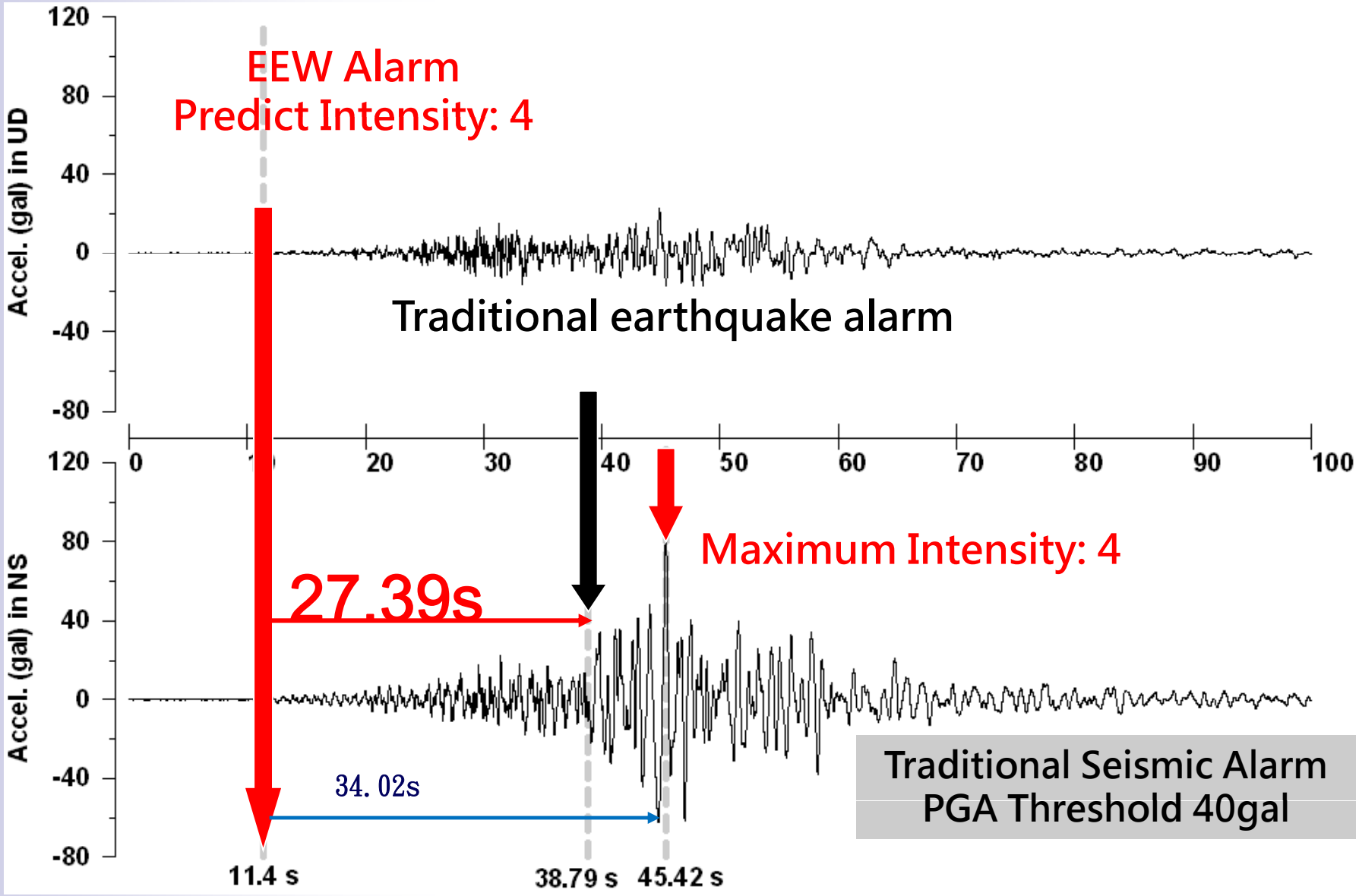


4.Integration Test of On-site Earthquake Early Warning System (1/4)

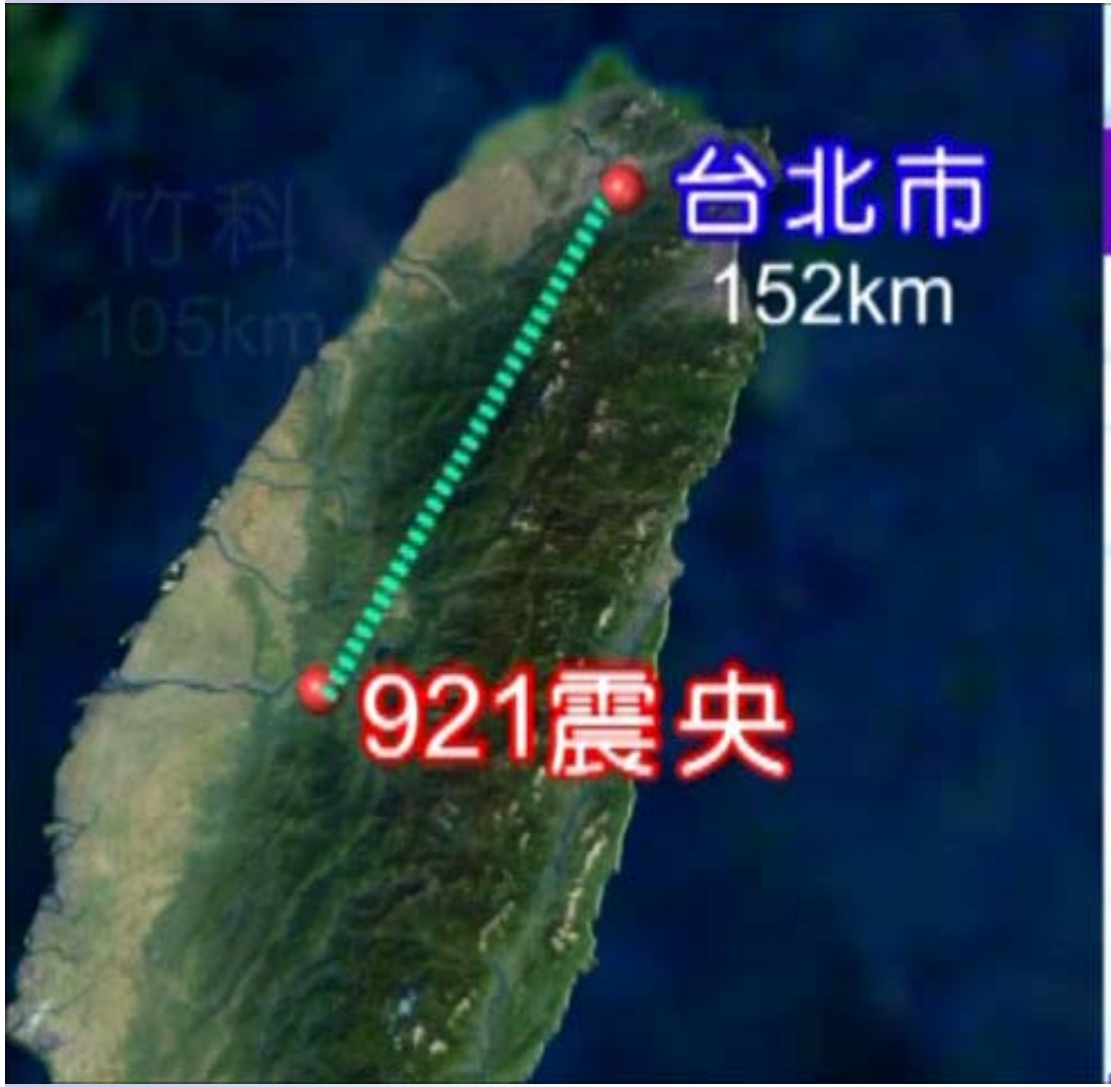
- ChiChi Earthquake
- Time : 88/9/21 1:47
- Depth: 8 km
- Magnitude: 7.3

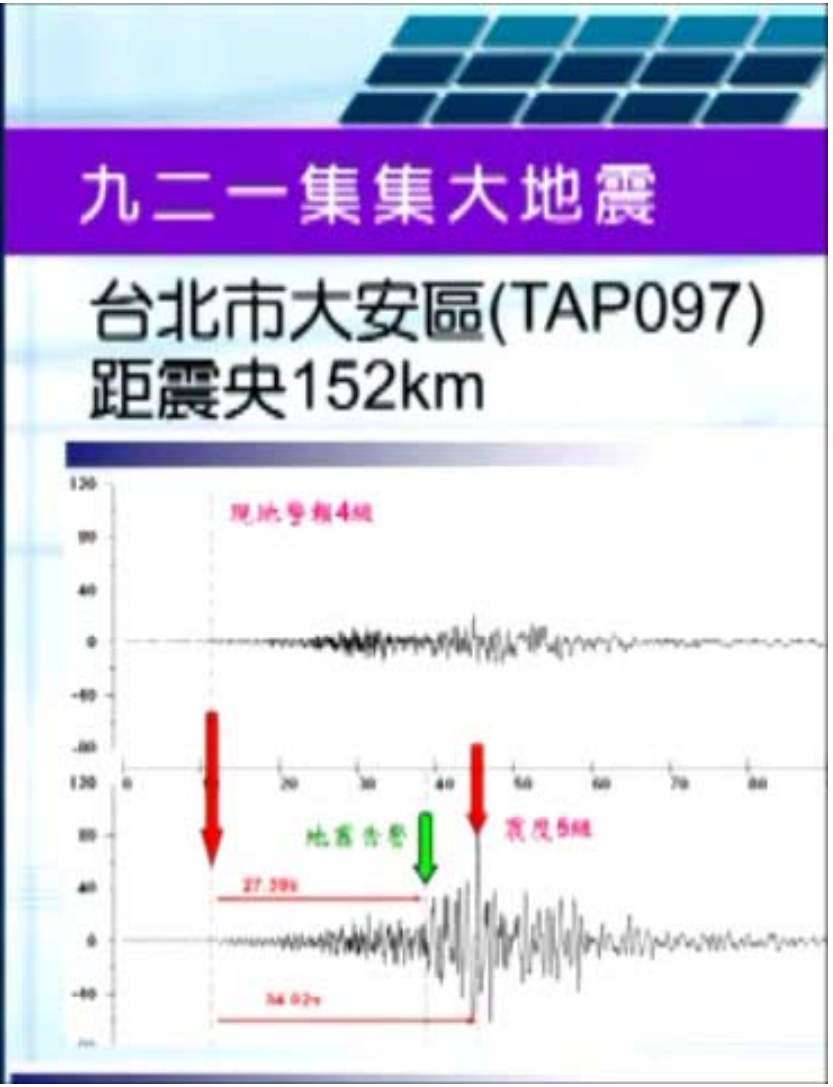
Photo of the press conference of the integration test on the shaking table on 2,22,2011

4. 921 Chi-Chi Earthquake Record in Taipei (2/4)



4. Integration test on the shaking table (3/4)

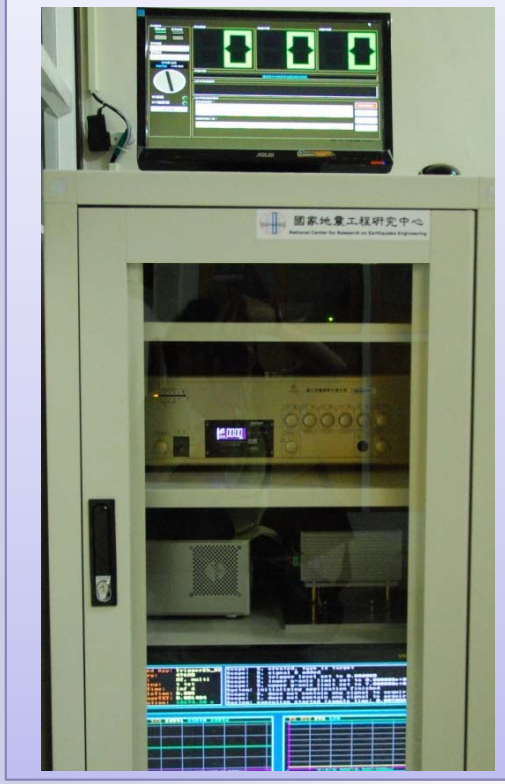




4. EEWS Demonstration Station (4/4)

NCREE On-site Sensor

CWB Regional EEWS Message



EEW LED Display

EEW Broadcast

E-mail

SMS Message

EEWS Locations

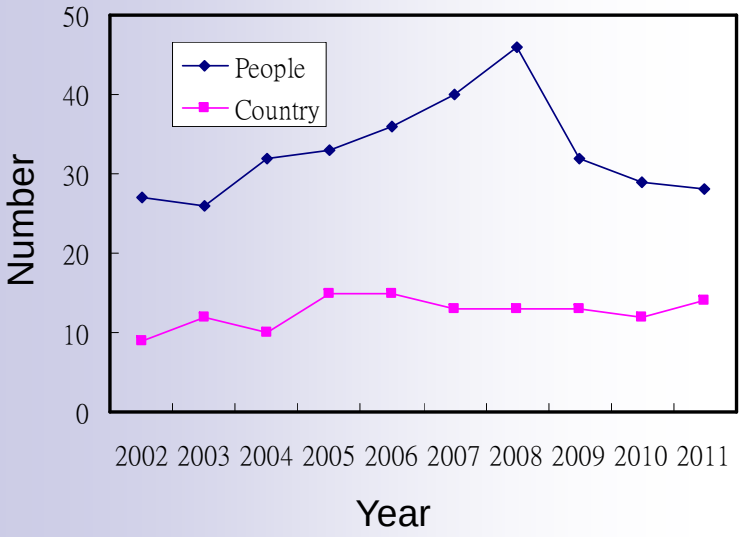
- 台北市立芳和國中
- 宜蘭縣宜蘭市宜蘭國小
- 宜蘭縣蘇澳鎮南安國中
- 中興保全羅東分公司
- 花蓮縣光復國小
- 花蓮縣玉東國中
- 花蓮火車站
- 國立中正大學
- 嘉義市港坪國小

Video: Earthquake disaster prevention drills

5. Introducing and Demonstrating Earthquake Engineering Research in Schools (IDEERS)

IDEERS has been successfully held for 11 consecutive years. This educational program is designed for high school, undergraduate and graduate students. Approximately 480 participants join the program each year.

6. International Training Program (ITP) for Seismic Design of Structures





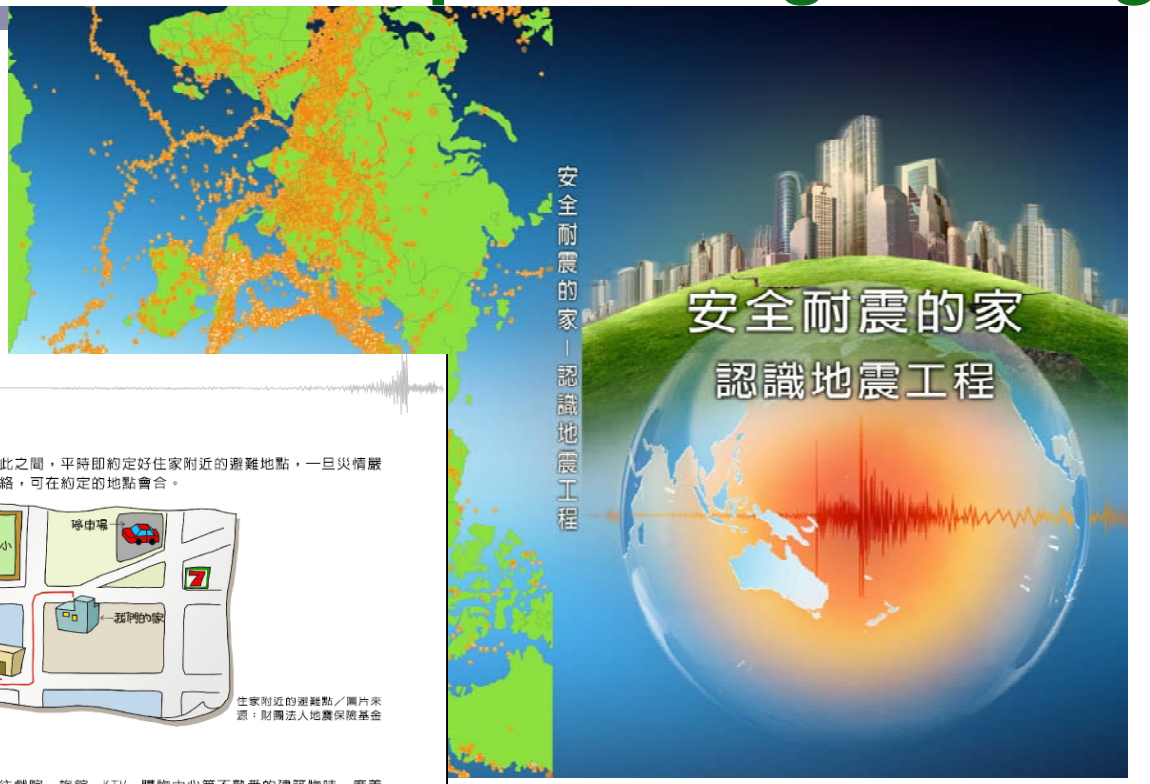








7. Building a Safe Homeland— Introduction to Earthquake Engineering



(三) 地震避難須知

■ 地震來了怎麼辦？

遇到危急狀況，應冷靜應變，才能自救。居家時，萬一發生大地震，在情況許可下，建議採取以下步驟應變：

1. 熄滅正在使用中的火源，並關閉瓦斯開關。
2. 打開大門，以避免門框變形而無法開啓。
3. 穿上鞋子。
4. 如果判斷可以及時逃到空曠處，立刻離開屋內（切忌搭乘電梯）；如果判斷來不及逃離屋內，則就近躲避在相對較安全的角落空間。

強烈地震過後，可疏散家人至戶外，並觀察建築結構有無立即的危險（參考附錄一），判斷無立即危險再回家。回到家中，應留意有無瓦斯外洩，確認無瓦斯外洩才能使用電器與爐火。

■ 如何避難到安全的地方？

● 規劃避難路線

預先設想避難路線，就不用在危急的情況下，考驗自己的運氣。家裡最好有二條以上的避難路線，並且不要在避難路線上堆放雜物。另外，因應深夜受災停電，避免黑暗中倉皇無措，最好在床頭處準備手電筒，以應付夜間突發狀況。

家裡的避難路線規劃

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家人彼此之間，平時即約定好住家附近的避難地點，一旦災情嚴重，失去聯絡，可在約定的地點會合。

住家附近的避難點／圖片來源：財團法人地震保險基金

平常前往戲院、旅館、KTV、購物中心等不熟悉的建築物時，應養成觀察緊急避難路線的好習慣，遇上地震或火災時，才能安全逃生。場所中如有工作人員指揮協助，則聽從指示，依序逃離。

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Thank you for your kind attention