

Research and development towards seismic risk reduction

Alper Ilki

Istanbul Technical University

Istanbul, Turkey

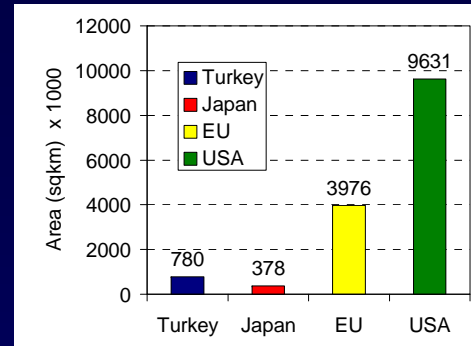




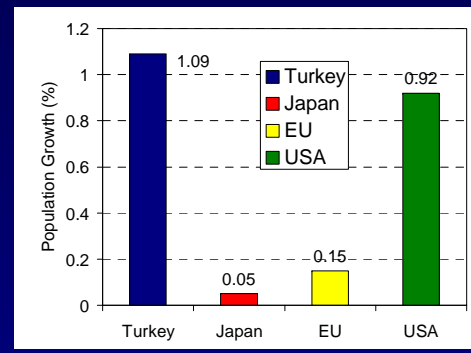
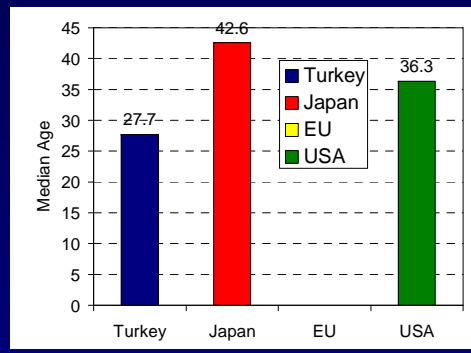
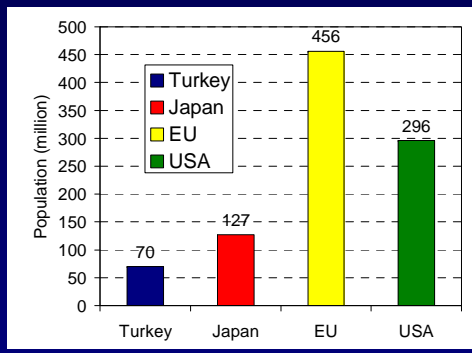
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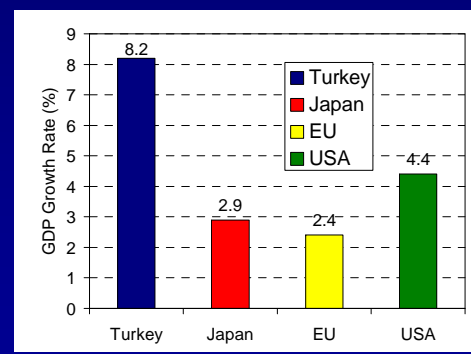
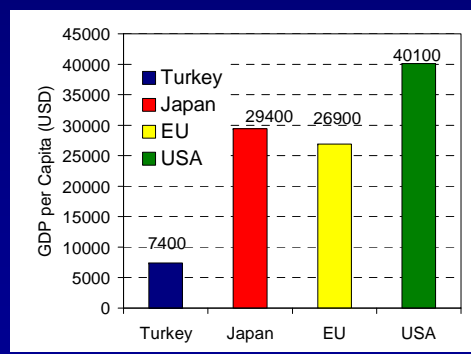
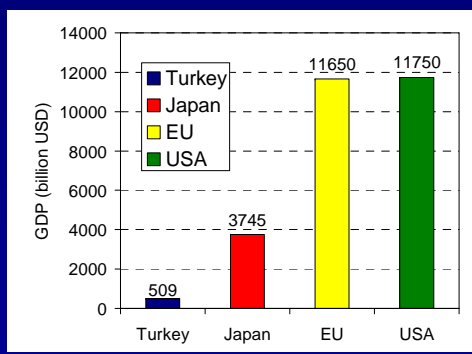
Brief information on Turkey



Quite large



Quite many people



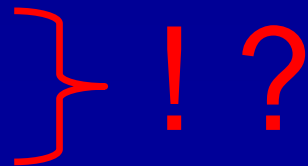
Not rich, but getting better

~ 96% of the country is under the threat of earthquakes,

~ 98% of the population live with this risk,

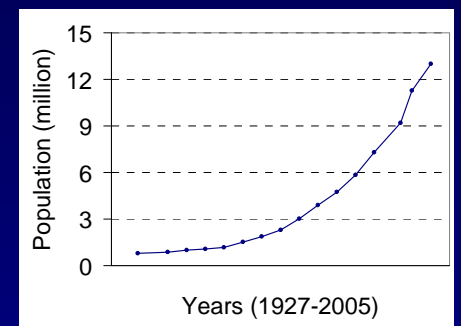
High quality seismic resistant design codes ?

Catastrophic results after each major earthquake !

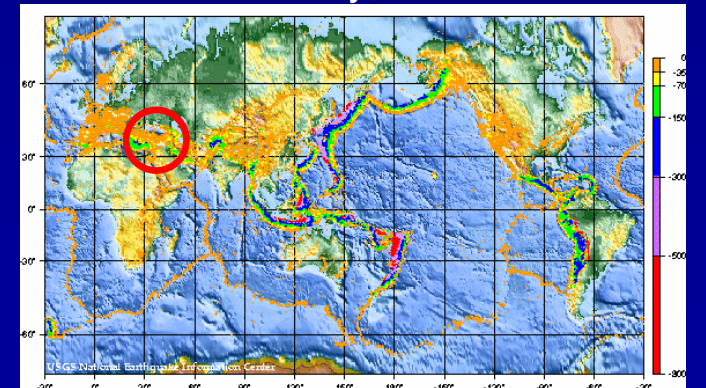


Brief information on Istanbul

- ➔ Old capitals of Byzantine and Ottoman Empires
- ➔ The share of Istanbul in GDP is ~22% of Turkey
- ➔ The population of Istanbul is ~20% of Turkey, ~13 million
- ➔ Located on highest seismic risk area
- ➔ Probability of magnitude 7~7.5 earthquake is ~60% in 30 years
- ➔ Many structures and monuments of universal cultural heritage
- ➔ HEART OF TURKEY



World seismicity, 1990-2000



Current State of Existing Buildings

In Cities

- ◆ So called reinforced concrete frame structures 4~5 stories (majority)
- ◆ Common concrete quality $\sim 100 \text{ kg/cm}^2$, poor homogenous distribution of quality
- ◆ Plain longitudinal bars of yield strength 2200 kg/cm^2
- ◆ No good connection of longitudinal bars at story levels (insufficient lap splices)
- ◆ Inadequate transverse reinforcement ($\phi 6/30$ before 1975, $\phi 8/20-25$ after 1975)
- ◆ Inadequate structural system planning (irregularities in plan and elevation)
- ◆ Inadequate reinforcing details
- ◆ Deterioration by time, lack of maintenance, low quality material and workmanship (particularly corrosion)
- ◆ Addition of illegal stories, removal of existing structural members, etc.

Retrofitting of existing structures is a major issue

In Villages

- ◆ Masonary, adobe and mixed type structural systems (majority 1~2 stories)
- ◆ Poor material and workmanship
- ◆ Poor details, heavy slabs, no good corner connections, large windows, etc.
- ◆ Removal of structural walls, etc.

Current Construction Practice and Inspection of New Buildings

- ◆ Land owner gives his land to a constructor & share the building considering the values of land & construction.
- ◆ Constructor generally transfers the construction to a master builder (no education, no licence).
- ◆ Municipality checks the plans in terms of structural design, architecture, city planning issues, etc
- ◆ For some districts, chamber of civil engineers also carry out an inspection on design (like municipalities).
- ◆ Land owner does not control the construction (needs engineering service=cost).
- ◆ People do not care much about seismic safety while buying a house (seismic safety is not a priority).
- ◆ Private inspection companies have strong responsibility both during design and construction phases (cost 4~8%).
- ◆ The constructor pays for the inspection company.
- ◆ Political issues; illegal permits, amnesties. (encouraging illegal construction)
- ◆ No professional liability insurance.
- ◆ No actual legal responsibility for substandard construction. Penalties are not clear and not applied.
- ◆ Unfortunately moral issues seem as the most serious obstacle in all phases of the construction.
- ◆ Insufficient and non-homogenous engineering education throughout the country.
- ◆ Licensed engineering

Current Construction Practice and Inspection of New Buildings

There are good things too;

- ✓ Construction practice is getting better.
- ✓ Particularly design phase is better for recent projects.
- ✓ Widespread use of ready mixed concrete Still there may be problems about concrete quality both due to concrete quality itself and/or compacting or curing mistakes during application).
- ✓ Widespread use of deformed bars Although some may easily fracture when bended due to brittleness.
- ✓ We have good codes (1975, 1998 and new version issued in 2006).
- ✓ There are many good projects designed and constructed by large Turkish Construction Companies in and out of Turkey.

Seismic Retrofitting Issues

Seismic safety assessment and retrofitting code is published, (this was a major obstacle for retrofitting),
Some public buildings like hospitals, schools, etc. are being retrofitted (for private buildings, retrofitting is very rare),
Currently, generally traditional retrofitting techniques are applied like concrete jacketing and shear wall addition,
Economical situation, high disturbance of traditional retrofitting techniques and fatalist attitude of Turkish people are among obstacles as well as legislative problems.

Obligatory Seismic Damage Insurance (Decree No. 587, 27.12.1999)

For buildings in the borders of municipalities (not villages)

For reinforced concrete and masonry buildings (not adobe)

Residential buildings (not industrial, official and public buildings)

The compensation of losses of disaster victims (according to disaster law) by the state is terminated.

The responsibility is transferred to Natural Disaster Insurance Administration.

Only about 20~30% of the buildings are insured (most of which were insured due to obligations while selling or buying procedure)

After recent earthquakes, government provided financial support to the owners of the damaged buildings, either insured or not (as before).

Special consideration; historical structures and unengineered housing units

There are many cultural heritage buildings from different civilizations (like Romans, Ottoman Empire, etc.) which are vulnerable to earthquakes.

Many of these structures were damaged during past earthquakes.

No systematic program is available for seismic upgrade of these heritage buildings.



In rural areas all around Turkey, many people are living in non-engineered structures formed using different materials like stones, adobe, wood, bricks, etc.

Since no special measure is taken for seismic resistance, many lives were lost (and to be lost) even during earthquakes of magnitudes 5~6.

These structures can be built earthquake resistant with some minor measures.

Potential areas of future research and development

Research studies:

Research towards simpler codes or guidelines (for new construction, seismic safety assessment and retrofit).

Research on simple and economic techniques of retrofitting, using locally available materials and workmanship, (preferably not causing much disturbance).

Research on seismic safety assessment of existing structures (do really all existing structures need retrofit?)

Research on reliable quick seismic safety assessment methods.

Research on seismic performance and retrofit of non-engineered buildings.

Research on seismic performance and retrofit of cultural heritage buildings (even though they are not housing units).

Research on usage of new materials; frps, sfrcs, light weight concrete, high strength steel and concrete.

Socio-economical studies for implementing a better inspection system.

Structural and Earthquake Engineering Laboratory of Istanbul Technical University established with the cooperation of JICA and BRI.

Potential areas of future research and development

Development studies:

Public awareness for creating demand for earthquake resistant housing;

For example: parents may be reached through school children. An awareness program focusing on school children can be organised, (courses, demonstrations, publications, videos, etc).

Dissemination of current state of knowledge in all levels including engineers, technicians and particularly workmen.

Studies towards a uniform level of engineering education.

Studies towards a system with responsible licensed engineers.

Disaster Management Center of Istanbul Technical University with experts from different disciplines.

Conclusions;

- Seismic safety assessment and retrofitting of existing poor structures is a major issue (methods, which are simpler, cheaper and causing less disturbance are needed),
- Better construction of new buildings is a also a major issue (better inspection is needed),
- We have good codes for construction and seismic resistant design (not being applied),
- We need simpler codes (for new construction, seismic safety assessment and retrofit),
- Public awareness (demand for seismic resistant buildings) should be increased,
- For any type of research and development activity, all stakeholders should better be invited to take part, like municipalities, ngos, social community leaders, media, etc.,
- Dissemination of current state of knowledge in all levels including engineers, technicians and particularly workmen and even ordinary people,
- Research and development studies concerning above items will help reduction of life and economic losses in future earthquakes.

Many thanks for your attendance