Seismic Risk Assessment and Mitigation in the Antakya - Maras Region on the Basis of Microzonation, Vulnerability and Preparedness Studies *(SERAMAR)*

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MKU – Mustafa Kemal University, Civil Engineering Dept., Antakya Hatay

Bauhaus-Universität Weimar
Earthquake Damage Analysis Center

Project Partners:

METU – Middle East Technical University, Ankara
ISOKIA – Institute of Socioeconomic and Cultural International Analysis, Kiel

1 Motivation

In the last years several strong earthquakes afflicted regions in Turkey (e.g. Mw 7.4 Izmit on 17.08.1999; Mw 6.4 Bingöl on 01.05.2003 – see Figure 1) and lead to thousands of casualties and billions of economic loss. Most of the harm and damage to be caused by these earthquake disasters occurred in small to middle-sized towns.

The main objective of the ***SERAMAR*** project is to utilize current tools for earthquake risk assessment ***in forefront of*** the next damaging seismic event and to establish a unique partnership between universities, professional associations as well as local governments that might serve as a model for similar future activities in Turkey and adjacent areas.

An intrinsic characteristic of the project is the interdisciplinary attempt combining the research areas of structural earthquake engineering with engineering seismology and sociology. Thereby the applicants revert to experiences gained during reconnaissance missions of GermanTaskForce into earthquake disaster areas of Turkey for many years.

Figure 1.1. *Documentation of structural damage by the German TaskForce (EDAC staff)*

2 Tasks and Activities ...

... of the Engineering group, which is lead by EDAC of Bauhaus-Universität Weimar:

- **Detailed inventory** of the current (undamaged building stock by on-site inspection)
- **Investigation of structural damage** being caused by future earthquake events
- **Geotechnical measurements**
- **Instrumental vulnerability studies** on selected building structures
- **Seismic risk assessment studies** on the basis of different earthquake scenarios likely to occur in the respective region
- **Identification/ tagging** of endangered settlement areas
- Elaboration of **recommendations** and strategies for institutions, building owners and local construction companies

Figure 2.1. *Capacity building; training of resident students by staff of EDAC, 09-2005*

... of the Sociological group, which is lead by ISOKIA include the following activities:

- **Interviewing inhabitants** to gather insights into the social structure, vulnerability structure, educational situation and level of preparedness and risk awareness in different groups of population
- **Comparison of the vulnerability level** of the building structures with the social vulnerability of inhabitants in several aspects
- **Interviewing representatives and staff** at different governmental and organizational levels and enterprises concerning the state of vulnerability, preparedness, mitigation, resilience and early warning in order to identify a differentiated view on social vulnerability and societal vigorous nesses to earthquake disasters at different levels of society, the society's state of preparedness, risk awareness, and early warning systems

Figure 2.2. *Interview situations; students from MKU conducting the questionaires*

3 Why Antakya is taken as study area?

3.1 Sociological aspects

Intrinsic characteristics and sociological composition

- Multi-ethnical
- Immigration city with a low migration rate
- High natality (birth rate)

Level of prevention and preparedness

- Awareness to earthquake risk
- Availability of master plans

Social-economic vulnerability, resilience of inhabitants

- Economic capital
- Level of education (cultural capital)
- Social connections and networks (social capital)

3.2 Seismological aspects (primary hazard)

Antakya is directly afflicted by the Dead Sea Fault System in the Eastern Mediterranean and by the East Anatolian Fault System which is in close proximity. Antakya is located in the highest zone (see Figure 3.1).

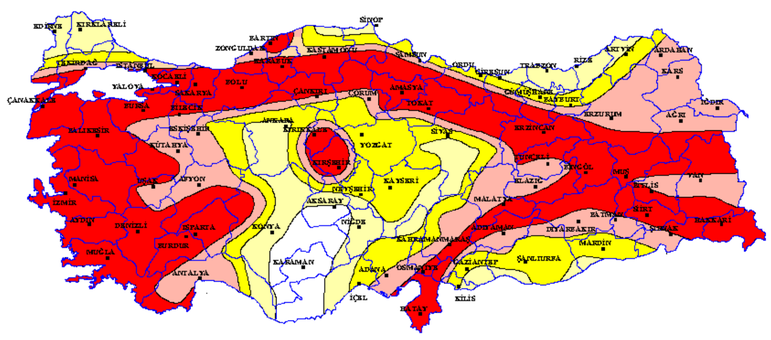


Figure 3.1. *Seismic zoning map of the Turkish earthquake code (TMPS 1998)*

3.3 Engineering aspects

Representativeness of the building stock

- Typical middle-sized towns in Turkey and Middle East
- Typical building types of different code generation

Vulnerability of the building stock

- Large variety of systems
- Different level of (uncertain) earthquake resistant design

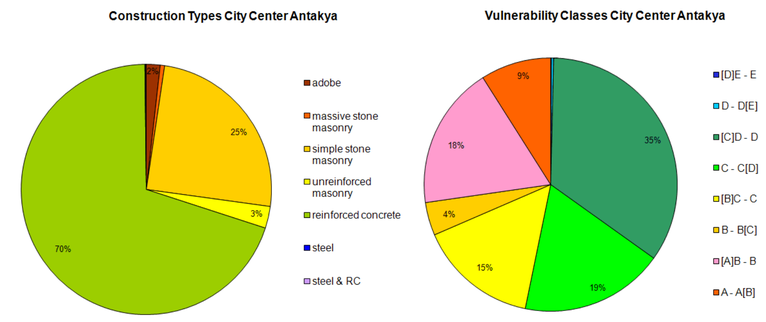
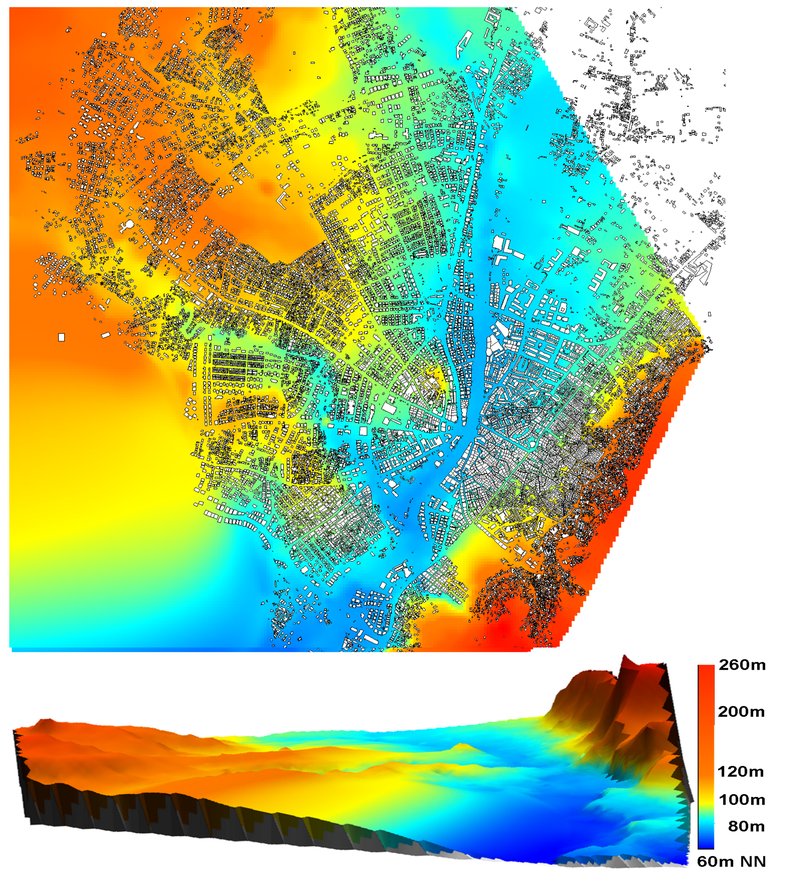


Figure 3.2. *Representativeness of the building stock in the sense of the distribution of construction types and vulnerability for middle-sized towns in Turkey and Middle East*

Figure 3.3. *Examples of typical building types in Antakya: RC frame structures (left) and simple stone masonry structures (right)*

3.4 Geotechnical aspects (secondary hazards)

- Different subsoil conditions
- Amplification potenial
- Need of microzonation study



4 Information Policy and Contributions to the Project Progress

In 2005 the interdisciplinary works of engineers and sociologists started in the test city Antakya, a historical multi-ethnical town.

The inventory of the city's building stock and the performance of sociological questionnaires with the local population were supported by a group of students from Mustafa Kemal University and local engineers from the Chamber of Civil Engineers Hatay Branch.

The 2005 field trip into the test area Antakya revealed that the organizational structure between EDAC, ISOKIA and MKU is suitable for the preparation and conducting of the project tasks.

To realize the ambitious aim of the SERAMAR project several smaller project were conducted. Table 4.1 indicates this projects, the several project partners, sponsors as well as related publications to it.

SYSCOM - SYSCOM Instruments SA, Sainte-Croix, Swiss
DEZA - Swiss Agency for Development and Cooperation, Swiss
BMBF - Federal Ministry of Education and Research, Germany
TÜBITAK - The Scientific and Technological Research Council of Turkey

Table 4.1. *Flowchart of SERAMAR subprojects and their partners as well as sponsors*

Task	Project Partners	Publication	Sponsor
Sociological Investigation:			
▪ Performance of interviews	ISOKIA & MKU		DEZA &
▪ Analysis of field studies	ISOKIA		EDAC
Engineering studies:			
▪ Building stock survey – part I	EDAC & MKU	[1], [9]	EDAC
▪ 3 Building Monitoring Systems	EDAC & MKU	[1], [7], [8]	SYSCOM
▪ Building stock survey – part II ▪ 1 Building Monitoring System ▪ Instrumental testing of three buildings	MKU, EDAC & METU	[3], [4]	TÜBITAK
▪ Instrumental geotechnical meas. ▪ Instrumental testing and analytical investigation of representative building types	EDAC & MKU	[9]	BMBF & TÜBITAK
▪ Evaluation of building stock data ▪ Seismic risk assessment studies	EDAC	[1], [9]	EDAC
▪ Certification of investigated buildings	EDAC, MKU & METU		

Publications

[1] Abrahamczyk, L., Schwarz, J., Lang, D.H., Leipold, M., Golbs, Ch., Genes, M.C., Bikçe, M., Kaçin, S. and Gülkan, P. (2008). Building monitoring for seismic risk assessment (I): Instrumentation of RC frame structures as a part of the SERAMAR project. 14th World Conference on Earthquake Engineering (WCEE), Beijing, China.

[2] EDAC (2004). Turkish-German-Swiss Joint Project on Seismic Risk Assessment and Mitigation in the Antakya-Maraş Region on the basis of Microzonation, Vulnerability and Preparedness Studies (SERAMAR) – Project description. Earthquake Damage Analysis Center, Bauhaus-Universität Weimar.

[3] Genes, M.C., Bikçe, M., Kaçin, S., Akyuz, U., Gülkan, P., Abrahamczyk, L., Schwarz, J. (2008). Building monitoring for seismic risk assessment (II): Instrumental testing of RC frame structures and analytical reinterpretation of response characteristics. 14th World Conference on Earthquake Engineering (WCEE), Beijing, China.

[4] Genes, M.C., Bikçe, M., Kaçin, S., Akyuz, U., Schwarz, J., Lang, D.H., Abrahamczyk, L. (2009). Identification of Dynamic Characteristics of Multistory RC Structures by Combining instrumental and numerical data: case study Antakya, Turkey. Earthquake and Tsunami, Istanbul, Turkey.

[5] Grünthal, G. (ed.), Musson, R., Schwarz, J., Stucchi, M. (1998). European Macroseismic Scale 1998. Cahiers de Centre Européen de Géodynamique et de Seismologie, Volume 15, Luxembourg.

[6] Kandilli Observatory and Earthquake Research Institute (KOERI) (2007). Latest Seismicity in Turkey. http://www.koeri.boun.edu.tr/sismo/map/en/index.html, Boğaziçi University.

[7] Schwarz, J., Lang, D.H., Abrahamczyk, L., Bolleter, W., Savary, C., Bikçe, M., Genes, M.C., Kaçin, S. (2006). Seismic Building Monitoring of Multistory RC Structures in Turkey – A Contribution to the SERAMAR Project. 1st European Conference on Earthquake Engineering and Seismology (ECEES), Geneva, Switzerland.

[8] Schwarz, J., Lang, D.H., Abrahamczyk, L., Bolleter, W., Bikçe, M., Genes, C.M., Kaçin, S. (2007). Seismische Instrumentierung von mehrgeschossigen Stahlbetongebäuden – ein Beitrag zum SERAMAR Projekt. D-A-CH Tagung 2007, Wien, Tagungsberichte, Beitrag 23.

[9] Schwarz, J, Abrahamczyk, L., Langhammer, T., Leipold, M., Genes, M.C., Bikçe, M., Kaçin, S. (2009). Building typology for risk assessment: case study Antakya (Hatay). Earthquake and Tsunami, Istanbul, Turkey.

[10] TMPS (1998): Turkish Ministry of Public Works and Settlements. Specification for Structures to be built in Disaster Areas. Part III-Earthquake Disaster Prevention (Chapter 5-13). English Translation, 1998; 84 pp.,