POLITECNICO DI TORINO
SECOND SCHOOL OF ARCHITECTURE
Master of Science in Land, Town and Environment Planning
Honors theses

THE SEISMIC RISK IN A MEGA-CITY. Emergency planning in Istanbul

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Natural phenomena, such as hurricanes, volcanic eruptions, earthquakes, etc., threaten always more often human communities all over the world, frequently causing large-scale disasters. The seismic events are amid the most catastrophic of these phenomena: in few seconds and without any warning, they might strongly shake human settlements causing numerous causalities, changing the anthropic and natural landscape and erasing the historical and cultural heritage. In turn, these direct effects could trigger other secondary consequences not less severe, such as the disruption of economic activities and services of public utility, social problems, etc.

Therefore, an earthquake could be potentially more dangerous when hits a global city. Among them, Istanbul is a megalopolis characterized by one of the highest level of seismic risk in the world[1]:

- by the 2030, it could be hit by a big shock (Magnitude 7 or more) with a 62±15% probability;
- more than 50% of Istanbul inhabitants live in irregular and squatter buildings (see Figure 1) characterized by precarious structural and functional conditions;
- it is the economic and financial capital of Turkey, an important attractive node of population (in Istanbul live officially more than 13 million of people) and national-international activities and capitals.

Inside each mega-cities, there are several neighborhoods with particular vulnerabilities. They could be characterized by a high density of residential population, economic activities, public services, etc. If they are seriously damaged due to a seismic event, for example, the consequences might have an impact not only at urban scale but probably also at national scale.

Therefore, in this thesis, the seismic risk has been evaluated for one of the numerous highly vulnerable Istanbul's areas. The zone analyzed is part of the old and historic neighborhood of Pera/Galata: it is a kind of "buffer" around İstiklal Caddesi, famous pedestrian street, which is being visited by nearly 3 million people during the weekends, according to unofficial sources. Furthermore, it is characterized by an important historical, cultural and architectonical heritage and it is the location of several economic activities and public facilities.

In particular, the seismic risk has been assessed confronting two different approaches: one traditional and one experimental (which has been elaborated in this research). The principal differences between them are the temporal dimension (static/dynamic during the day – see Figure 2), the exposure (residents/city users) and the vulnerability (general factors/specific factors characterizing the case study area).

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[1] The risk (R) is function of three components: Hazard (H), Vulnerability (V) and Exposure (E). The traditionally used formula is: R=H*V*E.

So, the case study area, marked by a low level of seismic risk according to the traditional approach, results be at middle-high risk according to the experimental approach. The difference in the evaluation is not due to the hazard component (in both cases not so much relevant) but rather to the specific peculiarities of the urban environment which increase notably the vulnerability: first of, the high presence of city users, not resident in the case study area, during 24 hours a day, 7 days a week. Indeed, the city users do not know very well the zone and, so, their continuative high presence increases the vulnerability as well as the exposure value.

Assessed the seismic risk, some mitigation actions have been proposed and, in particular, an evacuation-mitigation plan has been predisposed for the case study area (see Figure 3). If adequately developed and publicized, it would guarantee the reduction of casualties during and in the aftermath the seismic shock.

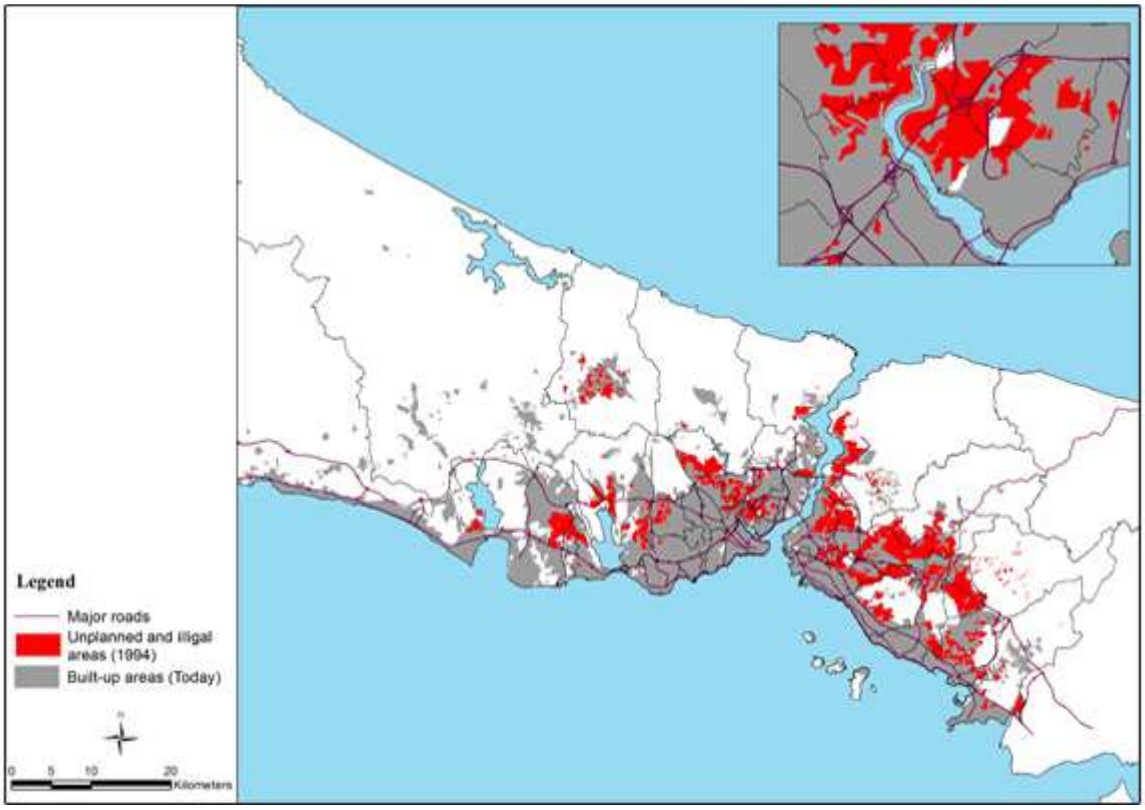

Figure 1. Irregular and squatter settlements (date back to 2004), still illegal or condoned in the past, compared to the entire metropolitan built-up areas (date back to 2011)

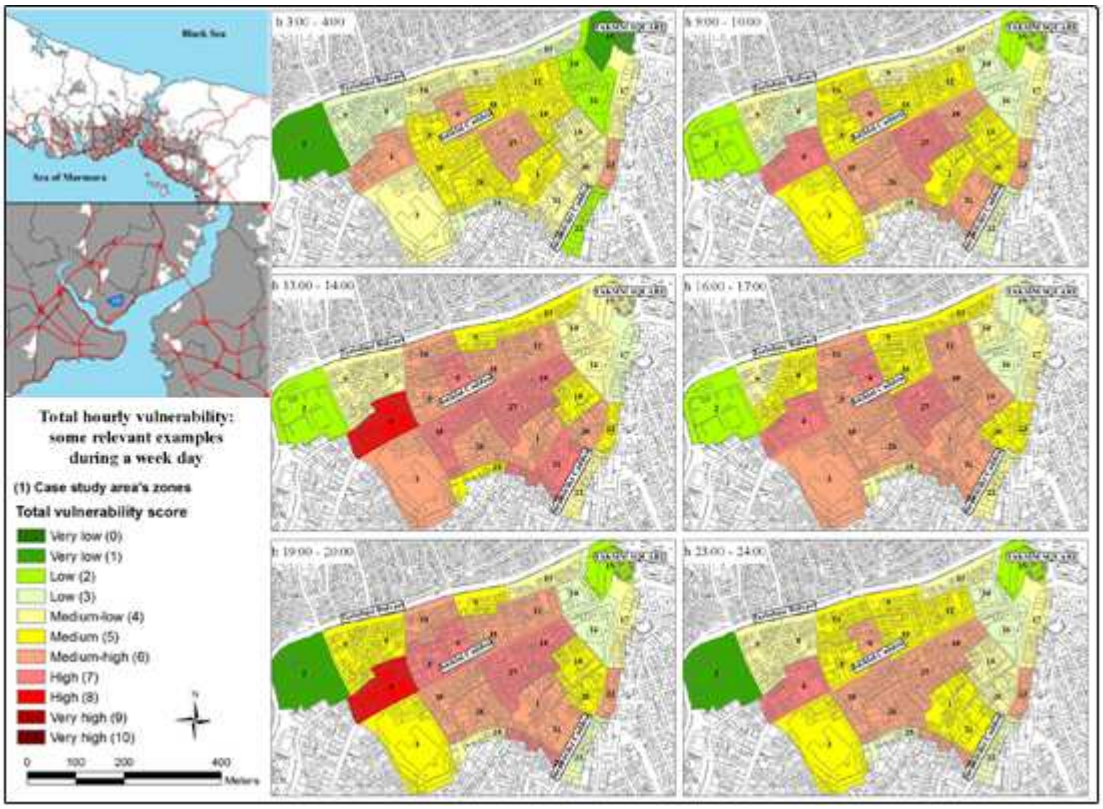

Figure 2. Some examples of “total hourly vulnerability” during a weekday

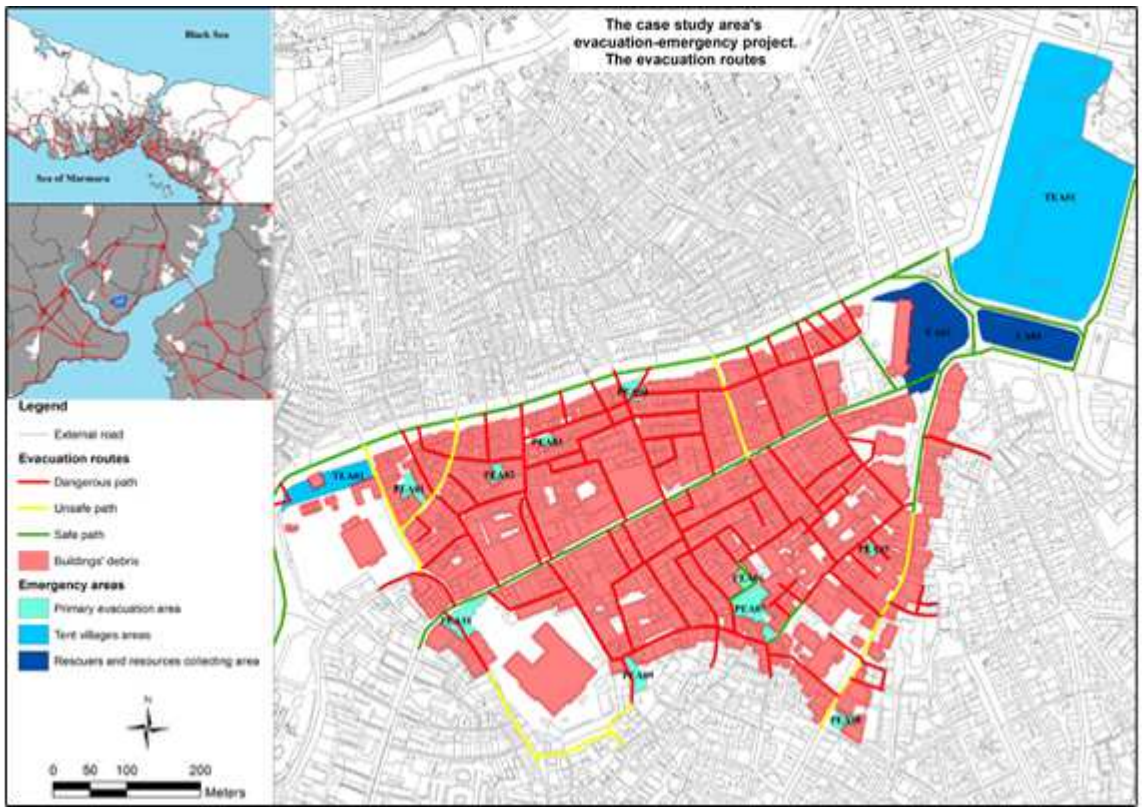

Figure 3. The case study area’s evacuation-emergency project

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