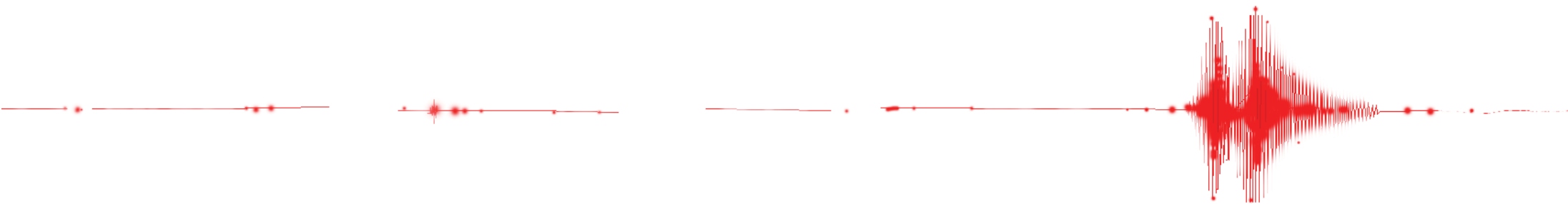
PEOPLE vs EARTHQUAKE



EPFL – ENAC ECOLE D'ARCHITECTURE

PEOPLE versus EARTHQUAKE

Temporary Housing for Earthquake victims, Istanbul, Turkey

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Tables of Acronyms

A
AKOM : Afet Koordinasyon Merkezi / Disaster Coordination Centre

D
DDVS : District Disaster Volunteers Support

E
EAF : East Anatolian Fault
EMPI : Earthquake Master Plan for Istanbul
EMS-98 : European Macroseismic Scale 1998
EU : European Union

F
FS : Frame Structure

G
GIS : Geographic Information systems

I
IGDAS : Istanbul Gaz Dağıtımı A.Ş. / Istanbul Natural Gas Distribution Corporation
IMM : Istanbul Metropolitan Municipality
ISKI : Istanbul Su ve Kanalizasyon İdaresi /Istanbul Water & Sewer Administration
ISMEP : Istanbul Seismic Mitigation and Emergency Preparedness Project

J
JICA : Japan International Corporation Agency

M
MS : Masonry Structure

N
NAF : North Anatolian Fault

O
ODSPD : One Disaster Station per District

R
RC : Reinforced Concrete

S
SD/SDs : Sub-District / Sub-Districts

T
TEM : Trans European North-South Motorway
TÜIK : Türkiye Istatistik Kurumu / Turkey Statistic Association

Z
ZESAT : Zeytinburnu Sehircilik Atölyesi / Zeytinburnu Urbanism Atelier
ZIB : Zeytinburnu Communication Unit
ZM : Zeytinburnu Municipality
ZPP : Zeytinburnu Pilot Project

ha : hectare
pr : person

INTRODUCTION

Earthquakes are natural catastrophes that occur along an active fault line. They become disasters because of their effects on man-made structures. It is important to understand every aspect of an earthquake and its effects on buildings to be able to design resistant buildings, thus preventing or reducing the damages caused, and preventing a natural event to turn into a disaster.

In Turkey most of the people are living in earthquake zones and we can say that they are used to it. In Turkey, most of the destroyed or damaged cities were reconstructed as they were, with their vulnerability and the same urban structure. But in 1999 two big earthquakes hit Izmit and Düzce, two cities on the coast of the Marmara Sea. The one in Izmit destroyed almost all the city and the losses were high. It was a beginning for big changes in the urbanisation procedures in cities. These earthquakes happened on the west side of an active fault line, NAF. Right after the event academics started to do a research to see the changes and current situation of the fault line. Stress accumulation maps of the fault line indicated a possible future earthquake at the end of the fault line, in the middle of the Marmara Sea, with the same intensity as that of the Izmit earthquake. This news alerted the authorities about a future disaster in Istanbul, the 12 million-inhabitant metropolitan city. Many studies have been done to understand and ameliorate the current situation of the city. All the studies pointed out to some districts with a high risk status. Zeytinburnu is one of the most vulnerable districts in Istanbul; its urban growth has been uncontrolled and illegal. The first settlements were illegal shanty houses, which have been later on legalised by law. Today the Zeytinburnu municipality conducts many projects to improve the urban quality of the district. One of the important issues, when dealing with earthquakes, is the disaster management.

Earthquake Master Plan for Istanbul has created and adapted frameworks on this subject, but today most of the efforts are towards renovation and mitigation strategies. Emergency strategies are only done on paper: a map has been made with plans of evacuation arteries, and location of the responsible organisation, primary community evacuation areas and tent villages.

But if the tent villages' layout has not been designed, will the villages be efficiently organised, especially as they are needed during the first hours after an earthquake?

Because it is important to understand the reasons behind the event that leads to create tent villages, I will first analyse what are earthquakes talk about earthquakes, their definitions and their effects on buildings. Then to be able to understand the reasons behind the inadequate urban structure, I will examine the general situation of Turkey and the Izmit earthquake in particular, and finally I will concentrate on Istanbul. The history and the current condition of Istanbul are important to understand the role of the people and authorities. The earthquake vulnerability of the city is explained in many studies done about this subject. Then I will focus on the case of Zeytinburnu which is a vulnerable district of Istanbul. I will try to show the approach of IMM and ZM toward the mitigation, renovation and emergency strategies. To conclude I will try to explain the importance of the tent villages as temporary refugee shelters and how they should be organized.

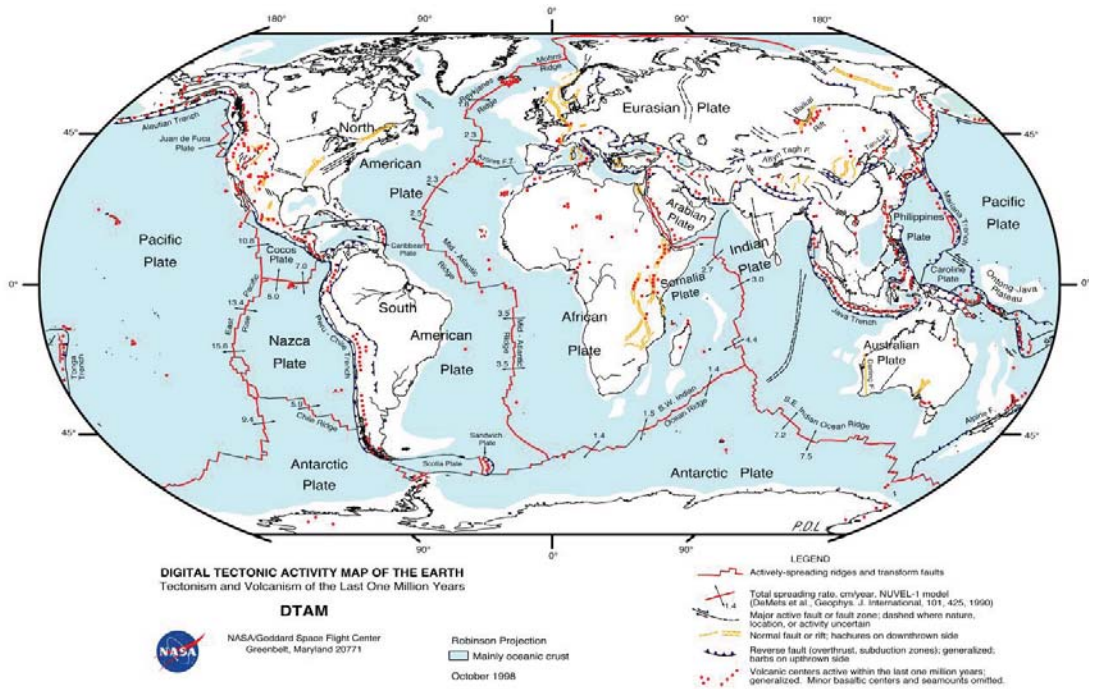


Image 1 : Tectonic Map

EARTHQUAKES

The surface of the earth, lithosphere, is composed of seven major and a lot of minor plates. Plates are in continuous movement, they approach each other or slide along each other a few centimetres every year. Tectonic activities mostly occur along plate junctions: the fault lines.

Definition

"Earthquakes are defined as occurrences resulting from plate tectonic activities at borders and interfaces of some of the plates covering the Earth where stress concentration and energy accumulation are produced. Convection flows from hot mold to cooler and stiffer covers increase these accumulations and concentration. Finally a rupture happens around this interface releasing an immense accumulated energy. This inner rupture area (source) originates a wave propagation traversing all the layers and geologic formation up to the surface of the earth." [1]

The starting point of earthquake, which is within the depth of earth, is called the *focus*. This point's projection on the surface is called the *epicentre*. Shakings that occur during earthquakes are caused by the passage of the seismic waves through the earth.

The major earthquake is generally followed by secondary earthquakes with less magnitude.

Fault [2]

It is a fracture of a rock formation caused by a dislodging or shifting of the crust, surfaces are displaced relative to one another and parallel to plane of fracture. 3 types of fault;

1] Dip-slip faults

a) Normal Fault
In a normal fault, the block above the fault moves down relative to the block below the fault. This fault motion is caused by tensional forces and results in extension. (Other names: normal-slip fault, tensional fault or gravity fault)

b) Reverse Fault
In a reverse fault, the block above the fault moves up relative to the block below the fault. This fault motion is caused by compression forces and results in shortening. A reverse fault is called a thrust fault if the dip of the fault plane is small. (Other names: thrust fault, reverse-slip fault or compression fault)

2] Strike-slip fault
In a strike-slip fault, the movement of blocks along a fault is horizontal. If the block on the far side of the fault moves to the left, as shown in this image, the fault is called left-lateral. If the block on the far side moves to the right, the fault is called right-lateral. The fault motion of a strike-slip fault is caused by shearing forces. (Other names: transcurrent fault, lateral fault, tear fault or wrench fault)

3] Oblique-slip fault
Oblique-slip faulting suggests both dip-slip faulting and strike-slip faulting. It is caused by a combination of shearing and tension of compressional forces.

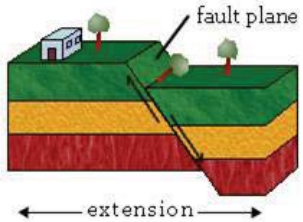


Image 2 : Normal Fault

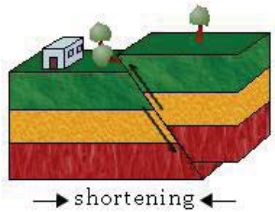


Image 2 : Reverse Fault

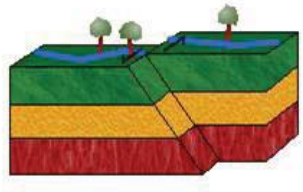


Image 2 : Strike-slip Fault

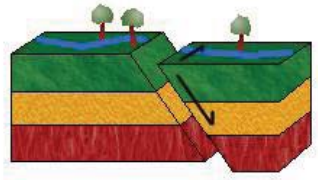


Image 2 : Oblique-slip Fault

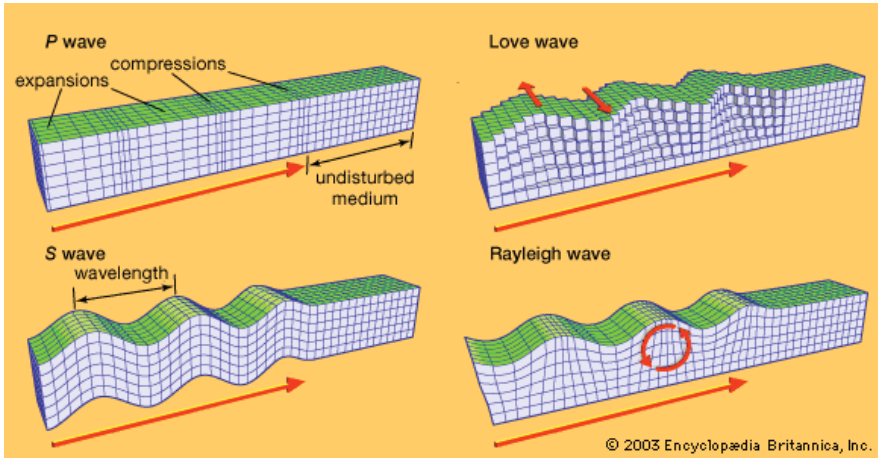


Image 3 : Seismic Waves Movements

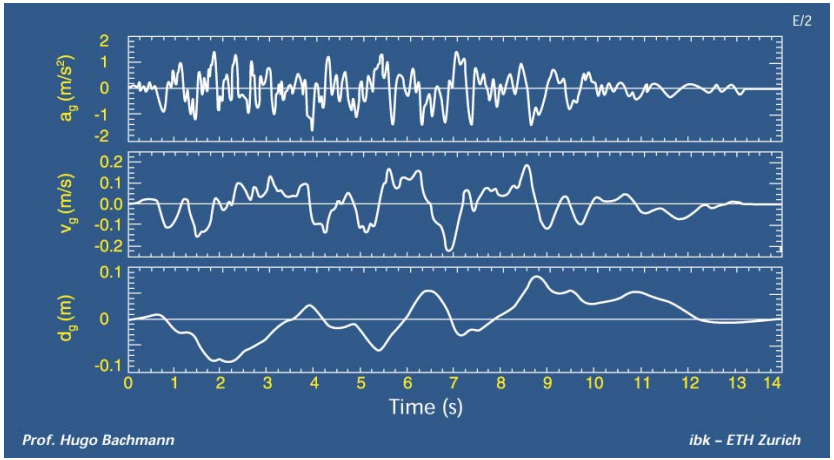


Image 4 : Linear Horizontal ground motion chart of an artificially generated " Valais Quake"

Seismic waves

There are three different types of seismic waves;

- P (primary) waves: They have the highest speed. They can travel through solid and liquid materials in the earth. During their passage rocks expands and compresses. People cannot sense this wave.

- S (secondary) waves: They come after P waves. They can travel through only solid materials. Rocks can move up and down, or right and left. People cannot sense these waves but it is said that animals can.

- Love and Rayleigh waves: They are the last waves to pass, and are causing most of the shakings. These waves travel on the surface of the earth. Love waves create a right-left movement on the surface. Rayleigh waves' effects are more an up-and-down and forwards-backwards movement. People can sense these waves which do most of the damages.

Ground motion parameters

"The effects of an earthquake on a building are primarily determined by the time histories of the three ground motion parameters: ground acceleration (a_g), velocity (v_g), and displacement (d_g), with their specific frequency contents."[3]

Variation of these parameters depends on numerous factors: distance and depth of the *epicentre*, fault zone characteristics, and local soil conditions.

Magnitude and Intensity

The magnitude is the classification of the energy released during an earthquake; *Richter scale* is the commonly used scale. The intensity is the classifications of the repercussions of the strength of shakings produced by an earthquake, classified with the *Mercalli Intensity scale.*

Table 1 : Magnitude and Frequencies of Earthquakes occurrences

Magnitude	Average Annually
8 and higher	1 [1]
7 - 7.9	17 [2]
6 - 6.9	134 [2]
5 - 5.9	1319 [2]
4 - 4,9	13,000 (estimated)
3 - 3.9	130,000 (estimated)
2 - 2.9	1,300,000 (estimated)

[1] Based on observations since 1900.
[2] Based on observations since 1990.

Table 2 : Modified Mercalli Intensity Scale

I. Not felt except by a very few under especially favourable conditions.

II. Felt only by a few persons at rest, especially on upper floors of buildings.

III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.

IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.

XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Image 5 : Socio-Economical effects

Earthquake's effects

Earthquakes that have the same magnitude can have different effects depending on the distance to the epicentre, the direction of the waves, the depth of the epicentre, the mechanism of the fault line and the local soil characteristics. Tsunamis are very large and destructive waves, generally caused by a tremendous disturbance in the ocean, such as an undersea earthquake or a volcanic eruption.

Socio-Economical effects

Socio-economical effects vary depending on the economic status of the country where the earthquake occurs. Because developed countries have an installed and controlled building code, the damages are less important than in developing countries or less developed countries. Economically less developed countries generally have urban development planning problems, which can turn a natural disaster into a catastrophe.

Economic effects

In a case of disaster less developed countries will be suffering from a serious long term economic impact. People lose their homes, their belongings and some lose their incomes such as their stores or factories. The country has to mobilise many resources for rescue operations and for the victims' safety.

Sociological effects

Earthquake victims are traumatised by the lost of their relatives, their homes, their belongings and their source of income. The first reaction of the survivors is to try and save the people stuck under the debris. Unfortunately, they often rush things and disrupt the rescue operations led by trained teams. As for uninjured people, after having got over the initial shock, they find themselves homeless and without anything.

Image 6 : Socio-Economical effects

Geological effects

Movement of tectonic plates can cause significant changes on the earth's surface: most of the heavy damages are created by displacement of the fault lines. Landslides, mudflows, avalanches, tsunamis and liquefaction of sandy grounds are other effects of earthquakes.

Image 7 : The San Andreas Fault

Image 8 : Landslide, Colonia Las Colinas

Image 9 : Landslide, Yingxiu, Sichuan Province, China

Effects on man-made structures

Natural hazards mostly turn to be disasters because of damages done to man-made structures. Damages caused to infrastructures may delay urgent actions, no communication and even in some situation no road been available to access to the required site.

Shocks of seismic waves can cause serious disturbance to the substructure of the city. Natural Gas pipe lines, LPG and Petrol stations can explode. Most of the time communication and electricity are completely or temporarily cut off. Buildings may collapse and block the roads or a fault line may deform a road or a railroad.

Buildings are the structures the most affected by earthquakes. Their damages vary depending on their construction type and construction conditions: respected construction regulations or earthquake resistant structures. It can be said that wooden structures are more resistant than RC framework structures because of their flexibility.

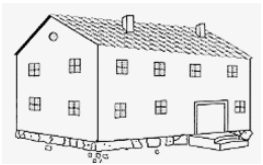
Image 10 : Damages to Man-made Structures, Izmit

Image 11 : Total Destruction, Izmit

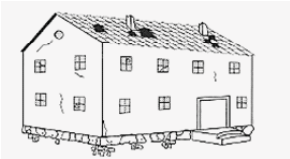
Classification of Damages & Vulnerability

European Macroseismic Scale 1998: EMS-98

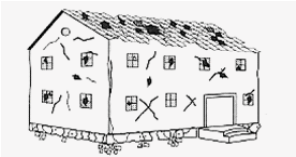
Table 3 : Classification of Damage to Masonry Buildings



Grade 1 : Negligible to slight damage (no structural damage, slight non-structural damage)
- Hair-line cracks in very few walls.
- Fall of small pieces of plaster only.
- Fall of loose stones from upper parts of buildings in very few cases.



Grade 2 : Moderate damage (slight structural damage, moderate non-structural damage)
- Cracks in many walls.
- Fall of fairly large pieces of plaster.
- Partial collapse of chimneys.

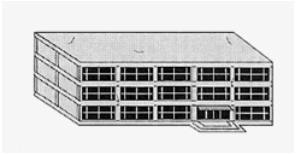


Grade 3 : Substantial to heavy damage (moderate structural damage, heavy non-structural damage)
- Large and extensive cracks in most walls.
- Roof tiles detach. Chimneys fracture at the roof line; failure of individual non-structural elements (partitions, gable walls).

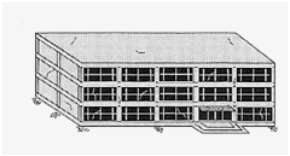
Grade 4 : Very heavy damage (heavy structural damage, very heavy non-structural damage)
- Serious failure of walls; partial structural failure of roofs and floors.

Grade 5 : Destruction (very heavy structural damage)
- Total or near total collapse.

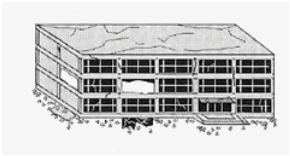
Table 4 Classification of Damage to Buildings of Reinforced Concrete



Grade 1 : Negligible to slight damage (no structural damage, slight non-structural damage)
- Fine cracks in plaster over frame members or in walls at the base.
- Fine cracks in partitions and infill's.

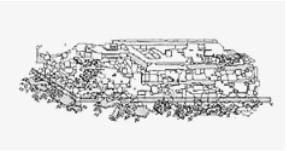


Grade 2 : Moderate damage (slight structural damage, moderate non-structural damage)
- Cracks in columns and beams of frames and in structural walls.
- Cracks in partition and infill walls; fall of brittle cladding and plaster. Falling mortar from the joints of wall panels.



Grade 3 : Substantial to heavy damage (moderate structural damage, heavy non-structural damage)
- Cracks in columns and beam column joints of frames at the base and at joints of coupled walls. Spading of concrete cover, buckling of reinforced rods.
- Large cracks in partition and infill walls, failure of individual infill panels.

Grade 4 : Very heavy damage (heavy structural damage, very heavy non-structural damage)
- Large cracks in structural elements with compression failure of concrete and fracture of rebars; bond failure of beam reinforced bars; tilting of columns.
- Collapse of a few columns or of a singe upper floor.



Grade 5 : Destruction (very heavy structural damage)
- Collapse of ground floors or parts (e.g. wings) of buildings.

Table 5 : Differentiation of Structures into vulnerability classes (Vulnerability Table)

	Type of Structure	Vulnerability Class A	B	C	D	E	F
MASONRY	rubble stone, fieldstone	○					
	adobe (earth brick)	○	⊣				
	simple stone	⊢ ··○	⊣				
	massive stone		⊢	○	··⊣		
	unreinforced, with manufactured stone units	⊢ ··○	··⊣				
	unreinforced, with RC floors		⊢	○	··⊣		
	reinforced or confined			⊢ ··○	··⊣		
REINFORCED CONCRETE (RC)	frame without earthquake-resistant design (ERD)	⊢ ·····	·····	○	··⊣		
	frame with moderate level of ERD		⊢ ·····	·····	○	··⊣	
	frame with high level of ERD			⊢ ·····	·····	○	··⊣
	walls without ERD		⊢	○	··⊣		
	walls with moderate level of ERD			⊢ ··○	··⊣		
	walls with high level of ERD				⊢ ··○	··⊣	
STEEL	steel structures			⊢ ·····	·····	○	··⊣
WOOD	timber structures		⊢ ·····	·····	○	··⊣	

○ most likely vulnerability class; — probable range;
·····range of less probable, exceptional cases

Image 12 : Pancake, Duzce

Image 13 : Soft Story, 2003 Boumerdes Earthquake

Image 14 : Short Column

Image 15 : Liquefaction

Detailed Damages to buildings [4]

Soft story:

In the case of Turkey most of the buildings ground floors have a commercial use. Because of the need of a maximum free space for the commercial use, ground floors' plans consist of columns only, no bracing elements like shear walls or truss bracings are used. Columns take damages because of the cyclic displacement, causing the ground floor to collapse sometimes leaving the upper floor intact.

Pancake effect:

It is the same effect as "soft story effects" put on upper floors. If horizontal resisting of the building is weakened or if the bracings have been forgotten, the upper floors can collapse one upon the other.

Short column:

Shear failures occur on columns which are thick compared to their height or are restrained by a masonry wall to half of their height, like a parapet wall. The upper and lower parts of the captive column have a different plastic deformation which creates the deformation. This effect can occur also if a frame structure is partially infill.

Liquefaction:

Soils like sandy soils can behave like liquids because of vibrations. In that case half of or the entire building can sink. Liquefaction is a phenomenon in which the strength and stiffness of the soil is reduced by earthquake.

"Liquefaction occurs in saturated soils, that is, soils in which the space between individual particles is completely filled with water. This water exerts a pressure on the soil particles that influences how tightly the particles themselves are pressed together. Prior to an earthquake, the water pressure is relatively low. However, earthquake shaking can cause the water pressure to increase to the point where the soil particles can readily move with respect to each other." [5]

Torsion's effects:

Buildings tend to twist about their centre of gravity. During an earthquake the building twists in a horizontal plane around its centre of gravity. When the rigid part (the centre of resistance) is away from the centre of gravity the structure collapses.

Damages to frame structures and X (cross) shaped cracks:

Concrete frame structures are mostly filled with masonry walls. They have different ductility, flexibility and rigidity. If the masonry walls are stronger than the columns, the columns are damaged and this often leads to collapse. If the columns are stronger than the masonry, either they crack in X shaped or they are completely destroyed.

Resonance between adjacent buildings:

In dense cities the buildings are mostly adjacent. Hammering and pounding may occur during an earthquake between those buildings. Most of the time, because of their height difference, their floor slabs are at different levels, so during oscillations floors slabs of one building can hit the adjacent building's columns creating a substantial damage, it may even lead to a total destruction.

Image 16 : Torsion

Image 17 : X (cross) Shaped Cracks

Image 18 : Resonance

Earthquake Resistant Construction / Design Principles [6]

→ Skeletal structure design principles:
- The use of lateral bracings can prevent soft story effect and pancake effect.
- Two walls in each major direction, acting as bracings during an earthquake, will be sufficient to avoid twisting.
- Offset bracings should be avoided; the offsets disturb the direct flow of forces, weaken the resistance and reduce the ductility of bracings.
- Modifications in the cross section of bracing system create discontinuities in stiffness and resistance causing a disturbance in the flow of forces and irregularities in the dynamic behaviour and so must be avoided.
- Mixed systems of columns and structural masonry walls must be avoided because of their different behaviour during an earthquake.
- Short columns should be avoided.
- Steel structures can have a low ductile or a brittle behaviour under cyclic actions so diagonal steel bracings should be designed accordingly.
- Holes on bearing capacity walls should be avoided.
- Connection points of prefabricated buildings should be secured, because they are designed for construction gravity loads only.
- Foundation structures should always remain elastic.
- Asymmetrical horizontal bracings should be avoided: during an earthquake the building twists on a horizontal plane about the centre of stiffness. If the centre of stiffness is away of the centre of gravity a columns' failure or a total destruction can occur.
- Adjacent buildings should be separated by joints; they must be empty to enable free oscillations and they must have a minimum width which is specified in building regulations.
- Compact plan configuration is necessary to avoid the hammering between different wings of the building. Wings have different plan direction so they will oscillate differently, damaged caused by these oscillations can be avoid by empty joints.

→ Design principles of non-structural elements:
- Non-structural masonry infill of the RC frame structures should be avoided. If needed separations of these should be made by soft joints otherwise X shaped cross occur on infill during an earthquake.
- In pure masonry buildings walls should be reinforced longitudinally so they can resist horizontal actions.
- Non-structural walls and facades which are integrated to the skeletal structure should be separated by soft joints, so they cannot collapse because of the flexibility of the frame.
- All different kinds of materials should be separated by joints.
- The stabilising and confining transverse reinforcement must be anchored with 135° hooks.
- Facades elements and free standing parapets walls should be anchored to prevent them from falling during the earthquake.
- Connections of suspended ceiling and light fittings should be design to carry vertical and horizontal accelerations and vibrations. Installations and equipment also should be fastened.

Image 1 : Map of Turkey

Image 2 : Map of Europe

TURKEY

Situation

Turkey is a peninsula surrounded by the Black Sea in the North, Sea of Marmara, the Aegean Sea in the West and the Mediterranean Sea in the South. The west of Anatolia is separated by the Bosphorus and the Dardanelles straits, creating a natural border between Europe and Asia. Geopolitically well situated, Anatolia has been the cradle of many different cultures and empires. Its importance as the starting point of the northern land route of the Silk and Spice Road is also a reason for this multicultural civilisation history.

Culture

Turkey's culture has been influenced by both Easter and Western cultures because of its geographical situation. Family is the foundation of the culture. The core of the family consists of the father, mother and children, but each individual of both the mother's and the father's sides are members of the family. Most of the core families live with one of the elders of the family. It is a patriarchal society; the fathers work and bring money home and the mothers take care of the house. That is why, when immigration starts inside or outside the country, the father goes first, then when he has settled the family follows, and then the other relatives. This behaviour also explains the apparition of the regional districts or sub-districts within big cities.

Geology & Earthquake Risks

Turkey is one of the countries where a natural catastrophe can turn into a disaster. Geological and topographic positions, local socio-politico-economic conditions, and fast settlements due to migrations are reasons for of these possible disasters. In Turkey, according to earthquake region maps, 70% of the total population lives on high (first and second) degree earthquake zones.

Table 1 shows the percentage of dwelling units destroyed by natural disasters during the last 70 years in Turkey. Earthquakes prove to be the most damaging natural disasters in the country.

Turkey is at the intersection of three plates, Arabian, Eurasian and African. "This interaction among plates created a different fault system in Anatolia and surrounding regions". [1]There are two main active fault lines in Anatolia: the first is the North Anatolian Fault (NAF), and the second is the East Anatolian Fault (EAF).

Over centuries many earthquakes, with a magnitude (M) 6 or plus, have occurred on NAF. The most recent earthquakes on this fault occurred in Izmit in August, 1999, with a 7.4 magnitude and in Düzce in November, 1999, with a 7.2 magnitude. This point out the high probability of another big earthquake along this fault, possibly located in the Marmara Sea, due to the east-to-west progression of seismic activities along NAF. The stress accumulation maps show this movement along the active fault line.

Table 1. Percentage of Types of Disaster in Turkey

Natural Disaster Type	% of Total
Earthquake	61
Flood	14
Landslide	15
Rockfalls	5
Fire	4
Avalanche, storm, rain	1

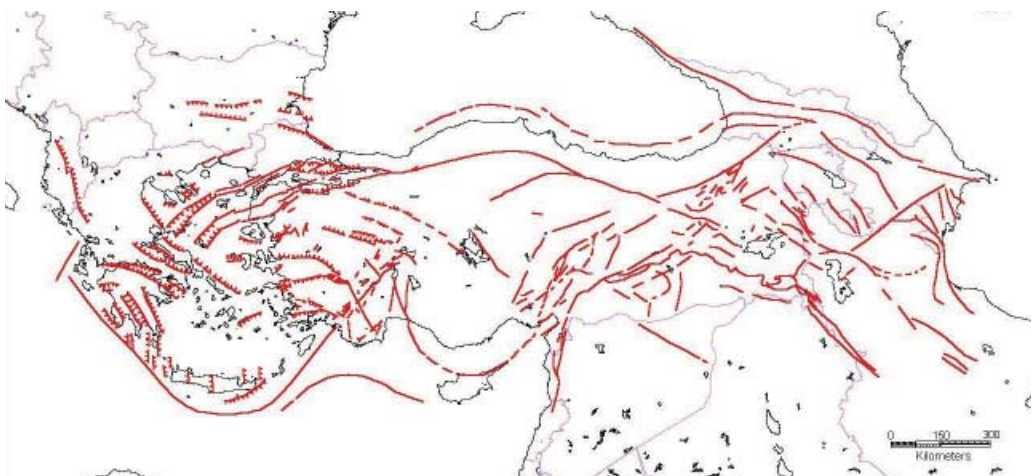


Image 3 : Turkey's Fault Lines

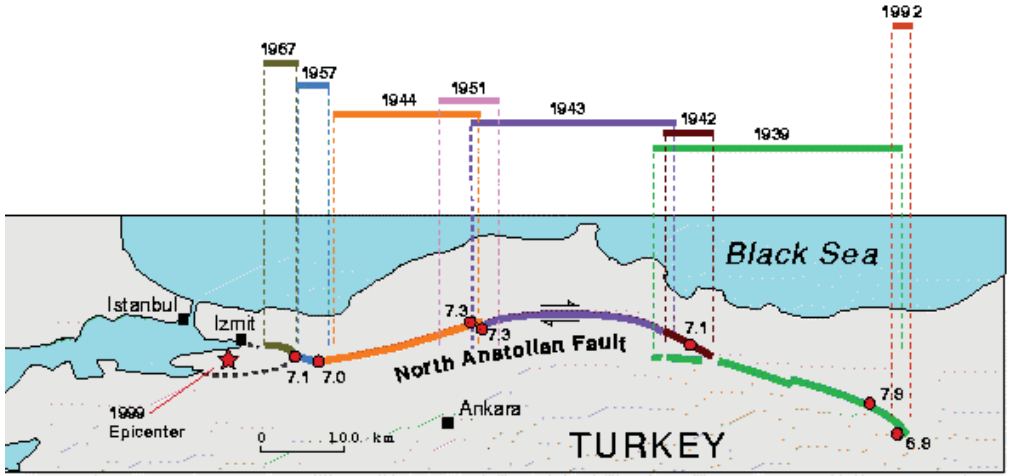


Image 4 : NAF the East-to-West Progression

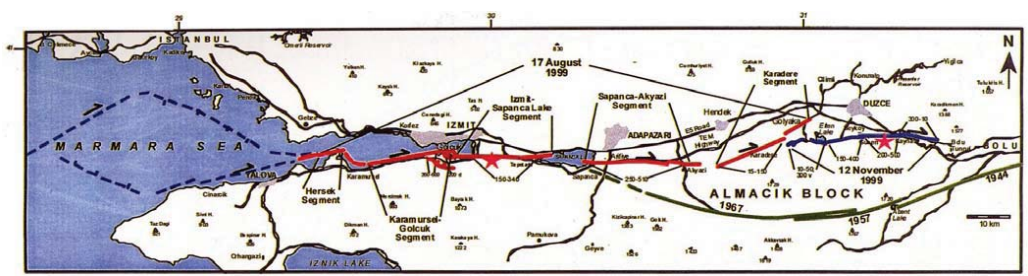


Image 5 : Izmit Earthquake

The Izmit Earthquake August 1999

In August 1999 around 03.00am a 7.4 magnitude earthquake started and lasted for 40 to 45 seconds. Most of the damages were caused by the length of the earthquake.

"The losses from the two Marmara earthquakes were devastating: around eighteen thousand people lost their lives and fifty thousand people were injured. In the two earthquakes, more than three hundred thousand housing units and forty-six thousand business premises were damaged, and 321,000 people lost their jobs". [2]

Post-earthquake studies and inspections showed the vulnerability of structures in Turkey. Along the poor construction quality, it pointed to problems with construction techniques and materials, and inadequate planning decisions such as allowing construction on fault line. But it also showed that the authorities were unprepared and unorganised for a disaster. Many problems occurred with the organisation of the rescue teams, the relocation of victims and the distribution of primary needs like food, drinking water, and clothes. The breakdown of the communications means was not only due to the insufficient infrastructures, which did not resist the earthquake, but also to the desire of the victims to join their relatives and friends as soon as possible

The Turkish government studied and understood their shortcomings in this type of situation. They asked themselves what would have happened if this earthquake had hit a bigger city like Istanbul. But detailed researched showed that Turkish authorities' worst nightmare may happen during the next 50 years.

Problems / Lessons Learned [3]

- Public buildings like schools and hospitals were not resistant to earthquakes, 47 schools collapsed while 377 others were damaged. Foreign aid teams had to set tent hospitals because all the local hospitals had collapsed.
- The only officers able to organize and direct a rescue operation were killed because a fault line ran through the naval base headquarters.
- Displacement of the fault line cut off the main telecommunication fibre optical cable. The telephones lines were unusable for the first 48 hours because of the high calling rate. Radio was the only means of communication. It took the authorities two days to understand the situation.
- Rescue activities: the second day at 5pm the first rescue teams arrived at Izmit. Each province in Turkey had 50 to 150-member rescue and relief teams, but they existed only on paper. Most of them lacked training; there were no serious plans neither for their mobilization, nor for the allocation of equipment for those who reached the affected area. The fire brigade had never been trained to do heavy rescue operations and they had not enough of the necessary tools and equipments for these kinds of operations. It took two days to ten people to remove a collapsed building where no victims were buried and with no legal problems. If there had been buried victims, or necessary legal procedures, the work would have been much more delayed. Heavy machines could not cut the columns of collapsed buildings.
- Search activities: both search and rescue operations were ineffective because they were not organized. Lack of guide slowed the rescue work. Searched buildings were not marked so a building was searched several times. There was a sound problem: one building was demolished using heavy machinery

Image 6 : Devastated City

Image 7 : Problems

Image 8 : Problems

while rescue teams were trying to hear victims crying for help in the next building. Logistic support was lacking. Non-trained rescuers created dangerous situations. During the night rescue operations slowed down because of the inefficient lightning. Following protocols delayed the activities.

- Engineers from the Ministry of Public Works and Settlement came 12 days after to do an official building damage assessment. The results of rapid inspection were not utilised for official assessment, nor were the results of official damage assessment given officially to the municipalities.
- Municipalities tried to open bank accounts for donation, but could only deal donated goods. The donated money could only be handled by the governor. People gave clothes and food together, so the food rotted. Another problem was the arrival of volunteers who came without food and who had nowhere to stay.
- There was enough medical stock for the first three days. After that period, necessary medicines were available by donation. Working with foreign rescue members was difficult because there were no translator in emergency management centres. Some of the medicines donated from abroad were not used because they lacked Turkish instructions.
- Psychological problems: Experiencing an earthquake is a traumatic experience and often leads to changes in people's behaviours. For example the fear of going back to concrete houses makes the people want to stay in temporary prefabricated houses. Another problem is anxiety, especially for the rescue team volunteer being without news from their families
- Relocation problems: Permanent housing areas were selected in good ground, but away from the city centre. The new areas lacked sufficient public transportation and social facilities such as schools and clinics. As a result, people preferred to live in temporary housing near the city centre. The tent cities lack of infrastructure was problematic.

Tent Villages

In Turkey in an emergency situation refugees are first oriented toward tent villages, and then toward temporary houses. These villages can be inside and outside the city. Most tents belongs to Kızılay (Turkish Red Crescent), they are made of cotton or polythene materials and are assigned a four-people family unit. These tents have been used over and over for many years. If the Kızılay's tents are in short supply the Turkish army's or international agencies' tents are used; the army's tents are thermal tents and can shelter about twenty people. All the emergency shelters are not tents, for example the Shigeru Ban paper tube houses which were used after the Düzce earthquake. These paper tube houses provide a quality environment for the refugees. "Paper tube construction provides, at minimal cost, a temporary dwelling that is more stable than the tents traditionally used in emergencies. It succeeds because it is available in a variety of thickness and sizes, and is durable, light, beautiful, and easy to make, transport, and install." [4] In a few seconds people can lose their homes, their relatives, their whole family, this situation leads to psychological problems, so providing them with a temporary shelter with a minimum comfort and a good environmental quality is important. They should at least have a warm place where they can take refuge after having to struggle through queues to get some food or water.
In Turkey, because the urban tissue consists of dense housing blocks with insufficient parks and open spaces, there are not enough places to accommodate all the refugees inside the cities limits, so tent villages have to put up outside the cities. It should never be forgotten that these shelters are temporary and only suitable for few months, unfortunately, as we have seen after the Izmit earthquake a few months became year because of the slow construction of temporary housings. Then these late constructed temporary housing became regular housings because of the unending reconstruction process of the city.

But today these areas are predefined to provide more efficient installation process. Disaster management gained a new status after these major earthquakes in Turkey.

Image 9 : Tent Village Izmit

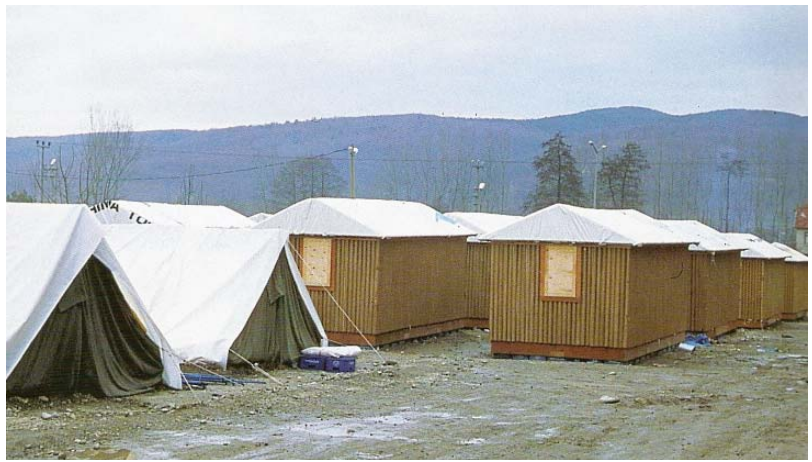


Image 10 : Shigeru Ban Paper Tubes Temporary Houses Düzce

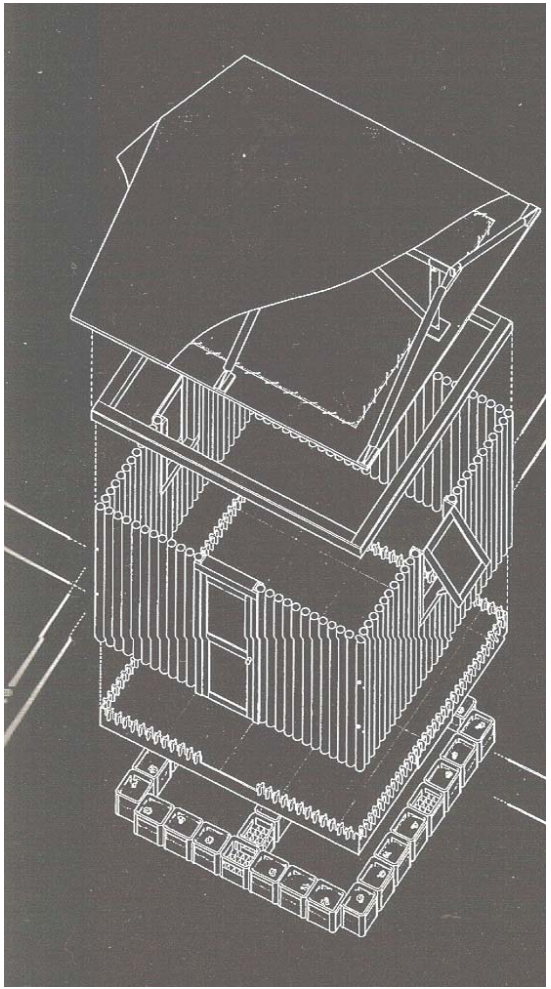


Image 11 : Shigeru Ban Paper Tubes Temporary Houses

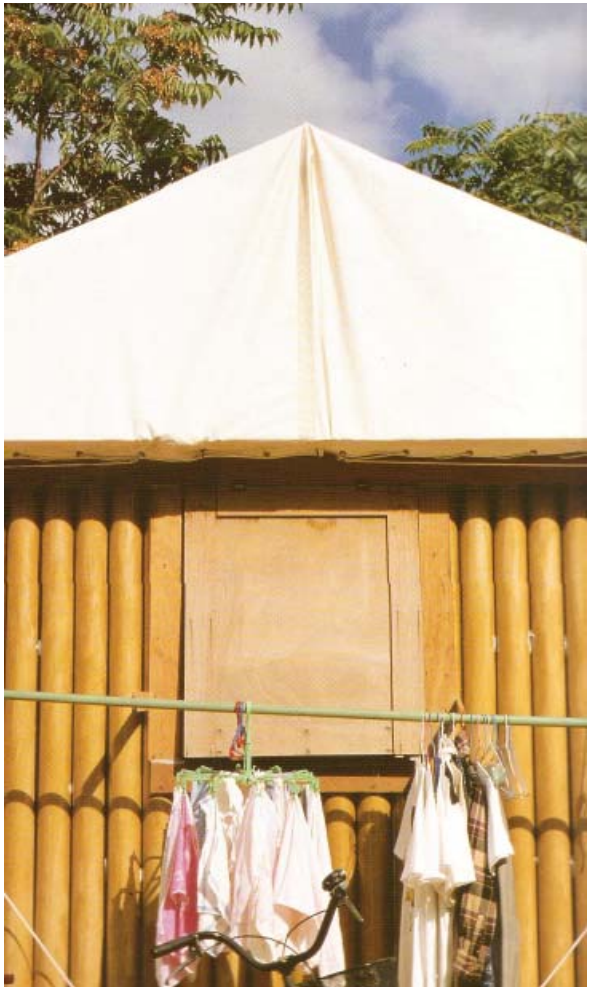


Image 12 : Shigeru Ban Paper Tubes Temporary Houses Kobe

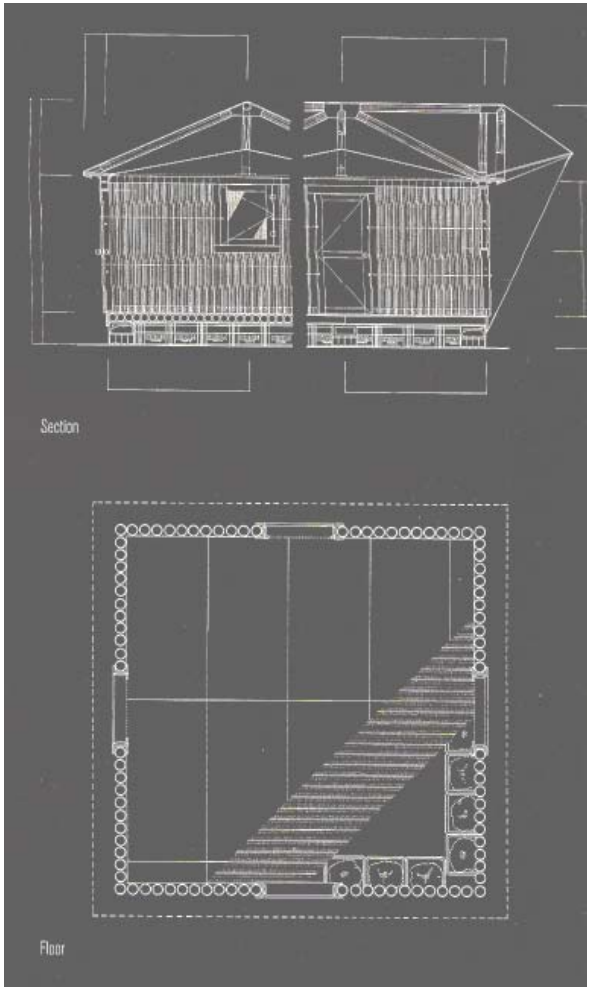


Image 13 : Shigeru Ban Paper Tubes Temporary Houses Plan and Section

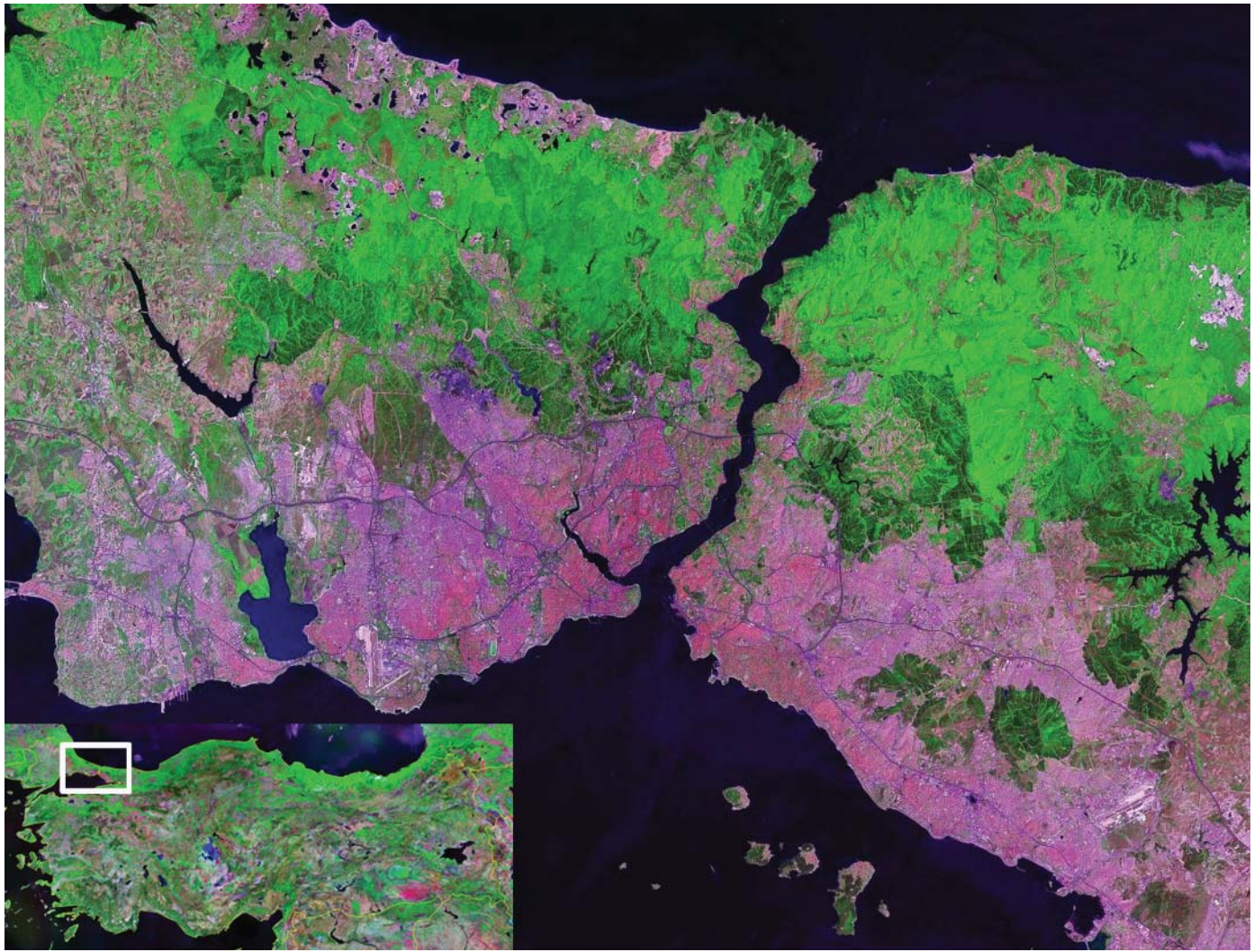


Image 1 & 2 : Maps of Turkey & Istanbul

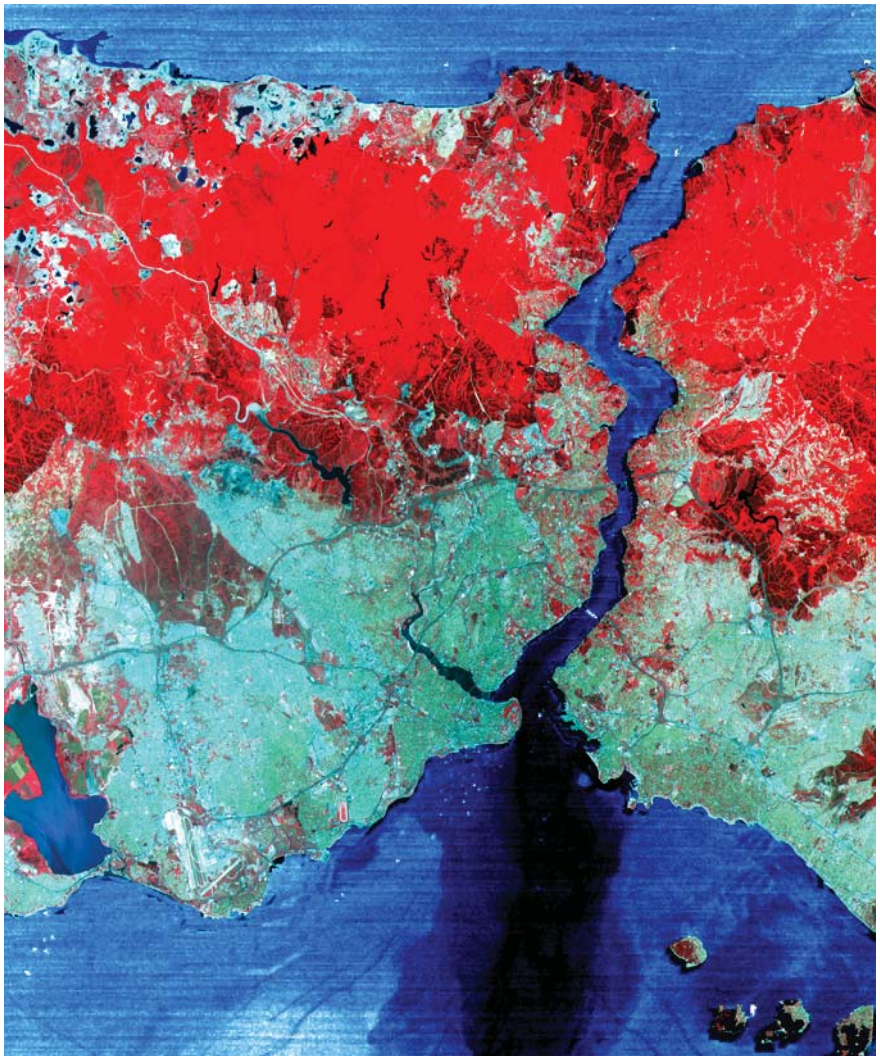


Image 3 : Maps of Istanbul

ISTANBUL

Situation

Istanbul is in the North-East of Turkey between the Black Sea in the North and the Marmara Sea in the South. The city is divided in two by the Bosphorus straits, as a geographical reference, European and Asian sides. The oldest part of the city is the Historic peninsula, which is on the European side entrance of the Bosphorus. The two sides are connected by two bridges: the Boğaziçi Bridge, the first one, can only be used by cars and Municipality buses, and the second bridge, the Fatih Sultan Mehmet Bridge, is open to all vehicles. Boats and ferry boats cross the straits every day and are used by millions of commuters mostly from the Asian side to the European side in the morning and vice-versa in the evening. The city's geological separation is also a social division: the European side is the economic centre and the Asian side is mostly residential.

History

Istanbul has a very long history and has been the capital of many empires. Constantinople was the capital of the Byzantine Empire, and was located on the Historic peninsula. In 1453 it became the capital of the Ottoman Empire having a symbolical importance for them. It protected its identity as a capital because of its already established importance as an economic and cultural city. After the foundation of the Republic of Turkey in 1923, Ankara became the capital because of its geopolitical importance. Istanbul lost its status of capital city. Around 1930 it became the economic and industrial centre of the country.
The population was mostly concentrated on the Historic peninsula and on the European side of the Bosporus. The Asian side was mostly rural areas or urban areas with summer houses for rich people. The Historic peninsula (the Fatih district) was the only economic, cultural and industrial centre till the '50s when Istanbul became a multicentre city.

Urban Growth

Istanbul (the Historic peninsula) has always been a fortified city. The first wall was constructed during the Severan Dynasty, between 193 and 235. At the beginning of this dynasty the city consisted mainly of an acropolis. As it grew a hippodrome was added.
The second wall was constructed about 3km outside the first wall by Constantine (272-337), who called the city Constantinople. It was a single wall with towers at regular intervals. During the reign of Constantine the city gain much in importance thus many urban changes occurred. Several monuments were restored, two new temples were constructed, narrow streets were enlarged and an imperial palace was built among many other new buildings. The idea was to create a new Rome. [1]
The third wall was constructed about 1.5 km outside the second wall by Theodosius II (401-450). It was about 5 km long, from the Golden Horn to the Marmara Sea. The single line wall was partly destroyed by an earthquake in 447. During the reconstruction, a second line of wall was added with a ditch in front of it.

During the Medieval era the city grew towards the other side of the Golden Horn. A new district appeared: Pera, which was encircled by a wall too.

In 1453, Constantinople was conquered by the Ottomans. A new palace, Topkapı Palace, was built over the ancient emplacement of the Severan Dynasty's. Constantinople became Istanbul. Istanbul developed and reached its peak around the 16th century. It became the governmental and economic centre with its vast bazaar complexes, monumental mosques and the palace. Around the 18th century the use of Topkapı Palace was abandoned and a new palace was built, Dolmabahce Palace, on the European shore of the Bosporus, due to western influences on urbanization. The wealthy class followed along the Bosporus; so a new spatial organization appeared. The districts were not founded on an ethnic or religious basis but more on a socio-economic one.

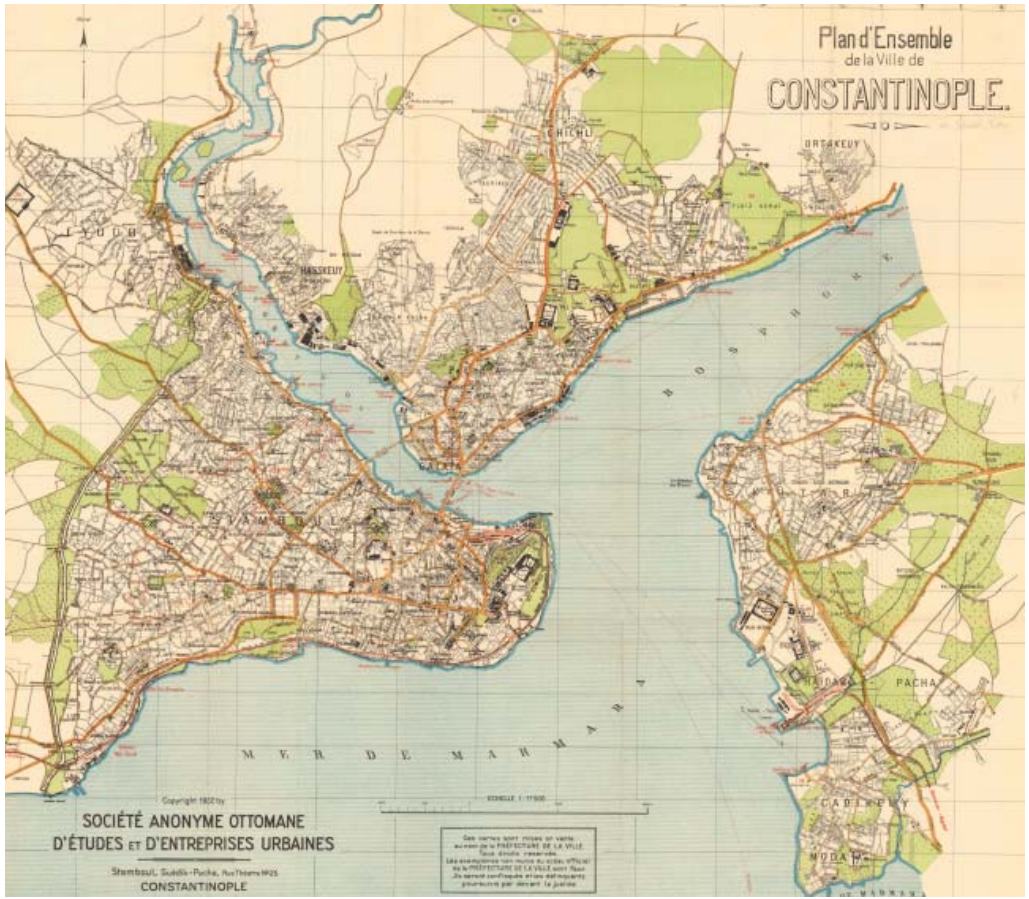


Image 4 : Maps of Istanbul in 1922

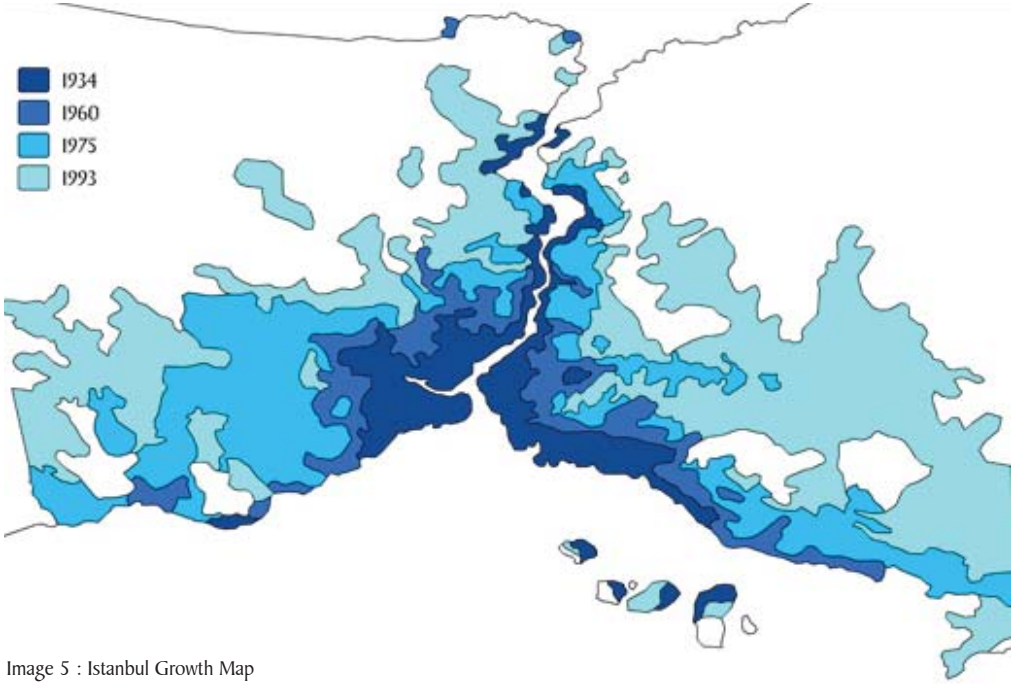


Image 5 : Istanbul Growth Map

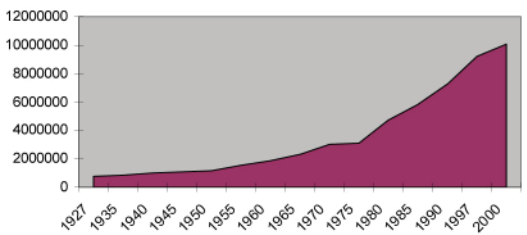


Table 1 : Istanbul Population Growth

The Golden Horn shores, along the Historic peninsula, became the economic centre, because of the bazaars, the merchants and the harbour. The city continued to grow on both sides of the Golden Horn, walls surrounding the Historic peninsula acting as a natural border till the '50s.

In 1923, with the foundation of the Republic, and after losing its status as the capital, the population started to decrease and it lost half of its population in a decade.

In 1936 Henry Prost, a French urban planner, took charge of the modernisation process of Istanbul. His planning approach was to destroy the old urban fabric and replace it with large streets and boulevards. His approach was more like a beautification process; the rapid growth of the city was not taken into consideration which created a lack of housing. Around 1950 his plans were utterly criticized by academic circles. Demand for housing was so high, and non-answered, that slum areas became more and more dense, and uncontrollable.

To be able to deal with the problem of shanty urban tissue which grew rapidly around Istanbul Municipality borders, the government decided to create new municipalities on the problematic zones. But the lack of knowledge and funds prevented most of these new districts to stop the growth of the slum areas. "In 1966, the *Squatter Housing Law* brought a new perspective to the phenomenon of *gecekondu* (Turkish word meaning "built overnight"), acknowledging them as both a social and a physical problem. The ministry developed a fund to provide loans for residents, to build and repair houses or to buy land. A second fund was provided to the municipalities to buy and build houses and provide public services. However the law also made clear that rural invasion to the municipal and public land was not acceptable, and such properties would be immediately demolished." [2] In 1976, all the slum areas built before that date became legal by a new law and thus created poor quality urban tissue with an inadequate infrastructure.

Istanbul grew rapidly after 1950, from 1 million habitants (1950) to 12.573.836 [3] today; the population density is 2420 person per square kilometre. [4] Istanbul was, and still is, the main destination of migration from rural areas, because of its importance as a social, economic and geopolitical centre. This growth still continues, new slum areas appearing mainly around the two major arteries: the TEM (Trans-European North-South Motorway) and the E-5, known as D-100 (the second major highway of Istanbul). And then after a certain time and for some reasons, these slums became legal urban zones. There is no distinction between industrial and residential areas. Even though slum areas have been legalized, most of the areas do not have building usage permission. "There are 724609 building according to the year 2000 data, and 80% of the buildings (that has actually been in use) have no building usage permissions."[5]This fast growth caused an unplanned use of lands, uncontrolled housing, inadequate infrastructure and quick depletion of the surrounding resources.

Image 6 : Istanbul Today

Image 7 : 1556 Istanbul Earthquake

Earthquake Risks

History

The Marmara Sea is located at the end of the NAF, which proved to be an active fault zone over 2000 years. As Istanbul is on the North of this zone it has always been shook by earthquakes. Some of them have caused significant damages.
One of the first to be recorded was in 447 A.D. It destroyed part of the third wall (Theodosius' wall) which was reconstructed in 60 days along with the second wall and the ditch. [6] During the 6th century Istanbul was struck by many earthquakes with a magnitude of 7.0 or more, in 543, 544, 555, and 557. The 557 one was followed by a plague epidemic. [7]

During the Ottoman reign three major earthquakes were recorded. The first one was in 1509, near Gebze and the Princes' islands. Among the citizens this earthquake was known as the "little apocalypse". Reports said that every house in both the Historic peninsula and Pera was damaged. It had been reported that in some areas water and sand erupted from the surface. The secondary waves lasted for months. Damages, according to Ambraseys & Finkel were as follow: around 1000 buildings were destroyed, 49 wall towers were destroyed or had suffered heavy damages, all the walls along the shores were destroyed, and Galata tower, in the Pera district, was totally destroyed. [8]

The second one was in 1766 in Tekirdağ with a 7.7 magnitude. Tsunami waves appeared. All regions around the Marmara Sea reported heavy damages. Most damages were concentrated in the Historic Peninsula, and many towers along the wall collapsed. Topkapı Palace underwent so many damages that during months the Sultan slept in a tent placed in the palace garden. The dome and minarets of the Fatih Sultan Mehmet mosque collapsed and reconstruction lasted 5 years.

The last one was in 1894 with a magnitude of 7.0. All the Shores of the Marmara Sea were affected by this earthquake; most damages and casualties were in Izmit and Istanbul. In Istanbul, it is said that it caused so much panic that citizens ran and screamed. Fisherman ships sank and when people looked toward the city from boats they saw big dust clouds caused by the collapsing buildings. Surface ruptures appeared in all Istanbul, one of them was 3km long 8cm wide. [9] "Many dwellings that did not fall were greatly damaged that they have been condemned and former occupants driven to tents." [10]

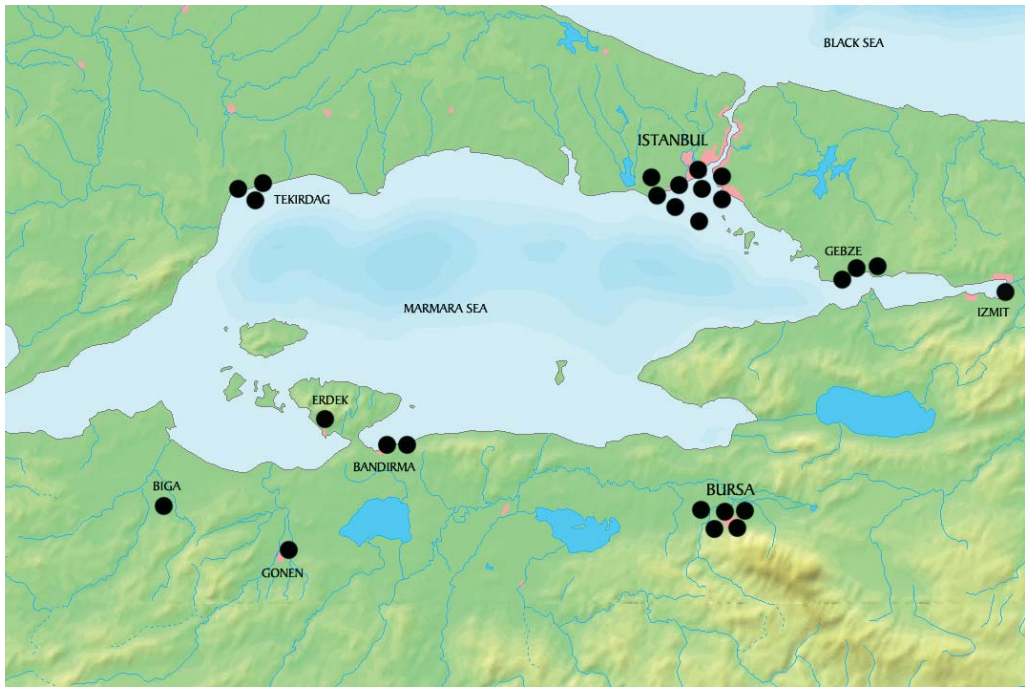


Image 8 : Historic Earthquakes in Marmara Sea Region

Table 2 : Marmara Region Earthquakes with Magnitude 7.0 or greater

Date (A.D.)	Magnitude	General Area
29	7.0	near Bursa
170.05.03	7.0	near Bursa
447.11.08	7.5	SW of Istanbul
450.01.26	7.0	near Bandirma
477.09.25	7.0	near Istanbul
488.09.26	7.0	near Gebze
543.09.06	7.0	near Erdek
544.08.15	7.0	near Gebze
555.08.16	7.5	Istanbul
557.12.14	7.0	Istanbul
715	7.0	Bursa
740.10.26	7.4	W of Istanbul
986.10.26	7.5	near Istanbul
1010.01.08	7.3	SW of Tekirdag
1063.09.23	7.2	W of Istanbul
1344.10	7.2	E of Tekirdag
1509.09.14	7.0	near Gebze
1766.08.05	7.7	Tekirdag
1855.02.28	7.5	Bursa
1855.04.11	7.0	Bursa
1894.07.10	7.0	S of Istanbul
1912.08.09	7.3~7.5	N of Biga
1953.03.18	7.4	near Gonen
1964.10.06	7.0	near Bandirma
1999.08.17	7.6	Izmit

Today

"Earthquake probability calculations forecasted a probability of an M>7 earthquake affecting Istanbul (Marmara Sea as epicentre) is 41% within 30 years." [11] Facing this probability and after seeing the result of unpreparedness of the Marmara earthquakes, authorities started a large scale research on the issue. First the Istanbul Provincial Governorship established the ISMEP Istanbul Seismic Mitigation and Emergency Preparedness project. Soon after, for a deeper understanding of the current situation and risk, the Japan International Cooperation Agency, JICA, prepared a "Study on Disaster Mitigation / prevention in Istanbul Seismic Micro-zoning". Then Istanbul Metropolitan Municipality, IMM, commissioned a committee from four leading Turkish Universities to prepare an "Earthquake Master Plan for Istanbul, EMPI. This master plan is based on the JICA report and tries to bring concrete solutions for the problems of Istanbul.

ISMEP [12]
It has been created soon after the 1999 Marmara earthquakes under the direction of Istanbul Governorship Special Provincial Administration and financed by The World Bank. Its aims and objectives are to:

- Enhance the institutional and technical capacity for disaster management and emergency response.
- Strengthen critical public facilities for earthquake resistance.
- Increase disaster awareness and developing safe-living by public training.
- Assess the seismic risk of cultural heritage buildings.
- Support measures for better enforcement of building codes and land use plans.

The following projects were done according to ISMEP project objectives:

- Planning Efforts : provincial disaster instant relief and rescue plan like communication services planning, logistical support coordination services and Humanitarian Aid organization services planning, search, rescue, and fire services planning.
- Retrofitting Studies: studies and retrofitting activities for important public buildings like schools, hospitals and social service buildings.
- District Disaster Volunteers Support, DDVS: creating teams and assuring their education for search and rescue operations.
- One Disaster Station per District, ODSPD: placing containers with first aid materials and enough basic materials for victims to survive till the search and rescue teams arrive. These containers are placed at key points in each district.

In this project most of the analyses to determine the vulnerability of a building are done by engineers, analysing not only the physical components of the building but also the vulnerability which differs according to the construction type and year of the building, and the economic and educational class of its inhabitants.

Today this project has been transferred to AKOM and most of containers are been removed because people are stealing equipments put in them for emergency situations.

Image 9 : Container of DDVS in Zeytinburnu

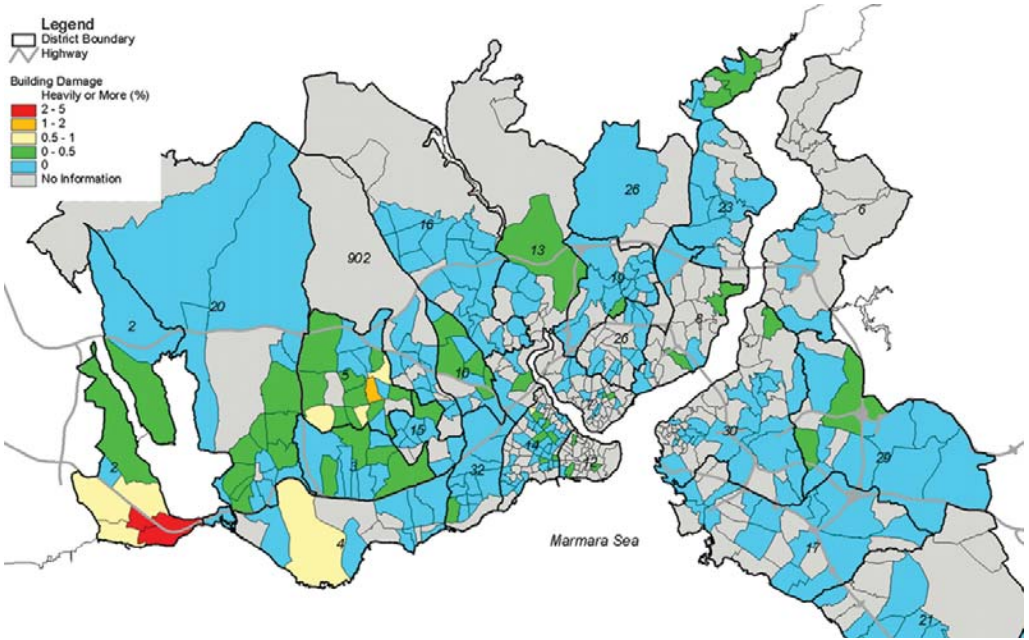


Image 10 : Damaged Building Ratio in Istanbul at 1999 Izmit Earthquake

JICA [13]

Their objective was to create micro-zoning maps which will serve as a data base for seismic disaster prevention plan for Istanbul. It will also serve to create recommendations for construction of earthquake resistant urbanization. The study area consists of 27 districts of IMM and 3 major municipalities around Istanbul.

"The Study intends to:

1) Integrate and develop seismic microzonation studies being carried out in Istanbul as scientific and technical basis for disaster prevention/ mitigation planning;
2) Recommend a citywide prevention/mitigation program against damage of buildings and infrastructures based on the detailed seismic microzonation study and building-vulnerability evaluation of areas;
3) Recommend disaster prevention considerations to be incorporated in urban planning of Istanbul City including land use plan and earthquake-resistant design regulation, etc; and
4) Pursue technology transfer of planning techniques to Turkish counterpart personnel in the course of the Study." [14]

The current situations is analysed under main topics: the administrative conditions, the civil society organizations, public awareness, urban conditions for earthquake disaster management. Then the study continues with the earthquake analysis, pursued by estimation of damages and casualties, evaluation of urban vulnerability and preparedness measures.

Under the topic of administrative conditions, it analyses the current situation of Turkey with a general overview of management systems and organizations. The reports states the problems civil society organizations endured during past earthquakes. Under the chapter of both civil society organization and public awareness, it states the efforts made with the ISMEP project but also mentions some gaps in the procedures and plans.

Public Awareness:

The educations of the citizens is based on volunteers who obtain a certificate at the end of their training. This training insists on how to help the local and international search and rescue teams in case of an earthquake. Governmental Education programs like the DDVS project and non-governmental projects are explained with their positive and negative sides. After the analysis of the current education level and training programs a list of recommendation for Disaster Management has been done:

1. Effective utilisation of Media
2. Development of common codes of conduct for Mass Media
3. Extensive Information circulation
4. Promotion of earthquake safety school programs
5. Capacity-building and Human resource development for different stakeholders
6. Increased focus on public information to assess the root causes of vulnerability.

Current Situation Analysis / Urban conditions for earthquake disaster management consideration:

- Total population of these 27 Istanbul and 3 other districts: 8.831.766 inhabitants
- Total areas: 98.981ha
- Population Density: 89 pr./ha
- Total number of building in these districts: 724.609

- Building Density: 7 buildings/ha
- Population Density :12pr./building
- Number of buildings according to their years of construction:
  - 1949 and before : 37.444
  - 1950 -1959 : 26.976
  - 1960 -1969 : 63.335
  - 1970 -1979 : 141.788
  - 1980 -1989 : 213.220
  - 1990 and after : 232.699
- Number of building according to their frame structure (FS) and materials of masonry structures (MS);
  - FS Steel : 1.037
  - FS RC : 538.977
  - FS Wood : 10.991
  - FS Other : 269
  - MS Brick : 157.050
  - MS Stone : 7.068
  - MS Sun Dried Brick : 759
  - MS Other : 398
- Number of Hospitals is 201 and the number of Policlinics is 267

Table 3 : Legand for the Numbersof Districts

2	Avcılar
3	Bahcelievler
4	Bakırkoy
5	Bagcılar
6	Beykoz
7	Beyoglu
8	Besiktas
10	Bayrampasa
12	Eminönü
13	Eyüp
14	Fatih
15	Güngören
16	Gaziosmanpasa
17	Kadıköy
19	Kagıthane
20	Kucukcekmece
21	Maltepe
23	Sarıyer
26	Sisli
29	Umraniye
30	Uskudar
32	Zeytinburnu
902	Esenler

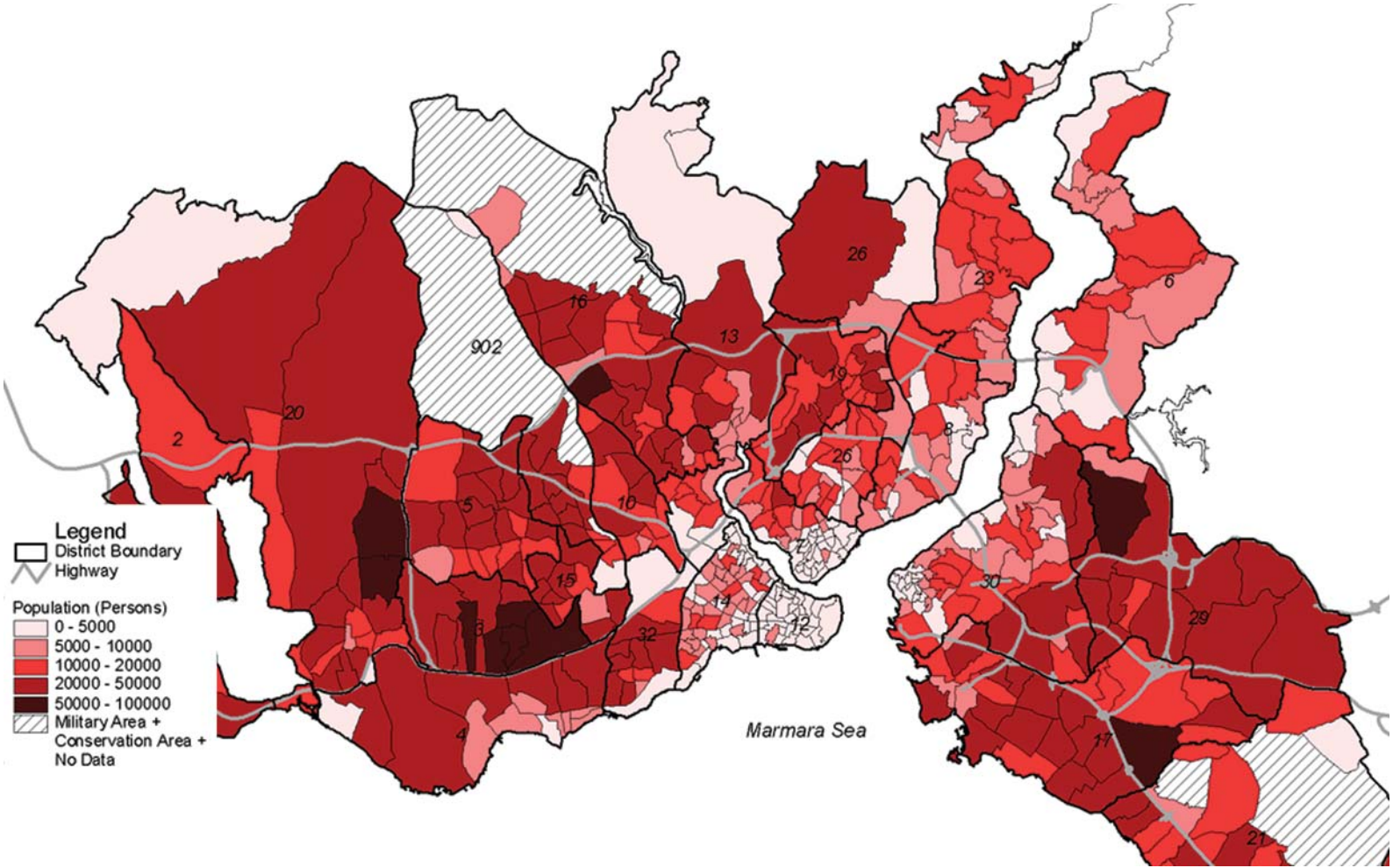


Image 11 : Population by Sub-District

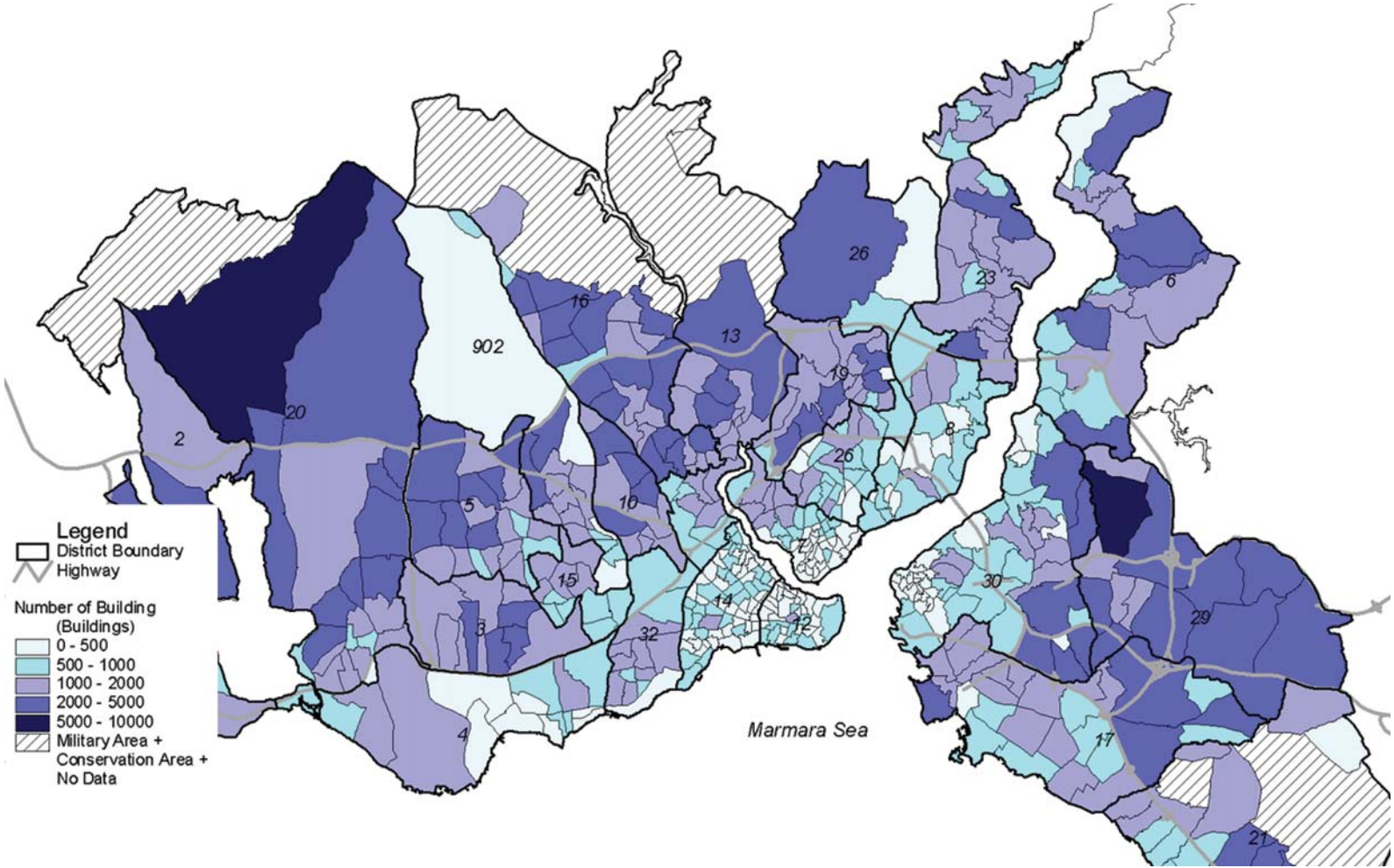


Image 12 : Building Distribution by Sub-District

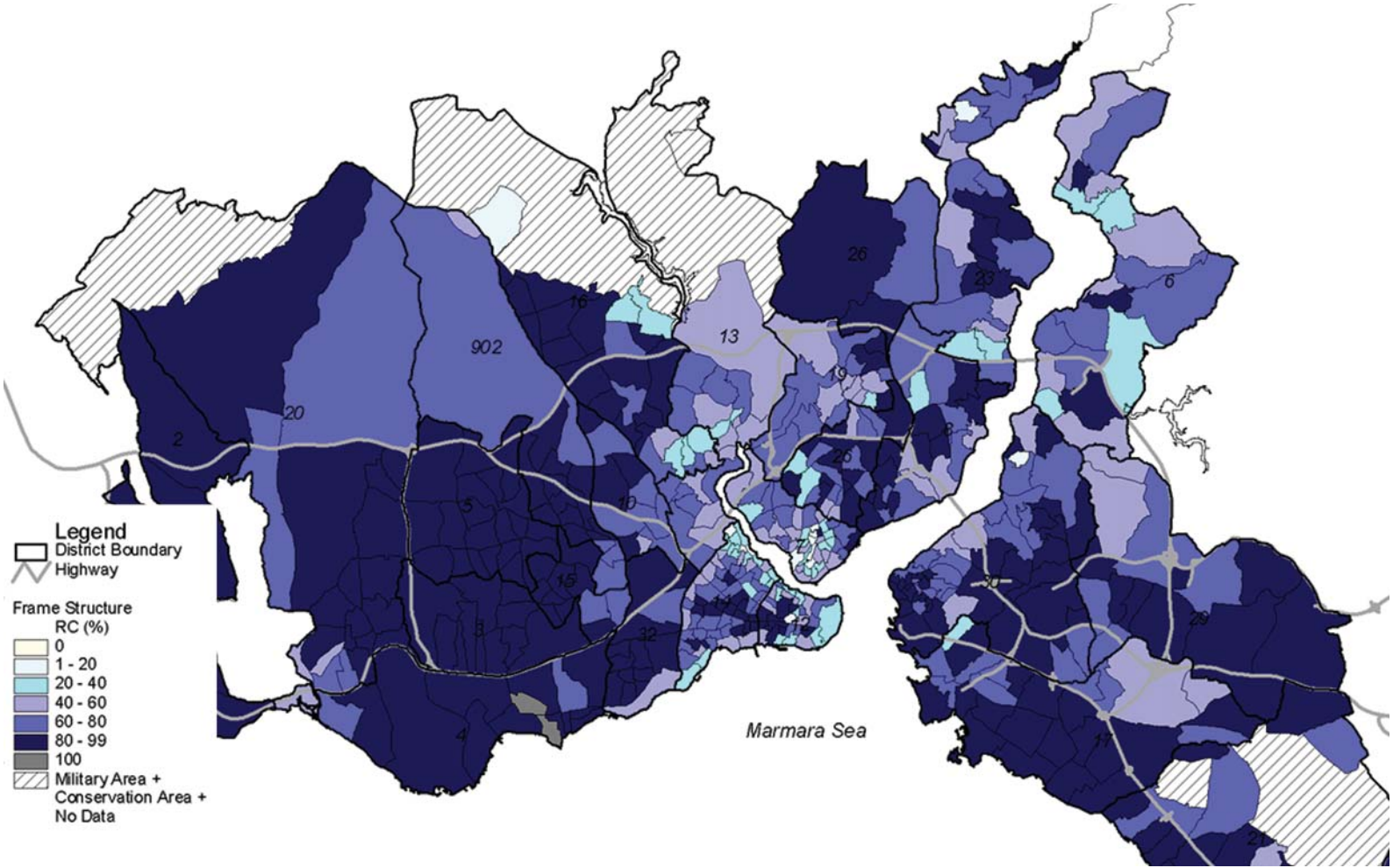


Image 13 : Building Distribution by Structure Type, Frame Structure: RC

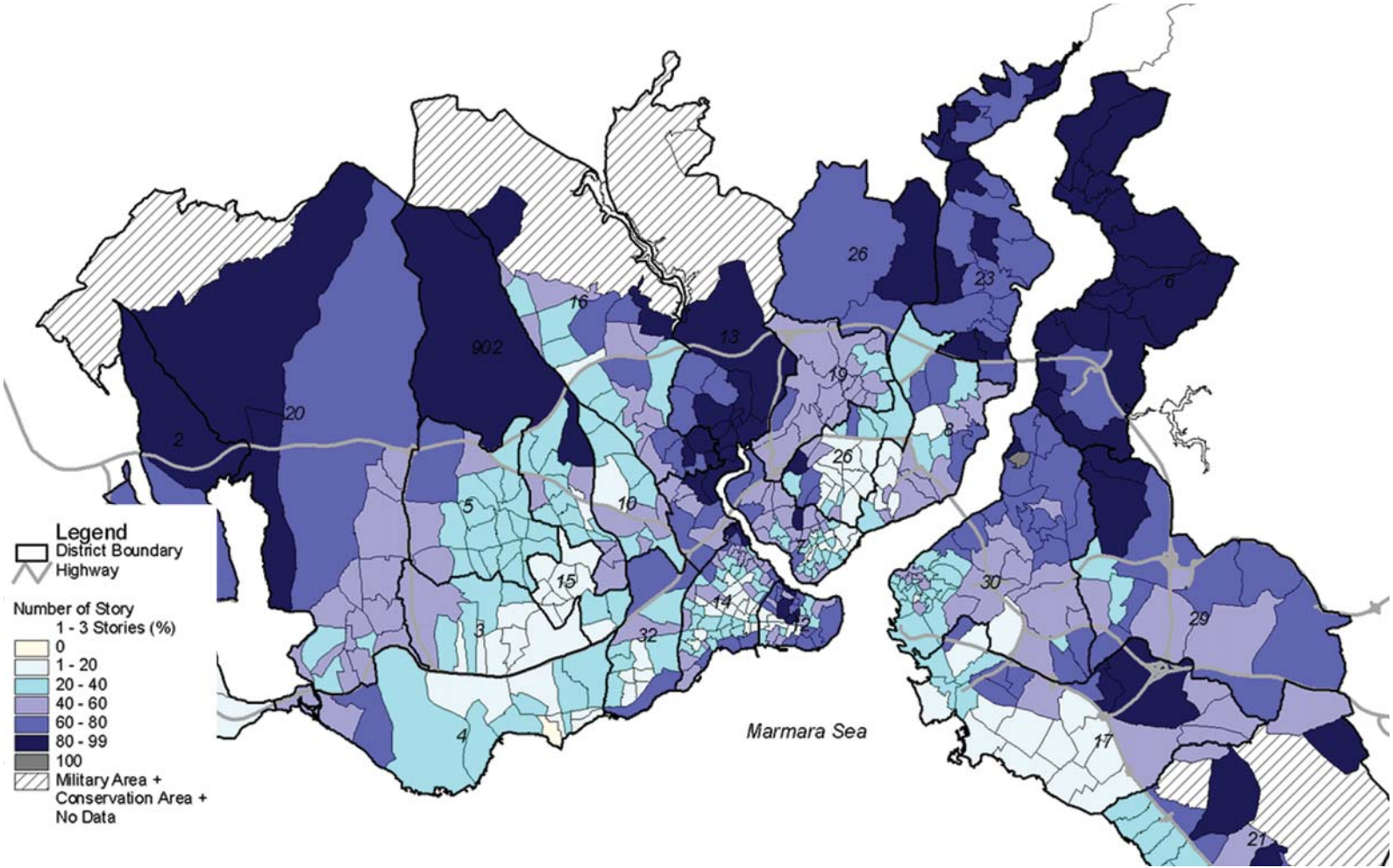


Image 14 : Building Distribution by Number of Stories, 1-3 Stories

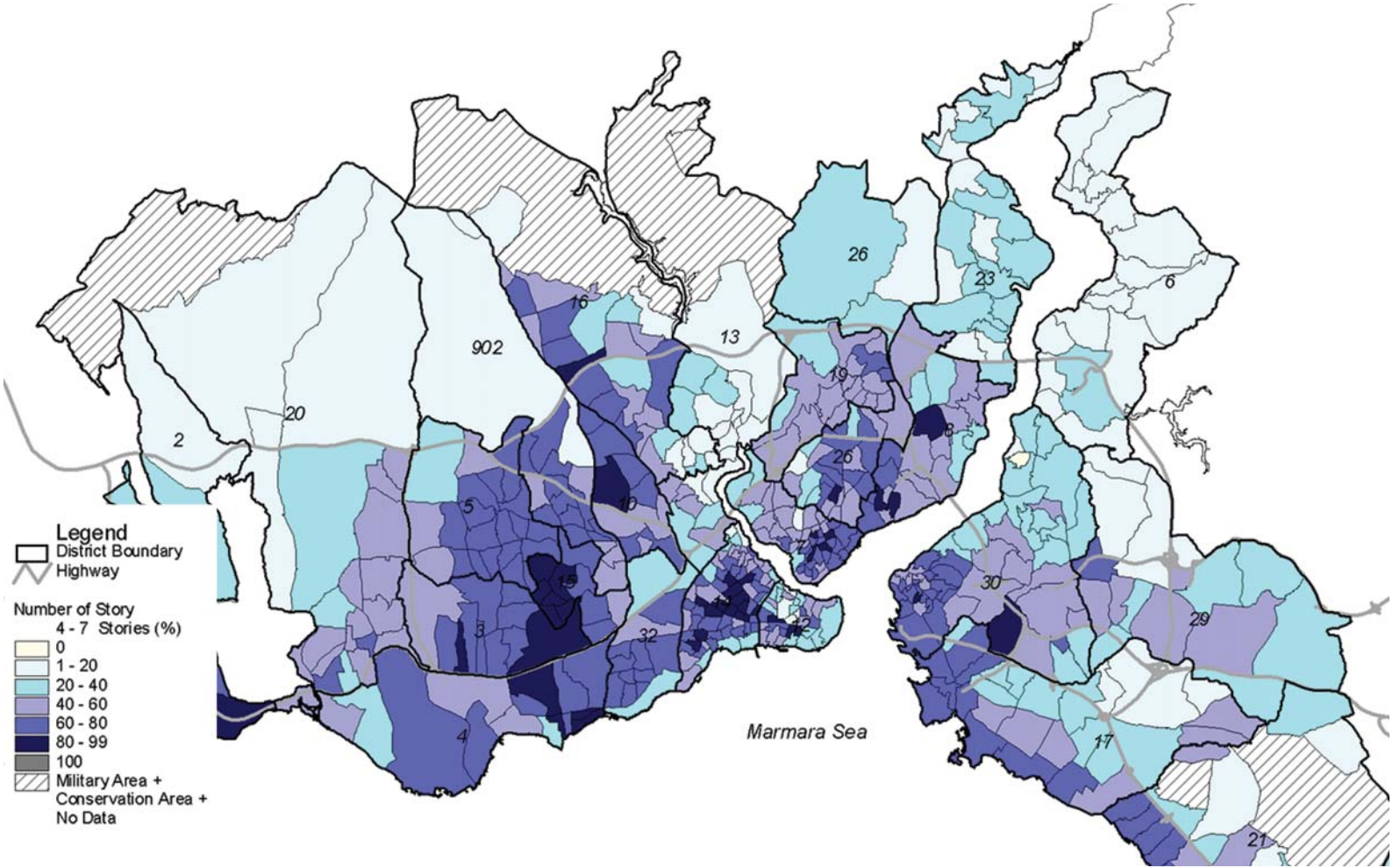


Image 15 : Building Distribution by Number of Stories, 4-7 Stories

Earthquake Analysis:

The terrain is divided into a grid system of 500m by 500m. The analyses are done by creating a simulation based on four different earthquake situation models. Each model is applied to each square of the grid, and results are put on a map to have a general view of the hole. Because Models A and C are more probable situations, general maps are created only for those two models.

“Model A: This section is about 120 km long from the west of the1999 Izmit earthquake fault to Silivri. This model is the most probable model of these four scenario earthquakes because the seismic activity is progressing to the west. The moment magnitude (Mw) is assumed to be 7.5.

Model B: This section is about 110 km long from the eastern end of the 1912 Murefte-Sarkoy earthquake fault to Bakırköy. The moment magnitude is assumed to be 7.4.

Model C: This model supposes a simultaneous break of the entire 170 km section of the NAF in the Marmara Sea. The moment magnitude is assumed to be 7.7. This is the largest magnitude that this area has ever experienced, as the maximum magnitude of historical earthquakes in the Marmara Sea area is 7.6. There is no evidence of a simultaneous break of the entire section in the past, though the eastern one-third did rupture in May 1766 and the rest on August 1766. If a rupture of the maximum length of the faults is assumed, this is the worst case within reason.

Model D: The continuous fault that was found in the north of the Marmara Sea follows the base of the northern steep slope of the Cinarcık Basin. A normal fault model was developed, which follows the northern slope of the Cinarcık Basin with reference to many recent researched work. The moment magnitude (Mw) was assumed to be 6.9 with the empirical formula for a normal fault.” [15]

Image 16 : Earthquake Model A

Image 17 : Earthquake Model B

Image 18 : Earthquake Model C

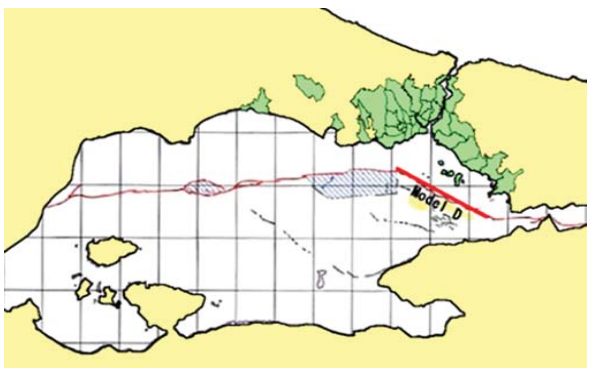


Image 19 : Earthquake Model D

Estimation of Damages & Evaluation of Earthquake Vulnerability:

Most of the buildings in Istanbul are classified as class C vulnerability, indicated in EMS-98 table.

"Buildings are calculated as "heavily" "moderately" or "partly" damaged.

- "Heavily" damaged buildings are buildings that are severely damaged or have collapsed, and these buildings are unfit to be occupied until they are repaired or rebuilt. Corresponding to damage grades 4 and 5 in EMS-98.
- "Moderately" damaged buildings are buildings that can be use for evacuation purposes just after the hazard, but they need to be repaired before been occupied permanently. Corresponding to damage grades 3 in EMS-98.
- "Partly" damaged buildings can be used for living, but they should be repaired because the structure is partly damaged and the earthquake-resistance has been compromised. Corresponding to damage grades 2 in EMS-98" [16]

Liquefaction, landslide, and fire are not included in the damage estimation, only the seismic vibration's damages are calculated.

Model A:

Most severely affected area is the southern coast of the European side. Several sub-districts along the coast have more than 30% of heavily damaged buildings :

51.447 Heavily damaged,
113.535 Heavily + Moderately damaged,
252.370 Heavily + Moderately + Partly damaged.

Model C:

One sub-district along the coast of the European side has more than 40% heavily damaged buildings:

59.176 Heavily damaged,
128.047 Heavily + Moderately damaged,
272.953 Heavily + Moderately + Partly damaged.

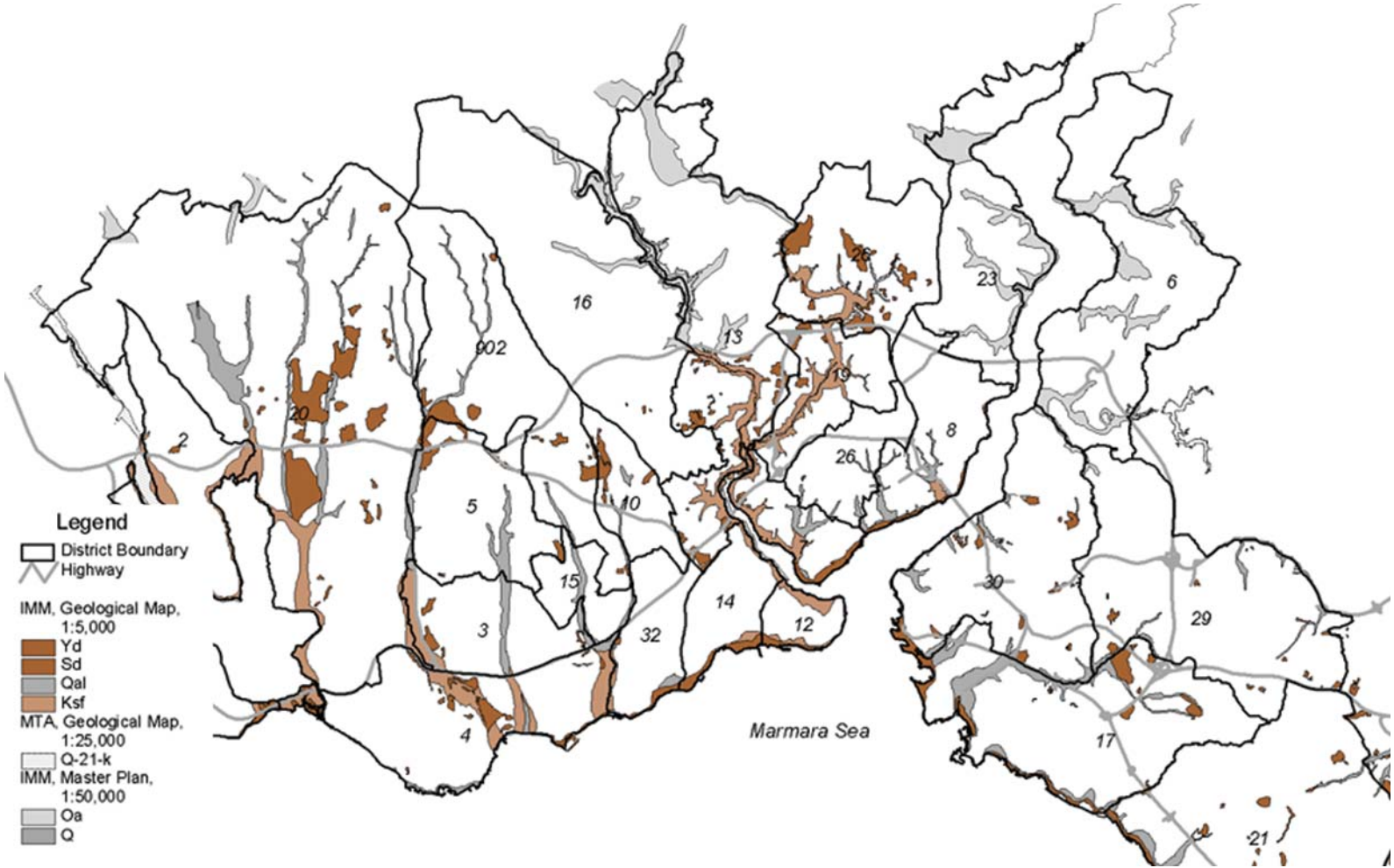


Image 20 : Distribution of Man-Made Ground and Quaternary Deposits

Only Maps done according to Model C are presented to analyse the maximum damage.

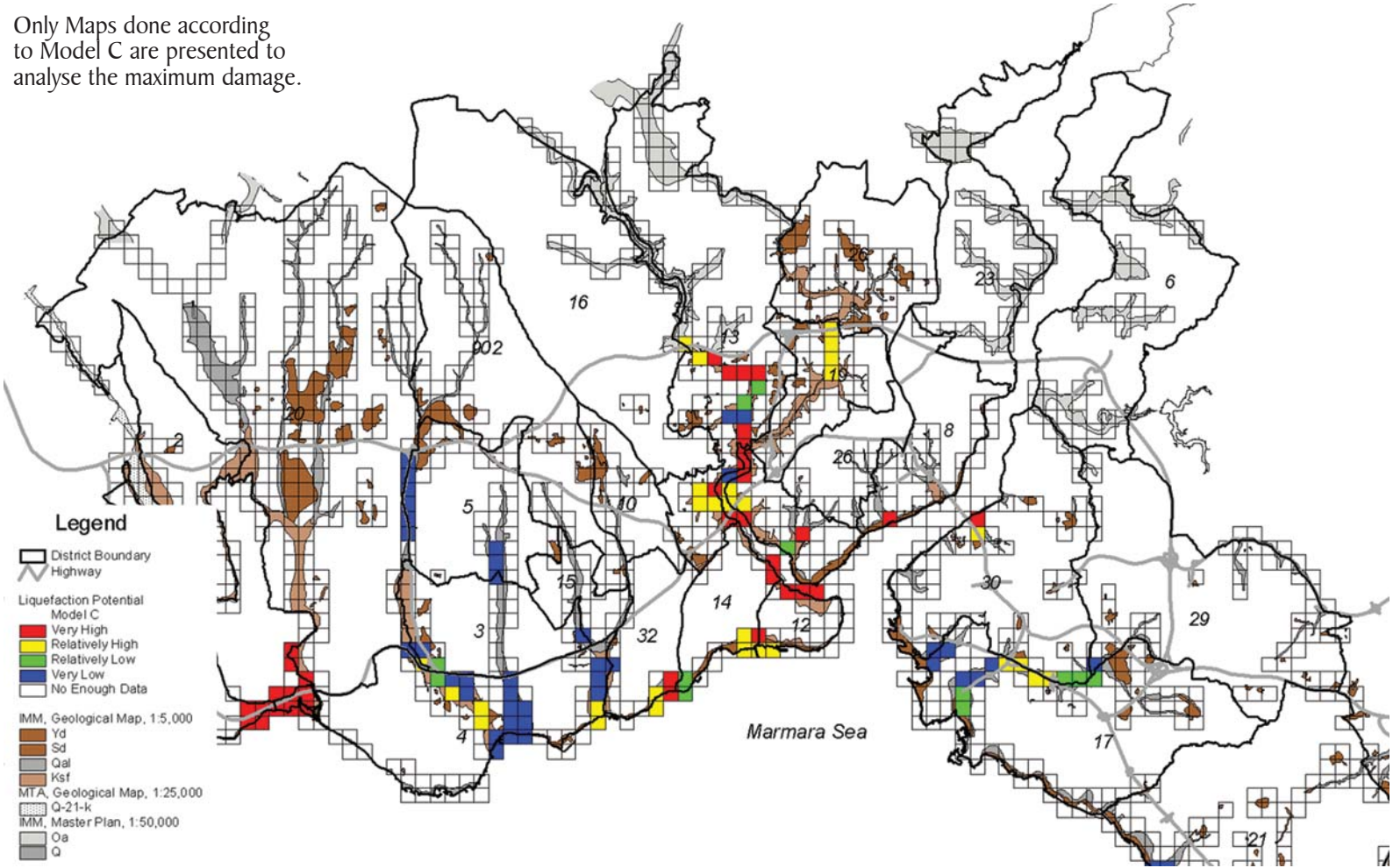


Image 21 : Distribution of Liquefaction Potential: Model C

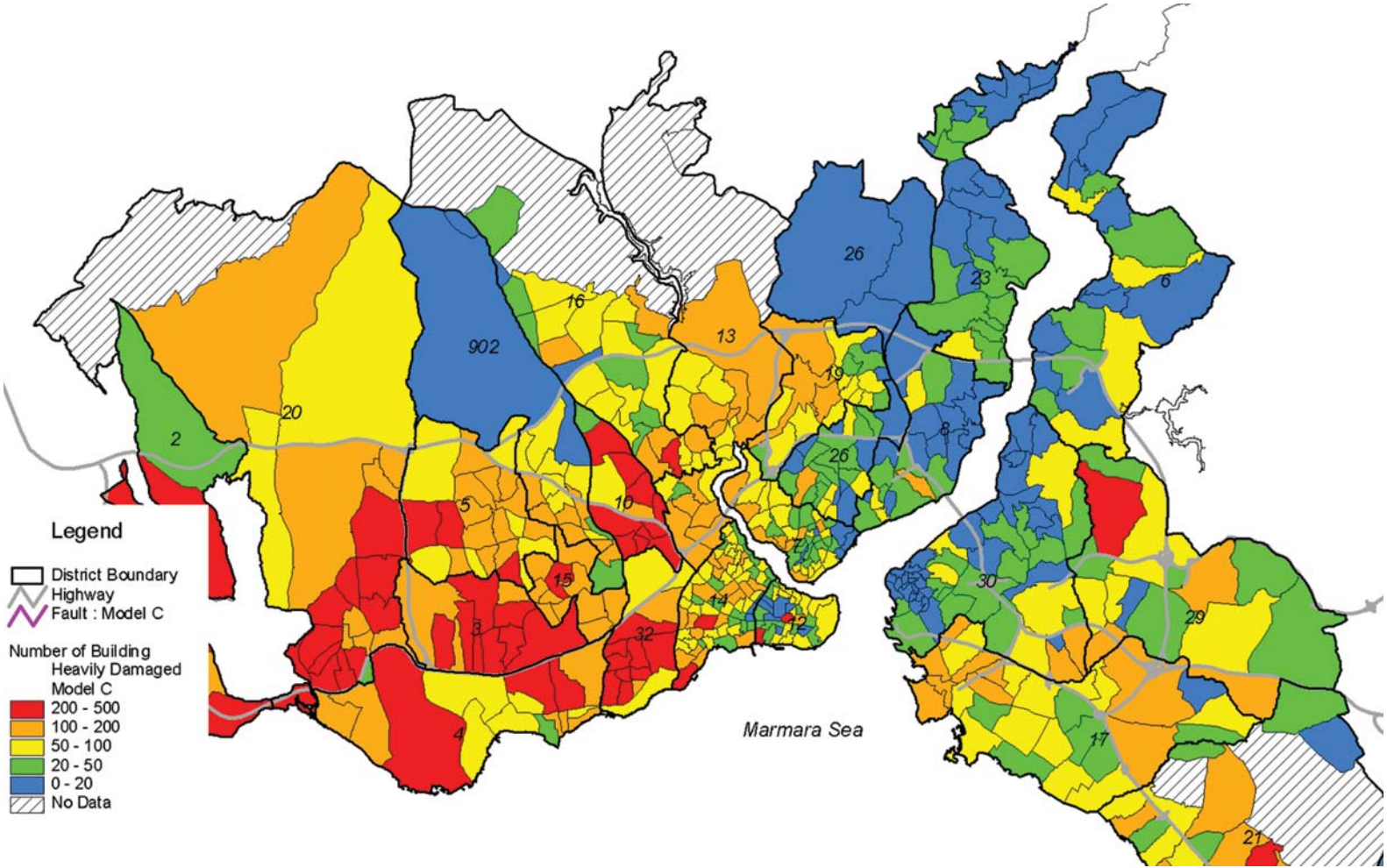


Image 22 : Number of Heavily Damaged Building: Model C

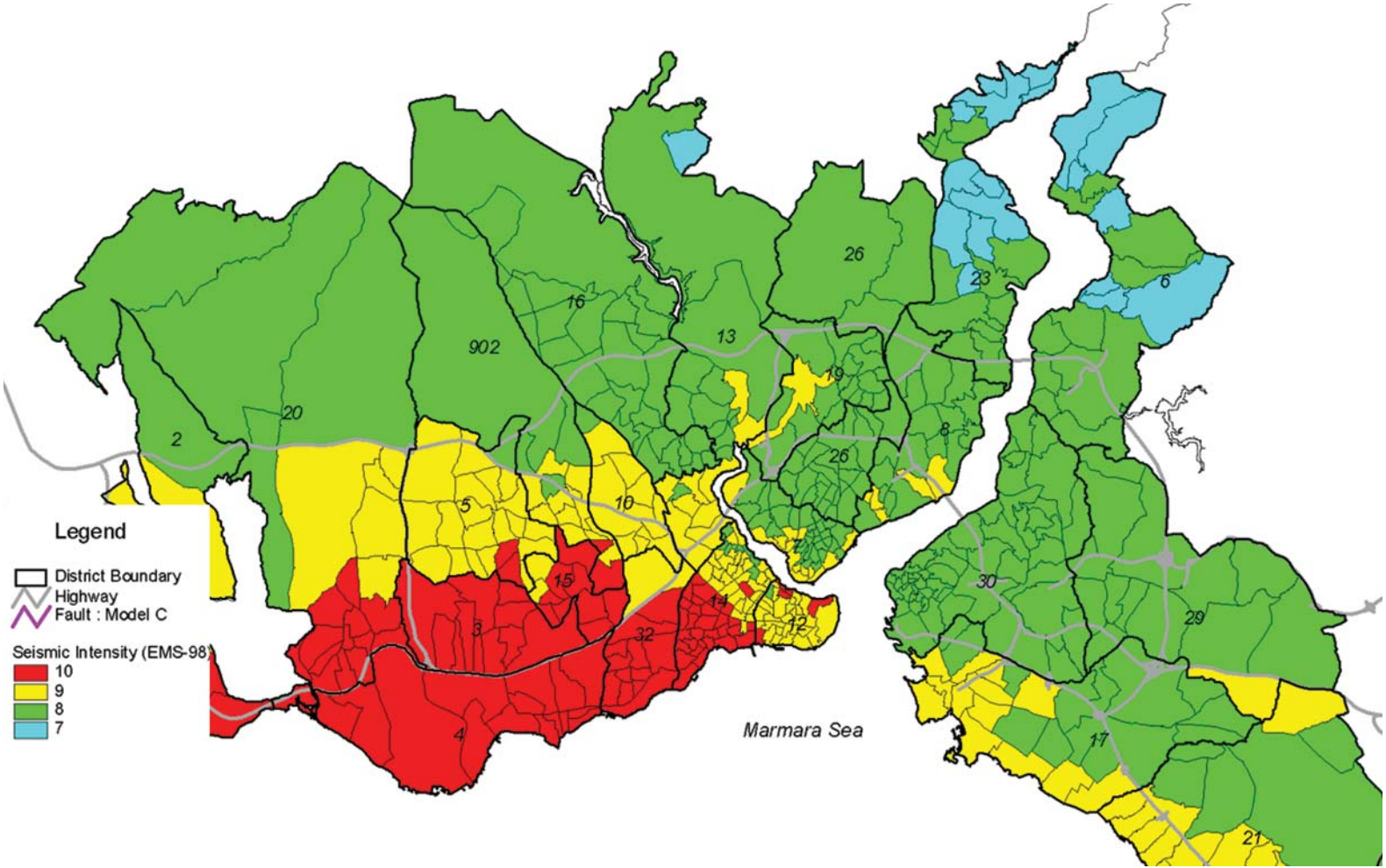


Image 23 : Seismic Intensity: Model C

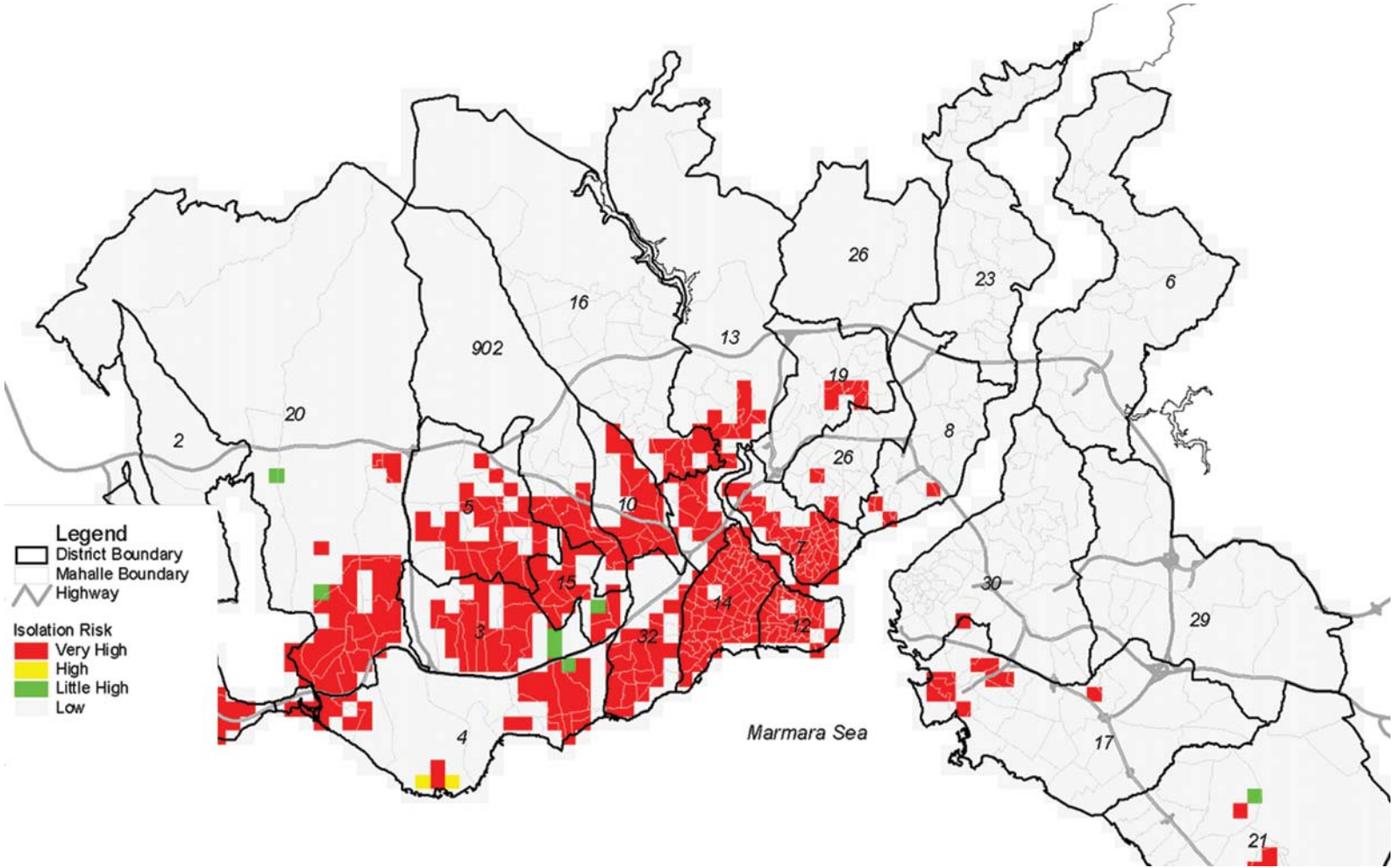


Image 24 : Isolation Risk Caused by Road Blockage

Vulnerability of buildings and urban structures:

The vulnerability evaluations are summarized here to have a global picture of estimated damages.

- Building damages situation and vulnerability by sub-district.
  - 54 sub-districts will suffer catastrophic damage
  - 105 sub-districts will suffer heavy damage
  - 298 sub-districts will suffer moderate damage
  - 457 sub-districts are vulnerable sub-districts

- Excessive land-use status: for the analysis, building floor area ratio and building coverage area ratio are used to assess excessive land utilization conditions.
  - There is a total of 98.981ha in all the analysed districts, 51.759 ha are urban areas representing 52,3% of the total areas.
  - 102 sub-districts (16% of total) have a extremely high land-use
  - 119 sub-districts (19% of total) have a high land-use
  - 120 sub-districts (19% of total) have a slightly high land-use

- Availability of Parks and Open spaces for required primary evacuation areas by sub-district:

  "Tent Village System, which is an organized system of 486 small (less than 500m^2) to bigger sized designated tent villages, has been planned and established in Istanbul." [17] Primary evacuation areas are necessary not only for the safety of the citizens but also to acquire primary damage information faster, and be more effective during search and rescue operations.

These areas can be also called "*safe zones*". Two types of different level of evacuation area are needed: the first is the city based *safe zones* which requires a minimum area of 1,5m^2/pr, and the second is the regional evacuation area with 9 to 10 m^2/pr. For the city, open spaces bigger than 2.000m^2 are the most appropriate areas. Pre-defined *safe zones*, along with emergency escape routes, should be designed before the earthquake.

The results of land availability can be categorized into 5 groups:

1. Less than 25% of demand: 340 sub-districts are lacking the necessary open spaces for evacuation. They represent 53% off all analysed sub-districts.
2. 25 to 49% of demand: 79 sub-districts have a very limited number of *safe zones*.
3. 50 to 99% of demand: 68 sub-districts have a shortage of open spaces.
4. 100 to 150% of demand: 23 sub-districts have sufficient space for evacuation.
5. Over 150% of demand: 115 sub-districts have 1.5 times more space than required.

As a result of the peculiar urban growth Istanbul suffered, parks and open spaces have not been developed or standardized in the past. Now 485 sub-districts are categorized as "*inhabitable sub-districts*" [18]

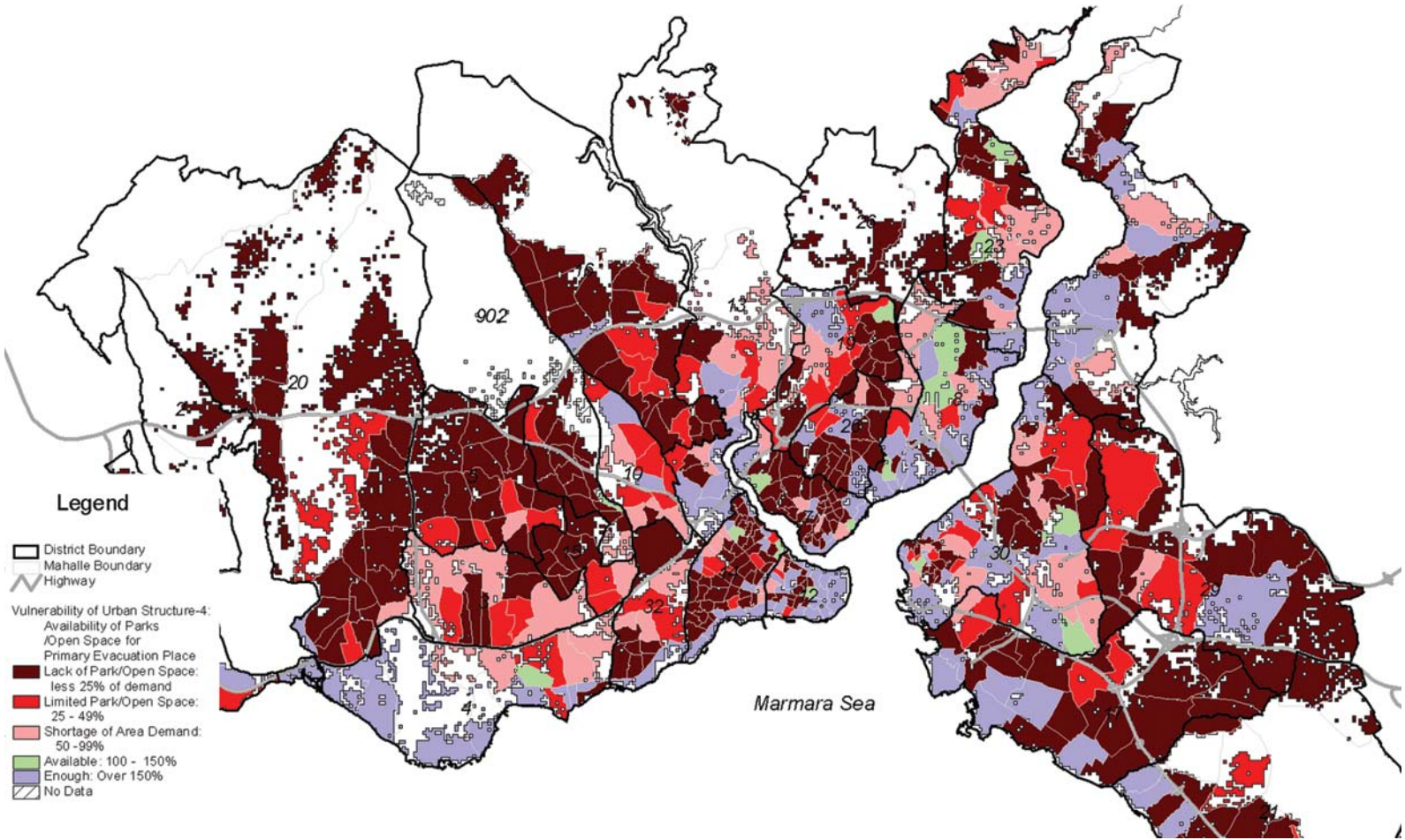


Image 25 : Vulnerability of Building Structure: Availability of Park/ Open Space for Primary Evacuation Place

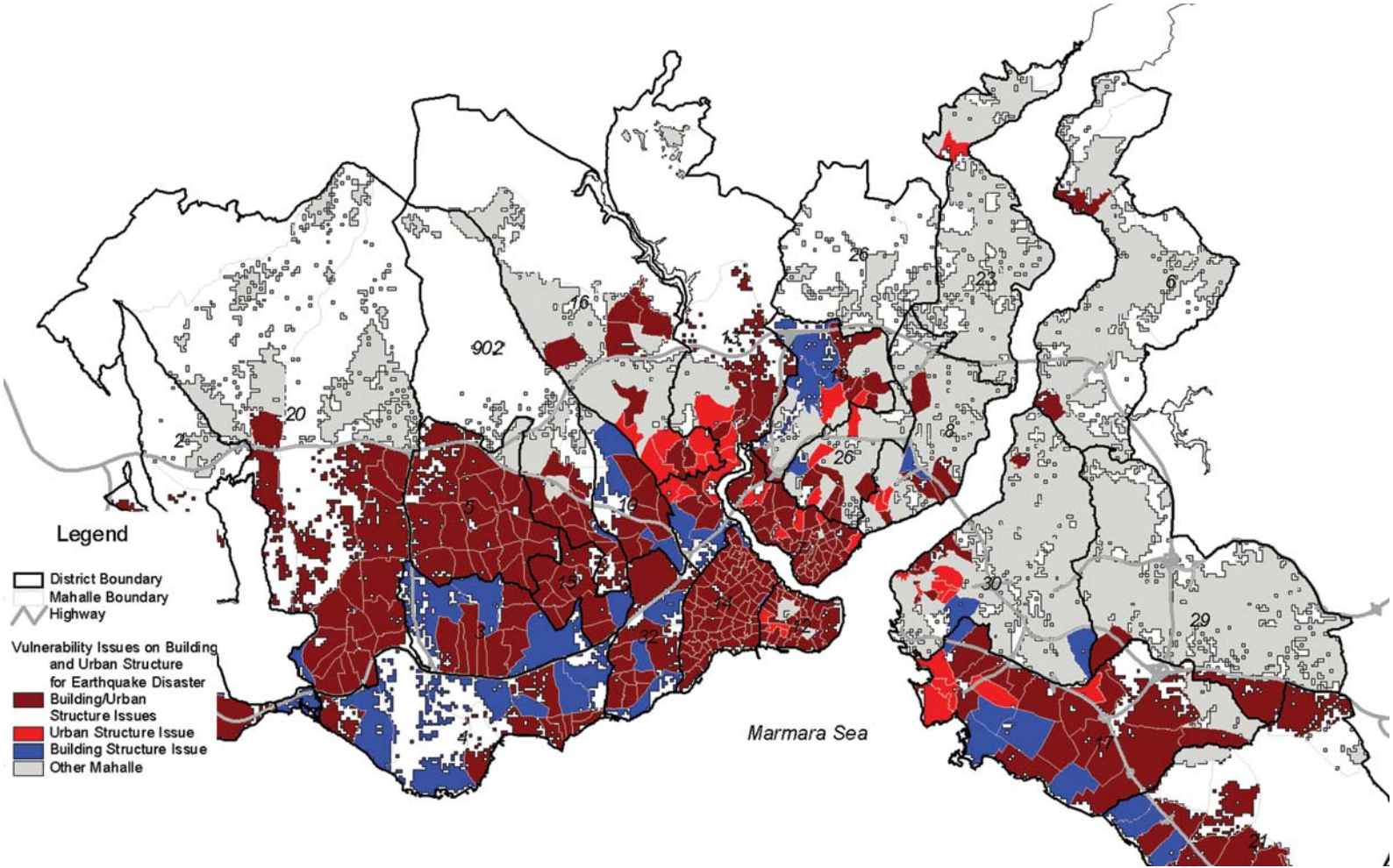


Image 26 : Vulnerability Issues on Building and Urban Structure for Earthquake Disaster

Recommendations:

1. Recommendation on the land availability for urban structure improvement.
   District base disaster management plan formulation is recommended to reorganize districts within the requirements and standards.
2. Recommended strategic improvement areas for sub-districts with serious building and urban structure vulnerabilities.
   The main topics are the combined strategic improvement measures for issues of building/urban structures and the Strategic improvement measures for issues of urban structures. Metropolitan and local district disaster prevention plans should include the principal measure to strengthen structures. All the strengthening projects should be formulated and well organized between municipalities.
3. Recommended strategic urban redevelopment measures and specialized measures for historical urban conservation areas.
   Emergency road network plan with road widening / improvement projects, evacuation plan with the development of new evacuation centres, seismic resistant diagnosis for crisis management centres, emergency response centres, emergency good centres and public facilities, should be planned and organized to ensure security and improve urban structure. Specific improvement measures for some particular structure types, like historic buildings or historic urban tissue, should be planned under the strict regulations of the conservation system.
4. Recommended land-use zoning system.
   To be able to minimise the damages, areas should be zoned according to their hazard risk and land properties. This zoning should be done to prevent and ameliorate use conditions, and to be able to provide a better urban structure.

Recommended measures for earthquake disaster mitigation can be regrouped under two main titles.

- Short-term measures, which are the retrofitting works of public buildings, the construction of disaster management centres, and campaigns for raising awareness on disaster prevention.
- As Medium to Long-term measures, preparation of a master plan for earthquake disaster prevention, formulation of urban redevelopment plan aimed at earthquake-resistant city, promotion of research on earthquake-resistant buildings, establishment of credit system for earthquake-resistant housing, and institutional system improvement for disaster management, are proposed to the authorities.

Frameworks for emergency response and rehabilitation work:

“The emergency response system should be planned and organized primarily with the scientific estimated disaster damages for the worst case scenarios in an earthquake-prone region or nation” [19] Model C should be considered when creating frameworks for emergency response and rehabilitation works. Framework for emergency rescue operation, first aid, and fire fighting operation are some of the examples of the studied cases. Two frameworks are especially important for a relocation of citizens: the Tent village framework and the temporary housing framework.

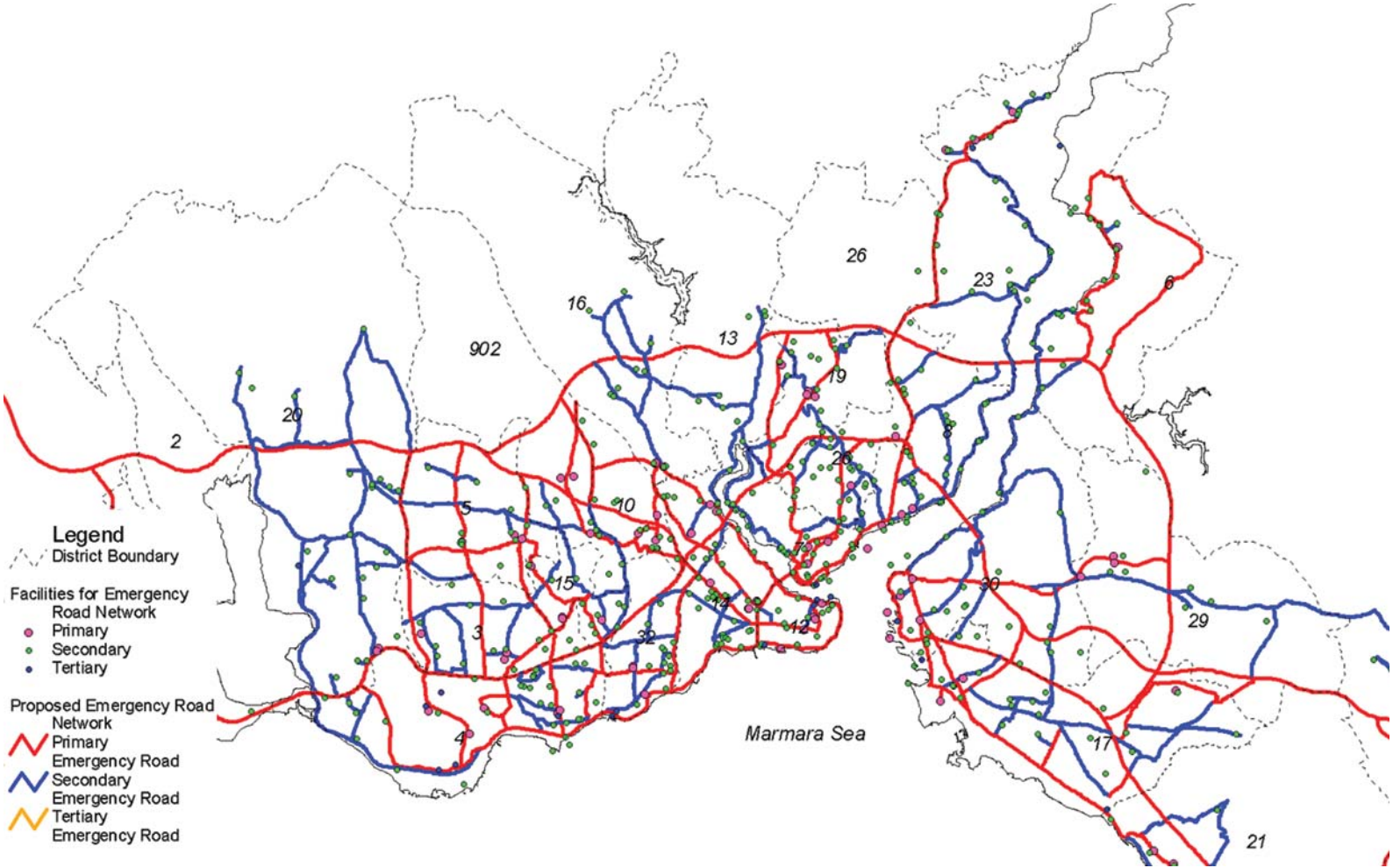


Image 27 : Proposed Emergency Road Networks

Framework for Tent Villages:

In Turkey, temporary shelter for refugees is based on the Tent Village system, local and regional, with the already defined area per tent. Demands on tent villages are estimated by the number of surviving people, which is calculated as follows: 100% of the residents in heavily damaged buildings, 50% of residents in moderately damaged buildings, and 10% of the residents in partially damaged buildings. One tent should be able to shelter one family, in Turkey family units are composed of 4 people. In the framework two types of cases are proposed, Case 1: 35m^2/tent, and Case 2: 25m^2/tent. Based on estimated casualties and damages a total of 333.000 tents are needed for 1.330.700 refugee in Istanbul. For case 1: 1.65,5 ha are needed, and for case 2: 832,5 ha are needed.

Image 28 : Tent Villages Izmit

Image 29 : Tent Villages Izmit

Image 30 : Tent Villages Izmit

Framework for Temporary Housing:

"After an earthquake disaster, the assigned emergency taskforces for temporary housing should take the following measures for the residents in the heavily, moderately and partially damaged housing:

- Prepare, set-up, open, and operate tent villages.
- Provide an assessment of building damage conditions for all building (collapsed/heavily damaged/demolish, repair/usable, partially damaged, and not damaged).
- Support measures of finance and material supply to repair the assessed repairable housing.
- Register and select applicants for tent villages.
- Modify temporary housing plan and preparation works of lands and materials.
- Construct lifelines and temporary housing.
- Open and operate temporary housing." [20]

Some measures can be taken to minimize the demands such as proposing to support the measures to repair housing assessed as repairable, to help victims move out of the municipality, and to help victims stay with relatives.

With all this data and recommendations a new approach to disaster management can be adopted by IMM. Even though the earthquakes models are not predictions but only probabilities, measures to prevent a catastrophe should be taken. Istanbul has to adopt a new urbanization process to secure its citizens. IMM is using this study and the ones which will follow to create and change the existing urban tissue and urbanization process.

EMPI [21]

The objective is to determine a course of action based on the JICA report. This plan is aiming at creating more precise guide lines to the recommendations and frameworks. The main subjects are:

- Determination of the current situation, Technical studies: analysis of building stock, and Cadastral applications
- Financial resources studies
- Legal / juridical studies
- Educational studies & Social activities
- Disaster and risk management

Determination of the current situation:

The objective is not just to pin point every building in need of a retrofitting action but to determine and create a better urban lifestyle quality and security. Determination of earthquake resistances of building stock is done from two different angles:

1. Evaluations of housing buildings (mid height RC buildings) by a street survey. It is done to create a more detailed building inventory, determine each house's vulnerability level, and determine the retrofitting priorities or take demolition and reconstruction decisions.
2. Evaluation of public and industrial buildings. Risk determination, engineering analyses, benefit versus cost analyses, and taking decisions to destroy or renovate buildings.

All the analysed buildings are processed and marked on 1/1000 scale maps, which can be crucial during search and rescue operations. Primary decisions for high risk buildings are destruction and reconstruction within the construction regulations. Retrofitting operations are mostly for cultural heritage buildings and important public buildings such as schools and hospitals.

Financial resources studies:

The objective is to determine and manage the national and international financial resources for studies to be made before and after the earthquake. Using project credits for the jobs with specific financial requirements and using financial securitization for jobs with constant funding need.

Legal / juridical studies:

Inspecting legislations about earthquake risks and analysing errors, flows, and gaps in the legislations, are the primary concern for this chapter. After these analyses a new legislation was prepared. A new code was proposed for risk, education and prevention. The researched showed that most of the problem was not that law was insufficient, but that the application was not controlled. To prevent that from happening again more codes are proposed for the control and application of urbanism codes.

Administrative structure:

The analyses of previous earthquakes showed that coordination problems occur because of the multi-titled administrative system. Simplified table shows the main branches for an administrative procedure, it should be known that between these there are more governmental and municipality departments.

Educational and Social Activities:

The guidelines given concern the following aspects of education and psychology.

1. Psychology of the society
   - Feeling unprepared
   - Focused on “that moment”
   - Didn’t recognize the benefits of precautions
2. Rudiments of social education
   - Reliability and credibility
   - Assessing sentiments - attitude - expectations
   - Changing definition of the earthquake from “disaster waited with fear and desperation” to “a natural event that can be cope with”
   - Creating a sense of adequacy
   - Making people believe that being prepared to earthquake is a human right
   - Establishing ethics of solidarity between society and government
   - Respecting people’s values and judgements
   - Testing efficiency of the programme and education.
3. Draft programmes submitted in the report
   - Applied Public Education Programme
   - Programme for Education of Instructors
   - Programme for Mass Education via Visual Media
   - Press Members Education Programme
   - Sub-district Organization Draft
   - Post-earthquake Public Psychological Support Programme
4. Applied Public Education Programme
   - What is an earthquake? And what is the reality of an earthquake for Istanbul?
   - Jobs to be done before the earthquake
   - Things to be done during the earthquake
   - Things to be done after the earthquake
   - General evaluation
5. Programme for Education of Instructors
   In the first stage of the training, a crew of specialists educates a small group of supervisors.
   The second stage of the programme is the phase when the supervisors pass on their knowledge to the instructors.
6. Content of the Education programme:
   First Module
   - Importance of public education and participation
   - Psychological basis of the resistance against preparation
   - Encouraging factors that can abate resistance

   Second Module
   - Theoretical information of the Applied Public Education Programme
   - Applications
   - How to teach the subjects

   Third Module
   - Factors that motivate instructors
   - Questions and discussions about educational technologies and pedagogy
   - Probable factors against motivation and precautions to abate those factors
7. Follow up Meeting
   Follow up meetings between instructors and supervisors after the first education sessions must be scheduled and should be renewed periodically.

Risk management:

EMPI propose two main branches for risk management.
The first branch concerns the definition of causes and effects of risks, and then their classification under risk sectors. Questions raised for each sector will be answered. The main goals are:

1. to develop, design and create methods of applications
2. to analyse the possibilities of rehabilitation of high risk buildings
3. to develop an effective way of land use in urban planning
4. to develop programs that aim to inform and educate citizens
5. to develop the emergency respond and action systems
6. to develop and ameliorate long-term socio-economic strategies
7. To research and comprehend earthquakes physical and sociological dimension

The second branch concerns the emergency action strategies, which have two emergency plans.

1. Written documents prepared according to disaster strategies showing necessary requirements for an emergency action plan.
2. Adjustments about how to meet requirements.

City scaled transformation projects according to earthquake master plan:

In the light of the previous analyses a settlement plan for all Istanbul is produced. The Metropolitan scaled model shows that a decentralisation process is needed in two different problematic zones.

- The first action is a decentralisation process at the border of forest areas, water basins, geologically and topographically unsuitable areas.
- The second action is a decentralisation process at the high risk residential zones.

As for the rest of the city:

- To constitute an industrial axis by creating a new industrial zone on the west side of Istanbul to compensate the industrial centre, Gebze, on the eastern border of Istanbul. This axis should be developed and supported by the collaboration of universities.
- The master plan created in 1995 for public transport, should be rearranged according to these criteria.
- Settlement areas that are not to be decentralized should be upgraded according to the new city standards.

Solutions to solve the problems of the existing institutional systems

- First principle: All areas of the country should be planned on a country, region, sub-region and city scale.
- Second principle: the new model of planning should be supported by new ideas, projects and opinion of individuals or corporations.
- Third principle: a flexible strategic planning approach should be implemented with relevant action plans

All prevention, mitigation, and emergency strategies are put together under three levels of strategies.

1. Macro level strategies: national and regional scale strategies should be prepared by the concerned governmental departments with the cooperation of universities and concerned municipalities.
2. Mid level strategies: City scale strategies should be prepared by the concerned metropolitan municipalities, urban development ateliers and sub-district municipalities.
3. Micro level strategies: district or sub-district strategies should be prepared by the concerned metropolitan municipalities, urban development ateliers and sub-district municipalities.

Disaster management:

The Disaster Management model developed as part of EMPI is not just limited to the intervention and restoration stages but beyond that consists of preparation and damage reduction activities at every level. Proposed model covers the four stages (preparation, damage reduction, intervention and restoration) of the disaster management.
Intervention based on the local disaster management model, presented according to the EMPI, depends on four main factors:

1. Coordination
2. Incident Command System
3. Resource Management
4. Disaster Management Training

Sub-district Organization:
Aim:

- Organizing the activities to make locals conscious of earthquake and to reduce damage.
- Developing a self-contained system, which will allow sub-districts to support themselves for the first 72 hours (or first week) of the disaster.

Sub committees have to be formed to be able to coordinate all the efforts during the earthquake.

1. Communication committee
2. Damage report committee
3. First aid committee
4. Light equipped search and rescue committee
5. Security committee
6. Sheltering and catering committee
7. Supply support committee
8. Distribution committee
9. General coordination committee

Things to do at sub-district level:

- Preparing sub-district disaster plan
- Preparing disaster intervention manual
- Forming core group (with the support IMM)
- Preliminary activities
- General meetings at sub-district level

AKOM [22]

Summary of the presentation by Mesut Pektaş: the president of AKOM.
AKOM is the disaster coordination centre which was established in August 2000 to organise the emergency and mitigation activities of IMM. AKOM provides the required coordination, regarding the implementation of governorship instructions by the related municipality units, attached establishments and municipal companies.

Emergency Action Plan
Emergency roads have been marked and bridges and viaducts along these roads have been strengthened. All these important transportation roads have been connected to potential tent areas.

Studies and Investments
Training man-power and equip them with modern machinery like audio-visual search detectors.

Disaster Recovery System has been introduced for the Municipal Units in AKOM to provide information security and management in case of disaster.
Considering the crises situation for communication infrastructure of Metropolitan Municipality and its attached units, the communication infrastructure is planned as a whole.

GIS Work
In order to reach the needed information directly and speedily in case of any disaster:
- The graphic and non graphic data should be updated, prepared in different mediums and times, collected in a single place and associated in a searchable way.
- The data, received from 11 different sources, collected under the single skeleton and comprising various questions, should be saved on GIS based software.

Sources:

- Soil & Earth research Department
- Directorate of Map
- Emergency Aid and Rescue
- Fire Brigade
- Transportation Department
- District Municipalities
- ISKI
- IGDAS
- Public Bread Factories
- Hamidiye Water
- City Disaster Management Centre

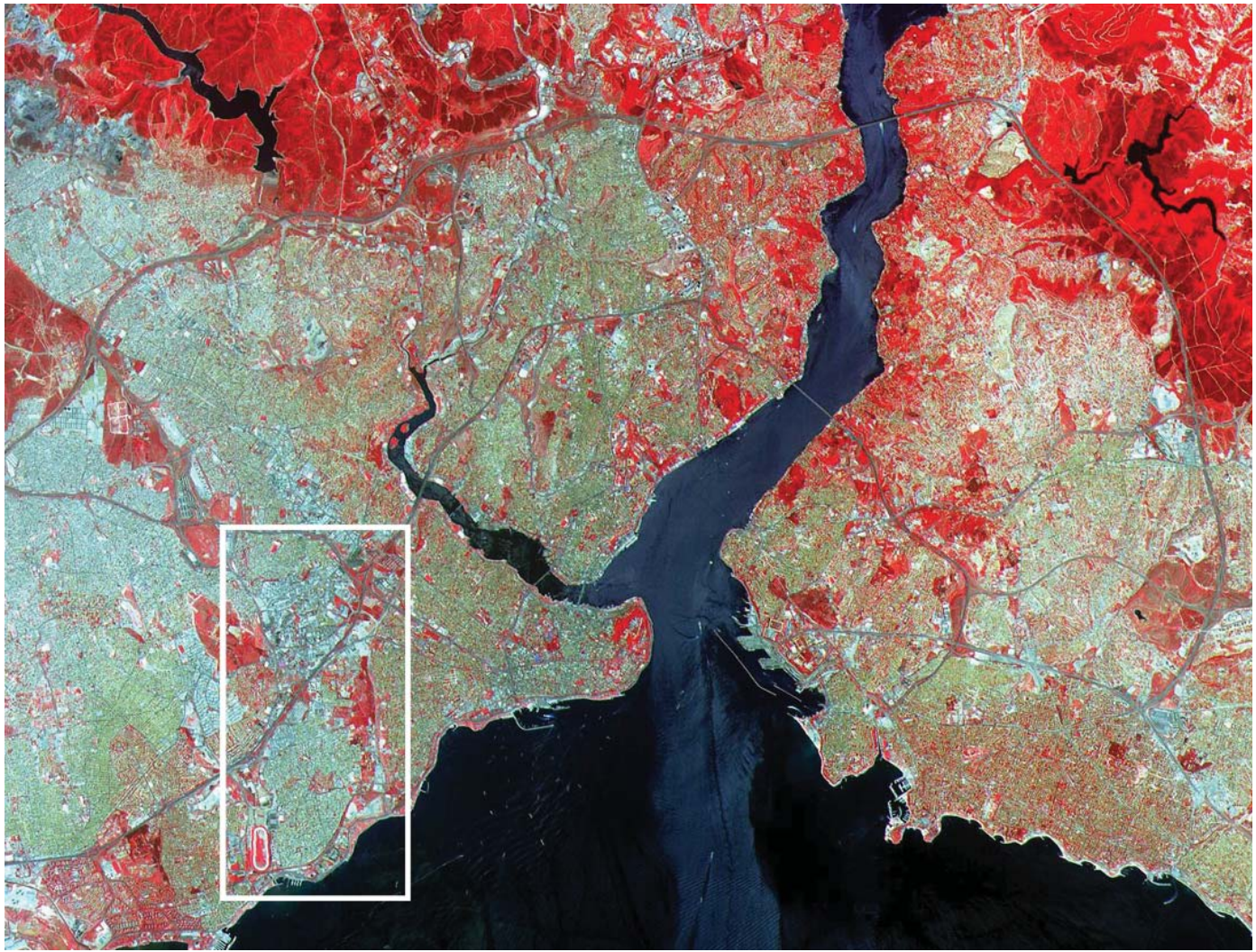


Image 1 : Istanbul

Image 2 : Zeytinburnu

ZEYTINBURNU

Situation

Zeytinburnu is located on the north shores of the Marmara Sea on the European side of the Bosphorus. Zeytinburnu and Fatih (Historic peninsula) are separated by the Theodosius wall, and a green zone mostly composed of cemetery grounds and two large hospital complexes.

The district is divided in 13 sub-districts:

- 9 residential
- 2 residential and industrial mixed
- 1 industrial
- 1 composed of two hospital complexes, cemetery grounds, a harbour, and the Theodosius wall, as a cultural heritage.

One of the most important highways, the E-5, functionally dividing the district in two. In the north, the Maltepe sub-district is the industrial zone, and the zones in the south are mostly residential. The E-5 highway in the north and the railroad in the south are important factors of the development of the district.

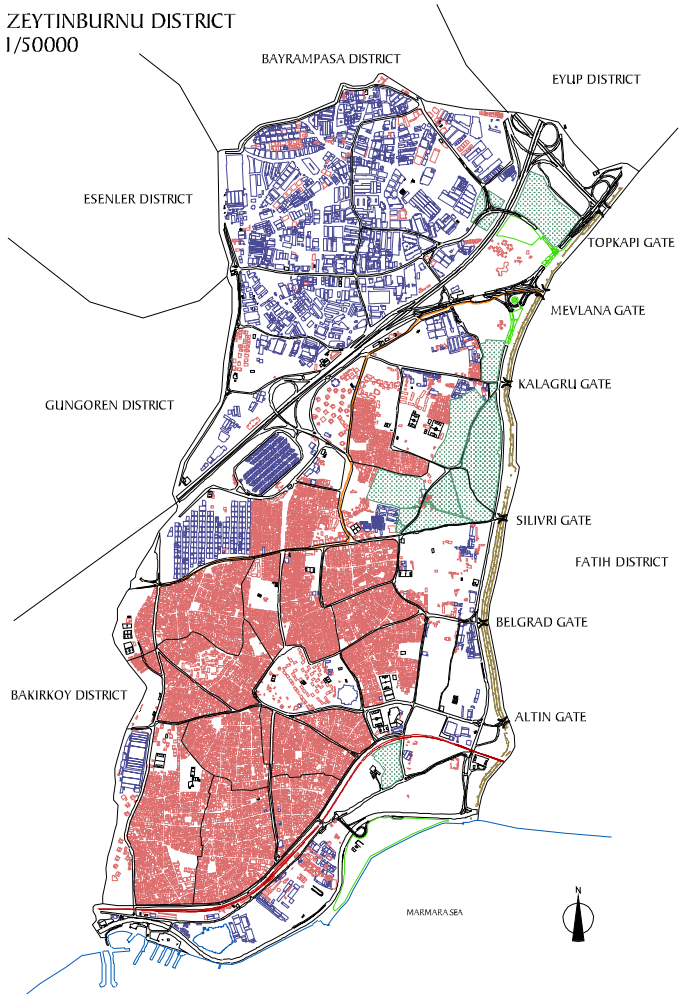


Image 3 : Zeytinburnu

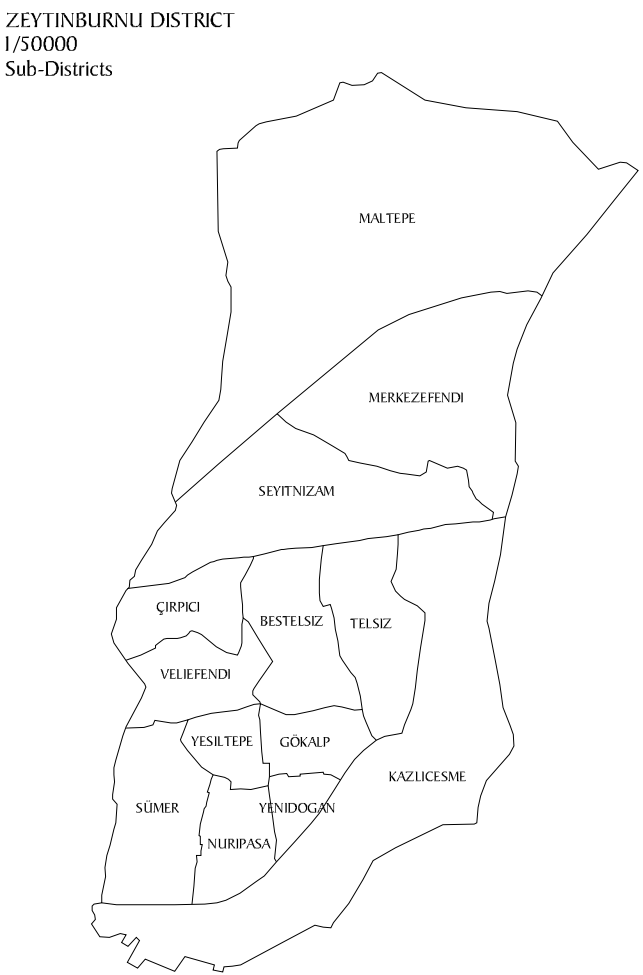


Image 4 : Sub-Districts of Zeytinburnu

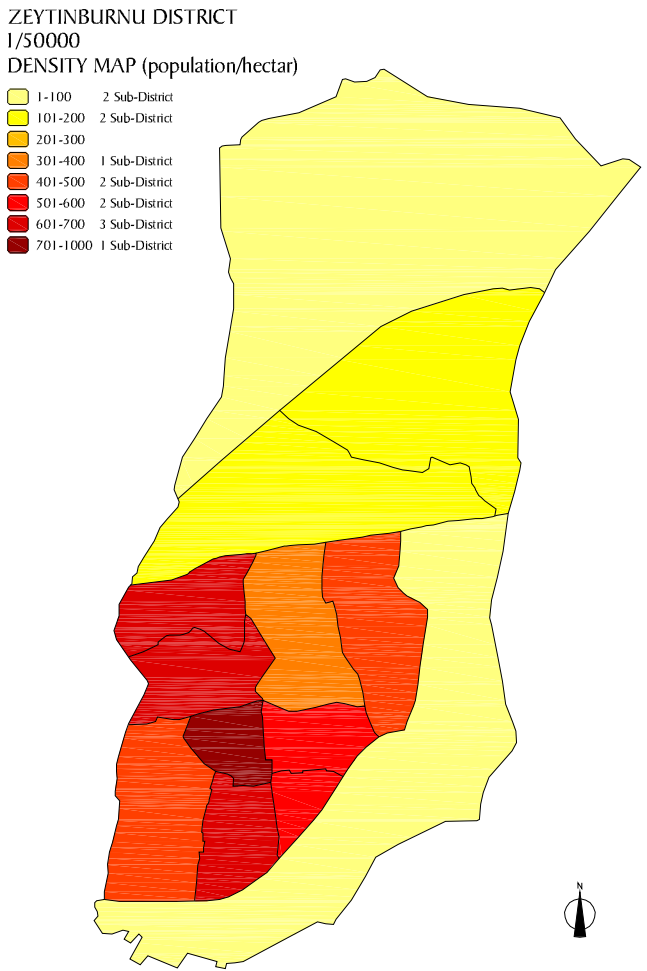


Image 5 : Population Density by Sub-Districts

Current Situation according to JICA report [1]

Population Distribution:
Population of the district: 239.927
Total area of the district: 1.149ha
Density of Zeytinburnu: 209pr/ha (the 8th district with the highest population density)

Area and Density:

Even though the total density seams low, when the density is analysed at sub-district (SD) level we notice a concentration of population in nine SDs. The four SDs left (Maltepe, Merkezefendi, Seyitnizam, and Kazlıcesme) represent 69,3% of the total area.
Total area of the district: 1.149ha

- Nine SDs represent a 375ha area (with concentration)
- Four SDs represent a 850ha area

Densities by Sub-Districts:

- For Kazlıcesme and Maltepe SD : density between 1 and 100pr/ha
- Merkesefendi and Seyitnizam SD : density between 101 and 200pr/ha
- Bestelsiz SD : density between 301 and 400pr/ha
- Telsiz and Sümer SD : density between 401 and 500pr/ha
- For Gökalp and Yenidogan SD : density is between 501 and 600pr/ha
- Cırpıcı, Veliefendi, and Nuripasa SD : density between 601 and 700pr/ha
- Yeşiltepe SD: density of 833pr/ha (the 4th SD with the highest population density in Istanbul).

Land-Use:
81,72% , 939ha of the district's total area is urbanized. 5,3% of the total area is cemetery grounds.

- 4 SD having extremely high land-use: 121ha
- 3 SD having high land-use: 188ha
- 3 SD having slightly high land-use: 391ha

Building Stock:

There are 15.573 buildings in Zeytinburnu district.
The building density of the district is 14 buildings/ha, it is the 8th district with a high building density in Istanbul.

Structure Types:

- 88,8% of the buildings have RC frame structure.
- 10,2% of the buildings are Masonry construction in briquette or brick.
- The 1% left is distributed between different kinds of masonry or frame structure.

Number of Stories:

- 66,4% of the buildings in Zeytinburnu are 4 to 7-story high. The height of a building is as important as the construction type. In general after an earthquake most of the damages can be seen in 3 to 8-story high buildings because of the ductility due to seismic oscillations. [2]

Numbers of Health Facilities:

- In Zeytinburnu there three major public hospital complexes in the Kazlıcesme SD. There are 6 hospitals and 10 private policlinics altogether in the district.

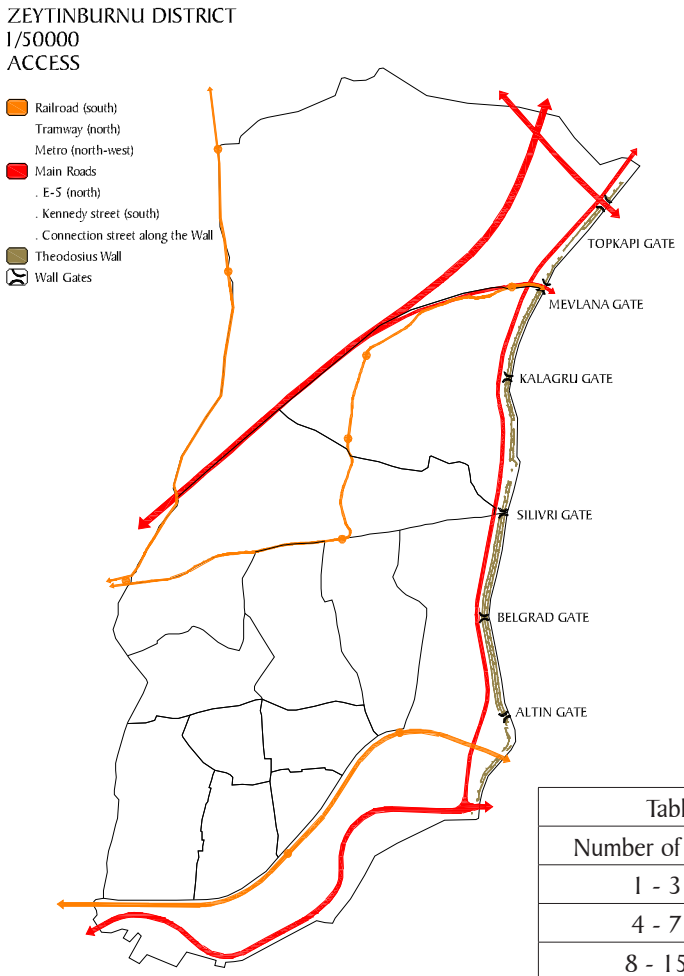


Image 6 : Access and Transports of Zeytinburnu

Table 1 : Buildings Stories

Number of Story	Number of Buildings
1 - 3	4471
4 - 7	10448
8 - 15	558
16 and Above	20

Table 2 : Area by Sub-Districts

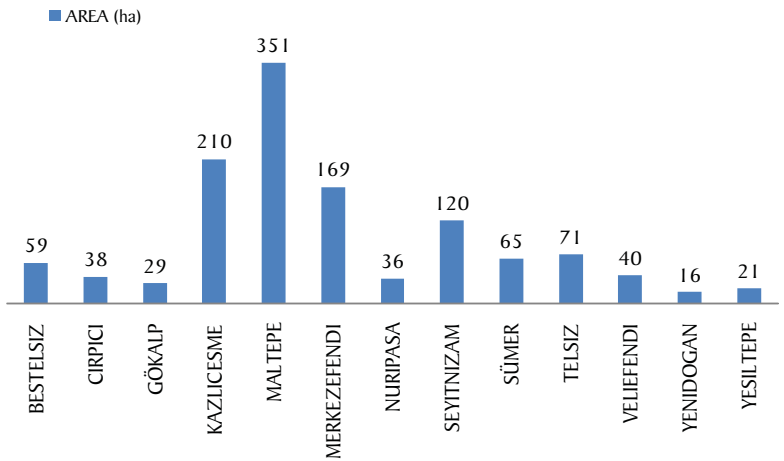


Table 3 : Population by Sub-Districts

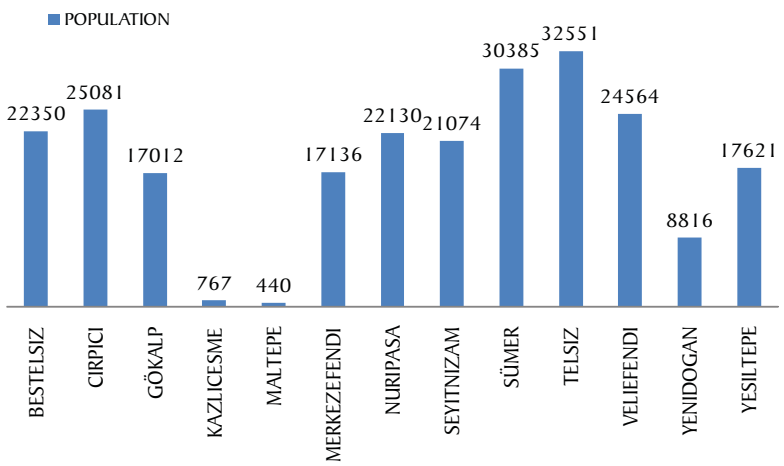


Table 4 : Building Construction Years (IICA)

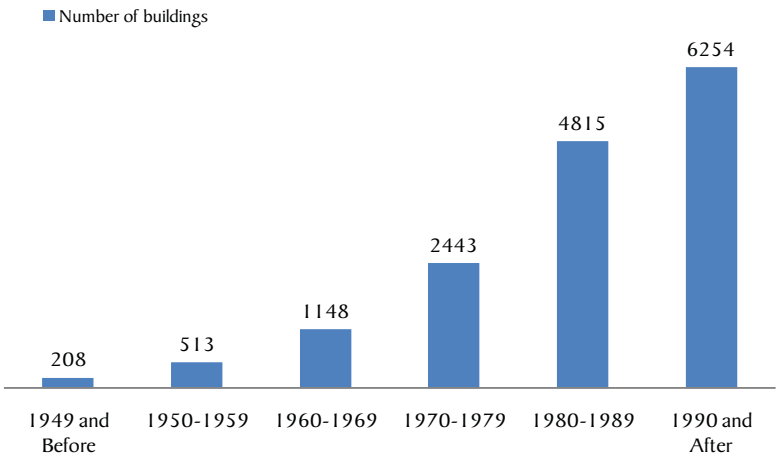


Table 5 : Building Construction Types		
	Building Structure Types	Number of Buildings
FS	Steel	21
	RC	13736
	Wood	18
	Other	2
MS	Briquette / Brick	1583
	Stone	51
	Sun dried brick	11
	Other	3
Other	Full Shear Wall	15
	Prefabric	20

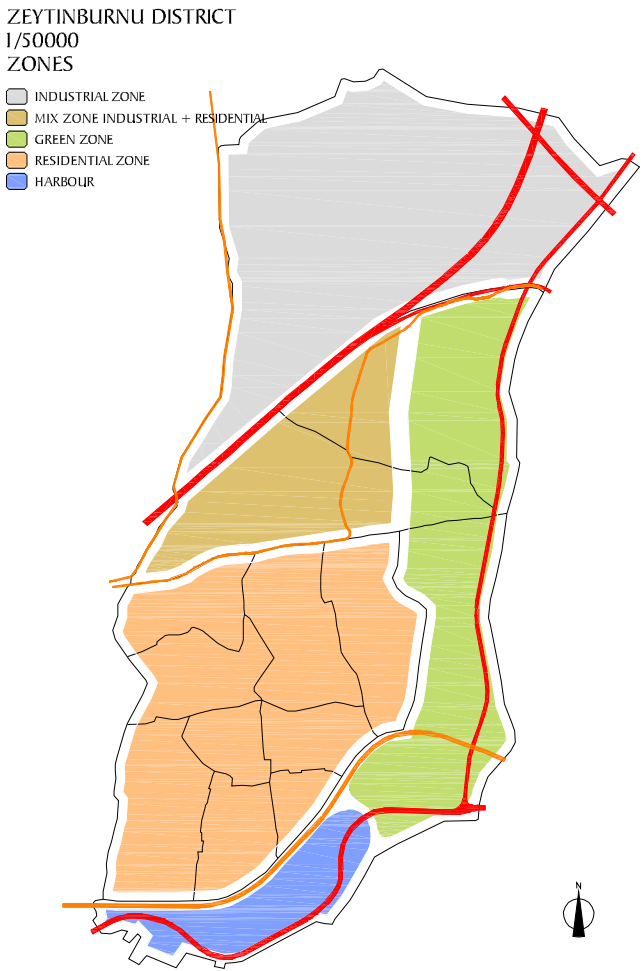


Image 7 : Zones

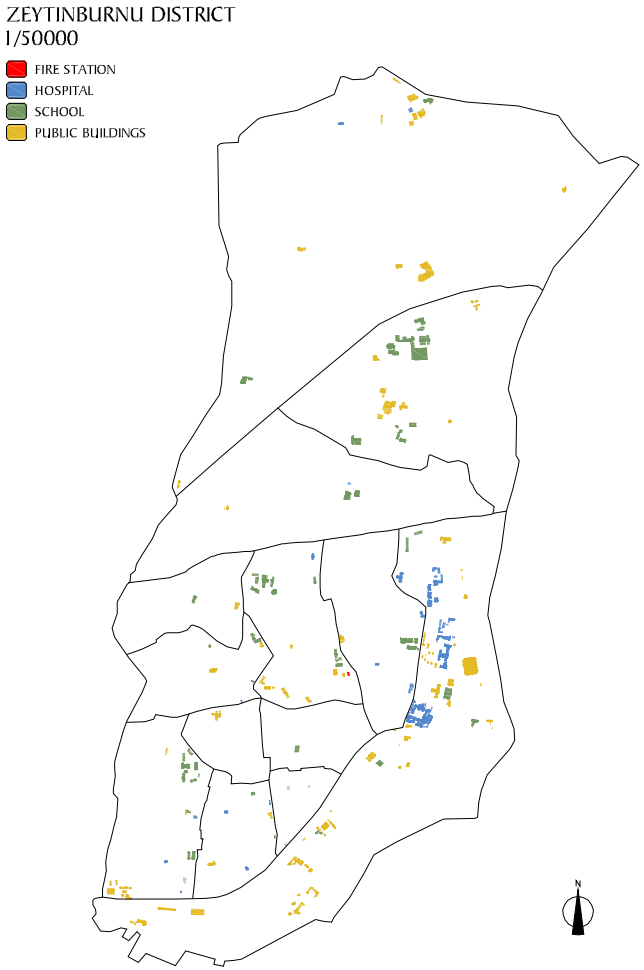


Image 8 : Special Buildings

ZEYTINBURNU DISTRICT
1/50000
HOUSING

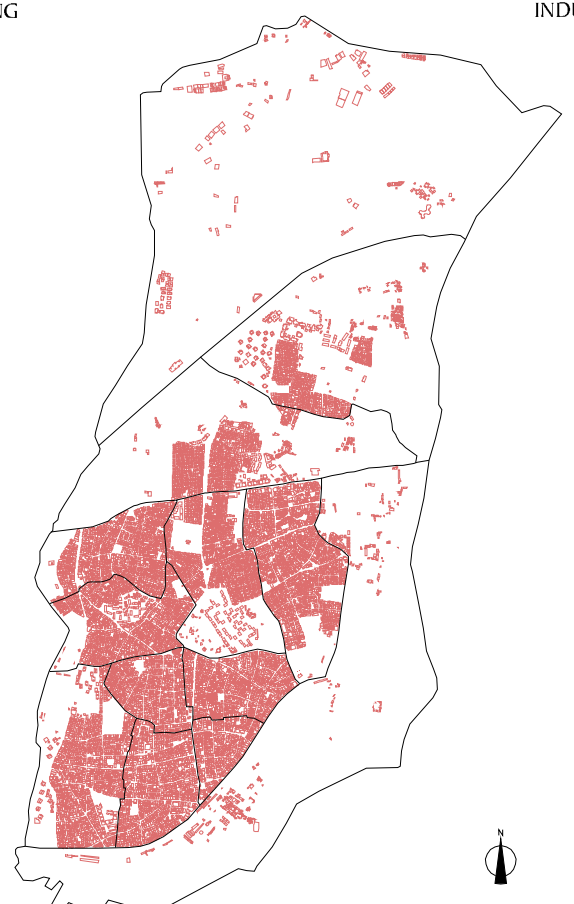


Image 9 : Residential Buildings

ZEYTINBURNU DISTRICT
1/50000
INDUSTRIAL BUILDINGS

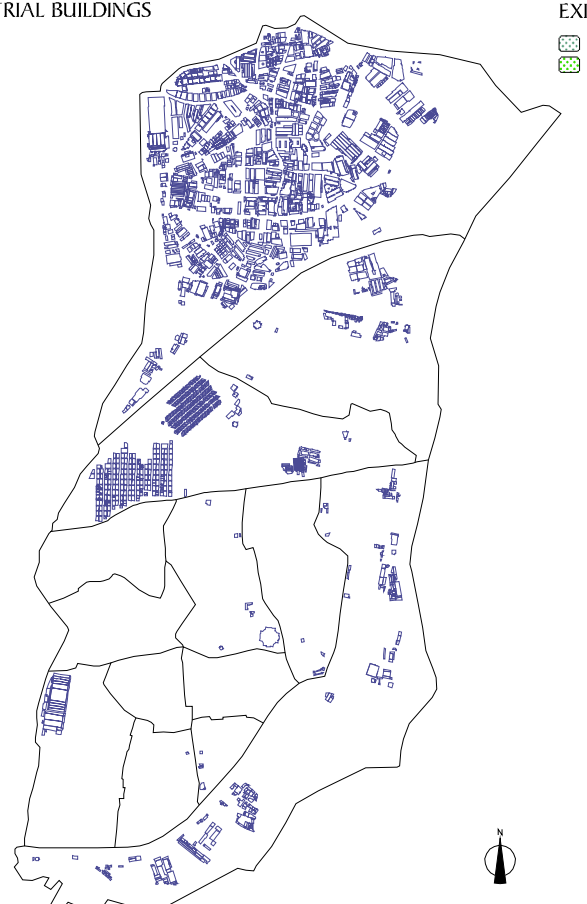


Image 10 : Industrial Buildings

ZEYTINBURNU DISTRICT
1/50000
EXISTING GREEN BELT

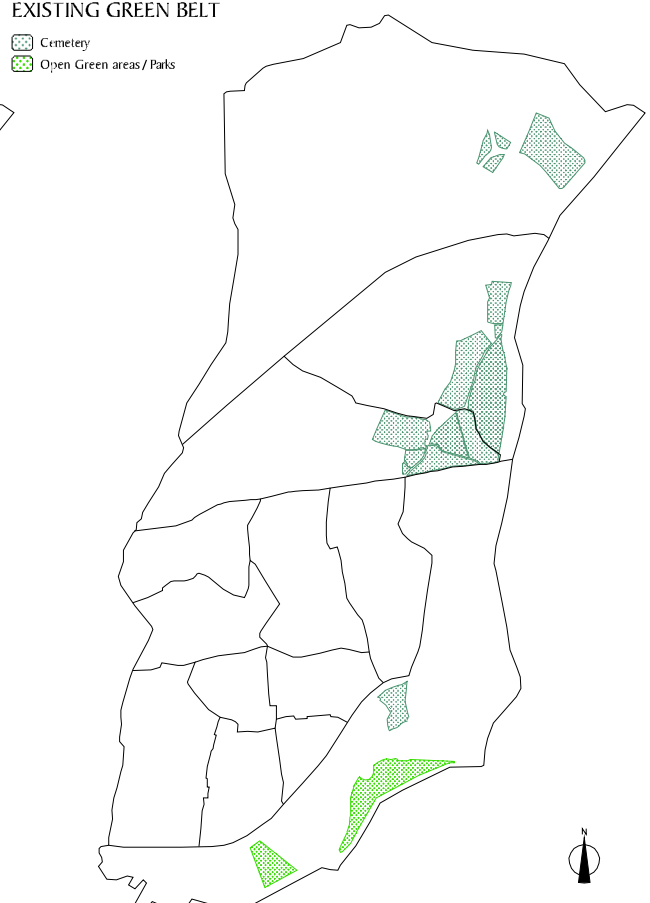


Image 11 : Green Belt

Urban Growth

The land, mostly composed of fields and orchards, has not been urbanised till the'50s because the Theodosius wall acted as a natural border. The only occupied land was the shores of the Marmara Sea, where an industrial zone was already established 150 years ago. (Images 12, 13, 14, and 15) [3] The lack of housing, which was the major problem for Istanbul, pushed the immigrants to move outside the city into shanty houses they constructed. Because the industrial zone in Zeytinburnu, was a good opportunity for jobs, it became the first focus point of migration. In 1957 Zeytinburnu became a municipality, but because of the limited capitals and technical resources the task of controlling the growth of slum areas became impossible. [4] In 1960, the population of the district was 89.397.

With the densification of housing, the industrial zone which attracted people was moved toward the North of the district leaving the shores free to use. The Layout of the urban fabric is the result of the first squatter settlements. The development started from the Kazlicesme sub-district, expanding toward the north. The first settlements were one- story high houses arranged along narrow streets as in a village. During 1957 with the high demand for housing, due to migration, most shanty houses were destroyed, and replaced by four to seven- story high apartment blocks. This process was quick and unplanned so the infrastructure was not able to follow this development.

Image 12 : South Coast of Zeytinburnu 1946

Image 13 : South Coast of Zeytinburnu 1966

Image 14 : South Coast of Zeytinburnu 1982

Image 15 : South Coast of Zeytinburnu 2005

Cultural Background [5]

The district population is composed only from immigrants, there is no local community. International immigrants represent 51,8% of the population, the 48,2% left are national immigrants. In the'50s there was a high national immigration toward Istanbul. At the same time the Bulgarian government evicted Bulgarian-Turks, who came directly to Istanbul. One of the districts the first Bulgarian immigrants where lodged was Zeytinburnu. The second eviction occurred in 1971 and the third in 1981. Most of the international immigrants are Bulgarian-Turks.

When the father of a family migrates to a city he generally seeks relatives or fellow villagers, and till he finds a job and a home, he lives with them. When he finds a house, or builds one (a gecekondu) it will be in the same neighbourhood, thus the concentration of people from the same region in a particular neighbourhood.

In Zeytinburnu, 48,7% of the national immigrants are from the Black Sea region. The mix between national and international immigrants is not easy because of their cultural differences different cultures. Even between different Turkish regions the cultural beliefs can be different, so it is easy to understand that sub-districts are also ethnic zones.

These relationships are a source of valuable information for search and rescue operations; the exact number of missing people and their addresses are gathered quickly so the rescue operations are more efficient, and focused. Unfortunately those bonds can be a handicap as volunteers will want to save their family first without waiting for specialized teams.

Earthquake Risks

After the almost destruction of Izmit during the Marmara earthquake, authorities started mitigation projects for Istanbul and for specific sub-districts. Zeytinburnu has the highest risk to undergo major damages in case of an earthquake. This fact was pointed out by both JICA reports and EMPI reports. The r reports proved to be true when a building collapsed on its own, in the densest sub-district.

To achieve and understand more precisely the situation, the first step was the establishment of the Zeytinburnu Urbanism Atelier (Zeytinburnu Sehircilik Atolyesi, ZESAT). ZESAT started the Zeytinburnu Pilot Project (ZPP) to outline, understand and to find solutions to the current condition of the district. They did a more precise micro-zoning of the land and buildings conditions. They prepared a detailed paper, with the collaboration of MATRA REGIMA, to point out the necessary precautions to take and explaining every aspect of the mitigation and risk managements that can be applied to the district.

Streets condition cannot be understood when analysing a plan. Town-planning codes allow 1,5m of cantilever for balconies, but there is a flaw in the code and it can be get around. Most of the constructions respect the codes of the implantation for the ground story but then all the floors become cantilevers. It is like putting a big cube on top of a small one .This is why most of the buildings in Izmit collapsed due to short story effect.

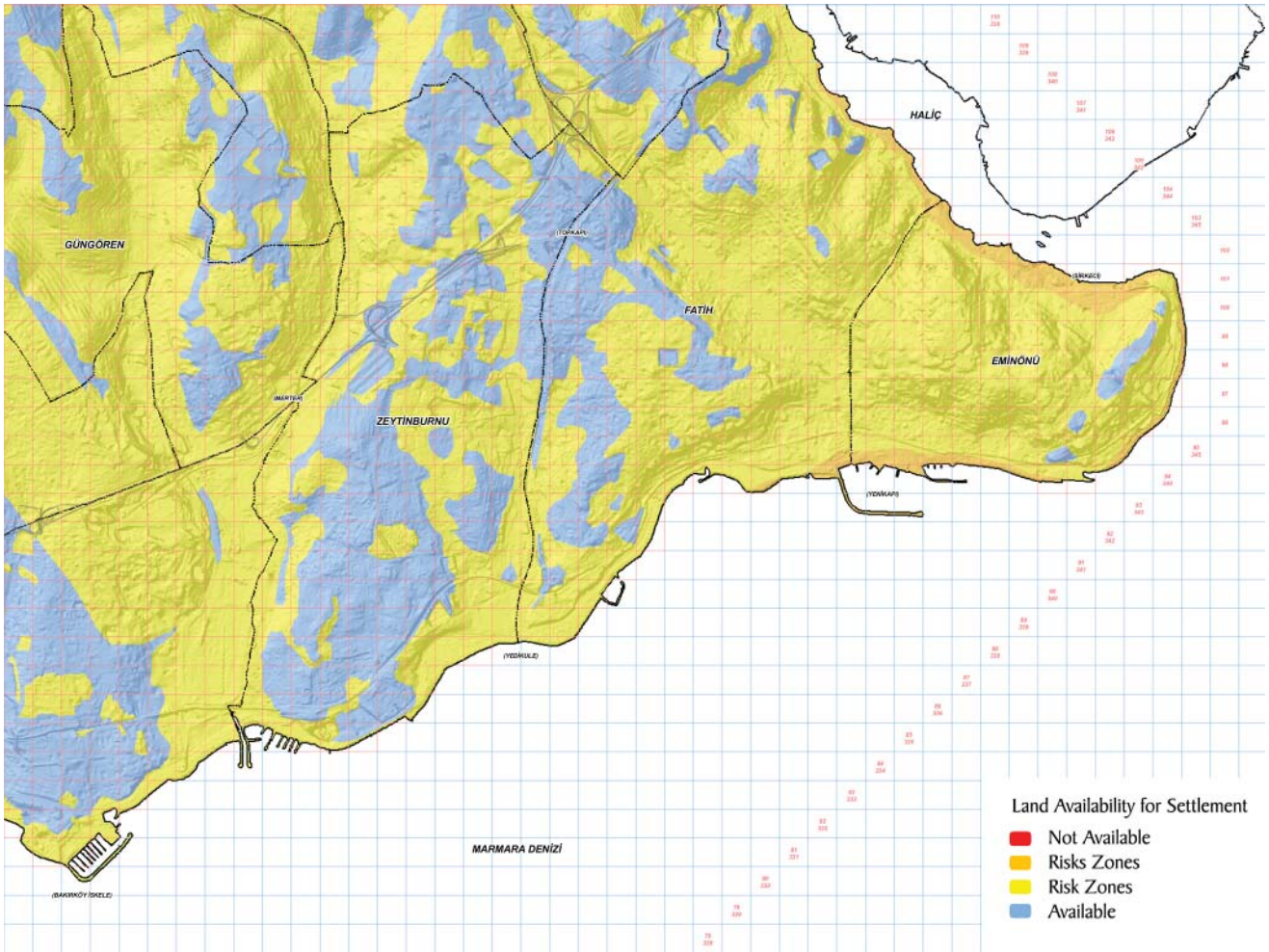


Image 16 : Land Availability for Settlement, IMM microzoning map

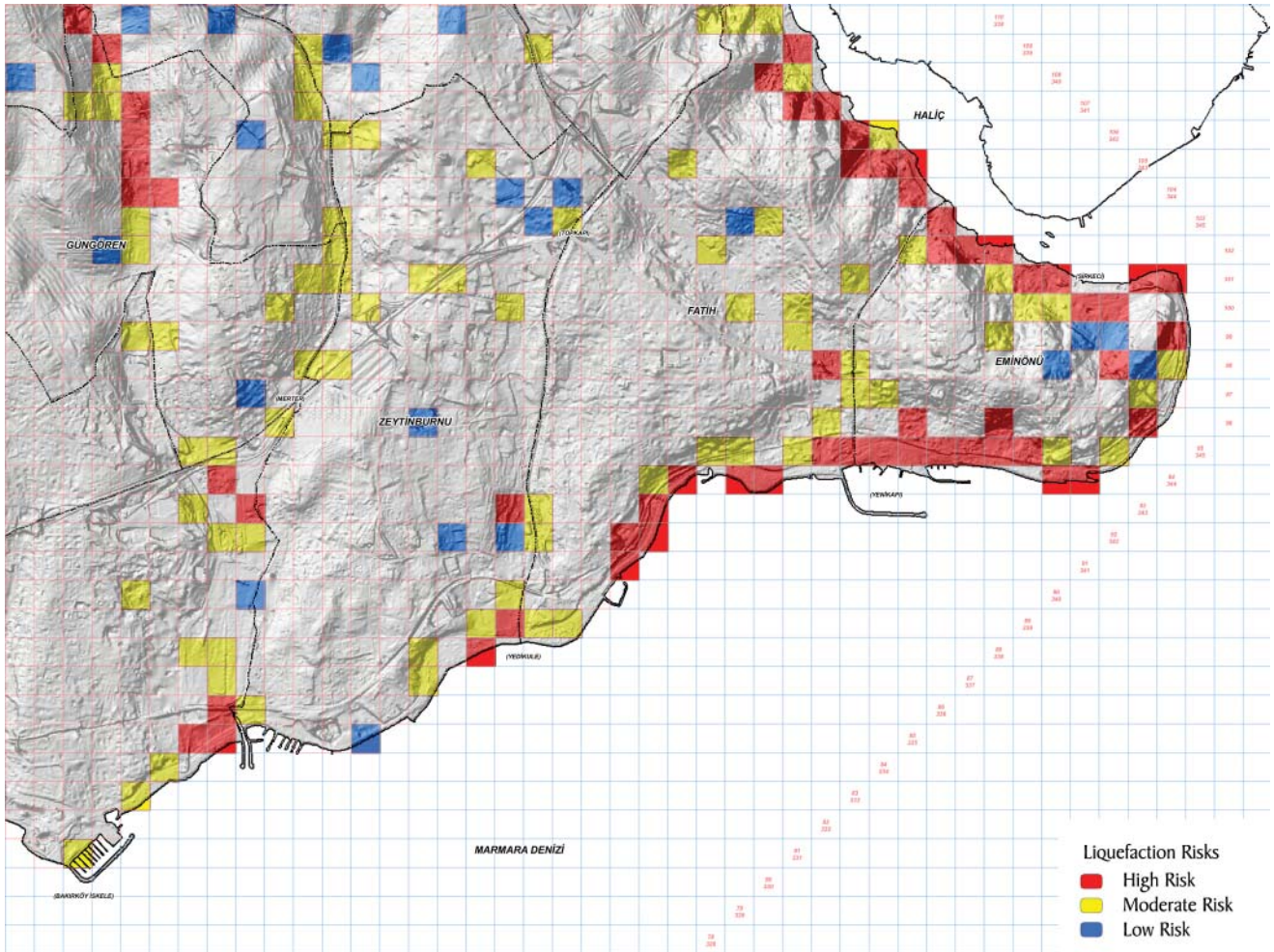


Image 17 : Liquefaction Risks, IMM microzoning map

JICA [6]

Damages and Vulnerability
The vulnerability to earthquakes of all the SDs in Zeytinburnu is of 100%: every single building will be damaged in an earthquake

- Eight SDs will be catastrophically damaged
- Three SDs will be heavily damaged
- Two SDs will be moderately damaged

Building Damage:

Heavily damaged buildings correspond to damage grades 4 and 5 in EMS-98.
Moderately damaged buildings correspond to damage grades 3 in EMS-98.
Partly damaged buildings correspond to damage grades 2 in EMS-98.
The total number of buildings is 15.573

Model A: Estimated damaged buildings' numbers
Total 9.525 buildings will sustain damages, which makes 61,2% of the total.

- 2.592 will be heavily damaged
- 2.704 will be moderately damaged
- 4.229 will be partly damaged

Model C: Estimated damaged buildings' numbers
A total of 10.184 buildings will sustain damages, which makes 65,4% of the total.

- 3.036 will be heavily damaged
- 2.963 will be moderately damaged
- 4.185 will be partly damaged

ZPP / Zeytinburnu Pilot Project [7]

IMM decided to start a pilot project with the corporation of the Zeytinburnu Municipality as it is one of the most vulnerable districts of Istanbul. JICA reports have specified every problem in building stock and legal issues on city and district bases. EMPI prepared detailed city scale solutions to the problems pinpointed by the JICA report. For a more accurate interpretation for pre-and post-earthquake strategies each data should be analysed in more details.

Aims and Objectives of ZPP:

- Gather all the necessary information to be able to create a specific project for the district.
- Determine high potential areas for the reorganization or urbanisation process.
- Gather more detailed information about the building stock: types of construction, construction year, and number of stories.
- Determine the social organisation of the district: industrial zones and ethnic or regional groups or sub-districts.
- Find and create new solutions for the specified high risk zones.

These objectives are organized in seven- step framework:

Step 1. Studying the district :
- Cataloguing and putting together all the data regarding the district from previous studies, JICA and EMPI.
- Analysing each data in detail and creating or adapting mitigation and emergency strategies at sub-district level.
- Understanding, Organizing, Finding, Specifications on legal and financial issues based on the new data.
- Defining the specifications or reorganisations of the chain of command between municipalities and non-governmental organisations.
- Creating an inventory of the building stock, and more detailed ground analyses.
- Choosing more suitable scenarios in the light of the new data.
- Preparing detailed plans for the chosen sub-districts, proposing new and adapted building models and types.

Step 2. Analysing of the infrastructure and then proposing new or readapted strategies for it.

Step 3. Specifying the potential damage according to JICA earthquake models and put them on a computer base system.

Step 4. Adapting the urbanisation process, pilot projects to EU standards, and reorganise funds for private projects.

Step 5. Adapting or creating organisations to EU standards, organisation, planning, distribution of duties, and specifications about their authority areas.

Step 6. Starting retrofitting projects in the light of the all previous steps.

Step 7. Gathering and storing of all the data acquired in the previous steps.

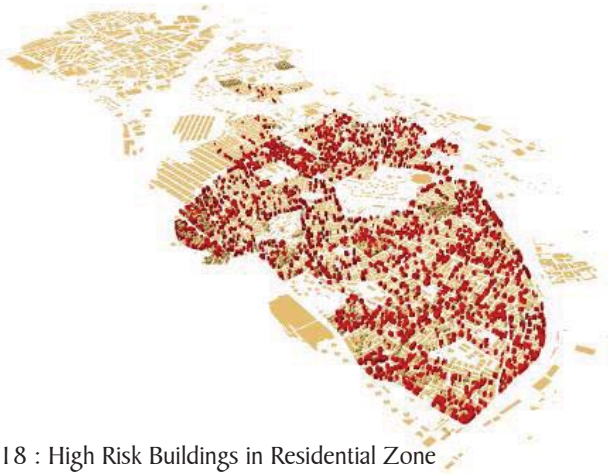


Image 18 : High Risk Buildings in Residential Zone

Image 19 : High Risk Buildings in Sümer Sub-District

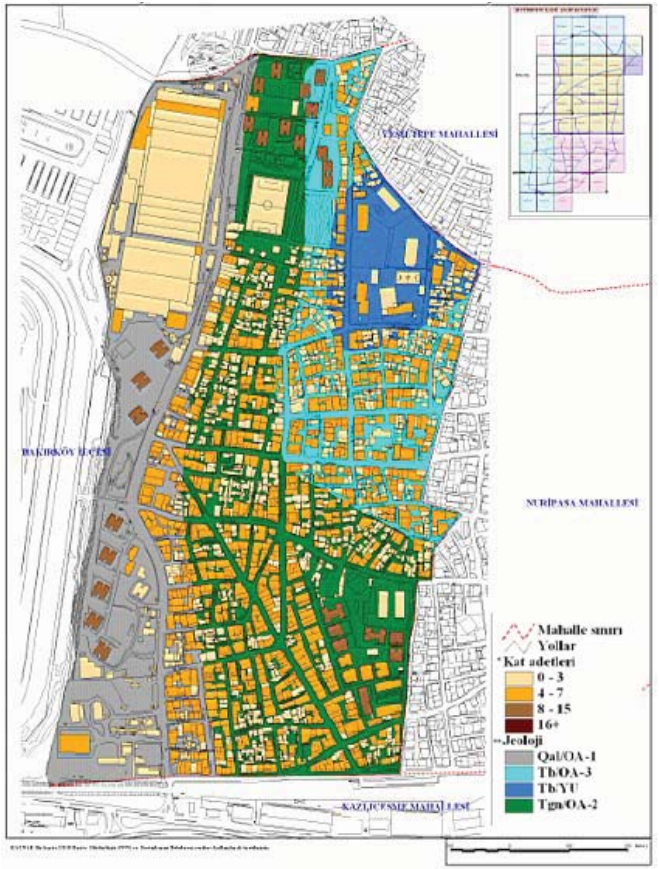


Image 20 : ZPP Sümer Sub-District

MATRA REGIMA Project [8]

"Together with Dutch partners Vestia Interconsult and Urban Solutions we jointly formulated MATRA proposal regarding a pilot project of Regeneration in the Istanbul Metropolitan Area (REGIMA)." [9]
This project has been developed to improve the condition of urban housing for low income communities in Istanbul and to meet the EU standards for a quality environment. After the 1999 Izmit Earthquake Turkey started a national scale process of reconstruction of the legal, economic and institutional systems. This project is a framework for Zeytinburnu and can be adapted to any other local regions by modifying the local data accordingly.

1. Decisions making of project organisation:
    - Organise a proper chain of command for the decisions making for various projects. Determining which administration will be in charge of which projects.

2. A strategic plan of Cultural Valley to improve the quality of the district new renovation plans and their organisations should be planned.
    - Creating an organisational structure which will implement the project.
    - Formulating the legal structure for projects.
    - Planning process: organising and determining the visions and missions for the district. According to these decisions, preparing a Master plan for the district including all regeneration, renovation and mitigation plans.

3. Action plan of Merkezefendi Sub-District. Five priorities for this plan.
    - Developing high quality living environments, ensuring the needs of the local community.
    - Increasing community involvement by appointment a community representative for each sub-district. Creating a community network. Developing a cultural strategy.
    - Improving the coordination and management of the area, between the representatives of non-governmental corporations, the volunteers and the community. Assuring the community of the plans and strategies.
    - Employment and enterprises. Improving the economical status of the district by creating sustainable businesses and so providing a better employment rate.
    - Information and shared learning: gathering all the data acquired, and sharing them with the community so that it can follow the process.

4. Establishing Zeytinburnu Communication Unit (ZIB):
   The aims of this unit will be to communicate every step of the regeneration process to the community, to facilitate the access of the information to the community, to organise events so that the community feels part of the project.

Today the community is still confused about the projects. For example the Cultural Valley project is only developing the coast making it a bigger and higher quality harbour, all the renovation projects are put aside. Even if we say the economic and political aspects of these projects are important one should not forget that life is more important, and that these projects are being done for the people.

Image 21 : Constructed in 60's

Image 22 : Constructed in 60's

Street Survey [10]

This Street survey was done in the context of a Workshop.

According to the survey:

- Population: 239.927
- Area: 1.150ha
- Number of buildings: 16.030

The survey shows four different generations in the building stock.

- 1st generation buildings, constructed in the'60s are mostly shanty houses, gecekondu.
- 2nd generation buildings, constructed in the' 70s right after the legalisation process low- high buildings.
- 3rd generation buildings, constructed in the' 80s.
- 4th generation buildings, constructed in the' 90s.

Table 6 : Number of Types of Structural Systems

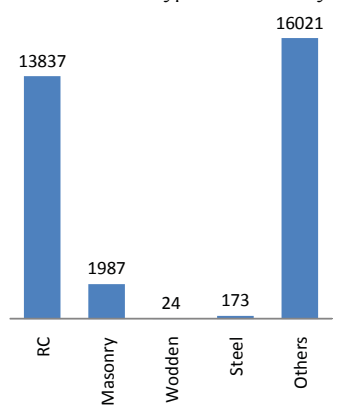


Table 7 : Number of Stories & Number of RC Buildings

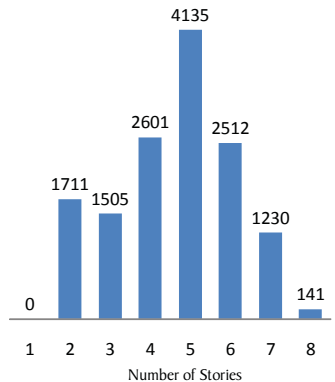


Image 23 : Constructed in 70's

Image 24 : Constructed in 80's

Image 25 : Constructed in 70's

Image 26 : Constructed in 90's

After a general survey, a more specific region with 3043 buildings was chosen to be analysed in detail. In this zone there is concentration of mid level buildings. The highest number of stories is six with a total of 1147 buildings. All the RC buildings of this zone were analysed, the safety conditions of every building is represented in charts according to their number of stories. Are not safe:

- All the 1 and 2- story buildings.
- 69% of the 3- story buildings.
- 55% of the 4- story buildings.
- 77% of the 5- story buildings.
- 70% of the 6- story buildings.
- 74% of the 7- story buildings.
- All the buildings with more than 7 stories.

Table 8 : Specific Region, Number of Stories & Number of Buildings

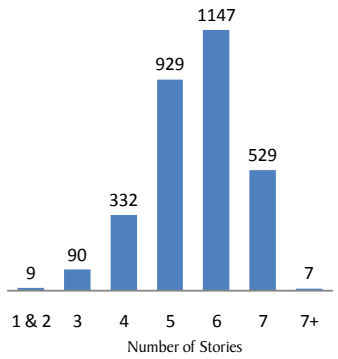


Table 9 : Specific Region : 3 stories RC Buildings

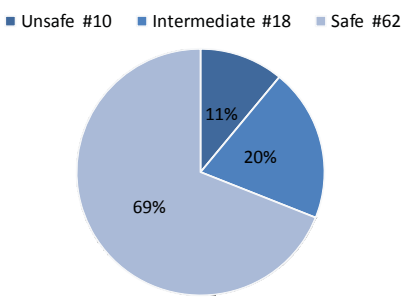


Table 10 : Specific Region : 4 stories RC Buildings

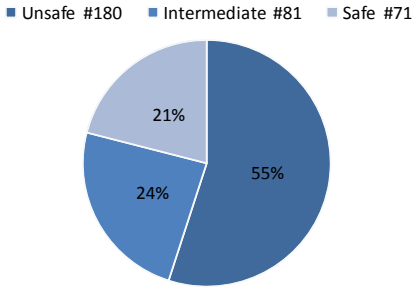


Table : 11 Specific Region : 5 stories RC Buildings

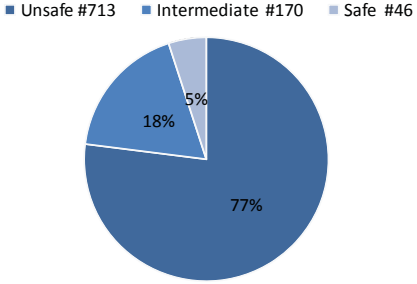


Table 12 : Specific Region : 6 stories RC Buildings

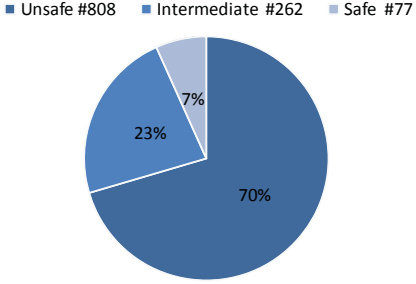


Table 13 : Specific Region : 7 stories RC Buildings

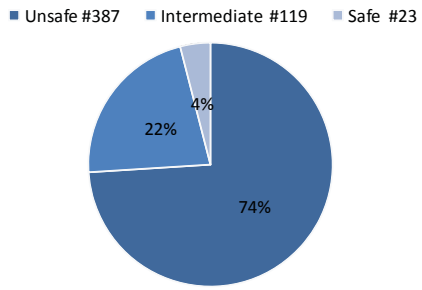
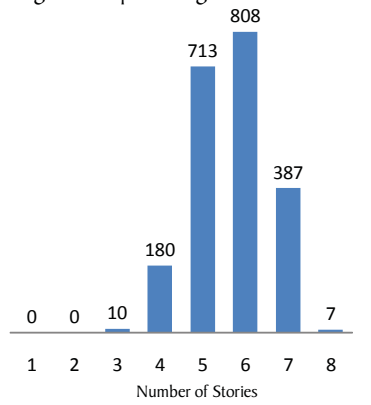


Table 14 : Number of Unsafe Buildings of the Specific region



Zeytinburnu Renovation Project by ZM [11]

Targets and principles:

- Gentrification should be avoided by letting people decide to leave or stay in their homes, unless it is earthquake vulnerable.
- Self-financing schemes depending on properties owners' own economic capacities, long term credit and dept programmes should be proposed under the coordination of the Community Partnership.
- Each individual and all community groups should participate in the process of the renovation.
- "Through the community Partnership, property owners will become share-holders in the Development Corporations, Consortiums, Urban Spine enterprises, and other income generating bodies in Zeytinburnu." [12]
- Aiming at a safer and a better quality environment, and at a new representation system within the city administration ladder.

Physical Design:
"Tunnel-frame construction, symmetrical designs, lowering centre of gravity, pyramidal sections in monolithic bodies with high rates of concrete curtain walls in either axes avoiding lifts were preferred for higher safety and relatively lower construction costs. Such preferences also promise alternative aesthetics, design solutions and some capacity to change urban identity in the city. This unification promises a rewarding area of professional practice for architects and urban designers." [13]

Workshop of Sarajevo and Yıldız Technical Universities [14]

In 2004, both universities decided to do a workshop to exchange knowledge between authorities, academics and workshop students. Within the context of the Zeytinburnu Renovation Projects, the Merkezefendi sub-district was chosen to be the object of this project. The subject of this workshop was to design a multi functional urban housing project within a building block in the Merkezefendi sub-district. Two Turkish assistant professors directing this workshop were academics who had worked at the preparation of EMPI.
Based on these analyses and students projects, new renovation scenarios and basic planning decisions have been made for the sub-district.

Europan 8 Competition, Renovation of Sümer Sub-district:

Program for the competition:
"Since the existing users are envisaged to reside in the same area after regeneration, the objective should not only be to preserve the total built area and population density but also to improve the conditions for living. Apart from necessary social, cultural and recreational domains, the area needs commercial spaces for international textile and leather trade that has a significant role in the economy of the district. The detached apartment blocks that constitute a big part of the study area will be demolished and equivalent property rights will be given to the owners of the demolished buildings in the area after regeneration. The necessary public spaces and commercial spaces will be planned in the same area. The housing blocks that exist in the stripe lying on north-south direction, will be preserved but the communal exterior spaces will be redesigned without giving any implication about new building facilities. An existing factory building that is located in the same stripe will be demolished and new design proposals for cultural and recreational uses are expected within its plot." [15]

But today-the Europan 8 competition winning project has been forgotten and instead a construction company, Kiptas, is planning a resident project for the same sub-district. [16] By 'resident project' I mean generally multi functional high rise building blocks creating a small high standard sub-district. If the funds behind the renovation projects belong to the inhabitants of the sub-district (self-financing situation) it is difficult to create and then to maintain the economic charges of high standards residents. Most of the districts inhabitants have low income, thus a low economic status. If the idea behind these renovation projects is to give the citizen a better, safer, and higher quality city life, the economic aspect should never be underestimated. Because the renovation projects are based on self-financing schemes, building high standard resident housing will bring more economic pressure to the inhabitants.

Image 27 : Europan 8 Winning Project

Image 28 : Kiptas Resident Project

Safe Zone

During and right after an earthquake people fleeing their damaged homes should gather in community evacuation areas. From there the injured should be sent to hospital and the others to nearby tent villages. This evacuation area people are guided toward hospitals, if injured, or toward nearby tent. Then the people whose houses have suffered heavy damages should be guided toward temporary housing. Because of the density of the district and the density of Istanbul, these temporary housings have to be outside the city limits. While people will be living in tents, slightly and moderately damaged buildings should be repaired and readied for their return.

JICA

Availability of Parks and Open spaces for requested Primary Evacuation Areas: [17]

To be able to be considered as a primary evacuation area, parks or open spaces should be at least 500m^2. So areas less than that are not included in the percentages.

- 7 SDs have less than 25% of the required area
- 2 SDs have between 25% and 49% of the required area
- 3 SDs have between 50% and 99% of the required area
- 1 SD have more than enough evacuation area for its inhabitants

Demand for Community Evacuation Locations: [18]

Community evacuations areas are the first safe places where neighbourhood population is gathered before being sent to shelters. The evacuation of the community is based on: in cities min. 1,5m^2/pr and outside cities 9-10m^2/pr, for the 239.927 people of this district it means a 36ha area.
Currently there is a total of 30ha of open space or parks. When analysed at a sub-district level, the result is as follows:

- One sub-district can respond to the demand of its own refugees
- Three SDs can only shelter 50% to 99% of their own refugees
- Nine SDs can only shelter less than 50% of their own refugees

Demand for Tent Village: [19]

For the first to the third week of a disaster a total of 72.900 people will be in needed of tents. In Zeytinburnu there will be a need of 18.200 tents, one tent accommodating a 4-member family unit.
There are 12,9ha designated as tent villages' areas in Zeytinburnu.
The need of the total area is analysed under two cases:

- Case 1: 35m^2/tent will require 63,7ha
- Case 2: 25m^2/tent will require 45,5ha

Demand of Temporary housing:

42.900 people will be homeless because their building will have suffered heavy damages. It is considered that 70% of these refugees will be going to stay with their relatives outside Istanbul. So only 12.900 people will need temporary housing, which is means 3225 housing units for a 4-member family. [20]
JICA based this 70% on Japanese standards, but if we consider the migration profile of Turkish families, I think that this percentage is a very optimistic. Most of the relatives will be living in the same sub-district if not in the same building which is the case if the first immigrant to Zeytinburnu built a gecekondu and then became the owner of the land, thanks to the 1976 law.

Safe Zones in Zeytinburnu

Since the JICA project, ZM has made many changes, trying to improve the community lifestyle and the district's living conditions such as retrofitting schools and hospitals. But because of the already existing urban tissue the open spaces needed as evacuation areas or tent villages are limited. Primary and secondary evacuation arteries have been reinforced all over Istanbul to insure proper search and rescue and debris removal operations. Most of designated tent village zones are next to main arteries to provide the refugees with primary needs such as food and water, and necessary products.

Today, there are 34,7ha of tent village zones (12,9ha during JICA studies), but this is still not enough.
When these areas are superimposed with liquefaction possibility maps of JICA, 20,4ha, representing the two widest tent zones in the south of the district, are in very high possibility liquefaction zone.
Is it not risky to prepare tent zones in such unsafe zones where a landslide can occur?

The emergency actions plans are limited to a theory implementation of the chain of command of the administrations and non-governmental organisations. The AKOM building with the people responsible for the evacuation of the refugees and for the allocations of the tents is situated inside the sub district, far away from the tent village zones. This situation causes organisation difficulties in a time when everything should be done quickly and automatically.

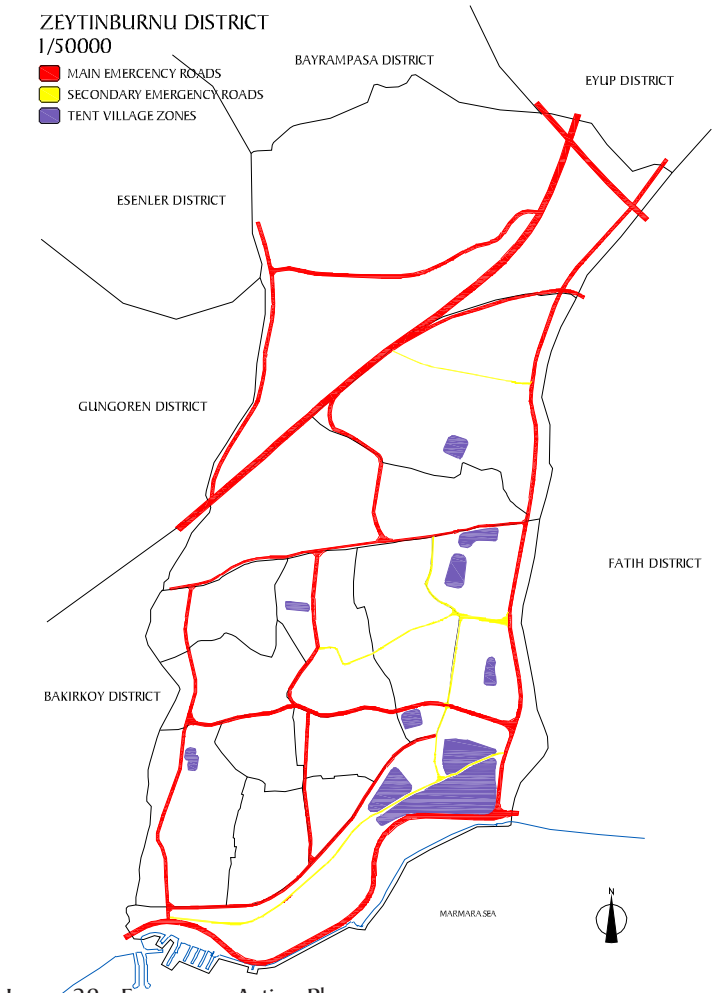


Image 29 : Emergency Action Plan

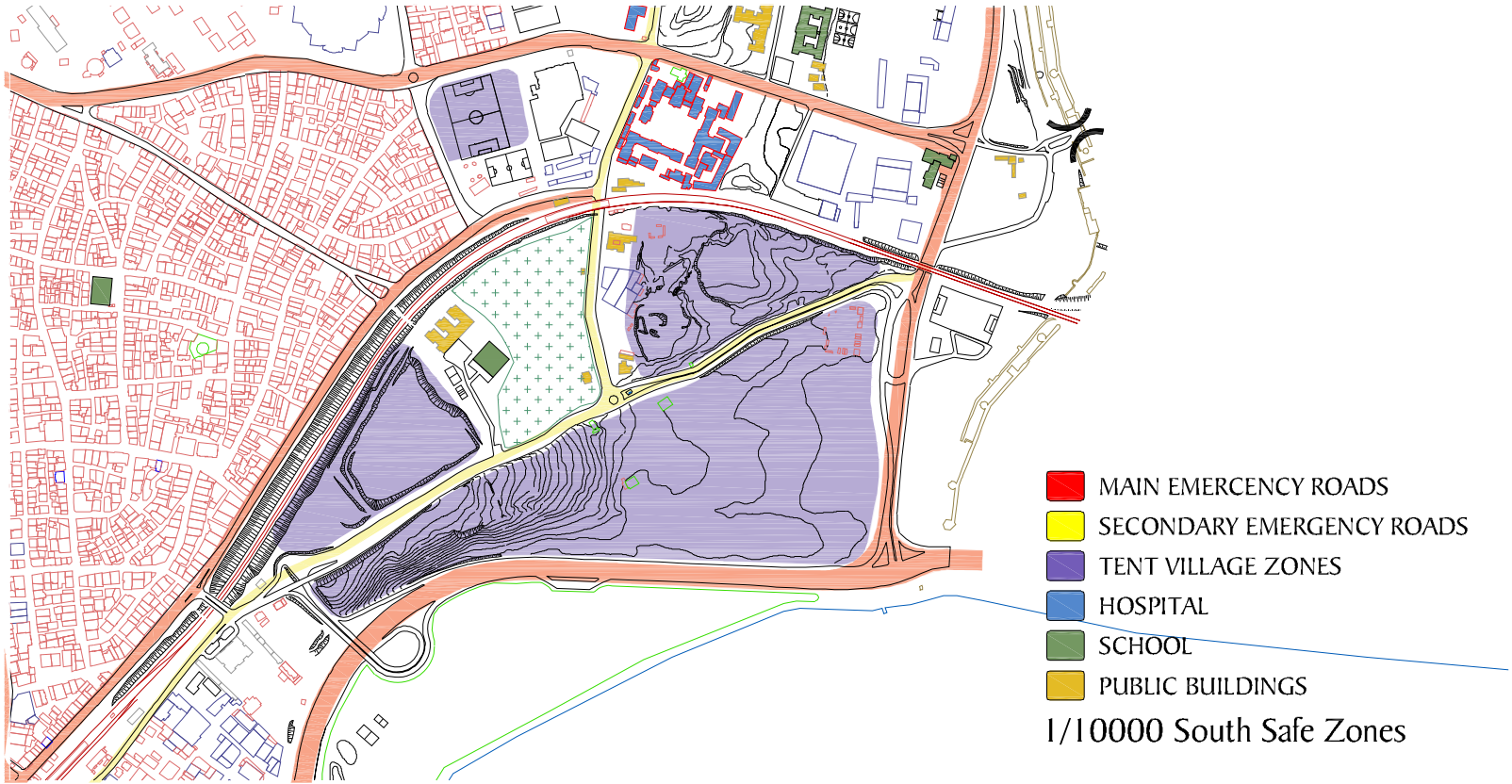


Image 30 : South Safe Zones

CONCLUSION

All the researches and projects about the Zeytinburnu district are focused on renovation, regeneration or mitigation strategies. These strategies are not only trying to secure and prevent risks to the citizens but also to improve their lifestyle and economic status. In Turkey authorities used these researches to improve all the aspects of Istanbul to fit a 21st century metropolitan city. As explained before the current urban tissue of Istanbul was created by an uncontrolled and unplanned process, resulting in a low standard and poor quality urban structure. It can be also said that the districts with low risk are generally inhabited by educated and high economic status people. High risk districts are generally the contrary; they are populated by less educated people with low economic income. This is one of the reasons why the renovation and retrofitting projects are funded by international organisations, and not by self-financing methods.

All these risk mitigations strategies are important to decrease the damages and losses but it should never be forgotten that there are unpredictable situations in every disaster. As JICA mentioned, the created earthquake models are just probabilities not realities. So authorities have to be prepared for a disaster not only with damage reduction strategies but also with emergency strategies.

Processes in Turkey for the relocation of the refugees:

1. Primary evacuation areas. These areas are generally less then 500m^2 and aims to regroup people. These areas can be parks and open spaces like school grounds. They should be planned carefully and communicated to all the people of the sub-districts. Each SD should have multiple evacuation zones to be able to guide refugees securely toward shelter.
2. Tent village, transitional shelters. People will be given tents as shelter for some time. As soon as the disaster occurs, authorities should start the reconstruction process alongside the debris removal and search and rescue operations. Lightly damaged or houses with no apparent damages should be checked and retrofit if it's necessary so people can return to their houses. People whose home was totally destroyed should be relocated as soon as possible to temporary housing outside the city.
3. Temporary housing. These houses are for the refugees whose homes were destroyed. But as in most of the encountered cases these temporary housing became a part of the urban tissue because the reconstruction process is too long. So if this solution is considered, it should be considered alongside with an efficient and rapid reconstruction process. The new buildings should not be vulnerable; the same inadequate structures should not be reconstructed due to the speed of the construction.

Some of the aspects of the emergency strategies were studied and organised. The emergency strategies planned the organisation between local and international organisations and determined the main evacuation arteries but the study of the organization and implantation shelter (tent villages) was not thoroughly examined. The installation of hundreds of tents in a not-well defined area in the quickest possible time is not an easy task.

JICA has already presented two cases for possible tent area requirements: Case 1: 35m^2/tent and for Case 2: 25m^2/tent. These areas should be designed and planned before an earthquake to be able to implant them as fast as possible. The design should provide effective and efficient arrangements for the chosen sites. The needed equipment and the tents should be stored on the site, not in anywhere else because the organisation of their transport can be delayed or even forgotten in the chaos. The tent village's needs should be organised locally and all the necessities should be on the site. The implantation of the tents, the guidance of the refugees, and the distribution of primary supplies should be done by volunteers working for the established organisation.

For my project I intend to design a tent village in one of the determined zones and try to find the most efficient way to use the given area. Alongside designing the area, I will try to put a constant function for the site because in a city as dense as Istanbul every open space can be squatted and an established function will prevent that. Designing a permanent building or building complex for the storage of the necessary equipments, organising and securing the access to the site according to emergency evacuation arteries are my priorities for the planning of the site. I will also try to find an efficient structure type, to provide minimum comfort for the refugees, to prevent the previous encountered difficulties and problems to be experienced again.

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