

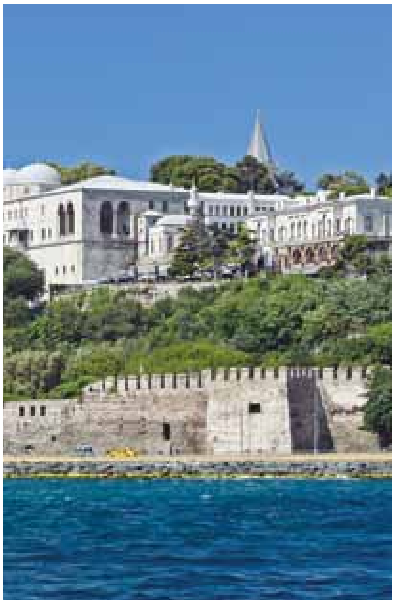


Retrofitting and Reconstruction Works

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PALACES OF ISTANBUL

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The Topkapı Palace

Introduction

Academic Assessment

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92 percent of Turkey's territory is prone to earthquakes, and 95 percent of its population lives in those regions with different levels of seismic risks.

Throughout the human history, despite the dangers adversely affecting the life such as earthquake, flood, landslide, avalanche, storm, tsunami and volcanic eruption, people have chosen to live in natural disaster areas, because of their benefits.

Notably after the Industrial Revolution, in unplanned growing cities due to migration from villages to urban areas, it is obvious that there will be a greater loss of life and property during the disasters.

In connection with population growth and rural-urban migration, it appears that seismic risks, soil conditions and topographic features are not thoroughly taken into account in the choice of development zones and new settlements.

Therefore, the future earthquakes will presumably bring far greater loss.

As can be seen in the other countries, the urbanisation in Turkey is unfortunately under the influence of similar trends.

92 percent of settlements in Turkey are prone to earthquakes, and 95 percent of the country's population lives in those regions with different levels of seismic risks.

In line with the current overview, there is an urgent need to take necessary measures against the social and financial losses of a potential disaster, the environmental issues and the rising frequency of the natural disasters in recent years.

Among the urgent measures to be taken, what should take first place is increasing resistance of low-performing structures against earthquakes.

In order to avoid re-experiencing of previous destructions such as Düzce, Marmara, Erzincan and Van Earthquakes and loss of life and property; structures that we use for various purposes such as shelter, education, health and workplace structures should be built with an earthquake-resistant design and structuring approach.

In the construction of buildings, structural elements that support the building must be verified in terms of seismic safety starting from design and construction stages and during the service life.

In order to have qualified building stock, it must be provided to inform the public about these issues and use of the buildings in accordance with the intended purpose.

It should be reminded that only civil engineers which have the necessary professional and academic background are on determinative position of a building's earthquake resistance, and an awareness of demand for qualified construction should be created.

Public support should be taken in limiting the risks arising from the existing building stock in cities through informing the public.

This would contribute to healthy growth of the cities and realization of proper urban transformation projects in the long run.

We can see the concrete outputs of these evaluations in the studies within the scope of Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP) which is also shown as an example in the world.

Along the studies carrying out, ISMEP is providing significant contributions in disaster preparedness and I believe that this book, as one of the outputs of ISMEP, will be a pathfinder to the institutions wishing to implement similar activities in their region.

Retrofitting and Reconstruction Works

In order to reduce the loss of life and property after potential earthquakes in Turkey, it is deemed necessary to focus on the quality of construction.

Natural disasters are originated from natural events, cause substantial loss of life and property, and happen in an instant manner. They can occur in different times, forms and within different impact durations all around the planet.

The most common natural disasters are comprised of earthquake, flood, landslide, avalanche, frost, storm, tsunami, volcanic eruption and forest fire.

In accordance with "Hazards of Nature, Risks to Development" released by the World Bank's Independent Evaluation Group (IEG), it is stated that the material costs reached $652 billion throughout the world merely in the 90's.

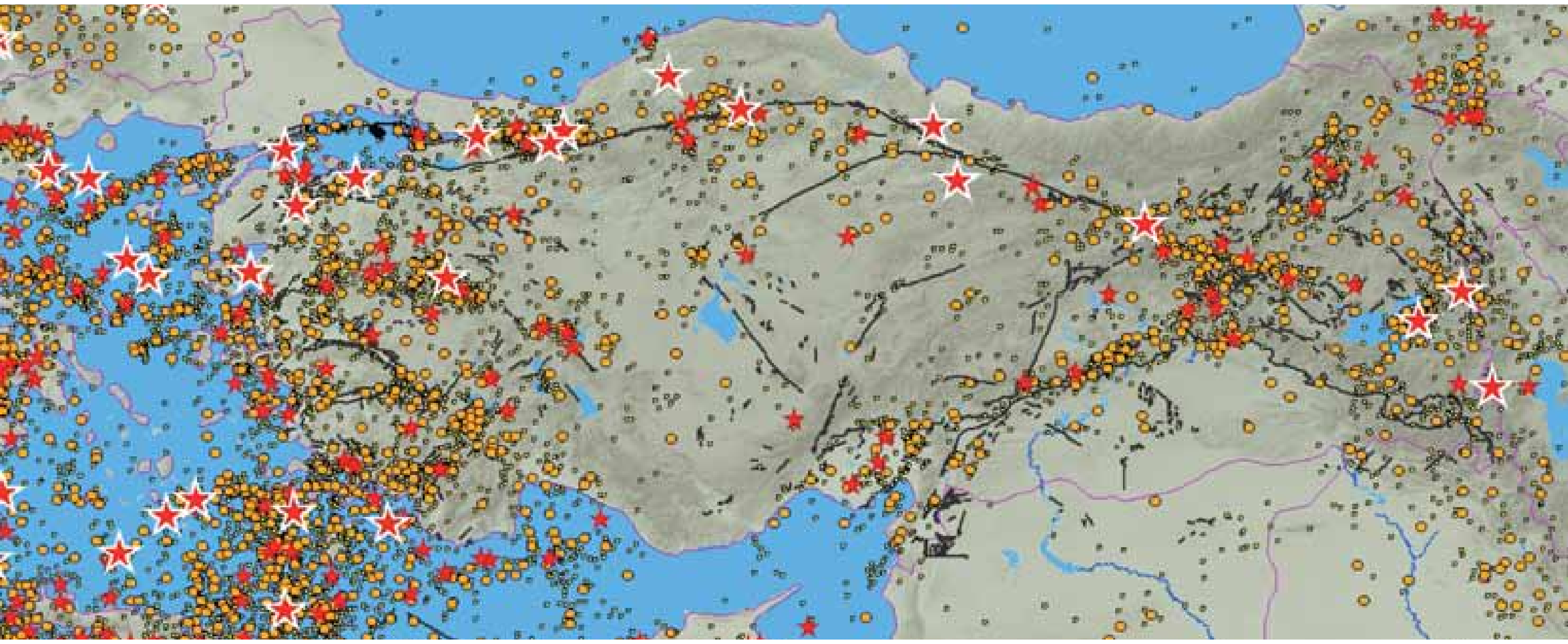
It appears that the disaster costs were more than 15 times higher than they were in 1950's.

According to the figures released by the Centre for Research on Epidemiology of Disasters (CRED), 3,852 disasters killed more than 780,000 people over the past ten years, affected more than two billion others and cost a minimum of 960 billion US$.

With respect to the natural disasters in Turkey, it is clear that earthquakes cause substantial loss of life and property. A major part of Turkey is located on active seismic zones.

Taking a retrospective look at the earthquake records, it is observed that a major part of Turkey's territory with high earthquake activity. Therefore, medium (and above) scale earthquakes frequently occur around the country.

The current extent of earthquake damage indicates the abundance of buildings constructed without civil engineering consultancy, and the deficiencies in construction techniques and the use of material.



Earthquakes between 1900 - 2013 (M>, 109090 Number)
Bogazici University Kandilli Observatory and Earthquake Research Institute

● 4.0 - 4.9 ● 5.0 - 5.9 ★ 6.0 - 6.9 ★ 7.0 - 7.9

Despite the seismic design codes enacted at various times, it is shown that people did not take lessons from the substantial losses experienced in some of the existing buildings. Further, the conditions stated in these codes have not been adapted, and there are numerous unconscious errors in constructions.

In order to reduce the loss of life and property to a minimum level after potential earthquakes in Turkey, it is deemed necessary to focus on the construction technique and quality.

The current Turkish Seismic Design Code and the other building regulations are complied with the global standards.

Seismic Design Code aims to provide foreseen performance conditions of buildings in the face of the largest earthquake expected in our country.

Despite current Seismic Design Code released in 2007 March and the previous seismic design codes released in 1975 and 1998, the main reason of the substantial earthquake damage and the loss of life and property was failing to comply with the standards and the regulations in constructions.

It is also observed that there was far less earthquake damage in the buildings complied with the seismic design code.

Analysing the forms of damage, it is shown that there are different reasons of damage in earthquake exposed structures.

It is possible to divide the risks arising from a potential earthquake into two main categories:

1. The risks associated with non-structural elements,

2. The risks associated with structural elements.

The risks associated with non-structural elements include lining walls, any damage in the chimney or equipment such as cabinets, shelves, ventilation ducts.

On the other hand, the risks associated with structural elements are comprised of column, beam, curtain and foundation damages.

The main reason of the risks observed in a major part of the existing buildings, and the earthquake damage is failing to construct the buildings in line with the conditions of seismic design codes and standards effective at that time period.

Structural and Non-Structural Risks

There are structural elements of load carrying system in reinforced concrete buildings. In addition to this, the problems including collapsed, peeling or fallen walls, peeled plasters, broken windows and fall of other movable furniture and materials can all be considered as non-structural risks.

Structural risks are required to examine thoroughly because of the substantial earthquake damage observed in previous years, and the earthquake safety risks in the existing stock of structure in Turkey.

Therefore, structural risks emerge from the earthquake damage because the elements of load carrying system (i.e. column, beam, shear wall, foundation, and floor) are lack of basic resistance and elasticity to earthquake forces, and are unable to resist.

As a result, the extent of damage in such kind of cases would be far greater or even causes the total destruction of a building.

An earthquake-safe structure means that the structure is not only resistant to the energy forces, but also has the elasticity to dissipate them.

In order words, the higher safety level (i.e. resistance and elasticity) the components of a load carrying system have, the fewer risks may arise.

Similarly, the lower safety-level a structure has, the more loss of life and property can be observed.

The main reason of the earthquake damages are failing to construct the buildings in line with the conditions of seismic design codes and standards effective at that time period.

Some Examples of Structural and Non-Structural Risks

By virtue of the growing knowledge from the academic researches and post-earthquake experiences, seismic design code revisions and improvements are also required in due course.

A section has been added with “The Regulations on Buildings to be Built in Earthquake Zones” released in 2007, that allows examination of seismic performance of the existing buildings that are unavailable in the earlier earthquake regulations.

Therefore, security of life and the survival of buildings can be ensured. It was also aimed to construct the priority buildings such as schools and hospitals in a way that they are able to render services immediately after an earthquake.

The buildings constructed in previous decades are not expected to entirely comply with the current seismic design codes and standards. However, total destruction risk can be eliminated on condition that the buildings were constructed in accordance with the codes effective in the year of establishment.

The below-mentioned cases have been admittedly experienced in the previous earthquakes.

However, it should be borne in mind that this risk is relatively higher for the previously constructed buildings. The structures complied with the recent code have better seismic performance.

Further, the risks associated with earthquake safety may arise in connection with temporal and environmental conditions.

The risks include a decrease in material strength (e.g. corrosion of iron in reinforced concrete structures), or in seismic load capacity of the components in line with the intensity of earthquakes.

Structural and Non-Structural Risk Mitigation

In both theoretical and practical terms, disaster risk mitigation refers to the systematic analysis and management of the factors contributing to disasters.

The activities within disaster risk mitigation include the reduction of the potential exposure to the hazards, the extent of material loss, the reasonable management of building land and environment, and to reach the maximum level of preparedness against undesirable circumstances.

With respect to seismic risk mitigation, it is required to take necessary measures against not only structural but also non-structural risks and other relevant hazards.




Detailed information is provided in the ISMEP Public Training Modules.

The basic definitions within the context of structural and non-structural risk mitigation are given as follows:

Structural Damage

Structural damage describes any damage, i.e. facture, breakdown, collapse, emerged on the components of load carrying system such as column, beam or curtain wall.

Non-Structural Damage

Non-structural damage refers to the damage emerged on the non-structural components, i.e. outside of the load carrying system, such as external surface coating, infill walls made from various construction materials for separating spaces, and installations.

Non-structural damage also includes the damages on furniture and materials in a building as a result of convulsions.

Non-Structural Hazards

Non-structural hazard is the common name of the hazards arising apart from the components of load carrying system such as partition walls, interior and facade cladding, installations, droplights, ceiling cladding along with the non-fixed furniture and materials.

Non-Structural Risks

Non-structural risk refers to the damage and loss emerging from non-structural hazards.

Structural Hazards

Structural hazards refer to the dangers emerged from the components of load carrying and transfer system (e.g. column, beam, covering) and their unfavourable grounding features.

Structural Risks

Structural risks describe the damage arising from the components of load carrying system.

Structural Measures

Structural measures describe the maintenance or retrofitting works conducted to increase the load carrying system capacity of the abovementioned structure components.

Retrofitting Stages in Sait Cordan Elementary School

Definitions of Retrofitting and Reconstruction

Retrofitting refers to the modifications carried out in a building or a structure to provide the expected performance levels to earthquake load.

Restoration is to transform a damaged structure component into its previous condition, namely to the strength value proposed in the construction project.

The main feature distinguishes retrofitting from restoration is that retrofitting aims to make the structure reach the expected performance level stated in the code against the impacts of a potential earthquake in a particular region.

In order to determine structural measures, the current safety level of a structure is required to be measured by means of different methods of analysis.

It is also necessary to identify the full details of building geometry and reinforcement, soil features, resistance characteristics of construction materials along with an analysis of regional seismic vulnerability.

Subsequent to the data collection, structural analyses (i.e. static and dynamic) are conducted in order to display the mathematical model of a structure.

In accordance with the results of analyses, the performance evaluation of a structure under earthquake loading can be conducted.

A considerable amount of experience and knowledge are necessary to prepare and implement a retrofitting project.

Civil engineering consultancy helps to properly implement the proposed rehabilitations in the course of a retrofitting project after a series of analyses.

It should be borne in mind that an unadvised retrofitting work or measurement analysis may not mitigate structural risks, but rather reduce a building's seismic performance, or even cause its destruction after an earthquake.

Objectives of Retrofitting

A retrofitting project is intended to make a structure reach the level of seismic performance defined within the current seismic design codes.

The main objective of retrofitting is to make a structure reach the proposed level of seismic performance in order to avoid loss of life after the largest potential earthquake in that region.

It also aims to avoid earthquake damage in priority buildings, e.g. hospitals and schools, or to provide these buildings immediately available.




There are various measures to be taken on the buildings with lower seismic performance in order not to re-experience the unfavourable impacts of large earthquakes as happened in Duzce, the Marmara Region, Erzincan and Van. Above all, the primary objective is to avoid loss of life and property.

Therefore, reconstruction describes the process which intends to mitigate potential disaster risks, and covers the destruction of existing buildings, and the construction of ergonomical new structures resistant to earthquakes.

There are various measures to be taken on the buildings with lower seismic performance in order to avoid loss of life and property during disasters.

It is possible to divide the measures into two categories. The first category covers the practises that increase seismic force resistance. The second category includes the practises that improve the ductility of structural components.

In the first category, additional structural components (e.g. shear walls) are integrated to the buildings unable to resists the largest potential earthquake in their locations.

Alternatively, structural sheathing is implemented in order to increase the capacity of column area and load carrying.

Different from thermal insulation sheathing, structural sheathing is to integrate additional concrete or reinforcement (i.e. steel) to extend the dimensions of the components of load carrying system (e.g. column or beam).

In the second category, on the other hand, the components are coated with special materials in order to improve the ductility of these components.

After this, it becomes possible to reach the required level of seismic performance on buildings.

Mustafa Eravutmuş Primary School Reconstraction Stages

Retrofitting Needs

The buildings in the need of restoration or retrofitting are classified below:

- Buildings with minor or moderate damage after an earthquake or any other disasters,
- Buildings with short economic life-span,
- Buildings whose load carrying system has been found resistless to earthquakes following the results of analysis in connection with maintenance requests. The buildings in this category are to have been constructed in accordance with the seismic design codes released before “the Code for the Buildings to be Constructed on Seismic Zones” effective since 1998, and be granted residence permit,
- Buildings whose load capacity has increased due to additional storeys or renovation works,
- Buildings whose usage has been changed (e.g. residential buildings transformed into hospitals or schools),
- Buildings which have been found with poor strength of materials for different reasons in the course of construction.
- Buildings which are required to renew its construction permit in accordance with the law no. 4708. These buildings are to have been designed before the release of “the Code for the Buildings to be Constructed in Seismic Zones” in 1998, and those whose constructions were suspended.

Factors Increasing Disaster Vulnerability

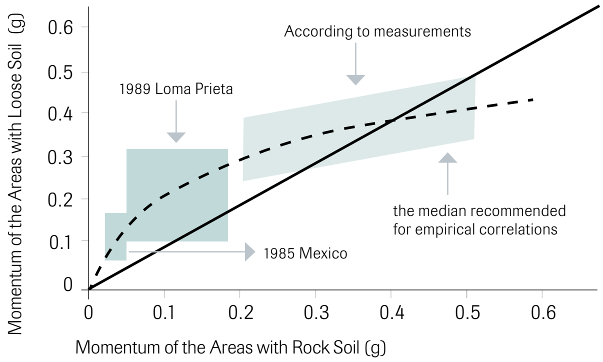
Soil Conditions

The engineering-related features including structure of soil layers, the level of resistance and the subsidence risk of buildings are some of the important vulnerability factors in an earthquake. Earthquakes are known as natural phenomenon happening many miles below the surface. Geologists generally explain this natural event with reference to the theory of plate tectonics.

Located above the magma in the Earth’s inner core, tectonic plates are in constant motion. Where the plates come into contact and when friction resistance is overcome, earthquakes can take place.

At the time of an earthquake, seismic waves are released, and then reach to surface and settlement areas in three different forms. Buildings are affected by the strong vibrations emerged from these waves.

Relation Between Maximum Accelerations of Rock Soil and Other Local Soil Conditions



Source: Relationship between maximum acceleration on rock and other local site conditions (Idriss, 1990, 1991)

In order to construct earthquake-resistant buildings, it is important to understand how seismic waves reach the surface through soil layers, and how they are transformed.

The distance that seismic waves travel until settlement areas may change the structure and the magnitude of an earthquake.

In particular, the type of soil layers on which building are constructed can change the magnitude (i.e. by magnifying or diminishing) of an earthquake.

Considering the existing buildings, it is possible to observe subsidence-related problems even before an earthquake on the buildings which are lack of a foundation system suitable with its soil, and were constructed without civil engineering consultancy.

Therefore, the extent of earthquake damage will be far greater on those buildings constructed without civil engineering consultancy.

In order to construct earthquake-resistant buildings, it is important to know how seismic waves travel through soil layers, and how they are transformed.

Depending upon the magnitude of an earthquake, the travel speed of seismic waves through hard and firm rocks are entirely different from loose and soft soil.

The earthquake damage will vary greatly from one building constructed on a soft/loose soil, to another building with the same structural design established on a firm or compacted soil.

In other words, soil conditions and both geological and morphological structures can transform the motion of an earthquake.

For instance, loose and soft soil can change the amplitude of seismic waves.

Compared with firm soil, although soft/loose soil can absorb and reduce the impacts of seismic waves with high amplitude (i.e. high seismic energy), they magnify seismic waves with less amplitude (i.e. less seismic energy). (Figure)

One of the reasons of the high extent of damage observed in the recent Marmara earthquakes was not the magnitude of the earthquake, but rather soil subsidence or dissolution of watery and loose soils. In other words, the main reason was failing to construct the buildings cohesive with its soil type.

In order to reduce the extent of damage and loss of life after an earthquake, it is required to take special measures and prepare construction designs for the soils prone to subsidence, landslide and dissolution.

Further, it is important to refrain from the construction of multi-storey buildings on soft/loose soils without taking any measures. In such cases, it is necessary to design specific foundation systems or to implement soil improvement methods.

The relationship between damage distribution and soil types has been a well-known discussion for a long time.

Examining the buildings damaged after the previous earthquakes, it is likely to observe the effects of this relationship.

For instance, 1783 Calabria-Italy, 1906 San Francisco, 1923 Kanto-Japan, 1957 Mexico, 1961 Niiagata, 1964 Alaska, 1976 Tangshan-China, 1994 Northridge USA, 1995 Kobe, 2011 New Zealand Earthquakes can be given as examples around the word. 1992 Erzincan, 1995 Dinar, 17th August1999 Kocaeli and 12th November 1999 Düzce, 2003 Bingöl, 2011 Van Earthquakes can also be the other similar examples from Turkey.

In an analysis conducted in USA, Richter found that the damage intensity of a 6 magnitude earthquake reached only 6-7 on a mesozoic limestone. However, the damage intensity of the same earthquake reached 11 on a quaternary alluvion soil.

After each earthquake, when damaged buildings examined, it was observed that the building sitting on different soil types are affected differently by the same earthquakes.

The relationship between earthquake damage and soil type is described as soil effect.

To explain soil impact, it is necessary to understand soil types.

It is also likely to discuss the types of soil in two categories, i.e. fine-grained and coarse-grained soils.

Coarse-grained (granules) soils are comprised of sand and pebbles, whereas fine-grained (cohesive) soils are made from silt and clay.

In nature, coarse-grained soils are found in a loose or firm shape. On the other hand, coarse-grained soils are cohesive, and when they come into contact with water, they may have soft or firm/solid consistency.

Some Examples of Soil Types

In order to reduce or refrain from soil-based damage on the buildings under dynamic forces (e.g. earthquakes), it should always be borne in mind that foundation of building is required to establish on firm soils as much as possible.

Compacted and Firm Soil

After the earthquakes occurred in the Marmara Region on 17th August and 12th November 1999, the terms such as firm and soft/loose soil have become a part of the daily language in Turkey.

In order to reduce or refrain from soil-based damage on the buildings under dynamic forces (e.g. earthquakes), it should be borne in mind that the foundation of building is required to establish on firm soils as much as possible.

Where this is not applicable or practical, it is required to implement soil improvement techniques or special foundation systems.

The term compacted or firm/hard soil refers to stable, resistant soils or rock soils which have lived through some geological ages; have relatively become compacted and hardened; and do not have any faults or fractures.

In order to be considered as earthquake-resistant, it is not necessarily required for a soil to be made from stable and massive rock blocks such as limestone, granite or kuvars.

It is possible to include most of the materials which have lived through some geological ages, namely have been existed under a heavy earth unit for a long period of time in this category.

Compacted/firm soils do not generally increase the intensity of earthquakes, but rather directly transfer its intensity to buildings.

For this reason, compacted/firms soil do not have any aggravating risks of damage on buildings in line with the fact that those buildings constructed on firm soil will only be affected by an earthquake's own intensity.

Above all, it is noteworthy to prefer correct soil properties in the selection of new settlement areas.

Soil-Dependent Earthquake Scenario Intensity Scale

CLASS	GEOLOGICAL UNIT	INTENSITY VARIATION
A	Plutonic and Metamorphic Rocks	-1.2
B	Pre-Cretaceous Sedimentary Rocks Jurassic and Cretaceous Rocks	-0.6
C	Upper Cretaceous, Palaeocene and Eocene Marine Sediments. Jurassic-Eocene Sedimentary Rocks	0
D	Tertiary Non-Marine Sediments	0.1
E	Oligocene and Miocene Sedimentary Rocks Tertiary Sedimentary Rocks	0.3
E	Plio-Pleistocene and Pleistocene Sedimentary Rocks Holocene and Quaternary Sediments	0.8

The classification of the geological units regarding the Reiche and Kahle model and Soil-Dependent Earthquake Scenario Intensity Scale designed according to the classification (California Division of Mines and Geology, 1986)

Source: The classification of the geological units regarding the Reiche and Kahle model and Soil-Dependent Earthquake Scenario Intensity Scale designed according to the classification Reichle, M.S., and Kahle, J.E., 1986

In the August 17, 1999, Kocaeli earthquake, the number of damaged buildings was higher on the loose soil in the city centre of Adapazarı (e.g. Adnan Menderes Boulevard). On the “firm” soils (psammite-schist units) near the boulevard, the ratio of building damage and the number of moderate and severe damaged buildings was lower.

Although closeness to a fault line, in the settlements such as Adapazarı and Kocaeli, it was observed that severe damage does not occur on buildings which have been constructed with civil engineering consultancy.

Loose and Soft Soil

The natural geological units which are extremely loosely and not tight materially are classified under this group.

To be more general and simple, loose soils are sedimentary and alluvial soils comprising of sand and gravel which haven’t passed too much time over their geological formation, and thus have not become tight and stick together loosely.

The term ‘soft ground’ is used for cohesive soils.

Due to their inner structure features, loose and soft soils have a tendency to increase the intensity of earthquake, and affect dramatically the extent of loss of life and damage considering the buildings constructed without civil engineering consultancy during an earthquake.

The alluvial lands on the seaside or riverside are classified to be dangerous risk group in terms of soil during an earthquake.

Even if the stream beds are drained, the drained, watery or swamp areas, reed beds and also unregulated filled lands are of weak soil quality.

These kind of soils cause further harm compared to other firm soils with respect to the magnitude of the earthquake. For the old buildings constructed on these kind of soils, additional measures must be taken, and the seismic performance of the buildings must be improved by soil improvement and structure reinforcement.

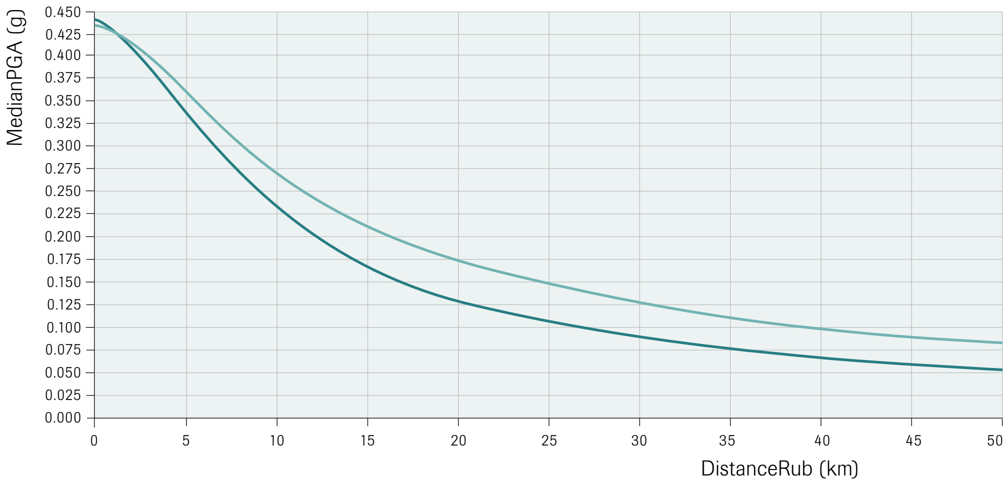
Soil-Dependent Earthquake Scenario Intensity Scale

GEOLOGICAL UNIT	INTENSITY INCREASE
MEDVEDEV (1962), MEDVEDEV–SPONHEUER–KARNIK (MSK) SCALE	
Granite	0
Schist, Psammite, Shale	0.2 – 1.3
Plaster Stone, Marl	0.6 – 1.4
Coarse Grained Soils	1.0 – 1.6
Sandy Soils	1.2 – 1.8
Clayed Soils	1.2 – 2.1
Filled Soils	2.3 – 3.0
Wet Soils (Gravel, Sand, Clay)	1.7 – 2.8
Wet Filling and Earth	3.3 – 3.9
KAGAMI ET AL. (1986), JAPAN METEOROLOGICAL AGENCY (JMA) SCALE	
Hillside Debris	0
Andesite	0
Gravel	0.2
Stream Deposit	0.4
Volcanic Ash	0.5
Sandy Silt	0.7
Clayey Silt	0.8
Silt	1.0
Peat Soils	0.9

GEOLOGICAL UNIT	INTENSITY INCREASE
EVERNDEN VE THOMPSON (1985), M.M ÖLÇEĞİ	
Granite And Metamorphic Rocks	0
Palaeozoic Rocks	0.4
Early Mesozoic Rocks	0.8
Craters and Eocene Rocks	1.2
Unbroken Tertiary Rocks	1.3
Oligocene and Pliocene Rocks	1.5
Pliocene and Pleistocene Rocks	2.0
Tertiary Volcanic Rocks	0.3
Quaternary Volcanic Rocks	0.3
Alluvium (water level < 9 m)	3.0
(9 m < water level < 30 m)	2.0
(30 < water level)	1.5
ASTROZA AND MONGE (1991), MSK SCALE	
Granite Rock	0
Volcanic Pumisti Killer	1.5 – 2.5
Gravel	0.5 – 1.0
Colluvion	1.0 – 2.0
Lacustrine Deposits	2.0 – 2.5

Source: Relative magnification factors in accordance with the various geological units given by Borcherdt ve Gibbs (1976), Shima (1978) ve Midorikawa (1987)

The change of median peak acceleration with the distance



The change of median peak acceleration with the distance for an earthquake with Mw7.4 magnitude. Light green soft soil (Vs. 30=300 m/s), Dark green hard soil (Vs. 30=1500 m/s)

As it is seen in the table, filled soil, loose and soft soils increase the earthquake intensity 2 or 3 times.

Because coastal zones and sandbank as well as stream beds are incompetent compared to the other formations in geological terms, for each region a detailed hazard maps must be prepared.

As a consequence of irregular and unplanned urbanization, the areas, which mustn't be zoned for construction such as streams, lakes and sea coasts, are frequently rehabilitated by draining and filling, and are opened to settlement.

These kind of areas have a high risk regarding earthquake.

Even though a fault line which gives rise to earthquakes is located far from these kind of lands, it causes severe structural damages.

In most of the earthquakes occurring in Turkey, especially the buildings located on loose and soft soils are under the risk of vertical or differential subsidence, rotation or bending, due to load carrying problems.

There may also occur dislocations in the slopes, and lateral flowing on the low-sloping loose and soft lands.

Moreover, loose soils with a high level of underground water have a high risk of liquefaction during an earthquake.

When the seismic wave has reached the soil, it increases the pressure of the space water between the particles, and eliminates the contact between them gradually. This leads the soil to act like viscous liquid and it is called liquefaction.

This liquefaction incident generally occurs on waterlogged loose sandy soils.

In the 1999 Kocaeli Earthquake, there were structural damages arising from liquefaction in the loose soils and loss of load carrying in the soft soils in Adapazarı (Erdik 1999).

On the loose and soft soils, the acceleration is felt more compared to the rock soils. This effect decreases depending on the distance from the fault line. As it is seen in the figure, farther the distance from the fault line is, the less maximum soil acceleration is.

Moreover, excluding the close-range distances the acceleration value observed on the soft grounds is higher compared to the rock soils.

The situation of the soil on which the building is constructed also affects the seismic performance. Also the fact that new load carrying components which are added to the load carrying system may exceed the foundation load carrying capacity lead to problems.

Soil Improvement

During the process of structure retrofitting, the improvement of the structural seismic performance of the buildings is the first implementation coming into mind.

However, the situation of the soil on which the building is constructed also affects the seismic performance. Also the fact that new load carrying components which are added to the load carrying system may exceed the foundation load carrying capacity lead to problems.

Then, it is explicit that the retrofitting works must be planned in such a way that they will also cover the foundation retrofitting.

In construction works, the soil may not have the capacity to carry the building safely.

In special cases, the construction of specific buildings is not impossible in terms of engineering; however, certain uneconomic measures must be taken.

If there is an excessive amount of load applied to the soil due to the building or a construction is underway on a soft soil, certain measures must be taken for the soil to carry the loads safely without giving rise to any soil collapse or excessive subsidence.

On the soils having the risk of liquefaction the onsite resistance may be increased with the improvement techniques.

Therefore, the soil features must be improved onsite.

There are mechanical, hydraulic, physical and chemical improvement techniques in order to rehabilitate the features of the soil.

In the mechanical improvement technique, by the effects of mechanical forces, i.e. vibrating roller, falling weight etc. the density of the existing soil is increased.

Compressing the soil layer on the surface with static, vibrating or pulsed rollers is a method to realize it.

For the improvement of granular soils, the most substantial application is to approximate the particles each other through the vibrations.

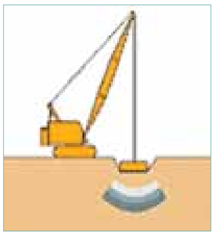
Falling an amount of weight from a certain height is resorted in order to improve the loose granular soils.

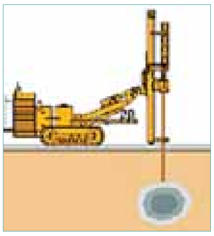
In the plan, the technique of falling weight at the designed intervals can be applied.

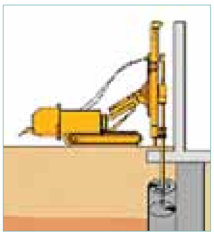
The application must be performed by taking into consideration the effect of the created energy waves on the environmental formations.

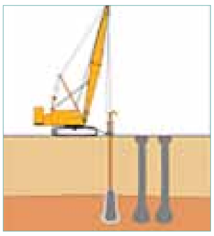
For the hydraulic improvement, on the fine-grained (clayed) soils the water trapped in the soil is extracted through drainage procedures.

Through the wells made from coarse-grained soils (sand, gravel) the water trapped in the soil is collected and removed.









Hence, the pressure of the water generated during an earthquake or because of the building load has been decreased and the resistance of the soil has been increased.

For the physical and chemical improvements, a mixture column is built in the depths of the soil by blending lime, cement and special chemical additives to the soil layers or by the help of specific construction equipment.

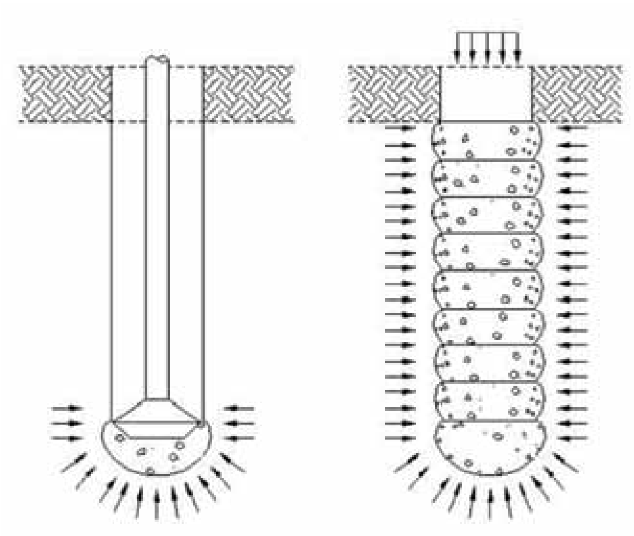
With the injection method, these ingredient is injected to the spaces in the soil through high pressure.

In the application named jet grout columns, a concrete floor column is constructed by applying a cement injection into the soil with high pressure.

By the help of appropriate equipment, the resistance of the sub-foundation soil can be increased within the buildings.

The effect of high pressure should be taken into consideration during the application. In order to increase the foundation loading capacity of the soft and loose soils, a stone column or compressed stone column is constructed in the soil depending on the application numbers stated in the plan.

In this method, by compressing stone-gravels or gravels is located in a cylindrical gap opened in the soil.



These gravel columns not only absorb the water pressure generated by the earthquake, but also help to carry the loads of the structure more safely by forming a firm column in the soil.

Today, the cities are getting crowded and more comprehensive structures need to be constructed in limited spaces.

When a deep trench is needed either for a construction base or because of sloping lands, a retaining wall is constructed on the edge of the trench.

While sustaining walls are constructed for the diggings 7-8 m deep, retaining walls with embedments are constructed for deeper diggings.

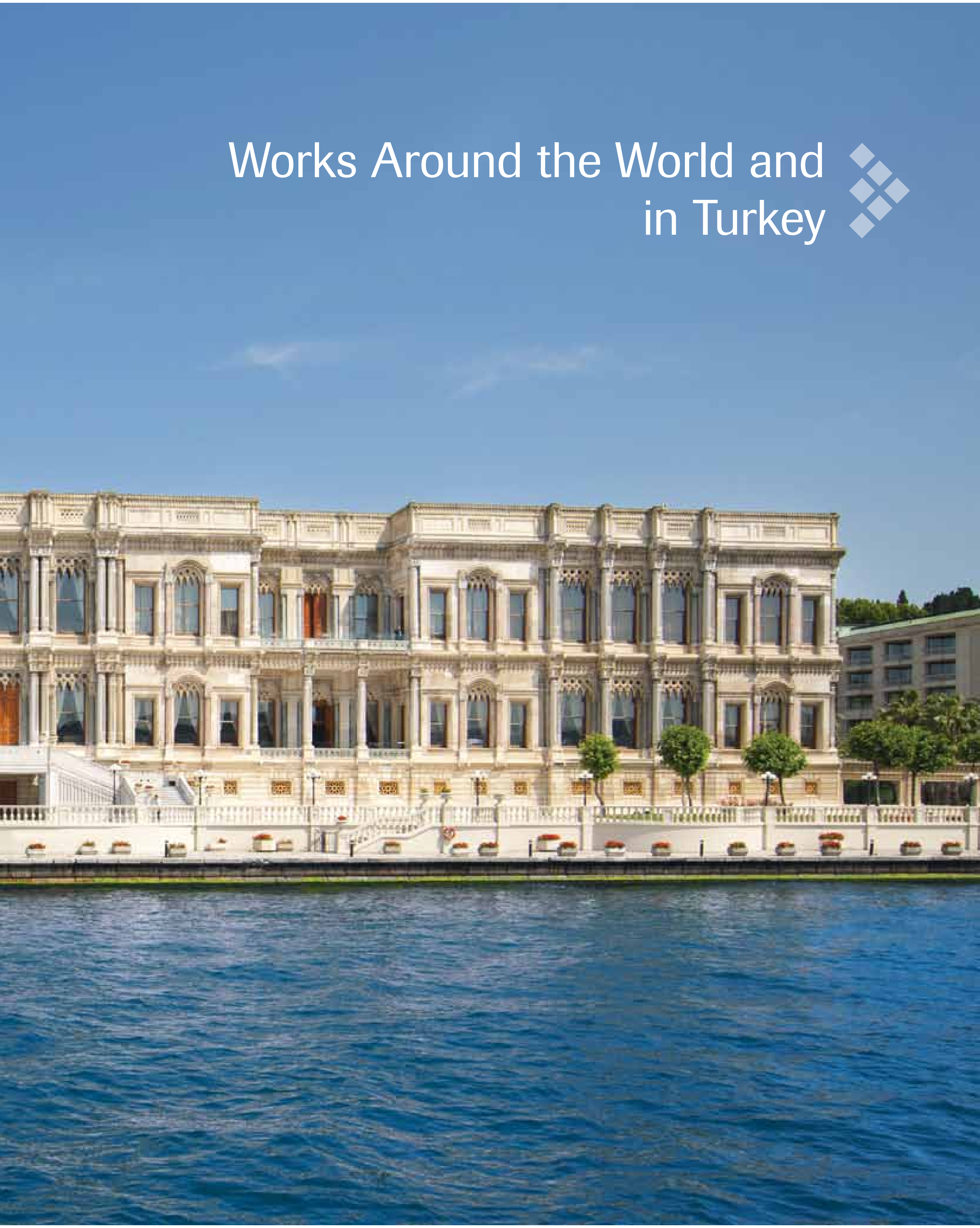
For the retaining walls to bear the lateral effects spreading from the soil, a structure of cement injected is formed in the soil by the help of a drill hole and steel ropes.

On the digging surface, a concrete wall or a cheval de frise is constructed.

Afterwards, by straining the steel ropes located in the soil a prestressing wall has been completed.

Çırağan Palace

Works Around the World and in Turkey



Exemplary Works Around the World

Thanks to the risk mitigation works commenced in Los Angeles in the 1980s, the loss of life was minimum in the earthquake which occurred in 1994.

The retrofitting and reconstruction works were conducted in different countries on various scales all over the world in order to mitigate the risks considering various disasters.

Whether they are conducted in developed or developing countries, or in underdeveloped countries, risk and damage mitigation works make safer schools, hospitals, emergency service buildings, infrastructure systems, public buildings and private properties as well as cultural heritages thanks to different kind of methods.

With the purpose of meeting the financing of the projects the steps taken with the support of the international institutions may sometimes vary on the basis of the projects.

The United States of America

In the study conducted by World Bank regarding the risk mitigation works, the instance of Los Angeles was given together with ISMEP as a successful example, because the risk mitigation works performed in the 1980s minimized the loss of life in the earthquake which occurred in 1994.

For instance, while none of more than 100 strengthened overpasses of beltway (highway-motorway) collapsed, 7 unstrengthened viaducts located in the same area went down.

Apart from decreasing the loss of life, the general fact that one dollar spent before the disaster prevents 7 dollars loss has been approved in the example of Los Angeles.

India

In India, of which 60% of the lands have a severe risk of earthquake 23000 people were died in 7 massive earthquakes which occurred between 1990 and 2009. Thus, in India “National Earthquake Risk Mitigation Project” is being conducted.

The project aims to create a capacity considering the partners, to increase social consciousness, to reform the regulations, to support the research and safety operations regarding the seismic safety, and to enhance the project management mechanisms as well as to strengthen the critical structures.

An Example of Retrofitting Work on Historical Buildings, ChiristChurch Cathedral, New Zelland

In the expected earthquake which would occur in the biggest city of India, Mumbai, which has 13 million citizens, between 25000 - 42000 loss of life and demolition of hundreds of buildings are predicted.

On the contrary, the works performed under the scope of national project the retrofitting works against structural risks mitigation are only rare.

In the regions bearing a high risk, in order to attract the attention of the people the retrofitting of 14 hospitals were completed.

Romania

Similar to ISMEP, the Romania Hazard Risk Mitigation and Emergency Preparedness Project is being conducted with the support of World Bank.

Romania, where is the hive of seismic activity in Europe, is subjected to earthquakes abundantly because of a fault line near Bucharest.

In one of the components of the project, which is considered in a very detailed way, it is aimed to reduce the potential exposure to the hazards of the buildings with highest priority.

Under the scope of the conducted works, in addition to the buildings belonging to the institutions giving disaster and emergency response service, 53 more buildings with high priority, comprising of health, education and public buildings, have been included in the project.

For the financing of structural risk mitigation works, the limited source used for the projects comes from the funds of the state and credits of World Bank which only equals to an amount of 75 million dollars in total.

The retrofitting of the cultural heritage buildings can be given as an example for that the performed works should be specific to the buildings.

These buildings which have endured the compelling environmental conditions for long years must be covered under the retrofitting works against potential disasters considering the high risk of collapse they have.

By allocating a budget of approximately 3 million dollars, the retrofitting of historical and architectural monument of Iasi City Hall is being planned in Romania.

For the retrofitting works of these kind of buildings, more expertise and technological innovation is required compared to the strengthening of ordinary buildings.

Within the scope of ongoing project, the technique of seismic foundation isolation has been resorted for the retrofitting of historical structure. These kinds of novel technological techniques have superior advantages compared to the conventional engineering methods.

People's Republic of China

Until recent times in China risk mitigation works are conducted more commonly with the scope of retrofitting activities rather than structural damage mitigation works which have been performed before the danger.

The countries which want to turn the destructive effects of the disaster into an opportunity to build safer settlements struggle to mitigate the risk while repairing the damaged buildings or constructing new buildings as in the Sichuan Region of China which cause 10 million people ended up homeless.

Following the earthquake occurring in 2008, the priority was given to the reconstruction of the residence and to the enabling of basic infrastructure systems (i.e. ways, drinking water, communication and energy) in the conducted repair and maintenance works.

With the help of 510 million of credit granted by World Bank, and as part of the works realized thanks to many national and international sources 2,2 million rural houses were repaired and strengthened while 1,45 million houses were rebuilt. Moreover, the concerned basic infrastructure systems were recovered.

Italy

Similarly, a source of 1 billion euros is being planned to be allocated for the works, which will be realized following an earthquake occurring in Italy, during the next 7 years.

In 2009, in the works commenced after the occurring earthquake not only the risky structures have been reinforced, but also the standards have been reformed in order to prevent the future disasters.

Next after the earthquake 35 school buildings with mild damage have been strengthened and 32 prefabricated school buildings were constructed temporarily.

In addition to the strengthening works of the school buildings rapidly, the funds were granted to the owners of private property depending on the extent of damage and thus they were given the opportunity to strengthen and reconstruct their buildings.

As in the example of China the necessity of retrofitting works following the destruction cannot be underestimated.

However, another significant fact which should be noted is that the advantage of the risk mitigation works conducted before the disaster is much further.

Studies in Turkey

Turkey is a country located amidst the most active fault zones of the world, and is always subjected to a massive earthquake hazard and risk.

When the seismic zone maps are considered, 96% of the lands of Turkey have earthquake risk in various levels and 98% of the population reside in these regions. 66% of these regions are 1st and 2nd degree earthquake zones, namely they are within the active fault zones.

Following the Earthquake of 17 August, which gave rise to massive loss of life and property, Istanbul attracted the attentions because the scientists were predicting a huge earthquake hazard which would occur in İstanbul.

The number of buildings built in İstanbul has already reached to the peak, and a considerable number of these buildings have been constructed unauthorized and illegally. Even though they are authorized, they are built without any soil study because the building audit and supervision is not efficient. And these facts demonstrate that the predicted earthquake will cause a total destruction in İstanbul.

In the light of the experience obtained in the consequence of what happened in Turkey and in other parts of the world, it is an explicit fact that unless a competent preparation is not planned, the cost of the earthquake will far exceed the amount which is predicted to be spent for the preparations before the earthquake.

The researches prove that one dollar spent before the disaster prevents 7 dollars loss.

Therefore, the limited sources of Turkey must be utilized in the most efficient way and the investments which will minimize the costs of the earthquake must be prioritised and given significance.

The works which will minimize the effects of a possible earthquake must be grouped into two. The works performed to strengthen the resistance of the buildings are as to the essential solution point of the first group.

If the buildings are earthquake-resistant, the destruction will be only transient and in smaller scale.

When the Turkey seismic zone maps are considered 96% of the country have different levels of earthquake, and 98% of the population reside in these regions.

The Criteria of Seismic Performance of the Buildings

- The buildings must survive from the small magnitude earthquakes without any damage.
- In the moderate magnitude earthquakes, even though it is an acceptable situation that there may occur some damage on the parts excluding the load-carrying elements, it is unacceptable for the load-carrying systems to be damaged.
- In a massive earthquake, it is acceptable that both load carrying elements and not carrying systems may be damaged at a certain level. However, even then the building shouldn't collapse.
- At the consequence of a massive earthquake, it is impossible from the economic perspective that not a single building which will not get any damage can be built.
  Thus, the basic logic is founded upon that during a large scale earthquake the building will not collapse and not a single loss of life will occur.

This can only be realized if the existing construction stocks are made resistant to earthquake and the new buildings are built to be earthquake-resistant.

The second group of works bear a vital importance until especially the first group of works are completed and the construction stock of İstanbul is built to be safe.

The second group of works is to evaluate the existing construction stocks and cover all the relatively short term works to minimalize the destruction under these conditions.

The most primary and significant provision for İstanbul to be prepared for a probable earthquake fully is to make safe the existing structure stock against earthquake.

Therefore, without any delay several detailed soil studies and a comprehensive risk evaluation must be conducted for the whole construction stock depending on the priorities.

In this respect, from Marmara Earthquake (1999) several lessons were taken and it is objected to maintain the overall control and the buildings to be constructed resistant according to the regulations.

The Regulations on Buildings to be Built in Earthquake Zones define the qualifying conditions about what kinds of buildings should be built, reconstructed or expanded in the earthquake regions, as well as about their designs and constructions.

"The Regulations on Buildings to be Built in Earthquake Zones" came into effect in 2007, covered the issues about the determination of seismic performance and the retrofitting of the behaviours considering the performance based design in a newly added chapter which was not found in the previous earthquake specifications.

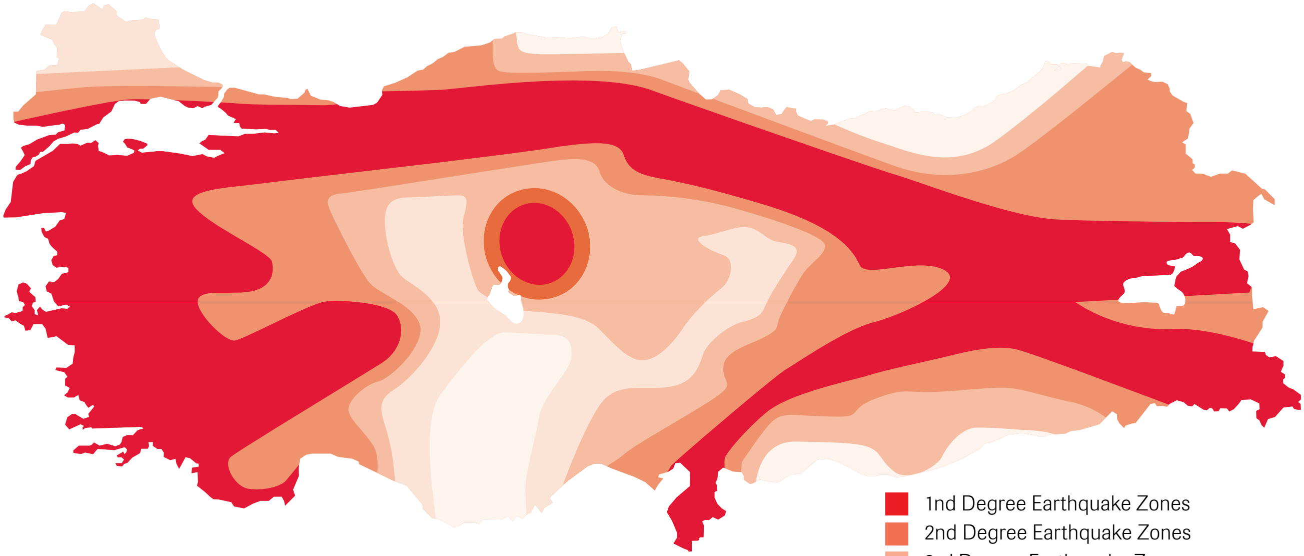
In the seismic design code, three categories of earthquake (mild, medium and severe) were defined with respect to the earthquake-resistant building design.

Accordingly, in frequently occurring mild earthquakes not only the load-carrying system of the building but also the elements which don't carry the load are aimed not to get any damage (i.e. interior walls). In medium scale earthquakes, the load-carrying and not load-carrying elements are expected to get only a minor damage or at a repairable level of damage.

In rarely occurring severe earthquakes, it is acceptable that the load-carrying systems of the buildings may get at a level of irreparable damage.

However, this must never be at a level which will lead to loss of life, and the unity of the construction should be preserved and it should not collapse and remain standing. At this point, the objective is to control the collapse, and to save the lives of the people in the building.

Earthquake Zones Map



Source: B. Özmen, M. Nurlu, H. Güler, "Coğrafi Bilgi Sistemi ile Deprem Bölgelerinin İncelenmesi", 1997

Current Situation in Turkey

According to the "The Report of Housing Problems and Housing Need in Turkey" prepared by the Chamber of Civil Engineers in addition to the data of Turkish Statistical Institute (TSI), in Turkey approximately 17 million construction stocks are available and while 67% of these are unauthorized and illegal, 60% of the constructions are over 20 ages old. 40% of the buildings must be strengthened against the earthquake.

Briefly, due to the deficiency of the legal regulations, and the loopholes in the audits, unhealthy housing spaces become widespread. Thus, the "building supervision" is of the highest priority.

On the other hand, the fact that up to 80% of the life losses occurring in earthquakes result from the damages in the instalments depending on the damage on the load-carrying systems is a crucial title for the mechanical engineering departments.

However, the cost of the load-carrying system of a building doesn't exceed the total construction cost more than 35%.

Most of the existing buildings were not built in compliance with the current provisions of standards and regulations.

This fact relatively increases the risk for the existing old buildings.

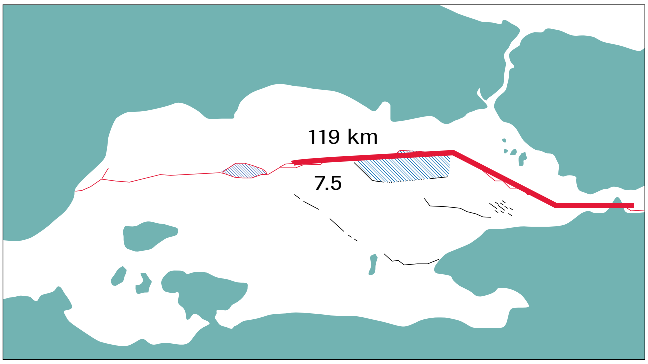
The problem originates from the fact that most of the existing buildings were neither constructed in compliance with the provisions of the standards and regulations which were effective during the time they were built.

The reason of the biggest destruction occurring following the earthquakes are improper structuring with the current specifications and lack of supervision. Depending on the time and environmental conditions as well as the effects of the occurring earthquakes, the seismic load capacity of the existing buildings decrease and the risk increases.

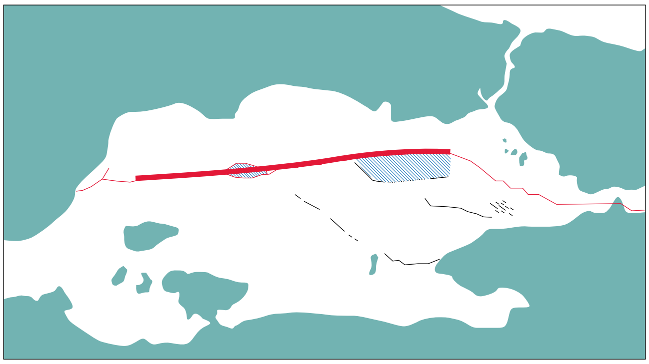
The several reasons covering the mentioned effects and increasing the structural risk are as such:

- The construction of the buildings without a project
- New structures which are added to the building which don't exist in the project
- Certain removal of the buildings which don't exist in the project
- The soil features which are not considered properly during the project phase
- The inappropriate features and quantity of the materials
- The irregularity of the lateral plane of the building (in the project)
- The irregularity of the vertical plane of the building (in the project)
- The damage occurring in the building during time
- The damage occurring in the building during earlier earthquakes
- Insufficient isolation of the steel buildings
- Closeness of the building to the fault line

Model A



Model B



The Costs of Marmara earthquake (Billion Dollar)

COSTS	TÜSİAD	State Planning Organization	World Bank
DIRECT COSTS	10	6,5–10,5	3,1–6,5
HOUSING	4	3,5–5	1,1–3
COMPANIES	4,5	2,5–4,5	1,1–2,6
INFRASTRUCTURE	1,5	0,5–1	0,9
INDIRECT COSTS	2,8	2–2,5	1,8–2,6
LOSS of ADDED VALUE	2	2–2,5	1,2–2
EMERGENCY AID EXPENDITURES	0,8	-	0,6
TOTAL LOSS OF DAMAGE 13 (ROUNDED VALUE) SECONDARY EFFECTS	13	9–13	5– 9
GENERAL LOSS OF VALUE	2	-	3
FINANCIAL COSTS	2	5,9	3,6–4,6

Source: OECD, Economic Effects of the 1999 Turkish Earthquakes: An Interim Report, Economics Department Working Papers No. 247, 2000, p.37.

The Organization for Economic Cooperation and Development grouped into three the costs as direct costs, indirect costs and secondary costs in the research which it conducted about the effects of 1999 Marmara earthquake on the economy. The direct costs demonstrate the effect of the earthquake on the capital assets and stocks while the indirect costs show the loss of production and income as well as emergency expenditures.

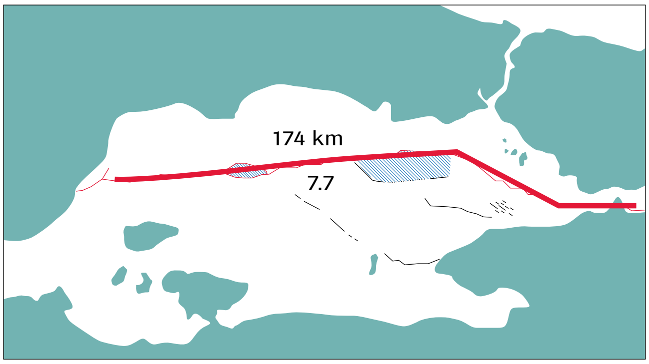
Secondary effects are the effects of the earthquake on the long-term and short-term economy in general; for instance, it represent the financial policies, balance of payments, inflation, and unemployment.

In several studies prepared by TÜSİAD, SPO and WB the Marmara Earthquake give close numbers as to the economic effects of the earthquake.

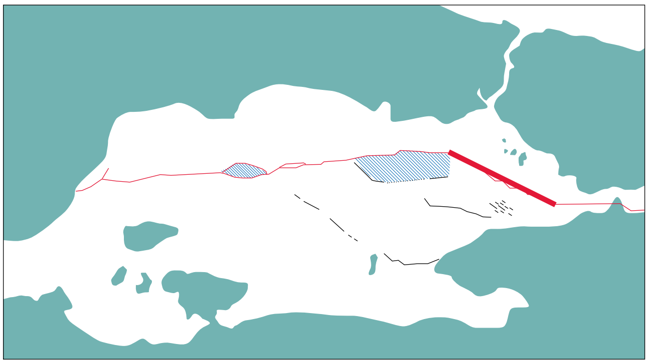
For example, while the total cost is 17 billion dollars according to TÜSİAD, SPO estimates it to be 15–19 billion dollars and the prediction of the World Bank is between 12–17 billion dollars. The detailed numbers related to these data can be seen in the upper table.

In terms of Gross Domestic Product (GDP) the economic damage equals to the 9% of the GDP in the light of given data.

Model C



Model D



Source: Japan International Cooperation Agency (JICA), Istanbul Metropolitan Municiplaity (IMM), The Study on A Disaster Prevention/Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey (2002); Earthquake Scenarios

In Turkey, in the retrofitting process conducted following disasters similar approaches were showed after the Marmara Earthquake, too.

Within the scope of Marmara Earthquake Emergency Reconstruction (MEER) which was conducted by Prime Ministry Project Application Department with the support of World Bank the retrofitting works were continued in the region which did undergo a massive destruction.

ISMEP project which commenced to be conducted in the light of the experiences learnt form Marmara Earthquake can be considered to be a cornerstone for Turkey.

Thanks to ISMEP, the approach as to the disaster risks has been changed radically, and moreover the efforts exerted during the retrofitting and reconstruction stages have left their place the works conducted previous to the disaster.

Studies In Istanbul

Istanbul, Bursa, Kocaeli and Sakarya meets 53,7 TL of 100 TL of public economy source.

Economically Istanbul is the leading power of Turkey, and when it is considered that it is at the head of the zones which have the risk to be affected mostly by the earthquake, and that it covers the regions including both first and second degree seismic hazard, it is not difficult to estimate how massive the loss would be.

Following the 1999 Marmara Earthquake, with the help of increasing consciousness as to the disaster risks, for Istanbul which is expected to undergo an earthquake having destructive effects in the future several measures are started to be taken. At the end of various studies conducted to reveal the risks of disaster in a scientific way striking numbers are reached.

In 2001, Istanbul Metropolitan Municipality and Japan International Cooperation Agency (JICA) signed a working agreement titled “Disaster Prevention / Mitigation Basic Plan” and the plan was completed in 2002. At the end of the plan four different models were considered for Istanbul.

In these models, the predictions about the loss of building and life showed explicitly that Istanbul is vulnerable for a massive destruction.

There are different researches conducted to predict what parts of Istanbul would be affected to what extent if an earthquake not less than 7 degrees magnitude occurs in Marmara Sea and it is possible to reach presumable results with the available data.

LOSS OF LIFE AND INJURED (Model A ve C)

MODEL	LOSS OF LIFE		INJURED	
MODEL A	73.000	(%0.8)	120.000	(%1.4)
MODEL C	87.000	(%1.0)	135.000	(%1.5)

Source: Japan International Cooperation Agency (JICA), Istanbul Metropolitan Municiplaity (IMM), The Study on A Disaster Prevention/Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey (2002); Earthquake Scenarios

In the table, two of these four models (most probable and the worst scenario) are given. According to it, the loss of life expected in Istanbul around 73,000-87,000.

It is predicted that there will occur loss of life equalling to between 0.8% (Model A) and %1 (Model C) of the population in Istanbul. Moreover, far greater numbers of people will be injured severely because of the earthquake.

The results of the buildings analysis are not optimistic. For the 2 models, more than 50,000 buildings will be severely damaged. Especially the south regions of the city will be affected more adversely and the results will be more devastating.

Apart from the loss of life economic and social structure will be upside down. All the data proves the necessity of damage mitigation works.

The results of the report Updating Probable Earthquake Losses for Istanbul (Istanbul Earthquake Scenario) conducted by İBB in 2009 are given below.

At the end of the studied completed in 2002, the data shows that the conducted damage mitigation works bring to positive conclusions.

However, for Istanbul it is evident that there will occur a devastating destruction which can't be underestimated. In the table below, several predictions are given about the conducted two researches.

The analysis which are valid for İstanbul helped to set the predictions in a scientific framework.

And this supported the assumption of destruction on a large scale which is accepted already.

Rather than taking such a destruction risk in Istanbul, which is the heart of Turkey, the works to mitigate the risks have been evaluated and ISMEP has been put into practice to mitigate the structural risks as vital step.

Under the scope of strengthening and reconstruction works conducted in the B component of ISMEP it is aimed to mitigate the predicted damages.

Through the works, particularly the schools and hospitals as well as dormitories, social service buildings and administrative service buildings were strengthened and reconstructed again. Moreover, for the historical and cultural heritage buildings strengthening, restoration and restitution projects are being conducted under the scope of this component

Damaged Buildings (Model A and C)

MODEL	SEVERE	SEVERE + MEDIUM	SEVERE + MEDIUM + MILD
MODEL A	51.000 (%7.1)	114.000 (%16)	252.000 (%35)
MODEL C	59.000 (%8.2)	128.000 (%18)	300.000 (%38)

Under the scope of the projects the public building have a strategic importance to mitigate the risks of the buildings because they must remain standing following the earthquake considering the fact that there is the necessity that the people will need the service given in these buildings as in hospitals.

During the earthquake, the buildings which are made safe for the people sheltering there in order to prevent the loss of life will also provide the infrastructure which Istanbul will need to recover from the effects following the earthquake.

There is the need for safe buildings in order to continue to provide heath, accommodation and safety services.

Retrofitting and reconstruction works serves to this object.

Potential Losses (Model C)

10,000 - 30,000 LOSS of LIFE
2,500 - 10,000 SEVERELY DAMAGED / 13,000 - 34,000 SEVERELY DAMAGED BUILDINGS
85,000 - 150,000 MODERATELY DAMAGED / 250,000 - 350.000 MILDLY DAMAGED BUILDINGS
20,000 - 60,000 HOSPITAL TREATMENT/ 50,000 - 140,000 SLIGHTLY INJURED
530,000 HOUSINGS for URGENT ACCOMODATION
80 - 100 BILLION TL TOTAL FINANCIAL LOSS
400 BUILDINGS DAMAGED because of INFLAMMABLES and EXPLOSIVES
450 DAMAGE of DRINKING WATER and 1500 DAMAGE of WASTE WATER
650 NETWORK DAMAGE/ 17,000 DAMAGE of GAS POT
LOSS OF LIFE of ISTANBUL POPULATION 0.1% - 0.2%,
BUILDING which can't be used (VERY SEVERE, SEVERE, MILD), 10% - 15%

Topkapı Palace

ISMEP's Works

The Activities within ISMEP

"Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP)" is a risk mitigation project conducted by the Governorship of Istanbul Special Provincial Administration Istanbul Coordination Unit (IPCU).

The specific objective of this project is to improve the city of Istanbul's preparedness for a potential earthquake. The project initially came into effect with a budget of 310 million Euros funded by the World Bank.

ISMEP involves supportive and preventive practises directed towards preparedness, mitigation, response and recovery works required before, during and after a disaster. It has now reached the budget of 1, 5 billion Euros with the additional funds granted by the World Bank, the European Investment Bank, and the European Council.

ISMEP's Retrofitting and Construction Works

It is expected that many public buildings will be able to survive, and continue to render services without any interruption even after the most major potential earthquake in Istanbul thanks to the retrofitting and reconstruction works within the scope of ISMEP's "B" Component.

This component covers the activities related with the retrofitting or reconstruction of state hospitals, schools and public buildings.

Considering the fact that the buildings are proposed to be designed to withstand earthquakes, they will not only save people, but also be used as a place to meet the urgent needs of the victims at the time of an earthquake.

Furthermore, the risk assessments of cultural heritage buildings are included in the scope of this component.

Objectives of the Program

This component includes the priority public buildings and the others that are regularly used in response and rescue operations by large masses of people, and provide important civil services at the time of a disaster.

These buildings are comprised of schools, hospitals, emergency response and information centres, along with administrative and public institutions.

The principal objective of this component is to maintain the functions of the above-mentioned buildings, and to mitigate potential earthquake damage.

Moreover, based on the intended objectives, the risk assessments have been able to meet another important prerequisite, that is, the future vision of ISMEP.

Progress of Program

It was observed on the 1999 Düzce and Kocaeli Earthquakes that there is a stock of existing buildings with seismic vulnerability in Istanbul and throughout the Marmara region.

In addition to loss of life and property damage, many essential facilities and instruments including hospitals, fire brigades and rescue equipments became either useless, or were destructed.

As a consequence, the necessary aid to the victims was either received late, or ultimately not sent out in such a chaotic atmosphere.

Afterwards, the Istanbul Metropolitan Municipality and the Governate of Istanbul started to take actions in order to reduce disaster vulnerability.

One of the urgent issues addressed within the ISMEP is the retrofitting of the priority public facilities required to render service after an earthquake.

Upon the enactment of the law - which assigns the duties of risk mitigation and emergency response to the local authorities and the municipalities - the local administrations, notably in Istanbul, have made significant progress in disaster vulnerability assessments and investments in seismic retrofitting.

The Earthquake Master Plan for Istanbul (EMPI) completed in 2003, and covers a building stock with almost 1, 5 million structures. 10,000 of these are classified as priority public buildings, e.g. hospitals, schools, emergency management and administrative centres, which serve in response and rescue operations.

It has been stated by the Government of Turkey that nearly 3,600 of these buildings require retrofitting.

A prioritisation selection has been started to identify the buildings in need of retrofitting and reconstruction by using the budget allocated for the ISMEP's "B" component.

The prioritisation list was initially prepared by the Istanbul Special Provincial Administration followed by a consultation with the local management institutions from different sectors.

After a series of meetings with the participation of the Governate of Istanbul, the relevant stakeholders, and academicians, the inventory and the prioritisation process took their final forms.

The Categories of the Public Buildings Received Approval for Retrofitting within the ISMEP

CATEGORY A	CATEGORY B	CATEGORY C	CATEGORY D
HEALTCARE BUILDINGS	EDUCATIONAL BUILDINGS	ADMINISTRATIVE BUILDINGS	SOCIAL SERVICE BUILDINGS
• Hospitals • District Polyclinics	• Schools • Dormitories	• The communication and coordination facilities along with the other buildings vital for the management of the masses at risk after a disaster	• Child Protection Centres • Orphanages • Nursing homes

303.85
million $

The Budget for Retrofitting or Reconstruction of the Priority Public Buildings

2.45
million $

The Budget for Supporting National Disasters Studies

The 840 of 2473 buildings identified in the prioritisation list have been proposed to strengthen against earthquakes with the support of the fund granted by the World Bank.

Definition of the Project

Component B covers the activities regarding the four building categories essential in response and rescue operations along with the other public services.

Based upon the criteria identified within the project framework, this component has been financing the retrofitting or reconstruction of the selected 840 public buildings.

Furthermore, Component B supports the risk assessments of the buildings with vital importance and the preparations of vulnerability inventories for the heritage buildings.

The activities under the scope of Component B are divided into two sub-categories:

The first category is "Retrofitting or Reconstruction of the Priority Public Buildings".

On the other hand, the second category is "Supporting the Studies on National Disasters".

In parallel with the scope of this component, seismic risk mitigation activities, retrofitting or reconstruction of important public facilities have been conducted, and extended with the contributions of the local administrations.

The feasibility and design studies specific to each sub-project are being carried out, and innovative methodologies related with seismic risk and earthquake damage mitigation are currently included in these studies.

The Results of the Prioritisation Process (The Number of the Buildings)

TYPE OF BUILDING	LONG LIST	SHORT LIST	% OF THE LONG LIST
HOSPITALS	308	130	%42
POLYCLINICS	241	14	%6
POLYCLINIC	1783*	598	%34
ADMINISTRATIVE	68	45	%66
DORMITORIES	46	26	%57
SOCIAL SERVICES	27	27	%100
TOTAL	2473	840	%34

* +/- 100 additional school buildings have been established or still under construction.

The Prioritisation Criteria for Retrofitting and Reconstruction Works

The selection process commenced with the preparation of a long list in four different building categories.

The list contains 2473 buildings with 12,000 public structures.

Following the weighting and the prioritisation studies, a shorter list with 840 buildings was prepared.

The figures before and after the prioritisation of the buildings are compared in the table shown above.

The inventory and prioritisation criteria were developed in a series of meetings with the Governate of Istanbul, the stakeholders, along with the selected academicians and experts.

The prioritisation criteria are given below:

- The functionality and criticality of response and rescue operations in case of emergencies,
- Social security area population and high risk groups,
- Economic cost-effectiveness or cost-benefit analysis,
- Harmonisation and long-term sectoral plans with respect to technical feasibility and retrofitting measures

A comprehensive critical facilities inventory has been prepared under the leadership of the Governorate of Istanbul and the relevant stakeholders. The inventory is comprised of the technical data of buildings, the transportation data (i.e. hospitals and schools), the buildings' distance to fault lines with particular attention to their importance within the Istanbul Disaster Management Plan, the regional population, the general population and the facility type. Furthermore, all relevant features and criteria of each sector are taken into account through a transparent prioritisation process.

The prioritisation process includes the workshops with the participation of the regional directors and the selected academicians in order to negotiate on facility characteristics and their divisions within the sectors.

The aforementioned criteria are identified in line with their priority within the Istanbul Emergency Management Plan, and for other sectors. The coefficients of the measurements are also taken into consideration

The Stages of Retrofitting and Reconstruction Works

1

Building Detection

The first stage starts with building detection under the authority of the Provincial Directorates of National Education, Security, Health, Social Services and the Higher Education Credit and Hostels Institution. Buildings are ranked with respect to some criteria such as household capacity, the number of floors, distance to fault lines and their locations in a disaster plan. A prioritisation plan is prepared in connection with the results.

2

The Selection of Consultant Firms

Subsequent to building detection, consultant firms are identified by the IPCU in line with the purchasing procedures of the World Bank, the international competition standards and the methodologies based on quality and cost selection. The selected firms are responsible for the feasibility studies (seismic analyses).

3

Seismic Analysis and Project Design

Seismic analyses are conducted to detect the current status of buildings by the selected consultant firms. If a decision is taken to demolish a building based on the results, another consultant firm is selected for reconstruction/ re-design and inspection. Following an independent inspection process, the next stage will be the project design.

4

Planning

The households are taken into consideration, with particular attention to their requests. A time schedule is then prepared for retrofitting/reconstruction projects without interrupting the services of the public buildings as much as possible.

5

Selection of Inspectors and Contractors

The next stage of the Retrofitting and Reconstruction Process is the selection of the inspectors and contractors by the IPCU in compliance with the admission criteria and the tender management.

6

Briefing and Preparations

In accordance with the briefings, the preparations start off. Throughout the process, social counselling workshops take place not only in the schools under retrofitting and reconstruction, but also the others hosting the guest students.

7

Retrofitting and Reconstruction Works

Following the necessary preparations, the consultant and the contractor firms start the constructions.
A counselling study is also carried out in the same time period.

8

Inspections

The progress of the retrofitting and reconstruction works is monitored by the IPCU and the consultant firms. At each stage, the works are examined by the consultant firms, and in the independent laboratories to check their compliance with the scientific conditions.

9

Completion of a Project

The provisional approval of the reconstructed buildings is granted after the necessary analyses. The deficiencies should be fulfilled within the one-year maintenance (warranty) period effective from the date of the provisional approval. The final approval is issued by the consultant firms, and the project is then finalised.

In order to achieve effective risk mitigation, it is required to include the relevant stakeholders, and start to work on the most prioritised buildings in compliance with the aforementioned criteria throughout the process.

The Stages of Retrofitting and Reconstruction Works

Building Detection

The scope of the seismic risk mitigation of the priority public buildings covers the selected public and cultural heritage structures such as schools, hospitals, polyclinics, healthcare centres, social service and administrative buildings.

Further, it necessary to detect the buildings which were constructed before the release of the "Regulation for the Buildings to be Constructed within the Seismic Zones". This regulation was entered into force in 1998 and updated in 2007.

The building detection starts with the participation of the Provincial Directorates of National Education, Security, Health, Social Services and the Higher Education Credit and Hostels Institution.

The buildings are ranked with respect to some criteria, such as household capacity, the number of floors, distance to fault lines and the building's location in a disaster plan. At the end of this stage, a prioritisation list is prepared for each sector.

The lists are submitted to the World Bank by the IPCU, and used as reference data in the loan agreements.

The progress of the necessary works is monitored through these lists during the process.

In order to avoid any concern with respect to the prioritisation ranks of constructions, the relevant institutions are involved in the prioritisation studies, and the rational criteria are applied in the preparations of the lists. Besides, it may become possible to effectively mitigate the risks by early intervention on the top most prioritised buildings.

Anchorage

Selection of Consultant Firms

Seismic analysis is defined as a study which calculates the response of the detected building structures, i.e. whose inventories have been completed, to potential earthquakes, and is used to determine the necessary structural interventions.

Seismic analyses are considered as specialist, comprehensive and long-term studies. Therefore, the IPCU is responsible for the selection of the relevant consultant firms for the analyses.

The specialist consultant firms are selected in compliance with the purchasing procedures of the World Bank, the international competition standards and the methodologies based on quality-cost selection by tender offers. The local, international or joint venture engineering companies participate in tender offers. It may also be possible to transfer the knowledge and experience of international firms to Turkey.

Seismic Analysis and Project Design

Seismic (feasibility) analyses are conducted by the selected engineering firms in accordance with the priority ranks of the buildings listed in the inventory.

First of all, a building survey is carried out for the structures without any construction project.

A building survey is comprised of all relevant features, including not only structural system (i.e. conveyor system and framework), but also architecture, mechanics and electrical system of buildings.

An investigation of ground conditions is performed to detect ground parameters. In order to determine rebar spacing and the class of iron, a concrete sample is taken, and an analysis with ferroscan detector is carried out.

After all, the ground parameters along with the material and structural features of the building are identified.

Following the detection of building features, a construction modelling is prepared with the use of engineering softwares in order to calculate the potential seismic load on the structure.

It may then be possible to measure the respond of the building to potential earthquakes with the results of the analyses. In order words, the results can show the possibility or the extent of seismic vulnerability. In case of a building with high vulnerability, the necessary structural interventions are taken in compliance with the relevant regulations.

Further, the proposed additions of structural elements are visually created on engineering softwares to observe the changes on seismic vulnerability. On condition that the respond of the building to an earthquake reaches its required level, the next stage would be the cost management. Assuming that the cost of the structural intervention model is too high, a decision is taken to demolish and re-construct the building.

The cost benchmark for retrofitting is based on over a 40% of the reconstruction cost of a building with the same dimensions. It is technically possible to carry out reconstruction works for all buildings. However, this method is implemented to make the works more affordable.

The comprehensive seismic analyses may take long periods, i.e. 8 to 12 months, under the responsibility of the consultant firms. The analyses are submitted in the form of technical reports after their approval from the expert researchers of the universities, including the Istanbul Technical University, the Bogazici University and the Middle-East Technical University.

In addition, some parts of the studies are assessed by the international consultants working with the IPCU, and the IPCU's construction engineers. In order to move to the next stage, the studies must be approved by all relevant authorities.

The project details regarding the technical conformity and the affordability for retrofitting works are finalised by the consultants, and the necessary actions for construction are immediately taken. It is then possible to move the planning stage for risk mitigation without losing time.

In case that, based on the results, a decision is taken to reconstruct a building, a call for tender is made to select a different specialist consultant firm to be responsible for the reconstruction design. The tender process is similar to the afore-mentioned ones, and the selected firms are expected to prepare the designs in collaboration.

After this, the due diligence of the buildings is conducted. As an example, a due diligence of a school includes a detailed review of physical features, the number of students and classrooms, mechanical and electrical infrastructure along with the requests of the school managers.

In compliance with the minimum design standards established by the Ministry of National Education, a preliminary design is prepared, and submitted to the school administration and the Provincial and District Directors of National Education. Following a revision on the proposed design according to the feedbacks, the next stage would be the implementation of the project.

The time allocated for a reconstruction project may vary from building to building. For instance, school reconstructions typically take 6 months. Considering hospitals, it appears that their current physical status is far below than the required standards.

Therefore, it is necessary to demolish and re-construct some large hospitals in order to eliminate their disadvantageous conditions, such as inconvenient patient rooms, insufficient ventilation systems and improper sterile and non-sterile areas.

The design process of hospital reconstructions generally take longer. The consultant firm is primarily required to conduct a status and needs assessment followed by an operational planning.

The project design is developed in accordance with the requests of the relevant hospital authorities and various experts, the limitations of construction area, the minimum design criteria of the Ministry of Health, and the international standards. The project progress meetings are organized with the participation of the representatives from the Health Department of the Provincial Special Administration, the Provincial Health Directorate, the hospital administration, the relevant experts and the Technical Department of the IPCU. The meetings take place every 2-3 weeks, and give the participants the opportunity to exchange their views.

In this context, it is also necessary to highlight the importance of the medical experts of the international firms. Their knowledge and experience are considered as a great value.

In the course of some stages, the representatives give presentations to the Ministry of Health in Ankara. The workflow progresses through a project management based on the participation of all stakeholders.

The time allocated for the project design of hospitals may vary, and it can take up to 1-1, 5 years to finalise a comprehensive work in large hospitals.

Planning

After the completion of seismic analyses, the next stage is the construction planning. The planning stage is applicable for the buildings whose projects are already ready for retrofitting, and whose designs are ready for reconstruction. The affiliated public institutions are informed, and an evacuation schedule is prepared in consensus. Particular attention is paid not to interrupt the services of the public buildings as much as possible.

It is observed that summer periods are not sufficient enough to complete retrofitting and reconstruction works in schools. For this reason, the works may be extended over the semesters, and the students are required to temporarily continue their education in a nearby school in line with the schedules of the Provincial Directorate for National Education. In case that there is no convenient host school in the region, the students are transferred to another, and the transportation fees are paid by the relevant authorities.

Similarly, there are different solutions implemented for different institutional structures. For instance, another building is rented, and the residents are temporarily moved those places in the course of the construction works conducted in the boarding houses of the Social Services Department.

On the other hand, there is a more complex procedure for hospitals. In order to complete the projects without any interruption in healthcare services, the construction works are divided into stages in the hospitals with more than one building.

The retrofitting works are carried out in some parts of the buildings, and thereby the services are rendered in the other parts. As soon as the newly retrofitted units are open to public, the left ones will be under construction.

The most challenging projects are the reconstruction of the large hospitals even unable to close some of their units.

It is possible to carry out a construction work in the three largest hospitals in Istanbul (i.e. Kartal, Göztepe and Okmeydanı Training and Research Hospitals), where there is a free area, e.g. car park, within the premises.

However, even the planning of such construction works requires expertise in the relevant field due to the hospitals' hectic environment, and the patients still being treated in the other units of the same building.

Following the completion of the new buildings in the feasible areas of the premises, the healthcare services are transferred to the new units, and the old buildings are demolished and reconstructed in compliance with the project design.

The necessary efforts are given not only in the planning of the construction works, but also to enhance the functionality of the hospital premises, and its compliance with the regional features.

There are numerous important factors taken into account at the stages of both project design and planning. These are the hospital's environment, infrastructure, transportation access, traffic, energy efficiency, opportunities for vulnerable patients and impacts on the region. Therefore, it is intended to construct hospitals which will be able to operate in long-term. There are also instances in which it becomes unlikely to start construction works without solving the problems related with the building land. These issues are addressed at the stage of planning.

The controversial issues regarding the building lands are solved with the participation of various institutions invited by the IPCU.

All issues with respect to the development rights and annotations of land sites, including the expropriation of private properties, integration or separation of different parcels, the lands belonged to the public way or the existence of occupied lands, are resolved at this stage.

After achieving the most favourable conditions, it becomes possible to proceed to the last stage, that is, the call for tenders for constructions.

Apart from large hospital projects, the scope of tenders does not cover merely the building structure. Different tender packages are listed by considering various factors, such as the square meter of buildings, construction costs and location.

Reconstruction Site Visit

As a recent example, the retrofitting projects for 40 schools in 2013 summer have gone out to tender with 6-8 different packages.

On the other hand, considering the large-scale of hospital projects, it is possible to go out to tender for merely 1 or 2 hospital buildings.

Selection of Inspectors and Contractors

Following the planning process based on a participatory approach, the relevant firms to be responsible for the projects are selected.

The contractors that will carry out the construction works, and the consulting firms as independent inspectors are decided by the IPCU in compliance with the purchasing procedures of the World Bank, and the international competition standards.

The tender notices can be followed from the releases of the World Bank or the European Investment Bank. Apart from the local firms in Turkey, there are various international firms from the USA, Japan, New Zealand, Italy and Spain participating to the bidding process.

The joint ventures with local and international firms are also welcomed in order to effectively raise the knowledge transfer from international organizations to the country, and to enhance the quality of works.

The tender process is built on a transparent and competitive environment, and there are different criteria applied in the selection of consulting firms and contractors.

Ultimately, the firm which offers the lowest price and meets the required qualifications with the necessary documents, wins the contract.

In order to get through the projects, it is deemed necessary to keep the criteria regarding the turnover and work completion capacity of the firms high.

Another reason for selecting large-scale firms is that their quality of work, financial status and organization capacity are better than their small-scale equals.

For example, the contractors are expected to have a previous experience in a similar-scale hospital construction, and it is necessary to keep the bar high in the reconstruction of large hospitals.

In addition, rather than the personal experience, the institutional work experience of the contractors is considered as valid.

In consideration of the consulting firms, the technical competence is graded out of 80%, and the financial capacity out of 20%.

Additional Works on the Retrofitted Buildings in compliance with the Regulations

- Installation of Natural Gas Heating System
- Central Heating System Improvement
- Changing boilers
- Electrical Installation Improvement
- Drainage
- Installation of insulated glazing
- Thermal sheathing,
- Changing the Roof,
- Maintenance and Painting
- Installation of Lighting Conductor
- Placement of handicapped toilets

Whereas it is important to select big contractor firms to achieve good quality of work, the experience, technical capacity and human resources are the priority criteria in the selection of consulting firms.

As an example, with regard to the tender packages for schools, the consulting firms are informed about the expected organizational structure.

Therefore, the minimum number of the staff including project managers, engineers and technicians are determined in line with the scope of tender packages, and the offers are evaluated by taking the firm's organizational structure into account.

Similar with the selection procedure of contractors, the previous experience in the relevant field is considered as an asset for the consulting firms.

In other words, the more experience a firm has, the more technical score it may receive.

The quality of construction work is also improved on condition that the firms with high knowledge and experience are selected as inspectors.

In line with the procedures of the tender process, the firms conducting seismic analyses may be assigned as inspectors in their own or another firm's retrofitting project.

Otherwise, a new firm which has not participated in the previous stages of the project could be assigned as a consultant.

In the reconstruction projects, the designer consultant can also act as an inspector firm.

However, the selection procedure is different in the large-scale hospital projects.
The architecture of hospitals is considered more important, and thereby the expert designer consultants are different from the inspector firms.

Preparation and Informing

The managers responsible for the building are regularly informed about the construction work schedule prepared in collaboration with the IPCU and the relevant institutions at the stage of planning.

The managers and school administration begin the necessary preparations and the evacuation plans of the buildings to be retrofitted or reconstructed.

The construction works in schools and dormitories that are closed during summer vacations are scheduled to be completed as soon as the academic year ends.

In case of any delay, there are alternative solutions including the student transfer or renting another building, to be arranged at the stage of planning.

Briefing for School Managers

In order to inform the relevant public communities, and manage the retrofitting and reconstruction works effectively, the Provincial Directorate of National Education in Istanbul organizes information and awareness-raising events along with social counselling workshops. These events take place not only in the schools under construction, but also in the other host school. These trainings are intended to inform all stakeholders (i.e. school managers, parents, teachers and students) affiliated with the retrofitting works.

At the end of the trainings, an assessment study related with the activities is carried out to get feedback from students, teachers and parents.

The results and the feedbacks are taken into consideration, and the necessary measures are identified in order to resolve the problems.

Retrofitting and Reconstruction Works

Initially, the principal objective of ISMEP was the seismic risk mitigation of the priority public buildings. However, as the project has progressed, different interventions such as structural retrofitting and renovations have been included.

Based on a participatory approach, the requests, the needs and the recommendations of all stakeholders have been taken into account in the course of the retrofitting and reconstruction projects. To illustrate, the schools which do not conform to the minimum design standards stated by the Ministry of National Education, have been renovated. There are also similar examples in which the hospitals have been designed in accordance with the standards of the Ministry of Health. In consideration of seismic risk mitigation, the regulations regarding the buildings to be constructed on the earthquake zones are the key elements of the projects.

Furthermore, the recent regulations, such as the Regulation on Fire Protection and Energy Performance, are considered important to fulfil the shortcomings of the existing buildings. They appear to be useful in terms of cost-effectiveness and safety.

The solutions are determined at the stage of reconstruction design in order to achieve the intended objectives.

The concerns related with the retrofitting works, and the needs of the buildings are evaluated, and all or some parts of the above-mentioned works could be preferred.

Following the evacuation of buildings, the works are started under the responsibility of the contractors and the consulting firms selected during the tender process.

There are also particular challenges of the construction works started in an intensive built-up area.

The principal aim of inspection system is not to use it a method for punishment, but rather as a system to avoid the mistakes before they happen.

Challenges of Retrofitting and Reconstruction Works

It may be difficult for the contractors to find free slots to establish construction site facilities, such as the places for storage, construction material preparation, and the residence areas for the workers.

The retrofitting and reconstruction works of the public buildings require detailed planning compared to the common constructions. Therefore, it may be necessary to develop problem- specific solutions for the challenges encountered in the construction site.

Considering the locations of the construction sites which are founded next to the buildings in use (e.g. the construction site of hospitals), additional measures need to be taken to provide the safety of people, neighbourhoods, patients and tourists within the surrounding area.

To a certain extent, it may be possible to examine the basic structural system of a building in use in the course of the seismic analyses for the retrofitting projects. However, the building's system can be thoroughly analysed with the onset of constructions.

There are instances in which the results of the seismic analyses are different from the authentic structure of the building. In case of this, the seismic analyses are re-done, and necessary revisions are made in the main project.

The logistics difficulties are common notably in the reconstruction works conducted in the dense population areas.

It becomes also difficult to bring construction materials and equipments to the site, and to carry the soil removal works and the debris to the dump sites located in the distant regions of Istanbul because of the unfavourable road conditions.

Retrofitting Work

Moreover, it may not always be possible for the trucks to carry construction material and soil removal works to the site at all hours of the day and night.

Thus, it is necessary to receive permission from the relevant authorities in order to determine the working hours of the trucks.

The challenges are overcome with the collaboration between the IPCU and both the consulting firms and the contractors. Ultimately, the buildings with less seismic vulnerability can be constructed.

Inspections

In the course of construction inspections, the IPCU is obliged to select consulting firms by tender offer as stated in the legislation of the World Bank. An independent inspection mechanism is implemented to monitor the contractors and report the inspections to the relevant authorities. This mechanism is more preferable than to assign only one organization for the whole project.

The inspector firms selected for the retrofitting projects may have previous experience in seismic analyses or not. On the other hand, the designer firms in the reconstruction projects also take part in inspections.

In large-scale hospital projects, the designers and inspectors are selected from different firms.

Inspector firms are responsible for the monitoring of the materials used by the contractors, and their activities in the construction sites. Additionally, the technical team of the IPCU regularly visits the site, and becomes a part of the inspection process.

The IPCU is also responsible for the monitoring of the consulting firms.

The principal aim of inspection system is not use it a method for punishment, but rather as a system to avoid the mistakes before they happen.

The quality of the projects are significantly improved by the sample room tests, and the analysis conducted by the independent laboratories. The materials used at each stage in the construction site, and the issues reported by the consulting firm are validated. As an example, the samples of iron used in construction are regularly sent for analysis.

The projects are not allowed to proceed without any approval.

Apart from the necessary analyses, sample rooms are arranged in order to validate the quality of construction materials.

Before using any construction material, the contractors are obliged to submit three samples of each material to the consulting firm. The materials complied with the technical specifications are approved by the consulting firm.

Emine and Hasan Aytaçman Elementary School (Reconstruction Completed)

After the approval, a sample of the relevant material is analysed in the sample room established in the construction site. At the further stages, the other materials are compared with the samples in this room, and might be tested if necessary. Only after its validation, the material can be used in the construction.

Apart from the standard controls during the construction, the improved or newly installed central heating, water, electrical wiring, natural gas and ventilation systems are tested before using, and delivered after their approval.

The independent inspection mechanism under the responsibility of the consulting firms continues from the beginning of the retrofitting or reconstruction works to the final approval of the buildings.

Completion of the Project

The completion of the contractor's work is not sufficient to hand the building to its users.

The consulting firms carry out some tests before the handing-over, and the equipments such as electrical and natural gas installations are delivered to the relevant authorities.

All relevant documents including the user manuals and the warranties of installations, removable materials and equipments are submitted to the users.

In addition, the necessary instructions are hanged on the walls, and some workshops are organized to train the staff about how to use these systems.

On condition that there is nothing found to interrupt the services of that building, the consulting firm gives the temporary approval.

It is expected from the authorities that any observed deficiencies should be communicated to the authorities within the one-year period.

The one-year duration is considered as a warranty period, the contractor responsible for the construction work is required to fulfil the deficiencies.

At the end of this period, the buildings without any deficiencies are received their permanent approval by the consulting firm.

Retrofitting and Reconstruction Implementations

The Retrofitting and Reconstruction Works of the IPCU (The Number of the Buildings)

TYPE OF BUILDING	PUBLIC BUILDINGS (RETROFITTING COMPLETED)	PUBLIC BUILDINGS (RETROFITTING ONGOING)	PUBLIC BUILDINGS (RECONSTRUCTION COMPLETED)	PUBLIC BUILDINGS (RECONSTRUCTION ONGOING)
SCHOOLS	640	39	152	34
HOSPITALS	29	7	1	1
CLINICS	50	9	2	-
ADMINISTRATIVE BUILDINGS	38	1	1	9
DORMITORIES	20	5	-	7
SOCIAL S. BUILDINGS	16	-	6	-
TOTAL	793	61	162	51

The Retrofitting Works in Educational Buildings

TOTAL NUMBER OF BUILDINGS	679
COMPLETED	640
ON-GOING	39
IN BIDDING PROCESS	-
OTHER	-
THE NUMBER OF STUDENTS	732.374
TOTAL NUMBER OF CLASSROOMS	13.727
TOTAL AREA OF CONSTRUCTION SITE	1.932.408 m²
TOTAL COST	361.643.756 TL

The Reconstruction Works in Educational Buildings

TOTAL NUMBER OF BUILDINGS	327
COMPLETED	152
ON-GOING	34
IN BIDDING PROCESS	141
OTHER	-
THE NUMBER OF STUDENTS	369.651
TOTAL NUMBER OF CLASSROOMS	6.414
TOTAL AREA OF CONSTRUCTION SITE	1.126.568 m²
TOTAL COST	726.454.269 TL

It has been possible to create projects which protect our economy, history, environment and historic fabric. In the retrofitted schools, this has been achieved with the improvements in mechanical installation, electrical wiring and thermal sheathing. In the reconstructed schools, there are other practises such as the building design preserving the historic fabric, solar energy systems based on energy efficiency and the use of exposed concrete without colouration.

Educational Buildings

Within the scope of ISMEP, 567 schools have been retrofitted against earthquakes, and 148 schools have been demolished and re-constructed from the academic year of 2007 to 2012-2013.

Currently, 40 schools are still under retrofitting, and 27 schools are under reconstruction.

Throughout the construction works, the students have temporarily been moved to another school in order not to interrupt their studies.

Upon the completion of these projects, more than 1, 1 million students safely will continue their studies in their own schools.

The scope of the retrofitting and reconstruction works does not only cover structural retrofitting, but also renovations and improving the existing capacity of buildings.

In the reconstructed schools, it is stated that the student capacity has approximately increased 1, 7 fold, and the number of classrooms has increased 1, 8 fold compared to the previous figures.

Furthermore, as stated by the Ministry of National Education, the student capacity in a classroom has been limited to (max.) 30 students with single-grade education in some of the schools. It has been possible to create projects which protect our economy, history, environment and historic fabric. In the retrofitted schools, this has been achieved with the improvements in mechanical installation, electrical wiring and thermal sheathing. In the reconstructed schools, there are other practises such as the building design preserving the historic fabric, solar energy systems based on energy efficiency and the use of exposed concrete without colouration. All of these achievements have enabled the students to continue their studies in a safer environment, and apparently are considered as the factors which have increased the quality of education.

“Kocatepe Elementary School” (Reconstruction Completed)

Prioritisation Criteria for Schools

NO	CRITERIA			SCORE
1	ACCESSIBILITY IN CASE OF A DISASTER (x0.10)			10
	ACCESSIBILITY RISKS (BETWEEN) 0-100			
2	TECHNICAL FEATURES OF THE BUILDING (x0.40)			40
	YEAR OF ESTABLISHMENT (X0.20)			
	(A)BEFORE 1965 (100)	BETWEEN 1965-1980 (60)	(C) AFTER 1980 (40)	
	THE NUMBER OF FLOORS (X0.20)			
	(A) > 5 FLOORS(100)	(B) 3-4 FLOORS (60)	(C) 1-2 FLOORS (20) (40)	
3	DISTANCE TO CENTER-RADIUS (x0.10)			10
	DISTANCE TO FAULT LINE >20KM. (40)			
	DISTANCE TO FAULT LINE <20KM. (100)			
4	IMPORTANCE IN THE DISASTER PLAN (STRATEGICAL LOCATION) (X0.10)			10
5	NUMBER OF STUDENTS (X0.20)			20
	NUMBER OF STUDENTS BETWEEN 0-500 (30)			
	NUMBER OF STUDENTS BETWEEN 500-1000 (60)			
	1000 STUDENTS OR ABOVE (100)			
6	WORKING HOURS(X0.10)			10
	HALF DAY (60)			
	FULL DAY (100)			
	TOTAL			100

"İhsan Hayriye Hürdoğan Elemantary School" (Retrofitting Completed)

The Retrofitted and Reconstructed Educational Buildings

Within the scope of ISMEP's B Component, 792 schools located in the 39 districts of Istanbul have been either retrofitted or demolished and then reconstructed to become more resistant to earthquake forces since 2013. The schools have been re-opened to the use of 1,102,025 students and teachers. A construction area of 3,058,976 m^2 have been completed in total.

The Retrofitting Works in Hospitals

TOTAL NUMBER OF BUILDINGS	44
COMPLETED	29
ON-GOING	7
IN BIDDING PROCESS	6
OTHER	2
TOTAL BED	2.154
DAILY OUTPATIENT	20.855
TOTAL CONSTRUCTION AREA	217.685 m²
TOTAL COST	143.568.498 TL

The Reconstruction Works in Hospitals

TOTAL NUMBER OF BUILDINGS	17
COMPLETED	2
ON-GOING	6
IN BIDDING PROCESS	3
OTHER	6
TOTAL BED CAPACITY	3.839
DAILY OUTPATIENT	20.412
TOTAL CONSTRUCTION AREA	884.598 m²
TOTAL COST	1.300.000.000 TL

Healthcare Buildings

(Hospitals, Polyclinic and Family Health Centres)

In case of a potential disaster in Istanbul, it is crucial for hospitals and other healthcare institutions to render services.

As a result of ISMEP's works aimed to preserve healthcare facilities from potential damages, 31 buildings have been retrofitted or demolished and then reconstructed. On the other hand, 9 buildings are still retrofitting or under reconstruction.

Similar with the other public buildings, energy efficiency is achieved through the improvements in mechanical installation and electrical wiring, thermal sheathing, the use of photoelectric taps.

In some of the reconstructed hospitals, it will be possible to generate a significant amount of electricity through a trigeneration system powered by natural gas. It is also intended to heat and cool the buildings with the use of waste heat generated by the same system.

Further, Göztepe and Kartal Training and Research Hospitals are the first three healthcare facilities, which have applied for U.S. Green Building Council's LEED Certification. The buildings with this certification are approved as Green Buildings which has a healthy and environmentally-friendly atmosphere, is more economical in terms of operating costs and achieve high performance compared to the common structures.

There won't be any service interruptions in case of an earthquake with the use of "seismic isolation" technology in both retrofitted and reconstructed buildings. Therefore, the vital healthcare services are able to be rendered during and after a disaster without interruption.

Within the scope of ISMEP's retrofitting, maintenance and replenishment project, the Marmara University Training and Research Hospital has become one of the world's biggest hospitals improved the same technology.

Some of ISMEP's investments in healthcare facilities are as follows: Umraniye Paediatric and Maternity Hospital, Kartal Lütfi Kırdar Training and Research Hospital, Okmeydanı Training and Research Hospital, Göztepe Training and Research Hospital and Marmara University Training and Research Hospital. ISMEP has put its signature under important developments in health sector with these projects.

After the completion of all projects, it is expected to reach 923.1 m² total area and 3,736 beds.

Okmeydanı Training and Research Hospital Project

Retrofitted or Reconstructed Polyclinics/Family Health Centres

TOTAL NUMBER OF BUILDINGS	61
COMPLETED	47
ON-GOING	14
THE DAILY NUMBER OF OUTPATIENTS	22.523
TOTAL AREA OF CONSTRUCTION SITE	108.584 m²
TOTAL COST	46.356.621 TL

Prioritisation Criteria for Hospitals

NO	CRITERIA			SCORE
1	ACCESSIBILITY IN CASE OF A DISASTER(x0,20)			20
	ACCESSIBILITY BY AIR (X 0,05)	(YES)-100	(NO)-0	
2	TECHNICAL FEATURES OF THE BUILDING (x0,20)			20
	ESTABLISHED AFTER 1980 (40)			
	ESTABLISHED BEFORE 1980 (100)			
3	DISTANCE TO CENTER-RADIUS (x0,10)			10
	DISTANCE TO FAULT LINE >20KM. (40)			
	DISTANCE TO FAULT LINE <20KM. (100)			
4	IMPORTANCE IN THE DISASTER MANAGEMENT PLAN(STRATEGICAL LOCATION)* (X0,40)			40
5	CAPACITY (BED) (X0,10)			10
	0-100 YATAK (30)			
	100-500 BEDS (60)			
	500 BEDS OR MORE (100)			
	TOTAL			100

Prioritisation Criteria for District Polyclinics

NO	CRITERIA	SCORE
1	DISTANCE TO CENTER-RADIUS (x0.20)	20
	DISTANCE TO FAULT LINE >20KM. (40)	
	DISTANCE TO FAULT LINE <20KM. (100)	
2	IMPORTANCE IN THE DISASTER MANAGEMENT PLAN (STRATEGICAL LOCATION)* (X0,50)	50
3	THE POPULATION RENDERED SERVICE (X0.30)	30
	0-100 PEOPLE (30)	
	100-500 PEOPLE (60)	
	500 PEOPLE OR ABOVE (100)	
	TOTAL	100

Levent District Polyclinic (Reconstruction Completed)

Retrofitted and Reconstructed Healthcare Buildings

Within the scope of ISMEP's B Component, 85 healthcare facilities located in the 39 Districts of Istanbul have been either retrofitted or demolished and then reconstructed in order to become more resistant to earthquake forces in 2013.

Reconstruction Works in Administrative Buildings

TOTAL NUMBER OF BUILDINGS	92
COMPLETED	39
ON-GOING	10
PLANNED	4
OTHER	39
TOTAL AREA OF CONSTRUCTION SITE	209.027 m²
TOTAL COST	102.565.566 TL

As a part of ISMEP, the establishment of two command and control centres which will support each other have been planned. The construction of Hasdal Command and Control Center has been completed, and equipped with state-of-art technology.

Administrative Buildings

As another part of the reconstruction and retrofitting works, 39 public buildings have been either retrofitted or reconstructed.

On the other hand, 10 public buildings are still retrofitting or under reconstruction.
As a part of ISMEP, the establishement of two command and control centres which will support each other have been planned. The construction of Hasdal Command and Control Center has been completed, and equipped with state-of-art technology.

The center is not only easily accessible by road and air, but also has a communication and information technology infrastructure with 500 staff capacity.

The services will be rendered without interruption because the technological infrastructure of the center will support the information service of the Provincial Disaster and Emergency Directorate and the other command and control center still under construction.

The Akfırat Disaster and Logistics Centre, which is under construction in Istanbul's Tuzla District, has also the capacity to operate without interruption thanks to its generators with back-ups. The center has also fuel tanks with four-day fuel capacity.

The other administrative buildings whose retrofitting and maintenance works have been completed within the ISMEP are as follows: provincial and district police headquarters, police academies, central police authorities, public security branch offices and government offices.

Pendik District Police Headquarter (Retrofitting Completed)

Prioritisation Criteria for Administrative Buildings

NO	CRITERIA			SCORE
1	TECHNICAL FEATURES OF THE BUILDING (x0.20)			20
	ACCESSIBILITY RISKS BETWEEN 0-100			
2	TECHNICAL FEATURES OF THE BUILDING (x0.40)			40
	YEAR OF ESTABLISHMENT (X0.10)			
	(A) BEFORE 1965 (100)	(B) BETWEEN1965-1980 (60)	(C) AFTER 1980 (40)	
	NUMBER OF FLOORS (X0.10)			
	(A) > 5 FLOORS (100)	(B) 3-4 FLOORS (60)	(C) 1-2 FLOORS (20) (20)	
3	DISTANCE TO CENTER-RADIUS (x0.10)			10
	DISTANCE TO FAULT LINE >20KM. (40)			
	DISTANCE TO FAULT LINE <20KM. (100)			
4	IMPORTANCE IN THE DISASTER MANAGEMENT PLAN (STRATEGICAL LOCATION) (X0.50)			50
5	NUMBER OF STAFF (X0.10)			10
	0-50 (30)			
	50-200 (60)			
	MORE THAN 200 (100)			
6	WORKING HOURS (X0.10)			10
	8 HOURS (60)			
	MORE THAN 8 HOURS (100)			
	TOTAL			100

Retrofitted or Reconstructed Dormitories and Social Service Buildings

TOTAL NUMBER OF BUILDINGS	51
COMPLETED	38
ON-GOING	6
PLANNED	7
THE NUMBER OF STUDENTS	11.793
TOTAL AREA OF CONSTRUCTION SITE	299.634 m^2
TOTAL COST	91.808.454 TL

Atatürk Dormitory Campus located in Istanbul's Zeytinburnu District, is one of the prominent student residences thanks to its accessibility to various universities in this region. Considering its location, the dormitory can also be used as a shelter in case of an earthquake.

Dormitories and Social Service Building

Up to date, 20 dormitories and 38 social service buildings have been either retrofitted against earthquakes or reconstructed within the scope of ISMEP.

The construction works in the Atatürk Dormitory is still on-going.

Known as Istanbul's biggest dormitory, the construction works in the Atatürk Dormitory located in Zeytinburnu District is expected to be finished within the year of 2014. The dormitory will have a capacity of 3500 students.

The Ataturk Dormitory is one of the prominent student residences thanks to its accessibility to various universities in this region. Considering its location, the dormitory can also be used as a shelter in case of an earthquake.

In the course of the construction, the state-of –art fire protection systems have been installed, and the necessary interventions have been done to use renewable energy sources in compliance with the building code. The dormitory is being constructed in accordance with the national and international green building standards.

Zeytinburnu Ataturk Dormitory for Girls (Reconstruction Ongoing)

The Prioritisation Criteria for Dormitories and Social Service Buildings

NO	CRITERIA			SCORE
1	ACCESSIBILITY IN CASE OF A DISASTER (x0.10)			10
	ACCESSIBILITY RISKS BETWEEN 0-100			
2	TECHNICAL FEATURES OF THE BUILDING (x0.40)			40
	YEAR OF ESTABLISHMENT (X0.20)			
	(A)BEFORE 1965 (100)	(B) BETWEEN 1965-1980 (60)	(C) AFTER 1980 (40)	
	THE NUMBER OF FLOORS (X0.20)			
	(A) > 7 FLOORS (100)	(B) 4-6 FLOORS (60)	(C) 1-3 FLOORS (20)	
3	DISTANCE TO CENTER-RADIUS(x0.10)			10
	DISTANCE TO FAULT LINE >20KM. (40)			
	DISTANCE TO FAULT LINE <20KM. (100)			
4	IMPORTANCE IN THE DISASTER MANAGEMENT PLAN (STRATEGICAL LOCATION) (X0.15)			15
5	NUMBER OF STUDENTS OF PEOPLE (X0.25)			25
	0-500 STUDENTS (30)			
	500-1000 STUDENTS (60)			
	1000 STUDENTS OR ABOVE (100)			
	TOTAL			100

Kadırga Dormitory (Retrofitting Completed)

Recently, 176 buildings including 26 structures (e.g. the Topkapı and Yıldız Palace) have been examined and saved into a special data base.

Cultural Heritage Buildings

The works related with the historical and cultural heritage within the scope of ISMEP's B component, and the inventories and seismic analyses of the buildings in Istanbul under the authority of the Ministry of Culture and Tourism have been accomplished.

In accordance with the data, the preparations of some buildings' retrofitting projects have been included within the scope.

The main stages of the project is comprised of literature review, field study, restitution plan, seismic risk analyses, risk mitigation measurements and the use of GIS (Geographical Information Systems) databases.

Recently, 176 buildings including 26 structures (e.g. the Topkapı and Yıldız Palace) have been examined and saved into a special data base.

The database including the archives related with the Ottoman Empire has been delivered by the Ministry of Culture and Tourism.

The database which is comprised of many searchable illustrations, photos, analyses upload by different organizations is accessible to universities, institutions, organizations and other users.

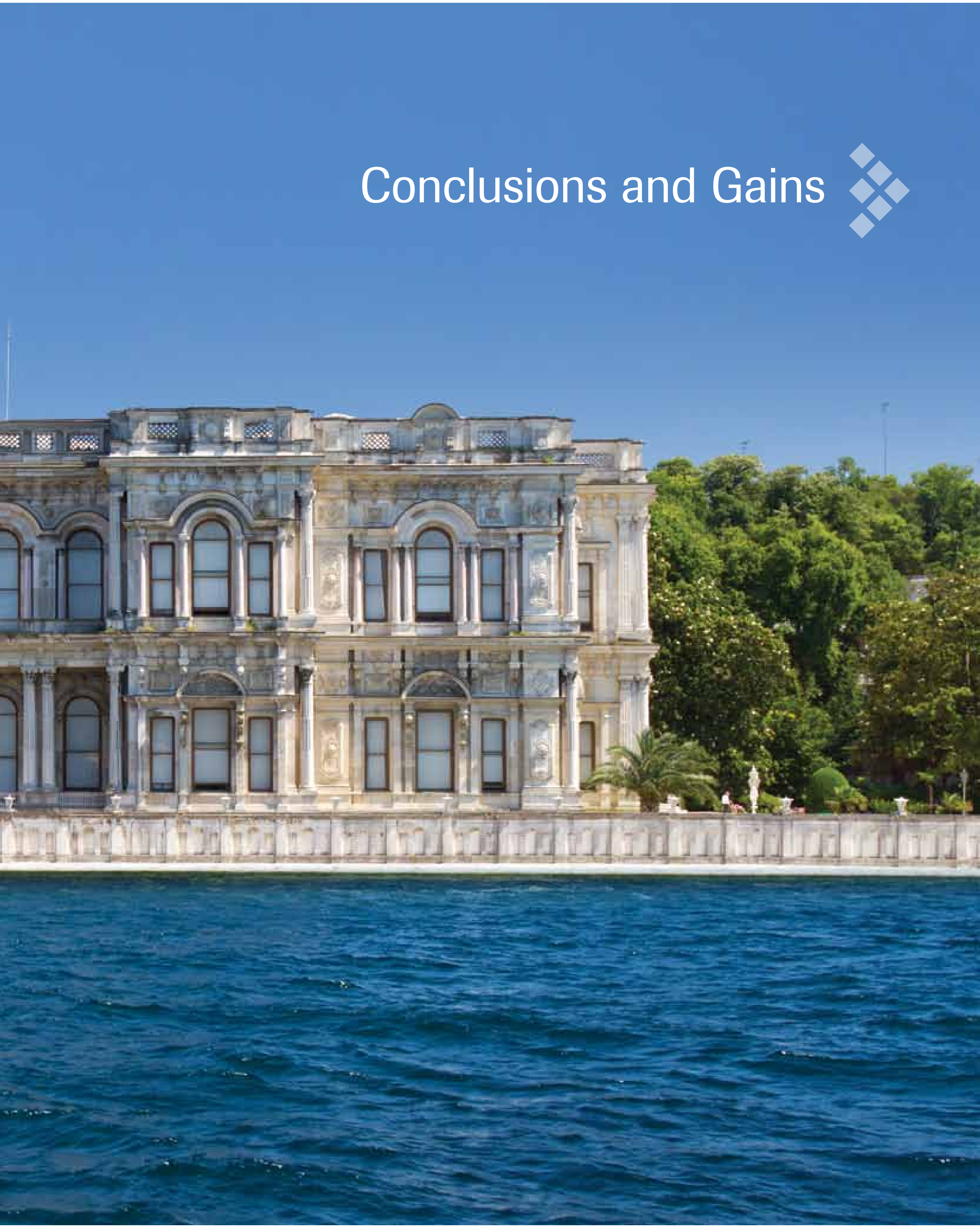
The earthquake vulnerability performance of the main and additional buildings of the Archaeological Museum, the Hagia Irene, and the Mecidiye Mansion has been completed. A retrofitting project against earthquakes has been developed for each building.

These three buildings with different structural typologies are expected to present as an example for future works.

The Mecidiye Mansion within the Topkapı Palace (Retrofitting Completed)

Beylerbeyi Palace

Conclusions and Gains



Conclusions and Gains

"Study for Providing Information, Awareness and Social Guidance in Schools" was initiated in cooperation with IPCU and Istanbul Provincial Directorate of National Education in order to support the Retrofitting and Reconstruction works psychologically and sociologically.

As part of the project, a majority of the goals set for the retrofitting and reconstruction works running since 2006 has been achieved by 2013.

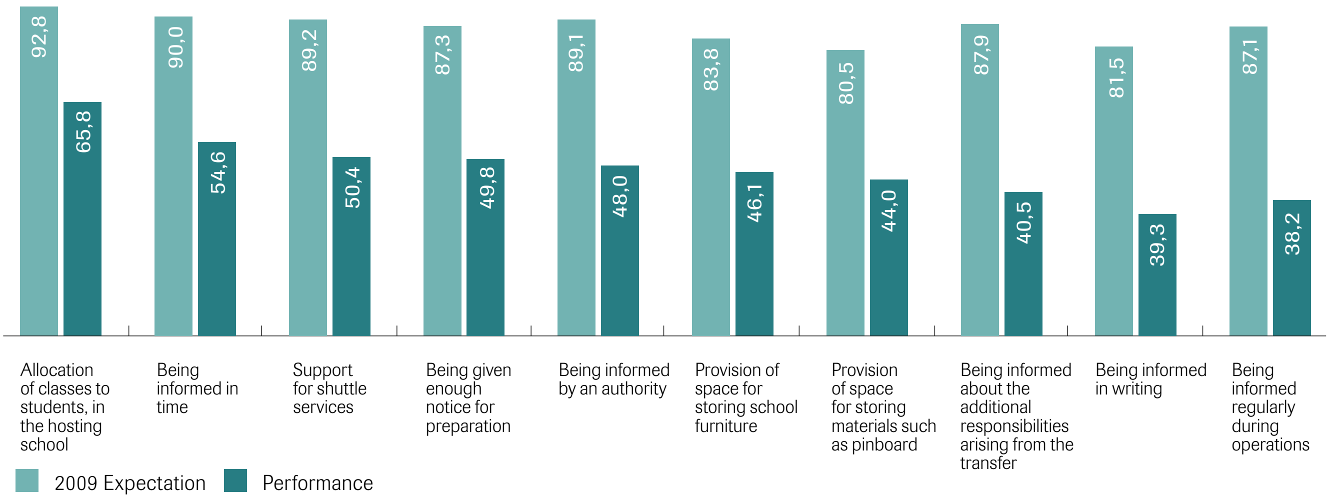
Buildings secured through component works stand out as future-oriented investments, while efforts for providing social guidance and information to prospective residents are among the other gains of the works.

During the works, informing both the employees of the consulting and constructing companies, and the beneficiary groups about work processes; transparency; increased technical capacity; and experience gained in project management contribute greatly to the qualification of project stakeholders to international standards.

Sustaining its own development together with all of its stakeholders, the project team continues to provide its services at international standards.
ISMEP project has not only been an education and self-improvement process for IPCU, it has simply become an academy containing all the stakeholders, with a vast accumulation of knowledge ranging from building construction works to the social guidance leg of the project, enhanced together with all stakeholders as part of the project. At this juncture, IPCU and its stakeholder relations are a project featuring high work performance with uncompromising work principles and quality.

In stakeholder relations, new perspectives were gained thanks to national and international partnerships and significant enhancements were made on the existing capacity. National and international examples were examined to jointly create an up-to-date literature about the works. Consultants' different opinions and alternatives concerning the construction system, construction element or any other subject were taken into consideration, best practices in international and national studies were implemented after being jointly selected and developed.

Comparison of Expectations and Performance concerning the Retrofitting and Reconstruction Works



In the project, examples examined under the leadership of an expert staff were compared with the demands and opinions of the site's user then a joint design was created.

Projects were based on shared wisdom that provided maximum benefit, rather than on individualistic approaches.
In the project, all stakeholders were consulted and a collective effort was made to put forth the right project.

Knowledge and experience of the stakeholders working on international good practice examples and standards were utilized to incorporate national stakeholders and provide them with information, skills and experience.

Social Guidance Study

The operations conducted necessitated to inform students, teachers, school administration and parents.

To this end, the Governorship of Istanbul conducted Impact Assessment for the Study on Retrofitting and Improvement of Schools primarily on parents, teachers and school administration, together with an independent research company in 2009 to assess the expectations from the retrofitting works.

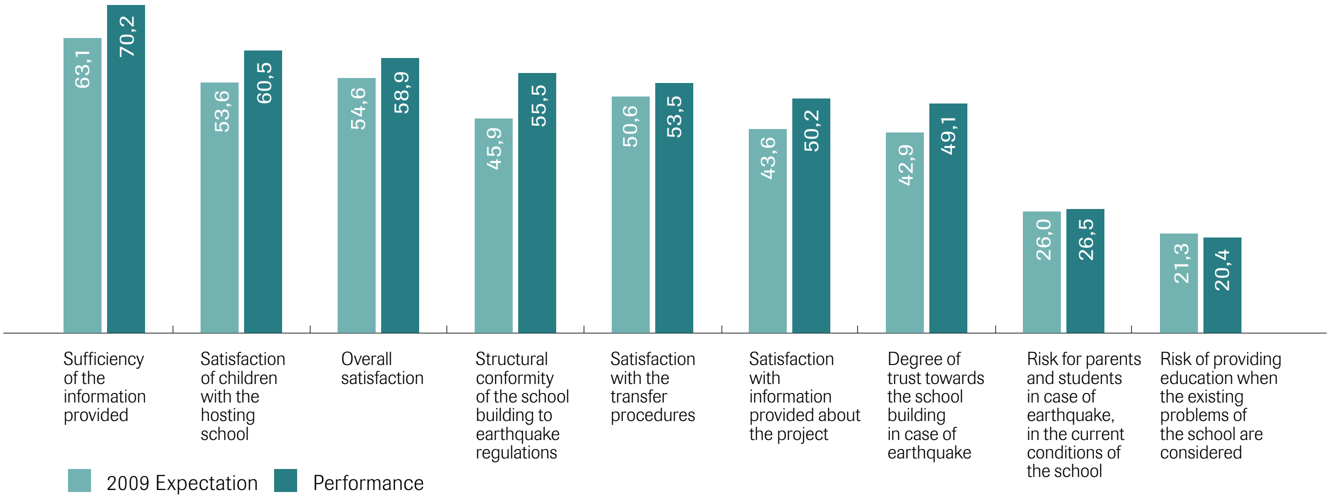
In the research, expectations were listed in the following order: allocation of classes to students, being informed by an authority in time, being given enough notice for preparation, provision of space for storing school furniture, being informed about the additional responsibilities arising from the transfer, being informed regularly during works, providing support in shuttle service.

At the end of the research, it was revealed that for the participators, allocation of classes to students and provision of timely information were on the top in terms of importance.

These are followed by the transport of children by shuttles driving them to and from school, as the third most important need.

Depending on these items determined in light of these studies conducted in 2009, steps were taken promptly to meet these needs/expectations. Using the solution offers developed for the expectations in question, the "Study for Providing Information, Awareness and Social Guidance in Schools" was initiated in cooperation with IPCU and Istanbul Provincial Directorate of National Education to support the Retrofitting and Reconstruction works psychologically and sociologically.

Assessment of Retrofitting and Reconstruction Works



Social Guidance Study can determine how the retrofitting works conducted in schools that will be under risk in case of an earthquake in Istanbul, are perceived and assessed by the education personnel, stakeholders and parents, while aiming individuals to assess these operations in return.

With the study, all parties that will be directly affected by the retrofitting works (school administration, parents, teachers, students) are informed. Thus, a guidance study is provided taking into account the possible social and psychological experiences of students, who will continue their education in another school.

Expectations prior to the Study for Providing Information, Awareness and Social Guidance in Schools as well as the performance assessment of the works conducted to meet these expectations are given in the table above. As it is understood here, the research reveals that approximately 50% of the expectations were met.

This research was conducted both on schools that were subject to retrofitting and on those that were not.

As a result of the interviews and surveys carried out before and after the retrofitting, with parents, students, teachers, directors, and technical personnel taking part in the retrofitting, it was revealed that people's views about the retrofitting changed positively, as it can be seen in the table on the next page.

Based on the assessment study conducted after the retrofitting works performed in the schools of parents, teachers and directors, it was observed that the school buildings become stronger, that they will not collapse during an earthquake and that children are safe.

Accordingly, in the 2010 school term, 49.1% of the parents display their trust to school buildings after the retrofitting and improvement works, by an increase of 6.2%.

This increase in the positive values shed light on the fact that the reliability of the works increased.

In the Social Guidance Study, Information is Given on the Following Topics

- What is retrofitting?
- How is the decision to undertake retrofitting made?
- Why is our school being retrofitted?
- What is the main purpose of retrofitting works?
- Which procedures are applied on buildings through retrofitting?
- Why is it important to retrofit our school?
- How will our school be retrofitted against earthquakes?
- How many months will the works continue?
- Will education be interrupted?
- How can we support our children?

Social Effects of Retrofitting and Reconstruction Works

According to the results of the research conducted to assess the perception towards retrofitting schools against a possible earthquake in Istanbul, retrofitting refers, as a positive concept, to turning a nonresistant object into a resistant one, fortifying a weak object, taking precautions against earthquakes, giving a form, and repairing/renovating.

People who approach retrofitting from its negative aspects, on the other hand, consider the retrofitting and reconstruction works as disruption of the existing order and as being away from school, with the retrofitting process perceived as nothing other than repair/renovation or falling behind classes.

As it can be understood from this analysis, those who rather associate retrofitting with pyhsical circumstances and think that it is performed starting from the foundation up, describe the buildings as “resistant” or “strong”. In the eyes of students, retrofitting the building and making it more resistant against earthquakes created quite a positive affect, as well.

For some students, the retrofitting process caused problems and inconveniences since their existing schedule, class arrangement and transportation were disrupted; for others, going to another school as guests was described as a change and novelty, and an enjoyable process.

Furthermore, it was revealed that receiving education in a more earthquake-resistant building made it more bearable for some students to study in another school.

Psychological Effects of Retrofitting and Reconstruction Works

In the first stage of retrofitting, it was observed that parents and school administration in almost all schools made efforts to improve schools’ appearance.

Although transfer of children studying in the schools to be retrofitted to other schools as guests created negative effects in the beginning, it was observed that afterwards the students had more trust in the physical structure of the building and that they felt more comfortable under that roof.

In addition, the thought of these works being conducted as a precaution for earthquakes is effective in reducing concerns about the physical structure of the school.

Design Compatible with Historical Texture, Üskudar Mustafa Noyan Primary School

The thought that the building can function as a shelter not only for students but also for other people in times of disasters creates quite a positive effect on the attitude of especially primary school students toward retrofitting.

Return of the students to their own schools after the modifications are completed, with their guest status ended, reveals a new situation: returning to a retrofitted school and studying under a more resistant roof, which reinforced students' sense of trust.

Characteristics of Retrofitting and Reconstruction Works

Designs Compatible with Historical Texture

Uskudar Mustafa Noyan Primary School was demolished and reconstructed as part of ISMEP's B component since it carried high risk.

Uskudar Mustafa Noyan Primary School is located on the same street as Valide-i Atik Mosque and Social Complex built by Mimar Sinan in 1583.

The school was recontructed with the project that was realized upon the approval of Cultural and Natural Heritage Preservation Board, and it was made physically compatible with today's conditions, while being compatible with the historical texture in terms of appearance.

Similar to other retrofitted and reconstructed schools, the capacity of Mustafa Noyan Primary School was increased as well.

Number of classrooms in the school was increased from 10 to 18, and its area of usage was increased from 1600 m2 to 4000 m2.

Energy Efficient Smart School

Energy Efficient Smart School aims at encouraging new practices by raising awareness on energy efficiency through sustainable infrastructure systems, and on energy production through natural energy resources.

Kazım Karabekir Primary School was selected for the implementation of the project, which will be one of the important examples in Turkey and in the world, since it featured the best equipped energy efficient infrastructure among the schools reconstructed as part of ISMEP together with Istanbul Project Coordination Unit (IPCU) and Istanbul Provincial Directorate of National Education.



Energy Efficient Smart School, Bahçelievler Kazım Karabekir Primary School

An Energy Efficient Smart School (The Smartest School) is a school that is equipped with energy efficient infrastructure systems such as rainwater harvesting system, photoelectric faucets, solenoid valves, thermostatic radiator valves, condensing boiler, air conditioning plants, exterior coating, hydrophores with frequency coverter for water pumps, circulation pumps with frequency converter, central ventilation with variable flowrates, computer controlled building automation system, energy efficient electrical connections.

As part of the Energy Efficient Smart School Project, a "Solar Tree" and solar panels producing solar energy were installed to the school's roof and garden.

The Smartest School can thus save energy through its energy efficient infrastructure in addition to producing its energy by itself.

At the end of the project, it is aimed to assess and share with the public the energy saving and gain obtained from a primary school which has energy efficient infrastructure and is supported with systems producing energy from natural resources.

For those who would like to keep themselves up-to-date with the project, the amount of energy to be stored by energy-storing Solar Tree and solar panels can be followed with a digital counter.

Through the counter, which can also be followed on Enakilliokul.org, it is aimed to sustain awareness on the contribution of energy efficiency by providing up-to-date information on the amount of solar energy to be produced.

Another aim of the Energy Efficient Smart School Project is to point out our country's geographical advantages in terms of sustainable energy resources.

Thus, the attempt will be to invite the related institutions and organizations to live in an energy efficient world and to show that an environment can be created which provides more healthy and efficient resources for both agricultural and commercial productions that will contribute to the country's economy.

The project also aims at giving individuals a sense of energy efficiency and encourage for creating energy efficiency in their own environment.

As part of the Energy Efficient Smart School Project, trainings are provided to school personnel, students and families on energy efficiency and renewable energy. Training manuals which were prepared by project experts and professional instructors, and contain practical information are used during trainings, which take approximately three hours.

Dissemination and Continuity of Component B Studies

It is one of ISMEP's greatest desires that the experience gained throughout the project can be shared and this knowledge lights the way for similar events.

In addition to the Retrofitting and Reconstruction Works performed as part of ISMEP's B Component, it is crucial to not limit the risk assessment and inventory works conducted under the title of Support for National Disaster Work to Istanbul, they should instead be extended to entire Turkey so that we dwell in more earthquake-safe buildings and also safeguard our historical and cultural heritage.

As part of the Safe Life Culture, coordinated efforts for community trainings and reducing non-structural risks must be sustained alongside the structural improvements discussed in this book, and a society-based disaster management approach must be quickly adopted and extended in our country.

The primary requirements of such an arrangement involves establishing units that will plan the characteristics of each city in accordance with the city's specific problems, taking into account the possible damage that city may suffer in case of a disaster, and will set up projects accordingly.

Furthermore, employing in these units individuals who are experienced in disaster preparation and disaster management and have the necessary qualifications will increase the efficiency of the works; similarly, it is essential that the authorities in local administrations who approve engineering-related plans are trained and appreciate the importance of the issue.

In addition, Safe City Safe Life Trainings prove to be successful trainings that can be provided prior to urban transformation works to raise people's awareness and to eliminate any question they may have on their minds concerning the necessity of these work.




Innovative methods, designs compatible with historical texture, and practices increasing the quality of education and health services noticeably, which have been introduced through the Retrofitting and Reconstruction Works as part of ISMEP, set an example for the local administrations or events that may want to carry out similar risk reduction work in their own regions in the future.

It is one of ISMEP's greatest aspirations that the experience gained throughout the project can be shared and this knowledge lights the way for similar events.

IPCU has received many requests from other municipalities of Istanbul and different parts of the country for the extension of the works carried out as part of ISMEP. However, extension of this project, which has reached its aim and is renowned for the deeds it has delivered, depends on the budgets allocated.

Extension of the work will prevent casualties, and it will surely decrease economic loss in case of a disaster that occurs in a city consisting of structurally resistant buildings.

Besides, service buildings which can continue their operations in case of a disaster can perform crucial tasks in the chaos caused by the disaster, and thus allow our society to recover from the negative effects of the disaster in a short time.

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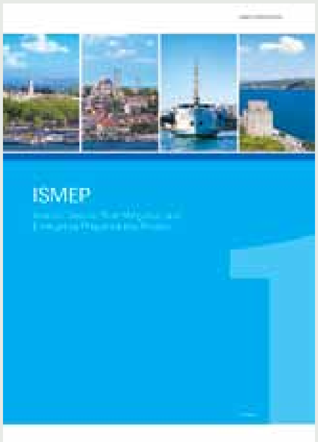

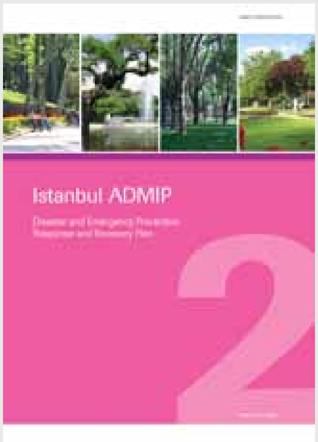

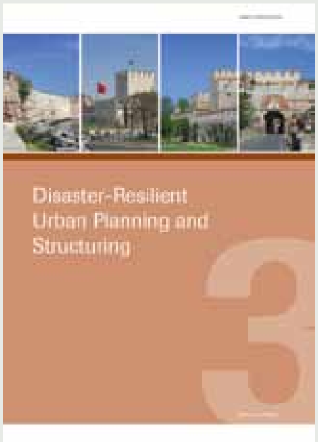

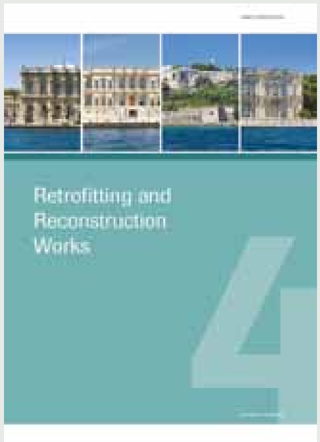

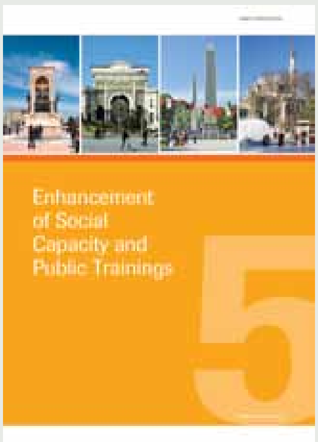

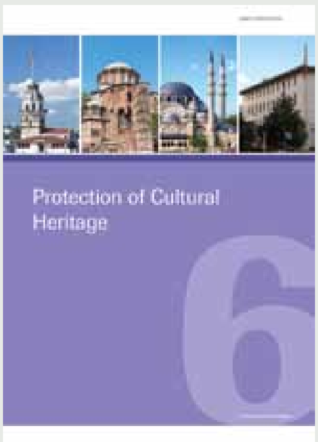

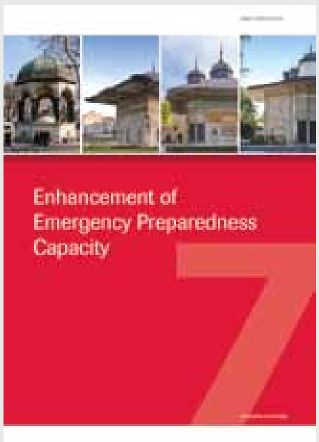

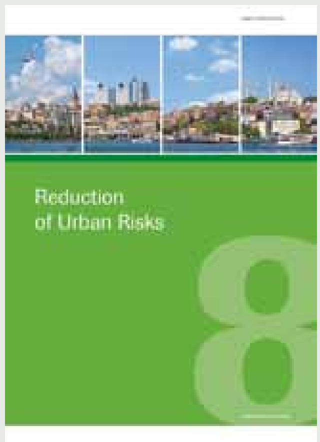

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