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Seismic Approach to Urban Design

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Abstract

Earthquake-concerning urban design, which is based on building cities in safer zones, makes communities less vulnerable to severe earthquakes and their consequent risks. Ideally, this type of urban design enables the city's infrastructure and its core structures to avoid the disabilities and shortages caused by the earthquake and thus simplify the repair and reconstruction processes. It also decreases the social vulnerability. Therefore, in this paper, first the concept and principles of earthquake-concerning urban design is explained to describe the framework of the research. Then the interdisciplinary interaction, analysis and classification of micro-zonation maps, tsunami and fires after the earthquake will be discussed. The final conclusion of the paper is the summary result of the analysis given in each section and is presented as design approach. Now the key question is that, according to the principles of earthquake-concerning urban design, whether it will possible to ease the repair and rebuild after the earthquake. The data collection method is the library type. The studies are in fact seeking to apply the principles, to show that the built environment around us, including homes, offices, schools and hospitals... have a better chance to survive the devastation caused by severe earthquakes. A correct seismic design enables the building to stay persistent without damage to low-intensity shocks, and not to subvert in the face of severe earthquakes.

Keywords: Urban design, earthquake, tsunami, interdisciplinary interaction.

Introduction

Human being, in balance and harmony with the universe, is always moving. Every type of turmoil, either internal or external to human beings is intolerable. In every era of history, human is seeking to balance its interactions with nature and other humans. Therefore, he has reached his own potential innate order and discipline through organizing internal and external interactions.

In order to achieve maximum environmental comfort (ventilation, shade, light, vision and perspective, etc.) to obtain the personality values (cultural, social, economic, religious, historical, aesthetic, technological, etc.) and access the maximum safety and protection against natural and human hazards (earthquake, tsunami, floods, industrial explosions, environmental pollution, radioactive radiations, etc.) at the residential centers, human is always trying to find rules and strategies to design and shape his environment. Over time, to obtain the environmental comfort and personality value goals in the urban areas, there have been gradually accumulated experiences, and the appropriate rules and regulations are well presented. But the issue of safety and environmental protection of urban areas against natural and human hazards has been of less concern in the urban design procedure. In this study, the safety and protection against earthquake hazards in urban areas is considered as the main target in order to achieve the appropriate regulations and strategies in building's design to make it safe against seismic risks. Thus, by the combination of regulations and strategies for safety against earthquake hazards, and other regulations and strategies for building's design to reach maximum environmental comfort and personality values of each region, we can obtain the optimized forms (shapes, styles and measures) for cities in accordance with the characteristics of the urban environment and geography of each region. To be able to sustain the urban development and other activities, and also, make it possible for people to have a good and safe living environment.

Earthquake safety is a subject that is raised against the risk of earthquakes. Since there's still no known method to change the earthquake mechanism, it is only possible to minimize the risk of earthquakes in urban areas by knowing the earthquake's act and behave in urban areas, and use of appropriate strategies and schemes in the field of urban planning, design and construction methods to reduce the potential damages[1].

Interdisciplinary Interaction

In general, the relationship between architects and urban planners, has two ways. On one hand, a small number of architects, depending on their architectural skills and training, are actively involved as members of the urban planning process. On the other hand, most architects struggle with the urban planning rules during a building design. Architects, while they design for their clients, must take into account the requirements of urban and regional planning. Regardless of the relationship between an architect and urban planner, it is necessary that the urban design implications on the architecture, including those associated with earthquake safety, be considered.

Due to the complexity of earthquake damage scenarios, designers need other professionals who need to be able to contribute comments advising them to improve their proposal and other possible negative effects that may be ignored. For example, if the urban planners attempt to introduce a new law on the ground floor and parking level rise, they are unexpectedly and unwittingly promoting the serious detrimental effects to configure soft story in the configuration of buildings. Some of the laws and rules of urban design are themselves an encouraging factor for their use. Even when they lead to the formation of irregular configurations with poor seismic performance. One of very prominent examples of the adverse consequences arising from the seismic design rules, is a usual procedure of customary in buildings, based on the first floor edging down to size 1.5m of ground floor columns. These methods, which lead to have broken perimeter columns, are considered as one of the main reasons for seriously damaging the multi-story buildings in the recent earthquakes[2].

Designers can combine active seismic zones with their design protection against earthquakes. They suggest that designers of fine mapping and zoning of areas vulnerable to seismic design tool to add. Zonation map of the tiny earthquake is perhaps better known as zoning maps, these areas are likely to experience earthquakes are more severely than other areas that may have the possibility of the territory of layered sediments profound soft. In addition, the exposed areas of psychotherapy integration (water diversity) or unstable slopes are located on areas with a high probability of a severe earthquake affected areas are likely to be split up on the fault surface and zonation map earthquake are shown.

Earthquake hazard zonation maps clearly describe the preparation of this plan to help cities and metropolitan areas as necessary to protect the public responsibility of the earthquake that to act splitting is to fulfill it. This would be possible by using earthquake hazard zonation maps.

When for the cities with high seismic hazard, zonation maps scheme is prepared, it is necessary for this process to be carried out all over the city. So that the knowledge about earthquake risk, will benefit both the developers and the community.

Information about earthquake risk, both for the completed buildings and proposed buildings (which have not yet implemented) is crucial. Architects and urban planners need to develop plans and projects for new urban development, land use information, including the possibility of severe earthquakes and ground deformation benefits.

When the earthquake zonation map of the city and suburbs is developed, they can help in reducing the steps and stages of vulnerability in earthquake-exposed cities.

Fracture of the surface and formation of fault

One of the most obvious steps is that urban planners need to reduce seismic vulnerability of cities to restrict construction on active areas known as fault lines. The construction of fault movement under building's foundation depends greatly and is affected by fault displacement and can be expected to incur heavy damage. Maybe yet moving along the same fault line that caused the object in foundation building high performance induction will be limited to horizontal surfaces. However, it is still a significant vertical motion, causing part of the building above the ground level on the other side of the fault, the brim. The distortion induced in that part of the building on one side and the other on the other side of the fault is constructed, it can lead to more severe damage to the imparted tremor damages of Earth. Because buildings are located on the fault rupture, the likely collapse of its face, with the account witnessed a dramatic increase in the number of injured people and victims of the earthquake. Fortunately, even in cities with the largest fault lines, fault is usually due to the narrow width of a few tens of meters, the percentage of sites affected by the formation of fault is very low[3].

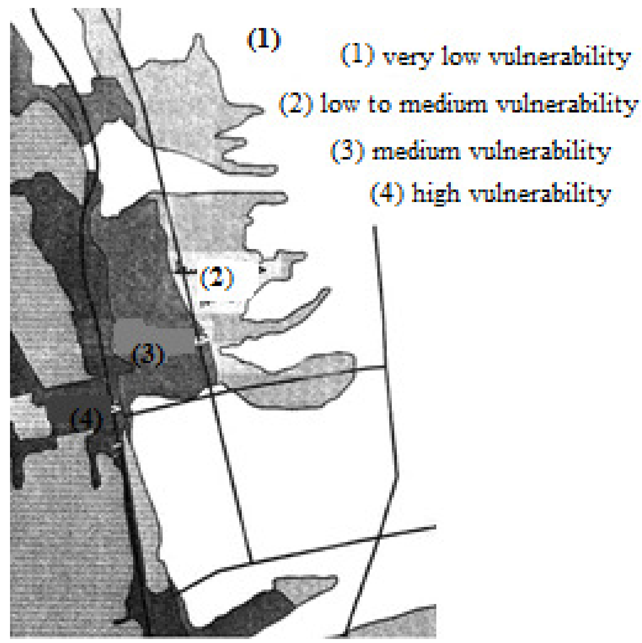

Figure-1
Earthquake hazard zonation map

Urban design guidelines considering seismic approach (conclusion)

When the time for replacement of critical facilities and buildings (such as hospitals) after the earthquake comes, it must be planned to re-locate to the sites to a safer place. Re-routing critical arteries of the city, such as plumbing or major city main roads to prevent them from breaking off due to being located in areas that are exposed to ground orientation or depletion. Impose restrictions on the urban development on high seismic risk areas in the city which leads to encouraging of development in appropriate areas. Instead of focusing on the development and employment in urban areas that are subject to wear, and historical contexts that are built on unstable slopes, we should convert them to parks and gardens in urban areas so that we may reduce the vulnerability caused by the severe earthquakes.

Constructed zones of urban areas can be classified based on their vulnerability to various factors, such as building's age, condition, materials, seismic design standards imposed on it when being built, and the usual shortcomings and deficiencies in the configuration. When zonation maps of earthquake hazard for the different layers are put on together, then the likely geographical distribution of earthquake damage can shape the nature of the urban design process. Owners of earthquake vulnerable buildings are required to upgrade the seismic performance of the building and thus help them in this regard, particularly in areas that have historical significance for the building to protect. Predict the reconstruction and re-development constraints of urban areas particularly vulnerable to the earthquake and prepare for it ahead of schedule, hoping that the devastating forthcoming earthquake will make a unique opportunity ahead us. Once the opportunity is lost, engage in the purchase and demolition of old buildings and old sets of open spaces and develop a multipurpose building to replace it, so that these areas become part of an integrated urban open space. These areas can contain the shocked survivors of the earthquake, so that they can come and shelter for themselves and perhaps to take refuge against the fire caused after the earthquake, or maybe these areas can be used to temporarily accumulate detrition left out of earthquake. Buying real estate in order to increase the width of the row of buildings and streets in areas of greatest vulnerability. After the streets are narrowed or blocked due to the loss of adjacent buildings' detrition, by reducing the mass density of debris daily, in addition to improving access to emergency vehicles, we can take advantage of a wide strap to prevent the spread of a fire anticipated after the earthquake in the city. Facilities and structures after the earthquake that have great importance to society, such as hospitals and fire stations should be located in the most secure areas. Otherwise they must be designed in a way that can still be usable after the earthquake. Access to essential facilities, no major damage to the vital artery of the city, such as roads and bridges take effect, particularly if the main arteries are on soft soils prone to ground orientation or other ground fissures caused by earthquakes. Locating the buildings where hazardous operations (such as oil and gas) on sites with soft soil, is unwise and foolish, unless approved in advance, the situation of the site can be improved. Specific vulnerable areas should be allocated to the recreational open spaces. In this regard, the use of classified information of micro-zonation maps of earthquake can lead to improve public safety. The urban planners should be able to reduce earthquake damage to the installations and facilities in the city. Using earthquake hazard zonation maps with input from engineers specializing in this field in urban design, enables them to select a site to build upon the quality of urban life, such as dams, facility components, and the system waste water treatment plants and transport shipping will be increased[4].

What is a tsunami and how it appears?

The word tsunami is combined of two Japanese words, "tsu" and "name" meaning "port" and "waves", respectively. Tsunami is a wave or series of waves in the ocean caused by an oceanic earthquake. These waves may be hundreds of kilometers wide and when they reach the coast, can be as high as 10 meters. These "water walls" travel across the ocean at a speed faster than a jet plane, collide the beach and cause extensive damage. To understand the tsunami, the structure of waves must be recognized[5]. Ordinary waves that we see on the beach or in the water ponds, are formed from a crest (highest point of the wave) and a trough (lowest point of the wave).

Figure-2
Tsunami

Waves are measured in two ways: Wave height: The distance between the crest and trough. *Wavelength: Horizontal distance between two successive wave crests.

Frequency of the waves depends on the time gap taken to cross point of two successive waves –called the wave period-. Tsunamis and waves both have these common parts and are measured in the same way. But there are a lot of differences between them in terms of size, speed, and origination[6]. Various factors cause the waves in the ocean including underwater activity, the pull of gravity and atmospheric pressure, but they are mainly due to wind. Wind is the source of wave's energy and it depends on wind speed. The important point to remember is that the waves are not indicative of water movement, but they show the movement of energy through the water[7].

Clashing the Tsunami to the Coast

When a tsunami reaches the coast, its familiar deadly shape appears. When a tsunami reaches land, hits the shallow water near the shore. Shallow water and coastal land is transferred to water which causes energy to accumulate. This begins the deformation of tsunami.

Topography of the sea floor in this area and the coast shape affects the tsunami appearance and behavior. As the wave speed decreases, the height rises dramatically above the water and energy accumulates. Normally, a tsunami is approaching fast and the water speed is reduced to 50 miles per hour, but the height reaches 30 meters above sea level. Wavelength increases while wave height decreased during this process (Consider squeezing an accordion for example).

The persons on the shore, witness the severe high and low motion of the water impending tsunami, followed by reaching the actual trough of the tsunami to the shore. Tsunamis are often presented as strong and fast water movement and not a single giant wave. Five to 90 minutes after the initial trauma may be followed by other waves. Tsunami wave train, after a series of waves travels long distances to the shore. Especially if the tsunami hit the coast without warning, leads to many deaths and levels the shoreline and the sea, killing all its residents. The area at greatest risk to be destroyed is the region between 1.6 kilometers of coastline, due to flooding and debris dissipation, the areas with height less than 15 meters above sea level, are vulnerable to the height of the impacting waves[8].

Tsunamis can even reach the offshore shelters due to varying in the characteristics of the seabed and coast. For example, a protected coastal area with a narrow entrance makes a "trumpet" route that triggers the destructive power of waves. River or canal makes the way for greater influence of tsunami on inner areas. Until a tsunami hit the coast, it is difficult to predict how its interaction with land would be[9].

Tsunami impact on Buildings

Wooden buildings except total destruction from tsunami. Buildings of stone, brick and concrete can resist flooding and wave height to stand 1 to 2 meters, but in the social emo taller surrender and be destroyed.

Starting point for architects and designers to specify the tsunami, to obtain maps of flooding, the area is under design. Number of options that lie ahead, are: Tsunami retaining walls and barriers, planting trees and plants short and dense urban space re-positioning, the installation of a massive concrete wall along the coast (continuous concrete wall with a height of over 12 meters and a thickness of 5/1 meter wide tunnel hull 5/8 m, It is worth noting that the proposed approach, the options are very expensive and have significant environmental effects is inconsistent, which creates large areas of tree planting is more effective. The walls and the ability to capture a major share of the tsunami energy, but does increase the volume of water ruined.

Re-locate the sat-affected areas and reconstruction of tsunami-ravaged areas, The tsunami early warning systems have the ability to identify and provide exit routes for people of other effective methods to reduce the loss of life.

The main requirement for a tsunami shelter, is to provide an opportunity for people to escape the tsunami to rise above the level or expected to be flooded. Since the structural features designed to shelter is concerned, it must be designed in such a way that the forces resulting from seismic ground shaking during an earthquake, and then be able to control whether the fight against the pressure In addition to the hydrodynamic impact forces from the rubble and debris, water will stand or not. Let's not forget that the Archimedes force, including the soil around and under the foundation also noted washed. Split and broken due to the possibility of oil supply sources close to the desired structure is resistant to fire.

Figure-3
Massive concrete wall along the coast

Tsunamis, the large horizontal forces perpendicular to the wall for flow imports. It should be avoided in the design of structural walls and non-structural walls are also designed to sort that forces small enough, to break down the overall performance of the wonderful structures. Out of the circle shear wall structures with appropriate structures to deal with the tsunami and consider all the requirements previously mentioned, the design of the building, only one option remains (reinforced concrete moment frame in the two orthogonal directions). Internal and external walls at ground level (or floor) of the initial tsunami victims are allowed to safely and easily through the column tsunami wave struck flows. For rubble and debris, and consider the possibility that the role of a temporary barrier function. Research shows that a twelve story moment frame buildings may not require additional strength of the forces exerted by a tsunami with waves as high as three meters of it to survive win swollen and. Shorter buildings, the forces of wind and earthquake less in terms of design, in particular the more vulnerable. Seismic Safety Commission today proposed guidelines developed in the structural design of multi-story buildings and buildings that have this features, can stand up to forces exerted on tsunami[10].

Fire after earthquake

The longer the major risks of severe earthquakes, it is the surrounding fire. Research has shown that sometimes damage after an earthquake can be much more severe than the damage caused by the earthquake itself. Because both serious and destructive fires and earthquakes, as are the buildings in the earthquake. In this case the actual situation and the need to assess the safety of buildings and specific analysis. Usually these types of damage are considered Destruction or structural damages, fire damage induced structural and non-structural damage of the fire. The possible risks of fire protection systems fire at the regional level in urban areas can lead to serious injuries. The design It can be very effective for reducing earthquake risk. After the earthquake a fire should not be taken for certain events. Perhaps the main reason for the multiple attacks in different countries earthquakes, fires were seen extensive use of non-flammable materials. Time of day at which the earthquake occurs, the prevailing climate, the lack of fire and impact. After the earthquake, the fire, the wind occurs; it will be more likely to spread fire quickly. This phenomenon may, by previous experience and by computer modeling of fire is revealed.

Conclusion

Design solutions to the threat of fire after earthquake: First, they must make the best procedures to reduce the risk of fire spreading from non-earthquake fire, in the fall. With an understanding of how fires after the earthquake, the fire becomes large, are widespread, designers need to recommend a higher standard. A wide street in front of the fire, which burned less likely to have been blocked by falling debris. City of gardens and parks to seek shelter can provide a safe space. Ease of viewing flammable materials management acceptance and roof, which has a major role in reducing the risk of fire. Current rules require that existing buildings to prevent the spread of fire to follow. As with other prevention strategies based on the construction of the main building, which is designed to act as a fire barrier. For more safety protection against fire, the use of advanced coatings for fire and shutters to cover windows visible is recommended. Provision of a water tank on site for fire sprinklers and other firefighting equipment handy little effective action in this area is considered. Provide flexible connections between buildings and gas tube technology can reduce the risk of gas explosions. This fitting makes pipe, without break, in order to adapt the building to the relative motion of b. Provide appropriate tools to optimize routing and emergency vehicles after the earthquake a fire, according to the geographical distribution of emergency relief areas (emergency operations centers, hospitals, fire stations, police stations, etc.) are also be effective.

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