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Urban Design Criteria for Earthquake Preparedness in Organic Urban Areas of Tehran

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Abstract

There are large areas of the world where seismicity is high while they form the whole or parts of urban conglomeration.

Iran can be literally compared to a large shaking table; various parts of it have been stricken by earthquake in the last four decades(1). Tehran is also expected to have a major earthquake in the near future(2).

Therefore, urban design criteria for earthquake preparedness in organic urban areas of Tehran should be prepared. Among various parts of the city, the organic areas are facing more problems due to their old and unsafe structures and being located in narrow lanes and alleys while gas pipes running every where. In case of earthquake, people will be traped in these places where it will be very difficult for the fire fighting vehicles, ambulances and othe facilities to reach to the affected parts to provide health care services and aid.

This paper tries to point out that although prevention of earthquake or strengthening of each and every urban structure is not possible, but at the same time the harsh effect can be toned down with the preparedness of urban transport and built form along them. It is a well known fact that after every earthquake, victims are trapped alive below the debris. This makes it imperative that a hierarchy of earthquake safe centers shall be available at all levels of the settlements and a network of roads is essential for the free flow of emergency vehicles and equipment to make the job of relief and rescue work easier.

Key Words: Earthquake preparedness, organic urban areas, urban design.

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The earthquake distribution map of Iran shows that most of the residential areas are located in seiscmic zones and facing with earthganake problems.

There have been three major earthquakes in Iran and each one of them have claimed between 30,000 to 50,000 precious human lives. The severity of these earthquakes have also been over 7 RM (Richter Magnitude).

The earthquakes have also struck different regions of southern, central and northern areas destorying cities like Ghir, Karzin, Tabas Zanian, Lahijan, Gilan, Mangil, Rondar, Ardebil, North east of Khorasan towns and villages. Being located on techtonic plates, Tehrah, toohas experienced several earthquakes thougl of low magnitude, but according to seismologists, it is expected to have a major earthyquake in the near future.

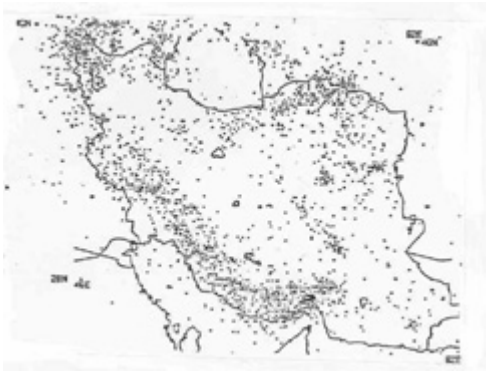


Figure1 Iran, Earthquakes Distribution (1900-1988)

By: N. Kamalian Istitute of Geophysics U. of Tehran

It is time to wake up to the hard realitlies of earthquake research, monitoring, warning and preparedness. It is a very daunting task, especially for the developing countries to prevent natural phenomenon such as earthquakes. Therefore, preparedness and relief operation should be geared up in a national network to minimize the loss of human lives as well as private & public properties.

In this regard this paper focuses on two major areas the man-power and the physical plan and urban design strategy to minimize the losses of both lives and the property.

The suggested hierarchy and list of most important aspects3 for protection may run as follows:

(One) human life;

(Two) storage of basic supplies;

(Three) operational capacity of the region;

infrastructure network of:

a) transportation and communication;

b) power supply;

c) drinking water supply;

d) sewage and drainage system;

(Four) health service facilities;

(Five) housing facilities / backup emergency shelters

(Six) social and cultural services:

a) cational facilities;

b) mercial facilitles;

c) cultural facilities;

d) special landmarks

e) historical monuments;

f) personal household property

Preparedness

It is the key to minimiz the devastating effects of an earthquake. The preparedness would involve various aspects such as warning system, earthquake monitoring system to assess any build up of seismic activity before the on- slaught of a

major earthquake. Earthquake drill which will involve the public as in Japan, every year on the first day of September month preparedness drill are gone through in a routine manner which helps the people of Japan to be every ready for the earthquake and is participated by all sections of the society. Such a drill include the benefits of preparedness and will reduce panic to a great extent. The follwing flow charts show the proposed preparedness administrative model and national earthquake warning network for Iran.

"More pleasant than the sound of love's speech, naught I heard;

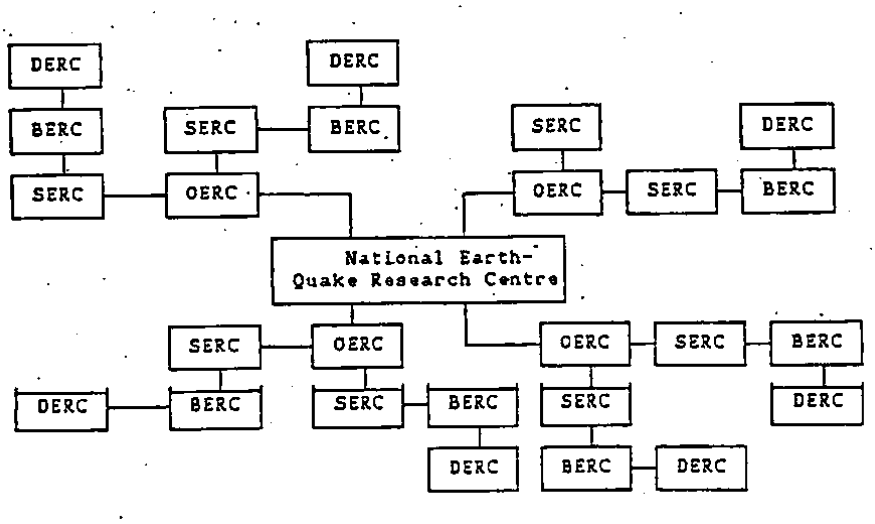


Figure 2 Schematic Table Showing Network of Research & Reslief Centres at National Level

Hierarchy of Earthquake Safe Centres (ESC) in a settlement is very essential as it is some how impossible to make all the buildings safe aginst vibrations. The hierarchy shall have its sequence right from the city level to the “Mahalleh” or Neighbourhood level and cluster of lanes or “Kucheh”.

There has to be an overall network super imposed on the existing built form of the settlements to link the ESC. The structures within the ESC shall be highly earthquake resistant. This can be composed of spaces for administration, medical relief, fire fighting and ambulance parking.

The main centre should be well linked to the National Earthquake Research Centres and should be fully earthquake resistant. The centre should be well equipped with a helicopter for both reconnaissance, supply of food and medicines should also be stacked to cater for emergencies. The other main public earthquake resistant buildings in the major centres are hospitals, large community buildings which can house large population, with enough storage both life saving drugs, food, building materials, simple tools and prefab elements for construction of temporary housing.(5)

The Model and Network

Tehran is divided into 5 zones (“Hozeh”) and 22 regions “Mantegeh”and the latter is further devided in to several sectors called “Nahieh”. Each “Nahieh” is composed of a number of neighbbourhoods. Each neighbourhood is devided to several lanes or (Kucheh), Fig 3.

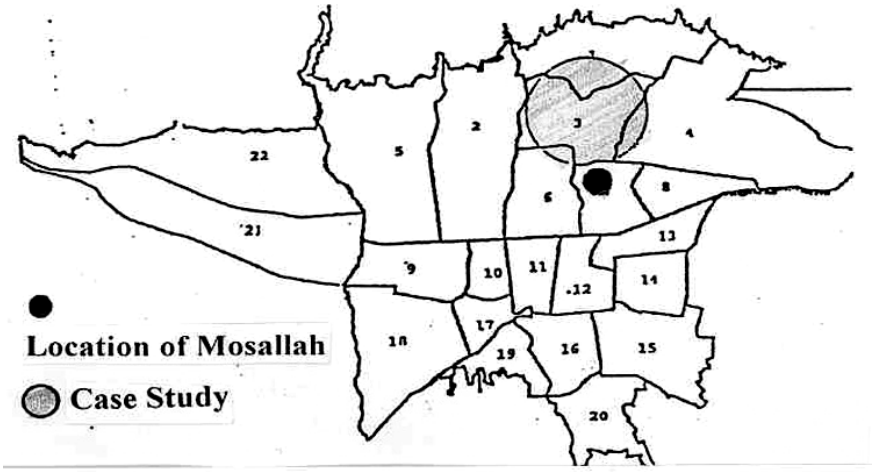


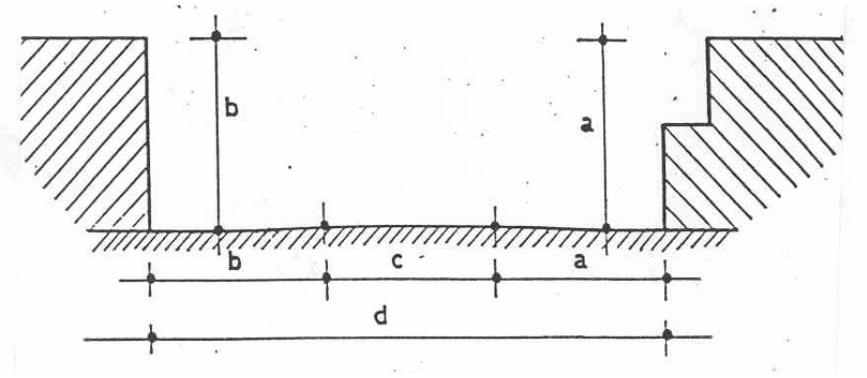
Figure 3 Tehran & Location of Mosallah

The centre is required for each sectors according to the population. There has to be a road network with enough width so that in case of an earthquake, building that falls down on both sides of the road yet should have enough space for an ambulance, bulldozer or fire fighting sevice to move from on centre to the other as per the design of roads as in guidelines in (Fig.3).

The Built form of the Settlement and the Proposed Network

Basically Tehran has 3 types of developments i.e., compact densely built traditional organic areas, the transit zone and the periphery areas and after that will be the future expnsion areas. To have a road and a centre (ESC) in the futue expansion areas (new suburb) will be of no problem as it can be planned accordingly. Similarly at the periphery of the settlements there are enough open spaces which can accommodate the centre (ESC) and the proposed network. The major problem is in the case of old cores and organic parts, which are historically part of our heritage, to provide a centre (ESC) and a road with required width (Fig. 4)

The space for provision of these requirements in traditional core arease should be through the conservation surgery similar to that of proposed by Patrick Geddes for revitalization of old areas i.e. defining space for expanding the roads by condition of structure survey. This strategy can be applied in traditional core & organic areas of Teheran such as the area around main Bazaar to other organic areas of Shemiran by providing ESC’s and also to conserve the valuable built form.



a & b = Building Block
c = width of Emergency vehicles
d = Road width (a+b+c)

Figure 4 Emergency service main Road

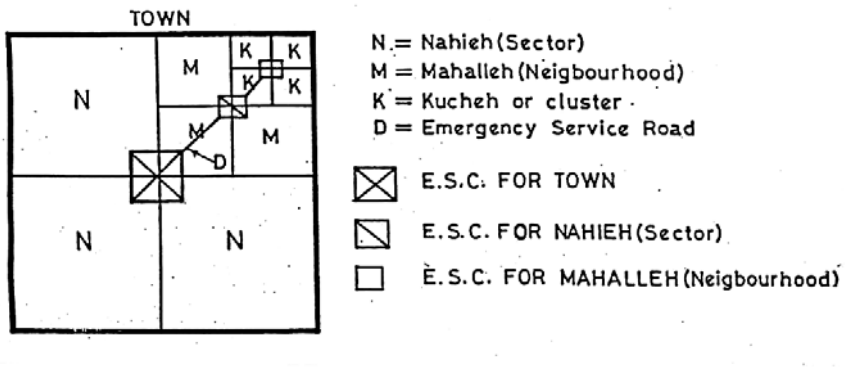


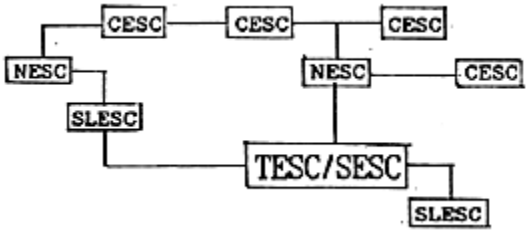
Figure 5 Conceptual Diagram of Earthquake Safe Centres (E. S. C) at Various levels

Cluster Level Earthquake Safe Centre (CESC) & Town / Settlement Earthquake Safe Centre (TESC).

These centres should be well connected by wireless facilities with the National Earthquake Research Centre where the monitoring equipment at the national level is kept. The monitoring equipment should be part of the centre also which is a key link at the National grid level for proper flow of data both way from all the TESC's to the National Earthquake Research Centre. Besides the monitoring equipment, the TESC should have the following spaces and facilities. A large meeting room to accommodate scientists, disaster maragement experts to plan out the action plan to rescue & relief operations or to have symposiums for imparting information to rescue and relief volunteers. Screen audio visual aids for rescue and rlief volunteers who will help conduct earthquake drills to familiarize the people with the activities in case of emergencies. The centre should be equipped with helicopters depending upon the population of the city for both reconnaissance, supply of food, medicines which should be stacked to cater to emergencies. The centre should have facilities to convert some multiple use space into emergency hospital beds. Besides the above facilities space for ambulances, fire fighters,

bulldozers should be provided to be pressed into service during emergencies. In Tehran the ESC's can be located along with Mosalla which already has provisions for large open spaces normally used for large gatherings. The Mosalla of Tehran is ideally located at the intersection of the two major highways Fig 3 which can be earmarked to act as network road between the (ESC's). The facilities will decrease in the descending hierarchial order with less facilities as the sector level, neighbourhood level and cluster level. The administrative setup required to manage these centres is equally important at the city level.

To take care of the above centres, an administrative set up required both at the national and country levels (5). At the same time a hierarchy of the Earthquake safe centres in an urban scale is required (Fig 6).



TESC Town Earthquake safe Centre
SESC Settlement Earthquake Safe Centre
SESC Sector Level Earthquake Safe Centre
NESC Neighbourhood Earthquake safe Centre

Figure 6 Urban Level Earthquake Safe Centres

The Proposed Model for Safe Routes in Organic Urban Areas of Tehran.

The traditional urban organic areas of Tehran have their special characteristics such as mendening, narrow and adobe and unsafe structures with regards to earthquake problems.

Considering various factors involved a more detailed model has been worked out in a thesis by O. Karami, under the supervision of the author, to catter the hazard of earthquake in these areas (6).

Seven factors have been considered in this regard which are: K1, k2, … k7. The property of these factors are usually subjective or qualitative. Therefore, a sum of 0 to 4 are decided for each factor. The above 7 factors are:

K1: the extent of hazard causing from the height of the building sides in a lane.

K2: the condition of used structures on both sides of the lane.

K3: bridges.

K4: relation of the width and length of the lane.

K5: kinds of used materials.

K6: percentage of traffic conflicts.

K7: slope.

Therefore,

kt= A2k1, A2k2, … , A7k7 and

kt = 7k1 +8k2 +6k3 + 5k4 + 5k5 + 6k6 + 4k7

This model has been applied in a case study in a mahalleh in an organic urban area of Tehran and finally a safe circulation system has been proposed with minimum requirement of interference for

strengthening with regard to earthquake hazards. These, could help to take care of easy traffic circulation of firefighting and ambulatory services after distruction, (Fig. 7).

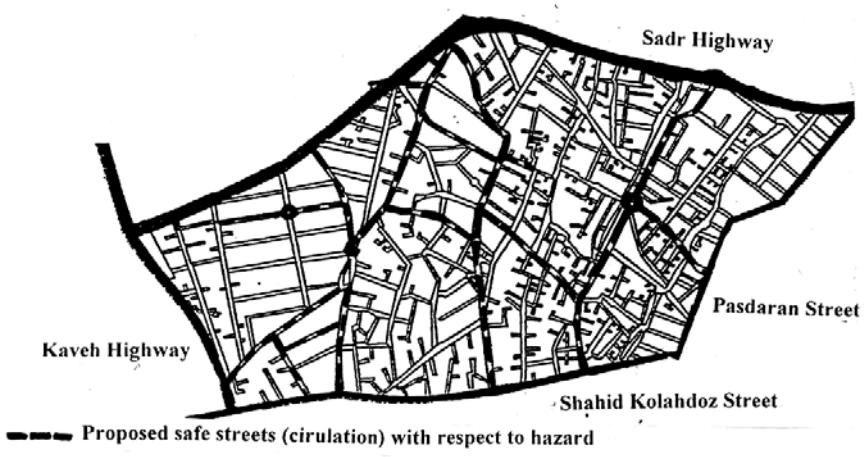


Figure 7 Proposed safe lanes for ambulatory services
Source :Karami, Omid , Prepration of Circulation System for Earthquake Hazard, TMU, Iran, 2001, p 82.

Conclusion

It is to be pointed out and must be kept in mind that prevention of earthquake is not possible, but at the same time the harsh effects can be toned down with preparedness. It is a well known fact that after earthquake, a number of victims are also trapped alive below the fallen debris. This makes it imperative that a hierarchy of earthquake safe centers be available at all city levels and a network of road is essential for the free flow of emergency vehicles and equipment to make the job of relief and rescue work easier. In the traditional and transit zones to conserve the old core it may be acceptable to have just a few roads of the specified width and in the periphery and the expansion areas road should be as proposed in the main model (model d).

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ملاکهای طراحی شهری برای آمادگی در مقابل زلزله در بافتهای ارگانیک تهران

محمدرضا پورجعفر[۱]، علی‌اکبر تقوایی[۲]

چکیده

مناطق وسیعی از نقاط مسکونی و شهرهای جهان شدیداً زلزله خیز هستند. ایران یکی از آن مناطق بشمار میرود که شهرها و نواحی مختلف آن تا کنون و بویژه در چهار سال اخیر بارها و بارها تکانهای زلزله را تجربه کرده‌اند و تهران یکی از آن شهرهاست که وقوع زمین لرزه‌ای بزرگ در آینده‌ای نزدیک در آن دور از انتظار نیست.

لذا تهیه طرح آمادگی در مقابل زلزله در تهران و بحث درباره ملاکهای مربوطه مخصوصاً در مناطق ارگانیک آن کاملا ضروری بنظر میرسد. بافت ارگانیک تهران به سبب فشردگی – کوچه‌های باریک و بن‌بست و راههای ارتباطی ناکافی و قدیمی که از گوشه و کنار آنها لوله‌های گاز شهری عبور کرده است در معرض خطر بیشتری است. در حقیقت در هنگام زلزله ساکنین چنین اماکنی در دام میافتند زیرا ماشین آلات و سایر وسایل اطفا حریق – آمبولانس و غیره نمی‌توانند به سادگی به آنان دسترسی داشته باشند.

مقاله حاضراین مطلب را خاطر نشان می‌نماید که گوچه نمی‌توان از وقوع زلزله جلوگیری کرد و یا تمام ساخت و ساز شهری را صددرصد در مقابل این خطر مقاوم ساخت ولی می‌توان آثار مخرب آن‌را با تمهیدات لازم از جمله آماده کردن اماکن و محله‌های مسکونی ارگانیک از طریق ایجاد دسترسی‌های مناسب به حداقل رساند. در آن‌صورت امکان نجات بموقع کسانی که زیر آوار مانده‌اند از طریق مراکز سلسله مراتبی و شبکه‌های کمک‌رسانی و گروههای نجات به سادگی انجام خواهد گرفت.

کلیدواژگان: آمادگی در مقابل زلزله، طراحی شهری، نقاط ارگانیک تهران

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