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ENGINEERING DESIGN OF SEISMIC ISOLATED BUILDINGS

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KEYWORDS: Conventional buildings, seismically isolated buildings.

ABSTRACT

These study reveals, and assess the safety level in Seismic architectural design, for research buildings, that use radioactive materials, the best design that fulfill the required safety of nuclear installation was treated. Seismic base isolation or base isolation system is one of the most popular means of protection against earthquake forces.

The objective of present study is to raise the awareness, within architectural community with the impact of natural seismicity on buildings design. In order to search the possible ways of incorporating architecture-based seismic design issues into the architectural design process. The case study is dealt with, the roles and the responsibilities of architects in seismic design. The critical importance of the architecture-based seismic design issues are defined as well as the importance of the topic for main research areas. Hypotheses are explained. And it is results are analyzed.

INTRODUCTION

Seismically isolated buildings have been developed on the basis of protection for buildings against big quake-vibrations. Recently 1500 buildings with seismic isolation excluding detached houses were designed and constructed in Japan.

The problem is that, there are buildings are not compatible, with the foundations of design. Leading to inadequate safety the internal architectural environmental design of radiological buildings. That requires identifying design in light of the requirements of safety, to ensure the environmental preservation of radiation pollution in case of normal operation or accident. Understanding the ground and building characteristics, certain architectural characteristics that influence seismic performance - which is necessary to guide the conceptual design of building. Either in a positive or negative way.

In addition, a number of building characteristics have been reviewed that, together with those of the ground, determine the building's performance: how much damage the building will suffer. These characteristics are common to all buildings, both new and existing, and all locations. A building's structural system is directly related to its architectural configuration, which largely determines the size and location of structural elements such as walls, columns, horizontal beams, floors, and roof structure. Here, the term structural/architectural configuration is used to represent this relationship.The purpose of this part is the licensing process for the construction of radiological buildings, as part of the approval process for a site license. To knows all the requirements that should be offered, to get approval permit from the new site.

The site evaluation covers criteria requirement, and required information of the following topics : geography and topography, population distribution, uses of land and water, meteorology, hydrology, hydrogeology, earthquake hazard analysis studies, dispersion studies in air and water, flood hazards, external human induced events, environmental monitoring of contamination, radiological and non-radiological impacts, social and economic aspects , quality assurance programme and emergency plan for a proposed site. And the environmental Impact Assessment requirements for NPP.

METHODOLOGY

So, what is the system of seismic isolation?

The following figures show the properties of buildings during quakes.

Conventional buildings

These buildings are set on the ground, vibration of quake is brought directly to the superstructure. Building vibration is severe, there are possibilities that furniture will move and overturn sometimes, doors distort, and walls crack.

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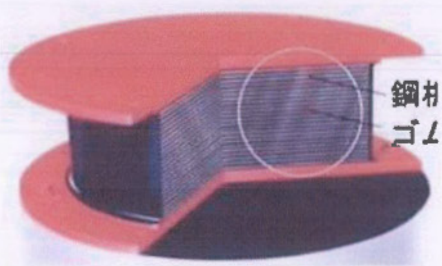
Seismically isolated buildings
Devices are installed between building and the ground, and they absorb energy of vibration during the quake. They can reduce vibration of building.

Building vibration is very slow, there are few possibilities of the foresaid situations.

KINDS OF DEVICES FOR SEISMIC ISOLATION USED IN BUILDINGS?

Generally, isolators and dampers are used. There are three types of isolators as shown below.

Elastomeric Isolator:
It consists of steel and rubber, it made of sandwiches of soft rubber sheets and hard steel plates as shown in the Photograph. It works as a bearing to sustain the weight of the building and is able to move the building laterally. Soft rubber reduces the building vibration to slow shaking, and hard steel plate contributes to sustain the weight of building.



Slider:
The slider has a coating of PTFE and a stainless steel plate finished with smooth surface as a mirror in the Photograph. It works as bearing to sustain the weight of the building and is able to move the building laterally on the surface of the plate with a certain amount of friction.

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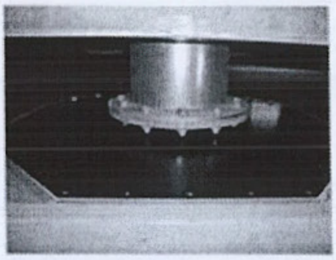
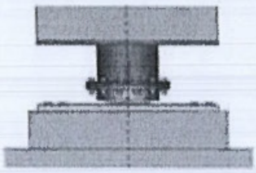
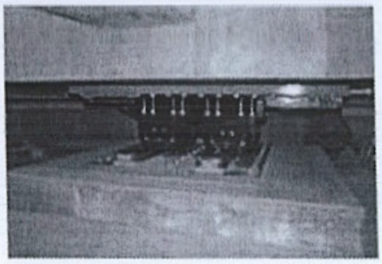


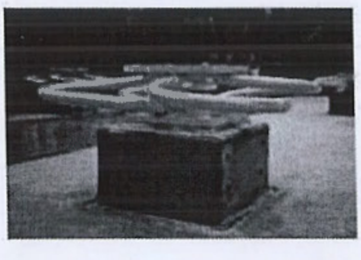


Rotating Ball Bearing:
It consists of ball bearings with retainers and rails or plates as shown in the Photograph. It works as a bearing to sustain the weight of the building and is able to move the building laterally without friction.



Damper:
Usually for a damper is used to suppress vibration, damper is used usually.
Mainly three types of dampers are used as follows;

Steel damper:
It utilizes the elasto-plasticity property of steel. The hysteretic loop contributes to energy dissipation. There are two types of steel dampers, one is square in section and other is round in section of the rods as shown in the Photograph.



Lead damper:
It utilizes the plasticity property of lead. The hysteretic loop contributes to energy dissipation. There are two types of lead dampers, one has a round section and a curved shape as shown in the Photograph and other has a cylindrical plug in core of the elastomeric isolator.

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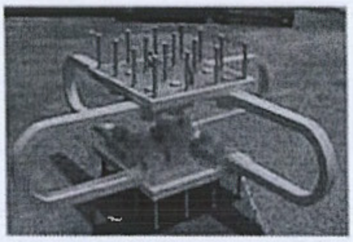
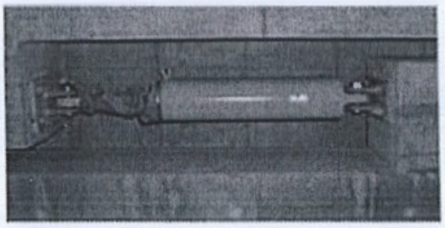


Oil damper:
It utilizes the viscous property of fluid. Oil or silicon are used as the fluid. Viscous resistance contributes to energy dissipation. Oil damper is a cylindrical shape as shown in the Photograph.



GENERAL REQUIREMENTS

The main purpose of the site evaluation is to protect the public and environment from the radiological consequences, of radioactive releases due to normal Operation, and Accidents. In the evaluation of the suitability of a site, for a Nuclear Facility, the following aspects shall be considered:

1. Effects of External Events (natural in origin or human induced) occurring in the region of the particular site;
2. Characteristics of the site and its environment that could influence the transfer of released Radioactive Material to Persons and the environment;
3. population density, population distribution and other characteristics of the External Zone and how these characteristics may affect risk to members of the public and the implementation of Emergency Measures;(Interrelationships of performance expectations, building program and site characteristics.

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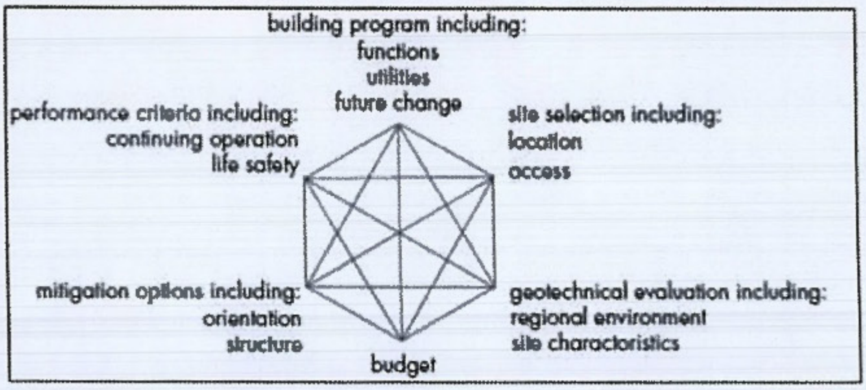

Figure:1 ***The main purpose of the site evaluation***

REQUIRED DESIGN CHARACTERISTICS

1. Site characteristics that may affect the Safety of the Nuclear Facility, shall be investigated and assessed, as well as characteristics of the natural environment in the region that may be affected by potential radiological impacts in operational states, and accident conditions. Shall establish measures to monitor and verify all site characteristics remain, within the assumptions used in the Design, and the final safety analysis report, throughout the life of the Nuclear Facility.
2. Proposed sites for Nuclear Facilities shall be examined in relation to the frequency, and severity of external natural and human induced events, and phenomena that could affect the Safety of the Nuclear Facility.
3. The foreseeable evolution of natural and human induced factors in the region that may have a bearing on Safety. Shall be evaluated for a time period that encompasses the projected lifetime of, the Nuclear Facility. These factors particularly population growth, and population distribution. Shall be monitored over the lifetime of the Nuclear Facility.
4. In assessing the risks associated with External Events, the potential consequences of combining these hazards with the ambient site conditions (e.g. hydrological, hydrogeological and meteorological conditions) shall be considered.

Shall define and implement performance based measures to monitor site characteristics and ensure they are consistent with the characteristics assumed in the Design of the Nuclear Facility over the lifetime of the Nuclear Facility. The characteristics of the natural and human induced hazards as well as the demographic, meteorological and hydrological conditions of relevance to the nuclear installation shall be monitored. This monitoring shall be commenced no later than the start of Construction and shall be continued through Decommissioning.
Before Commissioning of the Nuclear Facility the ambient radioactivity of the atmosphere, hydrosphere, lithosphere and biota in the region shall be assessed to provide a baseline for establishing the future effects of the Nuclear Facility.

Design specifications to control the radiation damage. Site is chosen radioactive buildings and designed according to the standards of engineering and following features are available:

1. That takes into account the safety standards compliant appropriately.
2. Be supported by administrative and organizational attributes relied upon in order to ensure the safety and prevention throughout the life of the Originator.
3. That include adequate safety margins design & Construction as which includes achieving performance, Subject to the quality and the investigation of non-probability accidents and mitigation of their consequences and reduce exposure to them in the future.
4. Factors that affect occupational exposure, including ventilation and away from populated areas.

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The importance of the process of assessing the site reports Geotechnical Engineering
In evaluating or selecting a site, the objective will be to identify those natural and man-made forces that will impact the structure, and then to design a site plan and the structure to avoid or withstand those forces.

It is necessary to start the site evaluation process with research of information available from local building and planning departments, the National Weather Service, Flood, the geological surveys, geology. And a geotechnical engineering with the region and sources of local information. Include, where available, hazard mapping zones of ground faulting, liquefaction, landslides and probabilistic assessments of ground motions.

The geotechnical investigation of the site is a resource to designer and structural engineer in designing and building an earthquake-resistant structure. The recommends that a geotechnical report include the following data:

- Description of the proposed project location, topography, drainage, geology, and proposed grading.
- Site plan indicating locations of all tests.
- Description of the "seismic setting," historic seismicity and location
- Of closest seismic records used in site evaluation.
- Detail (1:24,000) geologic map of the site indicating pertinent
- Geologic features on and adjacent to the site.
- Logs of all subsurface investigations.
- Geologic cross section of the site.
- Laboratory test results indicating pertinent geological data.
- Specific recommendations for site and structural design mitigation
- alternatives necessary to reduce anticipated geologic
- And seismic hazards.

Site Safety
For example: Disaster Risk Reduction in Practice the Architecture of Earthquake Resistant building

- Don't build: on steep/ unstable slopes or lose ground
- On steep/ unstable slopes or lose ground

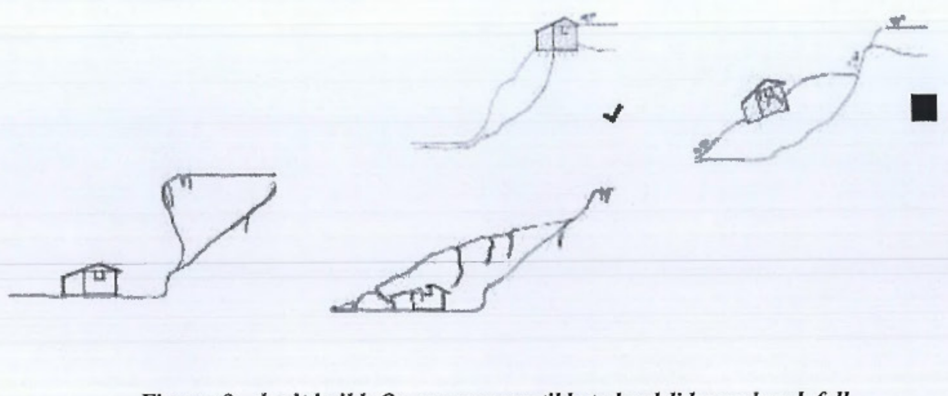
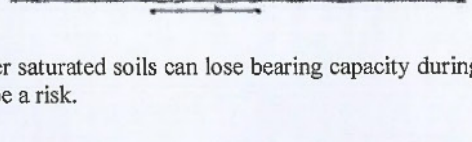


Figure: 2 don't build: On areas susceptible to landslides and rock fall

Do: Place buildings a good distance between each other (at least equal to height of tree or house).



Don't build: Near rivers as water saturated soils can lose bearing capacity during ground shaking (this is termed liquefaction) and flooding can be a risk.

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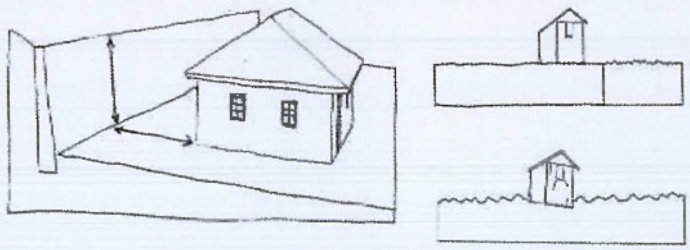


Figure :3 If building near a slope position house a minimum of 4ft from the slope and provide a retaining wall if necessary.

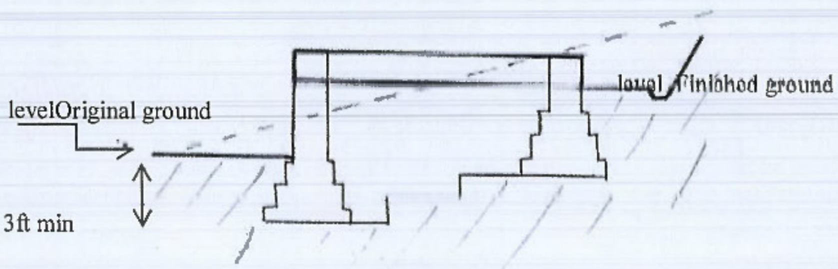
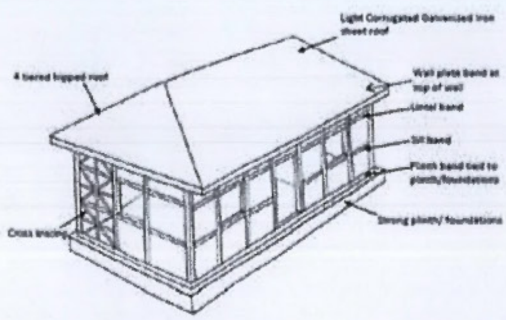


Figure: 4 *If building on a sloping site terrace and level the land prior to beginning house Constructi Floor finish level.*

Specialist studies show that the ability to construct buildings that have both flexibility and cohesion, is one of the most important considerations when designing earthquake resistant structures. A main objective is to provide an effective linking of different parts of a building so as to enable them to work together and avoid the dislocation which causes collapse."



(McDonald, Roxanna, Introduction to Man-made disasters and their effects on buildings, (Oxford: Architectural Press, 2003)

To disaster risk reduction and seismic mitigation for non-engineered structures:
Actions to reduce the risk: Land use planning and appropriate construction.
Risk assessment in development projects and planning

Mitigation Methods
- Effective building codes

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- Checking standards on-site
- Control of land use

PROMOTE...
- Planning control
- Training and education
- Economic assistance
- Subsidies on safety equipment/construction materials

PROVIDE...
- Safer buildings – seismic resistance/ cyclone shelters

Possible Risk Reduction Measures
1. Establish a technical assistance

PROGRAM ....
2. Encourage development on safer sites
3. Basic concepts of construction for seismic resistance (Seismic Mitigation)

Engineering design standard store duce the risk of the site, for example, (the earthquake) Use regular shapes

Regular shapes like square, rectangular and circular resist an earthquake more effectively as compared to irregular shapes. This is because during ground shaking the corner points of irregular shapes concentrate stress and consequently are more easily damaged An essential principle is to use box-type structures. Furthermore all components such as wall, roof and floor should be well tied together to allow the building to act as a unified box.

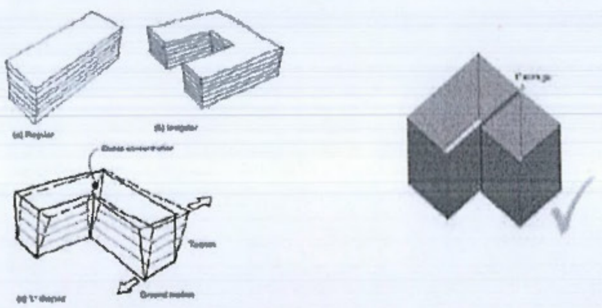

Figure : 5 ***If irregular shapes are required then a seismic separation gap should be made at points to create structurally isolated boxes.***

Door and window openings
1. Keep opening sizes small - 4ft wide maximum (stone walls 3ft wide).
2. Total length of openings should not exceed 50% of the wall length between cross walls.
3. Always provide continuous lintel band and roof band.
4. Best to provide continuous sill band.
5. Distribute openings evenly around all sides of the building.
6. If this is not possible avoid putting all openings on one side only.

Short walls....

If long and narrow buildings are built they should be divided into separate rooms rather than one long room. If this is not possible framing elements should be .Figure: 6

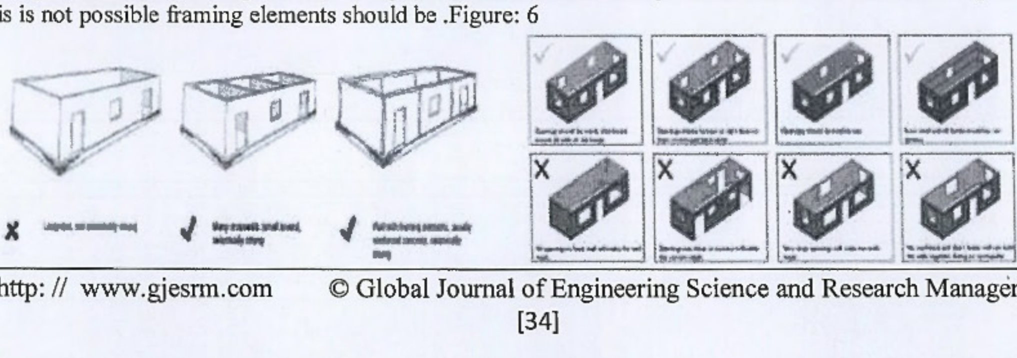

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Figure :6 Door and window openings, and walls

DESIGN: A CASE STUDY AMONG ARCHITECTS

Methodology

The study is based on the data of an empirical research about the architectural consciousness in seismic design. The study conducted qualitative (based on28comments) and quantitative (based on percentages) analyses to test the abovementioned hypotheses. The main concern is to point out the importance of seismic design within architectural community from the perspective of architects, who are experienced in designing.

Form / Geometry

According to Mezzi, Parducci and Verducci (2004), the shape has been recognized as a fundamental parameter in controlling buildings' response to earthquake forces. As Ambrose and Vergun (1985) state, "the form of a building has great deal to do with the determination of the effects of seismic activity on the building" (p.48). For a good seismic performance, regular configuration is obtained by simplicity and symmetry of the building form.

Earthquakes repeatedly demonstrate that the simplest structures have the greatest chance to survive after severe earthquakes. According to Dowrick (1987), there are three main reasons for this:

- The ability to understand the overall behaviour of a simple structure is greater than it is for a complex one. Therefore, unpredictable stress concentration that may cause local collapses and modifications of the dynamic behaviour are avoided (Mezzi, Parducci and Verducci, 2004).
- The ability to understand simple structural details is considerably greater than it is for complicated ones.
- Simple structures are likely to be more buildable than complex ones.

The most appropriate form of a building is a square or a circle from seismic point of view. A regular building form, which is simple and symmetric, proves the same rigidity in all directions. Accordingly, seismic forces acting to the buildings do not vary. In this respect, circle is the most ideal building form. However, generally it is.

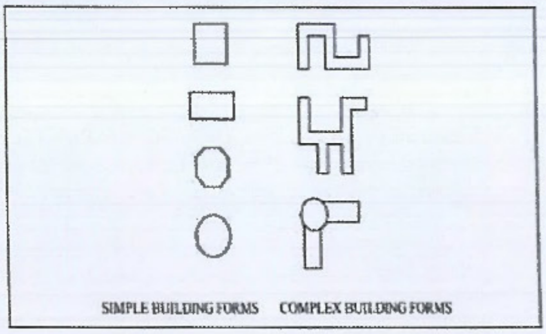

Figure :7 Simple and complex building forms

Not appropriate for analyses, construction, and functional requirements. A rectangular form approaching to a square, which is not so long in plan, is also an appropriate building form in terms of simplicity and symmetry (Figure 1) (Bayülke, 2001).

The shape of the building can become a negative factor as an irregularity in itself. This is mainly because of its effect on the structural system. Irregularities in the structural system are determinant in reducing the seismic performance of buildings. When a complex form is to be designed, the structural cost must be acknowledged. Moreover, appropriate three-dimensional earthquake analyses should be done in the design process (Ambrose and Vergun, 1985; Dowrick, 1987; Mezzi, Parducci and Verducci, 2004).

Symmetry

As Arnold (1989) states, "the term symmetry denotes a geometrical property of building plan configuration" (p.150). It is desirable to have symmetry both in the form of the building as a whole (architectural symmetry) in three direction(Figure 2) and in the disposition of the structural elements of the lateral resistive system (structural

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symmetry). Otherwise, torsional effects are produced leading to destruction of building. The critical concern is the coincidence of the center of building mass (generally considered as the geometrical center of the building) with the center of rigidity (considered as the center of vertical elements of the structural system) (Section 4.2.1.2). When a building is not architecturally symmetrical, the structural system must be adjusted so that the center of rigidity becomes close to the center of the mass (Ambrose and Vergun, 1985).

A building with re-entrant corners (Section 4.1.3) is not necessarily asymmetrical, but it is irregular. Thus, symmetry is not sufficient on its own and it is beneficial only when it is combined with simplicity. When good seismic performance is to be achieved with maximum economy of design and construction, symmetrical and simple forms should be preferred.
However, architectural requirements often make the symmetrical design impossible. In these circumstances, it may be necessary to take precautions (Arnold, 1989).

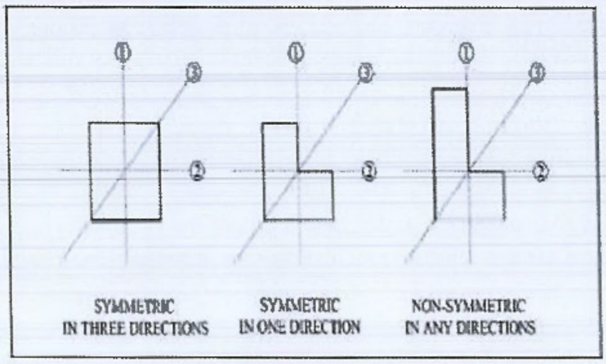

Figure :8 Architectural symmetry

Sometimes, although a building, whose form is a square or a rectangle, is simple and symmetrical in overall plan, torsional forces may be created due to the irregularities inside the building. The irregularities may result from the rigidity differences of diaphragms (Section 4.2.1.3), improper shear wall design or unsymmetrical location of service cores (Bayülke, 2001). *Scale, Size and Proportion.* The length, the height, and the proportions of these two have influences on seismic performance of the building.

Length

Limiting the size of a building in plan and making it compact are important considerations for seismic performance of a building. When a plan becomes extremely large, even if it is symmetrical and simple, it may have problems in responding to the ground movements as one unit (Arnold, 1989). Because, a building with elongated plan is likely to have different ground movements applied along its length. Moreover, a building with a long and an extended form in plan experiences greater variation in soil conditions. This variation may be due to differences in geological conditions (Dowrick, 1987).

When a long building is needed for planning reasons, the solutions are:

- To subdivide the building into separate short lengths and compact forms with movement gaps between them (the use of seismic separation joints) **(Figure :)** (Coburn and Spence, 1992),
- to add lateral force resisting elements (shear walls and columns) in order to reduce the span of the diaphragm **(Section 4.2.1.3),** although this may introduce problems in the use of the building (Arnold, 1989),
- tochose the appropriate types of the foundation **(Section 4.2.2.6)** (Dowrick, 1987).

Height

Although there had been some limitations on building dimensions in earthquake prone zones for the past years, with the introduction of new materials with greater strength, it has been recognized that height is not a negative factor for the seismic response. In fact, a greater height can increase the natural period of the building and shift it in the range where the response is lower (Mezzi, Parducci and Verducci, 2004).

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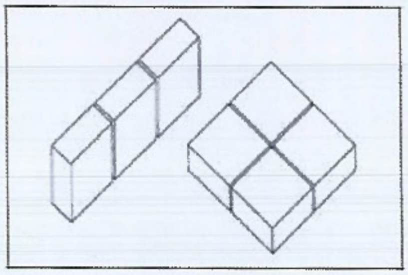
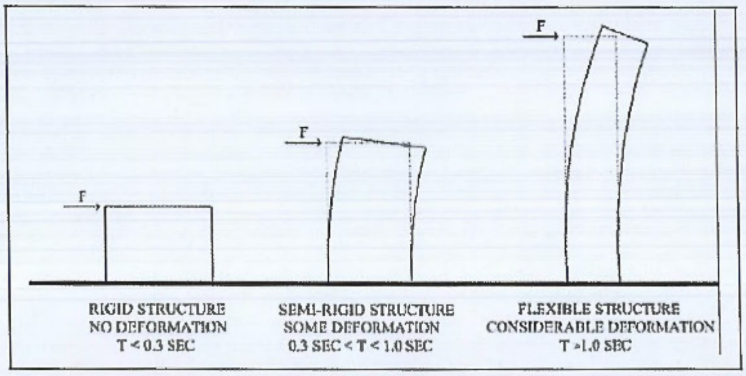


Figure : 9 Subdivision of the building into compact forms

In **Figure**, three different building profiles illustrate different potential responses to earthquake loads with regard to the natural period of vibration and the lateral deflection. In general, as the rigidity increases, the natural period of vibration of a building becomes shorter (Architectural Institute of Japan, 1970). The short and rigid building tends to absorb larger earthquake loads because of its quick response (short natural period of vibration). On the other hand, the tall, slender, and flexible building responds slowly to earthquake loads having long natural period of vibration. It dissipates the seismic energy in its motion. However, much deflection may create deformation problems (Ambrose and Vergun, 1985).



Fuiure : 10 Seismic response of buildings with different heights

As urban land becomes more expensive, there is a trend towards designing very tall buildings, which may have a large slenderness (height / depth) ratio. It is not illogical to build tall buildings on earthquake zones. Because tall buildings generally have complete earthquake analyses and construction processes. Moreover, they tend towards symmetry and simplicity. According to Arnold (1989), the seismic problems are most apparent in the medium height buildings, where considerable choice of plan forms and the multi masses of buildings exist. Yakut, Gülkan, Bakır and Yılmaz (2005) state that half of the buildings, which damaged (light, moderate and severe) and collapsed in the August 17, 1999 Kocaeli Earthquake, were five stories in height. The next largest group is for six-storey buildings comprising 32 % of the total. On the other hand, as the height of the building increases, two important seismic problems come to existence. These are resonance and overturning effect.

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When the natural period of vibration of a building coincides with the natural period of ground, a synchronized resonance between the two occurs **(Figure 11)**. If the 54 building exceeds its elastic range by absorbing the earthquake forces,

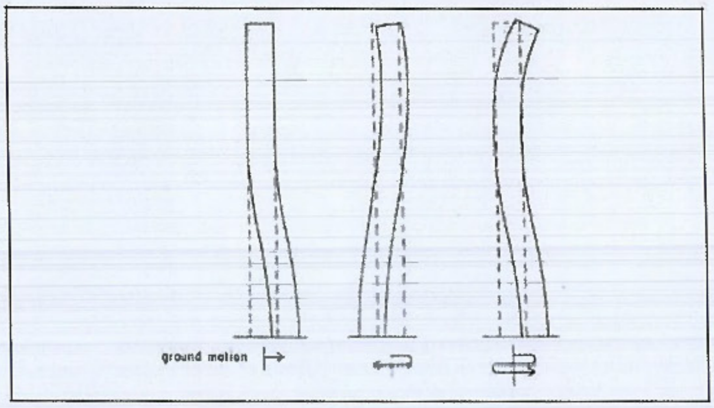

Figure : 11 Resonance in tall buildings (Ambrose and Vergun, 1985, p.23)

It may come to the fracture point resulting in failure or total collapse. So, the effect of the building period must be considered in relation to the period of ground movements. In the design of tall buildings, the architect must realize the importance of the relationship (Lagorio, 1990). It is important to compare the natural periods of vibration of building and ground and to prove the tall building not to suffer from resonance. If they are close to each other, precautions should be taken against earthquake loads by adjusting building configuration and structural configuration. Thus, the natural periods of vibration of the building and the ground become differentiated from each other (Zacek, 1999).

As the overturning effect is related to the vertical form of the building, tall and slender buildings are highly vulnerable to overturning. Overturning results in the building to tip over with or without its foundation **(Figure 6a, Figure 6b)**. There exist techniques in order to resist overturning. According to Ambrose and Vergun (1985), these are:

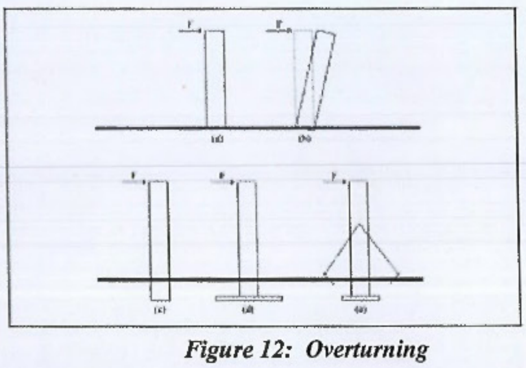

Figure 12: Overturning

- to modify the existence supports **(Figure 4.6c)**,
- to spread the base in order to increase the moment arm for stabilizing moment **(Figure 6d)**,
- to add a separate and an external bracing system **(Figure 6e)**.

Proportion

Arnold (1989) states that in seismic design, the proportions of a building may be more important that its absolute size. For tall buildings, the 'slenderness ratio' (height / depth) of a building is a more considerable issue than just 'height' (Coburn and Spence, 1992). A building with a large slenderness ratio exhibits large lateral displacement under lateral forces. Very slender buildings should be avoided in strong earthquakes zones. Because, the axial-

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column force due to overturning moment in a slender building tends to become very large. Moreover, their foundation stability may be difficult to achieve because of the forces acting on the foundation (Dowrick, 1987; Wakabayashi, 1986). Dowrick (1987) states that the slenderness ratio of a building should not exceed about 3 or 4, otherwise it leads to uneconomical structures and requires dynamic analyses for proper seismic response. On the other hand, Zacek (1999) states that it is recommended not to design a building whose ratio of the sides to one another is greater than 3 **(Figure 13)**.

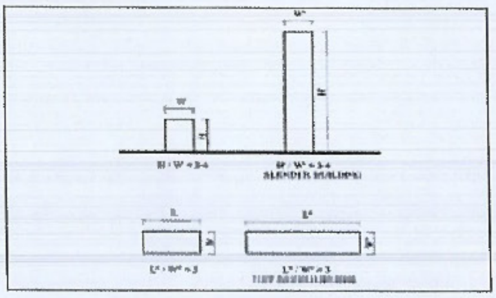

Figure : 13 Proportions

Building with Re-entrant Corners and Multi-massed Buildings

The shape of H, L, T, U, Y, +, or a combination of these forms are the typical examples of building configuration which have projections or wings in plan constituting re-entrant corners **(Figure: 14)**. They are commonly designed for high-density housing and hotel projects as they enable large plan areas in compact forms, which have different vistas and lighting opportunities from different angles (Arnold, 1989).

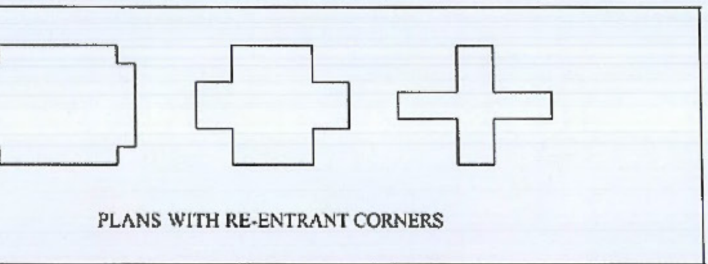

Figure: 14 Re-entrant corners in plan

The 1998 Turkish Earthquake Code states the ratio of the projections to the entire plan, as they are important in terms of seismic behaviour of the building. A3 – Projections in Plan:

The cases where projections beyond the re-entrant corners in both of the two principal directions in plan exceed the total plan dimensions of the building in the respective directions by more than 20%.

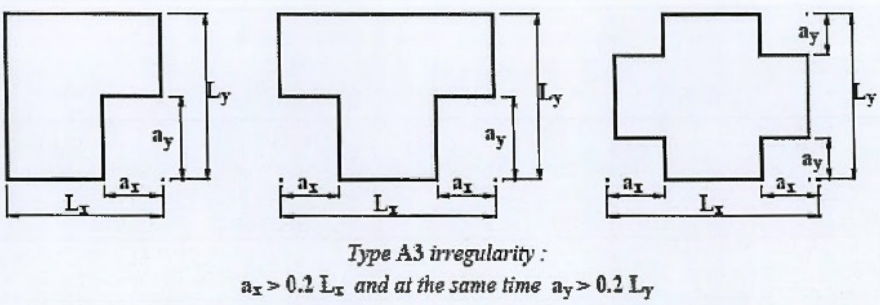

Figure: 15 a Projections in Plan (Turkish Earthquake Code, 1998, p.9)

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According to Arnold (1989), **Figure 9a -9b** the stress concentration at the notch and the torsional effects are interrelated. The magnitude of the forces and the serious of the problem depend on:

- the mass of the building,
- the structural system,
- the length of the wings and their ratios,
- the height of the wing and their slenderness ratios.

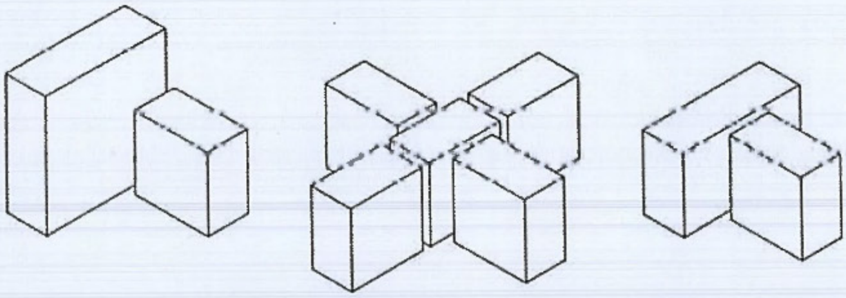

Figure : 16 b Separation of buildings into portions

Sandwich walls, which are designed for heat insulation, are also to be tied to each other with cramps in order to prevent overturning due to seismic forces **(Figure)** (Erman, 2002).

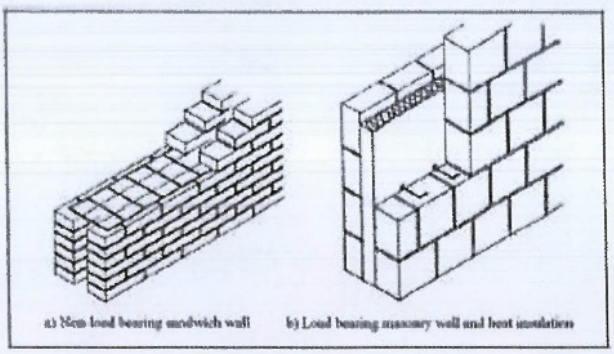

Figure :17 Details for sandwich wall (Erman, 2002, p.83)

Alternatively, they should be specially detailed on any walls subjected to deformations or drifts. Not only stones, but also large size tiles, terra cotta or precast concrete cladding must be sufficiently tied to the wall by means of metal anchors or specially designed fixings, which are fully separated from the horizontal drift movement of the structure (Architectural Institute of Japan, 1970; Dowrick, 1987).

On the other hand, external curtain walls may well be best dealt with as fully framed prefabricated storey-height units mounted on specially designed fixings capable of dealing with seismic movements (Dowrick, 1987) Brittle materials such as tiles, glass, or stone should not be applied directly to the inside of stairwells, escalators, or open wells. If they must be used, they should be mounted on separate stud walls or furrings. Preferably, stairwells should be free of materials, which may fall off and thus block the exit way or cause injury to persons using the area. Moreover, the parts projecting from the wall must be properly protected. The fall of the projecting parts has the danger of injuries on persons.

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RESULTS AND DISCUSSION

CONCLUSION

Egypt is a country may be prone to earthquakes; 'earthquake' is the reality of the geographic structure of the country. In order not to face destructive consequences of earthquakes, buildings must resist earthquake forces and standstill. Accordingly, professionals involved in construction process have their own roles and responsibilities in seismic design Concentrates on the roles and responsibilities of architects, as being the designer of the buildings and the coordinator of the construction process.

Design procedure of building

Architectural planning

- Isolators must support superstructure without losing supporting capacity of vertical loads subjected to fires expected to happen in the vicinity of isolation interface.
- Piping and wiring must have flexible joints and slack between superstructure and substructure, so as to follow the displacement at isolation interface during earthquakes.
- It must be planned that entrances, connecting bridges, stairs, elevators and etc. do not pound to other facilities or injure humans.
- Information panels, which show that the building is seismically isolated and deforms largely during earthquakes, must be set up on noticeable place in the building.

In this research, then, as being one of the ways, for incorporating 'earthquake' as a design parameter, architecture-based issues related to seismic design are investigated and explored for the use of architects.

RECOMMENDATIONS

In terms of the importance of seismic design issues in architectural education, further studies may search for the task of 'earthquake architecture' as being one of the ways of introducing seismic design issues into architectural design courses. Earthquake architecture is an approach to architectural design that draws upon earthquake engineering design issues as a significant source of inspiration (Charleson, Taylor and Preston, 2001). Arnold (1996) describes 'earthquake architecture' as the architectural expression of some aspect of earthquake action or resistance in order to contribute architectural enrichment of buildings. These expressive possibilities range from metaphorical and symbolic uses of seismic issues to the exposure of seismic technology (Charleson, Taylor and Preston, 2001).Charleson (2003) states that earthquake architecture helps bridging the gap between structure courses and architectural design studies and facilitates the integration of the two disciplines.
Not only the architect does, the obligation to coordinate the overall design of the building, but the architect is also responsible for the basic seismic safety of the design.

The architect should guide the other design professionals in the design decisions, rather than simply turning the design over to the project engineers. Since many nonstructural issues involve the intermixing of several engineering professions.

The architect needs to be able to visualize the system, its components, and how they will interact in an earthquake, strong winds, fire, etc. The architect should sit down with the consulting engineers early and often, beginning with a discussion of the earthquake performance objectives for the facility, to permit each of the disciplines to see the potential for interactions between systems and components.

The success of a project in the right team of architects, and geotechnical, civil, and structural engineers. Understanding the seismic hazards in all of their direct and indirect manifestations is critical to success. Good engineering is not an excuse or a remedy for an inadequate evaluation of the site and design that does not mitigate the earthquake risk. As can be seen in the remainder, successful design is a team effort, and starts at the site.

When selecting sites for radioactive buildings must Subject to:

- The main determinants for the site (climatic - geological - population density).
- Choose the best materials used in protective barriers for the different types of radiation.
- And flexibility in future planning and employability stretch.
- Synthesis and find internal movement axes and see trends.

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Radiation safety precautions set design:

- The application of conditions required in the workplace radiation and radioactive materials, in terms of space and ventilation system - the technical state of the roofs - protective armor accounts for each of the ceiling and the floor, walls and openings.

When designing buildings radioactive must Subject to

- The safety factor in the design is through:
- Radioactive sitting of buildings and designed according to the standards of engineering
- Taking into account the standards of nuclear safety that limit or mitigate the effects of radiation accidents.
- Recommendation for architect's engineers:
- Achieve engineering specifications and operating performance and specifications.
- Providing prevention and safety in accordance with the safety standards laid down.
- Design, operation and maintenance to prevent the possibility of occupational exposure to radiation doses.

The target:

1. Minimize radiation damage caused by radioactive facilities and access to appropriate environmental design and its maximum safe.
2. Study of the foundations and architectural design standards for Radiation Facilities research centers that have a special nature.
3. Supply sufficient information for architects engineers to help Subject to the required standards in the design process to those architectural styles of buildings research.

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