

Architecture Detailing based on Compliance to site regulations

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Abstract

Site Planning and building form are very important from the point of view of seismic performance of the structure. Also it is very important to have proper compatibility of elements resisting seismic forces. Site planning and selection of building forms is the first step in designing of any structure and the decisions taken are very crucial for the behavior of those structures during any earthquake. Based on examples taken from various past earthquakes and theories, this project gives guidelines for site planning, selection of building form and formulation of architectural design concepts for earthquake resistant structures in the earthquake prone zones.

1.INTRODUCTION

Compliance to site regulations is very important and has a historical basis. Even Napoleon had imposed regulations for compliance as for loss of serviceability in a construction project within 10 years of construction; say foundation failure or poor workmanship; the contractor and the architect were to be sent to prison. Whether such and other rules from ancient times stopped all failures is not known, but they certainly were a deterrent to shoddy construction practices and eliminated the possibility of repetitive malpractices. Present day law and order demands accountability for professional performance. One must be well aware @ past experience regarding architectural design concepts, from past earthquakes.

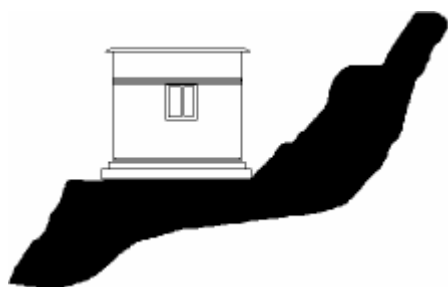
2.SITE SELECTION

The selection of suitable site is a crucial step in the design of a building or planning a settlement in an earthquake prone zone. There are a number of earthquake related hazards which should always be considered when choosing a site, together with the influence of the ground conditions at the site on the ground motion which the building may experience in a future earthquake. An assessment of the extent of the earthquake hazard should always form a part of the overall site assessment and of the specification for the design of any structures to be built there. No site can be expected to be ideal in all respects, so the choice of site will often involve a judgment about relative risks and the costs of designing to protect from them. But there can be some sites

which could be so hazardous that they should be avoided if at all possible, since the cost of building is likely to be prohibitive. A few important considerations for site selection are given below:

Steep Slopes

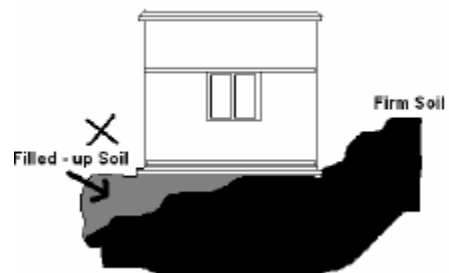
Buildings should be sufficiently away from steep slopes. Sites located on or very close to steep slopes are always prone to landslides, especially in the earthquake prone regions. Even if the building has good earthquake resistant construction, they are prone to damages or total destructions on such sites. Frequent landslides in Uttar kashi region after the October 1991 earthquake caused massive devastations in the region. The periodic landslides are triggered by other aspects like excess rains, seepage etc. The Himalayan regions are particularly prone to landslides. Such landslides often prove to be more disastrous than the actual earthquake event.



Buildings located near steep slopes

Filled Up Soil

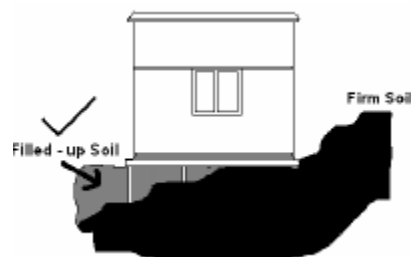
Foundation should rest only on firm soil and not on filled up soil. Such constructions on filled up soils have witnessed extensive damages in the January 2001 Gujarat earthquake.



Buildings located on filled – up soil should be avoided

Raft on Pile Foundations

Many times it is unavoidable to construct the structure on filled up soil, as in most cases choice of site is not the option we have. In such situations raft on pile foundations have to be provided



Buildings located on filled – up soil should be provided with raft on pile foundation

Cut-stone building in Bhuj



historic buildings). By now, over 1000 buildings across the world have been equipped with seismic base isolation. In India, base isolation technique was first demonstrated after the 1993 Killer (Maharashtra) Earthquake [EERI, 1999]. Two single storey buildings (one school building and another shopping complex building) in newly relocated Killer town were built with rubber base isolators resting on hard ground. Both were brick masonry buildings with concrete roof. After the 2001 Bhuj (Gujarat) earthquake, the four-storey Bhuj Hospital building was built with base isolation Technique.

Modern cut-stone masonry building in Mirzapur

Building on flexible supports
shakesLesser

Base Isolation in Real Buildings

Seismic isolation is a relatively recent and evolving technology. It has been in increased use since the 1980s, and has been well evaluated and reviewed internationally. Base isolation has now been used in numerous buildings in countries like Italy, Japan, New Zealand, and USA. Base isolation is also useful for retrofitting important buildings (like hospitals and

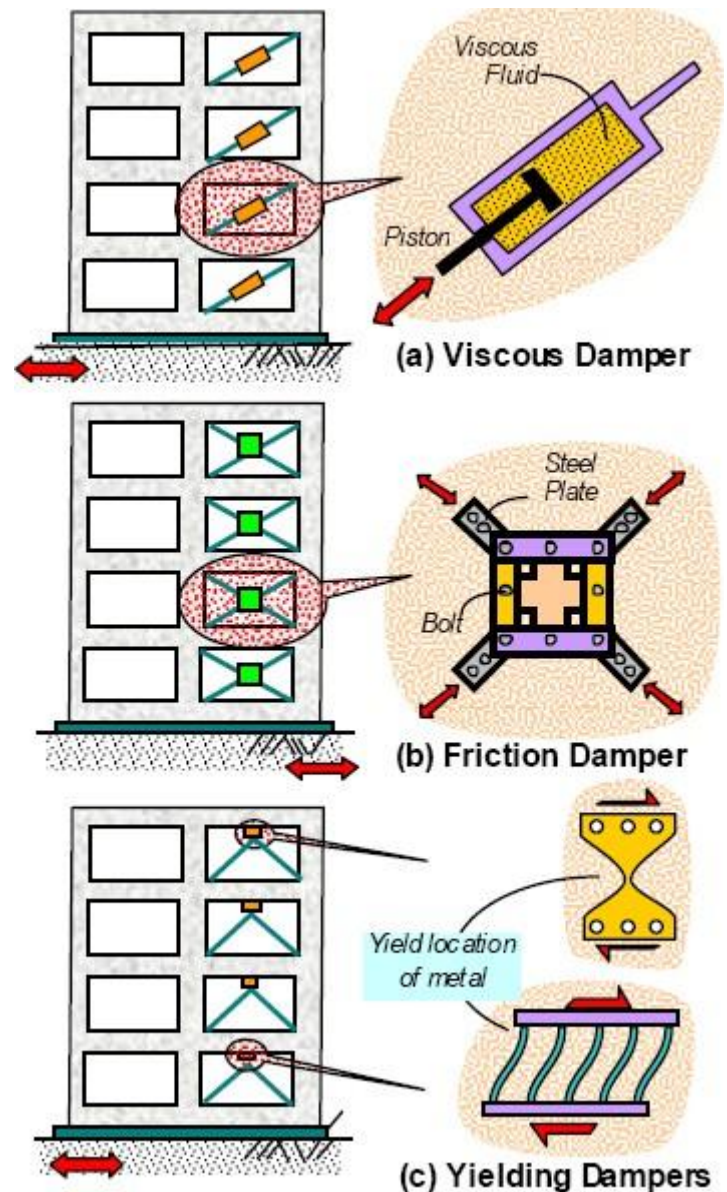


View of Basement in Bhuj Hospital Building

Seismic Dampers

Another approach for controlling seismic damage in buildings and improving their seismic performance is by installing seismic

dampers in place of structural elements, such as diagonal braces. These dampers act like the hydraulic shock absorbers in cars – much of the sudden jerks are absorbed in the hydraulic fluids and only little is transmitted above to the chassis of the car. When seismic energy is transmitted through them, dampers absorb part of it, and thus damp the motion of the building. Dampers were used since 1960s to protect tall buildings against wind effects. However, it was only since 1990s, that they were used to protect buildings against earthquake effects. Commonly used types of seismic dampers include viscous dampers (energy is absorbed by silicone-based fluid passing between piston-cylinder arrangement), friction dampers (energy is absorbed by surfaces with friction between them rubbing against each other), and yielding dampers (energy is absorbed by metallic components that yield). In India, friction dampers have been provided in an 18-storey RC frame structure in Gudgeon



Seismic Energy Dissipation Devices

CONCLUSIONS

The effects of building form and configuration refers not only to the overall building shape but to its design and constructional details also. Study of building performance in the past earthquakes indicates that the performance is quite sensitive to even a small variation in the

overall form. This is particularly true in relation to shear wall design and the location of service core, which acts as a major lateral resistance elements. Many buildings that were symmetrical and simple in overall plan suffered because of unsymmetrical location of service cores and escape staircases. Moreover, as soon as the structure begin to suffer damage (cracking in shear wall or columns) the distribution of its resistant elements change and thus most symmetrical structure becomes dynamically asymmetrical and is subjected to tensional forces. Finally it must be recognized that the architectural requirements will often make asymmetrical design difficult or sometimes impossible. In these circumstances it is necessary, depending upon the size of the building and the type of asymmetry, to subdivide the major masses of the building to improve the seismic performance.

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