Chapter 1

THE PROBLEM, OBJECTIVE AND SCOPE

1.1 THE PROBLEM

Most of the loss of life in past earthquakes has occurred due to the collapse of buildings, constructed in traditional materials like stone, brick, adobe and wood, which were not particularly engineered to be earthquake resistant. In view of the continued use of such buildings in most countries of the world, it is essential to introduce earthquake resistance features in their construction.

1.2 SOCIO-ECONOMIC CONSIDERATIONS IN SEISMIC SAFETY OF BUILDINGS

From the results of studies on the performance of buildings during past earthquakes, it appears that

(i) certain building types should entirely be ruled out in seismic zones having probable seismic intensity of VIII or more on Modified Mercalli or the MSK Intensity Scales. This would include earthen houses, random rubble masonry as well as brickwork in clay mud mortar, and the like;

(ii) rich mortars involving cement and lime should be used in fired brick and coursed stone masonry; and

(iii) substantial steel reinforcement should be introduced in the walls in both directions of the building.

But there are a number of socio-economic constraints such as the following which do not permit the adoption of high level of safety in the buildings for the masses:

(i) lack of concern about seismic safety due to infrequent occurrence of earthquakes;

(ii) lack of awareness that buildings could be made earthquake resistant at small additional cost only, hence lack of motivation;

(iii) lack of financial resources for additional inputs for meeting earthquake resistance requirements in building construction;

(iv) other normal priorities on financial inputs in the daily life of the people;

(v) scarcity of cement, steel as well as timber in the developing countries in general; and

(vi) lack of skill in aseismic design and construction techniques and unorganised nature of the building sector.

Such considerations therefore compel the continued use of seismically unsuitable construction practices.

While theoretically, if appropriate resources and building materials are made available, it may be possible to construct buildings which can withstand the effects of earthquake without any appreciable damage, but practically it is not feasible to do so due to very high costs involved. From the safety view point, the safety of human lives is the primary concern and the functioning of the buildings has lower priority except the buildings required for community activities such as schools, assembly halls, places of worship, and cinema halls, etc., and those required for the emergency, such as, buildings for hospital, operation theatre, telephone and telegraph, fire fighting and the like. The safety aims would therefore be met, if a building is designed and constructed in such a way that even in the event of the probable maximum earthquake intensity in the region,

(i) an ordinary building should not suffer total or partial collapse,

(ii) it should not suffer such irreparable damage which would require demolishing and rebuilding

(iii) it may sustain such damage which could be repaired quickly and the building put back to its usual functioning; and

(iv) the damage to an important building should even be less so that the functioning of the activities during post-emergency period may continue unhampered and the community buildings may be used as temporary shelters for the adversely affected people.

The present state of research indicates that fortunately the above structural safety can be achieved by adopting appropriate design and construction details involving only small extra expenditure which should be within the economic means of people in most countries.

1.3 OBJECT AND SCOPE

The object of this book is to deal with the basic concepts involved in achieving appropriate earthquake resistance of such buildings as stated above, which may be collectively called as Non-Engineered Buildings; to include suitable illustrations to explain the important points, and to present such data which could be used to proportion the critical strengthening elements. The term non-engineered building may only be vaguely defined as buildings which are spontaneously and informally constructed in the traditional manner without intervention by qualified architects and engineers in their design but may follow a set of recommendations derived from observed behaviour of such buildings during past earthquakes and trained engineering judgement. Specifically such buildings will include load bearing masonry wall buildings, stud-wall and brick-nogged constructions in wood, and composite constructions using combinations of load bearing walls and piers in masonry, reinforced concrete, steel or wood, and the like.

Reinforced masonry, reinforced concrete or steel frame buildings, tall buildings using various types of structural systems, and major industrial buildings, etc., are excluded from consideration although some of the principles stated herein will apply to these constructions with equal force.

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