These columns of ICJ offer an opportunity to the engineering fraternity to express their views on the current practices in design, construction and management being followed in the industry.

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Earthquakes are repeating and structures are collapsing (but who cares ?)

A M Ranade

On the day of 26th January 2001, a killer earthquake of the magnitude of 6.9 on the Richter scale rocked Gujarat, resulting in tremendous loss of human life and property worth crores of rupees especially in Ahmedabad. If we see pictures of the devastation we will notice that the major loss of human life is due to the collapse of multi-storeyed buildings. Several questions strike our mind immediately. Who is responsible for this widespread loss of life and property? Who have built these buildings, which have come down like a pack of cards? Who were the planners, designers and builders of these structures? The answer is "human being" only. That is why it is said that earthquakes do not kill people but badly designed and constructed buildings do!

Fortunately, there is sufficient study and research work in earthquake engineering dealing with the effects of earthquakes on the behaviour of the structures — small or high-rise. We have the map of earthquake zones. We have various Indian standard codes that lay down the different rules which apply to number of material items and building activities including the guidelines and precautionary measures to be taken while designing and building structures in earthquake-prone zones. In addition, there is the National Building Code, which governs the planning activities and building bye-laws of various types of structures.

An urgent will to abide by all these rules and regulations already laid down, whether they are mandatory or not, is lacking. The IS codes are being revised from time to time to match recent research carried out in various fields. There may be some lacunae or shortfalls in the framing of IS 456 or other earthquake codes. However, this does not mean that the codes should not be followed.

It can be said that IS codes are binding thread to control the various building activities throughout the country, which can help to build reasonably safe and good quality structures. The only drawback is that the provisions of IS codes are not made mandatory, with the result that proper implementation of the provisions of IS codes is just not possible. Hence, many structural engineers do not follow the provisions of these codes for reasons best known to them. It is also noticed that structural designers follow the IS codes for government jobs only and they do not follow this code for the building design works in the private sector. Why is this so? Why have the IS code provisions not been made mandatory is a big question.

It has now been shown, without any doubt, that the all-round collapse of many multi-storeyed buildings in the recent earthquake is entirely due to not following the provisions of the IS 456 besides other codes pertaining to earthquake-resisting structures. All the experts in earthquake engineering have opined that if codal provisions for earthquake resistance would have been followed by the concerned design engineers, then the death toll and loss of property would have been minimised to a great extent. Does no one care for these mishaps? Do design engineers not realise the gravity of the results of noncompliance on their part? Are we going to allow this to happen again and again?

About two years ago I wrote in these columns bearing the title "Safe Construction - Responsibilities and Public Awareness" (December 1998 issue of *The Indian Concrete Journal*) The main points dealt with therein included.

- Necessity of quality control
- ISO 9000
- Structural design checks
- Responsibility of municipal corporations
- Responsibility of housing finance institutions
- Responsibility of structural/RC consultants

A. M. Ranade, Consulting Engineer, Nayana, 63, Ideal Colony, Kothrud, Pune 411 029

- Responsibility of the architect/end user/owner
- Responsibility of the builder/promoter
- Safety in housing constructions, - during construction stage
- Safety in housing construction—post construction stage

Copies of the write-up were sent to the various municipal corporations, housing finance institutions, etc, who were directly or indirectly related to the construction activities in order to bring to their notice the bad quality construction works prevalent without any proper check of structural designs or quality control from anybody.

I feel that both the central and state governments should take some positive and harsh measures for enactment of certain laws pertaining to the building activities. Some of the suggestions, which I would like to make, are as follows:

For new construction

(*i*) Immediate steps to be taken for the enactment of a central "Engineers Act", and necessary revisions in the present "Architects Act" in relation to the present situation caused by the Gujarat earthquake.

(*ii*) Compliance with all relevant IS codes in connection with the construction of any type of building/structure should be made mandatory for all construction in government, semi-government or private sector.

(*iii*) Before the enactment, immediately issue an ordinance to abide by provisions of the relevant IS codes for all building activity.

(*iv*) National Building code should be made applicable throughout the country so that there will be uniformity in building construction activity. If any changes are required in the code based on the various problems which have now cropped up, they should be implemented.

(*v*) A provision should be made for compulsory registration of builders/promoters/structural engineers/building supervisors at the level of central/state governments, all municipal corporations, public sector undertakings, cooperative institutions, jilla parishads, etc.

(*vi*) *Gram panchayats* should not be given any right to give approval to any building plans in their jurisdiction. It should be done at collector's level. A necessary sanctioning authority with required technical manpower should be created at that level.

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(*vii*) Ownership flat acts should also be revised to incorporate certain restrictive provisions in connection with building activity.

(*viii*) A design check bureau consisting of experienced and competent structural design engineers at central and state levels should be set up to cross-check the structural designs of very important structures such as hospitals, bridges, city water supply schemes, power plants, very high rise buildings, cinema halls, public gathering halls, community centres, shopping complexes, etc. These checks should be made compulsory for such structures.

(*ix*) Construction of high-rise buildings should only be allowed at certain zones taking precautions such as sufficient side margins on all sides, etc. A separate code should be prepared for such type of building construction works with strict design and quality control checks.

(*x*) Responsibility of the various agencies such as town-planners, architects, structural designers, building site-engineers, builders, concerned local authority, employees, etc should be defined.

(*xi*) Creation of independent inspection and quality control authority at each local body level to exercise the required check on private and other institutional building construction works where there is no in–house facility of such type.

For old, existing and under-construction buildings

(i) Collect the complete data of all the existing high-rise and important public building specially those having parking and more than four/five upper floors, which have not been designed as earthquake resistant buildings.

(*ii*) Collect data of those buildings which have been provided with floating columns and very long cantilever beam projections, whose terraces are heavily loaded and which do not have sufficient side margin or open spaces in relation to their heights so that in case of collapse these building will not damage the adjacent building.

(*iii*) Collect the soil investigation and foundation data on which these buildings are standing.

(*iv*) Collect the data with respect to the present general condition of the various members such as slabs, beams, columns and toilet conditions, etc, and their age of construction.

(*v*) Collect the complete data of these building such as name of owner, architect, structural designer, builder, building plans, copies of structural design plans including design calculations, if any, whether structures are regular or unauthorised, number of occupants, etc.

(vi) After all the data is collected, a high level expert committee should analyse the data and suggest remedial measures, which need to be carried out.

I appreciate that this task is a laborious one, which will take lot of time and expenditure. However, if we look to the tremendous expenditure now being involved for the rehabilitation work, loss of manpower and energy it is a worth while to make this exercise now rather than to wait and witness the loss of human life afterwards!

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