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Lessons from the recent earthquake

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The effects of the recent earthquake in Gujarat should be taken positively and we should learn the lessons from it for the benefit of the society and for a safe future. We hold "authorities" (like urban development authority, municipal corporations) responsible for overall development of the area, "planners and architects" responsible for the development of the project, "builders and contractors" responsible for construction at site, "structural engineers" responsible for safe, economical and efficient structure, "site engineers / supervisors" responsible for execution and quality control at site, and "occupants" the end users.

Lessons for authority

- (i) Set up a continuous mechanism for modifications of bylaws from past experiences.
- (ii) Regulate the construction activity and illegal construction.
- (iii) Strictly implement rules and regulations.
- (iv) Advisory board consisting of experts of different field related to construction activity should be formed.
- (v) Only certified agencies (for construction-related activities) should be allowed for construction and their performance should be evaluated regularly.
- (vi) Provide transparent, unbiased, speedy and efficient administration to the local people.

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- (vii) For all important buildings proof checking of design and drawings should be imposed.
- (viii) Disaster preparedness/ management should be developed.
- (ix) In-house expertise should be developed for managing unforeseen calamity.
- (x) Regular interaction with technical institutions and professional should be maintained.
- (xi) Employees (of local authority) at all stages must be given time-bound assignments with responsibilities.
- (xii) The authorities should develop a good cadre of engineers who are technically competent. For this, they should be constantly trained and provided with good career and other opportunities so that good engineers will be willing to have a career with the local authorities.
- (xiii) The local authority's engineers should be competent enough to check structural design including earthquake provisions.
- (xiv) Quality assurance during construction should be made mandatory including testing, etc.
- (xv) Building use permission should be granted after thorough checking of all aspects of buildings.
- (xvi) Proper documentation about all construction projects of the area should be maintained.
- (xvii) Coordination with other agencies like electricity board, water supply and

drainage department should be maintained for providing better facilities to residents.

Lessons for planners and architects

- (i) Avoid excessive asymmetry in building plan. Irregular shapes should be avoided.
- (ii) Large projection from main load bearing structural element should be avoided.
- (iii) Sudden change in elevation as well as cross sectional area or stiffness should be avoided.
- (iv) Understand structural behaviour and maintain continuity in structural elements.
- (v) Structural engineers should be involved in the early stages of conceptualisation of the building and before fixing the load transfer schemes.
- (vi) Provide lateral load bearing elements like walls and bracing at appropriate position.
- (vii) Proper planning of staircases, communication and emergence escape routes should be done. Staircases should be structurally detached from the main building.
- (viii) Avoid large mass concentration at height in form of large water tanks, swimming pools, pent house, etc.
- (ix) Strictly follow the bye-laws imposed by authorities and manipulation in bye-laws should be avoided.
- (x) Orientation and shape of column should be provided as per the

recommendation of a structural engineer and floating columns should be avoided.

- (xi) Provide proper construction joints and separation joints.
- (xii) Plinth beams to tie the columns in both the direction at right angles must be planned.

Lessons for structural engineers

- (i) Strictly follow the codes of practice and ethics. Use three-dimensional analysis considering all types of loads and their worst combinations.
- (ii) Ductile detailing must be followed.
- (iii) Interaction with architects during the early stages of planning is essential for proper planning of structural elements.
- (iv) Structural stability and performance should not be compromised with economy and aesthetics.
- (v) Interaction with professional and academic institutes should be maintained for recent developments.
- (vi) Full documentation including calculations, drawings, etc, must be maintained.
- (vii) Fully and minutely-detailed drawings should be prepared.
- (viii) Insist on soil investigation, frequent testing of cement, concrete, steel reinforcement, etc.
- (ix) Checking of reinforcement as per detailing/drawing prior to concreting should be done.
- (x) Insist on quality control and site supervision by experienced technical personnel.
- (xi) Emphasise on weigh batching and controlled machine mixing of concrete.
- (xii) Use of vibrators at least in foundation, columns and beams to be emphasised.

Lessons for builders and contractors

- (i) Construction work should be started only after clearance from all agencies/authorities and completion of all architectural and structural and other drawings.
- (ii) Soil investigation should be carried out through reputed agencies.

(iii) Material testing should be carried out through certified laboratories at frequent intervals as directed by the quality control consultant/ structural engineer.

- (iv) Strict quality control at site must be maintained through experienced professional engineers.
- (v) All construction should be carried out strictly as per drawings. No modifications should be made without consulting the architect and structural engineer.
- (vi) Regular meetings at site with all agencies must be organised and their comments should be taken care of with proper documentation
- (vii) Strictly follow the rules and regulations imposed by the authorities from time to time and do not try to influence any agency for short term gains.
- (viii) All documents including structural calculations and drawings should be maintained and preserved. After the construction, there should be handed over to the owners/co-operative societies.
- (ix) All information and documents should be made available to the users.

Lessons for site engineers/supervisors

- (i) Study all the structural, architectural, plumbing, electrical, etc, drawings critically before starting construction and any discrepancy or conflicts found in drawings should be brought to the notice.
- (ii) They should familiarise themselves with the various codal provisions including the earthquake codes and ductile detailing requirements.
- (iii) Proper planning and management of resources and material at the site is imperative.
- (iv) During excavation if any weak or unusual strata is found, the same should be brought to the notice of the structural engineer.
- (v) Shuttering of the concrete work should be maintained and used properly.
- (vi) Concreting should be done with proper control over mixing, transporting, placing, curing, etc.

(vii) Due provision should be made for plumbing and other mechanical, electrical items during construction.

- (viii) Strictly follow the structural drawing and in case of doubt in reinforcement detailing, the structural engineer should be consulted.
- (ix) Lapping of the bars in beam and column should be done properly (as per the codes).
- (x) Quality control over materials used in construction, concreting and workmanship should be exercised with laboratory tests and in-situ testing, if necessary.
- (xi) Construction joints should be properly planned (preferably after discussion with the structural engineer) and due provision should be made for it.
- (xii) The structural engineer and architect should be informed about the progress of construction on the site.

Lessons for occupants/tenants

- (i) Always check whether the construction has been sanctioned by the authorities.
- (ii) Ask for all documents including the architectural, structural and other drawings. When the property is sold or purchased, along with other documents it must contain structural plan, drawings and detailing also.
- (iii) Before purchasing/occupying the property ensure that reputed architects/structural engineers were involved in construction and that proper quality controls have been taken.
- (iv) Do not compromise safety with economy.
- (v) Be aware of construction practices, rules and regulations prevailing.
- (vi) In case of any irregularity found in building activity, the same should be brought to the notice of the authority.
- (vii) Maintain building properly.
- (viii) For any change in building use or plan, consult architect and structural engineer.
- (ix) Prepare for any emergency during natural calamity.

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