Human Development as Important catalyst in understanding Bye-laws and Codes for Earthquake Risk Management

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"Risk of disaster is all about where people have chosen to live and how densely they have packed themselves together"

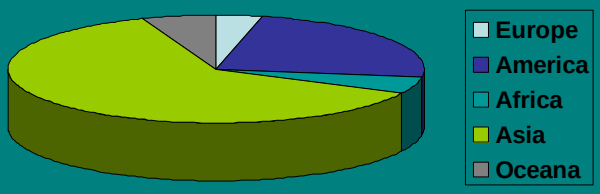
- Ernest Zebrowski

Population Density

Bangladesh	824 people/sq km
India	270 people/sq km
USA	27 people/sq km
World	37 people/sq km

Earthquakes and Tsunami Related Disasters in the world

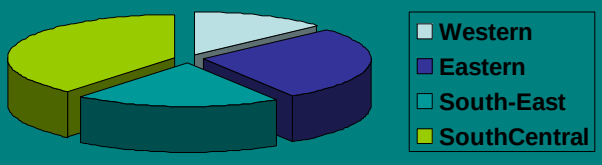
1974-2003 (30 years)



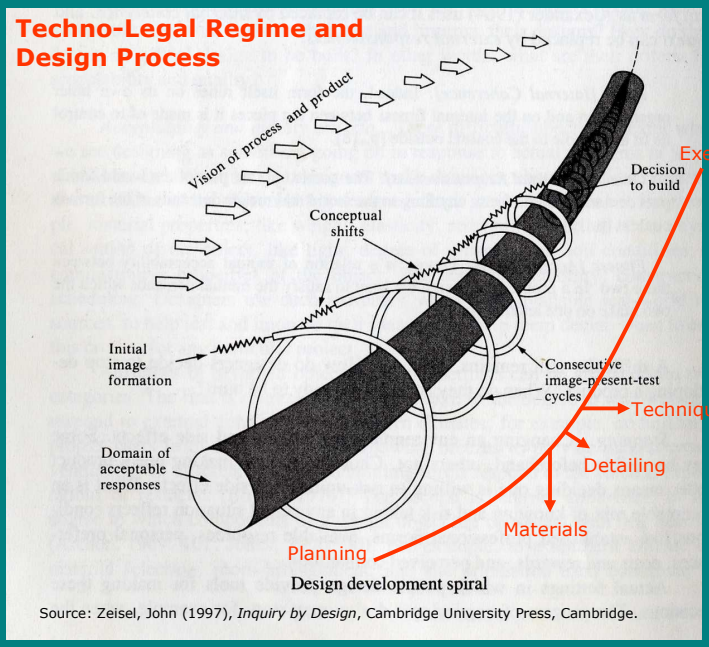
World	644
Asia	356

Earthquake and Tsunami Related Disasters in South Asia

1974-2003 (30 years)



Techno-Legal Regime and Design Process

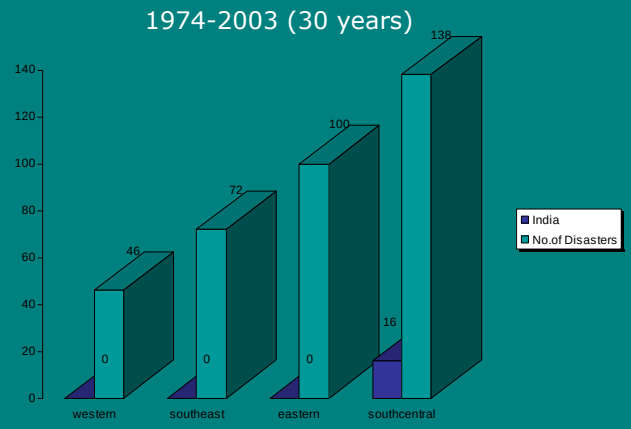


Source: Zeisel, John (1997), *Inquiry by Design*, Cambridge University Press, Cambridge.

Earthquake and Tsunami Related Disasters in South Asia

1974-2003 (30 years)

Earthquake and Tsunami Related Disasters in South Asia



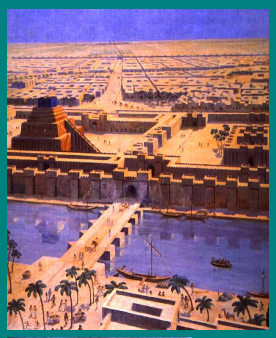
Significant Earthquakes

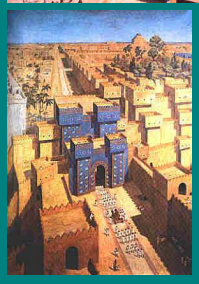
Year	Place	Casualties
1737, Oct 11	Calcutta	300,000
1819, June 18	Cutch	1,543
1897, June 12	Assam	1,542
1935, May 31	Quetta	60,000
1950, Aug 15	Assam	1,500

Biggest ever earthquake recorded:

1556, June 24	Shensi, China	830,000

Earliest Techno-legal Regime Evidence



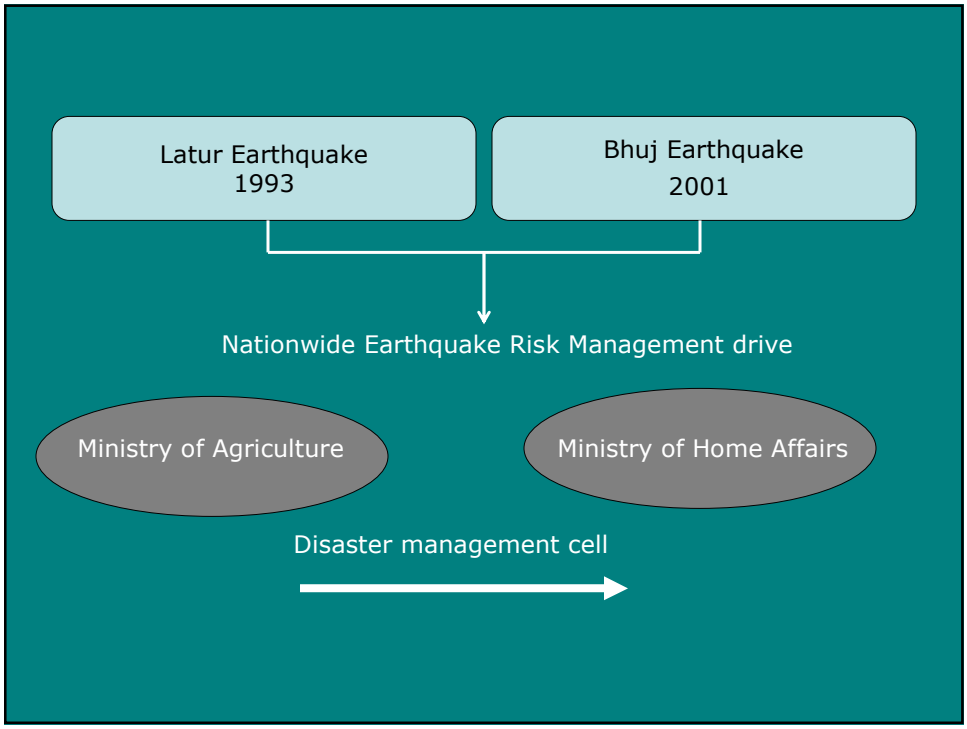


- 2000 BC Hamurabi in Babylon had formed building byelaws
- If house collapsed and owner died, the builder of the house met with the same fate.
- The essence was to ensure quality and safety.

Why techno-legal considerations take a back seat?

"Natural disasters are hypothetical matters; there are always more immediate, pressing demands"

-Bruce clary,1935.



Key players in structural Safety

- Structural Engineer –Fundamental responsibility
- Architect – Important role

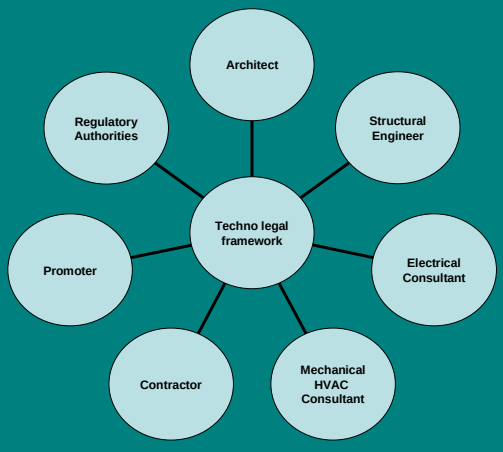
- Concept + Earthquake risk consideration = Robust proposal for structural engineer to work on

Factors to reduce vulnerability

(Building performance during Earthquake)

- Site organization
- Building shape geometry
- Configuration
- Structural system
- Services layout
- Detailing
- Consideration of non-structural elements

Techno-legal Regime



Latur Earthquake

- September 30, 1993 M 6.4
- Dead:<8000 Injured<160,000
- Complete collapse:53,000
- Damage: 181,000

Readymade housing units given to victims resulting in no sense of belonging.

Facilities should be well distributed than concentrated in a town.

Bhuj Earthquake

- January 26, 2001 M 6.9
- Dead :<13,000 injured:<167,000
- Collapsed: 370,000
- Damaged: 930,000

- Less or no consideration for seismic forces
- Simple text-book construction detailing followed sincerely could be a good savior.

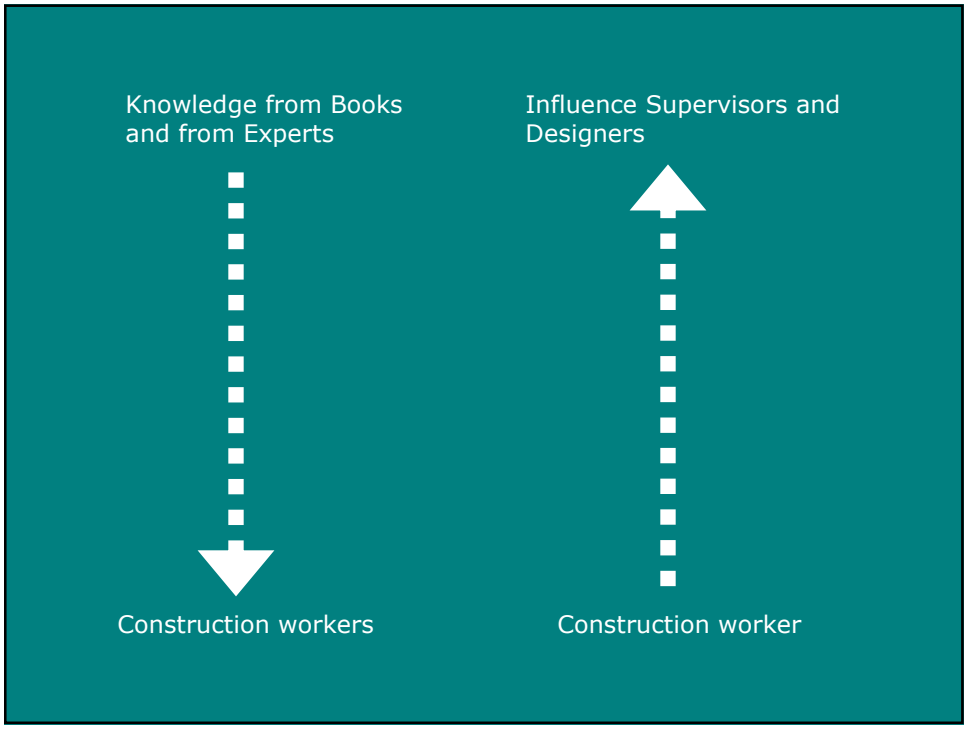
A Point to remember…

"The death toll from an earthquake has more to do with the type of building construction than with the intensity of the earthquake"

- Ernest Zebrowski, 1997

- " Though Bureau of Indian standards (BIS) has laid down the national standards for construction in seismically vulnerable areas, they are not mandatory in nature".
- " In many States, building byelaws are non-existent, and even in States where there are byelaws, which have considerations for seismic safety, the enforcement mechanisms leave a lot to be desired"

- MHA,2004 P3

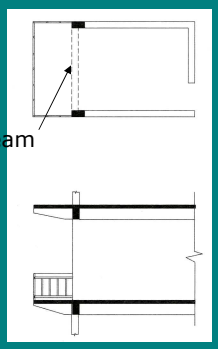


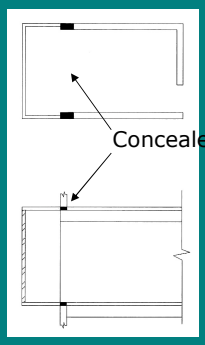
Logic of Experimental Theory

- The IS:456,2000 code states, "whilst the common methods of design and construction have been covered in this code, special systems of design and construction of any plain or reinforced concrete structure not covered in this code may be permitted on production of satisfactory evidence regarding their adequacy and safety by analysis or test or both"

-IS 456, 2000 p2

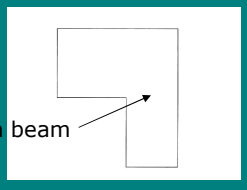
Hidden Beam concept 1

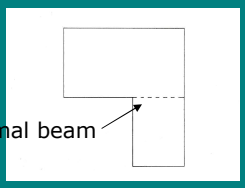




Hidden beam between balcony and room is very common to facilitate easy inclusion of balcony into room space later.

Hidden beam concept 2

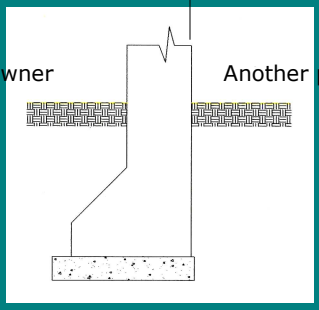




Hidden beam is provided between living and dining spaces right angle to each other. This gives a neat and level ceiling surface that is good for the look.

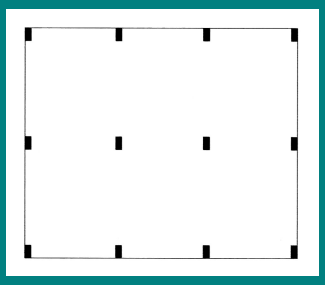
Structurally it creates a spanning problem, as spans for structural support are at right angle to each other. This means one slab structurally rests over the other.

Shoe footing concept

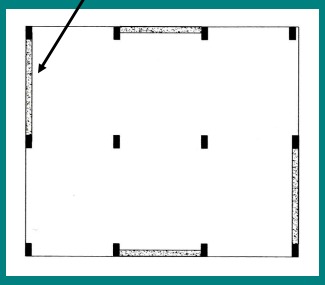


Shoe footing is important only in those unique situations in which built up space starts from the p lot boundary. In every urban city there are hundreds of such examples, making it a norm than exception.

Soft storey concept

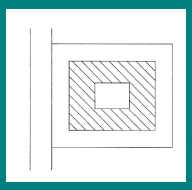


Normal Parking Level

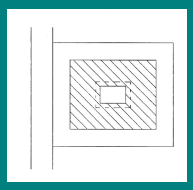


Parking level storey strengthened

Tricks to increase saleable area



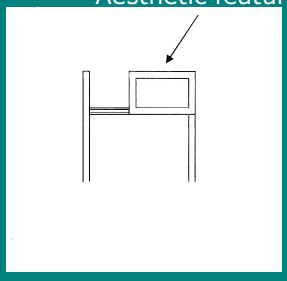
Plan as submitted



Plan as executed

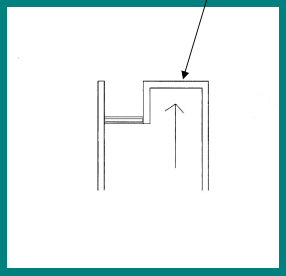
Tricks to increase saleable area

Aesthetic feature

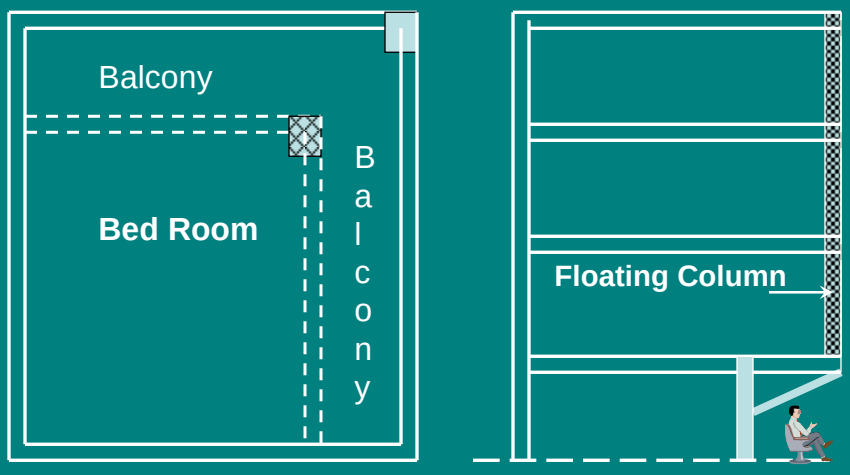


As submitted for approval

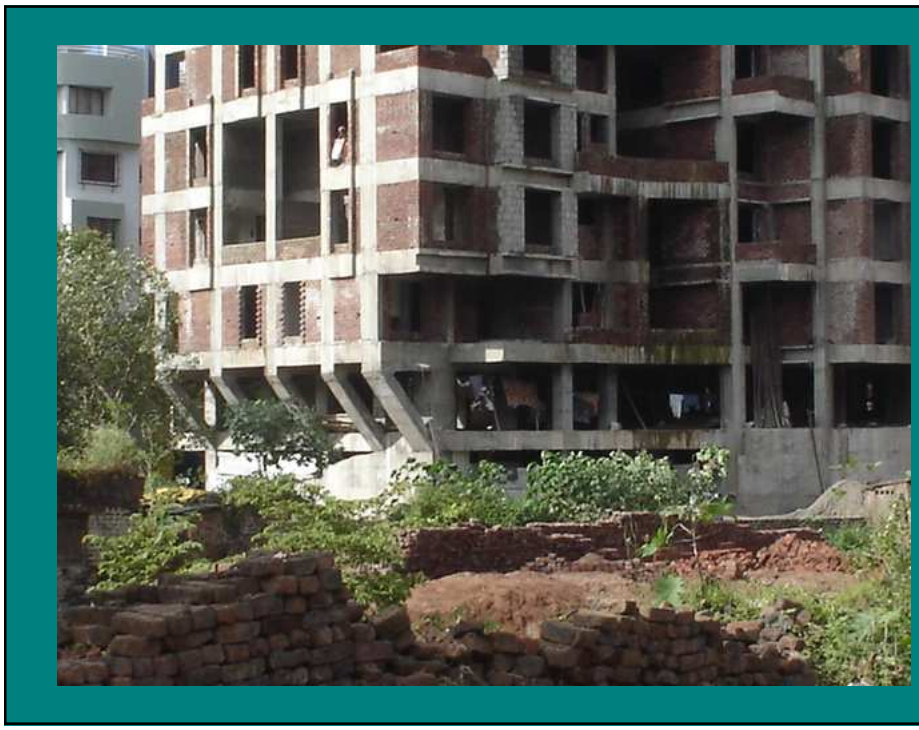
Opened up from inside to include into built up area



As executed on site



Floating Column Concept to add balcony to the room



Inferences

- Traditional practices can be effectively used to reduce vulnerability. these can be given place in codes and bylaws
- Interpretation of bylaws is highly infused by the economics of builder
- Fancy design concepts do not have consideration of vulnerability reduction
- Professionals need to think beyond ”fee” and consider vulnerability reduction as society’s call to them.

Recommendations

- All relevant code provision should be integrated with bylaws.
- Structural drawings and its review should be mandatory requirement along with submission of plan for approval of the authority.
- The regulatory authority should have qualified architects and engineers with professional affiliation for consideration of plan approvals
- It is recommended that the regulatory authority should commence on-line submission method and single window clearance of plan sanction, electrical, water supply and drainage connection approvals.
- Immediate and serious capacity building programs should be undertaken for engineers, architects and for all other levels of manpower in building industry.

"And some day this new knowledge, albeit still imperfect, will filter into the arena of public policy making, where it will result in improved codes and disaster plans that will save the lives of many who have not yet arrived on our planet"

- Ernest Zebrowski, 1997 p50

Thank you !

Authors are grateful to Shri. Ravi Ranade, Consulting Structural Engineer, Pune for his invaluable suggestions.