united nations
educational, scientific
and cultural
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international atomic
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the
abdus salam
international centre for theoretical physics

40th anniversary 1964 2004

H4.SMR/1586-16

"7th Workshop on Three-Dimensional Modelling
of Seismic Waves Generation and their Propagation"

25 October - 5 November 2004

Towards a Dialogue between the Seismologist and Earthquake Engineer

Part 1: Seismic Risk

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Tehran, Iran

Toward a Dialogue Between Seismologist and Earthquake Engineers

Part 1: Seismic Risk

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The Abdus Salam International Center for Theoretical Physics
7th Workshop on Three-Dimensional Modeling of Seismic Waves Generation, Propagation and Their Inversion

25 October – 5 November 2004
Trieste-Italy

Statement of the Seismic Risk Problem

✓Problem or Facts: High Seismic Risk in Most Part of the world

✓Challenge : Earthquake Risk Reduction and Control with the Objective of Saving Human Life and Resources

✓Role of Scientists: To Develop an Effective and Comprehensive Program for Risk Reduction, Reliable Assessment of Hazard, Provide Required Know-How and Provide Doable and Effective Solution

✓Role of People, Engineers and Decision Makers : To Implement the Know-How

The Effective Solution Requires Joint Effort

Joint Efforts Require Good Program and Management

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Seismic Risk

NATURAL DISASTER *is the consequences of the impact of a natural hazard on a socio-economic system with a given level of vulnerability which prevents the affected society from coping adequately with this impact (ISDR).*

Seismic Hazard: The effect of an Earthquake with the potential to lead to adverse Consequence.

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Seismic Risk

The Seismic Risk is the probability of consequences due to occurrence of an earthquake. The evaluation of a risk includes hazard assessment, vulnerability assessment and impact prediction taking into account thresholds that define acceptable risk for a given society.

Expected Consequences are: Losses of lives, Injury, Health, Physical damage, Environment, Property, Disruption of economic activity due to earthquake for a given area and reference period.

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Examples of Seismic Risk:

1. Probability of Life Loss and Injury
2. Probability of Structural Damage
3. Probability of Lifeline Failure and its Secondary Effect
4. Probability of Business Interruption Losses
5. Probability of Socio-economic Losses
6. etc.

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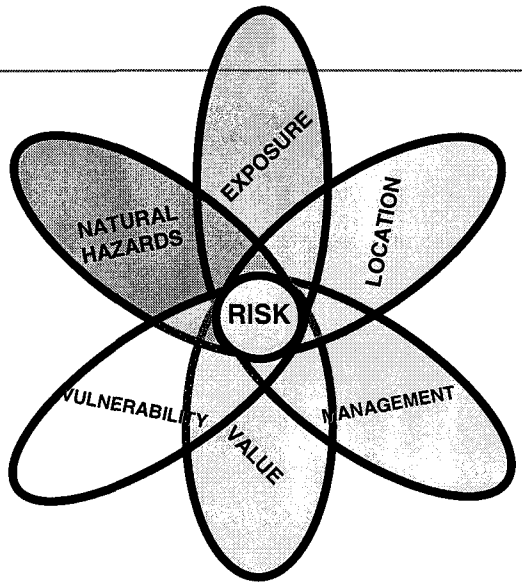
ELEMENTS OF RISK



Ref. Walter Hays

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Seismic Risk

$$\text{SEISMIC RISK} = \frac{\text{Seismic Hazard} \times \text{Vulnerability} \times \text{Value}}{\text{Management}}$$

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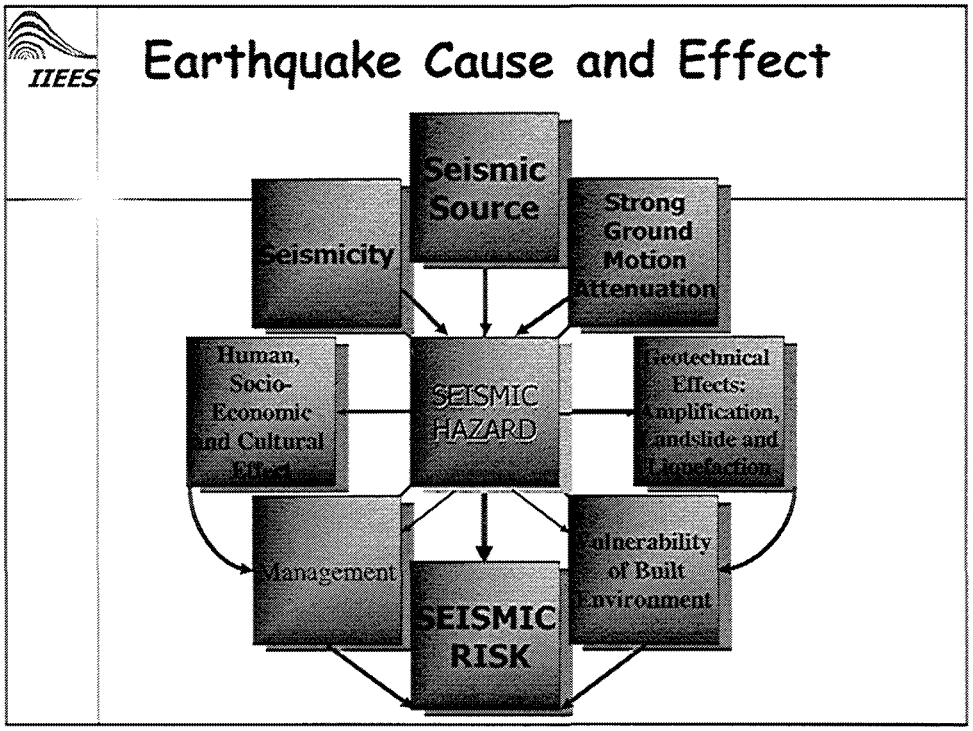
AIM: Reduce and Control Risk

Only and the Most Effective Approach is:

1. **To Look at TOTAL RISK and All the Effects.**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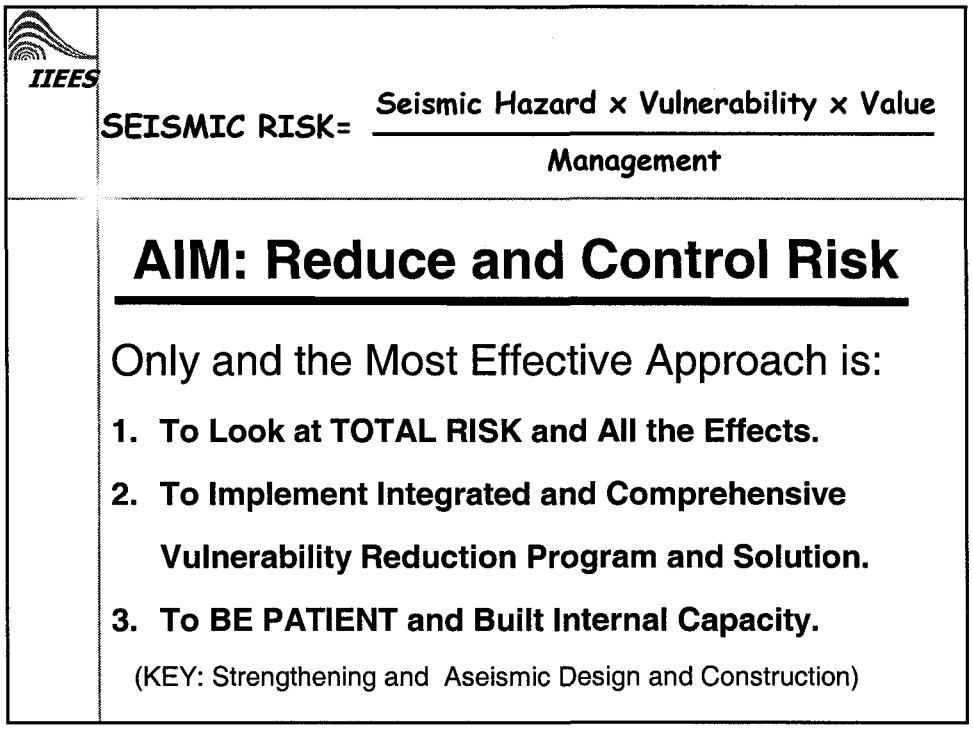
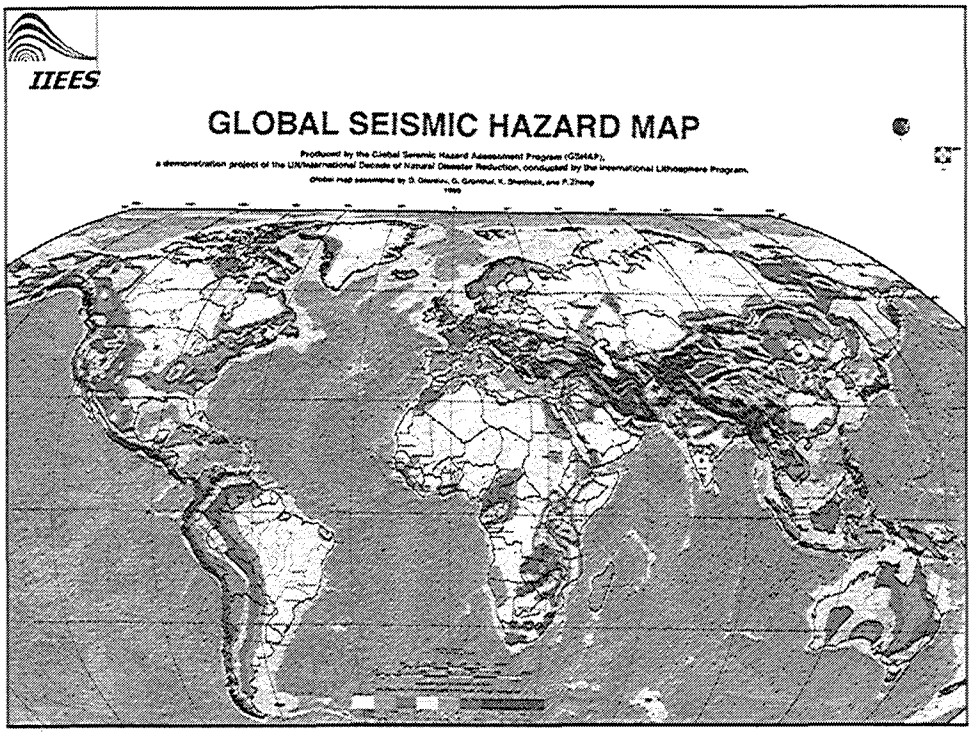
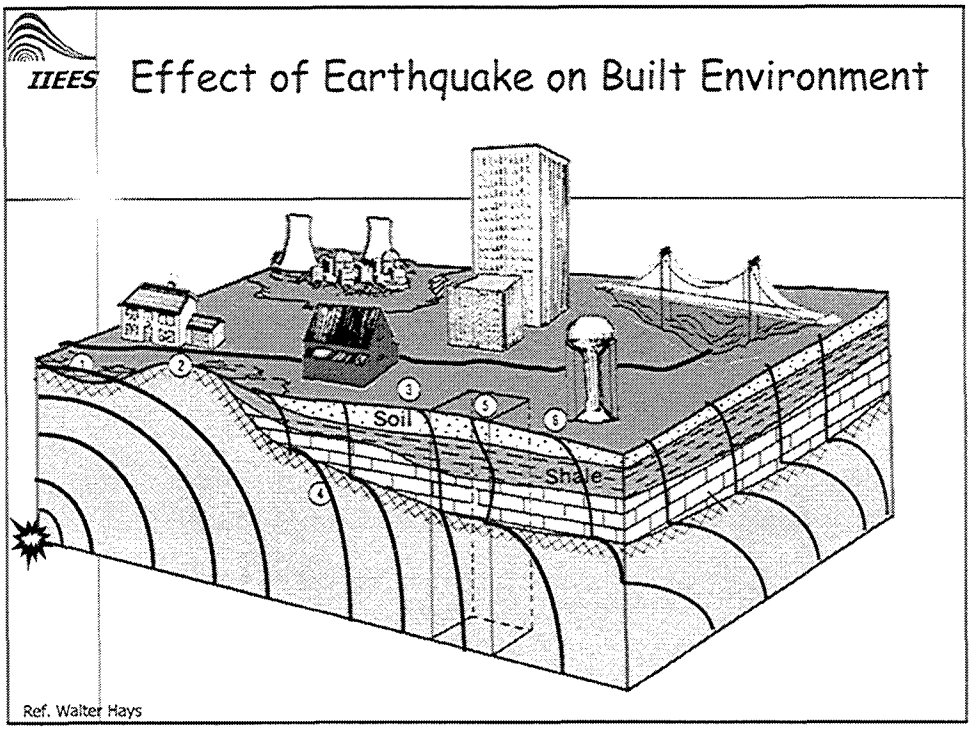
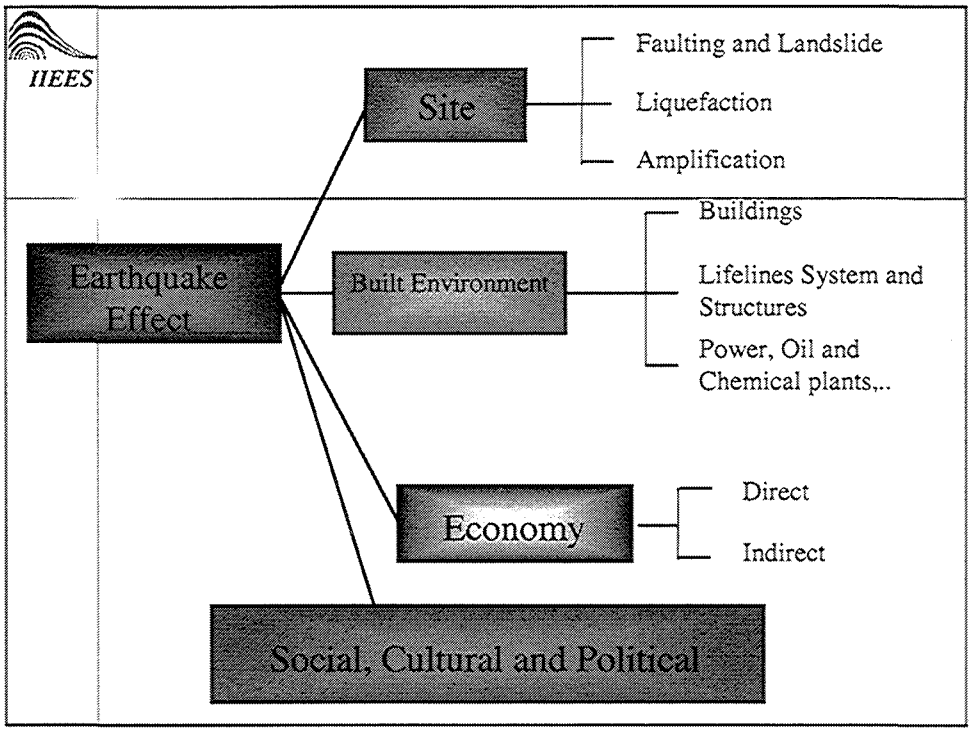
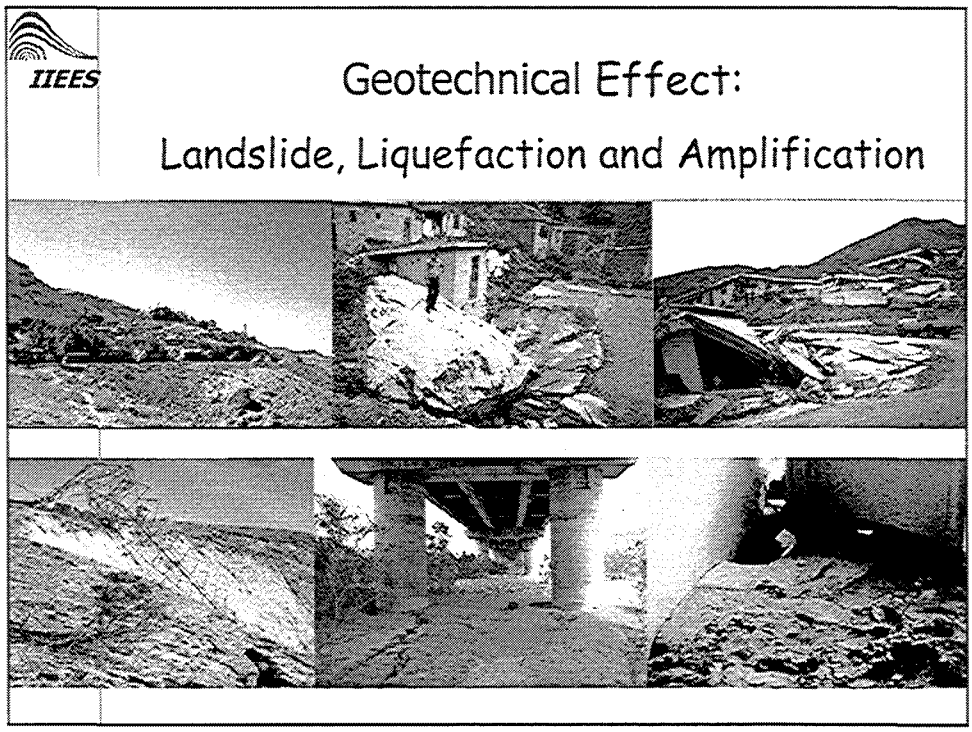
Earthquake Cause and Effect
Seismic Source
Seismicity
Strong Ground Motion Attenuation
Human, Socio-Economic and Cultural Effect
SEISMIC HAZARD
Geotechnical Effects: Amplification, Landslide and Liquefaction
Management
Vulnerability of Built Environment
SEISMIC RISK


IIEES
SEISMIC RISK= Seismic Hazard x Vulnerability x Value / Management
AIM: Reduce and Control Risk
Only and the Most Effective Approach is:
1. To Look at TOTAL RISK and All the Effects.
2. To Implement Integrated and Comprehensive Vulnerability Reduction Program and Solution.
3. To BE PATIENT and Built Internal Capacity.
(KEY: Strengthening and Aseismic Design and Construction)


IIEES
GLOBAL SEISMIC HAZARD MAP

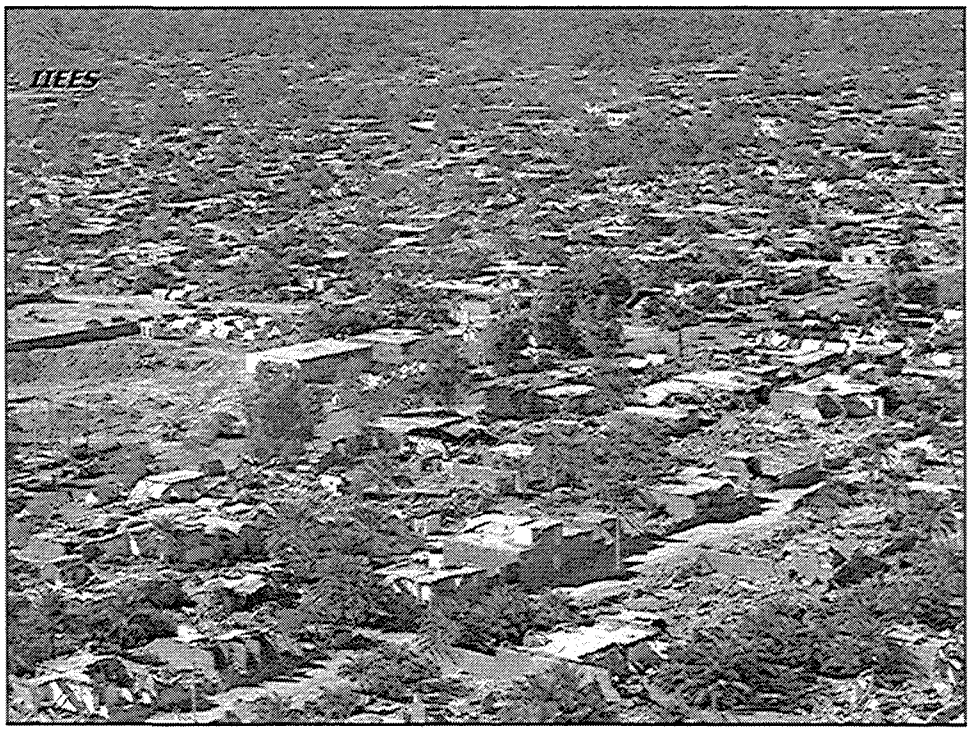

IIEES
Effect of Earthquake on Built Environment
Soil
Shale
Ref. Walter Hays


IIEES
Site
Faulting and Landslide
Liquefaction
Amplification
Earthquake Effect
Built Environment
Buildings
Lifelines System and Structures
Power, Oil and Chemical plants,..
Economy
Direct
Indirect
Social, Cultural and Political


IIEES
Geotechnical Effect:
Landslide, Liquefaction and Amplification

Building Effect:

Adobe, Masonry, Mixed, Historical



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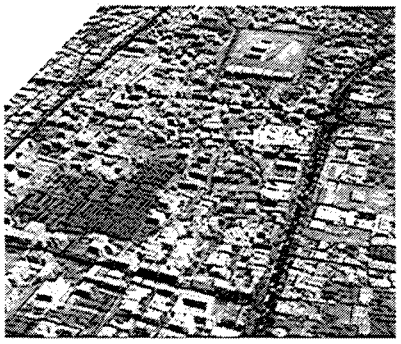
3D Fly-bys

Disaster Information System Team
EDM/NIED Japan



September 30, 2003

January 3, 2004

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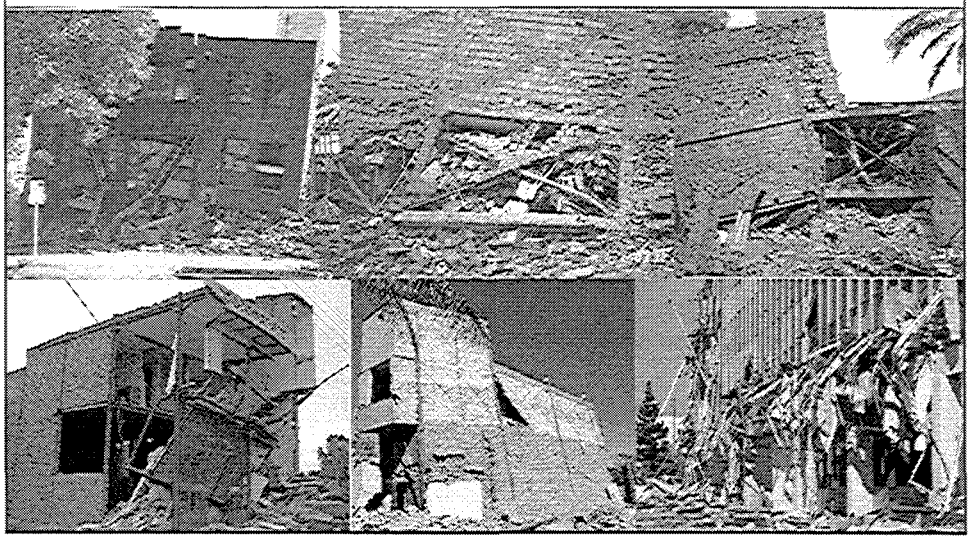
Building Effect:

Steel Structures



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Building Effect:

Reinforced Concrete

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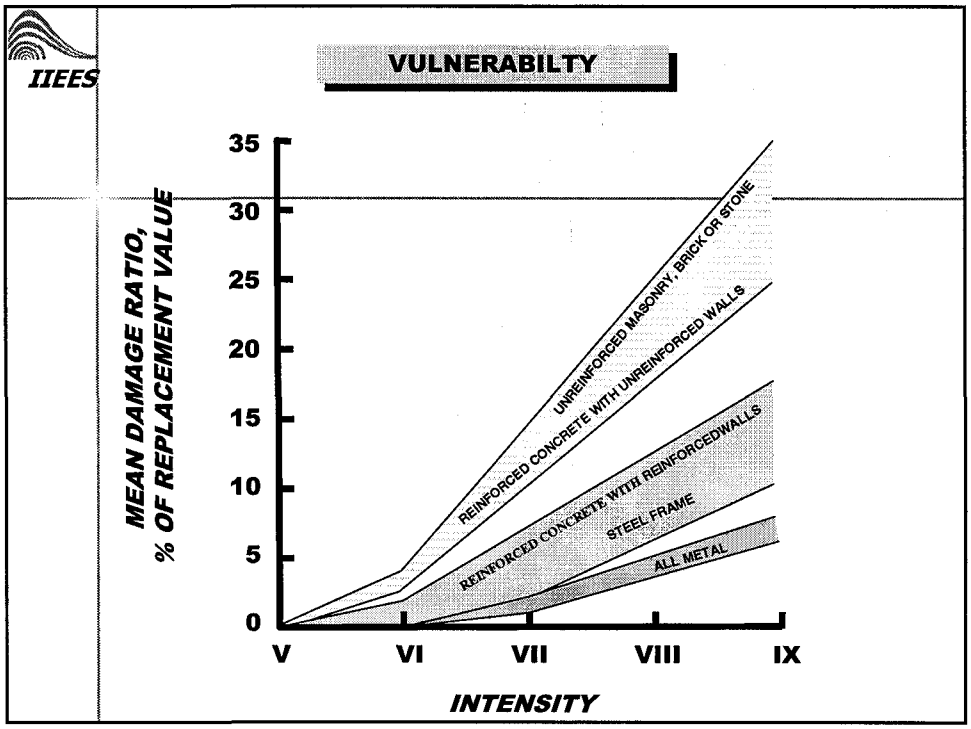
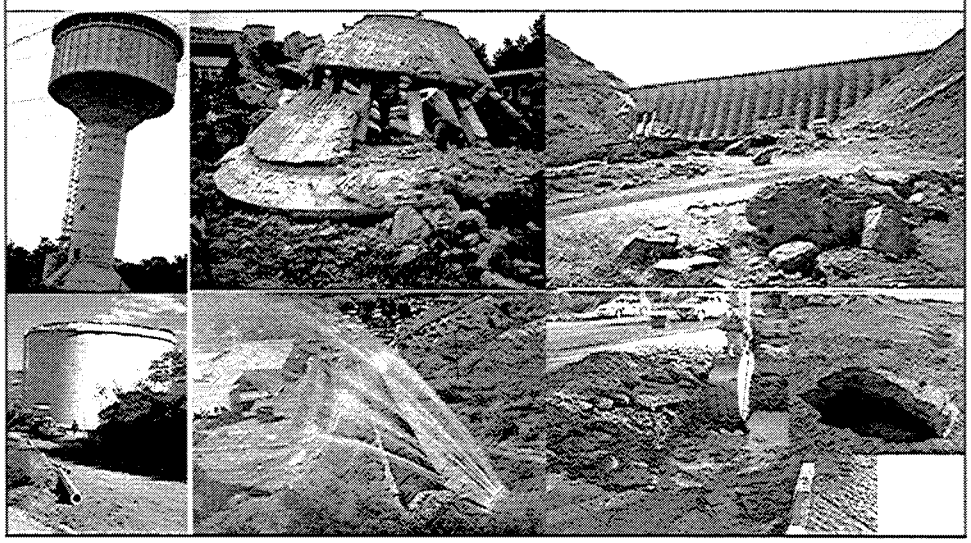


Lifeline and Infrastructures Effect:

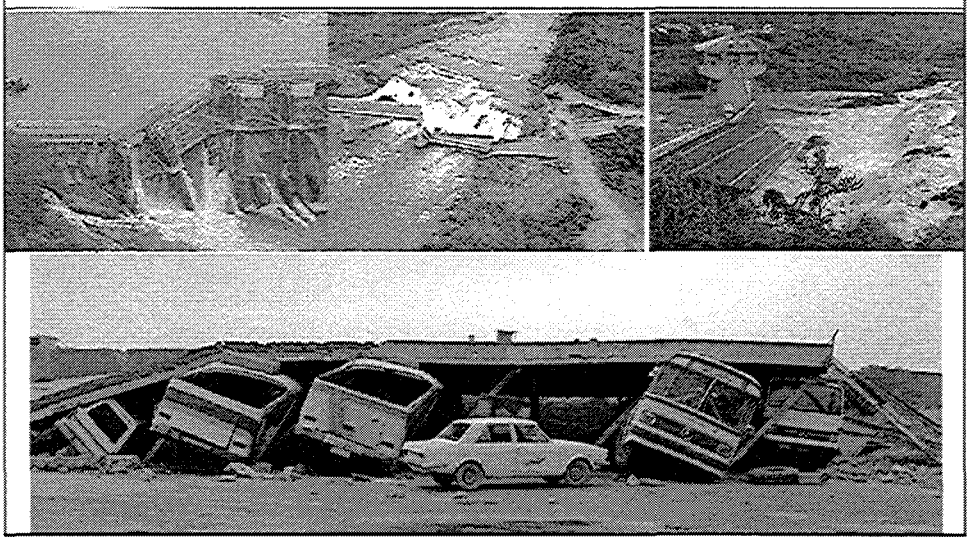
Power

Lifeline and Infrastructures Effect:

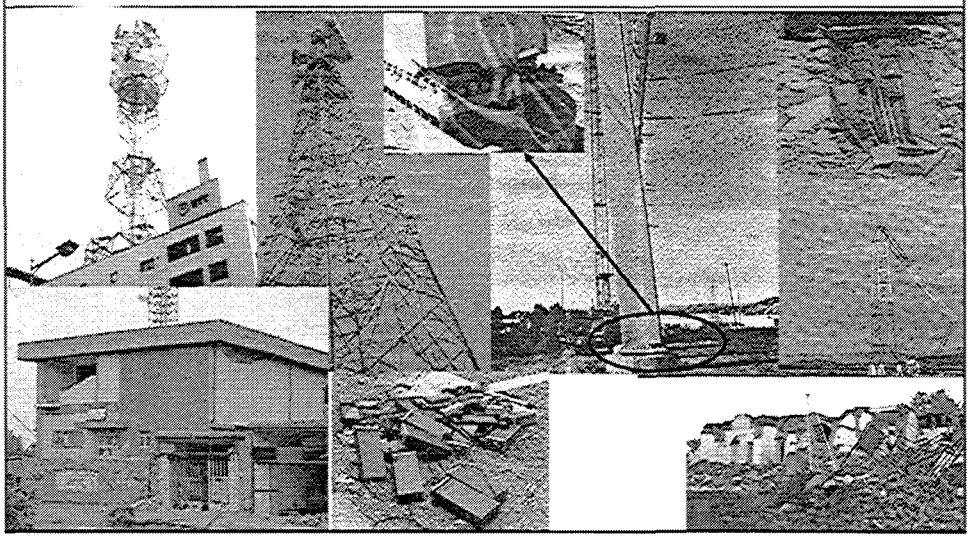
Dams and Water Network



Lifeline and Infrastructures Effect: Transportation



Lifeline and Infrastructures Effect: Communication



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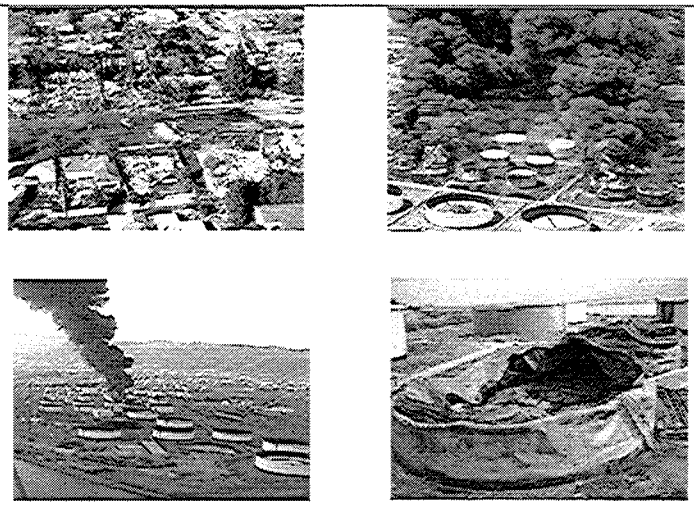
Lifeline and Infrastructures Effect:

Gas, Oil and Petrochemical Plants



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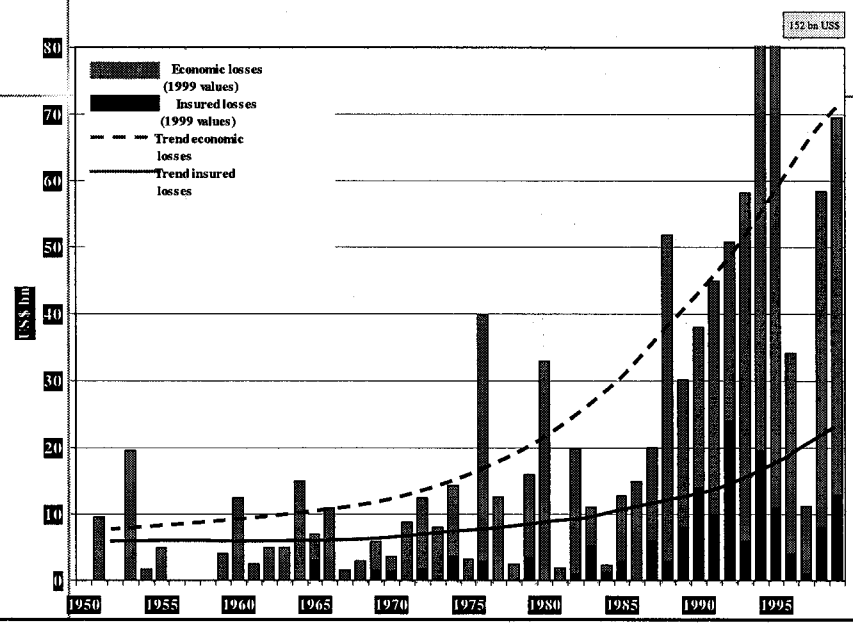
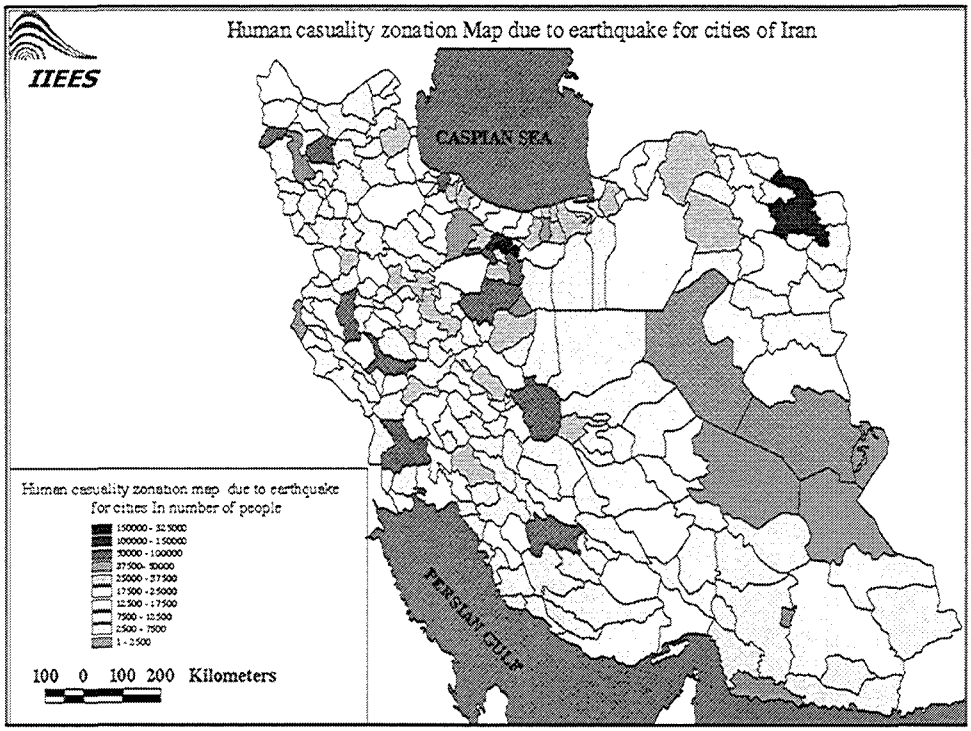
Economic losses





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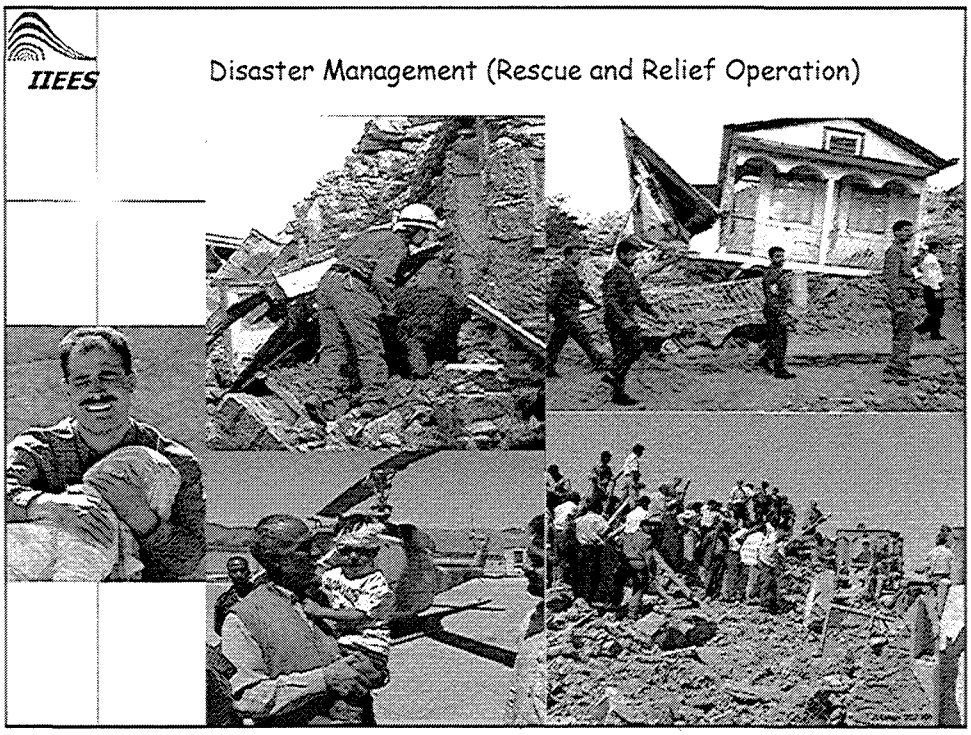
Estimated Building Damage and Human Casualty for the Bam (2000)

SITUATION	Buildings	ADOBE	MASPMRU	CONCRETE	STEEL	TIMBER	TOTAL
	RESIDENTIAL	17921	15501	11	20	160	33613
PRESENT	NON-RESIDENTIAL	2824	2442	2	3	25	5296
	TOTAL	20745	17943	13	23	185	38909
	RESIDENTIAL	7935	8626	7	7	17	16492
DAMAGED	NON-RESIDENTIAL	1236	1360	1	1	3	2601
	TOTAL	9071	9986	8	8	20	19093
	RESIDENTIAL	31860	35078	28	28	69	67062
DAY-POP	NON-RESIDENTIAL	3544	3900	3	3	9	7459
	STREET	20243	17509	13	22	181	37967
	TOTAL	101215	87544	63	112	903	74521
	RESIDENTIAL	37612	4140	34	34	82	79171
NIGHT-POP	NON-RESIDENTIAL	5760	6337	5	5	14	12120
	STREET	2024	1751	1	2	18	3797
	TOTAL	101215	87544	63	112	903	91291
COEFICENT		0.230	0.25	0.17	0.17	0.13	
	RESIDENTIAL	10620	8769	5	5	9	19401
FATALITIES-DAY	NON-RESIDENTIAL	1181	975	0	0	1	2158
	TOTAL	11801	9744	5	5	10	21566
	RESIDENTIAL	12537	10352	6	6	10	22911
FATALITIES-NIGHT	NON-RESIDENTIAL	1920	1584	1	1	2	3508
	TOTAL	14457	11937	6	6	12	26419
AVERAGE FATALITIES	ESTIMATE	13129	10840	6	6	11	23992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Disaster Management (Rescue and Relief Operation)


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FACTS of Earthquake

- Existence of Active Faults
- Global Seismicity and Seismic Hazard
- Many Urban Areas and Mega Cities are Located in High Hazard Zone
- Inadequate Planning and Rapid growth of urban areas
- Incompatible Development With Respect to Seismic Hazard
- Inappropriate population density

FACTS of Earthquake

- Inappropriate design and construction
- Poor code and law enforcement
- Lack of technical supervision
- High dependency on vulnerable infrastructure and services
- Poor Implementation of Existing Knowledge
- Poor Risk Management
- Unpreparedness of the Most Countries

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$$\text{SEISMIC RISK} = \frac{\text{Seismic Hazard} \times \text{Vulnerability} \times \text{Value}}{\text{Management}}$$

AIM: Reduce and Control Risk

Only and the Most Effective Approach is:

1. **To Look at TOTAL RISK and All the Effects.**
2. **To Implement Integrated and Comprehensive Vulnerability Reduction Program and Solution.**
3. **To BE PATIENT and Built Internal Capacity.**

(KEY: Strengthening and Aseismic Design and Construction)

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RISK REDUCTION and CONTROL

Integrated Implementation Programs should be designed to avoid, reduce or limit the adverse impact of natural hazards and related environmental and technological disasters:

PREVENTION: Outright measures taken to avoid the adverse impact of natural hazards and related environmental and technological disasters.

MITIGATION: Measures taken to limit the adverse impact of natural hazards and related environmental and technological disasters.

PREPAREDNESS: Measures taken in advance to ensure effective response to the impact of disasters.

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$$\text{SEISMIC RISK} = \frac{\text{Seismic Hazard} \times \text{Vulnerability} \times \text{Value}}{\text{Management}}$$

Reduction and Control of Seismic Risk in any given area (specially urban are) as a complex problem, requiring the integration of knowledge and the collaboration of experts from many disciplines.

The problem of Seismic Risk Reduction will not be solved just by the acquisition of the required knowledge through research. Research must be accompanied by the necessary technological developments and the implementation of the knowledge and the development in practice; as well as a good management.

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What Has Been Done

All of emphasis up to recent years were on:

1) Trying to accurately map the seismic sources (faults).
2) Trying to reliably assess the seismicity by expanding the monitoring networks.
3) Trying to predict or assess the level of seismic hazard.
4) Getting knowledge of the performance of different structures and facilities.
5) Improving more reliable analytical methods for estimation of structural response
6) Developing aseismic design guidelines and codes.
7) Developing vulnerability and risk assessment methods.
8) Developing guidelines for strengthening of existing structures.
9) Working hard to try to implement the codes and regulations.
10) Trying to aware the public on the importance of seismic safety and preparedness

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The Result of Knowledge and Application with its Relation to RISK

	Developed	Developing	Under Developed
Knowledge & Tech. Capability	High	Enough	Low
Construction Quality	Good	Average	Low
Socio-economic cond. and Awareness	Good	Limited	Very Low
Policy Implementation	Good	Average-Low	Very Low
Cooperation between Scientist&Government	Acceptable	Average	Very Low
RISK	**Average** Under Control	**Growing**	**High**

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What Needs To Be Done?

- Even though the work has been done so far are very important and were useful, but they have not solved the problems and have not successfully reduced risk.
- Thus it is necessary to improve the Mitigation, Prevention and Preparedness program with emphasis on DOABEL programs and Effective Implementation.

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What Needs To Be Done?

- Translation of current engineering and architectural know-how into simplified options which can answer the socio-political and economical concerns. This will require not only a multi-disciplinary approach, but also a comprehensive educational program, not only for the owners and future users but also for all of the different audience that in one way or another are involved in the implementation of the seismic risk reduction measure.
- Good government management and performance which is the key factors in Risk Reduction Program, and therefore is a major controllable factor influencing the impact of a disaster.

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TODAY We Need a New Initiative

- Initiative That Uses the CORRECT Definition of RISK MANAGEMENT Which Includes:
  PREPAREDNESS,
  MITIGATION,
  PREVENTION,
  RESCUE & RELIEF
  and RECONSTRUCTION & RECOVERY
  For Sustainable Development

DOABLE **I**NTIATIVE and **M**OMENTUM for
EARTHQUAKE **R**ISK **R**EDUCTION

DIMER

METHODS to Reach DIMER

- Defining ACCEPTABLE RISK
- Institutionalizing RISK REDUCTION
- Building AWARENESS & MOTIVATION
- Changing PUBLIC POLICY and PRACTICE
- Making SEISMIC SAFETY a priority
- Building internal mechanism for CHANGES
- Putting scientific knowledge into a USABLE and DOABLE form

METHODS to Reach DIMER

- Utilizing research and practical knowledge to PROMOTE Risk Reduction
- Meeting the NEEDS and REALITY
- Establishing Partnerships and Framework
- Cooperation between Scientist, Engineers, Builders, People and Officials
- Helping officials for making better Decisions
- Communicate the Risk to the Public
- Increase Public Awareness
- Translate Safety to Economic and Human Value

Educational Program

Objective:

- To provide and build the "Technical Capacity" required for implementation of Risk Reduction Program.
- To transfer of the technical know-how to the engineers.
- To promote earthquake safety culture in the society

Classification:

- Specialized Education

  Civil Engineering Curriculum and Gradate Studies.

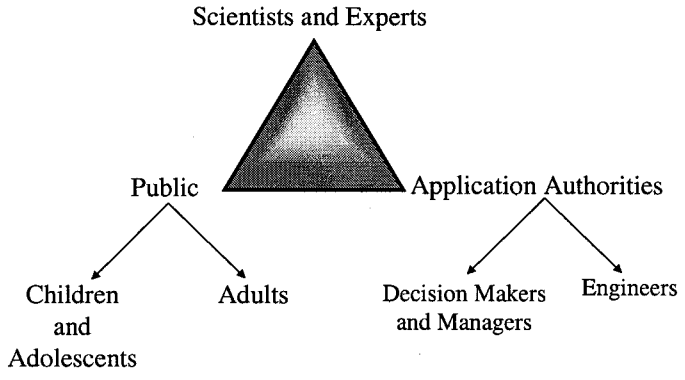
  Extension Courses and Training Programs

- Public Education

Public Education and Awareness

Objective:

- **Raise Awareness and Preparedness**
- **Raise Public's General Knowledge**
- **Communicate the RISK**



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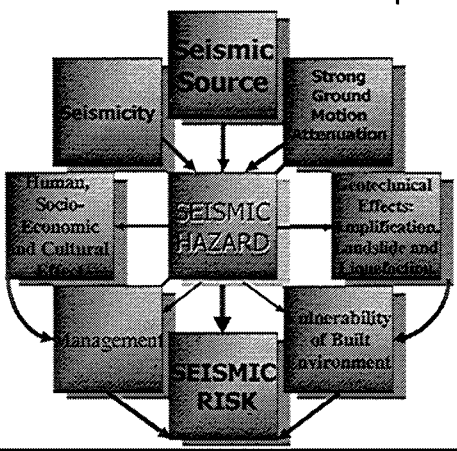
Conclusion

1. We need to see the total picture of earthquake from its source to its effects and impacts.



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Conclusion

1. We need to see the total picture of earthquake from its source to its effects and impacts.
2. We need to see what we have done and what needs to be done effectively in order to solve the "Earthquake Puzzle".
3. The Puzzle can be solved by integration of knowledge into practice by offering DOABLE and USABLE solutions in order to be put on the ground as well as collaboration of experts from many disciplines and good management.
4. To BE PATIENT and Built Internal Capacity.