



# ASSESSMENT OF VULNERABILITY THROUGH PARTICIPATION



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IGNITE STAGE

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# OVERVIEW OF CENTER OF EXCELLENCE IN DISASTER MITIGATION AND MANAGEMENT



AN INTERDISCIPLINARY CENTER  
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Human Resources development for disaster  
mitigation and management

- To protect the people
- Environment and Economy
- Ensure a disaster resilient society through education, research and development.

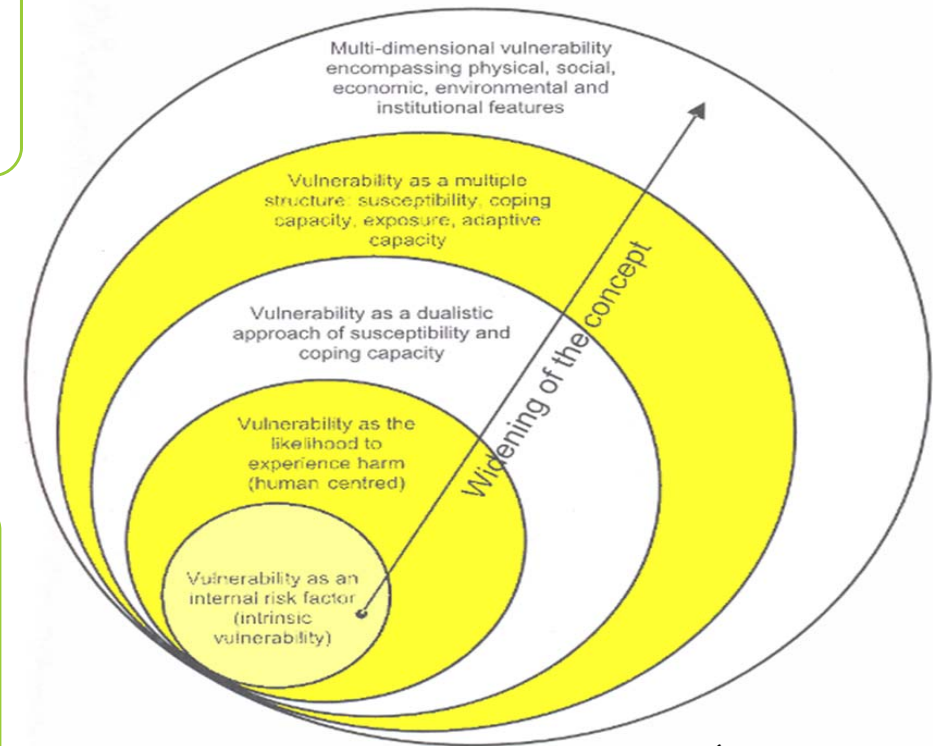
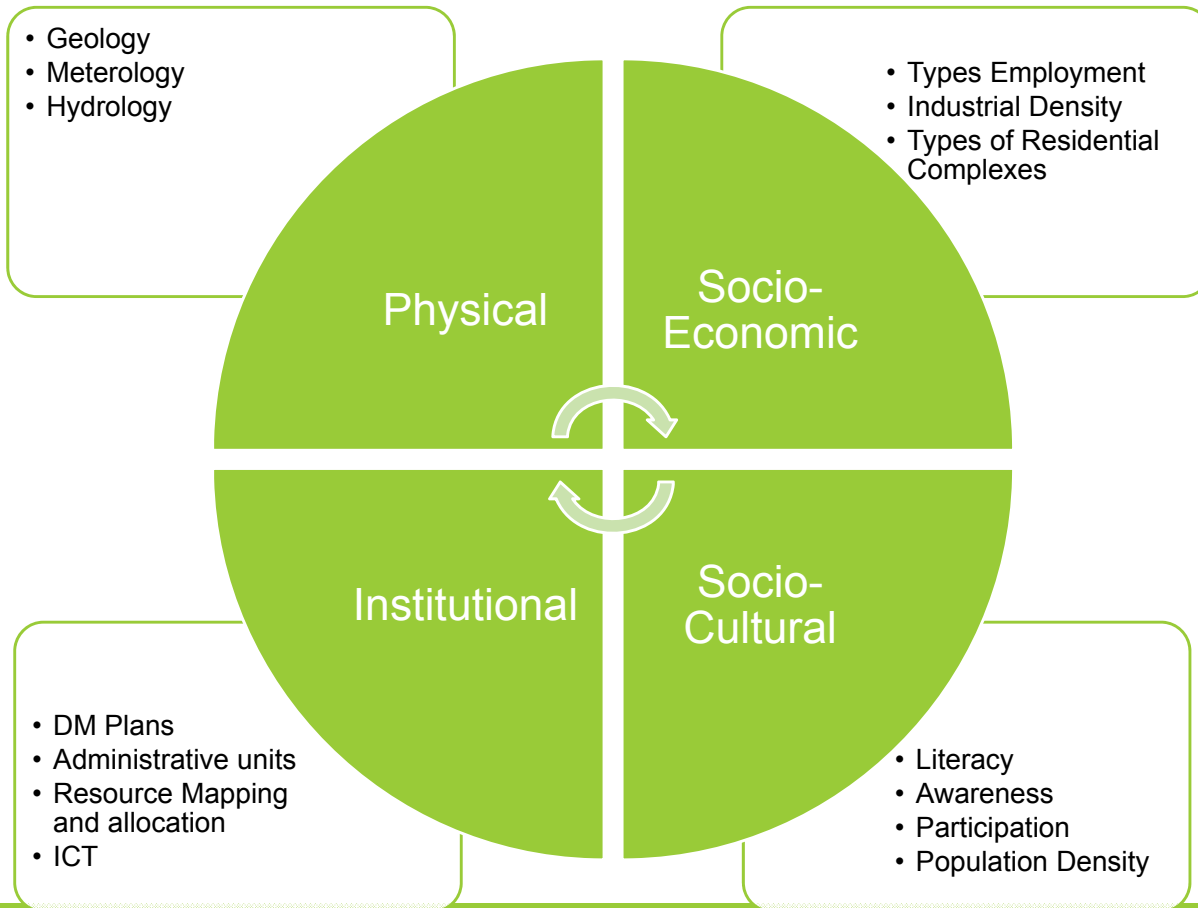


We deliver on our mission by-

- Research Activities
- Awareness and training program
- Field Visits and Surveys
- Collaborations with like minded organizations

# VULNERABILITY

The degree of loss to a given element at risk or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1 (total damage)” ( UNDR0, 1991)



Source: (Birkmann 2005)

# VULNERABILITY QUANTIFICATION

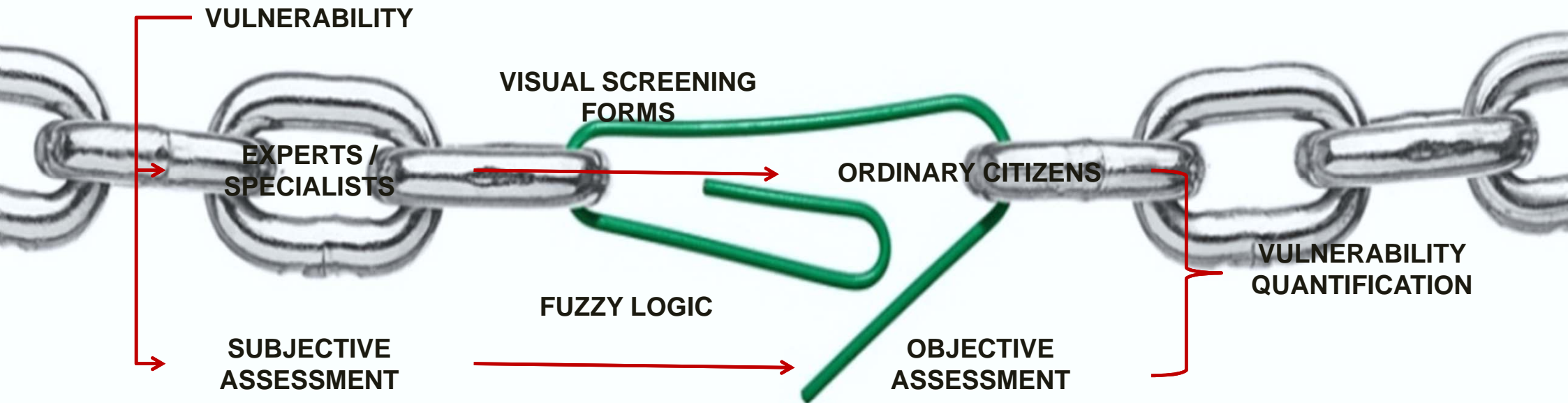





Fig. New Multi Department Building IIT Roorkee

# BUILDING SCREENING

1. Building Stakeholder Coordination
    - Building and Site Plans
    - Utilities Plan and Details
    - Emergency Plans of the Buildings
    - Interviews with building inmates
  
  2. Team of Multi-Disciplinary experts
    - Engineers
    - Architects
    - Security Specialists
    - Subject Matter Experts
    - Any other experts as and when required
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# EASY FIRE VULNERABILITY SCREENING FORM

Have you conducted any mock drills or workshops on fire hazard sensitivity?	Yes / No (Yes: Only if majority is aware)	Yes
Do you have well maintained fire fighting systems?	Yes / No (Yes: Only if majority is changed, usage of equipment is known to some)	No
	<input type="checkbox"/> Have staffs/students been instructed on its correct use and operation? <input type="checkbox"/> Are all fire extinguishers, hose-reels, and automatic sprinkler systems etc. regularly inspected and tested by competent persons? <input type="checkbox"/> Are regular checks undertaken to make sure equipment is not missing or damaged? <input type="checkbox"/> Confirm the extinguisher is visible, unobstructed, and in its designated location <input type="checkbox"/> Verify the locking pin is intact and the tamper seal is unbroken. <input type="checkbox"/> Make sure the operating instructions on the nameplate are legible and facing outward.	No No No Yes Yes Yes
Do you have any system of issuing warning?	Yes / No (Yes: Only if majority is aware)	
	<input type="checkbox"/> Is the fire alarm tested weekly and maintained on a regular basis? <input type="checkbox"/> Is there a procedure for contacting the fire brigade: during the working day? When the premises are closed? <input type="checkbox"/> Is the fire alarm system connected to a monitoring center which contacts the fire brigade?	No No No
Do you have safety and risk related discussions and forums?	Yes / No (Yes: Only if majority is aware)	No

# EASY FLOOD VULNERABILITY SCREENING FORM


Is the site near a body of water?	No
Has the area been affected by flood or water logging for long hours in the past?	No
What is the recurrence period?	More than that
Do you have drains or sewers that contribute to water logging?	No
The level of water logging or flood experienced?	NA
Does the lower level of the site have important equipment or documents?	Yes
General duration of flooding or water logging	NA
Is there are past experiences of flood or water logging related secondary issues like erosion, deposition, damping etc.?	NA
Are access roads usable during flood or water-logging?	Yes
Based on past experiences, have flood-proofing efforts been made?	NA
Is potable drinking water supply kept separated from the possibilities of contamination during flood or water-logging?	Yes
Are man-holes located at correct points of water logging and are they marked properly during flood?	Yes
Will important transmission lines (electricity, gas etc.) be affected during flood or water logging?	No



# EASY SEISMIC VULNERABILITY SCREENING FORM

Depth of groundwater table (m)	0-3 m	3-10 m	10-20 m	More than 20 m
Building type	Frame (Beams & Columns)	Pre-cast	Frame-shear wall	Flat slab frame
Thickness of the infill wall	Exterior: 9 inch		Interior: 4.5 inch	
Are the structural drawings and calculations for the building available	No			
Is the building an extension to the original building	No			
Structure of the staircase	Separated		Connected	
	<p>(a) Damage in building with rigidly built-in staircase</p> <p>(b) Building with separated staircase</p>			

# FUZZY LOGIC

- Quantification would be based on opinions which are subjective
  - Fuzzy logic is used to model through linguistic variables
  - The opinions on the factor-turned-questions are to be recorded as linguistic variables
  - Two phases of survey are to be conducted
  - The first round would involve expert panel which is supposed to assign importance to each of the identified factors.
  - IMPORTANCE matrix is developed which contains the importance of each factor as perceived by each of the panellists.
  - The second phase of the survey is to take the questions to the area of interest and indulge the locals as to how much they are aware of these factors.
  - We develop the WEIGHT matrix, which contains the awareness levels of the local people about any particular factor.
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# FUZZY LOGIC

Linguistic value of IMPORTANCE	Corresponding fuzzy number
Makes it vulnerable (v)	(0, 0, 2)
Does not affect much (i)	(2, 5, 8)
Makes it strong (s)	(8, 10, 10)

Mapping of Importance to Fuzzy Numbers

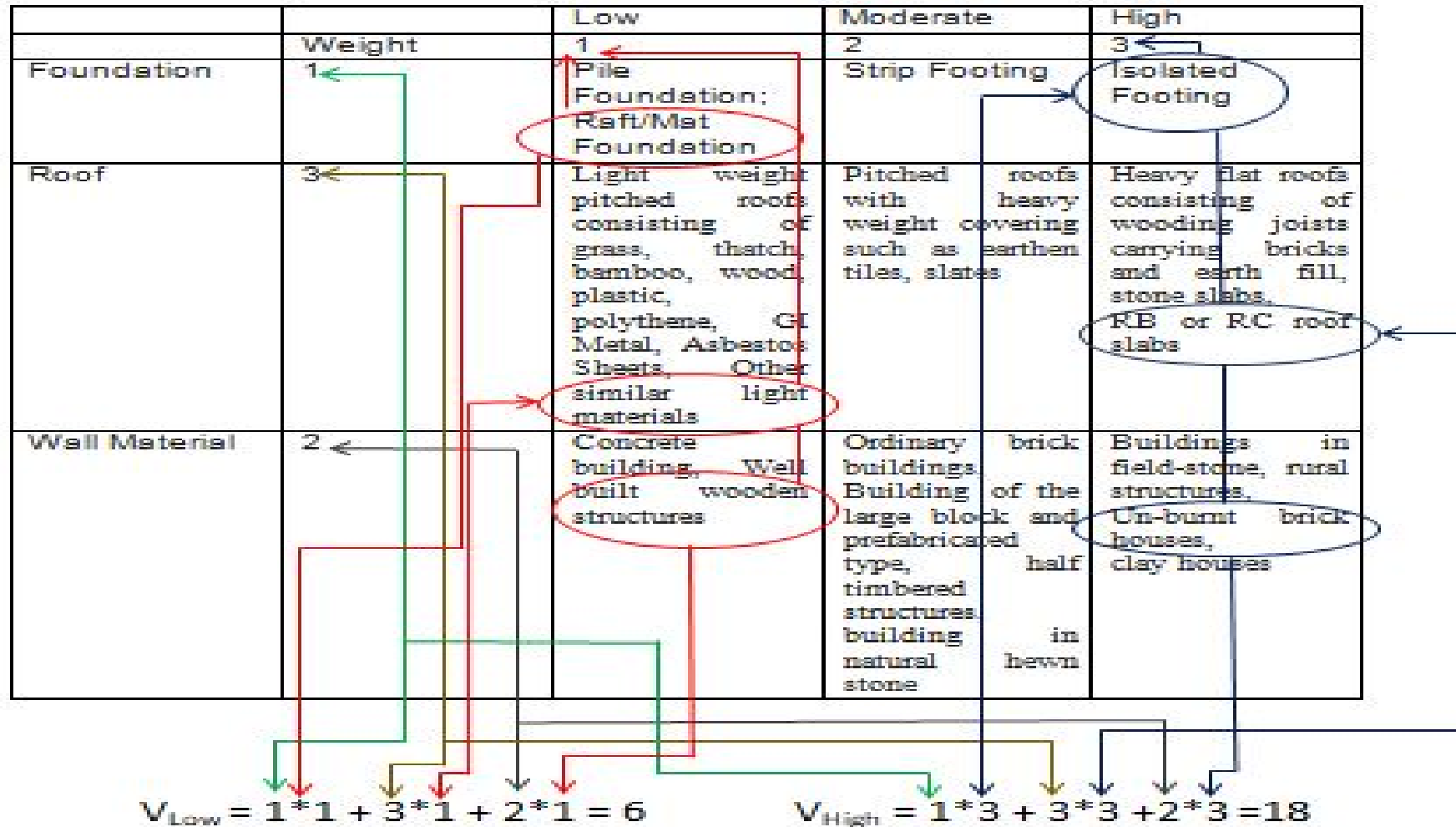


Mapping of Weight to Fuzzy Numbers



Linguistic value of WEIGHT	Corresponding fuzzy number
Weakness (w)	(0.0, 0.0, 0.1)
Neutral (n)	(0.1, 0.4, 0.7)
Strength (s)	(0.7, 1.0, 1.0)

# FUZZY LOGIC




# EASY FIRE VULNERABILITY SCREENING (EFVS) AND ASSESSMENT

Parameters	Completeness	Vulnerability
Absence of evacuation plan (what to do after the alarm is sounded)	0.01	0.34
Absence of awareness due to lack of mock-drills or workshops	0.03	3.15
Lack of maintenance of fire fighting systems	0.09	9.23
Absence of fire warning, fire alarm	0.04	4.94
Absence of discussions and forums on fire safety	0.01	1.24
Hazard mapping of building in terms of fire safety	0.02	2.19
Code-wise construction	0.01	0.34
Code-wise arrangement of exit	0.01	0.34
Code-wise construction of doorways	0.01	0.26
Code-wise construction of staircase	0.09	9.23
Lifts	0.01	0.34
Absence of procedure of restriction of spread of fire and smoke	0.05	4.94
Absence of staircase and corridor lights	0.03	2.80
<b>Fire Vulnerability</b>	<b>0.39</b>	<b>39.37</b>

# EASY SEISMIC VULNERABILITY SCREENING (ESVS) AND ASSESSMENT

Parameters	Completeness	Vulnerability
Storeys	0.03	3.07
Soil type	0.01	1.36
Foundation type	0.01	0.11
Ground water	0.01	0.09
Building type	0.01	0.73
Thickness of infill	8.13E-05	0.01
Extension to original building	0.01	0.21
Staircase	0.01	0.93
Vertical irregularity	0.01	1.64
plan irregularity	0.01	1.64
Falling hazards	0.01	0.93
Absence of Evacuation plan	0.02	2.35
Non-Conduction and non-participation of mock drills	0.01	0.08
Absence of knowledge of EEW	0.01	0.09
Absence of emergency communication system	0.01	0.06
Absence of safety and risk related discussion and forums	<b>0.13</b>	<b>13.37</b>
<b>VULNERABILITY</b>	<b>0.26</b>	<b>26.74</b>

# CONCLUSIONS

- This exercise reveals all of the avenues, i.e., factors, which contributes to vulnerability and thereby provides the scope of focussed training and awareness of the society, thereby resulting in building its capacity.
  - The factors encompass societal and institutional avenues and thus the entire process tends to assess and quantify vulnerability to the greatest detail.
  - This process should be able to reveal vulnerable aspects of the society, administration and institutions and quantify it and present opportunities of better preparedness of the society.
  - Rating System, questionnaire and the computing system of the methodology can be further modified and refined to improve the risk quantification of the built environment.
  - The methodology also can be further improvised for risk quantification of public and vital infrastructure such as stadiums, bridges, airports, ports, bus stations, railway stations, public transportation systems, military installations and etc.,
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*Thank  
you*



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