

CLE 324 NATURAL DISASTER MITIGATION AND MANAGEMENT

University Elective

Total : 50 Marks
Weightage : 20 Marks

Last Date for Submission: 26.04.2013

- STEP 1. Locate your town or city in Seismic Hazard Zonation Map of India (IS 1893 (Part 1) : 2002, CRITERIA FOR EARTHQUAKE RESISTANT, DESIGN OF STRUCTURES PART 1 GENERAL PROVISIONS AND BUILDINGS)
- STEP 2. Identify your Zone (Zone II /III/IV/V)
- STEP 3. Use the Appropriate form (Annexure 1)
- STEP 4. Download the manual Rapid Visual Screening (RVS) of Buildings for Potential Seismic Hazards: A Handbook. Second Edition (<http://www.fema.gov/library/viewRecord.do?id=3556>)
- STEP 5. Use the form from Step 3 and do Rapid Visual Screening of your house (procedures for RVS is details given in the manual). Find out the final score value for your building.
- STEP 6. Identify the damage probability of your House building

A sample filled form given in the last page with this for your reference

Rapid Visual Screening of Buildings for Potential Seismic Vulnerability

FEMA-154/ATC-21 Based Data Collection Form

(Seismic Zone II)

| | |
|--|---|
| | Address: _____ _____ Pin _____ Other Identifiers _____ GPS Coordinates (if available) _____ No. Stories _____ Year Built _____ Surveyor _____ Date _____ Total Floor Area (sq. ft./sq. m) _____ Building Name _____ Use _____ Current Visual Condition: Excellent <input type="checkbox"/> / Good <input type="checkbox"/> / Damaged <input type="checkbox"/> / Distressed <input type="checkbox"/> Building on Stilts / Open Ground Floor: Yes <input type="checkbox"/> / No <input type="checkbox"/> Construction Drawings Available: Yes <input type="checkbox"/> / No <input type="checkbox"/> |
| <p>PHOTOGRAPH (OR SPECIFY PHOTOGRAPH NUMBERS)</p> | |
| Plan and Elevation Scale: _____ | |

| OCCUPANCY | | | | SOIL TYPE (IS 1893:2002) | | | FALLING HAZARDS | | | |
|--------------|------------|-------------|------------------------|--------------------------|-------------|-----------|--------------------------|--------------------------|--------------------------|--------------------------|
| Assembly | Govt. | Office | Max. Number of Persons | Type I | Type II | Type III | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Commercial | Historic | Residential | 0 – 10 11 – 100 | Hard Soil | Medium Soil | Soft Soil | Chimneys | Parapets | Cladding | Other: |
| Emer.Service | Industrial | School | 101 – 1000 1000+ | | | | | | | |

| BASIC SCORE, MODIFIERS, AND FINAL SCORE, S | | | | | | | | | | |
|--|------|---------------|------------|-------------|------------|-------------|-------------------|-------------------|------|------|
| BUILDING TYPE | Wood | S1 (FRAME) | S2 (LM) | C1 (MRF) | C2 (SW) | C3 (INF) | URM1 (BAND-RD) | URM2 (BAND-FD) | URM3 | URM4 |
| Basic Score | 6.0 | 4.6 | 4.6 | 4.4 | 4.8 | 4.4 | 4.6 | 4.8 | 4.6 | 3.6 |
| Mid Rise (4 to 7 stories) | N/A | +0.2 | N/A | +0.4 | -0.2 | -0.4 | -0.2 | -0.4 | -0.6 | -0.6 |
| High Rise (>7 stories) | N/A | +1.0 | N/A | +1.0 | 0.0 | -0.4 | N/A | N/A | N/A | N/A |
| Vertical Irregularity | -3.0 | -2.0 | N/A | -1.5 | -2.0 | -2.0 | -1.5 | -2.0 | -1.5 | -1.5 |
| Plan Irregularity | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| Code Detailing | N/A | +0.4 | N/A | +0.5 | +0.4 | N/A | N/A | N/A | N/A | N/A |
| Soil Type II | -0.4 | -0.8 | -0.4 | -0.6 | -0.4 | -0.4 | -0.2 | -0.4 | -0.4 | -0.4 |
| Soil Type III | -0.8 | -1.4 | -1.0 | -1.4 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| Liquifiable Soil | -2.0 | -2.0 | -2.0 | -2.0 | -2.0 | -2.0 | -1.6 | -1.4 | -1.4 | -1.4 |

| FINAL SCORE, S | | Further Evaluation Recommended |
|--|--|--------------------------------|
| Result Interpretation (Likely building performance) S < 0.3 High probability of Grade 5 damage; Very high probability of Grade 4 damage 0.3 < S < 0.7 High probability of Grade 4 damage; Very high probability of Grade 3 damage 0.7 < S < 2.0 High probability of Grade 3 damage; Very high probability of Grade 2 damage 2.0 < S < 3.0 High probability of Grade 2 damage; Very high probability of Grade 1 damage S > 3.0 Probability of Grade 1 damage | | YES NO |

* = Estimated, subjective, or unreliable data
 DNK = Do Not Know
 FRAME = Steel Frame SW = Shear Wall URM3 = Unreinforced burnt brick or stone masonry (cem mortar)
 INF = Burnt Brick Masonry Infill Wall LM = Light Metal
 MRF = Moment-Resisting Frame BAND = Seismic Band RD = Rigid diaphragm
 FD = Flexible Diaphragm URM4 = Unreinforced masonry (lime mortar)

Rapid Visual Screening of Buildings for Potential Seismic Vulnerability

FEMA-154/ATC-21 Based Data Collection Form

(Seismic Zone III)

| | |
|---------------------------------|---|
| | Address: _____ _____ Pin _____ Other Identifiers _____ GPS Coordinates (if available) _____ No. Stories _____ Year Built _____ Surveyor _____ Date _____ Total Floor Area (sq. ft./sq. m) _____ Building Name _____ Use _____ Current Visual Condition: Excellent <input type="checkbox"/> / Good <input type="checkbox"/> / Damaged <input type="checkbox"/> / Distressed <input type="checkbox"/> Building on Stilts / Open Ground Floor: Yes <input type="checkbox"/> / No <input type="checkbox"/> Construction Drawings Available: Yes <input type="checkbox"/> / No <input type="checkbox"/> |
| Plan and Elevation Scale: _____ | PHOTOGRAPH (OR SPECIFY PHOTOGRAPH NUMBERS) |

| OCCUPANCY | | | | SOIL TYPE (IS 1893:2002) | | | FALLING HAZARDS | | | |
|---------------|------------|-------------|------------------------|--------------------------|-------------|-----------|--------------------------|--------------------------|--------------------------|--------------------------|
| Assembly | Govt. | Office | Max. Number of Persons | Type I | Type II | Type III | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Commercial | Historic | Residential | 0 - 10 11 - 100 | Hard Soil | Medium Soil | Soft Soil | Chimneys | Parapets | Cladding | Other: |
| Emer. Service | Industrial | School | 101 - 1000 1000+ | | | | | | | |

| BASIC SCORE, MODIFIERS, AND FINAL SCORE, S | | | | | | | | | | |
|--|------------|---------------|------------|-------------|------------|-------------|-------------------|-------------------|------------|------------|
| BUILDING TYPE | Wood | S1 (FRAME) | S2 (LM) | C1 (MRF) | C2 (SW) | C3 (INF) | URM1 (BAND-RD) | URM2 (BAND-FD) | URM3 | URM4 |
| Basic Score | 4.4 | 3.6 | 3.8 | 3.0 | 3.6 | 3.2 | 3.4 | 3.6 | 3.0 | 2.4 |
| Mid Rise (4 to 7 stories) | N/A | +0.4 | N/A | +0.2 | +0.4 | +0.2 | +0.4 | +0.4 | -0.4 | -0.4 |
| High Rise (>7 stories) | N/A | +0.8 | N/A | +0.5 | +0.8 | +0.4 | N/A | N/A | N/A | N/A |
| Vertical Irregularity | -3.0 | -2.0 | N/A | -2.0 | -2.0 | -2.0 | -2.0 | -2.0 | -1.5 | -1.5 |
| Plan Irregularity | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| Code Detailing | N/A | +1.4 | N/A | +1.2 | +1.6 | +1.2 | +2.0 | +2.0 | N/A | N/A |
| Soil Type II | -0.2 | -0.6 | -0.6 | -0.6 | -0.8 | -0.6 | -0.8 | -0.8 | -0.4 | -0.4 |
| Soil Type III | -0.6 | -1.2 | -1.0 | -1.0 | -1.2 | -1.0 | -1.2 | -1.2 | -0.8 | -0.8 |
| Liquefiable Soil | -1.2 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 |

| FINAL SCORE, S | | Further Evaluation Recommended |
|--|---|--------------------------------|
| Result Interpretation (Likely building performance) | | YES NO |
| S < 0.3 | High probability of Grade 5 damage; Very high probability of Grade 4 damage | |
| 0.3 < S < 0.7 | High probability of Grade 4 damage; Very high probability of Grade 3 damage | |
| 0.7 < S < 2.0 | High probability of Grade 3 damage; Very high probability of Grade 2 damage | |
| 2.0 < S < 3.0 | High probability of Grade 2 damage; Very high probability of Grade 1 damage | |
| S > 3.0 | Probability of Grade 1 damage | |

* = Estimated, subjective, or unreliable data
 DNK = Do Not Know

| | | |
|---------------------------------------|---------------------|---|
| FRAME = Steel Frame | SW = Shear Wall | URM3 = Unreinforced burnt brick or stone masonry (cem mortar) |
| INF = Burnt Brick Masonry Infill Wall | LM = Light Metal | RD = Rigid diaphragm |
| MRF = Moment-Resisting Frame | BAND = Seismic Band | URM4 = Unreinforced masonry (lime mortar) |
| FD = Flexible Diaphragm | | |

Rapid Visual Screening of Buildings for Potential Seismic Vulnerability

FEMA-154/ATC-21 Based Data Collection Form

(Seismic Zones IV & V)

| | |
|---------------------------------|---|
| | Address: _____ _____ Pin _____ Other Identifiers _____ GPS Coordinates (if available) _____ No. Stories _____ Year Built _____ Surveyor _____ Date _____ Total Floor Area (sq. ft./sq. m) _____ Building Name _____ Use _____ Current Visual Condition: Excellent <input type="checkbox"/> / Good <input type="checkbox"/> / Damaged <input type="checkbox"/> / Distressed <input type="checkbox"/> Building on Stilts / Open Ground Floor: Yes <input type="checkbox"/> / No <input type="checkbox"/> Construction Drawings Available: Yes <input type="checkbox"/> / No <input type="checkbox"/> |
| Plan and Elevation Scale: _____ | <p>PHOTOGRAPH (OR SPECIFY PHOTOGRAPH NUMBERS)</p> |

| OCCUPANCY | | | | SOIL TYPE (IS 1893:2002) | | | FALLING HAZARDS | | | |
|---|---------------------------------|---------------------------------|---|--------------------------|------------------------|-----------------------|--------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|
| Assembly Commercial Emer. Service | Govt. Historic Industrial | Office Residential School | Max. Number of Persons 0 – 10 11 – 100 101 – 1000 1000+ | Type I Hard Soil | Type II Medium Soil | Type III Soft Soil | <input type="checkbox"/> Chimneys | <input type="checkbox"/> Parapets | <input type="checkbox"/> Cladding | <input type="checkbox"/> Other: |

| BASIC SCORE, MODIFIERS, AND FINAL SCORE, S | | | | | | | | | | |
|--|------|---------------|------------|-------------|------------|-------------|-------------------|-------------------|------|------|
| BUILDING TYPE | Wood | S1 (FRAME) | S2 (LM) | C1 (MRF) | C2 (SW) | C3 (INF) | URM1 (BAND+RD) | URM2 (BAND+FD) | URM3 | URM4 |
| Basic Score | 3.8 | 2.8 | 3.2 | 2.5 | 2.8 | 2.6 | 2.8 | 2.8 | 1.8 | 1.4 |
| Mid Rise (4 to 7 stories) | N/A | +0.2 | N/A | +0.4 | +0.4 | +0.2 | +0.4 | +0.4 | -0.2 | -0.4 |
| High Rise (>7 stories) | N/A | +0.6 | N/A | +0.6 | +0.8 | +0.3 | N/A | N/A | N/A | N/A |
| Vertical Irregularity | -2.0 | -1.0 | N/A | -1.5 | -1.0 | -1.0 | -1.0 | -1.0 | -1.0 | -1.0 |
| Plan Irregularity | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| Code Detailing | N/A | +0.4 | N/A | +0.2 | +1.4 | +0.2 | N/A | N/A | N/A | N/A |
| Soil Type II | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| Soil Type III | -0.8 | -0.6 | -0.6 | -0.6 | -0.6 | -0.4 | -0.6 | -0.6 | -0.6 | -0.6 |
| Liquefiable Soil | -0.8 | -1.2 | -1.0 | -1.2 | -0.8 | -0.8 | -0.6 | -0.6 | -0.8 | -0.8 |

| FINAL SCORE, S | | Further Evaluation Recommended |
|--|---|--------------------------------------|
| Result Interpretation (Likely building performance) | | |
| S < 0.3 | High probability of Grade 5 damage; Very high probability of Grade 4 damage | |
| 0.3 < S < 0.7 | High probability of Grade 4 damage; Very high probability of Grade 3 damage | |
| 0.7 < S < 2.0 | High probability of Grade 3 damage; Very high probability of Grade 2 damage | |
| 2.0 < S < 3.0 | High probability of Grade 2 damage; Very high probability of Grade 1 damage | |
| S > 3.0 | Probability of Grade 1 damage | YES NO |

[†] = Estimated, subjective, or unreliable data
DNK = Do Not Know

FRAME = Steel Frame
INF = Burnt Brick Masonry Infill Wall
MRF = Moment-Resisting Frame
FD = Flexible Diaphragm

SW = Shear Wall
LM = Light Metal
BAND = Seismic Band
URM4 = Unreinforced masonry (lime mortar)

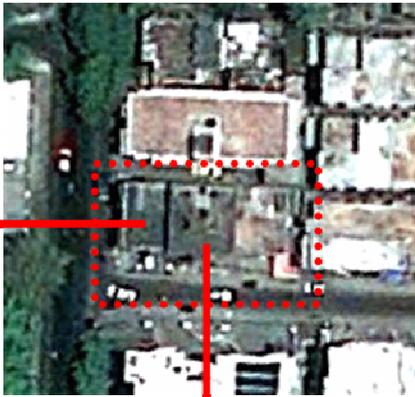
URM3 = Unreinforced burnt brick
or stone masonry (cem mortar)
RD = Rigid diaphragm

| RVS Score | Damage Potential |
|-----------------|---|
| $S < 0.3$ | High probability of Grade 5 damage; Very high probability of Grade 4 damage |
| $0.3 < S < 0.7$ | High probability of Grade 4 damage; Very high probability of Grade 3 damage |
| $0.7 < S < 2.0$ | High probability of Grade 3 damage; Very high probability of Grade 2 damage |
| $2.0 < S < 3.0$ | High probability of Grade 2 damage; Very high probability of Grade 1 damage |
| $S > 3.0$ | Probability of Grade 1 damage |

| Classification of damage to masonry buildings | Classification of damage to reinforced concrete buildings |
|--|--|
| <p>Grade 1: Negligible to slight damage (No structural damage, slight non-structural damage)</p> <p>Hair-line cracks in very few walls. Fall of small pieces of plaster only. Fall of loose stones from upper parts of buildings in very few cases.</p> | <p>Grade 1: Negligible to slight damage (No structural damage, slight non-structural damage)</p> <p>Fine cracks in plaster over frame members or in walls at the base. Fine cracks in partitions and infills.</p> |
| <p>Grade 2: Moderate damage (Slight structural damage, moderate non-structural damage)</p> <p>Cracks in many walls. Fall of fairly large pieces of plaster. Partial collapse of chimneys and mumpmys.</p> | <p>Grade 2: Moderate damage (Slight structural damage, moderate non-structural damage)</p> <p>Cracks in columns and beams of frames and in structural walls. Cracks in partition and infill walls; fall of brittle cladding and plaster. Falling mortar from the joints of wall panels.</p> |
| <p>Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage)</p> <p>Large and extensive cracks in most walls. Roof tiles detach. Chimneys fracture at the roof line; failure of individual non-structural elements (partitions, gable walls etc.).</p> | <p>Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage)</p> <p>Cracks in columns and beam-column joints of frames at the base and at joints of coupled walls. Spalling of concrete cover, buckling of reinforced bars. Large cracks in partition and infill walls, failure of individual infill panels.</p> |
| <p>Grade 4: Very heavy damage (heavy structural damage, very heavy non-structural damage)</p> <p>Serious failure of walls (gaps in walls); partial structural failure of roofs and floors.</p> | <p>Grade 4: Very heavy damage (heavy structural damage, very heavy non-structural damage)</p> <p>Large cracks in structural elements with compression failure of concrete and fracture of rebars; bond failure of beam reinforcing bars; tilting of columns. Collapse of a few columns or of a single upper floor.</p> |
| <p>Grade 5: Destruction (very heavy structural damage)</p> <p>Total or near total collapse of the building.</p> | <p>Grade 5: Destruction (very heavy structural damage)</p> <p>Collapse of ground floor parts (e.g. wings) of the building.</p> |

Rapid Visual Screening of Buildings for Potential Seismic Vulnerability
 FEMA-154/ATC-21 Based Data Collection Form (Seismic Zone III)

Address: BE, SAPULLAH STREET
PONDY BAZAR, T. NAGAR, PO 600017
 Other Identifiers: SAN. PENTAL. ORTHO. CLINIC
 GPS Coordinates (if available): _____
 No. Stories: 1+2+1 Year Built: 10-15 YRS
 Surveyor: _____ Date: _____
 Total Floor Area (sq. ft./sq. m): _____
 Building Name: RESIDENTIAL & COMMERCIAL
 Use: _____
 Current Visual Condition: Excellent / Good / Damaged / Distressed
 Building on Slabs / Open Ground Floor: Yes / No
 Construction Drawings Available: Yes / No
1, 2, 1, 1, 2, 3, 1, 2, 4, 1, 2, 6
 * OPPOSITE OF B.R. MCHAYKON
 * UBI PIPELOT
 * OWNER NAME - XXXXXXXXXX
 PHOTOGRAPH
 (OR SPECIFY PHOTOGRAPH NUMBERS)



| OCCUPANCY | | SOIL TYPE (AS 1893-2002) | | | | FALLING HAZARDS | | | | | | |
|---|--------------------|--------------------------|-------------|---------|-----------|-----------------|----------------|----------------|--------------------------|--------------------------|-------------------------------------|--------------------------|
| Assembly | Govt. / Industrial | Office | Residential | Other | Type I | Type II | Type III | Type IV | Chimneys | Parapets | Cladding | Other |
| Commercial | Industrial | Office | Residential | Other | Hard Soil | Medium Soil | Soft Soil | Very Soft Soil | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| BASIC SCORE, MODIFIERS, AND FINAL SCORE, S | | | | | | | | | | | | |
| BUILDING TYPE | W | S1 (FRAME) | S2 (RM) | C1 (RM) | C2 (RM) | C3 (RM) | URM1 (PARTIAL) | URM2 (PARTIAL) | URM3 (PARTIAL) | URM4 (PARTIAL) | URM5 (PARTIAL) | URM6 (PARTIAL) |
| Basic Score | 4.4 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.2 | 3.4 | 3.8 | 3.8 | 2.4 | 2.4 |
| Mid Rise (4 to 7 stories) | N/A | -0.4 | N/A | -0.2 | -0.5 | -0.5 | -0.2 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| High Rise (7+ stories) | N/A | -0.8 | N/A | -0.5 | -0.5 | -0.5 | -0.4 | N/A | N/A | N/A | N/A | N/A |
| Vertical Irregularity | -3.0 | -2.0 | N/A | -2.0 | -2.0 | -2.0 | -2.0 | -2.0 | -2.0 | -1.5 | -1.5 | -1.5 |
| Plan Irregularity | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| Code Deterioration | N/A | +1.4 | N/A | +1.2 | +1.6 | +1.2 | +2.0 | +2.0 | +2.0 | N/A | N/A | N/A |
| Soil Type II | -0.2 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.4 | -0.4 | -0.4 |
| Soil Type III | -0.8 | -1.2 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.2 | -1.2 | -0.8 | -0.8 | -0.8 |
| Liquefiable Soil | -1.2 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 | -1.6 |
| FINAL SCORE, S | | | | | | | | | | | | 2.8 |

Result Interpretation (Likely building performance)
 S < 0.3 High probability of Grade 5 damage; Very high probability of Grade 4 damage
 0.3 < S < 0.7 High probability of Grade 4 damage; Very high probability of Grade 3 damage
 0.7 < S < 3.0 High probability of Grade 3 damage; Very high probability of Grade 2 damage
 3.0 < S < 3.5 High probability of Grade 2 damage; Very high probability of Grade 1 damage
 S > 3.5 Probability of Grade 1 damage

Further Evaluation Recommended
 YES (NO)