

**A Report on RVS Training Programme
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Assam staff Administrative College
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Training Programme on Rapid Visual Screening

The northeast region of India has been assessed as seismically one of the six most active regions of the world, the other five being Mexico, Taiwan, California, Japan and Turkey. It is placed in Zone 5, the highest zone, of the seismic zonation map of India. It lies at the junction of Himalayan arc to the north and Burmese arc to the east. The region has experienced 18 large earthquakes ($M \geq 7$). Existing buildings in the State of Assam can cause large loss of life, injury, and property damage should earthquakes such as occurred in 1897 or 1950 in this region. Awareness of the earthquake threat has increased, and, with it, interest in quantifying and mitigating risk to the public.

Toward that goal, Bureau of Indian Standard Code IS: 13935 (Submitted draft code by Professor A.S. Arya) the Rapid Visual Screening methodology is major concern to identification of seismically vulnerable building stock in the India. The Rapid Visual Screening methodology is presented in this training program to acquaint various engineering officials to identify buildings that may pose substantial seismic risk.

In this training program screening process for two types of buildings i.e. masonry construction and RCC was carried out and evaluated. This method can be used by the engineers in near future to evaluate the various Governmental and non-Governmental buildings in the state. Assam type building is a unique type of construction that is prevalent in Assam. This type of house has not been considered in the RVS format prescribed by Ministry of Home Affairs (MHA). However, depending upon the individual features of such buildings, it was either classified as masonry or RCC.

The screening methodology is encapsulated in a one-page form, which combines a description of a building, its layout and occupancy, and a rapid structural evaluation related to its seismic hazard. The structure has been identified for various hazard level for two main construction pattern viz. Masonry and Concrete. Both of these construction could be analyzed using one-page format given. The structural score attempts to quantify seismic hazard based on regional seismic hazard, "average" seismic capacity of each of structural types, soil conditions, configuration, and various structural deficiencies that can affect seismic performance. To account for regional seismic hazard, RVS form for Zone V Ordinary building (Also for Zone IV Important building) a region of the India was used in the training, the format is attached at the end of the report. The basis for regional seismic hazard is the map developed by the IS: 1893 (2002) describing peak ground acceleration in earthquakes. The forms are identical, except for the map region identifier in the upper right. In case of masonry buildings the buildings are classified from A to D and RCC or steel buildings are classified from C to F in the increasing order of its good

performance in any seismic activity (Table 1 & 2). The damage of the buildings is divided into Grade 1 to Grade 5 in increasing order for both type of construction (Table 3 & 4).

Table 1

Masonry load bearing wall building

Building Type	Description
A	Rubble (Field stone) in mud mortar or earthen walls
A+	As above but one storey only having light roof
B	Semi-dressed, rubble, brought to courses, with <i>through</i> stones and long corner stones; unreinforced brick walls with country type wooden roofs; unreinforced CC block walls
B+	As above of only single storeys and/or better quality of construction
C	Fully dressed (ashler) stone masonry or CC block or burnt brick walls built using good lime or cement mortar. Unreinforced walls but having RC floor/roof.
C+	As at C but having horizontal RC bands (IS: 4329, 13828).
D	Masonry construction as at C but reinforced with bands & vertical reinforcement, etc (IS: 4329), or confined masonry using horizontal & vertical reinforcing of walls.

Table 2

Reinforced Concrete Frame Buildings (RCF) and Steel Frames (SF)

Building Type	Description
C	RCF without ERD or WRD built in non-engineered way; RCF with hollow plinth (open ground storey); SF without bracings having hinge joints without ERD or WRD; RCF of ordinary design without ERD or WRD.
C+	MR-RCF/MR-SF of ordinary design without ERD or WRD
D	MR-RCF with ordinary ERD without special details as per IS: 13920, without ordinary infill walls (Such walls may be earlier similar to C in masonry buildings; MR-SF with ordinary ERD without special details as per plastic design handbook SP: 6(6)-1972.
E	MR-RCF with high level of ERD as per IS: 1893-2002 and special detail as per IS: 13920-1993 MR-SF with high level of ERD as per IS: 1893-2002 & special detail as per Plastic design handbook SP: 6(6)-1972.
E+	MR-RCF as at E with well designed Infill walls MR-SF as at E with well designed braces
F	MR-RCF as at E with well designed & detailed RC Shear walls MR-SF as at E with well designed & detailed steel braces & cladding; MR-RCF/MR-SF with well designed base Isolation

Table 3

GRADES OF DAMAGE TO MASONRY BUILDINGS

<p>Grade 1: Negligible to slight damage (no structural damage, slight non-structural damage) 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>	[Restoration]
<p>Grade 2: Moderate damage (Slight structural damage, moderate non-structural damage) Cracks in many walls fall of fairly large pieces of plaster. Partial Collapse of smoke chimney on roof.</p>	[Restoration]
<p>Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage) Large & extensive cracks in most walls. Roof tiles detach. Chimneys fracture at the roof line; failure of individual non-structural elements (partitions, gable walls).</p>	[Restoration & Retrofitting]
<p>Grade 4: Very heavy damage (heavy structural damage, very heavy non-structural damage) Serious failure of walls (gaps in walls), inner walls collapse; partial structural failure of roofs & floors.</p>	[Reconstruction & Restoration with partial Rebuilding/Retrofitting]
<p>Grade 5: Destruction (very heavy structural damage) Total or near total collapse of the building</p>	[Debris removal & Reconstruction]

Table 4

GRADES OF DAMAGE TO RCC BUILDINGS

<p>Grade 1: Negligible to slight damage (no structural damage, slight Non-structural damage) Fine cracks over plaster over frame members or in walls at the base. Fine crack in partitions & Infills.</p>	[Restoration]
<p>Grade 2 : Moderate damage (Slight structural damage, Moderate non- structural damages) Cracks in columns & beams of frames & structural walls. Cracks in partition & Infill walls; fall of brittle cladding & plaster. Falling mortar from the joints of wall panels.</p>	[Restoration]
<p>Grade 3: Substantial to heavy damage (moderate structural damage, heavy nonstructural damage) Cracks in columns & beams column joints of frame at base & at joints of coupled walls. Spalling of concrete cover, buckling of steel rods. Large cracks in partition & infill walls. Failure of individual infill panels.</p>	[Restoration & Retrofitting]

Grade 4: Very heavy Damage (heavy structural damage, Very heavy nonstructural damage)

Large cracks in structural elements with compression failure of concrete & fracture of rebar's, bond failure of beams reinforcing bars; tilting of columns. Collapse of few columns or a single upper floor.

[Demolition or Extensive Restoration & Retrofitting]

Grade 5: Destruction (Very heavy structural damage)

Collapse of ground floor parts (e.g. Wings) of the building.

[Debris Removal & Reconstruction]

The probable damageability in few/ many buildings is determined using the above given tables and classify the buildings accordingly. The given format is used for each building in the region where the study is going to conducted. The time required to do RV for any building is around 30 minutes so the large number of building can be evaluated in RV's and check the adequacy to perform more detailed evaluation for the building.

SURVEY IMPLEMENTATION INSTRUCTIONS

The training programe was organised by the faculties from the Department of Civil Engineering, Assam Engineering Institute, Chandmari, Guwahati. Dr. Indrani Gogoi, Mr. Ankush Borgohain and Mr. Utpal Baruah presented lectures on methodologies for survey of different types of the buildings. Dr. Jayanta Pathak, Department of Civil Engineering, Assam Engineering College, Guwahati presented an overview of RVS methodology. Mr. Utpal Sarma, Department of Remote Sensing, Guwahati explained how the RVS data could be integrated in GIS for disaster mitigation. The two classes of the buildings discussed were under the category of Masonry and RCC buildings. RV of the buildings as per one page format was discussed describing the each heading in details. Participants were instructed in the value of structural and soil information that could be obtained from plans and geotechnical reports in building department records, and so on. Following this, the basic areas of the data collection form were explained. The portions of the form include basic identifier information, photograph, plan sketch, occupancy, structural score, comments, and conclusion. Participants were instructed in how to draw a plan, take a photo, estimate age, and floor area, and how to identify the building's structural type.

GUIDED WALKING TOUR – ASSAM TYPE/ MASONRY BUILDING

Using the instructions given by the resource persons the engineering officials evaluated the different Assam Type buildings in Assam Engineering Institute, Chandmari and PWD Office, Chandmari. The building sidewalk survey was done by making team of three participants. Each team would completed the RV format for the buildings. Each evaluation was followed by on-site group discussion.

CLASSROOM REVIEW

The building was assessed by each team and in the classroom discussion with all teams and faculties the building was ranked as given in Table 5.

Table 5

Sl. No.	Building	Type	Damage Grade	Recommendations
1.	Assam Engineering Institute, Chandmari (1) Science Lab (2) Workshop (3) Survey Lab (4) Auditorium	D C C+ D	G3 G4 G4 G3	To increase the capacity of the building so that at least it could be in the class D type
2.	PWD Office Chandmari	B+	G4	Retrofitting and upgradation to D type

GUIDED WALKING TOUR – RCC BUILDING

Using the same methodology the engineering officials evaluated different buildings in (1) Assam Engineering Institute, Chandmari, (2) PWD Office, Chandmari (3) ASEB Housing, Ulubari, (4) a private apartment and (5) Krishi Bhawan, Khanapara. The team participants walked around and through the building. They also photographed irregularities, deteriorated and damaged parts of the buildings. Each team completed the RV format for the buildings at the site. Evaluations and discussions were made on the site alongwith the faculties. They returned to the training centre to computerise the data collected at site.

CLASSROOM REVIEW

The buildings were assessed by each team and in the classroom discussion with all teams and resource persons. The RCC buildings were assessed as given below in Table 6.

Table 6

Sl. No.	Building	Type	Damage Grade	Recommendations
1.	Assam Engineering Institute, Chandmari (1) Old Building (2) New Building	C+ D	G3 G3	Falling Hazards identified and measures for proper anchorage recommended
2.	PWD Office, Chandmari	D	G3	Repair and restoration
3.	ASEB Housing, Ulubari	C/C+	G5/G4	Retrofitting/Demolish
4.	Krishi Bhawan	D	G3	Retrofitting

CONCLUSIONS

The 5-day course proved fairly effective in training engineering officials in RVS methodologies (the IS: 13935 Draft Code/ MHA). This was a pilot training session, however, and it highlighted several areas where the methodology can be used for evaluation of many ill constructed or seismically hazardous structures in the state. The success of the pilot training program indicates that local officials can employ the RVS methodology with fairly good accuracy. The officials who participated in the pilot training program were not structural engineers, and entered the course with little if any knowledge of seismic principles of structural engineering. Nonetheless, the seminar provided them with adequate tools and knowledge to screen dozens of buildings per day per person. The same officials could screen all their commercial or private buildings in near future and evaluate the buildings according to RV's format for a given prescribed area; they could make judgments regarding the seismic vulnerability of the housing stock within a similar period.

There were 35 participants from different departments: PWD, ASEB, Water Resources, GMDA, Agriculture, GMC, Assam State Housing Board, PHE and Town & Country Planning. After the assessment of the participants a total of 33 participants successfully completed the training programme. A feedback of the participants was taken at the end of the training. The participants are confident about using this technique for preliminary seismic assessment of buildings. Most of the participants have appreciated this assessment technique and suggested more field trips.

List of participants of Rapid Visual Screening Training

Sl.No.	Name	Designation	Department	Contact No.
1	Mr. Padum Prasad Borah	A.E.	GMDA	9864263356
2	Mr. Pradip Barman	A.E.		9435116232
3	Mr. Rup Konwar Gogoi	A.E.		9435116229
4	Mr. Gautam Barkakati	A.E.	Water Resource	
5	Dr. Juran Ali Ahmed	A.E.		
6	Mr. Rudreswar Sarma	A.E.E		
7	Mr. Prabirjyoti Talukdar	A.E.		
8	Mr. M.C. Sarmah	A.E.E		9864324621
9	Mr. Lochan Choudhury*	A.E.		
10	Mrs. Alin Begum	A.E.	GMC	
11	Mr. Mashuk Ahmed Laskar	J.E.	Town & Country Planning	9864054468
12	Mr. Debojit Das	A.E.		9954082187
13	Mr. Azad Hussain Laskar	A.E.		
14	Mr. Dilip Kumar Gogoi	A.E.	Assam State Housing Board	9864450414
15	Mr. Uma Gogoi	A.E.		03612663118
16	Mr. Bhagaban Chandra Das	A.E.	PWD	
17	Mr. Biman Chandra Das	A.E.		9435191104
18	Mr. Kushal Chandra Bhuyan	J.E.		9859031182
19	Mr. Aminul Islam	A.E.		9864059586
20	Mr. Pranab Roy	A.E.		
21	Mr. Lakhi Kanta Mudoï	A.E.		
22	Mr. Biswajit Kalita	A. A.		
23	Mr. Sumanta Moni Hazarika	A.E.		
24	Mr. Maksud Ahmed Barbhuiya	A.E.		9435072308
25	Mr. Balwant Singh	A.E.E.		9864054847
26	Mr. Arup Kumar Das	A.E.		9864354847
27	Mr. Robin Kumar Sarmah	A.E.		PHE
28	Mr. Anil Chandra Talukdar	A.E.	Agriculture	
29	Mr. Hemanta Sarma	J.E.		9435302786
30	Mr. Biswajit Kumar Nath*	A.E.E		9435025368
31	Mr. Rupam Das	A.E.E		9435168564
32	Mr. Prasanta Kumar Khound	E.E.	ASEB	9435048683
33	Mr. Atul Borah	S.E.		9435045136
34	Mr. Pankaj Kumar Gogoi	E.E.		
35	Mr. Sisir Kumar Das	E.E.		

* Participant not qualified in RVS training

