MAJOR PROJECT

on

SEISMIC VULNERABILITY ASSESSMENT OF MASONARY BUILDINGS

Submitted in Partial Fulfillment for the Award of the Degree of

Master of Engineering
in
Civil Engineering

with specialization in

STRUCTURAL ENGINEERING
by

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(Roll No: 12384)
(Enrollment No: 01/STR/05)

Under the guidance of

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Department of Civil & Environmental Engineering
Delhi College of Engineering
University of Delhi, Delhi
2005-2009

CERTIFICATE

This is to certify that the project entitled “SEISMIC VULNERABILITY ASSESSMENT OF MASONARY BUILDINGS” being submitted by me, is a bonafide record of my own work carried by me under the guidance and supervision of Prof. P. R. Bose and Mr. G. P. Awadhia in partial fulfillment of requirements for the award of the Degree of Master of Engineering (Structural Engineering) in Civil Engineering, from University of Delhi, Delhi.

The matter embodied in this project has not been submitted for the award of any other degree or diploma in any other institution.

GULAM QADIR
Enroll No: 01/Str/05
Roll No: 12384

This is to certify that the above statement made by the candidate is correct to the best of our knowledge.

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Acknowledgement

It is a great privilege to acknowledge my deep sense of gratitude and indebtness to my esteemed teacher & guides **Prof. (Mrs.) P. R. BOSE** and **Mr. G. P. Awadhiya, Asstt. Prof.,** for their valuable guidance without which, completion of this project would not have been possible. I found myself lucky to work under the patronage of persons who has been very respectable to me because of their encouraging, affectionate and constructive attitude through the entire period. Their compassionate guidance, unlimited professional skills & benevolence have inspired me to embark upon this task. I will always try to strive for the quality that I have seen in them as a teacher and as a human being. Their untiring zeal for perfection, punctuality and excellence not only in student care, but in all horizons of life are the qualities which are hardly seen.

I also express my sincere gratitude to the faculty of Civil Engineering Department, Computer Centre & Library Delhi college of Engineering.

I also express my indebtedness to many sources, including those specially mentioned in the references, at the end of the text for using their literature for the preparation of this report.

Last but not the Least, I am thankful to my parents and friends for their forbearance, patience, encouragement and guidance.

GULAM QADIR

Enrolment No: 01/Str/05

Roll No.12384

ABSTRACT

The rapid urbanization has led to proliferation of slums and has severely strained the resources in our urban areas. Most recent constructions in the urban areas consist of poorly designed and constructed buildings. The older buildings, even if constructed in compliance with relevant standards at that time, may not comply with the more stringent specifications of the latest standards. There is an urgent need to assess the seismic vulnerability of buildings in urban areas of India as an essential component of a comprehensive earthquake disaster risk management policy.

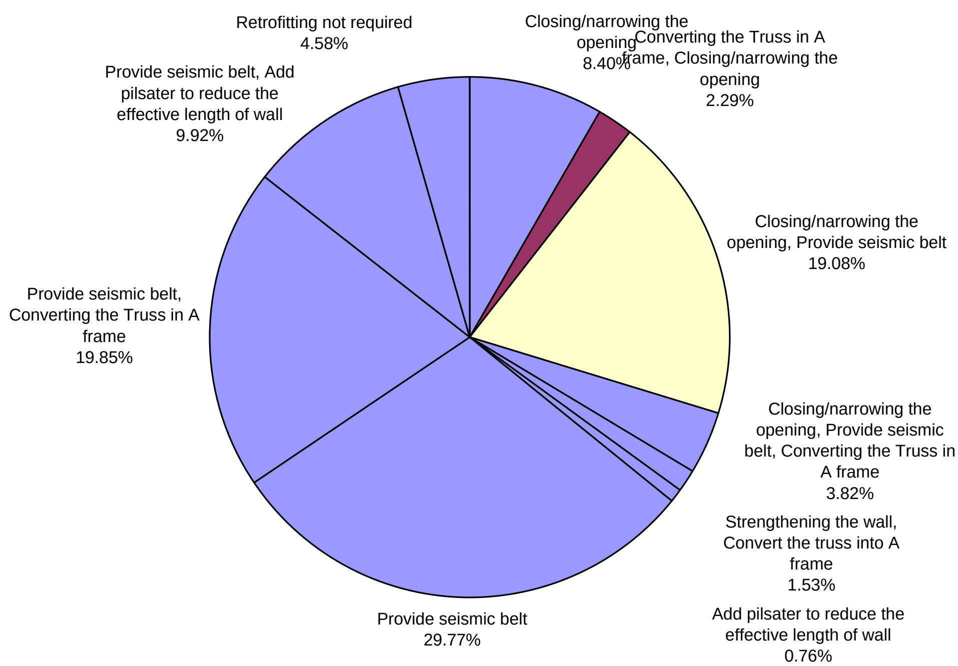
Detailed seismic vulnerability evaluation is a technically complex and expensive procedure and can only be performed on a limited number of buildings. It is therefore very important to use simpler procedures that can help to rapidly evaluate the vulnerability profile of different types of buildings, so that the more complex evaluation procedures can be limited to the most critical buildings. Assessment of one or two buildings is easy but becomes complicated procedure, when required for whole area. Therefore, a simple screening procedure is necessary to identify such vulnerable buildings, out of the existing building stock.

The visual assessment method (RVA/RSM Rapid Visual or Screening Method) is one of the most cost effective, reliable and efficient methods to determine the vulnerability levels of building structures. This method becomes particularly handy when mitigation priorities need to be determined for a large number of building stock. School buildings form a very important lifeline and can be very vulnerable, if located in region of high seismic hazard. This method can be applied more usefully to school buildings which would include a simple visual assessment of the structure in order to determine their seismic safety levels. This method involves determination of structural performance, when correlated with the school population, gives an indication of the vulnerability levels.

Most of the construction in Jammu & Kashmir is non-engineered masonry type because of easy availability of material. In most of the cases the Earthquake resistant measures are not provided. After October8’2005 earthquake people realize the importance of earthquake resistant building and looking for the guidance to retrofit the existing buildings and to construct new buildings incorporating all earthquake measures.

Retrofitting measures as per vulnerability assessment code(IS:4326, 13828,13827)

Status	No of Schools	%
Closing/narrowing the opening	11	8.46
Converting the Truss in A frame, Closing/narrowing the opening	3	2.31
Closing/narrowing the opening, Provide seismic belt	25	19.23
Closing/narrowing the opening, Provide seismic belt, Converting the Truss in A frame	5	3.85
Strengthening the wall, Convert the truss into A frame	2	1.54
Add pilsater to reduce the effective length of wall	1	0.77
Provide seismic belt	39	30.00
Provide seismic belt, Converting the Truss in A frame	26	20.00
Provide seismic belt, Add pilsater to reduce the effective length of wall	13	10.00
Retrofitting not required	6	4.62

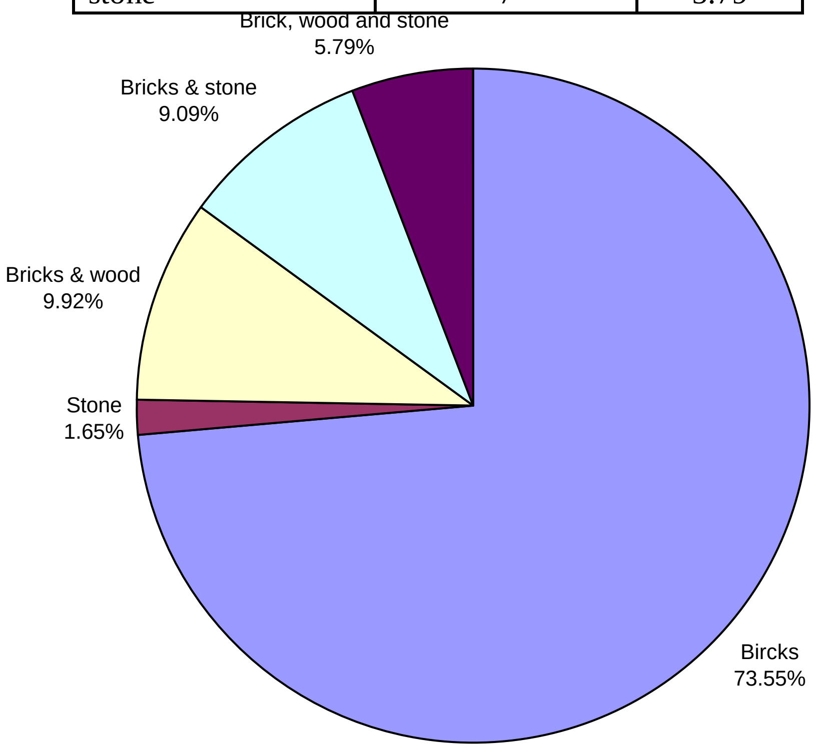


Analysis of collected data,

5.2.3.1 As per the structural system (superstructure/walls):

Mostly constructed buildings from burnt bricks with pitched roof system of wooden truss & CGI sheet. There was some buildings, which is the combination of brick & stone, brick & wood and brick, wood & stone.

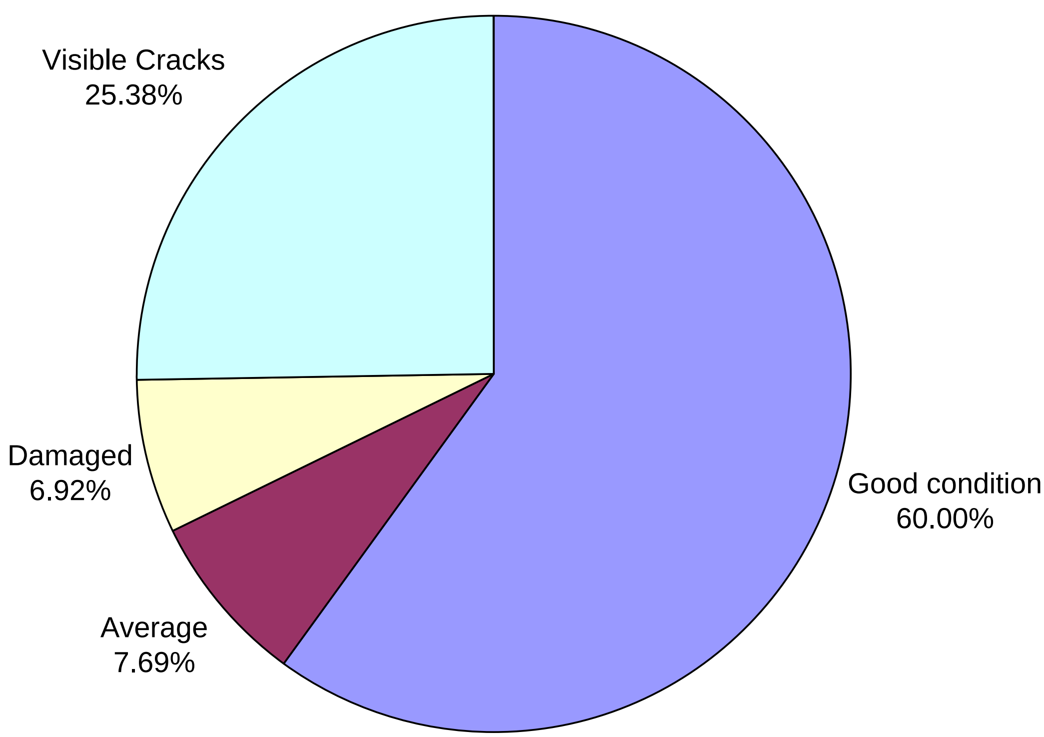
Status	No of Schools	%
Bricks	89	73.55
Stone	2	1.65
Bricks & wood	12	9.92
Bricks & stone	11	9.09
Brick, wood and stone	7	5.79



5.2.3.2 As per the condition assessment (as per visual inspection):

In this category assessment of the building is carried out on the basis of visual inspection at site. No visible cracks were found in about 60% buildings, this may be because of regular maintenance of the buildings, while there is 40% building were some damage, crack was visible. The seismic zone of the Srinagar is Zone-V and mostly buildings are Type-A, Type-B+ & Type-C, which are susceptible of grade 5 & grade 4 damages. [Ref: table 2.1, 2.2 & 2.3]

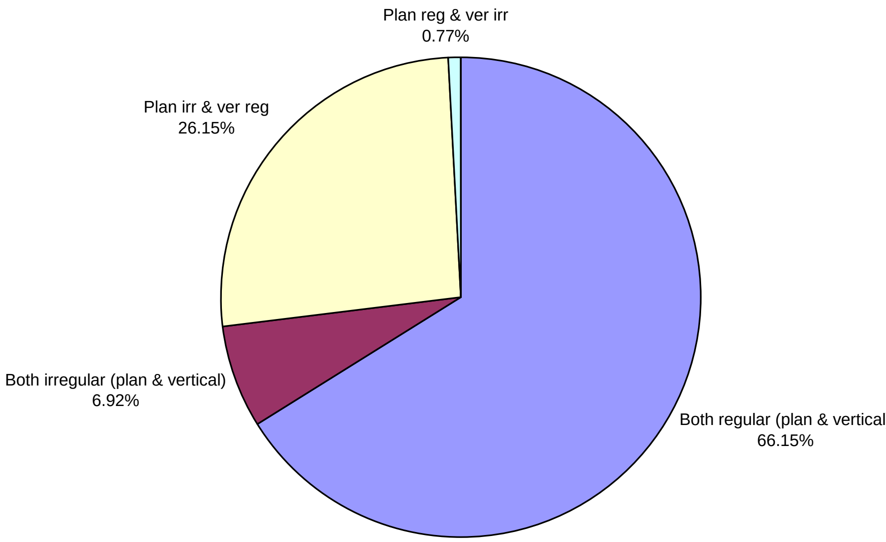
Status	No of Schools	%
Good condition, (No visible cracks)	78	60.00
Average, (some were plaster/ finishing needed repairing)	10	7.69
Damaged, (mortar coming out from joints)	9	6.92
Visible Cracks, (Diagonal, vertical, etc)	33	25.38



5.2.3.3 As per the irregularity:

As per code whole buildings are divided into :

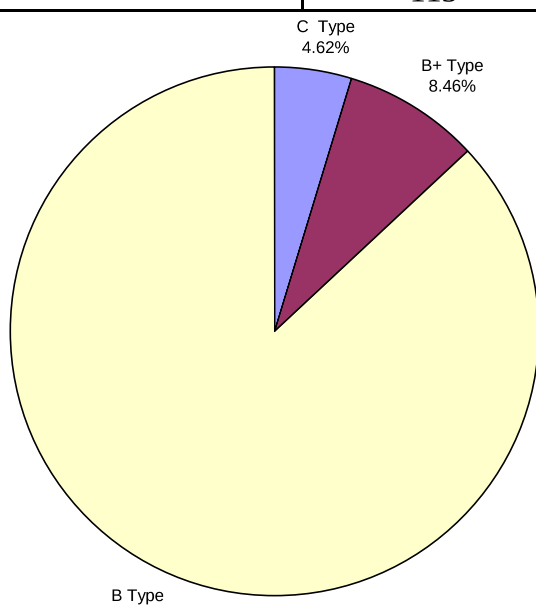
Status	No of Schools	%
Both regular (plan & vertical)	86	66.15
Both irregular (plan & vertical)	9	6.92
Plan irregular & vertical reg	34	26.15
Plan regular & ver irregular	1	0.77



5.2.3.4 As per the vulnerability:

whole buildings are divided into A to F type:

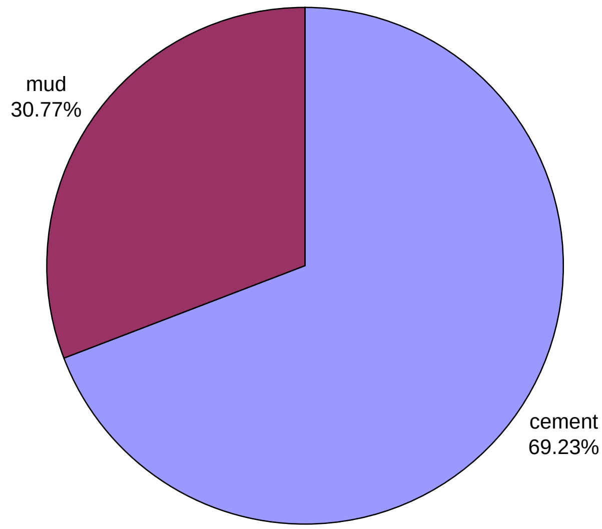
Status	No of Schools	%
C Type	6	4.62
B+ Type	11	8.46
B Type	113	86.92



5.2.3.5 As per the used mortar:

As per visual inspection whole buildings are divided into two type of mortar:

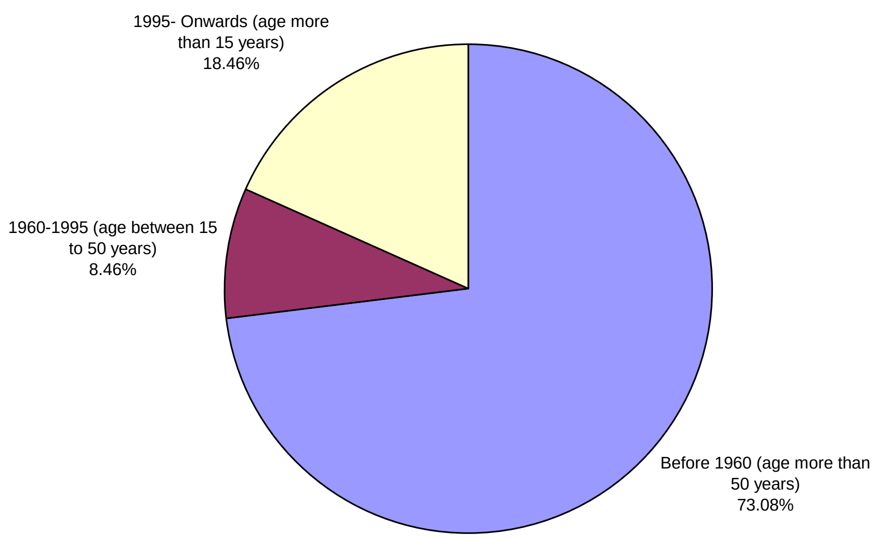
Status	No of Schools	%
Cement sand mortar	90	69.23
Mud mortar	40	30.77



5.2.3.6 As per the age of the buildings and built year:

Total building divided into three parts, newly constructed buildings (age less than 15 years), middle age building (age between 15 to 50 years) and old buildings (age more than 50 years).

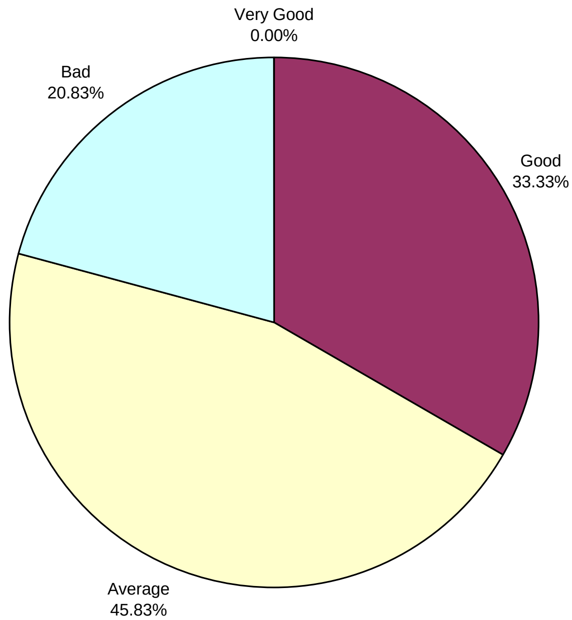
Status	No of Schools	%
Before 1960 (age more than 50 years)	95	73.08
1960-1995 (age between 15 to 50 years)	11	8.46
1995- Onwards (age less than 15 years)	24	18.46



5.2.3.7.1 Old age building (age more than 50 year):

Old age buildings further classified as per their visual condition:

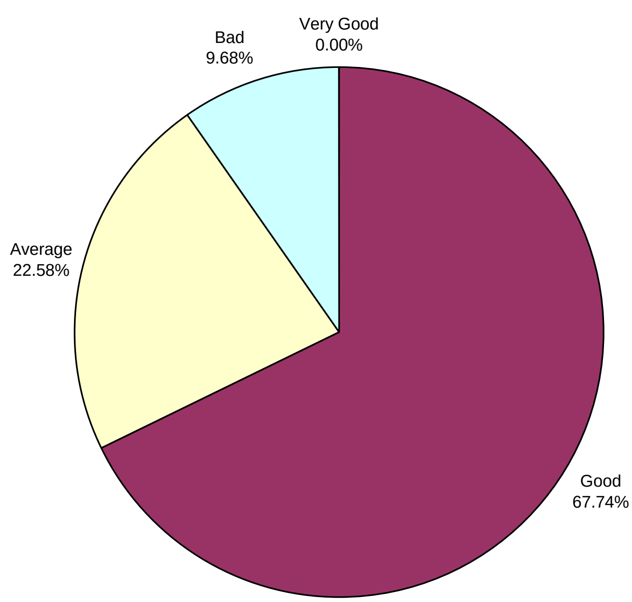
Status	No of Schools	%
Very Good	0	0.00
Good	8	33.33
Average	11	45.83
Bad	5	20.83



5.2.3.7.2 Middle age building (age between 15 to 50 year):

Middle age buildings further classified as per their visual condition:

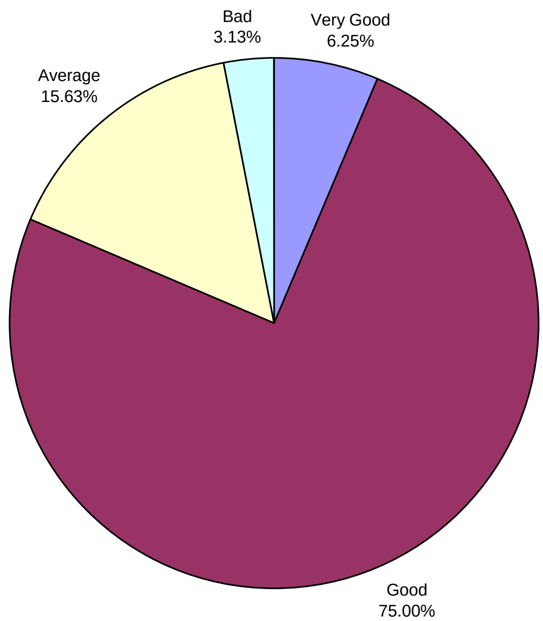
Status	No of Schools	%
Very Good	0	0.00
Good	63	67.74
Average	21	22.58
Bad	9	9.68



5.2.3.7.3 New building (age less than 15 year):

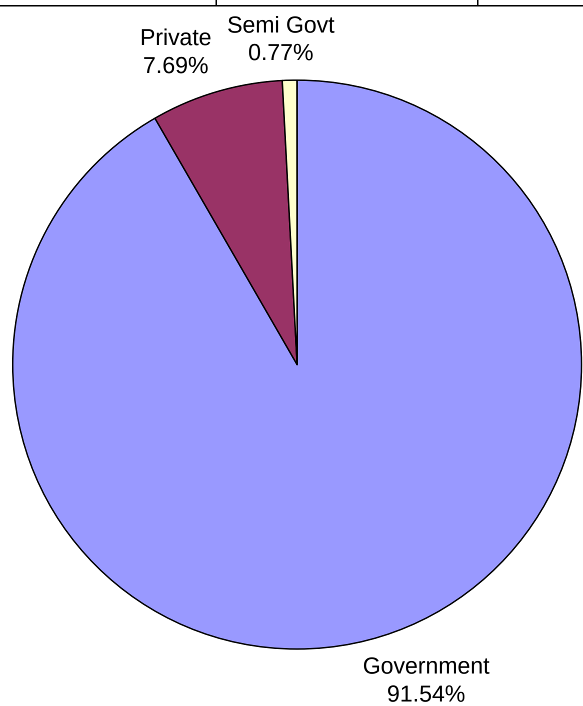
New age buildings further classified as per their visual condition:

Status	**No of Schools**	**%**
Very Good	2	6.25
Good	24	75.00
Average	5	15.63
Bad	1	3.13



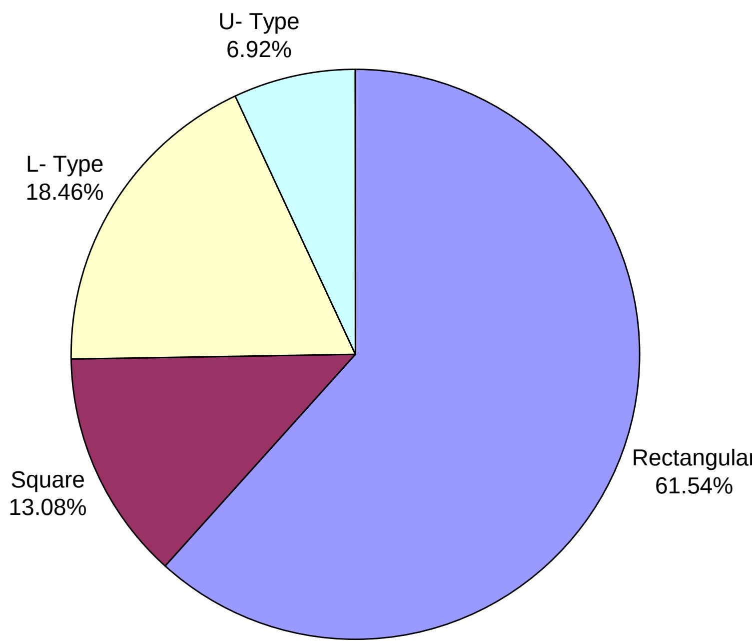
5.2.3.8 As per the School operation type:

Status	No of Schools	%
Government	119	91.54
Private	10	7.69
Semi	1	0.77



5.2.3.9 As per the shape of the school:

Status	No of Schools	%
Rectangular	80	61.54
Square	17	13.08
L- Type	24	18.46
U- Type	9	6.92

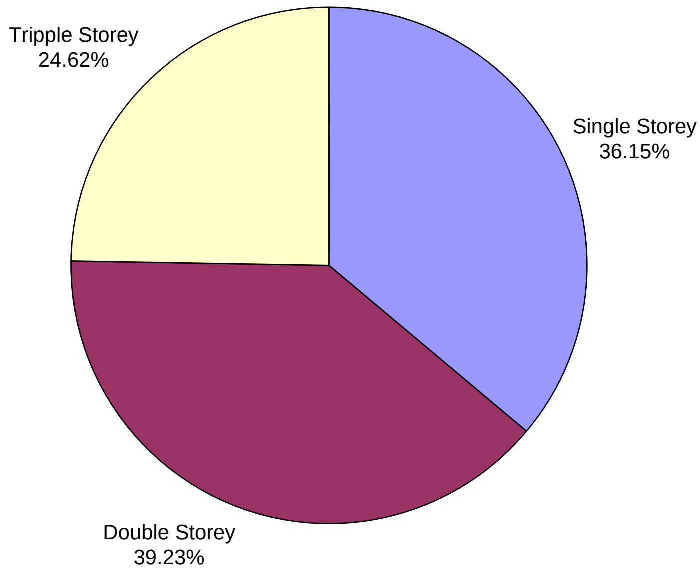


Shape	**Nos**	**Very good**	**Average**	**Bad**	**Good**	**% of Good**
Rectangle	80		18	9	51	63.75
L- Type	24	2	2	1	19	79.17
Square	17		5	2	10	58.82

From above graph it is seen that about 62% building constructed in rectangular shape while L-type shape building share is 18%. As per visual inspection it is seen that mostly building of L-Type shape is in good condition.

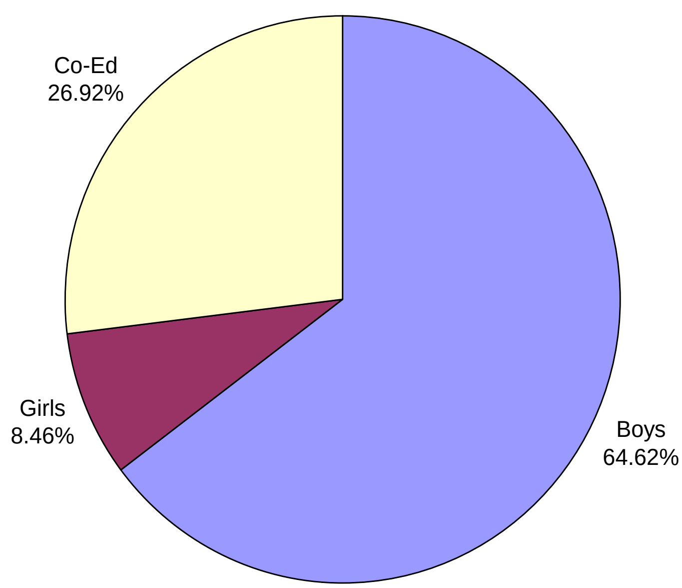
5.2.3.10 As per the Nos. of stories:

Status	No of Schools	%
Single Storey	47	36.15
Double Storey	51	39.23
Tripple Storey	32	24.62



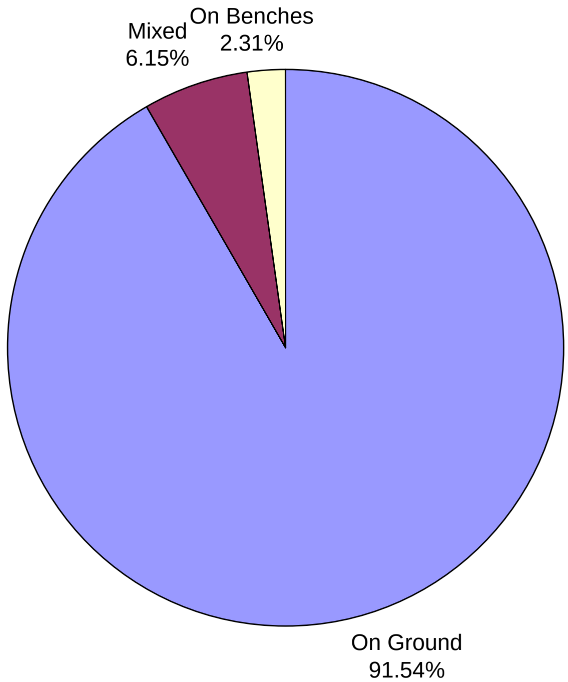
5.2.3.11 As per the type of education system:

Status	No of Schools	%
Boys	84	64.62
Girls	11	8.46
Co-Ed	35	26.92



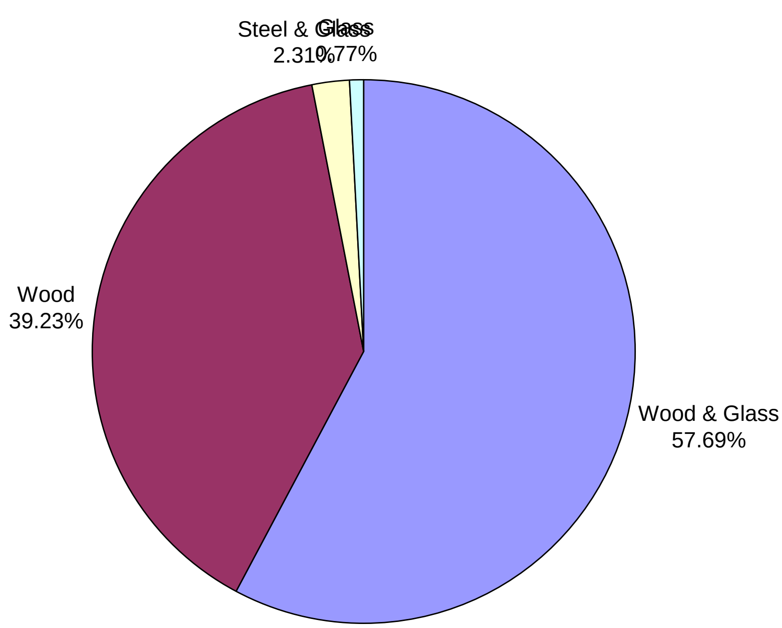
5.2.3.12 As per the seating arrangement:

Status	No of Schools	%
On Ground	119	91.54
Mixed	8	6.15
On Benches	3	2.31



5.2.3.13 As per the Door/Window:

Status	No of Schools	%
Wood & Glass	75	57.69
Wood	51	39.23
Steel & Glass	3	2.31
Wood, Steel & Glass	1	0.77



Seismic Design Compliance Assessment of Building

Name of Building: Dream land public school, Bemina, Srinagar (Building code 100)

Built year: 1988

Vertical irregularity: No

Plan irregularity: No

Building Category: – B

Material category: - Brick (Super str.)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys **02**	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit **BB**	Comp strength > 35mpa	8.1.1	Yes	Not required
3	Wall thickness G.F. I.F. **230 230**	BB = 230 mm CCB = 200 mm	8.5	Yes	Not required
4	Largest size room 4.1 m X 4.0m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	Yes	Not required
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(4x0.9+4x1.5+1.05)/13.95 = 76% (GF) =(4x0.9+4x1.5)/13.95 = 69% (FF) (ii) B4 min. =230 mm (iii) B5 min.=230 mm	 50% 42% 560 mm 450 mm	Table: 04, Figure: 07	 No No No No	Attain the limit by closing, narrowing an opening or reinforce the opening by seismic bending. Increase by building up or strengthening by ferro-cement plating.
7	Wall length/thickness ratio = l/t =4.10/0.23=17.8	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =2.55/0.23=11.1	Max 15t or 4m	Ref: 16	Yes	Not required

9	Soil at base : Medium	N/A	Ref: 16	Medium	Not required
10	Floor type: **RC slab**	Thickness 1/50 of span, min 100 mm	5.3.4.2	Yes	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not requied
12	Seismic Bands (i) at plinth No (ii) at lintel level No (iii) at ceiling or eave level No (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes No No No No	 Not required Provide seismic belt on both face of wall -Do- -Do- -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs (yes/no) (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

Seismic Design Compliance Assessment of Building

Name of Building: Bismillah Educational institute, Bemina, Shahi Hamdan, Srinagar (Building code : 50)
Built year: 1992
Vertical irregularity: No
Plan irregularity: Yes
Building Category: – B
Buiding material : - Brick (Super str.)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys **02**	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit **BB**	Comp strength > 35mpa	8.1.1	Yes	Not required
3	Wall thickness G.F. I.F. II. F. III.F 230 230	BB = 230 mm CCB = 200 mm	8.5	Yes	Not required
4	Largest size room 5.0 m X 3.5m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	Yes	Not required
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(5x0.9+4x1.4)/17.0 = 59% (GF) =(5x0.9+4x1.4)/17.0 = 59% (FF) (ii) B4 min. =350 mm (iii) B5 min.=230 mm	 50% 42% 560 mm 450 mm	Table: 04, Figure: 07	 No No No No	Attain the limit by closing, narrowing an opening or reinforce the opening by seismic bending. Increase by building up or strengthening by ferro-cement plating.
7	Wall length/thickness ratio = l/t =5.0/0.23=21.7	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =2.35/0.23=10.2	Max 15t or 4m	Ref: 16	Yes	Not required
9	Soil at base : medium	N/A	Ref: 16	Medium	Not required

10	Floor type: **RC slab**	Thickness 1/50 of span, min 100 mm	5.3.4.2	Yes	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not requied
12	Seismic Bands (i) at plinth No (ii) at lintel level No (iii) at ceiling or eave level No (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes No No No No	 Not required Provide seismic belt on both face of wall -Do- -Do- -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

<u>**Seismic Design Compliance Assessment of Building**</u>

Name of Building: Govt. Girls Middle School, Kraliyarpora, Srinagar (Building code: 9)

Built year: 1958
Vertical irregularity: No
Plan irregularity: No
Building Category: – B
Building material : - Brick/Stone/Timber(Super str)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys 03	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit BB/CCB (solid)/CCBC (hollow) **BB/Stone masonay with wooden framing**	Comp strength > 35mpa	8.1.1	No	Walls may be strengthened by ferro cement plating or injecting grouting
3	Wall thickness G.F. I.F. II. F. 230-BB & 450-SM 230-BB	BB = 230 mm CCB = 200 mm SM < or =450 (Through stone required, long stone at every alternate alternate course)	8.5	Yes No	Not required Install RC headers
4	Largest size room 4.0 m X 3.5m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	No	Walls may be strengthened by ferro cement plating or injecting grouting
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max	50%	Table: 04, Figure: 07	No	Attain the limit by closing, narrowing an opening or reinforce the opening by

	=(4x1.4+1.35)/10.0 = 83% (GF) =(5x1.4)/10.0 = 70% (FF) =(4x1.4)/10.0 = 56% (SF) (ii) B4 min. =560 mm (iii) B5 min.=690 mm	42% 33% 560 mm 450 mm		No No Yes Yes	seismic bending. Not required
7	Wall length/thickness ratio = l/t =4.0/0.23=17.4	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =2.30/0.23=10	Max 15t or 4m	Ref: 16	Yes	Not required
9	Soil at base : medium	N/A	Ref: 16	Medium	Not required
10	Floor type : Wooden	N/A	--	No	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not required
12	Seismic Bands (i) at plinth No (ii) at lintel level Yes (iii) at ceiling or eave level Yes (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes Yes Yes No No	 Not required Not required Provide seismic belt on both face of wall -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

Seismic Design Compliance Assessment of Building

Name of Building: Bemina Eagles Modern Educational Institute, Hamza colony, Srinagar (Building code: -01)
Built year: 1990
Vertical irregularity: No
Plan irregularity: No
Building Category: – B+
Building material : - Brick (Super str)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys 03	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit BB/CCB (solid)/CCBC (hollow) **BB**	Comp strength > 35mpa	8.1.1	Yes	Not required
3	Wall thickness G.F. 230 I.F. II. F. 230-BB	BB = 230 mm CCB = 200 mm	8.5	Yes	Not required
4	Largest size room 6.5 m X 3.5m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	Yes	Not required
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(3x2.2+2.0+0.9)/12.35 = 77% (GF) =(3x2.2)/12.35 = 54% (FF) =(3x2.2)/12.35 = 54% (SF) (ii) B4 min. =460 mm (iii) B5 min.=350 mm	 50% 42% 33% 560 mm 450 mm	Table: 04, Figure: 07	 No No No Yes Yes	Attain the limit by closing, narrowing an opening or reinforce the opening by seismic bending. Increase by building up or strengthening by ferro-cement plating.
7	Wall length/thickness ratio = l/t =6.5/0.23=28	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =3.5/0.23=15	Max 15t or 4m	Ref: 16	Yes	Not required

9	Soil at base Soft/ hard/medium	N/A	Ref: 16	Medium	Not required
10	Floor type: **RC slab 120 mm**	Thickness 1/50 of span, min 100 mm	5.3.4.2	Yes	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not requied
12	Seismic Bands (i) at plinth No (ii) at lintel level No (iii) at ceiling or eave level No (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes No No No No	 Not required Provide seismic belt on both face of wall -Do- -Do- -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

Seismic Design Compliance Assessment of Building

Name of Building: Govt. Primary school, Naidyar Payeen, Srinagar (Building code : 56)
Built year: 1960
Vertical irregularity: No
Plan irregularity: No
Building Category: – B
Building material : - Brick/Timber (Super str)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys 02	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit BB/CCB (solid)/CCBC (hollow) **BB with wooden framing**	Comp strength > 35mpa	8.1.1	No	Walls may be strengthened by ferro cement plating or injecting grouting
3	Wall thickness G.F. I.F. 115 115-BB-with timber framing @ 75 cm c/c of	BB = 230 mm CCB = 200 mm	8.5	No	Add pilsters to increase the effective thickness
4	Largest size room 6.5 m X 3.5m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	No	Walls may be strengthened by ferro cement plating or injecting grouting
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(2x0.85+1.4)/8.45 = 70% (GF) =(2x0.85+2x1.4)/8.45 = 53% (FF)	 50% 42%	Table: 04, Figure: 07	 No No	Attain the limit by closing, narrowing an opening or reinforce the opening by seismic bending.

	(ii) B4 min. =350 mm (iii) B5 min.=460 mm	560 mm 450 mm		No Yes	Increase by building up or strengthening by ferro-cement plating.
7	Wall length/thickness ratio = l/t =5.0/0.23=22	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =2.2/0.23=10	Max 15t or 4m	Ref: 16	Yes	Not required
9	Soil at base Soft/ hard/medium	N/A	Ref: 16	Medium	Not required
10	Floor type (tick mark) RC slab/RB slab/ Precast beams or slabs	N/A	5.3.4.2	No	N/A
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not requied
12	Seismic Bands (i) at plinth No (ii) at lintel level No (iii) at ceiling or eave level No (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes No No No No	 Not required Provide seismic belt on both face of wall -Do- -Do- -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

Seismic Design Compliance Assessment of Building

Name of Building: Govt. Girls Primary School, Barjee Nishat, Srinagar **(Building code : 101)**

Built year: 1985
Vertical irregularity: No
Plan irregularity: Yes
Building Category: – B
Building material : - Stone (Super str)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys 01	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit BB/CCB (solid)/CCBC (hollow) **Stone**	Comp strength > 35mpa	8.1.1	Yes	Not required
3	Wall thickness G.F. 450	BB = 230 mm CCB = 200 mm Stone =Not more than 450,	8.5	Yes	Not required
4	Largest size room 8.2 m X 4.3m	8 m X 8 m	Table: 6, Note:01	No	Add pilster or additional wall may be added to reduce the effective length of wall.
5	Mortar used C:S =-1:4	1:4	Table: 03	Yes	Not required
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(4x1.8)/12.8 = 56% (GF)	50%	Table: 04, Figure: 07	No	Attain the limit by closing, narrowing an opening or reinforce the opening by

	(ii) B4 min. =600 mm (iii) B5 min.=450 mm	560 mm 450 mm		Yes Yes	seismic bending. Not required.
7	Wall length/thickness ratio = l/t =8.2/0.45=22	Max = 35t or 8m	Ref: 16	No	Add pilster or additional wall may be added to reduce the effective length of wall.
8	Wall height/thickness ratio =h/t =2.45/0.23=5.4	Max 15t or 4m	Ref: 16	Yes	Not required
9	Soil at base Soft/ hard/medium	N/A	Ref: 16	Medium	Not required
10	Floor type (tick mark) RC slab/RB slab/ Precast beams or slabs	N/A	--	Yes	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not requied
12	Seismic Bands (i) at plinth No (ii) at lintel level Yes (iii) at ceiling or eave level No (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes Yes No No No	 Not required Not required Provide seismic belt on both face of wall -Do- -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

Seismic Design Compliance Assessment of Building

Name of Building: Govt. Middle School, Panjkharwari, Shah colony, Srinagar (Building code: -37)

Built year: 1980

Vertical irregularity: No

Plan irregularity: No

Building Category: – B+

Building material : - Brick (Super str)

S. No	**Date of Building under Assessment**	**Required as per code**	**Clause of Code IS:4326**	**Compliant Yes/No**	**Action for retrofitting**
1	Number of storeys 03	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit BB/CCB (solid)/CCBC (hollow) **BB**	Comp strength > 35mpa	8.1.1	Yes	Not required
3	Wall thickness G.F. 230	BB = 230 mm CCB = 200 mm	8.5	Yes	Not required
4	Largest size room 4.6 m X 3m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	Yes	Not required
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(6x1.0+0.55x6)/18.85 = 49% (GF) (ii) B4 min. =1000 mm	 560 mm	Table: 04, Figure: 07	 Yes Yes	 Not required

	(iii) B5 min.=1500 mm	450 mm		Yes	
7	Wall length/thickness ratio = l/t =4.6/0.23=20	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =2.5/0.23=11	Max 15t or 4m	Ref: 16	Yes	Not required
9	Soil at base Soft/ hard/medium	N/A	Ref: 16	Medium	Not required
10	Floor type: **Single storey**	N/A	5.3.4.2	N/A	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not required
12	Seismic Bands (i) at plinth No (ii) at lintel level No (iii) at ceiling or eave level No (iv) at window sill level Yes (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes No No No No	 Not required Provide seismic belt on both face of wall -Do- Not required -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	 Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	 Yes	Not required. Structural steel truss provided.

Seismic Design Compliance Assessment of Building

Name of Building: Govt. Girls Primary School, Ahmad Nagar, Srinagar (Building code: -108)

Built year: 1960

Vertical irregularity: No

Plan irregularity: No

Building Category: – B

Building material : - Brick (Super str)

S. No	Date of Building under Assessment	Required as per code	Clause of Code IS:4326	Compliant Yes/No	Action for retrofitting
1	Number of storeys 01	Less than 4 storey	8.4.1	Yes	Not required
2	Wall building unit BB/CCB (solid)/CCBC (hollow) **BB**	Comp strength > 35mpa	8.1.1	Yes	Not required
3	Wall thickness G.F. 230	BB = 230 mm CCB = 200 mm	8.5	Yes	Not required
4	Largest size room 6.4 m X 4.4m	8 m X 8 m	Table: 6, Note:01	Yes	Not required
5	Mortar used C:S =-1:4	1:4	Table: 03	Yes	Not required
6	Door, Window openings (Based on building height) Overall (b1 + b2+….)/l, max =(3x1.8+2x0.85)/14.3 = 49% (GF)	50%	Table: 04, Figure: 07	Yes	Not required

	(ii) B4 min. =560 mm (iii) B5 min.=450 mm	560 mm 450 mm		Yes Yes	
7	Wall length/thickness ratio = l/t =6.4/0.23=28	Max = 35t or 8m	Ref: 16	Yes	Not required
8	Wall height/thickness ratio =h/t =2.55/0.23=11	Max 15t or 4m	Ref: 16	Yes	Not required
9	Soil at base Soft/ hard/medium	N/A	Ref: 16	Medium	Not required
10	Floor type: **RC slab 120 mm**	N/A	5.3.4.2	Yes	Not required
11	Roof type : **sloping/trusses**	Gable band	Figure: 10	Yes	Not required
12	Seismic Bands (i) at plinth No (ii) at lintel level No (iii) at ceiling or eave level No (iv) at window sill level No (v) at gable ends No	 OnlyIf, type-III soil Needed Needed in sloping roof Needed Needed in sloping roof	 8.4.6 8.4.2 8.4.3 8.4.4 8.4.5	 Yes No No No No	 Not required Provide seismic belt on both face of wall -Do- -Do- -Do-
13	Vertical bar (i) at corners No (ii) at T-junctions No (v) at jambs of door No (vi) at jambs of windows No	 Needed Needed Needed Needed	Table: 07, 8.4.8	No No No No No	Install equivalent bars or vertical belts at corners and T-junction and around the opening.
14	Sloping Roofs : (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)	Prefebly use full truss. Horizontal X-barcing at level of ties of the roof. X-bracing in the planes of the rafter and purline	5.4.2	No	Convert rafter into A frame. Install the X-bracing and anchor trusses into walls and rafter into seismic belt at eve level.

S. No.	Name of School	height of building	Vertical Irregularity	Plan Irregularity	Vulnerability class as per IS:4326 (B to E+)	Vulnerability class (A to F)	Construction defects	Suspended /Non Structural Members	Length of longest wall		Score of Building	Time period	Storey shear	Action for Retrofitting
									Lx	Ly		Ta=0.09h/d1/	Vb=Ah*W	
													Ah=(ZISa/2Rg)	
1	Bemina Eagles Modern Ed. Instiute	7.70	Regular	Regular	E+	B+	Nil	-	12.35	8.5	3.2	0.238	0.45W	Retrofitting is not required.
2	Govt. Primary school	7.00	Regular	Regular	E+	B	Plinth beam not provided, length of longest wall is more than specified in code, boxing not provided, lintel beam not provided, building not designed	Window shutters	11.6	5.8	3.2	0.262	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
3	Govt. Boys Middle School	6.95	Regular	Regular	E+	B	.-Do- and gable end is open	-	12.6	10.2	3.2	0.196	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
4	Govt. Girls Primary School	7.30	Regular	Irregular	E+	B	.-Do-	Railing, supproting posts	14	9.2	2.4	0.217	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
5	Govt. Primary school	4.70	Regular	Regular	E+	B	Plinth beam, lintel beam not provided, Stone masonary is hollow at many places, opening is more than specified as per code.	Window shutters	13.3	7.3	3.2	0.157	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
6	Govt. Primary school (Boys & Girls)	5.40	Regular	Regular	E+	C	Plinth beam not provided.	Window shutters	15.5	12	3.2	0.14	0.45W	Provide seismic belt of equivalent on both sides of walls
7	Govt. Boys Middle School	7.18	Regular	Regular	E+	C	Opening is more than specified, pier width is less	Nil	9.3	4.5	3.2	0.305	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.Provide seismic belt of equivalent on both sides of walls
8	Govt. Girls Middle School	6.90	Regular	Regular	E+	B	Member in truss is less, pier width is less	Chajja	10	6.6	3.2	0.242	0.45W	Convert rafter into A frame, pier width increse with builtup or reinforce with belt.Provide seismic belt of equivalent on both sides of walls
9	Govt. Boys Middle School	6.90	Regular	Regular	E+	B	Member in truss is less, pier width is less	-	10	6.6	3.2	0.242	0.45W	Convert rafter into A frame, pier width increse with builtup or reinforce with belt.Provide seismic belt of equivalent on both sides of walls
10	ISME Azam school	7.35	Irregular	Irregular	E+	C	Opening is more than specified, pier width is less	Window shutters, railing	30.15	6.4	0.9	0.261	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
11	Govt. Boys Middle School	7.19	Regular	Regular	E+	B	Member in truss is less, pier width is less	-	9.9	4	0.9	0.324	0.45W	Convert rafter into A frame, pier width increse with builtup or reinforce with belt.Provide seismic belt of equivalent on both sides of walls
12	Govt. Primary school	7.00	Regular	Regular	E+	B	Opening is more than specified, pier width is less	-	11.6	5.8	0.9	0.262	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
13	Hindu High School(Boys and Girls)	8.00	Irregular	Irregular	E+	B	Opening is more than specified, pier width is less	Window shutters	20	15	0.9	0.186	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.Provide seismic belt of equivalent on both sides of walls
14	Govt. Primary school	2.57	Irregular	Irregular	E+	B	Member in truss is less, pier width is less	-	14.7	7	0.9	0.087	0.45W	Convert rafter into A frame, pier width increse with builtup or reinforce with belt.
15	Govt. Middle School	2.53	Regular	Regular	E+	C	Left side wall is more than specified,	-	17.4	7	3.2	0.086	0.45W	provide pilaster or butress to reduce effective length
16	Govt. Primary school	2.50	Regular	Regular	E+	C	Plinth beam not provided.	Railing	16	5	3.2	0.101	0.45W	Provide seismic belt of equivalent on both sides of walls
17	Govt. Girls Primary School	3.15	Regular	Regular	E+	B	Plinth beam not provided.	-	9.2	4.5	3.2	0.134	0.45W	Provide seismic belt of equivalent on both sides of walls
18	Govt. Boys Primary school	2.70	Regular	Irregular	E+	C	Nil	-	14.6	4	2.4	0.122	0.45W	Retrofitting is not required.
19	Miranda Public High School	6.20	Regular	Irregular	E+	B	Plinth beam not provided.	-	17.2	8	2.4	0.197	0.45W	Provide seismic belt of equivalent on both sides of walls
20	Govt. Primary school	1.95	Regular	Regular	E+	B	Plinth beam not provided.	-	6.5	3.75	3.2	0.091	0.45W	Provide seismic belt of equivalent on both sides of walls

S. No.	Name of School	height of building	Vertical Irregularity	Plan Irregularity	Vulnerability class as per IS:4326 (B to E+)	Vulnerability class (A to F)	Construction defects	Suspended /Non Structural Members	Length of longest wall		Score of Building	Time period	Storey shear	Action for Retrofitting
									Lx	Ly		$T_a=0.09h/d^{1/}$	$V_b=A_h*W$	
21	Govt. Girls Primary School	2.25	Regular	Regular	E+	B	Plinth beam not provided, pier width is less	window shutter	6.1	3.95	3.2	0.102	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
22	Govt. Primary school	2.50	Regular	Regular	E+	B	length of building is more than 3B (L>3B), lateral wall length is more, plinth beam is not provided	window shutter	17.7	6	3.2	0.092	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
23	Govt. Girls Primary School	2.65	Regular	Regular	E+	B	length of building is more than 3B (L>3B), lateral wall length is more, plinth beam is not provided	window shutter	15.1	7.4	3.2	0.088	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
24	Govt. Boys Primary school	2.65	Regular	Regular	E+	B	length of building is more than 3B (L>3B), lateral wall length is more, plinth beam is not provided	window shutter	15.1	7.4	3.2	0.088	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
25	Govt. Primary School(Eng Med)	2.60	Regular	Regular	E+	B	Plinth beam not provided, pier width is less	window shutter	9	5.5	3.2	0.1	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
26	Govt. Mixed Primary School	2.60	Regular	Irregular	E+	B	length of building is more than 3B (L>3B), plinth beam is not provided	window shutter	15	3.54	2.4	0.124	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening.
27	Govt. Mixed Primary School	2.70	Regular	Irregular	E+	B	Pier width is less, opening is more in front wall	-	8.3	6.6	2.4	0.095	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
28	Wisdom Public High School	2.30	Regular	Irregular	E+	B	Pier width is less, opening is more in front wall	window shutter	33	3.85	2.4	0.105	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
29	Govt. Mixed Primary School	2.60	Regular	Regular	E+	B	Pier width is less, opening is more in front wall	window shutter	14.6	4.15	3.2	0.115	0.45W	Provide seismic belt of equivalent on both sides of walls
30	Govt. Boys High School	2.75	Regular	Irregular	E+	B	length of building is more than 3B (L>3B), plinth beam, lintel beam is not provided	window shutter, verandah column	16.5	5	3.2	0.111	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening.
31	Govt. Girls Middle School	2.25	Regular	Regular	E+	B	Plinth, lintel beam is not provided	Window shutter	12.8	5.8	3.2	0.084	0.45W	Provide seismic belt of equivalent on both sides of walls
32	Govt. Primary school	2.60	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified.	-	15	6.5	3.2	0.092	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
33	Govt. Primary school	2.60	Regular	Regular	E+	B+	Plinth, lintel beam is not provided, gable end is open	Railing, window shutter	9.3	7.3	3.2	0.087	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening.
34	Govt. Primary school, Eng med	2.80	Regular	Regular	E+	B+	Plinth, lintel beam is not provided, gable end is open	-	13.8	4	3.2	0.126	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening.
35	Govt. Boys Middle school	2.33	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified.	Window shutter	9.45	4.5	3.2	0.099	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
36	Govt. Middle school	2.35	Regular	Regular	E+	B+	Pier width is less.	-	22	8.6	3.2	0.072	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
37	Govt. Middle school	2.50	Regular	Irregular	E+	B	Plinth, lintel beam is not provided,	-	18.85	4.6	2.4	0.105	0.45W	Provide seismic belt of equivalent on both sides of walls
38	Govt. Mixed Primary School	2.40	Regular	Regular	E+	B	Opening is more than specified, pier width is less	Window shutter	14	6.2	3.2	0.087	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
39	Govt. Girls Primary School	2.75	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified,	Window shutter	11.3	4.6	3.2	0.115	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.Provide seismic belt of equivalent on both sides of walls

S. No.	Name of School	height of building	Vertical Irregularity	Plan Irregularity	Vulnerability class as per IS:4326 (B to E+)	Vulnerability class (A to F)	Construction defects	Suspended /Non Structural Members	Length of longest wall		Score of Building	Time period	Storey shear	Action for Retrofitting
									Lx	Ly		$Ta=0.09h/d^{1/}$	Vb=Ah*W	
40	Govt. Primary school	4.50	Regular	Irregular	E+	B	Back wall length is more than specified, lintel and plinth beam is not provided	Window shutter	7	3.5	2.4	0.216	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
41	Govt. Boys Primary school	4.60	Regular	Regular	E+	B	Opening is more than specified, pier width is less	Chajja, window shutter	12.5	4.9	3.2	0.187	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
42	Govt. Primary school	4.60	Regular	Regular	E+	B+	Nil	Window shutter	9.4	4.7	3.2	0.191	0.45W	Retrofitting is not required.
43	Govt. Boys Middle school	5.20	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified,	Window shutter	14.7	4.6	3.2	0.218	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
44	Govt. Primary school	5.40	Regular	Regular	E+	B+	Pier width is less	Railing, window shutter	8	4.3	3.2	0.234	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
45	Govt. Primary school	2.72	Regular	Regular	E+	B+	Nil	Window shutter	16.65	9.6	3.2	0.079	0.45W	Retrofitting is not required.
46	Govt. Boys Middle school	5.35	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open	Window shutter	8.2	6.7	3.2	0.186	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening.
47	Govt. Higher Secondry school	2.75	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less	Window shutter	14.6	6.6	3.2	0.096	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
48	Govt Girls Middle School	4.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less		18	4.2	3.2	0.193	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
49	Govt. Mixed Primary School	5.09	Irregular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	10.2	8.85	2.4	0.154	0.45W	Provide seismic belt of equivalent on both sides of walls
50	Bismillah education institue	4.70	Regular	Irregular	E+	B	Opening is more than specified, pier width is less, members are less in truss	Window shutter	15.3	9.3	2.4	0.139	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Convert rafter into A frame.Provide seismic belt of equivalent on both sides of walls
51	Govt. Boys Middle school	8.05	Irregular	Irregular	E+		Plinth, lintel beam is not provided,	Window shutter	14.8	9.5	0.9	0.235	0.45W	Provide seismic belt of equivalent on both sides of walls
52	New Bright Candle Public School	5.30	Regular	Irregular	E+	B	length of building is more than 3B (L>3B), plinth beam, lintel beam is not provided	Window shutter	16	4.7	2.4	0.22	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
53	Govt. Primary school	5.00	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified,	Window shutter	7.2	5	3.2	0.201	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
54	Govt. Primary school	5.80	Regular	Regular	E+	B	Pier width is less	-	12	8.1	3.2	0.183	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.Provide seismic belt of equivalent on both sides of walls
55	Govt Girls Middle School	4.80	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified.	Railing	19	3.75	2.4	0.223	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
56	Govt. Primary school	4.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less as specified, gable end is open	Railing	8.45	5	3.2	0.177	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
57	Govt. Primary school	5.80	Regular	Regular	E+	B+	Lintel beam is not provided on some window	Window shutter	10.2	5.8	3.2	0.217	0.45W	Provide seismic belt of equivalent on both sides of walls
58	Govt. Primary school, Eng med	5.10	Irregular	Irregular	E+	B	length of building is more than 3B (L>3B), plinth beam, lintel beam is not provided	Railing, window shutter	12.9	3.96	0.9	0.231	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.

S. No.	Name of School	height of building	Vertical Irregularity	Plan Irregularity	Vulnerability class as per IS:4326 (B to E+)	Vulnerability class (A to F)	Construction defects	Suspended /Non Structural Members	Length of longest wall		Score of Building	Time period	Storey shear	Action for Retrofitting
									Lx	Ly		$Ta=0.09h/d^{1/}$	Vb=Ah*W	
59	Govt. Mixed Primary school	5.30	Regular	Irregular	E+	B	Plinth, lintel beam is not provided,	Window shutter	11.4	15.15	2.4	0.123	0.45W	Provide seismic belt of equivalent on both sides of walls
60	Govt. Mixed Primary school	5.00	Regular	Irregular	E+	B	Plinth, lintel beam is not provided,	Window shutter	8.5	4.5	2.4	0.212	0.45W	Provide seismic belt of equivalent on both sides of walls
61	Govt. Mixed Primary school	4.90	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, size of window is big	Window shutter	16	8.2	2.4	0.154	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
62	Govt. Mixed Primary school	4.80	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	10.3	8.5	3.2	0.148	0.45W	Provide seismic belt of equivalent on both sides of walls
63	Govt. Girls Primary School	2.60	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member is truss is less	Window shutter	17	4.35	2.4	0.112	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls, convert rafter into A frames.
64	Govt. Mixed Primary school	5.30	Regular	Irregular	E+	B	length of building is more than 3B (L>3B), plinth beam, lintel beam is not provided	Window shutter	17	4.35	2.4	0.229	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
65	Govt. Mixed Primary school	5.20	Regular	Regular	E+	B	Plinth, lintel beam is not provided, lateral wall length is more then specified	Window shutter	7.5	5	3.2	0.209	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
66	Govt. Girls High School	5.55	Irregular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less	Window shutter	15	8.5	0.9	0.171	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
67	Govt. Girls Middle School	6.00	Regular	Regular	E+	B	Nil	Window shutter	23	11.85	3.2	0.157	0.45W	Retrofitting is not required.
68	Govt. Boys Middle School	5.20	Regular	Regular	E+	B	Plinth beam is not provided	-	16	10.5	3.2	0.144	0.45W	Provide seismic belt of equivalent on both sides of walls
69	Govt. Mixed Primary school	4.90	Regular	Regular	E+	B	Plinth beam is not provided	Window shutter	10.05	3.8	3.2	0.226	0.45W	Provide seismic belt of equivalent on both sides of walls
70	Govt. Mixed Primary school	4.55	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less	-	11.5	3.8	3.2	0.21	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
71	Govt. Primary school, Eng med	5.20	Regular	Regular	E+	B	Plinth beam is not provided	Window shutter	12	6	3.2	0.191	0.45W	Provide seismic belt of equivalent on both sides of walls
72	Govt. Girls Middle School	5.20	Irregular	Irregular	E+	B	length of building is more than 3B (L>3B), plinth beam, lintel beam is not provided	Window shutter, post, railing	17	3	0.9	0.27	0.45W	Provide seismic belt of equivalent on both sides of walls, provide pilaster or butress to reduce effective length, install equivalent seismic belt alround the opening.
73	Well wisher Pubic high school	5.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less	Window shutter	11.1	6.5	3.2	0.191	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
74	Govt. Boys Middle School	4.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	12.2	6.7	3.2	0.153	0.45W	Provide seismic belt of equivalent on both sides of walls
75	Govt. Girls Secondry School	5.60	Regular	Regular	E+	B+	Nil	-	18.5	9.5	3.2	0.164	0.45W	Provide seismic belt of equivalent on both sides of walls
76	Muslim Boys & Girls High School	0.00	Regular	Regular	E+	B+	Nil	-	29.7	12.5	3.2	0	0.45W	Provide seismic belt of equivalent on both sides of walls
77	Govt. Primary school	5.50	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	-	12.3	6.3	3.2	0.197	0.45W	Provide seismic belt of equivalent on both sides of walls
78	Govt. Boys Primary School	4.95	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less	Window shutter	7.85	3.9	3.2	0.226	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
79	Govt Primary school, Eng Med	4.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less	Window shutter	8.7	4.15	3.2	0.194	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
80	Govt. Boys Primary School	4.45	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	-	5	3.25	3.2	0.222	0.45W	Provide seismic belt of equivalent on both sides of walls

S. No.	Name of School	height of building	Vertical Irregularity	Plan Irregularity	Vulnerability class as per IS:4326 (B to E+)	Vulnerability class (A to F)	Construction defects	Suspended /Non Structural Members	Length of longest wall		Score of Building	Time period	Storey shear	Action for Retrofitting
									Lx	Ly		$Ta=0.09h/d^{1/}$	Vb=Ah*W	
81	Akmal Public High School	4.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less, pier width is less	Window shutter	4.75	4.12	3.2	0.195	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
82	Govt. Girls Middle School	4.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	-	7.05	6	3.2	0.162	0.45W	Provide seismic belt of equivalent on both sides of walls
83	Govt. Middle School	5.00	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less, pier width is less	Window shutter	3.3	2.8	3.2	0.269	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
84	Govt. Girls High School	4.70	Regular	Regular	E+	B	Plinth, lintel beam is not provided,		11	9.6	3.2	0.137	0.45W	Provide seismic belt of equivalent on both sides of walls
85	Govt. Middle School	7.05	Regular	Irregular	E+	B	Plinth, lintel beam is not provided,	Window shutter, chajja	6	5	2.4	0.284	0.45W	Provide seismic belt of equivalent on both sides of walls
86	Govt. Primary school	6.70	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less, pier width is less	Window shutter	9	7.5	2.4	0.22	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
87	Govt. Girls Middle School	4.60	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member is truss is less member,	Window shutter	4.4	3.93	3.2	0.209	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
88	Govt. Primary school	5.10	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less	Window shutter, stair	4.8	3.6	3.2	0.242	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
89	Govt. Girls Primary School	4.80	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	6.4	6	3.2	0.176	0.45W	Provide seismic belt of equivalent on both sides of walls
90	Govt. Girls Middle School	5.00	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less, size of window is more as specified	Window shutter	8.9	8	3.2	0.159	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
91	Govt. Mixed Primary school	4.90	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	7.45	6.4	3.2	0.174	0.45W	Provide seismic belt of equivalent on both sides of walls
92	Govt. Primary school	4.60	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	Window shutter, chajja	3.66	3.66	3.2	0.216	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
93	Govt. Mixed Primary school	2.60	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	7	6.3	3.2	0.093	0.45W	Provide seismic belt of equivalent on both sides of walls
94	Govt. Mixed Primary school, Eng med	4.50	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	Window shutter	4	4	3.2	0.203	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
95	Govt. Mixed Primary school	2.75	Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less, size of window is more as specified, member in truss is less	Window shutter	4	3.8	3.2	0.127	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
96	Govt. Mixed Primary school	2.60	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	Window shutter	9	7.4	3.2	0.086	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
97	Govt. Girls Middle School	2.60	Regular	Regular	E+	B+	Size of opening is big as specified	Window shutter	8.6	6.9	3.2	0.089	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
98	Govt. Primary school		Regular	Regular	E+	B	Plinth, lintel beam is not provided, pier width is less, size of window is more as specified, member in truss is less	Window shutter	10.8	8.2	3.2	0	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
99	Govt. Boys Middle School	2.60	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	Window shutter	14.4	9	2.4	0.078	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
100	Dream land public school	5.10	Regular	Irregular	E+	B	Opening is more than specified, pier width is less, members are less in truss	window	13.95	4.1	2.4	0.227	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls

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									Lx	Ly		$T_a=0.09h/d^{1/}$	Vb=Ah*W	
101	Govt. Girls Primary School	2.45	Regular	Irregular	E+	B	Nil	Window shutter	12.8	8.6	2.4	0.075	0.45W	Retrofitting is not required.
102	Govt. Primary school	2.50	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	Window shutter	12.5	8.6	2.4	0.077	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
103	Govt. Boys Middle School	2.45	Irregular	Irregular	E+	B	Plinth, lintel beam is not provided, opening size of window is big	Window shutter	29.3	8.4	0.9	0.076	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
104	Govt. Girls Middle School	2.40	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	Window shutter	15	6.8	3.2	0.083	0.45W	Provide seismic belt of equivalent on both sides of walls
105	Govt. Boys Middle School	2.27	Regular	Regular	E+	B	Plinth, lintel beam is not provided, opening size of window is big	-	21	15.6	3.2	0.052	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
106	Govt. Girls Middle School	2.30	Regular	Regular	E+	B	Plinth, lintel beam is not provided, opening size of window is big	Window shutter	17.2	4.8	3.2	0.094	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
107	Govt. Girls Primary School	2.85	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, opening size of window is big	Window shutter	12	6	2.4	0.105	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
108	Govt. Girls Primary School	2.55	Regular	Regular	E+	B	Opening is more than specified, pier width is less	Window shutter	14.3	4.4	3.2	0.109	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
109	Govt. Primary School	2.60	Regular	Regular	E+	B	Opening is more than specified, pier width is less	-	12.15	8.5	3.2	0.08	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.
110	Govt. Girls Middle School	2.67	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	-	12.3	8.5	3.2	0.082	0.45W	Provide seismic belt of equivalent on both sides of walls
111	Govt. Boys Primary School	2.33	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	-	11.8	7.4	3.2	0.077	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
112	Govt. Girls Primary School	2.25	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	-	9.75	9.4	3.2	0.066	0.45W	Provide seismic belt of equivalent on both sides of walls
113	K. C. I.	2.95	Regular	Irregular	E+	B	Size of opening is big as specified, members are less in truss	-	12.5	11	2.4	0.08	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.convert rafter into A frame.
114	Govt. Girls High School	2.60	Regular	Irregular	E+	B	Pier size is less, members in truss are less	Window shutter	31.5	24.75	2.4	0.047	0.45W	Increase by building up or strengthening by ferro cement plating, Provide seismic belt of equivalent on both sides of walls
115	Govt. Boys Middle School	2.50	Regular	Irregular	E+	B	Plinth beam not provided	Window shutter	17.2	9.25	2.4	0.074	0.45W	Provide seismic belt of equivalent on both sides of walls
116	Govt. Girls Primary School	2.75	Regular	Regular	E+	B	Plinth, lintel beam is not provided, opening size of window is big	Window shutter	14.7	6.55	3.2	0.097	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls
117	Govt. Boys Primary School	2.75	Regular	Irregular	E+	B	Plinth beam not provided, members are less in turss	Window shutter	19.8	12.1	2.4	0.071	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
118	Govt. Boys Middle School	2.27	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	-	18.65	8.5	2.4	0.07	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
119	IQRA Public High school	5.10	Regular	Irregular	E+	B	Lintel beam is not provided on window, member are less in turss		20	4.8	2.4	0.21	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
120	Govt. Girls Primary School	5.40	Regular	Irregular	E+	B	Size of opening is big as specified, pier size is less	window shutter	19.5	4.5	2.4	0.229	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls

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									Lx	Ly		$Ta=0.09h/d^{1/}$	Vb=Ah*W	
121	Govt. Boys Middle School	5.10	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	window shutter	16.2	13.5	2.4	0.125	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
122	Govt. Boys Middle School	5.50	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	window shutter	17.95	10.8	2.4	0.151	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
123	Govt. Primary School	2.60	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	-	18	8.3	3.2	0.081	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
124	Govt. Girls Middle School	2.30	Regular	Regular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	-	19	8	3.2	0.073	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
125	Govt. Boys Middle School	2.70	Regular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	window shutter	13.5	13.6	2.4	0.066	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
126	Govt. Boys Middle School	2.70	Regular	Regular	E+	B	Plinth, lintel beam is not provided,	-	15	15	3.2	0.063	0.45W	Provide seismic belt of equivalent on both sides of walls
127	Govt. Girls Middle School	2.55	Regular	Regular	E+	B	Size of opening is big as specified, pier size is less, Plinth, lintel beam is not provided,	-	14.85	6	3.2	0.094	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening,
128	Govt. Boys Middle School	5.20	Regular	Regular	E+	B	Size of opening is big as specified, pier size is less, Plinth, lintel beam is not provided, member in truss is less,	Window shutter	9.5	9.5	3.2	0.152	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting. Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
129	Govt. Girls Higher Secondry School	5.20	Irregular	Irregular	E+	B	Plinth, lintel beam is not provided, gable end is open, member in truss is less,	Window shutter	13	8.3	0.9	0.162	0.45W	Provide seismic belt of equivalent on both sides of walls, install equivalent seismic belt alround the opening, convert rafter into A frame.
130	Govt. Primary School	3.00	Regular	Regular	E+	B	Size of opening is big as specified,	-	30	10.5	3.2	0.083	0.45W	Atttain the limit by closing/narrowing of opening or reinforcing the opening by seismic belting.

CHAPTER-6

CONCLUSION

From the vulnerability assessment of the buildings, following are the conclusion:

A: **STAAD-Pro analysis:** the buildings are analysis on real data and by strengthening of buildings. The maximum stresses are coming on the corner of the openings, junctions, corner of the walls. Which requires strengthening by the retrofitting measures.

B: **IS Code based analysis:** it is concluded that mostly building requires to reduce the opening size as well as opening percentage, requires to provide seismic belts, improve the truss arrangements/members and some building requires to add the pilaster to reduce the effective length of the walls.

Finally, it is concluded that, earthquake measures are not adopted in the mostly masonry building construction and it is found that about 40% buildings are in vulnerable condition, as these buildings are being used for school purpose, which are very important buildings, require retrofitting to improve the strength of the buildings.

Further scope of the study:

This study shows that the buildings which have been marked as vulnerable are highly unsafe and since all these structures are located in highest seismic zone (Zone-V), it has been proposed that all such buildings should be retrofitted to make them safe.

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CONTENTS

CHAPTER- 01

INTRODUCTION

1.1 INTRODUCTION:

The earthquake considered as the natural phenomenon which results in shaking of ground due to release of energy. The earthquake becomes a dangerous phenomenon only when it is considered with the capacity of the structure. India has a long history of frequent earthquakes with high life loss and property damage figures. Latest in India, the October'05, Kashmir Earthquake, January'2001 Gujrat Earthquake, which took thousands of lives and destroyed number of structures. It has been observed that under the action of moderate to severe earthquake occurrences, the masonry buildings performed the worst, causing the largest loss of lives as well as the properties of the residents. Hence, it is considered that the protection of such buildings form the disastrous impact of earthquakes will lead to reduction of vulnerability of the buildings and their occupants. As per the census of India 2001 had collected data on the house types and classified it by material of wall and roof.

Mud and un-burnt bricks	29.6%	
Stone	10.2%	
Burnt bricks	44.9%	
Concrete	2.6%	[Ref:16, Arya-2008].

The country is going through a major development phase wherein infrastructure is being added at an unprecedented pace. The same time, some areas are still very far from this development. Kashmir is the one of the region where mostly building are traditionally constructed and not very strong to resist the strong earthquake, while Kashmir lies in the highest seismic earthquake zone(Zone-V). Mostly houses are build with brick/stone masonry in low strength mortar/without mortar without any earthquake resistant measure. The majority of the buildings in Jammu and Kashmir are masonry houses made of burnt bricks(46%), Un-burnt Brick(20%), Stone masonry(24%) and wood(7.5%) and the remaining 2.5% built with grass, thatch and bamboo.[Ref.14,NIT

Srinagar-2006)]. People in J&K are relucted to introduce seismic resistant design provision in the building because of:

1. Lack of awareness of the effectiveness and need of such of provisions.
2. Lack of faith in such provisions and these provisions are regarded as wastage of money.
3. Lack of sufficient finance for construction.

The present study is carried out on primary schools of Kashmir (Srinagar and Budgam District), because mostly schools are located in both district of the Kashmir. Safety of the schools against earthquake is one of the most important criteria not only because of the life loss, but also because after event they serve as emergency shelters and are important resource for the following reconstruction process. With an extensively large stock of school buildings that are present today, effective mitigation measures need to be looked depending on their level of vulnerability. Out of many methods and techniques that can be used to determine the vulnerability of the structure, the visual assessment is one of the cost effective and efficient techniques, when dealing with number of buildings.

The attempt here is to use the rapid visual assessment tool to determine the structural performance modification factors that would help seek reasons for vulnerability of school buildings and provide basis for next steps for necessary actions.

1.2 OBJECTIVE:

- To study the various methods of vulnerability assessment for school buildings.
- To carried out a detailed survey of masonry school buildings.
- To collect the detailed information of various elements of selected school buildings.
- To analysis the colleted information and asses the possibility of damages and vulnerability of these buildings.

Based on the vulnerability assessment of visual screening a detailed analysis has been carried out for 08 buildings out of 130 buildings to study the behavior and compare with the visual data.

CHAPTER-02

LITERATURE REVIEW

2.1 Introduction:

The methodology applied to this study is based on the recent work by Meneses-Loja Jorge and Aguilar Zenón, on the visual assessment of seismic vulnerability of school buildings. Rapid visual screening (RVS) was first proposed in the US in 1988, which was further modified in 2002 to incorporate latest technological advancements and lessons from earthquake disasters in the 1990s. This RVS procedure, even though originally developed for typical constructions in the US have been widely used in many other countries after suitable modifications. The evaluation procedure and system is compatible with GIS-based city database, and also permits use of the collected building information for a variety of other planning and mitigation purposes. The results from rapid visual screening can be used for a variety of applications that are an integral part of the earthquake disaster risk management program of a city or a region.

Another work is carried out on seismic assessment of masonry buildings by Prof. A. S. Arya [Ref:16,2008]. As per the referred paper he explained that masonry buildings are the most vulnerable to damage and collapse under earthquake intensities MSK VII or more. *"Therefore, it has been realized that such existing buildings will need upgrading of seismic resistance by appropriate retrofitting techniques.* Whole seismic assessment work is divided into two steps

i: Rapid visual screening procedure.

ii: Detailed seismic assessment procedure.

The screening is based on code based seismic intensity, building type and damageability grade as observed in past earthquakes and covered in MSK/European macro-intensity scale.

Buildings divided into 6 class (A,B,B+,C,C+,D) based on expected seismic performance. Type-A have the highest seismic vulnerability while Type-D, have the lowest seismic vulnerability.

Building	Description
Type-A	(a) Rubble (field stone) in mud mortar or without mortar usually with sloping wooden roof. (b) Uncoursed rubble masonry without adequate through stone. (c) Masonry with round stones.
Type-B	Semi-dressed, rubble, brought to courses, with through stones and long corner stones; unreinforced brick walls with country type wooden roofs; unreinforced CC block walls constructed in mud mortar or weak lime mortar.
Type-B+	(a)Unreinforced brick masonry in mud mortar with vertical wood posts or horizontal wood elements or seismic band (IS:4326,13828). (b)Unreinforced brick masonry in lime mortar.
Type-C	(a) Unreinforced masonry walls built from fully dressed (ashler) stone masonry or CC blocks or burnt brick using good cement mortar, either having RC floor/roof or sloping roof having eave level horizontal bracing system or seismic band. (b) As at B with horizontal seismic bands (IS 4326,13828)
Type-C+	Like C (a) type but having horizontal seismic bands at lintel level of doors & windows (IS:4326)
Type-D	Masonry construction as at C(a) but reinforced with bands & vertical reinforcement, etc.(IS:4326), or confined masonry using horizontal & vertical reinforcing of walls.

[Source, Ref: 16, Arya-2008]

Table :2.1 Masonry load bearing wall buildings

Table 2.2 Grade of Damageability of masonry buildings:

Classification of damage to masonry buildings:
Grade 1: Negligible to slight damage (no structural damage, slight non-structural damage)
Structural : Hairline cracks in very few walls. Non structural: Fall of small pieces of plaster only. Fall of loose stones from upper parts of buildings in very few walls.
Grade 2: Moderate damage (slight structural damage, moderate non structural damage)
Structural: Cracks in many walls, thin cracks in RC* slabs and AC* sheets. Non Structural: Fall of fairly large pieces of plaster, partial collapse of smoke chimneys on roofs. Damage to parapets, chajjas. Roof tiles disturbed in about 10% of the area. Minor damage in under structure of sloping roofs.
Grade 3: Substantial to heavy damage (moderate structural damage, heavy non-structural damage)
Structural: Large and extensive cracks in most walls. Widespread cracking of columns and piers. Non Structural: Roof tiles detach. Chimneys fracture at the roof line; failure of individual non structural elements (partition, gable walls).
Grade 4: Very heavy damage (heavy structural damage, very heavy non structural damage)
Structural: Serious failure of walls (gaps in walls), inner walls collapse; partial structural failure of roofs and floors.
Grade 5: Destruction (very heavy structural damage)
Total or near total collapse of the building

Table 2.3: Building Categories (IS: 4326 & IS: 13828):

Building Use	**Building category in Seismic Zone**			
	II	**III**	**IV**	**V**
Ordinary	**B**	**C**	**D**	**E**
Important	**C**	**D**	**E**	**E+**

[Source, Ref: 16, Arya-2008]

Important building: hospitals, schools, railway stations, power stations, etc (any building having more than 100 occupants)

Other building: any building having more than 100 occupants

Table 2.4 Relationship of seismic intensity, Building type and damage Grades:

Building Type	**Zone II** MSK VI or less	**Zone III** MSK VII	**Zone IV** MSK VIII	**Zone V** MSK IXor more
A	Many of grade 1 and few of grade 2 (rest no damage)	Most of grade 3 and few of grade 4 (rest of grade 2or 1)	Most of grade 4 and few of grade 5 (rest of grade 3,2)	Many of grade 5 (rest of grade 4)
B , B+	Many of grade 1 and few of grade 2 (rest no damage)	Many of grade 2 and few of grade 3 (rest of grade 1)	Most of grade 3 and few of grade 4 (rest of grade 2)	Many of grade 4 and few of grade 5 (rest of grade 3)
C, C+	Few of grade 1 (rest no damage)	Many of grade 1 and few of grade 2 (rest of grade 1)	Most of grade 2 and few of grade 3 (rest of grade 1)	Many of grade 3 and few of grade 4 (rest of grade 2)
D		Few of grade 1	Few of grade 2	Many of grade 2 and few of grade 3 (rest of grade 1)

Note: As per MSK scale Few: 15%, Many 50% & Most: 75%

[Source, Ref: 16, Arya-2008]

Table 2.5: Deficiencies of a 'global nature' in buildings

S.No.	**Item**	**C D E, E+**	**Retrofitting Action if code provision not Satisfied**
1	Sloping raftered roofs	Preferably use full trusses	Convert rafters into A-frames or full trusses to reduce thrust on walls
2	Unsymmetrical Plans	Symmetrical plans are suggested	Inserting new walls to reduce dissymmetry
3	Perpendicular Walls not connected at corners and T-junctions	Perpendicular walls should be integrally constructed	Stitch the perpendicular walls using tie rods in drilled holes fully grouted or box them with seismic belts

[Source, Ref: 16, Arya-2008]

Table 2.6: Seismic Design Compliance Assessment of Building

Building Category (tick mark as applicable) – C . , D . , E . , E+ .

S. No	Date of Building under Assessment	Required as per code	Compliant Yes/No
1	Number of storeys	<or =4	
2	Wall building unit BB/CCB (solid)/CCBC (hollow)	Comp strength> 35mpa	
3	Wall thickness G.F. I.F. II. F. III.F	BB = 230 mm CCB = 200 mm	
4	Largest size room …….m X …… m	8 m X 8 m	
5	Mortar used C:S =-		
6	Door, Window openings (Based on building height) (i) Overall (b1 + b2+….)/l, max = (ii) B4 min. = (iii) B5 min.=		
7	Wall length/thickness ratio t = l = l/t =		
8	Wall height/thickness ratio t = h = h/t =		
9	Soil at base Soft/ hard/medium		
10	Floor type (tick mark) RC slab/RB slab/ Precast beams or slabs		
11	Roof type (tick mark) Horizontal flat/sloping/ RC or RB slab/trusses or rafters		
12	Seismic Bands (yes/no) (i) at plinth (ii) at lintel level (iii) at ceiling or eave level (iv) at window sill level (v) at gable ends (vi) at ridge top		
13	Vertical bar (yes/no) (i) at external corners (ii) at external T-junctions (iii) at internal corners (iv) at internal T-junctions (v) at jambs of door (vi) at jambs of windows		
14	Sloping Roofs (yes/no) (i) rafters (any x-bracing ?) (ii) trusses (x-bracing in plan?)(x-bracing in slopes?) (iii) tile covering (with holding down systems?)		

[Source, Ref: 16, Arya-2008]

2.2 FACTORS CONSIDERED IN SEISMIC SAFETY AS PER IS: 4326

The most important factors considered in IS 4326-1993 for ensuring seismic safety of various category buildings are the following:

A) Walls

- Mortar
- Door, window openings in walls
- Length of wall between cross walls
- Height of wall above floor to ceiling
- Unreinforced perpendicular walls, parapets, cantilever balconies, etc.
- Horizontal seismic bands i.e. plinth, door, window, ceiling, gable end, window sill level, etc.
- Vertical steel bars i.e. at each corner/junction of walls and at door and window sill level.

B) Roofs or Floors

- Roofs/floors with prefabricated or pre-cast elements
- Cantilever balconies
- Roof/Floors with wooden joists with various covering elements
- Sloping roofs with sheets or tile covering
- Jack arch roof or floors
- Sloping raftered roofs

2.3 VULNERABILITY :

Vulnerability is the existence of weaknesses that makes an entity susceptible to attack. When applied to existing structures, vulnerability is the susceptibility to damage from natural and manmade hazards. Design and mitigation for natural hazard is incorporated into existing building codes. Vulnerability can be divided into:

- **Devastating:** The facility is damaged/ contaminated beyond habitable use.
- **Severe:** The facility is partially damaged/contaminated. Examples include partial structure breach resulting in weather/water, smoke, impact, or fire damage to some areas.

- **Noticeable:** The facility is temporarily closed or unable to operate, but can continue without an interruption of more than one day.

- **Minor:** The facility experiences no significant impact on operations (downtime is less than four hours) and there is no loss of major assets.

[Ref:06, Nancy & Joseph]

2.4 LEVELS OF EVALUATION

Level-1 Rapid Visual Screening (RVS)

Level-2 Simplified Vulnerability Assessment (SVA)

Level-3 Detailed Vulnerability Assessment (DVA)

Rapid Visual Screening (RVS) Procedure

• For mass scale screening of existing buildings

• Limited to visual inspection and identification of potential seismic Defects/deficiencies

• Use of checklists

• For post-earthquake vulnerability survey

Simplified Vulnerability Assessment (SVA) Procedure

• For buildings identified during Rapid Visual Screening

• More detailed visual survey, preliminary measurements and study of available design documents, drawings and repair documents, if any.

• Simplified calculation for forces in members

Detailed Vulnerability Assessment (RVS) Procedure

• For vulnerability of assessment of individual buildings

• Detailed in-situ investigation of material strength, defects and deterioration

• Detailed analysis

[Ref:2, Yogendra Singh, IITB]

2.5 PROBLEMS IN VULNERABILITY ASSESSMENT OF EXISTING BUILDINGS:

Problem of assessment of safety of existing structures against various loads, including earthquake load, has been recognized world over. In developing countries, about 50% of the construction industry resources are being utilized for problems associated with existing structures. The problem is slowly showing its extent in India well. Assessment of an existing structure is much more difficult task than evaluation of a design on paper.

- Firstly, the construction of the structure is never exactly as per designers' specifications and number of defects and uncertainties crop up during the construction.
- Secondly, the quality of the material deteriorates with time and the assessment of the existing structure becomes time dependent problem.

2.6 SOURCES OF DEFICIENCIES IN THE STRUCTURES:

1. Defects arising from original design, such as under estimation of loads as per old standards or practices, inadequate section or reinforcements, inadequate reinforcement anchorage and detailing.
2. Defects are arising from original construction, such as under strength concrete, poor compaction, poor construction joints, improper placing of reinforcement and honey combing.
3. Deterioration since the completion of construction due to reinforcement corrosion, alkali aggregate reaction etc.

[Ref:2, Yogendra Singh,IITB]

2.7 NEED OF VULNERABILITY ASSESSMENT:

Vulnerability assessment is a systematic examination of building elements, facilities, population groups or components of the economy to identify features that are susceptible to damage from the effects of natural hazards. Vulnerability is a function of the prevalent hazards and the characteristics and quantity of resources or population exposed to those effects. Vulnerability can be estimated for individual structures, for specific sectors or for geographic selected geographic areas, e.g. areas with the greatest development potential or already developed areas in hazardous zones. The results of a vulnerability assessment can be used to prioritize mitigation activities and can help inform disaster recovery, mitigation and response planning.

2.8 The vulnerability assessment is typically only a portion of a broader evaluation.

PHASE 1: (QUALITATIVE ASSESSMENT)

Seismic vulnerability assessment in phase 1 belongs to **qualitative type of assessment** where method relies on general seismic response and observed strength and weakness of different structures under seismic actions based on some seismic properties of structures and type of structures etc.

PHASE-2: (QUANTATIVE ASSESEMENT)

Seismic vulnerability assessment in phase 2 belongs to **quantative metholodigies** are comparison of capacity of structure with seismic demand on the structure, consistent with the performance objectives decided for the structure.

PHASE-3 (PUSH OVER ANALYSIS)

There is always an effort to modify the existing methods and include complex behavior of structure under strong ground motion. Push over analysis has been used to find seismic vulnerability of asymmetric buildings.

2.9. RVS OBJECTIVES AND SCOPE

This RVS procedure, even though originally developed for typical constructions in the US have been widely used in many other countries after suitable modifications. The most important feature of this procedure is that it permits vulnerability assessment based on walk-around of the building by a trained evaluator. The rapid visual screening method is designed to be implemented without performing any structural calculations. The procedure utilizes a scoring system that requires the evaluator to:

1. Identify the primary structural lateral load-resisting system, and
2. Identify building attributes that modify the seismic performance expected for this lateral load-resisting system. The inspection, data collection and decision-making process typically occurs at the building site, and is expected to take around 30 minutes for each building.

[Ref: 17, Sinha & Goyal]

The RVS procedure can be integrated with GIS-based city planning database and can also be used with advanced risk analysis software. The methodology also permits easy and rapid reassessment of risk of buildings already surveyed based on availability of new knowledge that may become available in future due to scientific or technological.

2.10 BUILDING TYPES CONSIDERED IN RVS PROCEDURE:

A wide variety of construction types and building materials are used in urban areas of India. These include local materials such as mud and straw, semi-engineered materials such as burnt brick and stone masonry and engineered materials such as concrete and steel. The seismic vulnerability of the different building types depends on the choice of building materials. The building vulnerability is generally highest with the use of local materials without engineering inputs and lowest with the use of engineered materials.

The basic vulnerability class of a building type is based on the average expected seismic performance for that building type.

All buildings have been divided into six vulnerability class:

- Class A to Class F based on the European Macro seismic Scale (EMS-98) recommendations.
- The buildings in Class-A have the highest seismic vulnerability.
- The buildings in Class-F have lowest seismic vulnerability.

[Ref: 17, Sinha & Goyal]

A building of a given type, however, may have its vulnerability different from the basic class defined for that type depending on the condition of the building, presence of earthquake resistance features, architectural features etc. It is therefore possible to assign a vulnerability range for each building type to encompass the expected vulnerability considering the different factors affecting its likely performance.

2.11 USE OF RVS RESULTS:

The results from rapid visual screening can be used for a variety of applications that are an integral part of the earthquake disaster risk management program of a city or a region. The main uses of this procedure are:

- To identify if a particular building requires further evaluation for assessment of its seismic vulnerability.
- To rank a city's or community's (or organization's) seismic rehabilitation needs.
- To design seismic risk management program for a city or a community.
- To plan post-earthquake building safety evaluation efforts.
- To develop building-specific seismic vulnerability information for purposes such as regional rating, prioritization for redevelopment etc.
- To identify simplified retrofitting requirements for a particular building (to collapse prevention level) where further evaluations are not feasible.
- To increase awareness among city residents regarding seismic vulnerability of buildings.

[Ref: 17, Sinha & Goyal]

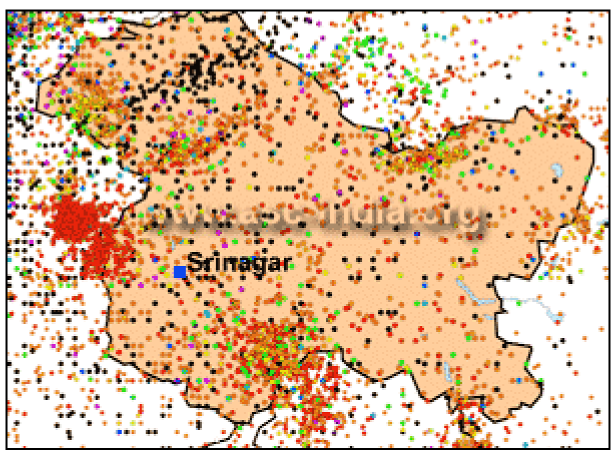
2.12 LOCAL MODIFICATION OF COMPONENTS:

A few components (such as beams, columns, connections, shear walls, diaphragms, etc.) in an existing building may not have adequate strength or deformation capacity, though the building in whole may have substantial strength and stiffness. For such components, local modifications can be performed, while retaining the basic configuration of the building's lateral force resisting system. The local modifications considered are component connectivity, their strength, and/or deformation capacity. A modification of the existing structural members so that their individual strength and/or ductility are improved. As a result, the respective characteristics of the structure are influenced (e.g., jacketing of the columns), even though the overall structural scheme is unmodified.

[Ref:10, Rai D. C.,IITK]

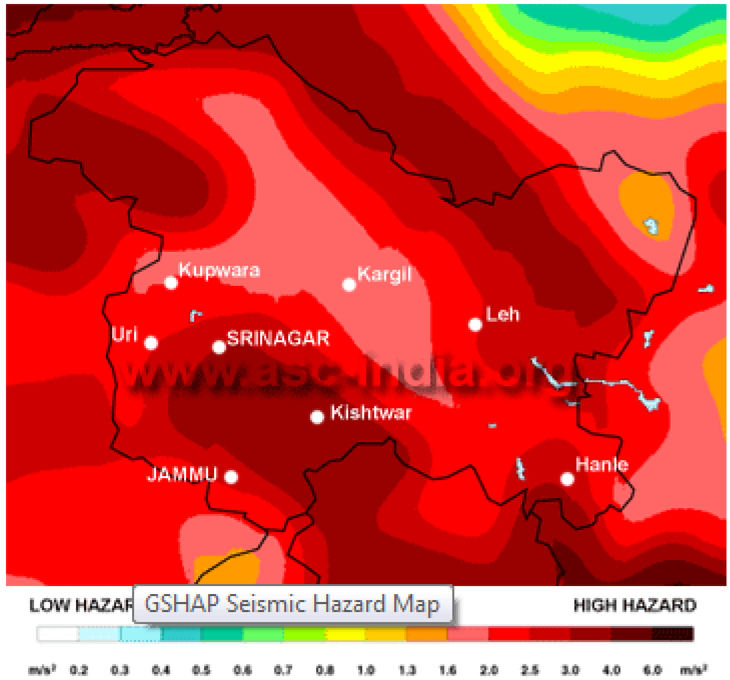
2.13 EARTHQUAKE HISTORY :

The state of Jammu & Kashmir is the western most extension of the Himalayan mountain range in India. Here it comprises of the Pir Panjal, Zaskar, Karakoram and Ladakh ranges. The boundary of the Punjab plain and the mountains forms the Himalayan Frontal Thrust (HFF), which in this area is the Murree Thrust. The Main Boundary Thrust (MBT) underlies the Pir Panjal Range and is known as the Pir Panjal Thrust in the region. The Zaskar range which are part of the Great Himalayan range are underlain by the Zaskar Thrust. The Kashmir Valley lies between the Pir Panjal and the Zaskar thrusts, making it very vulnerable to earthquakes. Other northern parts of Jammu & Kashmir are heavily faulted. Along the Zaskar and the Ladakh ranges runs a NW-SE trending strike-slip fault, the longest in the Jammu & Kashmir area. Apart from the routine small tremors moderate to large earthquakes have hit nearly all parts of the state. However, it must be stated that proximity to faults does not necessarily translate into a higher hazard as compared to areas located further away, as damage from earthquakes depends on numerous factors such as subsurface geology as well as adherence to the building_codes.



2.14 Seismic Hazard:

Kashmir North and Kashmir South districts lie in Zone V. Gilgit, Chilas, Gilgit Wazarat, Muzaffarabad, Punch, Anantnag, Mirapur, Riasi, Udhampur, Jammu, Kathua, Leh, Ladakh and Tribal Territory districts lie in Zone-IV.



2.15 Largest Instrumented Earthquake in Jammu & Kashmir :

8 October 2005 - Kashmir-Kohistan, Pakistan-India border, Mw 7.6
34.432 N, 73.537 E, D=020.0 kms, OT=03:50:40 UTC

A major earthquake struck the India-Pakistan border on the morning of 8 October 2005. It had a magnitude of Mw=7.6 and was felt strongly in much of Pakistan, northern India and eastern Afghanistan. The earthquake resulted in more than 80,000 deaths in northern Pakistan and adjoining parts of Jammu & Kashmir, India and is by far one of the deadliest in the sub-continent. At least 10 people also died in other parts of north India (including 1 person in the Dehradun region) and 4 in Afghanistan due to this earthquake. Tremors from the earthquake were felt more than a thousand kilometres away in the Indian states of Gujarat, Madhya Pradesh and Uttar-Pradesh.

2.16 Significant Earthquakes in Jammu & Kashmir:

The following list briefly outlines known earthquakes in this region. General locations are provided for historical events for which "generalized" epicentral co-ordinates are available. Some events which were significant for other reasons are also included. This list will be updated whenever newer information is available. Please note that Magnitude and Intensity are NOT THE SAME. All events are within the state or union territory covered on this page unless stated otherwise.

6 June 1828 - Srinagar area (Jammu & Kashmir), M 6.0 (TS)
34.08N, 74.833E

This earthquake caused widespread devastation in Srinagar and other parts of the Kashmir Valley. 1,000 people were killed in this earthquake.

30 May 1885 - NW of Srinagar (Jammu & Kashmir), M 7.0 (TS)
34.60N, 74.38E

This earthquake is one of the deadliest shocks in Kashmir. It was centred just north of the Wular Lake. It jolted the Valley of Kashmir and along with it Srinagar, Baramulla and Sopur. 3,200 people are said to have been killed in this earthquake. There were also unconfirmed reports of fissures in the ground as a result of the quake. The Kamiari area was totally destroyed.

17 May 1917 - Ladakh (Jammu & Kashmir), M 6.0 (TS)
21:45:50 UTC, 34.20N, 77.50E

11 November 1921 - Ladakh (Jammu & Kashmir), M 6.0 (TS)
01:18:45 UTC, 34.20N, 77.50E

15 November 1937 - Northern Ladakh (Indo-China Border region), M 6.0 (TS)
21:37:22 UTC,35.10N, 78.10E

22 June 1945 - Near Padua, Kathwa District, J&K (H.P.-J&K Border region), M 6.0 (TS)
18:00:51 UTC, 32.599N, 75.90E

10 July 1947 - Near Padua, Kathwad District, J&K (H.P.-J&K Border region), M 6.0 (TS)
10:19:20 UTC, 32.599N, 75.90E

12 August 1950 - Near Padua, Kathwad District, J&K (H.P.-J&K Border region), M 6.0 (TS)
03:59:06 UTC, 32.599N, 75.90E

12 August 1950 - Gilgit Wazarat (P.O.K.), M 6.0 (TS)
06:16:12 UTC, 36.20N, 73.00E

12 September 1951 - Chamba-Udhampur Districts (H.P.-J&K Border region), M 6.0 (TS)
20:41:48UTC, 33.30N, 76.50E

17 June 1962 - Udhampur District (Jammu & Kashmir), M 6.0 (TS)
04:39:26.6 UTC, 33.30N, 76.20E

22 June 1965 - Ladakh (Jammu & Kashmir), M 6.1 (TS)
05:49:18.90 UTC, 36.30N, 77.70E

28 December 1974 - NE of Malakhand, NWFP, (Indo-Pakistan Border region), Ms 6.2 (NEIC)
12:11:43.70 UTC, 35.054N, 72.870E, 22kms depth

28 April 1975 - Aksai Chin (Indo-China Border region), Ms 6.3 (NEIC)
11:06:43.50 UTC, 35.819N, 79.915E, 33 kms depth.

12 September 1981 - Gilgit Wazarat (P.O.K.), Mw 6.1 (HRV), mb 6.2 (NEIC)
07:15:54.17 UTC, 35.693N, 73.594E, 33 kms depth
Atleast 220 people were killed, 2,500 were injured in the Gilgit region. There were also unconfirmed reports of surface faulting. The shock was felt in Srinagar (J&K, India) and in Peshawar and Rawalpindi (Pakistan).

6 July 1986 - Xizang (Indo-China Border region), Ms 6.1 (NEIC)
19:24:22.99 UTC,34.424N, 80.161E, 9kms depth

5 March 1990 - Gilgit Wazarat (P.O.K.) Ms 6.0 (NEIC)
20:47:00.76 UTC, 36.907N, 73.021E, 12 kms depth

25 March 1990 - Gilgit Wazarat (P.O.K.), Ms 6.3 (NEIC)
14:17:18.82 UTC,37.034N, 72.942E, 33 kms depth

19 November 1996 - Aksai Chin (Indo-China Border region), Mw 6.9 (GS)
10:44:46.06 UTC, 35.345N, 78.133E, 33 kms depth
Felt in Hotan, Shule, Wushi and Yecheng (Xizang), China

28 January 2002 - Kithar, Jammu & Kashmir, Mw 5.3
33.100 N, 75.987 E, D=30.8 kms, OT=22:33:42 UTC

A moderate earthquake struck southern Jammu & Kashmir and adjoining parts of Himachal Pradesh, on 28 January 2002 at 04:03 AM local time. It had a magnitude of Mw=5.3 and was felt strongly in parts of the region.

1 November 2002 - Astore Valley, P.O.K., Mw 5.3
35.361 N, 74.718 E, D=29.3 kms, OT=22:09:28 UTC
A moderate earthquake struck the Astore Valley in the Kashmir Himalayas, on 2 November 2002 at 03:39 AM local time that killed 1 person. It had a magnitude of Mw=5.3. This earthquake was followed by additional moderate events on November 3rd and 21st, that resulted in further damage and casualties.

3 November 2002 - Astore Valley, P.O.K., Mw 5.3
35.359 N, 74.636 E, D= 15.1 kms, OT=07:33:35 UTC
A moderate earthquake struck the Astore Valley in the Kashmir Himalayas, on 3 November 2002 at 12:33 PM local time killing 17 people and causing damage to property. It had a magnitude of Mw=5.3. This earthquake followed a similar sized earthquake on 2 November and was followed by a larger event on 21 November 2002.

20 November 2002 - Astore Valley, P.O.K., Mw 6.3
35.345 N, 74.592 E, D=13.0 kms, OT=21:32:27 UTC
A strong earthquake struck the Astore Valley in the Kashmir Himalayas, on 21

Acronyms Used:

D=Depth, **OT**=Origin Time, **Mw**=Moment Magnitude, **Ms**=Surface Wave magnitude, **Mb**=Body Wave Magnitude, **ML**=Local Magnitude, **M?**=Magnitude Type unknown

[Source: Ref: 18, www.asc.india.org]

CHAPTER-3

METHODOLOGY

3.1 INTRODUCTION:

This methodology is adopted [Ref:8,Chandra] from the published paper of Mr. Chandra, (as shown in fig.) is particularly suitable for conditions where within limited economic resources a large stock of buildings can be looked for earthquake risk mitigation actions. Total work is divided into three parts (as shown in fig: 3.1):

- Pre school inspection
- During school inspection
- Post school inspection

The visual assessment is conducted using a pre-defined format to be filled by the trained inspectors. This form collects the information to define the structural type and attributes that modify seismic performance.

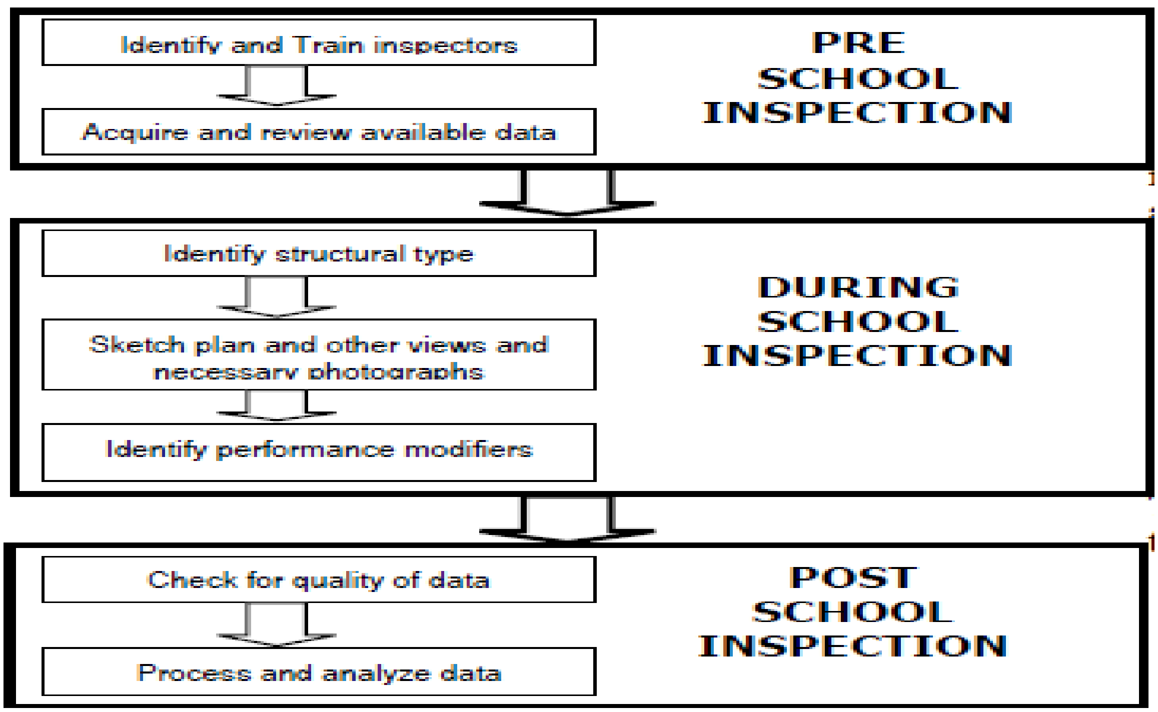


Fig: 3.1 STEPS OF RAPIC VISUAL ASSESSMENT PROCEDURE

[Source: Ref: 8, Chandura, 2006]

Mr. Chandura explained that *"The attributes include performance modification factors such as height, vertical irregularity, soft story, torsion, plan irregularity, pounding, short* *columns, lateral resistance capacity and poor condition (quality and maintenance). These structural features are assumed to affect the expected seismic performance of the buildings. The basic scores and its modifiers are simplified to obtain true logical values only."* The form also contains additional information on number of students, classrooms, emergency handling capabilities etc. so that a basis can be formed for the implementation of data collected, necessary mitigation activities, Sketches and photographs are a very important part, as they will give necessary visual information. A sketch of the general plan should always be included together with a quick line section of the structure that will provide a clearer picture. Photos of the buildings from different sides and angles, of spotted structural attributes, and of features that illustrate the structural type should be taken. This photographic information will allow a later study of the building without returning to the school site. *"The screening is based on numerical seismic hazard and vulnerability score. The scores are based on the expected ground shaking levels in the region as well as the seismic design and construction practices for the city or region. The scores use probability concepts and are consistent with the advanced assessment methods."* The RVS procedure can be integrated with GIS-based city planning database and can also be used with advanced risk analysis software. The methodology also permits easy and rapid reassessment of risk of buildings already surveyed based on availability of new knowledge that may become available in future due to scientific or technological advancements.

The RVS methodology can be implemented in both rural and urban areas. However, the variation in construction practice is more easily quantifiable for urban areas and the reliability of the RVS results for rural areas may be very low. It is therefore preferable that the RVS methodology be used for non-standard (or non-government) constructions in rural areas only with adequate caution. The RVS methodology is also not intended for structures other than buildings. For important structures such as bridges and lifeline facilities, the use of detailed evaluation methods is recommended.

3.2 SEISMIC VULNERABILITY ASSESMENT:

Different seismic vulnerability assessment techniques exist in general, and they depend on the requirements and the resources. They range from the ones that involve simple analysis to more detailed and complex ones. A typical seismic vulnerability assessment would require necessary information on identifying hazard, assessing soil conditions and defining the structural type. This is then correlated with the school population to determine their vulnerability levels (Refer fig. 3.2)

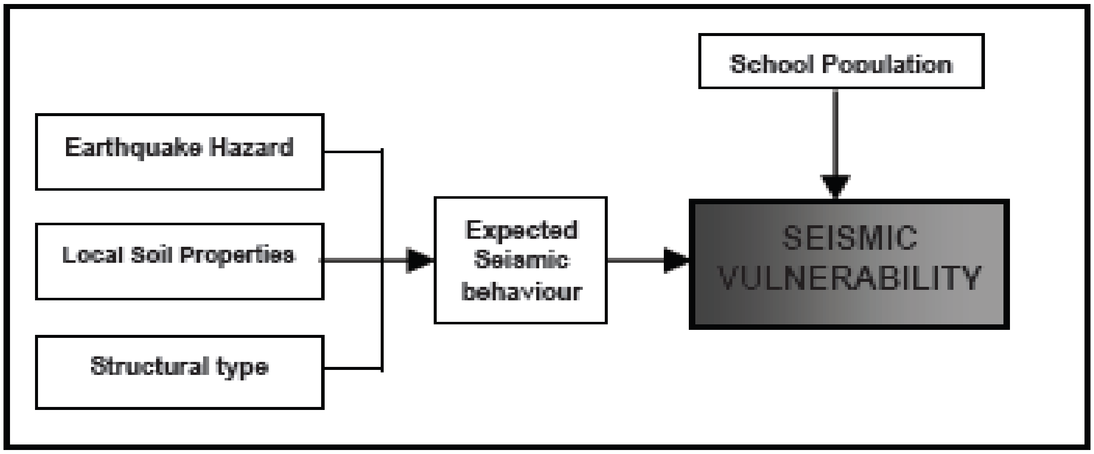


Fig: 3.2 METHODOLOGY FOR ASSESSING SEISMIC VULNERABILITY

[Ref: 8, Chandura, 2006]

For a particular geographical area evaluation of earthquake hazard includes identification of all possible sources of seismic activity and their potential for generating future strong ground motions. In the absence of data, earthquake sources may also be identified from records of historical (pre-instrumental) seismic. Areas may be divided into zones and would give a basis for anticipated ground acceleration. However, it is also important to assess the existing local soil conditions. *"The local geology and soil conditions very deeply influence amplitude, frequency, and duration of strong ground motions. It may be likely that high amplification of ground motions would adversely affects the seismic performance of the structure. Identification of typical structures of the school building stock type should be based on a classification of the buildings according to their horizontal-force resisting system. The detailed vulnerability analysis may define their own specific criteria. However, it is always advisable to classify the existing building types as per the local conditions and requirements. The population can then be correlated to determine the vulnerability status of a school building."*

3.3 DATA SHEET:

Following datasheet has been developed on the basis of Mr. Chandura's paper, IS: 15499-2004, IS: 875(3)-1987 and site requirement.

Rapid visual inspection of school buildings at Srinagar

Name of Building				
Address				
Year of Built				
City/Head Quarter			State:	
Type of Soil	Hard	Medium	Soft	
Earthquake Zone	V			
School type	Government	Private	Semi Govt.	
Availability of Drawings	Yes/No			
Is Building Designed	Yes/No			
Basement	Yes/No			
Accessibility to Roof	Yes/No			
Nos. of Stories	G+			
Plan Shape	Square/Rect./ L / T / Others			
Height of Plinth level				
Type of teaching	Boys/Girls/Co-ed			
Seating arrangement	On Ground/Benches/Mixed			
Suspended/Non Structural Members	Chimney/Parapet/Cladding/Others			
Boxing provided around Door/Window	Yes/No			
Plinth protection	Yes/No			
Builtup area/Total area				
Ventilator	Fixed/Openable			
Door/Window	Wood/Wood & Glass/Steel & Glass/Aluminum/Others			
Fire fighting system	Yes/No			
Type of Plaster	None/Cement/Mud/Lime			
Quality of Construction	Bad/Average/Good/Very Good			
Beam/Bend provided	Plinth/Lintel level/Roof level/None			
Height of Building	GF:	FF	SF	
Type of foundation	Brick	RCC	RRM	
	Raft		Stepped	
Type of Superstructure	Brick	RCC	RRM	
Thickness of wall				
Roof type	Flat		Pitched	
	Wooden Truss		Structural Steel Truss	
	CGI Sheet	Wooden	Tiles	RCC
Spacing of Truss				
Gable Ends	None/Brick wall/Cladding(Sheet)			

Holding bolt provided	Yes/No
Condition assessment	Wall
	Column
	Roof
Maintenance	(Nil/Repaired damaged/As & when req./ Regular /Good
Lengths of the walls	
	GF FF SF
Opening	Front wall
	Back wall
	Side 1
	Side 2
	Middle wall/ along front
	Middle wall/ along side
Total length	Along length wise
	Along width wise

Plan and elevation of the building (Hand sketch)

PLAN

		BLANK SPACE		

ELEVATION

		BLANK SPACE		

PHOTOGRAPHS

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
1	Bemina Eagles Modern Ed. Instiute	Hamza Colony, Bemina	1990	Medium	Private	No	No	No	No	3	7.70	Rectangular	Regular	Regular	0.75	Co-ed	Benches
2	Govt. Primary school	Iqbal, Aabad	1990	Medium	Government	No	No	No	No	3	7.00	Rectangular	Regular	Regular	0.75	Co-ed	On Ground
3	Govt. Boys Middle School	Bagaht-e-kanipora,Budgam	1980	Medium	Government	No	No	No	No	3	6.95	Rectangular	Regular	Regular	0.30	Boys	On Ground
4	Govt. Girls Primary School	Chaidubh, wanganpora	1994	Medium	Government	No	No	No	No	3	7.30	Rectangular	Regular	Irregular	0.65	Girls	On Ground
5	Govt. Primary school	Dag Mohalla, Rainawari	1970	Medium	Government	No	No	No	No	3	4.70	Rectangular	Regular	Regular	0.40	Co-ed	On Ground
6	Govt. Primary school (Boys & Girls)	Pull Napora	2002	Medium	Government	yes	yes	No	No	3	5.40	Rectangular	Regular	Regular	0.75	Boys	Mixed
7	Govt. Boys Middle School	Safakadal	1983	Medium	Government	No	No	No	No	3	7.18	Rectangular	Regular	Regular			
8	Govt. Girls Middle School	Kraliyar Pora	1958	Medium	Government	No	No	No	No	3	6.90	Rectangular	Regular	Regular			
9	Govt. Boys Middle School	Kraliyar Pora	1958	Medium	Government	No	No	No	No	3	6.90	Rectangular	Regular	Regular	0.80	Boys	On Ground
10	ISME Azam school	Noor Bagh	1995	Medium	Private	yes	yes	No	No	3	7.35	Square	Irregular	Irregular	1.10	Girls	On Ground
11	Govt. Boys Middle School	Noor Bagh	1980	Medium	Government	No	No	No	No	3	7.19	Rectangular	Regular	Regular	0.40	Co-ed	On Ground
12	Govt. Primary school	Samisabad	1990	Medium	Government	No	No	No	No	3	7.00	Rectangular	Regular	Regular	0.75	Co-ed	On Ground
13	Hindu High School(Boys and Girls)	Kralkhudh	1940	Medium	Private	yes	yes	yes	yes	3	8.00	Rectangular	Irregular	Irregular	1.10	Girls	On Ground
14	Govt. Primary school	Sheikh colony, Noor Bagh	2005	Medium	Government	No	No	No	No	1	2.57	Rectangular	Irregular	Irregular	0.80	Co-ed	On Ground
15	Govt. Middle School	Nalibal Nowshere	1990	Medium	Government	No	No	No	No	1	2.53	Rectangular	Regular	Regular	0.45	Co-ed	On Ground
16	Govt. Primary school	Ellahi bagh	1965	Medium	Government	No	No	No	No	1	2.50	Rectangular	Regular	Regular	0.75	Co-ed	On Ground
17	Govt. Girls Primary School	Baghwan Pora	1995	Medium	Government	No	No	No	No	1	3.15	Rectangular	Regular	Regular	0.50	Girls	On Ground
18	Govt. Boys Primary school	Zadibal	1990	Medium	Government	No	No	No	No	1	2.70	Rectangular	Regular	Irregular	0.60	Boys	On Ground
19	Miranda Public High School	Chainkeral Mohalla, Habbakadal	1972	Medium	Private	yes	No	No	yes	3	6.20	Rectangular	Regular	Irregular	0.75	Co-ed	Benches
20	Govt. Primary school	Chotabazar Kanikadal	2005	Medium	Government	No	No	No	No	1	1.95	Square	Regular	Regular	0.30	Co-ed	On Ground

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
21	Govt. Girls Primary School	Daungerpora	1985	Medium	Government	No	No	No	No	1	2.25	Rectangular	Regular	Regular	0.75	Girls	On Ground
22	Govt. Primary school	Kokarbagh	1995	Medium	Government	No	No	No	No	1	2.50	Rectangular	Regular	Regular	0.45	Co-ed	On Ground
23	Govt. Girls Primary School	Parimpora	1960	Medium	Government	No	No	No	No	1	2.65	Rectangular	Regular	Regular	0.45	Co-ed	On Ground
24	Govt. Boys Primary school	Parimpora	1980	Medium	Government	No	No	No	No	1	2.65	Rectangular	Regular	Regular	0.45	Co-ed	On Ground
25	Govt. Primary School(Eng Med)	Shergarhi Mohalla	2004	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Regular	0.30	Co-ed	On Ground
26	Govt. Mixed Primary School	Fisherman colony Gulab bagh	2000	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Irregular	0.15	Co-ed	On Ground
27	Govt. Mixed Primary School	Peth Batapora	2000	Medium	Government	No	No	No	No	1	2.70	Rectangular	Regular	Irregular	0.75	Co-ed	On Ground
28	Wisdom Public High School	Noor Bagh	1990	Medium	Private	yes	yes	No	No	1	2.30	Rectangular	Regular	Irregular	0.90	Co-ed	Mixed
29	Govt. Mixed Primary School	Pamposh colony zone Eidgah	2005	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Regular	0.45	Co-ed	On Ground
30	Govt. Boys High School	Batpora, hazaratbal	1960	Medium	Government	No	No	No	No	1	2.75	Rectangular	Regular	Irregular	0.25	Boys	On Ground
31	Govt. Girls Middle School	Guzarbal Noor Bagh	1995	Medium	Government	No	No	No	No	1	2.25	Rectangular	Regular	Regular	0.30	Girls	On Ground
32	Govt. Primary school	Gogzi Pora Bemina	1980	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Regular	0.30	Co-ed	On Ground
33	Govt. Primary school	Aliabad	2002	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Regular	0.85	Co-ed	On Ground
34	Govt. Primary school, Eng med	Hamza Colony, Bemina	1990	Medium	Government	No	No	No	No	1	2.80	Rectangular	Regular	Regular	0.40	Co-ed	On Ground
35	Govt. Boys Middle school	Batmaloo, Panzipore	1990	Medium	Government	No	No	No	No	1	2.33	Square	Regular	Regular	0.40	Boys	On Ground
36	Govt. Middle school	Barjee Nishat	1985	Medium	Government	No	No	No	No	1	2.35	Rectangular	Regular	Regular	0.80	Co-ed	Mixed
37	Govt. Middle school	Panjkharwani, Meerak shah colony	1980	Medium	Government	No	No	No	No	1	2.50	Rectangular	Regular	Irregular	0.30	Co-ed	On Ground
38	Govt. Mixed Primary School	Hamza Colony, Bemina	1970	Medium	Government	No	No	No	No	1	2.40	Rectangular	Regular	Regular	0.30	Co-ed	On Ground
39	Govt. Girls Primary School	Karan nagar	1955	Medium	Government	No	No	No	No	1	2.75	Square	Regular	Regular	0.30	Girls	On Ground

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
40	Govt. Primary school	Balgarden	1980	Medium	Government	No	No	No	No	2	4.50	Square	Regular	Irregular	0.30	Co-ed	On Ground
41	Govt. Boys Primary school	Anchar Soura	1980	Medium	Government	No	No	No	No	2	4.60	Square	Regular	Regular	0.30	Boys	On Ground
42	Govt. Primary school	Old Barzulla	1980	Medium	Government	No	No	No	No	2	4.60	Rectangular	Regular	Regular	0.10	Co-ed	On Ground
43	Govt. Boys Middle school	Kohlipora, Budgam	1995	Medium	Government	No	No	No	No	2	5.20	Rectangular	Regular	Regular	0.50	Boys	On Ground
44	Govt. Primary school	Yahil Rawalpora	2000	Medium	Government	No	No	No	No	2	5.40	L - Type	Regular	Regular	0.50	Co-ed	On Ground
45	Govt. Primary school	Rawalpora, Pora Bagh	1990	Medium	Government	No	No	No	No	1	2.72	Rectangular	Regular	Regular	-	Co-ed	On Ground
46	Govt. Boys Middle school	Harwan Chanpora	1965	Medium	Government	No	No	No	No	2	5.35	Rectangular	Regular	Regular	0.40	Boys	On Ground
47	Govt. Higher Secondry school	Gund Hassibal	1985	Medium	Government	No	No	No	No	1	2.75	L - Type	Regular	Regular	0.30	Co-ed	Benches
48	Govt Girls Middle School	Shatateng Batmalloo	1990	Medium	Government	No	No	No	No	2	4.40	Rectangular	Regular	Regular	0.30	Co-ed	Benches
49	Govt. Mixed Primary School	Bangi Mohalla Shanpora	2000	Medium	Government	No	No	No	No	2	5.09	Rectangular	Irregular	Regular	0.65	Girls	On Ground
50	Bismillah education institue	Shahi hamdan colony, Bemina	1992	Medium	Private	No	No	No	No	2	4.70	L - Type	Regular	Irregular	0.50	Co-ed	Mixed
51	Govt. Boys Middle school	Khaniyar	1970	Medium	Government	No	No	No	No	3	8.05	Rectangular	Irregular	Irregular	0.30	Co-ed	On Ground
52	New Bright Candle Public School	Batapora balla	1980	Medium	Private	No	No	No	No	2	5.30	Rectangular	Regular	Irregular	0.30	Boys	On Ground
53	Govt. Primary school	Sourtang Rainawari	1985	Medium	Government	No	No	No	No	2	5.00	Square	Regular	Regular	0.30	Co-ed	Mixed
54	Govt. Primary school	Chaudhri Bagh	1970	Medium	Government	No	No	No	No	2	5.80	Rectangular	Regular	Regular	0.30	Co-ed	On Ground
55	Govt Girls Middle School	B D Sahib Zone Rainawari	1990	Medium	Government	No	No	No	No	2	4.80	Square	Regular	Irregular	0.95	Co-ed	On Ground
56	Govt. Primary school	Naidyar Payeen	1960	Medium	Government	No	No	No	No	2	4.40	Rectangular	Regular	Regular	0.45	Girls	On Ground
57	Govt. Primary school	Sikandar Pora	1990	Medium	Government	No	No	No	No	2	5.80	Square	Regular	Regular	0.30	Co-ed	On Ground
58	Govt. Primary school, Eng med	Rampora, Chattabal	1995	Medium	Government	No	No	No	No	2	5.10	Rectangular	Irregular	Irregular	0.75	Co-ed	On Ground

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
59	Govt. Mixed Primary school	Gulshan Aabad	1990	Medium	Government	No	No	No	No	2	5.30	Rectangular	Regular	Irregular	0.75	Co-ed	On Ground
60	Govt. Mixed Primary school	Mehbobabad Hawal	1975	Medium	Government	No	No	No	No	2	5.00	Rectangular	Regular	Irregular	0.75	Co-ed	On Ground
61	Govt. Mixed Primary school	Madin Sahib	1990	Medium	Government	No	No	No	No	2	4.90	Rectangular	Regular	Irregular	0.30	Co-ed	On Ground
62	Govt. Mixed Primary school	Shah Faisal colony Batpora	1960	Medium	Government	No	No	No	No	2	4.80	Rectangular	Regular	Regular	0.60	Co-ed	On Ground
63	Govt. Girls Primary School	Gund Hassibal	2004	Medium	Government	No	No	No	No	2	2.60	Rectangular	Regular	Irregular	0.57	Girls	On Ground
64	Govt. Mixed Primary school	Hafiz bagh Gulab Bagh	2000	Medium	Government	No	No	No	No	2	5.30	Rectangular	Regular	Irregular	0.60	Co-ed	On Ground
65	Govt. Mixed Primary school	Shahi hamdan colony Zakura	2004	Medium	Government	No	No	No	No	2	5.20	Rectangular	Regular	Regular	0.60	Co-ed	On Ground
66	Govt. Girls High School	Barzulla	1960	Medium	Government	No	No	No	No	2	5.55	Rectangular	Irregular	Irregular	0.20	Co-ed	On Ground
67	Govt. Girls Middle School	Saida Kadal	2000	Medium	Government	No	No	No	No	2	6.00	Rectangular	Regular	Regular	0.70	Co-ed	On Ground
68	Govt. Boys Middle School	Habak Home Hair	1990	Medium	Government	No	No	No	No	2	5.20	Rectangular	Regular	Regular	0.45	Boys	On Ground
69	Govt. Mixed Primary school	Shesha Bagh	1985	Medium	Government	No	No	No	No	2	4.90	Rectangular	Regular	Regular	0.45	Co-ed	On Ground
70	Govt. Mixed Primary school	Hasi bhat Rainawari	1970	Medium	Government	No	No	No	No	2	4.55	Square	Regular	Regular	0.30	Co-ed	On Ground
71	Govt. Primary school, Eng med	Sultan mohalla Saida kadal	1960	Medium	Government	No	No	No	No	2	5.20	Square	Regular	Regular	0.30	Co-ed	On Ground
72	Govt. Girls Middle School	Dalkawpora	1955	Medium	Government	No	No	No	No	2	5.20	L - Type	Irregular	Irregular	0.30	Girls	Mixed
73	Well wisher Pubic high school	Gousia colony Bemina	1909	Medium	Private	No	No	No	No	2	5.40	Square	Regular	Regular	0.50	Co-ed	Mixed
74	Govt. Boys Middle School	Nishat	1970	Medium	Government	No	No	No	No	2	4.40	Rectangular	Regular	Regular	0.45	Boys	On Ground
75	Govt. Girls Secondry School	Ashai Kucha Fateh kadal	1950	Medium	Government	No	No	No	No	2	5.60	Square	Regular	Regular	0.30	Co-ed	Mixed
76	Muslim Boys & Girls High School	Qalamdanpora	1978	Medium	Semi Govt.	No	No	No	yes	2	0.00	Rectangular	Regular	Regular	0.30	Co-ed	Mixed
77	Govt. Primary school	Gath Zogi lanker	2000	Medium	Government	No	No	No	No	2	5.50	Square	Regular	Regular	0.25	Co-ed	On Ground
78	Govt. Boys Primary School	Sakijafar	1954	Medium	Government	No	No	No	No	2	4.95	Square	Regular	Regular	0.75	Boys	On Ground
79	Govt Primary school, Eng Med	Chiragarhi mohalla	1960	Medium	Government	No	No	No	No	2	4.40	Rectangular	Regular	Regular	0.50	Co-ed	On Ground
80	Govt. Boys Primary School	Wantipora	1986	Medium	Government	No	No	No	No	2	4.45	Rectangular	Regular	Regular	0.45	Boys	On Ground

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
81	Akmal Public High School	Ahmada Kadal	1980	Medium	Private	No	No	yes	No	2	4.40	Rectangular	Regular	Regular	0.30	Co-ed	Benches
82	Govt. Girls Middle School	Gili Kadal Zoonimar	1985	Medium	Government	No	No	No	No	2	4.40	Rectangular	Regular	Regular	0.45	Girls	On Ground
83	Govt. Middle School	Barbarshah Babapora	2006	Medium	Government	yes	No	No	No	3	5.00	Rectangular	Regular	Regular	0.65	Co-ed	On Ground
84	Govt. Girls High School	Shadi Kadal	1990	Medium	Government	No	No	No	No	3	4.70	Rectangular	Regular	Regular			
85	Govt. Middle School	Habba kadal chinkaeral mohalla	2004	Medium	Government	No	No	No	yes	3	7.05	Square	Regular	Irregular	0.65	Girls	On Ground
86	Govt. Primary school	Rehbab shahib	1960	Medium	Government	No	No	No	No	3	6.70	Square	Regular	Irregular	0.30	Co-ed	On Ground
87	Govt. Girls Middle School	Bachi Darwaza	1990	Medium	Government	No	No	No	No	2	4.60	Rectangular	Regular	Regular	0.45	Girls	On Ground
88	Govt. Primary school	Mainshah shahib	2000	Medium	Government	yes	yes	No	No	2	5.10	Square	Regular	Regular	0.65	Co-ed	On Ground
89	Govt. Girls Primary School	Jinab sahib Soura	1970	Medium	Government	No	No	No	No	2	4.80	Rectangular	Regular	Regular	0.35	Girls	On Ground
90	Govt. Girls Middle School	Taplee mohalla Anchar	1990	Medium	Government	No	No	No	No	2	5.00	Square	Regular	Regular	0.45	Girls	On Ground
91	Govt. Mixed Primary school	Rather Mohalla Nalibal	1990	Medium	Government	No	No	No	No	2	4.90	Rectangular	Regular	Regular	0.60	Co-ed	On Ground
92	Govt. Primary school	Khanpora pattan	1985	Medium	Government	No	No	No	No	1	4.60	Square	Regular	Regular	0.30	Co-ed	On Ground
93	Govt. Mixed Primary school	Gousia colony Bemina	1980	Medium	Government	No	No	No	No	2	2.60	Rectangular	Regular	Regular	0.60	Co-ed	On Ground
94	Govt. Mixed Primary school, Eng med	Pather Masjid	2004	Medium	Government	No	No	No	No	2	4.50	Square	Regular	Regular	0.30	Boys	On Ground
95	Govt. Mixed Primary school	Kavi Mohalla	1995	Medium	Government	No	No	No	No	1	2.75	Square	Regular	Regular	0.80	Co-ed	On Ground
96	Govt. Mixed Primary school	Mandibal Nowshera	2000	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Regular	1.10	Co-ed	On Ground
97	Govt. Girls Middle School	Watal Kadal Shahi Kadal	1990	Medium	Government	No	No	No	No	1	2.60	Rectangular	Regular	Regular	0.60	Girls	Mixed
98	Govt. Primary school	Sheikh Mohalla Panzinore	1982	Medium	Government	No	No	No	No	1		Rectangular	Regular	Regular	0.60	Co-ed	On Ground
99	Govt. Boys Middle School	Dodi Mohalla Shalimar	1997	Medium	Government	No	No	No	No	1	2.60	L - Type	Regular	Irregular	0.40	Boys	On Ground
100	Dream land public school	Bemina	1988	Medium	Private	No	No	No	No	2	5.10	Rectangular	Regular	Irregular	0.50	Co-ed	Mixed

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
101	Govt. Girls Primary School	Barjee Nishat	1985	Medium	Government	No	No	No	No	1	2.45	L - Type	Regular	Irregular			
102	Govt. Primary school	Upper Barjee Harwan	1993	Medium	Government	No	No	No	No	1	2.50	L - Type	Regular	Irregular	0.70	Co-ed	On Ground
103	Govt. Boys Middle School	Habak Zone Gulab bagh	1950	Medium	Government	No	No	No	No	1	2.45	L - Type	Irregular	Irregular	0.30	Girls	Mixed
104	Govt. Girls Middle School	Habak Zone Gulab bagh	1965	Medium	Government	No	No	No	No	1	2.40	L - Type	Regular	Regular	0.20	Co-ed	On Ground
105	Govt. Boys Middle School	New Colony Batamalloo	1960	Medium	Government	No	No	No	No	1	2.27	Rectangular	Regular	Regular	0.50	Girls	On Ground
106	Govt. Girls Middle School	Buchpora	1960	Medium	Government	No	No	No	No	1	2.30	L - Type	Regular	Regular	0.50	Boys	On Ground
107	Govt. Girls Primary School	Dalgate	1990	Medium	Government	No	No	No	No	1	2.85	Others	Regular	Irregular	0.40	Girls	On Ground
108	Govt. Girls Primary School	Ahmad Nagar	1960	Medium	Government	No	No	No	No	1	2.55	Rectangular	Regular	Regular	0.30	Girls	On Ground
109	Govt. Primary School	Buchpora	1985	Medium	Government	No	No	No	No	1	2.60	L - Type	Regular	Regular	0.45	Co-ed	On Ground
110	Govt. Girls Middle School	Muzigund Panzipore	1990	Medium	Government	No	No	No	No	1	2.67	L - Type	Regular	Regular	0.40	Girls	On Ground
111	Govt. Boys Primary School	Devipora Gulab Bagh	2000	Medium	Government	No	No	No	No	1	2.33	L - Type	Regular	Regular	0.30	Boys	On Ground
112	Govt. Girls Primary School	Zakura	1964	Medium	Government	No	No	No	No	1	2.25	L - Type	Regular	Regular	0.55	Girls	On Ground
113	K. C. I.	Bilal colony Bemina	1987	Medium	Private	No	No	No	No	1	2.95	L - Type	Regular	Irregular	0.20	Co-ed	Mixed
114	Govt. Girls High School	Drougjan	1960	Medium	Government	No	No	No	No	1	2.60	L - Type	Regular	Irregular	0.60	Girls	Mixed
115	Govt. Boys Middle School	Buchpora	1955	Medium	Government	No	No	No	No	1	2.50	L - Type	Regular	Irregular	0.30	Boys	Mixed
116	Govt. Girls Primary School	Shaltang	1990	Medium	Government	No	No	No	No	1	2.75	L - Type	Regular	Regular	0.80	Boys	On Ground
117	Govt. Boys Primary School	Bagaht Barzulla	1990	Medium	Government	No	No	No	No	1	2.75	L - Type	Regular	Irregular	0.70	Boys	On Ground
118	Govt. Boys Middle School	Shalimar	1972	Medium	Government	No	No	No	No	2	2.27	L - Type	Regular	Irregular	0.35	Boys	On Ground
119	IQRA Public High school	High MIG colony , Bemina	2000	Medium	Private	No	No	No	No	2	5.10	L - Type	Regular	Irregular			
120	Govt. Girls Primary School	Aarbal Sharlimar	2005	Medium	Government	No	No	No	No	2	5.40	L - Type	Regular	Irregular	0.48	Co-ed	Mixed

S. No.	Name of School	Address	Built year	Type of Soil	School type	Availability of Drawings	Is Building Designed	Basement	Accessibility to Roof	Nos of stories	height of building	Shape	Vertical Irregularity	Plan Irregularity	Height of Plinth level	Type of teaching	Seating arrangement
121	Govt. Boys Middle School	Kalashpora	1931	Medium	Government	No	No	No	No	2	5.10	L - Type	Regular	Irregular	0.30	Boys	Mixed
122	Govt. Boys Middle School	Qadipora	2003	Medium	Government	No	No	No	yes	2	5.50	L - Type	Regular	Irregular	0.30	Boys	Mixed
123	Govt. Primary School	Syedpora Nishat	1992	Medium	Government	No	No	No	No	1	2.60	L - Type	Regular	Regular	0.45	Boys	Mixed
124	Govt. Girls Middle School	Shalimar	1983	Medium	Government	No	No	No	No	1	2.30	U- Type	Regular	Regular	0.45	Boys	Mixed
125	Govt. Boys Middle School	Gargibal	1930	Medium	Government	No	No	No	No	1	2.70	Others	Regular	Irregular	0.35	Co-ed	Mixed
126	Govt. Boys Middle School	Kathi Darwaza Rainawari	1980	Medium	Government	No	No	No	No	1	2.70	L - Type	Regular	Regular	0.40	Boys	On Ground
127	Govt. Girls Middle School	Umarhere Buchpora	1980	Medium	Government	No	No	No	No	1	2.55	Rectangular	Regular	Regular	0.85	Boys	On Ground
128	Govt. Boys Middle School	BMS Dourgen	1990	Medium	Government	No	No	No	No	2	5.20	U- Type	Regular	Regular	0.50	Boys	On Ground
129	Govt. Girls Higher Secondry School	Nishat	1980	Medium	Government	No	No	No	No	2	5.20	Rectangular	Irregular	Irregular	0.90	Girls	Benches
130	Govt. Primary School	Khawaja Yarbal saida kadal	1980	Medium	Government	No	No	No	No	1	3.00	Rectangular	Regular	Regular	0.60	Co-ed	On Ground

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Sample Building for detailed analysis:

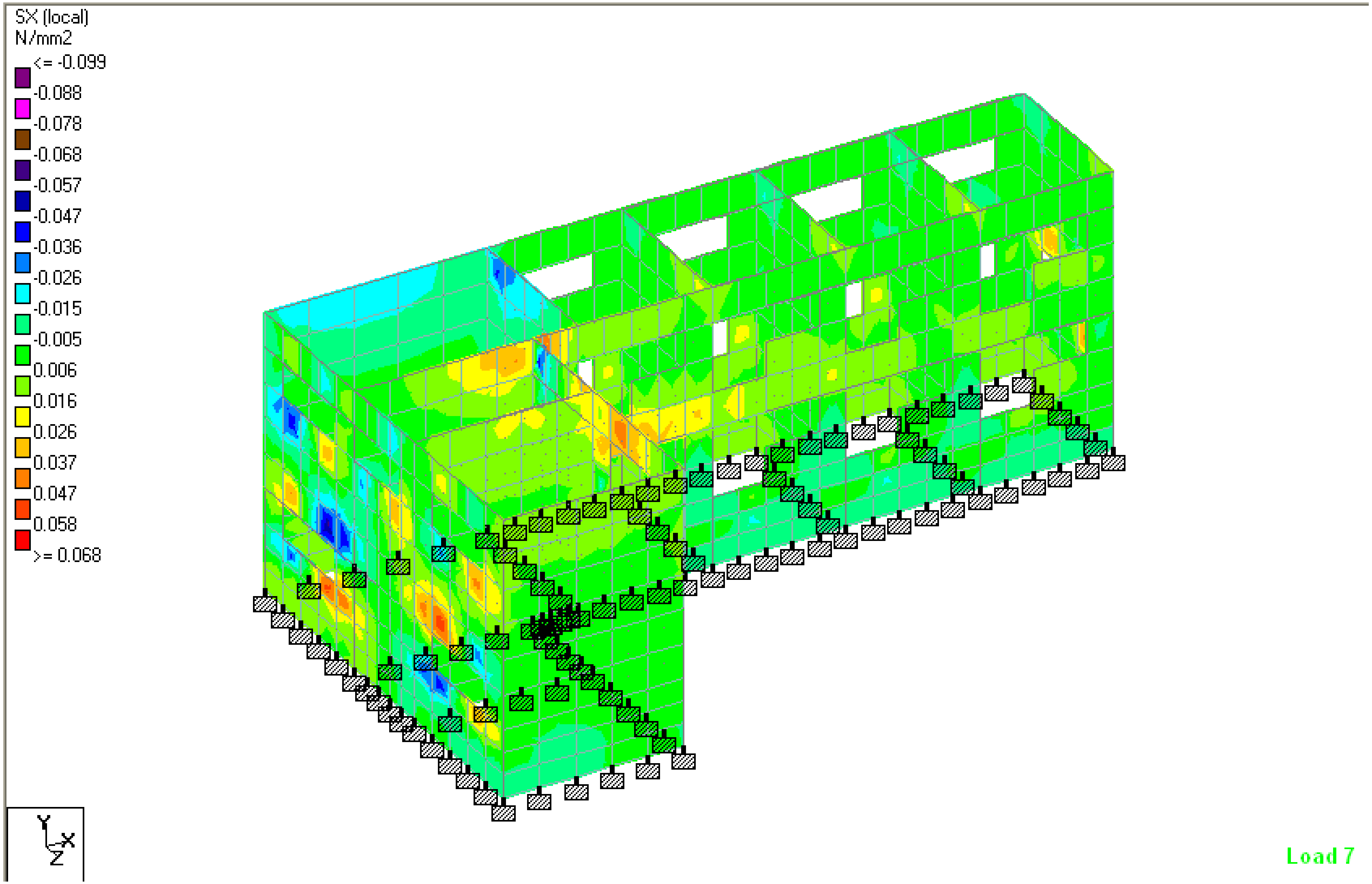
Following buildings are adopted for the detailed analysis (i.e. Analysis on STAAD-Pro & IS Code)

S. No.	Bldg. No	Name of Building
1	1	Bemina Eagles Modern Ed. Instiute, Hamza Colony, Bemina
2	50	Bismillah education institue, Shahi hamdan colony, Bemina
3	9	Govt. Girls Middle School, Kraliyar Pora
4	108	Govt. Girls Primary School, Ahmad Nagar
5	101	Govt. Girls Primary School , Barjee Nishat
6	37	Govt. Middle school, Panjkharwani, Meerak shah colony
7	56	Govt. Primary school, Naidyar Payeen
8	100	Dream land public school, Bemina

Part-I: Analysis by STAAD-Pro.
Above mentioned buildings are first analysis on real data and after the idealization. (in idealization, above buildings are strengthened with reinforced steel at all corners, junction, openings of door, windows, etc.) and then compare the reduction of stresses from real buildings.

Part-II: Analysis based on IS Codes.
Above mentioned buildings are checked as per IS Codes and action for deficiencies are recommended.

Part-III: Analysis based on collected data.
In this part of analysis all building checked for plan/vertical irregularity, vulnerability class, suspended members, score of building, time period, storey shear and then action for retrofitting is suggested for all buildings.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-0.078
-0.068
-0.057
-0.047
-0.036
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-0.015
-0.005
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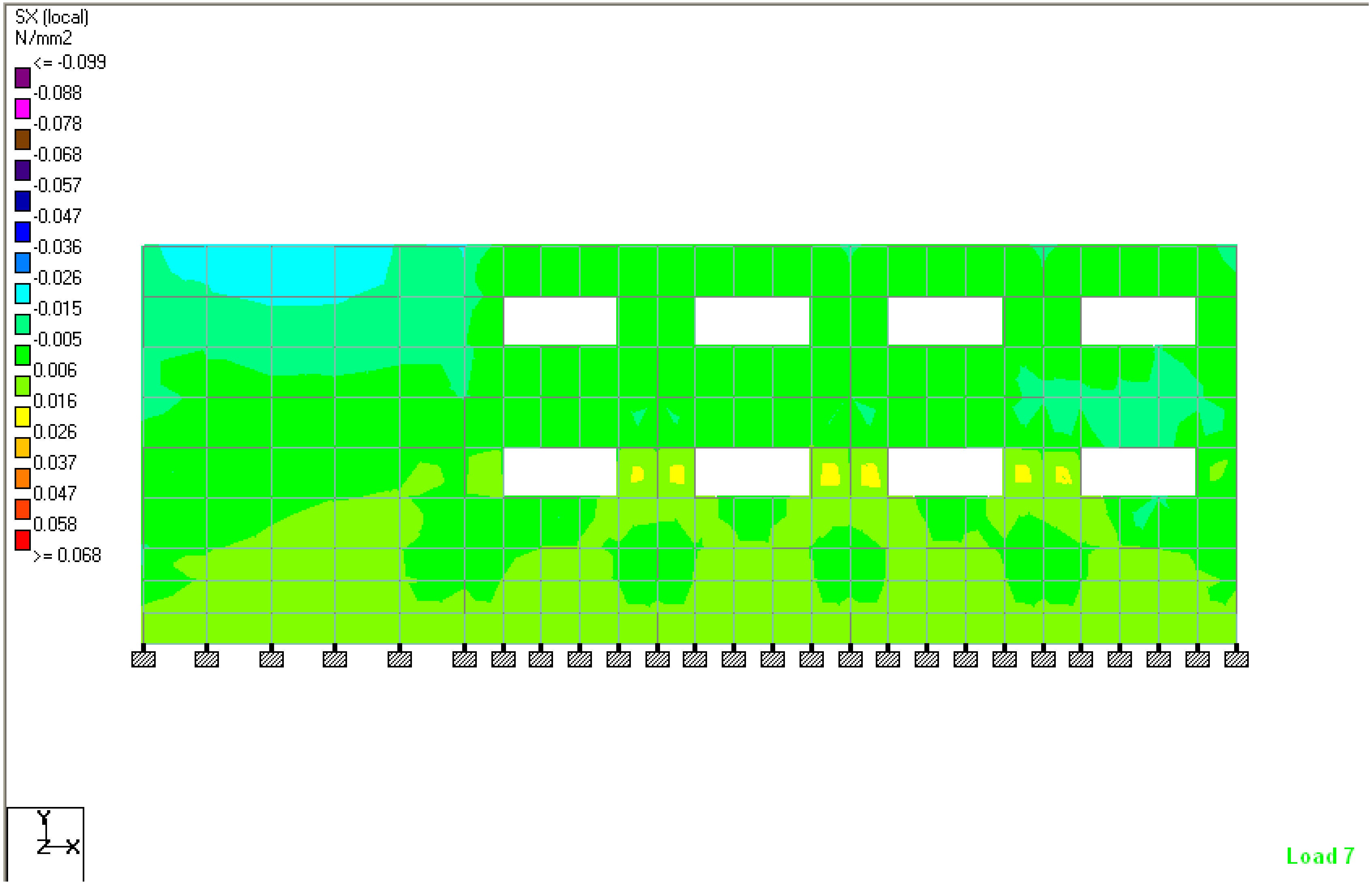
0.058
>= 0.068
Y
X
Z
Load 7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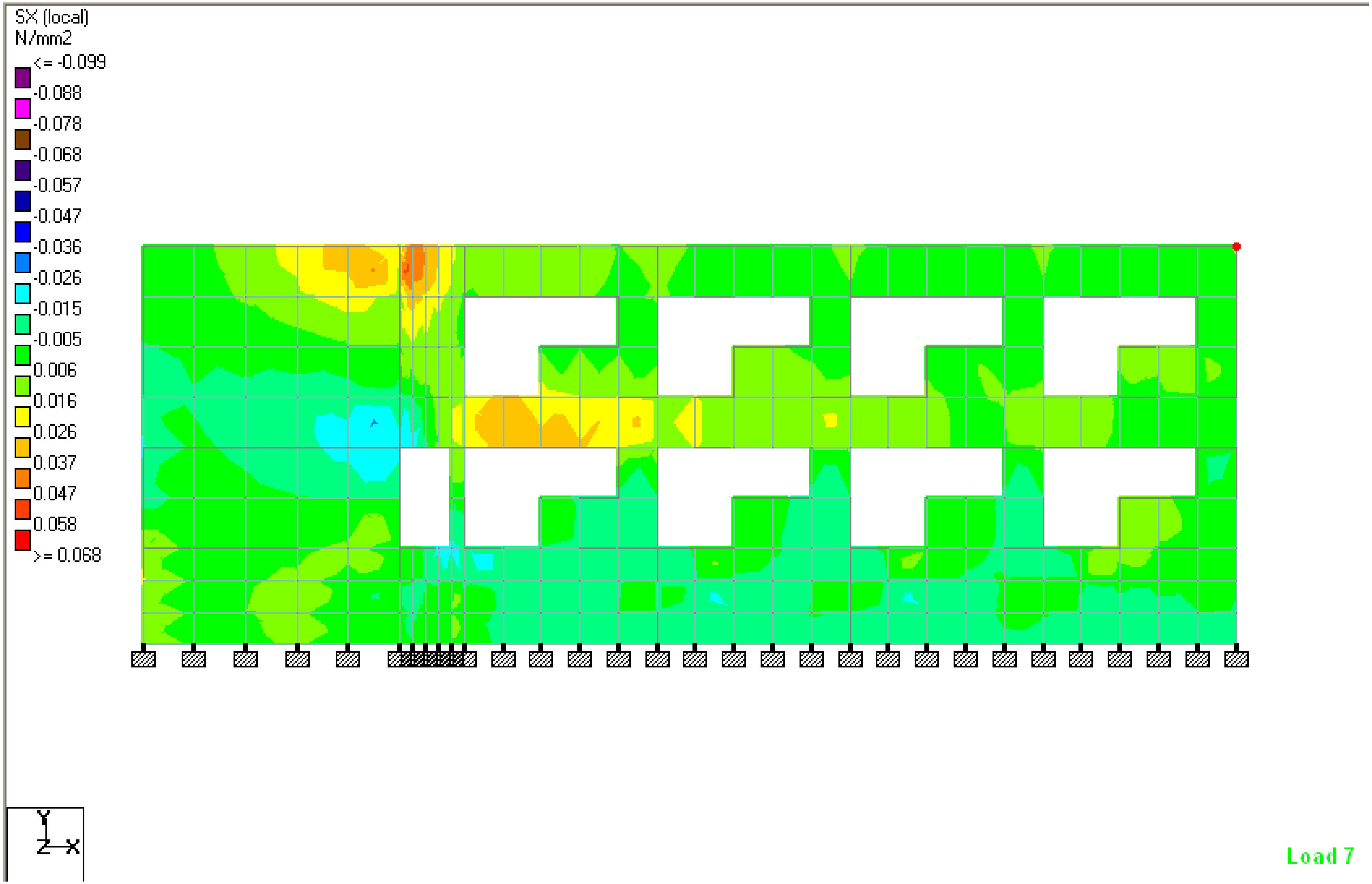

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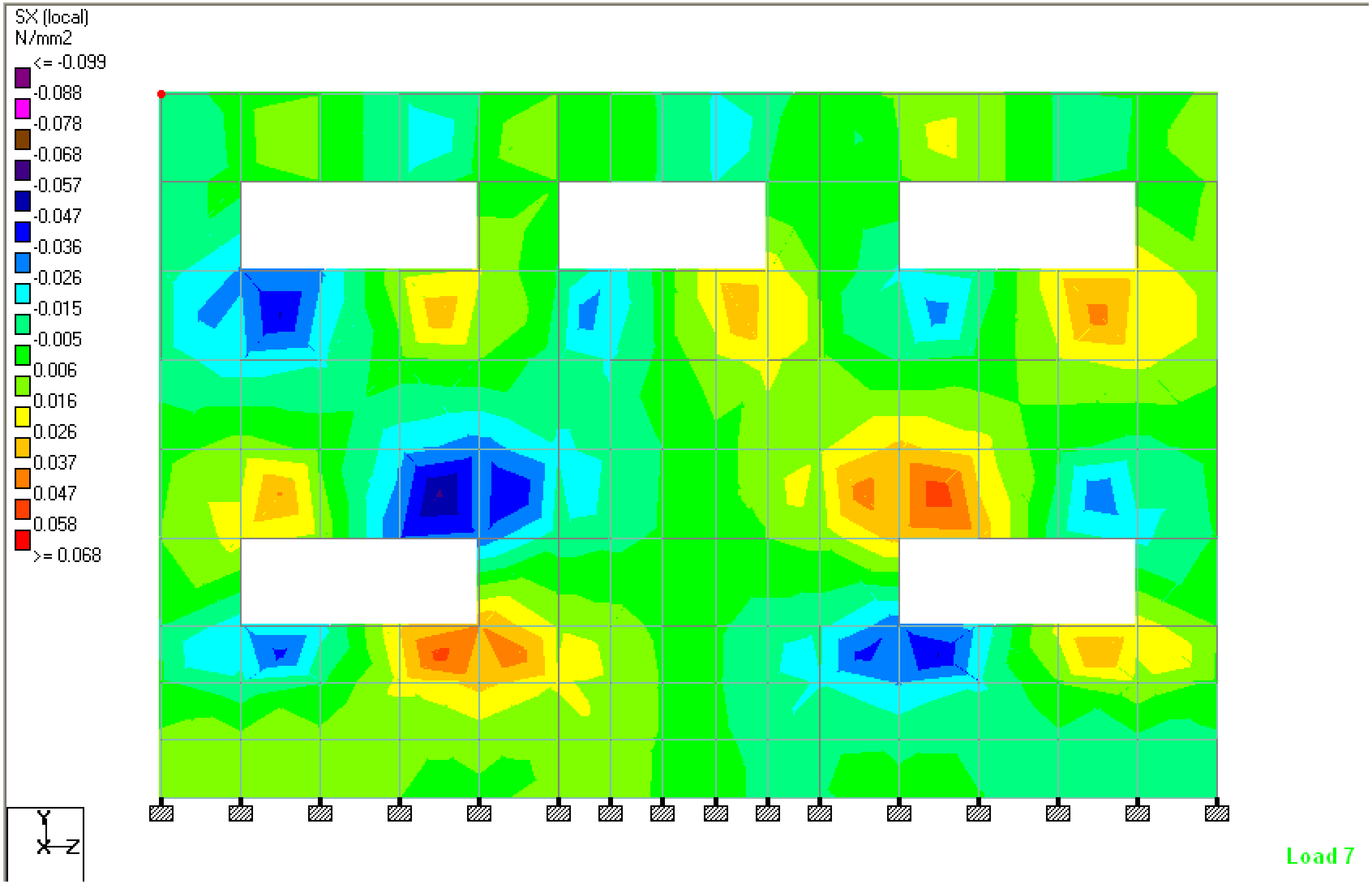
Load 7



SX (local)
N/mm2
<= -0.099
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-0.078
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-0.047
-0.036
-0.026
-0.015
-0.005
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0.016
0.026
0.037
0.047
0.058
>= 0.068
Y
X
Z
Load 7

COMPARISION OF STRESS OF REAL BUILDING TO IDEALIZED BUILDING
(PERCENTAGE REDUCTION IN STRESSES)

Bldg. No	Name of Building	**Shear**		**Membrane**			**Bending Moment**		
		SQX (local) I	**SQY (local)**	**SX (local)**	**SY (local)**	**SXY (local)**	**Mx kNm/m**	**My kNm/m**	**Mxy kNm/m**
1	Bemina Eagles Modern Ed. Instiute, Hamza	0.000	-0.565	1.780	-8.719	11.149	-0.392	0.629	-0.154
		-1.005	0.000	2.096	13.667	3.871	0.053	-0.159	0.178
50	Bismillah education institue, Shahi hamdan c	0.000	**15.000**	9.574	0.000	1.587	-0.056	1.707	0.498
		0.000	7.143	3.226	19.512	0.685	-0.269	-0.293	0.791
9	Govt. Girls Middle School, Kraliyar Pora	0.000	0.000	14.000	5.607	14.679	0.000	0.022	0.021
		0.000	0.000	**22.535**	39.196	-1.818	0.007	0.027	0.015
108	Govt. Girls Primary School, Ahmad Nagar	0.000	0.000	6.132	-2.055	38.043	-0.148	**22.204**	0.120
		0.000	12.000	3.727	29.947	-0.420	0.509	-0.296	-0.115
101	Govt. Girls Primary School , Barjee Nishat	0.000	0.000	14.525	42.778	21.898	**0.701**	0.026	-0.121
		1.220	0.000	13.823	40.299	0.699	0.005	-0.095	0.077
37	Govt. Middle school, Panjkharwani, Meerak	0.000	0.000	-1.695	-16.000	**38.636**	0.148	-0.608	**1.861**
		0.000	0.000	9.375	**49.573**	3.604	1.112	-0.556	1.145
56	Govt. Primary school, Naidyar Payeen	0.000	0.000	0.000	1.139	0.557	0.033	0.080	0.048
		0.000	0.000	0.064	1.296	0.097	0.015	0.023	0.042
100	Dream land public school, Bemina	0.000	0.000	0.272	0.403	10.753	0.000	0.000	-0.028
		0.820	0.000	4.787	15.043	1.475	-0.238	-0.056	0.231
Maximum reduction in stresses		**1.220**	**15.000**	**22.535**	**49.573**	**38.636**	**0.701**	**22.204**	**1.861**

From the above table:

Stress	%age reduction
Shear stresses reduces upto	15.00%
Membrane stress reduces upto	49.60%
Bending moment reduces upto	22.20%

Bemina Eagles Modern Ed. Instiute, Hamza Colony, Bemina

S. No. -01

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	2409	29 SEISMIC-Z	**0.19**	0.134	0.026	-0.121	-0.055	19.696	20.983	-9.252
Min Qx	714	29 SEISMIC-Z	**-0.199**	0.177	-0.007	-0.018	-0.045	24.264	20.593	-6.037
Max Qy	714	29 SEISMIC-Z	-0.199	**0.177**	-0.007	-0.018	-0.045	24.264	20.593	-6.037
Min Qy	2420	29 SEISMIC-Z	0.055	**-0.273**	-0.019	-0.041	-0.07	12.893	12.097	-3.736
Max Sx	3461	29 SEISMIC-Z	0.056	-0.011	**0.337**	0.142	-0.424	12.336	1.136	-0.501
Min Sx	3270	29 SEISMIC-Z	0.058	0.011	**-0.334**	-0.247	-0.419	-13.562	-1.242	-0.629
Max Sy	1095	7 SEISMIC Z	0.01	0.027	0.042	**0.367**	0.017	0.204	1.667	-0.052
Min Sy	4241	29 SEISMIC-Z	-0.012	-0.001	-0.197	**-0.6**	-0.238	0.473	0.598	-0.319
Max Sxy	3462	20 1.5(DL + WIND	-0.024	0.011	-0.071	-0.324	**0.296**	-9.136	-1.278	1.832
Min Sxy	3268	29 SEISMIC-Z	0.075	0.036	-0.031	-0.444	**-0.465**	-19.803	-2.728	-3.346
Max Mx	714	29 SEISMIC-Z	-0.199	0.177	-0.007	-0.018	-0.045	**24.264**	20.593	-6.037
Min Mx	402	29 SEISMIC-Z	0.029	0.014	-0.027	-0.066	0.013	**-22.781**	0.65	2.183
Max My	2203	29 SEISMIC-Z	-0.193	0.168	0.035	-0.168	0.101	24.018	**22.252**	-7.754
Min My	262	28 0.9(DL) + 1.5 *	0	-0.034	-0.01	-0.049	0.011	-2.09	**-12.575**	-0.018
Max Mxy	1915	29 SEISMIC-Z	0.023	0.058	-0.178	-0.072	-0.086	16.949	2.103	**7.79**
Min Mxy	2389	29 SEISMIC-Z	-0.047	-0.083	0.02	-0.03	-0.029	8.413	17.8	**-11.26**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	857	29 SEISMIC-Z	**0.19**	0.138	-0.012	0.062	0.05	18.92	20.639	-6.889
Min Qx	714	29 SEISMIC-Z	**-0.201**	0.178	-0.031	0.071	-0.061	24.359	20.739	-6.017
Max Qy	714	29 SEISMIC-Z	-0.201	**0.178**	-0.031	0.071	-0.061	24.359	20.739	-6.017
Min Qy	2420	29 SEISMIC-Z	0.056	**-0.273**	-0.008	0.074	-0.041	12.832	12.08	-3.786
Max Sx	3461	29 SEISMIC-Z	0.055	-0.01	**0.331**	0.194	-0.424	12.301	1.147	-0.496
Min Sx	3270	29 SEISMIC-Z	0.058	0.011	**-0.327**	-0.191	-0.41	-13.572	-1.241	-0.64
Max Sy	1095	29 SEISMIC-Z	0.012	0.032	0.045	**0.399**	0.024	0.246	1.985	-0.063
Min Sy	1485	29 SEISMIC-Z	0.012	0.034	-0.064	**-0.518**	-0.008	0.243	2.035	-0.053
Max Sxy	3462	28 0.9(DL) + 1.5 *\	-0.024	0.012	-0.066	-0.226	**0.263**	-9.171	-1.266	1.842
Min Sxy	3462	29 SEISMIC-Z	0.071	-0.035	0.028	0.366	**-0.447**	18.173	2.567	-3.092
Max Mx	714	29 SEISMIC-Z	-0.201	0.178	-0.031	0.071	-0.061	**24.359**	20.739	-6.017
Min Mx	402	29 SEISMIC-Z	0.029	0.014	0.076	0.001	-0.003	**-22.769**	0.65	2.175
Max My	2203	29 SEISMIC-Z	-0.192	0.167	0.016	-0.069	0.08	23.916	**22.112**	-7.755
Min My	262	20 1.5(DL + WIND	0	-0.034	0.002	0.012	0.015	-2.093	**-12.595**	-0.018
Max Mxy	1915	29 SEISMIC-Z	0.023	0.058	-0.118	-0.029	-0.038	17.014	2.088	**7.802**
Min Mxy	2389	29 SEISMIC-Z	-0.047	-0.083	0.015	-0.002	-0.021	8.376	17.701	**-11.24**

Bismillah education institue, Shahi hamdan colony, Bemina

S. No. -50

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	1554	31	**0.051**	-0.001	0.041	-0.04	-0.044	2.537	0.904	1.406
Min Qx	1547	31	**-0.046**	-0.007	-0.006	-0.025	0.003	3.154	0.742	-1.169
Max Qy	652	31	0.002	**0.02**	-0.003	-0.054	0.019	0.289	0.047	0.205
Min Qy	667	31	0.002	**-0.014**	0.004	-0.095	0.014	0.236	-0.219	0.605
Max Sx	602	20 1.5(DL + WIND	-0.007	-0.002	**0.094**	-0.035	-0.009	1.076	-0.063	-0.035
Min Sx	624	31	-0.002	0.001	**-0.124**	-0.13	0.126	-0.097	0.031	-0.058
Max Sy	821	8 SEISMIC X	-0.003	-0.009	0.012	**0.103**	0.005	-0.019	-0.371	-0.014
Min Sy	619	31	-0.001	0.002	-0.105	**-0.328**	0.111	-0.122	-0.034	0.137
Max Sxy	624	31	-0.002	0.001	-0.124	-0.13	**0.126**	-0.097	0.031	-0.058
Min Sxy	495	32	-0.001	0	-0.114	-0.18	**-0.146**	0.263	0.04	0.065
Max Mx	895	31	0.001	-0.009	-0.042	-0.05	0.003	**3.579**	-0.662	0.06
Min Mx	1551	31	-0.003	0.013	-0.015	-0.082	-0.006	**-4.089**	1.035	-0.129
Max My	697	20 1.5(DL + WIND	0	0.01	-0.015	-0.11	0.003	0.219	**1.757**	-0.014
Min My	949	27 0.9(DL) + 1.5 *	0	-0.012	-0.003	-0.024	0.002	-0.327	**-2.39**	0.022
Max Mxy	1554	31	0.051	-0.001	0.041	-0.04	-0.044	2.537	0.904	**1.406**
Min Mxy	1549	31	-0.028	0.012	-0.016	-0.067	0.007	-2.019	0.865	**-1.265**

Result with idealization

	Plate	L/C	Shear		Membrane			Bending Moment		
			SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local) I	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	1554	31	**0.051**	-0.002	0.039	0.006	-0.022	2.533	0.925	1.399
Min Qx	1547	31	**-0.046**	-0.006	-0.003	0.006	-0.002	3.14	0.74	-1.163
Max Qy	510	31	-0.008	**0.017**	0.003	-0.107	0.021	-0.023	0.453	0.019
Min Qy	667	31	0.002	**-0.013**	0.003	-0.052	0.013	0.22	-0.291	0.569
Max Sx	474	32	0.001	0.001	**0.085**	0.01	-0.038	0.256	0.068	0.01
Min Sx	624	31	-0.002	0.001	**-0.12**	-0.119	0.116	-0.096	0.031	-0.056
Max Sy	821	8 SEISMIC X	-0.003	-0.009	0.012	**0.103**	0.005	-0.019	-0.37	-0.014
Min Sy	619	31	-0.001	0.002	-0.096	**-0.264**	0.103	-0.113	-0.03	0.13
Max Sxy	544	31	-0.003	0	-0.016	-0.093	**0.124**	0.26	0.045	-0.016
Min Sxy	421	32	0	0.001	0.015	-0.078	**-0.145**	0.254	-0.001	-0.037
Max Mx	895	31	0.001	-0.009	-0.033	0.002	0.002	**3.581**	-0.655	0.057
Min Mx	1551	31	-0.003	0.013	0.003	0.003	-0.007	**-4.1**	1.036	-0.122
Max My	697	20 1.5(DL + WIND	0	0.01	-0.009	-0.064	0.002	0.213	**1.727**	-0.014
Min My	949	27 0.9(DL) + 1.5 *	0	-0.012	0	-0.003	0.003	-0.328	**-2.397**	0.022
Max Mxy	1554	31	0.051	-0.002	0.039	0.006	-0.022	2.533	0.925	**1.399**
Min Mxy	1549	31	-0.028	0.012	-0.004	0	-0.002	-2.029	0.874	**-1.255**

Govt. Girls Middle School, Kraliyar Pora

S. No. -09

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	441	17 1.5(DL + WIND	**0.065**	0.001	-0.034	-0.004	0.011	-5.566	-0.817	3.31
Min Qx	463	25 0.9(DL) + 1.5 *	**-0.064**	0.013	-0.015	0.002	-0.009	-3.449	-0.708	-3.451
Max Qy	739	26 0.9(DL) + 1.5 *	0.002	**0.051**	0	0.009	0.002	-0.159	7.066	-1.998
Min Qy	488	17 1.5(DL + WIND	0	**-0.044**	-0.001	-0.001	0	-0.461	-9.448	-0.014
Max Sx	341	19 1.5(DL + WIND	0.001	-0.001	**0.05**	-0.007	0.009	3.23	-0.138	0.007
Min Sx	1137	19 1.5(DL + WIND	0.001	0	**-0.142**	-0.129	0.103	0.016	-0.008	0.05
Max Sy	1412	20 1.5(DL + WIND	0.005	0.004	0.013	**0.107**	0.014	0.239	0.998	-0.163
Min Sy	1173	19 1.5(DL + WIND	0.001	-0.001	-0.064	**-0.398**	0.048	0.121	-0.035	-0.061
Max Sxy	1078	17 1.5(DL + WIND	-0.001	0	-0.13	-0.134	**0.109**	0.166	0.01	-0.032
Min Sxy	996	28 0.9(DL) + 1.5 *	0	0	-0.009	-0.037	**-0.11**	-0.023	0.002	0.01
Max Mx	445	25 0.9(DL) + 1.5 *	0.006	0.006	-0.023	0	0	**14.503**	0.154	-1.117
Min Mx	697	18 1.5(DL +WIND	-0.001	-0.007	-0.036	-0.002	-0.003	**-13.788**	-0.13	0.437
Max My	751	18 1.5(DL +WIND	-0.01	0.035	0	0.005	0.001	2.203	**13.532**	0.388
Min My	499	17 1.5(DL + WIND	0	-0.042	-0.001	-0.001	0	-2.997	**-18.253**	-0.006
Max Mxy	465	17 1.5(DL + WIND	0.018	0.019	-0.016	0.006	0.001	-2.561	-0.273	**4.823**
Min Mxy	724	18 1.5(DL +WIND	-0.002	0.036	0.004	0.016	0.004	-2.046	-0.02	**-6.604**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	441	17 1.5(DL + WIND	**0.065**	0.001	-0.033	-0.003	0.01	-5.565	-0.815	3.31
Min Qx	463	25 0.9(DL) + 1.5 *\	**-0.064**	0.013	-0.015	0.001	-0.009	-3.451	-0.706	-3.453
Max Qy	739	26 0.9(DL) + 1.5 *\	0.002	**0.051**	0.001	0.009	0.002	-0.159	7.064	-1.998
Min Qy	488	25 0.9(DL) + 1.5 *\	0	**-0.044**	-0.001	-0.001	0	-0.461	-9.445	-0.013
Max Sx	278	20 1.5(DL + WIND	0	0	**0.043**	-0.008	-0.002	-0.011	0	0.002
Min Sx	254	18 1.5(DL +WIND	0.002	0	**-0.11**	-0.058	0.069	-0.119	-0.001	0.039
Max Sy	1007	20 1.5(DL + WIND	0	0	0.029	**0.101**	-0.086	-0.002	0.024	-0.014
Min Sy	282	17 1.5(DL + WIND	0	0	-0.082	**-0.242**	-0.034	-0.05	0.034	-0.021
Max Sxy	1061	19 1.5(DL + WIND	-0.001	0.001	-0.008	-0.129	**0.093**	-0.105	-0.023	-0.075
Min Sxy	996	20 1.5(DL + WIND	0	0	-0.008	-0.009	**-0.112**	-0.023	0.002	0.009
Max Mx	445	25 0.9(DL) + 1.5 *\	0.006	0.006	-0.022	0	0	**14.503**	0.154	-1.118
Min Mx	697	18 1.5(DL +WIND	-0.001	-0.007	-0.035	-0.002	-0.003	**-13.787**	-0.131	0.437
Max My	751	18 1.5(DL +WIND	-0.01	0.035	0	0.005	0.001	2.203	**13.529**	0.388
Min My	499	17 1.5(DL + WIND	0	-0.042	-0.001	-0.001	0	-2.996	**-18.248**	-0.006
Max Mxy	465	25 0.9(DL) + 1.5 *\	0.018	0.019	-0.016	0.006	0.001	-2.562	-0.273	**4.822**
Min Mxy	724	18 1.5(DL +WIND	-0.002	0.036	0.004	0.016	0.004	-2.045	-0.022	**-6.603**

Govt. Girls Primary School, Ahmad Nagar

S. No. -108

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	65	28 0.9(DL) + 1.5 *	**0.03**	0.006	-0.011	-0.009	-0.002	-1.577	-0.297	1.113
Min Qx	446	27 0.9(DL) + 1.5 *	**-0.031**	0.005	0.007	-0.009	-0.004	-2.392	-0.398	-0.965
Max Qy	216	20 1.5(DL + WIND	-0.007	**0.013**	-0.009	-0.06	0.012	-0.403	-0.344	0.426
Min Qy	301	30 SEISMIC-X	-0.013	**-0.025**	-0.009	-0.102	-0.01	-0.157	-1.012	0.63
Max Sx	134	30 SEISMIC-X	0.001	-0.001	**0.212**	0.146	-0.173	0.101	0.04	-0.03
Min Sx	174	30 SEISMIC-X	0	0	**-0.161**	-0.16	-0.152	-0.027	-0.049	-0.006
Max Sy	134	30 SEISMIC-X	0.001	-0.001	0.212	**0.146**	-0.173	0.101	0.04	-0.03
Min Sy	76	17 1.5(DL + WIND	0	0	-0.108	**-0.187**	0.044	-0.088	-0.071	-0.03
Max Sxy	441	17 1.5(DL + WIND	0	0	-0.068	-0.071	**0.092**	-0.016	0.004	-0.006
Min Sxy	126	30 SEISMIC-X	-0.002	0	0.065	0.009	**-0.238**	0.022	-0.157	-0.135
Max Mx	69	28 0.9(DL) + 1.5 *	0.003	0.003	-0.04	-0.04	0.036	**4.052**	0.05	-0.362
Min Mx	205	28 0.9(DL) + 1.5 *	-0.016	-0.003	-0.045	-0.007	-0.003	**-4.521**	-0.65	0.36
Max My	292	30 SEISMIC-X	0.021	-0.01	-0.011	-0.096	0.003	0.079	**1.806**	0.077
Min My	514	26 0.9(DL) + 1.5 *	0	-0.018	-0.004	-0.029	0	-0.665	**-4.39**	0
Max Mxy	448	19 1.5(DL + WIND	0.011	0.001	-0.077	-0.113	0.052	-1.022	-0.063	**1.663**
Min Mxy	80	20 1.5(DL + WIND	-0.011	0.001	-0.078	-0.113	-0.056	-1.088	-0.082	**-1.732**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	65	28 0.9(DL) + 1.5 *\	**0.03**	0.006	-0.013	0.001	0.003	-1.555	-0.279	1.125
Min Qx	446	27 0.9(DL) + 1.5 *\	**-0.031**	0.005	-0.001	0.001	-0.005	-2.386	-0.389	-0.97
Max Qy	216	20 1.5(DL + WIND	-0.006	**0.013**	-0.012	-0.017	0.018	-0.402	-0.248	0.438
Min Qy	301	30 SEISMIC-X	-0.011	**-0.022**	-0.004	-0.047	-0.005	-0.156	-0.851	0.532
Max Sx	134	30 SEISMIC-X	0.001	0	**0.199**	0.149	-0.171	0.084	0.037	-0.027
Min Sx	174	30 SEISMIC-X	0	0	**-0.155**	-0.131	-0.14	-0.005	-0.046	-0.003
Max Sy	134	30 SEISMIC-X	0.001	0	0.199	**0.149**	-0.171	0.084	0.037	-0.027
Min Sy	174	30 SEISMIC-X	0	0	-0.155	**-0.131**	-0.14	-0.005	-0.046	-0.003
Max Sxy	111	20 1.5(DL + WIND	0.018	-0.002	-0.028	-0.028	**0.057**	-1.864	-0.265	0.098
Min Sxy	126	30 SEISMIC-X	-0.002	0	0.066	0.038	**-0.239**	0.009	-0.141	-0.121
Max Mx	69	20 1.5(DL + WIND	0.003	0.003	-0.011	0	-0.001	**4.058**	0.052	-0.368
Min Mx	205	28 0.9(DL) + 1.5 *\	-0.015	-0.002	-0.043	-0.004	-0.001	**-4.498**	-0.645	0.38
Max My	292	30 SEISMIC-X	0.016	-0.007	-0.005	-0.044	0.001	0.044	**1.405**	0.054
Min My	514	26 0.9(DL) + 1.5 *\	0	-0.018	0	0.002	0	-0.668	**-4.403**	0
Max Mxy	448	19 1.5(DL + WIND	0.011	0.001	-0.004	0.004	0.001	-0.967	0.009	**1.661**
Min Mxy	80	20 1.5(DL + WIND	-0.011	0.001	-0.005	0.004	-0.004	-1.038	-0.011	**-1.734**

Govt. Girls Primary School , Barjee Nishat

S. No. -101

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	69	29 SEISMIC-Z	**0.064**	0.038	0.023	-0.099	0.008	-14.463	-1.208	1.404
Min Qx	143	29 SEISMIC-Z	**-0.082**	0.05	0.004	-0.035	0.023	-1.835	5.996	-3.385
Max Qy	79	29 SEISMIC-Z	0.035	**0.087**	-0.077	-0.213	-0.014	-6.167	1.548	1.43
Min Qy	448	29 SEISMIC-Z	-0.009	**-0.057**	-0.008	-0.068	0.006	-2.346	-15.784	0.489
Max Sx	92	30 SEISMIC-X	0	0.001	**0.179**	0.085	-0.122	-0.052	0.031	-0.004
Min Sx	117	30 SEISMIC-X	0	0	**-0.463**	-0.165	-0.156	0.064	0.008	0.027
Max Sy	115	19 1.5(DL + WIND	-0.001	-0.002	-0.119	**0.18**	0.055	0.231	0.005	0.096
Min Sy	79	17 1.5(DL + WIND	0	0	-0.106	**-0.268**	-0.028	-0.002	-0.013	-0.01
Max Sxy	163	29 SEISMIC-Z	0.01	-0.004	-0.163	-0.08	**0.137**	2.55	0.367	0.14
Min Sxy	79	30 SEISMIC-X	0	0	-0.239	-0.256	**-0.286**	-0.003	0.007	-0.034
Max Mx	115	29 SEISMIC-Z	-0.04	-0.004	-0.081	0.147	0.033	**14.399**	1.606	-4.192
Min Mx	122	29 SEISMIC-Z	-0.069	-0.02	-0.026	-0.057	-0.059	**-21.806**	-0.467	-3.716
Max My	108	29 SEISMIC-Z	-0.01	0.045	-0.001	-0.073	-0.012	2.313	**15.35**	0.459
Min My	448	29 SEISMIC-Z	-0.009	-0.057	-0.008	-0.068	0.006	-2.346	**-15.784**	0.489
Max Mxy	88	29 SEISMIC-Z	0.054	0.016	0.003	-0.055	-0.047	-0.195	5.575	**6.629**
Min Mxy	126	29 SEISMIC-Z	0.026	0.026	-0.031	-0.123	-0.005	0.34	2.671	**-6.479**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	69	29 SEISMIC-Z	**0.064**	0.038	0.027	-0.001	0.002	-14.463	-1.204	1.404
Min Qx	143	29 SEISMIC-Z	**-0.081**	0.05	0.009	0.005	-0.007	-1.837	5.995	-3.38
Max Qy	79	29 SEISMIC-Z	0.035	**0.087**	-0.001	-0.002	-0.01	-6.166	1.559	1.436
Min Qy	448	29 SEISMIC-Z	-0.009	**-0.057**	-0.002	0.001	-0.005	-2.348	-15.799	0.489
Max Sx	92	30 SEISMIC-X	0	0	**0.153**	0.103	-0.13	-0.039	0.034	-0.002
Min Sx	117	30 SEISMIC-X	0	0	**-0.399**	-0.079	-0.177	0.011	-0.001	-0.003
Max Sy	92	30 SEISMIC-X	0	0	0.153	**0.103**	-0.13	-0.039	0.034	-0.002
Min Sy	88	30 SEISMIC-X	0	0	-0.188	**-0.16**	-0.178	-0.007	0.02	-0.001
Max Sxy	496	30 SEISMIC-X	-0.001	0	0.031	0.01	**0.107**	0.224	0.067	-0.032
Min Sxy	79	30 SEISMIC-X	0	0	-0.166	-0.048	**-0.284**	-0.002	0.019	-0.029
Max Mx	115	29 SEISMIC-Z	-0.04	-0.002	0.016	0.003	-0.011	**14.298**	1.604	-4.247
Min Mx	122	29 SEISMIC-Z	-0.069	-0.019	0.021	-0.001	-0.004	**-21.805**	-0.465	-3.715
Max My	108	29 SEISMIC-Z	-0.01	0.045	0.002	0.005	-0.006	2.313	**15.346**	0.461
Min My	448	29 SEISMIC-Z	-0.009	-0.057	-0.002	0.001	-0.005	-2.348	**-15.799**	0.489
Max Mxy	88	29 SEISMIC-Z	0.054	0.016	0.003	-0.007	-0.011	-0.194	5.577	**6.637**
Min Mxy	126	29 SEISMIC-Z	0.026	0.026	-0.001	-0.007	-0.01	0.335	2.653	**-6.474**

Govt. Middle school, Panjkharwani, Meerak shah colony

S. No. -37

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	618	25 0.9(DL) + 1.5 *\	**0.022**	0.003	-0.007	-0.008	0.004	-0.771	-0.194	0.562
Min Qx	625	25 0.9(DL) + 1.5 *\	**-0.024**	0.005	-0.006	-0.008	-0.001	-0.482	-0.214	-0.515
Max Qy	880	26 0.9(DL) + 1.5 *\	0	**0.011**	-0.002	-0.014	0	0.26	1.974	0
Min Qy	652	25 0.9(DL) + 1.5 *\	0	**-0.012**	-0.002	-0.016	0	-0.288	-2.157	0.019
Max Sx	598	30 SEISMIC-X	0	0	**0.059**	0.024	-0.044	0.019	-0.008	0.001
Min Sx	770	29 SEISMIC-Z	0	0	**-0.064**	-0.043	-0.011	-0.026	-0.004	0.004
Max Sy	128	8 SEISMIC X	0	0	0.044	**0.075**	-0.063	0.003	0.002	-0.003
Min Sy	736	19 1.5(DL + WIND	0	0	-0.042	**-0.117**	0.003	0.027	0.009	-0.008
Max Sxy	578	18 1.5(DL +WIND	0.006	-0.001	-0.04	-0.042	**0.044**	0.028	0.02	0.045
Min Sxy	932	30 SEISMIC-X	0	0.001	-0.024	-0.095	**-0.111**	-0.012	-0.041	-0.002
Max Mx	622	17 1.5(DL + WIND	0	0.001	-0.017	-0.059	-0.001	**2.704**	0.195	-0.023
Min Mx	107	17 1.5(DL + WIND	0.007	-0.001	-0.041	-0.019	0.023	**-2.787**	-0.223	-0.026
Max My	880	26 0.9(DL) + 1.5 *\	0	0.011	-0.002	-0.014	0	0.26	**1.974**	0
Min My	652	25 0.9(DL) + 1.5 *\	0	-0.012	-0.002	-0.016	0	-0.288	**-2.157**	0.019
Max Mxy	632	17 1.5(DL + WIND	0.01	0.003	-0.004	-0.03	0.005	-0.396	-0.036	**0.806**
Min Mxy	639	17 1.5(DL + WIND	-0.007	-0.004	-0.003	-0.044	-0.009	0.087	0.138	**-0.873**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	618	17 1.5(DL + WIND	**0.022**	0.003	-0.006	0	0.002	-0.768	-0.166	0.579
Min Qx	625	17 1.5(DL + WIND	**-0.024**	0.006	-0.006	0.003	-0.001	-0.484	-0.191	-0.537
Max Qy	880	18 1.5(DL +WIND	0	**0.011**	0	0.004	0	0.263	1.986	0
Min Qy	652	17 1.5(DL + WIND	0	**-0.012**	0	0.003	0	-0.291	-2.169	0.019
Max Sx	739	29 SEISMIC-Z	0	0	**0.06**	0.013	-0.02	0.019	0.008	-0.007
Min Sx	770	29 SEISMIC-Z	0	0	**-0.058**	-0.01	-0.019	-0.024	-0.004	0.004
Max Sy	128	30 SEISMIC-X	0	0	0.05	**0.087**	-0.076	0.003	0.003	-0.003
Min Sy	276	29 SEISMIC-Z	-0.002	0.008	-0.005	**-0.059**	0.008	0.035	0.368	-0.014
Max Sxy	200	30 SEISMIC-X	0	0	0.017	-0.006	**0.027**	-0.032	-0.024	0.023
Min Sxy	932	30 SEISMIC-X	0	0.001	-0.002	-0.013	**-0.107**	-0.008	0	-0.004
Max Mx	622	17 1.5(DL + WIND	0	0.002	-0.007	0	0	**2.7**	0.209	-0.025
Min Mx	107	17 1.5(DL + WIND	0.007	0	-0.04	-0.004	-0.001	**-2.756**	-0.218	-0.064
Max My	880	18 1.5(DL +WIND	0	0.011	0	0.004	0	0.263	**1.986**	0
Min My	652	17 1.5(DL + WIND	0	-0.012	0	0.003	0	-0.291	**-2.169**	0.019
Max Mxy	632	17 1.5(DL + WIND	0.01	0.002	-0.003	0.006	0.003	-0.391	-0.032	**0.791**
Min Mxy	644	17 1.5(DL + WIND	-0.009	0.002	-0.003	0.004	-0.003	-0.157	-0.42	**-0.863**

Govt. Primary school, Naidyar Payeen

S. No. -56

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	262	30 SEISMIC-X	**0.14**	-0.071	-0.024	-0.103	0.03	1.877	0.161	1.349
Min Qx	390	30 SEISMIC-X	**-0.169**	0.018	-0.01	-0.055	-0.004	2.913	0.418	-1.442
Max Qy	1091	29 SEISMIC-Z	0.088	**0.107**	-0.113	-0.317	-0.162	0.569	4.413	1.795
Min Qy	698	30 SEISMIC-X	0.006	**-0.114**	-0.04	-0.497	0.197	0.214	-0.031	0.387
Max Sx	952	8 SEISMIC X	0.001	0	**1.142**	0.433	-0.676	-0.002	-0.001	-0.012
Min Sx	969	30 SEISMIC-X	0	0	**-1.569**	-0.746	-1.033	0.011	0.001	0.008
Max Sy	428	7 SEISMIC Z	-0.019	0.019	0.276	**0.439**	-0.327	0.093	1.059	-0.335
Min Sy	317	29 SEISMIC-Z	-0.023	-0.026	-0.6	**-1.003**	-0.63	-0.12	-1.204	-0.392
Max Sxy	952	18 1.5(DL +WIND	0	-0.001	-0.617	-0.551	**0.539**	-0.002	-0.001	0.011
Min Sxy	969	30 SEISMIC-X	0	0	-1.569	-0.746	**-1.033**	0.011	0.001	0.008
Max Mx	376	30 SEISMIC-X	0.038	0.018	-0.009	0.021	-0.028	**5.984**	2.319	-0.716
Min Mx	392	30 SEISMIC-X	-0.071	-0.002	-0.001	-0.106	0.005	**-6.561**	0.077	-0.553
Max My	364	30 SEISMIC-X	-0.049	0.044	0.006	0.029	-0.009	0.491	**4.972**	-0.61
Min My	428	30 SEISMIC-X	0.081	-0.091	-0.039	-0.109	0.071	-0.425	**-4.357**	1.801
Max Mxy	396	30 SEISMIC-X	-0.024	-0.007	0.03	-0.037	0.032	2.222	3.032	**2.075**
Min Mxy	1022	29 SEISMIC-Z	-0.11	-0.009	0.016	-0.031	-0.024	-0.364	-0.51	**-2.365**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	262	30 SEISMIC-X	**0.14**	-0.071	-0.026	-0.104	0.03	1.875	0.162	1.348
Min Qx	390	30 SEISMIC-X	**-0.169**	0.018	-0.01	-0.056	-0.004	2.911	0.419	-1.441
Max Qy	1091	29 SEISMIC-Z	0.088	**0.107**	-0.111	-0.31	-0.159	0.569	4.412	1.794
Min Qy	698	30 SEISMIC-X	0.006	**-0.114**	-0.04	-0.496	0.196	0.214	-0.031	0.387
Max Sx	952	8 SEISMIC X	0.001	0	**1.142**	0.432	-0.676	-0.002	-0.001	-0.012
Min Sx	969	30 SEISMIC-X	0	0	**-1.568**	-0.745	-1.032	0.011	0.001	0.008
Max Sy	428	7 SEISMIC Z	-0.019	0.019	0.275	**0.434**	-0.324	0.093	1.059	-0.335
Min Sy	317	29 SEISMIC-Z	-0.023	-0.026	-0.596	**-0.99**	-0.624	-0.12	-1.204	-0.391
Max Sxy	952	18 1.5(DL +WIND	0	-0.001	-0.616	-0.548	**0.536**	-0.002	0	0.012
Min Sxy	969	30 SEISMIC-X	0	0	-1.568	-0.745	**-1.032**	0.011	0.001	0.008
Max Mx	376	30 SEISMIC-X	0.038	0.018	-0.009	0.022	-0.028	**5.982**	2.319	-0.715
Min Mx	392	30 SEISMIC-X	-0.071	-0.002	-0.002	-0.106	0.006	**-6.56**	0.077	-0.553
Max My	364	30 SEISMIC-X	-0.048	0.044	0.005	0.027	-0.009	0.492	**4.968**	-0.61
Min My	428	30 SEISMIC-X	0.081	-0.091	-0.038	-0.107	0.069	-0.425	**-4.356**	1.801
Max Mxy	396	30 SEISMIC-X	-0.024	-0.006	0.03	-0.036	0.033	2.222	3.031	**2.074**
Min Mxy	1022	29 SEISMIC-Z	-0.11	-0.009	0.014	-0.031	-0.024	-0.364	-0.511	**-2.364**

Dream land public school, Bemina

S. No. -100

Result with real building

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	797	30 SEISMIC-X	**0.128**	0.011	0.009	-0.033	0.005	-8.839	-2.57	3.408
Min Qx	690	30 SEISMIC-X	**-0.122**	0.027	-0.014	0.007	-0.036	-6.193	-1.78	-3.328
Max Qy	815	30 SEISMIC-X	0.003	**0.038**	0.015	-0.056	-0.001	7.893	1.996	0.256
Min Qy	403	30 SEISMIC-X	-0.006	**-0.053**	-0.002	0.003	-0.059	-0.417	-0.16	0.193
Max Sx	266	30 SEISMIC-X	0.012	0.004	**0.367**	0.135	-0.128	-3.537	-0.386	-0.561
Min Sx	279	30 SEISMIC-X	0.007	0.007	**-0.376**	-0.352	-0.398	-1.312	-0.085	-0.526
Max Sy	222	8 SEISMIC X	0.003	-0.002	0.168	**0.496**	-0.263	0.265	0.105	-0.09
Min Sy	286	29 SEISMIC-Z	-0.002	-0.001	-0.099	**-0.585**	0.156	-0.384	-0.047	-0.217
Max Sxy	163	29 SEISMIC-Z	-0.004	0.002	-0.056	-0.22	**0.186**	0.105	0.069	-0.117
Min Sxy	277	30 SEISMIC-X	0.001	0.001	-0.287	-0.443	**-0.61**	1.336	0.394	0.186
Max Mx	687	30 SEISMIC-X	0.004	-0.041	-0.05	-0.093	0.007	**12.408**	-3.512	0.081
Min Mx	797	30 SEISMIC-X	0.128	0.011	0.009	-0.033	0.005	**-8.839**	-2.57	3.408
Max My	821	30 SEISMIC-X	0.003	-0.044	0.004	-0.17	-0.005	6.394	**3.175**	0.313
Min My	744	30 SEISMIC-X	0.004	-0.041	-0.037	-0.096	0.003	12.022	**-3.563**	0.17
Max Mxy	742	30 SEISMIC-X	0.079	-0.037	-0.029	-0.073	0.015	6.143	-3.024	**3.55**
Min Mxy	689	30 SEISMIC-X	-0.072	-0.036	-0.044	-0.068	-0.012	7.749	-2.681	**-3.462**

Result with idealization

			Shear		Membrane			Bending Moment		
	Plate	L/C	SQX (local)	SQY (local)	SX (local) N	SY (local) N	SXY (local)	Mx kNm/m	My kNm/m	Mxy kNm/m
Max Qx	797	30 SEISMIC-X	**0.128**	0.012	0.012	-0.002	0	-8.86	-2.56	3.416
Min Qx	690	30 SEISMIC-X	**-0.121**	0.028	-0.012	0.044	-0.034	-6.156	-1.726	-3.346
Max Qy	758	30 SEISMIC-X	0.002	**0.038**	0.009	0.011	-0.006	7.71	1.87	0.259
Min Qy	403	30 SEISMIC-X	-0.006	**-0.053**	0	0.043	-0.058	-0.407	-0.103	0.196
Max Sx	266	30 SEISMIC-X	0.012	0.004	**0.366**	0.159	-0.136	-3.54	-0.38	-0.566
Min Sx	279	30 SEISMIC-X	0.007	0.007	**-0.358**	-0.321	-0.382	-1.31	-0.077	-0.515
Max Sy	222	30 SEISMIC-X	0.004	-0.002	0.183	**0.494**	-0.299	0.318	0.115	-0.104
Min Sy	286	29 SEISMIC-Z	-0.002	-0.001	-0.089	**-0.497**	0.144	-0.376	-0.035	-0.225
Max Sxy	163	29 SEISMIC-Z	-0.004	0.002	-0.05	-0.199	**0.166**	0.109	0.074	-0.117
Min Sxy	277	30 SEISMIC-X	0.001	0.001	-0.279	-0.366	**-0.601**	1.332	0.366	0.178
Max Mx	687	30 SEISMIC-X	0.004	-0.041	-0.033	0.002	0.008	**12.408**	-3.508	0.095
Min Mx	797	30 SEISMIC-X	0.128	0.012	0.012	-0.002	0	**-8.86**	-2.56	3.416
Max My	707	30 SEISMIC-X	0.003	-0.044	0.013	-0.064	-0.001	6.522	**3.175**	0.3
Min My	744	30 SEISMIC-X	0.004	-0.041	-0.017	0	0.003	12.02	**-3.565**	0.175
Max Mxy	742	30 SEISMIC-X	0.079	-0.037	-0.015	0	0.004	6.134	-3.03	**3.551**
Min Mxy	689	30 SEISMIC-X	-0.071	-0.036	-0.032	0.006	0	7.764	-2.664	**-3.454**

CHAPTER- 01

INTRODUCTION

CHAPTER- 02

LITERATURE REVIEW

CHAPTER- 03

METHODOLOGY

CHAPTER- 04

DATA COLLECTION

CHAPTER- 05

ANALYSIS OF INFORMATION

CHAPTER- 06

CONCLUSION

ANNEXURES

REFERENCES