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A Critical Appraisal of Diagnostic Alternatives for Seismically Excited Structures

[1]Vikram Kumar, [2]Rishabh Sharma

[1]M.Tech. Scholar, [2]*Assistant P*rofessor

Department of CE
BRCM College of Engineering and Technology, Bahal (Bhiwani) India

ABSTRACT
The enormous increase in Population explosion and the skyrocketing cost in the land price, skyscrapers have become the necessity of the present day for optimum use of scarce land. As the structures becometaller and taller, apart from dead load and live loads the structures have to withstand lateral forces. The lateral loads due to wind and earthquake are a matter of great concern. These require special consideration in the design ofall structure.
The buildings, which had already been constructed are susceptible to face seismic risk, due to the increased seismic vulnerability. Hence, proper evaluation of the building against seismic hazards is absolutely necessary. Population explosion and increase in pollution have become the challenges of the present day for optimum use of resources available on earth and reduction in waste. The debris from the demolition of buildings by natural or manmade methods has posed enormous difficulties for engineer to dispose the wreckage. The earthquake results in a large amount of building debris. The waste could be reduced by reuse of repaired or old building. Rehabilitation and reuse of damaged building result in earthquake could reducing the pollution due to debris. The GFRP and CFRP wrapping are two of the rehabilitation methods used widely in the field.

INTRODUCTION
It is a more improved method compared to cantilever method and portal method of analyzing multi-storey frames for horizontal loads. One can take into account the stiffness of beams and columns while apportioning the total B.M induced by wind loads on a multi-bay, multi-storey frame.

Girder and column factors:
At the outset, it is necessary determine the relative stiffness k =I/L at each joint of every member beam or column. From the k values of every member at each joint, it is possible to get the girder factor g of the beams and the column factor C of the columns.
The girder factor at a joint is
g=Σk of columns/Σk of all members.
Moment factor
C or G are got by multiplying $c_m k$ and $g_m k$Total column moments
Column moments=$C/\Sigma C.M_T$
Basis
The factor method is also an approximate method, but instead of making gross approximations as in the portal and cantilever methods, this takes into
At any joint the total moment is shared by all members inproportion to their stiffness.
That half the moment at each end gets carried over to theopposite end when one accommodate, rotation at each joint.
A part of the overturning moment on a frame is taken by thecolumns as B.M and another part as thrust.
The following method is mostly used in the design of portal frame subjected to horizontal forces.
city design is based on deterministic allocation of strength andductility in the

EXPERIMENTAL
GENERAL
The experimental work consisted of casting and testing ofa 1/3rd scale model of single-bay, three-storey R.C.C. frames without infill. The frame is subjected to dynamic loading. Casting is done by using a proper steel mould, a proper designed mix and by adhering to a strict quality control during casting and identical curing condition.

PROPERTIES OF MATERIALS USED
The frame used for the experimental investigation consists of the following materials.
Cement
The cement used for this thesis work was Ultratech brand 53 grade Portland cement. The properties of cement are furnished in Table 1.1.

Table 1.1 Properties of cement

S.No	Description		Values
1	Specific gravity		3.15
2	Fineness		5%
3	Compressive strength of cement		
	(i)	At 3 days	26.5 N/mm^2
	(ii)	At14 days	39.75 N/mm^2
	(iii)	At28 days	53.52 N/mm^2

Fine Aggregate
The Sand used is collected from locally available river bed source. Sieve analysis for fine aggregate has been carried out and given in Table 4.2.
Coarse Aggregate
Crushed granite aggregate of nominal size 12 mm was used as coarse aggregate. Sieve analysis for coarse aggregate has been done and it found to be Zone III. It is well graded and cubical in shape. The various properties of aggregate have been found and shown in Table 1.2.

Table 1.2 Properties of aggregate

S.No	Properties	Coarse Aggregate	Fine Aggregate
1	Specific Gravity	2.61	2.5
2	Free Surface Moisture	Nil	2%
3	Water Absorption	0.5%	1%

Water
Potable water was used for mixing and curing whose pH values range from 7 to 8.
Reinforcement Steel
The main reinforcement used for the specimen was HYSD (Fe 415) bar of diameter 8mm. The lateral tie and shear reinforcement were mild steel bar of diameter 6mm and IS specification was used to manufacture the test result.
Glass Fiber Mat
Glass E-Glass fiber of grade (M6-450-1040-1E) used as fiberreinforcement is shown in Figure 1.1. Chopped strand mat fiber of E-Glass of 450 gm/sqm of uniform bi-direction fabric was used as fiber reinforcement and for this twice the weight of resin mix was used for bonding with RCC beam. The properties of Glass fibers are displayed in Table 1.3.

Table 1.3 Properties of Glass fiber mat

S.No	Properties	Magnitude
1	Colour	White
2	Density	2.5 g/cm^3
3	Loss of ignition	4%
4	Moisture	0.3%
5	Fiber thickness	0.363mm
6	Fiber orientation	Bi-direction
7	Nominal thickness per layer	1mm
8	Specific gravity	1.4
9	Tensile strength	200Mpa
10	Modulus of Elasticity	60 Gpa

Figure 1.1 Glass fiber mat

Unsaturated Polyester Resin
The properties of unsaturated Polyester resin of Grade 8810 (Isopathalic resin) are listed in Table 4.4. The accelerator (Cobalt octoate 6% solution) was used with resin and a catalyst was used for hardening the resin. The unsaturated polyester resin, accelerator, catalyst and FRP powder are shown in Figure 1.2.

Table 1.4 Properties of unsaturated polyester resin

S.No	Properties	Magnitude
1	Colour	Light yellow
2	Density	1258kg/m^3
3	Specific gravity @ 27°C	1.1
4	Viscosity @ 25°C	500 cps
5	Hardness (Barcol 934-1)	40
6	Elongation	2.5%

Figure 1.2 Unsaturated polyester resin, accelerator, catalyst and FRPpowder

and CFRP was allowed to cure and then tested. The compressive strength of the specimen was calculated by dividing the maximum load applied to the specimen by the

Carbon Fiber Mat

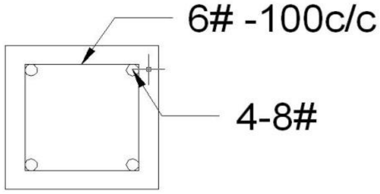


Figure 1.3 CFRP fiber mat

cross sectional area.

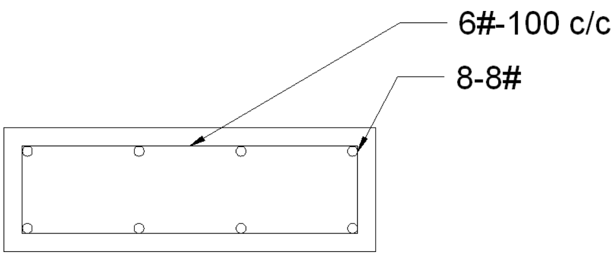
Split Tensile Test

This test is carried out by placing a cylindrical specimen horizontally between the loading surface of a compression testing machine and the load is applied until failure of the cylinder, along the longitudinal direction.

REINFORCEMENT DETAILS

Three-storey, reduced size, single-bay R.C frame was cast and tested. Totally fifteen numbers of frames have been used for the experimental study. The details of the specimen are shown in Figure 4.4. It is named as C1, GFRP-1, GFRP-2, CFRP1 and CFRP2. The specimen is detailed as per IS 456-2000 recommendation. The details of the beams and columns of theframe and also the reinforcement details are given in Table 1.5.

Table 1.5 Model dimensions and reinforcement details



Model	Details	Size (mm)	Flexural Reinforcement (HYSD bars)
FRAME	Beam 1,2,3	100x100	8mm Φ 2 Nos. both at top & bottom
	Columns 1,2,3,4,5,6	100x100	8mm Φ 2 Nos. on either side

For columns: 6mm ϕ 2 legged at 100mm c/c distance

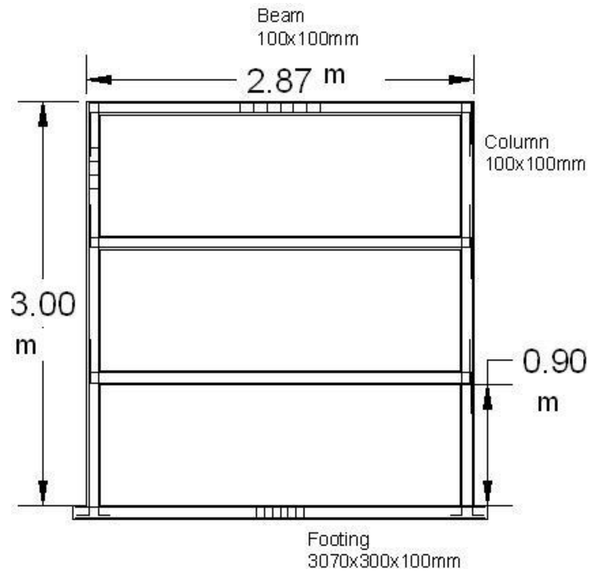


Figure 1.4 Reinforcement details

Reinforcement details of frame

Cross section of beam and column Cross section of footing

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