RESEARCH ARTICLE OPEN ACCESS

Dynamic Response of Rcc and Composite Structure with Brb Frame Subjected To Seismic and Temperature Load

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ABSTRACT
Concrete structures impart more seismic weight and less deflection whereas Steel structures instruct more deflections and ductility to the structure, which is beneficial in resisting earthquake forces. Composite Construction combines the better properties of both steel and concrete. Buckling restrained braced frames (BRBFs) are primarily used as seismic-force resisting systems for buildings in seismically-active regions.The objective of the present work is to compare a twenty storied RCC and composite framed structure with BRB frame subjected to Seismic and different Temperatureloadings using Non-Linear Time History Analysis. Three dimensional modeling and analysis of the structure is carried out with the help of SAP-2000 v16 software. It is observed that the storey displacements were decreased by 36% for twenty storey RCC building and for composite buildings it was decreased by 45% for twenty storeys suggesting the effectiveness of Buckling restrained brace frame. The overall results suggested that BRB were excellent seismic control device for composite building as the roof displacement is reduced by 40% but whereas for RCC it is reduced only by 25%. For Seismic prone areas composite building with BRB frame is more effective. Under Temperature loading RCC building is more effective than composite structure.

Keywords: RCC Structure, Concrete Structure, BRB Frame, Seismic and Temperature load, SAP.

I. INTRODUCTION

A composite building with steel and the concrete sections would resist the external loading by interacting together by bond and friction. Supplementary reinforcement in the concrete encasement prevents excessive spalling of concrete both under normal load and fire conditions.

A buckling-restrained brace, or an unbounded brace, is a bracing member consisting of a steel core plate or another section encased in a concrete-filled steel tube over its length as shown in Figure.During an earthquake, seismic ground forces have the effect of applying lateral loads to buildings. If these loads are strong enough, they have the ability to damage the structure, leading to an economic loss or even loss of human life. In order to prevent both of these from happening, it is crucial to have buildings that are able to withstand seismic loads they may be subjected to. Structures fitted with BRBs are likely to absorb even more energy as both diagonal braces (in tension and compression) are resisting the lateral loads.

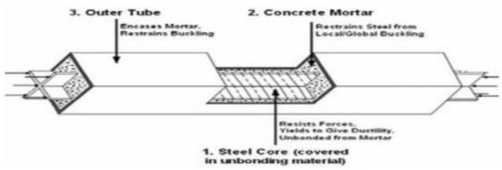


Figure1. Buckling Restrained Brace cross sectional view

The objectives of the present study are:

1. To study the Seismic behavior of RCC and Composite building using the Non-linear time history analysis with and without BRB Frame.
2. To find the effect of Temperature load on RCC and Composite building withBRB Frame.
3. To illustrate the effects ofBRB Frame on the response of the High-rise Buildings.

II. STUDY AREAFIGURE

Bhuj is a place located in Gujarat which is a High intensity earthquake zone of zone factor 0.36 which comes under the Zone-V according to the classification of seismic zones by IS 1893-2002 part-1.The records are defined for acceleration points with respect to time interval of 0.005 seconds. The acceleration record has units of m/sec^2 and has total number of 26,706 acceleration data.Frame temperature load is defined for normal as well as for high temperature(28^{0}C and 400^{0}C respectively).

Figure2.Bhuj Earthquake

III. MATERIAL AND METHOD

SAP 2000 is integrated software for analysis and design of structures. Using SAP nonlinear time history analysis is performed on the proposed building. Models are prepared by using assumptions; input data is feed into the SAP to analyze the structural parameters such as base shear, base moment, lateral displacement, storey drift, time period, bending moment and axial force.The following methodological approach is used for evaluating the Dynamic Response of RCC & Composite Structures using BRB frame.

1. Identification of study area
2. Collection of the data
3. Analysis and Results
4. Conclusions.

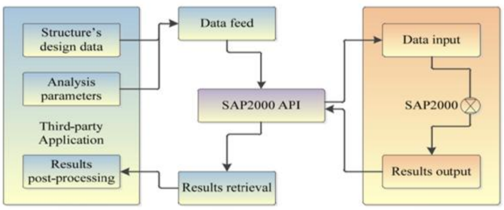


Figure 3. Application of SAP2000 API

S.No	Description	Information	Remarks
1.	Building height-20 storey	60.0 m	Including the foundation level
2.	Number of basements below ground	Zero	----
3.	Open ground storey	Yes	----
4.	Special hazards	None	----
5.	Type of building	Regular Space frames	IS 1893:2002 Clause 7.1
6.	Horizontal floor system	Beams and slabs	----
7.	Software used	SAP 2000 V16	----

Table 1. General data collection and condition assessment of building

Seismic Load		
S.No	Variable	Data
1.	Type of structure	Moment Resisting Frame
2.	Seismic Data	Bhuj Earthquake data
3.	Number of Stories	20
4.	Floor height	3 m
5.	Plan Dimensions	88 m x 140 m
6.	Total height of Building	60 m
7.	Live Load	2.0 kN/m²
8.	Dead load	1.25 kN/m² & wall load of 10 kN/m²
9.	Materials	Concrete (M25) and Reinforced with HYSD bars (Fe500)
10.	Size of Columns	RCC structure 300x900 mm
		Composite structure 300x900 mm encased with ISMB 350
11.	Size of Beams	RCC structure 300x600 mm
		Composite structure 300x600 mm encased with ISMB 350
13.	Depth of slab	125mm thick
14.	BRBF	STARBRB-23.5
15.	Specific weight of RCC	25 kN/m³
16.	Zone	V
17.	Importance Factor	1
18.	Response Reduction Factor	3
19.	Type of soil	Medium

Table2. Preliminary data considered in the analysis of the framed structure for seismic load

Temperature Load		
S.No	Variable	Data
1.	Type of structure	Moment Resisting Frame
2.	Temperature Data	28⁰C and 400⁰C
3.	Number of Stories	20
4.	Floor height	3 m
5.	Plan Dimensions	88 m x 140 m
6.	Total height of Building	60 m
9.	Materials	Concrete (M25) and Reinforced with HYSD bars (Fe500)
10.	Size of Columns	RCC structure 300x900 mm
		Composite structure 300x900 mm encased with ISMB 350
11.	Size of Beams	RCC structure 300x600 mm
		Composite structure 300x600 mm encased with ISMB 350
13.	Depth of slab	125mm thick
14.	BRBF	STARBRB-23.5
15.	Specific weight of RCC	25 kN/m³

Table3. Preliminary data considered for Temperature load

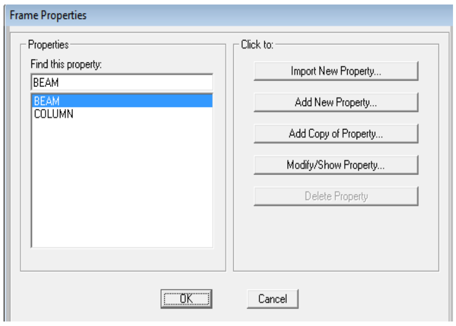


Figure 4.Defining Materials

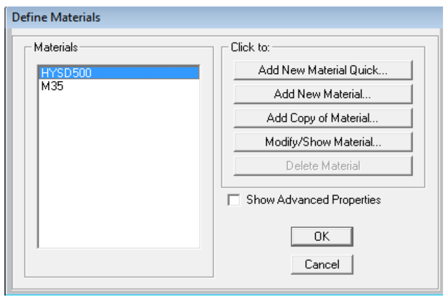
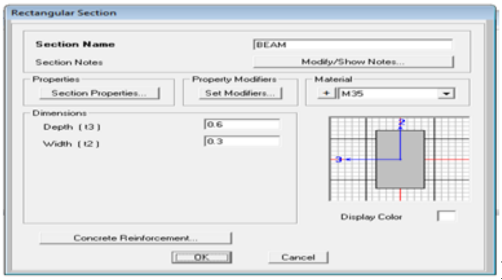


Figure 5. Defining Properties



Figu
re6.Defining beam

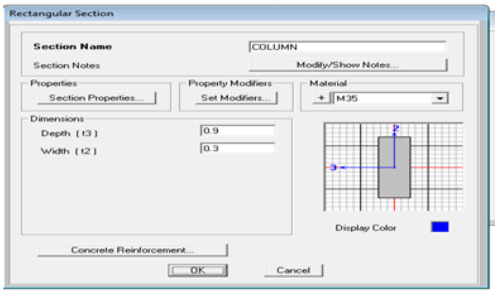


Figure7. Defining Column

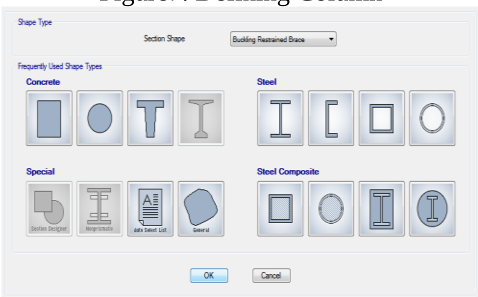


Figure8.Selecting Type of Brace

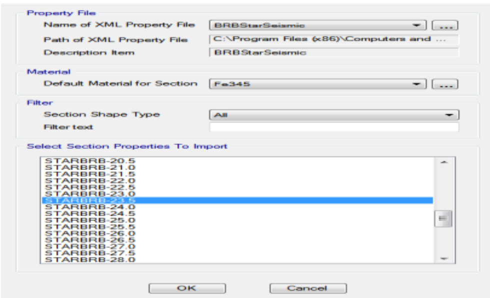


Figure9. BRB properties

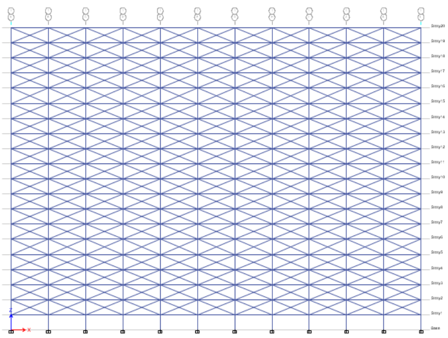


Figure10.BRB in X-direction

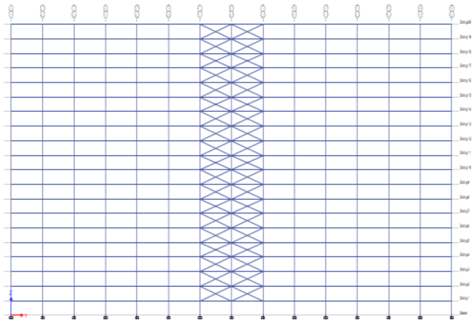


Figure11. BRB in Y-direction

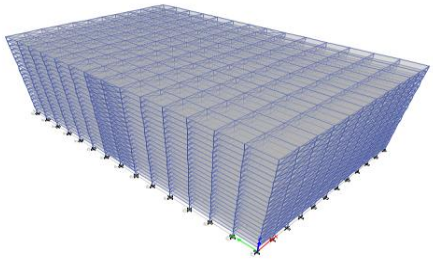


Figure12.Showing 3D view of Model with BRB

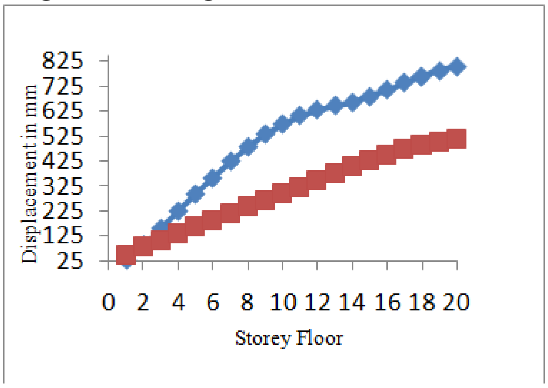
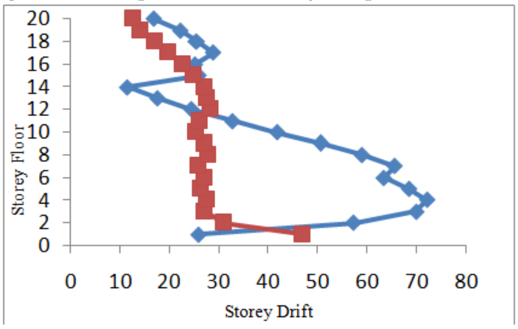


Figure13.Comparison of Storey Displacement



14. Comparison of Storey Drift with& without BRB frame with & without BRB frame

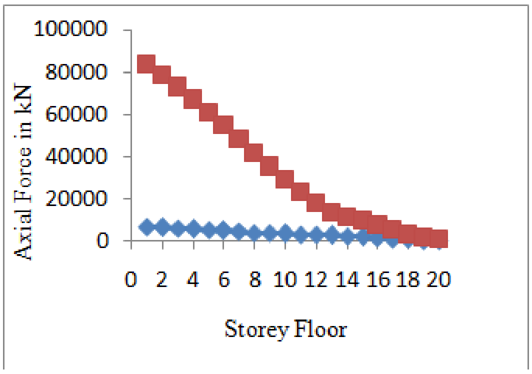


Figure15.Comparison of Axial force

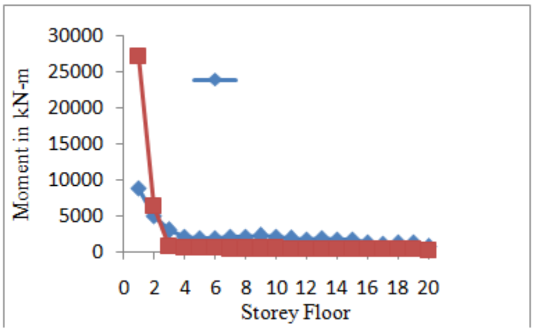


Figure16. Comparison of Moment

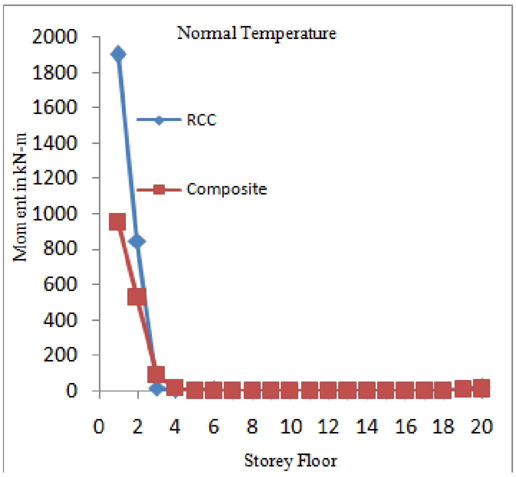


Figure 17.Moment of RCC and Composite building

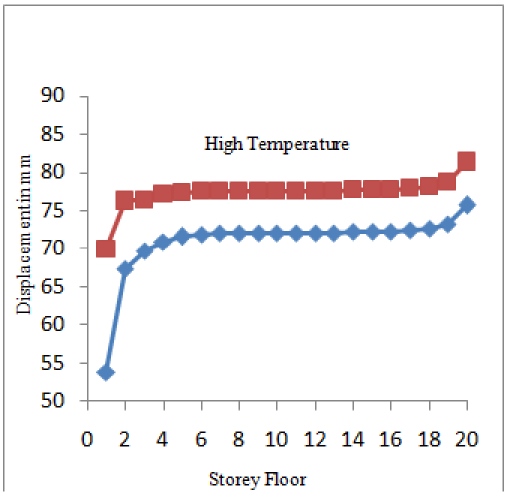


Figure 18.Displacement of RCC and composite Under Normal Temperature building under High Temperature

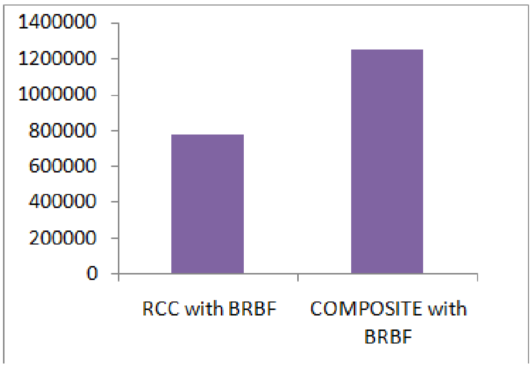


Figure19. Base shear comparison for twenty storied

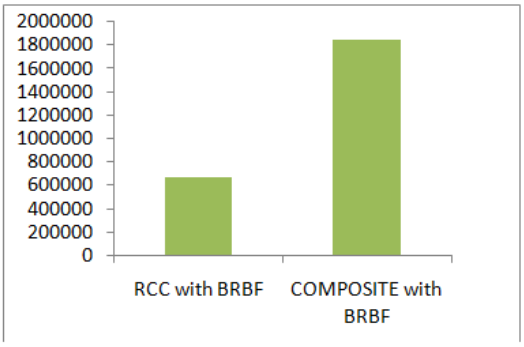


Figure20. Base moment comparison for twenty storied RCC and Composite building with BRBFRCCand Composite building with BRBF

IV. CONCLUSIONS

1. The storey displacements were decreased by 36% for RCC building and decreased by 45% for composite buildings suggesting the effectiveness of Buckling restrained brace frame.
2. The overall results suggested that BRB were excellent seismic control device for composite

building as the roof displacement is reduced by 40% but whereas for RCC it is reduced only by 25%. It suggests that they are excellent for composite structure.

3. Lateral displacement and storey drifts were more in composite building model of fixed base with BRB frame but they are under permissible limits as compared with RCC building model of fixed base with BRB frame.
4. For Seismic prone areas composite building with BRB frame is more effective.
5. Under Normal and High Temperature loading, displacement and Storey drift of RCC building with Buckling restrained brace frame is less as compared to composite building.

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