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Comparative Study of RC Column and Composite column under seismic load

Dhruvit H Chevli[1] ,Grishma Thaker[2],Abhishek Raturi[3]

[1]*Post graduate student, Department Of civil engineering, CGPIT Uka tarsadia University,*
[2] *Ass. Professor, Department Of civil engineering, CGPIT Uka tarsadia university,*
[3] *Ass. Professor, Department Of civil engineering, CGPIT Uka tarsadia university,*

Abstract— ***Due to a large population and small per capita area in India, the need for tall buildings become more essential in the society. The RCC Structure is no longer suitable because of increased dead load, span rejection, and less stiffness.The structural engineers are trying to use different materials for a most efficient design solution. Composite members are structural members composed of steel and concrete. It combines the advantages of both steel and concrete. In recent years, composite columns are gaining popularity over conventional reinforced concrete (RC) columns for high-rise construction, and also, relatively a new concept for the industrial construction. Steel-concrete composite elements are used widely in modern building construction. This paper contains review analysis for RCC as well as composite building regarding seismic performance. Effect of each building is studied with respect to time period, base shear, story drift, resisting force, fire effective performances. The developments related to seismic design motivate the review of composite column behavior and current design provisions.***

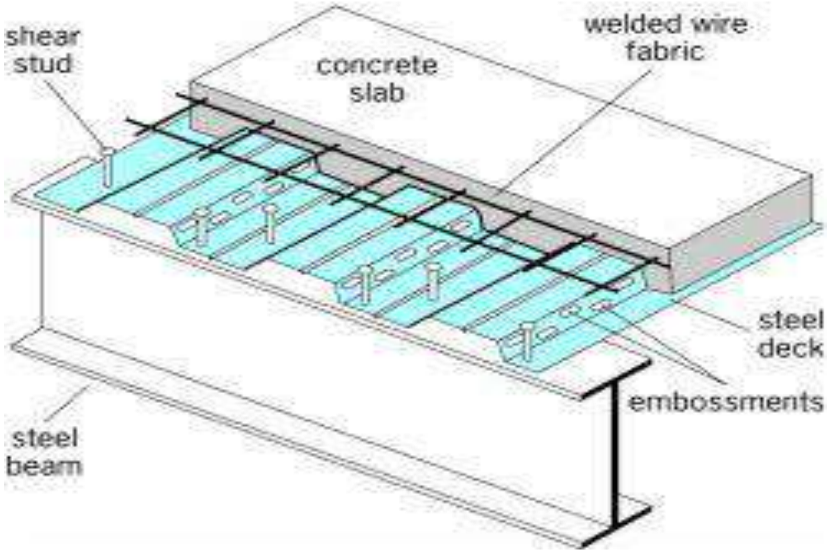
Keywords— comparison, RC column, composite column, seismic analysis

I. INTRODUCTION

In today's modern era of innovation, two materials widely and inevitably used as construction material are steel concrete for structures ranging from buildings to bridges. The failure of many multi-storied and low- rise RCC and masonry buildings due to earthquake has forced the structural engineers to look for the alternative method of construction having lesser depth which saves the material cost. The use of Steel in construction industry is very low in India compared to many developing countries. In India With the latest requirements in the market, it has become a necessity to reduce the construction time by adopting fast-track construction methodologies as well as allowing parallel construction activities. Steel-concrete composite construction being a faster technology saves a lot of time of construction and hence the adoption of such methodology will help the planner to narrow the gap between demand and supply. Hence, steel-concrete composite construction is the answer to the future development in India.

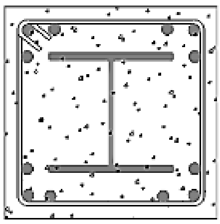
COMPOSITE CONSTRUCTION

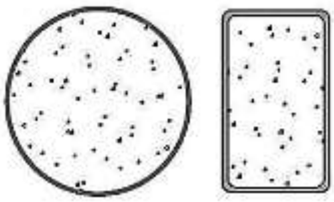
Composite structures can be defined as the structures in which composite sections made up of two different types of materials such as steel and concrete are used. In composite member a rolled or a built-up structural steel shape that is either filled with concrete, encased by reinforced concrete or structurally connected to a reinforced concrete slab. Composite members are constructed such that the structural steel shape and the concrete act together to resist force. In composite structure the advantage of bonding property of steel and concrete is taken in to consideration so that they will act as a single unit under loading. These essentially different materials are completely compatible and complementary to each other. They have almost the same thermal expansion. They have an ideal combination of strengths with the concrete efficient in compression and the steel in tension. Concrete also gives corrosion protection and thermal insulation to the steel at elevated temperatures and additionally can restrain slender steel sections from local or lateral-torsional buckling. In steel concrete composite sections both steel and concrete resists external loads together and helps to limit sway of the building frame. It should be added that the combination of concrete cores, steel frame and composite floor construction has become the standard construction method for multi-story commercial buildings . The main reason for this preference is that the sections and members are best suited to resist repeated earthquake loadings, which require a high amount of resistance and ductility.



Composite Column

A steel-concrete composite column is conventionally a compression member in which the steel element is a structural steel section were joined together concrete. Composite columns are one of those composite members. There are three basic types of composite column as-Fully encased column (FEC),Partially encased column (PEC)and Concrete filled tube (CFT).In FEC section as shown in Fig, the steel I section is fully encased in concrete. Additional longitudinal and transverse bars are provided in the surrounding concrete. It has better fire resistance and corrosion protection as compared to other types of composite columns. On the other hand PEC column refers to Fig. an I-shaped (or H-shaped) steel section in-filled with concrete between opposite flanges which takes prefabrication, simple installation framework. Finally, CFT column Fig consisting of a steel tube filled with concrete.

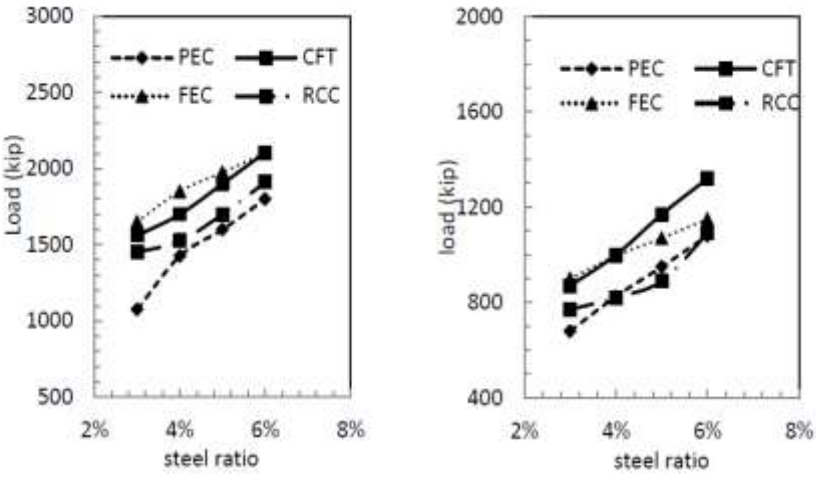




II. Literature review

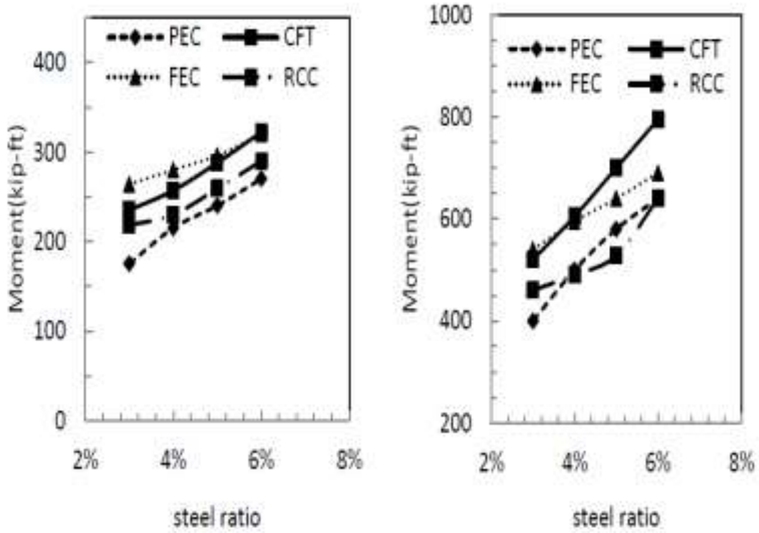
A. Suman Adhikary, Mahbuba Begum "Comparative Study on Different Types of Composite Column Sections" International Conference on Recent Innovation in Civil Engineering for Sustainable Development (IICSD-2015) Department of Civil Engineering duet - Gazipur, Bangladesh

In this paper author **Suman Adhikary, Mahbuba Begum** introduce the various type of composite column section. An attempt has been made in this study to compare the behaviour of these composite columns with respect to conventional RCC. And analysis of these columns has been studied for 18"×18" constant section sizes with four different steel ratios (2% to6%) and two different end eccentricities for the three different types of composite columns (fully encased, partially encased and concrete filled composite columns.) the axial capacity and load moment interaction curve has been formulated according to the design guidelines provided in AISC and CISC codes. In this paper author research carried out by design the composite section using code guideline for different steel ratio and different eccentricities. By using this design result graph will plotted for above different criteria such as axial capacity of column and moment capacity of column.



(a) (b)

Fig.1.Comparison of axial load for eccentricity of (a) 10% (b) 40%

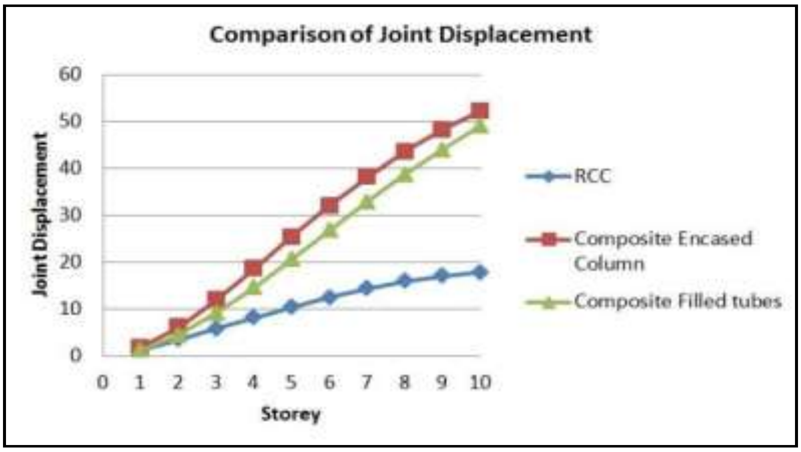


(a) (b)

Fig.2.Comparison of moment for eccentricity of (a) 10% (b) 40%

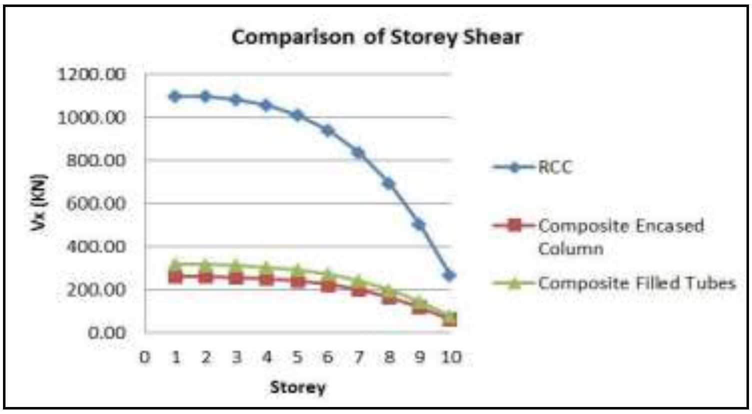
B. V.Preetha M.C. Arun Prasad "Comparative study on behaviour of rcc and steel - concrete composite multi-storey building" International Research Journal of Engineering and Technology Feb -2017

In this article author V.Preetha M.C. Arun Prasad presented comparison of rcc and steel concrete composite building using ETABS software. In this present paper, G+9 multi-storey building is modelled and analysed. Three different types of model is made in this research. One for RCC building in which whole structure member were of monolithic material (concrete), and remaining two for Steel Concrete Composite Structure with two different types of columns such as encased column and Concrete filled tubes. In composite building slab element model was deck slab and steel beam was used. The model was analysed by Equivalent Static Method Keeping the basic load on all type of structure were same. The building model was then analysed by using Etabs-2016 for RCC, Steel Concrete Composite with Encased Column and Steel Concrete with Filled tubes for parameters such as Joint Displacement, Storey Drift, Storey Shear and Cost Comparisons was made with referencing IS 1893 (PART-1): 2002 is the main code that governs the outline for Seismic design force.



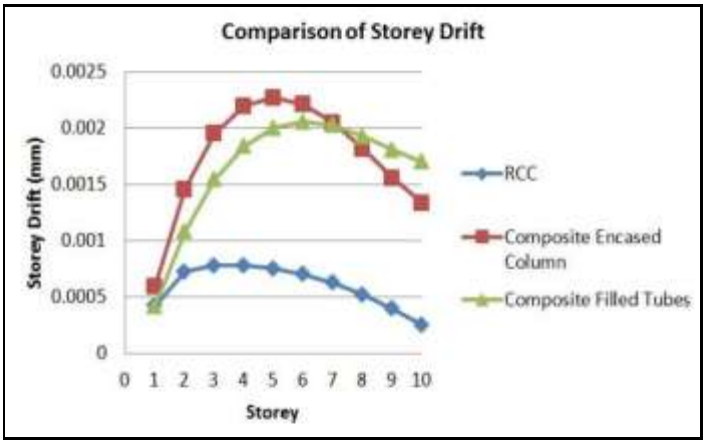
Storey	RCC	Encased Column	CFST
10	17.852	52.288	49.197
9	17.101	48.296	44.11
8	15.921	43.622	38.689
7	14.353	38.171	32.899
6	12.478	32.029	26.827
5	10.379	25.403	20.655
4	8.128	18.593	14.643
3	5.791	11.997	9.12
2	3.446	6.148	4.49
1	1.273	1.791	1.25

Fig.3Comparison graph and table of joint displacement



Storey	RCC	Encased Column	CFST
10	267.04	61.58	73.13
9	503.09	117.98	141.86
8	689.59	162.54	196.17
7	832.39	196.65	237.75
6	937.30	221.72	268.29
5	1010.15	239.13	289.51
4	1056.78	250.27	303.08
3	1083.01	256.53	310.72
2	1094.66	259.32	314.11
1	1097.58	260.01	314.96

Fig.4Comparison graph and table of storey shear



Storey	RCC	Encased Column	CFST
10	0.00025	0.0013	0.0017
9	0.00039	0.0016	0.0018
8	0.00052	0.0018	0.0019
7	0.00063	0.0020	0.0020
6	0.00070	0.0022	0.0021
5	0.00075	0.0023	0.0020
4	0.00078	0.0022	0.0018
3	0.00078	0.0020	0.0015
2	0.00073	0.0015	0.0011
1	0.00042	0.0006	0.0004

Fig.5Comparison graph and table of storey drift

C. Hajira Nausheen, Dr.H.Eramma "Comparison of Seismic Behavior of a Structure with Composite and Conventional Columns" International Research Journal of Engineering and Technology (IRJET) Nov-2015

In this paper authors **Hajira Nausheen, Dr.H.Eramma** objective is to the study the behaviour of steel concrete composite column in a multi storey (low rise structure) building and comparison of composite and conventional structure is carried out. Just varying the design of column i.e., by using composite (fully encased concrete column) and conventional column (RCC) and keeping all other structural members same for both the structures by giving some importance to structural response in seismic areas. The buildings to be placed in III seismic zone. Referring seismic code IS 1893-2002 Modelling and analysis has been carried in ETABS software. The results are obtained of various parameters such as base shear, storey overturning, storey drift etc.., thus by obtaining those results graphs have been plotted.

STOREY LEVEL	BASE SHEAR (kN)		% increase of base shear	STOREY OVERTURNING MOMENT (MN-m)along X direction		% increase of
	COMPOSITE	CONVENTIONAL		COMPOSITE	CONVENTIONAL	
LMR TOP	281.616	0	0	0	0	100
LMR BOTTOM	776.5786	0	100	0.5913	0	100
TERRACE	2566.665	349.305	100	1.5232	0	86.39
8F	4777.847	737.262	88.52	9.7366	1.1177	84.56
7F	6755.505	1047.6	86.10	25.0257	3.4770	84.49
6F	8499.639	1288.98	85.35	46.6433	6.8293	84.83
5F	10010.25	1470.04	85.16	73.8422	10.9540	85.31
4F	11287.33	1599.46	85.21	105.875	15.6582	85.82
3F	12330.9	1685.87	85.36	141.994	20.7764	86.32
2F	13140.93	1737.93	85.57	181.453	26.1712	86.77
FF	13717.45	1764	85.80	223.504	31.7326	87.14
GROUND FLOOR	14100.11	1774.75	86.02	267.4	37.3784	87.41
PLINTH	14128.06	1774.98	86.22	312.52	43.0576	87.43
			86.29	333.713	45.7200	

Table 1.Comparison table of base shear and over turning moment

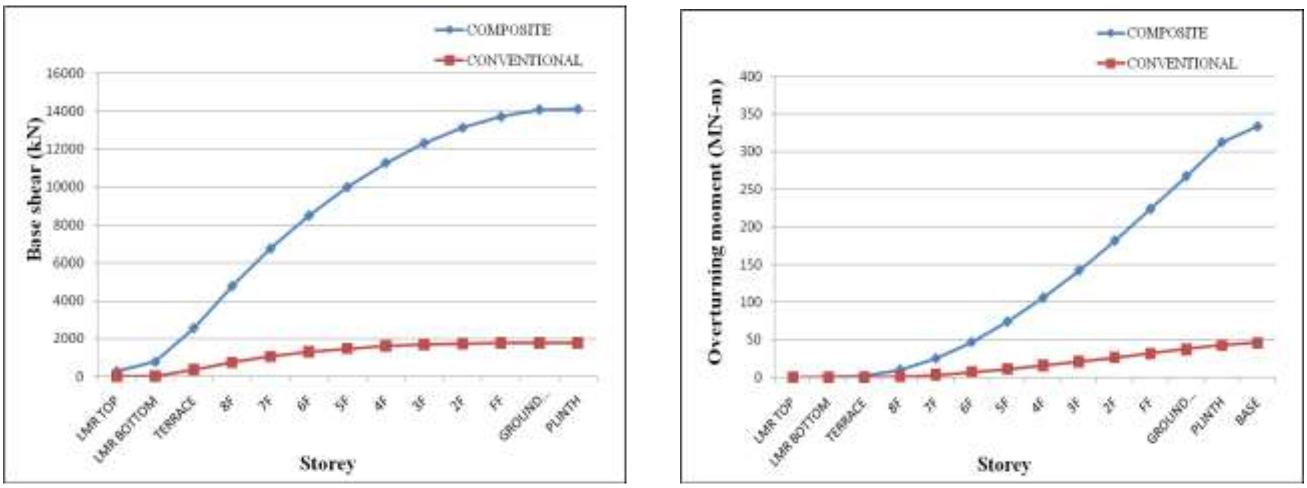


Fig.6 Comparison graph of base shear and over turning moment

D. Vidhya Purushothaman Archana Sukumaran "Comparative Study on Seismic Analysis of Multi Storied Buildings with Composite Columns" International Journal of Engineering Research & Technology (IJERT) June 2017

In this article author's objective was to evaluate the comparison of composite columns with concrete filled steel tube and composite encased I section column. This paper mainly emphasizes on structural behaviour of multi-storey building for different plan configurations like Rectangular, C, L and H shape with two different column property. It is also to compare and find which building with composite column is more effective against lateral loads. Modelling of 15- storey buildings are analysed using ETABS 2015. From the output of ETABS, various results are obtained and tabulated. From the evaluation of result preparing various graphs.

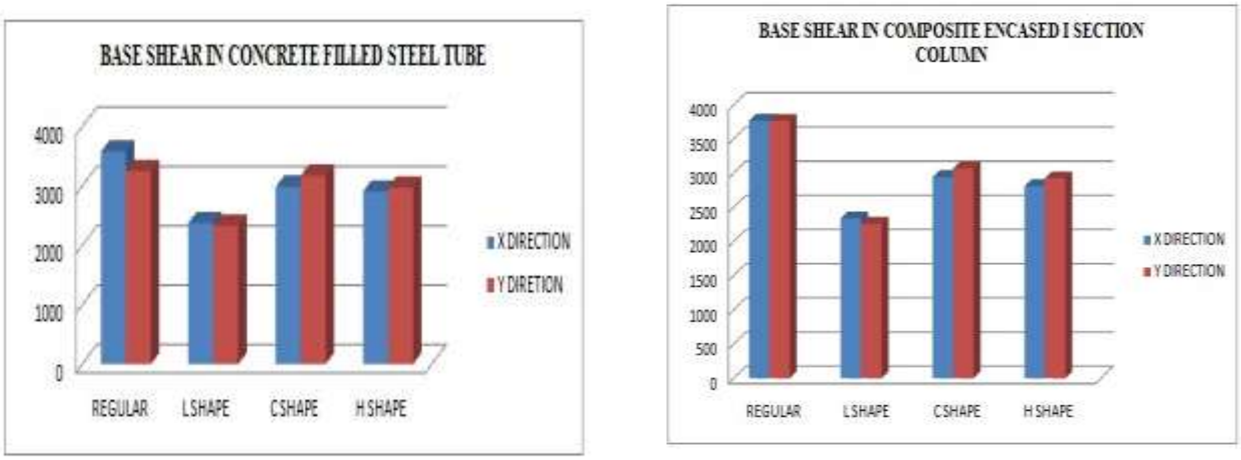


Fig.7Comparison graph of base shear

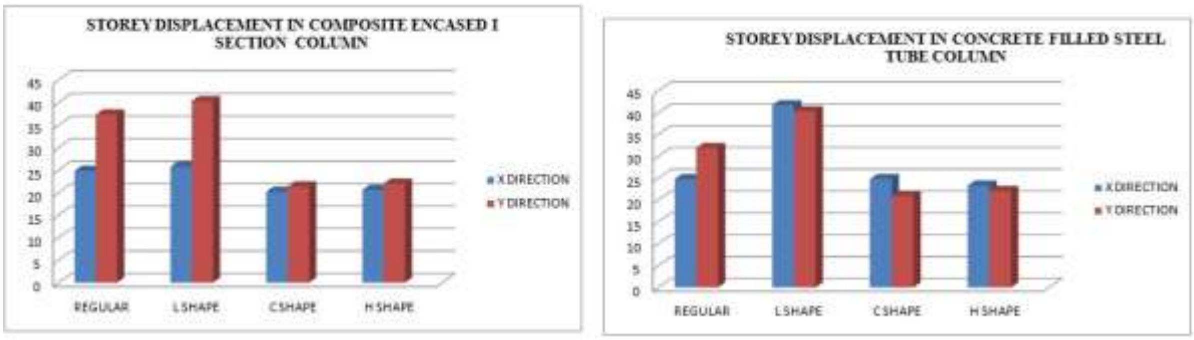


Fig.8Comparison graph of storey displacement

III. CONCLUSION

From the above research paper it can be conclude that

1. FEC column at small eccentricity showed highest compression load & moment capacity. On the other hand CFT columns showed higher strength and stiffness as compared to other column sections for large eccentricity ratios.
2. As the steel ratio increases the axial & moment capacity of the column increases for low and high eccentricities.
3. For High rise building Composite structure is more economical than the conventional method.
4. Story Shear is low for Composite structure than with R.C.C structure but the Deflection level is within permissible limit.
5. Higher stiffness results in less deflection, longer spans and less overall height.
6. For a typical low rise building, the base shear is more in composite structure and so it is more vulnerable to earthquake than the RC building.
7. Storey drifts and overturning moments are also higher that is 80% and 85% in the case of composite building.
8. The concrete filled steel tube columns performed better in regular buildings and composite column with encased I section columns performed well in irregular buildings.

REFERENCES

[1] Suman Adhikary, Mahbuba Begum "Comparative Study on Different Types of Composite Column Sections" (IICSD-2015) Department of Civil Engineering duet - Gazipur, Bangladesh

[2] V.Preetha M.C. Arun Prasad "Comparative study on behaviour of rcc and steel - concrete composite multi-storey building" International Research Journal of Engineering and Technology Feb -2017

[3] Hajira Nausheen, Dr.H.Eramma "Comparison of Seismic Behavior of a Structure with Composite and Conventional Columns" International Research Journal of Engineering and Technology (IRJET) Nov-2015

[4] Vidhya Purushothaman Archana Sukumaran "Comparative Study on Seismic Analysis of Multi Storied Buildings with Composite Columns" International Journal of Engineering Research & Technology (IJERT) June 2017

[5] IS: 11384, Code of practice for composite construction in structural steel and concrete, Bureau of Indian Standards, New Delhi, 1985.