ANALYSIS OF MULTISTORIED R.C.C. BUILDING SUBJECTED TOTEMPERATURE LOADING WITH DIFFERENT SEISMIC ZONES

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Abstract

A construction joint is defined as a straightforward divider used to relieve strain on the structural fabric while a project is being completed. The growth of a structure is influenced by several variables, including the building's views, temperature changes, temperature control options, development materials, etc. We had to establish or make an area known as an Expansion Joint in order to allow for temperature variation-related building expansion and contraction. This analysis focuses on how a tall, RCC-framed structure behaves. applying temperature stresses while eliminating forming joints to test for the absence of a development joint beneath seismic and temperature stacking in each of Zones 2, 3, 4, and 5, twelve models of 60, 80, and 120 m permits have been made. The range of temperatures between 20°C and 40°C is the most crucial one that causes expansion, and it is in this range that we can successfully tailor the expansion of an arch. In order to compare the results, use a building with and one without an expansion joint. The major objective of this analysis is to investigate the responses of structures to temperature stacking and seismic stacking in various seismic zones, such as base shear, story float, and story uprooting.

Keywords: Staad pro, seismic zone, Seismic Analysis, Expansion joints, Temperature stresses.

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1. INTRODUCTION

Buildings require a lot of labour to construct. Aside from that, various temperatures are employed to suit structural elements. The structure may be stressed and displaced as a result of this temperature variation. The term "thermal load" describes a high temperature that has an impact on a structure, such as the temperature of the air inside, the surface and subsurface, solar radiation, internal heat sources, and storage tanks for materials with fluctuating temperatures.
Buildings would collapse without expansion joints due to thermal expansion and contraction. An architect or engineer creates a movement joint in the building's framework to allow for movement in response to temperature variations. The research of the interaction of the mechanical and thermal stresses helps us understand how the member responds to various types of restraints and how mechanical structures behave.

In this project, the behaviour of a longer RCC frame building with multiple expansion joints is illustrated. This endeavor includes structural analysis both with and without expansion joints. This study will look at models with andwithout expansion joints as well as those with various places for expansion joints within a building to evaluate whichstructure is more suitable for construction.

Thermal Load-
The change in ambient air temperature, solar radiation, subsurface temperature, or an analogous number over a 100- year return period is the basic thermal load. The computation of the fundamental load of thermal energy used to determine the temperature of the air present in outdoor air is based on the values of the twelve-monthly highest and lowest temperatures throughout a 100-year return period. Time-history analysis, which is advised, is used to developand analyse the members. It is advised to design the member's temperature using time-history analysis, taking solar radiation and variations in the outside air temperature into account.

A. Expansion Joint
1) Details of expansion joint-
Adding movement joints between reinforced concrete slabs is usual practise when building trains, bridges, buildingsand highways, as well as at intersections with other structures. After that, seals are put on the related files. Concrete gently expands as the temperature rises.

Figure 1. Expansion Joint

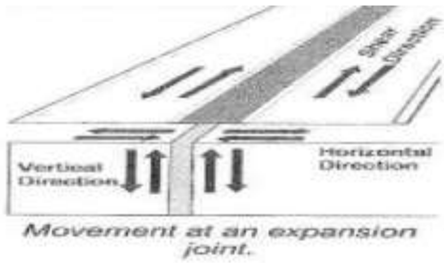

Figure 2. Movement at an Expansion Joint

2) Problems due to Expansion Joint-
The expansion joints major problems are –

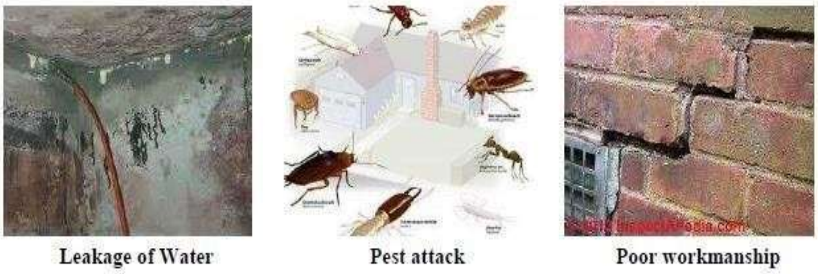

Figure 3. Problems in Expansion Joint

However, the harmful effects of water flow and pest invasion are quite uncomfortable and dangerous.

3) Need of Expansion Joints-

- Internal compressive stresses must be applied to the structure if they are not anticipated. These stresses, which could be very significant, could cause the structure to fail. The degree of temperature change, the size of the structure, and the linear expansion coefficient of the material are the parameters that affect the expansion amount, as described above and by some earlier researchers. There are three properties, but only two of them can be controlled: temperature variation and linear expansion coefficient.
- Only a structure's scope can be reduced to keep its expansion within predetermined limits.

4) Position of Expansion Joints-

- Change in Material: Steel deck with Flexible to Rigid Flutes and Concrete to Steel Flutes.
- The architectural industry uses the following shapes: C, H, O, T, X, and Y.
- The structure's size can fluctuate, typically by more than 30 metres in any direction, from larger to smallersections.

5) Creation of Expansion Joint-

The expansion joint should be incorporated into the height of the building from the ground floor to the top floor. Thetop floor of the building must have the extension joint built. once placing the fiberboard where the practise joint will be, the second side of the practise joint is created once the first side has been raised to the necessary level. Usingsealants, fiberboard is sealed. This marked the completion of the entire project's construction.

6) Cure methods for expansion joints in various elements-

Walls: The wall should conceal the joints. Covering sheets must be used to protect them. This could be made of aluminium, AC sheet, hard board, or wood boards. The joint is normally covered with AC sheet.

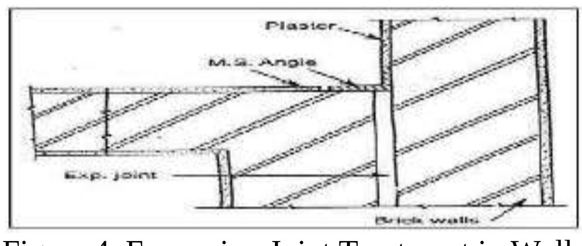

Figure 4. Expansion Joint Treatment in Walls

Framed Walls: Two frames and an expansion joint on either side of one of the frames are required for framing astructure. Similar to how an expansion joint in a masonry wall is treated, joints are handled similarly.

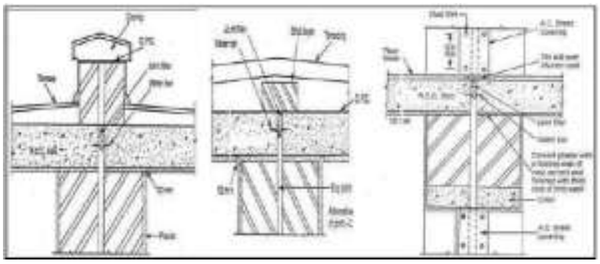

Figure 5. Expansion Joint Cure in Framed Walls

LITERATURE REVIEW

Jyothi Makate, et, Al. (2019) [(1)] In these investigations, a model is produced using the E-tabs program and the researchers work on a two-story RCC building with a greater span. Three models were developed: Model I (a building with no temperature loading), Model II (a building with minimal or moderate temperature loading), and Model C (a building with maximum temperature loading). To determine the effect of varying temperature Load, the result tabulated are compared. The data are displayed in a table for comparison and assessing the effect of temperature change.

K. Vaishnavi, et, al. (2018) [(2)] The researchers in this study create a model of a two-story RCC building with a largerspan using the E-tabs programme. There were created three models: The tabulated results are compared in order to ascertain the impact of changing temperature Load. For comparison and evaluation of the impact of temperature change, the data are presented in a table.

Pooja M, et, al. (2017) [(3)] For the investigation in this study, the researchers chose a flat slab. Similar to earlier studies, the author is working on two different structures, one of which has an expansion joint and the other does not. The lengths of the various constructions range from 180 metres to 138 metres to 80 metres, for example. In this study, the researchers combined loading in an expansion joint construction with temperature load.

G. Suchitra, et, al. (2017) [(4)] The authors of this work take into account four buildings that are made up of RCC and have four different shapes: C, L, T, and rectangular. In this study, the amount of steel needed for a structure with or without an expansion joint is compared along with the amount of lateral displacement. They had utilised the STAAd Pro programme. The structure is G+4. 20°C, 30°C, and 40°C are the temperature variations that are taken into account.The study and inquiry employ the linear static approach.

2. METHODOLOGY

1. Modelling and Structural Parameters

In this paper 3 types of models are used for analysis

1. Building with span 60m
2. Building with span 80m
3. Building with span 120m

All the three building have same loading condition but changes in zone factor and temperature as per the condition ofzone.

Table 1. Geometrical Parameter

Sr. No.	**Column size in mm**	**Beam sizein mm**	**Total height in m**	**Story height inm**	**Slab thicknessin mm**	**Grade of concrete**	**Grade of steel**
1	500x500	300x450	25.60	3.2	150	M25	Fe500

Table 2. Loading

Sr.no	**Live loadin kN/m²**	**Dead loadin kN/m²**	**Load of the Wall kN/m**	**Temperature Load**
1	2	3.75	11.79	31 (zone II), 28 (zone III), 31 (zone IV), 35 (zone V)

Table 3. Seismic Parameters

Sr.no	**mportance factor(I)**	**Factorof Zone (Z)**	**Factor of Response reduction (R)**	**ype of soil Medium**	**ampingratio**
1	1	0.1	5	Medium (II)	0.05
2	1	0.16	5	Medium (II)	0.05
3	1	0.24	5	Medium (II)	0.05
4	1	0.36	5	Medium (II)	0.05

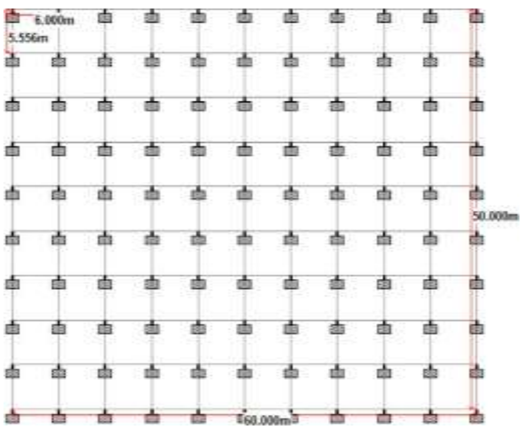

Figure 6. Plan of 60 M Span Building

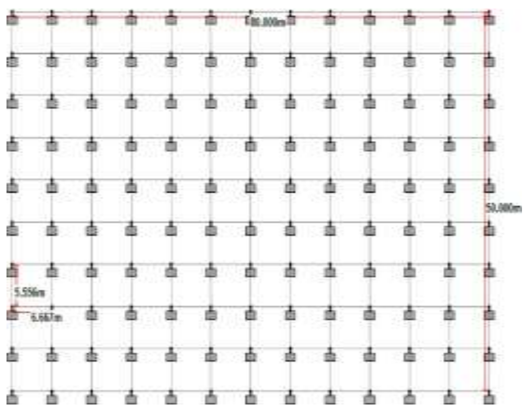

Figure 7. Plan of 80 M Span Building

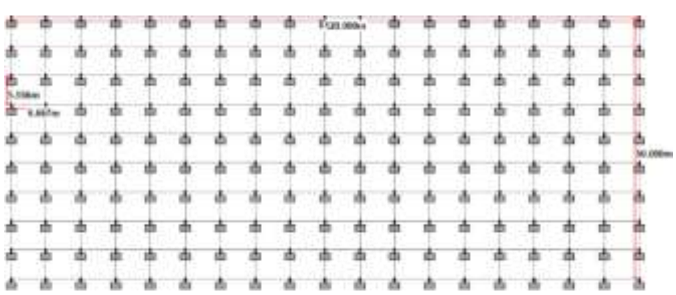

Figure 8. Plan of 120 M Span Building

3. RESULTS

1. Comparison between story drift and story displacement

Table 4. Comparison between Story Drift and Story Displacement

Storey Height	**Storey Displacement (mm)**		**Storey Drift (mm)**	
(m)	**X-Direction**	**Z-Direction**	**X-Direction**	**Z-Direction**
3.2	3.42	3.19	3.42	3.19
6.4	9.32	9.56	4.98	6.25
9.6	14.2	15.5	6.5	6.01
12.8	21	21.3	6.22	5.8
16	27.5	25.4	5.32	5.1
19.2	31	29.8	4.24	3.99
22.4	36.1	33.2	1.85	2.44
25.6	35.1	32.5	1.06	2.02

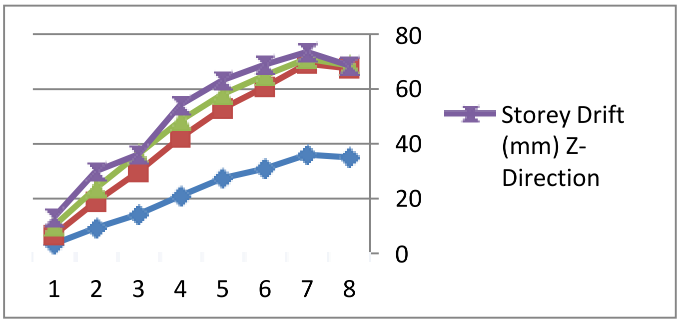

Figure 9. Comparison Chart of Story Drift and Story Displacement

2. Story Drift and Story Displacement in Zone 2

Table 5. Comparison between Story Drift and Story Displacement

Storey Height	**Storey Displacement (mm)**		**Storey Drift (mm)**	
(m)	**X-Direction**	**Z-Direction**	**X-Direction**	**Z-Direction**
3.2	3.45	3.3	4.55	3.54
6.4	8.65	9.98	4.78	5.58
9.6	15.6	14.2	5.98	6.23
12.8	21	20.4	4.99	6.55
16	26.4	23.2	5.33	5.1
19.2	31	28.6	4.5	3.96
22.4	35.9	32.3	2.75	2.45
25.6	34.8	33.5	1.2	1.3

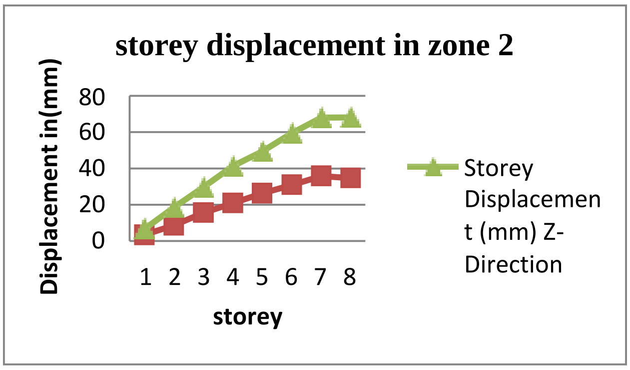

Figure 10. Storey Displacement In Zone 2

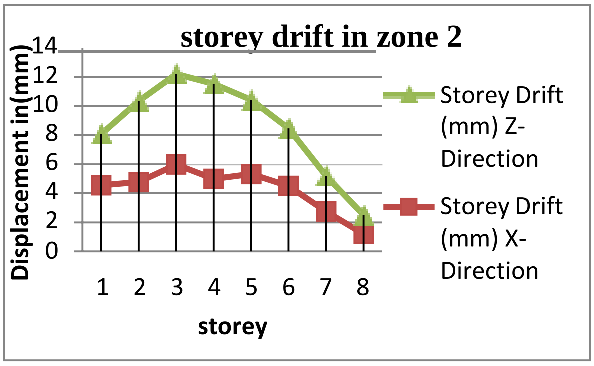

Figure 11. Storey Drift In zone 2

3. Story Drift and Story Displacement in Zone 3

Table 6. Comparison between Story Drift and Story Displacement

Storey Height	**Storey Displacement (mm)**		**Storey Drift (mm)**	
(m)	**X-Direction**	**Z-Direction**	**X-Direction**	**Z-Direction**
3.2	5.3	5.2	5.3	5.2
6.4	14.9	14.5	9.8	9.1
9.6	24.6	23.6	10	9.85
12.8	34.5	32.5	9.86	9.16
16	49.8	47.6	8.52	8.26
19.2	49.2	47.5	6.8	6.28
22.4	53.9	51.6	9.5	4.16
25.6	55.9	54	1.9	1.89

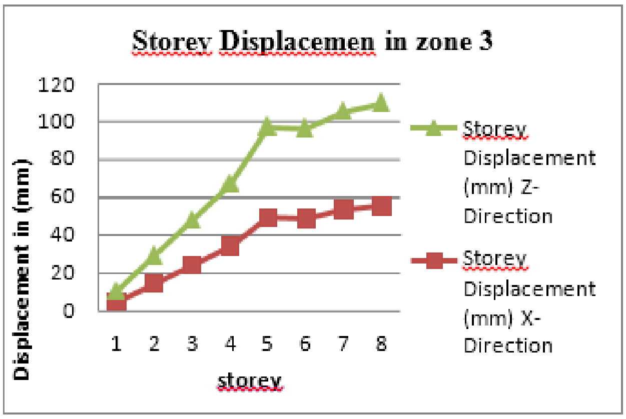

Figure 12. Storey Displacement in Zone

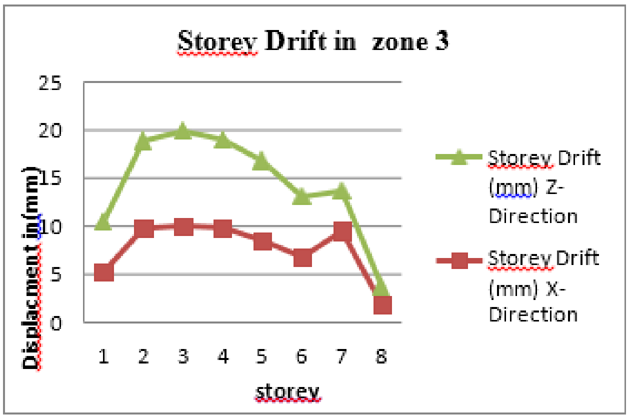

Figure 13. Storey Drift in Zone 3

4. Story Drift and Story Displacement in Zone 4

Table 7. Comparison between Story Drift and Story Displacement

Storey Height (m)	Storey Displacement (mm)		Storey Drift (mm)	
	X-Direction	Z-Direction	X-Direction	Z-Direction
3.2	7.9	8.02	7.9	8
6.4	22.3	21.1	14.5	13.1
9.6	37.6	35.4	15.3	14.7
12.8	51.7	49.8	14.6	13.5
16	64.8	61.5	12.9	12
19.2	74	70.7	9.98	9.46
22.4	80.5	76.4	6.39	6.58
25.6	83.6	95.8	2.87	2.57

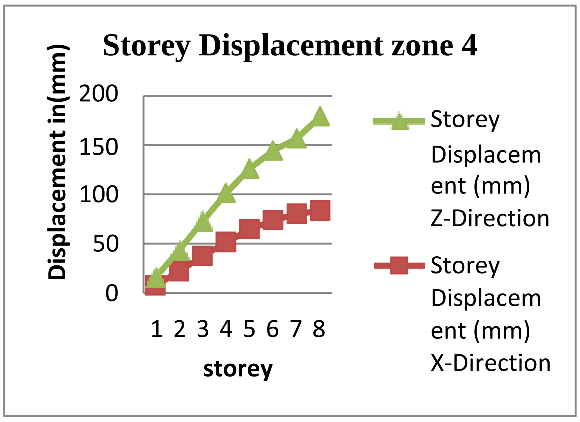

Figure 14. Storey Displacement Zone 4

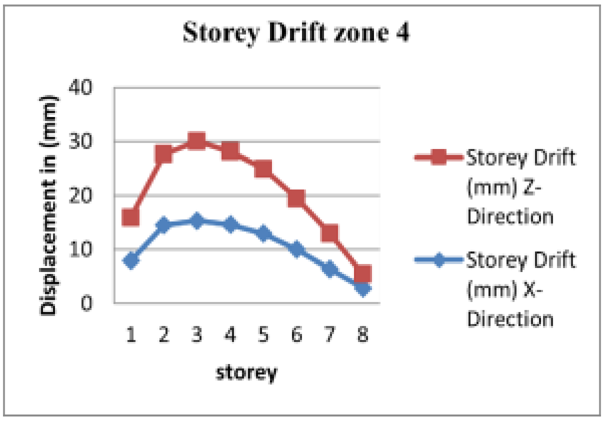

Figure 15. Storey Drift Zone 4

5. Story Drift and Story Displacement in Zone 5

Table 8. Comparison between Story Drift and Story Displacement

Storey Height (m)	Storey Displacement (mm)		Storey Drift (mm)	
	X-Direction	Z-Direction	X-Direction	Z-Direction
3.2	12	11.7	12	11.7
6.4	33.4	31.5	21.4	20.4
9.6	55.9	53.7	22.8	20.8
12.8	77.6	74	21.8	20.4
16	96.5	92	18.7	18.7
19.2	111	106	14.8	14.4
22.4	121	115	9.45	9.15
25.6	125	119	4.26	3.97

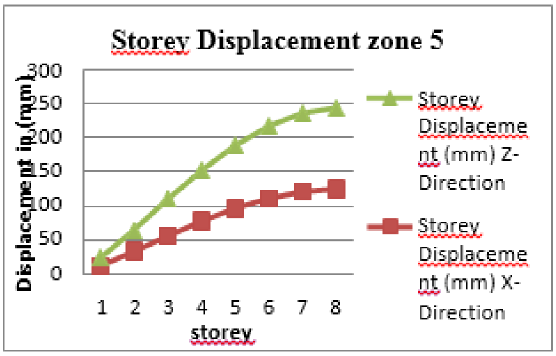

Figure 16. Storey Displacement Zone 5

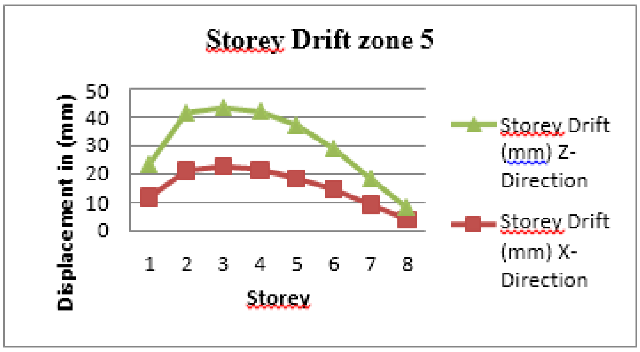

Figure 17. Storey Drift Zone 5

4. CONCLUSION

The above results show the temperature loading for different zones of the seismic forces with different span ofbuilding. It was found that.

1. Despite temperature variations, the displacement decreases as the building's span increases.
2. The top level of the building is the only one where the maximum shear force and bending moment results from the temperature loading that was applied to the slab and beam. Due to the distribution of the thermal load over a wider span, it was discovered that the results of the shear force and bending moment were decreasing as building size increased.
3. At the top floor, where the temperature load is applied, there is a tendency for the quantity of steel to rise. Steel is required for 0.8% of the loading in the column where the temperature load is not applied, whereas it is necessary for 2.55% of the loading in the column when the temperature load is applied.

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