

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 6, June 2018

A Study of Composite column in High-Rise Building under Seismic Excitations Using ETABS

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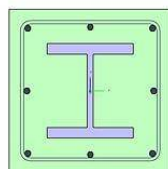
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ABSTRACT: The present work seeks to research the seismic behavior of different heights of multi storey structure in 30,60 meters height structure with composite columns and examine the key style problems involved. The current study deals with unstable behavior different heights of multi storied framed structure assessed through equivalent static technique of study as per IS: 1893-2002 for zone II & zone V in loose soil (soil-III) by using ETABS software. The analyses performed on a collection of two forms of standard moment resisting framed 3D area models with totally composite columns. The analysis is provided and therefore the results compared in terms of important earthquake response parameters like displacement of the structure.

KEYWORDS: Composite columns, ETABS, Highrise building.

I. INTRODUCTION

Composite columns are constructed using various combinations of structural steel and concrete in an attempt to utilize the beneficial properties of each material. The interactive and integral behavior of concrete and the structural steel elements makes the composite column a very stiff, more ductile, cost effective and consequently a structurally efficient member in building and bridge constructions.



In early 1900's, concrete was used to encase steel columns and beams, and as a filler material for floor systems. In 1907, the first experimental test was carried out by Emperger on built up composite columns under concentric load. Experimental investigations on concrete encased steel composite columns have been conducted by different researchers since long before. Analytical method was developed in early 1900 to investigate the behavior of FEC columns. On the other hand numerical simulations of reinforced concrete structures using finite element method, witnessed a remarkable advancement since 1990. Though, experimental research is costly and time consuming than numerical research, yet the progress in numerical studies are comparatively less. Recently, a nonlinear finite element models investigating the behavior of concentric and eccentric axial load of FEC columns was developed by different researchers. The design of composite columns has been addressed by a large number of design specifications.

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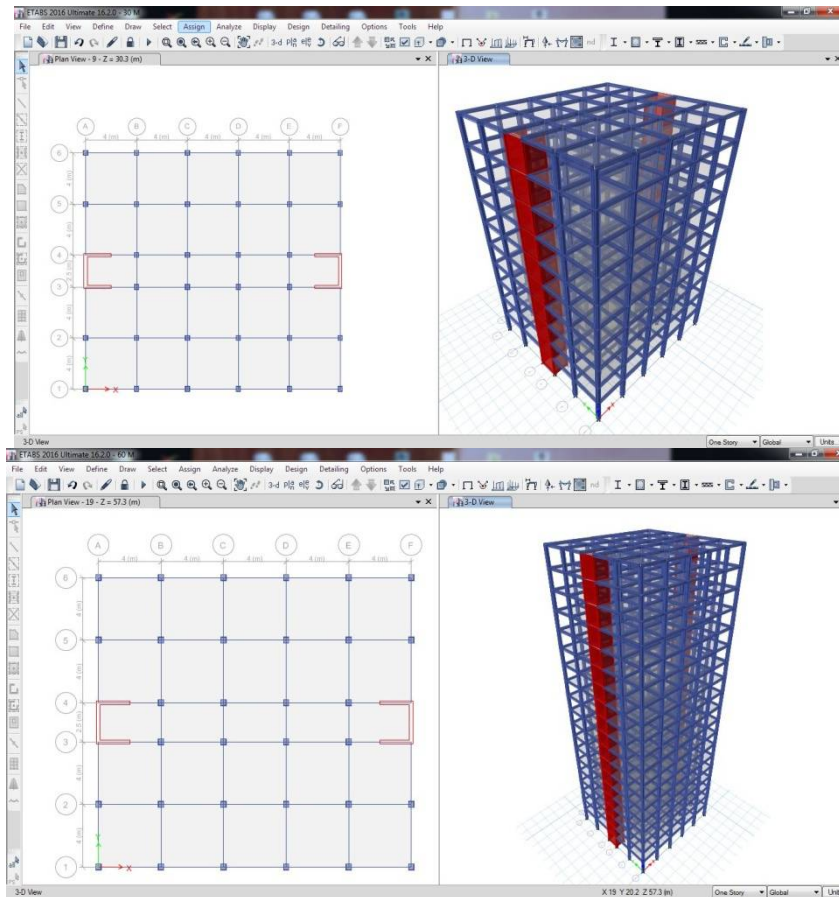
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II. NUMERICAL MODELLING

- Storey height = 3 m
- Ground Storey height = 3.3 m
- Beam = 250 x 300 mm
- Slab = 110 mm thickness
- Column: 400 x 350 mm



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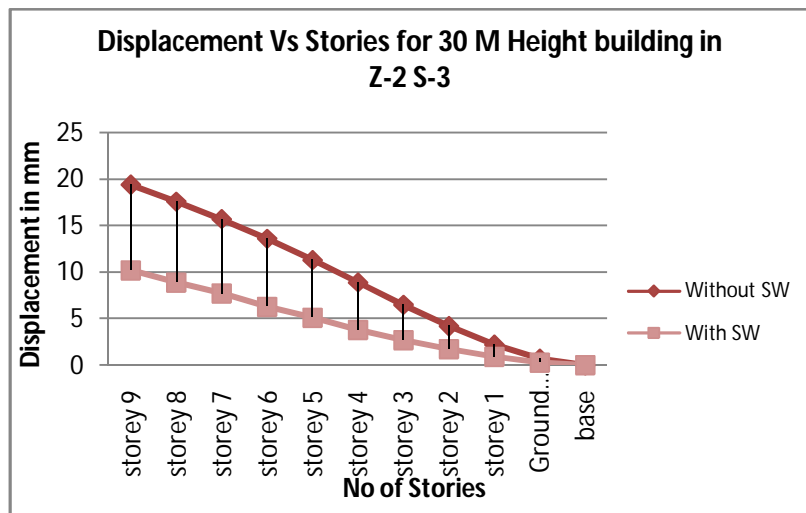
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III. EXPERIMENTAL RESULTS

Table : 1 Comparative values of displacement in zone-2 soil-3 for 30 m height building without Shear wall and with shear wall

No of Stories	Without SW	With SW
storey 9	19.4	10.2
storey 8	17.6	8.9
storey 7	15.7	7.7
storey 6	13.6	6.3
storey 5	11.3	5.1
storey 4	8.9	3.8
storey 3	6.5	2.7
storey 2	4.2	1.7
storey 1	2.2	0.9
Ground Floor	0.7	0.3
base	0	0



Graph 1 Displacement curve for 30 m height building in zone-2 soil-3

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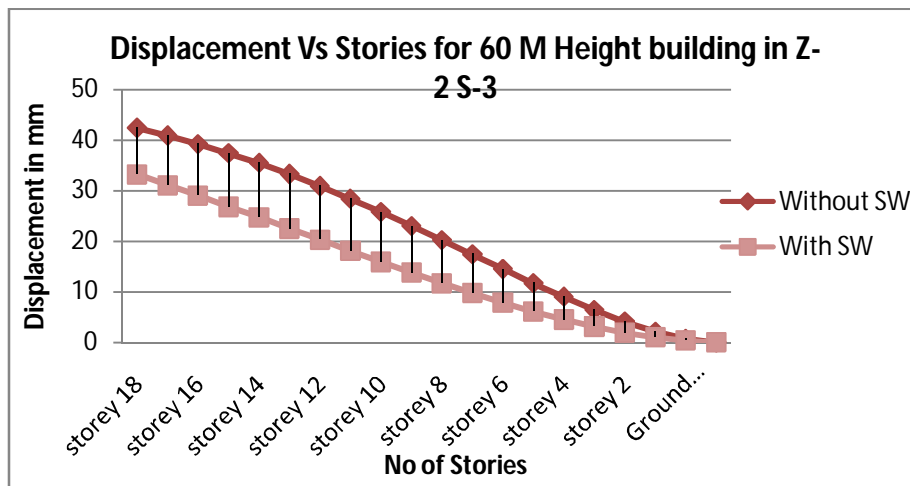
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Table : 2 Comparative values of displacement in zone-2 soil-3 for 60 m height building without Shear wall and with shear wall

No of Stories	Without SW	With SW
storey 18	42.4	33.2
storey 17	40.9	31.1
storey 16	39.2	29
storey 15	37.4	26.8
storey 14	35.5	24.7
storey 13	33.3	22.5
storey 12	30.9	20.3
storey 11	28.4	18.1
storey 10	25.8	15.9
storey 9	23	13.8
storey 8	20.2	11.7
storey 7	17.4	9.7
storey 6	14.5	7.8
storey 5	11.7	6.1
storey 4	9	4.5
storey 3	6.4	3.1
storey 2	4.1	1.9
storey 1	2.1	1
Ground floor	0.7	0.4
Base	0	0



Graph 2 Displacement curve for 60 m height building in zone-2 soil-3

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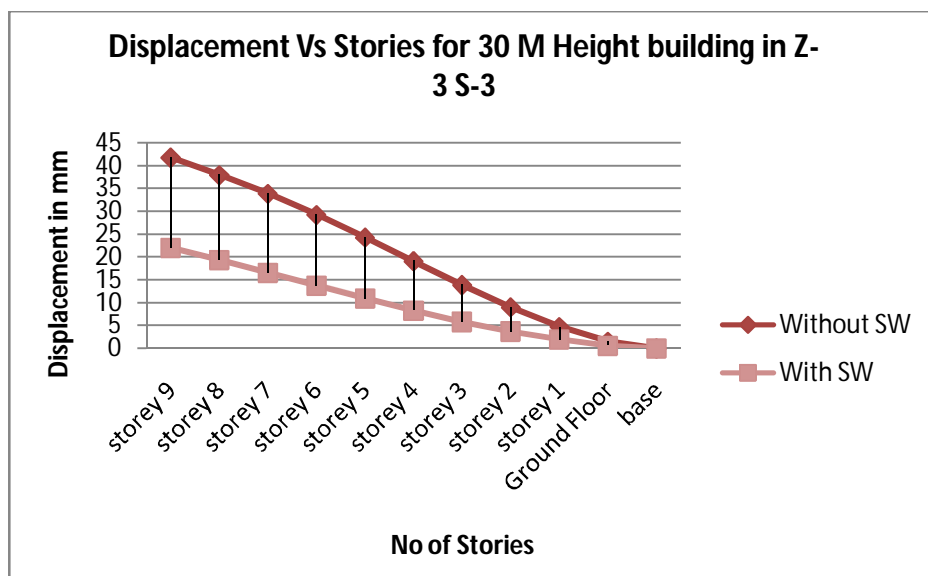
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Table : 3 Comparative values of displacement in zone-5 soil-3 for 30 m height building without Shear wall and with shear wall

No of Stories	Without SW	With SW
storey 9	41.8	22
storey 8	38	19.3
storey 7	33.9	16.5
storey 6	29.3	13.7
storey 5	24.3	10.9
storey 4	19.1	8.3
storey 3	13.9	5.8
storey 2	9	3.7
storey 1	4.7	1.9
Ground Floor	1.5	0.6
base	0	0



Graph 3 Displacement curve for 30 m height building in zone-5 soil-3

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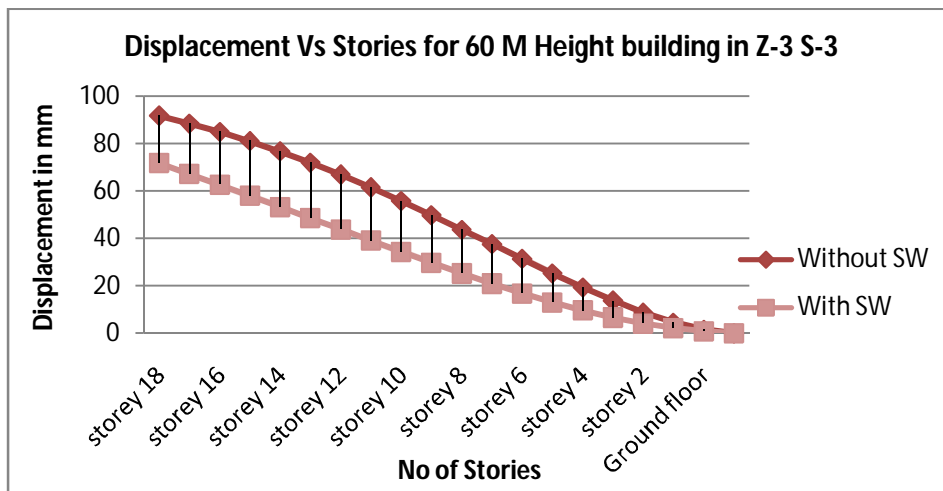
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Table : 4 Comparative values of displacement in zone-5 soil-3 for 60 m height building without Shear wall and with shear wall

No of Stories	Without SW	With SW
storey 18	91.6	71.7
storey 17	88.3	67.1
storey 16	84.8	62.6
storey 15	80.9	57.9
storey 14	76.6	53.2
storey 13	71.9	48.5
storey 12	66.8	43.7
storey 11	61.4	39
storey 10	55.7	34.3
storey 9	49.7	29.7
storey 8	43.6	25.2
storey 7	37.5	20.9
storey 6	31.3	16.8
storey 5	25.2	13
storey 4	19.3	9.6
storey 3	13.7	6.6
storey 2	8.7	4.1
storey 1	4.5	2.1
Ground floor	1.5	0.7
Base	0	0



Graph 4 Displacement curve for 60 m height building in zone-5 soil-3

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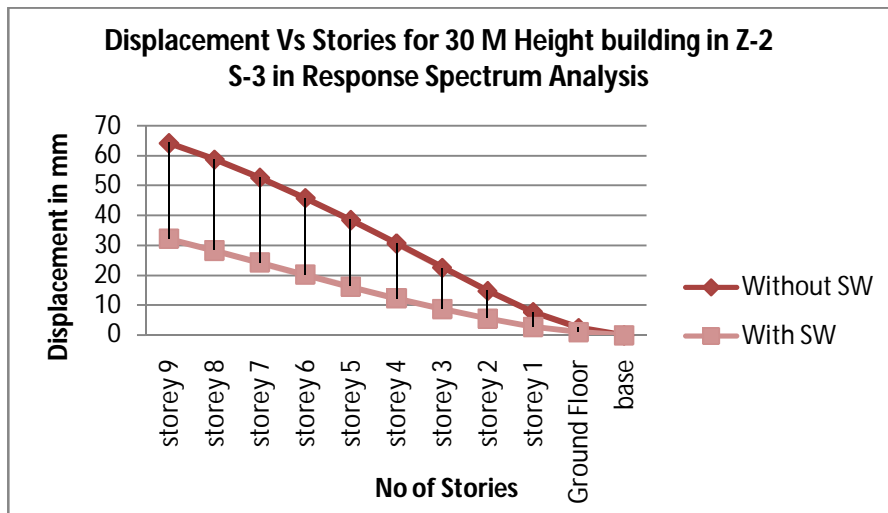
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Table : 5 Comparative values of displacement in zone-2 soil-3 for 30 m height building without Shear wall and with shear wall in dynamic analysis

No of Stories	Without SW	With SW
storey 9	64.2	32.2
storey 8	58.8	28.3
storey 7	52.7	24.3
storey 6	45.9	20.2
storey 5	38.5	16.2
storey 4	30.7	12.3
storey 3	22.6	8.7
storey 2	14.8	5.5
storey 1	7.8	2.8
Ground Floor	2.5	1
base	0	0



Graph 5 Displacement curve for 30 m height building in zone-2 soil-3 response spectrum analysis.

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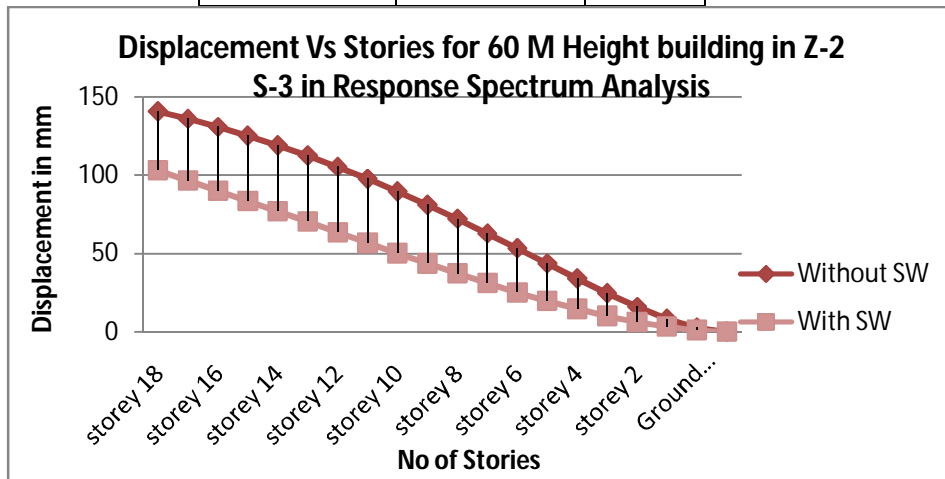
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Table : 6 Comparative values of displacement in zone-2 soil-3 for 60 m height building without Shear wall and with shear wall in dynamic analysis

No of Stories	Without SW	With SW
storey 18	140.6	102.9
storey 17	135.9	96.4
storey 16	130.7	90
storey 15	125.1	83.4
storey 14	119	76.8
storey 13	112.4	70.1
storey 12	105.2	63.3
storey 11	97.6	56.6
storey 10	89.5	50
storey 9	80.9	43.5
storey 8	72	37.1
storey 7	62.7	30.9
storey 6	53.2	25
storey 5	43.5	19.5
storey 4	33.9	14.5
storey 3	24.5	10
storey 2	15.8	6.1
storey 1	8.2	3.1
Ground floor	2.6	1
Base	0	0



Graph 6 Displacement curve for 60 m height building in zone-2 soil-3 in dynamic analysis

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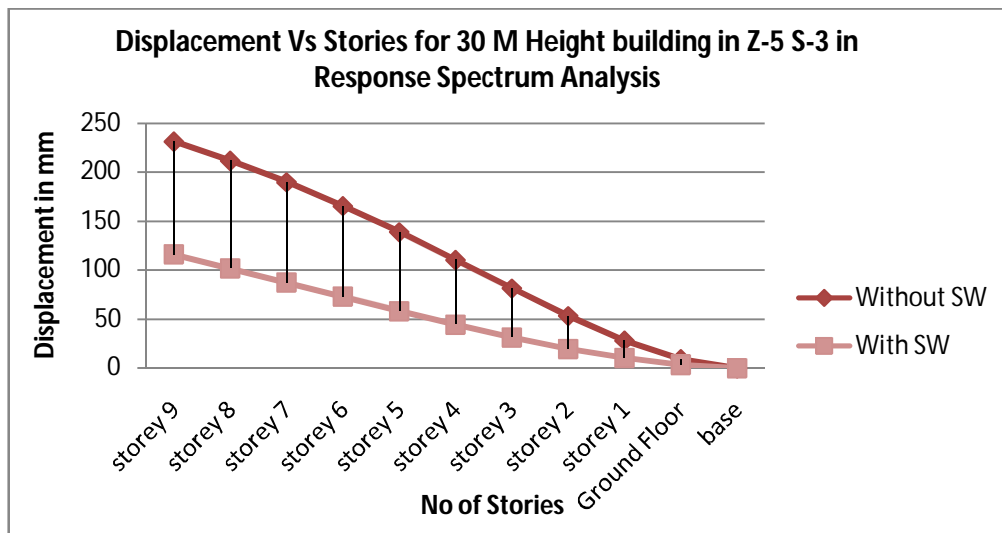
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Table : 7 Comparative values of displacement in zone-5 soil-3 for 30 m height building without Shear wall and with shear wall in dynamic analysis

No of Stories	Without SW	With SW
storey 9	231.1	115.9
storey 8	211.6	101.8
storey 7	189.7	87.3
storey 6	165.4	72.7
storey 5	138.8	58.2
storey 4	110.4	44.2
storey 3	81.4	31.2
storey 2	53.3	19.7
storey 1	28.2	10.2
Ground Floor	9.2	3.5
base	0	0



Graph 7 Displacement curve for 30 m height building in zone-5 soil-3 in dynamic analysis.

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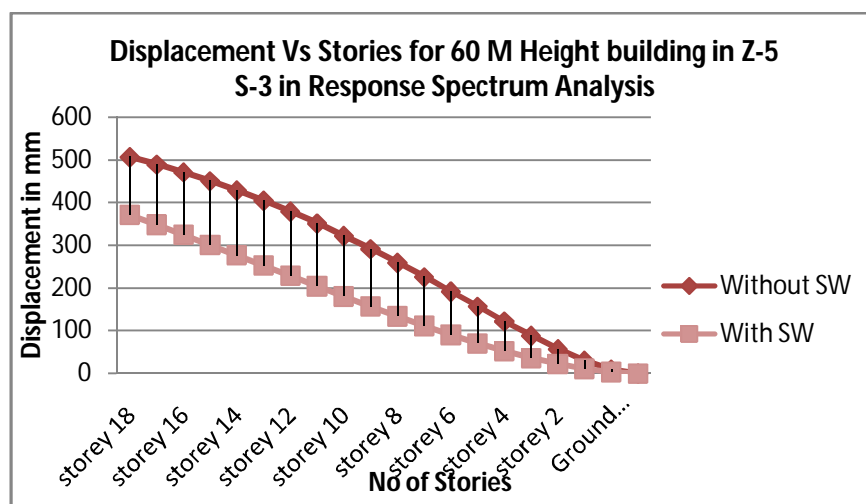
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Table : 8 Comparative values of displacement in zone-5 soil-3 for 60 m height building without Shear wall and with shear wall in dynamic analysis.

No of Stories	Without SW	With SW
storey 18	506.2	370.3
storey 17	489.1	347.2
storey 16	470.6	323.9
storey 15	450.4	300.2
storey 14	428.4	276.3
storey 13	404.5	252.2
storey 12	378.8	228
storey 11	351.3	203.9
storey 10	322.1	180
storey 9	291.3	156.4
storey 8	259.2	133.4
storey 7	225.8	111.2
storey 6	191.5	90.1
storey 5	156.6	70.3
storey 4	121.9	52.1
storey 3	88.1	35.9
storey 2	56.7	22.1
storey 1	29.6	11.1
Ground floor	9.5	3.7
Base	0	0



Graph 8 Displacement curve for 60 m height building in zone-5 soil-3 in dynamic analysis

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IV. CONCLUSION

1. Analysis carried out on two different heights of buildings i.e.. 30m, 60m in both static analysis and dynamic analysis with composite column and shear wall at optimum locations.
2. From the analysis Displacement is compared for all the models in zone 2 & zone 5 and it can be concluded that displacement is increasing with increase in height and the displacement can be reduced by providing shear walls at optimum locations.

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