International Journal of Research in Advent Technology, Vol.6, No.6, June 2018
E-ISSN: 2321-9637
Available online at www.ijrat.org

Optimum Location of Shear Wall in T-Shaped RC Building Under Earthquake Load

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Abstract- Tall buildings are the demand of the current situation. the lateral forces on the buildings increases as the height o the building increases. these lateral forces are resisted by some structral elements, which are known as shear wall. The properties of shear wall are high influence stiffness and strength which resists the gravity loads. our main aim is to find the optimum location of shear walls in 'T' shaped high rise buildings. For this purpose we have selected 'T' shaped plan and placed the shear walls in 4 different positions , to find out the effective location of shear wall, we have performed all the analysis using ETABS 15 software.

Index Terms-shear wall; Response spectrum analysis; ETABS.

1. INTRODUCTION

The verticle walls which resists the horizantal forces is called shear wall.the main aim to construct the shear wall is to counter the effect of lateral load. Shear walls are structral elements which are provided to enhance the strength of rcc structre. Usually we use shear walls in high rise buildings to resists the lateral loads due to earthquake and winds.The strength and stiffness of the structre increases in the direction of orientation of shear wall. The lateral sway of the multistorey structre is considerabally reduced by providing the shear wall at the right position, hence there is no damage to the structre.

1.1 Need to provide the shear wall in multi storey structres

If the multistorey building is designed without shear wall, the size of structral elements such as beam ,column comes to be very large and also the displacement of the structre is very large, hence to decreese the size of the structral elements such as beams and columns we need shear wall to be constructed. By providing the shear wall the rigidiity of the structre increases and also the seismic resistance . the application of shear walls is more in service apartments and commercial office buildings.

1.2 Shear walls resisting seismic loads

Structral design of the building for seismic loading is done for saftey during major earthquake. Seismic loading is determined by the behaviour of the multistorey structre during major earth quakes.Behaviour of the structre under this loding is totally different from gravity loading or wind loading. Some of the structral damage is occured when the building experiences the design ground motions because all the building codes allow inelastic energy dissipation.Shear wall behaves similarly to the columns which are subjected to combined axial load and flexure.shear walls are also known as flexure members ,The design of shear walls need special attention in high seismic regions, there fore it is necessary to determine the optimum location of shrear wall in the structres.

2. OBJECTIVES

1. Determination of optimum location of shear wall on 'T' shaped plan of the multistorey building.
2. To determine the total storey dislacement , storey drifts and storey shear.
3. Determination of optimum location of shear wall with equal cross sectional area on structral response under seismic loading.

4. To povide clear cut image for structral designers on serviceability obtained by using shear wall.

3. METHODOLOGY

Plan Details

For this study a 30 storey building each storey of height 3 m is modeled. The building comprised of ‘T’ shaped plan. The structre is designed by using indian code of practice for seismic resistance design of building.

The structre is fixed at the base , the columns in the structre are of square shape and beams are of rectangular shape.

The structre is modelled using ETABS 15, 5 different models were prepared according to the position of shear wall.

4. ANALYTICAL MODELLING

Model 1 : Bare frame model without any shear wall.

Model 2: This model consists of shear wall at corner and inside edge of the building.

Model 3: This model consists of shear walls at the outer corners of the buildings.

Model 4: This model consists of shear walls at the periferi of the buildings.

Model 5: This model consist of shear walls at the core position of the building.

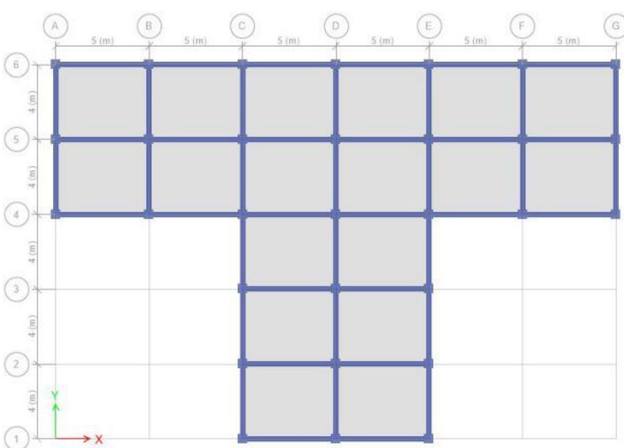

Figure 1: Model 1

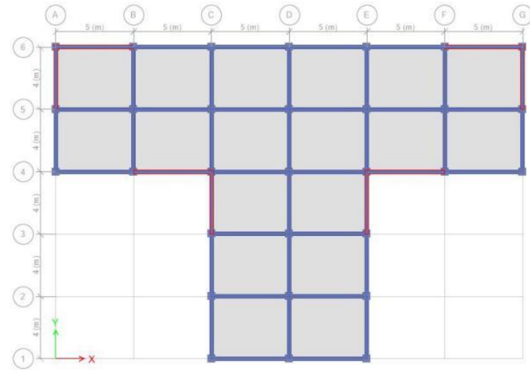

Figure2: Model 2

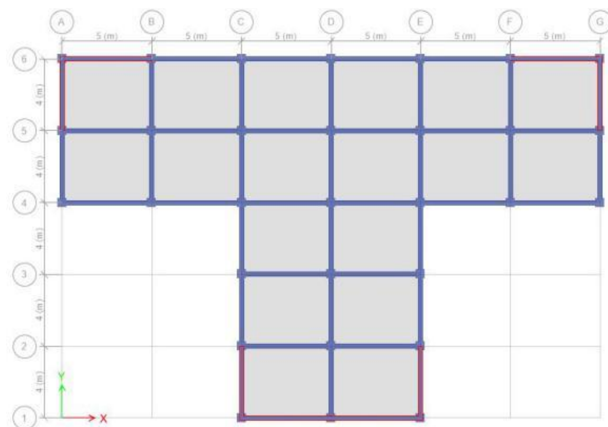

Figure 3:Model 3

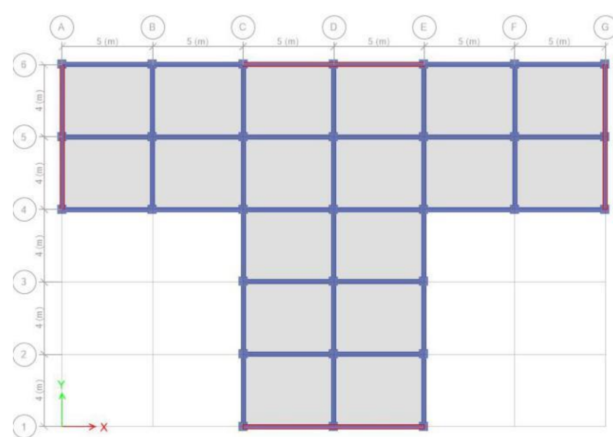

Figure 4: Model 4

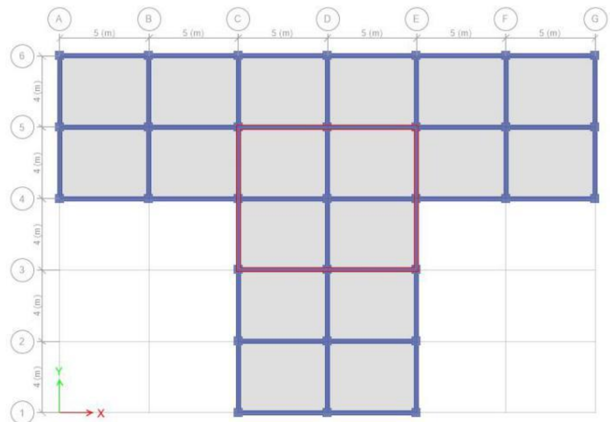

Figure 5: Model 5

4. DESIGN DATA

The structural details of models are as follows:-

- No of storeys= 30
- No of bays = 6 bays in both direction
- Spacing of bays = 5m in x directions and 4m in y direction.
- Storey height = 3m
- Bottom storey height = 3m
- Beam size = 0.23m x 0.45m
- Column size = 0.6m x 0.6m and 0.5mx0.5m
- Slab thickness = 0.127m
- Grade of materials = M30 and Fe 550
- Seismic zone = 5
- Floor finish = 1 KN/sqm
- Self wt of wall on each floor = 5.3 KN/sq.m
- Live load = 3 KN/sqm
- Response reduction factor = 5
- Importance factor = 1
- Zone factor = 0.36

5. RESULTS

The analysis results such as storey dispacement, storey drift, storey shear & modal period in x&y direction obtained from response spectrum method are compared and discussed below.

5.1 Storey displacement

5.1.1 storey displacement comparisn in x-direction for Eqx

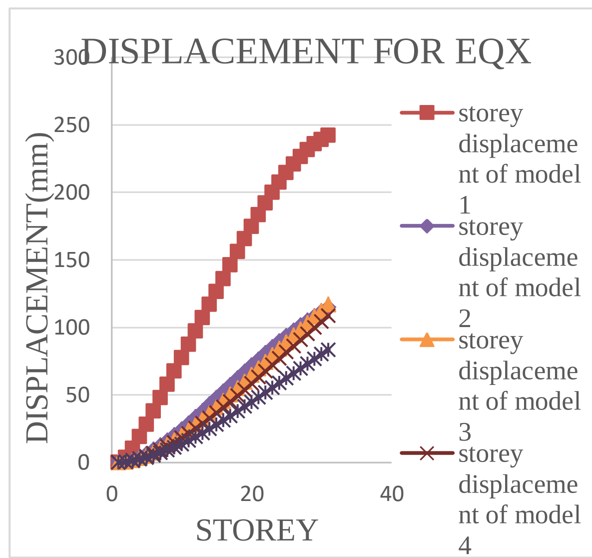

Figure 6

Figure 6 shows the least displacement is of model 5 which is reduced by 65.6% of model 1.

5.1.2 storey displacement comparisn in y-direction for Eqy .

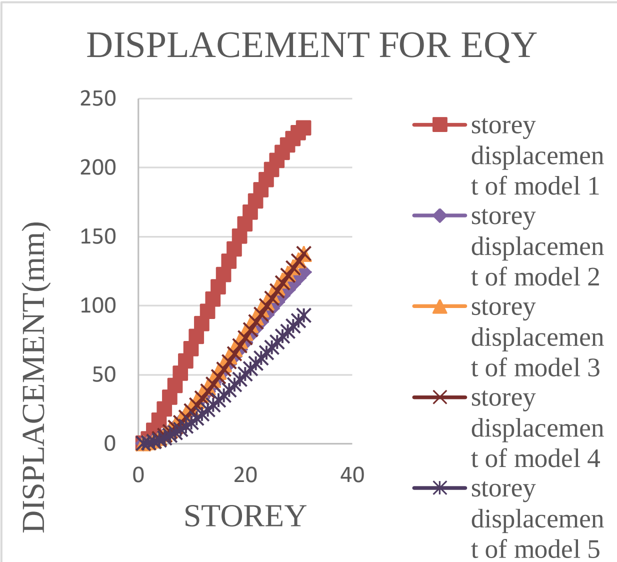

Figure 7

Figure 7 shows the least displacement is of model 5 which is reduced by 59.5% of model 1.

5.1.3 showing storey displacement comparisn (mm) in x direction for response spectrum method.

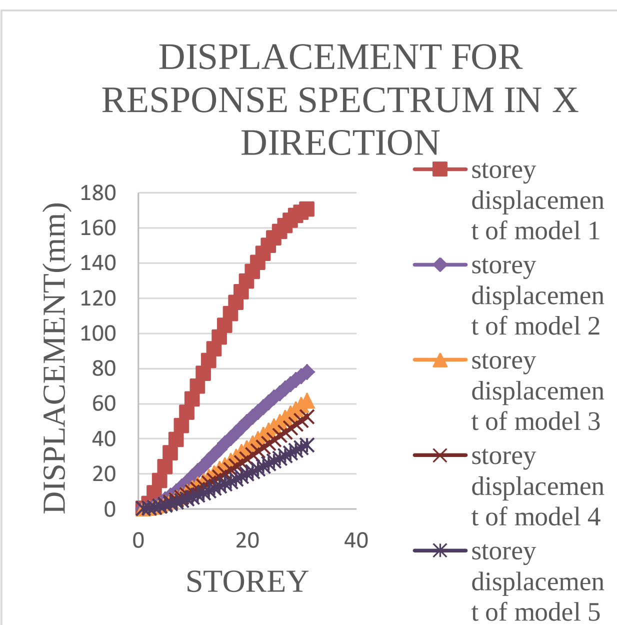

Figure 8

Figure 8 shows displacemebt model 5 which is reduced by 79.8% of model 1.

5.1.4 showing storey displacement comparisn (mm) in y direction for response spectrum method.

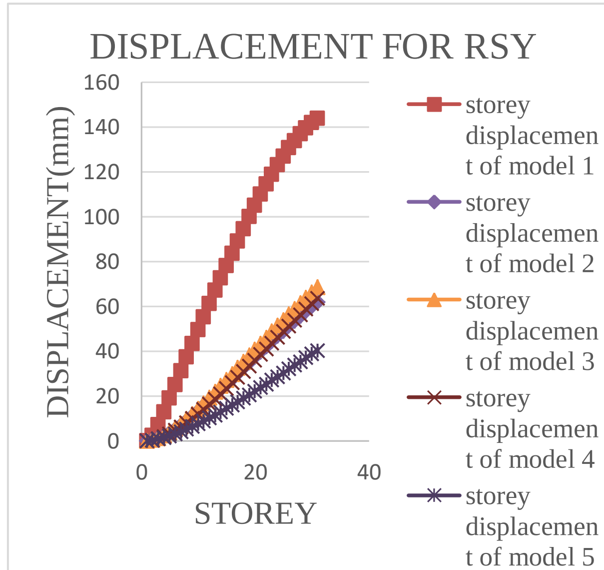

Figure 9

Figure 9 shows the least displacement is of model 5 which is reduced by 70.2% of model 1.

5.2 Storey drift

5.2.1 Storey drift **comparison** in x-direction for Eqx.

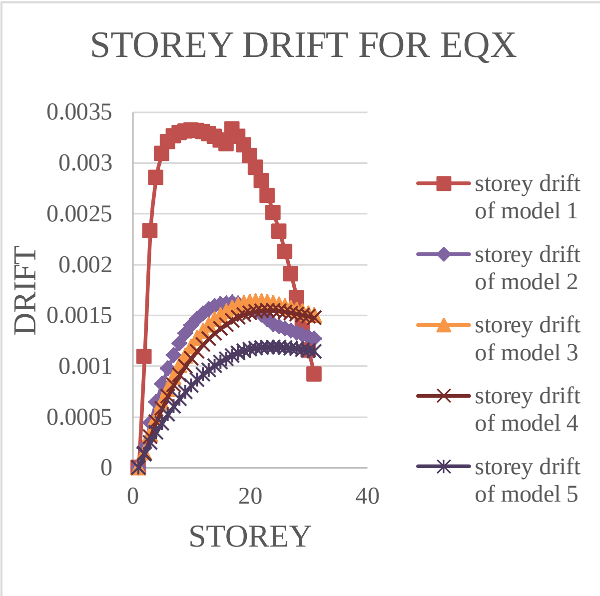

Figure 10

Figure 10 shows the least storey drift is of model 5 ,which is reduced by 35.74% of model 1.

5.2.2 Storey drift comparisn in y-direction for Eqy.

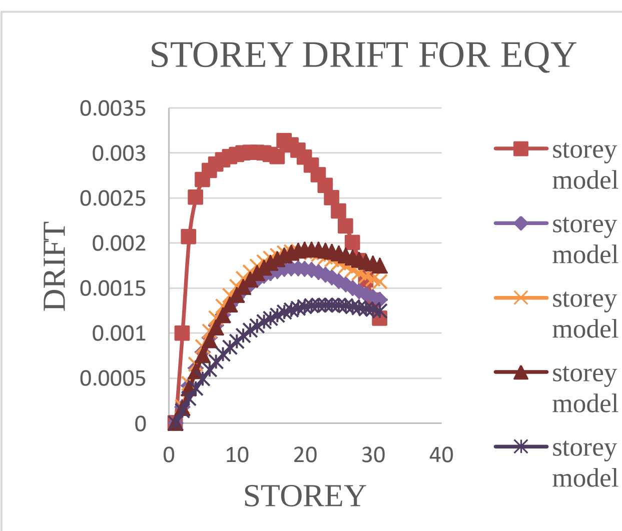

Figure 11

Figure 11 shows the least storey drift is of model 5 ,which is reduced by 58.2% of model 1.

5.2.3 Storey drift in x-direction for Rsx.

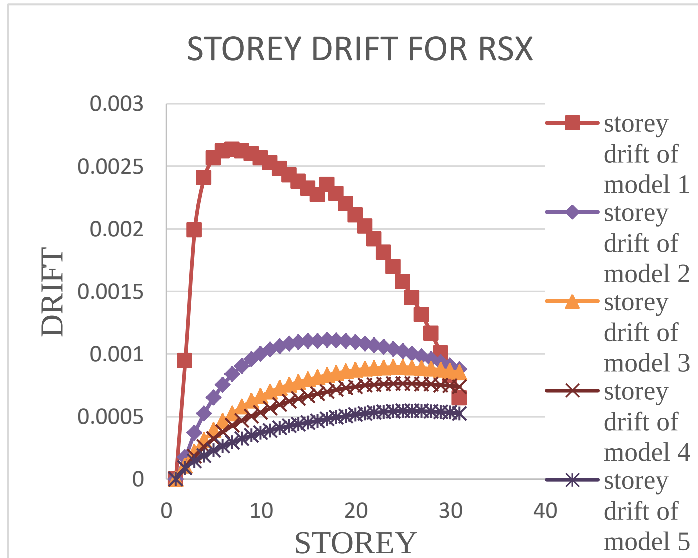

Figure 12

5.2.4 Storey drift comparisni n y-direction for Rsy.

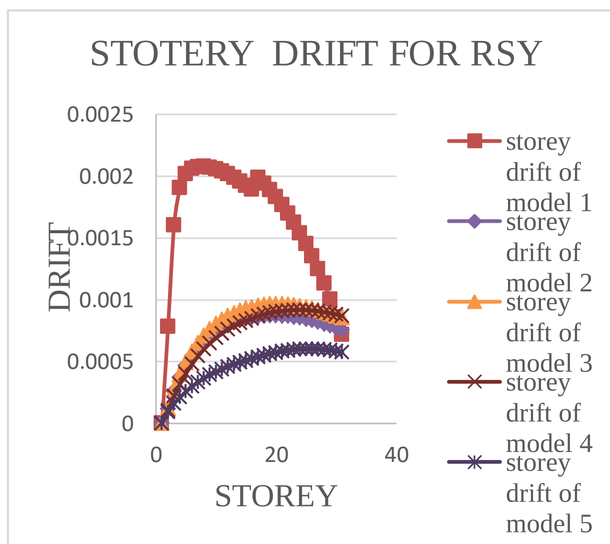

Figure 13

Figure 13 shows the least storey drift is of model 5 which is reduced by 70.2% of model 1.

5.3 Storey shear

5.3.1 Maximum Storey shear comparisn for EQX.

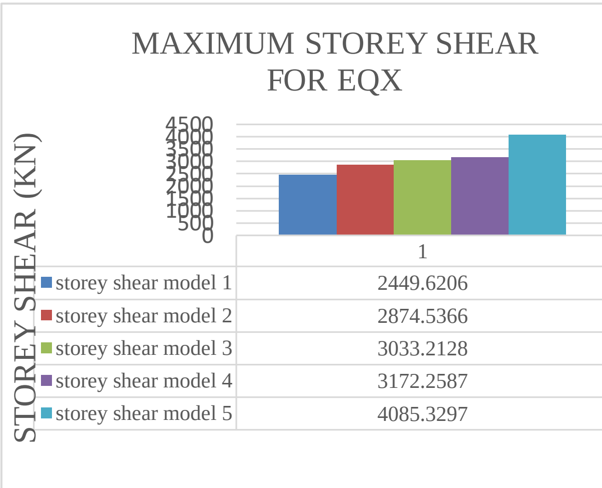

Figure 14

Figure 14 shows the highest storey shear is of model 5 which is increased by 66.77% of model 1.

5.3.2 Maximum Storey shear comparisn for EQY.

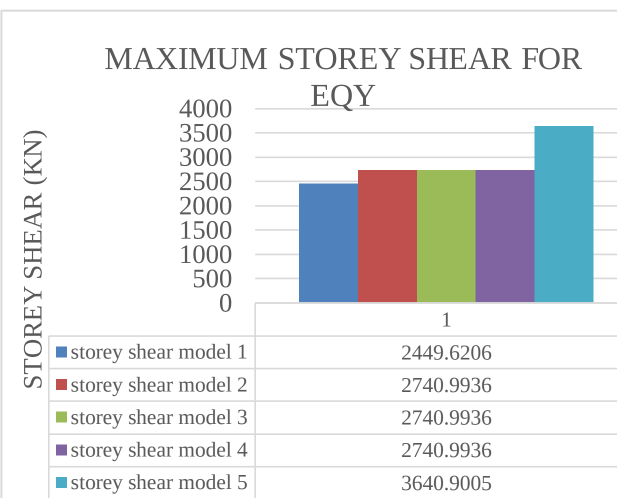

Figure 15

Figure 15 shows the highest storey shear is of model 5 which is increased by 48.63% of model 1.

5.3.3 Maximum storey shear comparisn (mm) in x direction for response spectrum method.

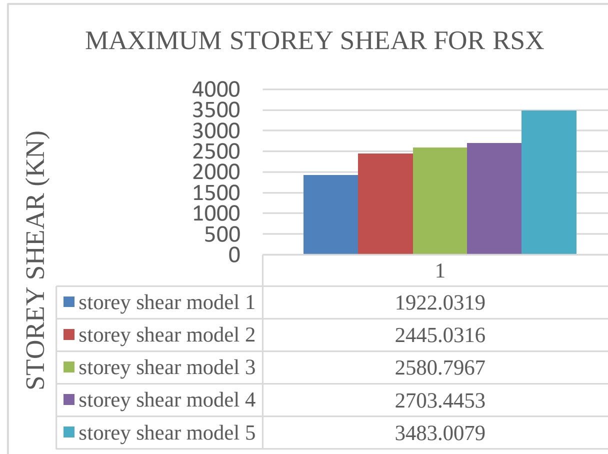

Figure 16

Figure 16 Maximum shows the highest storey shear is of model 5 which is increased by 81.21% of model 1.

5.3.4 storey shear comparisn (mm) in Y direction for response spectrum method.

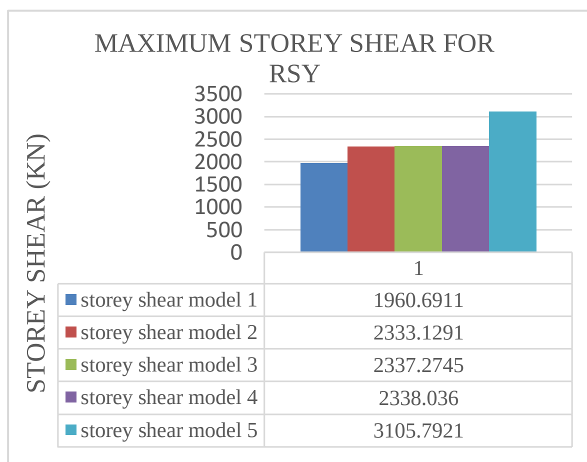

Figure 17

Figure 17 shows the highest storey shear is of model 5 which is increased by 58.04% of model 1.

6. CONCLUSIONS

- From equivalent static analysis and response spectrum analysis it is observed that, the bare frame model has the large storey displacement than the permissable value, so it is not considered.
- The model with shear walls at corners and inner edges has the lower storey displacement values. The average percentage of storey displacement reduction is 52.42%.
- The model with shear walls at corners has the lower storey displacement values. The average percentage of storey displacement reduction is 52.25%.
- The model with shear walls at periferi has the lower storey displacement values. The average percentage of storey displacement reduction is 55%.
- The model with shear wall at the central core has the lowest storey displacement values compared to all other models. The average percentage of storey displacement reduction is 68.7%.
- From equivalent static analysis and response spectrum analysis it is observed that, the bare frame model has the highest storey drift of all models.
- The model with shear walls at corners and inner edges has the lower storey drift values. The average percentage of storey drift reduction is 52.65%.
- The model with shear walls at corners has the lower driftt values. The average percentage of storey drift reduction is 52.10%.
- The model with shear walls at periferi has the lower drift values. The average percentage of storey drift reduction is 56.9%.
- The model with shear wall at the central core has the lowest drift values compared to all other models. The average percentage of storey drift reduction is 60.80%.
- Hence the best model is model 5 containing shear wall at central core, with the lowest storey displacement and lowest storey drift.
- The optimum location of shear wall in the 'T' shaped building is at the centaral core position.

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