e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:04/Issue:04/April-2022 Impact Factor- 6.752 www.irjmets.com

SEISMIC ANALYSIS OF HIGH RISE STRUCTURE ALONGWITH MODAL ANALYSIS IN A STRUCTURE

Sanket J Kalugade[*1]

[*1]Student, Department of Civil Engineering, ICOER, Pune, Maharashtra, India.

ABSTRACT

This is an High rise Structure with Total floors upto 18 storeys which is located in India. In this project , as this is an high rise project , this project is mostly an wind governing structure , so in order to rectify it Dynamic wind analysis is used on the structure to control the stability of structure along with Seismic Analysis as well. This building is situated in Zone III in India so the code used is mostly IS 1893-2016 along with Ductile Detailing code of IS 13920. In order to give lateral stability to the structure , shear wall has been modelled near the lift core of the structure. The Software used for the modeling of the above structure is CSI Etabs

Keywords: ETABS ,High Rise , Dynamic (Response Spectrum) , Modal Analysis.

I. INTRODUCTION

1.1 BACKGROUND

As the population of country is increasing tremendously and with rapid pace there is a huge demand for the construction of houses . But due to restriction in the lateral development of the structure , the structures that are constructed nowadays are mostly high rise specially in a location like Metropolitan cities like Mumbai , Pune , Delhi , Kolkata. So this is an high rise structure to demonstrate how to model an ETABS model by following Indian Norms and how to rectify the desired results that we've got from the model that we've modelled on the CSI ETABS , so in further section we've discussed all the required parameters for the study and analysis of the above project as per the required Indian standards as well.

The Structure comprises of the shear walls located near the life core lobby throughout the structure to give lateral stiffness to the structure. Along with standard sizes of columns have been provided throughout the periphery of the structure.

1.2 SHEAR WALLS

Shear Walls is basically a structure to resist the lateral forces like wind and earthquake , it means if your building is mostly wind governing so we mostly go for the shear wall structure . As per code the minimum ratio of the length of wall to thickness shall be 4 . Shear wall increases the lateral stiffness of the structure as the shear walls are mostly good in taking the inplane forces and shear wall is weak in taking the out of the plane forces.

There are also 3 types of shear wall.

1. Squat walls.
2. Intermediate walls.
3. Slender Walls.

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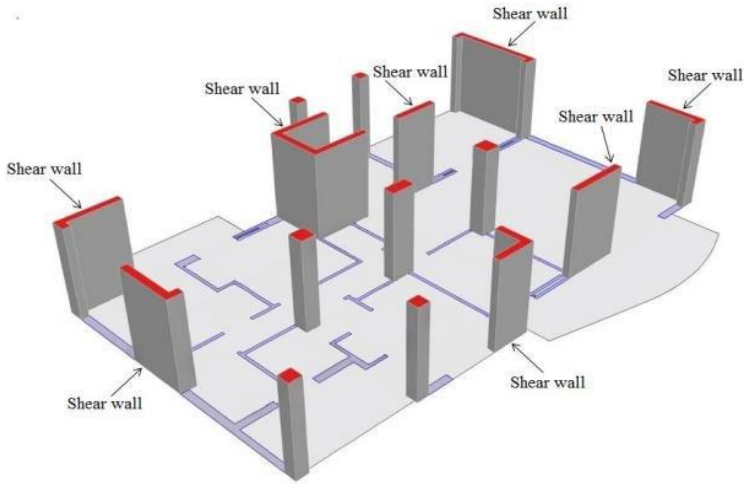

Fig 1.2.1

II. METHODOLOGY

1. For the complete study we will be modelling 1 high rise structure with lift core having shear wall to give the lateral stiffness for the structure.
2. Both the structures will be of 18 storey , having an height of 3m throughout.
3. We've used Seismic Analysis and Design code of IS 1893:2016 for the analysis of structure.
4. The software which is taken into consideration is CSI Etabs to get the consistent results.

2.1 Specifications of the building

BUILDING SPECIFICATIONS	DETAILS
Type of structure	It is an Special Moment Resisting Frame Structure
Building Plan	16m X 16m
Number of floors	18
Floor Height	3m
Slab Depth	200mm
Length along X direction	16m
Length along Y direction	16m
Size of Shear Wall	300mm
Size Of column	300X450
Size of Beam	230X300
Live Load	2 KN/M^2
Dead Load	1.5 KN/M^2
Grade of Concrete	M30
Density Of Concrete	25 KN/M^3
RCC Damping	5%
Steel Grade	Fe 500
Steel Density	78.5 KN/M^3

2.1 Seismic Parameters.

ZONE	III
TYPE OF SOIL	MEDIUM

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RESPONSE REUCTION FACTOR	5
IMPORTANCE FACTOR	1.5
DAMPING	5%
HORIZINTAL ACCELERATION COEFFICIENT	2.5

III. MODELING AND ANALYSIS

3.1 Structure Model of Building.

Below as shown is the plan layout of the structure along with the 3D rendered view of the structure.

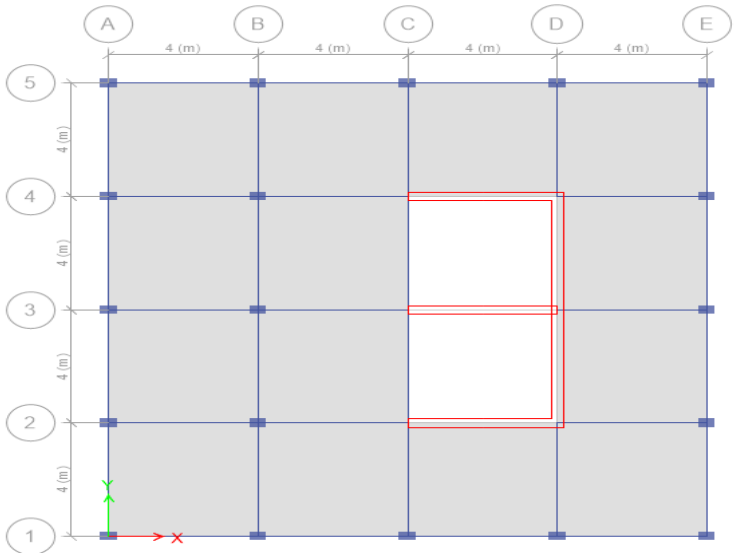

Figure 3.1.1 Plan Of the model

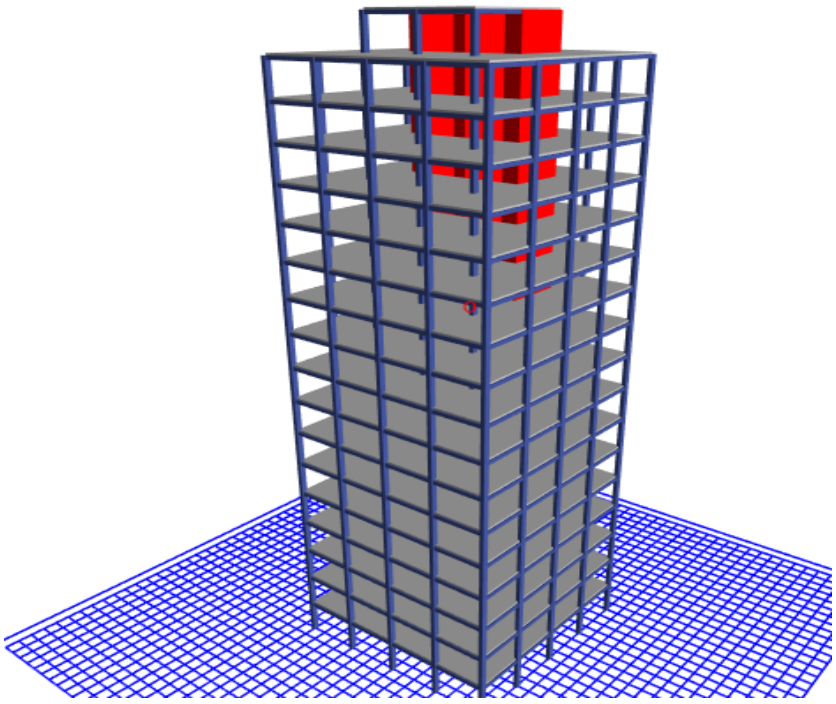

Figure 3.1.2 3D Rendered view

Following structure is assumed to be fixed at the base for the foundations

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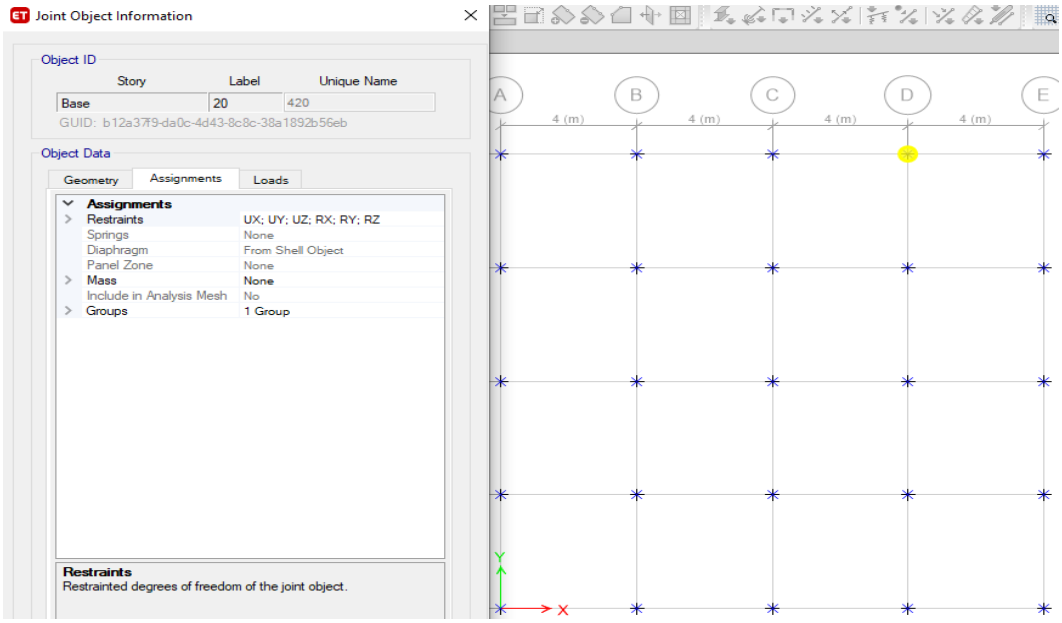

Figure 3.1.3 All fixed support

IV. RESULTS AND DISCUSSION

4.1 Seismic Analysis Results.

After running the analysis we have to check whether the analysis results are right or wrong as per the. As per IS 1893 : 2016 Dynamic Analysis is performed using the Response Reduction Factor. As per the code the Dynamic Base Shear Shall not be less than the Static Base Shear. Following are the resuts shown below.

We have to multiply (Static/Dynamic) if Dynamic is less.

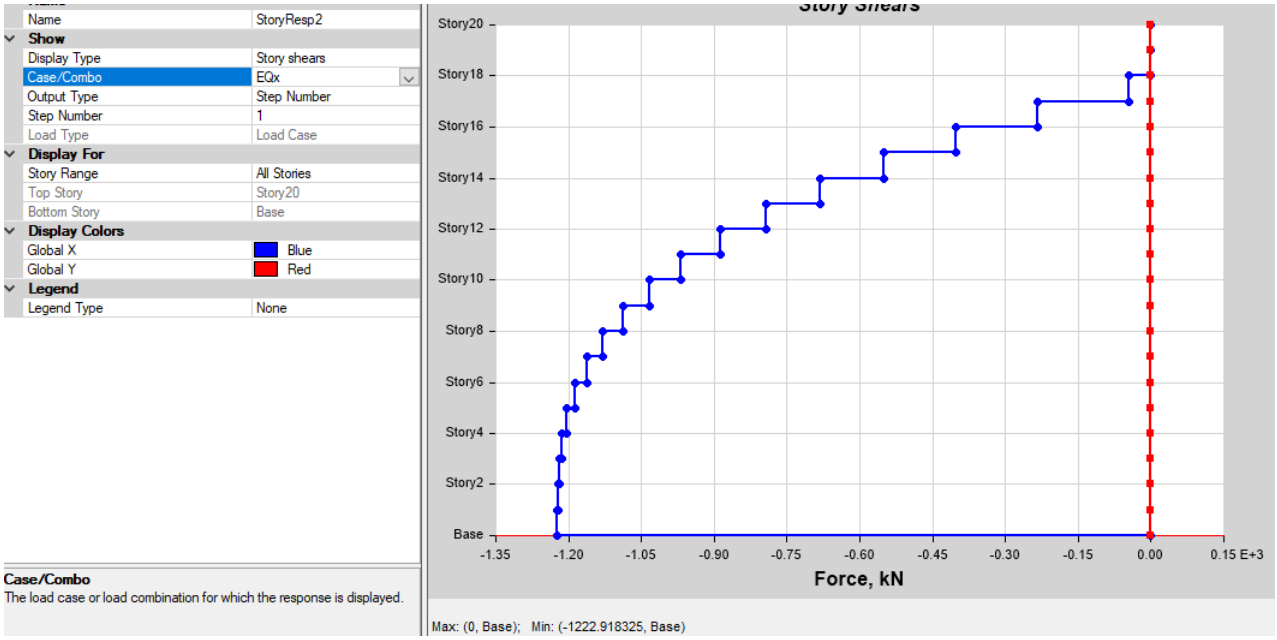

Figure 4.1.1 Static Base Shear along X direction

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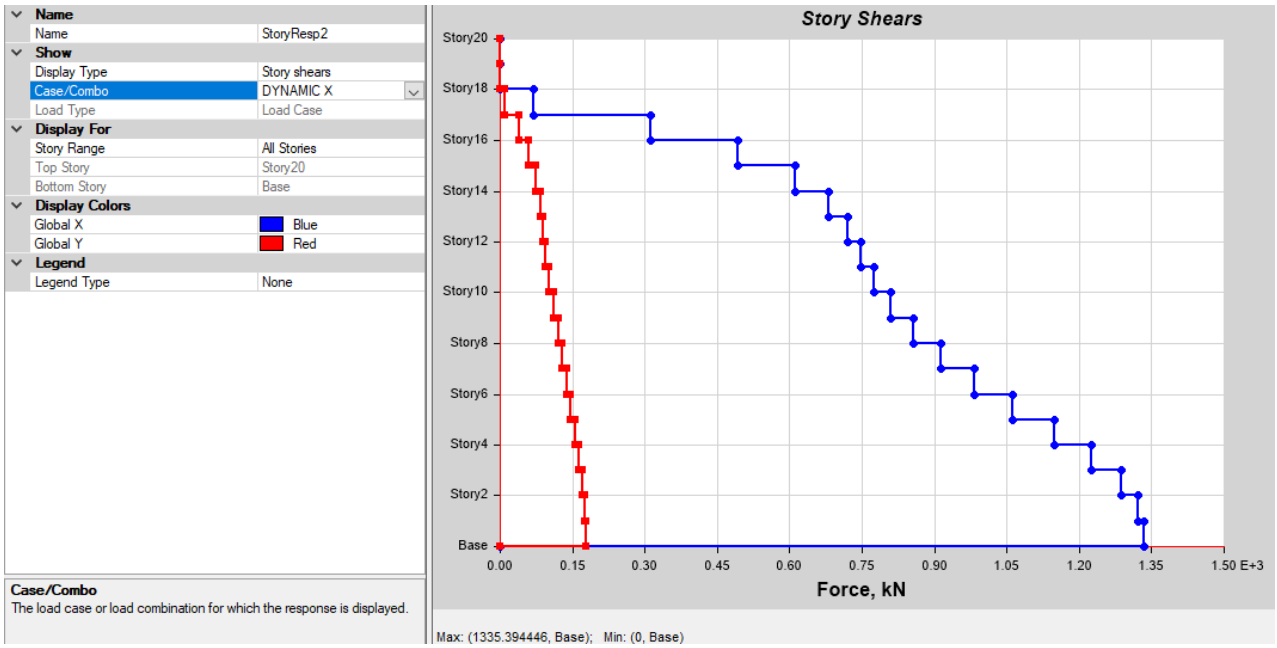

Figure 4.1.2 Dynamic Base Shear along X direction

As per the Indian Standard code , the Dynamic Base Shear For the X Direction is more than the Static Base Shear. Hence the above analysis is correct.

i.e. Dynamic (1335.39) > Static (1222.91)

Following is the result for the analysis along Y direction.

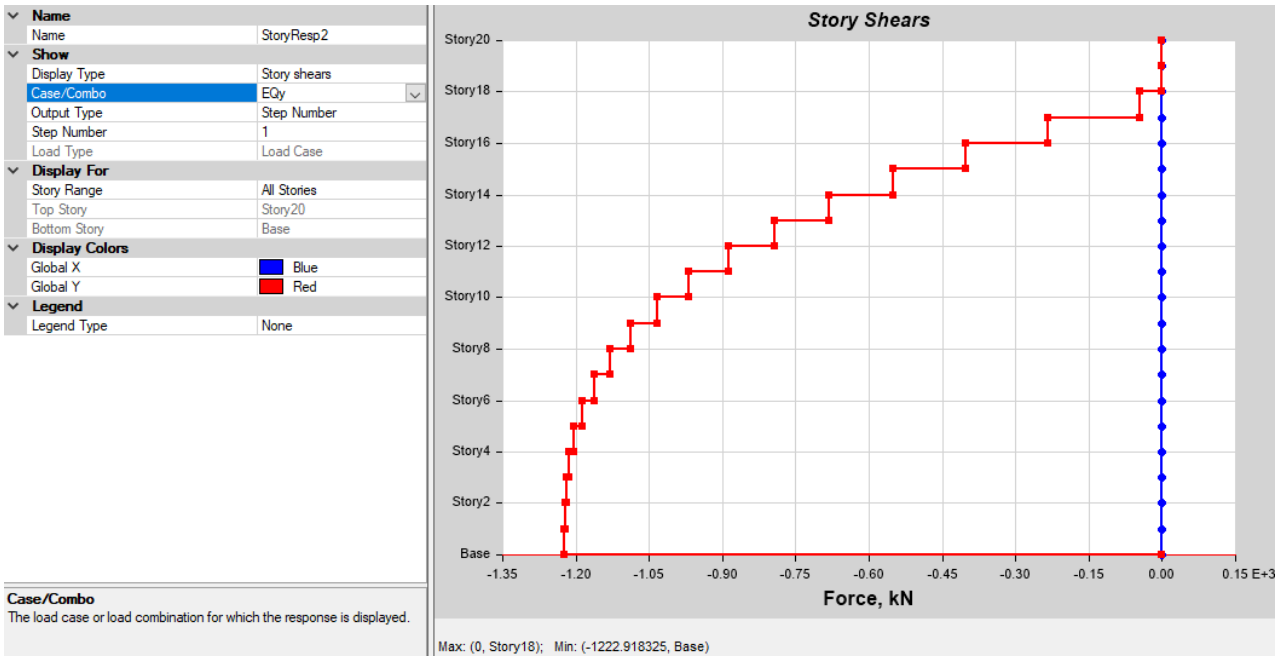

Figure 4.1.3 Static Base Shear along Y direction

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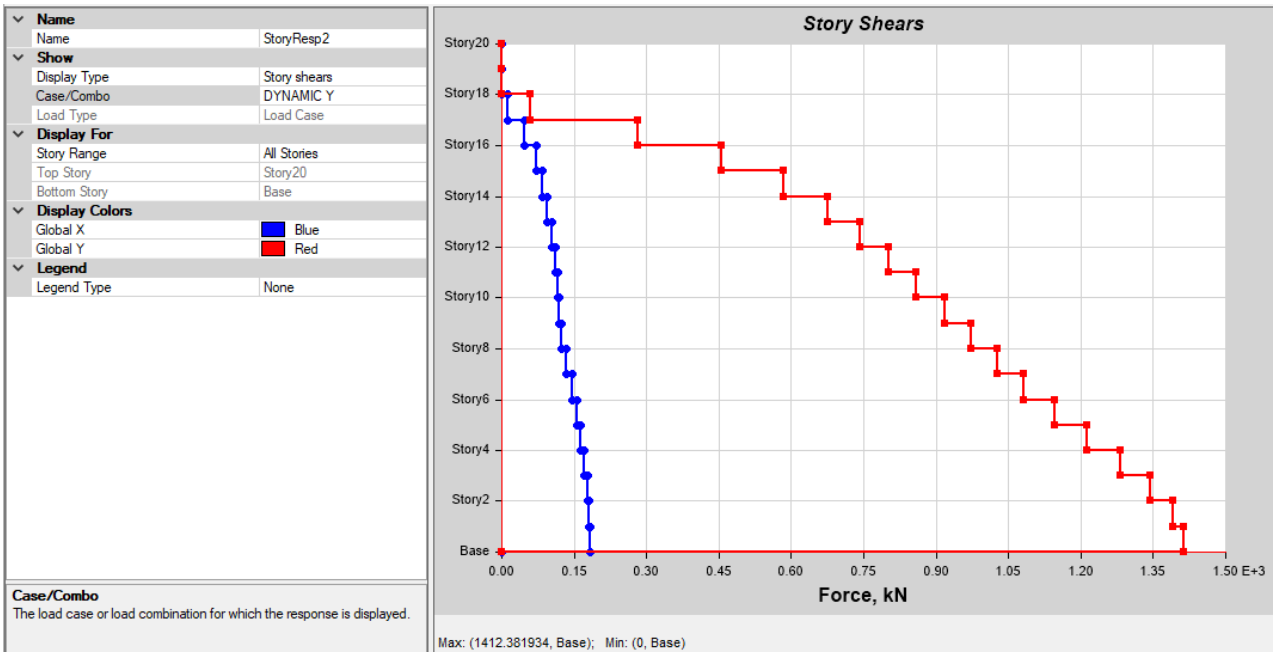

Figure 4.1.4 Dynamic Base Shear along Y direction

As per the Indian Standard code , the Dynamic Base Shear For the Y Direction is more than the Static Base Shear. Hence the above analysis is correct.

i.e. Dynamic (1412.38) > Static (1222.91)

4.2 Modal Analysis Of The Structure

TABLE: Modal Participating Mass Ratios								
Case	Mode	Period	UX	UY	SumUX	SumUY	RZ
		sec					
Modal	1	4.24	0.0026	0.7947	0.0026	0.7947	0.0199
Modal	2	3.666	0.6312	0.0121	0.6339	0.8069	0.1642
Modal	3	3.251	0.1698	0.0103	0.8037	0.8171	0.6334
Modal	4	1.366	0.0004	0.0954	0.804	0.9125	0.0022
Modal	5	1.181	0.0794	0.0016	0.8834	0.9142	0.0186
Modal	6	1.051	0.0231	0.0013	0.9065	0.9155	0.0694
Modal	7	0.792	0.0001	0.031	0.9067	0.9464	0.001
Modal	8	0.68	0.023	0.0007	0.9297	0.9472	0.0096
Modal	9	0.611	0.0104	0.0004	0.9401	0.9476	0.0222
Modal	10	0.561	0.0001	0.0155	0.9401	0.9631	0.0005
Modal	11	0.475	0.0124	0.0003	0.9525	0.9634	0.0046
Modal	12	0.44	0.00003609	0.0081	0.9526	0.9715	0.0002

Figure 4.2.1 Modal Analysis Of The Structure.

1. As per the IS 1893:2016 In Seismic Zone III , it shall be ensured that atleast 65 percent of the modal mass participating ratio should be contributed . But as you can see in the above Fig.4.2.1 SumUX and SumUY is contributing around 80 percent , hence structure is safe.

2. The Fundamental Natural Period should have a difference of atleast 10% for the first two modes . hence this criteria is also satisfied.

3. The Todal SumUX And SumUY should me more than 90 percent , but the above Fig.4.2.1 have 95 percent , hence this criteria is also satisfied.

V. CONCLUSION

Based on the above analysis we can conclude the following

1. How to decide the seismic parameters and and use it in the software effectively.

2. After running the analysis how to study the dynamic and static base shear as per the Indian Standard lauses.

3. After studying the Story shear parameters for high rise , how to study the table for the modal participating mass ratio effectively and do the corrections as required , if the above parameters are not satisfied.

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