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ANALYSIS AND DESIGN OF A MULTI-STORIED BUILDING FOR DIFFERENT SEISMIC ZONES BY PROVIDING SHEAR WALLS

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Abstract – *This Study Presents The Design And Analysis Of A G + 17 Multi-Storied Building Incorporating Shear Walls To Withstand Seismic Forces In Different Seismic Zones. The Analysis Is Performed Using ETABS Software, Which Is Widely Recognized for Its Capability In Structural Analysis And Design. The Seismic Zones Considered In The Study Represent Varying Levels Of Seismic Activities, Ranging From Low To High. The Inclusion Of Shear Walls In The Building Design Is Crucial For Enhancing Its Seismic Resistance And Insuring Structural Integrity During Earthquakes. Through Comprehensive Analysis And Design Iterations, The Effectiveness Of Shear Walls In Mitigating Seismic Loads Is Evaluated, Considering Factors Such As Building Materials, Geometry, And Load Distribution. Finding Of This Study Provide Valuable Insights Into The Optimization Building Designs For Seismic Resilience Across Different Seismic Zones , Contributing To Safer And More Sustainable Construction Practices.*

Key Words: analysis and design, manual, zone comparisons zone III zone IV

1.INTRODUCTION

Seismic Design And Analysis Of Multi-Story Building Play A Critical Role Insuring The Structural Integrity And Safety Of Structures Located In Different Seismic Zones. In This Comparative Analysis, We Will Explore The Use Of Shear Wall In The Design Of Muti-Story Buildings In Seismic Zone III And Seismic Zone IV Using The ETABS Software. ETAB Widely Use Structural Analysis And Design, Provides Engineers With Powerful Tools For Modeling, Analyzing And Designing Buildings Subjected To Seismic Forces. The Use Of ETAB Software In Both Seismic Zone Iii And Seismic Zone Iv Allows Engineers To Conduct Comprehensive Structural Analysis And Design, Considering Factors Such As Seismic Load Combinations, Material Property And Geometric Constraints. ETABS Provides The Necessary Tools For Modelling Shear Walls, Analyzing Their Performance Under Seismic Loads And Ensuring Compliance With Local Building And Regulations Specific To Each Seismic Zones.

The Comparative Analysis Will Delve Into Specifics Of Using ETABS Software To Design Multi-Story Buildings With Shear Walls In Seismic Zone Iii And Seismic Zone Iv, Highlighting The Software's Capability's.

1.1 EARTHQUAKE

Earthquake Can Be Understood As Earth-Surface Shaking Because Of Energy Which Is Suddenly Released By Reason Of Earth's Movement. This Earth's Movement Is Consequence Of Plates Are Termed As Tectonic-Plates. The Crust Of The Earth Is Surrounded By Large-Number Of Very Big Size Bodies Called Tectonic-Plates, They Are Constantly Under Motion With Respect To One Another, Due To Their Unexpected Collision With One Another-Leading To Release Of Energy Which Travels Towards The Earth -Surface In The Form Of Waves.

1.2 DIFFERENT SEISMIC ZONES IN INDIA

Indian Plate Is Responsible For Earthquakes Of High Intensities And Frequency Reading Indian Subcontinent To Catastrophic Earthquakes Around 53% Indian Land Mass Is Vulnerable To Earthquakes, Based On Indian Geographical Statistics. According To Estimations Based on Report Of World Bank And United Nations, Around 200 Million Indian

Population To Be Affected From Storms And Earthquakes Around 2050. According To Latest Design Practice Code (Is: 1893: Part-1; 2016), India Is Divided Into 4 Zones Based On Seismicity Observed Of Indian Land Mask This Zones Are Namely Zone Ii, Iii, Iv, V Which Covers Entire Country. Before The Present Code This Divisions Of Zones Is Of 5 To 6 Types For Entire Country Which Is Now Reduce Two Only Four Ranging Between Zone V To Zone Ii Associated With Highest To Lowest Seismicity Respectively.

Zone V : -
This Zones Attracts Earthquake Of High Intensity With Highest Risk Involved Attributed With Very High-Risk Damaged. Zone Factor Indicates Effective Level Of Earthquake I.E. For Zero Period Which Is Used For Designing Of Earthquakes Resistance Structures By Structural Engineers. Earthquake Prone Areas Generally Consists of Trap And Basalt Rocks, Regions Under This Zones Are Kashmir And Himalayan Regions, North East States, Northern Areas Of Bihar And Region Of Gujrat State Mainly Kutch.

Zone IV :-
This Zone Attributed With High Risk Damage With Factor Of 0.24 As Per Is Code. The Zone Income Passes Gangetic Plains, National Capital Delhi, State Of Jammu And Kashmir, Faltan Area Of Maharashtra, Northern Regions Of Bihar And Border Of Nepal And India.

Zone III :-
This Zone Classified As Moderate Damage Risk Zone With Factor Of 0.16 As Per Is Code. Regions Included Are Some Parts Of Himalayas And Kashmir, Andaman And Nicobar.

Zone II :-
This Zone Attracts Less Intensities Of Earthquakes And Classified Under Low Damage Risk Zone, As Per Is Code Assigned Factor Of 0.10 As Only 10% Of Gravitational Acceleration Is Experienced By Structure As Maximum Horizontal Acceleration.

1.3 SHEAR WALL

What Is A Shear Wall ?
Shear Wall Is Structural Member In A Reinforce Concrete Framed Structure To Assist Lateral Forces Such As Wind Forces. Shear Walls Are Generally Used In Multi-Storied Buildings Subject To Lateral Wind And Seismic Forces. In Reinforced Concrete Framed Structures The Effect Of Wind Forces Increased In Height. Codes Of Practice Imposed Limits On Horizontal Movement Or Sway. Shear Wall Are Typically Vertical Components Made Of Reinforced Concrete Strategically Placed In The Building's Layout To Provide Stiffness And Stability.

Shear Walls Work By Transferring Lateral Forces Acting On Structure To The Foundation, Thus Reducing The Buildings Vulnerability To Side Ways Movement And Potential Collabs During Earthquakes Or High-Winds. They Are Essential For Ensuring The Safety And Stability Of Buildings In Areas Prone To Seismic Activity Or Strong Winds.

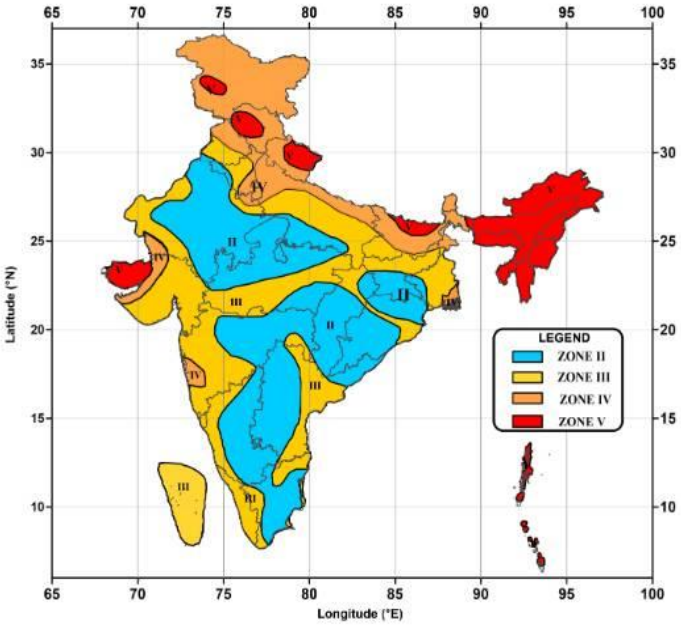


Figure 1:- Seismic Zones In India

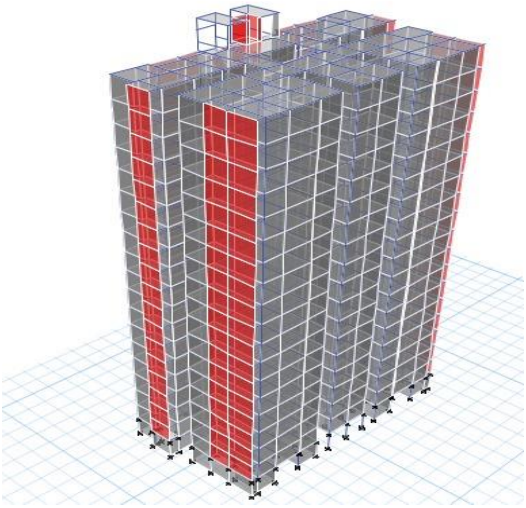
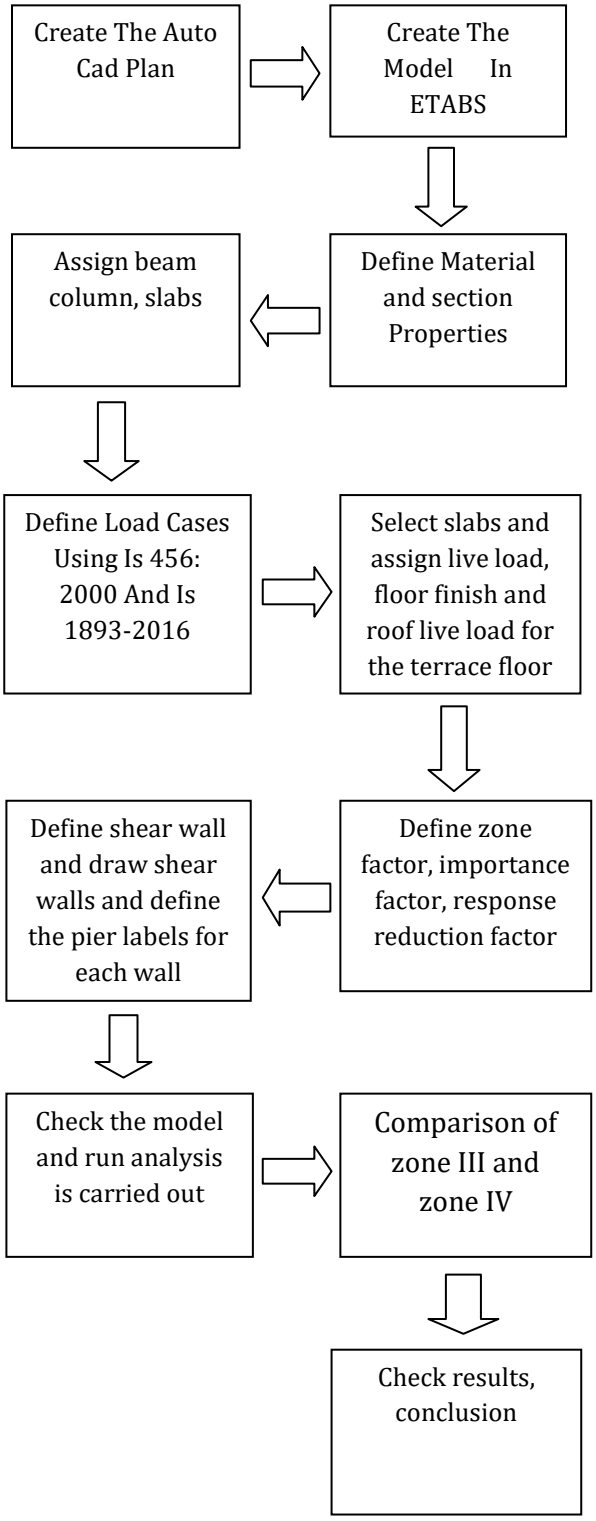


Fig 2:- shear wall

2 METHODLOGY



3. SPECIFICATIONS OF BUILDING

3.1 DEVELOPMENT OF PLAN IN AUTOCAD

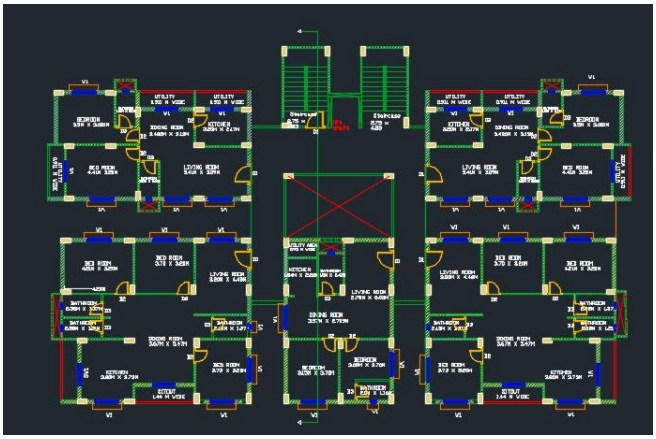


Fig 3:- AutoCAD Plan

3.2 BUILDING PROPERTIES

Particulars	Values
Types Of Building	Residential
Height Of Structure (M)	55.4
Number Of Stories	G+17
Height Of Each Floor In (M)	3.1
Grade Of Concrete Used	M 40
Steel Grade Used	HYSD 500
Beam Dimension	230X700
Column Dimension	450X600
Concrete Density	24 KN/M
Density Of Steel	78.5 KN/M
Type Of Soil	Medium
Seismic Zone Factor	0.16, 0.24
Live Load	4kN/M^2
Dead Load	11.04kN/M^2
Floor Finish Load	1.5 KN/M^2
Shearwall Thickness	23mm
Slab Thickness	200

4 MODEL GENERATE IN ETABS WINDOWS

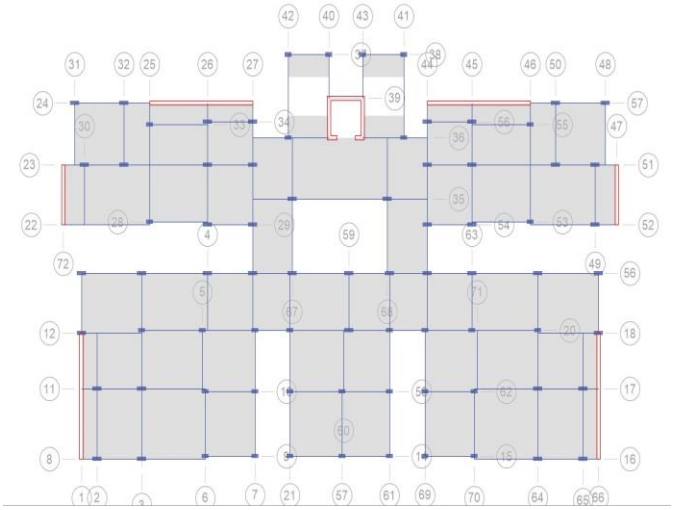


Fig 4:- center line diagram

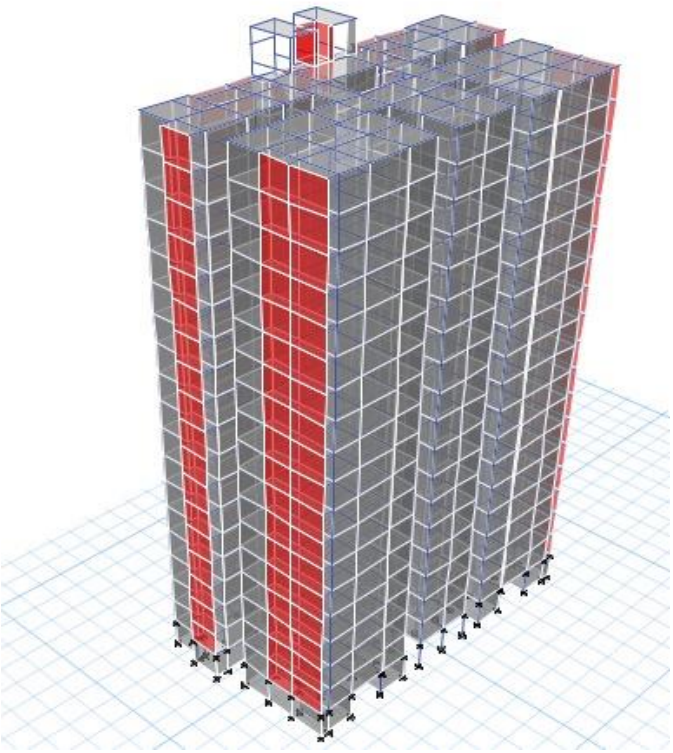


Fig 5:- 3D Model Of Structure

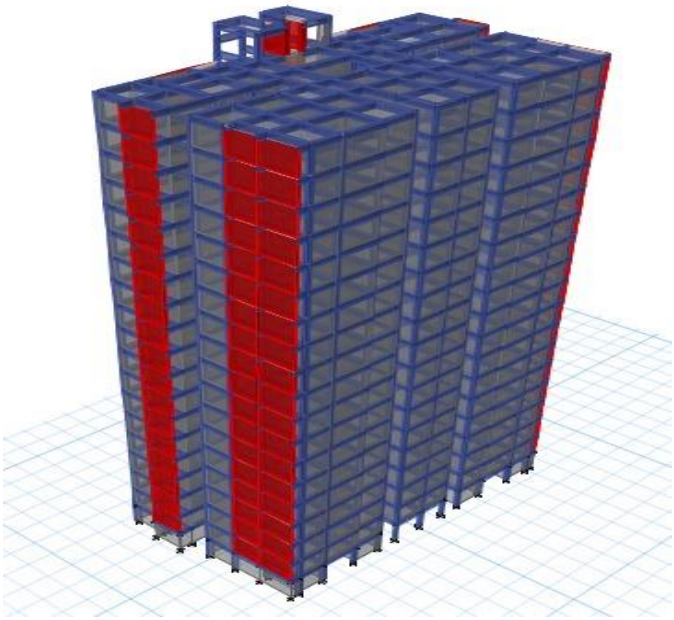


Fig 6:- rendering view of structure

5 RESULT AND DISCUSSION

5.1 Base Shear

Base Shear Is The Fundamental Concept In Structural Engineering And Earthquake Engineering. It Refers To The Total Lateral Forces Exerted On A Building's Foundation By The Ground During An Earthquake This Force Is Calculated Based On The Seismic Design Parameters Of The Structures, Such As Its Mass, Stiffness, And The Charcaterstics Of The Ground Motion.

Base shear		
Sr.no	Zone III	Zone IV
STATIC X	935	1181.3
STATIC Y	667.98	910.02
RESPONSE X	206.25	216.28
RESPONSE Y	106.83	111.83

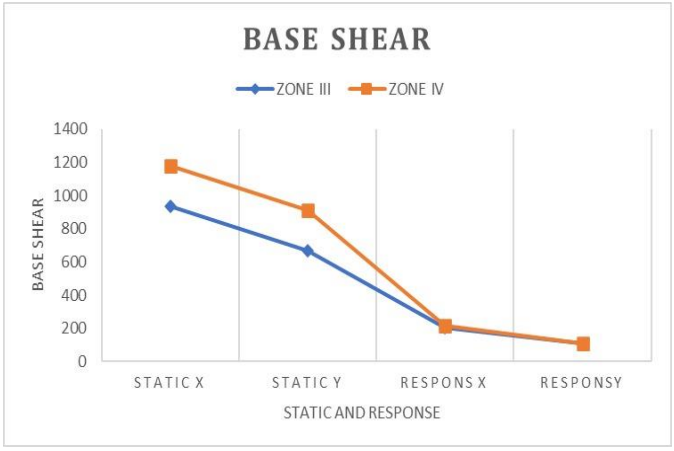


Fig 7. Base Shear Graph

5.2 Displacement Of Earthquake Load

The Maximum displacement in the building along the x direction is obtained for seismic load combination. (1.2 DL+LL+EQX) and along Y- direction is obtained for the seismic load combination (1.2 DL+LL+EQY) .

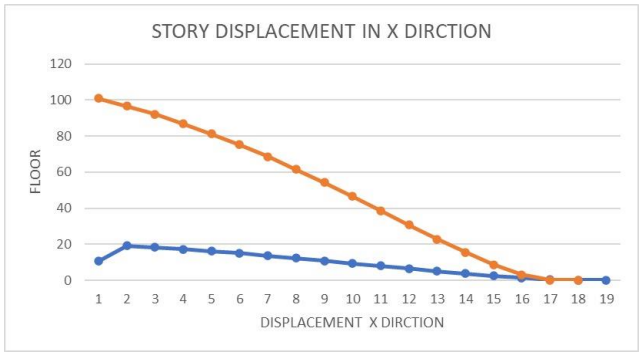


Fig :-8 Story Displacement In X Direction

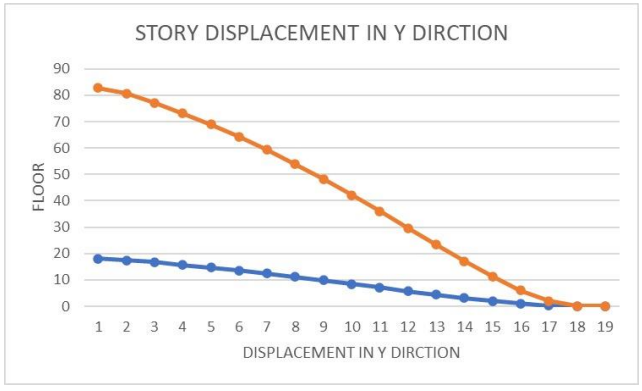


Fig:- 9 Story Displacement In Y Direction

5.3 story drift for earthquake load

The story drift in the building along x direction is obtained for the seismic load combination (1.2DL+LL+EQX) And along y direction is obtained for the seismic load combination (1.2DL+LL+EQY).

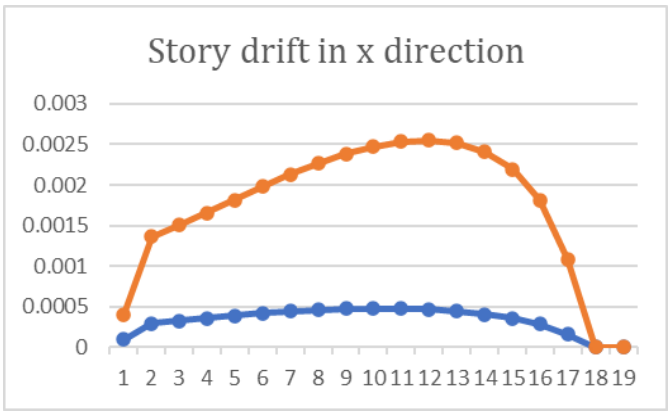


Fig- 9 story drift in X direction

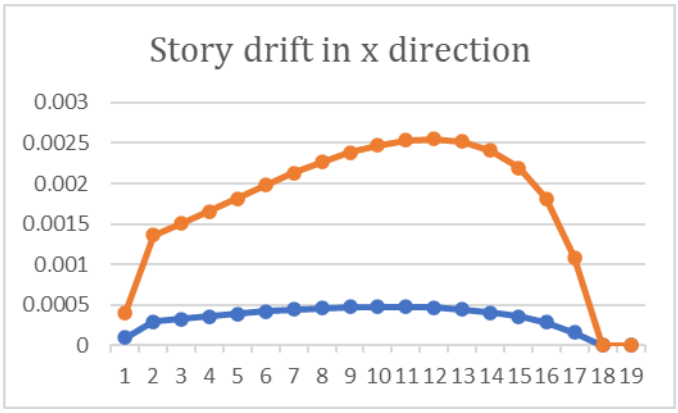


Fig-10 Story Drift In Y Direction

6 CONCLUSION

Based On The Analysis Conduct Using ETABS Software, The Comparison Between Zone III And Zone IV Reveals Significant Insights Into Structural Behavior And Performance. The Conclusions Drawn From The Projects Are:

1. Seismic Performance: Zone IV Structures Demonstrate Higher Resistance and Resilience Against Seismic Forces Compared To Zone III Structures. This Is Evident In The Reduced Structural Damage And Lower Displacement Observed In Zone IV Buildings Under Seismic Loading.

2. design considerations : engineering design and detailing for zone IV structures should prioritize stricter seismic design criteria, including stronger materials, enhanced reinforcement detailing, and more robust structural systems to ensure safety and functionality during seismic events.

3. economic implications : while zone IV constructions might involve higher initial costs due to stricter design requirements and material specifications, the long terms of reduced damaged and maintenance expenses justify the investment, especially in high seismic risk regions.

7. REFERENCE

1. Mohammed Affan, Md. Imtiyaz Qureshi Syed Farooq Anwar (Nov 2018)

2. Ravikumar, P Raghava, Dr. T. Suresh Babu (April 2017)

3. Siva Naeen E , Nimmy Mariam Abraham Et Al (2018)

4. Rakshith G.M, Pangender Naik G, Et Al (2019)

5. Mv Naveen Kj Brahma Chari (2016)

6. A. Fathia< Shahi Kumar Nv

7. Vishal Yadav And Sandeep Singla (2019)

8. M.Pavani g. Nagesh kumar et al (jan 2015)

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