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ANALYSIS OF AIR TRAFFIC CONTROL TOWER

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Abstract: Air traffic control tower (ATC) is a very indispensable and special type of structure for airports for controlling the direction of aircraft, etc. The aim of this study, found the Response Reduction Factor air traffic control tower under push over analysis. In this study we can use Two shapes of tower Cross shape and octagonal respectively. ATC tower is designed based on the assumption that they are fixed at their base, without considering the foundation as well as soil. But in reality, when a structure is subjected to an earthquake excitation, it interacts with the soil, influencing the structural response. The results of pushover analysis, it was determined that the base shear of a cross shape is greater than that of another configurations.

Keywords - Air Traffic Control (ATC) Tower, Response Reduction Factor, Seismic analysis, Push over analysis or non-linear static analysis, Steel frame, shear wall.

I. INTRODUCTION

Airport regulation framework are different airplane route and correspondence frameworks that utilizes pcs, sensors, satellite phones and possible scenarios and gadgets to gives direction to flying airplane. Prepared staff filling in as air traffic regulators at stations on the ground continually screen these frameworks and track the areas and speed of different airplane.

The objective of aviation authority framework is to limit the danger of airplane impacts while augmenting the quantity of airplane that can fly securely simultaneously. Aviation authority frameworks likewise give refreshed climate data to air terminal around the nation, so airplane can take off and land securely. This data is significant not exclusively to aircraft travellers yet in addition to businesses that depend on avionics for the convenient vehicle of merchandise, materials and faculty.

Aviation control (ATC) is a service provided by ground-based controllers who direct planes in relation to the surface and through controlled airspace, as well as provide admonition and other types of assistance to planes in non-controlled airspace, and handle all take-off, landing, and ground traffic. Private pilots flying into and out of small air terminals and rural zones can get data (environment, course, scene, and flight plan) from flight administration stations (FSS).

1.1 HISTORY OF TOWER

Historically, around 1920 at Croydon airport, London. The first use of ATC towers took place. A timber hovel 15 ft. (4.6 m) large with windows on each of the four sides was really the ‘aerodrome control tower'. It was dispatched on 25 February 1920 and gave pilots fundamental data on traffic, environment and area. The principal air terminal traffic signal pinnacle, controlling appearances, take offs and surface development of airplane at a particular air terminal, opened in Cleveland in 1930.

The primary ATC tower at Kuala Lumpur International Airport, about 50 kilometers from Malaysia's capital city, stands at 130 meters (426 feet), making it the world's second highest. The ATC tower, which is shaped like an Olympic light, allows the airport to handle 120 planes per hour. The Ministry of Transport's Department of Civil Aviation (DCA) oversees the ATC tower, as well as the entire airport regulatory system, which was authorized in 1998.

1.2 OBJECTIVE

- To evaluate response reduction factor of ATC tower.
- The impact of various parameters on the ATC tower's seismic factor.

II. RESEARCH METHODOLOGY

- In this investigation, the limit range technique described in ATC 40 is used to assess the seismicity of the ATC tower.
- This technique uses the crossing point of the limit bend and a flexible reaction range to determine given the considered seismic risk level, the most extreme removal interest of a structure.
- When the most severe removal interest is obtained, the manufacture of plastic pivots is tested to assess the earthquake behavior of structures.
- Analysis Methods
  - Linear static Analysis (Seismic Coefficient Method)
  - Linear Dynamic Analysis (Response Spectrum Method)

- Nonlinear Analysis
    - Non-linear Static Analysis
    - Non-linear Dynamic Analysis

2.1 Pushover Analysis

A framework's pushover analysis might be a permanent analysis's pushover analysis. Loads of gravity and steadily increasing horizontal loads Static lateral loads that are comparable are essentially equivalent to earthquake-induced forces. A plot of maximum shear strength vs top displacement is obtained in an extreme structure by an observation that will reveal any early failure or weakness. The test is carried out until it fails, allowing the collapse load and ductility to be calculated. The same kind of study may be used to find vulnerabilities in a system. The findings of these tests will be used to determine whether or not to retrofit.

2.2 Pushover Curve

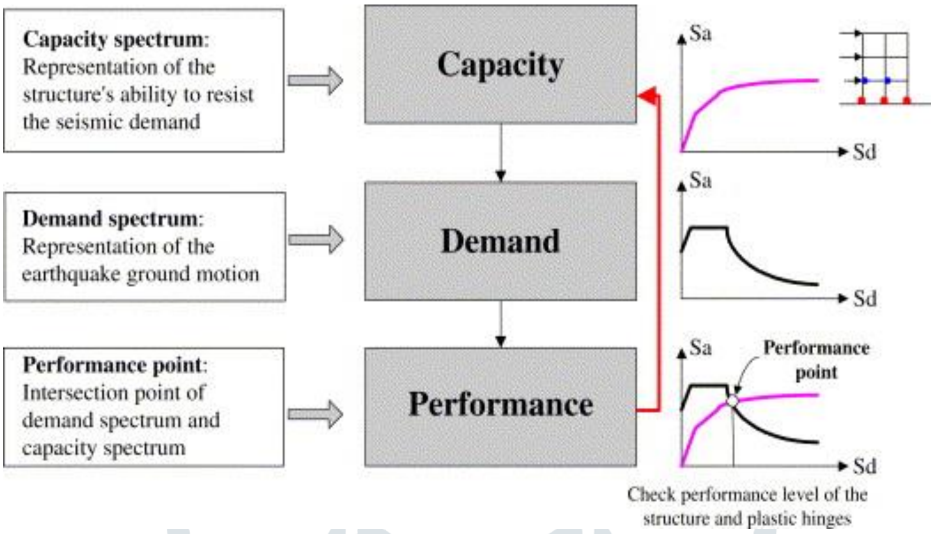
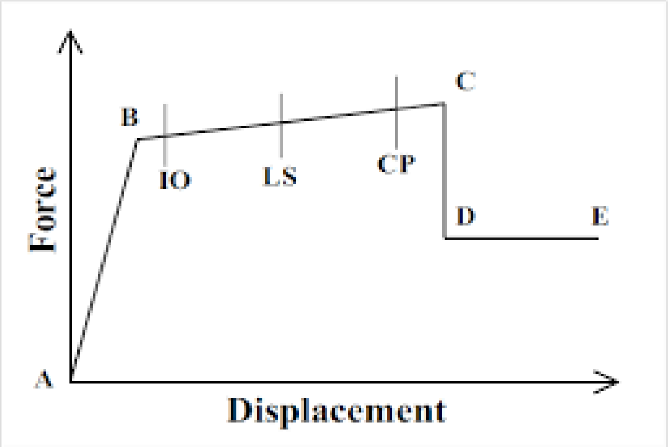


Figure 1 Pushover Curve

2.3 Plastic Deformation Curve

One can identify a force-deformation (moment-rotation) curve for each degree of freedom that gives the output point and the plastic deformation after yield.



Graph 1 Plastic Deformation Curve

2.4 Input Data of the Tower

Table 1 Nonlinear modeling parameters

Material	Ultimate compressive strain	Ultimate tensile strain
Concrete	0.005	-
Steel Reinforcement	0.02	0.05

Table 2 Parameters for concrete, reinforcement and steel

Material	Modulus of elasticity (MPa)	Poisson's ratio	Compressive strength (MPa)	Yield strength (MPa)
Concrete	27386.12	0.2	M30	-
Steel Reinforcement	200000	0.3	-	Fe-415
Steel Section	210000	0.3	-	F_y-345

Table 3 The cross section in the column

Levels		Height X Flange Width X Thickness (mm)
From (m)	To (m)	
0	22.2	300 X 200 X 16
22.21	25.84	300 X 300 X 25
25.85	29.07	200 X 200 X 12
29.1	30.17	200 X 300 X 10

Table 4 The beam cross section

Levels		Height X Flange Width X Thickness (mm)
From (m)	To (m)	
0	5.2	300 X 200 X 16
5.2	8.44	300 X 200 X 10
8.44	11.68	300 X 200 X 16
11.68	14.92	300 X 200 X 16
14.92	18.16	350 X 250 X 12
18.16	22.21	350 X 250 X 15
22.21	25.84	350 X 250 X 15
25.84	27.24	300 X 200 X 10
27.24	29.07	350 X 200 X 15

Table 5 Seismic Parameters

Seismic Parameters	
Seismic Zone	0.36 or V
Response reduction factor	5 (SMRF)
Important factor	1.5

Table 6 Core dimension of tower

Core	Octagon Shape	Cross Shape
Size (m)	Diameter (m)	Width and length (m)
Inner Core	0.91	2.5 & 2.5
Outer Core	2.81	2.5 & 2.5

2.5 Calculation

1. Over strength Factor (RS)

$$Rs = \frac{Vu}{Vd}$$

= 3350.34/520
= 6.44

2. Redundancy Factor (RR)

As per ASCE7 the redundancy factor was considered as 1 in this study.

3. Ductility Factor (R_μ)

$R\mu = (\mu-1/\Phi) + 1$

$\mu = \Delta \boldsymbol{m} / \Delta \boldsymbol{y}$

= (0.004*30170)/ (124.39)

$\mu = 0.97$

$\Phi = 1 + (1/(12T-\mu T) - (2e-2(\ln T-0.2)$ ^2/5T)

$\Phi = 0.8545$

$R\mu = 0.96$

4. Damping Factor ($R\xi$)

In this Model there is no use of damper or energy dissipating devices so that $R\xi = 1$.

So, that

$$R = R_S \times R_\mu \times R_R \times R_\xi$$

$$= 6.44*0.96*1*1$$

$$R = 6.18$$

IV. RESULTS AND DISCUSSION

1. Octagon Shape Configuration Results

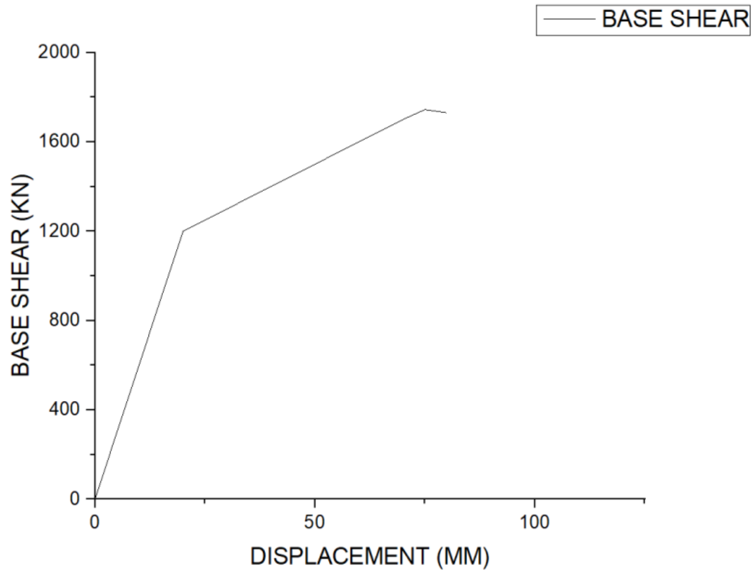


Figure 2 Octagon shape push over curve.

2. Cross Shape Configuration Results

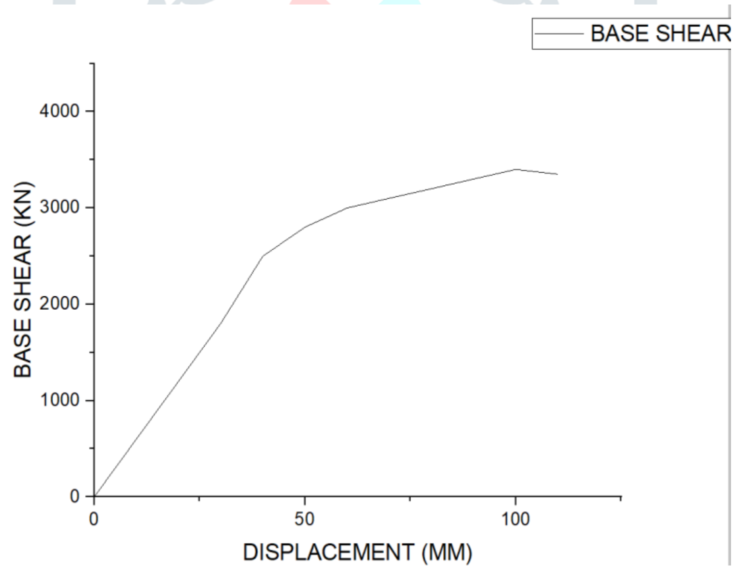


Figure 3 Cross shape push over curve

Shape Type	R_S	R_μ	R_R	R_ξ	R
Octagon	6.02	1.14	1	1	6.86
Cross	6.44	0.96	1	1	6.18

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