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Seismic Analysis of Intz Tank with Change in Seismic Zones

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Abstract: ***A 10 lac liters of Intz type water tank is considered for this thesis work. The structural size was decided on the basis of the various literates studied and considering practical site considerations. For this purpose, types of loads and their intensities were considered as per the particular Indian code such as IS 875 part-01 and 02 for dead load and live load and IS 1893 part 01 for seismic loading on water tank. As these loading and loading combinations undergoes a tedious manual calculations structural design software Staad Pro. will be used for analysis and design. After detailed analysis it is found that Change in seismic severity has significant effect on the beam reaction in horizontal X direction with no change in horizontal Z-direction. Changes in seismic severity does not affect the moment values of structure from zone II to Zone III but a slight change was observed between the values of Zone III and Zone IV in Horizontal X and Z direction. An Increase of 261.53 % in the intensity of absolute pressure was observed as the severity changes from low to high, thus reflecting the significance of seismic severity.***
Keywords: STAAD pro., seismic zones, base shear, displacement

I. INTRODUCTION

Storage reservoirs and overhead tank are used to store water, liquid petroleum, petroleum products and similar liquids. The force analysis of the reservoirs or tanks is about the same irrespective of the chemical nature of the product. All tanks are designed as crack free structures to eliminate any leakage. Water or raw petroleum retaining slab and walls can be of reinforced concrete with adequate cover to the reinforcement. Water and petroleum and react with concrete and, therefore, no special treatment to the surface is required. Industrial wastes can also be collected and processed in concrete tanks with few exceptions. The petroleum product such as petrol, diesel oil, etc. are likely to leak through the concrete walls, therefore such tanks need special membranes to prevent leakage. Reservoir is a common term applied to liquid storage structure and it can be below or above the ground level. Reservoirs below the ground level are normally built to store large quantities of water whereas those of overhead type are built for direct distribution by gravity flow and are usually of smaller capacity.

II. LITERATURE REVIEW

Shrutismita Talukda *et al* 12 In this project, the general design of the water tank, column and the foundation is done by using MS Excel. The water tank and the columns are modeled and analyzed using ANSYS. The columns and the bottom slab of the water tank is modeled and analyzed in ETABS. This analysis is then exported to SAFE for doing the soil structure interaction. The soil structure interaction is done by importing the analysis from ETABS to ANSYS and then the uplift pressure of the soil to the structure is studied. From the study it was concluded that maximum equivalent stresses obtained from ANSYS analysis are 2.866MPa which is present inside the cylindrical portion. the stresses generated is very minimum and hence the structure is safe for constructing in field. The soil structure interaction is an important phenomenon and has to be given more priority before the construction of the structure. Most of the structures are constructed with doing analysis based on soil structure interaction and thus the structure can fail mainly due to the soil structure correlation during severe earthquake. Hence, the analysis is carried out in this project with SAFE and the deformation obtained is minimum. From this analysis it can be concluded that the structure will have a good service period. From response spectrum analysis done in ETABS2016, it is derived that the structure is safe against severe ground motion.

Reshma Kulkarni *et al* 13 This paper gives in brief about the designing stage of reservoir or tank using JAVA program, Water tanks are traditionally designed by working stress method but as per revised IS 3370 water tank can also be designed by limit state method. The paper consists of manual procedure i.e. design program as per working stress method. Comparative study of design between program and manual outputs. After comparison it was found that, As technology changes every field work of area requires an automation to get accurate and efficient work, to minimize the time period at design period .If software or programmes are accurate at design, the life span of structure will be more by neglecting human's errors.

Asif Khan *et al* 14 The main aim of the study is to evaluate the effect of lateral forces (like seismic and wind forces) on elevated water tanks. For the sake of simplification of analysis, STAAD Pro. V8i is use. After analysis it was fund that For Columns maximum bending moment occurred in Z-direction. For Ring beams @ Bottom of the tank maximum bending moment occurred in Z-direction. For Ring beams @ Top of the tank maximum bending moment occurred in Z-direction. For Tie beams maximum bending moment occurred in Z-direction.

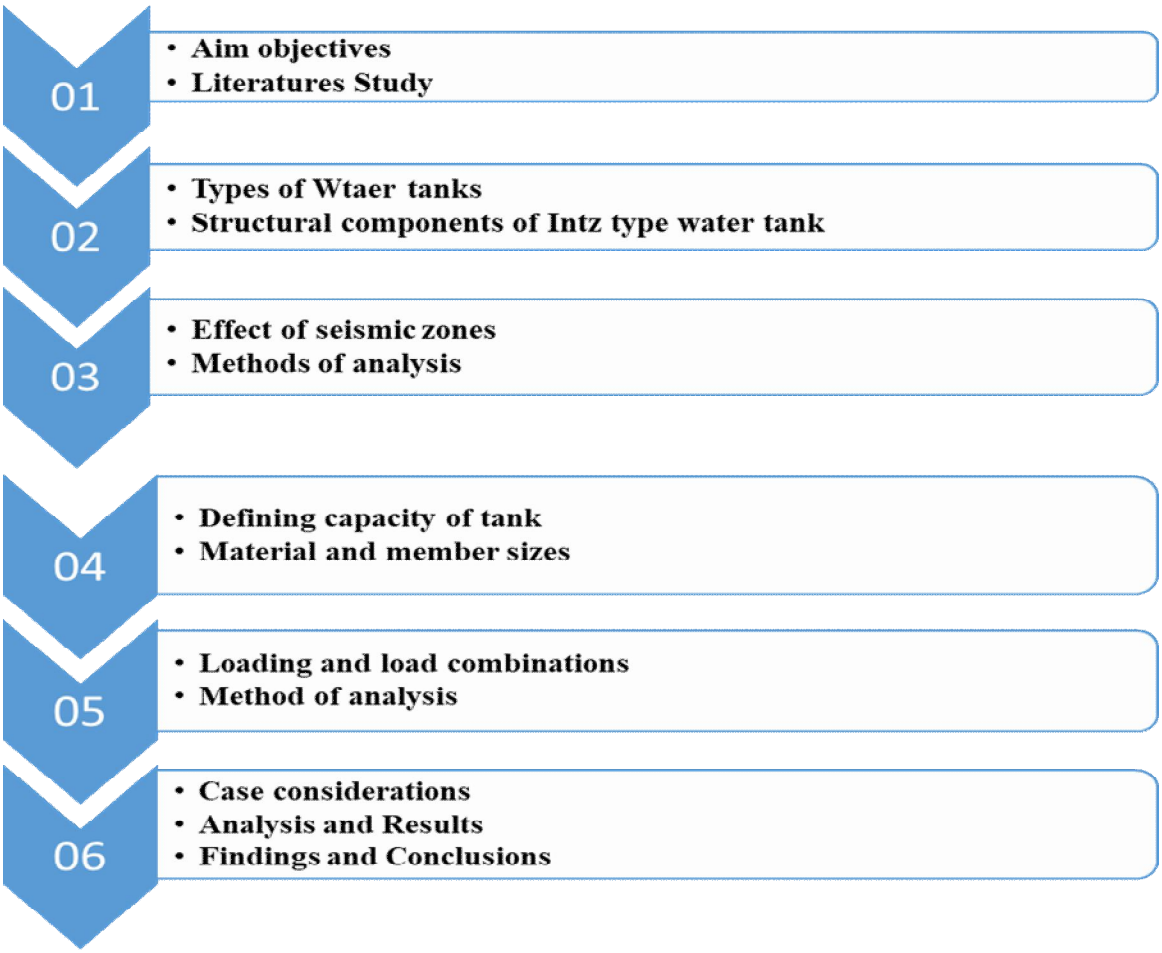
Chandana Imadabathuni *et al* 15 In this paper Intz type water tank was designed by using Stadd. Pro software. After analysis and design, it was found that, design is safe. Less reinforcement was obtained from software design as compared to manual design.

Neha. S. Vanjari *et al* 16 This paper gives an overall designing procedure of an Overhead Circular Intze tank using LIMIT STATE METHOD from IS-3370:2009. In IS-3370:2009, limit state method considering two aspects mainly limits the stress in steel and limits the cracking. After analysis it was found that design of circular overhead water tank which is more economical, simple and having a better life span with the help of IS 3370-2009 in WORKING STATE METHOD.

Ketan Ashok Akolkar *et al* 17 The primary intention of this paper was to analyze the behaviour of various staging system under different loading condition. STAAD PRO software is used to analyze the effects of different bracing on base shear, roof displacement and buckling values at different conditions like full-filled, half-filled and empty condition including the wind zone. After studying many research papers, they concluded that the wind force and earthquake forces are the major forces that affects the design of elevated water tank. In some researches it seems that INTZE type elevated water tank is more stable and can resist more forces as compared to other type of elevated water tank structure.

III.METHODOLOGY

To maintain the path of work and to obtain the efficient results with optimum efficiency it is necessary to decide the work flow in other term which is known as methodology. The detailed methodology for the present work is as follows:-



IV. CASE CONSIDERATION AND MODELLING

A. Model details

Tank is designed for capacity of 10,000,00.00 lit capacity

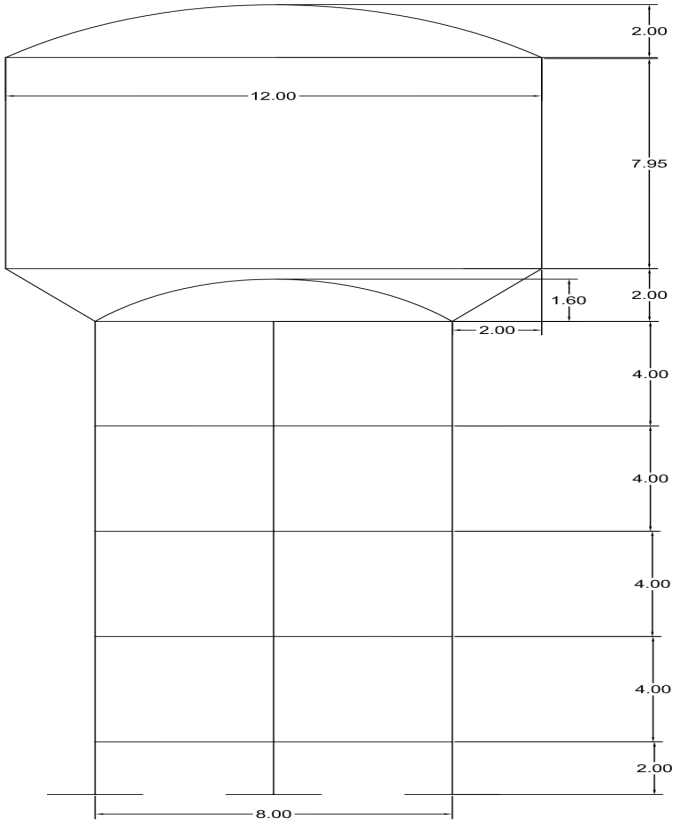


Fig 4.1 Salient dimensions of Intz tank

Table 4.1 structural parameters for models

Sr. No.	Structural Component	Value
01	Concrete	M30
02	Structural Steel	FE-500
03	Zone	II/III/IV/V
04	Response Reduction Factor	5.0 (SMRF)
05	Importance factor	1.0
06	Type of Soil	Medium Stiff
07	Size of bracing Beam	500mm x 500mm
08	Size of column	650 mm diameter
09	Thickness of Side wall	400 mm at bottom and 200mm at top
10	Thickness of Top dome	100mm
11	Thickness of Bottom dome	300mm
12	Staging Height	4.00m
13	Depth of Foundation	2.0m
14	Top Ring beam	300 mm x 300 mm
15	Bottom ring beam	1200 mm x 600 mm
16	Bottom dome beam	600 mm x 1200 mm
17	Diameter of Cylindrical wall	12.00 m

Table 4.2 Model Nomenclature

Sr. No	Model Details	Labels
01	Intz type water tank in Zone-II	I-01
02	Intz type water tank in Zone-III	I-02
03	Intz type water tank in Zone-IV	I-03
04	Intz type water tank in Zone-V	I-04

B. Loading on Tank

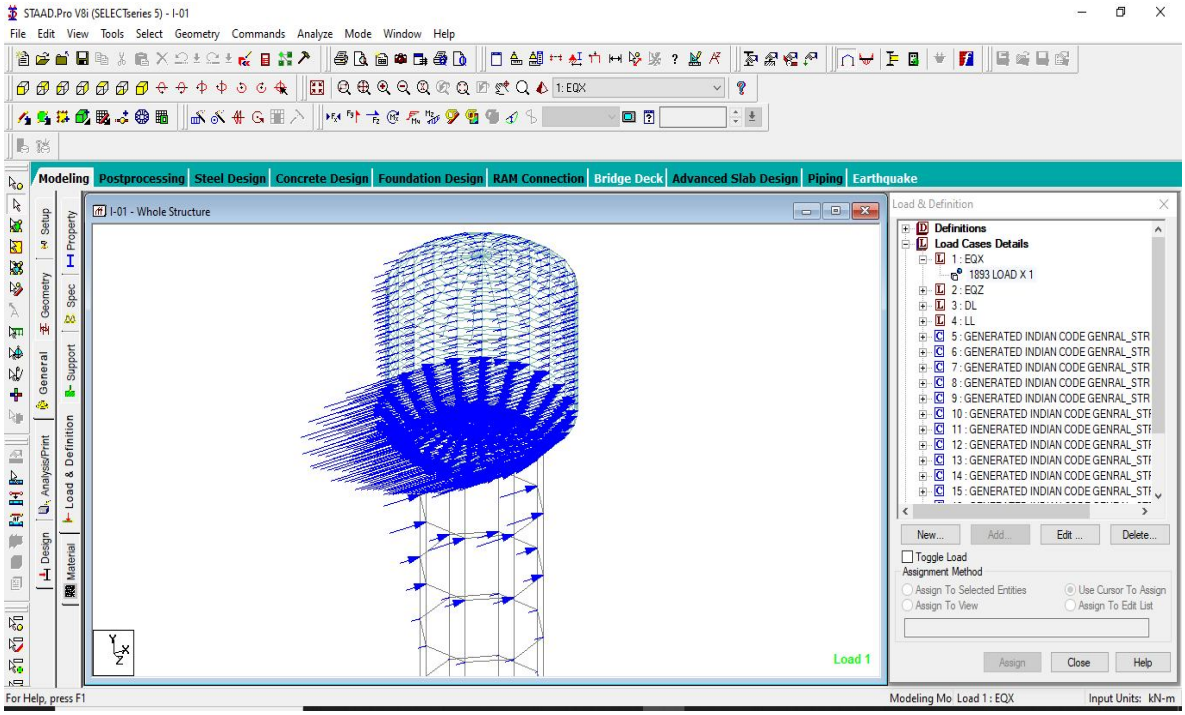


Fig 4.2 Seismic Loading in X-direction

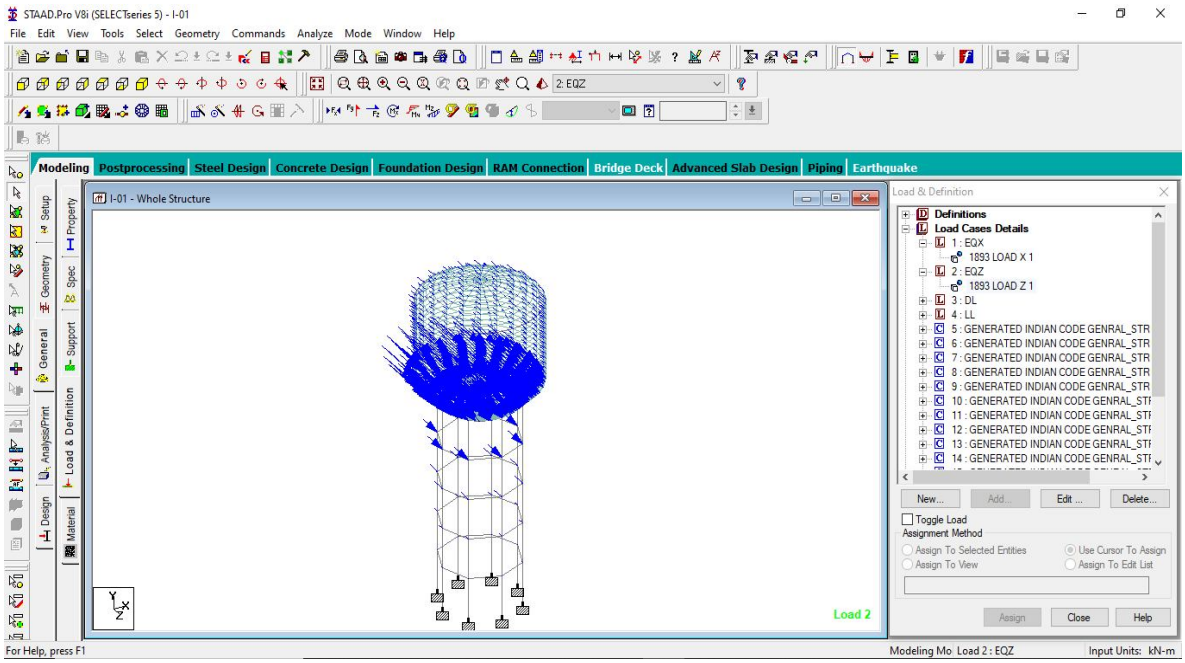


Fig 4.3 Seismic Loading in Z-direction

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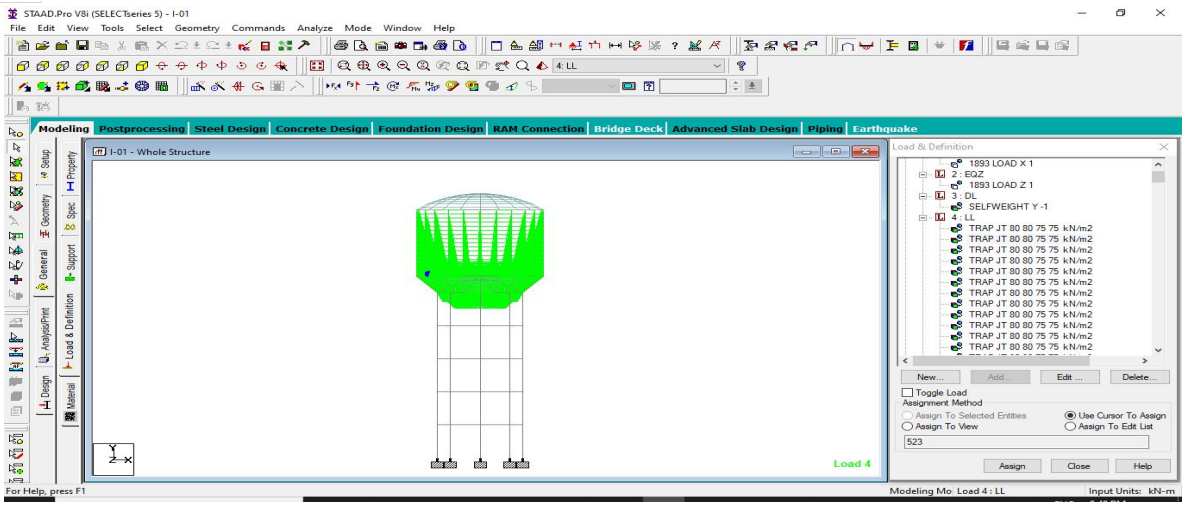


Fig 4.4 Hydrostatic Pressure on bottom dome and wall

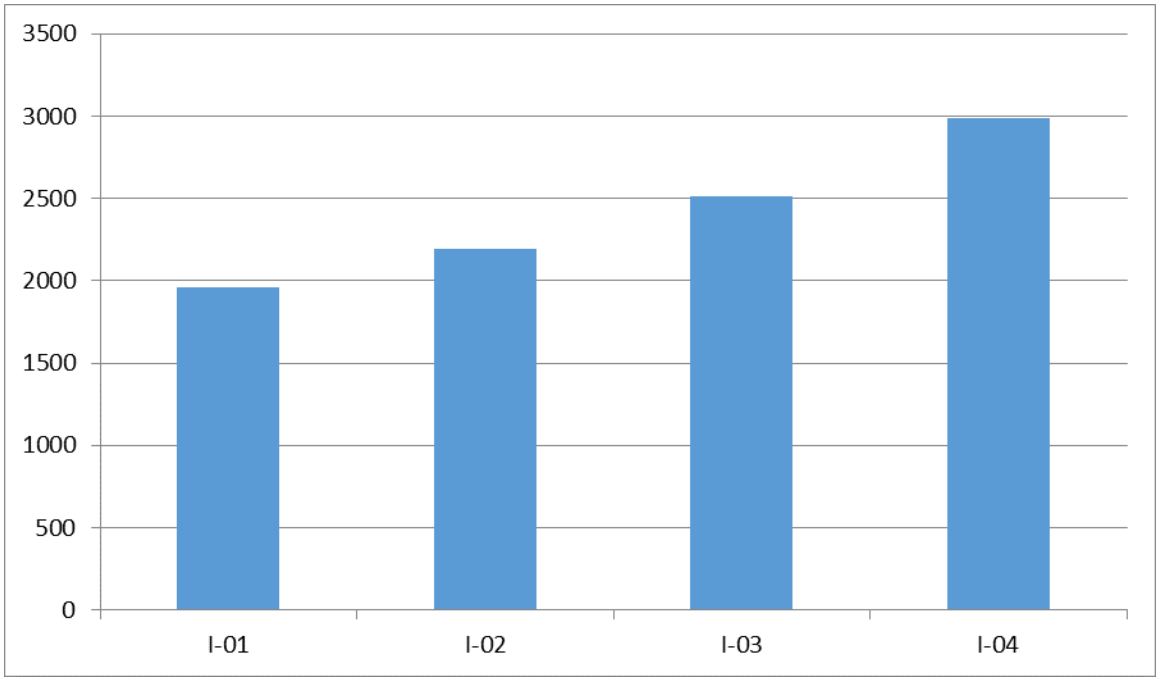
V. RESULTS AND DISCUSSIONS

A. Maximum Beam Reaction Comparison for all models

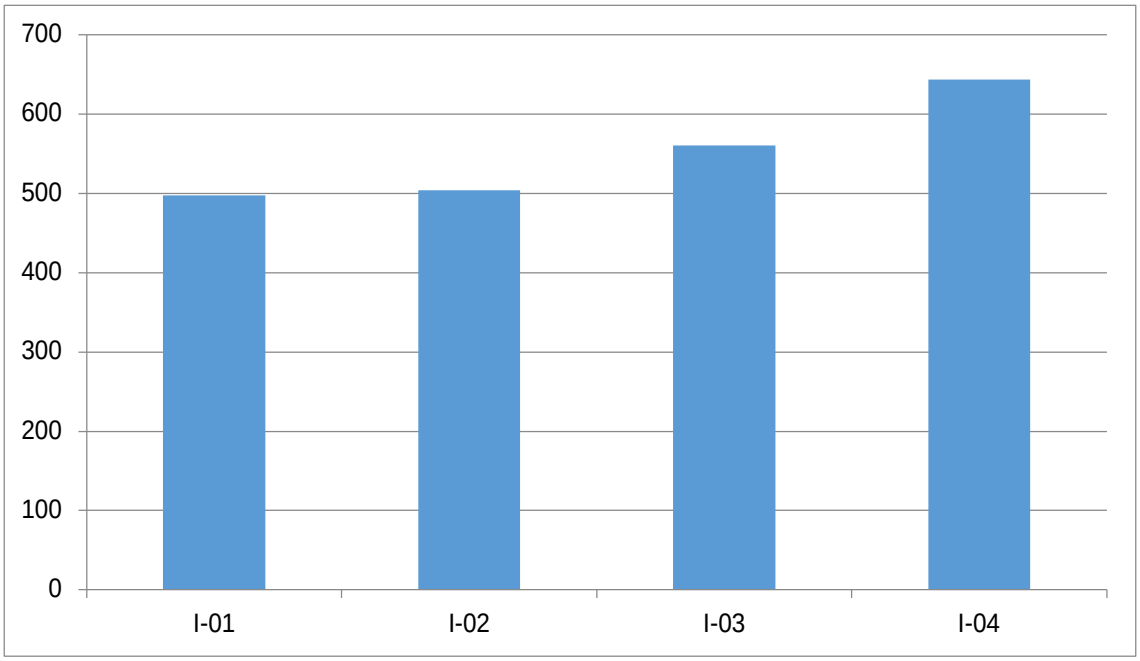
Table 5.1 below shows the various values of Maximum beam reactions comparison of all models in X, Y and Z directions

Table 5.1 Maximum Reaction comparison of beam for all models

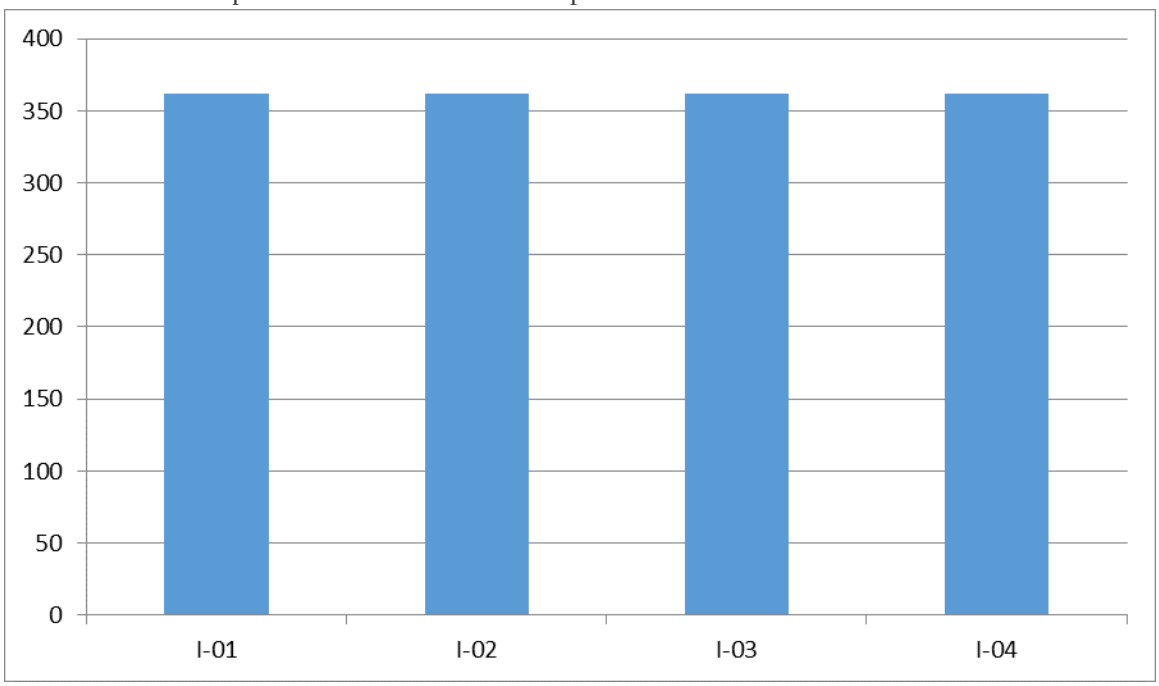
Sr No	Model No.	Reaction in X direction (KN)	Reaction in Y direction (KN)	Reaction in Z direction (KN)
01	I-01	1957.08	496.81	361.87
02	I-02	2194.53	503.98	361.87
03	I-03	2511.13	559.76	361.87
04	I-04	2986.02	643.41	361.87



Graph 5.1 Maximum Beam Reaction comparison in X- direction for all models



Graph 5.2 Maximum Reaction comparison in Y- direction for all models



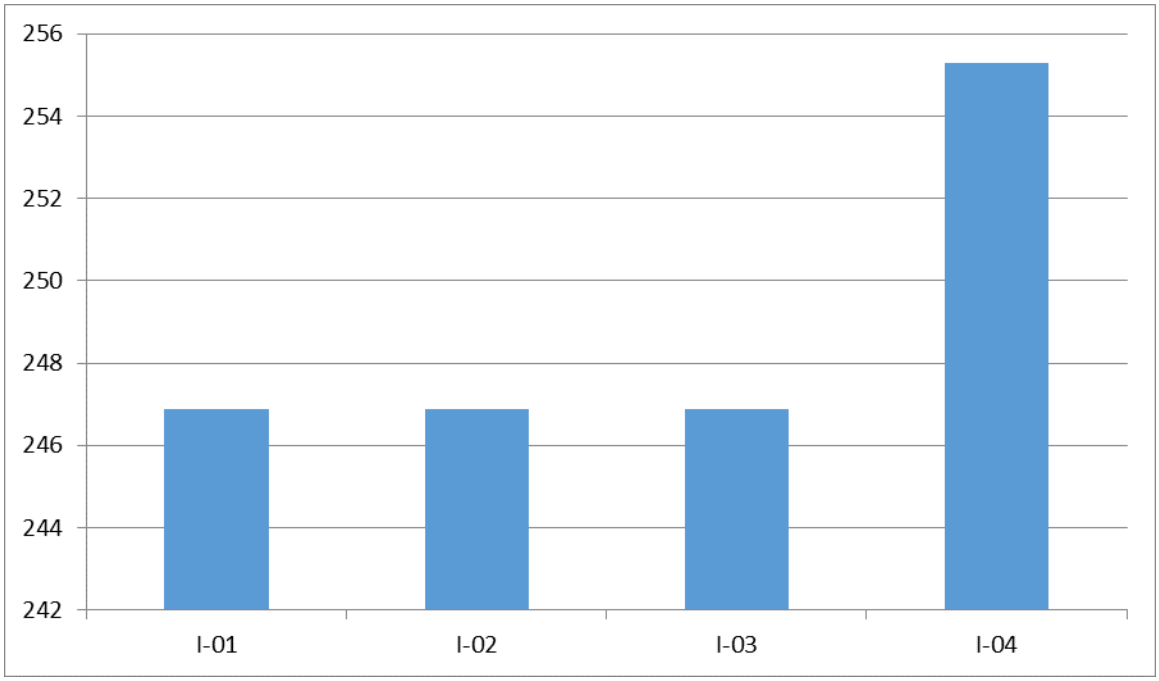
Graph 5.3 Maximum Reaction comparison in Z- direction for all models

B. Maximum Moment Comparison of Beam for all Models

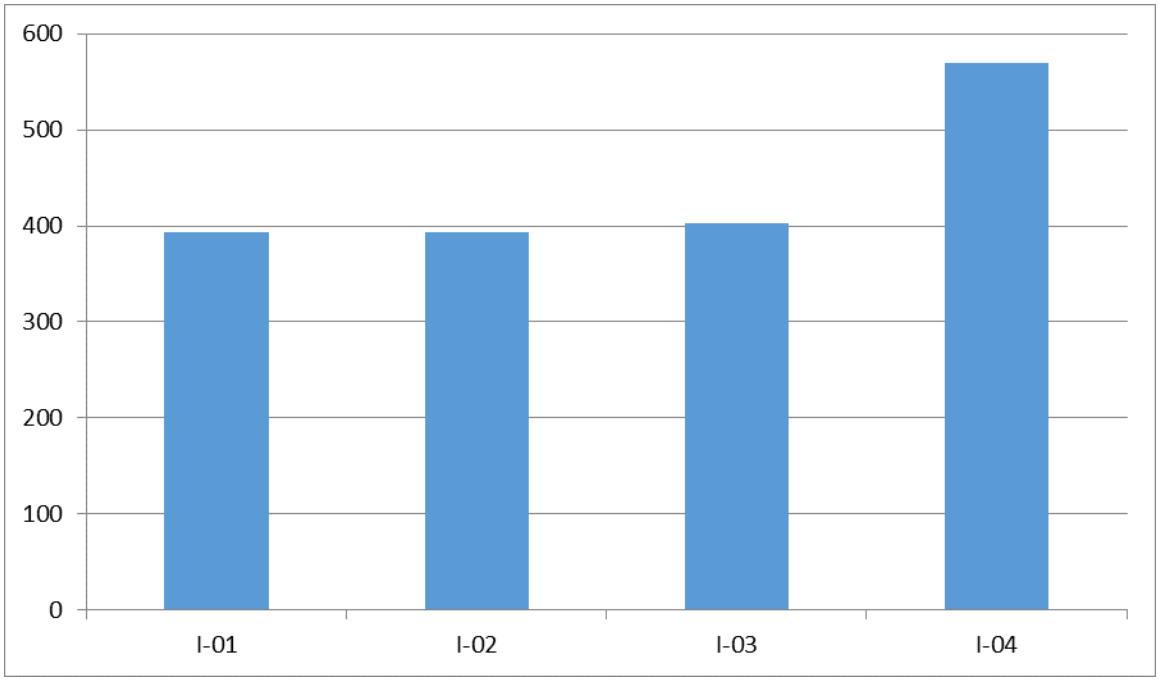
Table 5.2 below shows the various values of Maximum beam moment comparison of all models in X, Y and Z directions

Table 5.2 Maximum moment comparison of beam for all models

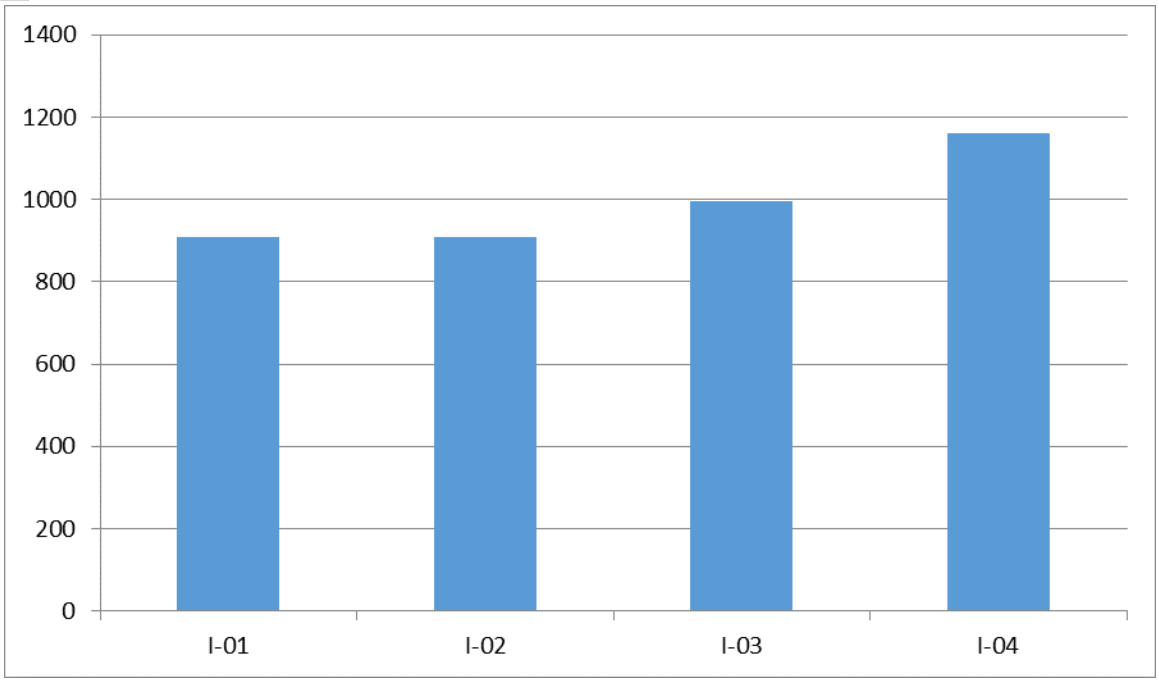
Sr No	Model No.	Moment in X direction (KN.M)	Moment in Y direction (KN.M)	Moment in Z direction (KN.M)
01	I-01	246.87	393.62	909.57
02	I-02	246.87	393.62	909.56
03	I-03	246.87	403.30	995.98
04	I-04	255.28	568.88	1162.03



Graph 5.4 Maximum Beam Moment comparison in X- direction for all models



Graph 5.5 Maximum Beam Moment comparison in Y- direction for all models



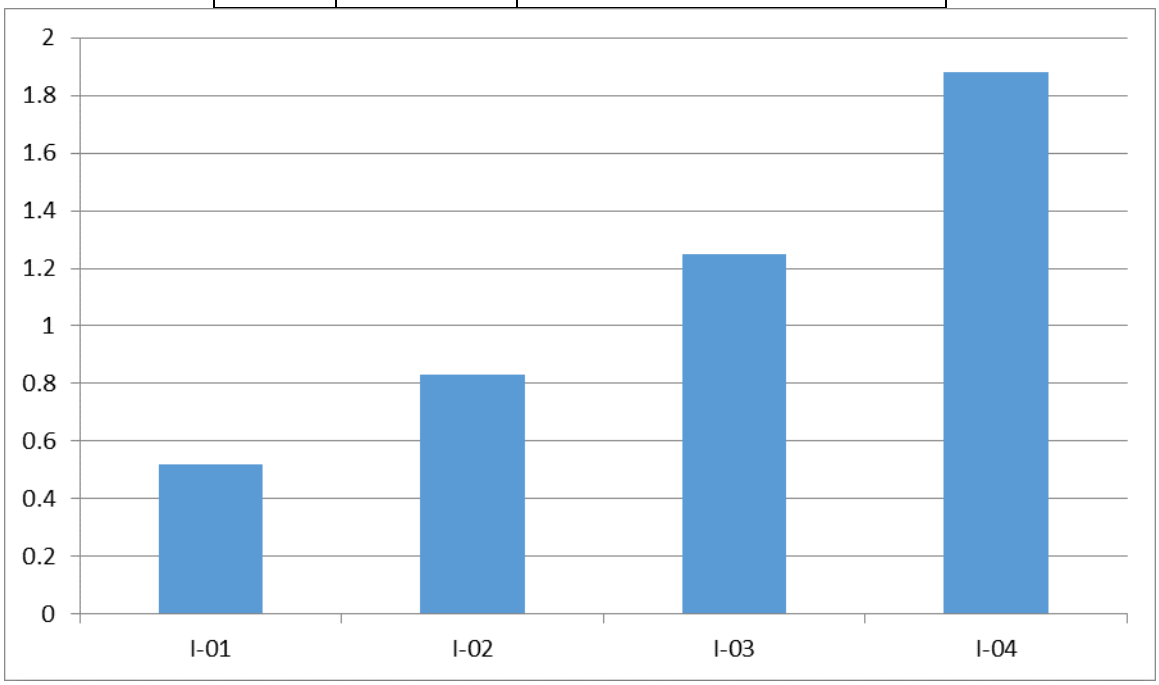
Graph 5.6 Maximum Beam Moment comparison in Z- direction for all models

C. Maximum Absolute Pressure Comparison for all models

Table 5.3 below shows the various values of Maximum absolute pressure comparison of all models.

Table 5.3 Maximum absolute pressure comparison for all models

Sr No	Model No.	Due to seismic loading (N/MM^2)
01	I-01	0.52
02	I-02	0.83
03	I-03	1.25
04	I-04	1.88



Graph 5.7 Maximum Absolute Pressure comparison for all models

VI. CONCULSIONS

1) Change in seismic severity has significant effect on the beam reaction in horizontal X direction with no change in horizontal Z-direction.

2) Changes in seismic severity does not affect the moment values of structure from zone II to Zone III but a slight change was observed between the values of Zone III and Zone IV in Horizontal X and Z direction.

3) An Increase of 261.53 % in the intensity of absolute pressure was observed as the severity changes from low to high, thus reflecting the significance of seismic severity.

VII. ACKNOWLEDGMENT

It gives me great pleasure on bringing out the report entitled.
"*Seismic analysis of Intz Tank with Change in Seismic Zones*"
No undertaking of the magnitude involved in the preparation of this project can be accomplished alone. Many have contributed till the successful acknowledge the assistance of the following individuals and would like to thank each one of them.

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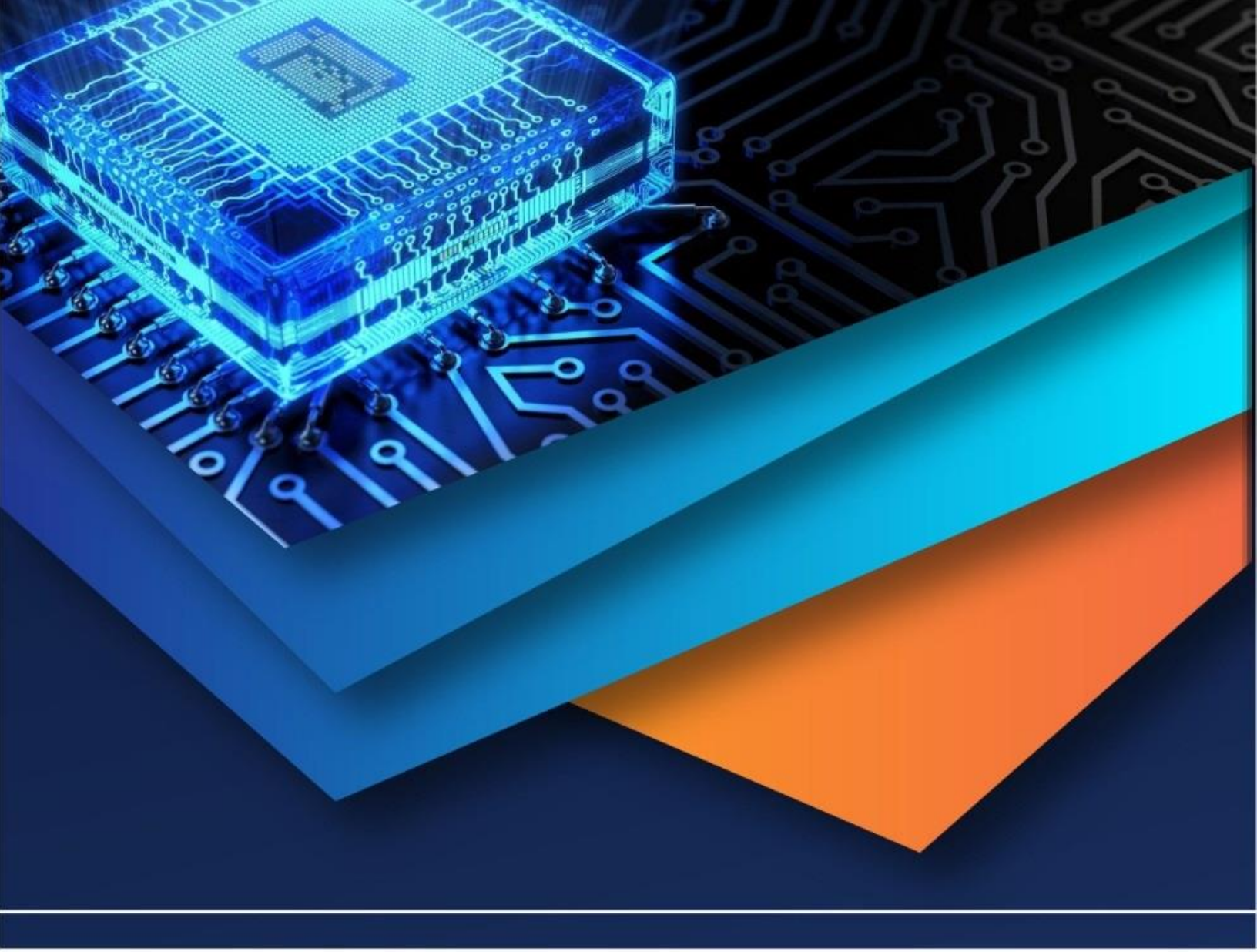

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