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RESEARCH ARTICLE

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COMPARATIVE STUDY OF SEISMIC CODES FOR PRESSURE STATIC EQUIPMENTS

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ABSTRACT

The Problem considered in this paper is of compatibility of seismic code with other seismic codes for same specifications and geometric conditions of that installation area for pressure static equipment. These tall equipments built today are self-supported i.e. they are supported at the base only. This paper presents comparative study of world's major seismic codes and common model shall be prepared to check compatibility for the particular specifications and same geometric conditions of that installation areas. Because design of the equipment effects the safety of equipment, human as well as the cost of equipment. Due to this study, we can design safe and competitive cost equipment.

Keywords- Pressure static equipment, Seismic codes, Comparative study of world's major seismic codes.

1. INTRODUCTION

For the ancient Greek, "seismos" meant an earthquake. Later on, when study of earthquakes became a science, anything seismic meant anything related to the study of the pressures in the Earth's crust. Earthquake is caused due to seismic waves. Seismic waves are the waves of energy caused by the sudden breaking of rock within the earth or an explosion.

Pressure static equipment is defined as a container with a pressure differential between inside and outside. They are the basic equipments for any fluid processing industry.

Pressure static equipments designed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII – Division I whereas Division II and III provide alternative rules for construction of pressure vessel and high pressure vessel, respectively. But these codes do not give guideline for design of equipments for temperature loading like seismic effects.

For calculating the loads and moments due to seismic on the pressure static equipment, seismic design codes are used. Various countries have developed their own seismic codes for design. Though the constants and parameters are different but basic fundamental remain same.

2. PROBLEM DEFINITION

Major countries have their own seismic codes (like India, Europe, Russia, USA etc.) but some of (like Nepal, Bhutan etc.) haven't it. Everybody does not know about the seismic codes of all areas of all countries while designing the equipment, the designer has to read whole code. This task is much time consuming. So at that time, one can get all the compiled data at same time through this study & it will helpful to safe the design at initial as well as final stage. And one can judged better compatibility

of one country code with respect to the other country code through this comparative study.

3. COMPARISION OF SEISMIC CODES

Globalization of the manufacturing and construction industry and the development of unified international codes and standards intensifies the need to better understand the underlying differences between the major international seismic loading standards.

A comprehensive comparison of the seismic loads and their effects on pressure static equipment is conducted utilizing four major international codes & standards. These codes are: IS-875 (Indian standard); ASCE-7-05 (United States of America); SP 14.13330.2011 (Federation of Russia) and Eurocode-8 (European standard).

The key area of comparison includes design seismic pressure, seismic load and other related parameters for design stability, safety and cost of the equipments.

3.1 SITE SELECTION FOR STUDY

For comparative study, Jamnagar site is selected which is located at Gujarat, India. Because largest refineries are located at Jamnagar like Reliance, Essar etc which is near to sea shore.

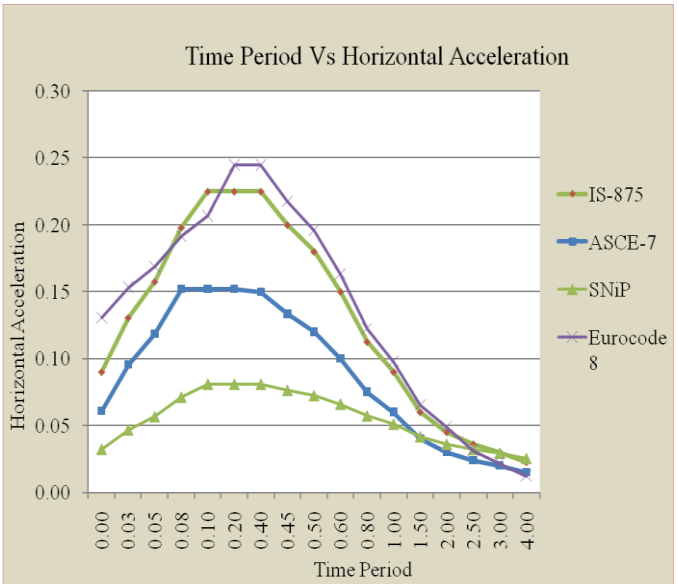
Earthquakes depend and affect the parameters of ground structure. So while calculating seismic analysis, all the parameters related to ground structure have been taken into account. Our site ground structure contains rocks or hard soils.

Also pressure static equipment containing hazardous or explosive materials which is dangerous to population. So it requires more safety.

Also the peak ground acceleration of Jamnagar site is 0.14. This data is taken based on the estimation of seismic ground motions for major cities of Gujarat which is published on "Natural Hazards and Earth System Science".

3.2 COMPARISION OF DESIGN SEISMIC PRESSURE

Based on the calculation of Design seismic horizontal acceleration of various codes, Graph of Horizontal acceleration to time period have been prepared. This graph shows the Design seismic horizontal acceleration comparision of different codes as we have taken for our study.



3.3 CONCLUSION BASED ON ABOVE GRAPH

From Seismic comparision, it is very clear that European code (Eurocode-8) gives maximum value of horizontal acceleration for any time period compare to other codes while SNiP code will give less value of horizontal acceleration compare to other codes.

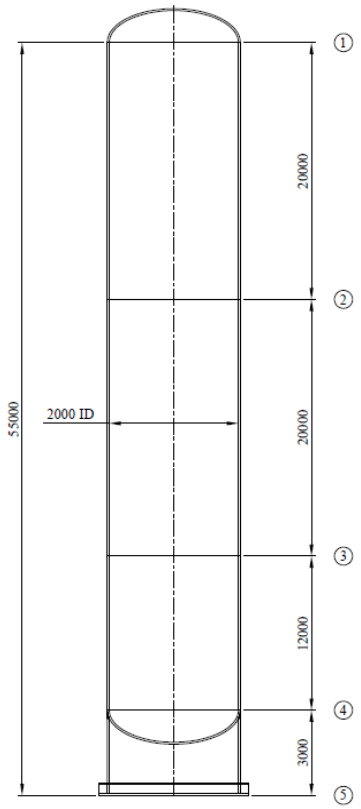
4 ANALYSIS OF TALL PROCESS COLUMN

Each of the codes contain its own set of rules for establishing the response spectrum to be used in the model analysis and for scaling the results from this analysis to allow for inelastic behavior both in terms of strength and deformation.

This complete analysis is very lengthy and subjected to errors if done by hand calculation; hence the analysis is performed by using developed spread sheet.

4.1 DESIGN DATA

As to start with this investigation, the initial practical design data have been taken. The general arrangement drawing with weight, thickness and diameter of each section is shown in below figure:



Some Other basic data:

Shell inside diameter: 2000 mm

Column overall length: 55000 mm

Design Pressure: 1 MPa

Material: SA-516 Gr. 70

Modulus of elasticity of shell material: 2.00E+05 MPa

Maximum Allowable Stress from ASME sec. II D: 138 MPa

4.2 NATURAL PERIOD OF VIBRATION FOR PROCESS COLUMN

Natural period of vibration is calculated by using Rayleigh's approximation, for calculating the seismic base shear. Based on the natural period of vibration, the horizontal seismic acceleration has been decided which is further used in calculating seismic base shear by taking other applicable parameters. Fundamental natural period of vibration has been calculated as per Annexure-2:

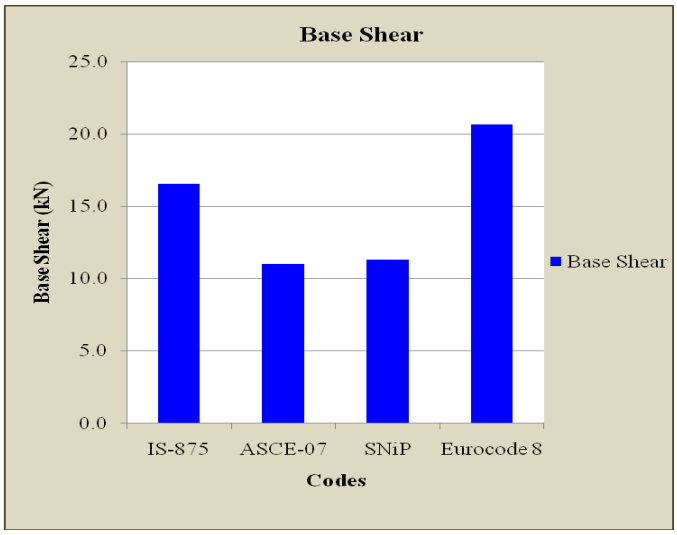
4.3 CALCULATION OF BASE SHEAR & MOMENT DUE TO SEISMIC LOAD

Base shear and moment due to seismic load are calculated as per Annexure-3 for all four codes and comparision graphs have been plotted.

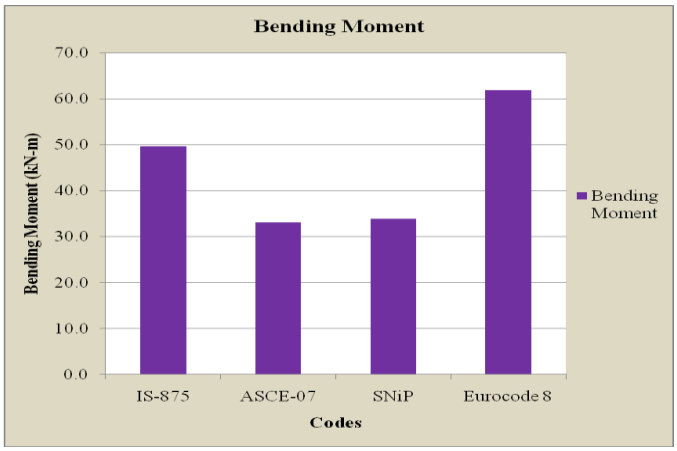
4.4 RESULTS

Based on calculation as per Annexure-3, results are obtained as under:

Code	Base Shear	Moment (kN-
IS-1893	16.5	49.6
ASCE-7-05	11.0	33.1
SP 14.13330	11.3	33.9
Eurocode-8	20.7	61.9



Code comparison of Base Shear due to Seismic



Code comparison of Bending Moment due to Seismic

5.4 CONCLUSION

From Seismic base shear and seismic moment chart, it can be concluded that value of base shear and moment will be maximum for European code (Eurocode-8). Hence European code (Eurocode-8) has stringent requirement. While the value of US code (ASCE-7) is lower side among all other codes.

Seismic pressure and stresses should be considered while designing of pressure static equipment in combined loading. Design with Eurocode 8 is more safer side than any other codes. This will ultimately result in higher thickness and hence weight.

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