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Analysis of Pressure Vessel with Different Heads: A Review

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Abstract: ***Pressure Vessel is a vessel or container used to hold pressure which is both internal and external, different from the atmospheric pressure. Pressure vessels are used in aerospace, oil and chemical industries, nuclear fields and many other industries and the study of stresses in pressure vessel is very important. Finite Element Analysis is usually employed for the design and analysis of pressure vessel with ASME standards. In this paper, we study the stresses of pressure vessels with different heads to determine the most effective pressure vessel***
Keywords : ***Pressure vessel, stress, numeriacal analysis, different heads, stresses, finite element analysis***

I. INTRODUCTION

Pressure vessels are leak proof containers designed to hold pressure substantially different from the atmospheric pressure. Pressure vessels and associated equipments are used in oil, space, chemical, nuclear power and many other industries. Pressure vessels are classified into two based on their shape i.e. cylindrical pressure vessel and spherical pressure vessel. Advantage of spherical pressure vessel over cylindrical pressure vessel is that for a given diameter and pressure, spherical pressure vessels require thin walls than cylindrical pressure vessels. Still cylindrical pressure vessels are usually preferred for construction over the spherical pressure vessels since the construction of spherical pressure vessels is more complicated and expensive. In cylindrical pressure vessel, end caps are connected to it called heads. Types of head in a cylindrical pressure vessel are dish end, hemispherical, ellipsoidal, flat etc.

II. LITERATURE REVIEW

C. K. Ramesh[1] in his paper made an elastic analysis involving partial differential equation of cylindrical pressure vessel with different heads such as ellipsoidal, torispherical and hemispherical head for the classic theory of thin shells of revolution. He attempted a step-by-step numerical integration procedure following Goldberg's earlier works involving segmentation technique. Numerical results are obtained from the general computer program FORTRAN for number of cases and for given values of poisons ratio, elastic moduli, thickness to diameter ratio. The results obtained are then compared to the values from literatures and also with the stress predicted by ASME code.

Dražan Kozak [2] presented a numerical analysis of cylindrical pressure vessel with different heads such as pressure vessel with hemispherical head and pressure vessel with semi-elliptical head. For a given material property and dimension, both pressure vessels are analysed using finite element method and von Mises stresses are determined. Based on the analytical solutions for membrane stress state of pressure vessel, numerical analysis of the pressure vessels with different head is also performed.The result obtained for hemispherical head is compared with that of the result obtained from finite element analysis. After the analysis, it was conclude that the equivalent stresses in hemispherical head is lesser than that in the semi-elliptical head. Nevertheless, in exploitation, there is much more pressure vessels with semi-elliptical heads, because manufacturing of hemispherical heads is much more complicated and expensive.

Apsara C. Gedam[3] analysed a thin cylindrical pressure vessel with different heads such as hemispherical, flat circular, standard ellipsoidal and dished end using finite element analysis. Three cases were considered in the analysis. In first case, axisymmetric models of pressure vessel with different heads were analyzed. In second case, finite element analysis of horizontal pressure vessel with saddle supports were conducted and in third case, finite element analysis of vertical pressure vessel with straight leg support were conducted. Longitudinal and circumferential stresses in all the three cases were plotted and the comparison of stresses was made for different heads of pressure vessel. Effect of supports on pressure vessel was also studied by the authors.

Shildip D. Urade [4] made a stress analysis of multilayer pressure vessel which is made of homogeneous and isotropic material and subjected to internal loading. The stress analysis of the model was carried out in finite element tool, ANSYS. The number of layers are varied for calculating the hoop stress for finite element and theoretical analysis. In multilayer pressure vessel, the layers are brought in contact by applying shrink fit between the layers of the pressure vessel. The analytical estimation of hoop stresses in

pressure vessel consisting n layers is carried out.

III. CONCLUSIONS

From the study, it is observed that, as the head of the pressure vessel changes, the stress concentration also changes for same material property and given pressure. Finite element analysis was usually employed in pressure vessel analysis and it gives a comparable result to that of the numerical analysis. Some of the researcher considered the effect of composite materials in pressure vessel analysis. The use of composite material have its own merit like reducing manufacturing cost of pressure vessel, determining optimal thickness of pressure vessel head, reducing the weight of the pressure vessel, increasing corrosive resistance of the pressure vessel[5].

IV. ACKNOWLEDGMENT

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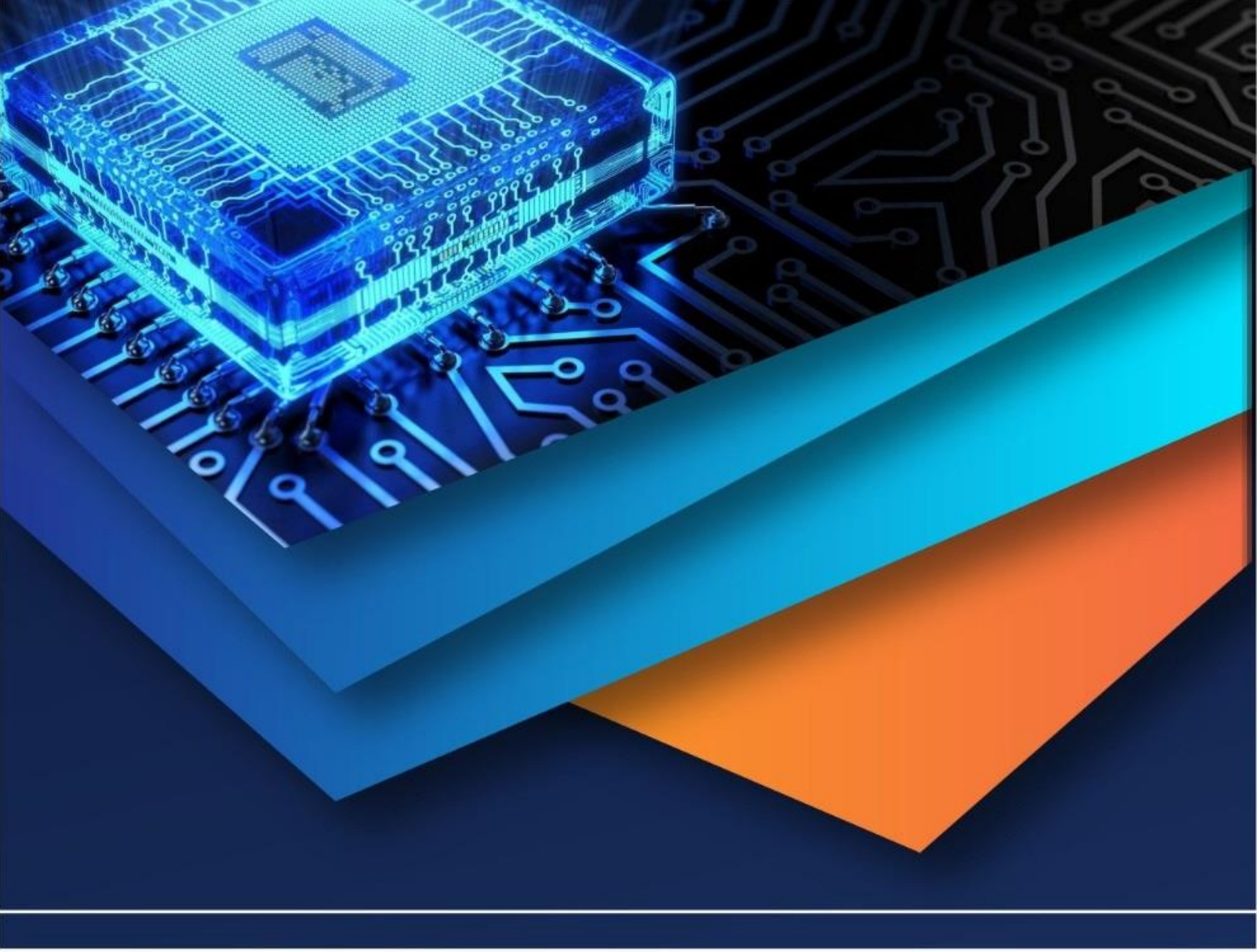

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