Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 2, Number 7; April-June, 2015 pp. 586-588

http://www.krishisanskriti.org/jbaer.html

Design and Analysis of Structural Frame of FuelDischarge System

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Abstract—*In this paper a tilting mechanism is introduced. The bowl containing the fluid will be kept on the stand designed and then the stand holding the bowl will be tilted by an external force which will be applied by a gearbox through a motor. The mechanism which is designed here is a tilting mechanism which will carry the load of the bowl as well as fluid in the bowl. This mechanism will have a frame on which the bowl will be seated and locked. The receiving bowl which will receive the fuel will be equipped with load cell below it and these load cells will measure the weight of the fluid in receiving bowl.A parametric model of structural frame has been designed and the effect of geometrical parameters on stress value arising in the structure has been examined by means of FEA.*

1. INTRODUCTION

Even before the invention of wheel, the earlier people were thinking ideas and new technologies to lift heavy loads with minimum efforts. This was the first step towards the development of material handling equipment's.Nowadays such fuels are very costly and the amount of fuel filled is dependent on the size of the container which will decide its capacity. There are a number of fuel transmission ways and mechanisms.This mechanism is designed to carry the fuel from a mixer to a vessel which is kept below the ground in which the area is filled with vacuum. The bowl containing the fluid will be kept on the stand designed and then the stand holding the bowl will be tilted by an external force which will be applied by a gearbox through a motor. Such mechanisms are being used in some fuelling station in the European and American countries. This helps in controlling the amount of fluid as well as the spillage of fluid if the operation would have been manual.

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2. LITERATURE REVIEW

The literature survey done on designing of bowl tilting fixture. This mainly focuses on the work done by the various people in their research. Almost every primary research study begins with a review of the literature. Its main goals are to present the current study within the body of literature and to provide context for the particular reader.Thepurpose of this topic is to give an overview of the state of knowledge on the bowl tilting fixture design. The issues covered are presented roughly in chronological order and relate to theoretical studies related to design of Bowl tilting fixture.

[1]Karl Buhler of Bbc Brown Boveri& Company Limited, 1981have introduced the furnace tilting device assembly with the help of hydraulic system. It consists of a furnace supported by rolling rockers. The rolling rockers will reduce the friction in the mechanism. The apparatus includes one hydraulic cylinder connected to a spout side of the furnace, one hydraulic cylinder connected to a back side of the furnace. [2]LimbasiyaVimal, K M Patel and Chintan Mehta[2010]have published a paper on "Design and analysis of fixture for heavy shell tilting". They developed Heavy shell tilting fixture used for tilting the shell from horizontal to vertical and vice versa. Design and analysis of heavy shell tilting fixture for weight capacity 110 MT has been carried out in this work. They also explained the need of reducing cost of components by reducing final weight of the component. [3] Anil R. Sahu, Prof. Dr. S. B. Jaju and Prof. N. K. Mandavgadehave done FEM analysis of manually operated tilting mechanism of three furrows reversible plough. [4] Berote, Johan, van Poelgeest, Auguste, Darling, Jos, Edge, Kevin, Plummer, Andrew have investigated dynamics of three-wheeled tilting vehicles. [5]ShaileshS.Pachbhai, LaukikP.Raut] have published paper on 'Review of design fixture' in this paper they proved that efficient and reliable fixture design by modern CAE and CAD can reduce cycle time required for loading and unloading of part hence significant improvement can be assured in overall efficiency. [6] Edmund F. Schulze, Omaha, Nebrhave

invented the mechanism for controllably tilting l5adles used in foundry furnaces and the like where molten metal is poured intomolds. The main objective of the invention was to provide a Simplified, highly efficient ladle tilting ‘mechanism which is steady and positive in its operation.

3. DESIGNING OF THE TILTING FIXTURE

The tilting fixture is a part of the whole assembly of the fuel handling system. There are many parts arranged in a sequential order for the transportation of this fluid in the required manner. The tilting fixture is a fuel handling device in which the bowls are filled with the fluids are place on this tilting fixture. The main purpose of the tilting fixture is to feed the receiving hopper with the fuel in a controlled manner.

The fuel transportation system can be best depicted by showing a line diagram and illustrating some of its parts.

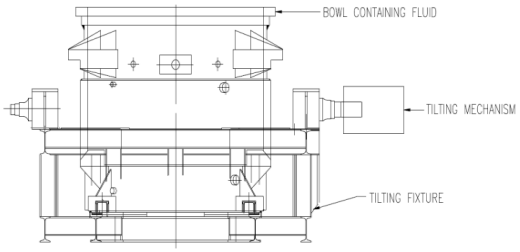

Fig. 1: Fuel transportation system

4. RESEARCH METHODOLOGY

The work is intended to do the structural analysis of the bowl tilting frame and the working of its mechanism. A rough model is drawn in CAD. Then this is modelled in Solid works software by use of three Dimensional commands. The whole model is then assigned with a material properties and is taken to a neutral format for analysis purpose. The neutral format is IGES which is the Initial Graphics exchange software. This makes the model to be compatible to any Finite element analysis software like Pro E Mechanica, UG NASTRAN, Hyper mesh,Ansys, Cosmos works etc.

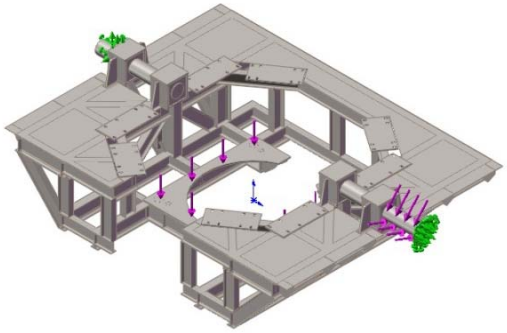

Fig. 2: Tilting Fixture Model

The model is then taken through the stages of FEA and is then the results of FEA are depicted. In the Finite Element analysis the model is exploded in a number of discrete elements which have a FCC, HCC, tetrahedron elements. The elements have different corners which are termed as nodes .The degree of freedom of the FCC, HCC and tetrahedron elements.On the basis of degrees of freedom the matrix of equation is made. These equations are then solved by the Rayleigh’s Method or Gauss Elimination theorem.

There are many softwares for three dimensional analysis like

1. Ansys
2. Nastran
3. Pro E Mechanica
4. Hypermesh
5. Cosmos Works
6. Catia Stress Analysis

We can do the analysis in any of these software’s. For transferring the model information a native format for reading the file is given in all modelling software’s. This format is accepted by any of the three dimensional software’s.The format used for transfer is IGES. IGES refers to the Initial Graphics Exchange Software. This IGES file is then opened in any of the above mentioned software. Once the file is imported due to the data loss certain surface do not merge completely. In such a situation the model is to be knitted. The analysis tools which we have used for our analysis of the tilting frame is Cosmos Works . Cosmos works is an analysis software developed by Dassault system.Solidworks uses CosmosWorks as a analysis tool. The model is thus just moved to analysis part.

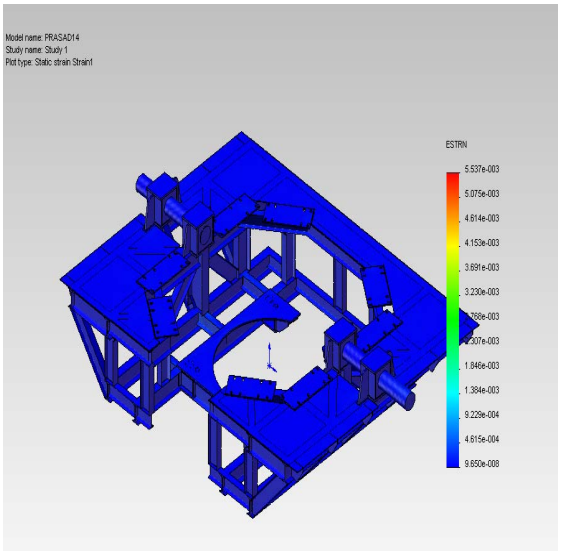

Fig. 3: Stress analysis of model in solid works

In the analysis part the following are the steps to be followed. The material of construction is assigned to the model. The material of construction is selected from the library is **AISI 1020**. We have considered the different type of loads, torque 500 N-m and force 120000 N. Following figure shows the stresses on the model after doing stress analysis in solid works

5. CONCLUSION

From the fringe pattern generated in analysis result it is clear that the maximum stresses are in the range of around 80 to 100 N/mm^2. Te highest stress shown in the fringe pattern occurs at a local point wherein the loading pattern is considered.In a stress analysis result a fringe pattern colour spread over a area more than 70 to 80% is in blue colour where the value ranges from 80 to 100 n/mm^2. We had considered a material whose yield strength is 351 N/mm^2. This plate is made of IS2062 whose yield is about 240 N/mm^2. Factor of safety in Structural codes is about 1.5 for such structures considering impact. Hence the allowable yield is

AllowableYeild = 240 /1.5= 160N/mm^2.

In The tilting frame structure on the maximum loading stress generated is 80 to 100 N/mm^2

Hence structure is safe.

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