INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume3, Issue2)

Available online at www.ijariit.com

Design and Analysis of Baseplate of Centrifugal Pump

Rushabh Shah, Akash Sutariya, Tejas

Students of Mechanical Engineering in Vadodara Institute of Technology

Abstract: Baseplates comes in as many configuration, design and styles as there are pump models. No matter the design ,the main purpose of the baseplate is to mount the pump and driver together, while maintaining the shaft alignment between the two pieces of equipment .The primary objective of this paper is to observe different types of baseplates based on the standards specified by American petroleum institute in API610.The theoretical study related to selection of baseplate structural members carried out by finite element analysis using ANSYS to check the structural stiffness of the baseplate

Keyword: Baseplates, Pumps, FEA, API, ANSYS, Structural Stiffness.

1. INTRODUCTION

Pumps are hydraulic device used to move fluids such as liquids, gases and slurries. It converts mechanical energy into hydraulic energy. They are used widely in different industries like petrochemical , textile, natural gas and chemical based on application .For petrochemical industry compliance of API610 specified by American petroleum institute is compulsory[1]. The pump baseplates are designed as 'grouted type'. The cement grouting overcomes the effects of uneven foundation. The loads from the pump pedestal are transferred to baseplate and finally to grout [6].The grouting helps to reduce the vibration, deflection and noise of the whole pumping unit. Along with the concrete grouting. The foundation bolts secure the baseplate firmly to ensure vibration free pump performance [4].When the pump needs to be installed on the FPSO ,the baseplate needs to be designed as 'non-grouted type'[7].

2. METHODOLOGY

STEP 1: Preparation of CAD model

For preparation of CAD model of baseplate after finalizing the specific pump is done in software like Pro E, Creo, etc.

STEP 2: Finite Element analysis

The finite element analysis (FEA) is the method used for solving practical problem on engineering. The number of mathematical equations and calculation are usually so large that arriving on a solution without utilizing software becomes practically impossible.

Finite element analysis is done using ANSYS for FEA,it is necessary to perform meshing of the baseplate model .

STEP 3: Stress analysis

Properties of the selected material and boundary conditions for it are applied to perform the stress analysis.

TABLE 1: STIFFNESS TEST ACCEPTANCE CRITERIA

Basplate intended for grouting		Baseplate not intended for grouting	
Loading condition	Pump shaft displacement µm in mm	Pump shaft displacement µm in mm	Direction
Myc	175 (0.007)	125(0.005)	+Z
Mzc	75 (0.003)	50(0.002)	-Y

Myc and Mzc the sum of the allowable suction and discharge nozzle moments

Myc = (My)suction + (My)discharge

Mzc = (Mz)suction + (Mz)discharge

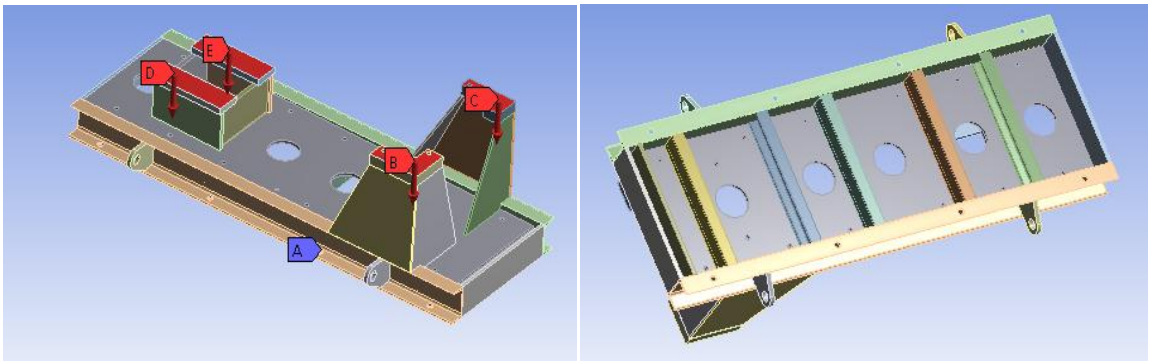

Fig -1 Design of baseplate of centrifugal pump

3. LITERATURE REVIW

D.V. Yadav and S.J. Modki, (2015)[2] studied various pump models to select the most demanded baseplate .They used pareto analysis for it. Pareto analysis is a formal technique useful where many possible courses of action are available. CAD model prepared in Pro E was analysed in finite element analysis. By making modification in existing baseplate in thickness and removed of extra channels but fufilling the requirement of API standards, they were able to cut weight by 21% and thus significant reduction in cost.

Pramod H. Kadam and Sanjay B. Belkar,(2016)[3] carried out their work for pump baseplates in FPSO applications. Structural stiffness analysis of the baseplate is performed using finite element analysis in ANSYS. Also, ANSYS is used for modification and measure the shaft end displacement under different moment loads. They concluded that shaft end displacement results of both FEA and experimental analysis are within the allowable limits and pass API610 stiffness criteria.

Greg Towsley, (2009)[4] explains about various configuration designs, styles and requirements of the baseplate. Brief explanation for soleplates, cast iron baseplate, fabricated steel baseplate and fibre glass reinforced polyester (FRP) is given. Baseplate specifications are taken from technical professional societies like ANSI B73.1M-2001,ANSI/HI1.3.5-200,and API610.

Mayuri M. Choundikar and V.J.Khot,(2015)[5] worked for base frame optimization of multistage pump and shaft deflection analysis as per API standards. In this dissertation work, they determined that the factor of safety of existing base frame is very high

leading to higher costs. For analysis they used FEA in ANSYS 14. After modifications they concluded bringing factor of safety near about market value and reducing the weight causes deduction in cost.

Vorsha N. Bhairat and Prof. Dr.M.R.Phate,(2015)[8] studied linear static and modal analysis of pump base frame. They carried experimental and finite element analysis of base frame for rigidity. They proposed experimental design of layout for the baseframe.

Abhay C. Suke and B.P. Londhe, (2015)[9] studied base frame optimization of multistage centrifugal pump by finite element analysis. They carried out analysis to determine the induced stresses and the deflections at various locations on existing frame. From the experimental and FEA results they deduced that after reducing the weight of the frame, the stiffness of the frame is much good and deformation is nearer to the existing baseframe.

Aditi A. Godse and Prof. M.K.Wasekar, (2015)[10] studied the design and analysis of skid frame module for it's strength and stiffness. They utilized Pro-E for the modeling and HYPERMESH for analysis purpose. They analyzed the frame in three steps. First,pre-procesing involving modeling ,meshing etc. second step for solution of the problem ,involving analysis of the result plotting different parameters.

Todd R. Monroe and Kermit L. Palmer [6] described pre filled equipment baseplate & how to get a superior equipment installation for less money. They presented a new void-free baseplate installation technique that cuts installation costs of over 30 percent. They discussed about convention grouting methods, field installation methods for pregrouted baseplates and field installation cost.

CONCLUSION

The analysis of the current design of the baseplates proves to be the safety optimizing the design, making changes in the thickness of the various parts of the baseplate and still maintaining the baseplate to according the safety standard helps to reducethe weight and ultimately the cost of baseplate. Thus, bringing down the cost of the pump and baseplate assembly.

REFERENCES

[1] API610, “Centrifugal pumps for petroleum,petrochemical and Natural gas industries” 12th edition ,American Petroleum Institute,Washington D.C,2010.

[2] D.V.Yadav and S.J.Madki, “Design analysis & optimization of baseplate of centrifugal pump system”,volume 4,issue 9,september 2015.

[3] Pramod H. Kadam and Sanjay B. Belkar , “Baseplate structural stiffness analysis of API BB5 type centrifugal pump for FPSO application”, vol.5 Issue 09,september-2016.

[4] Greg Towsley, “Foundations” White paper published in grundfos pumps journal,2009.

[5] Mayuri M. Choundikar and V.J.Khot, “ Base frame optimization of multistage pump and shaft deflection analysis as per API standards”. Choundikar,4(11):november,2015.

[6] Todd R. Moroe and Kermit Palmer, “ prefilled equipment baseplate – How to get a superior equipment installation foer less Money”, nineteenth intenational pump users sympoium ,2002.

[7] David sear and suriyanty pushpadewi, “Critical pumps o FPSO”, pump engineer magazine ,2004.

[8] Varsha N. Bhairat and Prof. Dr. M.R. Phate, “Linear static nd modal analysis of pump base frame”,IERJ special issue 2 pag 305-307,2015, ISSN 2395-1621.

[9] Abhay C. Suke , B.P. londhe, “ Base frame optimization of multistage centrifugal pump by finite element analysis “, IERJ special issue 2 page 1925-1995,2015, ISSN 2395-1621.

[10] Aditi A. Godse, Prof. M.K.Wasekar, “design and analysis of skid frame module for its strength and stiffness”, August 2015,volume 3,issue 8,ISSN 2349-4476.

