

# Linear static & modal analysis of pump base frame

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## ABSTRACT

The paper presents the study of performance characteristics of the support frame structures, according to changes in their connections, considering the loads caused by rotating machinery work has been done and compared with the limits of displacements of the structures. In this paper the experimental and Finite Element Analysis of Base Frame for Rigidity is been carried out. The test is carried out to check the conformance of the existing design. Based on these results, best feasible design solution is proposed and validated experimentally.

*Keywords*— Frame Structure, Experimental & Finite Analysis, Rigidity

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## I.INTRODUCTION

The centrifugal pump is the most used pump type in the world. The principle is simple, well-described and thoroughly tested, and the pump is robust, effective and relatively inexpensive to produce. There is a wide range of variations based on the principle of the centrifugal pump and consisting of the same basic hydraulic parts. It has two main components, A rotating component & a stationary component. The basic purpose of a centrifugal pump shaft is to transmit the torques\ encountered when starting and during operation while supporting the impeller and other rotating parts. It must do this job with a deflection less than the minimum clearance between the rotating and stationary parts. When failures occur in pumps and their associated systems, they generally fall into one of four categories: fracture, fatigue, rubbing wear, or leakage. Fracture occurs due to excessive loading, for example from higher than expected pressure or nozzle loading beyond recommended level.

## III.OBJECTIVES

- Modal analysis of the base frame to get the mode points and natural frequencies of the structure.

- Linear static analysis of the base frame by applying valid boundary conditions.
- Optimization of model for better nodal deformation.

## II.LITERATURE REVIEW

To understand the background of the project, following research paper dealing with the topic have been studied.

**1.Rafael Marin Ferro, Walnório Graça Ferreira**

**& Adenilcia Fernanda Grobério Calenzani** : This paper conducts a performance check of the support frame structures, according to changes in their connections, considering the loads caused by

rotating machinery and compared with the limits of displacements of the structures established by standards of equipment and structures. It conducts a study establishing a practical application of dynamic loads caused by rotating equipment on supports with different connections structures using computational models with STRAP software. Applying loads of rotating machines and viewing which support base has the best performance in relation structure versus dynamic loading in accordance with connections.

**2. Mayuri Maruti Choundikar, 2Prof. V. J. Khot, 3Prof. P. P. Malage** : Studied existing model of base frame and

shaft deflection analysis method Theoretical calculation for various parts of base Frame was done. Shaft deflection was carried out analytically and also by using CAD / CAE software's like CATIA. Then this configuration was simulated in HYPERWORKS / ANSYS. Optimized model was obtained finally.

**3. Michael Singer and Torsten Johne :** This study contains recommendations of rigorous pump casing design techniques. A comparison of different design methods is made. The most sophisticated of these is then described in detail. Finally, a list of design checks by which most centrifugal pump casings might be evaluated is given.

**4.Maki M. Onari,Paul A. Boyadjis :** when the vibration is due to a resonance of a structural natural frequency or an unexpected geometry change such as looseness or cracking, it becomes more complicated . The ODS is a powerful troubleshooting tool to facilitate and visually understand most vibration problems in any type of turbomachine. Detailed vibration data should be taken when performing an ODS, capturing all flange-to-flange interface areas between assembly parts, flexible components.

**5.Tony DeMatteo:** Resonance testing and Operational Deflection Shape studies are useful tools for analyzing vibration problems. When resonance is identified as the problem, a Modal

Survey is necessary to identify all of the natural frequencies and evaluate each mode shape. Without knowing the mode shape, it is impossible to know how to correct the

resonance. Resonance is best corrected by using FEA tools to evaluate the effectiveness of potential structural modifications. To date, the modification has not been implemented on Pump.

**6.David Yemboini Kader Toguyeni, Stanislas Sanfo and Fati Zoma:** The present study focuses on the design and choice of materials (steels S355 and 45SCD6) of a chassis of stirred tank. This work highlights the difficulty of modeling a real

problem and the effects of thermo-elastic coupling. The simulations show that the values of the Von Mises equivalent stress are mainly determined by the rate of filling of the tank. The work has permitted to identify potential vibration problems during the design stage.

**7.Dr. Barun Chakrabarti, Rajeev R. Singhai, S. V. Herwadkar:** This paper demonstrates how machine-structure interaction problems can seriously affect the operational reliability of large centrifugal pumps in critical Refinery service. It is essential to ensure the dynamic compatibility of a machine vis-à-vis its support system. The best solution, is to adopt a proactive engineering methodology, as outlined above, when the plant and equipment are being designed.

#### CONCLUDING REMARK:

- From the literature survey, it is clear that the base frame & vibration related issues in pumps have been a topic of interest for many researchers.
- Linear static analysis can be done to find the value of allowable stress in the structure.
- Modal analysis can be done in order to find out the values of natural frequency, damping ratio n mode shapes.
- Then with these safe values the pump base frame design can be modified.

#### PROBLEM STATEMENT:

The life of the mechanical seal is directly related to shaft movement. Vibration can cause carbon face chipping and seal face opening. Pump components can be damaged by vibration. Pump and motor hold down bolts can become loose. . Fracture occurs due to excessive loading.

#### PROPOSED WORK:

This is suggested to carry out "Linear static & modal analysis of Pump Base Frame", The proposed work is divided into different stages.

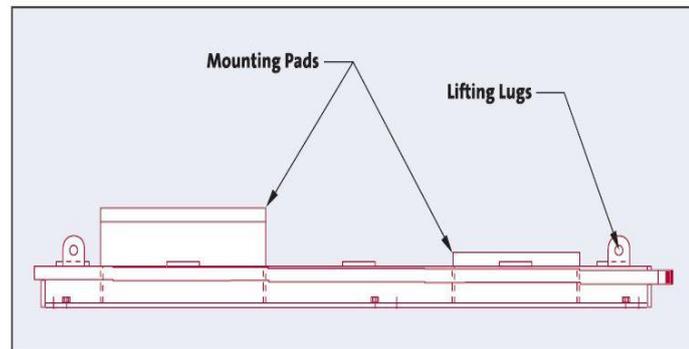
- Information gathering and Literature survey
- Finalization of aims and objectives
- Analysis of model
- Development of experimental setup and instrumentation
- Experimentation
- Critical analysis of model.
- Final report writing and Publication.

#### METHODOLOGY:

The following methodology is proposed for the work completion:

- CAD Model Generation
- Determination of loads or boundary conditions
- Meshing and Application of boundary conditions
- Solving and Analysis
- Fabrication of pump base frame
- Experimentation
- Validation and Conclusion

#### IV. PROPOSED EXPERIMENTAL DESIGN OF LAYOUT



Design of the base frame

#### EXPECTED OUTCOME:

- Design and manufacturing of Pump base frame
- Analysis and experimentation of pump base frame
- Validation of the results and final conclusion
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