Linear Static Analysis and Design Optimization of Boiler Platform Using CAE

Anjappa S.B
Asst professor, Department of Mechanical Engineering, Sree Chaitanya College of Engineering, Karimnagar, Telangana India.

Dr. G Venkateshwaralu
Professor & HOD Mechanical Engineering Department, Sree Chaitanya College of Engineering, Karimnagar, Telangana India.

Abstract – Boiler Platform is one of the major components of the boiler assembly. This will be mounted on the structure support of boiler through mounting arms, for the purpose of maintenance, readings and calibration of boiler. As the Boiler platform experience the vibrations, Static Loads and temperature it becomes imperative that analysis is carried out thoroughly, mainly the Linear static stress analysis due the application of static load before fabrication and installation. Static stress analysis or linear static analysis had been part of design strategy for many years on platforms and other supporting structures in all forms of applications. This determines load carrying capacity of the platform by means of displacements, strains, stresses, and reaction forces under the effect of applied loads and boundary conditions. Here the Computer Aided engineering (CAE) and Finite element analysis (FEA) will be used. In present work linear static load carrying behavior of the boiler platform is evaluated and its load carrying capacity will be improved by approximately 20% with design optimization keeping the material as constant using FEA.

Index Terms – Boiler Platform, Rigid Support, Holder pipes, CAE.

1. INTRODUCTION

Boiler Platform is one of the major components of the boiler assembly. This will be mounted on the structure support of boiler through mounting arms, for the purpose of maintenance, readings and calibration of boiler. As the Boiler platform experience the vibrations, Static Loads and temperature it becomes imperative that analysis is carried out thoroughly, mainly the Linear static stress analysis due the application of static load before fabrication and installation

The Boiler Maintenance Work Platform is the ideal solution for power plant boiler maintenance, providing a robust support base for scaffolding and access systems to maintain and repair the boiler nose and upper furnace areas.

The broad aim of this project was to develop a Boiler Maintenance Platform for the inspection and repair of water-walls in the boiler furnace of a major power generating plant.

2. METHODOLOGY

- Familiarize with the tools which are required to perform FE analysis: pre –processing, solving and post-processing.
- Study to arrive at an optimal mesh size.
- Preprocessing (modeling) of platform.
- Analyzing supporting systems and loads.
- Modal analysis (Eigen Value).
- Linear Static analyses
- Post processing
- Design evaluation based on the linear static results.
- Evaluate with design modifications, if required.
- Report findings and learning.

2.1. BOUNDARY CONDITION

In order to correctly use a linear finite element program, the boundary conditions must not be dependent on the load application. The figure below illustrates an example where this is not true. A structure placed on an elastic foundation might tend to physically separate under the load, resulting in the formation of a gap. This gap is dependent on the load and therefore behaves as non- linear.

CAD Data and Properties of Platform

- Steel manufactured
- Welding done using steel material
- Assembly of 23 parts
- Volume=3.552e+08mm3
- Surface are=2.196e+07mm2

3. GEOMETRY MODEL-1

Components

- Consists of two C hinge Member and two rest member for Load carrying.

- C Frame to transfer the load to carrying member.
- Plat from rest welded to the frame. Holder pipes connected on frame.

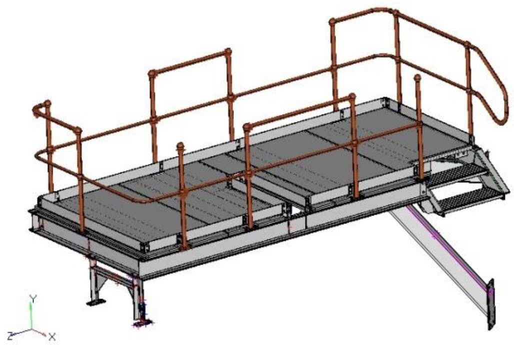

Fig.1 Isometric View of Platform

3.1. Geometry Model -2

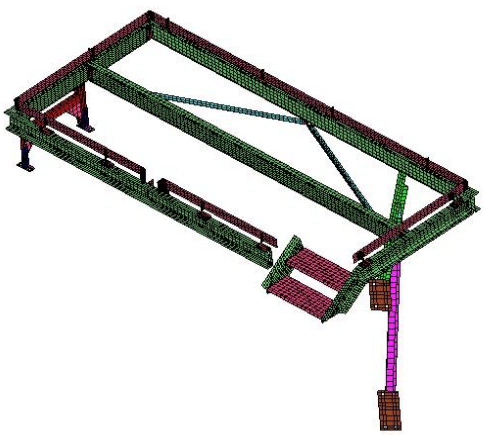

Fig.2 Individually Meshed Member or Components.

3.2. Geometry Model-3

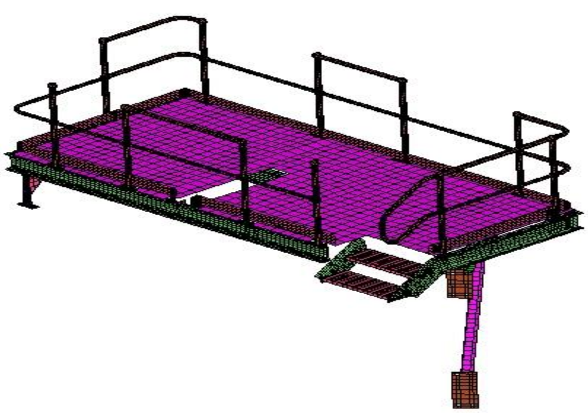

Fig .3 Fully Meshed Model

4. RESULTS AND DISCUSSIONS

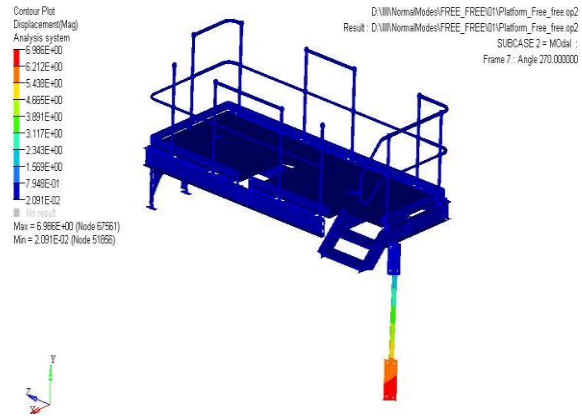

Fig 4 Free Model Analysis

Mode	Natural Frequency(Hz)
1	0
2	0
3	1.34e-03
4	3.04e-03
5	5.734e-03
6	1.43e-02
7	6.01e+00
8	1.o7e+01

Table 1: Natural frequencies of first 08 modes of Base Line Model Constraints and Loading on Platform to perform Linear Static Analysis:

Iteration 01: Base Line Model with 500Kg of Loading Mass

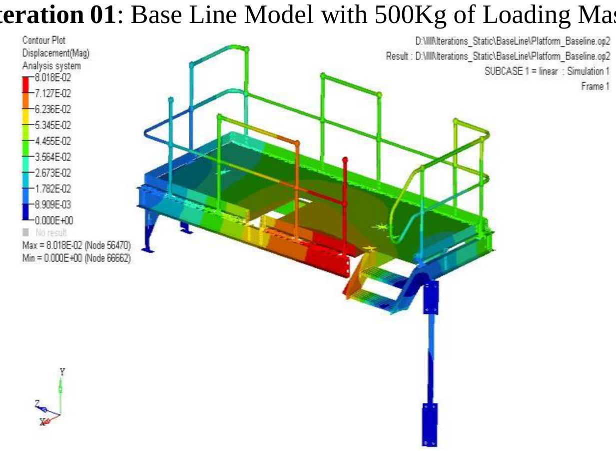

Fig .5 Maximum deflection (Displacement) of 8mm (Highlighted in Red).

Iteration 02

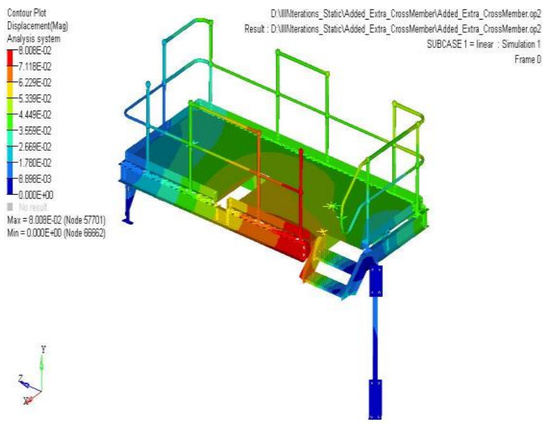

Fig.6: Observation: With Added cross member the deflection is 8.0mm which is same as base line.

Iteration 03

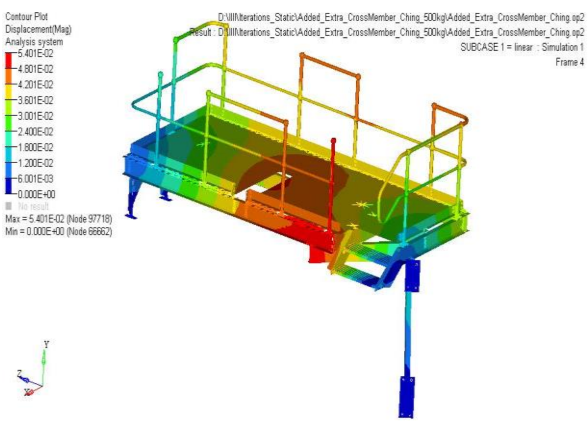

Fig 7: With Cross Member connecting to Rigid Structure the displacement is 5.4mm

Iteration 04

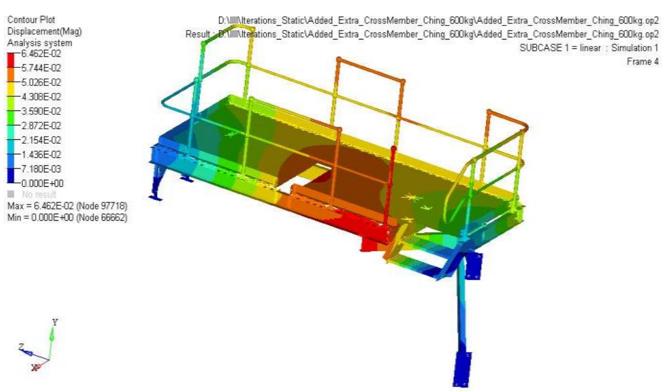

Fig 8: Applying 600kg of mass the deflection is 6.4mm.Which is well under the limit

Tabulated results of all the experimental run for respective design modifications

M0del	Deflection (mm)
Baseline Model	8.0
Added Cross Member Connecting Lateral Member	8.0
Extra Cross Member connecting Rigid Support Extra Cross Member	5.4
connecting Rigid Support with 600kg of mass	6.4

Table 2: Tabulated Results of All Run

5. CONCLUSION

After the static stiffness analysis, we clearly observe that the unsupported region adjacent to stairs has maximum deflection of 8.0mm.Hence we introduced a cross member which connects to the rigid support and observed the improvement of load carrying capacity more than 20% i.e. from 8.0mm to 5.4mm.

REFERENCES

[1] Allen S.B. Tam, John W.H. Price, Alan Beveridge, (2007) "A maintenance optimization framework in application to optimize power station boiler pressure parts maintenance", Journal of Quality in Maintenance Engineering, Vol. 13 Iss: 4, pp.364 – 384.
[2] Brad Buecker, "Basics of Boiler and Design," Pennwell Books, 2002.
[3] "Computerized Information Technology," http://www. cituk online.com/a catalog/Thermal-Power-Plants .html
[4] P.K. Nag, "Engineering Thermodynamics," 3rd Edition, Tata Mc Graw Hill.

Authors

The author is a post-graduate in Thermal Engineering from visvesvaraya Technological University Karnataka India, Author is currently working as an assistant professor in the Department of Mechanical Engineering, sree Chaitanya College of engineering Telangana India.

The author is a PhD in NIT Warangal Telangana India, Author is currently working as a professor and HOD Department of Mechanical Engineering, sree Chaitanya College of engineering Telangana India.