ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.5

Design Modifications of Rear Panel of Hearth Layer Screening Machine of Sinter Plant in Visakhapatnam Steel Plant

Jaga Janardhan[1], Dr.S.Adinarayana[2]
M.Tech Student[1], Professor & HOD[2]
Department of Mechanical Engineering
MVGR College of Engineering, India

Abstract:
In Visakhapatnam Steel Plant (VSP) a new sinter machine-3 of 408 square meters and rated capacity of 456 tons / hour was commissioned as a part of expansion of production capacity. In the process of sinter making the hot sinter machine is fed to the single roller crusher and fed to the rotary cooler. The sinter from the rotary cooler is conveyed to hearth screen to separate +10mm size from fines. During performance frequent breakdown problems in the conveyor handling return sinter and the hearth layer screen are observed. The problems like chute jamming, conveyor belt cut were faced regularly. In the hearth layer screen the bottom flange of the rear panel walls at the charging end of the return fines screen at sinter machine-3 is found torn from the bottom in the middle of the width of the screen. The maintenance engineers tried to arrest the damage by welding the patch plate over the crack and has repaired the cracks and given additional stiffening channels and angles to the rear panel of the screen. The problem is seen to persist even after welding. In order to increase the life of the rear panel plate we have considered placing a channel in between the stiffeners of a Indian Standard Medium Channel (ISMC) 200 with dimensions 200×75×6.2 mm. The present work deals with the design and analysis of rear panel plate of hearth layer screen, the modeling of the rear panel plate has been done using creo parametric and finite element analysis has been carried out using ANSYS and further optimization of the rear panel plate has been done for a new design to erect the formation of necking regions to the rear panel plate and also the cost analysis to estimate the cost saved by the suggestion and implementation of the design modifications.

Keywords: channel, cost analysis, hearth layer screen, rear panel, sinter, stiffening channels.

I. INTRODUCTION

Sintering is a process of agglomerating iron ore fines into a porous mass due to incipient caused by the combustion of fuel present within the mass of the ore particles. In the process of sinter making, the hot sinter from the sinter machine is fed to the single roller crusher and fed to the rotary cooler.The sinter from the rotary cooler is conveyed to hearth screen to separate +10mm size from fines.The fines are also known as return sinter, which is re-circulated and put back into sinter making process. When doing any kind of beam design using structural design software will greatly ease the entire process of calculating stresses. There are several different engineering design software packages available for beams, columns, or foundation design. Structure Calculation, Energy calculation, Beam Check and the most important thing which has been considered for industrial check up for beams is the von-misses stresses as they deal with the yield point of the material which has been considered when doing any kind of beam design.

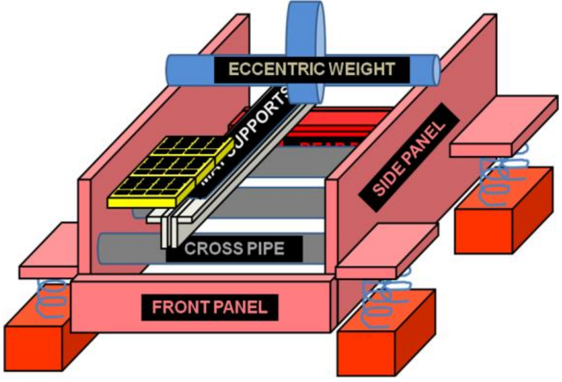


Figure.1.4- Construction of Hearth Layer Screen

II. LITERATURE REVIEW

While Roll Pressing dealt exclusively with aspects of pressure agglomeration in roller presses, Size Enlargement by Agglomeration covered the entire operation and some related fields from a fundamental view point.

It described in much detail the newly evolving science of the natural phenomenon "Agglomeration", which has been used by living creatures, including humans and modern mankind, for thousands of years, and the technologies that were derived from it. In contrast, Agglomeration Processes–Phenomena, Technologies, Equipment was trying to offer a complete, up-to date compilation of the various agglomeration techniques and, in general terms only, their applications.

To that end, in addition to introducing the properties of agglomerates and the specific characteristics of the different technologies, descriptions of equipment and their special features for particular uses as well as engineering know-how and information on specific peripheral equipment were the main topic of the book. Emphasis was on up-to-date practical knowledge, not theory.

III. PROBLEM IDENTIFICATION

The present work details the design and analysis of rear panel plate of hearth layer screen, the modeling of the rear panel plate has been done using creo parametric and finite element analysis has been carried out using ANSYS and further optimization of the rear panel plate has been done for a new design to erect the formation of necking regions to the rear panel plate.

IV. MODELING OF REAR PANEL PLATE

The modeling of the Rear Panel Plate is done in Creo Parametric 2.0.

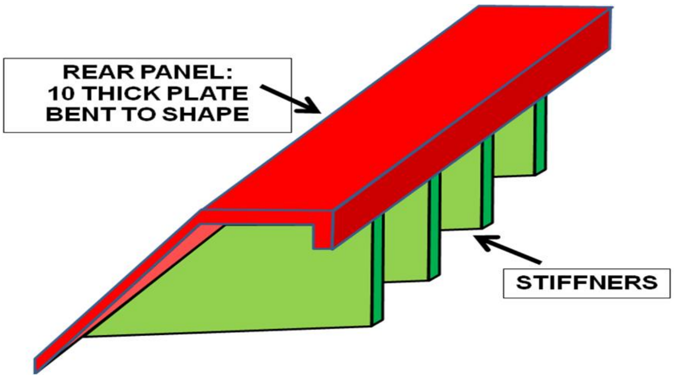


Figure .2. The rear panel plate before the modification

Introduction to Creo Parametric:

Creo Parametric is a computer graphics system for modeling various mechanical designs and for performing related design and manufacturing operations. The system uses a 3D solid modeling system as the core, and applies the feature-based, parametric modeling method. In short, Creo Parametric is a feature-based, parametric solid modeling system with many extended design and manufacturing applications. Creo Parametric was designed to begin where the design engineer begins with features and design criteria. Creo Parametric's cascading menus flow in an intuitive manner, logical choices and pre-selecting most common options, in addition to short menu descriptions and full on-line help. Produce engineering drawings of parts and assemblies created in Creo Parametric. These drawings are fully associative with the 3D solid model. When a dimension in the drawing is changed the dimension of the associated 3D model(s) will be automatically updated, and vice versa. The following diagrams shows the drawing specifications and modelling of rear panel plate of hearth layer screen in sinter plant using creo Parametric 2.0.

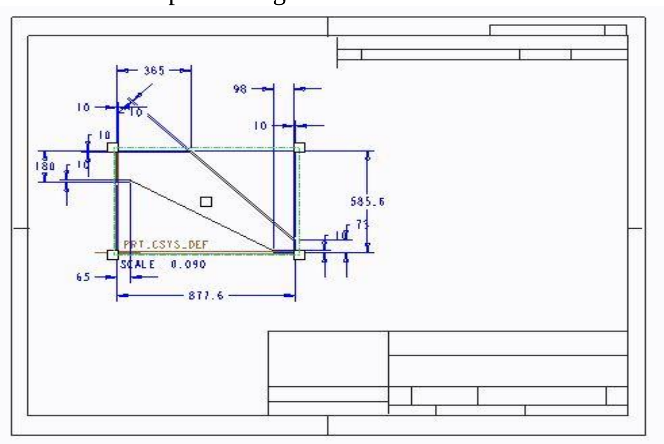


Figure 3 Drawing Specifications of the Rear panel plate after modification

1) Click on File→New→Select the system of units in mm
2) Enter the file name as Rear panel plate.
3) Draw a rear panel plate with dimensions 65,180,365,725,73,98 mm distance as shown in figure3
4) Draw the rear panel plate with 10mm thickness.
5) Draw the stiffener with 780mm and by using pattern option the number of stiffeners are drawn into 8.
6) Extrude the rear panel plate with 3650mm.

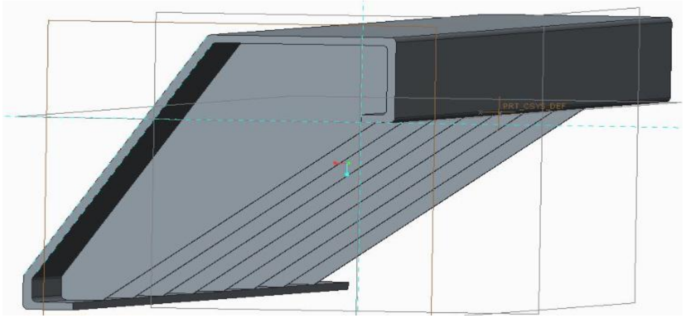


Figure .4. Model of Rear panel plate before modification

1) Click on File→New→Select the system of units in mm
2) Enter the file name as Rear panel plate .
3) Draw a rear panel plate with dimensions 65,180,365,725,73,98 mm distance as shown in figure
4) Draw the rear panel plate with 10mm thickness.
5) Draw the stiffener with 780mm and by using pattern option the number of stiffeners are drawn into 8.
6) Extrude the rear panel plate with 3650mm.
7) Draw a c-channel of dimensions 200 × 75 × 6.2 mm is inserted between the stiffeners to the selected surface. The rear panel plate after modificaion as shown in figure 6

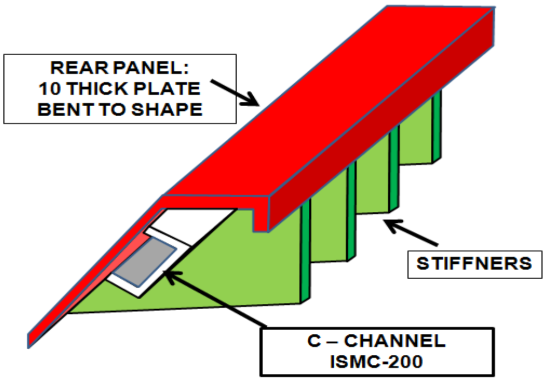
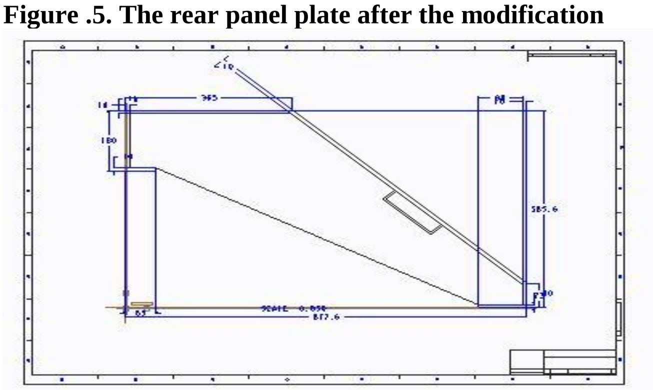


Figure .5. The rear panel plate after the modification



Figur.6. Drawing Specifications of the Rear panel plate after modification

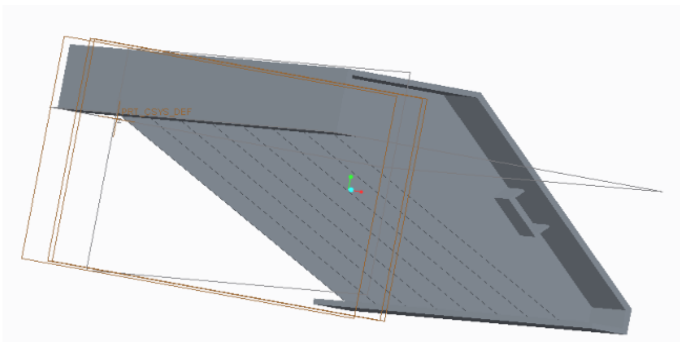


Figure. 7. Model of Rear panel plate after modification

V. TESTING AND VALIDATION BY ANSYS

1. Introduction

The finite element method is numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems. Because of its diversity and flexibility as an analysis tool, it is receiving much attention in engineering schools and industries. In more and more engineering situations today, we find that it is necessary to obtain approximate solutions to problems rather than exact closed form solution. The finite element method has become a powerful tool for the numerical solutions of a wide range of engineering problems. It has developed simultaneously with the increasing use of the high-speed electronic digital computers and with the growing emphasis on numerical methods for engineering analysis. This method started as a generalization of the structural idea to some problems of elastic continuum problem, started in terms of different equations or as an extrinum problem.

2. Geometric Model

Modeling of Geometry was performed in creo parametric and it exported for analysis. Then it was importing into the ANSYS WORKBENCH. The imported geometry as shown in Fig. 7.1.

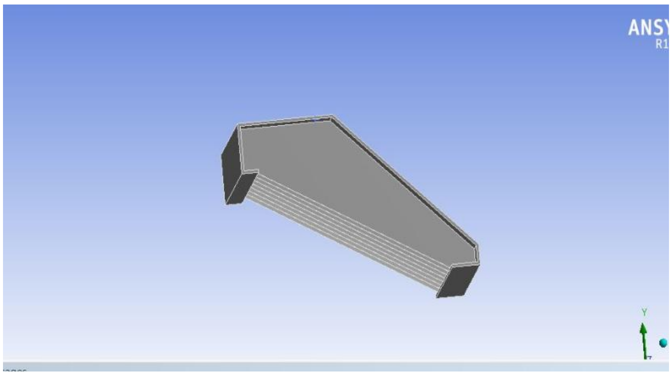


Figure.8. Geometry of the rear panel plate of hearth layer screen before modification

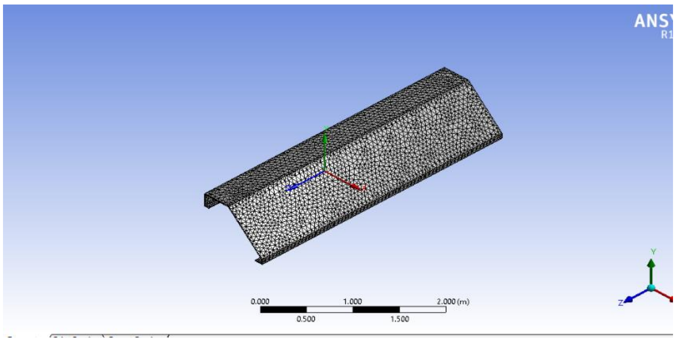


Figure .9. Meshed model for the rear panel plate of hearth layer screen before modification

3.Material Properties

TABLE .1. SHOWS PHYSICAL PROPERTIES

Outline of Schematic A2: Engineering Data				
	A	B	C	D
1	Contents of Engineering Data		Source	Description
2	Material			
3	Structural Steel			Fatigue Data at zero mean stress comes from 1998 ASME BPV Code, Section 8, Div 2, Table 5-110.1
*	Click here to add a new material			

The material of the rear panel plate of hearth layer screen is structural steel as shown in table 1

4. Boundary Conditions

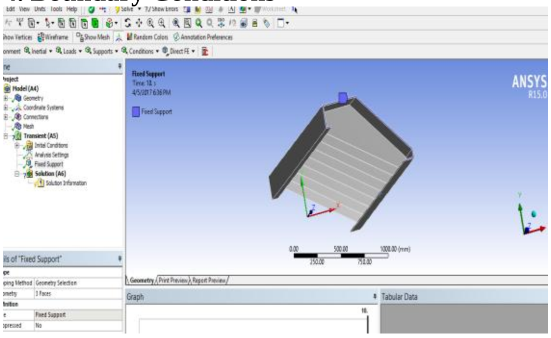


Figure.10. Fixed supports for the rear panel plate of hearth layer screen before modification

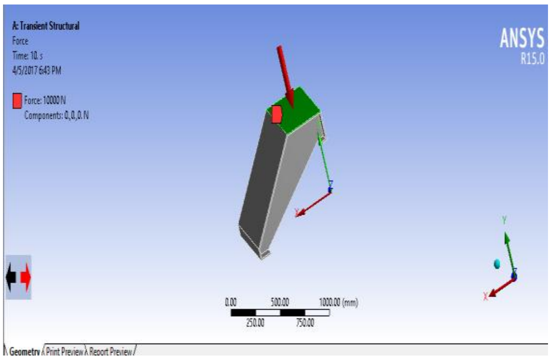


Figure.11. Force for the rear panel plate of hearth layer screen before modification

The boundary conditions of rear panel plate of hearth layer screen is as follows

1) 3 fixed supports on 3 faces of a plate has taken 2 at the ends of the rear panel plate, 1 at the bottom of the rear panel plate.

2) Load (Force) is taken at the top of the rear panel plate of hearth layer screen.

3) The impact load is acting downwards on the top of the rear panel plate of hearth layer screen.

5. Procedure of transient analysis

By considering the given flow rate as 350Tons/Hour we have converted the given feed rate to load with respect to time , as to take over the transient analysis in ANSYS. By converting the given feed rate to a time period of analysis, we get the impact load which is transient on the beam, by conversion we get 1000 N for the first sec and by assuming the load to get increased for the next sec ,2000 N for the second sec and similarly increasing the load for a few number of steps like up to 10 sub steps and solving the solution .we observe a huge change in the stresses in the rear panel plate before modification and after the modification.

6. Analysis of Rear panel plate without Channel

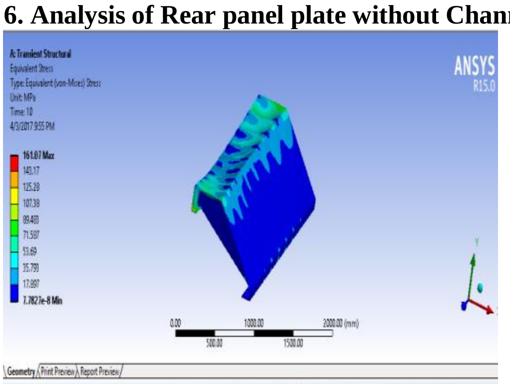


Figure.12. Von-mises stresses before modification

We can see that the stress formation which is high at the edges of the plate, forms the necking regions which are the cause. The maximum and minimum Equivalent von-mises stresses are 161.07 and 7.7827e-8 MPa as shown in figur12.

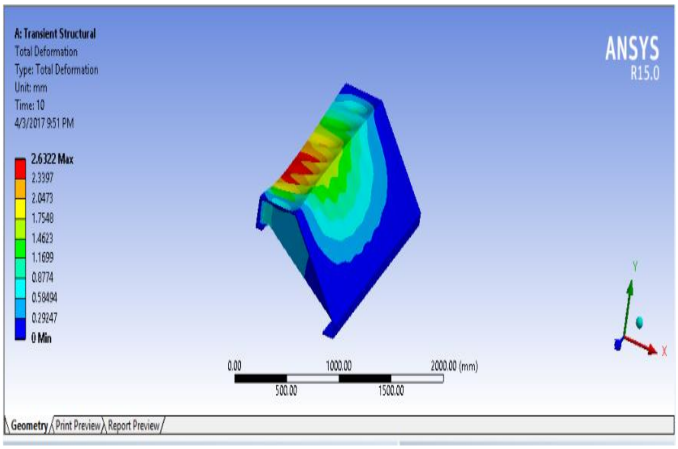


Figure .13. Total deformation before modification

The maximum deformaion is acting on edge of plate in the middle. The maximum and minimum total deformation are2.6322 and 0 mm as shown in figure 13

7. Geometric Model of rear panel plate after modification

Channel is taken as Indian Standard Medium channel ISMC 200 with dimensions 200×75×6.2 mm.

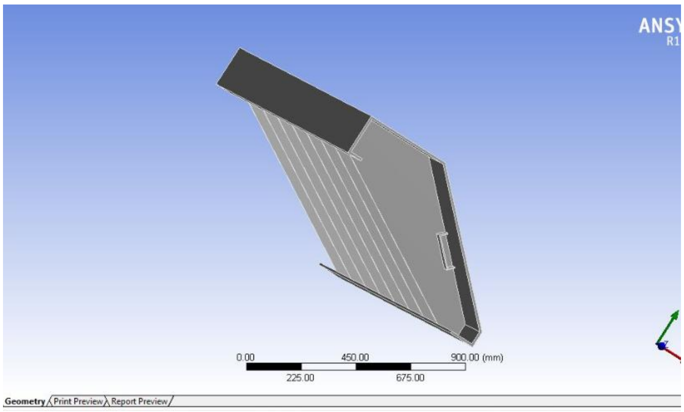


Figure.14. Geometry of the rear panel of hearth layer screen after modification

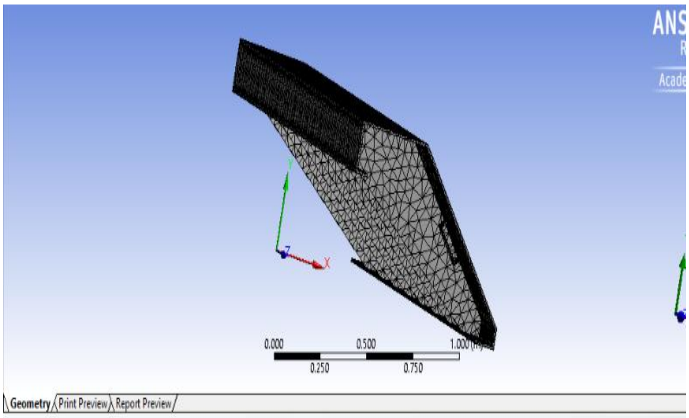


Figure.15. Meshed model for the rear panel of hearth layer screen after modification

8. Boundary Conditions

The boundary conditions of rear panel plate of hearth layer screen is as shown in figures 7.3 and 7.4

1) 3 fixed supports on 3 faces of a plate has taken 2 at the ends of the rear panel plate, 1 at the bottom of the rear panel plate.
2) Load (Force) is taken at the top of the rear panel plate of hearth layer screen.
3) The impact load is acting downwards on the top of the rear panel plate of hearth layer screen.

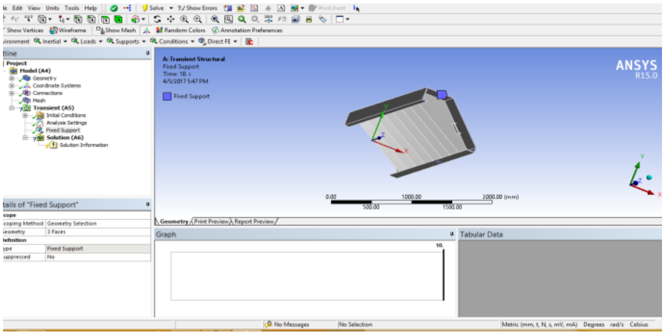


Figure.16. Fixed supports for the rear panel plate of hearth layer screen after modification

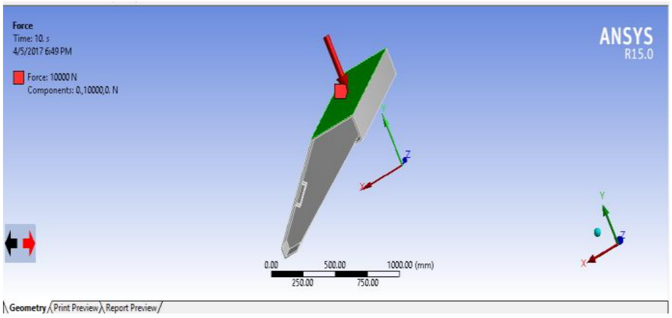


Figure.17. Force for the rear panel plate of hearth layer screen after modification

9. Analysis of Rear panel plate with Channel

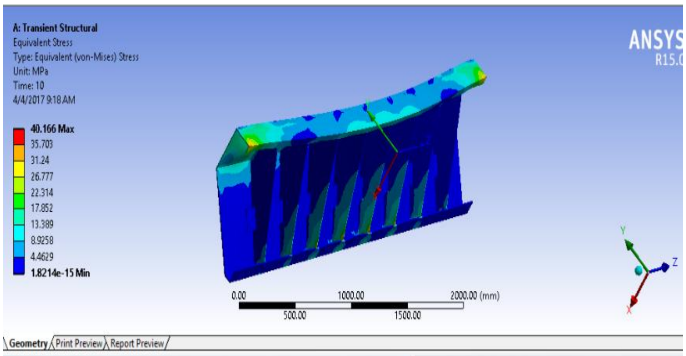


Figure .18. Von-mises stresses after modification

We can see that the stress formation is reduced after adding a C-channel .The maximum and minimum Equivalent von-mises stresses are40.166 and 1.8214e-15MPa as shown in figure 18

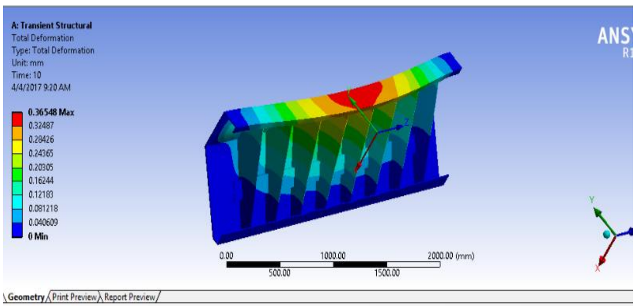


Figure. 19. Total Deformation when channel is present

The maximum deformaion is acting on the top of of plate in the middle. The maximum and minimum total deformation are0.36548 and 0 mm as shown in figure 19. Hence the deformation is reduced when compared to the deformation of rear panel plate before modification.

VI. RESULTS AND DISCUSSIONS

In the present work, the rear panel of the hearth layer screen is loaded with the parameters and analyzed for their effectiveness and finding out the reason for necking regions. Continuous loading is done by transient analysis based on available data; similar loading conditions are given to the designed panel (by creating a channel near the vent of the plate). The results obtained from the above two operations is compared by tables. The values obtained when a channel is present have very vast change, comparatively. So, to obtain the better design, a channel substitution is preferred. The Transient structural finite element analysis was performed using ANSYS workbench FEM module. The equivalent von-mises stresses and Total deformation are shown in the table.

Table.2. Solution Determined For the Analysis Of Rear Panel Before Modification

Results	Equivalent von-mises Stress (MPa)	Total deformation (mm)
Minimum	7.7827e-8	0
Maximum	161.07	2.6322

Table.3. Solution Determined For the Analysis of Rear Panel after Modification

Results	Equivalent von-mises Stress (MPa)	Total deformation (mm)
Minimum	7.7827e-8	0
Maximum	161.07	2.6322

From the tables we conclude that the rear panel plate with the aid of a C-Channel possesses to resist the feed rate when compared with the Rear panel plate before modification.
Hence it can be suggested to have a C-Channel welded, to overcome the teething problems which are being caused at the vents of the rear panel plate while there is a continuous flow of material.

VII. CONCLUSIONS

A computational 3-D model for the rear panel plate is presented in this study. Through the study, several conclusions can be drawn with regard to the Rear panel plate before and after modification when subjected to complex variable loading conditions.

Table.4. Transient Analysis of Rear Panel before and Afer Modification

	Before modification	After modification
Von-mises stresses	161.07 MPa	40.166 MPa
Total deformation	2.6322 mm	0.36548 mm

1. COST ANALYSIS:

The down time period before and after experimental are as follows

- Before modification the down time period is 11.36 hrs/week @ Rs/5416/hr.
- After modification the down time period is 2 hrs/week @ Rs/5416/hr.
- Therefore, cost saved per year is 9.36hrs 52weeks Rs5416 = Rs. 2,636,075.52
- Gross savings per year = Rs. 2,727,507.52
- Implementation cost = Rs. 91,160
- Therefore, net direct savings per year = Rs. 2,727,507.52 - Rs. 91,160= Rs. 2,636,347.52

The results of modified rear panel model are as follows:

- The designed rear panel plate should be capable of holding von-misses stresses successfully.
- Stress and deflection are within the permissible limits.
- By the above comparison, it is concluded that the modified rear panel is performing satisfactorily.
- After trial implementation the breakdown time reduces from 11.36hrs to 2hrs per week.
- Hence the breakdown time reduces to 486.72hrs per year.

So from the cost analysis it concludes that the cost saved per year is maximum when compared to cost saved before trail implementation.

VIII. REFERENCES

[1].Sri. A. Bhattacharya DGM (M) I/C/ SP-3 Note sheet GM (Iron) I/C/BF(W)/599 dated 25/02/2014 approved by ED (works) Days of visit :05.03.2014 & 06.03.2014.

[2]. R Suresh Kumar Chief Project Manager, Pranab Saha Project Manager (BF#8),Matta Satyanarayan Project Manager (SP#3), "Bhilai Steel Plant's(BSP) expansion drive of 23 t crude steel plant by 2012 forms a major part of Steel Authority of India's (SAIL) expansion drive". *In-house Journal of L&T Construction Oct - Dec 2012 • Volume-35 • Issue-4.*

[3]. Shri P.N. Maravi(facilitator), Shri M.D.Sahu, Shri V. K. Choudhary,Shri A.K. Gupta, Shri A.K. Mishraand Shri S.S. Dhurve" Optimising moisture in sinter raw-mix"This innovation was awarded a gold medal in the International Conference of Quality Circles -2009 held in Cebu, Philippines. Bhilai Steel Plant's(BSP) *navonmesh magazine*.

[4]. Raj Kumar Goel, Managing Director, Vankam Vasu, DGM SLR Metaliks Limited
Sinter Plant 6.

[5]. Thomas Kronberger, Martin Schaler and Christoph Schönegger" Latest Generation Sinter Process Optimization Systems" *Siemens VAI Metals Technologies GmbH (Siemens VAI) Linz, Austria.*

[6]. PIENAAR, P.c..and SMITH. W.F.P. "A case study of the production of high-grade manganese sinter from low-grade Mamatwan manganese ore". *INFACON* 6. *ProceetliTlg.foftilt! 6th 11Itcrnal;O/lalFcrroal/oys Congress, Cape Towll. Volume I. Johannesburg. SAIMM. 1992. pp.131-138.*

[7]. Neil John BRISTO Wand Chin Eng LOO "Sintering Properties of lron Ore Mixes Containing Titanium" BHP

Research Newcastle Laboratories, BHPCo.. Ltd., POBox 188, Wallsend, NSW2287, Australia. (Received on December24. 1991; accepted in final form on April 24. 1992*). ISIJ International, Vol. 32 (1 992), No, 7, pp, 81 9-828.*

[8].Liborio Munive" The effects of bed depth, basicity and suction on sintering technology", Master of Engineering (Hons.) thesis, Department of Materials Engineering, *University of Wollongong, 1992.*

[9].Ram PraveshBhagat "Factors Affecting Return Sinter Fines Regimed and Strand Productivity in Iron Ore Sintering" *pp. 889-895, 10.2355/isijinternational.vol.39.889.*

[10].V. I. Shatokha, Yu. Yu. Korobeynikov, L. V. Kamkina, N. A. Kolbin "Application of 3D Tomography Method for Analysis of Iron-Ore Sinter Porosity. *National Metallurgical Academy of Ukraine 4 Gagarin Ave., Dnipropetrovsk, 49600, Ukraine Metallurgical and Mining Industry, 2010, Vol. 2, No. 6.*