DESIGN MODIFICATION TO ACHIEVE PROCESS STABILITY OF SINTERSCREEN AT SINTER PLANT-3 BY OVERCOMING THE TEETHING PROBLEMS

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ABSTRACT: *In the expansion to 6.3 Million tons plant, a new sinter machine-3, of 408 square meter and rated capacity of 456 tons / hour was commissioned. 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. The fines also known as return sinter, is re-circulated and put back into sinter making progress. On process stabilization, we faced frequent breakdown problems in the conveyor handling return sinter and the hearth layer screen. The problems like chute jamming, conveyor belt cut were faced regularly. In the hearth layer screen is the bottom flange of the rear panel (plate form to shape) walls at the charging end of the return fines screen (supplied by M/S. TVV, ITALY), at sinter machine-3 are found tearing 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 a channel form and cut to shape in situ at site to add strength to the side wall. The problem is seen to persist even after welding. The fabrication of the side plate at engineering shop is not viable because of the size of the bend plate to be handled is 3.6 m × 1.7 m × 12 m.*

1. Introduction

Sintering:

Sintering is a process of Agglomerating iron ore fines into a porous mass by incipient fusion caused by combustion within the mass of the ore particles.

History of Sintering:

Iron ore fines (0-10 mm) which were a result of mechanized mining could not be charged in a Blast furnace because they reduce the permeability of burden in a blast furnace. These iron fines that were generated at mines could not ignored because of their

i) Huge quantity and

ii) High iron content.

To use these fines effectively in a Blast furnace many processes were developed. Sintering being one of them and widely in integrated steel plants.

Raw materials used in sintering:

Various raw materials used in sintering process are

i) Iron ore fines (0-10 mm)

ii) Coke - used as fuel

iii) Limestone & Dolomite - to maintain required sinter basicity.

iv) Sand - to maintain required sinter basicity.

Metallurgical wastes - to use wastes effectively and thus reduce the cost of Sintering

v) Lime - to enhance the process of sintering.

Sintering process:

1) Preparation of various raw materials.

2) Mixing & Blending.

3) Mixing with sinter returns in presence of water to form green balls.

4) Charging on to the machine.

5) Ignition and suction.

Figure 1.1 Sinter Screen

Factors affecting the sintering process: As you have discussed before sinter process consists of mixing of various raw materials, palletizing the mixture with water, charging the sinter mix on the machine, igniting the top layer and sucking atmosphere air through the ignited the bed till the entire sinter mix becomes sinter.

Broadly the productivity of a sinter machine depends on the following factors.

Quality of input raw materials

Vacuum under grate

Quality of sinter

Permeability of sinter bed

Quality of input Raw materials:

Both physical and chemical qualities of input raw materials affect productivity of sinter machines. The various raw materials used in sintering are Iron ore fines, Coke breeze, Limestone, Dolomite, Sand, Metallurgical waste and Lime.

Physical properties:

Iron ore fines used for sintering should be of the size of 0-10 mm. More of ñ1 mm fraction will reduce bed permeability and will reduce the vertical speed of sintering reducing machine productivity. More of +.0 mm fraction will not participate in the process of sintering leading to poor quality of sinter and low productivity. All other raw materials should be within the size range of 0-3 mm to provide for uniform chemistry and for best ignition conditions. At VSP about 85% of iron ore fines lie between the size range of 0-10mm and 95% of other raw materials lie within the range of 0-3mm. As these size ranges are best suitable for sintering nothing more could be done in improving this factor.

2. Design

Consider the standard design data:

In work the standard design specifications of rear panel plate at the hearth layer screen-3 is considered for the design study. Table 2.1 lists the technical parameters of sinter machine; table 2.2 lists the technical parameters of the straight line cooler and table 2.3 lists the technical parameters of hearth layer screen. The given design supports the given feed rate but gets necked when the number of cycles is increasing day by day and reducing the life of the panel plate. In order to increase the life of the rear panel we have considered placing a channel in between the stiffeners.

Type	Dwight Lloyd
Total grate area	312 m^2
Effective / Sintering area	276 m
Length between sprockets	93.4 m
Width of the machine	4 m
No. of pallets	135
Number of wind boxes	26
Drive arrangement	Left hand
Wind box arrangement	Right hand
Speed of machine pallets	1.5 to 8 m/min
Capacity of the machine	up to 450 TPH
Bed height	500 mm
Height of bed layer	40 mm

Table 2.1 Technical parameters of Sinter Machine

Active working area:	420 m^2
Length:	118.4 m
Height of the sinter bed:	0.75 m to 1.0 m
Capacity:	Up to 550 TONS/HOUR
Number of wind boxes:	16
Number of blower fans:	8
Specific flow rate:	66,000 m^3/ton

Table 2.2 Technical parameters of Straight- Line Cooler

S.No	Parameter	Value
1	Product handled	SINTER
2	Bulk density	1.7 T/m^3
3	Moisture	DRY
4	Temperature	100°C (140°C max)
5	Feed rate	350 T/Hr
6	Size of material	<50 mm
7	Screening efficiency	94%
8	Screen deck length	8700mm
9	Screen deck width	3650 mm
10	Deck plate hardness & thickness	500 HB, 10mm
11	Total area / effective area	31.75 m^2/ 26.45 m^2

Table 2.3 Technical Details of Hearth Layer Screen

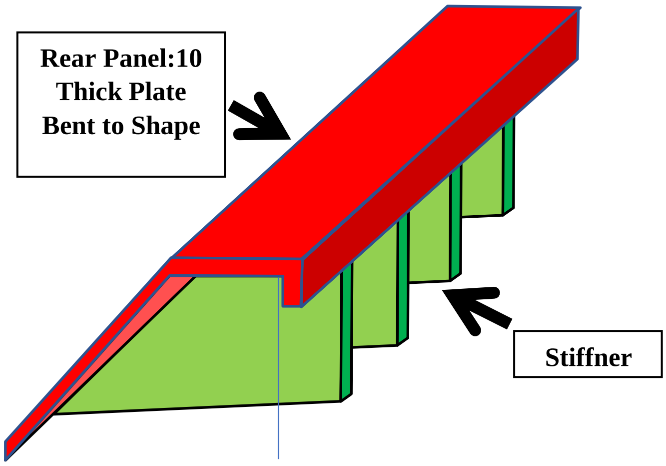


Figure 2.1 The rear panel plate before the modification Design for strength

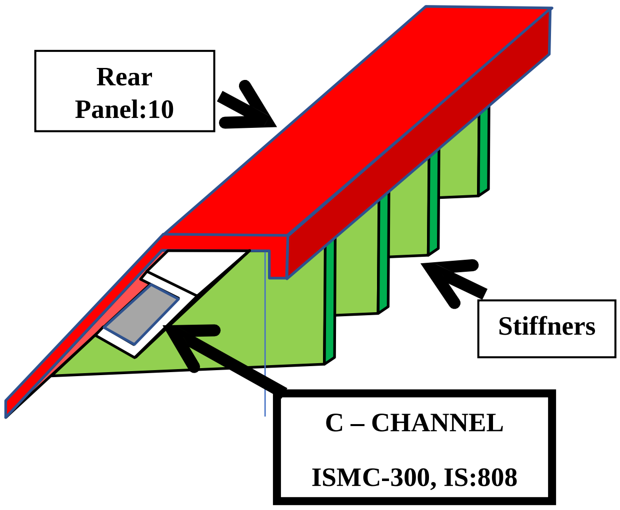


Figure 2.2 The rear panel plate after the modification

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 we will be taking 1200 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 for a hourly period of time, we observe a huge change in the stresses in the rear panel plate before modification and after the modification.

3. CATIA

There are different modules in CATIA sing which different tasks can be performed. The main window and modules of CATIA shown in figure:

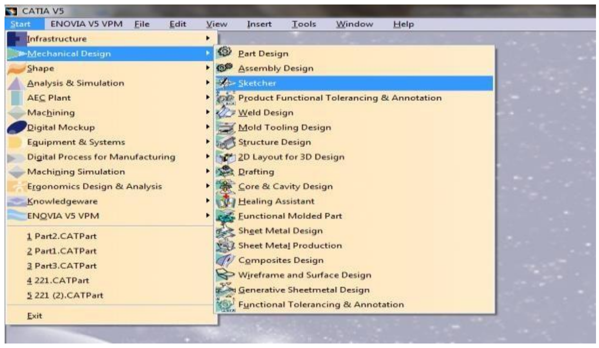


Figure 3.1 CATIA V5 Interface

The main modules are: Part Design

Assembly Drafting

Wireframe and Surface Design Core and Cavity Design

Part Design

The Version 5 part design application makes it possible to design precise 3D mechanical parts with an intuitive and flexible interface, from sketching in an assembly context to iterative detailed design. Version 5 Part Design application will enable you to accommodate design requirements for parts of various complexities, from simple to advanced.

This application, which combines the power of featured-based design with the flexibility of a Boolean approach, offers a highly productive and intuitive design environment with multiple design methodologies, such as post-design and local 3D parameterization.

Select Start >> Mechanical Design >> Part Design from the menu bar

DESIGNS BY USING CATIA

Design of Rear Panel Plate:

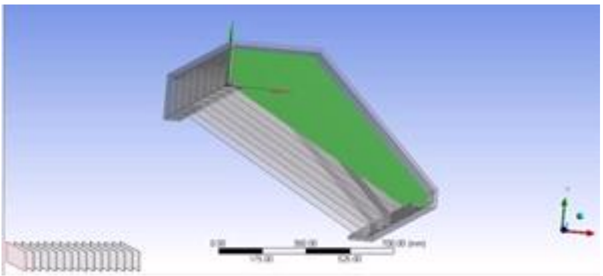


Figure 3.2 Rear panel plate

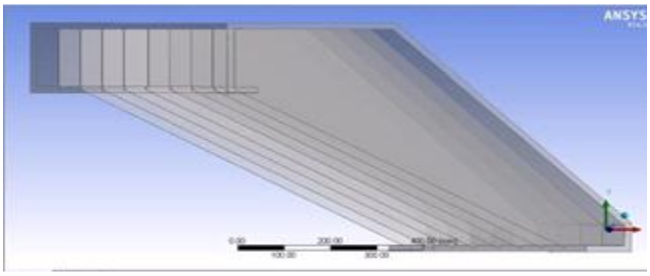


Figure 3.3 Pad operation

Same step is going to be executed by shifting the axis to 800 mm away from the original xy axis then we perform pad operation at that point

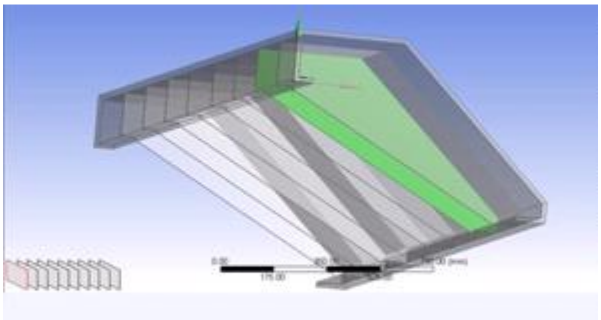


Figure 3.4 Pad operation

By shifting the axis to next distance away from the axis the same step is executed again

Justification

In the above figures we have designed the Rear panel plate of Hearth layer screen and the Rear panel plate which has been modified with the required standard dimensions and imported to ANSYS work bench to find out the desired stresses acting on each of them.

4. Result

In the present work, the front and rear panels of the sinter screen are 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 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 graphical representations. 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 results are present and discussed in the present chapter.

The Transient structural finite element analysis was performed using ANSYS workbench FEM module. The equivalent von mises stresses are shown in the table.

Solution determined for the analysis of rear panel plate before modification:

Object Name	***Equivalent Stress***	***Total deformation***
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Shell		Top/Bottom
Definition		
Type	Equivalent (von-Mises) Stress	*Total deformation*
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Use Average		Yes
Results		
Minimum	1.0525	0
Maximum	262.17	4.1589
Information		

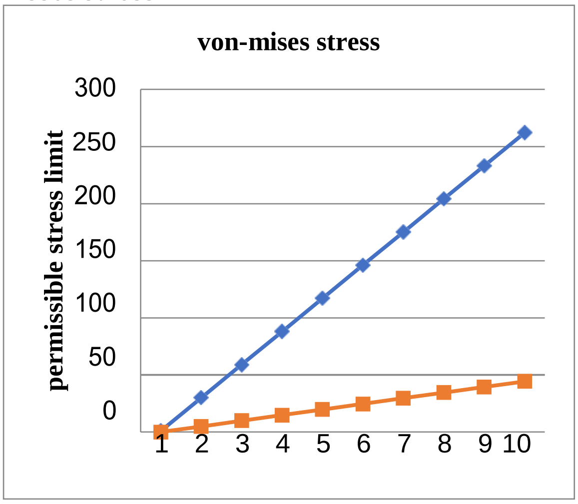
Time	1.s – 10. s
Load Step	1
Sub step	1
Iteration Number	1

Solution determined for the analysis of rear panel plate after modification:

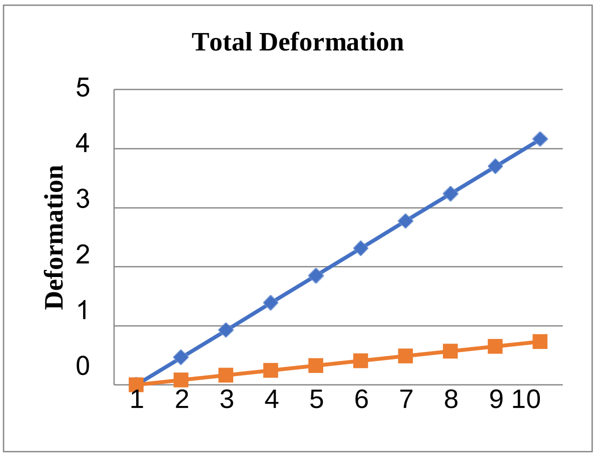
Object Name	***Equivalent Stress***	***Total deformation***
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Shell		Top/Bottom
Definition		
Type	Equivalent (von- Mises) Stress	*Total deformation*
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Use Average		Yes
Results		
Minimum	0.076464	0
Maximum	44.43	0.73033
Information		
Time	1.s – 10. s	
Load Step	1	
Sub step	1	
Iteration Number	1	

Prediction Results and Analysis through Graphs:

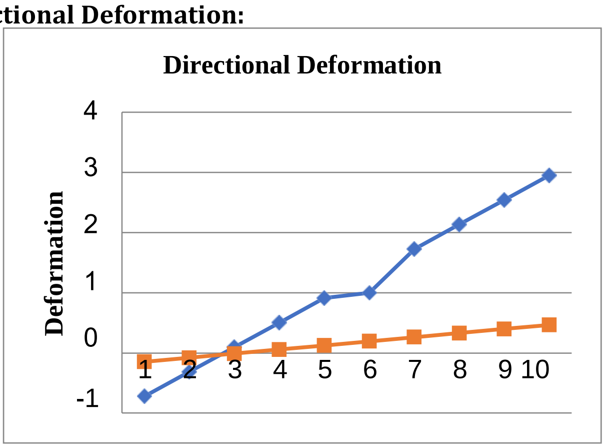
Von-misses stress:



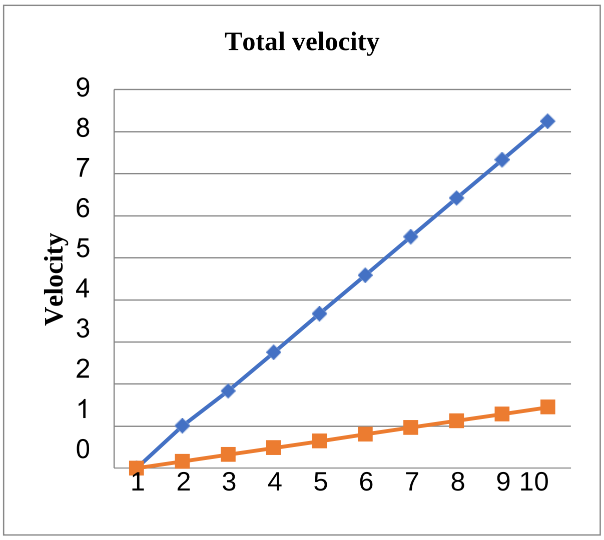
Total deformation:



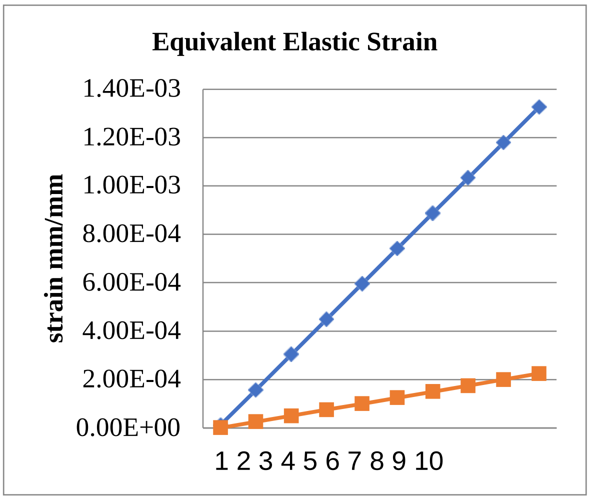
Directional Deformation:



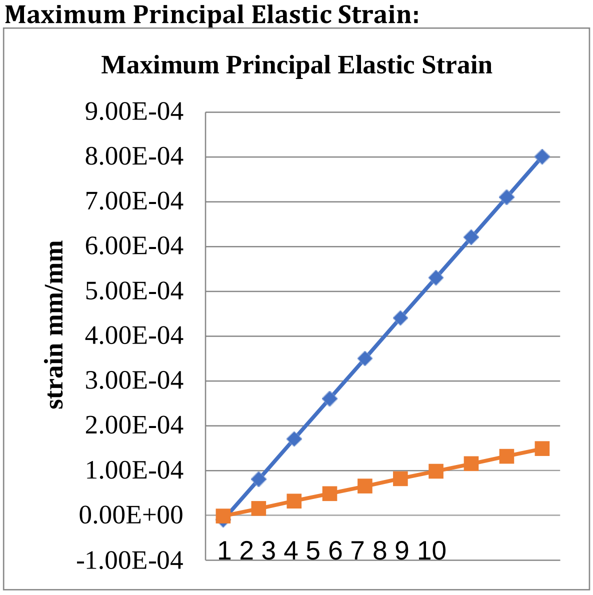
Total velocity:



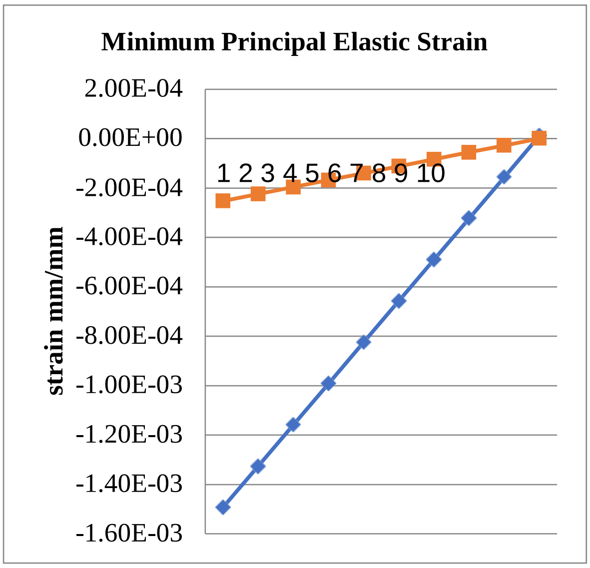
Equivalent elastic strain:



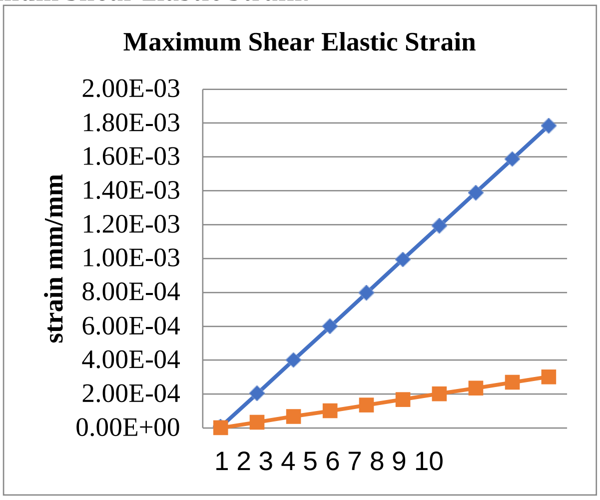
Maximum Principal Elastic Strain:



Minimum Principal Elastic Strain:



Maximum Shear Elastic Strain:



From the graphs 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.

5.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.

Three-dimensional model of Rear panel plate was developed and analysis was carried out using ANSYS workbench. A quadratic 4 node 181 tetrahedron element was used for the solid mesh using patch conforming method is employed. A total of 1764 elements and 1270 nodes were generated at 1.0mm element length

It can be concluded that the equivalent von mises stress is used for subsequent fatigue analysis and comparisons. From the analyzation of results, the value of maximum von mises stress for the rear panel plate with channel is found to be 44.43 Mpa , which is comparatively less when compared with the rear panel plate before modification.

References:

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