RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES SRIKAKULAM
S.M PURAM, ETCHERLA(M), SRIKAKULAM DISTRICT

DEPARTMENT OF MECHANICAL ENGINEERING

Analysis of Rail joints in Vertical load

A Project report submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

In

MECHANICAL ENGINEERING

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Certificate

This is to certify that the thesis entitled "**Analysis of Rail joints in Vertical loads"** being submitted by **K.Venkatesh(S160294), K.Vimath kumar(S160173), CH.Priyanka(S160333), Y.Pavankumar(S160460), Y.Yakob(S160591), B.Durga prasad(S160711)** in partial fulfillment of the requirement for the award of the degree of **BACHELOR OF TECHNOLOGY** in **MECHANICAL ENGINEERING** is a record of bonafide work done by them under my supervision during the academic year 2020-2022.

Project Guide

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Abstract

Railways are the principal mode of transportation for freight and passengers in India, is comprised 126,366km of track.Rail joints which are used to join rails in order to create long path are the critical elements where more stress is developed, and due to that failure occurs. This project deals with different configured rail joints in a vertical load. The analysis is observed for three possible positions of the rail joints mainly, rail joint between the two sleepers (suspended rail joint), rail joint near to one of the sleepers, and rail joint exactly on the sleeper (supported rail joint). The 3D modeling of the bolted rail joint, was modeled in SOLIDWORKS 2019 and the analysis in ANSYS V 19.2

Here fish plates are used to join rails in bolted joint manner. The suitable fish plate for rail joint of suspended type will be obtained.

PROBLEM STATEMENT

Rails are joined using thermit welding ,but the problem associated with that is there will be no gap for expansion in regions with high temperature. Due to the imperfection and expansion gap, the rail will break in case of continuousness of the rail in X and Y directions. On the other hand, the imperfection of the rail joint causes thermal effects. To avoid this, rails are joined using fish plates. Now this project introduces three configurations in which rails are joined namely,

1.Suspended rail joint

2.Supported rail joint

3.Joint near to the sleeper

CONTENTS

Introduction

Nowadays, the railroad is the most widely used way of transporting goods and passengers from place to place. Therefore, studying the interactions of the rail wheel and rail and analysis of the contact stress developed in this area is a crucial area in railway engineering. For the suspension and comfort of the passengers, the railways should be designed carefully as much as possible having the required ability. The contact stress between rail joints and wheel is determined under the static loading for different physical phenomena in the contact zone .

In track, the rail joint is the most essential element where the overall load is applied to it. So, for the safe and accurate working performance of the track proper function of these rails should be appropriate. In the track or railway system, the rail joint is the weakest part.

RAIL :

Rails are steel girders placed an end to end to provide a level and continuous surface for the movement of trains.

FUNCTIONS:

- The rails provide the level and continuous surface for the movement of trains.
- The rails carry the stresses developed due to vertical loads transmitted to it through axles and wheels of the rolling stocks due to braking forces and thermal stresses etc..

SLEEPERS:

Sleeper is **a load distributing component of track structure which is laid transversely to hold the rail**. Sleepers are also called **"Ties"** because they tie the rails together.

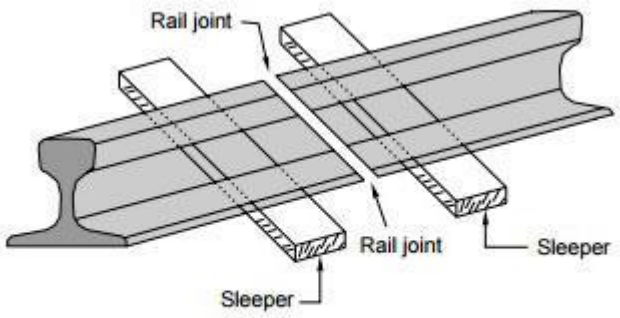
FUNCTIONS:

- The primary function of a sleeper is to grip the rail to gauge and to distribute the rail loads to ballast with acceptable induced pressure.
- The side functions of a sleeper include the avoidance of both longitudinal and lateral track movement.

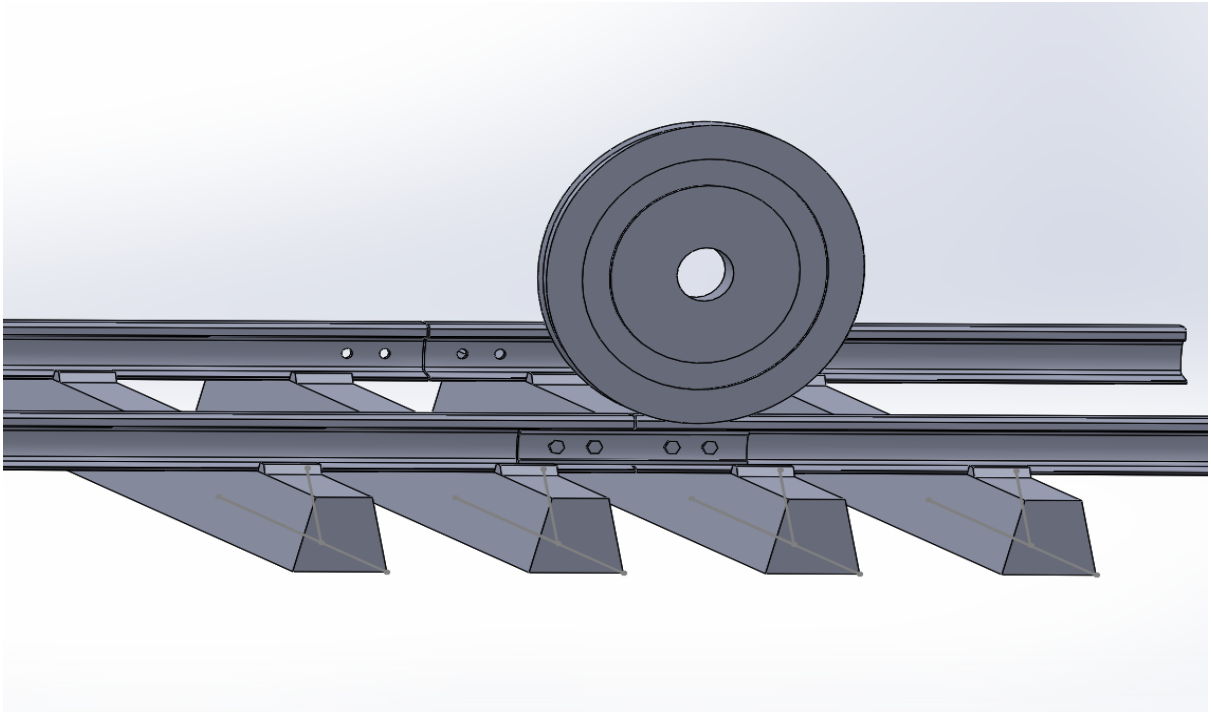
SLEEPERS

SUSPENDED JOINTS

A rail joint coming between two railroad rail sleepers and some portion of rail is cantilevered at the joint. Just because the cantilever action, the joint becomes loose due to the hammering action of passing train loads



Suspended Rail Joint

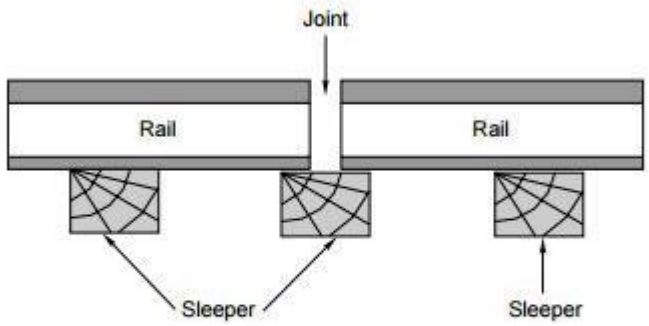


SUPPORTED JOINT

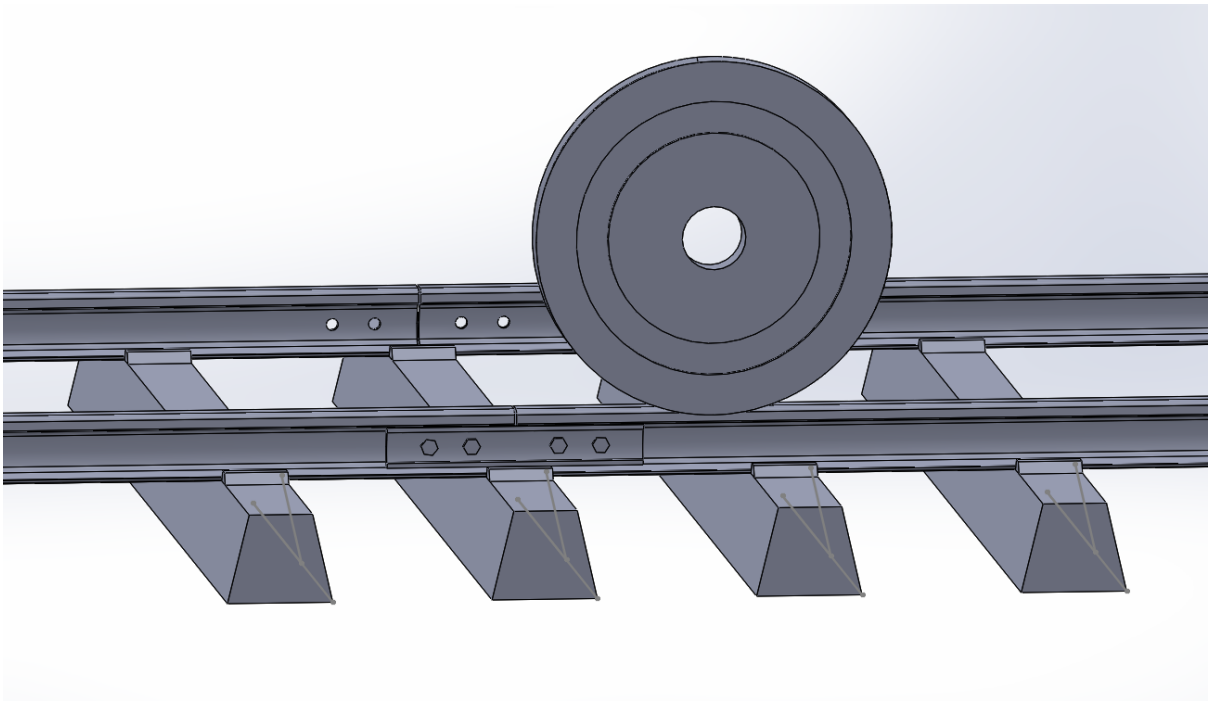
A rail joint in a railroad rail having a sleeper directly under the rail ends.

FUNCTIONS:

- It makes the joint move hard even though the support may have a slightly raise the height of the rail ends.



Supported Rail Joint

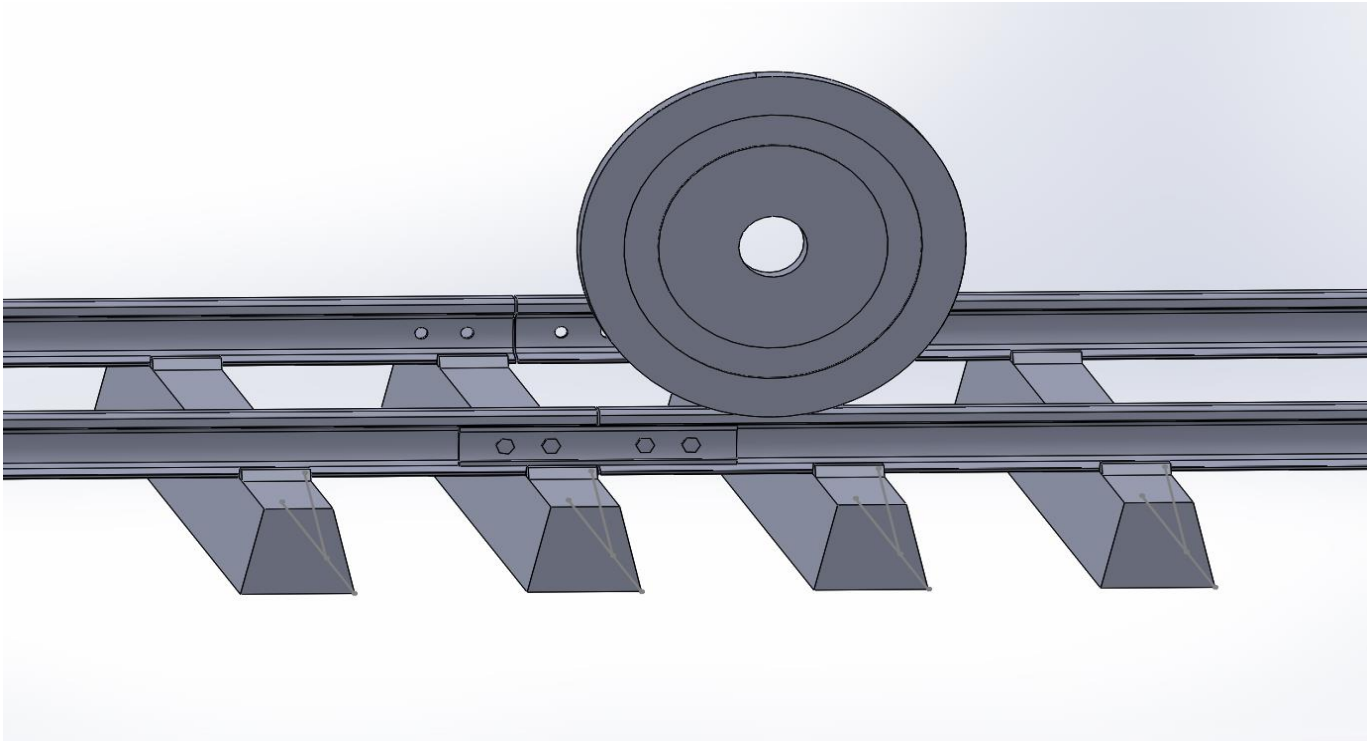


JOINT NEAR TO THE SLEEPER :

A rail joint in a rail road which is near to the one of the sleeper.

Rail is supported on the sleeper but the joint didn't have any support.

Rail joint is near to the sleeper but not fully supported.



FISH PLATE

Fish plates are specially rolled section used for joining the rails end to end with the help of fish bolts. The name fish plate is traditionally given to this fitting as its section looks like a fish.

FUNCTIONS:

- To transfer the load of the wheels from one rail to the other.
- To provide vertical and lateral stiffness to the rail joint.
- To allow for the expansion and contraction of rail ends due to temperature variations.

TYPES OF FISH PLATES

❖Ordinary Fish Plate:

Provides continuous support and maintain line and level. These are used for joining single rail, Short Welded Rail, Buffer Rails of Long Welded Rail(LWR), and its approaches etc.

Fig. Ordinary Fish Plate

❖One Metre Long Fish Plate:

This is a better substitute of ordinary fish plates in high density routes and is generally used in laying of LWR, Destressing of LWR, Repair of rail fractures, Bridge and its approaches, etc. As per instructions, for rail joints on Mono Block Concrete (MBC) Sleepers, One Metre Long Fish Plates to be used.

Fig: One Metre Long Fish Plate

❖Combination Fish Plate:

A set of four combination fish plates are used at joints of two different rail sections The four fish plates are different from each other and are marked IR, OR, IL & OL (Right In, Right Out, Left In, Left Out respectively) apart from their part numbers and sections of rails fishing with it. Full length of rail should be used with combination fish plates without any gap.

Fig. Combination Fish Plate

Literature Review

Vinod: Presented the analysis of rail joint in a structural and thermal load using ANSYS. The applied stress on the rail joint is influenced by sleeper selection.

Zuccarelli: Investigated the failure of underground railway wheels during the contacts in the rail wheel and rail joint using experimental. The failure of wheel, rail, or rail joint is not only a manufacturing process or mechanical proprieties rather a fatigue load and thermal effect on the wheel/rail.

Nannan and Manicka: Studied the discontinuity effect of rail ends under wheel load in the presence of insulation material in the rail joint. The numerical stress analysis of a three-dimensional (3D) model of the rail joint was obtained.

Guta and Tilahun: Developed to predict and minimize failure that occurs due to wheel load on the bolted rail joint. In their study, the 3D model of the rail bolted joint was modelled in CATIAV5R16 and the stress caused by the vertical load was evaluated by ANSYS workbench. They conclude that the high stress and contact pressure occur bolted rail joint is in the middle of sleepers.

DESIGN

Solid works version 2019 is used for the design.

The commonly used commands are :

Extrude boss/base

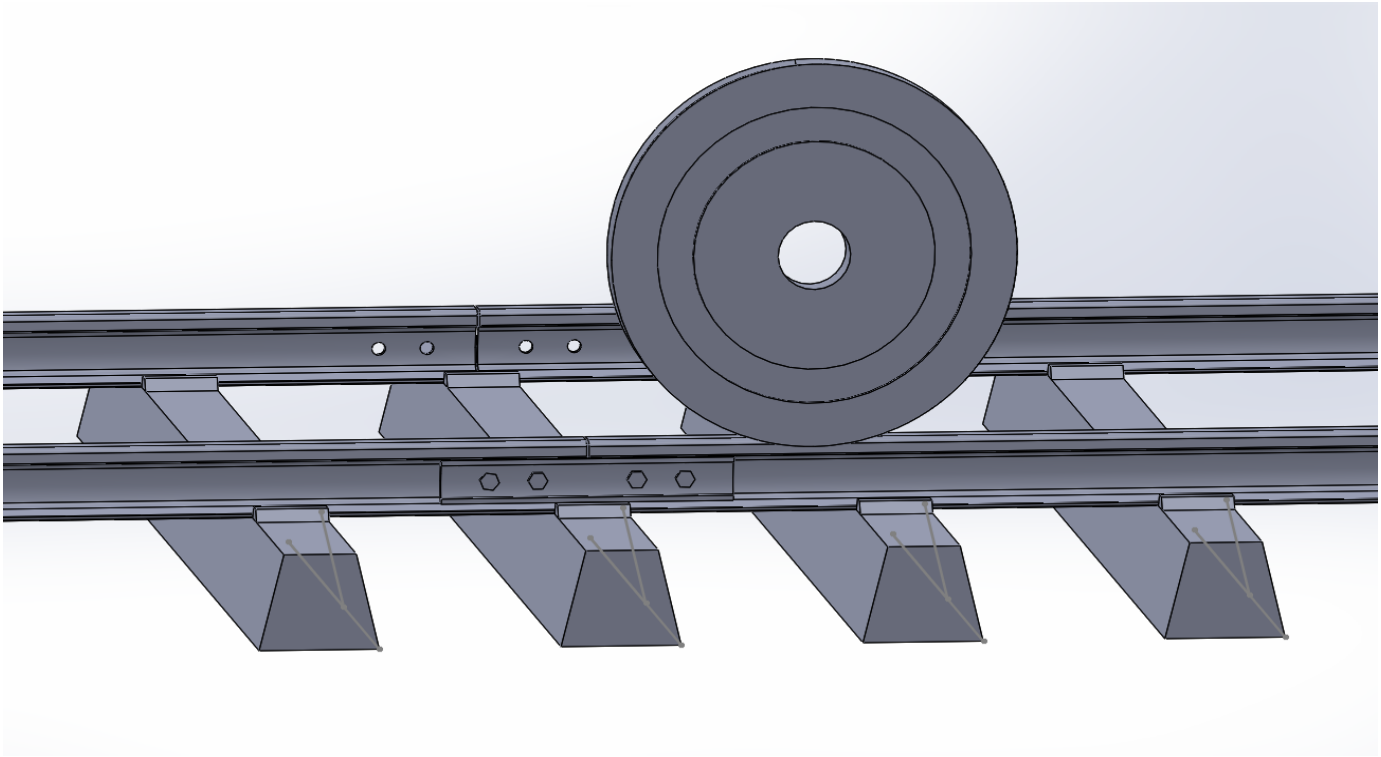
Extrude cut

Sketch and features toolbars are used for the design

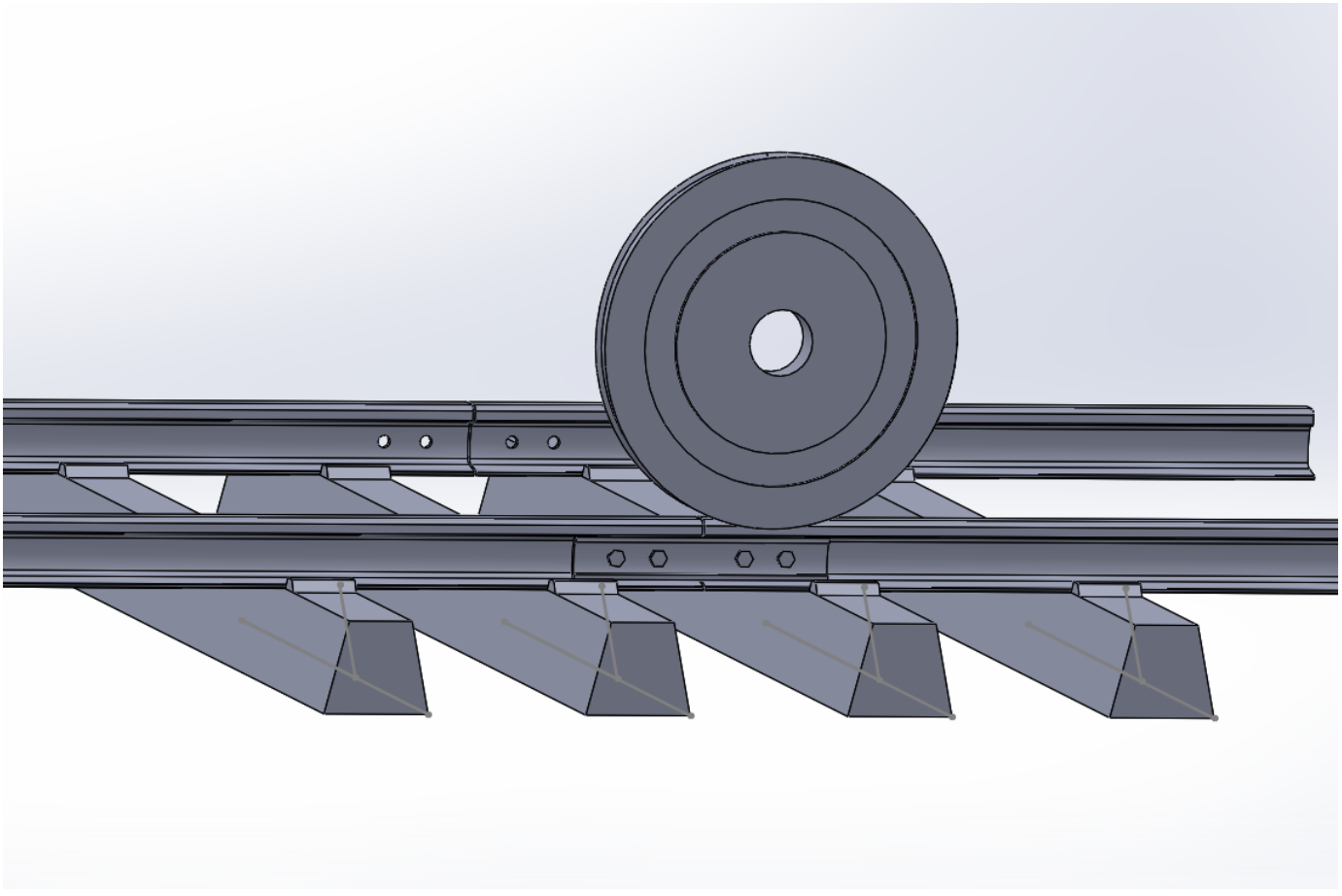
Assembly toolbar is used for the assembly of individual parts.

S. No	Description	Dimension
1	Rail	50kg/m
2	Diameter of the wheel	840mm
3	Length of the sleeper	2750mm
4	Depth of the sleeper	210mm
5	The gap between sleeper	625mm
6	End gap of rails	5mm
7	Joint bar bolt and nut respectively	M28

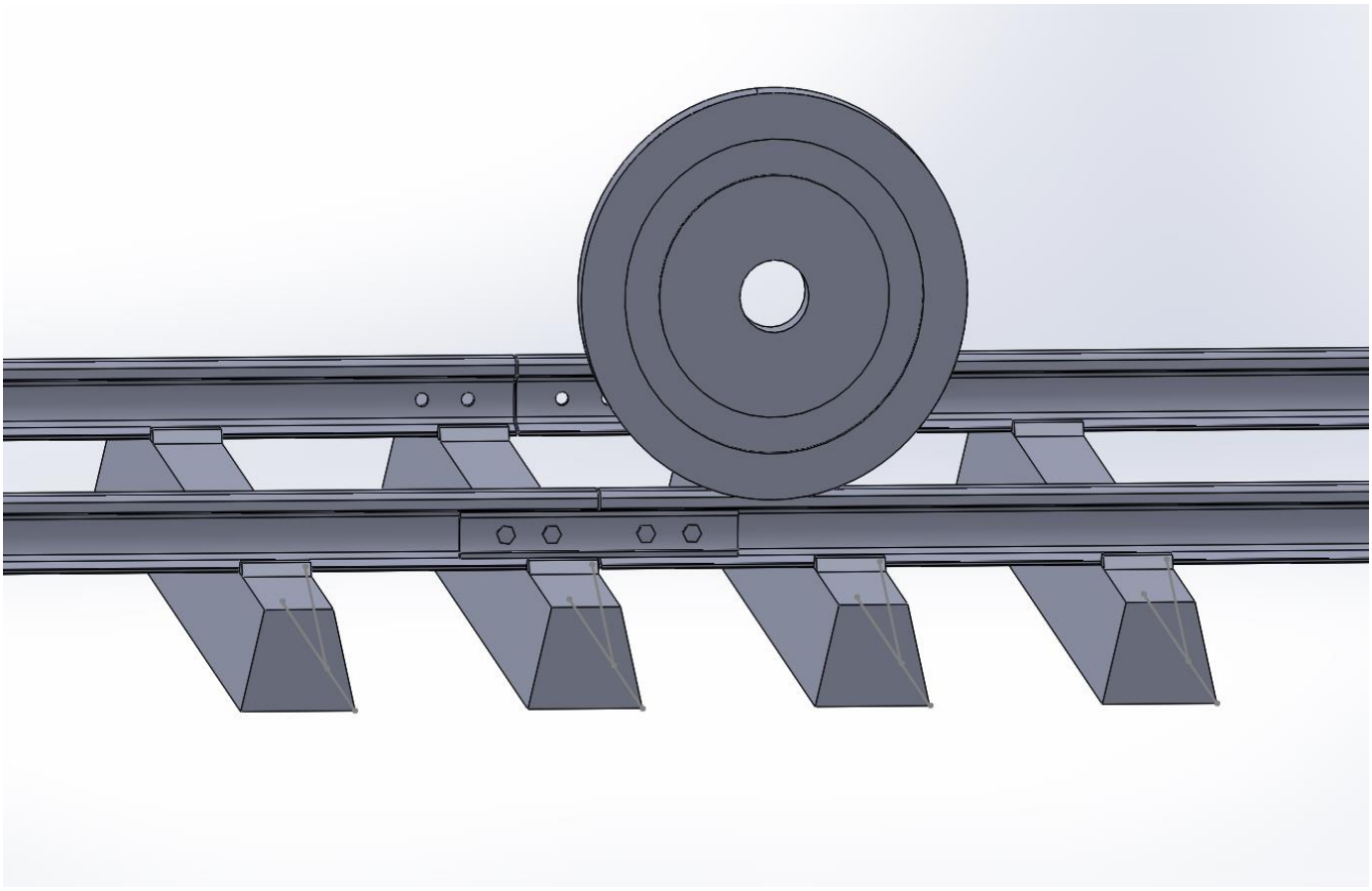
Dimensions



SUPPORTED RAIL JOINT



Suspended rail joint



Joint near to the sleeper

Analysis

Software used is Ansys V19
Workbench used is Static Structural

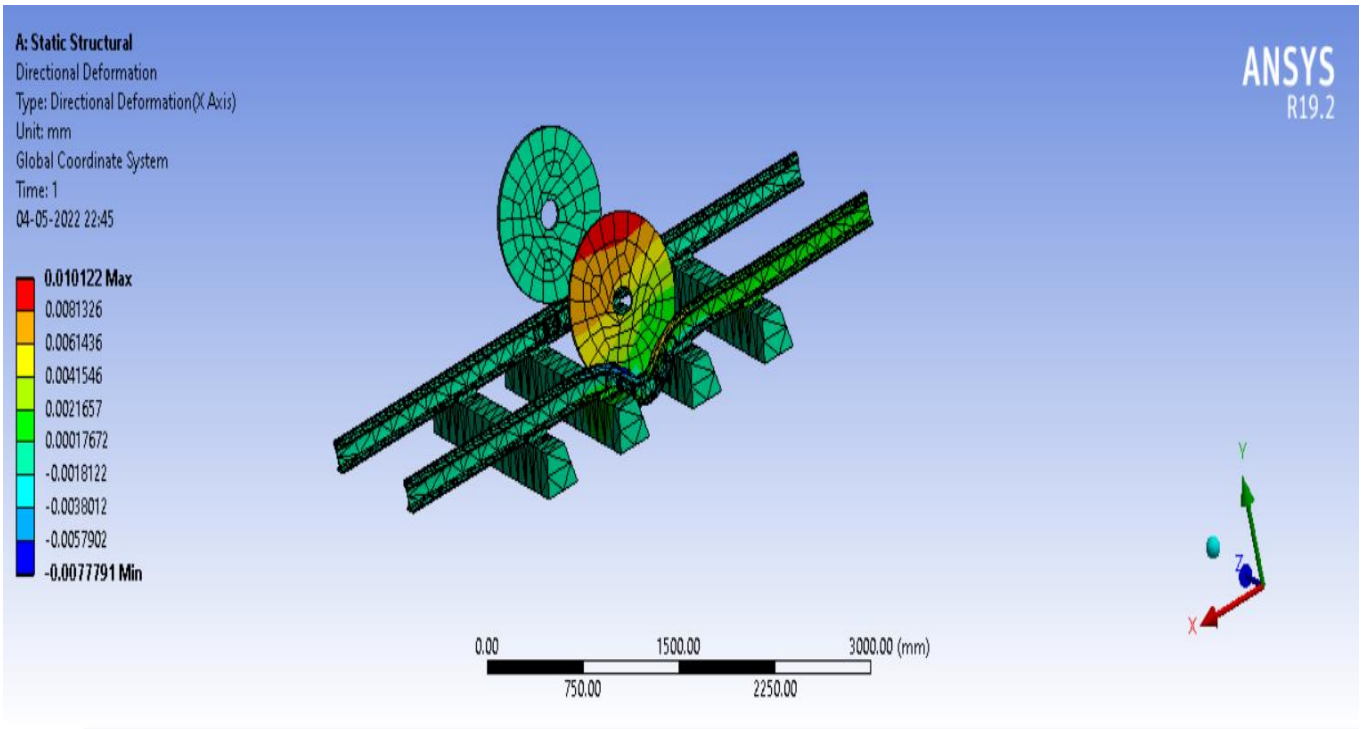
Structural analysis is performed on the rail assembly using Anysis software.
Here the supports are fixed supports are the sleepers.
The load acting on each wheel is 53KN.
After the application of supports , loads and meshing operation was performed.
And finally got the solution and the results were tabulated.

Steps :

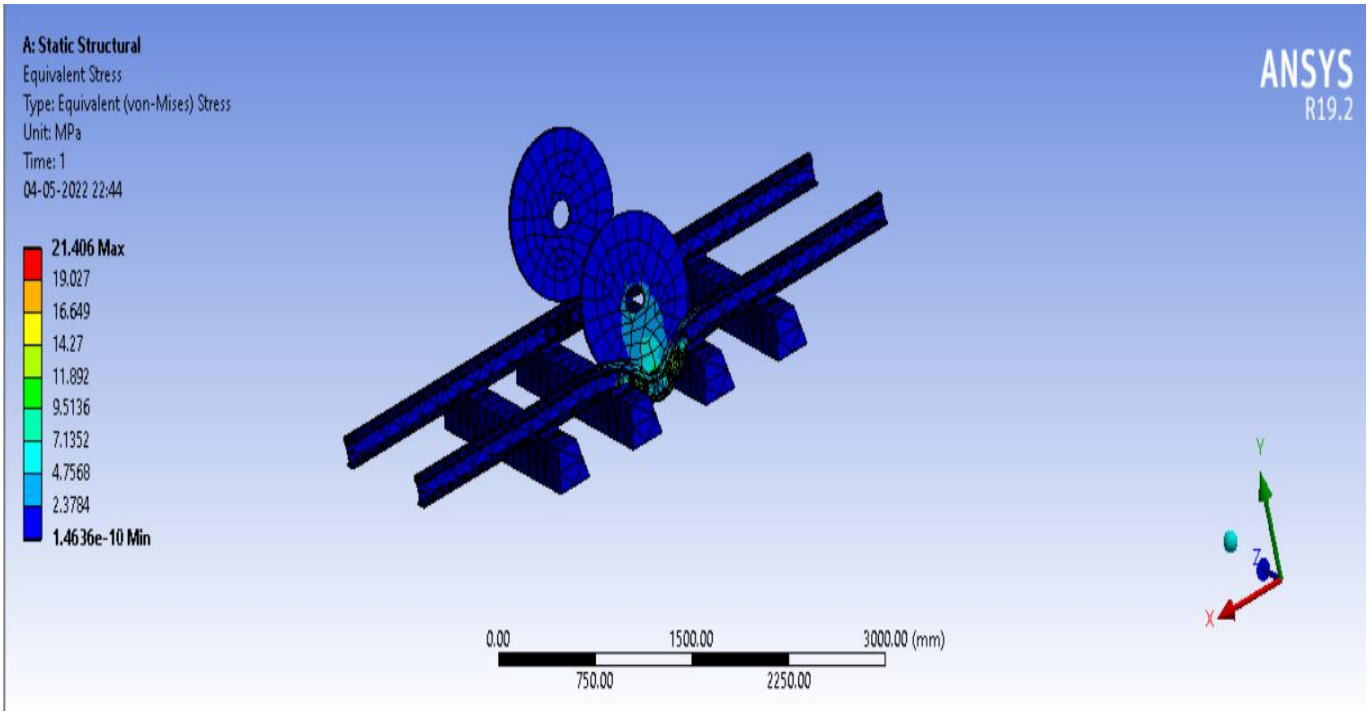
Engineering Data
Geometry
Model
Setup
Solution
Results

Materials used

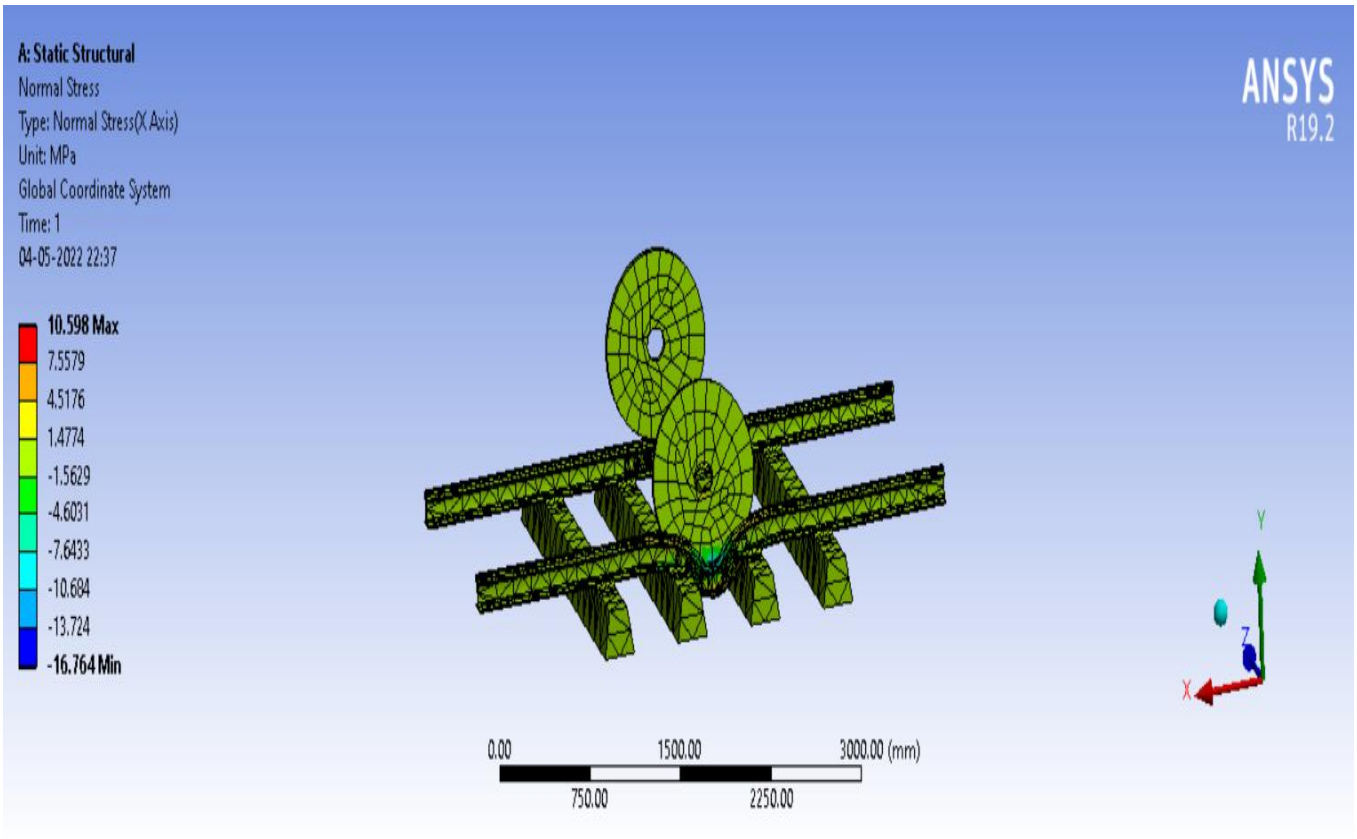
Rails : Hot rolled Steel
Sleepers : Concrete
Fish plate : Steel
Wheel : Chromium molybdenum steel



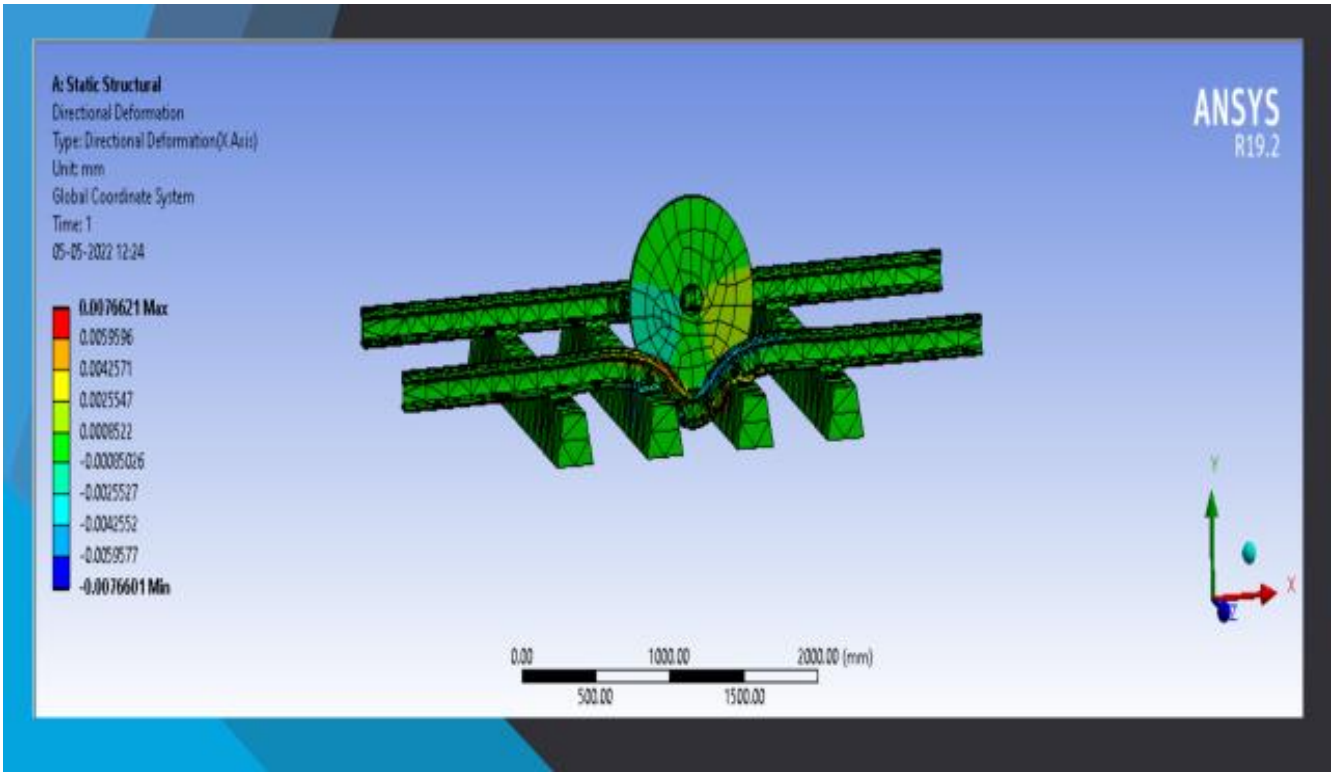
DEFORMATION WITH FOUR HOLED FISH PLATE



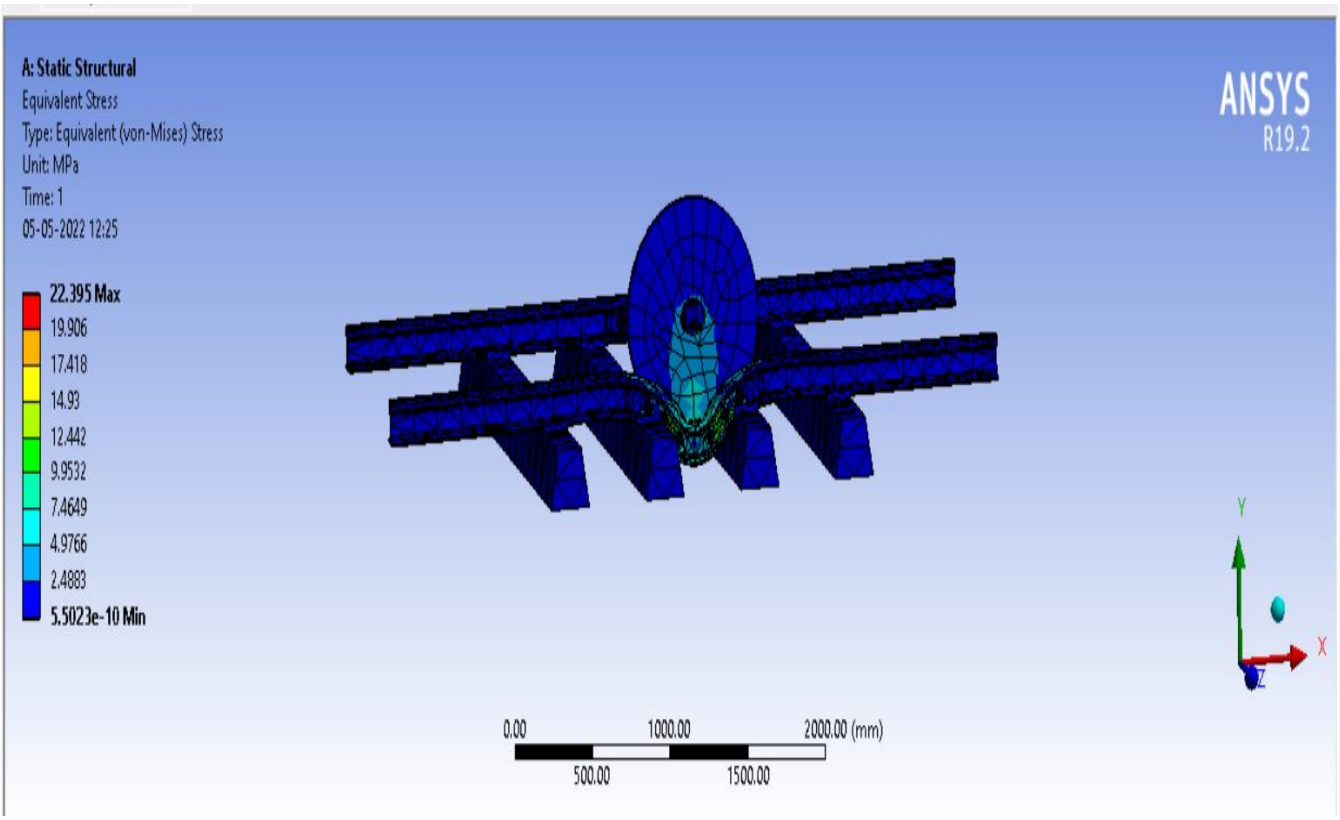
EQUIVALENT STRESS WITH FOUR HOLED FISH PLATE



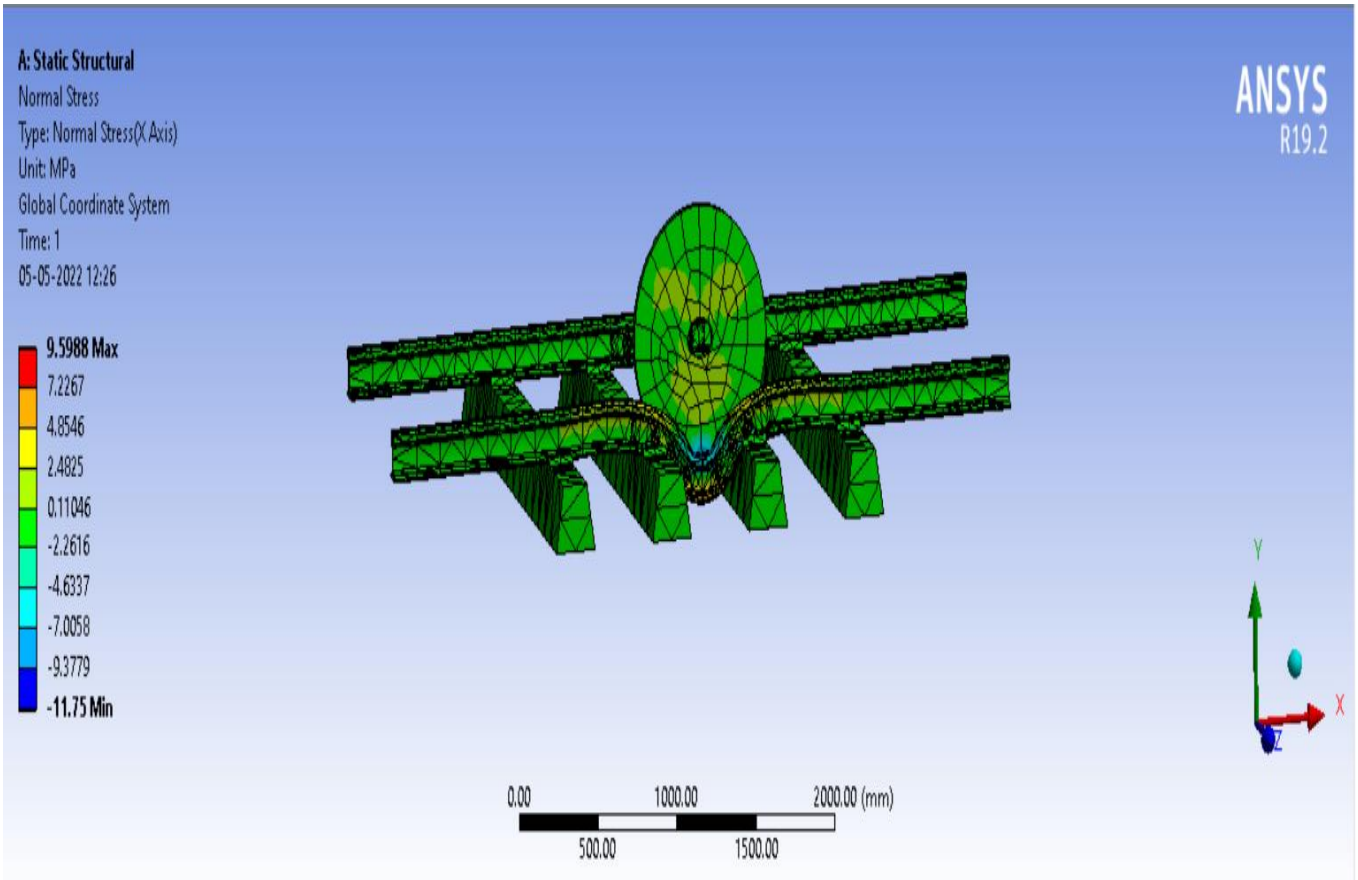
NORMAL STRESS WITH FOUR HOLED FISH PLATE



DEFORMATION WITH SIX HOLED FISH PLATE



EQUIVALENT STRESS WITH SIX HOLED FISH PLATE



NORMAL STRESS WITH SIX HOLED FISH PLATE

Advantages of four holed fish plate over six holed fish plate:

Reduced material usage
Easy Assembly and reduced assembly times
Reduced labour costs

	Four holed fish plate	Six holed fish plate
Deformation	0.01mm	0.007 mm

Results table

CONCLUSION

Any fish plate either four holed or six holed acts well in joining but four holed saves material costs.

The only advantages of six holed plate is that it gives reduced directional deformation than four holed fish plate.

So this project concludes that having a four holed fish plate to join rails is better than using six holed fish plate, because we can save material, labour costs and reduce assembly times with the use of four holed fish plates to join the rails.

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