R.D.S.O

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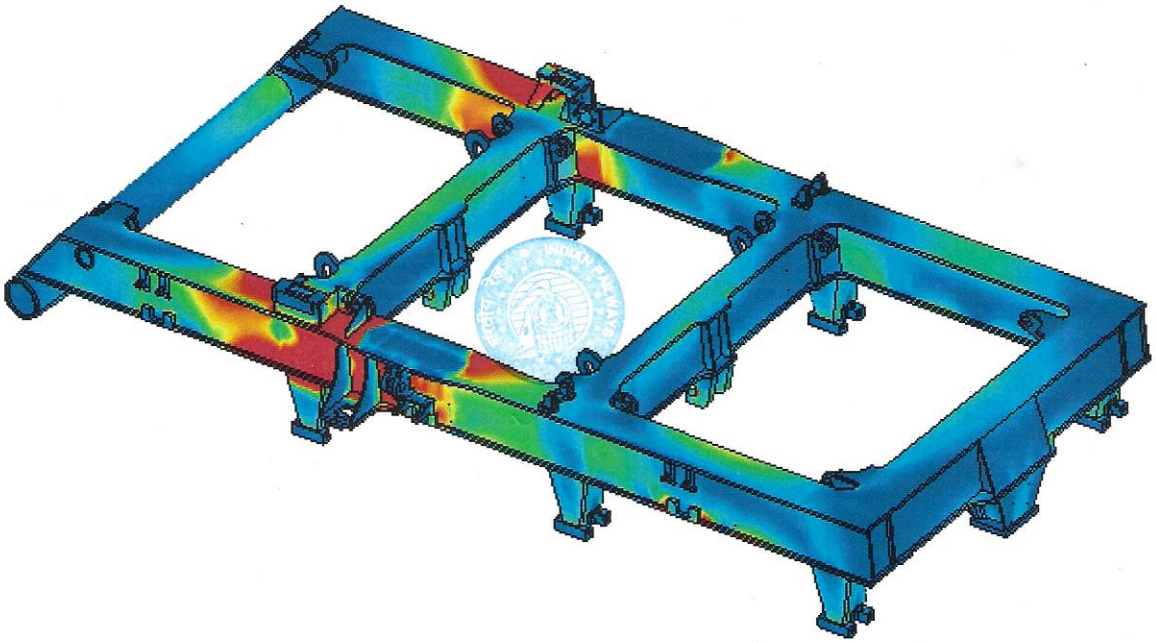
भारत सरकार, रेल मन्त्रालय

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

FINITE ELEMENT ANALYSIS OF FABRICATED BOGIE FRAME OF WAP7 LOCOMOTIVE



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अनुसंधान अभिकल्प और मानक संगठन
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RESEARCH DESIGNS & STANDARDS ORGANISATION
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INTRODUCTION

WAP7 Locomotive is provided with three-axle bogie having two-stage suspension. The existing bogie frame is having box type section, fabricated from steel plates to IS: 2062 E 410.

Based on the 3D- model and design data extracted from report No.RDSO/2018/EL/RM/0183 (Rev.0) May'2018 provided by Electrical Dte. FEM model has been prepared and carried out FEA by using software package MSC APEX structure. The design of bogie frame has been analyzed for 18.34 T Axle load by Finite Element Analysis to confirm its adequacy for strength consideration.

Based on the service condition seven critical load cases has been applied to verify the structural strength of bogie frame by comprising various combination of vertical, lateral and longitudinal force under linear static analysis against there's materials yield.

This report illustrates the detailed preprocessing & post processing with FEA plots of stress and deformation of each critical load cases.

MODELING & IDEALIZATION

The geometric model for FEM has been prepared in NX (UG) Software and imported in MSC APEX Structure environment for pre and post processing. The bogie frame meshed with solid tetrahedron elements. The bogie frame structure has been represented by nodes and solid tetrahedron elements as shown below. The total number of elements is 415959 has been created by meshing for FEM.

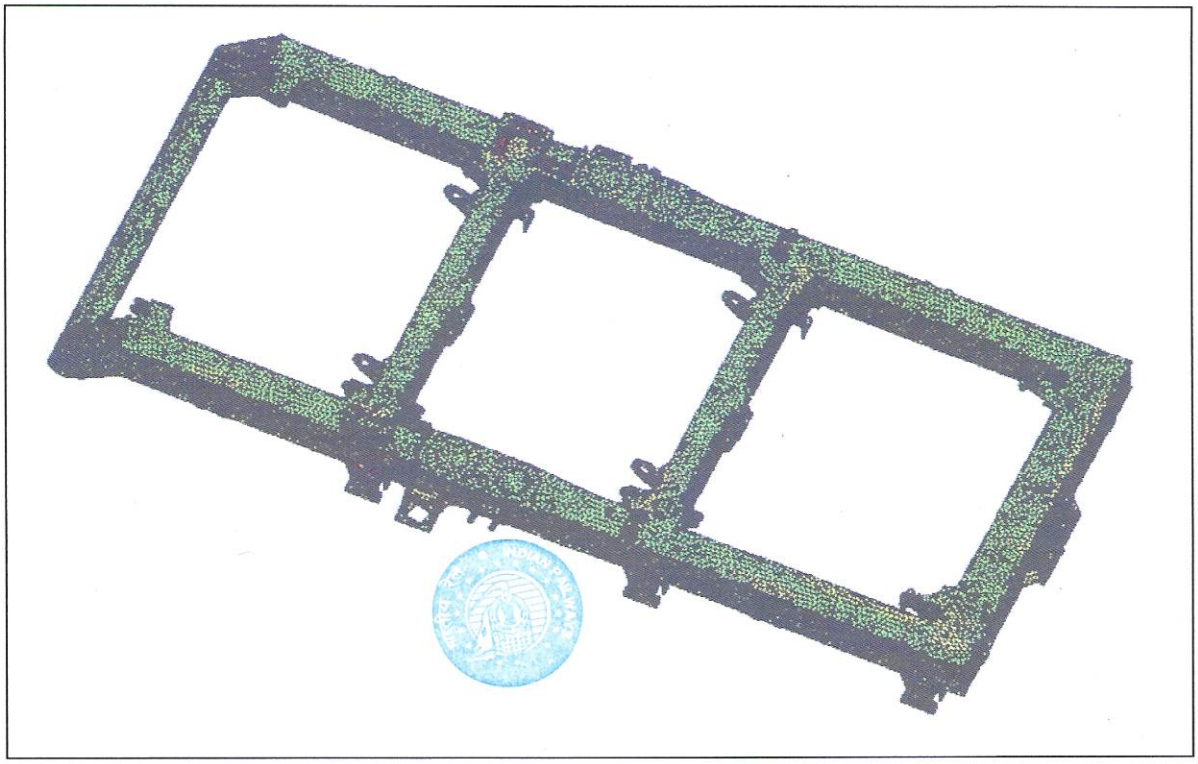


Fig. Mesh Model of Bogie frame

PHYSICAL PROPERTIES OF THE BOGIE FRAME MATERIAL

The bogie frame has been fabricated from steel to IS: 2062 Gr. E 410 , its UTS 540 MPa and yield stress is 410 MPa

Permissible Stress:

As per Motive Power Directorate existing Practice,following criteria has been adopted for permissible stresses of bogie frame material under different load cases:

- The maximum stress should not exceed 60% of the yield stress of material i.e. 246MPa for all load cases except 3.0V load case
- For 3.0V load case the maximum stress should not exceed the 100% of yield stress of material

COORDINATE SYSTEM & UNITS

Coordinate system used herein is as given below:

Axis	Direction
X	Longitudinal
Y	Lateral
Z	Vertical

The following units have been used for measurement of length & force:

Length : mm

Force : N

RESTRAINTS

For all the load cases, the restraints for ***Vertical Loads*** are as given below:

Axis	Type
X	Free
Y	Free
Z	Fixed

For all the load cases, the restraints for ***Longitudinal Loads*** are as given below:

Axis	Type
X	Fixed
Y	Free
Z	Free

For all the load cases, the restraints for ***Lateral Loads*** are as given below:

Axis	Type
X	Free
Y	Fixed
Z	Free

FEA Result Summary

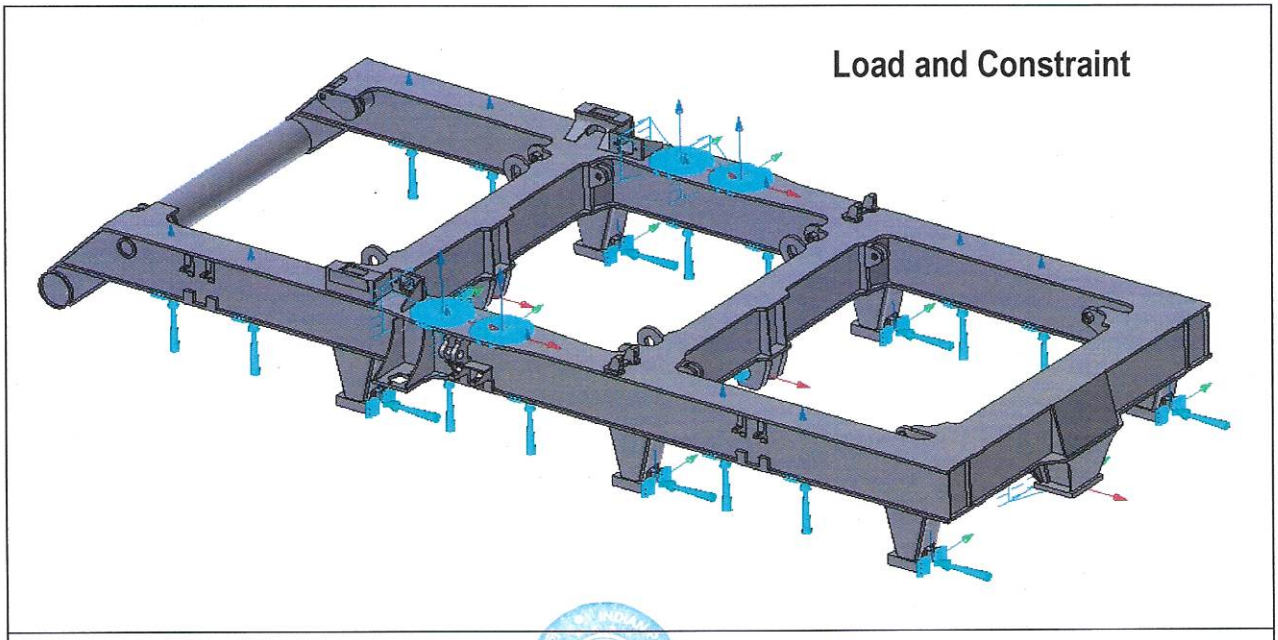
Bogie Frame FEA Result:

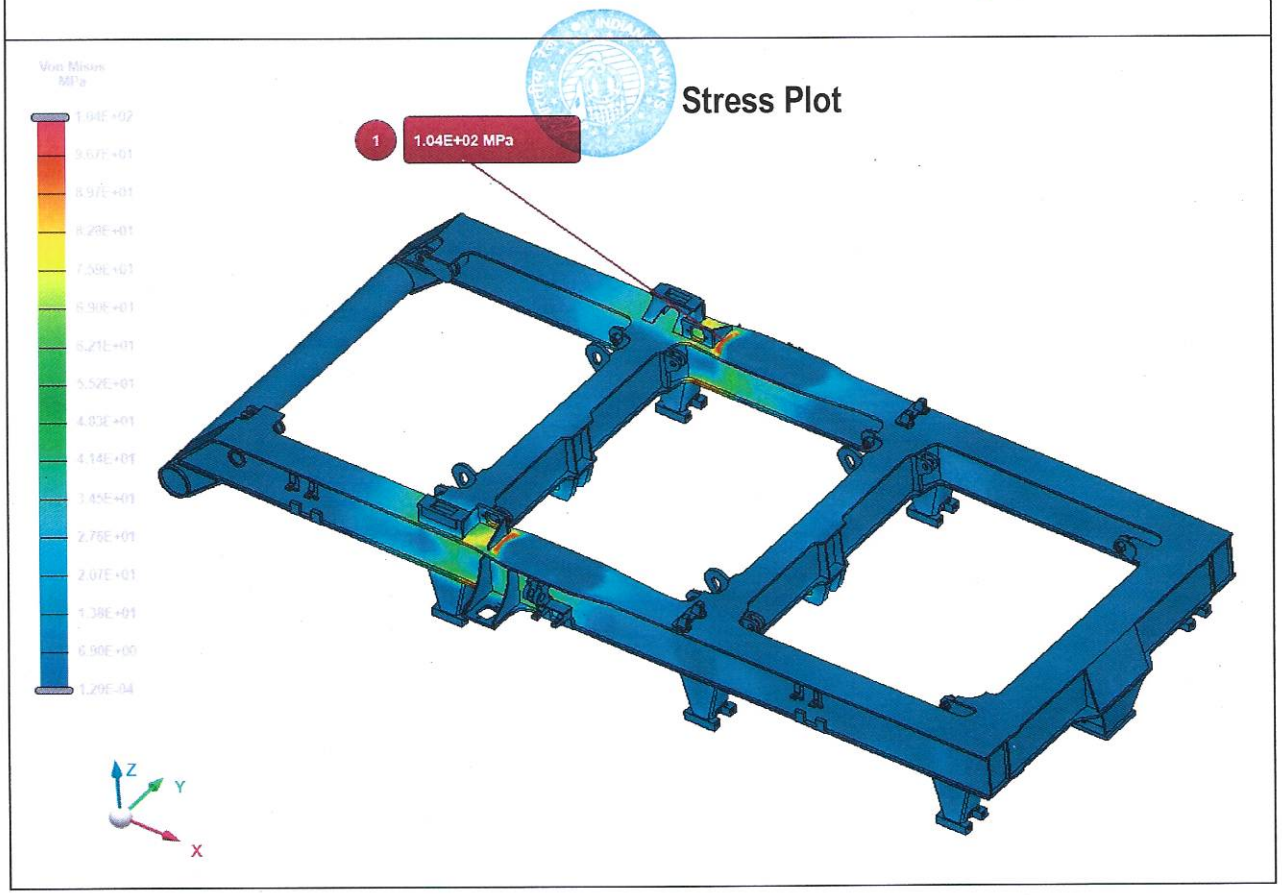
The following seven critical load cases are formed in accordance to Motive Dte. existing practice to analyze bogie frame structure strength in worst scenario.

S.No.	Critical Load Case	Max. Stress Value at critical location (MPa)	Limiting Value
1.	1.35V+ADHs	104.0	246 MPa
2.	1.35V-ADHs	94.0	246 MPa
3.	3.0 V	210.0	410 MPa
4.	1.5Vlt+1.35Vrt+ADHc+FTMr+LAT	146.0	246 MPa
5.	1.5Vrt+1.35Vlt+ADHc+FTMr+LAT	152.0	246 MPa
6.	1.5V+ADHc+ FTMr +LAT	158.0	246 MPa
7.	1.5V+FBH+ FTMr +LAT	125.0	246MPa

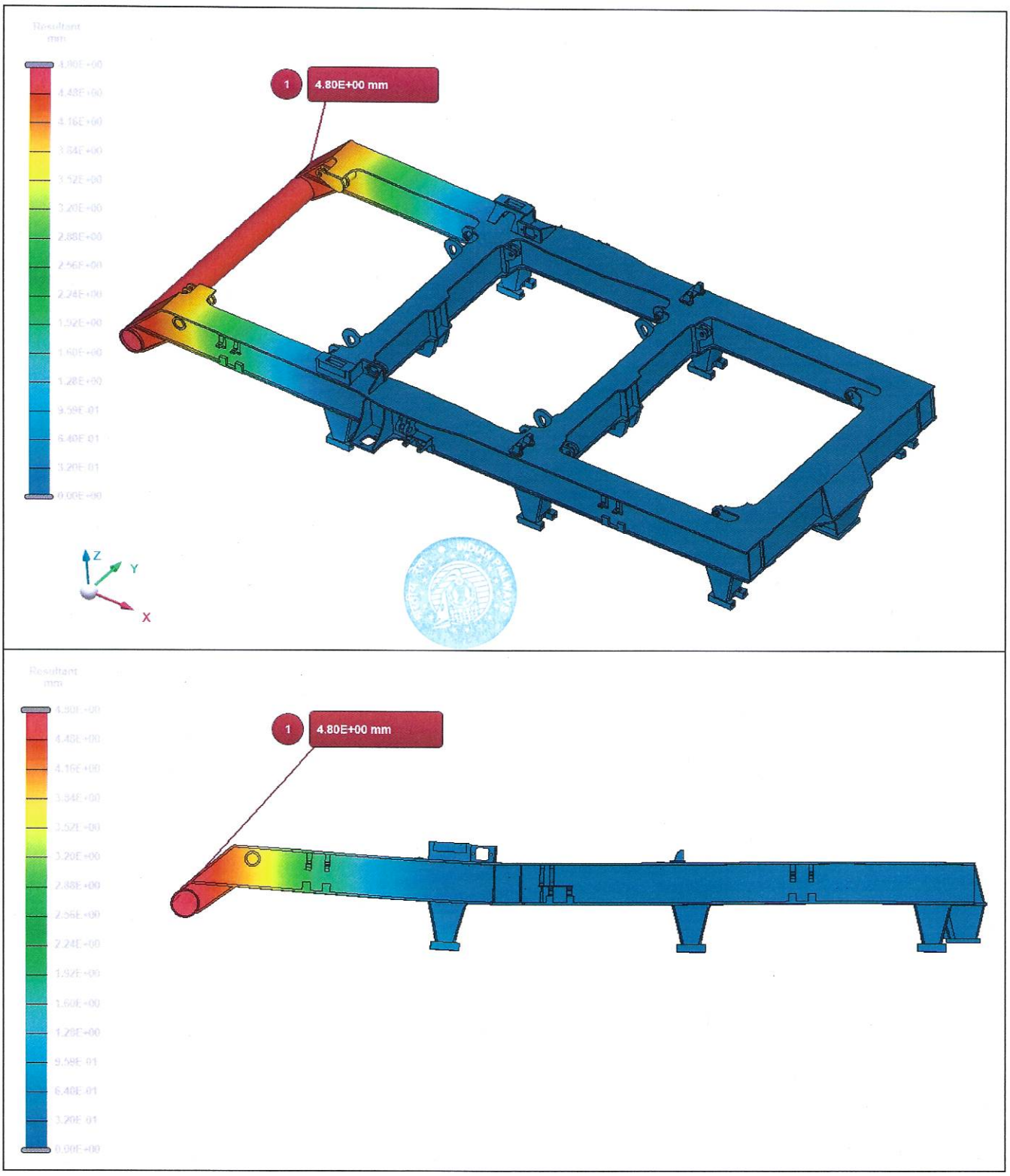
Stress and Deformation plots of Bogie Frame FEA results

Load Case 1. 1.35V+ADHs

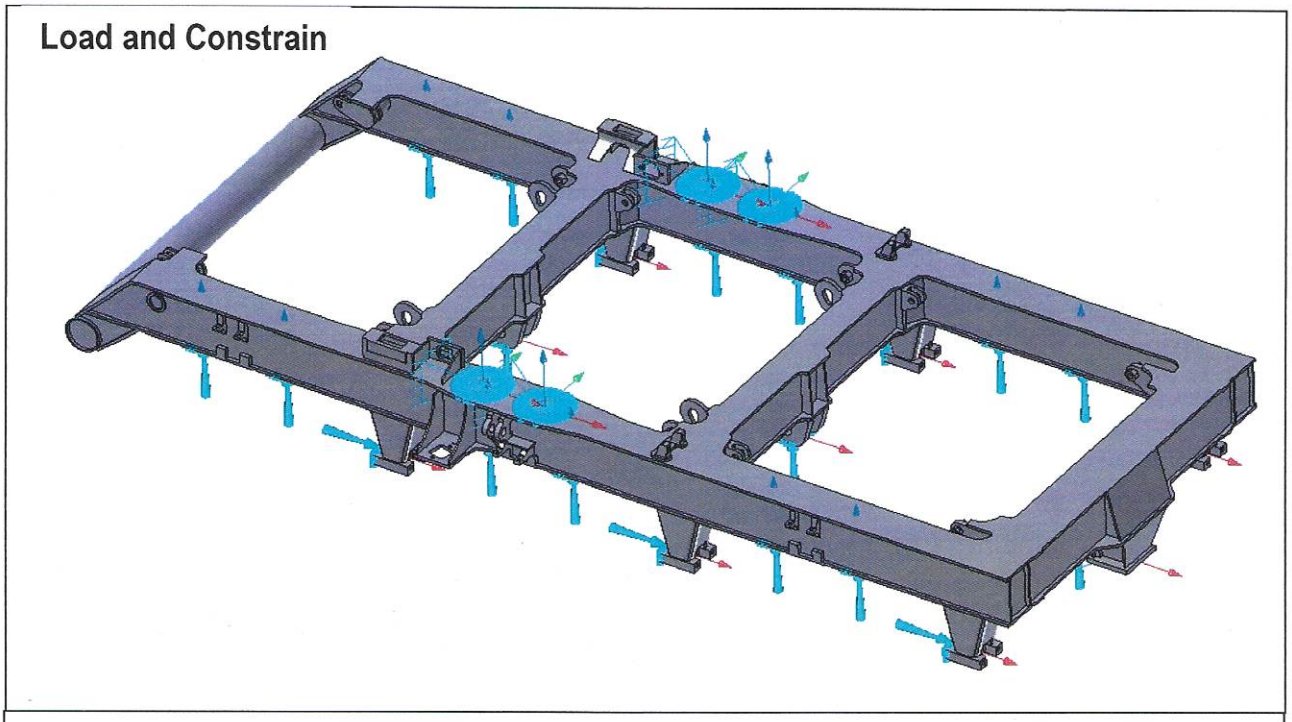


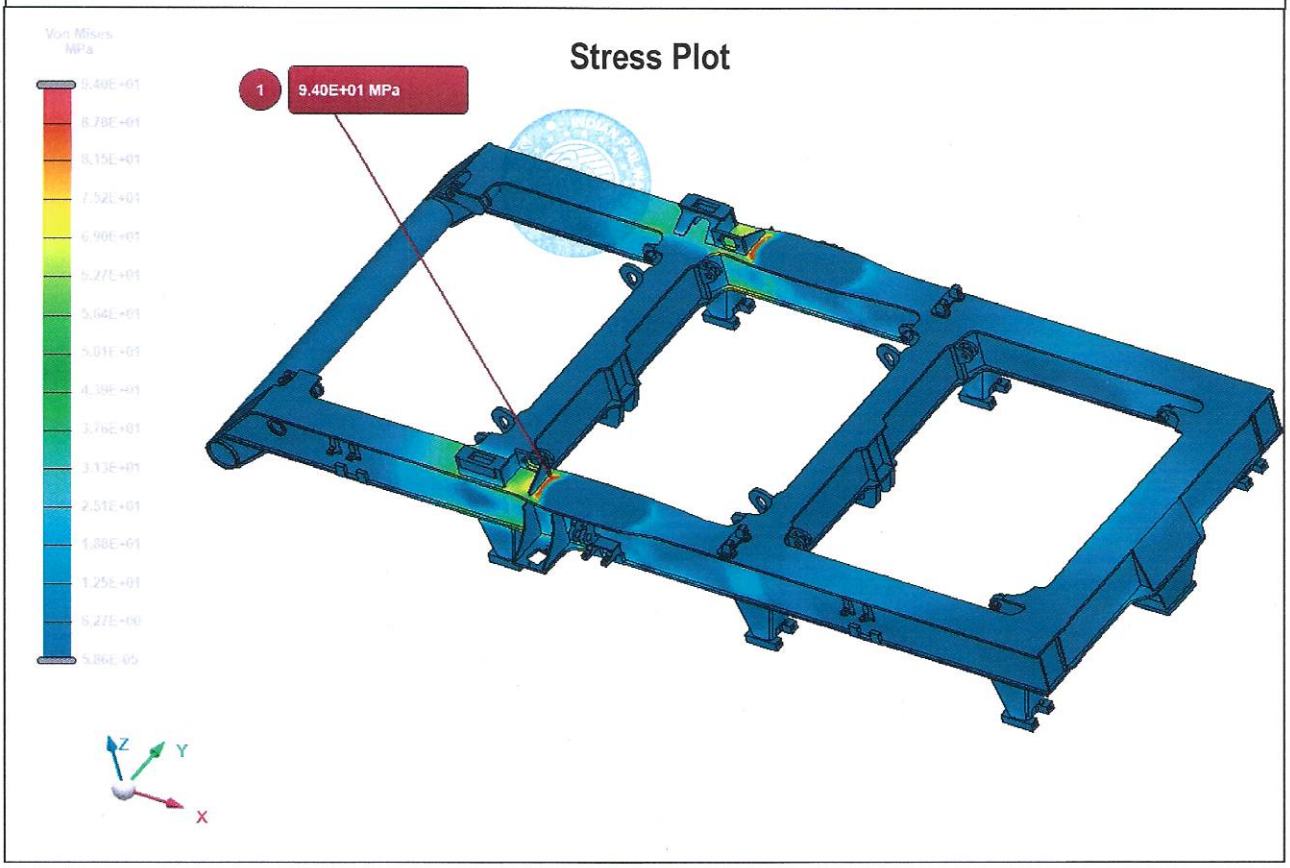


Deformation



Load Case 2. 1.35V-ADHs





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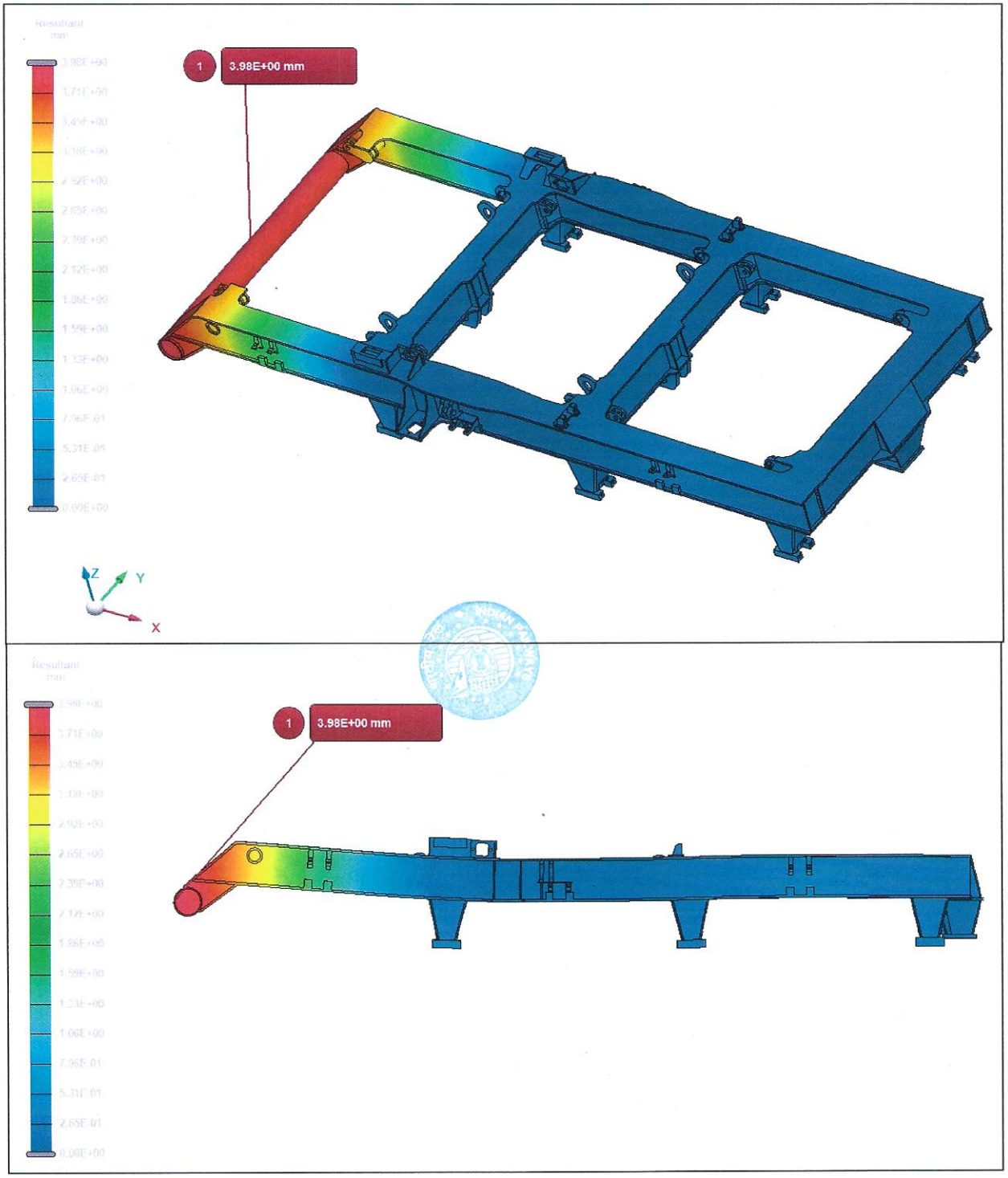
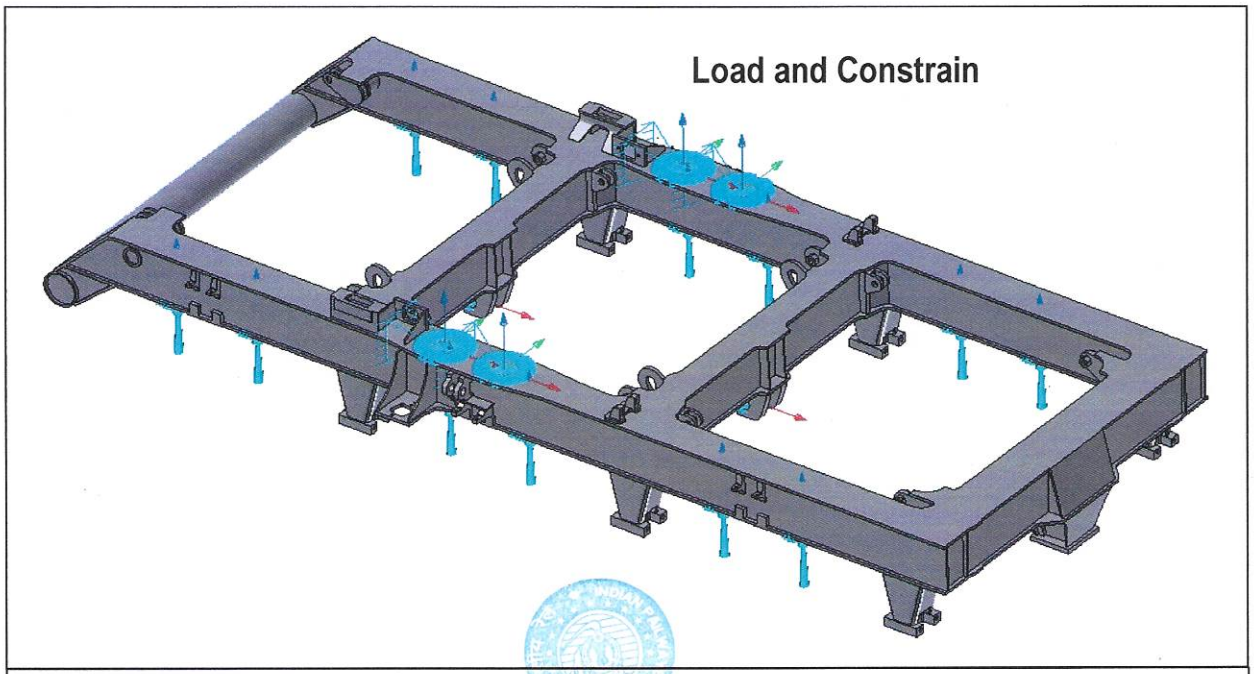
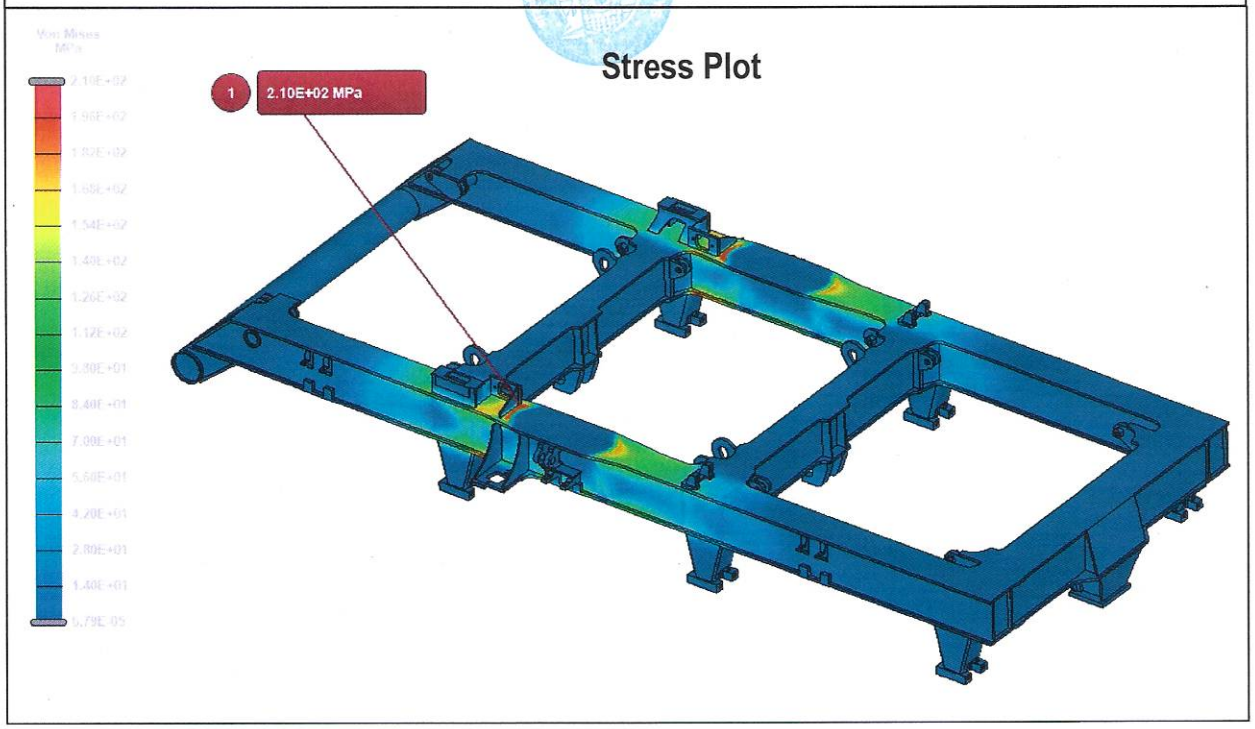


Load Case 3. 3.0V





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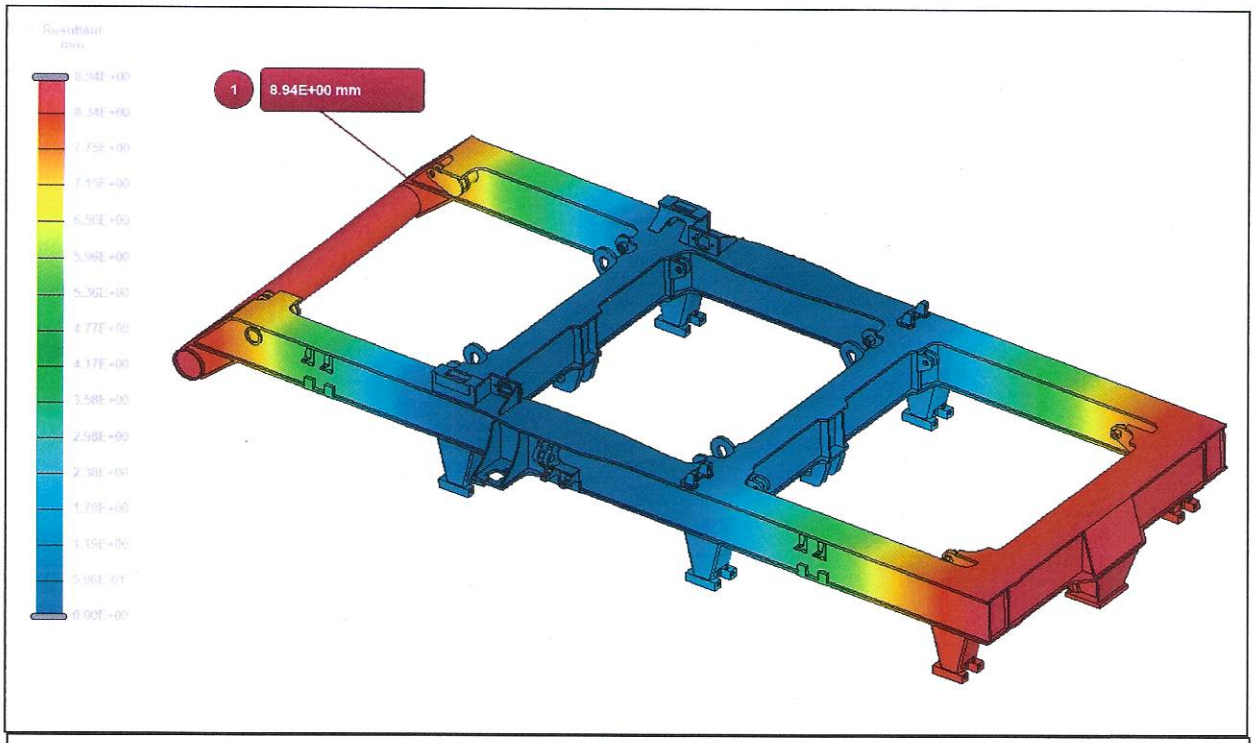
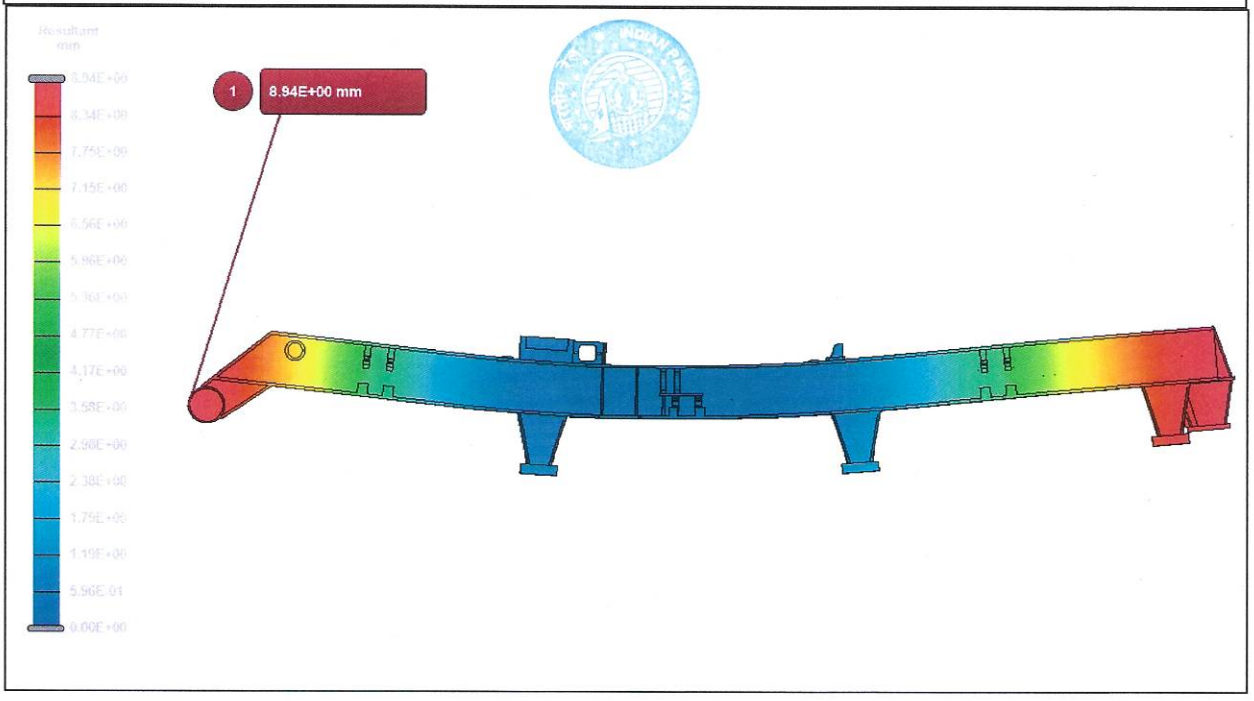
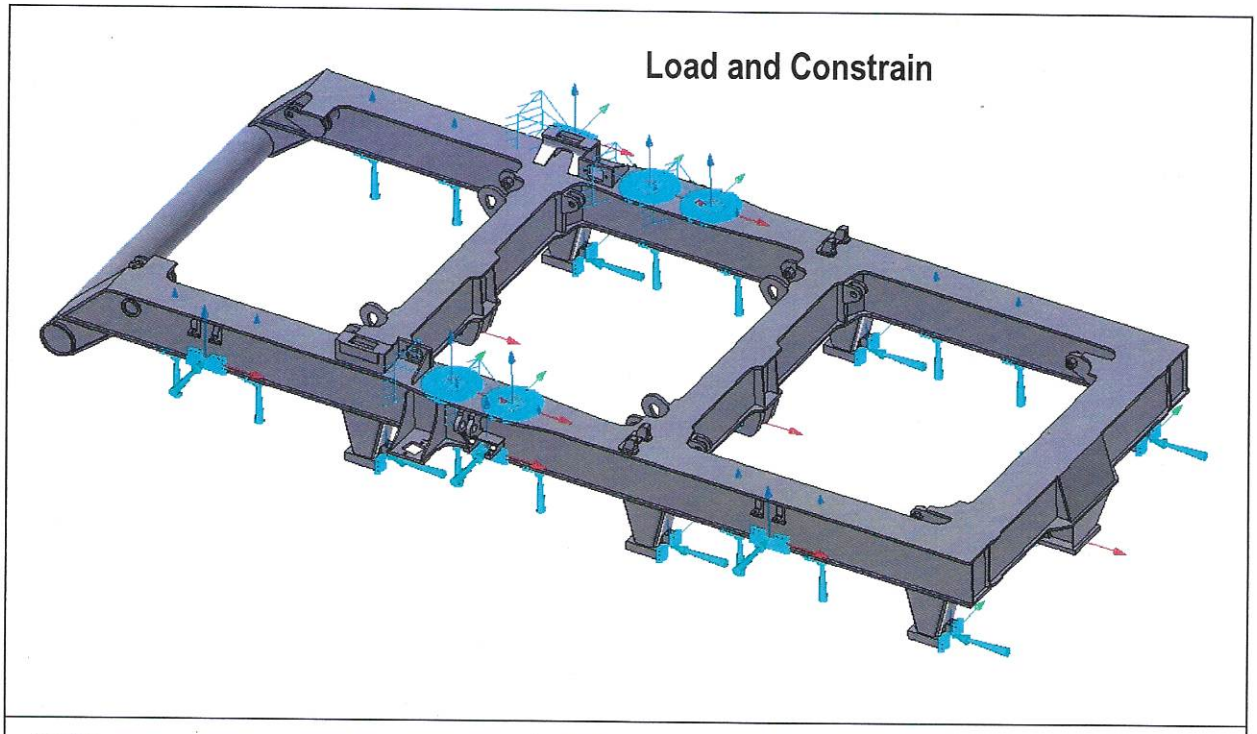
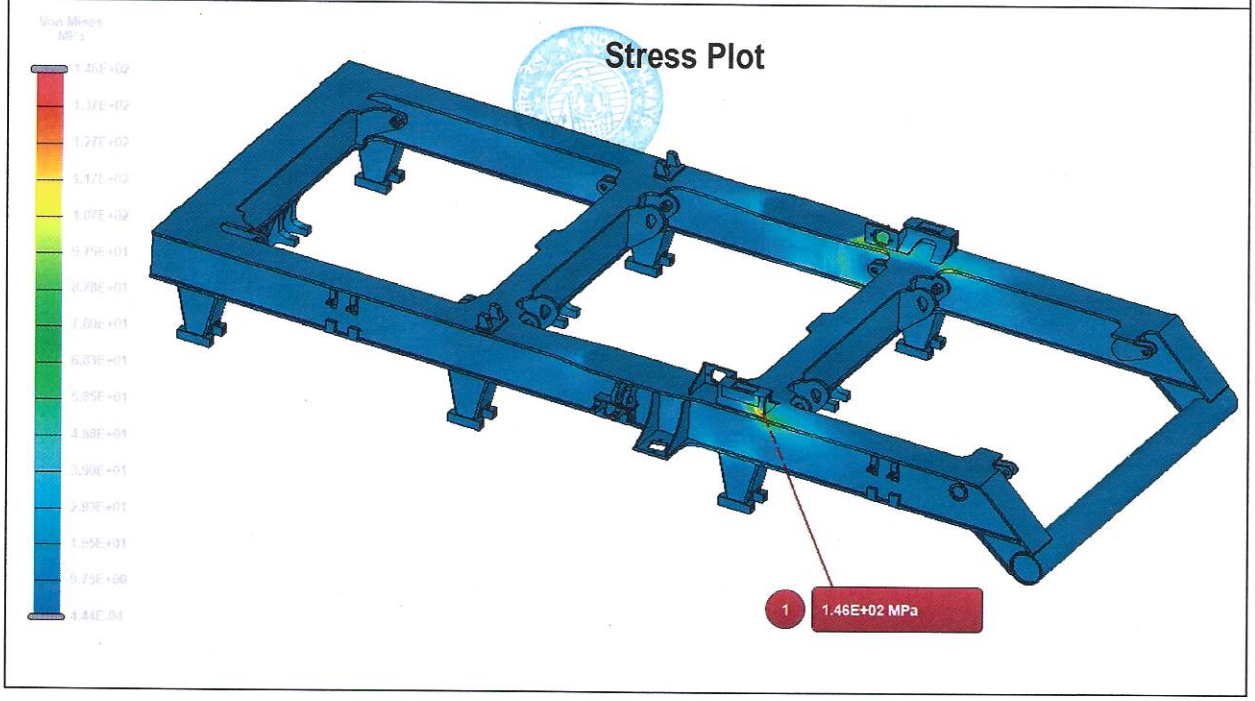




Load Case 4. 1.5 Vlt +1.3Vrt + ADHc + LAT





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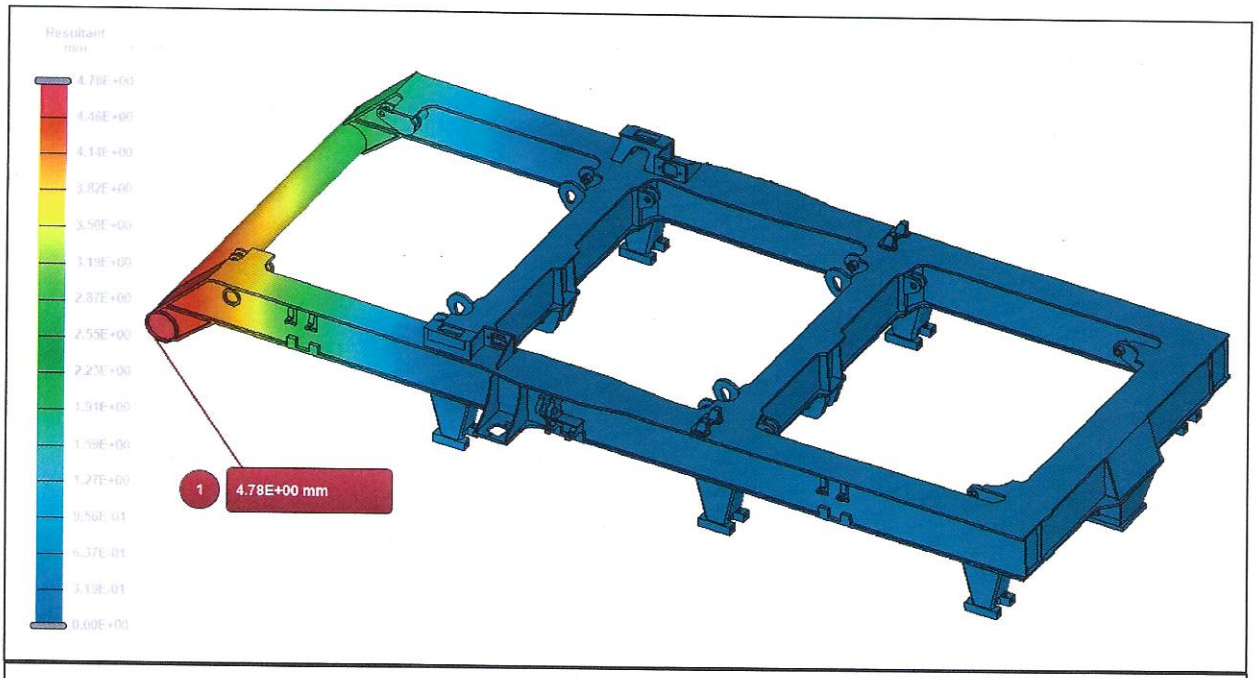
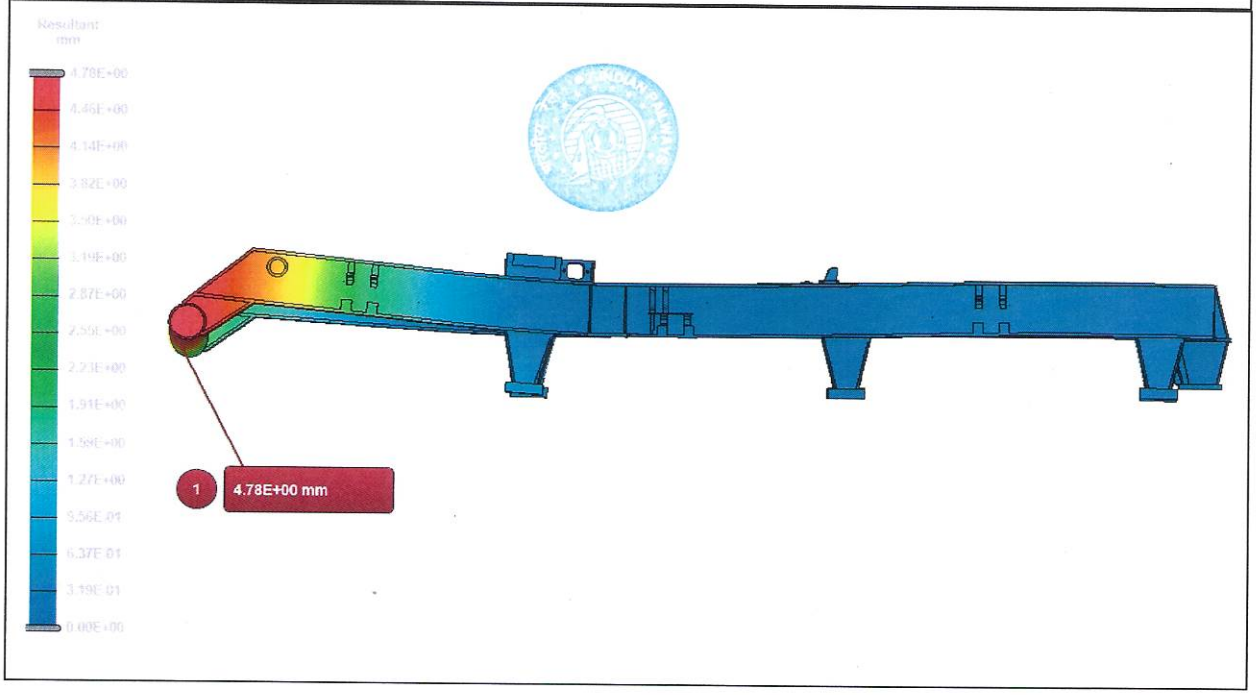
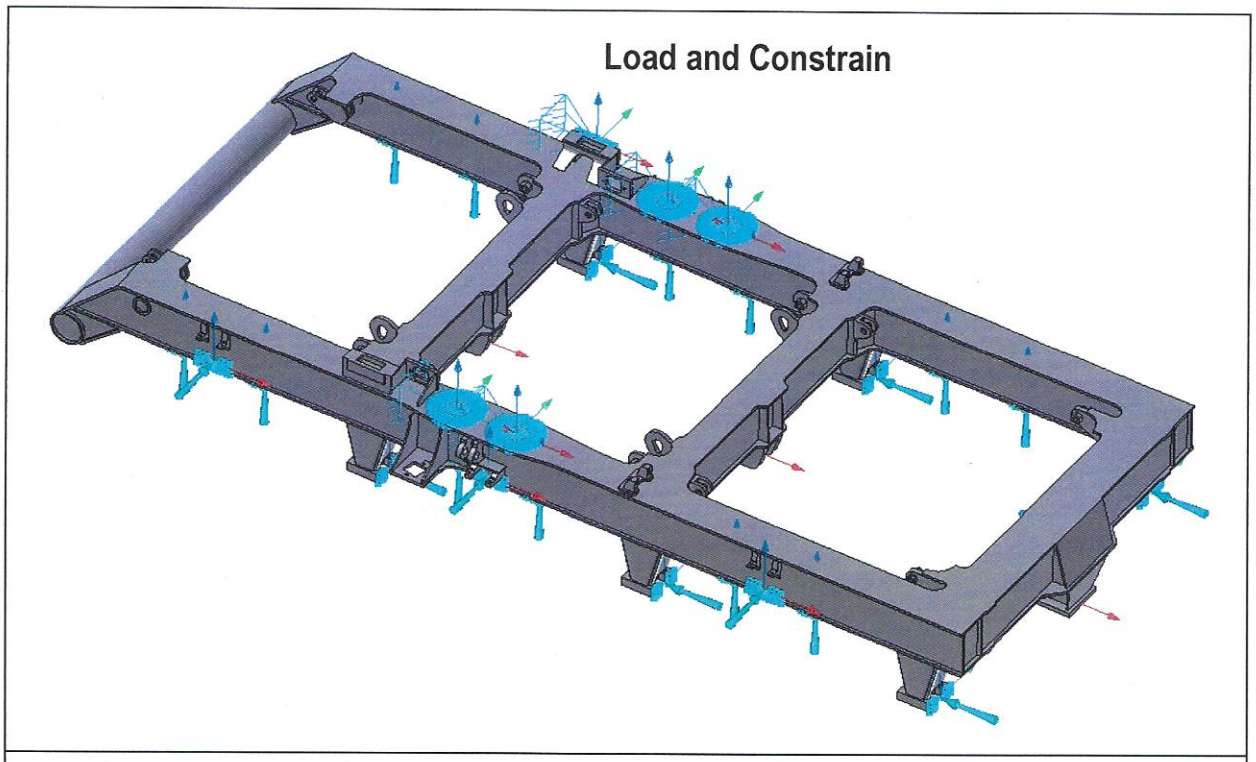
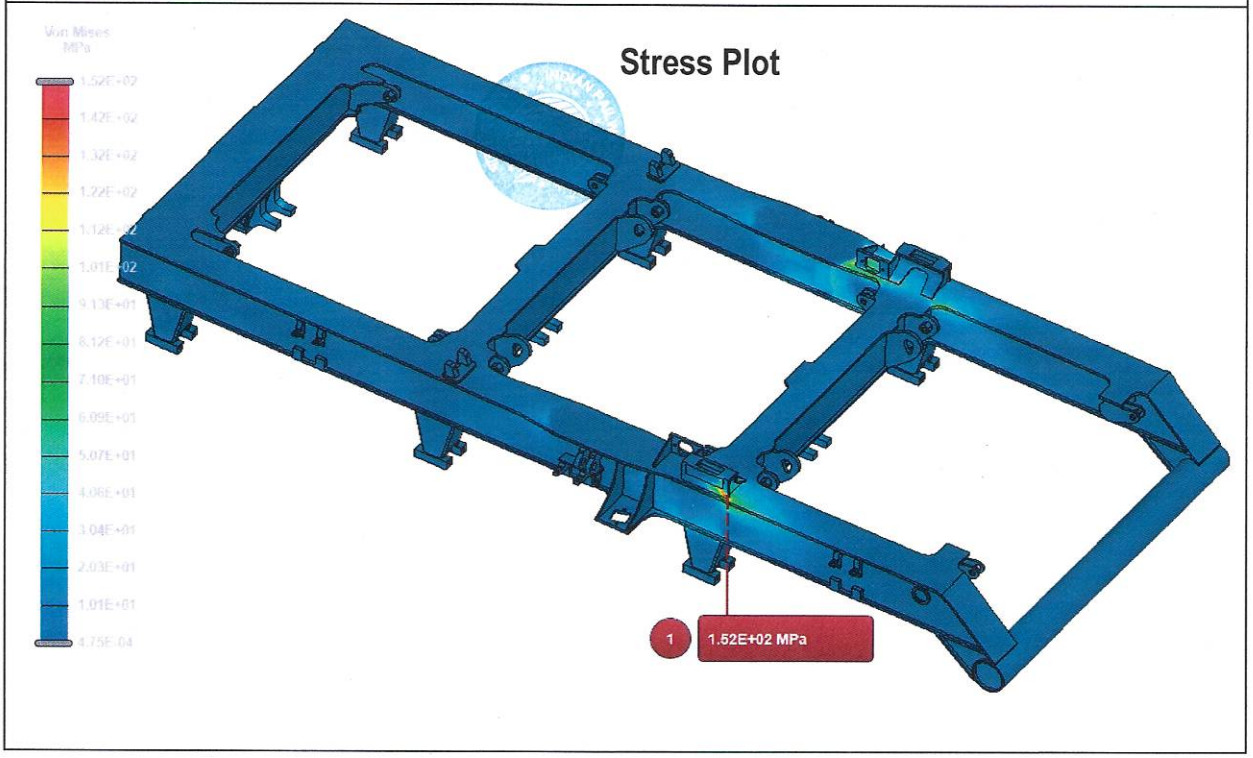




Load Case 5. 1.5 Vrt +1.3Vlt + ADHc + LAT





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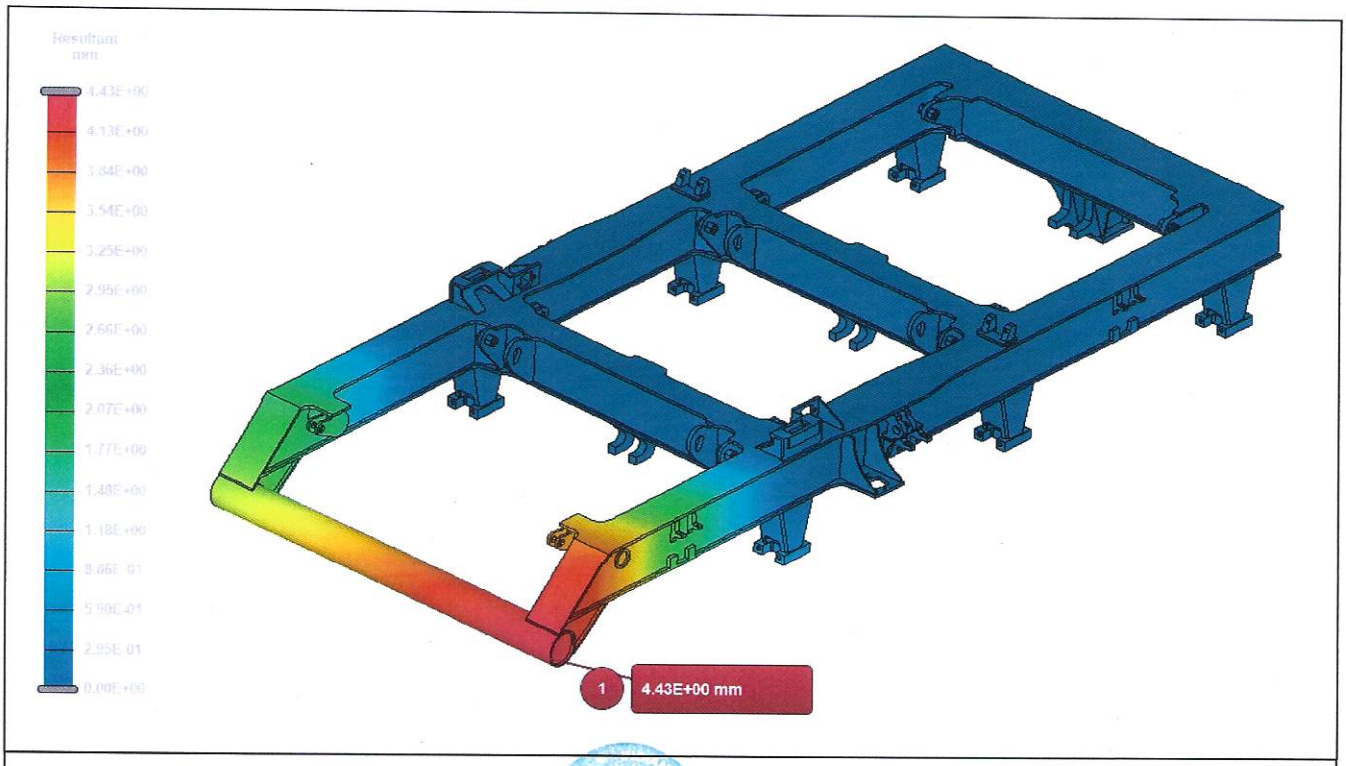
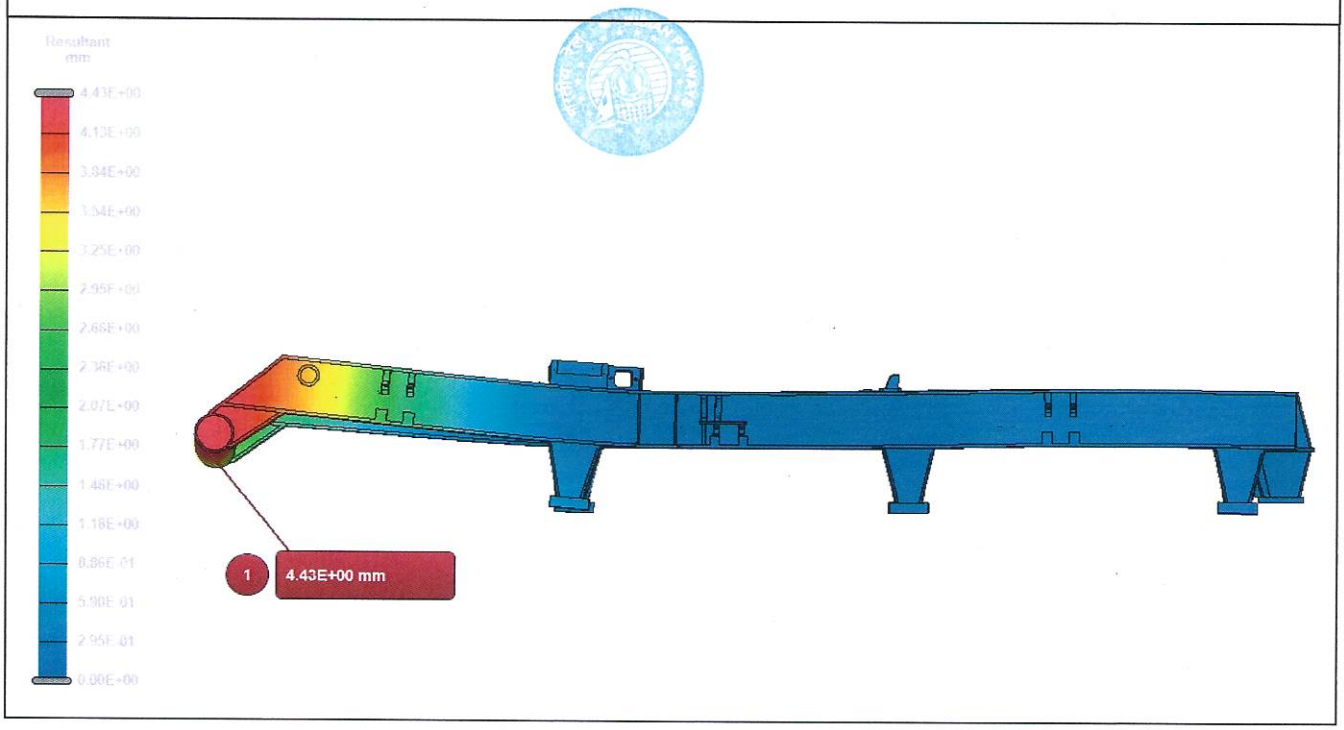
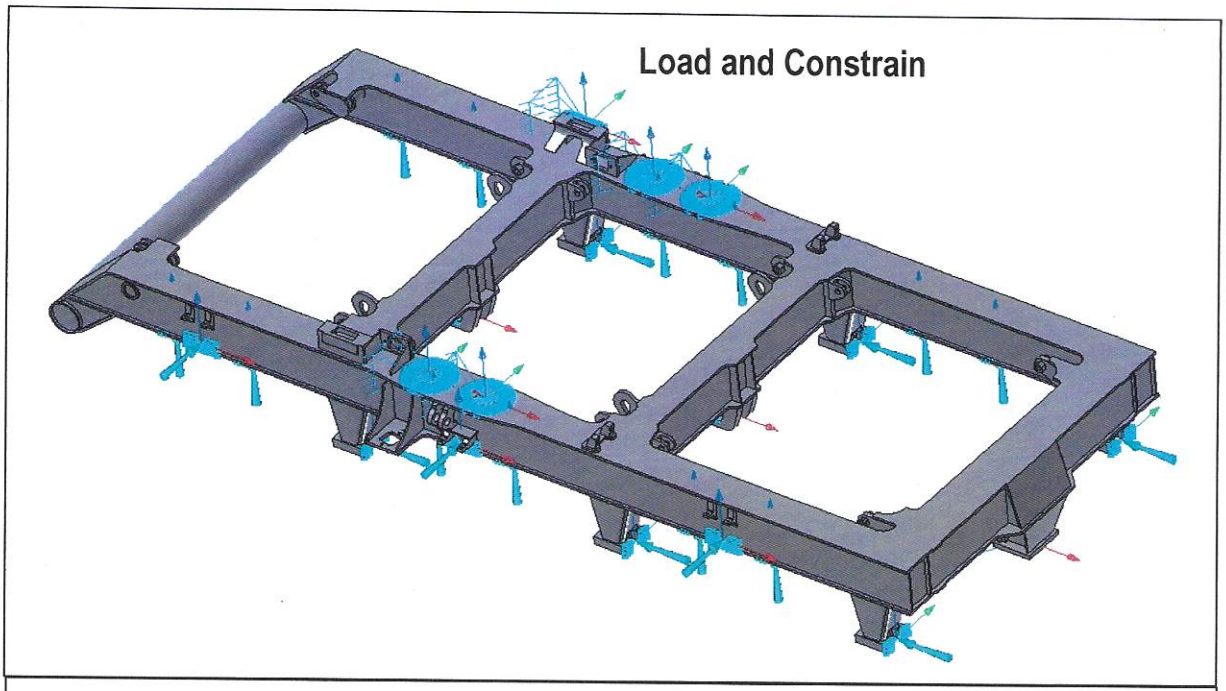
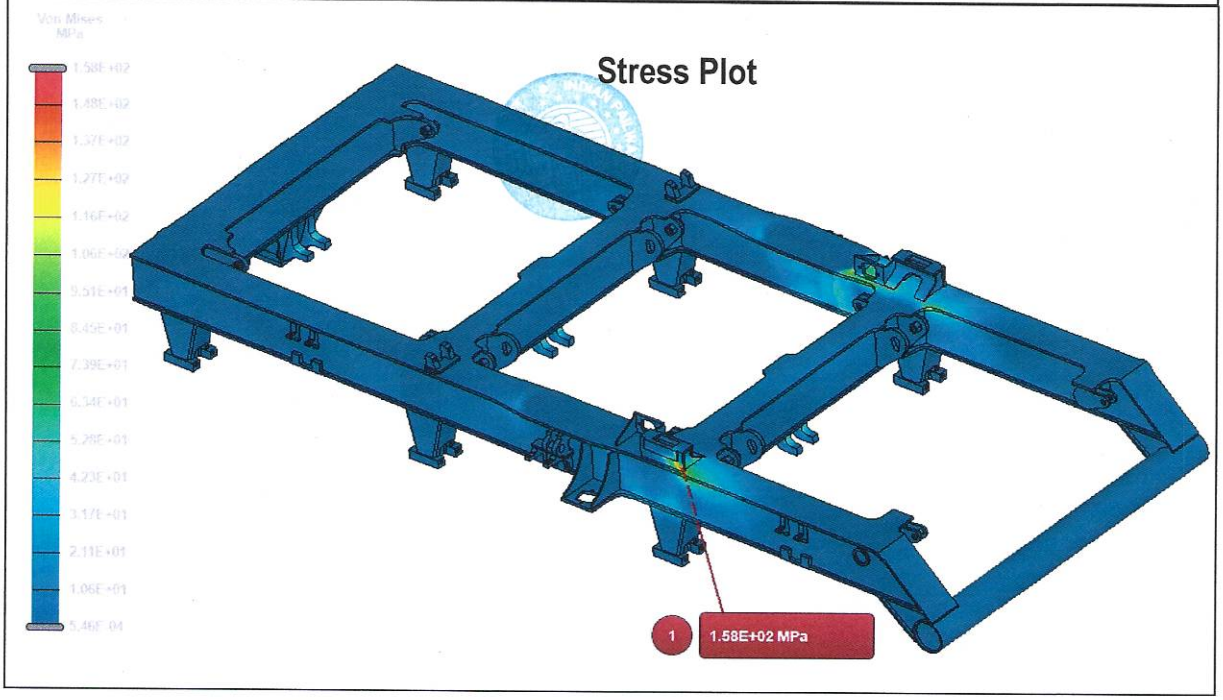




Load Case 6. 1.5V+ADHc+LAT





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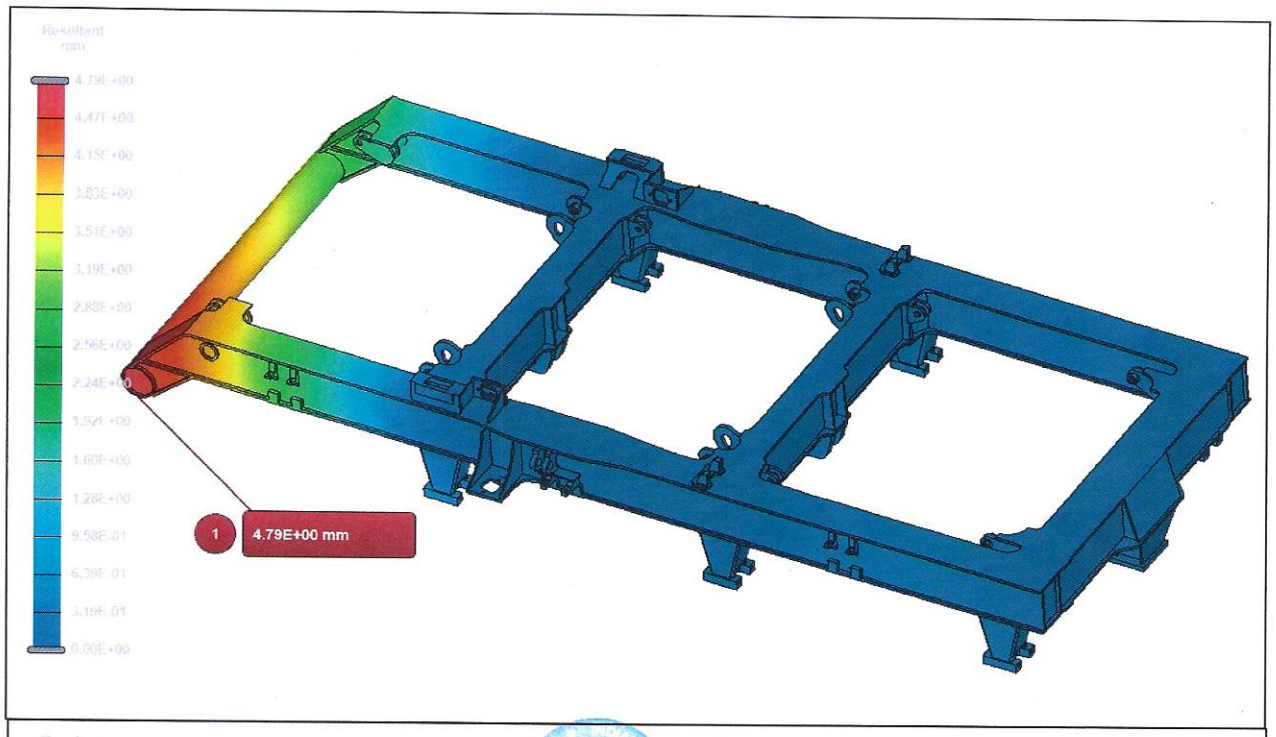
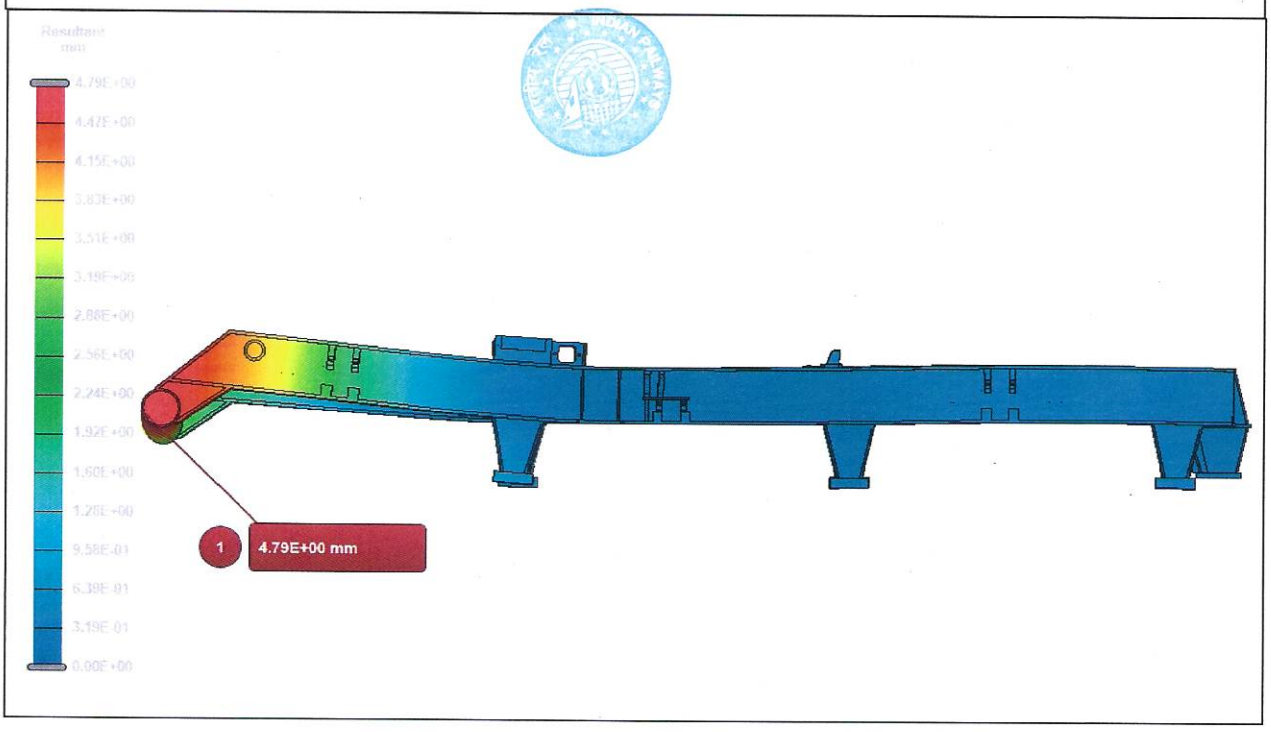
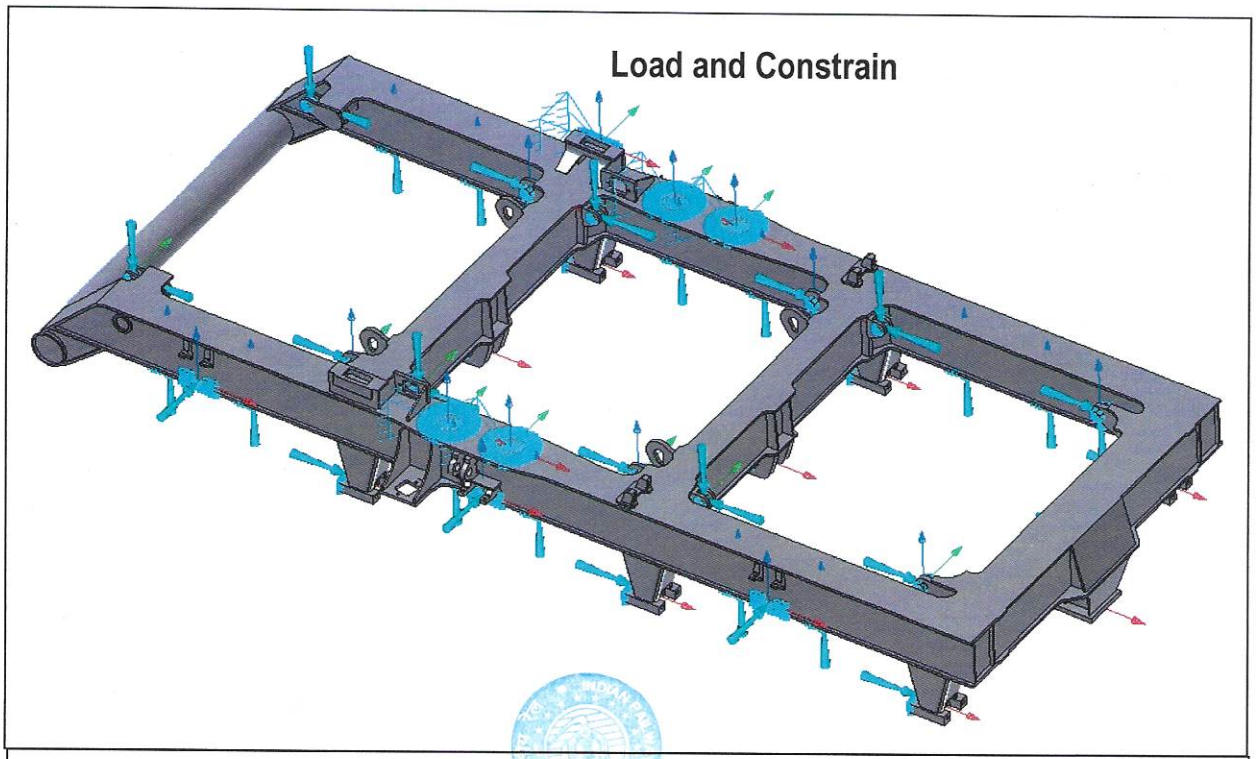
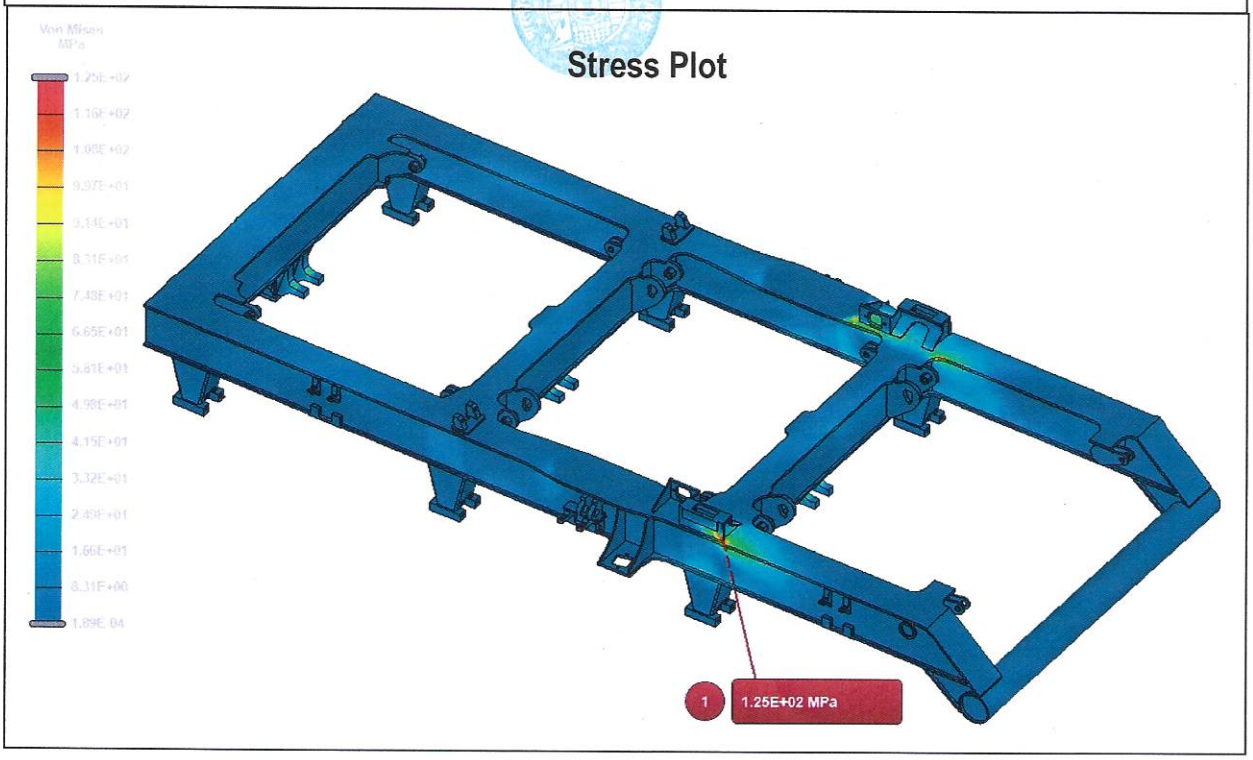




Load Case 7. 1.5V+FBH+LAT





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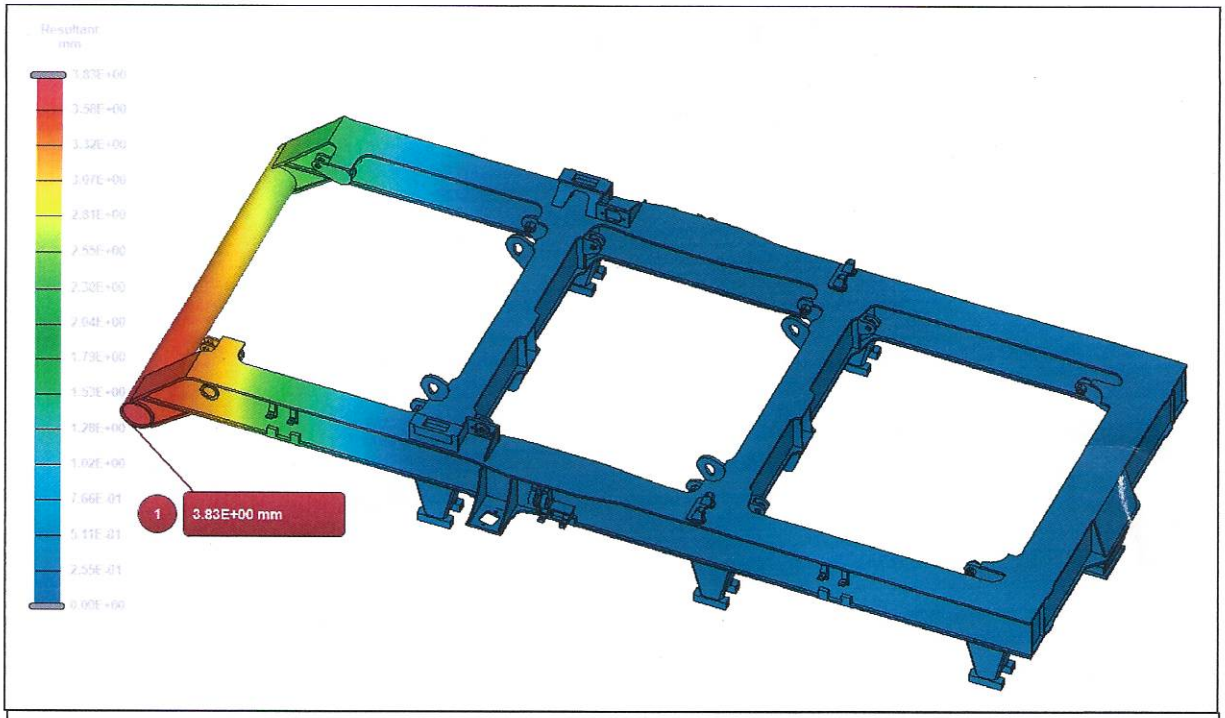

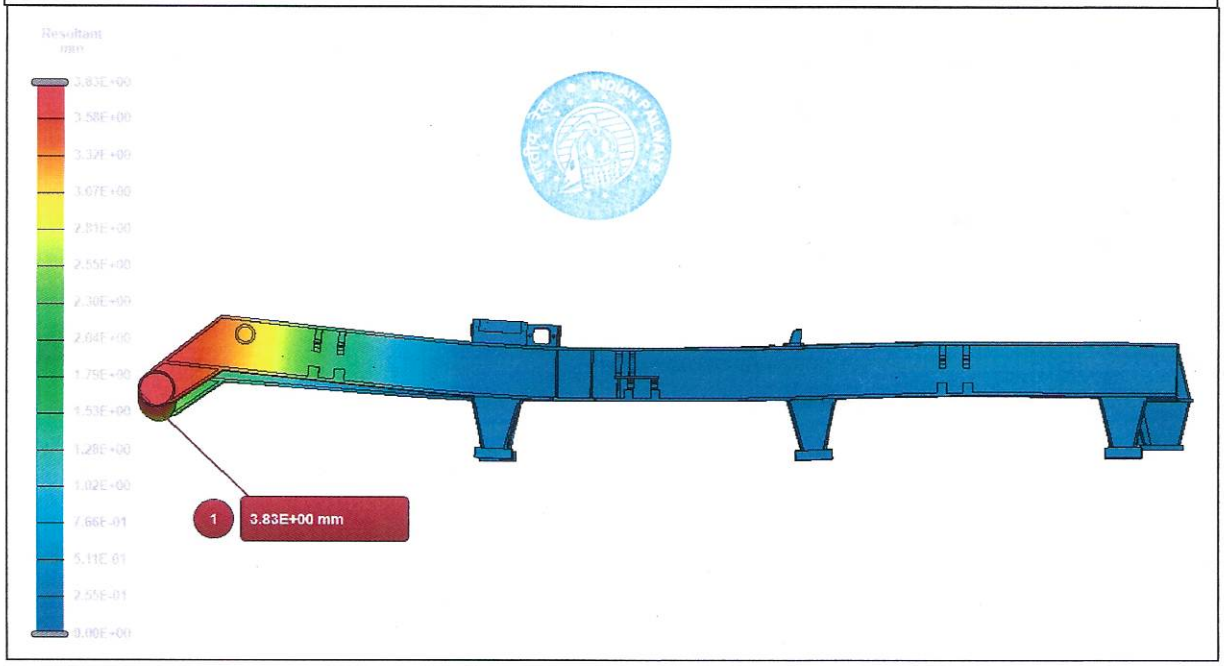

Conclusion: **Analysis of Bogie frame has been completed with different critical load combinations and the resultant stress values observed are within permissible limit of material strength.**