Structural and Failure Analysis of Suspension Spring of Railway Engine WAG-9,Locoshed Ajni,Nagpur,India.

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ABSTRACT : The objective of the research paper is to give analytical treatment to suspension spring used in Indian railways engine WAG-9 at Loco Shed Ajni,Nagpur,India,using CREO and ANSYS tool.This paper is extension part of previous paper entitled,"Study and problem identification for failure analysis of suspension springs of Indian railway engine WAG-9 Loco Shed Ajni,Nagpur, India.We are provided with official data regarding the design details of suspension spring.According to the design details provided by the railway officials we prepared the design of suspension spring using CREO paramateric.The structural analysis is used to perform various analysis on same structure by considering various material used for manufacturing of suspension spring. In order to carry out the analysis ,we have gone through the various research papers,websites of various spring manufacturing industries to find out the best possible material that will meet our objective.The static analysis is carried out with the help of Finite Element Method by using ANSYS 14.0. For dynamic analysis concern, it is not possible to measure random dynamic forces which causes the failure of suspension spring in running condition.As the damage is only detected by physical supervision by railway maintainance staff,we performed various structural analysis on different materials for assembly of suspension spring comprises of primary and secondary spring.Thus,we have performed static analysis on selected materials and the detailed information regarding the best possible material selection is suggested in this paper.

INDEXTERMS - ANSYS, Structural,suspension,CREO,dynamic.

I. INTRODUCTION

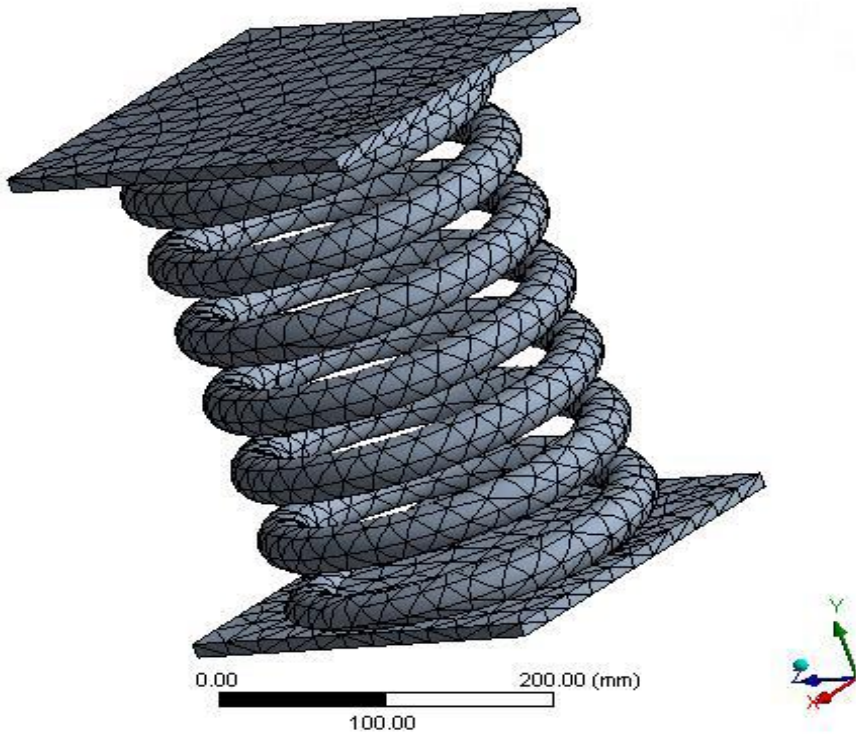
WAG-9 is a electric locomotive commissioned on 14.11.1998. It is placed in electric locoshed ajni. It is specially used for hauling goods. It has total 24 primary springs which is present in wheels of the loco and 8 secondary springs. The engine has a high rate of failure of specific spring. The study of failure revealed that the specific components fails at much higher rate between first to third coil from the top end. We discussed this with railway officials. They provided us with suitable data of the spring for our analysis. With the help of the dimensions provided we prepare the existing spring model by using CREO parametric 3.0 for further analysis on ANSYS 14.0. Currently, the spring which is used in railway engine WAG-9 is made up of chromium vanadium. For suggesting a better alternative in terms of performance, we have selected some materials in terms of various mechanical properties and then we analysed it on ANSYS 14.0. For selecting the spring material as a better alternative in terms of performance, we have gone through the official websites of various spring manufacturing industries.Various materials used for analysis are shown in following table-

SR.NO	MATERIALS
1.	Carbon Alloy
2.	Stainless Steel
3.	Chromium-Vanadium Steel (50CRV4)
4.	Titanium Alloy
5.	Copper Alloy
6.	Beryllium Copper Alloy
7.	Phosphorous Bronze
8.	Silico-Manganese Steel (38Si7,54SiCr6,60SiCr7)
9.	Aluminium Alloy
10.	Inconel 600

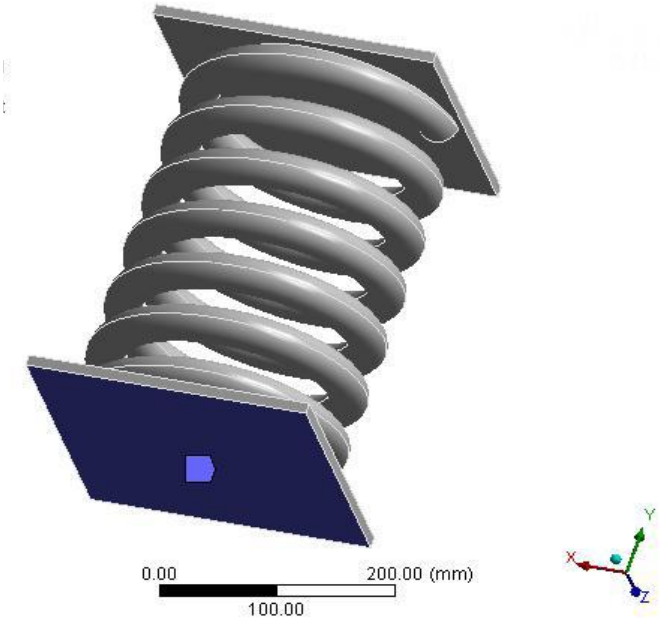
II. PROCEDURE TO CARRY OUT ANALYSIS

The design **of** springs which is shown above is used for further analysis of spring in order to identify the problem regarding the failure of suspension spruing as well as to suitable alternative to the problem identified.the analysis is carried out in ANSYS 14.0.The various aspects of analysis is shown in below figure.

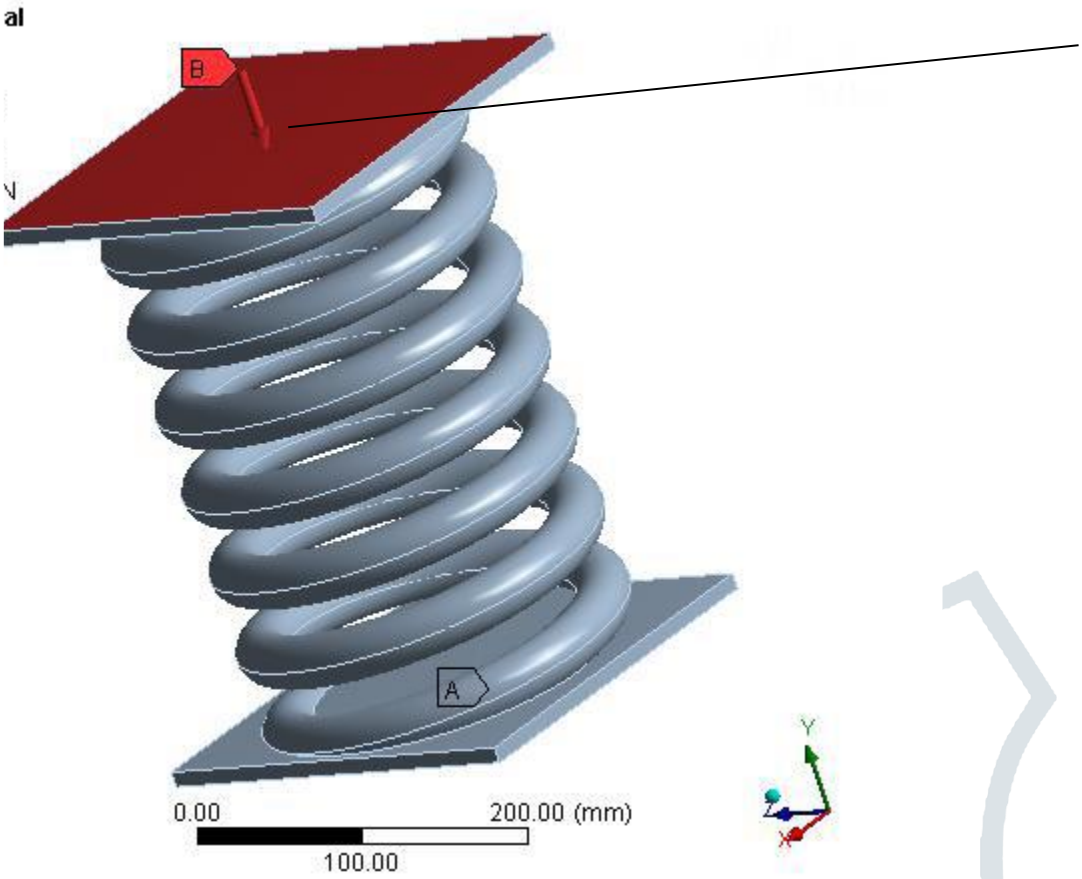
2.1 Meshing:- The spring design is prepared in order to mesh the spring in number of finite elements.



2.2 Applying Fixed Support:Fixed support is applied at base supporting plate.



2.3 Applyimg load :- The load is applied at above supporting plate.



SPRING TESTING DATA OF WAG-9 FOR ANALYSIS OF SECONDARY AND PRIMARY SUSPENSION SPRING

Spring	Free Height	Working Height	Working Load
Secondary spring	733.2mm	580.570mm	9867kg
Primary spring end axle	238.8mm	194.190mm	4138kg
Primary spring middle axle outer	258.6mm	194.190mm	3190kg
Primary spring middle axle inner	252.4mm	190.186mm	948kg

RESULT OF ANALYSIS(SECONDARY SPRING):-

SR.NO	MATERIALS	DISPLACEM -ENT	MAX STRESS	MIN STRESS
1.	Carbon Alloy	122.76	1239.9	223.36
2.	Stainless Steel	131.82	1082.9	254.53
3.	Chromium-Vanadium Steel (50CRV4)	128.27	1277	937.61
4.	Titanium Alloy	274.52	1637.9	916.24
5.	Copper Alloy	236.35	1268.2	1031
6.	Beryllium Copper Alloy	203.93	1277	937.61
7.	Phosphorous Bronze	236.52	1227.2	920.35
8.	Silico-Manganese Steel (38Si7,54SiCr6,60SiCr7)	192.32	1268.2	1031
9.	Aluminium Alloy	363.57	1269.8	946.18
10.	Inconel 600	117.14	1607.1	627.2

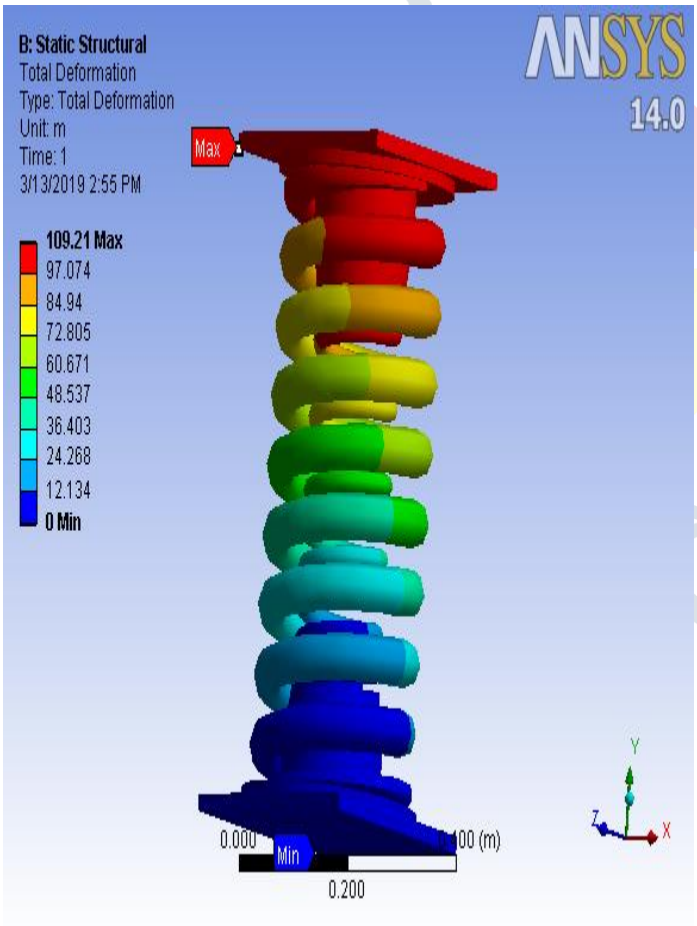


Fig. Secondary spring Displacement

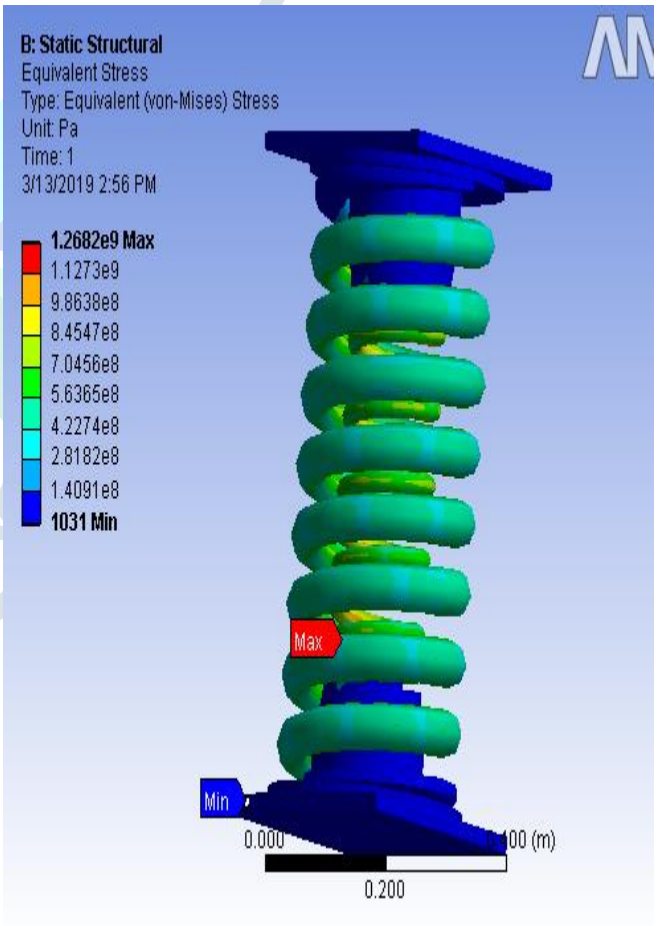


Fig. Secondary spring Stress

RESULT OF ANALYSIS(PRIMARY SPRING):-

SR.NO	MATERIALS	DISPLACEM -ENT	MAX STRESS	MIN STRESS
1.	Carbon Alloy	61.85	1599.7	**148.9**
2.	Stainless Steel	66.71	1626.6	**114.31**
3.	Chromium-Vanadium Steel (50CRV4)	64.9	1620.5	**122.48**
4.	Titanium Alloy	138.98	1637.9	**99.084**
5.	Copper Alloy	119.6	1648	**85.365**
6.	Beryllium Copper Alloy	102.99	1641.5	**94.086**
7.	Phosphorous Bronze	119.69	1619.9	**123.32**
8.	Silico-Manganese Steel (38Si7,54SiCr6,60SiCr7)	66.78	1648	**85.368**
9.	Aluminium Alloy	183.99	1643.1	**92.018**
10.	**Inconel 600**	**59.29**	**1607.1**	**139.84**

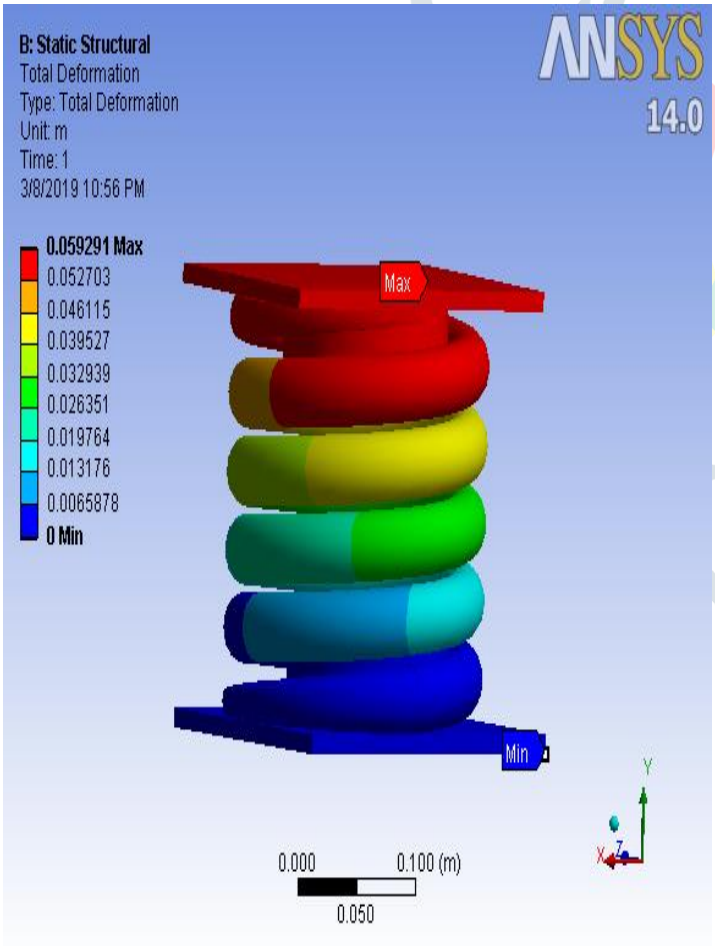


Fig. Primary Spring Displacement

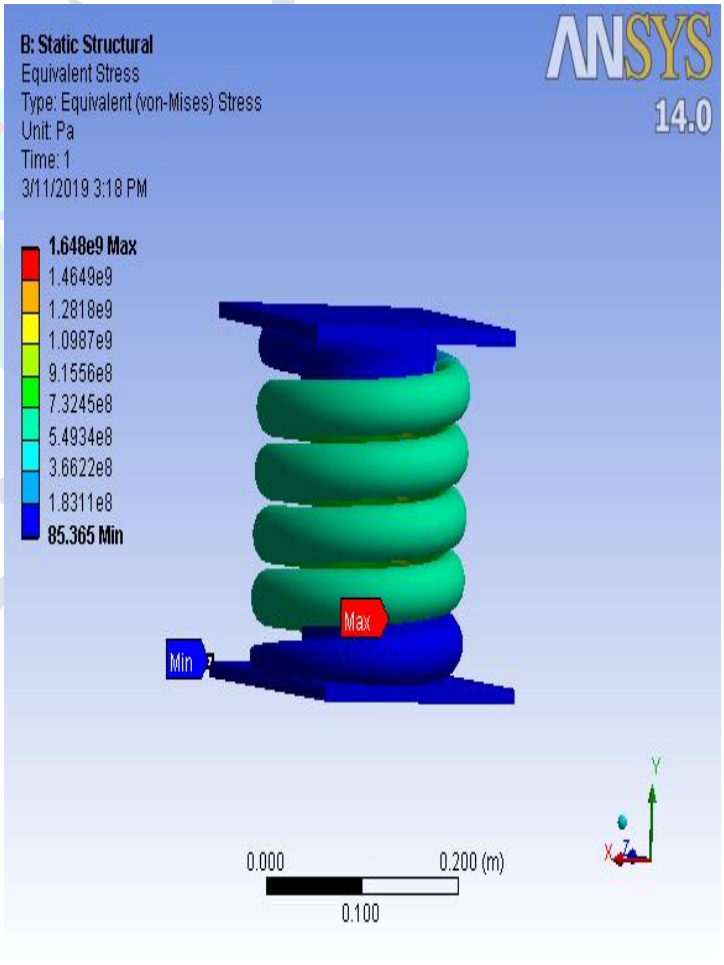


Fig. Primary Spring Stress

III. RESULT AND CONCLUSION:-

- We have successfully analysed the various materials of spring.
- After analysing the various materials, we found that INCONEL 600 has the lowest displacement and higher strength among the various materials that we have selected.
- Therefore, according to our analysis we found that INCONEL 600 is the better alternative in terms of performance.

REFERENCES

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