ISSN XXXX XXXX © 2017 IJESC

Research Article Volume 7 Issue No.10

Analysis of Locomotive Brake-Hanger Failure

Sachin Bhakare[1], Vednath Kalbande[2], Rajat Kakde[3], D.R. Bele[4]
Student[1, 3], Assistant Professor[2], Senior Section Engineer[4]
Department of Mechanical Engineering[1, 2, 3]
GHRCE, Nagpur, India[1, 2]
DBACER Nagpur, India[3]
Electric Loco Shed Ajni, Nagpur, India[4]

Abstract:
The locomotive is an assembly of various systems which provides the required tractive force for the train. The braking system is the most critical system of the locomotive. There are some systems which need inspection. One such system is the brake system. One of the components in the brake system more subjected to failure is the BRAKE HANGER. The cases of breakage of inner hangers towards bogie frame are much more with 80% of the total failures. In this paper the failure of the brake hanger is analyzed in static and dynamic stress conditions. This paper deliberates on root cause analysis of the problems, issues related with brake hanger in WAG-9 locomotives, operating at a speed of 130 KMPH and on remedial measures most suitable for WAG-9 locomotives without making any structural change in bogies. The goal of the project is to develop a high-speed train system capable of reaching the maximum speed and to secure its key technologies, one of which is the braking technology.

Keywords: Locomotive, Hanger, WAG-9, Failures.

1. INTRODUCTION

Indian Railways is the largest transportation system in the country. Based on purpose we are having the power generation units like WAG and WAP. To drive the massive load of the train we require the heavy motive power. When we had this heavy power, we need a good controlling system (braking system) for the safe operation to stop the train at a safe without any discomfort to the passenger. The breakages of hanger are directly related with the higher speed of 130 KMPH in WAG-9, which are due to high level of vibrations and shocks at higher speed. The matter was so serious from the point of view of safe train operation. Thus, each and every component of the braking system should function properly for the safe journey.

1.1 WAG-9 Type Electric Locomotives:

WAG-9 is the name of a type of electric locomotive used in India. It is the 7th class of Broad Gauge's (W) AC charged (A) and Freight-dedicated (G-Goods) locomotives. In the locomotive vehicle market WAG-9 is more economical option and one of the most affordable in the world. Hence, it has the highest production figures of any locomotive in India.

Figure.1. WAG-9 Type Electric Locomotive

Table.1. Technical Specifications of Electric wag-9

INTRODUCED IN	NOVEMBER 1998
SYSTEM VOLTAGE	25KV AC
CONTINUOUS H.P.	6120
TRACTION MOTOR	3 PHASE AC
MAXIMUM SPEED	100 KMPH
STARTING T.E.	46.9 T
CONTINUOUS T.E.	33.1 T
TYPE OF BOGIE	FABRICATED
GEAR RATIO	15:77 AND 21:107
BRAKE SYSTEM	AIR & REGENERATIVE
WAIGHT OF LOCO	123 T
APPLICATION	GOODS

1.2Brake Hanger of Electric Locomotive WAG-9

The braking system of WAG-7 and WAG-9 loco are identical in all respect of its working, the bogie and brake rigging. Of late, Railways have reported and failures of brake hangers in WAG-7 locos only from 2004. The brake block holders are prevented from dropping to the ground by brake hangers, to which they are connected by the lower brake hanger pins. The upper part of the brake hangers are connected to brackets on the bogie frame by the upper brake hanger pins. The brake head pins and the upper and lower brake hanger pins are all secured using washer and split pins. The brake beam, however only control the movement of brake blocks in horizontal plane and provides no vertical restraint. The upper part of the brake hangers are connected brackets on Bogie frame by the upper brake hanger-pins. The

typical brake hanger assembly in a locomotive and the material properties of hanger are as follows:

Figure.2. Brake Hanger Assembly

2. OBSERVATIONS

1. The main reason to failure hanger is manufacturing defects and aging.
2. Initiation of failure at the neck of hanger, the root cause for it is the formation of micro cracks during welding.
3. 100% of the breakage took place at the top of the hanger plate and just below the welding done for fixing of additional ring to enable fixation of bush of 20 mm width.

Figure.3. Various Type of Hanger Failure

TABLE 2: PROPERTIES OF IS2062

S. No.	Property	Value
1	Density	7850 kg/m3
2	Tensile Strength	410 MPa
3	Yield Strength	240 MPa
4	Elastic Modulus	200 GPa
5	Rigidity Modulus	76.9 GPa
6	Poisons Ratio	0.3
7	% of Elongation	2.3

4. Hanger fails in the dynamic condition.
5. The maximum failure occurring at the top part of the bush.
6. If wear of the bush is more than the 4 mm diametrically it is not fit for operation.
7. The brake hanger usually fails during running condition after certain period.
8. Both the inner as well as outer hangers are braking but the breakage of inner hanger towards bogie frame is much more with 80% of total failures
9. 100% of breakages at the top of hanger plate.

3. ANALYSIS USING-ANSYS

The above observed failures in brake hanger could be analyzed by using ANSYS. The following are the outcomes for existing model.

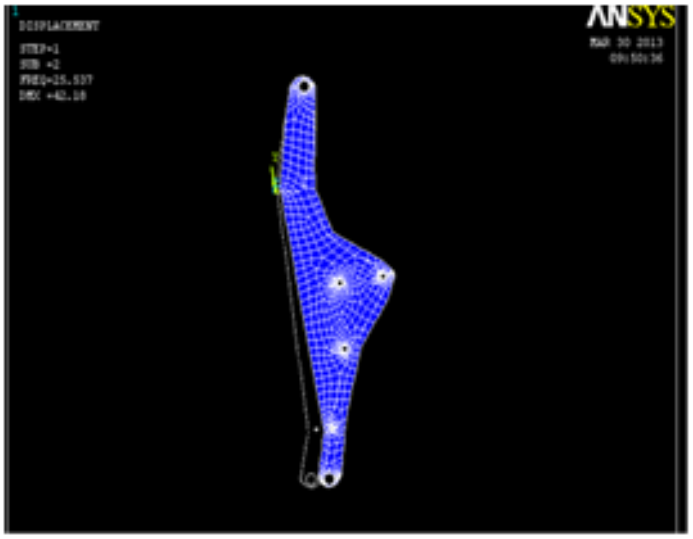

Figure .4. Model of brake hanger

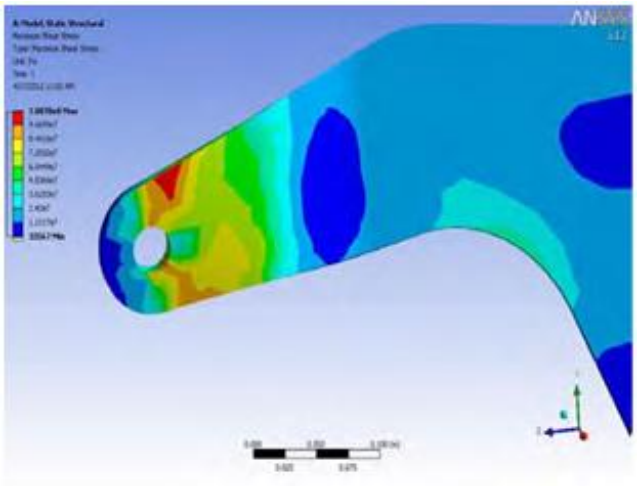

Figure.5. max. Shear stress (inner side)

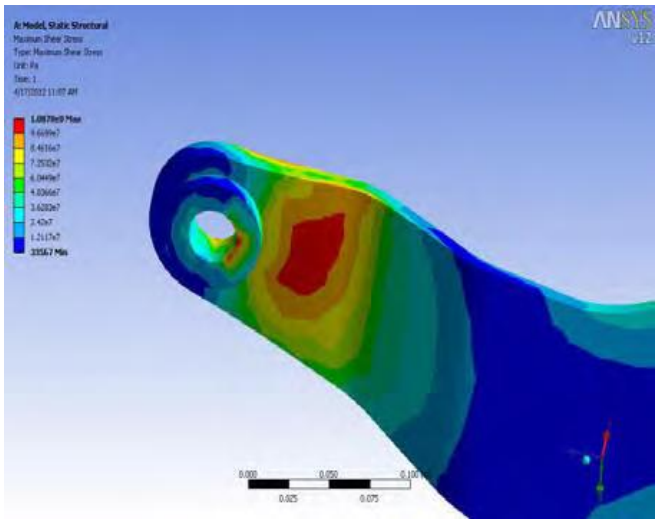

Figure.6. max. Shear stress (outer side)

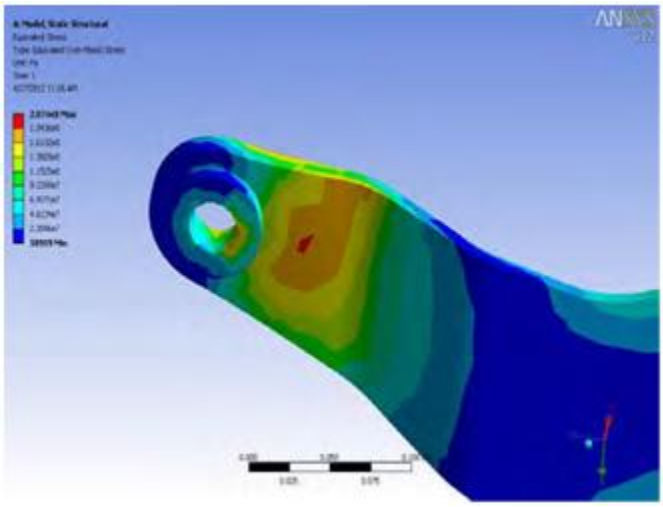

Figure.7. von-mises (outer side) stress in brake hange

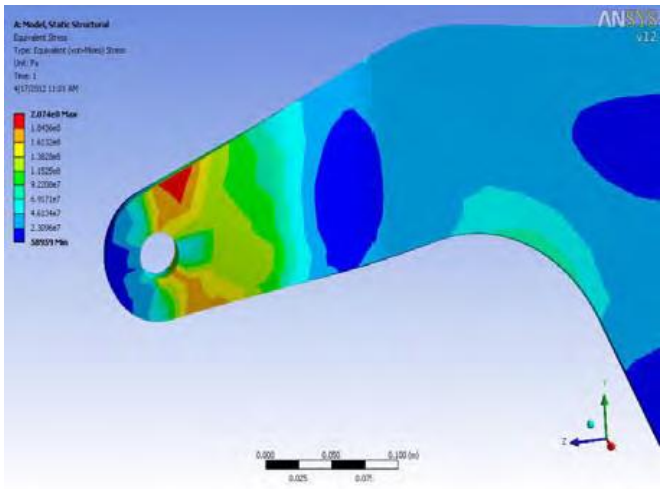

Figure.8. von-mises (inner) stress in brake hanger

4. CONCLUSION

The necessity to study the failure of the brake hanger is identified in railway locomotives. Since with the analysis of present brake hanger using ANSYS the critical points were observed where high stress concentration is present and value of respective stresses are calculated. From this location of critical zones only the fracture may start and it's confirmed to present failure occurring in the brake hanger.

5. REFERENCES

[1].NAVNEET SINGH and Prof. A.K. MAHALLE, "Failure analysis in locomotive Bogie", International Journal of Engineering Science and Technology, Vol. 4 NO. 05 May 2012, ISSN: 0975-5462.

[2]. V.P. SERGIENKO, S.N.BUKHARAV, A.V.KUPREEV (2008), "Noise and vibration in brake system of vehicles", Journal of friction and wear, vol.29, no.3

[3]. CHUL GOO KANG (2007), "Analysis of the braking system of the Korean high speed train using real time simulation", Journal of Mechanical science and Technology 21.

[4]. R.N. Lal, SREDSE, M.K. Gupta, DSE, "Action Plan to arrest Breakage of Brake lever assembly in WAP-7 Locomotives", R.D.D.O. (Research Design & Standards Organization) Luckhnow India.