

Failure Analysis Of Tamping Unit Using FEA- Trend Engineering Jalgaon

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Abstract : The Tamping arm is joined to main body using a sleeve and a pin and the joint is pivot point. The upward end of arm is connected with hydraulic cylinder and lower one is connected with tamping tool. During the working of Tamping machine, the Tamping Unit because of its self-weight penetrates through the bed of ballast up to desired depth, after which the hydraulic cylinder cranks outwards causing the tamping arm to move inwards. This inward movement of arm squeezes the ballast and fill the gap below the sleeper. Due to reactions from the self weight and Hydraulic force, the pivot point that connects the tamping arm with main body fails frequently. The main cause of this failure is the high friction between sleeve and pin due to surface to surface contact. This high friction causes erosion of material and induces play in the fit between the tamping arm and sleeve. There is requirement to replace tamping arm at a small span due to which cost is high due to frequent downtime on railway line. Further literature review is to be done to verify this cause to avoid the failure of Tamping Unit the Failure Analysis is being done. For this CAD modeling of the tamping unit is carried out in CAD software PRO-E.

I. INTRODUCTION

Due to frequent loading from rail traffic the track accordingly changes position, causing movement from the preferred vertical and horizontal aligned position. Ballast tamping is method of re-establishing the geometry and re-arranging the ballast present below the sleeper for keeping the track in desired position and provide it with a homogenous and align ballast bed. The track profile and its geometry should be measured regularly and at least, the track should be tamped at short intervals to ensure that trains can travel safely with normal speed of track line. When availing low quality machines or other manual tamping process, geometry of track line is corrected using track jacks and the visual judgements of Track Master. These methods are not able to provide the quality or durability required for a modern railway line. Today in every modernised railway, tamping machineries equipped with automatic holding and lifting operation, lining operation and synchronized tamping operation on open trajectory, checked rail checked segments and splice linkages etc. is strictly needed for maintaining the track at the required standards.

II. LITERATURE REVIEW

- 2.1 Analysis of ballast behaviour in traffic and tamping process:** The goal of present literature is a better knowledge of ballast degradation and the modelling of a tool to check the efficiency of track tamping, comparing the ballast condition and the infrastructures stiffness. Because of this knowledge it is possible to diminish the destroying influence of tamping on ballast and, hence, maximize the life- period of track profile and ballast. Due to this it is possible to check separately the long-span influence of traffic impact and tracks tamping on ballast degradation and its behaviour. As the ballast degradation permits to apply maintenance strategy in a minimum aggressive way to increase its lifetime and the durability of tamping operations. In such manner maintenance costs for the railway companies can be decreased.
- 2.2 Numerical examination of the tamping method:** Numerous readings have been accompanied to define the effect of tamping factors. In this review, we will revise the influence of tamping parameters for two different models on the compaction of ballast in one sleeper during the various tamping phases. We commotion a parametric examination for the three different stages of the tamping processes, namely , the penetration of tamping tines into ballast, squeezing of the ballast between prongs and lift with the help of three-dimensional (DEM) analysis. A full review of the compaction beneath one sleeper is discussed and the settlement is analyzed. The aim of this literature is to gain an improved understanding of ballast compaction during the (tamping) compressing process and its results for settlement in train traffics.

- 2.3 Numerical analysis of the tamping process by Discrete Element Method:** Ballasted trails have been broadly used because of their convenience in structure and maintenance. The decline of the railway track in weighty train traffics increases countless indiscretions in the track mostly, which result in differential settlement. The ballast packing operation is used to renovation the preliminary geometry of the pathway. In this graft, we emphasis on the result of tamping on (heavy) ballast packing with 3-D DEM (Discrete Element Method) analysis based. This article is concentrated on the demonstrating of the tamping operation with assistance of FEA. Also author has discussed various sorts of maintenance including ballast tamping operation used for railway pathway deterioration.
- 2.4 Fundamentals of Wear Failures:** wear (grab) is a serious concern in numerous types of machines components; in fact, it is frequently a major factor defining or limiting the lifetime of a component. An important example is the wear of the dies and molds, tamping arm used in railways etc. Wear generally is manifested by a change in appearance and profile of surface. Wear results from contact between surface and body or substance that is moving comparative to eachother. Wear is progressive in which it increases with usage or increasing amounts of motion, and it results in the erosion of material from a surface or the transfer of the material between surfaces. Wear failures occur because of the sensitivity of a material or system to the surface changes caused because of wear. Typically, it is the geometrical or profile phases of these changes, like dimensional change, a change in a profile, or a residual thickness of a coating, that cause failure. In this article, failure due to wear stresses is discussed on the basis of material sensitivity and type of surfaces in contact which are moving or slidding with each other.
- 2.5 Failure Investigation and Design of Greatly Loaded Pin Joint:** Normal and plane sliding sleeves and pins are frequently engaged which creates pin joints at heavy machinery. At very high loads and low speeds, these bearings works in the regime of borderline lubrication, and are very much prone to failure because of galling, in which involves a transfer of materials amid the pins and sleeve. This thesis entails of hypothetical and investigational revision of the stresses and lubricants distribution plain pin and bushing pairs. A FEA is piloted to conclude the contact stress distribution at the bottommost portion of the pin and bushing, and relationships are made with Hertz contact theory. We study the stresses for a conventional pin and bushing in which that is calculated for a bushing with lobes and undercuts. The consequences propose that an undercut and dented bushing will have a lengthier lifespan than a straight or lobed bushing. In this article, author has discussed miscarriage of pin joint under various loading conditions with the help of design and FEA.
- 2.6 The outcome of straightening and grinding of the welds on track roughness:** In this article various track defects are discussed and effort is being done for their probable solutions with the advantage of some experiments. The present railway track surface defects that increases the irregularity or roughness of the track most important to the poor traveller journey and improved safety risk in freight traffic. Railway track surfaces defects increase deprivation rate of other track constituents. Yet not all flaws yield perceptible track deterioration. Dynamic impact produced by the rolling store running on rail surface defects, likely poor welds will overtime create continuous rail defects. Relaxing of fasteners, scrape and tipping of sleepers, crushing of counterweight ballast and destruction to the formation of geometry. It is only the recent years that the reputation of poor welds in track has been found out. Dips and peaks necessarily be removed as a sever track indiscretion that prerequisites to be addressed and detached.
- 2.7 Tamping Benefits of the In-Tie Machine:** In this article, all the tracks related problems and their solution with the help of tamping device are discussed. A ballast tamper usually gambols a Wayside Switch Machine section. since the Wayside Switch Machine LAYOUT RODS are laid in between the Connections. which is where the ballast (stabilising)tampers packs the ballast. Since this section was skipped: The ballast in this section becomes loose or relaxed, and doesn't support the tracks correctly Causing the train to disturb at this section known as track pumping Causing severe vibration. This Causes Machine Failures and also maintenance of tracks.

III. IDENTIFIED GAPS IN THE LITERATURE

Research up to day has studied the various failures of tamping arm. But there is limited research on the failure of the tamping unit at the pivot point. The objective of this report is to know the various reasons behind the failure of Tamping arm at the pivot point and on the origin of that alter design and/or recommend technical changes to reduce such failures.for that purpose we will validate our results through FEA and develop strong connection with the actual behavior of the tamping arm. With this research, the company will reduce the downtime penalty on railway line by failure of tamping arm.

IV. PROBLEM FORMULATION

Due to reactions from the self weight and Hydraulic force, the pivot point that connects the tamping arm with main body fails frequently. The main cause of this failure is the high friction (rubbing) between the sleeve and the pin due to surface to surface contact. This high friction causes erosion of material and induces play in the fit between the tamping arm and sleeve. Here is a need to replace tamping arm at a very short intervals due to which cost is high due to frequent downtime on railway line.

V. RESEARCH METHODOLOGY

In the present report, we will gather all the data from the site. After gathering all the data basic calculation will be done in which we will calculate shear stresses on the pivot point. Once the calculation is over we will design CAD model of tamping unit. The further step will be analysis of the design with the help of FEA. On the basis of results in FEA, we will make modifications in the design. After proportional study of the results given by two models, we will finalize the design.

VI. CONCLUSION

By changing design of tamping unit, based on the comparative study between the outcomes of two models, it is proved that the stresses on the pivot point reduced, which will obviously prevent the tamping arm.

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