Life Enhancement of Tamping Tool using Finite Element Analysis

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Abstract— Tamping machines are used on large scale by railways for maintenance of the railway lines. This project is based on the requirement of Dulocos Pvt. Ltd.-Nagpur. During the working of Tamping machine, There 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. This project is undertaken to design a Tamping tool which is capable of long cycle time. This research paper based on the literature review related to our project.

Key words: Tamping Tool, Tamping Process

I. INTRODUCTION

A ballast tamper or tamping machine is a machine used to align the track ballast under railway track to make the tracks more durable. Prior to the introduction of mechanical tampers, this task was done by manual worker with the help of beaters. As well as being faster, more accurate, more efficient and less worker-intensive, tamping machines are essential for the use of concrete sleepers as they are too heavy (over 250 kg) to be lifted. Ballast tamping is the process to restore the geometry and re-arrange the ballast under the sleeper to keep the track in position and provide it with a levelling ballast bed. The track geometry should be measured regularly or at least, the track should be tamped at regular intervals to ensure that trains are able to travel safely. When using inferior machines or other manual tamping methods, geometry is corrected using track jacks and the visual judgement of the Track Master. These methods are not able to provide the quality or durability required for a improvement railway line. On any modern railway today, tamping machines with automated lifting, lining and synchronised tamping.

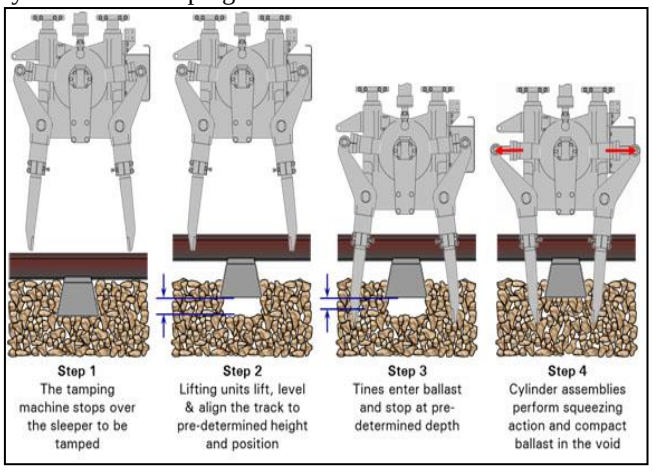

Fig. 1: Simple diagram of basic tamping process

II. LITERATURE REVIEW

A. Aubry, D., and Hujeux, J. C

The goal of this research is a better understanding of ballast degradation and the development of a tool to evaluate the effectiveness of the track tamping, according to the ballast condition and the infrastructure stiffness. This knowledge will make it possible to decrease the destroying effects of tamping over ballast and, consequently, increase the durability of track geometry and ballast. This will make it possible to analyses separately the long-term effects of traffic loading and track tamping on ballast degradation and its consequent behavior. Knowing the ballast degradation permits to apply maintenance strategy in a less aggressive way in order to increase its lifetime and the durability of tamping operations. In this way maintenance costs for the railway companies can be decreased. [1]

B. Saussine, N. Milesi: Sncf, Paris, France

In this paper, we will focus on the influence of tamping parameters for two different samples on the compaction of ballast under one sleeper during the different tamping phases. We carry on a parametric study for the three phases of the tamping process, namely the penetration of tamping tines into the ballast, squeezing of ballast between tines and the lift by means of three-dimensional Discrete Element Method (DEM) simulations. A detailed study of the compaction under one sleeper is presented and the consecutive settlement is analyzed. The objective of this literature is to gain a better understanding of ballast compaction during the tamping process and its consequence for settlement under train traffics. [2]

C. Gilles Saussine, Emilien Az´Ema

Ballasted tracks have been widely used because of their flexibility from the point of view of construction and maintenance. The deterioration of the railway track under heavy train traffics induces various irregularities in the track mainly as a result of differential settlement. The ballast tamping operation is used in order to restore the initial geometry of the track. In this work, we focus on the influence of tamping on ballast compaction by means of three-dimensional Discrete Element Method (DEM) simulations based. This article is focused on the, modeling of the tamping operation with the help of FEA. Also author has discussed various types of maintenance including ballast tamping operation used for railway track deterioration. [3]

D. Nader Farzaneh

Plain sliding bushings and pins are often employed to create pin joints in heavy machinery. At high loads and low speeds, such bearings operate in the regime of boundary lubrication, and are prone to failure by galling, which involves a transfer of material between the pin and bushing. This thesis comprises a theoretical and experimental study of the stress and lubricant distribution plain pin and bushing pairs. A finite-element study is conducted to determine the contact stress distribution at the interface of the pin and bushing, and comparisons are made to the Hertz contact theory. We compare the stresses computed for a straight pin and bushing

to that computed for a bushing with lobes and a bushing with undercuts. The results suggest that an undercut bushing will have a significantly longer life than a straight or lobed bushing. In this article, author has discussed failure of pin joint under various loading conditions with the help of design and FEA. [4]

E. Melissa E Bona Be (QUT)

In this article various track defects are discussed and effort is being done for their probable solutions with the help of some experiments.

The present rail surface defects generally increases the roughness of the track leading to the poor passenger ride and increased safety risk with freight traffic. In addition rail surface defects will generally increase degradation rate of other track component. However not all defects produce visible track deterioration. Dynamic impact produced by the rolling stock running over rail surface defects, such as poor welds will overtime create continuous rail defects. Loosening of fastenings, abrasion and skewing of sleepers, crushing of ballast and loss of formation geometry. It is only the recent years that the importance of poor welds in track has been identified. Dips and peaks must be recognized as a sever track irregularity that needs to be addressed and removed. **[5]**

III. NEED OF DESIGNING THE TAMPING TOOL

- To understand the failure of tamping tool.
- To alter design and/or recommend procedural changes to reduce such failures.
- To validate our results through Finite element analysis and develop strong correlation with the actual behavior of the tamping tool.
- To help the company reduce the downtime penalty on railway line due to failure of tamping tool.

IV. RESEARCH METHODOLOGY

In present study, we create the CAD model of tamping tool then analysis of the design will be performed. If required the optimization and analysis of optimized design will be performed after that results will be discussed and design will be finalized.

V. CONCLUSIONS

In this research we will develop a CAD model of tamping tool and optimization of tamping tool using FEA. After the completion company Dulocos Pvt. Ltd.-Nagpur, will be benefited from the advancements of computer technologies and thus will be able to reduce the running cost of tamping tool without compromising on the performance parameters.

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[4] Failure Analysis and Design of a Heavily Loaded Pin Joint: Nader Farzaneh: Massachusetts Institute of Technology.
[5] The Effect of Straightening and Grinding of Welds on Track Roughness: Melissa E Bona Be (Qut)

