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FEM ANALYSIS OF PRESTRESSED CONCRETE SLEEPER WITH ADDITION OF ELASTOMERIC BEARING IN RAIL SEAT

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ABSTRACT

The Present study is to analysed prestressed concrete sleeper with addition of Elastomeric bearing in rail seat by using ANSYS numerical model. The demand for replacement of existing prestressed concrete sleeper is increasing and hence the current scenario of deteriorated PSC sleeper and an urgent need to develop maintance standards for machines with PSC sleepers. There are very few studies that evaluate the effects of various parameters such as concrete materials, prestressing tendon & PSC deformation. In the earlier studies the mechanism destruction of PSC sleeper due to shock load generated of wheels & rail joint was completed by the experiments & dynamic linear analysis. In this study to check the structural behaviour like speed of rail vehicle, axle load of train, rail track performance and crack pattern of the PSC- Elastomer Sleeper under Static loading. We are overcome the following deterioration in present Prestressed concrete sleeper

Keywords: PSC Sleeper, ANSYS model, Elastomer bearing, Von mises stress, Static Loading Test.

I. INTRODUCTION

Prestressed concrete sleepers must be able to prevent the effect of stress waves created by the relationship betwee n the railway and the highway. The extent of shock or load velocity depends on the situation, such as axle loads of the train, wheel type, rail defects, speed and operation of rolling stock. Loads are usually short but very high. Mo st of them predicted the bending behavior of
railway seats of sleeper trains.Traverses are beams placed on the ballast bed support. The main
and important role of railway sleeper.

a) To support the rope and hold the Track gauge.

b) With vertical and longitudinal movement of the rails.

c) Transfer and distribute all loads from the rails to the ballast bed.

d) Insulation between the parallel rail track system.

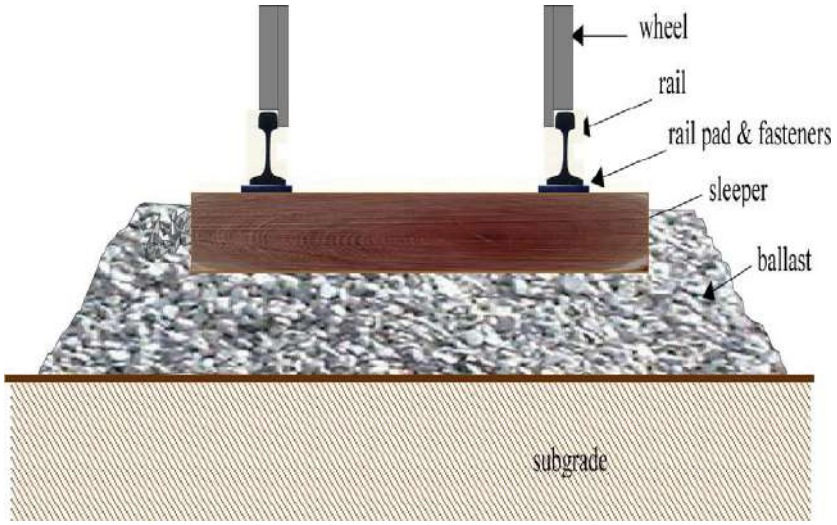


Fig.1 Railway sleeper Track system

Fig.2 Partial Replacement sleepers

Merits of PSC Elastomeric Sleeper –

a) Lateral resistance displacement is to be better

b) More elastic behaviour of PSC –Elastomeric sleeper

c) It's a light weight as compare to normal sleeper

Demerits of PSC Elastomeric sleeper –

a) For a PSC elastomeric bearing inserted in sleeper is to be critical.

b) Require better insulating devices

Properties of Railway concrete sleeper:-

The properties of the railway prestressed concrete sleeper are –

Properties	Concrete
Adaptability	Difficult
Workability	Difficult
Handling & Installation	Difficult
Durability	High
Maintenance	Low
Replacement	Difficult
Availability	High
Cost	Very High
Fasteners	Very Good
Tie ballast interaction	Very Good
Electric conductivity	High
Impact	Low
Weight	285
Service life, years	60

II. REVIEW OF LITERATURE

J.M Sadeghi et.al :- In this research study to analysis of railway sleepers are examined and suggest a new recommendation to improve the accuracy of the current practices in a railway track system analysis. To evaluate the stress distribution under a concrete sleeper, rail load seat bottom and the dynamic coefficient factor.

M. Gutierrez Romero et.al :- For a research investigation to measurement of rail seat bottom pressure distribution with different loading parameter condition by using Tekscan pressure measurement sensors and also obtain through full scale laboratory testing of a concrete sleeper and the fasting system.

H.P J. Taylor:- In this paper investigation to examine the some history of the early development of prestressed sleeper and also design development with our codes. Research is not to emphasise the successfully working of prestressed concrete sleeper.

Won Young Yun et.al :- In research study to evaluate the replacement policy of pre demand for the inventory management of the railway sleeper for a optimal replacement strategy and also consider the preventive replacement measurements.

H.wakui et.al:-During a research study to design a prestressed concrete sleeper by using a limit state method also access the behaviour of prestressed concrete sleeper when load are coming to rail seat.

K matsuoka et.at:- Analysis of a prestressed concrete sleeper for higher order of vibration properties by using damage detection method. This method to check the crack pattern of PSC sleeper.

Ehsan Rezaei:- In this study to check the vibration of partly supported concrete railway sleeper and also check a dynamic changes in a railway sleeper.

III. METHODOLOGY

In section outline of the properties of the PSC sleeper with addition of Electrometric bearing in rail seat, the current scenarios considered and methods used for analysis of PSC sleeper with addition of bearing.

The following Preparation and modelling of PSC - FEM model with creo software –

i) Materials properties

ii) Mesh and Elements

iii) Boundary condition

iv) Contact pattern

v) Comparison and validation

i) Materials Properties:- For a analysis of the concrete sleeper has a simplify geometry & a properties of the materials are the same throughout the railway sleeper length. So it's considered to be a structure with homogenous material properties. In a shear modulus of the concrete can be obtained

G = E/2(1+V)

Properties of the different railway tack sleepers are outline below in table 1.

Category	Concrete	PC steel tendon wire (Strand)
Young's Modulus of elasticity (KN/mm^2)	43	200
Poisson's ratio	0.2	0.3
Density (KN/m^3)	23	77

Properties of elastomeric bearing are outline below in table.2

Elastomer bearing length (mm)	500
Elastomer bearing width (mm)	160
Elastomer thickness(mm)	30
Shape factor S	2.02

ii) Mesh and Elements:- To create mesh modelling of concrete sleeper with the two rails.

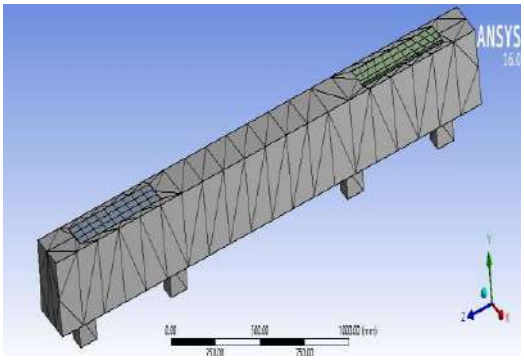


Fig.3 Mesh of Concrete PSC sleeper

iii) **Boundary Condition: -** The following Boundary conditions a model are prescribed. So that they reflect the real case as close as achievable. Description leads to model with boundary condition that has been fixed points in all direction of given point of rail seat.

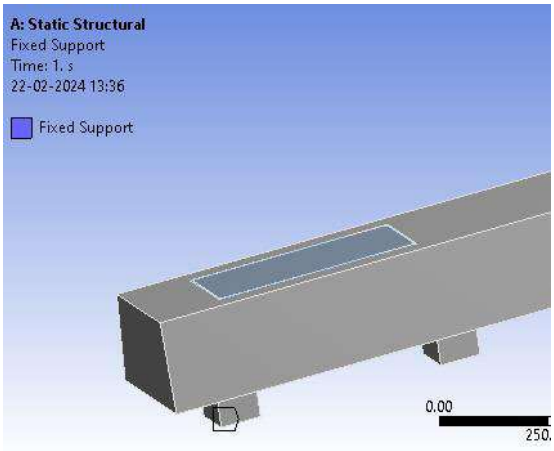


Fig.4 Fixing joint at rail seat

iv) **Contact Pattern: -** The arrangement of a contact relating between the railway sleeper & a ballast bed with PSC Elastomer shape.

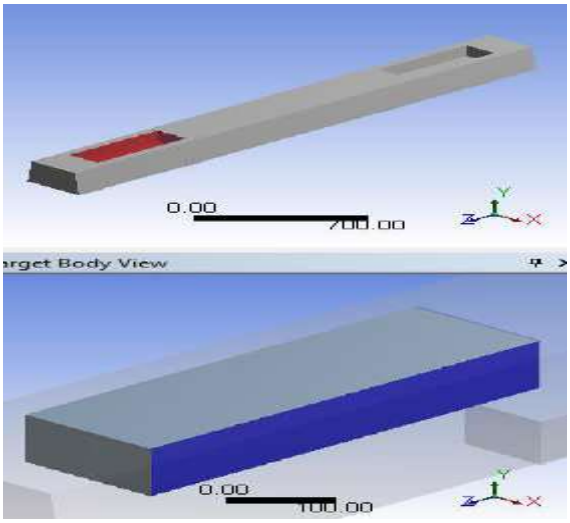


Fig.5 Contact pattern between materials

v) **Comparison & validation:-** For results section, a comparison and validation between the Finite element model of PSC Elastomer model.

IV Test Result & Discussion

After analysis of PSC –Elastomer model, to check the deformation pattern of PSC – elastomer sleeper and von – mises stress in the form of graphical representation are as fellows-

a) Analysis of critical point of damage sleeper.

b) Check the contact pressure between the sleeper and ballast.

c) Check the behaviour pattern of elastomering bearing under loading.

d) Vibration pattern of PSC – Elastomeric sleeper is done.

e) Check the crack on sleeper bottom

Table.3 Modeling of Specimen

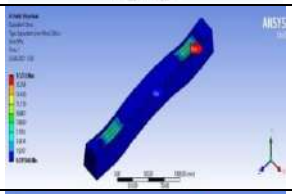
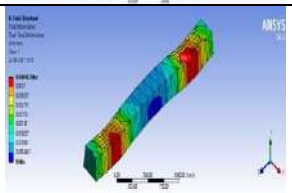
Model Name	Specification in mm	Loading analysis of ANSYS model
PSC- Elastomer (Geometry)	L=2700, B=290, H=210	
PSC- Elastomer (Position of Elastomer in Sleeper)	L=2700, B=290, H=210	
PSC –Elastomer (Deformation)	L=2700, B=290, H=210	

Table.4 Comparison between PSC sleeper and PSC Elastomer Sleeper

S.No	Model Name	Specification in mm	Load (N) per rail load	ANSYS model			
				Deformation (mm)		Equivalent Von-mises stress (mpa)	
				Max	Min	Max	Min
1	Normal PSC Sleeper	L=2700, B=290, H=210	11200	0.05997	0.0066	2.069	0.000220
2	PSC –Elastomer sleeper	L=2700.B=290, H=210	11200	0.0491	0.054	7.454	0.000257

V. CONCLUSIONS

In this research area studies was to be conducted to determine the load capacity of PSC – Elastomeric bearing sleeper by using numerical models to reproducing a static bending test & impact loading test. Result of a static analysis indicates that the wear of a surface bottom of the PSC – Elastomeric bearing sleeper significantly affected to the loading capacity of a cross section at rail seat section of PSC- Elastomeric bearing sleeper. As

result are obtain to analyse the effect of reaction time of a impact load on the crack generated load reduces on 40 percentage compared to crack generated load at 12 ms due to the response to third vibration mode of the PSC – Elastomeric Bearing sleeper. So indicate that dynamic behaviour of PSC – Elastomeric Bearing sleepers has dependence on a reaction time of impact force. Due to the use of a new innovative technology and a highly optimized shape, additional materials such as elastomer have been investigated. However, these investigations generally overlook the new material performance under dynamic loading, the new model of sleeper offers improved structural behavior of railway sleeper and durability aspects of PSC –Elastomer railway sleepers at rail seat of the railway track.

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