Modification In EMU Bogie For High Speed Application

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Abstract— **The rail industry is one of the biggest part of India society in transport as well as economical way. We have so much developed from steam engine to current EMU Train. But as population increase so this rail technology has to be continuously developed so as to meet requirement of current era.**

Current using technology referred as EMU i.e electric multiple unit. Instead of using single power unit to drive coaches of train, multiple unit drive attached to each distinct number of coaches. As we know each technology has drawback, this technology is not exception for this. In India we can drive rail upto the speed of 150 km/hrs. If the speed exceeds beyond this limit, some serious problem can occur such as bogie failure, hunting of bogie, failure of suspension etc. this leads to catastrophic results such as mass destruction, public property damage.

In this project has to tackle the problem of vibration Roll rubbers are used instead of springs in secondary suspension.

Keywords- Bogie, Suspension, EMU.

I. INTRODUCTION

Railcar bogies usually go unnoticed by rail passengers, but despite their obscurity, they are very important in safe railway operations. A bogie is a structure underneath a railway vehicle body to which axles and wheels are attached through bearings. The term “bogie” is used in British English, while a “wheel truck”, or simply “truck” is used in American English. The overall term is “running gear”, which covers bogies as well as vehicles with two, or more axles without any bogies. In this case, these axles are directly fitted to vehicle body via guiding devices and springs, and for very low speed even without springs.

Running gears serve a number of purposes:

- Support of the rail vehicle body
- Stability on both straight and curved tracks
- Providing ride comfort by absorbing vibration, and minimizing centrifugal forces when the train runs on curves at high-speed
- Minimizing generation of track irregularities and rail abrasion.

For designing a bogie for EMU train for high speed application, safety is a prime parameter to be considered, hence the design has to be full proof. The running or working performance of train depends on the bogie design.

Figure 1.1 Modern Bogie for Bombardier EMU Train

The derailment of trains mainly caused due to bogie failure, hunting of wheelsets, failure of suspension on due to imbalance of curvatures.

Hence there is a need to design a bogie for high speed to overcome the above mentioned failure causes. In order to overcome the cause of imbalance in curvatures, radial steering mechanism is to be included in the design, also a quill shaft is to be designed for reduction in a weight of bogie. Appropriate suspension systems are to be selected for both reasons, comfort & stability.

Railway bogies are complex subsystems in railway vehicles and contain brake systems, drive systems including gearbox coupling and traction motors for powered wheelsets, bogie frames with secondary spring systems and the wheelset subsystems, which are basically the assembly of two wheels and an axle. In this chapter, the focus is on some general bogie design principles and especially design features that interact with the axle box bearing system. Directly connected to the wheelset and the bogie frame is the axlebox containing the axlebox bearing system. The axlebox is very much linked to further subsystems and components like primary spring systems, axlebox guidance, dampers, steering mechanisms of wheelsets, earth return devices as well as sensors to detect operational parameters and bogie monitoring systems. Further bogie- connected subsystems are wheel flange lubrication systems. Articulation joints, slewing bearing and special plain bearings for damper supports.

Indian Railways is now planning to have high speed EMU train services instead of the conventional locomotive pulled trains. The existing EMU's and DMU's consist of conventional ICF bogie with a few modifications in it but these bogies are designed for top speed of 120 km/hr. To make the train capable for running at approx. speed of 200 km/hr, there is a need to modify the design, regarding the bogie structure, suspension system, braking system etc.

II. Modeling And Analysis Of EMU Bogie

A. Modeling of EMU Bogie

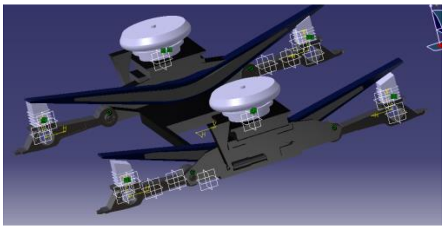

Figure 1

It is a multi-stage CAD/CAM/CAE business programming suite created by the French organization Dassault Systemes. Written in the C++ programming language, CATIA is the foundation of the Dassault Systemes Commonly alluded to as a 3D Product Lifecycle Management programming suite, CATIA bolsters numerous phases of item advancement from conceptualization, plan (CAD), producing (CAM), and building (CAE). CATIA encourages shared building across disciplines, including surfacing and shape plan, mechanical building, hardware and frameworks designing.

CATIA can be connected to a wide assortment of v, from aviation and protection, car, and modern gear, to innovative, shipbuilding, shopper products, plant structure, buyer bundled merchandise, life sciences, design what's more, development, process power and oil, and administrations.

There are commonly two kinds of model utilized for examination that are utilized in industry: 2-D demonstrating, and 3-D displaying. While 2-D demonstrating saves effortlessness and enables the examination to be kept running on a moderately ordinary PC, it will in general yield less precise outcomes. 3-D displaying, be that as it may, delivers progressively precise outcomes while relinquishing the capacity to keep running on everything except the quickest PCs adequately

B. Analysis Of EMU Bogie

The ANSYS Workbench condition is an instinctive in advance limited component investigation apparatus that is utilized related with CAD frameworks as well as Design Modeller. ANSYS Workbench is a product domain for performing auxiliary, warm, and electromagnetic examinations. The class centres around appending existing geometry, setting up the limited component model, fathoming, and looking into results. The class will depict how to utilize the code just as essential limited component reproduction ideas and results elucidation. The finite element model (FEM) is a technique for partitioning up an extremely confounded issue into little components that can be illuminated in connection to one another. Its common sense application is frequently known as Finite Element Analysis (FEA)

- Meshing Method

ANSYS Meshing innovation has been based on the qualities of remain solitary, class-driving meshing instruments. The most grounded parts of these separate instruments have been united in a solitary situation to deliver probably the most dominant meshing accessible. We mesh with the goal that the solver can fathom for different conditions as the mind boggling model is limited and isolated into standard shape. Meshing for investigation is intricate and requires progressively refined meshing instruments for exact arrangement. For the current investigation a fine mesh is utilized with smoothing and beginning range edge kept fine. Beginning seed size ought to be kept part since we need the mesh to be unmistakable.

Advance> pertinence focus >fine

Produce the mesh by choosing Mesh > Generate Mesh

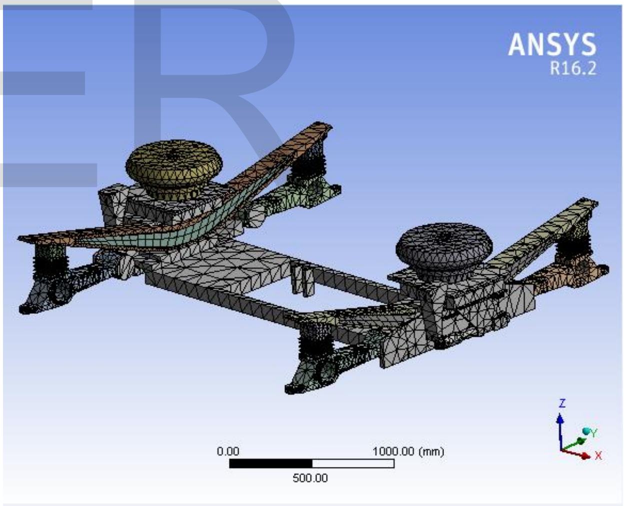

Figure 2:Mesh

- Boundary Conditions

Next, we will apply the boundary conditions to the geometry. In the Outline window, select modal>initial condition>Fixed support. Make sure the Edge Selection Filter is selected, hold down Ctrl, and left mouse click the outer rim Geometry >Apply.

➢ Solutions

Figure 5: Equivalent Stress in EMU BOGIE

1. Load on each spring = 4.41tons.
But the load of spring is not exact as mentioned above because the tare weight of the coach is first acted on the bolster on secondary suspension.
In over design we used 2 air springs as sec. Suspension in single bogie.
2. Load on each air spring = 70/4 =17.5 tons.
3. Load on each roll rubber = 2.1875 tons.
As exact load > selected load.
4. Select next-
B = 229mm Tare weight = 2.34t
L = 229mm Loaded = 4.41 t.
A = 312mm, Max = 6.03 t
Spring length = 275mm
Spring travel = 25mm
Spring loaded = 17mm
Taper Roller Bearing (From SKF)
5. Design-
Application- High speed EMU Train
Static axle load = G00 = 17.5 TONNES = 171.675 KN
Wheelset weight = Gr = 1.52 tonnes = 14.93 KN
Wheel diameter = Dw = 915mm = 0.915 m
Maximum speed = 200 km/h
Axle box type = symmetrical
6. Basic dynamic load rating = c = 913KN
Outer ring angle = 10
Bore diameter = 130mm
Outside diameter = 230mm
Width = 160mm

7. Axle load calculation =
Axle load = (G00-GR)/2 = 78.36 KN
8. Equivalent radial axle box =
$Kr = f_{frdftr}*G$
= 0.9*1.3*1.05*78.05
= 96.26KN
Equivalent axial axle box load-
$Ka = f_o*Fad*G$
= 0.9*0.1*78.36
= 7.05KN
Bearing load calculation-
Bearing load F_r = Kr+2fcka
F_c = had/l
= 0.25*130/112.06
= 0.29
F_r = 96.26+(2*0.29*7.05)
= 100.34 KN

Equivalent dynamic bearing load P = Fr+yfa
P = 109.94
Basic rating life calculations-
$L_{10s} = (\pi * L10*Dw/1000)$
= (c/p)
= 1159 million revolutions
$L_{10s} = (\pi*1159*0.915/1000)$

$\boxed{L_{10s} = 3.33 \text{ million km.}}$

III. Result And Conclusion

1. For suspension of EMU train, composite material will be the most suitable material as it gives better performance in mechanical properties as elongation and load carrying properties.
2. Analytical result shows that, carbon fiber is best suitable composite than any other when all the parameter are taken into considerations.
3. Practical results also proves the same results an analytical, load carrying capacity of test specimen in composite was found almost double than conventional material which proves the efficiency of the selected material.
4. Lowering of weight in suspension will ultimately lead to increase in the overall efficiency of the system.

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