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Distinctive Modeling of the Railway Passive Suspension System

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Abstract: Railways used worldwide for the safe transportation of large number of passengers and goods from one place to another. Suspension system in railways play an important role in ride comfort and it is an essential element for the safe transportation of passengers and goods. It Suspension system requires proper timely guarantee comfortable journey. This paper provides an analysis of railway suspension system based on the review of the different technology proposed by various researchers. The results of the analysis provide the researchers a basis to enhance the ride quality and comfort in railways.

Index Terms **- Railways, Passive Suspension System, Active Suspension System, Semi-Active Suspension System.**

I. INTRODUCTION

Over the past decades, research has been carried out in the area of railway suspension systems. Active, passive and semi-active types of suspension are used in railways. The use of active and semi-active control systems in railway suspension systems has been the subject of extensive research since the 1960s. [1].But we are going to research on passive suspension because till now this system is adopted by railways many country [2]. The function of the suspension is to isolate the body from road discomfort to achieve a comfortable ride and improve the handling of the vehicle. A passive suspension system consists of springs and dampers.

Passive suspension system design was formerly used fixed point theory. Passive suspension systems control body and wheel movement by controlling relative velocity to a limit point that provides the desired ride comfort. This is achieved by using some kind of damping element placed between the vehicle's body and the wheels. Such as hydraulic shock absorber. The function of the damper is to reduce the vertical acceleration of the body and improve the wheel-rail contact force. In other words, for a comfortable ride, it is desirable to use soft absorbers to limit body acceleration. On railroads, coaches have two sets of four-wheel axles on the front and rear bogies, with primary and secondary suspension systems. They are designed for maximum working speed and super stability of the passengers [3].

Railway suspension is an important part due to which the wheels generate vibration. This vibration make a damage to different part of the vehicle & retrain a back to the track for that the suspension is used to provide a flexibility[7].

II. BRIEF THEORY ABOUT SUSPENSION SYSTEM USED IN RAILWAYS

The suspension systems are mainly divided into two parts primary and secondary suspension system.

The primary suspension it connects wheel set to the bogie frame. It provides only vertical direction. The primary suspension system consist of a rubber disk, centering disk, internal spring, external spring, locking plate, rubber joint, control arm & damper etc. The part of the load on the primary suspension is absorb by the spring protect lifting the bogie frame for lifting.

The secondary suspension consist an internal spring, external spring, centering disk, bogie frame, vertical damper, yaw damper, lateral damper, antiroll bar, safety cable, traction rod etc. Secondary suspension provides lateral and vertical displacement and rotational bogie with respect to the body when the train is running load transmitted to the axel and wheel through the primary suspension.

III. TYPES OF SUSPENSION SYSTEM

A. Passive Suspension

The passive suspension systems shown in Fig. 1 are examples of mechanical suspension. Arrangement of viscous dampers and linear springs with constant damping coefficient or constant stiffness [4].

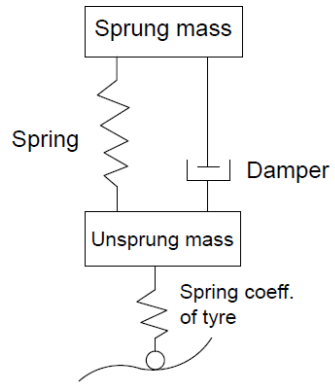


Fig.1. Passive suspension

B. Semi-active Suspensions

A semi-active suspension is similar to a passive design, with the only differences being that it has a variable damping coefficient, a fixed spring rate, and no active power source. [5]. This type of system allows seamless switching between passive dampers and semi-active damping factors as shown in Fig. 2.

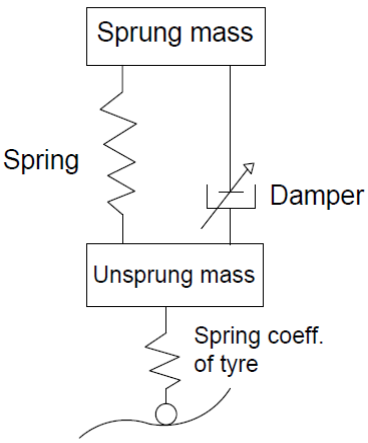


Fig.2. Semi-active model

C. Active Suspensions

Compared to other previous systems, active suspension includes actuators that can provide active forces that are regulated by control algorithms that use information gathered from attached vehicle sensors. As shown in Fig. 3, active suspension comprises an actuator, mechanical spring, and damper; or an actuator and mechanical spring only [6].

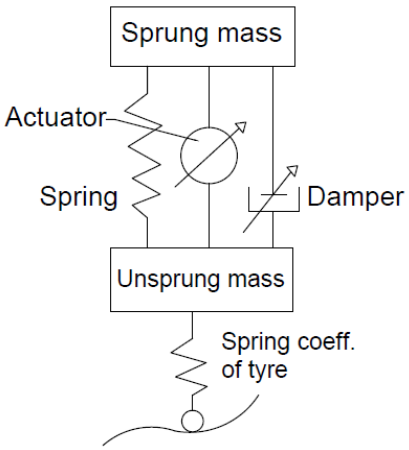


Fig.3. Active Suspension

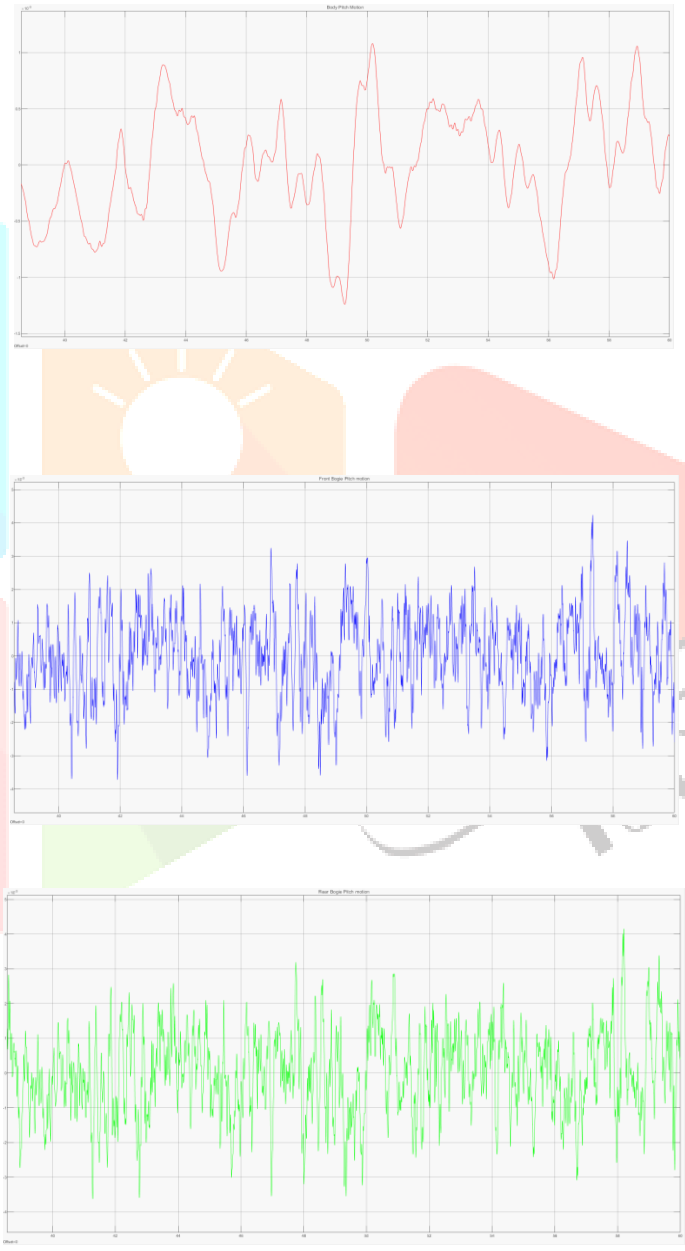
IV. MODELING OF THE SUSPENSION SYSTEM IN RAILWAY VEHICLE

There are two type of suspension system used in railway one is primary suspension and another is secondary suspension. In primary suspension it connects wheel set to the bogie frame. It provides only vertical direction. The primary suspension system consists of a rubber disc, centering disc, internal spring, external spring, locking plate, rubber joint, control arm and damper etc. The articulated control arm, nested helical coil spring and vertical damper other main parts of the primary suspension system. The part of the load on the primary suspension is absorb by spring protect the bogie frame for lifting.

The secondary suspension system consists of internal spring, external spring, bolster bean, centering disc, bogie frame, vertical damper, yaw damper, lateral damper, anti roll bar, safety cable, traction rod etc. Secondary suspension provides lateral and vertical displacement and rotational bogie with respect to the body when the train is running load transmitted the axel and wheel through the primary suspension.

V. RESULTS AND DISCUSSIONS

We have developed a model of a railway vehicle as discussed in the above Section using MATLAB/Simulink environment.



The results show the graph generated for the model of the developed railway vehicle. The graph represents the vertical acceleration of body, front bogie, rear bogie which are under the acceptable limit for the developed model of the railway vehicle.

VI. CONCLUSIONS

A suspension system play a critical role in railways, hence required proper maintenance for maintaining the flexibility and ride comfort in the field of railways. There are two main type of suspension system which are primary and secondary. The model of a passive suspension system is analyzed at present using MATLAB/ SIMULINK. The results show that the vertical acceleration of body , front bogie and rear bogie are within the limit .We have started our work in this field and we are trying to develop a complete model a railway vehicle in the future to perform the analysis.

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