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Investigating Effects of Vehicle Speed and Road PSDs on Response of a 35-Ton Heavy Commercial Vehicle (HCV) Using Mathematical Modelling

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Abstract : The use of mathematical modeling has seen a considerable boost in recent times with the development of many advanced algorithms and mathematical modeling capabilities. The advantages this method has over other methods are that they are much closer to standard physics theories and thus represent a better theoretical model. They take lesser solving time and have the ability to change various parameters for optimization, which is a big advantage, especially in automotive industry. This thesis work focuses on a thorough investigation of the effects of vehicle speed and road roughness on a heavy commercial vehicle ride and structural dynamic responses. Since commercial vehicles are kept in operation continuously for longer periods of time, it is important to study effects of various physical conditions on the vehicle and its user. For this purpose, various experimental as well as simulation methodologies, are adopted ranging from experimental transfer path analysis to various road scenario simulations. To effectively investigate and eliminate several causes of unwanted responses, an efficient and robust technique is needed. Carrying forward this motivation, the present work focuses on the development of a mathematical model of a 4-axle configuration heavy commercial vehicle (HCV) capable of calculating responses of the vehicle on different road PSD inputs and vehicle speeds. Outputs from the model will include response transfer functions and PSDs and wheel forces experienced. A MATLAB code will be developed to implement the objectives in a robust and flexible manner which can be exploited further in a study of responses due to various suspension parameters, loading conditions as well as vehicle dimensions. The thesis work resulted in quantifying the effect of various physical conditions on ride comfort of the vehicle. An increase in discomfort is seen with velocity increase; also the effect of road profiles has a considerable effect on comfort of the driver. Details of dominant modes at each frequency are analysed and mentioned in work. The reduction in ride height or deflection of tire and suspension with loading along with load on each axle is analysed and it is seen that the front axle supports a greater portion of vehicle weight while more of payload weight comes on fourth and third axles. The deflection of the vehicle is seen to be well inside acceptable limits.

Keywords : mathematical modeling, HCV, suspension, ride analysis
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