A Study on Automotive Seat Track (Upper Rail & Lower Rail)

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Abstract - Objectives of automotive industries are to design quicker more efficient vehicles & it travelling greater distances in short interval of time. Safety &comfort of passengers are very important. Automotive seat structures play a major role in the car passive safety. Due to their adjustment function mechanisms are generally involved in the seat failure mode. With the current evolution of automotive techniques, one of major automotive industry priorities is to decrease the product mass, design quicker and more efficient vehicles, emphasizing on travelling greater distances in short interval of time. For this comfort with safety of passengers is very important, thus the design of the seating system is very important. The aim of this project is to design & optimize upper & lower rail of an automotive seat track mechanism subjecting to static analysis by changing parameters & maintain feasibility of seat track. Also,achieving the feasibility of peel off or rupture of track. Scope of the present work involves Finite Element Modelling of Seat track mechanism using FEA software like Hypermesh or Ansys. The results in the form of stress, load and displacement are extracted using FEA result. It compare with analytical & experimental method.

Keywords- Automotive track,Seat track upper and lower rail, Low Cost, Safety, Rail thickness, FEA.

I. INTRODUCTION

Generally, good automotive seating system is not only to provide comfort but also to provide style and more importantly the safety feature. Seat structures play a major role in the car passive safety. Due to their adjustment function mechanisms are generally involved in the seat failure mode.

Automotive seating structures are subject to an important set of comfort and safety demands requiring the accommodation of variation of users while meeting safety standards under crash scenarios. Seat position adjustment in multiple degrees-of-freedom (DOF) facilitates the location of the user within the vehicle cabin in a comfortable and functional seating position. An essential DOF required by all seating structure designs is the fore and aft movement of the seat. As automotive seating structures have evolved over an extended development period, there has been a convergence of practical embodiments. Accordingly, fore and aft movement is typically achieved using a sliding track assembly consisting of interlocking rail sections. Due to the random probability distribution nature of manufacturing processes, track assembly performance is affected by manufacturing variation. For low cost track assembly markets, latitude in manufacturing variation is desirable. For mature markets, predictable and repeatable functional efforts take priority. Accommodating the effects of manufacturing variation early in the development cycle through design to achieving competitive quality, cost and development time objectives for a range of target markets.

Benchmarking study of alternative automotive seat track profiles according to their sensitivity to manufacturing variation. The analysed track assemblies include commercially available designs as well as proposed concepts. All track assemblies consist of two interlocked rail sections (with symmetric or asymmetric profiles) separated by rolling elements (spherical and cylindrical). The upper and lower rail sections are elastically preloaded by an interference fit upon assembly. Variation in the geometric parameters of the rail section affects the magnitude of the elastic rail preload and consequently the rolling effort of the track assembly.

M. Chauffeay, G. Delattre, L. Guerin (2011) describe tracks are the mechanisms which enable to translate the seat; they are key contributors in occupant safety as link between seat and car. With the current evolution of ecologic legislation,one ofmajor automotive industry priorities is to decrease the product mass. To reach this objective, the use of high strength steels appears as a good solution with the drawback to be more brittle. In parallel, FEA models have to be more and more predictive in order to reduce the validation cost. With dual phase material, primary track failure mode is generally a profile rupture. First results highlighted correctly the area of rupture, but the ultimate strength was generally higher in FEA model than in the hard-test. This gap can be explained by the difference of scale between characterization of failure, which is a very local phenomenon, and the evolution of strain in simulation which is dependant of mesh size(1).

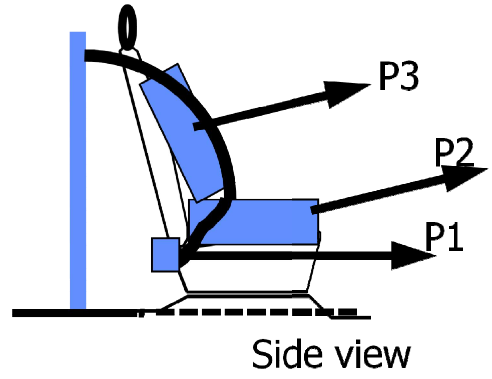
Praise Tom, M. Ramalingam, Kannan. S (2012) focused on seat track mechanism as slider mechanism use in car seat. A Multi body system consists of mechanical linkages and these linkages are interconnected with Rigid Bodies or Flexible Bodies approach and due to linkages dynamic behaviour they may experience translational and rotational displacements. This study deals with design and development of new seat slider mechanism and simulation by using the Multi body Dynamics. In this study, the behaviour of seat mechanism is predicted and corrected to increase the performance of the seat mechanism. The study includes theoretical calculation, tolerance stack-up, Multi body Dynamic simulation study using ADAMS (extraction of forces) and validated with the experimental data. ADAMS is software of DigitalAssetManagement. It concluded that the seat slider mechanism is simulated in ADAMS and model according to the real condition (2).

Maciej Mazur, Martin Leary, Sunan Huang, Tony Baxter and Aleksandar SUBIC (2011) describe that benchmarking study is presented on the performance of automotive seat track profiles according to their sensitivity to manufacturing variation. Variation in rail geometry affects the elastic track preload and consequently the rolling effort of the track assembly.

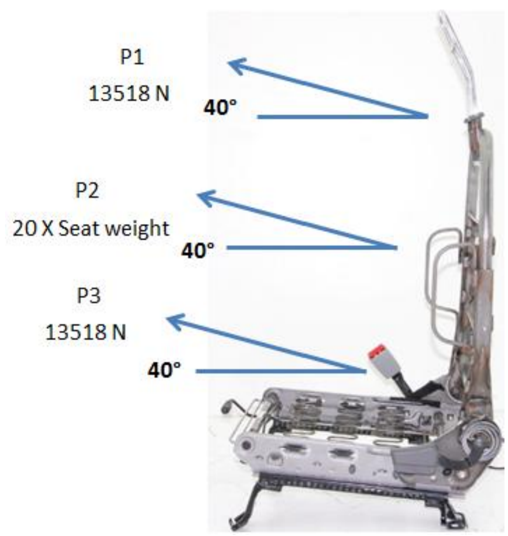
In this work a rapidly implement manufacturing sensitivity benchmarking study carry out for alternative automotive seat track designs. The benchmarking study focus on seat track rolling effort by considering variation in bearing clearance and variation in bearing contact force. Significant variation in sensitivity to manufacturing variation identifies between alternative automotive seat track designs. The benchmarking study identifies conceptual designs which offer superior performance robustness compared to existing designs. The benchmarking approach applied in this work demonstrated a method of rapidly assessing the relative robustness of automotive seat tracks when subject to expected manufacturing variation. This outcome assists automotive manufacturers to apply a systematic approach to automotive seat design base on a robust evaluation of alternative conceptual seat track embodiments (3).

II. TEST REQUIRED

1.Track Load Analysis:-For seat belt anchorage test, we have three loads on a front or self-standing sat, as shown figure. Seat bolt loads & 20gm load of a seat.Load is shown in figure are load apply on seat which give result of peel off load for seat track assembly. It useful for maintain strength of upper & lower rail seat track assembly.



From figure, P1 &P3 are load at upper & lower belt anchorage point. P2 is 20 times weight of overall seat structure.so that P1, P2 & P3 have some load value that is 13518N for P1 & P2 both.



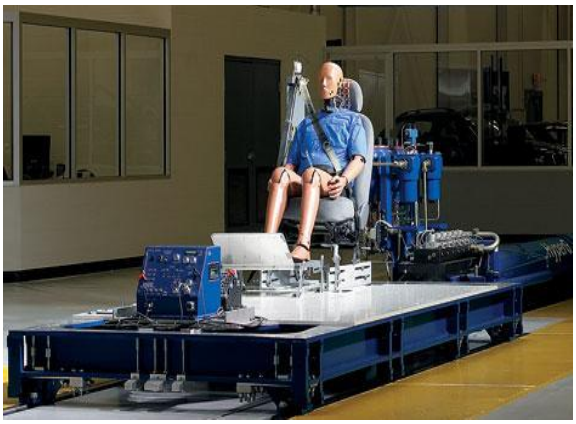
1.1.Requirement:-Belt anchorages must withstand specified load at least 0.2 second & no part to deform in such a manner as to present any hazard to occupant. During test no track tilt and latching must not disengage during the test

2.Forward & Rearward Impact Test (SLED)

2.1Requirement:-The seat shall withstand a 20 g impact in the forward and rearward direction for not less than 30ms. No breakage in the seat frame, seat anchorage, adjustment/displacement /locking systems. No release of any locking system shall occur during the test. The displacement system intending for permitting/facilitating the egress of an occupant must work at least once.

2.2Test Procedure: Load application:-Subject the BIW to a rearward impact acceleration of not less than 20 g's for 30 ms

2.3 Forward and Rear Impact:-Assemble the seat into a body-in-white (BIW) or fixture. Set the seat back angle to design or close to 25°.Set the head restraints to the most unfavourable position. Set the seat tracks and the cushion height adjustment to the most unfavourable position. For forward impact seat moved forward & rear impact seat moved rearward with speed between 45 km/h and 55 km/h.



III. METHODOLOGY

3.1 Survey & Benchmarking:

Track mechanisms available in market. Comparing there advantages & disadvantages, internals parts profile. Also, survey with literature history of track find out.

3.2 Concept CAD model :

Track assembly upper & lower track CAD model concept design on CATIA V5 design software with their parametric dimension.

3.3 Hand calculation & manufacturing feasibility :

Theoretical calculation to find out feasibility of track assembly & to compare with result from FEA & experimental.

3.4 Finite Element Analysis

Upper & lower track will be modelled using CatiaV5R22 with the exact dimensions which will be used in the seat track assembly of automotive seat The model will be imported to ANSYS software or Hypermesh software. Using FEA software meshing, analysis is carried out.

IV. CONCLUSION

Seat plays such a key role in areas related to safety, durability and reliability. Seat testing is critical in regards to a customer's perception of a vehicle. In frontal & rear crash accident the safety of occupant is measurably depend on seat system design.The design of seat track is very important because during an accident or a crash, occupants tend to be thrown back against their seat backrest due to peeloff forces and if the track is not built to withstand such an impact, it results in failure & may cause measure injury to occupant. While designing seat track it is very important to consider testing such as track load analysis, 3 & 2 Point Seat Belt (lap) Anchorage strength static testSeat back strength,Forward & rearward impact etc.

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