Design and Optimization of Lower and Upper Rail for Track Mechanism by Using Finite Element method

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1.0 Abstract

The purpose of this research work is to design & optimize upper & lower rail of seat track mechanism subjecting to static analysis. The design of upper & lower rail of seat track mechanism by changing parameters & maintain feasibility of seat track. Tracks are the mechanisms which translate the seat & them helpful in occupant safety as link between seat and car. Also, they must provide individual length adjustments possible. The compactness of the seats warrants design and is a complicated problem. Seat track assembly is the most critical criteria in the design of seat structures in automotive industries. From all seat parts, the seat tracks (upper and lower tracks) carry most of the load on seat structure considering human load & structure load. The automotive industry is growing very fastly. Each year new and better automotive components are introduced by the automotive manufacturers in view of improving passenger's safety and comfort as well as aesthetics. Comfort & Safety of passengers are very important. Sliders (Track) are the mechanisms which is giving the travel the automotive seat. Seat track assembly is the most complicated portion in the design of seat structures in automotive industries. From all seat parts, the seat tracks (upper and lower tracks) carry most of the load on seat structure considering driver & passenger load & structure load. The objectives of automotive industries are to design quicker more efficient vehicles & it travelling greater distances in short interval of time. Proper design of the seating system is very important. Also, achieving the feasibility of peel off or rupture of track. Scope of the present work involves Finite Element Modeling of Seat track mechanism using FEA software like Hyper mesh or Ansys. Pre-processing steps such as updating of element type, material properties, application of loads and Boundary condition is performed software usingFEA. The results in the form of stress, load and displacement are extracted using FEA result. It compares with analytical &

experimental method. There is 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 means changing thickness & material with maintain feasibility of seat track & achieving the feasibility of peel off track.

Key Words: - Quality Function Development, Finite Element Method, Finite Element analysis, CAD Peel Load.

2.0 Introduction

Today, the automotive industry is advancing very rapidly. Each year new and better automotive Components are introduced by the automotive manufacturers in view of improving passenger's safety and comfort as well as aesthetics. Today's global competition has prompted many automotive manufacturers to design their products based on consumer's preference and satisfaction. An essential DOF required by all seating structure designs is the front forward and rear forward movement of the seat. As automotive seating structures have evolved over an extended development period, there has been a convergence of practical embodiment. Accordingly, front forward and rear forward movement is typically achieved using a sliding track assembly consisting of interlocking rail sections. Due to the random probability distribution nature of production processes, track assembly performance is affected by production limit variation. For lowest cost track assembly manufacturers, latitude in production 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.

The topic of this paper concerns the mechanisms used for longitudinal adjustment, the"tracks position". The main thing of a good automotive seating system is not only to give 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. During lasts years, the lotof changing in the automotive industry strategy. Nowadays one of the preferences is the reduce the car weight without impact on safety or cost. To overcome this need, theword approach goes through a structure optimization and the use of big strength steel material. This kind of material has generally the drawback to have a more ductile behavior. Rupture is now more present during development phase.

Benchmarking study of alternative automotive seat track profiles according to their sensitivity to manufacturing variation. 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. The analyzed 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) divided by rolling elements (spherical and cylindrical). Rolling effort is significant to customer perceived product quality, and must be:

Due to these conflicting demands, rolling effort is highly sensitive to manufacturing variation which results in both large scale batch-to-batch variation between assembly production batches, as well as piece-to-piece variation within single assemblies.

- Sufficiently high to avoid chatter in the track assembly.
- Sufficiently low to allow the track to slide without excessive effort.

Fig 1 Track system

1.1 Quality Function Deployment In a few words:

The voice of the customer translated into the voice of theengineer to design a product well, a design teams needs to ken what it is they are designing, and what the cessation-users will expect from it. Quality Function Deployment is a systematic approach to design predicated on a close cognizance of customer desires, coupled with the integration of corporate functional groups. It consists in translating customer desires (for example, the facileness of indicting for a pen) into design characteristics (pen ink viscosity, pressure on ball -point) for each stage of the product development (Rosenthal, 1992). Ultimately the goal of QFD is to translate often subjective standard criteria into objective ones that can be quantified and quantified and which can then be acclimated to design and manufacture the product. Itis a complimentary Procedure for determining how and where priorities are to be assigned in product development. The intent is to employ objective procedures in incrementing detail throughout the development of the product. (Reilly, 1999).

Quality Function Deployment was developed Quality Function Deployment was developed by Yoji Akao in Japan in 1966. By 1972 the power of the approach had been well demonstrated at the Mitsubishi Cumbersomely hefty Industries Kobe Shipyard (Sullivan, 1986) and in 1978 the first book on the subject was published in Japanese and then later translated into English in 1994 (Mizuno and Akao,1994).In Akao‟s words, QFD "is a procedure for developing a design quality aimed at satiatingthe consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the engenderment phase.

[QFD] is a way to assure the design quality while the product is still in the design stage." As a very consequential side profit he points out that, when opportunely applied, QFD has demonstrated the reduction of development time by one-half to one-third. (Akao, 1990).

The 3 main goals in implementing QFD are:

- Prioritize verbalized and unspoken customer wants and needs.
- Translate these design data into technical characteristics and designations.
- Build and distribute a quality product or accommodation by

focusing everybodytoward customer Contentment.

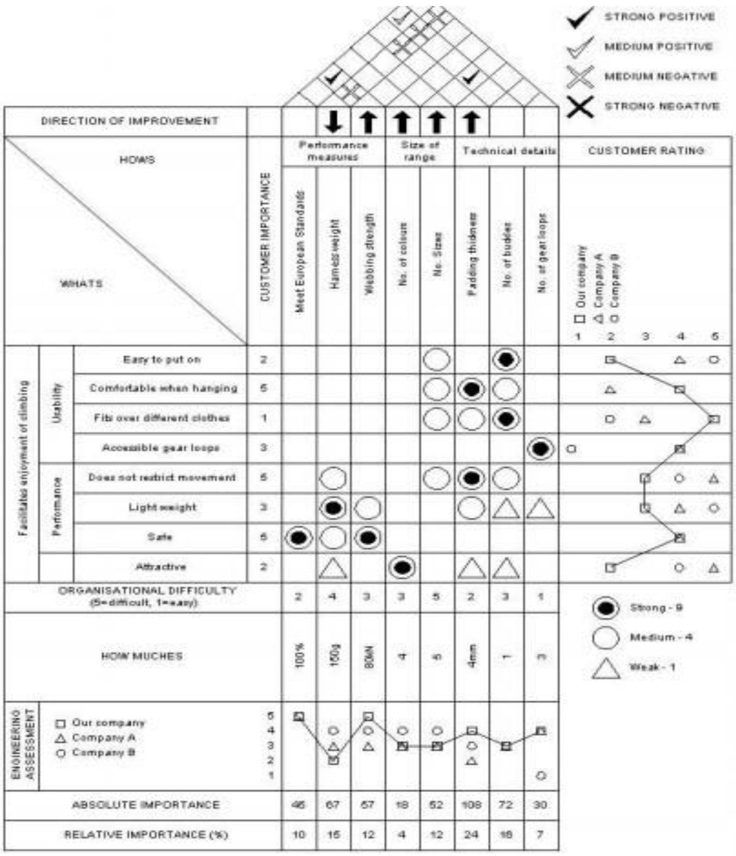

Fig 1.2: Track system QFD

1.2 Objectives of the Thesis:

1. Reduction of automotive seat track weight & maintain thickness optimizing upper& lower rail design.
2. Designed upper & lower rail with appropriate material selection with using properoptimization method.
3. Finite element analysis of upper & lower rail to meet all regulatory automotiveseat requirements.
4. To achieve feasibility in peel off or rupture test for seat track assembly to getregulatory requisite.
5. Designed upper & lower rail should give benefits in safety & comfort compare tosubsisting seat track assembly

3.0 Literature Review

Mahesh Morge et. al. has portrayed that Seat structures assume a noteworthy partin the auto uninvolved security. Because of their modification work systems are for the most part required in the seat disappointment mode. With the present advancement of car procedures, one of imperative car industry needs is to lessen theitem mass, plan faster and more proficient vehicles, accentuating on voyaging long separations in short interim of time. For this solace with security of travelers is critical, hence the outline of the seating framework is vital. In the meantime, situate rails need to satisfy great quality criteria, there are exceptionally strict prerequisites viewing quality and crash value as the seat rail is viewed as a wellbeing segment it exchanges powers from the driver/traveler to the auto floor life systems in the event of a crash and they need to give singular length conformities conceivable. Among many parts, the seat tracks (upper and lower tracks) convey the greater part of the heap on seat life systems considering human load. The point of this venture is to upgrade a car situate track by lessening track broadness and its cost subjecting to static examination.**[1]**

Akbar Basha.S et. al have depicted that the destinations of car enterprises are to outline snappier and more proficient vehicles, underlining on voyaging more noteworthy separations in short interim of time. For this solace with wellbeing of travelers is critical, along these lines the plan of the seating framework is vital. The seat tracks give the base to the vehicle situates and are required to perform essential capacities. They have physical association with the vehicle and exchange energy to the undercarriage. In the meantime, they need to give singular length changes conceivable. The Seating in a vehicle is a tradeoff amongst solace and space imperative. The minimization of the seats warrants careful plan and is a convoluted issue. Situate track get together is the most basic criteria in the outline of Seat structures in car enterprises. Among many parts, the seat tracks (upper and lower tracks) convey a large portion of the heap on seat structure considering human load. The point of this venture is to enhance the outline of a car situate track subjecting to static investigation.**[2]**

Maciej Mazur et. al. has portrayed that benchmarking study is introduced on the execution of car seat track profiles as per their affectability to assembling variety. Variety in rail geometry influences the versatile track preload and therefore the moving exertion of the track gathering. Moving exertion must be unequivocallycontrol to accomplish client execution targets. Two benchmarking parameters are pertinent to moving exertion. Critical variety in execution recognizes for the chose track profiles, which incorporate monetarily accessible outlines and proposed ideas. The benchmarking approach exhibit in this work gives a method for quickly surveyingthe relative power of car seat track outlines subject to assembling variety. The result helps car producers to apply a methodical way to deal with car situate configuration in view of a powerful plan assessment of option epitomes.**[3]**

M. Chauffray et. al. concentrated on tracks are the components which empower to decipher the seat; they are enter donors in inhabitant security as connection amongst seat and auto. With the present development of ecologic enactment, one of major car industry needs is to diminish the item mass. To achieve this target, the utilization of high-quality steels shows up as a decent arrangement with the downside to be weaker. In parallel, FEA models must be increasingly prescient keeping in mind the endgoal to diminish the approval cost. In this unique situation, burst chance expectation shows up as a solid need from outline office and regular post-handling techniques are not sufficiently precise to convey adequate support to configuration groups. The arrangement picked is a coupling amongst ansys and the disappointment criteria to FEM created by Mate Fem Organization.**[4]**

Laud Tom et. al. concentrated on seat track system as slider component use in auto situate. A Multi-body framework comprises of mechanical linkages and these linkages are interconnected with Unbending Bodies or Adaptable Bodies approach and because of linkages element conduct they may encounter translational and rotational removals. Multi-body Element examination is utilized to assess a multi-body framework. It is broadly utilized as a part of Car, Aviation, and Apply autonomy space for researching the dynamic conduct of the framework.**[5]**

Sung Jong Kang et. al. concentrated on Security is a critical issue in car outline,

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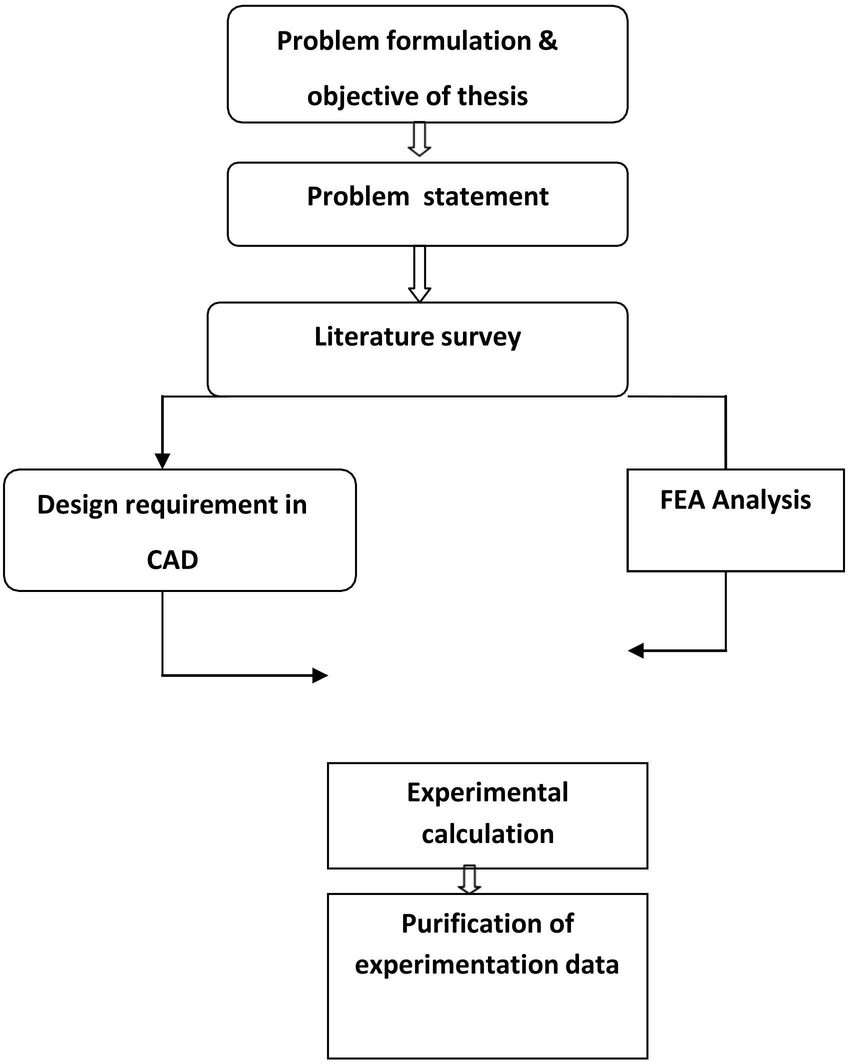
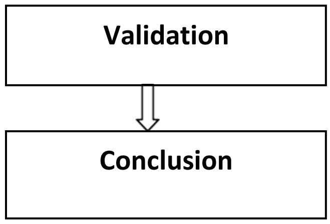
in which the seat structure has an imperative impact. Building of the seat structure has an extensive variety of advantages for the maker in the ranges of cost investment funds and better outline systems. The seat in a vehicle must be agreeable for the traveler, as well as be intended to shield the inhabitant from an extensive variety of effect circumstances. The seat structure in our progressing car world should likewise have a straightforward, lightweight outline to keep down material and assembling costs.**[6]**

4.0 Methodology





4.1 Finite Element Method:

FEM can be analyzed as instruments for the approximated of differential conditions portraying diverse physical things. The accomplishment of FEM is construct to a great extent with respect to the essential limited component techniques utilized: thedetailing of the issue in vibration shape, the limited component optional of this definition and the powerful arrangement of the subsequent limited conditions. Limited component examination (FEA) has turned out to be typical lately, and is presently the premise of a multibillion dollar for every year industry. Numerical answers for even extremely confounded anxiety issues can now be acquired routinely utilizing FEA, and the technique is important to the point that even starting medicines of Mechanics of Materials –, for example, these modules ought to blueprint its essential elements. From opposite side, the limited component strategy (FEM) is considered also settled and helpful system for the PC arrangement of most noticeably bad issues in various building compound designing, atomic building, hydrodynamics, geo-mechanics, and so on. These means are a similar whichever issue is considered and together with utilization of the computerized PC introduce a characteristic way to deal with building arrangement. In the part, strategies for the effective arrangement of the limited component balance conditions in element and statics investigations will be talked about. In the third piece of the course, some demonstrating angles and general elements of some Limited Component Programs (ANSYS, NISA) will be quickly analyzed.

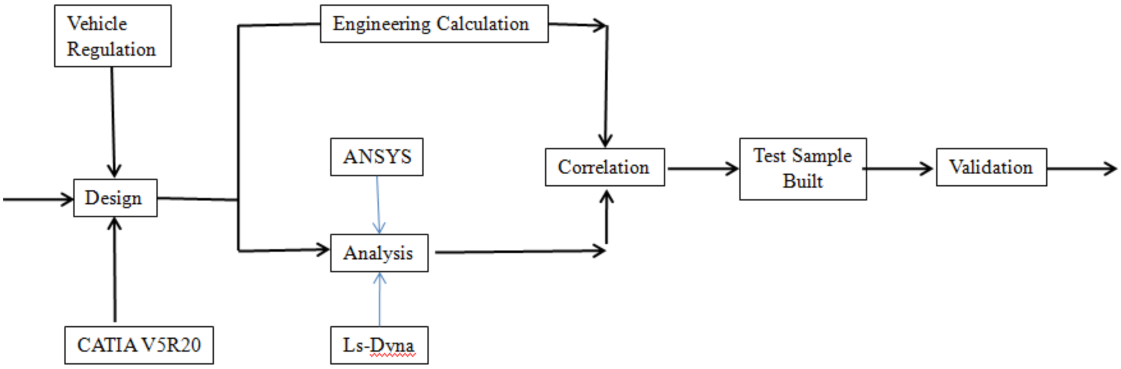


Fig 4.1: Process Flow of Methodology

5.0 Result Summary

Table 5.1 Result summary for project

Sr. No.	Method	Condition	Load	Weight
1	Hand Calculation	Complete seat load	11.46KN	
2	FEA-I	Individual track- Material - ASTM-A619,2.6mm Thk.	15.4KN	0.940 Kg
3	FEA-II	Individual track- Material- DP800,2.3mm Thk.	16.1KN	0.760Kg

6.0 Conclusion:

Weight diminishment is accomplished by using 2.3mm thickness of track and contradict decrease is 6.89 %. Using Quality capacity organization (QFD) enhancement strategy DP800 gives most extreme outcome for power, formability and material accessibility. According to FEA result DP800 material 16.1kN peel of load iswatched which more dominant than material ASTM-A619 peel of load 15.4 kN is watched. Be that as it may, according to material qualities DP800 having high return and extreme ductile force. according to test come about and graphical introduction DP800 material track manage greatest load for most extreme time to peel of track. Planned upper and lower rail ought to give benefits in wellbeing and solace think about according to ECE control necessities for Seat Belt Anchorage (SBA) test.

6.1 Future Scope:

As per regulatory standard, current seat track rail has been developed & validated. Butas per OEM‟s specification, additional requirements are, seat should comply with are as follows.

- Durability- for full forward position of track
- Durability- for full backward position of track
- Validation with different track profile.

To check whether track is complying with above requirements, respective forces needto be resolve for hand calculations. Dynamic FEA needs to be done accordingly.

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