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Fabrication of Suspension in Rear Seats of Buses

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Abstract - It is observed by the passengers of the BMTC buses that the Shocks/Jerks experienced in the rear seats is more while compared to the front seats as the shock absorbers are located at position A (Front Wheels) and B (Rear Wheels). The jerks are directly absorbed in these zones. However, the position C (Free End) acts as a free handing lever. Imagine it somewhat like holding a scale with half the length outside the table and you are holding the end on the table. The hanging part acts like a cantilever. Even slight disturbance near the free area closer to the table results in large displacement in the extreme free end. The same thing happens in the bus. Point C is the free extreme and point B is the fixed end. Hence to overcome the effect on rear seat passenger we are fabricating and implementing suspensions in the rear seats.

Keywords: BMTC Bus, Passenger, Shocks/Jerks, Shock Absorbers, Displacement

1 INTRODUCTION

Seat suspensions are customary in commercial vehicles for industrial, agricultural and public transport purposes. To decrease passenger fatigue due to disclosure to severe working environment such as rough road conditions and also to improve passenger security, comfort and health.

1.1 THE BASIC COMPONENTS OF SUSPENSION SYSTEM

1.1.1 SPRINGS

The springs sustain the weight of the passenger, retain seat height and absorb road shock caused by bumps or dips on the road. The coil spring is the most universal and may be used in the rear seats of the vehicle. The leaf spring is made of several steel plates of different lengths and can also be used at the rear of the vehicle.

1.1.2 SHOCKS

Shock absorbers are generally used in cars and light trucks and now we are using it on the rear seats with standard suspension systems. Shock absorbers offer resistance by forcing hydraulic fluid through valves in the piston as it moves up and down which dampen movement of the vehicle and spring as they compress and spring back during vehicle journey. The amount of resistance depends on how fast the suspension moves. Without the shocks the vehicle would constantly bounce.

1.1.3 STRUTS

Unlike shock absorbers, struts are chief structural part of the suspension. Struts perform two main jobs. Firstly, they act like a shock absorber to dampen the motion of the springs as they constrict and recoil. Secondly, struts provide structural support for the seat suspensions

1.2 THE THREE MAIN TYPES OF SEAT SUSPENSIONS

1.2.1 PASSIVE SEAT SUSPENSIONS

The study of passive seat suspension primarily focuses on improving parameters such as spring stiffness and the damping co-efficient.

1.2.2 SEMI ACTIVE SEAT SUSPENSION

Semi active control of seat suspension has been proposed to provide variable damping force with less external power consumption. They have lower implementation cost, easier to control, simpler design, easy to install.

1.2.3 ACTIVE SEAT SUSPENSION

Active suspension system uses hydraulic actuator to decrease the amount of exterior power required to attain the desired performance trait that is able to exert an independent force on the suspension to improve the riding characteristic. Active systems have a broad range of force, no force velocity restraint and can achieve better performance.

2 METHODOLOGY

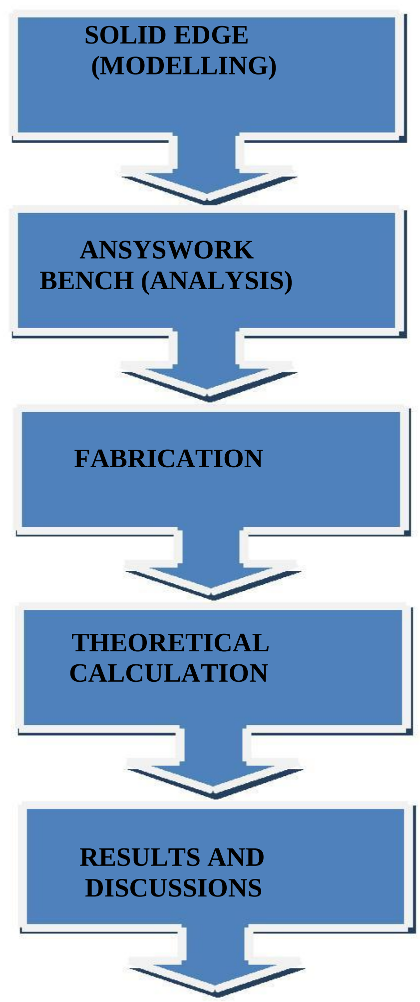


Fig 1. Methodology

2.1 MODELLING IN SOLID EDGE

Fig 2.1(a) 3D Model Of Shock Absorber

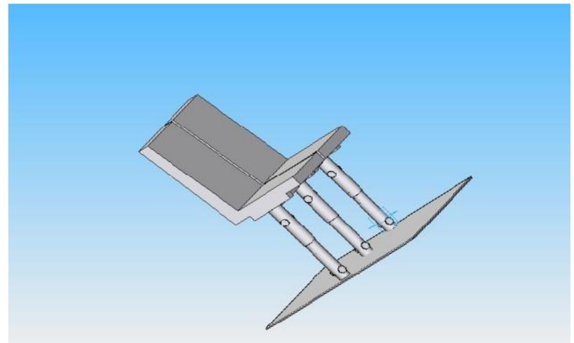
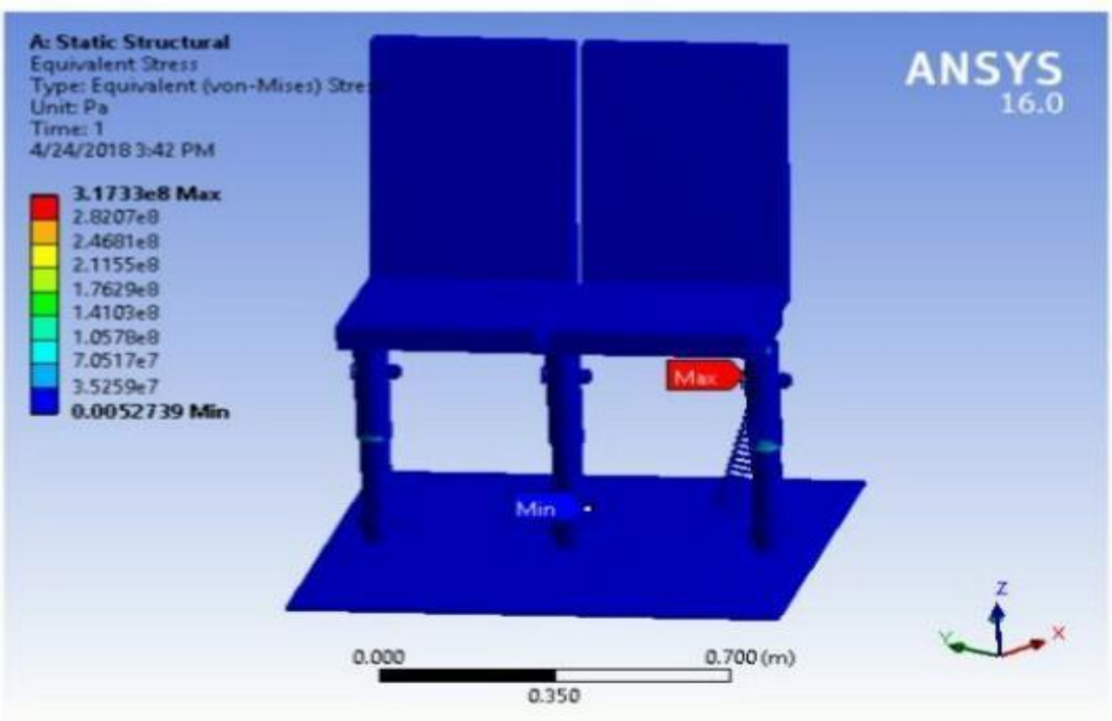


Fig 2.1(b) 3D Model Of Seat With Suspension

2.2 ANSYS WORK BENCH ANALYSIS

Equivalent Stress

Subject:	Suspension in rear seats of buses
Author:	Team
Prepared For:	Rear seat
Date	Monday, April 23, 2018
Comments:	Right side suspension is going under extreme deformation



Total Deformation

Subject:	Suspension in rear seats of buses
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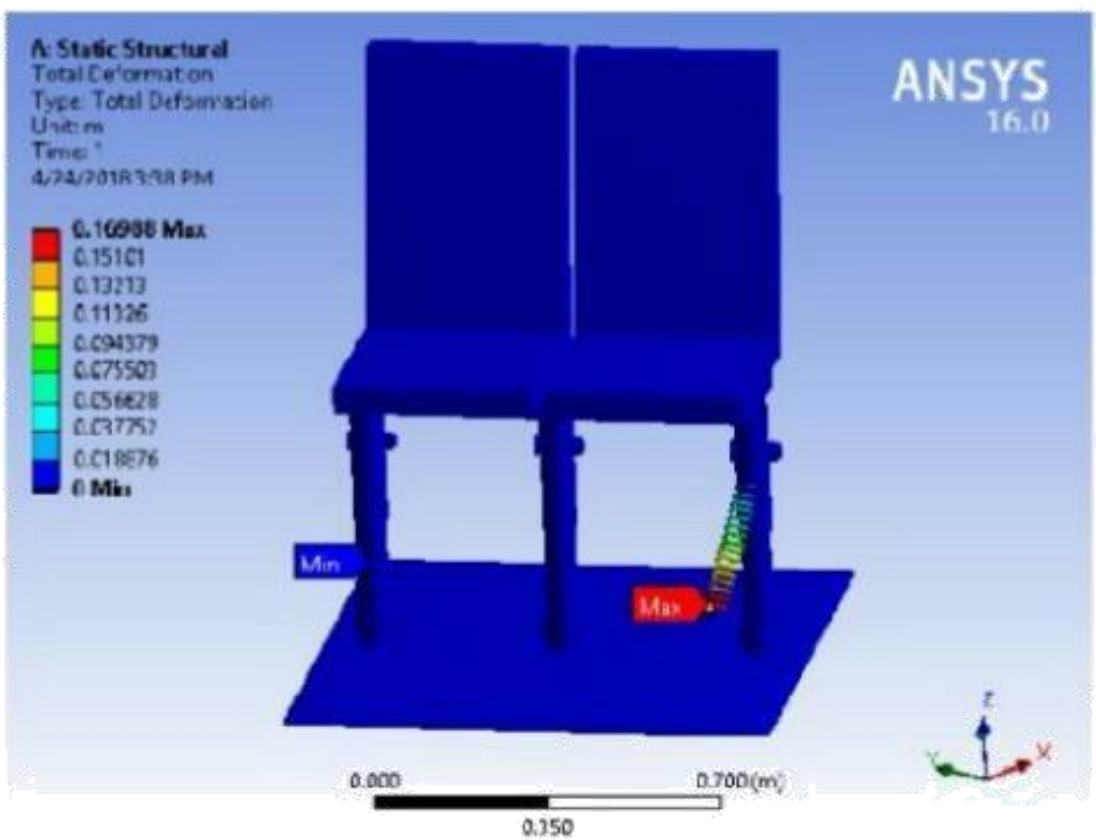

2.3 FABRICATION

2.4 THEORETICAL CALCULATION

- Major dia. (D)=50.04 mm
- Minor dia. (d)=7 mm
- Free length (l_o)=240 mm
- No. of turns (i)=17
- Load (F)=1176 N
- g=79000 (constant)

Solid length = i*d= 17*7=119 mm

Spring index (c)= D/d= 50.04/7= 7.148

Pitch (p)= (l_o-2d)/i= (240-2(7))/17= 13.2914 Direct stress τ_1= $8FD/\pi d^3$ = 436.8885 N/mm^2

Stress due to curvature of wire τ_2= $4F/\pi d^2$ = 30.5577 N/mm^2 Max shear stress $\tau = \tau_1+\tau_2$ τ= $8FD*k_s/\pi d^3$ where, k_s= 1+1/2c

τ= 467.4462 N/mm

Deflection (y)= $(8FD^3*i)/24*g$= $(8*1176*(50.04)^3 *17)/7^4 *79000$= 105.652282 mm

Rate of spring (required stiffness) F_o= F/y= 1176/105.652282= 11.13085 Actual rate of spring (actual spring stiffness) F_o= $d^4G/8iD^3$= 11.13085

2.5 RESULTS AND DISCUSSIONS

2.5.1 THEORETICAL RESULTS

Direct stress τ_1= 436.8885 N/mm^2

Stress due to curvature of wire τ_2= 30.5577 N/mm^2
Equivalent stress τ= 467.4462 N/mm^2

Deflection (y)= 105.652282 mm

Rate of spring (required stiffness) F_o= 11.13085
Actual rate of spring (actual spring stiffness) F_o= 11.13085

2.5.2 PRACTICAL RESULTS (ANSYS)

Equivalent stress= 317 N/mm2 Total
deformation= 169.88 mm

2.5.3 DISCUSSION

The practical equivalent stress was less than that of theoretical equivalent stress, the same is seen with deformation and also the required spring stiffness is equal to the actual spring stiffness. Hence satisfactory results were achieved.

3 CONCULSION

The design, fabrication and tests were successfully run and conducted by our group. The results were more than satisfactory. Our intension/motive to reduce the impact on the passengers and provide a more safe and comfortable ride for them met our expectations. The budget of fabricating the seat also stayed on track and turned out economical.

4 SCOPE OF FUTURE WORK

1. Use a bigger shock absorber with better spring rate between the 2 seats as it is subjected to more stress and deformation compared to the ones on the extreme ends.

2. A better way to mount the legs of the seat to the base of the bus.

3. Practically testing the seat in action while mounted to the bus.

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