MACHINE DESIGN

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TOPIC- Self-Navigating Trike for the Blind

ABSTRACT

Mobility of physically disabled persons is a concerning social issue nowadays. Various hand driven tricycles, wheelchairs, retrofitted vehicles etc. are commonly available for disabled people as a mode of transportation. Existing means of transportation for disabled people require a disabled person to dismount from the wheelchair. A retrofitted tricycle is designed to overcome this problem by allowing the disabled person to wheel up or down his wheelchair onto or down the tricycle. This is achieved using a specially designed platform that allows the wheelchair to be wheeled up or down. This paper discusses an attempt to design and fabricate a retrofitted tricycle for disabled people. This tricycle is specifically designed to suit wheelchair occupants.

SPECIFICATIONS

1. Consists of proximity sensors, GPS sensors, voice controlled sensors.
2. Electric
3. HeadLights provided
4. Bottle stand provided
5. Basket provided in the front
6. Charger provided since electric

ADVANTAGES

1. Economical- No fuel consumption
2. One time investment
3. Helps the blind/disabled to commute on their own
4. an easily skip the public transport
5. Take trips any time of the day

DESIGN CONSIDERATIONS

Design of frame and platform includes space considerations for cycle positioning and travel. Thus, parameters such as length from wheel base of cycle to shoulder support, length from wheel base of wheel chair to hand rest, width of cycle, total length of cycle were needed. Also to consider reach-ability data design for a disabled person sitting on the wheel chair was required. For selecting the above parameters data consideration is required. As per ADA standards, size of cycle has been taken as. Reach-ability data is needed to finalize the positions of functional controls such as handle, brakes, accelerator etc.

Length of platform = 1.1 m
Height of the hand rest = 0.75 m above the platform
Position of functional controls = 0.73 m above the platform

MATERIAL SELECTION

MATERIAL SPECIFICATION While selecting the material for fabrication, the prime motive is to select material that can provide high strength and reliability to the tricycle. Another consideration is to reduce material cost and overall weight of cycle. Some desirable properties of material required for fabrication of model are

1. Material must have high tensile strength.
2. Material should withstand torsional and shear stresses.
3. Material should be highly resistant to changing weather conditions.
4. Material should be light in weight.
5. Material should be cost-effective & cheap.

As the application includes various forces and moments on the fabricated model, the material selected must be either metal rods or tubes for safety and efficient working. Mild Steel provides high tensile and torsional strength required for the application.

AISI 1050

Sr No	**Properties**	**Value**
1	Density	7.85 gm/cm3
2	Elastic modulus	200 GPa
3	Poisson’s ratio	0.29
4	Tensile strength	725 MPa
5	Yield strength	415 MPa
6	Hardness	229 HB
7	Impact strength	31.0 J

FRAME DESIGN

The size of the tube is selected on the basis of factor of safety consideration and reaction forces calculations. A function of chassis is to make the vehicle robust and strong enough to withstand all the forces acting on the vehicle. To determine the desirable size of pipe, it is necessary to find out the critical component in the vehicle which is most likely to fail when impact occurred on wheels. Stresses developed in the pipe depend upon the area of cross section of pipe. Larger the area, smaller the stress in the pipe. By considering available sizes of pipe, maximum stresses developed in the critical component and factor of safety is calculated and the size which gives maximum factor of safety is selected.

CALCULATIONS FOR FRAME WHEN THE VEHICLE HITS OBSTRUCTION

Impact force is transmitted to chassis through suspension spring. So, the component on which suspension spring is mounted is the critical component.

Let,

F = Force that is transmitted through suspension system

θ = Angle made by the spring to vertical axis

Do = Outer diameter of the pipe

Di = Inner diameter of the pipe

Syt = Yield strength of the MS pipe

y = Position of neutral axis

I = Area moment of inertia

Assuming total impact force acting on the rear wheels of the vehicle in upward direction is "2g" times the weight of the vehicle.

Here,

$\theta = 30°$

Total Force =2*9.81*25 (since weight of vehicle is 25 kg) =490.5 N

As two suspensions are given, force acting on each suspension is

(F)=(Total force/2) = 245.25 N Vertical force acting on the pipe,

$(F_v) = F\cos(\theta) = F\cos(30) = 212.39$ N

Horizontal force acting on the pipe,

(Fh) = Fsin(θ) = Fsin(30) =122.6 N

Length of the critical component of chassis is 0.38m, and it acts as a cantilever beam fixed at one point and load is applied at the 0.19 m away from fixed point.

Maximum bending moment due to vertical force,

Bmax v = 212.39 x 0.38 = 80.7082 N-m

Maximum bending moment due to horizontal force,

Bmax h = 122.625 x 0.19 = 23.3035 N-m

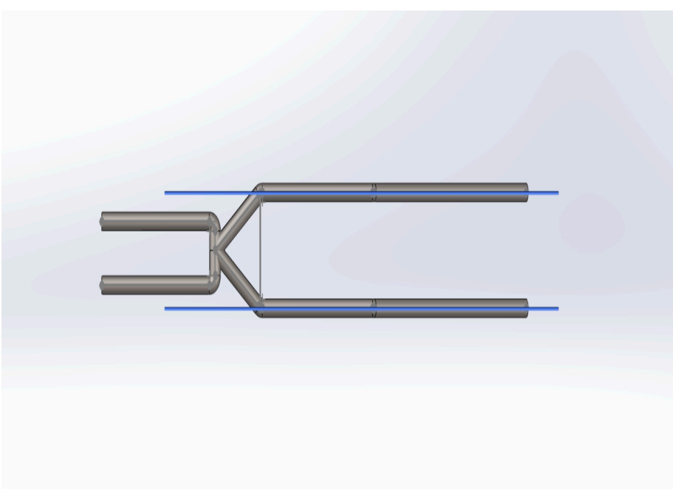
Resultant bending moment, Bres = √(80.7082^2 +23.3035^2) = 84.0051 N-m

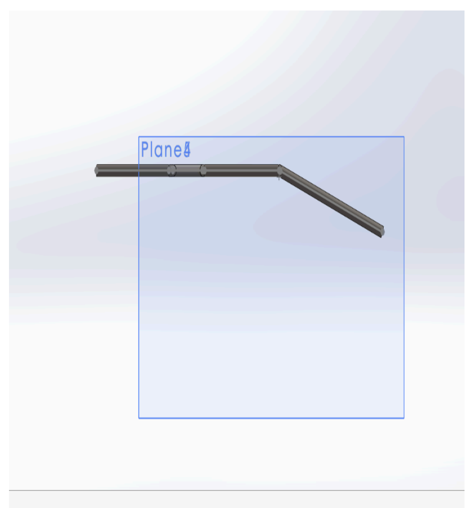
Maximum bending stresses,

Fbmax. = Bres * Y / I

= 84.0051 x (0.0381/2) ∏/64 (0.03814 - 0.03414) = 589.43 N/mm2

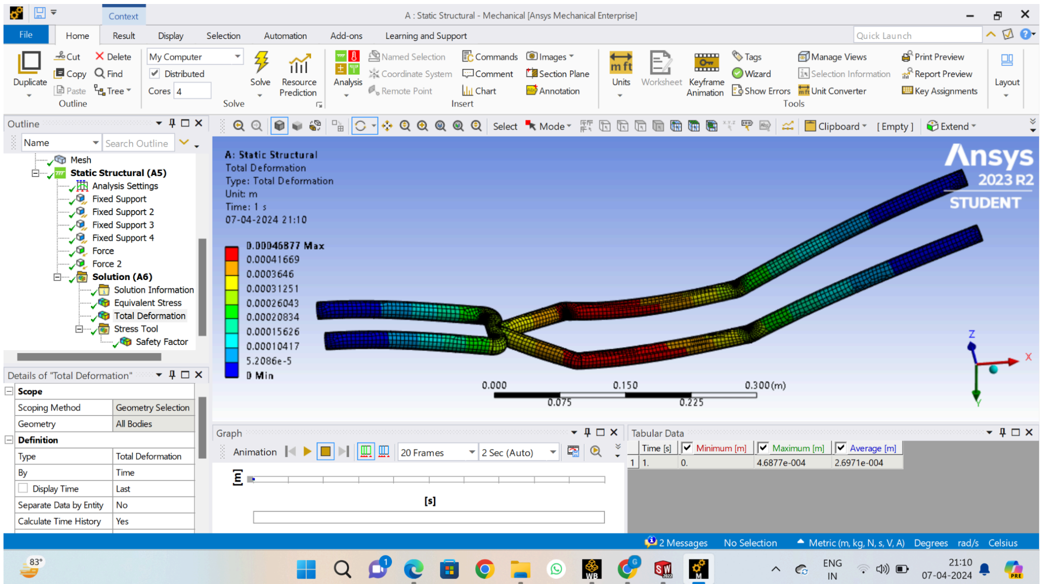
Available factor of safety = (Syt / Maximum bending stress) = (725/589.43) = 1.23



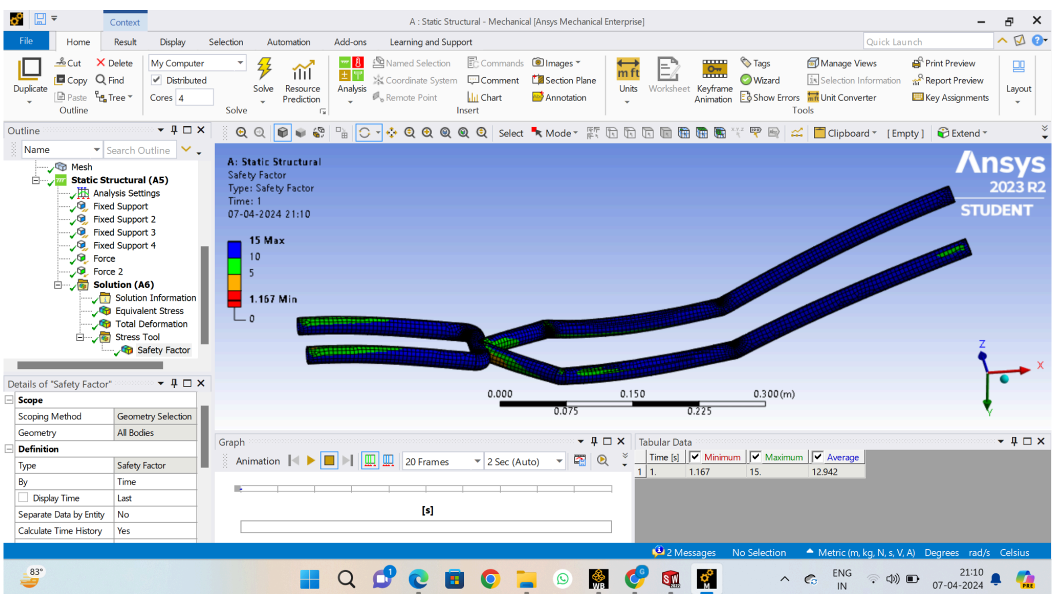


Theoretical analysis was carried out on the critical component which is most likely to be failed after the impact. In the frame, the member on which suspension is mounted is the critical component. Considering the maximum possible forces that can be developed during the impact, maximum bending stress developed and factor of safety is calculated. Maximum bending stress developed in the critical component is 239.92 MPa and available factor of safety is 1.23. Similarly, computational stress analysis is carried out and the results are compared with theoretical analysis.

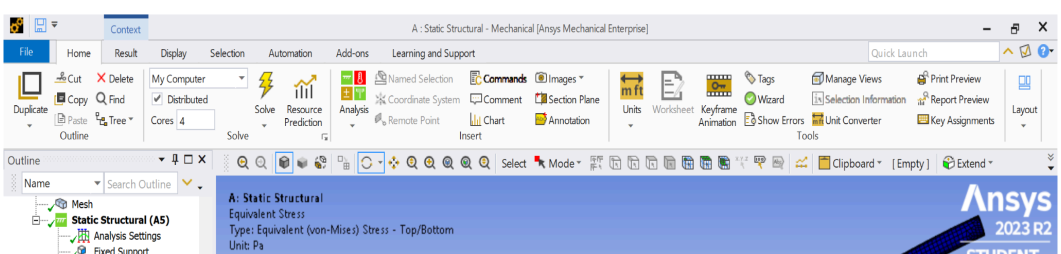
1) DEFORMATION



2) STRESS ANALYSIS



3)STRESSES DEVELOPED



Factor of Safety	CALCULATIONS	ANALYSIS
	1.23	1.167

SPECIFICATION OF CYCLE

MODEL	SPECIFICATION
Weight of Chassis	10.525 N
Weight of Wheelchair	24.525 N
Weight of Driver	686N N
Weight of Accessories	343.35 N

TYRES

There are 3 tyres in the cycle. One in the front, two in the rear.

BRAKING SYSTEM

A brake is a mechanical device which inhibits motion, slowing or stopping a moving object or preventing its motion. Most commonly, brakes use friction between two surfaces pressed together to convert the kinetic energy of the moving object into heat. Drum brakes are used in the tricycle because the vehicle is a slow speed application. Hence, high braking torque is not necessary and cost of the drum brakes is less.

FINAL DESIGN

This design is of a tricycle which we used as reference to make the frame and considered for analysis and calculations of our design. We intent to have a final design which is similar to this design.