DESIGN AND FABRICATION OF ELECTRIC MOTOR CYCLE CHASSIS FRAME

KARTHIK K N[1], RAGUNANTHAN M[2], GOWTHAM B[3], ABINANTH G[4]

[1]Assistant Professor - III, Mechanical Engineering & Bannari Amman Institute of Technology

[2]UG Scholar, Mechanical Engineering & Bannari Amman Institute of Technology

[3]UG Scholar, Mechanical Engineering & Bannari Amman Institute of Technology

[3]UG Scholar, Mechanical Engineering & Bannari Amman Institute of Technology

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ABSTRACT:

Our undertaking centers on the plan and creation of an electric scooter's chassis frame, underlining execution and security. Using progressed computer aided design and FEA apparatuses; we enhance plan boundaries like material choice and burden dissemination. Fabricating joins conventional and current strategies for mechanical effectiveness and simplicity of creation. Thorough actual tests approve load-bearing limit and strength. Our work adds to feasible metropolitan transportation by making a lightweight, strong body Chassis (frame), improving electric motorcycle (scooter) well being and proficiency.

The design process consists of several steps, including:

- ➢ Defining chassis requirements
- ➢ Doing data analysis of existing chassis models
- ➢ Creating a quantity design concept
- ➢ Choosing the best design concept
- ➢ Select Finite Element Analysis of Design (FEA)
- ➢ Chassis fabrication

The final design is an incredibly light and strong chassis that meets the requirements of the power plant. The final analysis results show that the chassis can withstand the expected loads during normal operation. The chassis is made by a combination of welding and machining.

KEYWORDS:

An unnatural weather change, Electric Bike, Case, Triangulation, Ansys.

I. INTRODUCTION:

The raising natural worries presented by traditional petrol filled vehicles have set off a fast shift towards Electric Vehicles (EVs) as a practical arrangement in 2023. In this day and age, the difficulties of an Earth-wide temperature boost and energy emergencies are at the very front of cultural talk, delivering the quest for practical options basic. This crossroads, described by an intersection of thriving populaces and fast innovative headways, has amplified the worldwide interest for energy assets. Remarkably, information from ongoing reports, for example, the 2023 BP Measurable Survey of World Energy and the BP Energy Standpoint, highlight the critical commitment of the auto business to energy utilization, with a significant offer credited to oil-based powers.

The excessive utilization of non-sustainable power sources has yielded broad ecological results, remembering troublesome adjustments for normal environment designs that have resounded through living souls. Notwithstanding these squeezing worries, there is an undaunted push to change towards sustainable power sources for the purpose of moderating natural debasement. The contemporary scene has seen a particular change in outlook towards vehicles that produce negligible to no poisons. Electric vehicles, outfit by environmentally friendly power sources, have arisen as a strong technique to relieve ozone depleting substance emanations and check contaminations. Studies and examinations directed in 2023 have shown that the mix of EVs controlled by sustainable sources holds the possibility to reduce ozone depleting substance discharges overwhelmingly.

The charm of sustainable power is highlighted by its multi-layered benefits, including a decreased natural impression, supported long haul accessibility, monetary practicality, and the inactive potential to cultivate financial development through work creation. Strikingly, the idea of EVs, especially as e-bikes, has gotten forward momentum because of their inborn straightforwardness and practicality inside the metropolitan scene. An e-bike, symbolic of this change, typifies indispensable electric parts, including an electric engine, battery, and charger. Significantly, the quest for naturally cognizant transportation stretches out to focusing on wellbeing, a critical concern especially relevant to the taking off pace of street mishaps including bikes in thickly populated regions.

Tending to these wellbeing concerns requires strong suspension plan for bikes. A versatile case configuration isn't simply essential to rider security during crashes yet additionally vital in engrossing shocks, conveying loads successfully, and keeping up with vehicular soundness. The developing scene of current transportation has seen a conclusive shift from petroleum products to electric and half-breed vehicles. In the domain of earlier examination, frame plans for e-bicycles have been investigated, utilizing different materials, for example, AISI 1020, Aluminium compounds, and AISI 4130, all based on improving the variable of wellbeing (FOS).

The year 2023 has seen eminent steps in computational systems, with modular and dynamic examinations being executed to evaluate the way of behaving of electric bikes. These examinations, frequently tackled through modern computational devices, have approved their true capacity as far-reaching primary appraisal

II. DESIGNING:

II. 1. Purpose And Goal:

The focal point of this venture is to imagine and understand an intentional electric bike undercarriage outline. This system frames the foundation of the bike's construction, conveying the double liability of giving primary trustworthiness to house different vehicle parts and guaranteeing the rider's wellbeing. This highlights the vital job that the undercarriage configuration plays in the achievement of the undertaking. Any split the difference in the case's presentation could essentially endanger both the electric bike and the rider's prosperity. The overall objective is to design a frame that ensures the rider's security, lays out strong associations for all subsystems, adjusts fastidiously with wellbeing guidelines, all while focusing on a lightweight development.

II. 2. Background:

With regards to electric mopeds fueled by electric engines, accomplishing most extreme speed increase requires a lightweight suspension. In any case, this suspension should likewise persevere through the difficulties presented by Indian street conditions. Limited component examination (FEA) gives an answer, separating the design into components for stress, diversion, and response investigation. Transient FEA, zeroing in on weight and strength improvement, arises as a pivotal reproduction technique. Presumptions are utilized to help plan and examination in exploring these intricacies really.

II. 3. Design Objectives:

The frame plan targets include:

•Perseverance under Burden: Endure dynamic burdens.

•Rider Wellbeing: Guarantee rider security on shifted landscapes.

•Weight Equilibrium: Achieve even weight dispersion.

•Low Focus of Gravity: Upgrade mobility through low focus of weight.

•Administrative Consistence: Comply to somewhere safe principles and guidelines.

•Weight Breaking point: Keep up with weight under 65 kg.

II. 4. Driver Comfort and safety:

To guarantee the reasonableness of the planned case for a 6-foot-3-inch, 65Kg driver, computations were performed during the plan stage. Given its understudy driven plan, the handlebar is deliberately raised to support an upstanding stance for a loose and slow riding experience.

II. 5. Design measures:

1. CAD Displaying with Combination 360: Starting the plan cycle spins around making a computer aided design model, empowering perception of the model's way of behaving upon development. Combination 360, a powerful 3D displaying device, was chosen to work with this imperative stage.

2. Emphasizing Primary Congruity: Vital thought of twists was incorporated to limit the requirement for unnecessary weld focuses. Selecting a persistent part over different weld-spots decreases weight, a crucial worry for E-Bicycle plan.

3. Prioritizing Manufacturability: Effortlessness in creating processes holds foremost significance. The plan approach fixates on choosing manufacture strategies that are clear yet exact, lining up with the overall target of making a plausible and powerful plan.

4.8. 3D Model:

ISOMETRIC VIEW

FRONT VIEW

SIDE VIEW

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Length	1054.64mm
Height	674.96mm
Width	381.00mm
Head Tube Angle	25*
Seat Height	736.25mm

TOP VIEW

III. Frame Material Specification:

AISI 4130 is a chromium-molybdenum steel mix known for its high-fortitude to-weight extent and wonderful strength. Its mechanical properties make it fitting for applications requiring fundamental trustworthiness and impact resistance. Aluminum T6 is an aluminum blend that has been heat-treated to achieve additionally created strength. Its low thickness and extraordinary disintegration block seek after it an engaging choice for lightweight plans. Delicate Steel (MS) is a regular material with moderate strength and sensibility. For the arrangement and production of the electric bicycle body frame, AISI 4130 offers a strong decision in light of its high strength and toughness. It's thought could update The is capacity to case to get through anxieties and shocks, in this way ensuring the security of the rider. The compound's mechanical properties would presumably add to a strong and solid packaging.

Table 1.1: Material synthetic arrangement

Element	Content
Iron	97.03 – 98.22%
Carbon	0.280 – 0.330%
Chromium	0.80 – 1.10%
Molybdenum	0.15 – 0.25%
Silicon	0.15 – 0.30%
Sulfur	0.040%

Table 1.2: Material Mechanical Properties

Properties	Value
Density	7.85 g/cm^3
Poisons Ratio	0.27-0.30
Shear modulus	80 GPa
Modulus of Elasticity	205 GPa
Tensilestrength, ultimate	670 MPa
Tensile strength, yield	435 MPa

CALCULATION OF BENDING STRENGTH AND BENDING STIFFNESS:

Material Cross-Section Type; A x B x t where;
A = Outer Diameter for circular section
B= Inner Diameter for circular section
t= wall thickness

Material-1 (AISI 4130) Circular cross-section; Primary Member: 25.4 x 23.9 x 1.5mm, Secondary member: 22 x 20 x 1mm.

Elasticity (E): 205 GPa
Yield Strength (σ_yield): 435 MPa

Pipe Bending Strength Calculation:
Essential Part:
Compute the snapshot of latency (I) about the nonpartisan pivot (expecting the 23.9mm side is the level):
I _ essential = (1/12) * 25.4 * (23.9^3) mm^4 ≈ 39450.81 mm^4
Ascertain the part modulus (S) (expecting the 23.9mm side is the level):
Primary = I _ essential/(23.9/2) mm^3 ≈ 1651.56 mm^3
Compute the greatest twisting second (M _max) for the essential part (expecting a basic upheld pillar with a uniform burden):
We should expect a heap for each unit length (w) of 100 N/mm and a length (L) of 1000 mm.
M _ max _ essential = (w * L^2)/8 = (100 N/mm * (1000 mm) ^2)/8 = 12500000 N.mm = 12.5 kN.mm
Ascertain the twisting pressure (σ _ twist) for the essential part:
σ _ twist _ essential = (M _ max _ essential * (23.9/2))/S_ essential ≈ 143.28 MPa
Auxiliary Part:
Compute the snapshot of latency (I) about the nonpartisan pivot (expecting the 20mm side is the level):
I _ auxiliary = (1/12) * 22 * (20^3) mm^4 ≈ 14666.67 mm^4
Ascertain the part modulus (S) (expecting the 20mm side is the level):
S _ auxiliary = I _ optional/(20/2) mm^3 ≈ 733.33 mm^3
Compute the greatest twisting second (M _ max) for the optional part (expecting a basic upheld pillar with a uniform burden):
Utilizing a similar expected load value:
M _ max _ optional = (100 N/mm * (1000 mm) ^2)/8 = 12500000 N.mm = 12.5 kN.mm
Work out the twisting pressure (σ _ twist) for the optional part:
σ _ twist _ auxiliary = (M _ max _ optional * (20/2))/S _ auxiliary ≈ 340.43 MPa

Load Calculation:

Applying 1G force to with stand our frame up to maximum speed of 35km/hrs. This is applied for Front, Rear, Side, Torsional impact and drop test.
The calculation is given below:
Weight of the vehicle (m) = 65 kg

Introductory speed (V beginning) = 0 m/s

Last Speed (V last) = 9.7m/s (35 Km/hr.)

Influence time (t) = 0.50 seconds.

From work energy rule,

Work done = Change in K.E,

|W| = |1/2×m× (V final)2 - 1/2×m× (V initial)2|

|W| = |1/2×m× (V initial)2| = 3057.925 Nm

Dislodging (s) = Velocity(V) x Time (t)

s = V last x t = 9.7 x 0.5 = 4.85 m

W=Force(F) x Dislodging (s)

F = W/s = 3057.925/4.85= 630.5 N ≈ 650 N.

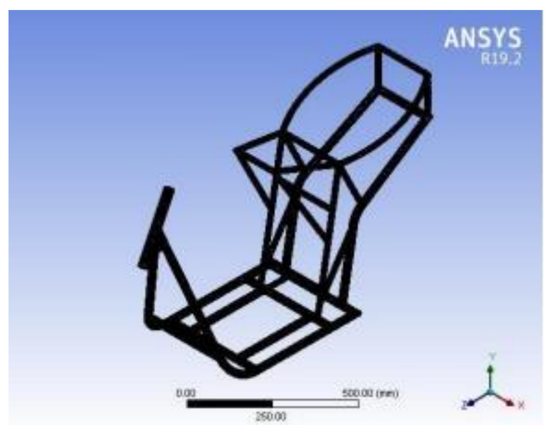
IV. SIMULATION AND ANALYSIS:

Ansys 19.5 R1:

ANSYS 19.5 R1 is a thorough designing reenactment stage that supports progressed examinations. It includes an instinctive task schematic view, making complex Multiphysics examinations less complex through simplified usefulness. The stage offers bi-directional computer aided design incorporation, mechanized lattice, refreshes, boundary the board, and streamlining instruments, improving efficiency for Recreation Driven Item Advancement. Inside ANSYS, strategies like Punishment, Lagrange, and expanded Lagrange are utilized for contact and non-straight examination. These standards add to a large number of examinations. In a venture, ANSYS 19.5 R1 assumed a critical part in Modular and Static Underlying Examination. ANSYS 19.5 R1 is a far-reaching designing reproduction stage that supports progressed examinations. It includes an instinctive task schematic view, making complex Multiphysics investigations easier through simplified usefulness. The stage offers bi-directional computer aided design coordination, robotized coinciding, refreshes, boundary the board, and streamlining apparatuses, improving efficiency for Recreation Driven Item Improvement. Inside ANSYS, procedures like Discipline, Lagrange, and extended Lagrange are used for contact and non-straight assessment.

FRONTAL IMPACT ANALYSIS:

MESHING CONDITION:



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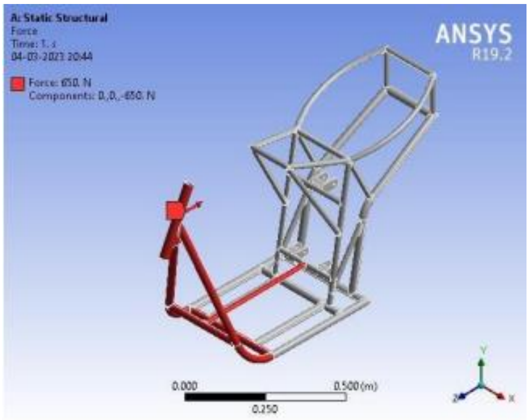
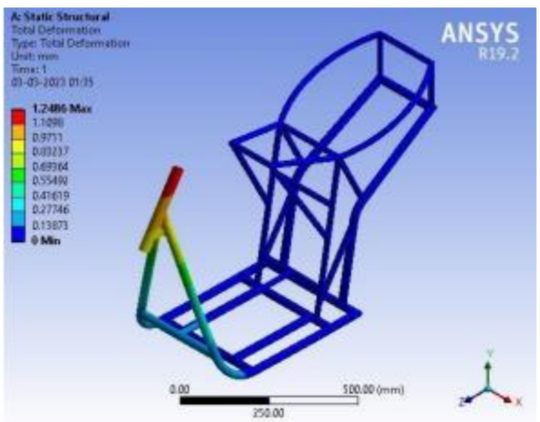
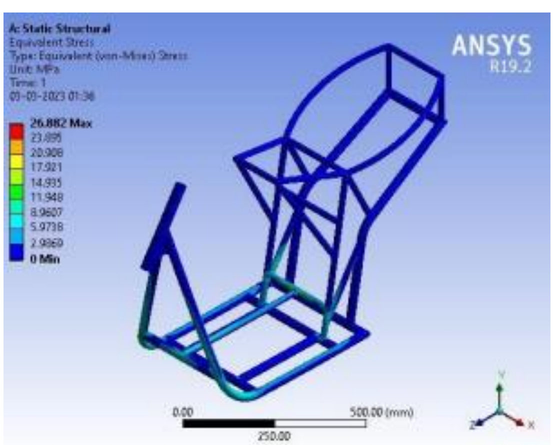
AREA OF FORCE APPLIED ON THE FRAME:



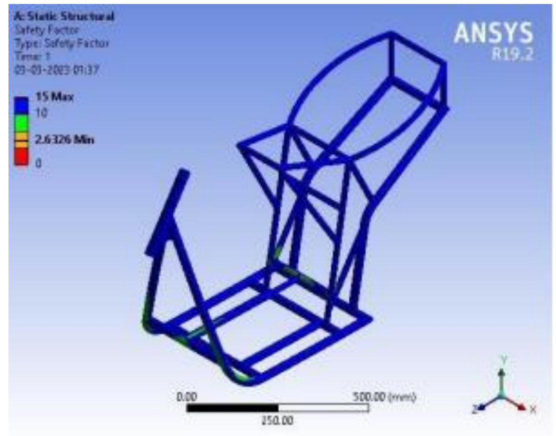
TOTAL DEFORMATION:



Equivalent Stress:

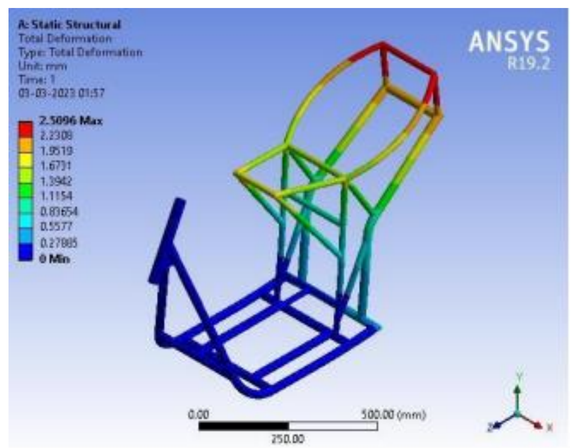


Safety Factor:

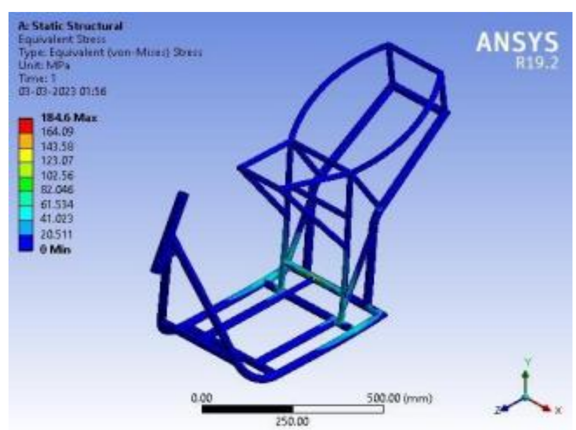


REAR IMPACT ANALYSIS:

TOTAL DEFORMATION:



Equivalent Stress:



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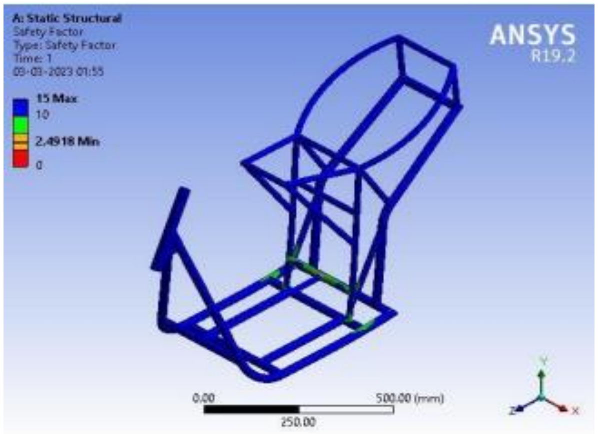
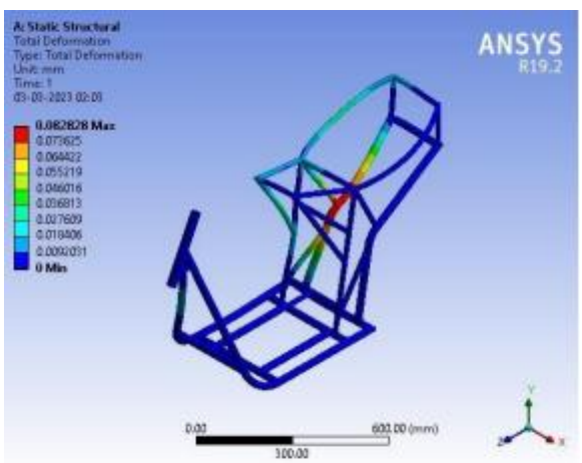
Safety Factor:

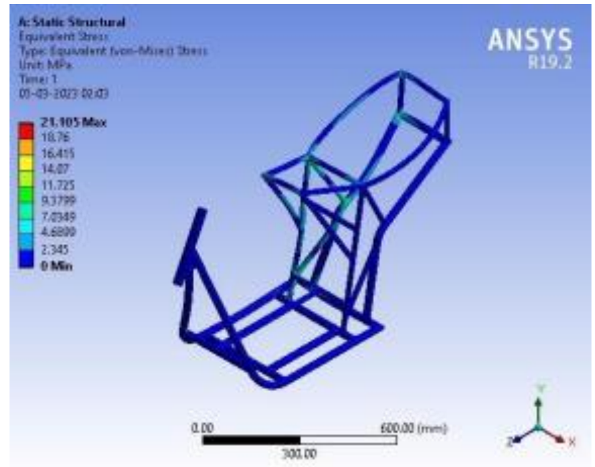


SIDE IMPACT ANALYSIS:

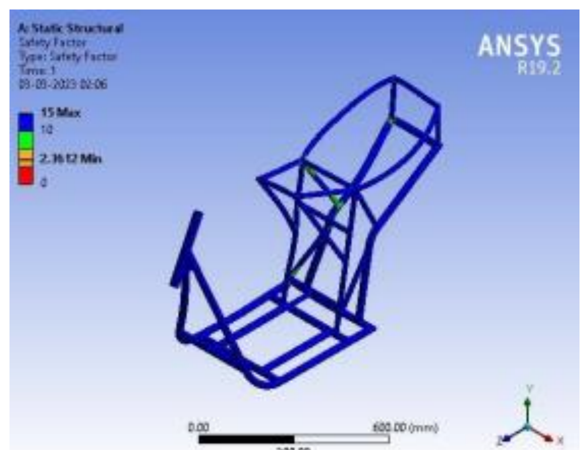
TOTAL DEFORMATION:



Equivalent Stress:

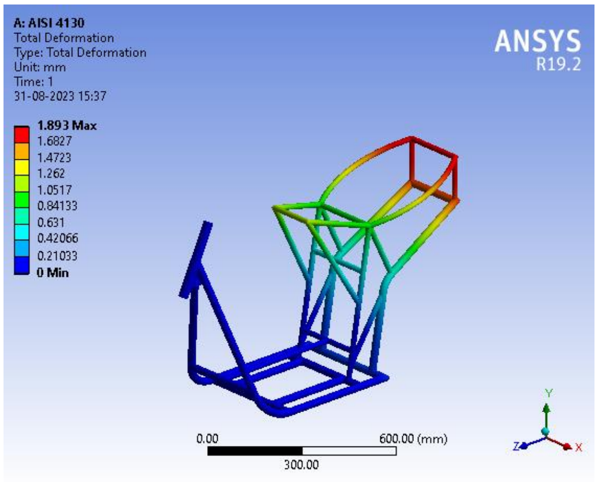


Safety Factor:

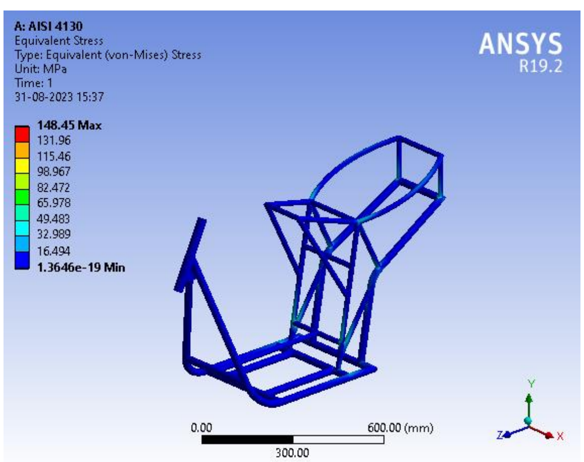


TORSIONAL IMPACT ANALYSIS:

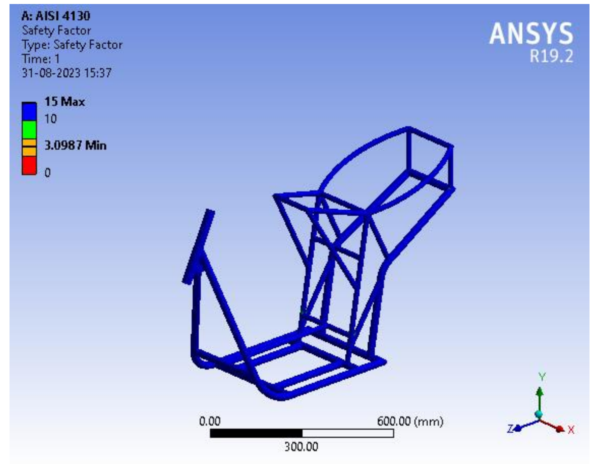
TOTAL DEFORMATION:



Equivalent Stress:

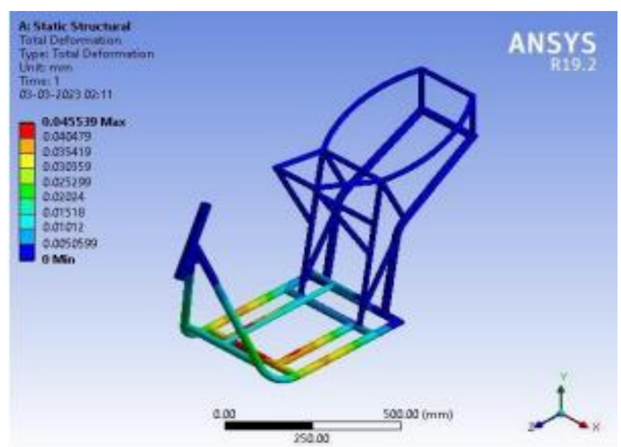


Safety Factor:

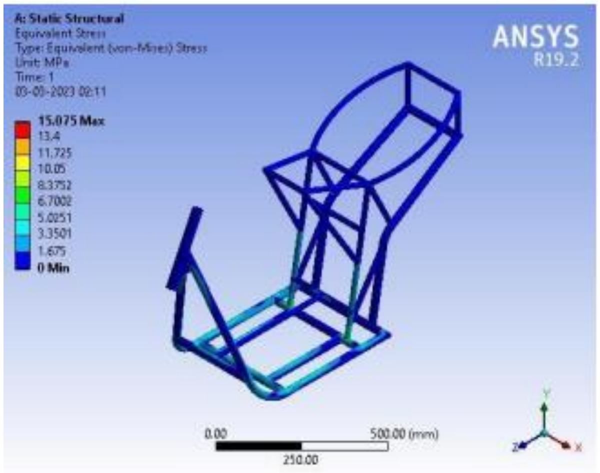


DROP TEST ANALYSIS:

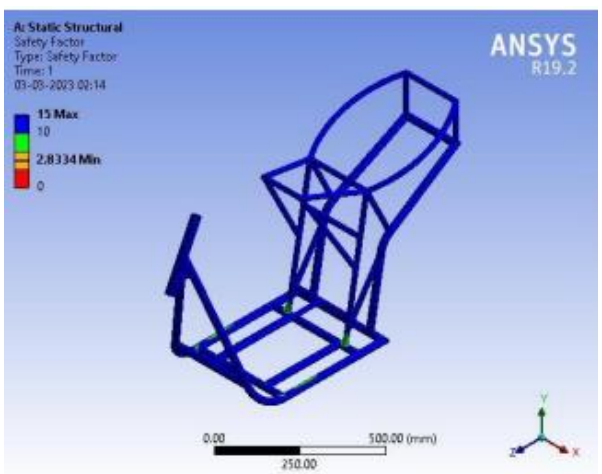
TOTAL DEFORMATION:



Equivalent Stress:



Safety Factor:



V. CONCLUSION:

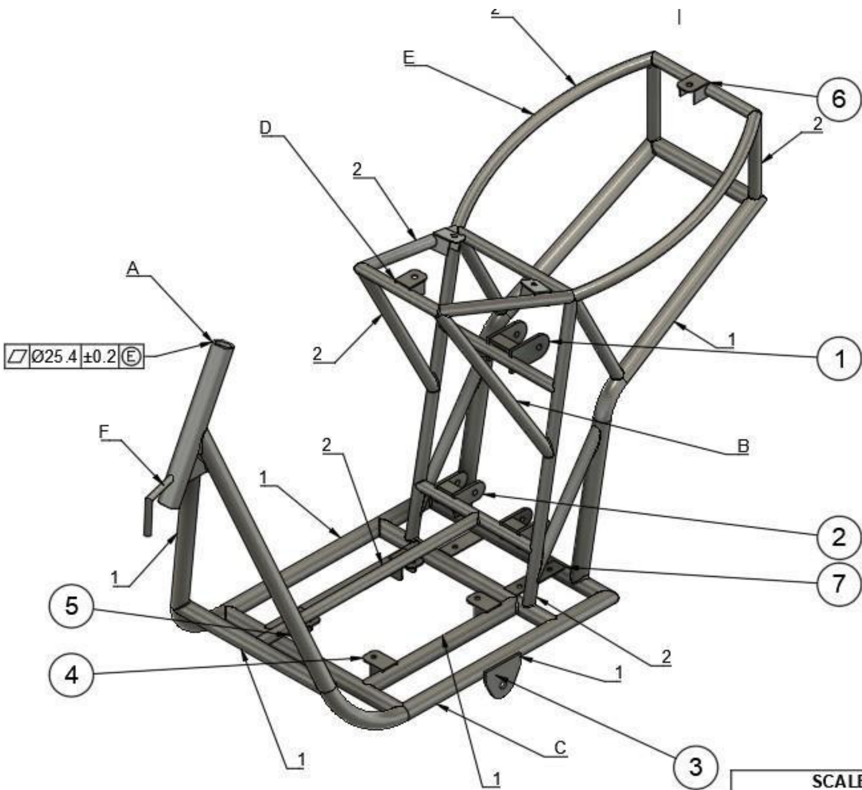
The key goal is to achieve the lightweight edge and from the above plan and the examination we have achieved the light weight frame by reducing the unfortunate material and we achieved it

- The cost is reduced by decreasing the material and the additional welding are moreover lessened which lessened the cost of work and welding.
- The part of safety is above 2.4 which is good to go for on road with all the impact powers and the edge upheld them.
- The packaging was made incredibly fundamental with straightforward get-together by have essentially three to four joins to make it totally gather and any repairman without prior data can moreover accumulate the bike so no need of skilled workers which decreases the cost.
- The edge was made so it might be used after its life cycle that it will in general be changed over totally to clear bicycle frame and reuse it. All in all, All things considered, the electric bicycle body frame was meticulously advanced to agree with plan and utilitarian basics. This edge plan ensures overhauled strength as well as works with ideal part foundation. Through Restricted Part Examination (FEA), the edge went through intensive evaluation against various loads and impacts. The revelations verify the edge's security, impressively under mentioning conditions, for instance, the most outrageous load of 65kg (650N).

Test Run	**Max. Deformation**	**Max. Stress**	**Min. FOS**	**Acceptability (Yes/No)**
Frontal	1.2486mm	26.882 N/m^2	2.6326	Yes
Rear	2.5096mm	184.6 N/m^2	2.4918	Yes
Side	0.0828mm	21.105 N/m^2	2.3512	Yes
Torsional	1.8930mm	148.45 N/m^2	3.0987	Yes
Drop Test	0.0455mm	15.075 N/m^2	2.8334	Yes

VI. RESULT:

Diagram:



1	Primary Member (Ø25.4 * 1.5 mm)
2	Secondary Member (Ø18 * 1 mm)

S.No.	Part Number	Material
A	HEAD PIPE	AISI 4130
B	SEAT SUPPORT MEMBER	AISI 4130
C	BASE MEMBER	AISI 4130
D	SEAT MEMBER	AISI 4130
E	REAR SEAT MEMBER	AISI 4130
F	Steering Lock mount	AISI 4130

Parts List

Item	Qty	Part Number	Material
1	1	UPPER MOUNT FOR SUSPENSION	Steel
2	2	SWING ARM MOUNT	Steel
3	1	Stand Mount	Steel
4	2	BATTERY MOUNT	Steel
5	2	BATTERY MOUNT v3(Mirror)	Steel
6	4	Seat Mount	Steel
7	2	Controller Mount	Steel

SCALE 1 : 5

Dept.	Technical reference	Created by	Approved by
Design	SAE E-Bike Rulebook	RAGUANANTHAN M 03-03-2023	GOWTHAM B 03-03-2023
VOLTRAGE ELECTRICS		Document type: DWG	Document status: COMPLETED
		Title: CHASSIS FRAME	DWG No. 001
			Rev. Date of issue Sheet

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