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DESIGN AND STATIC ANALYISIS OF FORK LIFT FRAME USIN VARIOUS MATERIALS

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Abstract

The main paper work is to replace the standard materials from the materials using at present for fork lift, by analyzing the different materials from the database or from our knowledge A forklift (also called lift truck, jitney, fork truck, fork hoist, and forklift truck) is a powered industrial truck used to lift and move materials over short distances. The forklift was developed in the early 20th century by various companies, including Clark, which made transmissions, and Yale & Towne Manufacturing, which made hoists. Since World War II, the use and development of the forklift truck have greatly expanded worldwide. Forklifts have become an indispensable piece of equipment in manufacturing and warehousing.

Presently there is a lot of future scope because future technology is all automation, in automation there is a major work was done by the fork

lift or material handling.

Key words: Fork lift,Automation

1. Introduction

Becauseofthevarieties,differentshapes,differentpackagingofthegoods, loading and unloading has always been a heavy process duringtransportation. Forklifts were naturally invented and became the solutionto this problem; they save time and space. If cargos are being organizedproperly, the use of forklifts with the right attachments would be the bestway to load and unload, which would make the whole process less timeconsuming and less labor intensive. In addition, forklifts optimize the useof storage space by eliminating the need for many people to handle theloading and unloading operations and enabling the stack-up of goods. Thestacking height of goods can be up to 4~5m, some even can be as high as10m, which brings up the utilization of warehouse by least 40%. Now,most ofthetransportation operationsareusing forklifts.

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Forklifts fall under the category of lifting and transport machinery. Aforklift has a lifting system for loading packages and a mobile system for

moving around, like a truck. A forklift is also called a forklift truck. It ismainly used for loading and unloading common packaged goods. With

some special attachments, it can also be used for non-packaged goods oruntraditionalshapedgood.Figure1.1showsaforkliftequippedwith

attachment picking up a roll of paper. This hydraulic clip attachmentallows the operator to open and close a clip around a load. Products like

Figure 1 Forklift with Paper Handling Chassis

Figure 2 Hyster Forklift Trucks Equipped with Heavy Duty Vista Masts

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cartons and boxes can use this type of attachment. Figure 1.2 aforkliftwith aspecialattachment allowingtherotation.

2. Experimental procedures

2.1 MATERIAL PROPERTIES:

(a) Mild steel

Mild steel is a ferrous metal made from iron and carbon. It is a low-priced material with properties that are suitable for most general engineering applications. Low carbon mild steel has good magnetic properties due to its high iron content; it is therefore defined as being 'ferromagnetic.

Property	Mild Steel
Composition (wt %)	C: 0.14-0.2, Mn: 0.6-0.9, P: 0.04, S: 0.05, Fe: balance
Specific gravity ($g.cm^{-3}$)	7.8
Melting point (^0C)	1523
Thermal conductivity ($W.m^{-1}.K^{-1}$)	51.9
Specific heat capacity ($J.g^{-1}.C^{-1}$)	0.472
Electrical resistivity (μΩ.cm)	1.74
Hardness (HRB)	143
Tensile strength (MPa)	475
Yield strength (MPa)	275

(b)Inconel

onel is a registered trademark of Special Metals Corporation for a family of austenitic nickel-chromium-based superalloys.

Inconel alloys are oxidation-corrosion-resistant materials well suited for service in extreme environments subjected to pressure and heat. When heated, Inconel forms a thick, stable, passivating oxide layer protecting the surface from further attack. Inconel retains strength over a wide temperature range, attractive for high temperature applications where aluminium and steel would succumb to creep as a result of thermally induced crystal vacancies.Inconel's high temperature strength is developed by solid solution strengthening or precipitation hardening, depending on the alloy. Inc

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Property	Unit	
Density	Kg/m^3	8190
Young's Modulus	GPa	200
Ultimate Tensile Strength	MPa (min)	1375
Yield Tensile Strength	MPa	1100
Thermal Conductivity	w/m°K	11.4
Specific Heat Capacity	J/Kg°C	435
Melting Point	°C	1260-1336

(C) Carbon fiber

Carbon fibres or carbon fibres (alternatively CF, graphite fibre or graphite fibre) are fibres about 5 to 10 micrometres (0.00020–0.00039 in) in diameter and composed mostly of carbon atoms. Carbon fibres have several advantages including high stiffness, high tensile strength, low weight to strength ratio, high chemical resistance, high temperature tolerance and low thermal expansion.These properties have made carbon fibre very popular in aerospace, civil engineering, military, and motorsports, along with other competition sports. However, they are relatively expensive when compared with similar fibres, such as glass fibre, basalt fibres, or plastic fibres.

To produce a carbon fibre, the carbon atoms are bonded together in crystals that are more or less aligned parallel to the long axis of the fibre as the crystal alignment gives the fibre high strength-to-volume ratio (in other words, it is strong for its size). Several thousand carbon fibres are bundled together to form a tow, which may be used by itself or woven into a fabric.

Property	Value	Standard
Tensile strength (MPa)	2550	TY-030B-01
Tensile modulus (GPa)	135	TY-030B-01
Elongation (%)	2.1	TY-030B-01
Density (g/cm^3)	180	TY-030B-02
Carbon content (%)	93	

(D)Carbon steel

Carbon steel is a steel with carbon content from about 0.05 up to 3.8 per cent by weight. The definition of carbon steel from the American Iron and Steel Institute (AISI) states:no minimum content is specified or required for chromium, cobalt, molybdenum, nickel, niobium, titanium, tungsten, vanadium, zirconium, or any other element to be added to obtain a desired alloying effect.the specified minimum for copper does not exceed 0.40 per cent.or the maximum content specified for any of the following elements does not exceed the percentages noted: manganese 1.65 per cent; silicon 0.60 per cent; copper 0.60 per cent.

The term *carbon steel* may also be used in reference to steel which is not stainless steel; in this use carbon steel may include alloy steels. High carbon steel has many different uses such as milling machines, cutting tools (such as chisels) and high strength wires. These applications require a much finer microstructure, which improves the toughness.

Properties	Values
Ultimate tensile strength (MPa)	1,584
Young modulus (GPa)	207
Yield strength (MPa)	1,487
Coefficient of the fatigue strength (MPa)	2,063
Exponent of the fatigue strength	-0.08
Exponent of the fatigue ductility	-1.05
Coefficient of the fatigue ductility	9.56
Exponent of the cyclic strain hardening	0.05
Coefficient of the cyclic strength (MPa)	1,940
Poisson ratio	0.27

(E) .Aluminum 7075 alloy

7075 (Unified Numbering System (UNS) designation A96061) is a precipitation-hardened aluminium alloy, containing magnesium and silicon as its major alloying elements. Originally called "Alloy 61S", it was developed in 1935. It has good mechanical properties, exhibits good weldability, and is very commonly extruded (second in popularity only to 6063). It is one of the most common alloys of aluminium for general-purpose use.It is commonly available in pre-tempered grades such as 6061-O (annealed), tempered grades such as 6061-T6 (solutionized and artificially aged) and 6061-T651 (solutionized, stress-relieved stretched and artificially aged).

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Properties	AA6061-T6 (aged)
Yield stress (σ_y), MPa	276
Ultimate stress (σ_u), MPa	310
Fatigue limit (σ_f), MPa	96.5
Rupture strain, %	17
Elasticity Modulus (E), GPa	68.9
Poisson's ratio (v)	0.33
Density (ρ), g/cm^3	2.7

2.2. DESIGN PROCEDURE;

Creation of a cad model of the structure.

2. Generation of mesh.

3. Application of the loads & constraints in depending.

4. Solution of the respective test Determination of the stress values and deformation forces.

2.3. DESIGN DIMENSIONS:

Forklifts are one of the most powerful vehicles for builders. Whether you need to move heavy loads in a warehouse or construction field, forklifts can safely lift objects humans cannot, making them indispensable on any job site.Since there is a wide selection of styles and models, it can be difficult to select a forklift. Whether you're looking to rent a forklift for your next project or purchase one, our guide covers the different forklift types, the benefits of each equipment, and popular forklift models to help choose theright forklift for your needs..

3..1 CATIA V5 WORKBENCHES

CATIA V5 serves the basic design tasks by providing different workbenches. A workbench is defined as a specified environment consisting of a set of tools that allows the user to perform specific design tasks. The basic workbenches in CATIA V5 are Part Design, Wireframe and Surface Design, Assembly Design, Drafting.

1 Part Design Workbench:

The Part Designworkbench is a parametric and feature-based environment in which you can create solid models. The basic requirement for creating a solid model in this workbench is a sketch. The sketch for the features is drawn in the Sketcherworkbench that can be invoked within the Part Designworkbench. You can draw the sketch using the tools in this workbench. While drawing a sketch, some constraints are automatically applied to it. You can also apply additional constraints and dimensions manually. After drawing the sketch, exit the Sketcher workbench and convert it into a feature. The tools in the Part Designworkbench can be used to convert the sketch into a sketch-based feature. This workbench also provides other tools to apply the placed features, such as fillets, chamfers, and so on. These features are called the dress-up features. You can also assign materials to the model in this workbench.

3.1.2Wireframe and Surface Design Workbench:

The Wireframe and Surface Designworkbench is also a parametric and feature-based environment, and is used to create wireframe or surface models. The tools in this workbench are similar to those in the Part Designworkbench with the only difference that the tools in this environment are used to create basic and advanced surfaces.

3.1.3 Assembly Design Workbench:

The Assembly Design workbench is used to assemble the components using the assembly constraints available in this workbench. There are two types of assembly design approaches:

1. Bottom-up

2. Top-down

In the bottom-up approach of the assembly design, the components are assembled together to maintain their design intent.

In the top-down approach, components are created inside the assembly in the Assembly Designworkbench. You can also assemble an existing assembly to the current assembly.

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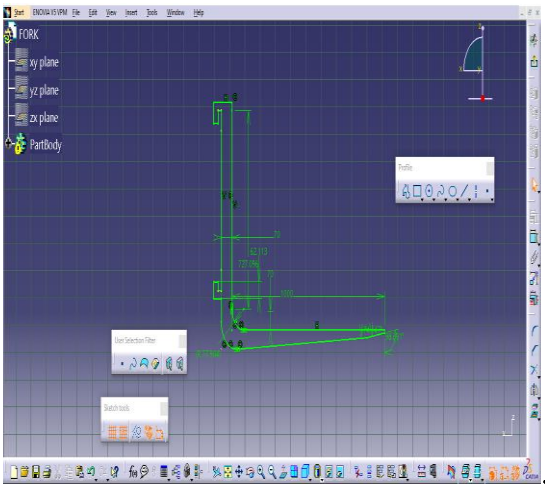
The Space Analysistoolbar provides the Clashanalysis tool that helps in detecting clash, clearance, and contact between components and sub-assemblies.



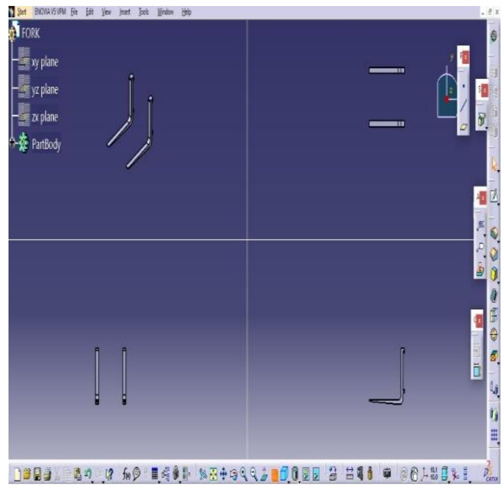
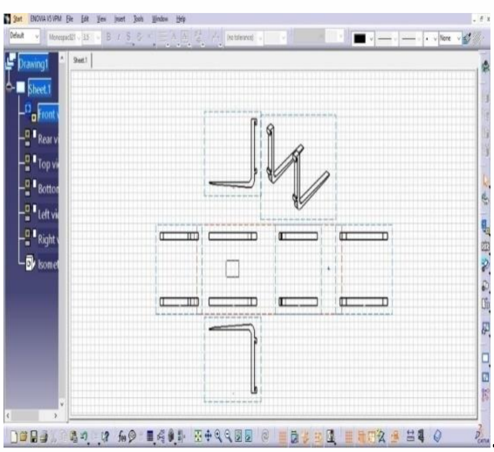


Figure.3FORK DIMENSIONSFigure .43-D VIEWS OF FORK



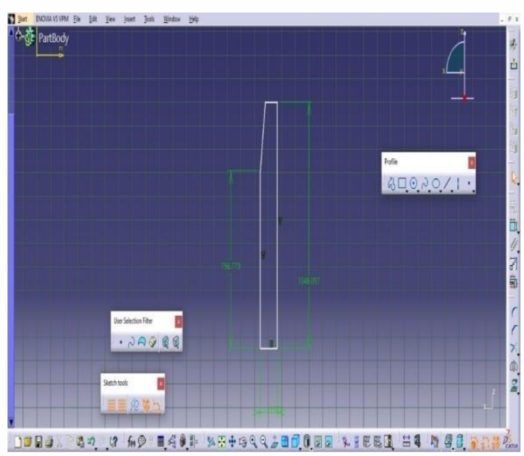
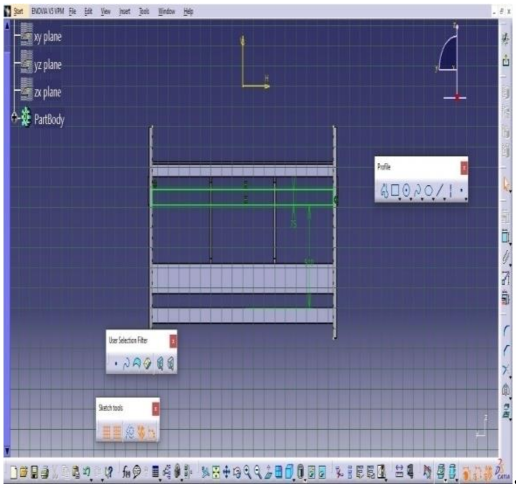


Figure..5 FORK DRAFT Figure .6 FRAME DIMENSIONS



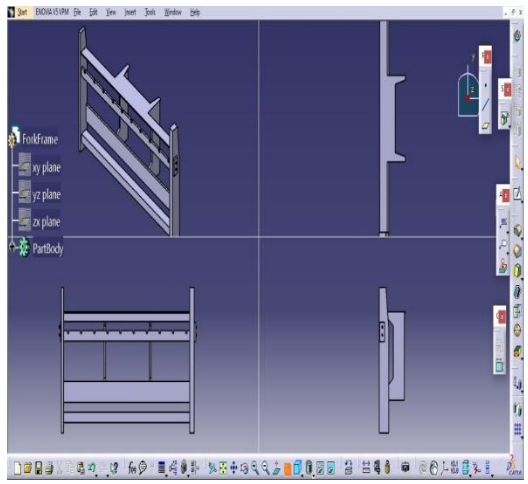
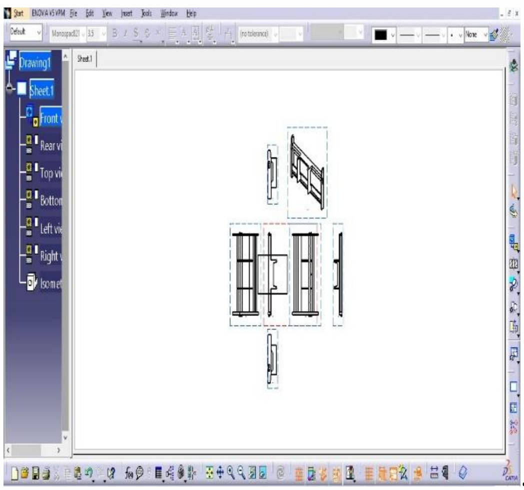


Figure.7FRAME DIMENSIONS -3Figure. .83D VIEWS OF FRAME



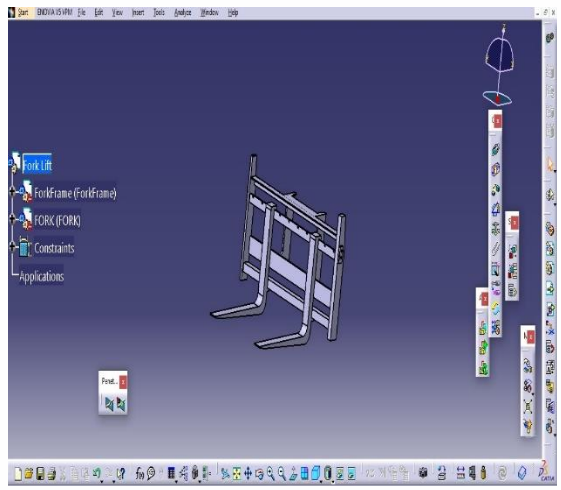


Figure.9FRAME DRAFT **Figure .10 FORK FRAME CATIA PRODUCT**

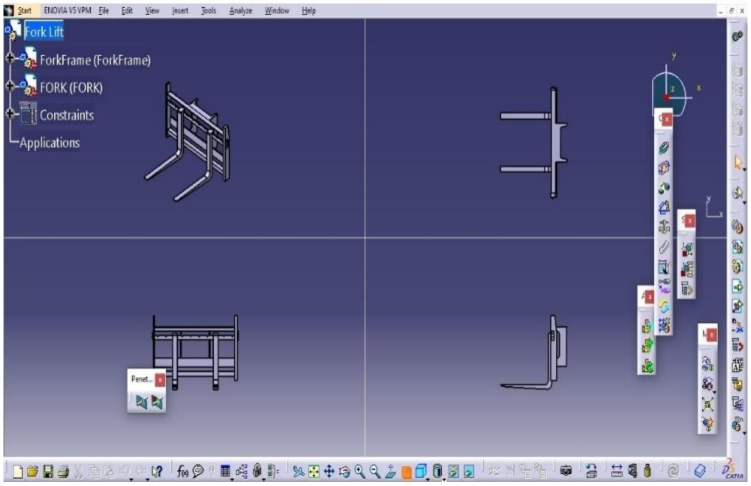


Figure .113-D VIEWS OF FORK FRAME CATIA PRODUCT

4. STATIC ANALYSIS:

A static analysis calculates the effects of steady loading conditions on a structure, while ignoring inertia and damping effects, such as those caused by time varying loads. A static analysis can, however, include steady inertia loads (such as gravity and rotational velocity), and time-varying loads that can be approximated as static equivalent loads (such as the static equivalent wind and seismic loads commonly defined in many building codes).

Static analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects. Steady loading and response conditions are assumed; that is, the loads and the structure's response are assumed to vary slowly with respect to time. The types of loading that can be applied in a static analysis include:

_ Externally applied forces and pressures.

_ Steady-state inertial forces (such as gravity or rotational velocity).

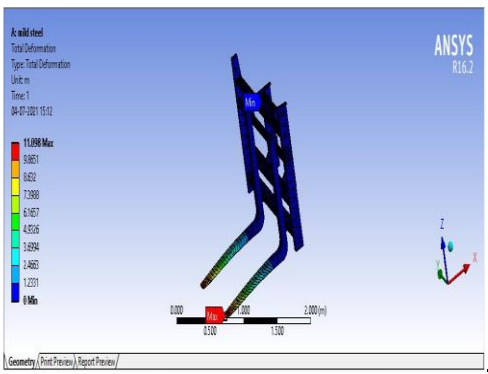
_ Imposed (nonzero) displacements.

_ Temperatures (for thermal strain).

_ flounces (for nuclear swelling).

A static analysis can be either linear or nonlinear. All types of nonlinearities are allowed large deformations, plasticity, creep, stress stiffening, contact (gap) elements, hyper elastic elements, and so on. This analysis gives a clear idea whether the structure or component will withstand for the applied maximum forces. If the stress values obtained in this analysis crosses the allowable value, it will result in the failure of the structure in the static condition itself. To avoid such a failure, this analysis is necessary.

4.1 STATIC ANALYSIS OF MILD STEEL MATERIAL:



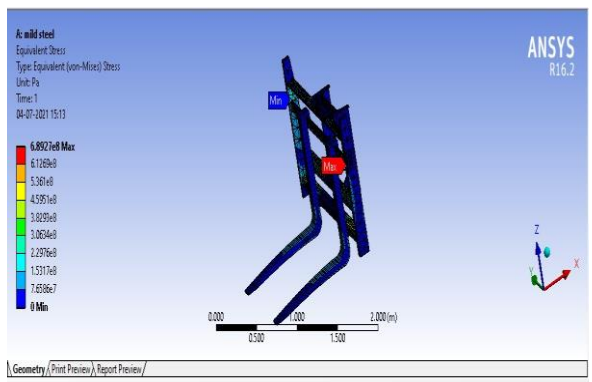


Figure.12 Total deformation of Mild Steel Material. **Figure.13 Factor of Safety of Mild Steel Material**

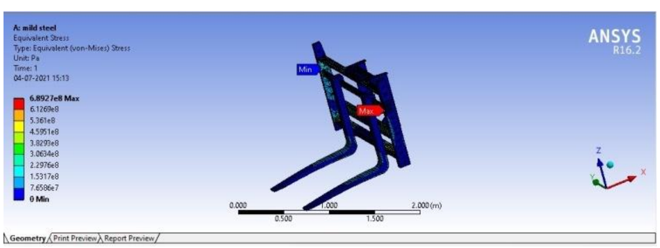
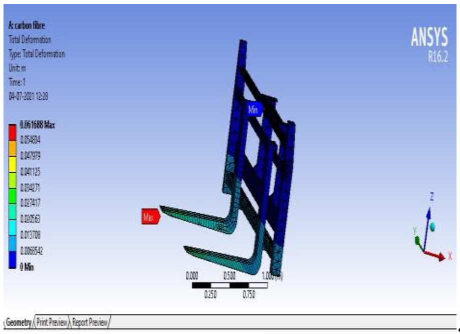


Figure.14 Von-misses stress of Mild steel Material

4.2 STATIC ANALYSIS OF CARBON FIBER MATERIAL:



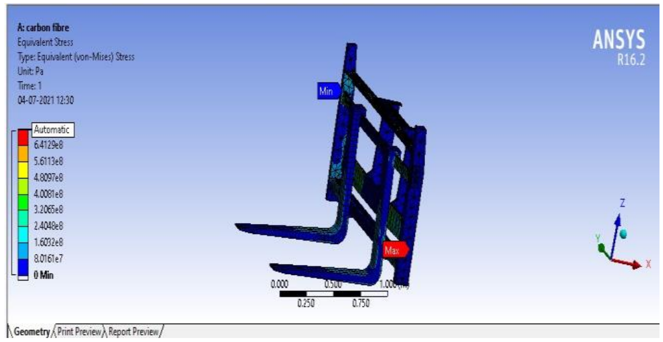


Figure.15 Total deformation of Carbon Fiber. Figure.16Von-misses stress of Carbon Fiber Material

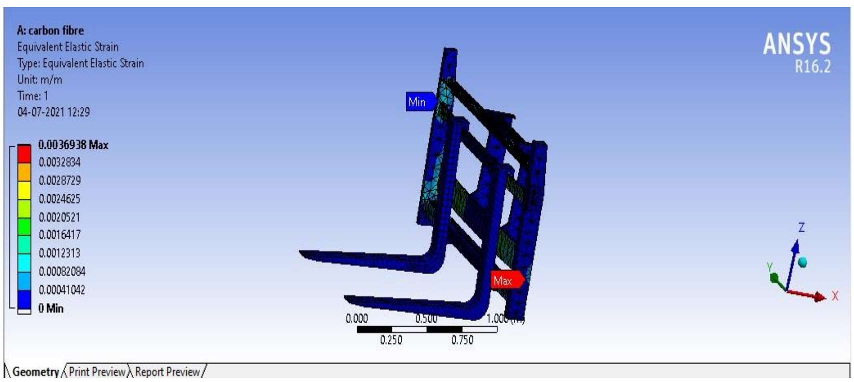
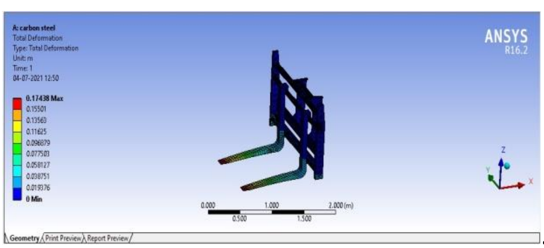


Figure.17Strain of Carbon Fiber Material

4.3 STATIC ANALYSIS OF CARBON STEEL MATERIAL:



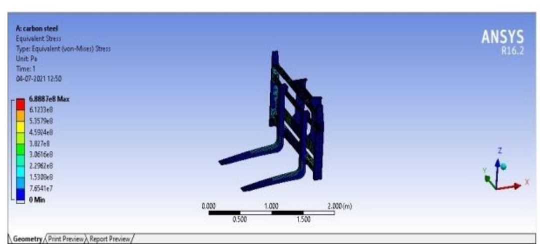


Figure 18 Total deformation of Carbon Steel Material. Figure 19 Von-misses stress of Carbon Steel Material

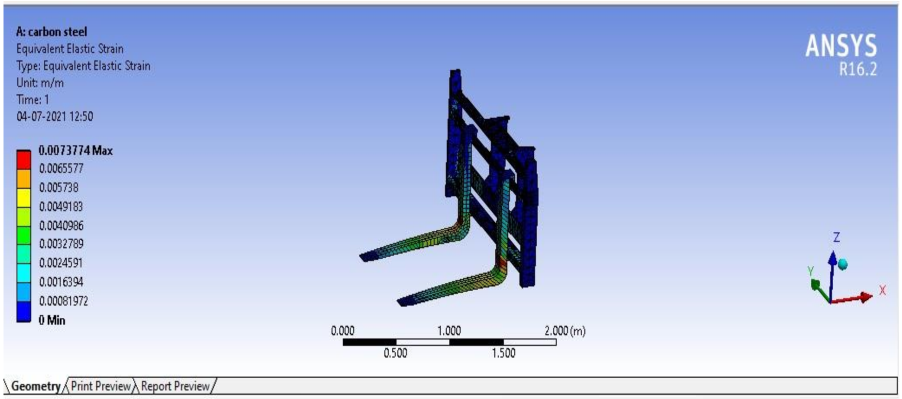
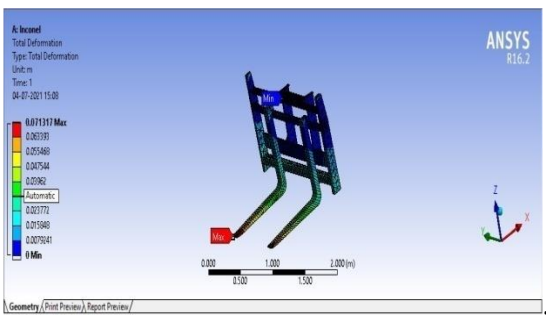


Figure 19 Strain of Carbon Steel Material

4.4 STATIC ANALYSIS OF INCONEL MATERIAL:



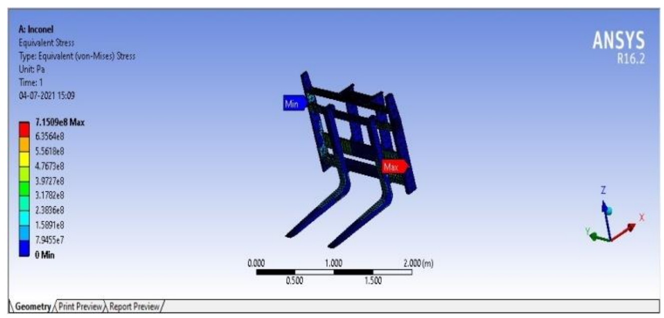


Figure 20 Total deformation of Inconel Material. Figure 21 Von-misses stress of Inconel Material

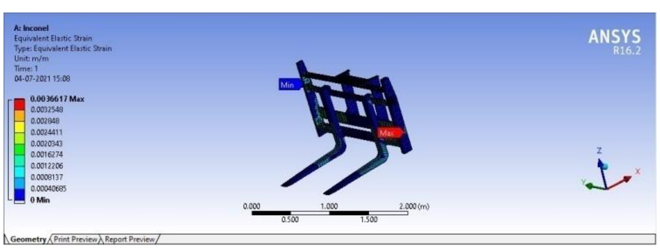


Figure 22 Strain of Inconel Material

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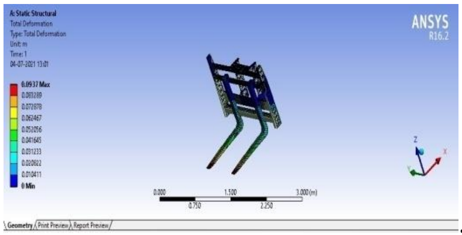
4.4 STATIC ANALYSIS OF Al7075T6 MATERIAL::



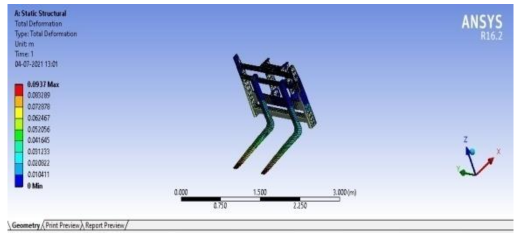


Figure 23 Total deformation of Al7075T6 Material Material

Figure 24 Von-misses stress of Al 7075T6

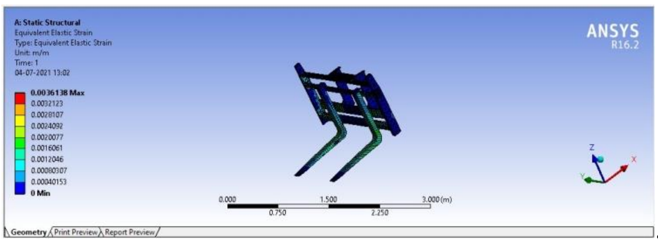


Figure 25 Strain of ALUMINIUM 7075T6 Material

5.Conclusion:

To achieve the set goals, we used the finite element for the evaluation and selection of best material for given input condition. Our prior aim was to test the materials for fork lifting function with compromising the performance of the fork member. Fork and fork frame assembly design and analysis are done with ALUMINIUM 7075 T6, CARBON FIBER, CARBON STEEL, INCONEL, and MILD STEEL materials finally Result concluded that the INCONEL, CARBON STEEL and ALUMINIUM 7075 T6 material is gives better performance compared to the Remaining material. Under this we also compared those materials in Impact condition. We get Carbon Steel is the suitable material to be used for the Fork because of High Strength to weight ratio., Rigidity, Corrosion resistance, Fatigue Resistance. We are concluded based on stresses, strain and deformation values the suitable material for fork. Static and Impact analysis is performed using finite element method was successfully carried out on Fork Catia model to determine in Ansys equivalent stresses, maximum deformations, Hence the Fork design is safe with Carbon Steel material compared to remaining material than proceed the manufacturing process.

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