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Analysis on ANSYS 19.0 and Fabrication of Portable Packet Unit

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***Abstract*: Our project proposal is aluminum counteract plate's carrier which comprises of a hollow aluminum pipe casing. The L bend is soldered at the free end of the main frame. The frame connects to the lower cross bar at the bottom end and the shoulder cross bar height. The bent hook is linked to the upper shoulder cross bar which latches into the shoulder. The wheels are attached to the bottom end of the frame so that we be able to incorporate the offset plates on horizontal outward. The flat load tray is hinged to the lower cross bar that remainder on the free end of the L Bend. The Telescopic legs are supplied that are implanted in the hollow key frame supplied with side space. This component be able to be applied involve the offset plates from one location to another on normal road and in multiple floor building, thus decreasing the rejections via scuff and inappropriate stuff management.**

***Keywords*: Counteract plates, Scuff and stuff management.**

1. Introduction

Offset printing is a generally applied printing system in which the inked picture is moved (or "offset") from a plate to a latex layer, then again to the printing surface. After rummage-sale in mixture through the lithographic course, which is grounded on the revulsion of oil and water, the offset method services a flat (planographic) image transporter on which the copy to be reproduced gets ink from ink rollers, whereas the non-printing part entices a water-based film, possession the non-printing areas ink-free. The plates utilized in counteract printing are thin, variable, and generally bigger than the paper size to be printed. Two major materials are used: Metal plates, normally aluminium, even though occasionally they are rendered of multimetal, paper, or plastic Polyester plates are much inexpensive and can be used in place of aluminium plates for lesser formats or medium quality jobs, as their dimensional constancy is lower. This design is based on a material management tool which is exclusively utilized to keep these aluminium counteract plates from one location to another. The offset plates are used in offset printing industry. We have designed a unit which would help the workers to carry the offset plates effortlessly with no spoiling the plates at the angles and owing to scrape and inappropriate stuff management thus lessening the rejection of these plates. The intended purpose of the venture is to construct and fabricate a prototype of a portable packet transporting unit which would take the delicate aluminium counteract plates from one place to another, designing the compact frame which ought weigh about 3 kg and the time for loading or unloading of the plates and receiving prepared for conveyance must be within 45 sec and enterprise of the component must be such that the plates might be effortlessly carried on ground surface as well as on numerous floors in the building.

2. Methodology

A. Operational Procedure

Operational Procedures involves the design considering methodology for a different invention with Brainstorming and new concepts were created by researching the problems of the inventions, sketches and rough enterprises were performed which offered the source for the additional definite composite plan in software. Further, CAD model was intended in Solid Edge v19 and processes that were believed through the plan idea were executed, Ansys Software for FEA analysis and for various stuff and loading the model was tested and finally, Fabrication of prototype is manufactured with genuine testing is completed on the prototype.

B. Initial Design using Design thinking approach

Scuffing is a defect which occurs in offset printing plates, wherein the thermal sensitive coating is scraped off due to abrasion between the adjacent plates. Causes for scuffing are improper material handling, small grits in roller trains, transportation, manufacturing defects and packaging. The design of the packet carrying unit must be compliance to several aspects. The design consideration must be done carefully so that the design can be fabricated, and the parts are all functioning. The aspects that are important for the designing are:

1) Strength: The design must withstand certain strengths like Tensile, shearing, compression and bending under the given load condition.
2) Ergonomics: the design was started with the basic study of the Human Anthropometry wherein the overall average measurement of the Human being was taken into consideration.
3) Mobility and compactness: The unit must be user friendly as easy and convenience. The unit must be compact to avoid occupying mire space and it should weigh less.

C. Anthropometry

The scientific study of human measurement and proportion is called as Anthropometry. It plays an important role in the design aspect of the Packet Carrying Unit. The body measurement of workers varies from person to person. Thus, by considering the average Indian measurement of a person, we have designed some of the critical parts of the unit.

The standard measurements are:

Average Height of the person = 5 feet 3 inch (1600 mm)
Average Arm length = 720 mm
Average shoulder length = 450 mm
Average neck size = 200 mm
Average elbow lift = 425 mm

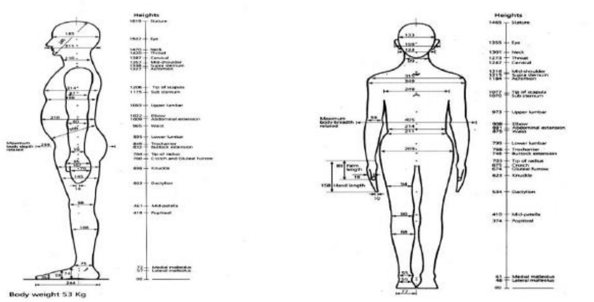

Fig. 1. Anthropometry

D. Sketching and 3D CAD Model

We started working on the design with simple sketch and patterns that are executable. It is an iterative process where small mechanisms and overall structure was designed on frame, basic sketch, and lever mechanism.

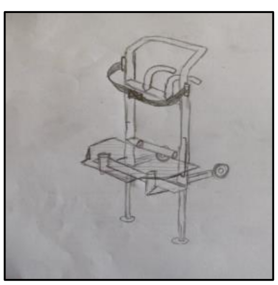

Fig. 2(a). Frame

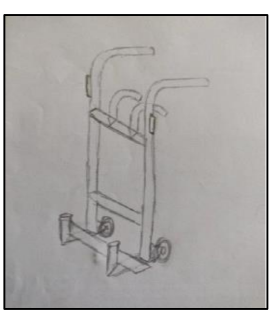

Fig. 2(b). Basic sketch

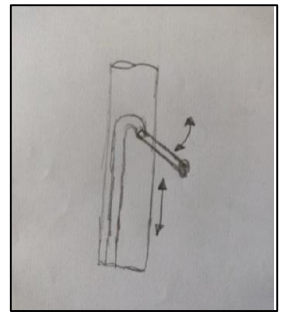

Fig. 2(c). Lever mechanism

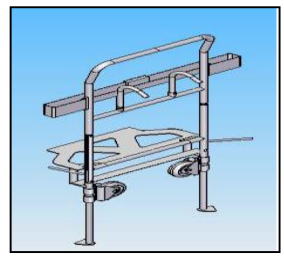

Fig. 2(d). Isometric view

After the sketches have been selected, the next step in the designing process is dimensioning. The dimensioning is based on relevant dimensions and also referring to the anthropometry details so that the design is fit into others part. After dimensioning, the engineering drawing of the design is drawn using Solid edge v19 application; at this stage solid modelling method is used. Part by part solid modelling created according to the dimension done before, after all part created, the 3D model is assembled with each other base on the design.

E. Calculations

The static analysis is applied when the value of any load acting on frame does not change with time. Generally linear behaving materials are used for manufacturing of frames. Thus the structural welded base frame structure was subjected to linear static analysis. The material used is structural Mild steel.

1) Calculations of Hook (Fig. 3)

a) The area of section

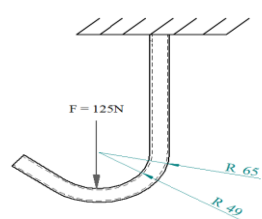

Fig. 3. Hook

$$A = \frac{\pi}{4} \times (d_1^2 - d_2^2)$$

$$= \frac{\pi}{4} \times (23^2 - 21^2)$$

$$= 69.11\ mm^2$$

b) Distance from centroidal axis to neutral axis (e)

$$e = R - R_n = R - \frac{0.5\,(r_1{}^2 - r_2{}^2)}{\sqrt{R^2 - r_2^2} - \sqrt{R^2 - r_1^2}}$$

c) Radius of curvature

$$R = 47 + \frac{23}{2}$$

$$= 58.5mm$$

From DDHB,

$$e = R - Rn = R - \frac{0.5(r_1^2 - r_2^2)}{\sqrt{R^2 - r_2^2}) - \sqrt{R^2 - r_1^2}}$$

$$e = 58.5 - \frac{0.5(11.5^2 - 10.5^2)}{\sqrt{58.5^2 - 10.5^2} - \sqrt{58.5^2 - 11.8^2}}$$

$$= 58.5 - \frac{0.5(22)}{\sqrt{57.55 - 57.35}}$$

$$= 58.5 - \frac{11}{0.193}$$

$$= 58.5 - 56.99$$

$$e = 0.61mm$$

d) Moment

$$M = W \times R$$

$$= 125 \times 58.5$$

$$= 7312.5N$$

e) Neutral Axis

$$Rn = R - e$$

$$Rn = 58.5 - 0.61$$

$$= 57.89mm$$

f) Direct Stress

$$\sigma_t = \frac{W}{\frac{\pi}{4}(23^2 - 21^2)}$$

$$\sigma_t = \frac{125}{\frac{\pi}{4}(23^2 - 21^2)}$$

$$= 1.8N/mm^2$$

g) Bending Stress

$$\sigma = \frac{My}{A \times e \times R}$$

$$\sigma_{bi} = \frac{7312.5 \times 10.9}{69.11 \times 0.60 \times 47}$$

$$= 40.88\ Mpa$$

$$\sigma_{b0} = \frac{7312.5 \times 7.1}{69.11 \times 0.60 \times 65}$$

$$= 19.26\ Mpa$$

$$Yi = Rn - Ri$$

$$= 57.9 - 47$$

$$= 10.9mm$$

$$Yo = 65 - 57$$

$$= 7.1mm$$

h) Resultant stress at inside fiber

$$\sigma_t + \sigma_{bi}$$

$$= 1.8 + 40.88$$

$$= 42.68Mpa\ (tensile)$$

$$\sigma_t - \sigma_{bo}$$

$$= 1.8 - 19.26$$

$$= -17.46$$

$$= 17.46\ (compression)$$

2) *U shape calculations (Fig. 4.)*
Moment for UDL cantilever Beam

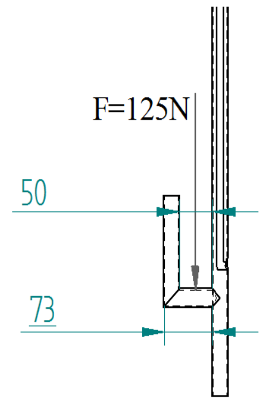

Fig. 4. Main Frame

$$M = \frac{wl^2}{2}$$

$$M = \frac{2 \times 60^2}{2}$$

$$M = 3600N\text{-}mm$$

$$\frac{M}{I} = \frac{\sigma_b}{y}$$

$$\sigma_b = \frac{M \times y}{I}$$

$$= \frac{3600 \times 12.5}{\frac{\pi}{64}(25^4 - 21^4)}$$

$$\sigma_b = 4.673\ N/mm^2$$

$$Deflection = \frac{Wl^8}{8EI}$$

$$= \frac{2 \times 60^8}{8 \times 80 \times 10^8 \times \frac{\pi}{64}(25^4 - 21^4)}$$

$$= 0.070 \times 10^{-3} mm$$

3) Shearing stress on Pin

$$\tau_s = \frac{F}{A}$$

$$\tau_s = \frac{125}{\frac{\pi}{4}\times 8^2}$$

$$\tau_s = 2.45\ N/mm^2$$

Double shear

$$\tau_s = 2.45 \times 2$$

$$\tau_s = 4.97\ N/mm^2$$

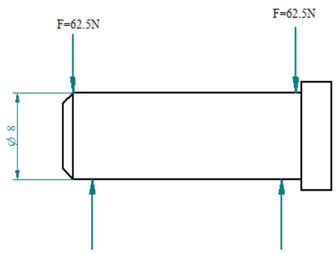

Fig. 5. Pin

3. Results

A. Analysis on ANSYS 19.0

1) Analysis of main body frame
Material =Aluminium alloy 6061

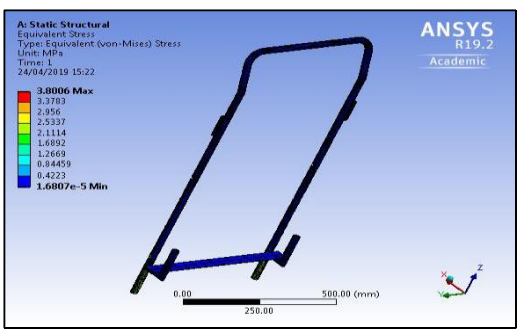

Fig. 6(a). Equivalent Stress: Von-Mises:
Maximum stress =3.8 MPa
Minimum stress = 1.608e-5 MPa
Blue to red colour represents stress values from lower to higher, respectively

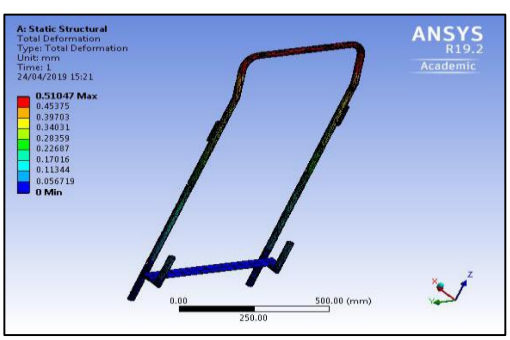

Fig. 6(b). Total deformation: maximum =0.510mm
Blue to red colour represents deformation values from higher to lower, respectively

2) Analysis of Hook (Applied load =125N on each hook)

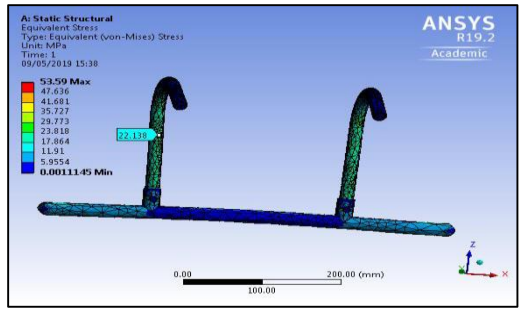

Fig. 7(a). Equivalent Stress: Von-Mises:
Maximum stress =53.59 MPa
Minimum stress = 0.001114 MPa
Blue to red colour represents stress values from lower to higher, respectively

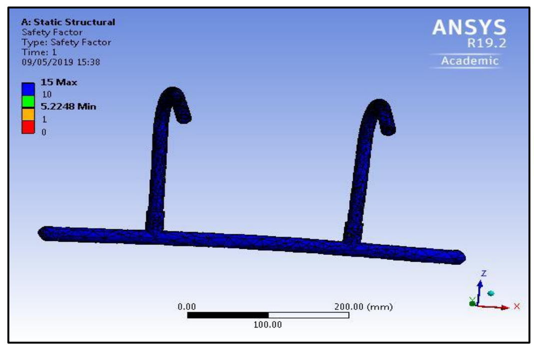

Fig. 7(b). Minimum Factor of safety = 5.22
Blue to red colour represents FOS values from higher to lower, respectively

3) Analysis of Telescopic leg

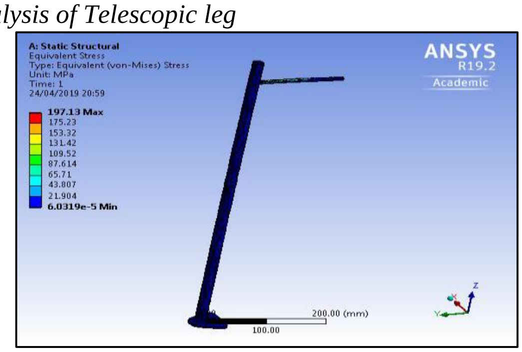

Fig. 8(a). Equivalent Stress: Von-Mises: Maximum stress =197.13 MPa
Minimum stress = 6.0319e-5 MPa
Blue to red colour represents stress values from lower to higher, respectively

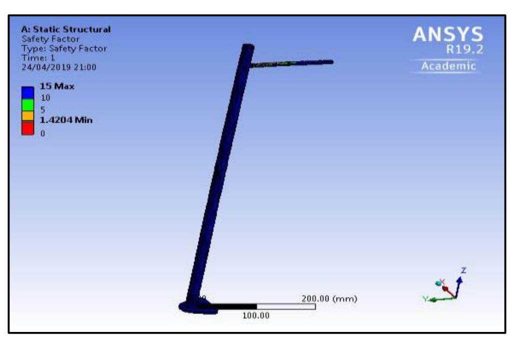

Fig. 8(b). Minimum Factor of safety = 1.42
Blue to red colour represents FOS values from higher to lower, respectively

4) *Analysis of Load tray (load capacity=20kg)*

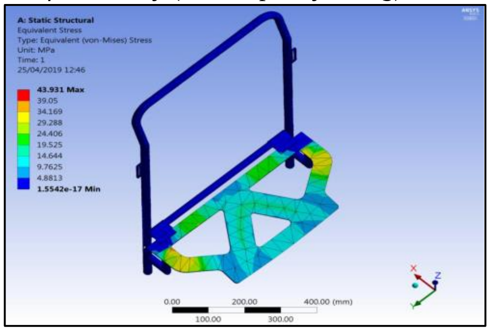

Fig. 9(a). Equivalent Stress: Von-Mises: Maximum stress = 43.93 MPa
Minimum stress = 1.55e-17 MPa
Blue to red colour represents stress values from lower to higher, respectively

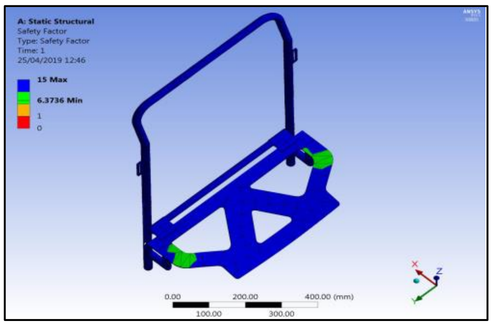

Fig. 9(b). Minimum Factor of safety = 6.37
Blue to red colour represents FOS values from higher to lower, respectively

B. Analysis of Epoxy Carbon fibre 390 materials

1) *Analysis of main body frame*

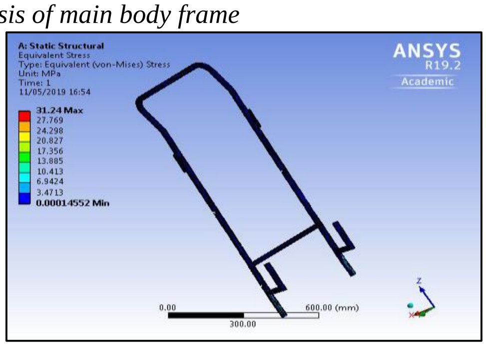

Fig. 10(a). Equivalent Stress: Von-Mises: Maximum stress = 31.24 MPa
Minimum stress = 0.0001 MPa
Blue to red colour represents stress values from lower to higher, respectively

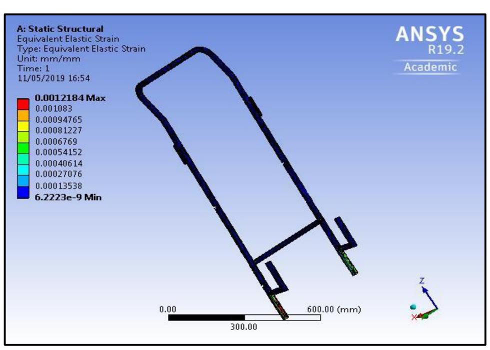

Fig. 10(b). Total deformation: maximum =0.00121mm
Blue to red colour represents deformation values from higher to lower, respectively

2) *Analysis of hook (Applied load =125N on each hook)*

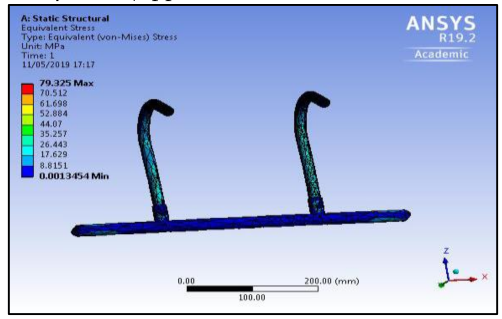

Fig. 11(a). Equivalent Stress: Von-Mises: Maximum stress =79.32 MPa
Minimum stress = 0.00134 MPa
Blue to red colour represents stress values from lower to higher, respectively

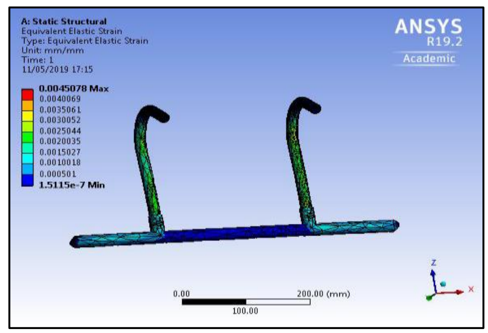

Fig. 11(b). Total deformation: maximum =0.00450mm
Blue to red colour represents deformation values from higher to lower, respectively

3) *Analysis of Load tray (load capacity=20kg)*

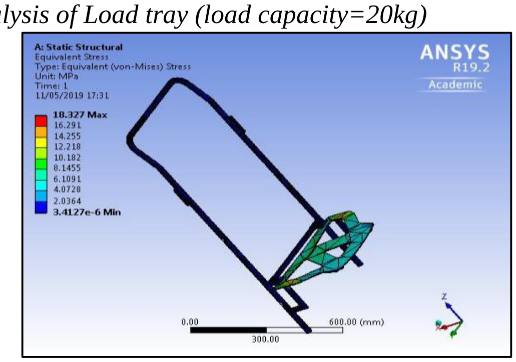

Fig. 12(a). Equivalent Stress: Von-Mises: Maximum stress =18.327 MPa
Minimum stress = 3.41e-6 MPa
Blue to red colour represents stress values from lower to higher, respectively

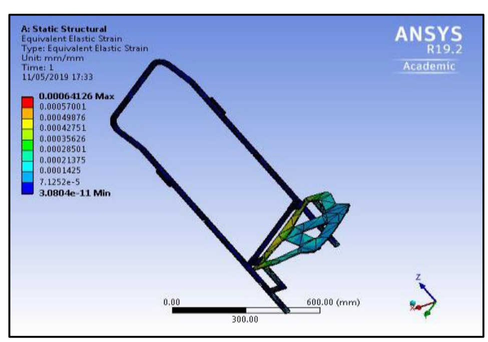

Fig. 12(b). Total deformation: maximum =0.000641mm
Blue to red colour represents deformation values from higher to lower, respectively

C. Comparison with different material

The material selection is a crucial aspect which is to be considered before manufacturing of the actual prototype. This table provides the properties of different material.

Table 1
Properties of material

Topic	M.S	Aluminium	Epoxy Carbon Fibre Unidirectional
Youngs Modulus	2×1011 Pa	7.1×1010 Pa	220 Gpa
Shear Modulus	7.7×1010 Pa	2.7×1010 Pa	----
Bulk Modulus	1.67×1011 Pa	6.96×1010 Pa	----
Density	7850 Kg/m^3	2770 Kg/m^3	1800 Kg/m^3
Yield Strength	2.5×108 Pa	2.8×108 Pa	----
Ultimate Strength	4.6×108 Pa	3.1×108 Pa	8.618×108 Pa

Analysis of the important parts on Ansys 19.0

1) Main frame

Table 2
ANSYS results

Parameter	Aluminium 6061	Epoxy carbon fiber pipe
Von mises stress in MPa	3.8	31.24
strain	.0000675	0.0012
Total deformation in mm	0.5	9

2) Hook

Table 3
ANSYS results

Parameter	Aluminium 6061	Epoxy carbon fiber pipe
Von mises stress in MPa	53.59	79
strain	.00083	0.0045
Total deformation in mm	1.46	8

3) Load tray

Table 4
ANSYS results

Parameter	Aluminium 6061	Epoxy carbon fiber pipe
Von mises stress in MPa	43.93	18.327
strain	.00065	.006
Total deformation in mm	4.6	1.89
Factor of Safety	6.4	

Comparison on weight and cost of the unit:

Table 5
Comparison of the material cost

S. no.	Material	Total weight (approx.) in Kg	Material cost in Rs.
1	Mild steel	7	315.00
2	Aluminium alloy 6061	3.5	700
3	Epoxy carbon fibre 390	2	14000

D. Caster wheel

A caster is a wheeled device typically mounted to a larger object that enables relatively easy rolling movement of the object. Casters are essentially housings that include a wheel and a mounting to install the caster to objects (equipment, apparatus and more).

Caster wheel specification:

1) Diameter of the wheel = 6 inches (150 mm)
2) Width of the wheel = 1 inch (25.4 mm)
3) Load carrying capacity = 50 kg
4) Material of the wheel = Polyethylene (fiber)

E. Fabrication of the Prototype

After finalizing CAD model, 2D drawings of individual part are plotted and according to the drawings material procurement for fabrication is done. After material procurement, the marking and cutting of pipes was done for further operations.

1) Bending Process

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis.

Bending process started with filling sand into the pipe and then sealing both ends of the pipe. This is done to prevent the dents occurring on the pipe surface while bending. While bending the portion of bend is heated slightly to perform the operation smoothly and with damaging the pipe. The pipe is bent at angle of 1300.

2) Drilling

Drilling is easily the most common machining process. One estimate is that 75% of all metal-cutting material removed comes from drilling operations. Drilling involves the creation of holes that are right circular cylinders. This is accomplished most typically by using a twist drill, something most readers will have seen before. The chips must exit through the flutes to the outside of the tool. As can be seen in the figure, the cutting front is embedded within the work piece, making cooling difficult. The cutting area can be flooded, coolant spray mist can be applied, or coolant can be delivered through the drill bit shaft.

Drilling operations performed are:

Table 6
Drilling operation

S. no.	Operation	Part name	Dimensions	Tool used
1.	Linear slotting	Main body frame	Length=425mm Width =8mm	Reamer
2.	Through Drilling	Upper crossbar	$\emptyset 8mm$	Twist drill
3.	Through Drilling	Hook	$\emptyset 8mm$	Twist drill

F. Tungsten inert gas (TIG) welding

This is an arc welding process that uses a non-consumable tungsten electrode to produce the weld. The weld area and electrode is protected from oxidation or other atmospheric contamination by an inert shielding gas (argon or helium), and a filler metal is normally used, though some welds, known as autogenous welds, do not require it. When helium is used, this is known as heliarc welding. A constant current welding power supply produces electrical energy, which is conducted across the arc through a column of highly ionized gas and metal vapors known as plasma.

Specifications:

Regulator = Single flow tube
Cooling type = Gas cooled torches
Base metal = mild steel
Welding current= Direct current straight polarity
Welding ampere = 80-100
Shielding gas = 75% Argon, 25% Helium
Electrode = 2% Ceriated (EW-Ce2)

G. Prototype of the "portable packet unit"

Fig. 13. Portable packet unit

4. Discussion and Conclusion

Following production, the prototype, it was assessed by transporting a load of 25kg on horizontal surface as well as climbing the stairways by hauling it on shoulder. It was noticed out that the plates were not harmed. Separately from transporting counteract plates, the unit be able to bring moderate size boxes. Consequently, we assume that the prototype is reliable, and this unit offered an effortless stuff management with no considerable strain on individual body. Therefore, for in potential the identical development will be intended first stage with by choosing lower concentration stuff may probably use as a substitute of mild steel for weight reduction. We can make use of aluminum or carbon fibre contemplating price of the stuff into account. Second stage with by upgrading in the method that as an alternative of latching method roller system be able to be applied to lessen the intricacy of the confining system. Third stage with by progressing in softening, so that we can boost the solace by combining latex pads and cotton straps and ultimately final stage is efficient construct might be produced further efficient by bending the unit into half so that it ought to use less space.

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