Design And Manufacturing Of Package For Armament Store

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ABSTRACT

There is a need to carry armament store from one place to other. Thus here packaging comes into picture. Many types of Packages are used nowadays. Materials used for packaging widely are steel, high strength plastics etc. But quite before we knew that steel packages are best for packaging, wood packages were used. These packages were durable, had high strength and could hold the armament stuff efficiently. But because of some of its disadvantages, wood material for package is ruled out. Then plastic packaging was given a thought. But because of their availability, cost and manufacturing difficulties; plastic packaging became obsolete. Then came steel models as package. A perfect rectangular model just eliminated most of the disadvantages. This project mainly consists of the basic design of four models whose materials are wood, plastic, steel and designs are either rectangular or cylindrical. The design is done on the Cad software. The optimum model is selected. The parts of the optimum model is analysed and welding calculations are done. After manufacturing of this model, various tests were performed.

***Keywords**: Models, Manufacturing, Analysis, Packageetc.*

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1. INTRODUCTION

Armament weapons are sturdy, well-constructed machines. But, because of their size, weight, and bulk, they are not that easy to handle nor are Armament weapons indestructible. Most Armament weapons damage is, unfortunately, a result of carelessness and poor handling practices. To reduce the possibility of damage, Armament weapons are shipped, stored and handled with special equipments. Approved containers, canisters, and handling equipments provide maximum Armament weapons safety with minimum handling by personnel. The Armament weapons container used previously was of lid type (suitcase) containers. This type of container has large contact area at the closing region. So it is very important that the manufacturer has to take extreme care in producing this container without any warpage at the closing region. Else there will be a leakage of gas from the gap developed due to warpage. Therefore the manufacturing becomes more complex and more expensive. We have a certain constraints that we should follow according to war head conditions, travel conditions, expenses condition etc.

1.1 Constraints

1. The weight of store along with LP container should be 30 kg approximately.
2. Total weight should not exceed 50 kg so that two people could easily lift the package.
3. It should sustain drop from a 3 ton vehicle from height of 1.5 m with store in the package.
4. The package designed should be leak proof.
5. The store should be removed by minimum effort and with ease.
6. The cost of the package should not exceed Rs.20000.
7. The life of the container should be minimum 7 years.
8. It should be easy to stack the packages in height.
9. There should be proper sealing of the store.

2. LITERATURE REVIEW

Initially, after understanding the constraints of the package required; the different materials used to make the package are studied. These different materials are wood, plastic and steel.

2.1 Wood as Package

The types of wood are as follows: Teak, Mahogany, Sheesham, Oak Wood, Walnut

Out of all the wood types, according to the properties of wood, availability of wood and its cost which is suitable for our package, we select Teak wood.

2.1.1 Mechanical Properties of Wood:

1. Average Dried Weight:41 lbs/ft^3 (655 kg/m^3)
2. Specific Gravity (Basic, 12% MC): .55, .66
3. Density: 650-900 kg/m^3
4. Elastic Modulus: 1,781,000 lb$_f$/in^2 (12.28 GPa)
5. Crushing Strength: 7,940 lb$_f$/in^2 (54.8 MPa)
6. Shrinkage: Radial: 2.6%, Tangential: 5.3%, Volumetric: 7.2%, T/R Ratio: 2.0
7. Cost: Rs.1500 to Rs.3500 per cubic feet

2.1.2 Design of Teak Wood Package

1. Basic Design: For it is a wood package, it was obvious that the basic design from outer side should be rectangular. But for the ease of clamping and unclamping of armament material, a semi-circular cutting was introduced. It sure increases the manufacturing cost because of this shape and more advanced wood cutting tools but the functioning and maintenance becomes easy. Slots are made at the edges so that hinges could fit in and some clearance is made in diameter slot so that the foam could fit in. The other rectangular edges are made thick to increase strength and the handles are made inside the base model. The density of the wood material is 550 kg/m^3 and the volume is studied.

Fig. 1 Wood as Package

2.1.4: Advantages:

1. This design can sustain a drop from 1.5m because of its high strength.
2. The store can be removed within minimum effort.
3. The box can sustain a life upto 7 years.
4. It is easy to stack these packages in height.
5. Density is 550 kg/m^3 and volume of box is 66246030 mm^3.

2.1.5: Disadvantages:

1. The design is not leak proof.
2. The total weight of this design is 33kg which doesnot fit into our constraints.

3. The design is not durable.

2.2 Plastic as Package

2.2.1 Specification of torlon:

Properties	Test Method	Units	Neat Torlon	30% GF Torlon	30% CF Torlon
Tensile Strength	ASTM D638	MPa	152	221	221
Tensile modulus	ASTM D638	GPa	4.5	14.5	16.5
Tensile Elongation	ASTM D638	%	7.6	2.3	1.5
Flexural Strength	ASTM D790	MPa	241	333	350
Compressive Strength	ASTM D695	MPa	221	264	254
Shear Strength	ASTM D732	MPa	128	139	119
Izod Impact Strength	ASTM D4812	J/m	1070	530	320
Specific gravity	ASTM D792		1.42	1.61	1.48

Table No. 1 Properties of Torlon

2.2.2 Design of Cylindrical Plastic Package

1. **Main Body:** Main body is made with torlon material in unibody design .a through hole is provided considering the dimension of store and LP cylinder. An opening provision is provided at both ends considering the dimensions of gaskets and foam. Any extension or extruded parts are avoided so as to improve impact behavior. The handles are facilitated by cutting holes through body.

2. **Covering Lead**: Two covering leads are included in design with latch mechanism .Gasket surrounding is provided so as to prevent leakages and prevent rusting. The cam profile latches are used so as to pressurize the lid .The extended rod is also used with groves designed. on the inner surface of main body.

Fig. 2 Basic body for plastic design

2.2.3 Advantages:

1. 1. Up to 60% lighter than metals and metal alloys
2. Up to five times higher specific strength than metals and alloys
3. More than ten times higher impact strength and damage tolerance than thermosets

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4. Insulating properties that reduce noise, vibration and harshness
5. Greater durability in harsh chemical environments compared to metals

2.2.4 Disadvantages:

1. Plastic resins are very costly.
2. It requires use of high manufacturing techniques which is not that easily available in small scale industries.

2.3 Steel as Package

2.3.1 Types of Mild Steel:

Mild Steel is classified as follows:

	UTS (MPa)	Yield Strength (MPa)	Elongation (%)	Modulus of Elasticity
SAE1010	310-360	180-240	32-48	200 GPa
SAE1008	303-358	180-240	42-48	200 GPa
SAE1012	275-370	200-310	19	205 GPa
S355	490-630	355	12-22	210 GPa
S235	340-470	235	17-26	210 GPa
S275	410-560	275	14-22	210 GPa
Corten_A	470-630	355	20	200 GPa

Table No. 2 Classification of Mild Steel [2]

Out of all these Steel types, we select S355 Steel type because it fulfills all the required properties for our design.

2.3.2 Mechanical Properties of S355 are:

1. Density: Density of S355 is 7850 kg/m3.
2. Hardness: 146-187 BHN
3. Youngs' Modulus: 190-210 MPa

2.3.3 Design of Rectangular Steel Package:

1. **Main Body:** As the Armament store is of diam. 192 mm and length 1042mm, leaving 30 mm on both sides of the circle and laterally leaving 40 mm on both sides, the dimensions become 252mm×252mm×1122mm. If the 4 long edges of the box are harsh, then it may not take the impact very well. So, they are made in chamfered shape. The space of 20 mm was kept in between lid and lower box to attach a rubber layer of 10 mm on both sides to keep the box leakage free.

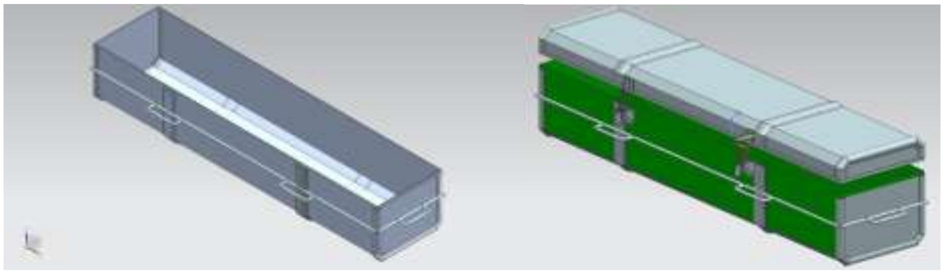

Fig. 3 Main Body for steel package

Fig. 4 Latch for steel package

2.3.4 Advantages:

1. Fulfils all constraints.

2.3.5 Disadvantages:

1. More surface area of packing
2. Leakage problems

2.4 Steel as Cylindrical Package

2.4.1 Design of Model:

1. **Main Body:** Main body consists of three rims connected by four rods which are welded on inner surface of the rims, these rods constrains the lateral motion of rims. Cushion is provided between cylinder and rims to minimize the vibrations. Rims contain handles to carry the package.

Fig. 5 Main Body for cylindrical steel body

2. **Covering lead :**

Fig. 6Covering lead for cylindrical steel body

2.4.2 Advantages:

1. Fulfills all constraints
2. No leakage problems

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2.4.3 Disadvantages:

1. Complex design

3. SELECTION AND MODIFICATION OF OPTIMUM MODEL

After all the observations, it is known that cylindrical model is very useful, fulfilling all the constraints. Hence, Steel Cylindrical model is further modified. Parts name was given and assembled.Minor modifications in the design was done.

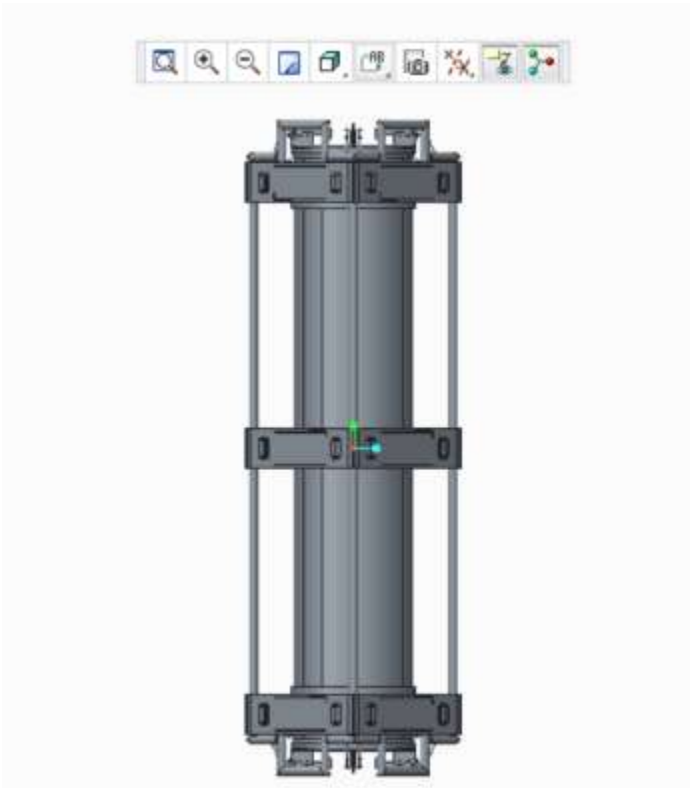

Fig no. 7 Side View of Model

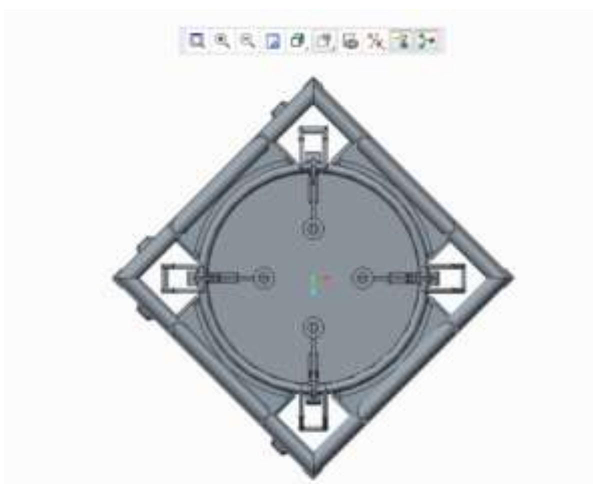

Fig no. 8 Top View of Model

Fig no. 9 Isometric Model

4. THEORY AND ANALYSIS OF MODEL PARTS

The force analysis was performed. The analysis includes following steps:

1. Force on model calculated according to impulse momentum theorem. Force applied on each part.
2. Plotting of SFD, BMD
3. Calculation of Reaction forces
4. According to reaction forces, welding analysis is performed.
5. Modes tested on ANSYS for approximate results.

5.

6. MANUFACTURING OF MODEL

Manufacturing of the model was done in industry using following methods:

Sr. No.	Part Name	Dimension	Manufacturing Processes	Raw Material
1.	Angle Support	Sheet Metal of Thickness 1.2mm bent with fillet R2.4	Bending	Low Carbon Steel sheet IS 513
2.	Bracket Foam	128*52*16 – Cross linked polyethylene foam	Cutting + Pasting	Cross Linked Polyethylene Foam
3.	Bracket Plate (Bottom)	Plate- 268*70*1.6, 2 stacks	Die Forming	Low Carbon Steel sheet IS 513
4.	Bracket Plate (Top)	Plate- 268*70*1.6, 2 stacks	Die Forming	Low Carbon Steel sheet IS 513
5.	Container	Ø212, L1070	Rolling followed by Teak Welding	Low Carbon Steel sheet IS 513
6.	Gasket	Ø219.5 (outer), Ø209.5 (Inner)	Compression Molding	Vulcanized Chloroprene Rubber (Neoprene) C40
7.	Guard I	125*80, Ø16 border	Fabrication	Steel Tube for Automotive Purposes IS 3074:2005
8.	Guard II	L shape guard, 70*Ø16	Fabrication	Steel Tube for Automotive Purposes IS 3074
9.	Hook	Ø3, 35 mm length	Cutting + Bending	Low Carbon Steel sheet IS 513
10.	Inner Foam	1040*120*12	Cutting + Foaming + Pasting	Antistatic expanded polyethylene foam
11.	Lid	Ø223.5, Ø205	Cutting + Punching	Low Carbon Steel sheet IS 513
12.	Lid Foam	Ø195	Cutting + Foaming + Pasting	Antistatic expanded polyethylene foam
13.	Locking Bracket		CNC Turret Press + Cutting	High Tensile Structural steel IS2062 , Grade E250
14.	Locking Link	Ø5, 60*28	Bending + Welding	15C4, Carbon Steel IS1570
15.	Locking Plate		CNC Turret Press + Cutting	High Tensile Structural steel IS2062 , Grade E250
16.	Longitudinal Support (Pipe)	Ø16, L1025	Rolling + Laser Welding	Steel Tube for Automotive Purposes IS 3074
17.	Rivet	Ø6(outer), Ø3(inner), both side 1.95 tap	Capstan Lathe machine	15C4, Carbon Steel IS1570
18.	Rolling Plate	128*56*1.2, R120.3	Bending	Low Carbon Steel sheet IS 513
19.	Stiffener Plate	130*34*1.2, R117.3	Cutting	Low Carbon Steel sheet IS 513
20.	Stopper Bracket		Cutting + Bending	High Tensile Structural steel IS2062 , Grade E250
21.	Support Plate		Punching	High Tensile Structural steel IS2062 , Grade E250
22.	Washer	Ø20(outer), Ø10(inner), t2	Cutting + Punching	Low Carbon Steel sheet IS 513

Table no. 3 Manufacturing data

7. TESTING

Various tests were conducted on the final model. They were as follows:

1. Drop Test: In this test the model is dropped from a height of 1.5m and if there are any chances of bending, it is seen. There are two types of drop tests:
   - Horizontal Drop Test: The model was dropped horizontally from a height of 1.5m. It was observed that it sustained that drop.
   - Vertical Drop Test: The model was dropped vertically from a height of 1.5m. It was observed that it sustained that drop.
2. Vibration Test: The model was mounted on a vibration test specimen. Natural frequency is measured. The frequency at which the model vibrates at maximum frequency is measured.
3. Pendulum Test: The model is suspended on two ropes and given a swing.

8. CONCLUSION

1. Steel was considered as best material for package design.
2. Cylindrical model was selected as optimum model which fulfilled all the constraints.
3. Model was modified and analysed.
4. Model was tested.
5. Model is now used in warhead.

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