ISSN: 2456 - 4664
International Journal of Advanced Trends in Engineering and Technology
Impact Factor 5.965, Special Issue, January - 2018
1st International Conference on Innovations in Mechanical Engineering (ICIME-2018)
On 5th & 6th January 2018 Organized By
Guru Nanak Institute of Technology & Guru Nanak Institutions Technical Campus, Hyderabad

DESIGN AND ANALYSIS OF UNIVERSAL TROLLEY CARRIER WITH STAIR CLIMBING MECHANISM

Dr. E. Rajkumar*, Vivek Kumar & M. Subba Reddy*****
* Department of Design and Automation, VIT University, Vellore, Tamilnadu
** M.Tech CAD/CAM, VIT University, Vellore, Tamilnadu
*** Department of Mechanical Engineering, Nellore, Andhra Pradesh

Cite This Article: Dr. E. Rajkumar, Vivek Kumar & M. Subba Reddy, "Design and Analysis of Universal Trolley Carrier with Stair Climbing Mechanism", International Journal of Advanced Trends in Engineering and Technology, Special Issue, January, Page Number 128-131, 2018.

Abstract:
Rush at the railway stations and airports is common in country like India. In most of the cases, there are limited number of escalators. One has to handle luggage manually. Carrying luggage with ordinary trolley bags at the lengthy platforms and terminals are always difficult. Especially when one has to climb up & down the stairs. Design a trolley carrier considering the problem of lugging about handling and maneuvering. Situation becomes more difficult for elderly and women. Keeping in mind all these problems and requirements of different generation, Features added in such a way that it make one's journey comfortable and headache free. Universal trolley carrier is easy to carry on stair as well as on ground. Even with holes and bumps on road, one can easily handle this. There is folding chair attached with this for self-dependence and helpful during rush. There are some other features power bank etc. The emphasis is on the clear and minimalistic design, as well as the optimized details.

Key Words: Universal Trolley Carrier, Stair Climbing, Chair, Power Bank, Self-Dependence, Minimalistic Design

1. Introduction:

Design accordingly prescribed value is easier but to found the prior dimension and then try with design iteration is difficult job. It's not just giving accurate dimensions but also follow the standards which is presents in markets. Variety in trolley bags is not so important but nowadays people seeking towards the innovative designs. Model developed is innovative because of its aesthetics and ergonomics. Trolley bag make ones journey comfortable. The bag not only for carrying luggage but this design also solve other problems like mobile charging and comfortable sitting. Material selection for different components are not easy talks. Things become trickier in the era of composite material. Cost and easy availability of the material also a factor in selection of material. In most of the cases conventional materials are considered because of their availability and fulfil of requirements. After selection of material the biggest challenge is withstand with customers desires and not effect ones pocket a lot. With all of these aspects, aesthetics is equally important. The most important thing is customer gets their value which one pay for it.

2. Literature Survey:

There are already many luggage carrier are available in the market but still there are continuous work and study are going on in this sectors. There are lot of scope in this field. Nowadays it's not just a way of carrying luggage from one place to another place but it's a way to make ourselves in comfort zone by carrying necessary utilities with one. If Dimension is concerned there are after many iteration, 760mm* 500mm * 340mm (55cm) is preferred. Because this dimension is worldwide used and second thing is all purpose are fulfilled by this. With this dimension, all desired features can be included otherwise there may be some compromise with features, if length * width is reduced. There are plenty of material are available in market. For trolley bag purpose we can categorize it in hard-sided and soft sided material. Hard sided includes ABS, polycarbonate, polypropylene, PVC etc. In soft sided leather, nylon, polyester etc. include.Acrylonitrile butadiene styrene is usually mixed with other material to make a stronger trolley bag. It is widely used. Polycarbonate is lightest material in this category and almost impossible to break but its cost is high. Polypropylene is also extremely light and stronger than ABS and PVC but its cost also high. In case for light weight and easily adjustable, soft sided materials are better choice. In this design, both soft and hard sided material is used. For chair purpose, in this design PET is choose. This material is worldwide used for chair manufacturing. For trilobe Al alloy is used. Al is first choice for this because of its light weight and good strength. For handle rod and handle Al alloy and ABS preferred respectively. These materials are also use worldwide for this purpose. Dimensions of the trilobe is consider on the basis of general height of stairs. Chair dimensions and material is considered in this manner that it can loaded a normal adult man with 80kg without any buckling. The most of the literature regarding this topic are dedicated to trilobe dimensioning and material selection. This is area of interest for many researchers from decades.

3. Methodology:

Before start any task, One should have proper aware about the steps of following to complete it within time. For in this case, Main focus on adding the features in such manner that it add the value of the design. After many iteration of design, one can get a final design. After finishing the design part, analysis of the design is important to make sure; this design is sustainable or not with applied load in given conditions and it fulfil its purpose or not. These are the steps for modelling and analysis of object as shown in figure 1.

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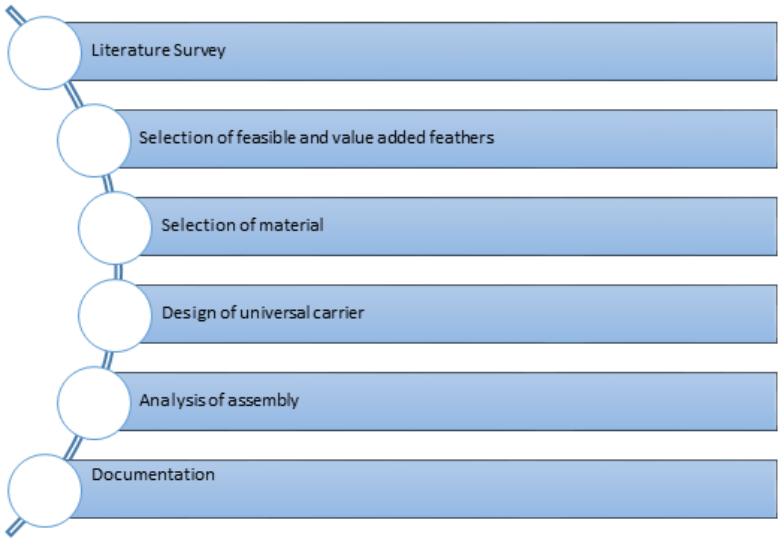

Figure 1: Methodology for design and analysis

Using this methodology, Design and analysis process is performed.

4. Design of Universal Trolley Carrier:

Designing of CAD model for universal trolley carrier, Solid works 2014 is used. For this purpose after many iteration, the final design is achieved. First of all, a rough sketched is developed. On the basis of that; modelling of trolley carrier is started. For climbing purpose, trilobe assembly is as shown in figure 2 given below.

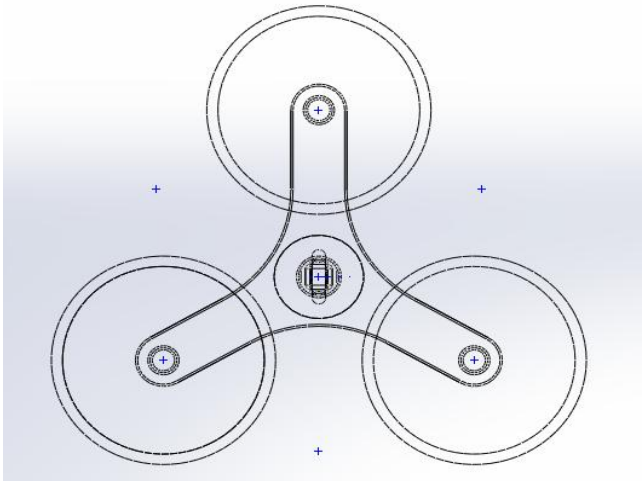

Figure 2: Trilobe Assembly

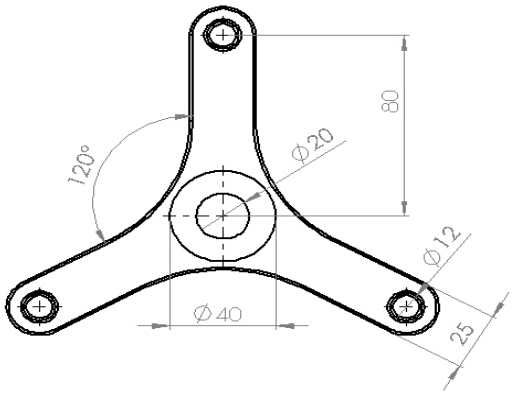

Figure 3: Trilobe Dimensions

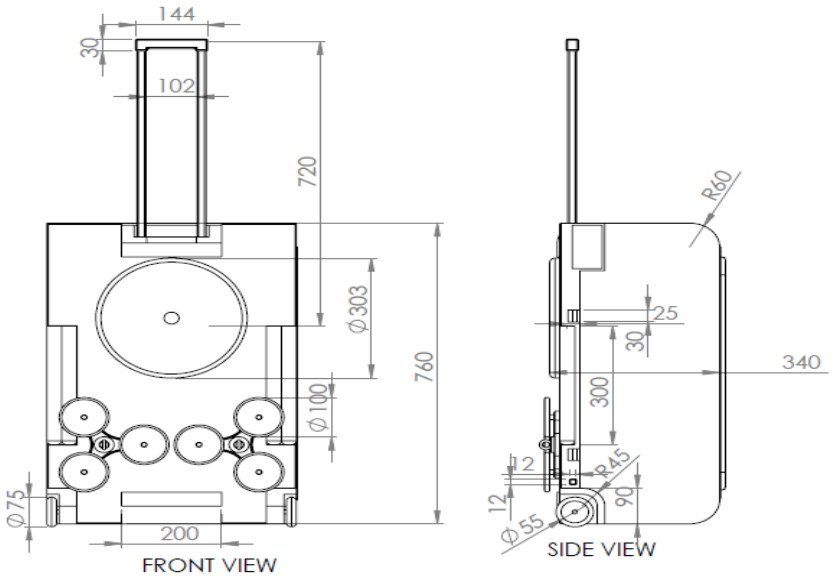

Figure 4: Assembly with dimensions

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Item No	Part Number	Description	Qty
1	base	ABS	1
2	Wheel cover	ABS	2
3	trilobe shaft	EN8	2
4	trilobe	AL ALLOY	2
5	Trilobe wheel	PVC	6
6	Chair leg	MS	4
7	Chair	PET	1
8	bag_handle_18-18	AL ALLOY	2
9	bag_handle_20-20	AL ALLOY	2
10	Base handle lower	ABS PC	1
11	Base handle upper	ABS PC	1
12	Bag handle	ABS	1
13	Power bank		1
14	bag	NYLON	1
15	Generator		2
16	Generator wheel	PLASTIC	2
17	BOLT	ABS	4

Table 1: Bill of Materials

In the similar way, dimensions of the chair considered. After prectical experience 300mm diameter and 300mm height is choosen for comfortable sitting. Placement of chair and trilobe is shown in figure 4. Dimensions of trilobe and full assembly is given in figure 3 and figure 4 respectively. For fitting all these features 760mm * 500mm * 340mm bag is choosen. Because it's a common dimension which is used by many bag manufacturer companies. After completing the sketching and dimensiong, next step is part modelling and assembly. The final model in this case with different view and arrangement is shown in figure 4 . There is a table provided for bill of materials with are required to model the full assembly of trolley bag. Table1 is provide the material discription and quantity of parts as mentions.

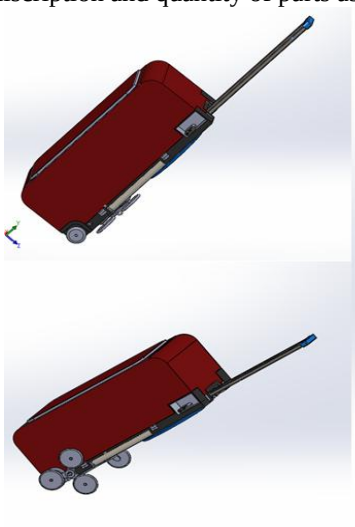

Figure 5: Universal Trolley Bag Model

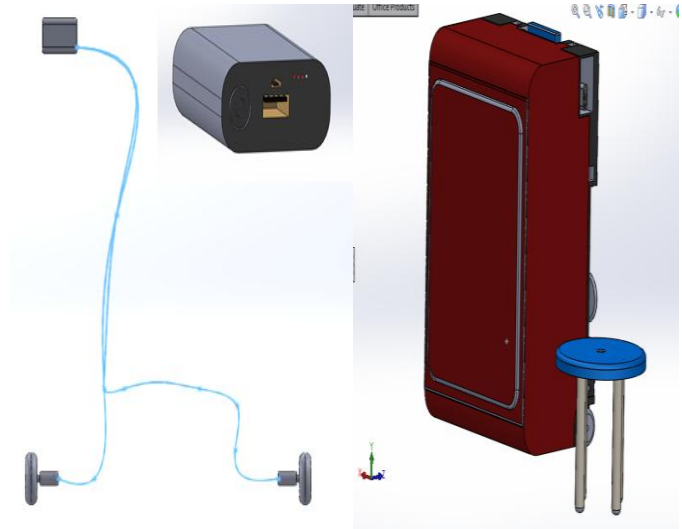

Figure 6: Features in Model

Power bank is provided to charge the mobile phone and small electrical gadgets which supported by USB. This can be charge outside power source and with the help of generator. There is 10400mAh power bank provided which can charge 4-5 times in a single full charging. To reduce the cost, it can be replace by lower capacity power bank.

5. Analysis of Model:

Analysis of the model is done with the help of WORKBENCH 14.5 version. In this assembly and necessary subassemblies analysis is performed. For this some conditions are assumed. They are:

- ✓ Bag can carry load up to 50kg.
- ✓ Chair can carry load of 80 kg person.

On the basis of this, Analysis of the assembly and subassemblies is performed in WORKBENCH. There are all the properties of the material of different parts is assigned. After define the engineering data, geometry is imported in WORKBENCH. After this meshing is generated and load is define with supports. Total deformation of trilobe, assembly structure and chair is shown in figure 7; figure 8 and figure 9 respectively.

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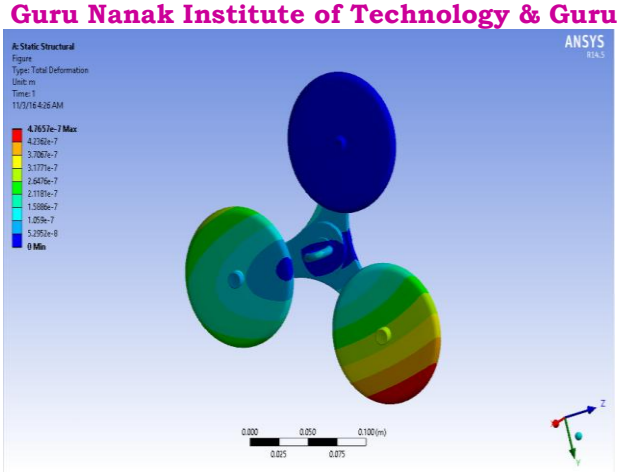

Figure 7: Total deformation in Trilobe

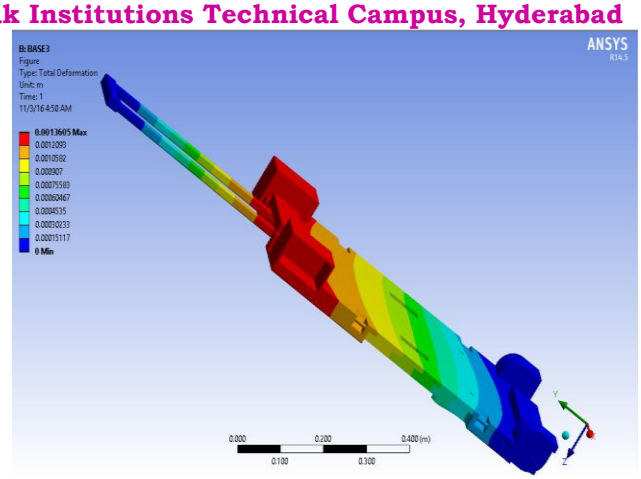

Figure 8: Total deformation in assembly structure

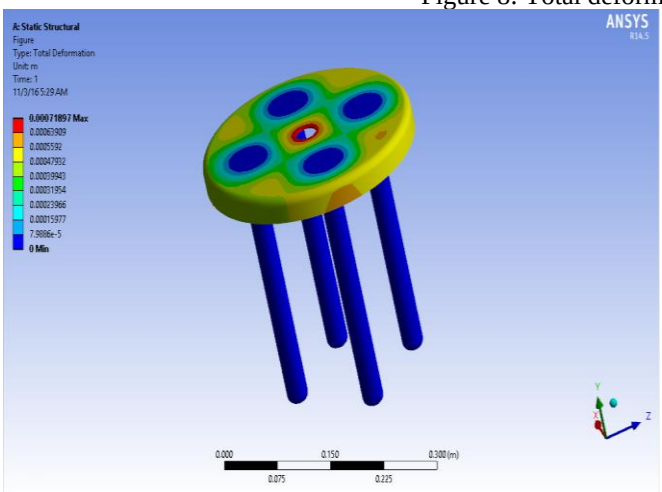

Figure 9: Total deformation in Chair

In all the cases, the Total deformation is below 0.001mm. In analysis of assembly structure, the handle is its extreme position. If it is safe in this condition than it can use at any defined possible between extreme points. With total deformation von mises stress and strain is also calculated. All stress and strain are in acceptable limit and ensure the quality life of product.

6. Aesthetics & Ergonomics:

Ergonomics plays a key role in the designing of trolley. It provides the comfort as well as maintains the aesthetic look of bag. The notable points where ergonomics play a role are

- ✓ Stair climbing mechanism without complicating the design.
- ✓ Chairs are kept at such a way that easily use and feel comfort.
- ✓ Power Bank help one in isolated area and in rush. Especially in era off android phones where battery discharges is big issue.

7. Conclusion:

After analysis, it can be concluded that universal trolley carrier is safe and ready to production. In this case, Solidworks software is used for modelling. This design can be further optimized to reduce the material cost as well as for aesthetic point of view by using optimization software. With the help of optimization its stiffness also increased. Overall, it's good concept for providing a comfort journey.

8. References:

1. Loper: A Quadruped-Hybrid Stair Climbing Robot":- Sam D. Herbert, Andrew Drenner, and Nikolaos Papaniko lopoulos, Department of Computer Science and Engineering University of Minnesota Minneapolis, MN 55455 2008 IEEE International Conference on Robotics and Automation Pasadena, CA, USA, pp.19-23, 2008.
2. Mourikis, A.I., Trawny, N., Roumeliotis, S.I., Helmick, D.M., and Matthies, L., 2007, "Autonomous StairClimbing for Tracked Vehicles," International Journal of Computer Vision & International Journal of Robotics Research - Joint Special Issue on Vision and Robotics, 26(7), pp.737-758.
3. Hsueh-Er, C., "Stair climbing vehicle", 2008, Patent No. US2008164665 (A1), Jan 24.
4. A.F. Hoermann. "Feasibility analysis of a design for a stair-climbing wheelchair". Department of Mechanicl Engineering, Massachusetts Institute of Technology, June 1997.
5. Lawn, Murray J., and Takakazu Ishimatsu. "Modeling of a stair-climbing wheelchair mechanism with high single-step capability." IEEE Transactions on Neural Systems and Rehabilitation Engineering, 2003 pp. 323-332.