

# Design and Development of Hybrid Storage Shelf

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**Abstract:** This paper deals with the design and the development of the hybrid storage shelf which can be used as portable and foldable type by the users. This will increase the storage utility and the aesthetics will contribute to the interior beauty of the living space. When contracted the dimensions of the product will be very compact and small so that the user can transport or move as per the user defined purposes.

**Keywords:** Hybrid storage shelf, Keyshot, CATIA, Rendering

## 1. INTRODUCTION

The objective of this thesis is to identify and analyze various storage patterns and their problems faced by an inmate in a typical hostel room. The various patterns of storage and their limitations were identified through a demographic survey and key requirements, expectations for a better storage concept was then identified. A detailed market analysis was carried to identify the different type of products available in the market which meets the expectations. Concepts for combining all the requirements into a single product was then identified. Construct the 3D model of the identified concept and complete functioning of the model was rendered in virtual reality and cost analysis was conducted. The idea is to create a design for feasible and sustainable Multi-functional furniture that can satisfy the present need of a student living in a hostel room. However, the scope of work on such a project went beyond planning and designing different aspects of concern. Dealing with such unconditonal environment whose elements were untidiness, lack of available material and financial resources, required innovative work methods in order to lead the project in the right direction. Sustainable and multifunctional furniture design might increase the efficiency of living space utilization. Usually, the normal rack satisfies only the specific purposes like, as a wardrobe arrangement and book shelves etc. As the requirement increases no. of racks also to be used also increases which in turn makes the room congested and untidy and also consumes more space, it also increase the cost. So a portable and multipurpose rack can satisfy the present user need. By making a new concept, the Space and location constraint can be reduced to a large extent. It should be also easy to handle and access items since all are stored in single rack.

## 2. PRODUCT DESIGN AND PROCESS

In the present concept of design, various product design processes are established on different aspects. The process shown below, for example, is "The Seven Universal Stages of Creative Problem-Solving," outlined by Don Koberg and Jim Bagnell. This series of process helps designers formulate their product from ideas. This process is usually completed by a group of people and designers, i.e. industrial designers, field experts, engineers, etc. depending upon the products involved. The process focuses on figuring out what is necessity, brainstorming possible ideas, creating mock prototypes, and then generating the product. In real case that is not the end of the process. At this point, design engineers would still need to execute the idea, making it into an actual product and then evaluate its success by seeing if any improvements are necessary.

The design of new products and its process has experienced huge leaps in evolution over the last few years with the rise and adoption of 3D printing. The evolution of new consumer-friendly 3D rapid prototype printers can produce dimensional objects and print the prototypes upwards with a plastic like substance.

The design process follows a guideline involving three main sections:

- Analysis
- Concept
- Synthesis

The later two sections are often taken care, depending on how often the design needs updating, to improve or to better fit the criteria. This is a continuous loop and repeat for the optimisation, where feedback is the main component. If we look into more and break it down even more, the seven stages specify how the process works. Analysis consists of two stages, concept is only one stage, and synthesis encompasses the other four.

Analysis

- Accept Situation: The design engineer should accept the reality and the current practises for the better understanding on the scope of the project. The detailed study of the current systems will put more light in the concept generation.

- **Analyse:** Analysing the situations and the current problems will help to conceptualise the solution for those problems or necessities. The analysis can be made with many surveys, questionnaires and feedback forms. This can lead to form a requirement list.

**Concept**

- This phase will involve in defining the problem and the solutions for that. The concept phase can have more ideas and alternate designs. The feasibility study on these concepts will figure out the best affordable design for the users.

**Synthesis**

- This phase will have all the brainstorming sessions. This will be irrespective of the possibility of executing and without considering all other basing possibilities. This can gather more ideas and features for the concepts.

**Select:** After all these process, the designers will have ended up in selecting a suitable concept which can satisfy the user necessities. In the other stages we have to check how to implement and manufacture the concept to real world.

- **Implement:** This is where the prototypes are built, the plan outlined in the previous step is realized and the product starts to become an actual object.
- **Evaluate:** In the last stage, the product is tested, and from there, improvements are made. Although this is the last stage, it does not mean that the process is over. The finished prototype may not work as well as hoped so new ideas need to be brainstormed.

**3. DESIGN INPUTS DERIVED FROM SURVEYS**

Based on the questionnaire and the surveys done, the product design got more optimised. The optimised methodology will make the processes more focussed to the final stage of the product and its effectiveness. The revised needs and target specification is as shown below.



**Fig- 1:** Revised customer needs assessment

Benchmarking will provide better resolutions in the steps and the parameters to be attained during the process. The proper benchmarking will make the concept more competitive and the designer can assure that the product is having all the features that the competitors provide to the end users. This will ensure for a better environment for the product in the selling market

**4. MECHANISM AND MATERIAL SELECTION**

There are many lifting and expanding mechanisms available in the market. The simplest one is the screw jack mechanism which is widely used in the lifting of heavy weights. The requirements doesn't call for such bulky mechanisms for this design. The next sorted out design was chain and sprocket, but it will call for higher maintenance cost and noise problems due to the loosening of the chains. The researches came to the scissor lift mechanism which can give a maximum limit of expansion in its elongated position and the minimum in its contracted position. So this will be feasible for the current concept. Its symmetrical inks will provide more rigidity to the structure and will help to handle necessity load for the user purposes.

Regarding the material selection of the product, first thing we have to look is the rigidity, availability and feasibility to manufacture. It's easy to get the Mild steel or stainless steel but when we consider about the portable feature for the user it will be bulky. So the best option in the metals will be Aluminium, which can impart more strength and anti-corrosive. This will give a good look and less weight for the entire structure but it may not be able to withstand as much as load that stainless steel can bear. Still it can be considered if the user is ok with the load capacity of the aluminium. If

the cost has to be again reduced so that the product will be affordable for larger consumers, then pipes can be made of PVC with higher hardness and the structure with Aluminium itself.

### 5. MODELLING PLATFORM

The platform used for 3D modelling is CATIA. There are many 3D and 2D software are available in market. The initial layouts and concepts can be generated by 2D software and later the frozen concepts can be modelled by 3D software. CATIA is good in sheet metal modelling and can be transferred to CAD/CAM manufacturing process. When it comes to the presentation levels of the concept, CATIA can bring out the best rendered images with KEYSHOT 4 software. This will help in creating a better impact of product images in the posters, brochures etc. The complete package of the Software can perform preliminary analysis of the load carrying capacity of the product and draw out the BOM of the assembly. These features will help us to have a complete package of design and the manufacturing assistance.

### 6. 2D - ASSEMBLED SKETCHES

The models are generated in the 3D platform and assembled. The 2D sketches of the same are shown below

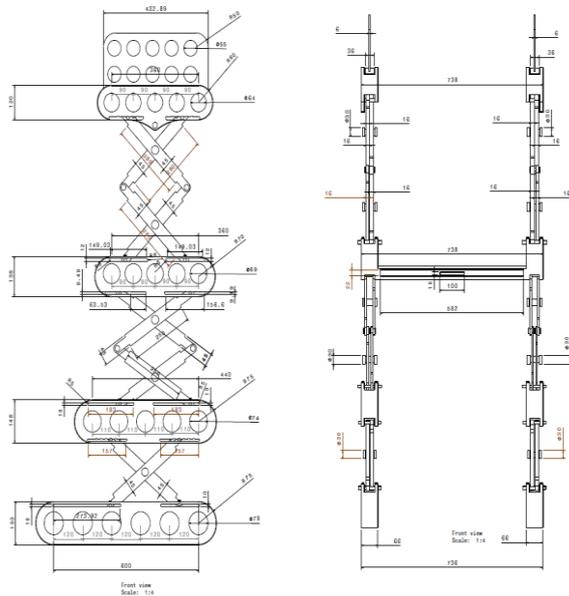


Fig-2: Side view and front view of the product

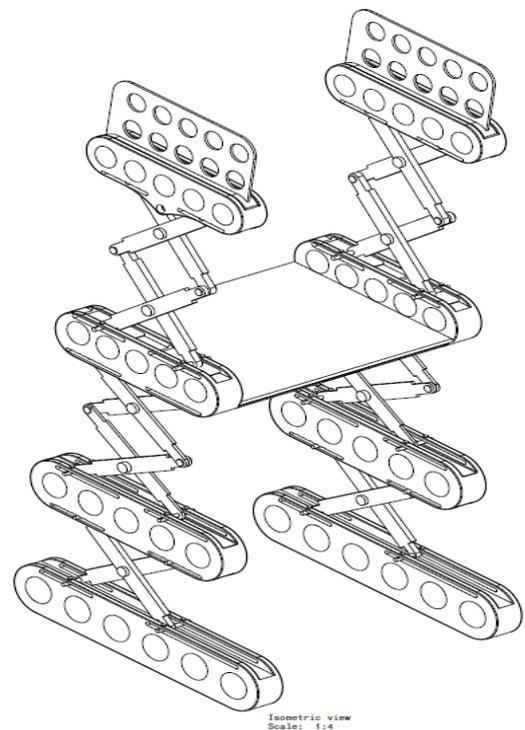


Fig -3: Assembled view of the product

### 7. RENDERED IMAGES OF THE HYBRID STORAGE SHELF

The rendering is done in the KEYSHOT 4. This is done to understand the final product and its aesthetic looks. Below shown are the rendered images of the product



Fig-4: Rendered image of the final product



**Fig-5:** Rendered image of the final product in use

## 8. KEY FEATURES

The Advantages of Product:

1. Less Weight when compared to other existing storage systems.
2. Good aesthetic look and contributes to internal beauty
3. Low chances for rusting because of the coating
4. Rigid structure
5. More Storage options for the user
6. Portable and foldable feature makes it more comfortable for the user
7. Visibility is more in the storage space
8. Air circulation will be there, so less foul smell will be generated.

Disadvantages of Product:

1. Slightly costlier than the average storage systems
2. The mechanism can be get loosen or jams in frequent usage
3. It's not fully closed and covered, dust can enter
4. Technical skill required for the assembly and disassembly of the product

## 9. CONCLUSION

The objective of this thesis was to create a design for feasible and sustainable Multi-functional furniture that can satisfy the present need of a student living in a hostel room. However, the scope of work on such a project went beyond planning and designing different aspects of concern. Dealing with such a convoluted environment

whose elements were untidiness, congested living space, and lack of available material and financial resources, required innovative work methods in order to lead the project in the right direction. Sustainable furniture design might increase the efficacy of living space utilization. Usually, the conventional rack satisfies only specific purposes like, as a wardrobe arrangement, book shelves. As the requirement increases no. of racks also to be used also increases which intern makes the room congested and untidy, it also increase the cost. So a portable and multipurpose rack can satisfy the present need. An open rack that can accommodate all materials like books, clothes and even computer can be developed. So a survey was conducted among different students from different colleges, Based on the survey needs are identified and converted to design specification accordingly and different concepts were developed. The free hand sketches are drawn and part modeling was done using CATIA modeling software. The final assembled product was then rendered to maximum quality in terms of aesthetic and style.

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