

Design and Fabrication of Multifunctional Furniture

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Abstract: Majority of the Indian middle class population are living in small flats and homes mostly because of their economy scale as well as the lack of space availability for living. In the present scenario, furniture occupies a majority of the space in the home interior causing spaces congested. To overcome this problem the furniture should have a multipurpose than their primary function. It is mainly of generating a new concept in furniture. This study is approached to design and develop a multipurpose space saving dining table for Indian middle class homes.

A study was made to understand the lifestyle, need and comfort in the Indian homes as well as different activities associated with specific interiors. Several furniture design stores were visited in order to understand the present market scenario, demand and needs of the customers. Existing dining furniture was analyzed in detail including its components and parts and their assembly and sub-assemblies. After the study, the product is created by considering the cost reduction of the product

Drawings were developed for final concept, and designed using SOLIDWORKS 2016 and analyzed using ANSYS software. A prototype was made and the ergonomic validation was done. The proposed concept is found to occupy just less than its deployed area. We thereby believe that the proposed design will largely suits the constrained space conditions of the urban segment in India.

Keywords: multifunctional furniture

1. Introduction

Furniture refers to movable objects intended to support various human activities such as seating (e.g., chairs, stools, and sofas), eating (tables), and sleeping (e.g., beds). Furniture is also used to hold objects at a convenient height for work (as horizontal surfaces above the ground, such as tables and desks), or to store things (e.g., cupboards and shelves). Furniture can be a product of design and is considered a form of decorative art. In addition to furniture's functional role, it can serve a symbolic or religious purpose. It can be made from many materials, including metal, plastic, and wood. Furniture can be made using a variety of woodworking joints which often reflect the local culture.

The main motto of this paper is to make the work table as a multi-purpose one. The work table can be dragged such that the size of the table is increased which can be used for other purposes. The dragged table can be used as a dining table otherwise it can be used for showcase etc. For long lifetime of the product, good quality of material should be used.



Fig. 1. Furniture table

A. In future

Many tables have tops that can be adjusted to change their height, position, shape, or size, either with foldable, sliding or extensions parts that can alter the shape of the top. Some tables are entirely foldable for easy transportation, e.g. camping or storage, e.g., TV trays. Small tables in trains and aircraft may be fixed or foldable, although they are sometimes considered as simply convenient shelves rather than tables.

2. Space saving approach

Space-saving furniture designs are unique in our daily lives and workplaces. Effective space saving does not depend on downscaling, but on smart ways of collapsing a piece of furniture or making it more collapsible. Among the many space-saving mechanisms such as stacking, implosion, and bundling folding is perhaps the most frequently observed and best practiced on furniture.



Fig. 2. Space Saving Table

3. Design methodology

A systematic design methodology is followed to achieve reliable and most suitable solution. It involves the following steps.

- Survey
- Conceptual Development
- Design
- Analysis
- Fabrication
- Testing
- Product

A. Different types of dining table

- Wood Dining Table
- Metal Dining Table
- Glass Dining Table
- Plastic Dining Table



Fig. 3. Different types of table

All types of tables have some advantage and disadvantage. The customer buys the dining table according to their requirement. In terms of aesthetics, the choice of dining table material affects the look surrounding. For example, a wooden table looks more classic and warm than the glass and metal combination. Different types of dining table shown in the Fig.

B. Types of Material

For manufacturing dining table commonly used materials are wood, plywood, glass, plastic, aluminium frame and stainless steel- frame.

C. Market Study

A market study has been conducted on the furniture segment and studied the present market and collected various data for the output. The market study is having importance role in product design and new product development. So market trend and study of new arrival of products have been understood by conducting market study.

D. Main Observation of Study

The main observations of the study are,

- Existing one is analyzed in detail including its function, assembly and parts.
- Table is used as multipurpose like cutting vegetables, sometimes used as writing purpose.
- In flat and apartments people feel uncomfortable, if a large table occupied their maximum space in the dining room space.

- Cost of the table should be with in Rs. 3000 to 5000.
- The table should occupy around two to four peoples
- Dining table is not only used for dining but for other purpose
- People not comfortable with the current dining table
- The Present dining table is immovable
- Table occupying more space in the dining room
- It's not ergonomically designed; most of them are manufactured by the local carpenter
- People staying in flat have less space and keep big table is very difficult.

E. Concept generation

For making the concepts more modular and flexible the design of the table should be in such a way that it should be folded and can be easily stored.

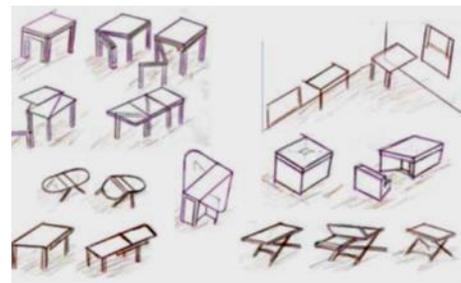


Fig. 4. Concept Generation

F. Final Concept

This concept is more modular and flexible that the design of the table should be in such a way that it should be folded and can be easily dismantled stored. This concept was derived from the laptop. The laptop is foldable making it handier. The main theme of the concept was the folding theme in which the table was foldable; this makes the concept more flexible and modular. The working principle of this concept is shown in the Fig.

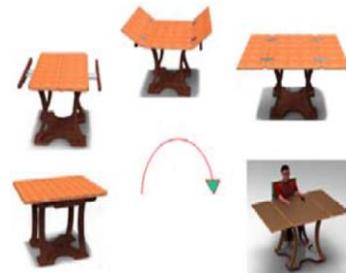


Fig. 5. Different stages of the concept

In the closed condition two people can sit comfortable and have food. This concept comes in useful for entertaining guests. Folding table is great for dining or for use as a serving table. Folding table made of wood are strong, durable, the combination of aesthetic as well as creative ideas. Wooden folding tables have easy-slide action, with leg locks that gets engage when opened.

4. Detailed design

Detailing of various parts of the selected concept has been done. Detailed engineering drawing and CAD drawing was done for making the prototype.

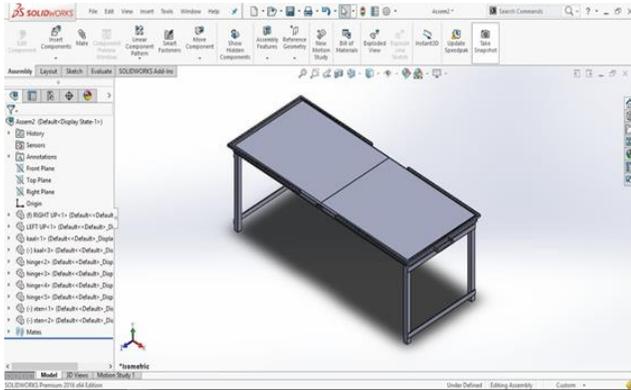


Fig. 6. Assembled structure overview

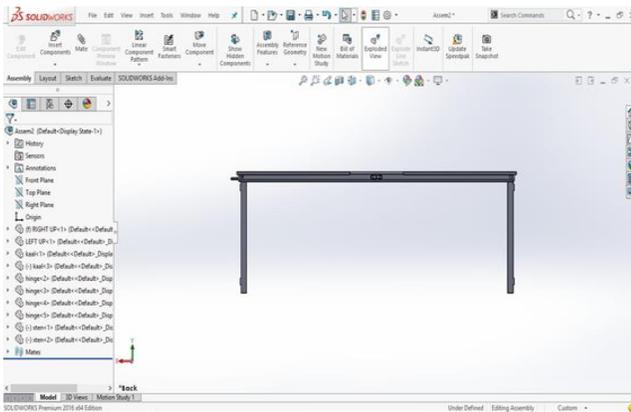


Fig. 7. Side View 1

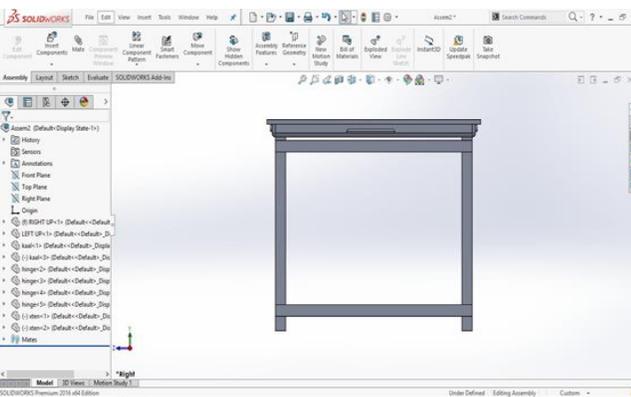


Fig. 8. Side View 2

A. Prototype

Detailed drawing was created in SOLIDWORKS 2016. This drawing was 1:1 model and used the same as template for prototype.

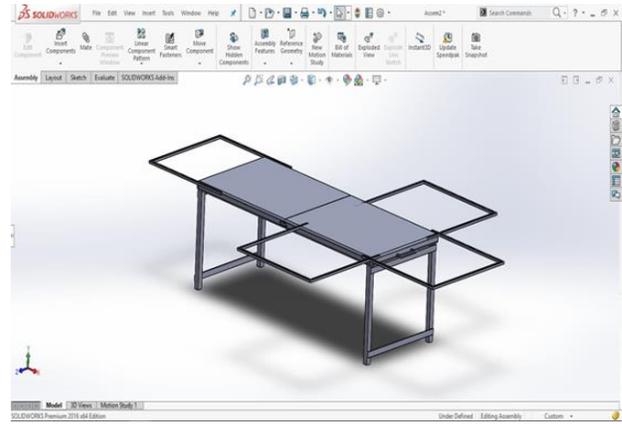


Fig. 9. Maximum extended structure

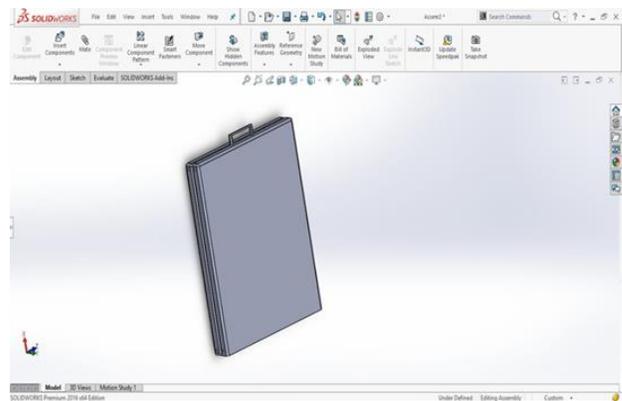


Fig. 10. Minimum foldable structure

B. Material properties

The following material for the Aluminium is provided below,

Table 1
Material properties

Material	Aluminium
Tensile strength(MPa)	89.6
Elongation %	60
Hardness (HB)	52
Yield Strength (MPa)	34.47
Poisson's Ratio	0.33
Young's modulus (GPa)	69

C. Analysis of the material

The detailed analysis is done using the analysis software ANSYS, where the analysis of total deformation and Von misses stress analysis is done.

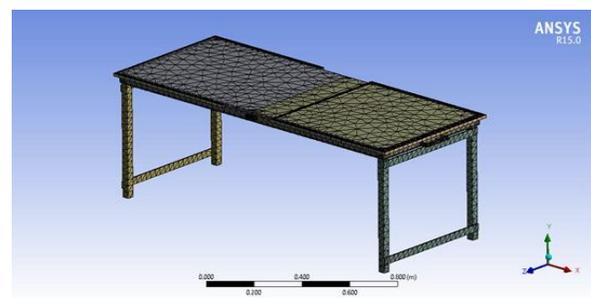


Fig. 11. Meshing

D. Pre-processing

The pre-processing step is, quite generally, described as defining the model and includes,

- Define the geometric domain of the problem.
- Define the element type(s) to be used.
- Define the material properties of the elements.
- Define the geometric properties of the elements (length, area, and the like).
- Define the element connectivity (mesh the model).
- Define the physical constraints (boundary conditions).
- Define the loadings.

E. Post processing

Analysis and evaluation of the solution results is referred to as post processing. Postprocessor software contains sophisticated routines used for sorting, printing, and plotting selected results from a finite element solution. Examples of operations that can be accomplished include:

- Sort element stresses in order of magnitude.
- Check equilibrium.
- Calculate factors of safety.
- Plot deformed structural shape.
- Animate dynamic model behaviour.

F. Applying 25 KG load

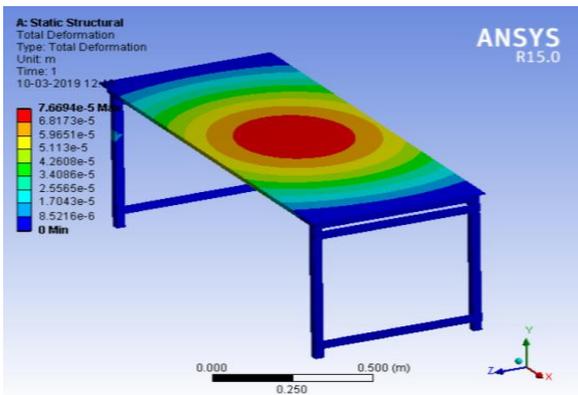


Fig. 12. Total Deformation of 25kg

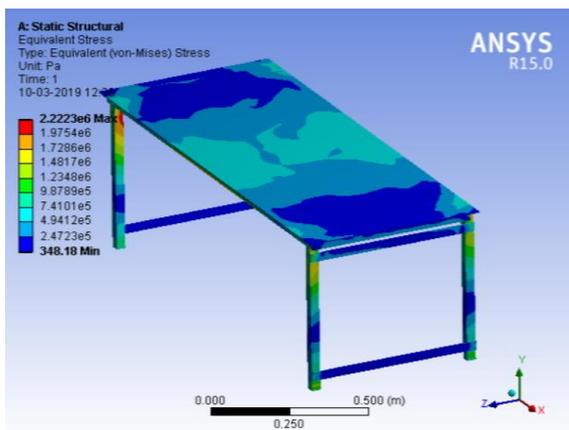


Fig. 13. Von-Mises Stress of 25kg

G. Applying 50 KG load

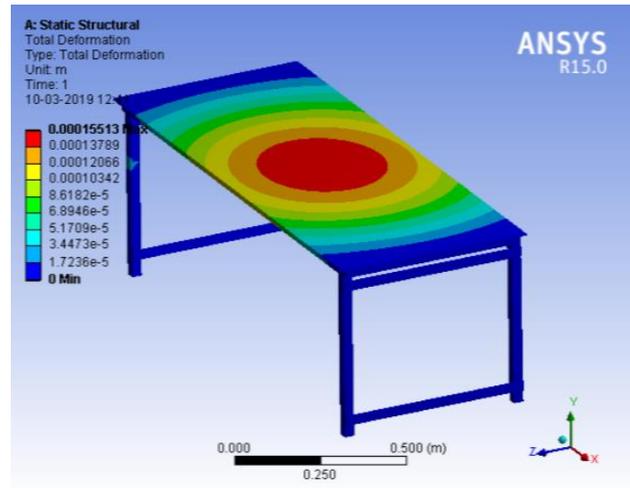


Fig. 14. Total Deformation of 100kg

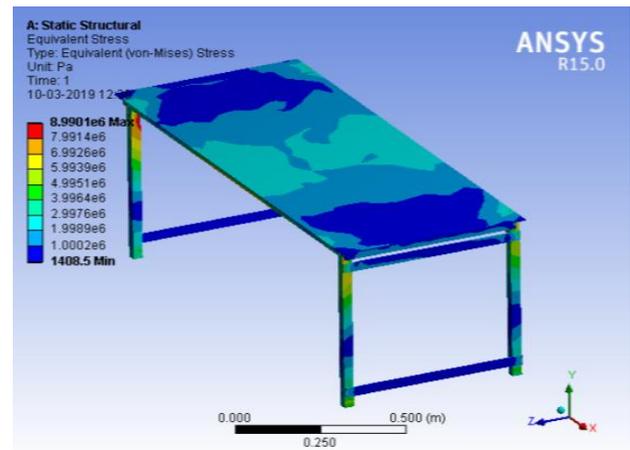


Fig. 15. Von-Mises Stress of 100kg

Hence the analysis of the product is successfully done using ANSYS software and the results are obtained in the software and it favors for the productivity.

5. Conclusion

The product is developed by generating concept for the course of urbanization in India. This study has helped to develop the product design skills. The product study, market study and the user study helped to understand the present modular dining table in the market. Digital modeling was done using SOLID WORKS 2016 was used for better visualization. The analysis of the product is done using ANSYS software. A prototype of selected concept was made for validation. The product is made which is surely a multipurpose by saving its space when not in use. In stowed form, the proposed concept is found to occupy just less than its deployed area. We thereby believe that the proposed design will largely suit the constrained space conditions of the urban segment in India.

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