Modelling Analysis and Fabrication of Laptop and Projector Stand

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ABSTRACT

A laptop or a notebook is a portable personal computer with a form factor, suitable for mobile use. Laptops are commonly used in a variety of settings, including at work, in education, and for personal multimedia.

A laptop combines the components and inputs of a desktop computer,
including display, speakers, keyboard and pointing device (such as a touchpad or a track pad) into a single device. Most modern-day laptops also have an integrated webcam and a microphone. A laptop can be powered either from a rechargeable battery, or by mains electricity via an AC adapter. Laptop is a diverse category of devices and other more specific terms, such as rugged notebook or convertible, refer to specialist types of laptops, which have been optimized for specific uses. Hardware specifications change significantly between different types, makes and models of laptops.

Portable computers, which later developed into modern laptops, were originally considered to be a small niche market, mostly for specialized field applications, such as the military, accountancy, for sales representatives etc. As portable computers developed and became more like modern laptops, becoming smaller, lighter, cheaper, and more powerful, they became very widely used for a variety of purposes.

Considering one of the purpose like presentations, seminars, conferences…etc. the mounting structure should be supportive, aesthetic and effective in the space and placement also, since counting this purpose the new laptop stand design accommodated with projector arm such that to provide multi benefits to the occupant who can easily and effectively carry out the presentations, seminars, conference.etc.

The lap top stand is designed as per considering the regular height of the occupant and as per standing conditions, mounting space for the stand

INTRODUCTION

In today's world ergonomics plays an important role, with digitalization of every information, it may be teaching in class room, Presentation in a seminar hall or explanation about the product in corporate conference hall, details has to be presented with the help of Laptop and Projector. The Laptop and Projector has to be placed in such a way that, both have to be set up in less time, acquire less space and easy to handle.

Also considering the good out looking conditions in designing the suitable devices such that which could be effective in all perspective, in order to

design such that the following measures are taken.

1.1 MEASURES FOR DESIGN:

1. Function
2. Ergonomics
3. Aesthetics

1.1.1 FUNCTION

The laptop & Projector both are used to present the information in class room, seminar hall and conference hall. The setting up of the equipment requires lot of time; in conventional way both laptop and projector will be kept on student desk or table in class room, which causes inconvenience to the presenter and student or audience.

To eliminate all the above said problems an Ergonomically stand is designed and Fabricated for using Laptop and Projector using Acrylic material which is light in weight, and very easy to carry any place.

1.1.2 ERGONOMICS

Ergonomics is a hybrid science calling for knowledge of anatomy, physiology, psychology and engineering. In terms of man-machine relationship ergonomic has two aspects. Fitting the machine to man and fitting man to machine.

In general there is a little point in fitting man to the machine when the machine is not fitted to man by design. Fitting the machine to man has two dimensions, namely usability and aesthetic compatibility thus ergonomic is studies interactions among man, machine the environment.

1.1.3 AESTHETIC

Aesthetic is concerned with the study or appreciation of beauty, this may tends to create a number of impressions which reflection. An aesthetic experience can be so strong as to evoke an intense emotional surge or it may be merely mild awareness of something pleasing.

Because the appreciation of beauty is a highly personal experience, it might seem to form a subject for psychological study. In fact, studies of this kind have been undertaken in the main they have been undertaken. In the main they have been conducted by asking groups of people to show their preferences when faced with various comparatively simple shapes

Such tests produce are by no means equivalent to the complexity of forms and colors which make up our normal environment. Second it may be questioned whether a majority

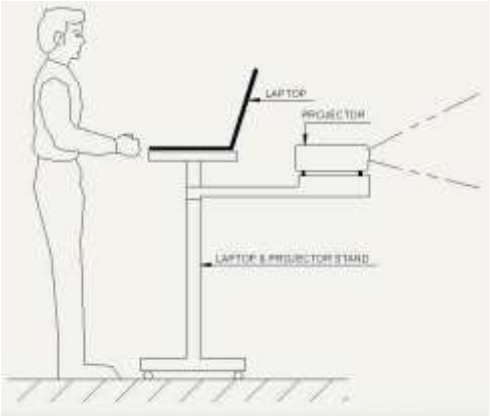
Preference for a particular shape can be taken as indicating beauty. For example a shape could conceivably have a particular meaning for one observer and not for another.

The material used for stand is acrylic, which is a transparent, suit with any color laptop and projector.

1.2 CONCEPTUAL DESIGN

Designing of product on the basis of concept is concept designing and is the first step or phase of designing. The conceptual design gives a set of integrated ideas and concepts about what it should do, behave, and look like, that will be understandable by the users in the manner intended. It describes how a new product will work and meet its performance requirements.

In this current project the concentrate on creation of the lap-top and projector multi user stand by developing the concept such that ensures the aesthetic and effective design by using the suitable material.



Conceptual design based on user comfort

LITERATURE REIVIEW

ERGONOMICS:

Ergonomics is concerned with making the workplace as efficient, safe and comfortable as possible. Effective application of ergonomics in work system design can achieve a balance between worker characteristics and task demands. This can enhance operator productivity, provide worker safety and physical and mental well-being and job satisfaction.

Ergonomic workstations bring improved productivity and lowered costs to your assembly and fabrication operations. When you bring the work to the operator, you can eliminate the reaching; stooping and straining that can lead to health issues.

2.2 STRUCTURAL DESIGN:

The basic requirements for an efficient structural design is that the response of the structure should be acceptable as per various specifications, The best design could be in terms of minimum cost, minimum weight or maximum performance or a combination of these.

2.2.1FORCE

When an object is pushed or pulled, we say that a force is exerted on it.

Forces can

- Cause an object to startmoving
- Change the speed of a moving object
- Cause a moving object to stop moving
- change the direction a moving object
- Change the shape of an object

Force is measured in Newton (N).

2.2.2 WEIGHT

Weight is a force that is caused by the pull ofgravity and is measured in Newton (N). On Earth, an object with a mass of 1kg will experience a force of 10N due to gravity, i.e. the weight of a 1kg mass is 10N. This ratio of

Weight-to-mass (g) is called the gravitational field strength.

We calculate weight using the equation

Weight = mass x gravitational field strength

W = mg…… (1)

2.3 CADD-CAE

This penetration of technique concern has helped the manufacturers to

CAD: Computer Aided Designing is, Technology to create, Modify, Analyze or optimize the design using computer.

CAE: Computer Aided Engineering is, Technology to analyze, Simulate or Study behavior of the cad model generated using computer.

CAM: Computer Aided Manufacturing is, Technology to Plan, manage or control the operation in manufacturing using computer.

Uses:

a) Increase productivity.
b) Shortening the lead-time.
c) Minimizing the prototyping expenses.
d) Improving Quality.
e) Designing better products

CREO

Creo is the software currently selected to design in this project. Creo is developed by PTC. The suite consists of apps, each delivering a distinct set of capabilities for a user role within product development.

Creo is used for solid modeling, 3D direct modeling, Finite Element Analysis and simulation, schematic design, technical illustrations, and viewing and visualization.

Importance of PTCCreo Parametric:

- Quickly and easily create 3D CAD models of any part or assembly
- Create manufacturing drawings automatically with complete confidence that they will always reflect your current 3D design
- Improve product design aesthetics with comprehensive surfacing capabilities
- Repurpose neutral and non-PTC CAD data from customers and suppliers easily, avoiding the need to convert files or recreate 3D CAD models from scratch
- Get instant access to comprehensive learning materials and tutorials from within the product to get productive with 3D CAD faster.

2.3.2 ANSYS:

ANSYS software is a comprehensive FEA analysis (finite element) tool for structural analysis, including linear, nonlinear and dynamic studies. The engineering simulation product provides a complete set of element behavior, material models and equation solvers for wide range of mechanical design problems.

CAD geometry can be used directly with ANSYS structural analysis software-with no translation, no IGES and no intermediate geometry formats. ANSYS has provided native bidirectional integration with the most popular CAD systems for more than a decade. Integration directly in to the CAD menu bar

makes it very simple to launch word-class simulation directly from a CAD system. It has automatic body by body meshing, all TETRA mesh of complex assemblies.

The most versatility in the ANSYS is the use of multiple software tool formats and can be easily import the structure of any format. The most versatile examples the ANSYS can read and write the .txt file which is very complicate to other analysis software to execute.

2.4 ACRYLIC MATERIAL

Acrylic is a useful, clear plastic that resembles glass, but has properties that make it superior to glass in many ways. Common brands of high-grade acrylic include Polycast, Lucite and plexi-glass.

There are two basic types of acrylic: extruded and cell cast. Extruded or "continuous cast" acrylic is made by a less expensive process, is softer, can scratch easier and may contain impurities. Cell cast acrylic is a higher quality acrylic and U.S. domestic cell cast is a good choice for applications that require the best. Imported cell cast acrylic is often manufactured to lesser standards.

Acrylic is used to make various products, such as shower doors, bath enclosures, windows and skylights. It is chosen over glass for many reasons. It is many times stronger than glass, making it much more impact resistant and therefore safer. Another great advantage of acrylic is that it is only half as heavy as glass. This makes working with acrylic much easier. It can also be sawed, whereas glass must be scored. Adding to this favorable array of properties, a transparency rate of 93% makes acrylic the clearest material known.

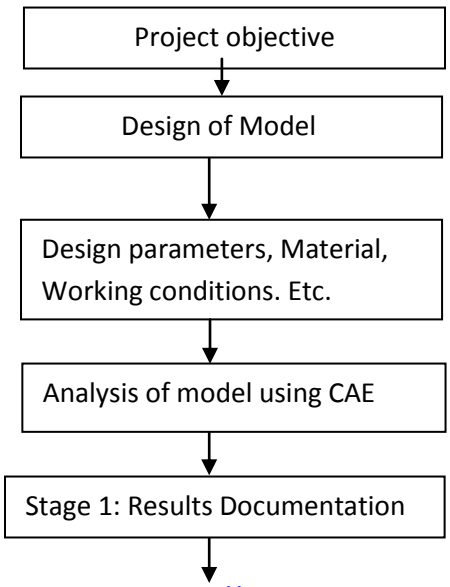
The material properties of acrylic is listed below

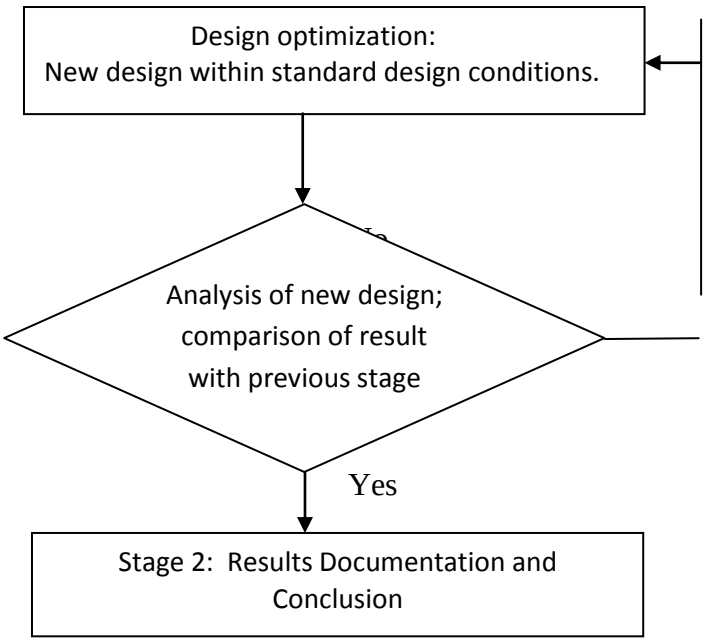
- Tensile Modulus (young's modulus) at 73°F=184000 to 512000 psi (ISO 527-2) {1psi =0.006895 Mpa; 3530.24Mpa or 3.5e4pa}
- Tensile strength at Yield, 73°F=5370 to 12100 psi (ISO 527-2)
- Compressive strength at 73°F=5950 to 17000 psi (ISO 604)
- Poisons ratio at 73°F= 0.3 to 0.35 (ISO 527-2)

For all of its advantages, there are two disadvantages of acrylic: it is more expensive than glass, and if exposed to a direct flame it will melt and eventually burn.

METHODOLOGY

METHODOLOGY FLOW CHART





Methodology Flow chart.

Methodology has been developed according to the main objective of the project and following proceedings are carried with precise of work flow starting from conceptual design to standard design and also considering the Assembly for the FEM analysis to ensure design is safe for the given loading and boundary conditions, and finally the results are documented if there any changes required the design procedure is reconsidered and when once satisfied results are occurred the design will be sent proto type. The following methodology flow chart has been represented in above figure

DESIGNING OF LAPTOP AND PROJECTOR STAND

4.1 ERGONOMIC DESIGN

Ergonomics is about designing for people, wherever they interact with products, systems or processes. We usually don't notice good design because it gives us no cause to, but we do notice poor design. The emphasis within ergonomics is to ensure that designs complement the strengths and abilities of people and minimize the effects of their limitations, rather than forcing them to adapt. In achieving this aim, it becomes necessary to understand and design for the variability represented in the population, spanning such attributes as age, size, strength, cognitive ability, prior experience, cultural expectations and goals. Principles of ergonomic design basically there are three way of designing ergonomically.

1. Designing for the Average: This means that the design is made to fit everyone. In the end this way of thinking may lead to a product that will not fit anyone.

2. Designing for the Extremes: This approach demands a good knowledge of the extreme population. Not everyone will be able to use a product designed for the extreme user, the design will fit one extreme population very well but the population at the other end of the scale will not be able to use the product.

3. Design for a Range: Designing for a range is basically to design for about 90 % of the population. From the 5th to the 95th percentage, are depending on task and cost budgets. This is

the most common approach because a product will be able to be used by more people. To be able to design with an ergonomic way of thinking following data is needed:

1. The anthropometric data of the intended population.

2. Data about the nature of the intended work.

3. Behavior patterns of the user population.

A standing workstation if not adjustable should be designed for the taller persons; shorter people can always stand on a platform or stool. A design that is to short is more difficult to compensate for. A tall person will inevitable bend his back and keep an awkward work posture. Recommended work-surface height for standing work for the 2.5th to 97th percentile are 5 to 10 centimeters above the elbow height (Grand jean, 1988).

To be able to calculate a good work-surface height from anthropometric data following equation can be used, (TayyaErgonomic design)

By considering the ergonomic design, a formulation can be developed.

$F(x) = A(x) + B(x) + h(x)$…… (2)

F(x)-functional objective

A(x)-Variables.

B(x)-In variables.

h(x)-Human factors.

Here the functional objective is to develop the lap top and projector stand where variables are the physical parameters like height and width for both lap-top top basement and arm basement for placing the projector. The selected invariables are material where it has been decided as acrylic in the first level of the project itself. The human factors are decided by the easiness in usage and comfort in handling the object or the stand.

For designing the stand, the height of the stand has been decided to the 46 inch (3.5ft 4inch) such that it could nearly to the waist height of an occupant. Here the occupant height is considered as 6 feet, which is considered as the standard height.

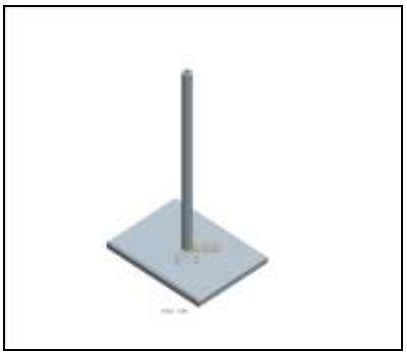
By considering the finally height of the stand we could use the height value to decide the standard width such that, Width of the stand should be effectively less than stand height nor it may cause imbalance in design. Hence forth the stand width is taken as 44 inch (3.5ft 2inch) where a projector could be placed and it could project effectively.

The gap between the lap top stand to projector stand is consider as 6inch (1/2ft) such that it makes very easy to connect and trouble shoot if necessary.

CADD DESIGN OF THE STAND

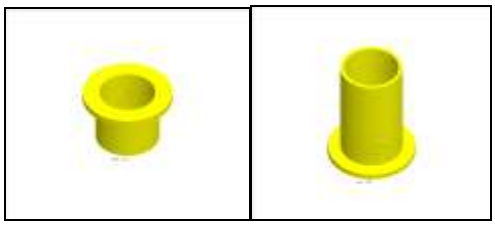
4.2.1BASE

Base has been designed to the length 24 inch with the width 18 inch.Which has a pillar of 2 inch diameter and pillar height is around 35.5 inch. This could satisfy the above design condition. The base has been represented in the below figure.4



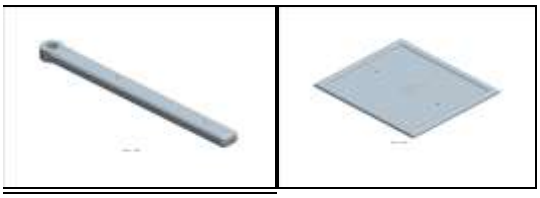
4.2.2 SUPPORTS 1 &2

Supports are designed such that to support the base arm in the both the ends to sustain the external load, where support-1 has been designed to support the top base and support-2to support the pillar attachement in the base. The following figures 5 and 6 represent the supports 1and 2.



4.2.3 ARM

Arm has been designed to the length of 20.44 inch and with the platform of width of 14 inch length of 16 inch, where the thickness of the platform is 0.5 inch. Where a projector is placed,which could satisfy the above design condition. The Arm has been represented in the below figure.7.

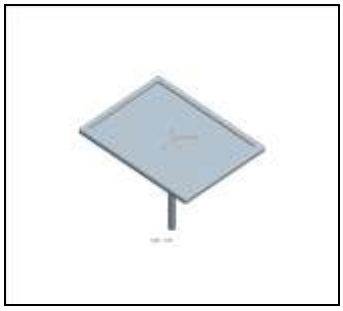


4.2.4 COUPLINGS 1&2

Couplings are designed to support the arm.Couplings 1 and two are designed such that to support the arm which has been designed to fit like a cantilever beam position. Where both the couplings helps to avoid the torsional effects of the arm on to the pillar fitted to the base figures 9and 10 represent the couplings 1and 2.

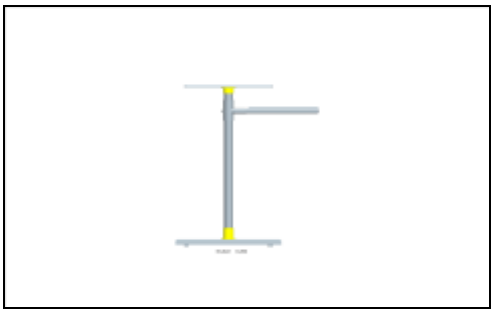
4.2.5 TOP BASE

Top base has been designed to the height of 12 Inch and with the plat form of Length 20Inch and of Width 15 inch, where the thickness of the platform is .5Inch. Where a laptop is placed, which could satisfy the above design condition. The top base has been represented in the below figure.11.



4.2.6 ASSEMBLY

After designing all the individual components are assembled together to represent the main objective of the project(represented in figure.10) where it could satisfy the following human ergonomic conditions.The height of the stand has been achieved at the end of assembly to the 46 inch (3.5ft 4inch) (represented in figure.11) such that it is to the waist height of an occupant. The stand width is taken as 44 inch (3.5ft 2inch) where a projector could be placed. Here the occupant height is considered as 6 feet, which is considered as the standard height. Hence the functional objective (eqn.1)has been satisfied by the designed components and assembly.



COMPARISON

Models present in the market.

- Big in size
- Not portable
- Heavy in weight
- Can use only as laptop stand
- Very expensive in price

Model designed

Compact in size

- Portable
- Light in weight
- Does multiple function, Can use as Laptop stand and as well as Projector stand
- Affordable price
- Aesthetic appearance

CONCLUSION

The design of the Laptop and Projector stand is quite attractive yet Aesthetic. The fabrication method of the stand requires very ordinary skills, like Turning, Drilling, Cutting, Welding, Grinding, Electroplating and Buffing. It can be

very easily manufactured by semi-skilledlabors. This stand was designed for using Laptop and Projector in a single stand. Mainly can be used in big stages, Seminar halls and Class rooms.

The stand was made with Acrylic material and is quite expensive, but it gives an attractive look on the stage. It'slight in weight and portable. Height and direction of the Laptop platform can be changed by operating the Knob provided.

SCOPE FOR FUTURE WORK

The present research work leaves a wide scope for improvisation and further investigations to explore many other design changes for the Laptop and Projector stand.

Some recommendations for further improvisations include;

- Designing the Coupling joint so that the Projector arm can rotate along the axis of the Base-shaft so that, the Projector arm can fix at any required position.
- Designing concealing power cable in the shaft and providing power supply points up to the projector platform
- Fabricate the coupling and supports by Aluminum. This will reduce its weight more than half.

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