

Design and Development of Adjustable Height Stool

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Abstract— The stool is very convenient and economical in use, because it is manually operated. We can utilize this stool for various types of applications such as domestic, official, workshop, collages, hotels, hospitals etc. and even unknown person can also operate this stool very easily. We can use the scissor mechanism by which we can obtain maximum height in minimum movement of strips. It can be easily manufactured in any workshop because of its simple construction. This type stool is used in day to day life, so its demand is increasing day by day. 1) It is multi-purpose type of stool. 2) Its manufacturing cost is less. 3) It is manually operated machine. 4) It does not require external power supply.

I. INTRODUCTION

Normally, conventional stool is utilized in domestic application for sitting purpose, for keeping domestic things on stool such as tape-recorder, music system, mixer, sewing machine etc. Conventional stool is also required in industries, offices, workshops etc.

Various types of conventional stools are used for above applications. Each stool is designed according to its application. So it can be utilized only for specific application.

Therefore, stools are designed in different height depending upon its purpose.

By considering above condition there is height limitation of conventional stool. The height is not varying with respect to required height of application. Therefore the height of stool should be adjusted according to various height of application.

Due to this height limitation of conventional stool, the adjustable height stool is designed and developed. The problem of limited height of conventional stool is overcome in adjustable height stool by changing its height.

II. THE CONCEPT

The concept of working of adjustable stool is similar to working of scissor mechanism. In the scissor mechanism, the change in height is achieved by change in distance between extreme ends of scissor.

Therefore, for achieving change in height of the stool by adjusting of extreme ends of scissor strips toward each other.

In the scissor one extreme end of scissor strips is pivoted and other end of scissor is adjustable.

III. CONSTRUCTION & WORKING

A. Parts of Adjustable Height Stool

The adjustable height stool consists of following parts:-

- Wooden Platform.
- Upper Angular Frame.
- Scissor Mechanism.
- Lower Angular Frame.
- Base.
- Turn-Buckle Joint.

B. Construction

- The construction of base of adjustable height stool is simple and similar to conventional stool without using top wooden platform.
- Scissor mechanism is rested on the angular frame of base.
- There are four inclined slots are provided on vertical edge of lower angular frame for adjusting height.
- For making scissor mechanism, two strips are joint each-other at center by riveted joint.
- The extreme ends of two scissors are connected to each-other with the help of riveted joint.
- The turn buckle joints are used for supporting between two scissor mechanisms.
- The upper angular frame is fitted on scissor mechanisms.
- The top wooden platform is placed on upper angular frame.
- The horizontal slots are provided on vertical edges of upper angular frame for sliding.
- The scissor mechanisms are placed between lower and upper angular frame. The base of adjustable height stool is made-up of square pipes.

C. Detail Construction Of Each Part

1) Base

The base of adjustable height stool is similar to base of conventional stool.

It has four legs which are made up of square pipe. The square pipes are connected to each-other by electric arc welding. End of Square pipes are joint to the lower frame by welding. Square pipes are also used for supporting legs of base.

The thickness of square pipes is 3 mm, the width of square pipes is 40 mm and the length of legs of base is 640 mm. The square pipes are connected to the lower frame in incline position. Because it can be balanced or supported to stool as well as load acting on stool.

2) Lower Angular Frame

The lower frame is made up of angle; therefore it is called as angular frame. Angle is cut by abrasive wheel cutting machine at 45 degree in inner edge of angle. Angles are connected to each-other by electric arc welding on its 45 degree edge. To form the angular frame corner joint and edge joint of welding are used.

The inclined slots are provided on vertical edge of lower angular frame.

Slots are provided for adjusting the height of stool or strips end is rested in this slots. The slots are provided only on two angles which are opposite to each-other. The distance of each slot is about 40 mm.

The lower angular frame has square shape and dimensions are 500 mm in length and 500 mm in width i.e. 500 mm X 500 mm. The size of angle is 40 mm in width and 6 mm in thickness i.e. 40 mm X 40 mm X 6 mm.

3) Scissor Mechanism

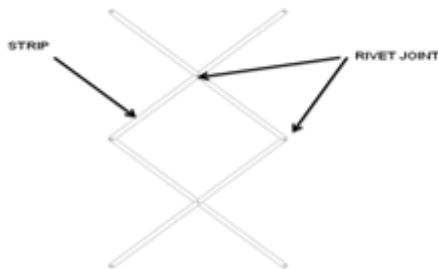


Fig. Scissor Mechanism

In scissor mechanism two strips are connected to each-other at the center of strips by using riveted joint. In riveted joint there are three washers are provided for reducing the friction between two strips. The center point of strips is pivoted. The extreme ends of the scissor strip are rested on the lower angular frame and another ends of scissor strip are connected to second scissor strip which is connected to upper angular frame.

The two ends of strips are rested on lower angular frame one end is pivoted and other end is movable. The pivoted end is connected to lower angular frame with the help of nut and bolts joint. Two washers are provided to reduce the friction between scissor strips and lower

angular frame. Three washers are used at connection of two scissor strips.

The thickness of scissor strip is 6 mm and 20 mm in width. The length of the scissor strip is 560 mm. The 6 mm drills are provided at two ends of strip and center of strip for riveted joint.

4) Upper Angular Frame

The upper frame is made up of angle; therefore it is called as angular frame. Angle is cut by abrasive wheel cutting machine at 45 degree in inner edge of angle. Angles are connected to each-other by electric arc welding on its 45 degree edge. To form the angular frame corner joint and edge joint of welding are used.

The horizontal slots are provided on vertical edge of upper angular frame.

Slots are provided for guiding the movement of scissor end of stool or strips end is rested in this slots. The slots are provided only on two angles which are opposite to each-other parallel to lower angular frame.

There are four drills provided at center of horizontal edge of upper angular frame for mounting wooden platform.

The length of slot is 160 mm but only 120 mm length of slot is useful for guiding the movement of strip. The diameter of slot produced is 8 mm. The rivet of diameter 6 mm is slide in that slot.

The upper angular frame has dimensions 530 mm in length and 500 mm in width i.e. 530 mm X 500 mm. The size of angle is 25 mm in width and 3 mm in thickness i.e. 25 mm X 25 mm X 3 mm.

5) Top Wooden Platform

The top wooden platform is rectangular in shape. It is placed on the upper angular frame mounted with the help of screw. Sun mica is staked on the wooden platform with the help of fevicol.

The dimensions of wooden platform are 575 mm in length, 550 mm in width and the thickness is 15 mm.

6) Turn Buckle Joint

Two scissor mechanisms are connected by turn buckle joint. In turn buckle joint there two metal strips are welded on two opposite edges of nut. The bolt is screwed to nut through hole of scissor mechanism. Two washers are used between turn buckle end, scissor strip and bolt head to reduce the friction and wear and tear of parts.

The total length of turn buckle joint is 460 mm i.e. the distance between two scissor mechanisms. The distance between two metal strips is 10 mm.

D. Working of Adjustatble Height Stool

Working of adjustable stool is similar to working of scissor mechanism. In the scissor mechanism, the

change in height is achieved by change in distance between extreme ends of scissor.

For achieving change in height of the stool by adjusting of extreme ends of scissor strips toward each-other.

- Base is use to support the lower scissor and sustain the load of applied load as well as load of adjustable height stool.
- The working of lower angular frame is adjusting the height of stool with the help of inclined slots. We can adjust the height at desired level by resting one extreme ends of scissor strips in the incline slots.
- There are four incline slots on the lower angular frame to adjust the height at desired level in four steps.
- When one end of strip moves toward the pivoted end strip of the height of scissor mechanism will automatically increases.
- One end of upper scissor mechanism is sliding in horizontal slots of upper angular frame. It moves toward the pivoted end.
- The top wooden platform is used for sitting, standing, doing work such as removing fans, tube lights, bulbs etc.
- The top wooden platform is also used for keeping some things on its surface.
- The working of turn buckle joint is to balance or support the scissor mechanisms and maintain fixed distance between them.

IV. DESIGN

A. Design of Adjustable Height Stool

1) Design of Upper Angular Frame

The size upper angular frame is 500mm X 530mm and the size of angle is 25mm X 25mmX3mm.

- ∴ b = width of angle = 25mm
- ∴ t = thickness of angle = 3mm
- ∴ d = diameter of horizontal slot = 8mm
- ∴ l = length of horizontal slot = 160mm
- ∴ Useful length of slot = 120mm

$$\sigma_t \text{ For M.S.} = 60 \text{ N/mm}^2$$

$$\tau \text{ For M.S.} = 47 \text{ N/mm}^2$$

$$\sigma_c \text{ For M.S.} = 112 \text{ N/mm}^2$$

$$P = \text{applied load} = 50 \text{ kg} \\ = 50 \times 9.81 \text{ N}$$

$$= 490.3 \text{ N}$$

$$P = \text{load on one side} = P / 2 \\ = 490.3 / 2$$

$$= 245.25 \text{ N}$$

a) Failure of Upper Angular Frame in Tension at Slot

$$\therefore \sigma_t = \frac{P}{t(b-d)} \\ \therefore \sigma_t = \frac{245.25}{3(25-8)} \\ \therefore \sigma_t = 4.80 \text{ N/mm}^2$$

As calculated tensile stress is less than given tensile stress of material, i.e. calculated < given.

b) Failure of Upper Angular Frame in Double Shear at Slot

$$\therefore \tau = \frac{P}{2t\left(\frac{b-d}{2}\right)} \\ \therefore \tau = \frac{245.25}{2 * 3\left(\frac{25-8}{2}\right)} \\ \therefore \tau = 4.80 \text{ N/mm}^2$$

As calculated tensile stress is less than given tensile stress of material, i.e. calculated < given.

2) Design of Lower Angular Frame

The size upper angular frame is 500mm X 500mm and the size of angle is 40mm X 40mmX6mm.

- ∴ b = width of angle = 40mm
- ∴ t = thickness of angle = 6mm
- ∴ d = diameter of inclined slot = 8mm
- ∴ l = length inclined slot from end of angle = 20mm

a) Failure of Lower Angular Frame in Tension at Inclined Slot

$$\therefore \sigma_t = \frac{P}{t(b-l)} \\ \therefore \sigma_t = \frac{245.25}{6(40-20)} \\ \therefore \sigma_t = 2.043 \text{ N/mm}^2$$

As calculated tensile stress is less than given tensile stress of material, i.e. calculated < given.

3) Design of Scissor Strips

The size of scissor strip is 18mm X 4mm.

- ∴ b = width of angle = 18mm
- ∴ t = thickness of angle = 4mm
- ∴ d = diameter of hole = 6mm

a) Failure of Strip in Tension at Hole

$$\therefore \sigma_t = \frac{P}{t(b-d)}$$

$$\therefore \sigma_t = \frac{245.25}{4(18-6)}$$

$$\therefore \sigma_t = 5.10 \text{ N/mm}^2$$

As calculated tensile stress is less than given tensile stress of material, i.e. calculated < given.

b) Failure of Scissor in Double Shear at Hole

$$\therefore \tau = \frac{P}{2t\left(\frac{b-d}{2}\right)}$$

$$\therefore \tau = \frac{245.25}{2 * 4\left(\frac{18-6}{2}\right)}$$

$$\therefore \tau = 5.10 \text{ N/mm}^2$$

As calculated tensile stress is less than given tensile stress of material, i.e. calculated < given.

4) Design of Rivet

d = diameter of rivet = 6mm

a) Failure of Rivet in Double Shear at Hole

$$\therefore \tau = \frac{P}{2\left(\frac{\pi}{4}d^2\right)}$$

$$\therefore \tau = \frac{245.25}{2\left\{\frac{\pi}{4}(6)^2\right\}}$$

$$\therefore \tau = 4.33 \text{ N/mm}^2$$

As calculated tensile stress is less than given tensile stress of material, i.e. calculated < given.

b) Failure of Rivet in Crushing

$$\therefore \sigma_c = \frac{P}{\pi d}$$

$$\therefore \sigma_c = \frac{245.25}{\pi * 6}$$

$$\therefore \sigma_c = 13.011 \text{ N/mm}^2$$

As calculated crushing stress is less than given crushing stress of material, i.e. calculated < given.

V. ADVANTAGES, DISADVANTAGES & APPLICATIONS

A. Advantages

The advantages of adjustable height stool are

- Stool can be adjusted at desired height.
- It is simple in construction.
- It is manually operated.

- It is easily foldable.
- Its maintenance is less.
- Its manufacturing cost is less.

B. Disadvantages

The disadvantages of adjustable height stool are

- Its weight is more.
- More space is required.
- Used for limited weight.
- It is difficult to handle.

C. Applications

There are many applications of adjustable height stool:-

- It can also used for sitting purpose.
- For changing the ceiling fans, tube lights, bulbs etc.
- Used as material handling equipment also.
- Applications of conventional stool also perform.
- Used for work of desired height.

VI. CONCLUSION & FUTURE MODIFICATION

As this is multi-purpose stool use it has many scopes in domestic, offices, workshops, collages, hotels, hospitals etc.

Contemporary Chrome Plated Backless Stool with Adjustable Lift - If you are planning to modernize the look of your kitchen area, then the addition of this kind of counter stool is the best way to do that. A chrome plated backless stool will surely add a contemporary flair to your kitchen space. Meanwhile, its adjustable lift allows it to be adjusted in varying heights, from the typical counter height to the standard bar stool height.

Today's fleet of adjustable stools feature hydraulics that easily move a person up or down an inch or two or all the way to the top or bottom. You add real versatility when you introduce adjustable height stools into your home.

Other modifications of adjustable height stool are:-

- We can replace scissor strips by pipe for increasing strength as well as load carrying capacity.
- We can use Hydraulic or Pneumatic system for decreasing human efforts.
- We can make it compact so it required less space.

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