

# Design and Fabrication of Pro-Fit Tricycle

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**Abstract**— Fitness has become a major area of concern in today's fast paced society. Health related problems can be solved to a great extent by having good fitness methods. Some of the best fitness equipment are mostly available in fitness centers or health clubs. Space restrictions and high expense make it difficult to install such devices in households. This project aims to build a design and fabricate a tricycle which can also be used as a fitness equipment, called 'Profit Tricycle'. It generates drive by pressing the pedals downwards rather than pedalling. By this project, a compact product serving multiple functions of cycling and fitness exercise will be attempted. At the time of workout, the resistance to push the pedals downwards will be greater and hence time effective intense cardio workout can be obtained. The main objective of project is to design a multi purpose fitness equipment consuming less space. After fabrication, the aim is to commercialise the product into market targeting urban population.

**Keywords**— Fitness; Tricycle; Fabrication; Design

## I. INTRODUCTION

Lack of time is one of the major problems for most of the people that hinder them to go to gymnasium or fitness centres. In order to setup a mini gym in home, it may be space consuming and it is also costly. In order to solve this problem to an extent, a low cost multipurpose fitness equipment is required. It is essential to develop a concept in which various body workouts can be performed on single equipment which requires less space. This project is a tricycle in which all body workouts can be performed which is called 'PRO-FIT TRICYCLE'. As it is a tricycle cum fitness equipment, it is portable, therefore can be used multi functionally for workouts and transportation. Space utilisation is one of the major aims while doing this project. Also, this project incorporates many exercises in one single product.

## II. BACKGROUND STUDY

This project deals with an equipment which can be used to perform all body workouts. These include: lower body workouts, upper body workouts, cardio workouts, etc. The idea is simple: to have simple, effective workout techniques and equipments properly designed and incorporated into a basic design of a tricycle[1]. Finally the following devices were selected based on their compactness and efficiency: mini stepper (for basic lower body and cardio workouts), abs roll and waist rotating disc (for strengthening the core

muscles), bench and barbell( to perform basic upper body workouts). [2]

### A. Study On Fitness Devices:

- The Mini Stepper



Fig.1 Mini Stepper

Mini stepper (Fig 1) is a fitness device which is provided to improve physical fitness and give a workout to the cardiovascular system by increasing the aerobic capacity. With a step, a person uses both his muscles and cardiovascular system. Over the course of several sessions, both breathing and coordination of a person will improve. It not only helps a person to lose weight and get a cardio workout, but it also shapes and firms up the lower limbs. To use it, simply stand on the small steps as if walking up stairs. Using a mini stepper provides similar benefits to walking, but a key benefit of using the machine is convenience; using the machine for a thorough indoor workout.

The benefit of using a mini stepper is the simple idea to get the legs moving. Human legs contain the largest muscle groups, particularly in the thighs. To get these working, various methods like cycling, elliptical training or running can be preferred and in doing so, the heart and lungs will have to work to push blood there.

In turn this improves the cardiovascular health, and burns calories, which can lead to great health benefits such as weight loss and a feeling of wellbeing after the workout. The mini stepper achieves this by producing a very simple rhythmic step.

*Comparison between walking and mini stepper:*

*Walking:* The calories which can expect to burn during a cardio exercise such as walking vary according to the speed at which a person walks the length of the walk and his/her weight. If a person weighs 175 pounds and walk at a speed of 3 miles per hour for 90 minutes, he/she will burn approximately 519 calories. If the person is able to maintain

a pace of 4 miles per hour, it'll burn 614 calories in the same amount of time.

*Mini Stepper:* Using a mini stepper is comparable to walking, given that with the machine, the person is essentially walking on the spot. The chief difference is that the person can adjust the stepper to increase its resistance, which helps burning calories at a faster rate than walking. A 175-pound person who uses a stepper for 90 minutes will burn 834 calories, which makes this type of workout slightly more beneficial than walking.

- *Waist Rotating Disc*

A waist rotating disc or twist board is a round platform on which a person stands and performs exercises while twisting from side to side. A twist board works core muscles involved in maintaining balance. The workout intensity can be made from simple to tuff as the person grows accustomed to the equipment.

Human body's core provides stability and strength for all other movement. A strong core helps the person excel in athletic pursuits while decreasing chances of injury. The spine, hips, abdomen and pelvis make up the core. Exercising on this equipment can help strengthen muscles in these areas by engaging the muscles to help a person balance, even when performing exercises to focus on other specific areas of the body. When a person stands on an unstable surface it engages muscles throughout the core to help the person maintain his/her balance. Even if the person is performing other exercises while on the twist board, the core muscles remain engaged.

The calories burned using a twist board would come under the category used for general abdominal training and is based on the size of the muscles you are using and based on the time spent activating them. The following figures gives the calories burned on workouts on rotating disc and gives some guidance and are based on someone using ideal technique:

Table I Calories burnt for workout in waist rotating disc

Minutes	Calories burnt
1	9
5	45
10	89
20	178
30	267
40	356

- *Abs Roll*

An abs roll is a small sturdy wheel with a rod traversing the centre that serves as the handles. Building a stable core helps in all physical activities . It is effective in strengthening the core not only because it targets abs but also because it works the muscles of lower back. A person needs strong back muscles to counteract the natural arching of his/her back that occurs as the person rolls forward on the wheel.

Fifteen minutes might pass slowly when a person is working through abs exercises such as crunches, but the workout won't burn enough calories to significantly contribute to weight loss. Health Status notes that a 165-pound person burns just 84 calories in 15 minutes of moderate-intensity sit-ups or crunches and 151 calories in 15 minutes of vigorous-intensity sit-ups or crunches. Although a person might incorporate other abs exercises in his/her workout, the caloric burn of such strength-training exercises is comparably low.

Losing weight requires a dedication to cardiovascular exercises, as this form of workout yields a significant calorie burn. It'll burn less than 200 calories performing abs crunches for 15 minutes, but the caloric burn is higher while performing cardio. A 165-pound person burns 198 calories bicycling around 15 mph for 15 minutes and 215 calories running at 7 mph for 15 minutes. Most notably, these forms of exercise are possible to sustain for a longer duration than abs exercises.

- *Barbell*

The benefits to using barbell exercises when working out are plentiful. First of all, barbell exercises require few and relatively inexpensive equipments. Unlike gym exercise for which a person needs special equipments for each exercise, he/she can perform most barbell exercises using a simple barbell, a set of weights and a workout bench. This also means that since barbell exercises take little room to perform, they can be performed anywhere; be it at home, at the gym, wherever. Additionally, barbell exercises are very good at exercising stabilizing muscles on top of the main muscle groups. This feature is helpful in making sure little muscles are not left behind are allowed to keep up with bigger ones.

- *Bench*

The bench press is widely known as a "chest" exercise, however, that's definitely not all it is. The bench uses shoulders, triceps, forearms, and pretty much every muscle in a person's upper body. However, the bench press doesn't just use the upper body. When a person bench properly, he/she uses the lower back, hips, and legs as well. Just like other main lifts , the bench press, while putting an emphasis on specific muscle groups, is a full body movement. While benching, the rest of the body is not just lying there doing nothing. The shoulders are pinched together, stabilizing the entire body to create a solid base and help the person generate drive from the round.

### III. THEORY

#### A. Design Parameters

Major design parameters which were taken into consideration were: Overall length and width of the product, Ergonomics, Length and motion of the pedals and transmission to the wheels and Analysis of frame. Overall length and width were decided based on the comfortable pedalling position and handling position by an average adult of height 5 feet and weight 60kg. The pedals are provided in a shoulder width apart as it is the basic walking position that people adopt. Length of the pedals was calculated theoretically by taking Grashof's condition which is explained below.

**B. Study Of Four Bar Mechanism**

A four-bar linkage consists of four bodies, called bars or links, connected in a loop by four joints. Generally, the joints are configured so the links move in parallel planes, and the assembly is called a planar four-bar linkage.

• **Grashof condition**

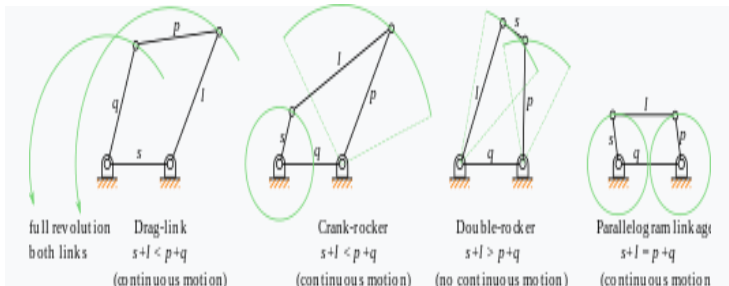
The Grashof condition for a four-bar linkage states: If the sum of the shortest and longest link of a planar quadrilateral linkage is less than or equal to the sum of the remaining two links, then the shortest link can rotate fully with respect to a neighboring link. In other words, the condition is satisfied if  $S+L \leq P+Q$  where  $S$  is the shortest link,  $L$  is the longest, and  $P$  and  $Q$  are the other links.

• **Planar quadrilateral linkage**

Planar quadrilateral linkage, RRRR or 4R linkages have four rotating joints. One link of the chain is usually fixed, and is called the ground link, fixed link, or the frame. The two links connected to the frame are called the grounded links and are generally the input and output links of the system, sometimes called the input link and output link. The last link is the floating link, which is also called a coupler because it connects an input to the output.

Assuming the frame is horizontal there are four possibilities for the input and output links and is shown in Fig 2.

- A crank: can rotate a full 360 degrees
- A rocker: can rotate through a limited range of angles which does not include 0° or 180°
- A 0-rocker: can rotate through a limited range of angles which includes 0° but not 180°
- A π-rocker: can rotate through a limited range of angles which includes 180° but not 0



Types of four-bar linkages,  $s$  = shortest link,  $l$  = longest link.

Fig.2 Examples of the various cases for a planar quadrilateral linkage

The configuration of a quadrilateral linkage may be classified into three types: convex, concave, and crossing. In the convex and concave cases no two links cross over each other. In the crossing linkage two links cross over each other. In the convex case all four internal angles are less than 180 degrees, and in the concave configuration one internal angle is greater than 180 degrees. There exists a simple geometrical relationship between the lengths of the two diagonals of the quadrilateral. For convex and crossing linkages, the length of one diagonal increases if and only if the other decreases. On the other hand, for non convex non-crossing linkages, the opposite is the case; one diagonal increases if and only if the other also increases.

**C. Design of four bar mechanisms**

The synthesis, or design, of four bar mechanisms is important when aiming to produce a desired output motion for a specific input motion. In order to minimize cost and maximize efficiency, a designer will choose the simplest mechanism possible to accomplish the desired motion. When selecting a mechanism type to be designed, link lengths must be determined by a process called dimensional synthesis. Dimensional synthesis involves an iterate-and-analyze methodology which in certain circumstances can be an inefficient process; however, in unique scenarios, exact and detailed procedures to design an accurate mechanism may not exist.

**IV. DESIGN AND COMPONENTS**

**A. Design**

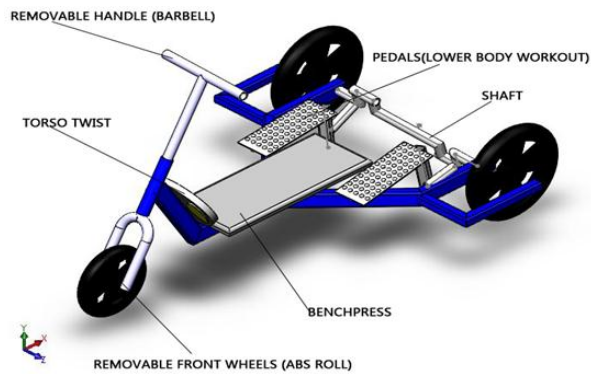


Fig.3 Proposed model

As shown in Fig.3, the design is very minimalistic so as to provide easiness in fabrication of the project. Basically, two rear and a front wheel is connected by rectangular cross sectional GI frame. Freewheel is connected to the back wheels to produce unidirectional movement of the wheel. The drive is given by a 4 link mechanism. Pedal is connected to main frame through hinges which gives oscillatory motion to the pedal. The cycle contains a mini stepper, waist rotating disc, abs roll, barbell and a bench press. For storage purposes, the handle can be folded to make the equipment more compact.

**B. Main Components**

The main components of this project are:

- **Main frame:** The main frame used in tricycle is of GI pipe. GI is chosen as it is cost effective, have high radius of gyration which improves concentric strength, torsional rigidity, better lateral stability and is light weight.
- **Adjustable handle:** For the maximum space utilization, the handle can be folded. The handle can be detached from the tricycle by adjusting the tightening bolt.
- **4 link drive mechanism:** For the movement of the tricycle, the input pedaling motion should be converted into rotation of the wheels. A four bar link is used for this purpose. The input oscillatory motion is converted into circular motion of the crank.

- **Waist rotating disc:** A disc which is fixed on a surface in which upper portion of disc can be rotated by standing on the disc. With the help of a supporting system (adjustable handle), it can be used as a twist board.

- **Removable front wheel (abs roll):** The front wheel is connected to the fork through the shaft. The shaft connected to the fork through adjusting screws. By removing these, the front wheel can be removed and can be used as abs roll.

- **Bench:** A mini bench is included in the tricycle. It can be raised and fixed to a particular position using nut and bolts.

- **Stand:** The stand is used for doing workout under steady positions. When performing workouts on tricycle, it may move the tricycle which reduces the stability of workout. To avoid this problem, a nut is connected to bearings at rear side in which the bolt act as stand.

Detailed view on each of these major components is done in the next chapter.

**C. Other Components**

- **Freewheel**



Fig.4 Free wheel

A freewheel or overrunning clutch is a device used in a transmission that disengages the driveshaft from the driven shaft when the driven shaft rotates faster than the driveshaft. The freewheel is shown in Fig 4. The condition of a driven shaft spinning faster than its driveshaft exists in most bicycles when the rider holds his or her feet still, no longer pushing the pedals. In a fixed-gear bicycle, without a freewheel, the rear wheel would drive the pedals around. This is included in the tricycle for the very same reason, i.e. to keep the pedals still even while the tricycle moves forward.

- **Ball bearings**



Fig.5 Ball bearing

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The simplest form of bearing, the plain bearing, consists of a shaft rotating in a hole. A ball bearing is shown in Fig 5.

In bicycle applications, there are neither high speeds nor high loads. The smaller contact stresses would result in

longer service life of the bearing even if water and contaminants penetrate the bearing.

A basic designation typically contains three to five digits. Some products, like cylindrical roller bearings, can have a combination of alphanumeric characters. The number and letter combinations have the following meaning:

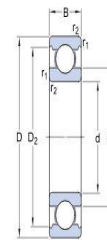
The first digit or letter or combination of letters identifies the bearing type and eventually a basic variant.

The following digits identify the ISO dimension series. The first digit indicates the width or height series (dimensions B, T or H). The second digit identifies the diameter series (dimension D). The last two digits of the basic designation identify the size code of the bearing bore. The size code multiplied by 5 gives the bore diameter (d) in mm.

Eg: 6202, 6204 bearings.

**6202 Bearing:**

Dimensions



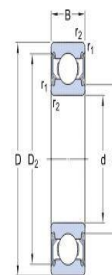
d	15	mm
D	35	mm
B	11	mm
d <sub>1</sub>	≈ 21.7	mm
D <sub>2</sub>	≈ 30.35	mm
r <sub>1,2</sub>	min. 0.6	mm

Fig.6 Dimensions of 6202 bearing

It is a ball bearing with outer diameter 35mm and inner diameter 15mm. It is used in front wheels which in this project can be used as an abs roll. A shaft of diameter 15 mm is used as the handle for abs roll. Detailed dimensions are shown in Fig 6.

**6204 Bearing:**

Dimensions



d	20	mm
D	47	mm
B	14	mm
d <sub>2</sub>	≈ 26.05	mm
D <sub>2</sub>	≈ 40.59	mm
r <sub>1,2</sub>	min. 1	mm

Fig.7 Dimensions of 6204 Bearing

It is a bearing with outer diameter 47mm and inner diameter 20 mm. There are two bearings used for each rear wheel. The input pedaling force is transmitted to the rear wheels through these bearings. Detailed dimensions are shown in Fig 7.

- **Fork**

A bicycle fork is the part of a bicycle that holds the front wheel. A fork typically consists of two blades which are joined at the top by a fork crown. Above the crown, a steerer tube attaches the fork to the bicycle and the handlebars (via a stem) allowing the user to steer the bicycle. The steerer tube of the fork interfaces with the frame via bearings called a headset mounted in the head tube. At the bottom of the



fork, dropouts hold the wheel. Usually, either the axle is bolted to the fork, or a skewer passes through a hollow axle, clamping the axle to the fork.

• Brake system

This project uses common bicycle shoe brakes. A bicycle brake reduces the speed of a bicycle or prevents it from moving. Most bicycle brake systems consist of three main components: a mechanism for the rider to apply the brakes, such as brake levers or pedals; a mechanism for transmitting that signal, such as Bowden cables, hydraulic hoses, rods and the brake mechanism itself, a caliper or drum, to press two or more surfaces together in order to convert, via friction, kinetic energy of the bike and rider into thermal energy to be dissipated.[3]

Table.II List of materials

SL. NO.	NAME OF THE PARTS	MATERIAL	QUANTITY
1	Frame	G I	Required
2	Freewheel	C I	2
3	Bearing	Steel	4
4	Fork	C.I	1
5	Wheels	Rubber tyre +Rim	3
6	Waist rotating disc	Plastic	1
7	Weights	C I	2
8	Resistance band	Rubber	1
9	Hinges	C I	2

V. FABRICATION



Fig.8 Fabricated model

A. Frame

This is the basic frame of the tricycle which is shown in Fig 9. It is made of GI rectangle section and welded to form the required dimensions. The design was analyzed to take static load of a 70kg person. The frame from the handle branches at appoint to the two rear wheels. Rear wheels are fixed on the space between two frames on rear side which helps to minimize the weight concentration on one side of wheel during riding, i.e. it provides the uniform weight distribution on two sides of the wheel. Static load analysis on frame is carried out which is shown in Fig 10.

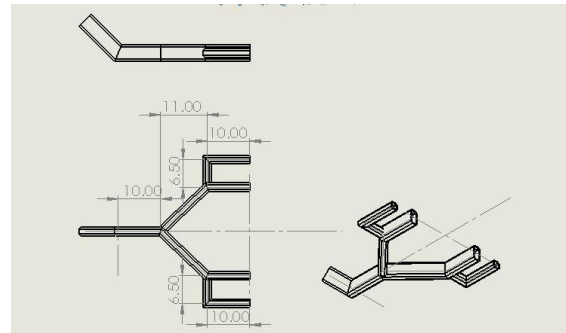


Fig.9 Main Frame (All dimensions are in inches)

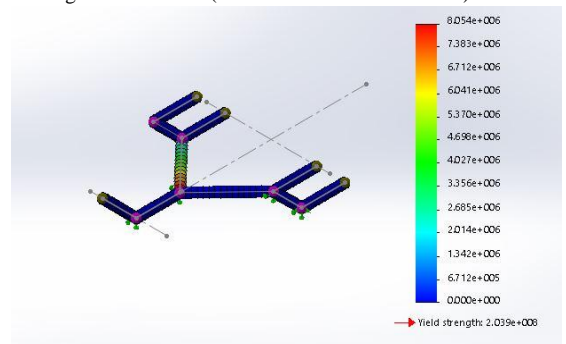


Fig.10 Static load analysis of frame

B. Fork

The frame was fabricated according to the proposed design. Then an already existing bicycle fork was taken and modified. The fork lower end is slightly bended for the proper fixing of the front wheel shaft after it is detached. The handle frame connected to the fork can be folded thus providing compactness to the whole equipment.

C. Housings

• Bearing housing

When bearings used, the outer ring of bearing is tight fitted to the bearing housing and inner ring rotates. For connecting the front and rear tyres to the frame, the bearing housings were made to accommodate the bearings and freewheel. These housings are mounted to the frame and their dimension varies according to the bearings and flywheel used. Since loads are produced during rotation of shafts these bearing housings should be strong enough to take the loads on bearings. These were fabricated by turning a solid cylindrical mild steel work piece in lathe.

• 6202 Bearing housing

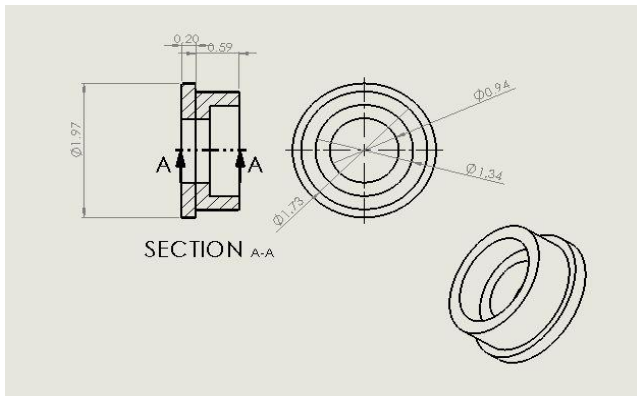


Fig.11 Bearing housing for 6202 bearing(dimension in inches)

The outer diameter of 6202 bearing was 35mm therefore the inner diameter of the housing also had to be same so that the bearing makes a tight fit with the housing. The hole diameter of the housing is 24mm so that the shaft which holds the purpose of handle in abs roll can be fixed. So this housing which is shown in Fig 11 is placed at front wheel.

• 6204 bearing housing

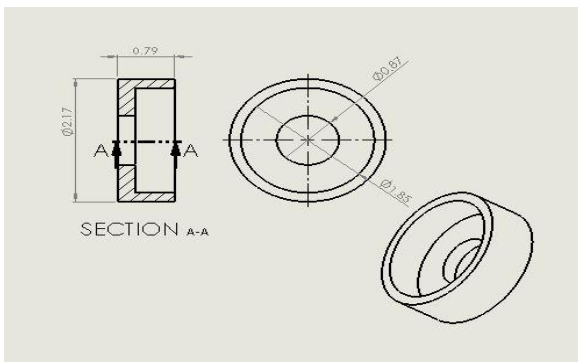


Fig.12 Bearing housing for 6204 bearing(dimensions in inches)

The outer diameter of the 6204 bearing is 47mm; therefore the inner diameter of housing was also 47mm so that the bearing is a tight fix on it. The hole diameter was 22mm so that the drive shaft passes through it. Separate housings are provided for each rear wheel which is shown in Fig 12.

• Freewheel housing

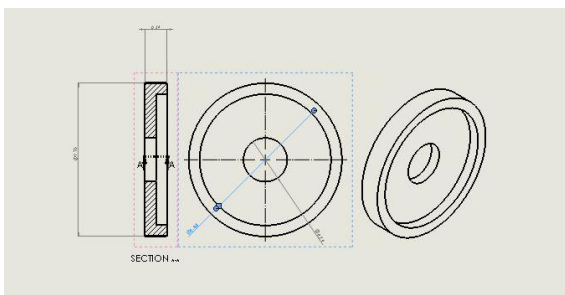


Fig.13 Housing for freewheel (dimension in inches)

Since it is not a chain drive, the rear wheels cannot be fixed to body like in normal cycles. The inner portion or threaded part of freewheel is connected to the hub of rear

wheels and the outer ring of freewheel is tight fitted in the housing (Fig 13) which is mounted to the frame.

D. Abs Roll

In profit tricycle, the front wheel serves the purpose of abs roll as it is easily detachable. A 15 mm diameter shaft is used for the purpose of handle in abs roll. There are two keys on either side of the fork which holds the wheel in proper position during riding. By removing the two keys the front wheels can be transformed into abs roll. In abs roll, the wheel should be rolling, but the handle is stationary. Hence, a ball bearing (6202) is used and it is placed in the hub of the wheel. After the workout, it can be fixed back to the fork using the keys.

E. Pedalling

Unlike other bicycles or tricycles, PRO-FIT tricycle is not a chain drive. Basically a four bar mechanism is adopted for pedalling. The two rear wheels are connected by a single shaft which is similar to crankshaft. The length of the pedal and connecting rods were found out by using line diagrams in CatiaV5 by keeping the distance between wheels and pedal hinge and the crank constant.

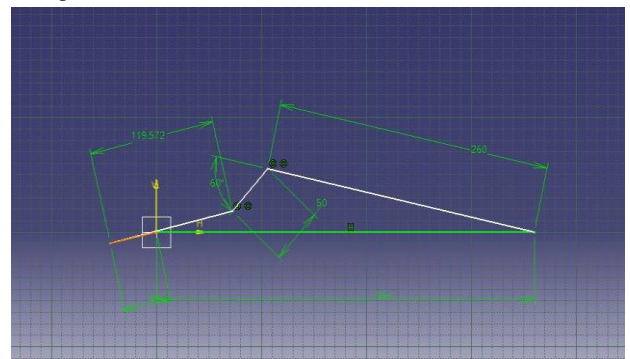
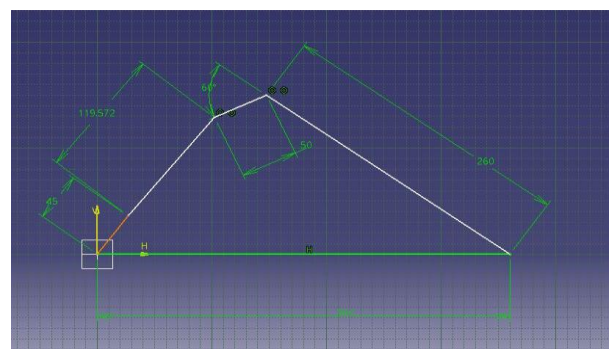


Fig.14 Extreme positions of the pedals by line diagrams in catia:(a)



(b)

The crankshaft as shown in Fig 15 and the four link including the pedals were fabricated and the length were adjusted to get the desired motion as the theoretical values (Fig 14) were slightly different from the actual value. The angle offset of both the wheels were fixed by using trial and error method, which would give continuous rotational motion of wheels. While pressing one pedal, the other pedal undergoes return motion because the links of two pedals are connected to the same shaft at an offset angle less than 180°. Complete 180° offset will cause locking or interrupted motion.

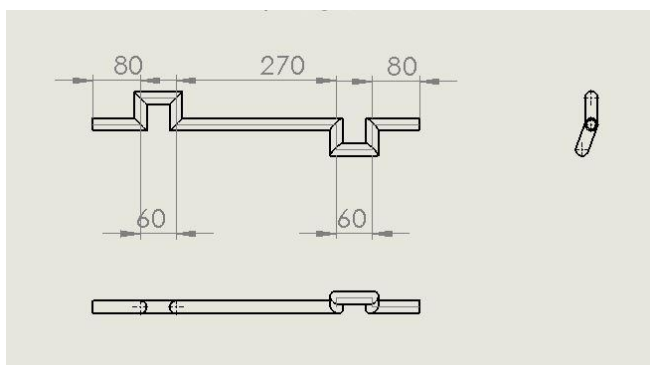


Fig.15 Drive shaft (dimensions are in mm)

The alternative design or a modification of a mini stepper is included in the tricycle. It provides lower body workouts. It uses the pedal for workout. Two rectangular flat plates are hinged on the frame which is connected to the rear shaft using links. As in mini stepper, the pedal undergoes oscillatory motion. The rear shaft is adjusted in such a way that, when a force act on one pedal, the other pedal undergoes return motion. The handle of tricycle acts as the supporting member when the workout is performed. When the pedaling action performed, the rear wheels rotates. It will cause difficulty to perform workout at stationary condition. In order to solve these problems, a supporting system is introduced in the tricycle. For that a 0.75 inch nut and bolt is used for stationary workouts. The nut is welded at the rear side of the frame and the bolt can be lowered or raised. When stationary workout is required as in mini stepper, the bolt is lowered and a flat plate is welded at the bottom of the bolt. It provides as supporting legs at two ends and the rear wheels raised and there were no contact with the surface. Thus the pedaling action can be performed at required braking effort. After the workout, the bolt can be raised until the rear wheels come in contact with the surface.

#### F. Handle

Barbells are normally used for upper body workouts. In order to make a compact design, the components used in the tricycle should be minimum. So the handle of the tricycle serves the function of barbell. When the handle become detachable in nature, normally breaking system cannot be adopted in this tricycle. To solve this problem, the breaking is applied to only rear wheels. A thin sheet of metal part is welded to the adjuster provided on the vertical member. The braking system is fixed to these part. The handle of the tricycle is a hollow circular member which can be removed by loosening the adjuster provided on the vertical member. Two weight blocks are placed on the shaft of front wheel on each side of the fork. This also helps the whole system to balance the weight when the force to apply pedaling is given in the back half of the tricycle.

#### G. Adjustable brake

One of the features of this tricycle is the braking effect can be adjusted according to the users need. In normal bicycle or tricycle, it is difficult to change the braking effect. But in mini stepper, the resistance for workouts can be adjusted according to users need. In order to accommodate these in tricycle, adjustable braking mechanism is introduced.



Fig.16 Adjustable brake

The adjustable braking mechanism is shown in Fig 16. The brake cable from the handle is connected to one of the brake bolts which is welded to another bolt at a particular angle. After this process, a thin sheet metal is taken and two small holes are drilled on top and bottom surface. This is because of two brake cables are required for separate rear wheels. In the same sheet metal, a centre hole is produced which is larger than the top and bottom holes. Its dimension is same as the previously welded bolt in which it enters through the central hole. From the two holes at top and bottom, two cables are connected to the rear wheel. By adjusting the nut, the small metal plate moves to one side and thus the brake cables connected to the rear wheels are also tightened.

#### H. Waist Rotating Disc

Another attachment provided in the tricycle was waist rotating disc. Since it is an all body workout tricycle, the attachments or equipments needed for the whole body workout should be incorporated in the tricycle. So the design should be made compact and also it can be used for riding purpose without removing any components. It is basically a circular disc which acquires space for a person to stand on it. In order for the compact nature and for the proper riding, the disc can be folded. For that, a rectangular plate is bolted to the bottom of the disc. These rectangular plate hinged to the main frame (bottom of inclined frame). Whenever the abdomen workout is required, the disc can adjusted to horizontal position and the workout can be performed using handle as the supporting member

#### I. Bench

Incorporating a actual bench press to the tricycle is quite difficult since its dimensions are not compactable with tricycle. To solve these problem, a mini bench press is included which can be folded. Only sitting exercise can be performed on this bench press due to space constrains. A rectangular frame is welded with dimensions 16\*8 inch. A same sized metal plate is attached on it for providing seating purpose. It is then bolted to the main frame using long metal pieces on either side (larger sides) of rectangular plate. To avoid the forward movement of the bench, a rectangular metal piece is connected to rectangular plate (shorter rear side) bolted to a rectangular metal piece which is bended and bolted to the main frame.

#### J. Resistance Cable

Resistance cable is used for upper body workouts. It is actually a cable with a holding attachment on either ends of the cable. Because of its light weight nature, it can be folded on handle. The workout can be performed by pulling the



cable against stationary member. Since it is hard to pull, required workouts can be performed. By changing the orientation of workouts, more than 10 workouts can be performed on resistance cable.

## VI. ADVANTAGES AND DISADVANTAGES

### A. Advantages

Pro-fit tricycle:

- gives more value for money and time  
It saves money which spend in fitness centres or to buy costly fitness equipments. Also this tricycle saves time for travelling to gym.
- can be used multi-functionally.  
Used for both riding purpose and for workout purpose whenever required.
- is less space consuming makes it more compact.  
Simplified design make its more compact in nature. Foldable handle also helps for more space consumption.

### B. Disadvantages

- It is difficult to ride on steep surface. The front wheel is comparatively small when compared with rear wheels, so it is difficult to ride on steep surfaces. Mechanical moving links causes more difficulty in working and to repair than chain drive. Since it is not chain drive, movement of links cause cause difficulty in movement which affects smooth running.
- Initial cost of this arrangement is high. For the initial manufacturing, cost is high due to many trial and error methods.

## VII. FUTURE SCOPE

Future scopes of this project can be a more compact motorized tricycle. The current prototype fails to move up on steep roads. Making it motorized can overcome this problem. More workouts can be incorporated making this project more versatile and value for money. The validation of the current project based on calories burned and health benefits can be done to check its efficiency.

Possible improvements:

- A more compact design and using a stronger yet lighter material.
- Motorised using a rechargeable battery.
- Better ergonomics and provide provision for speed adjustments.
- May include more fitness devices.
- More advanced mechanism may be used for easy transportation.

## VIII. CONCLUSION

In this busy world, most of the people don't get enough time to spend on fitness purpose. In order to overcome these problems to an extent, our project helps the people who don't get time to go to gym centres. Since it is a multi functional tricycle, it can be used for both riding and workouts. Due to its compact design and foldable handle, maximum space utilization can be achieved. All body workouts can be performed on the PRO-FIT TRICYCLE.

It is able to extend this project by using more fitness equipments. Also the riding can be made more simple with proper arrangements. Simplicity in design with minimum cost makes our project more acceptable.

This project mainly concentrates on the various fitness devices that can be incorporated in the tricycle. Also, the material strength was taken into account for withstanding load capacity. A survey was conducted to analyze if there is a scope for marketing this product. However, the pedaling mechanism of the product can be improved using advanced mechanism. By using simpler mechanism the cost of production of the product can be reduced. A material that is lighter in weight and that can withstand high loads is preferred.

## REFERENCES

- [1] A tricycle design for the future. Applied Energy, Volume 6, Issue 2, March-April 1980. Page 151-158.
- [2] Impact of an exercise program on adherence and fitness indicators, Applied Nursing Research, Volume 30, May 2016, pages 184-186.s
- [3] A touchdown bearing with surface waviness: Friction loss analysis, Mechanism and Machine Theory, Volume 110, April 2017, Pages 73-84.