

This document describes the idea of a foldable treadmill which can be easily stored and making it more accessible to the people, which is intended to help them live a healthier life by being able to exercise at the comfort of their home.

COMPACT FOLDABLE TREADMILL

PDM J-Comp.

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INTRODUCTION:

In the age of COVID'19, with the onset of social distancing and lockdowns, people have been restricted to their homes for months at a stretch. This has led to a sedentary lifestyle and a lack of daily exercise. It is proven that running and even walking is one of the most efficient methods of exercise. Unfortunately, most treadmills are very bulky, take up a lot of space, and are very difficult to transport from one place to another. So, we have designed a compact and foldable treadmill which can easily be stored under the bed or inside a cupboard, hence eliminating the problem of space and transportation.

SCOPE: The treadmill is usable for any person, irrespective of gender or age, as long as he/she weighs not more than 100kg.

FEATURES:

- The treadmill makes use of two kind of rollers. The first and the last rollers have been kept slightly larger to create a clearance space and for better traction and to help with the folding
- The treadmill is built up of three different section.
- The first section consists of the handle, rollers, bearings and the frame
- The second section is made up of only two rollers which make it possible for the treadmill to be able to fold
- The third section also consists of the same components as the first section but without the handle.

OBJECTIVE: To enable people to stay fit and healthy right at their homes, with having to worry about storing a bulky treadmill which takes up a lot a space and needs electrical energy to function by substituting it with a more compact and non-electrical means to help people exercise.

DESCRIPTION:

- **When in use: -**
 - Length: 1.28 m
 - Width: 0.59 m
 - Height: 0.72 m
 - Weight: NA

➤ **When folded: -**

- Length: 0.71948 m
- Width: 0.59 m
- Height: 0.16868 m
- Weight: NA

The treadmill has two revolute joints in the middle of the base, about which it folds by acting as a hinge or anchor point for it to be able to rotate, thus reducing the effective length by almost half. The handle-bars will fold around the body of the folded treadmill, thus the end result being a treadmill looking analogous to a cuboid.

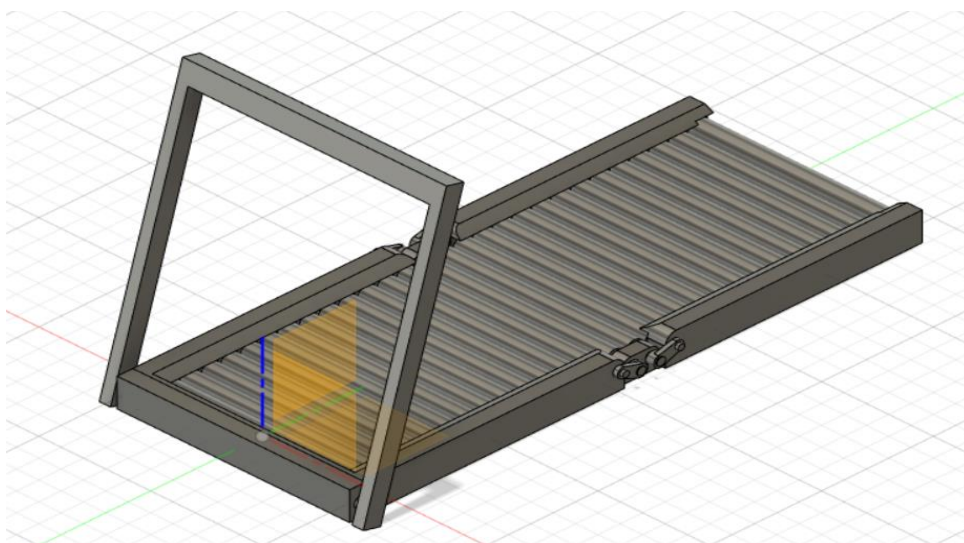
This variant of the treadmill is a manual one, i.e., there is no electric motor. The treadmill is solely driven by the person standing on its, making use of friction. To reduce the effort needed for it to rotate ball bearings have been installed at the end of each roller which help it to rotate. Also, the treadmill is set a little slope to help to make it easier for people to walk on it as a component of their weight will act along the surface of slope which makes it easier to walk on it. Unlike the standard treadmill used in markets and gyms this treadmill function on rollers rather than slipping between the treadmill conveyer and the metal sheet used which further makes it more usable.

It has 28 rollers, with a conveyer (with a rubber inner lining) belt running over them.

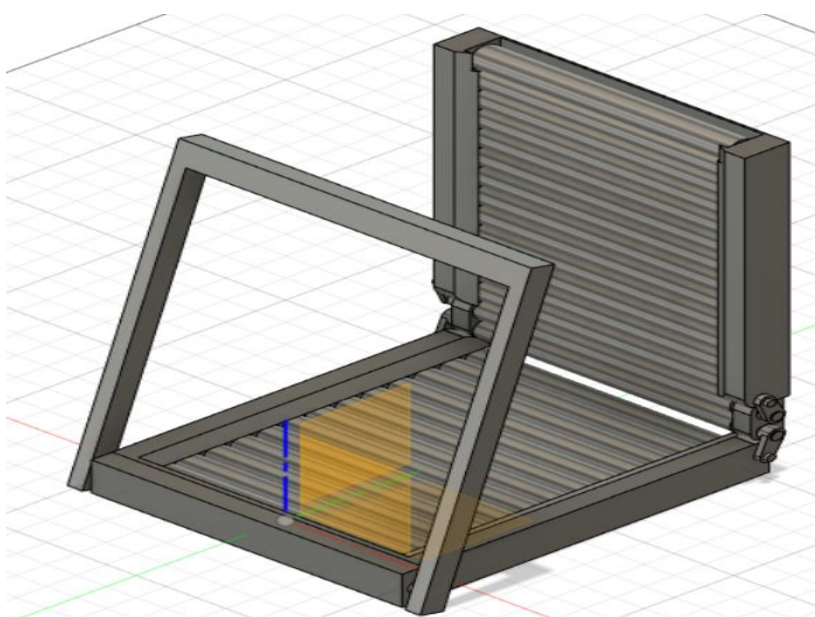
COMPONENTS:

Component	Quantity
Mainframe	1
Roller $\phi 40$	26
Roller $\phi 50$	2
Bearings	28
Handlebar	1
Conveyor belt	1

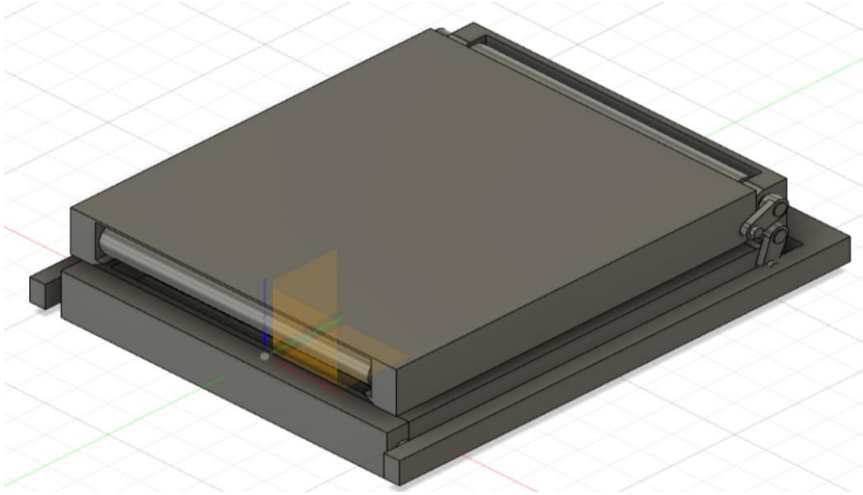
PHOTOS:



Fully unfolded



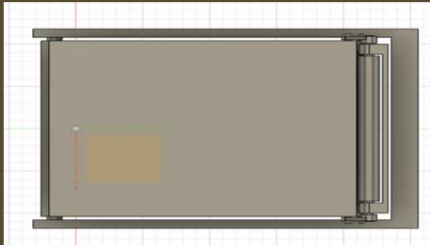
Partially folded



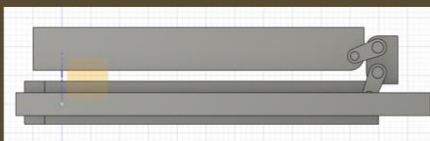
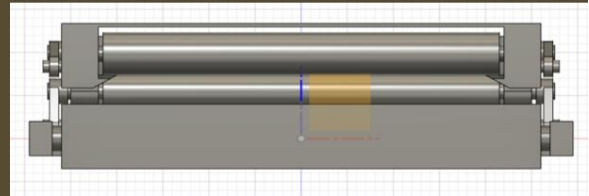
Fully folded

Treadmill After Folding

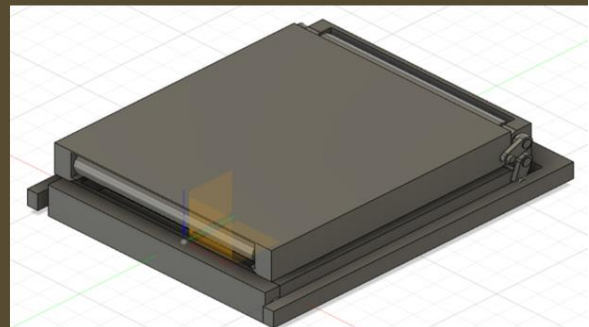
Top View
(Dimension-720x590 mm)

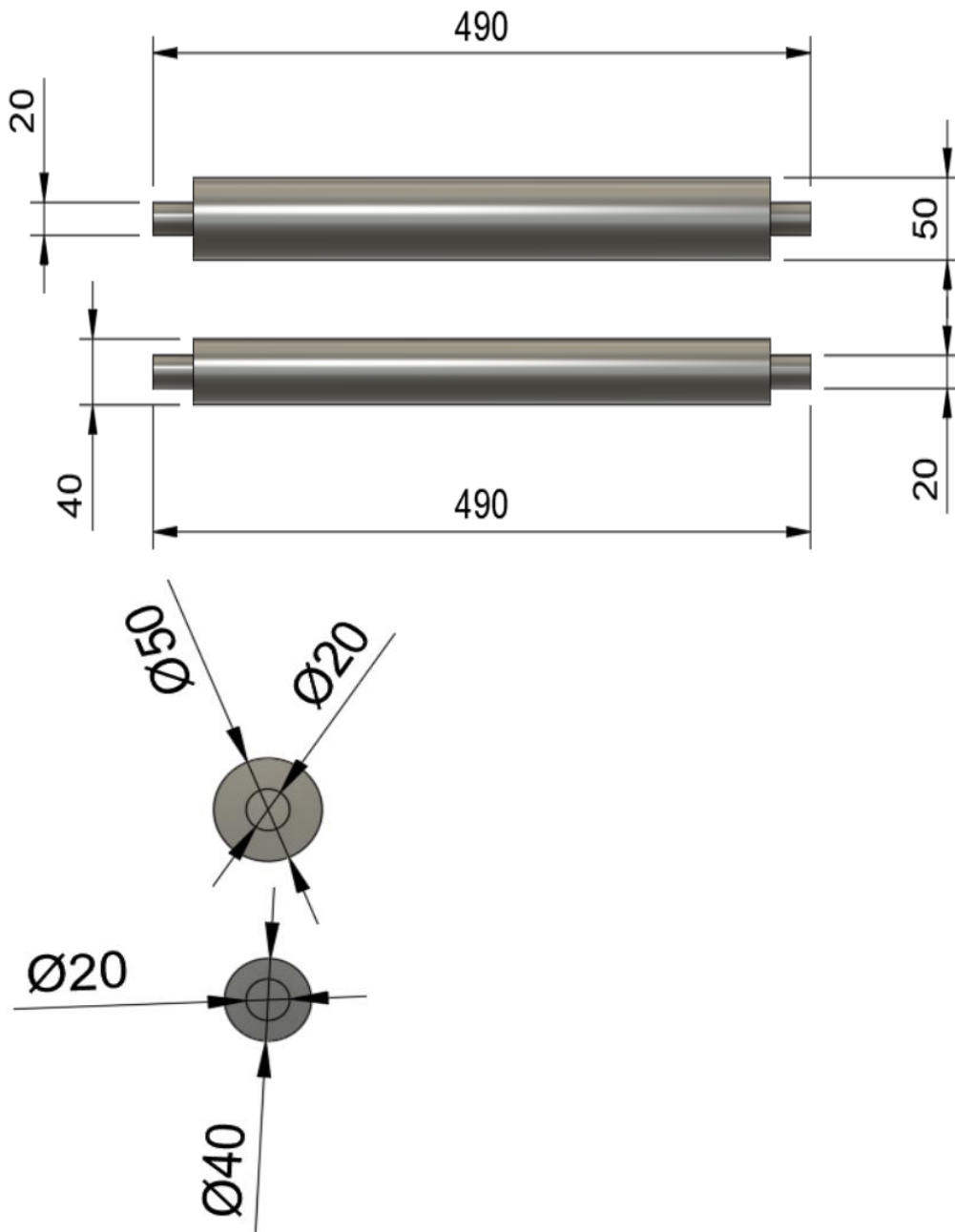


Front View
(Dimension-170x590 mm)

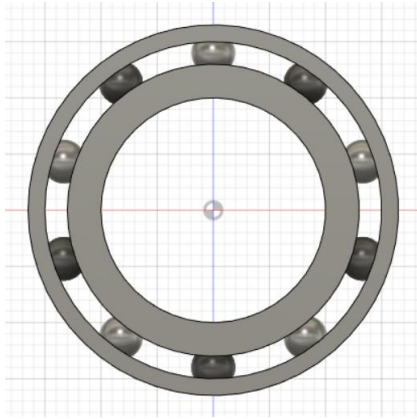


Right View
(Dimensions-169x720 mm)

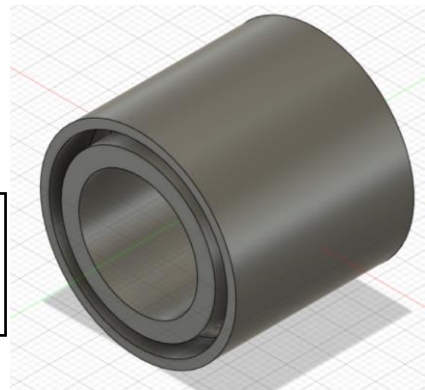




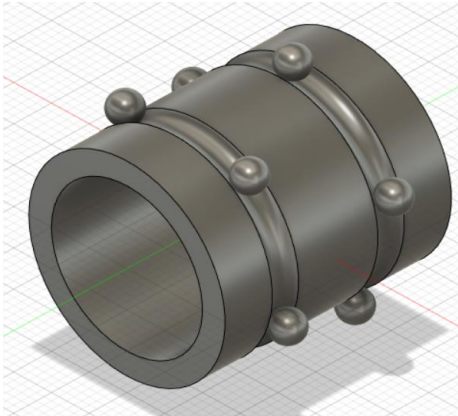
Rollers



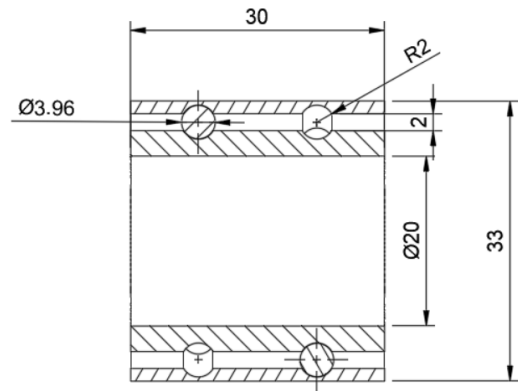
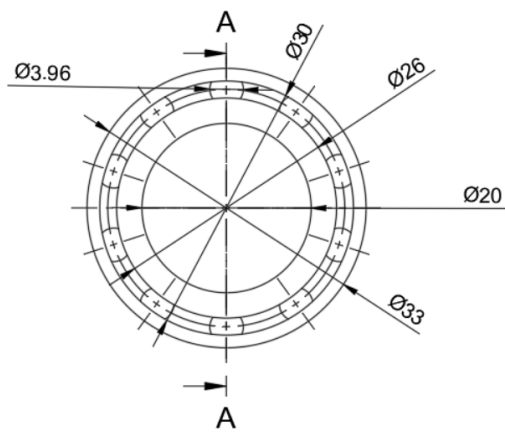
The overall shape
of the bearing and
their look from the front



The isometric view
of the ball bearing

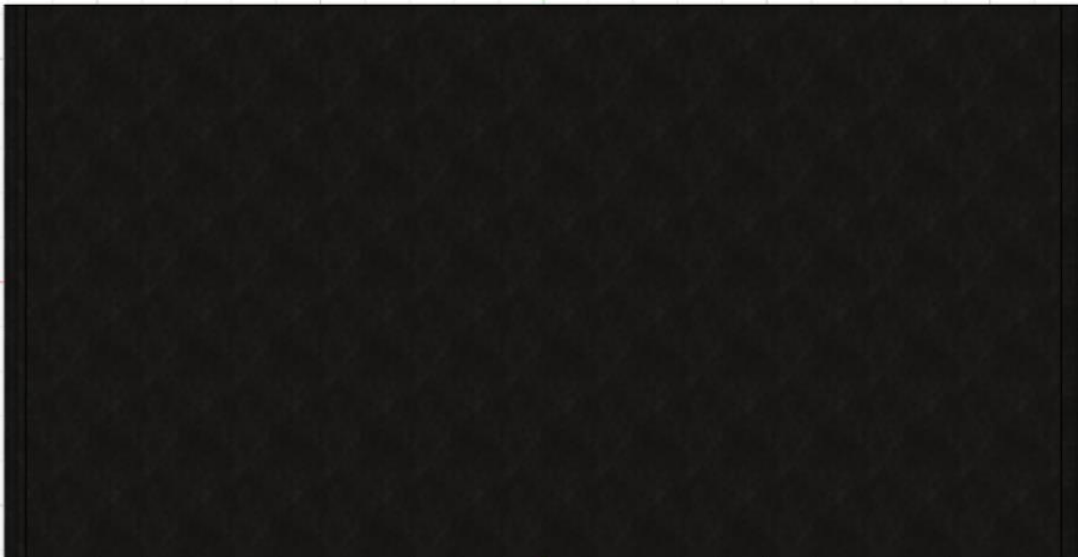


View without the
outer shell



A-A (2:1)

Ball bearings

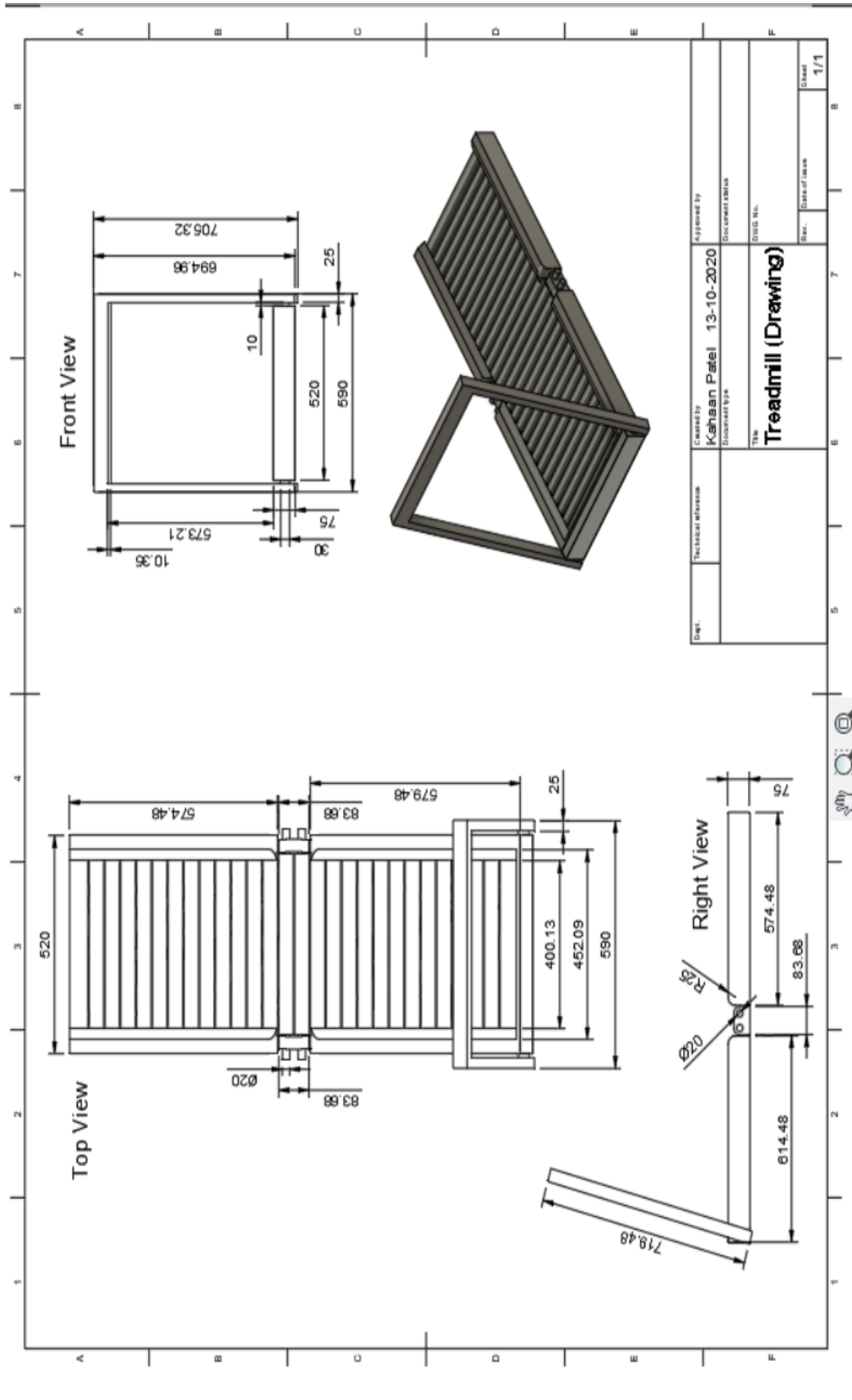


Made of rubber on the inner side for extra friction and preventing any slipping between the rollers in contact.

As, we are using roller here we do not need to have any worry about the amount of force needed to walk on the treadmill. Since the bearings will reduce the friction to a minimum making it easier to walk on the treadmill

(Dimensions- 1210x690x3 mm)

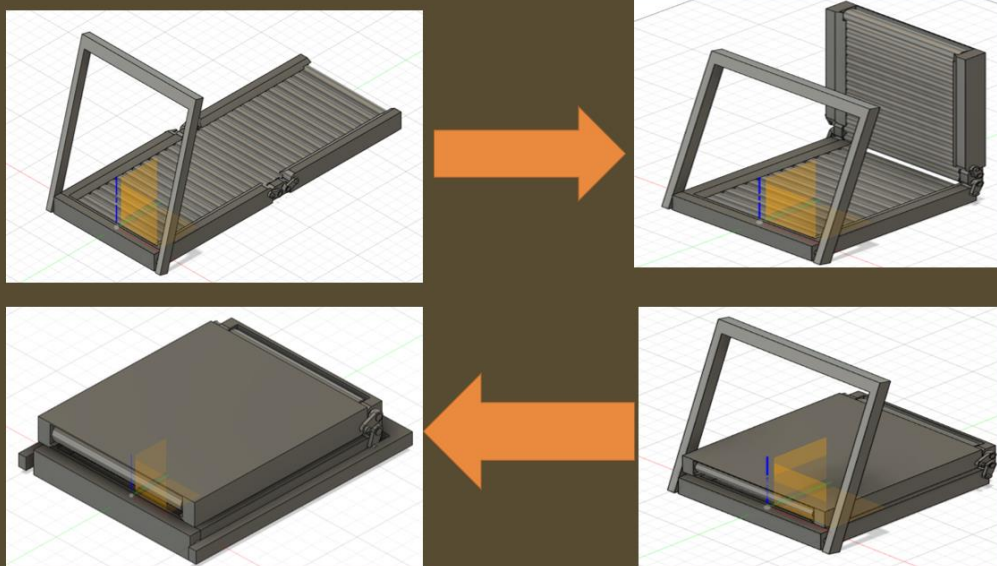
Conveyor belt



HOW DOES THE TREADMILL FOLD?

- The treadmill fold over it section using a mechanism of couplers.
- As, for the conveyer it will have no problem. Due to the triangle inequality theorem being that the sum of two sides of a triangle is always greater than the third.
- Also, since the 1st and the last roller in the treadmill given are larger than the rest of the roller it will help to provide clearance when it tries to fold and it tight when being used.
- The advantage of the folding is that it almost brings the length pf the treadmill to half of its original length making it easier for storage.

Procedure of Folding



CALCULATIONS:

- Calculated the applied Impulse Load as,

$$F_R = \frac{dp}{dt} + mg = \frac{120 * 8 * 5}{18 * 1} + 120 * 9.81$$

$$F = 1440 \text{ N}$$

- Calculated the Failure Load using Bending Moment Equation as,

$$\frac{M}{I} = \frac{\sigma}{y}$$

$$M = \frac{\sigma_{yt}}{y} * I = \frac{215 \text{ MPa}}{20 \text{ mm}} * \frac{\pi}{64} * 40 \text{ mm}^4 = 1350.884 \text{ Nm}$$

Since the Roller can be compared to a Simply Supported Beam, Max BM is,

$$\frac{wl}{4} = 1350.884 \rightarrow w = 9005.899 \text{ N}$$

- $FOS = \frac{9005.899}{1440} = 6.25$
- The Impact Time required for the Roller to fail is

$$F_R = \frac{120 * 8 * 5}{18 * t} + 120 * 9.81 \rightarrow t = 0.03 \text{ s}$$

Which is too small when you are considering walking. Hence, the Rollers won't fail.

- The Treadmill is a manual one aimed at walking, with an inclination of 15° to facilitate easy movement.

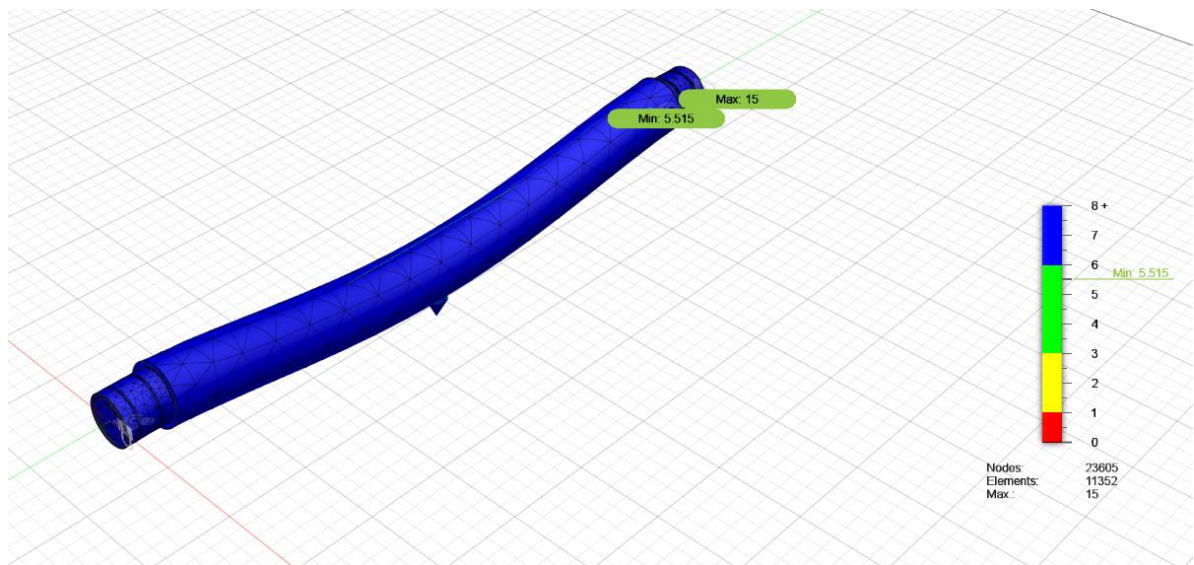
Assuming sliding friction, and $\mu = 0.6$ for rubber-plastic interface, the angle of repose is,

$$\alpha = \text{atan}(0.6) = 30^\circ$$

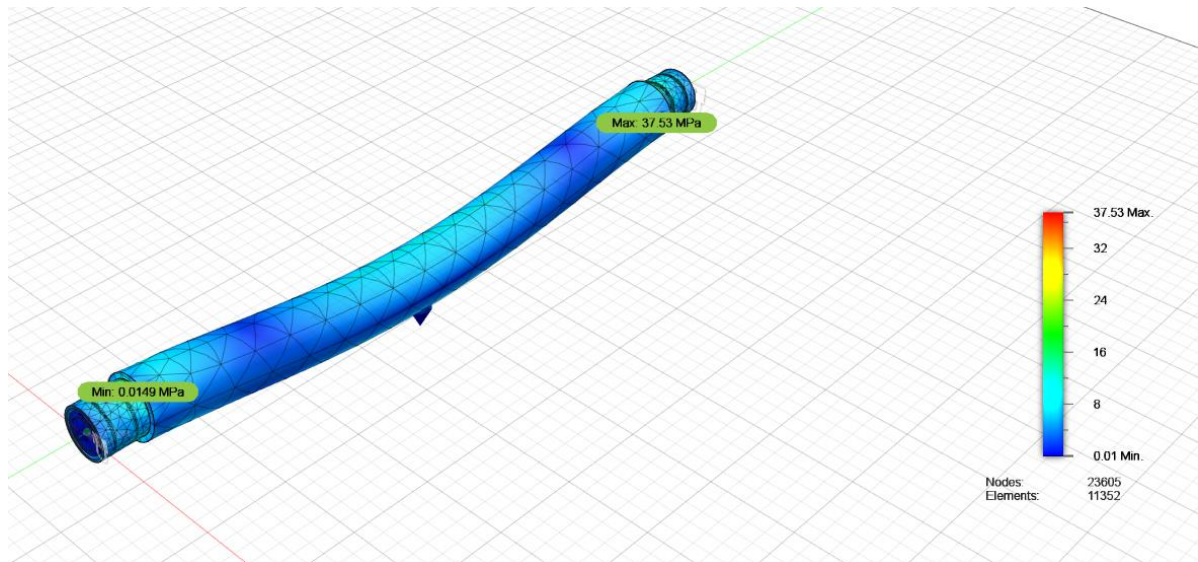
SIMULATION STUDY:

- We created a static stress study on a single roller (with two bearings) with a force of 2000N (approx. the weight of a 200kg person), and still got a Factor of Safety greater than 5.

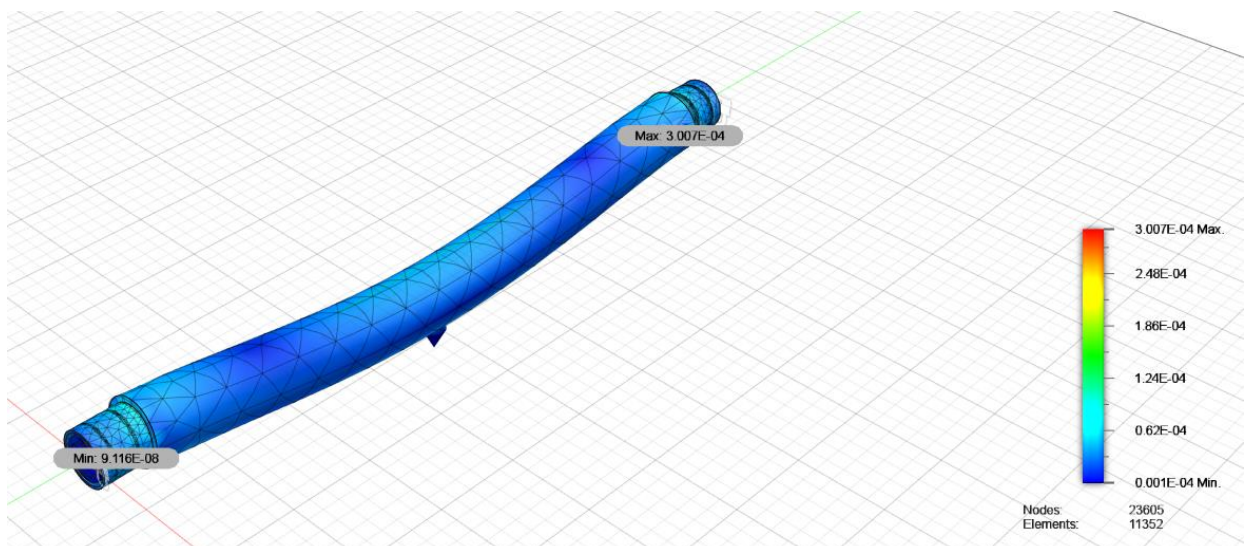
Factor of Safety



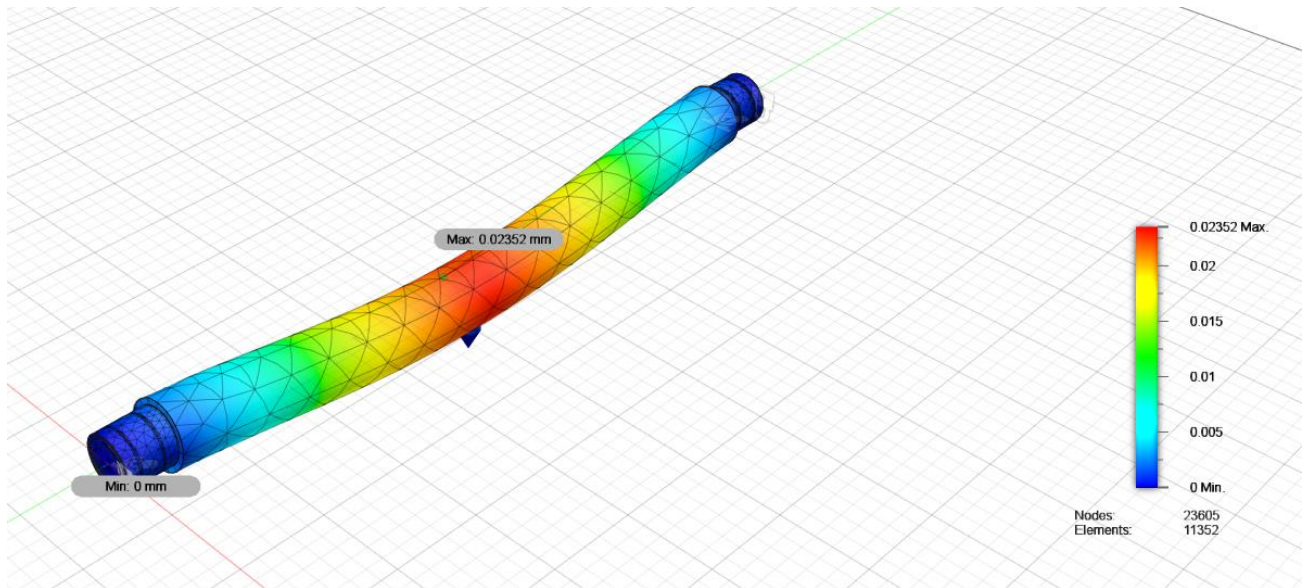
Stress



Strain



Displacement



- We created a static stress study on the entire treadmill with a force of 1000N (approx. the weight of a 100kg person), and still got a Factor of Safety greater than 5.

TARGET AUDIENCE: Anyone (not exceeding 100kg) who wants to stay fit and healthy at home, either because they don't have access to gyms or because of convenience. Also, who don't have enough space to store treadmill but can afford it. Which makes our product a perfect choice for them as this a highly portable and compact treadmill, making it very easy to be stored.

PRACTICES TO BE FOLLOWED FOR IMPLEMENTATION/RECOMMENDED BEST PRACTICES:

- Suitable for walking, brisk walking and slow jogging.
- NOT suitable for running and sprinting.
- Max. weight limit not to exceed 100kg.
- Use only when fully unfolded.
- Do not try to used spiked shoes while using it.
- Place it on a hard surface.

RESULT: The Treadmill can withstand a load of 120kg, with a Factor of Safety of 6.

ACKNOWLEDGEMENT: We would like to express our special thanks to our faculty Dr. Seenuvasaperumal P for giving us this golden opportunity to do this project, as well as provide us with valuable guidance and feedback which helped us in completing this project.