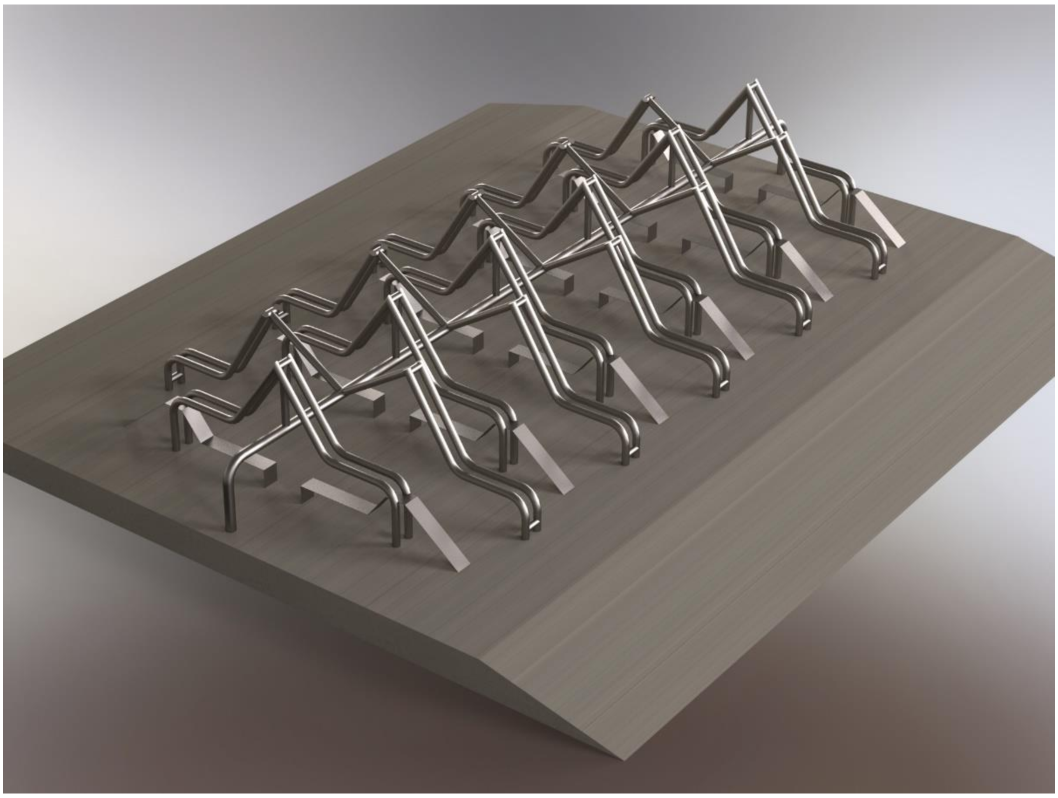
COMPACT CYCLE STAND

CAMPUS DEVELOPMENT PROJECT

REPORT



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ABSTRACT

In NITT, cycles are the **major mode of transportation** of the students, staff and faculty. This ensures that the campus promotes a greener way of life. However, the same cycles are a **cause of disorder** in majority of the hostels due to the lack of a proper system in place **to park** them. Most of the cycles are **arranged very haphazardly** leading to **wastage of space** and at the same time, **lack of space to take out the cycles and walk around**. Our solution is a model that can overcome these issues and make the cycle sheds and hostels look organized. There are **vertical quadrilaterals** into which the cycles can be placed. These stands come with **a ramp** that can ensure **easy placement** and **removal of cycles** into and out of the stand. The model is a versatile one that can **accommodate** majority of the **different types of cycles** available in the Indian markets. It was designed based on the measurements taken from Garnet hostel in campus. The CAD design was done using **Solidworks**.

KEYWORDS

- Cycles
- Stand
- Vertical Quadrilateral
- Ramp
- Versatile

CONTENTS

INTRODUCTION

Parking of cycles in an orderly fashion is very important and necessary. Solving this problem can help the college students save time. When it comes to cycles, there are various kinds. Some cycles have a **disc break** attached to the **front wheel**. **Handle bars** of some of them tend to **extrude upwards**, while **some handle bars are horizontal**. So, a **minimum space of 40 centimeters** is required for **one cycle** to be comfortably and neatly parked. Cycle stands in the hostels do not have any structure ensuring the proper horizontal distance. The cycles are thus, **haphazardly parked** and can **fall** one by one leading to a dominoes effect. Cycles falling can cause damage to the back wheel or front handle. The amount of time required to carefully take one cycle out or keep it in, ensuring other cycles do not fall is high and with classes in mind, such time is a waste. Current cycle stands present in other colleges have a semicircular structure which accommodates the front wheel. The following types of cycles are in mostly found in our campus.

Has a disk brake

EXISTING PROBLEMS IN GARNET HOSTEL

A research was conducted on the existing problems with the arrangement of cycles at Garnet hostel. The following problems were found:

The cycles were **not spaced evenly**, which made it **difficult to walk** through to **take a cycle**. This meant that several cycles couldn't fit within the shed due to inefficient usage of space. This usually leads to cycle theft and makes the cycles vulnerable to damage.

Most of the cycles were seen **lying on the ground**. This is because the of the unavailability of support systems for the cycles. Even a slight push or hit can make an entire line of cycles fall, one on top of the other. This means that the cycles must be taken for repairs and servicing often leading to property damage and lose of money of the owners. It also **reduces the lifetime of the cycles by months or even a year** due to frequent damages incurred.

Another issue faced by the cycle owners is that they must **move at least 3 or 4 cycles in order to take out their cycles**. This is particularly a menace in the mornings, when most of the students are in a hurry to reach their classes.

Once again, during this process of hurriedly moving the other cycles and taking out one's own, there's a **great chance that the adjacent cycles may fall down**.

Above all, the chaotic arrangement of cycles **does not contribute to an aesthetic environment**. This provides people with a negative impact on the institution and campus, that is meant to produce graduates who can create a better environment and positive development.

The following pictures show the haphazard arrangement of cycles in Garnet Hostel. As we can see, the cycles are arranged quite haphazardly, because of which **most of them lie on the ground**, or **stand in a random fashion**, making **access difficult**.

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EXISTING SOLUTIONS

Many colleges have come up with different solutions to accommodate cycles in their campus. Some of them are as shown below:

Design 1

These designs are based on a semicircle into which the cycle wheels can fit in.

These models lack in the following aspects

- Cycles which have a **disc brake cannot be fitted** in into these structures.
- There is **no support structure in the back**, in the case of a vertical semicircle.
- The **handle bars of adjacent cycles collide** over one another.
- The **number of cycles** that can fit in a **module is less**.

Design 2

Though the given arrangement addresses the issue of haphazard arrangement and provides an aesthetic appeal. However, it has the following disadvantages:

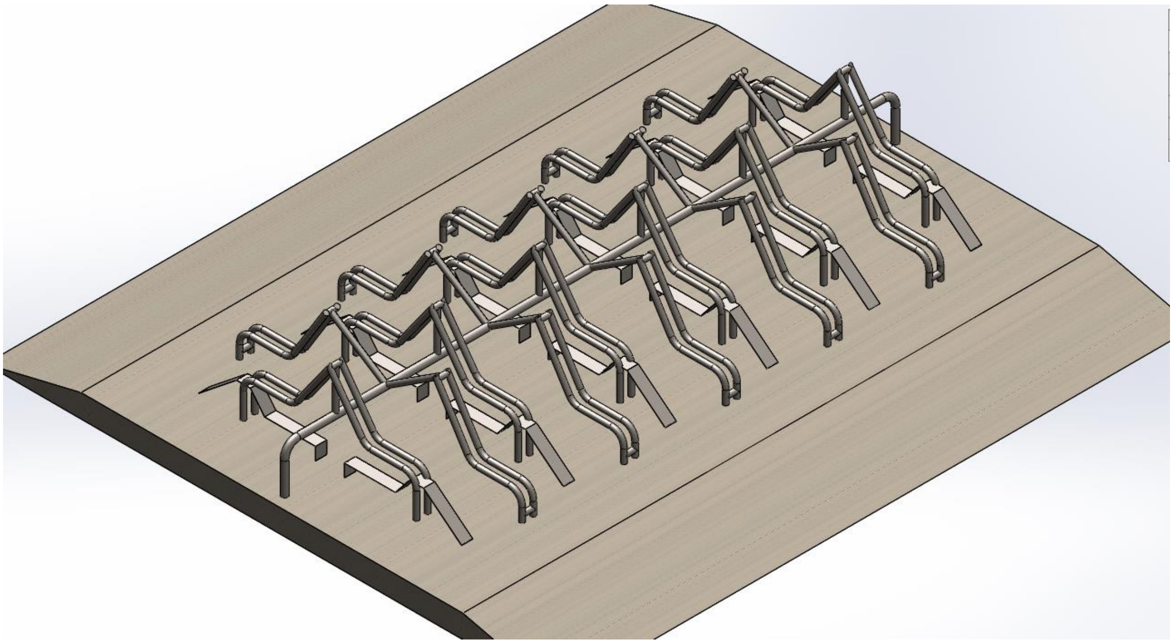
- The **support** provided to the cycle is **very less** and there's a high chance that the cycles may **fall down**.
- Cycles can only be **parked on one side of the stand** leading to **inefficient usage of space**.
- **Handlebars of adjacent cycles may collide.**

Design 3

The given **design is bulky** and can **accommodate** cycles only on a **single side** leading to **inefficient space usage**. Also, the type of cycles that can be parked will depend on the wheel size as large vehicles will not fit inside the given gap. The given support is also **difficult to manufacture** as it's a **single rod with several curves**. The **thick diameter** of the rod adds to the **difficulty.**

OUR DESIGN

Our design was made after taking into consideration all the problems faced with the existing models and the various types of cycles found in NIT Trichy. Our design is a **trapezium like structure, with ramps for the cycle to rest on**. **Two adjacent cycle stands have different lengths**, thus making the design look like a **zig-zag line from the top**. On **both sides** of the **central resting rod**, there are trapezium shaped structures, ensuring **more cycles** are parked **within one module**. Looking at the design three basic questions arise.



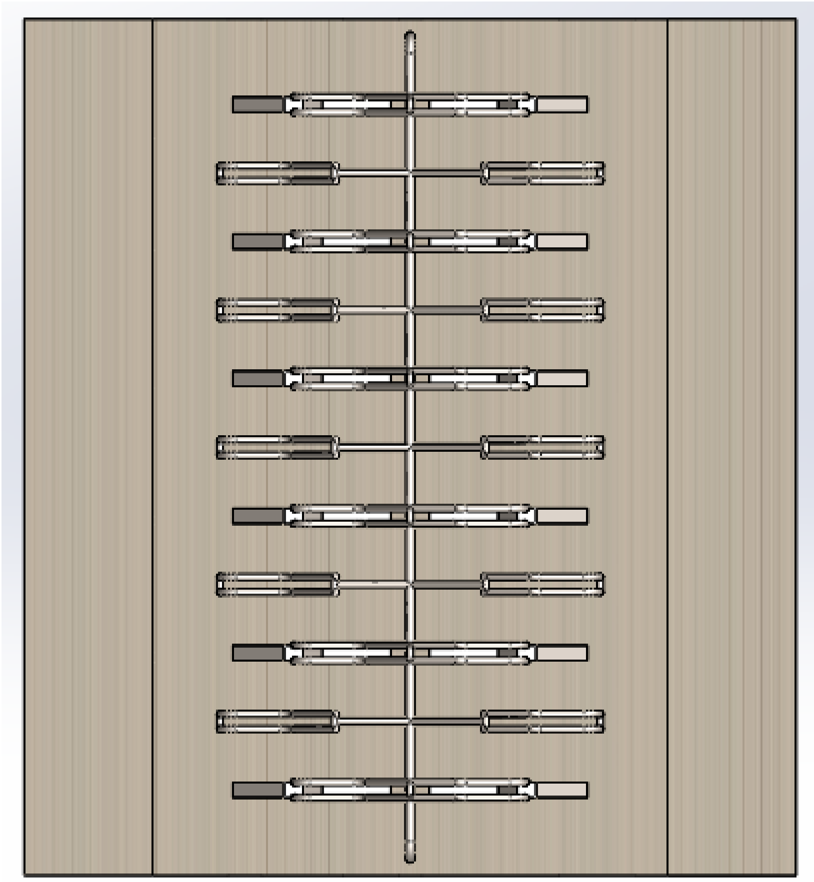
How can it accommodate all kinds of cycles?

All cycle stands designs consist of basically **two hollow metal pipes between** which the **front wheel** is placed to provide **support** such that the cycle will **not fall** due to a push, or the wind unbalancing it. What most **existing designs don't account** for is the **varied width of the tire and wheel**, along with whether a **disc brake exists on the front wheel**. Our trapezium shaped cycle stand has specifically been **optimized to accommodate** a wheel with a **brake disc** while **not sacrificing** the primary purpose of **balancing** the cycle about the support **through its front wheel**. It also **considers varied tire widths**, with the **distance between the two trapezium pipes is 5.5 cm**, which is sufficient to **fit the front wheels** of all cycles in campus comfortably. For those with much smaller widths, such as the Photon or Mach City, there is no issue of imbalance, since the stand has a **sufficient minimum height of 20 cm** from where the wheel rests, which **won't allow** any cycle **wheel to fall out**. Also, the cycle will **not roll back** since there is a **stopper of height 17 cm** to support from behind.

How it overcomes the problem of adjacent handle bars making contact?

Most cycle stands have the issue of docking cycles efficiently, since the handlebars of cycles from end to end is about 50-60 cm and that demands a lot of horizontal space, to prevent their overlap and contact with adjacent cycles when docked. Our design's unique selling proposition is that it successfully overcomes this problem without sacrificing the primary purpose of cycle stands, and without compromising convenience of the user when docking their cycle. Our stand is such that the **cycles are kept in a zig-zag fashion**, with the **adjacent cycles' handlebars not in the same line**.

This allows us to **reduce the space between adjacent cycles** and over multiple segments of stands, it **significantly improves the efficiency of cycle docking**. The trapezium stands are simply placed such that **adjacent cycle stands have a 40 cm offset** between one another to **prevent consecutive cycles' handles from colliding**.



What happens when the handle bars extrude vertically?

Some cycles have handlebars which curve upwards at their ends, much like racing cycles. The situation was analyzed, and it was found that the **maximum height of the curved portion was 15 cm**. Subsequently, a **stopper of height 19 cm** was designed for the **inner stand** such that as the cycle goes over the stand at the maximum height of 19 cm, its **handlebars will cross over those of the outer cycles adjacent** to it, even if they had vertically extruded handle bars. The height was decided to be 19 cm to **provide a further allowance of 4 cm** beyond the height of the curved portion, to **prevent any mishap** if cycles of more extreme dimensions may be introduced into this system at a time after the installation is complete.

THOUGHT FLOW OF THE PROJECT

MONTH	THOUGHT PROCESS
May 2018	Researched about the problem statement. Analyzed the cycle sheds and lanes in the campus and realized that the extent of the problem is serious and a solution must be sought.
June – July 2018	Carefully studied the existing products that address the same issue and compiled the list of advantages and disadvantages of each.
August 2018	Collected data on the various models of cycles in campus. Determined the average size of wheels, height of the cycles, size of handles, and other necessary dimensions.
Sept 2018	Several designs were drafted and their effectiveness on different models of cycles were discussed. Finally, a quadrilateral-type design was found to be the most convenient and effective.
October 2018	It was realized that certain cycles had disc brakes and some had extruded handles. As a result, it was decided to have two different cycle stands in a diagonal manner along with trapezoidal bases to avoid these issues.
November 2018	A solution was devised for two different kinds of cycle stands placed adjacent to each other and a prototype was manufactured for testing.
January 2019	The flaws in our design were diagnosed and it was concluded that the amount of material used was more than required and some space management was possible.
February 2019	Model was redesigned, final solution was arrived at and manufactured it for the need of the campus.

CALCULATIONS AND DIMENSIONS

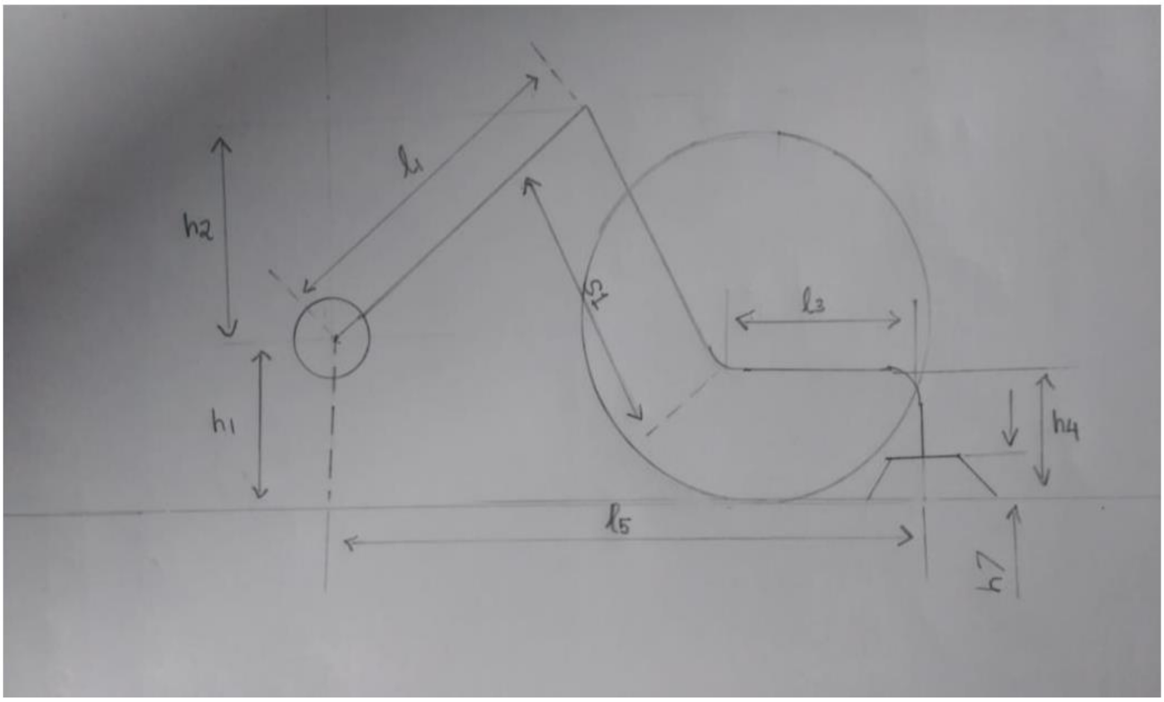
The following table gives the measurements of various cycles.

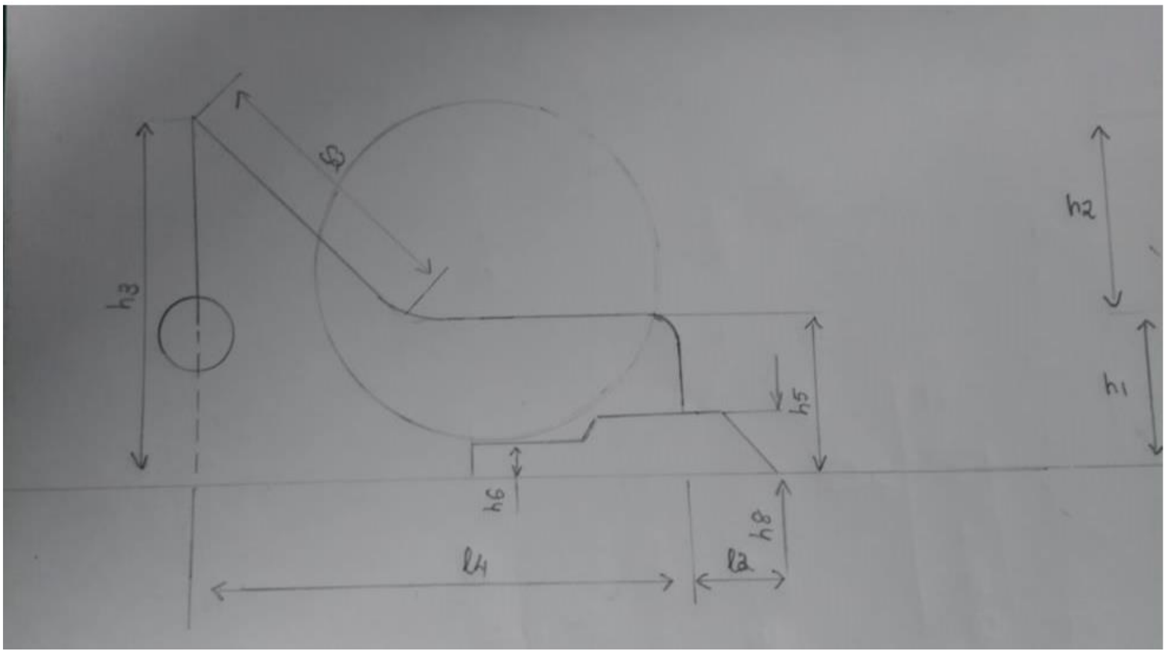
Cycle Brand	Wheel width (mm)	Wheel radius (mm)	Length of mudguard from fork (mm)	Hub width (mm)	Handle width (mm)	Radius of locus of spoke (mm)	Disk break presence
Atlas Ultimate	40	340	130	145	610	110	No
Btwin	45	345	No mudguard	130	620	130	No
Mach city	50	340	185	165	590	90	No
Huge hd51	50	350	210	155	630	75	Yes
Land Rover	50	345	No mudguard	150	635	60	Yes
Atlas stallion	35	365	150	140	480	210	No
Fire fox	55	350	210	160	680	95	No
HerculesBrute	55	350	200	140	600	100	No
Atlas Kick	50	340	180	145	620	110	No
Skyrock	50	340	No mudguard	145	590	95	No
Kross	50	340	No mudguard	155	630	105	Yes

The **locus of the spoke** is a **line joining all points on the spoke with same width as that of the wheel**, between them. It is important to know that, because there is a high chance that the spokes can have contact with the frame before allowing the wheel to rest on the ground. The calculations for the design were made considering the following factors. The width of the cycle stands, and horizontal length were chosen accordingly, such that a wheel perfectly goes in.

1. Two adjacent cycles can be parked such that their handle bars do not coincide.
2. Disk brakes do not have contact with the structure.
3. There is enough space for a person to take his/her cycle or park it.

The following dimensions were required to make our model.

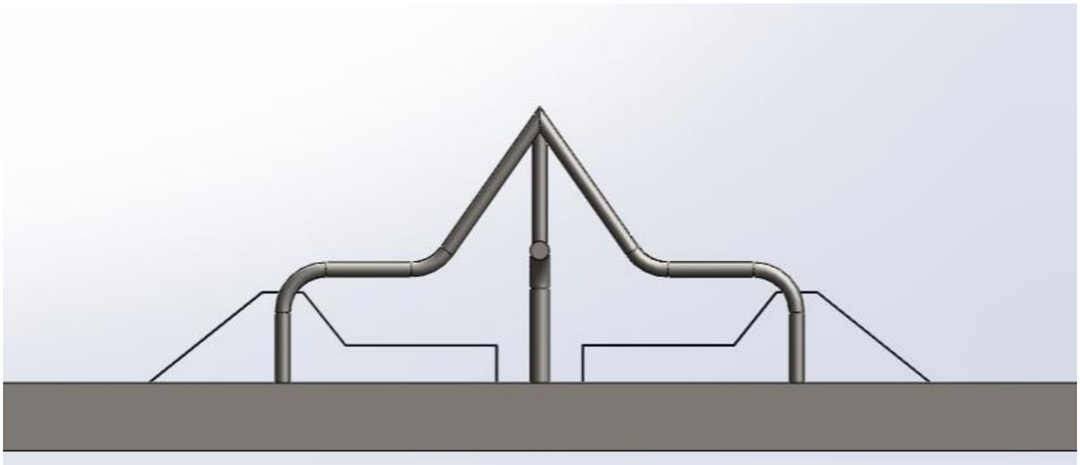

l1
h2
S1
l3
h1
h4
l5
h7


S2
h3
h2
h1
h5
h6
h8
l4
l2

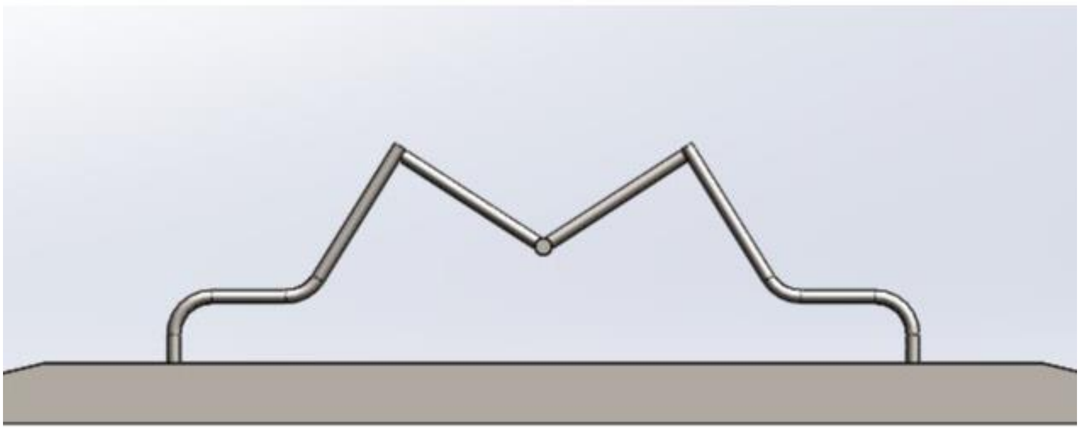
The main factors required were to ensure that the **wheel goes in** and **rests** according to the diagram and the **disc break is outside the frame**. Based on this, the height of the frame and length of the frame was calculated using the above table of measurements. Also, the **handlebars of two consecutive stands should not intersect**. For this, one cycle with extruded handlebars was placed on the smaller ramped cycle stand (outer stand) and a normal handled cycle on the bigger ramped cycle stand (inner stand). The base length calculations were done so that the handle bars lie in the same vertical plane when the wheel of the cycle comes to the top most part at a height of h_8. Thus, the height h_8 had to be more than the height of an extruded handle bar which was found to be 15 cm. We decided to give 5 cm extra to give h_8 = 20cm. The slant heights S_2 and S_1 were calculated purely by considering the radius

of the disk brake which was found to be 7.5 cm. The heights h_4, h_5 and h_6 had to be such that the **effective height is less than the difference between radius of the wheel and that of the disk brake**. The minimum radius for maximum safety would be to have h_4 and (h_5 – h_6) lesser than 34 -7.5, which is 26.5 cm. Thus, h_4, h_5 and h_6 were taken accordingly as 18cm, 27cm and 10cm respectively. The lengths l_1 and l_2 are provided for people to walk in and take their cycles comfortably, and to have some space along the frame so that the cycle does not bump often with the central rod. Some tolerances are given in our design for the ease of manufacturing.

Below shown are the front view of our design.



Smaller stand

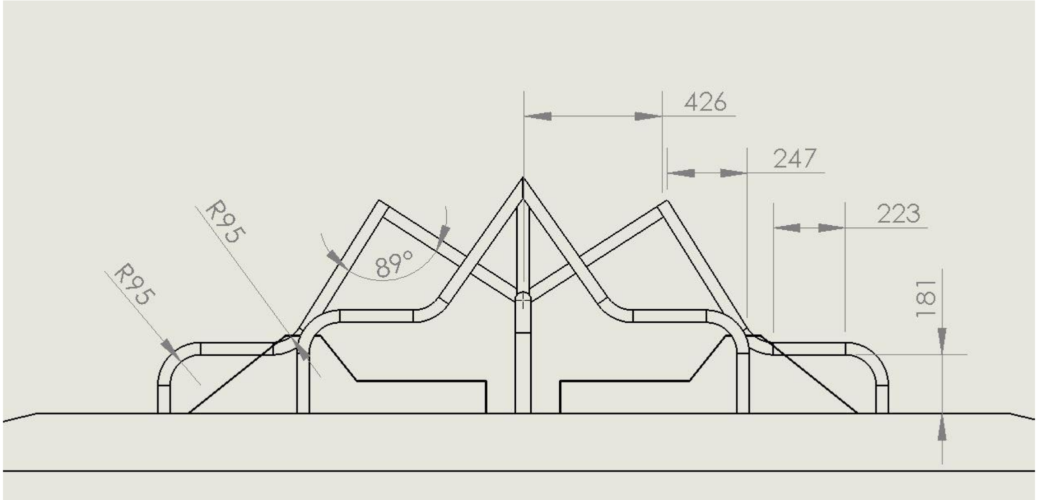


Larger stand

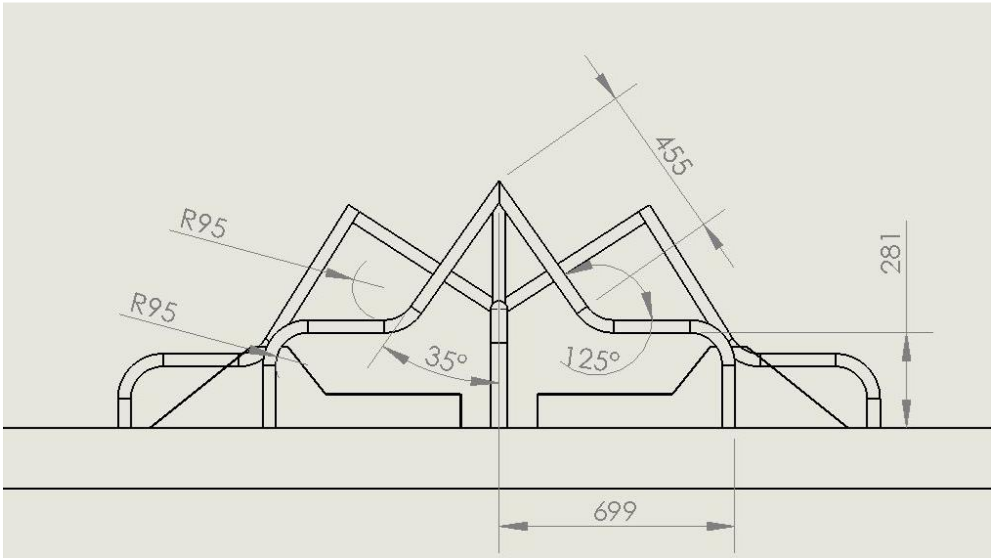
DRAWINGS

ALL DIMENSIONS ARE IN MILLIMETER

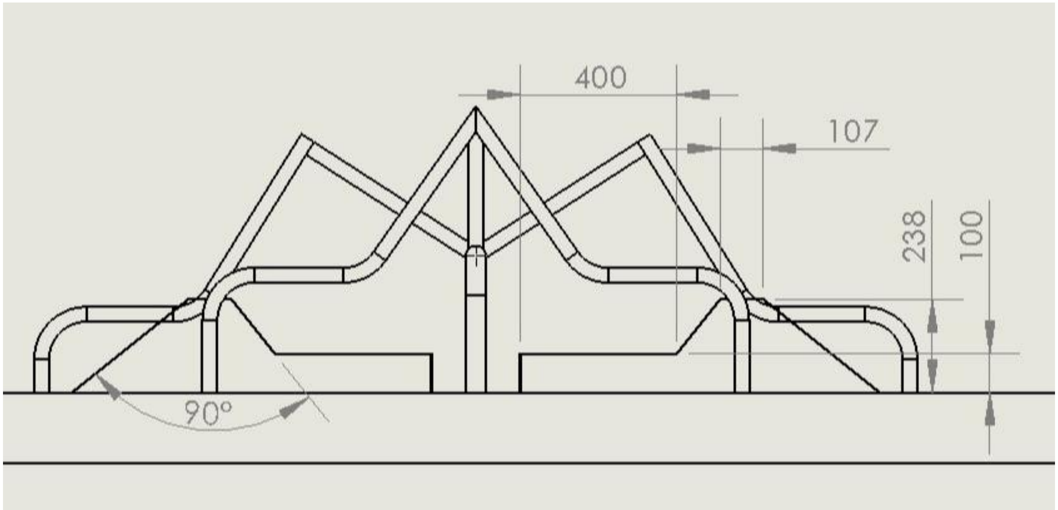
Larger stand



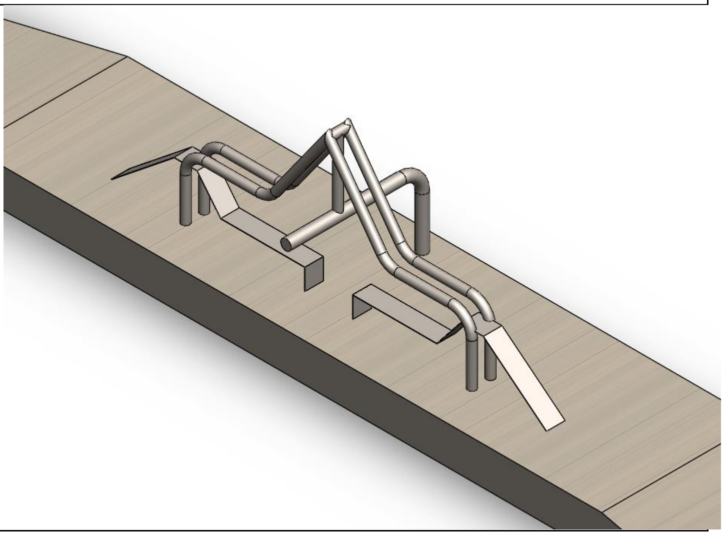
Smaller stand

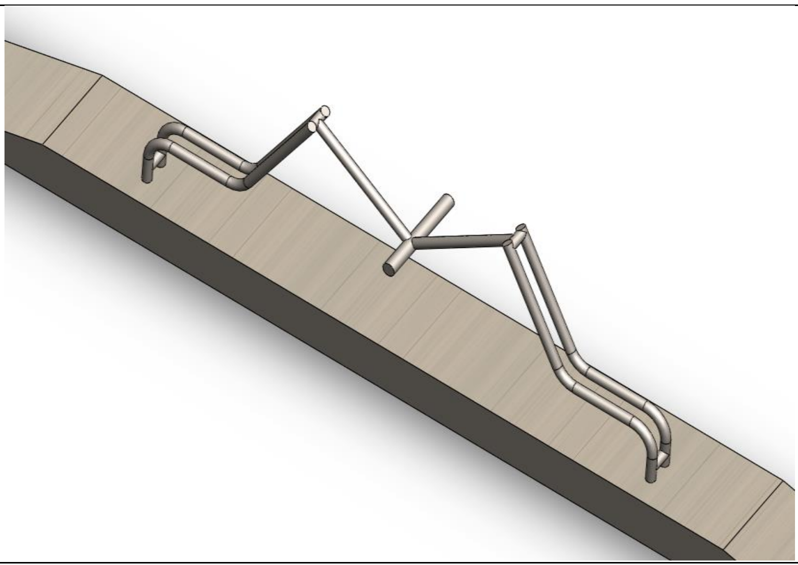


Trapezoidal base

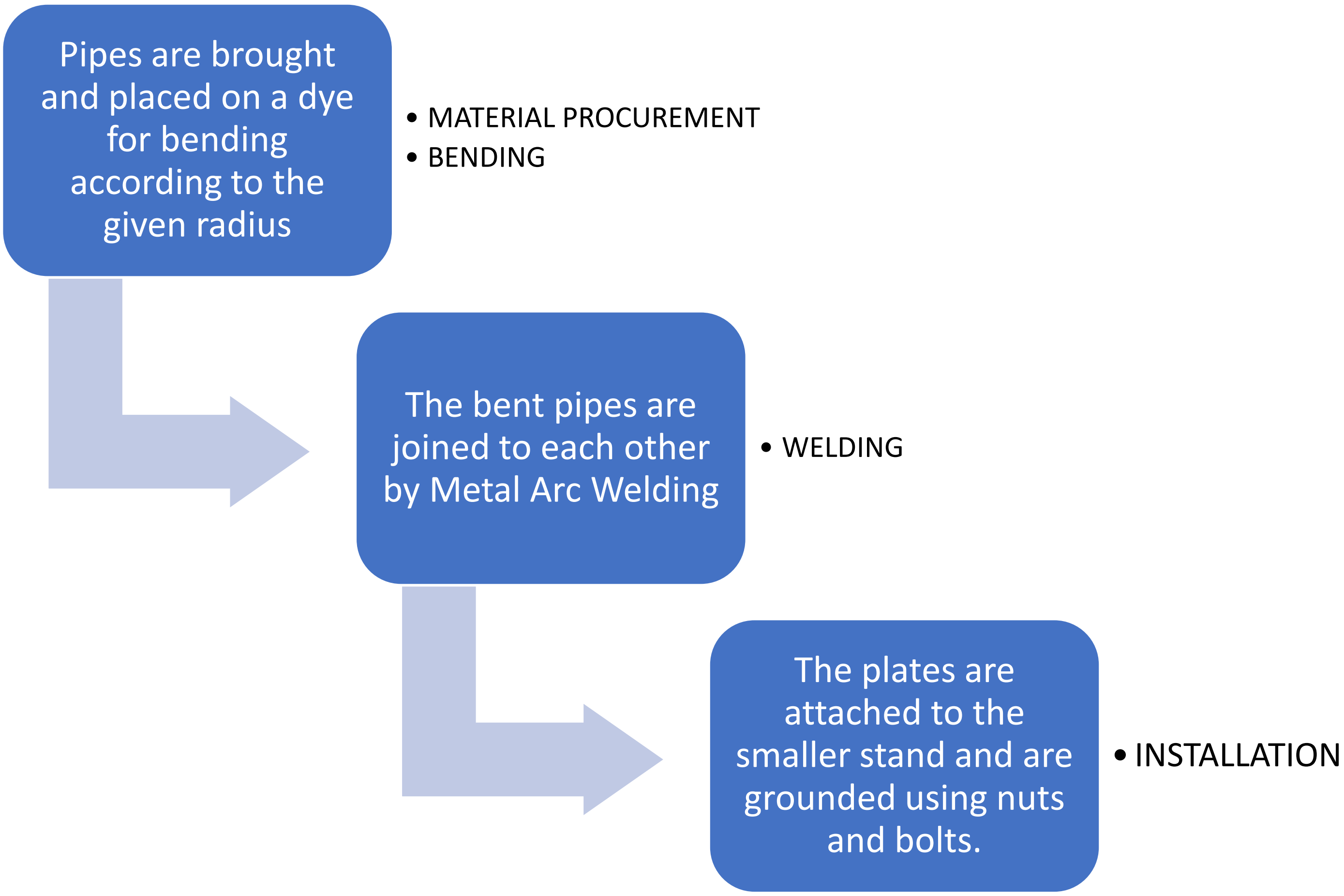


MATERIALS USED

FOR SMALL STAND			
MATERIAL	**SPECIFICATION**	**LENGTH/QUANTITY REQUIRED**	**IMAGE REFERENCE**
Mild Steel Pipes	38 mm Diameter 2 mm Thick	1.1 Meter X 4 (Incl. Bends and Allowance for Welds)	
Mild Steel Plates	2mm thick 90mm wide	1.2 Meter X 2 (Incl. Bends and Allowance for Welds	
Nuts and Bolts	M10	4 X 2	

FOR LARGE STAND			
MATERIAL	**SPECIFICATION**	**LENGTH REQUIRED**	**IMAGE REFERENCE**
Mild Steel Pipes	38 mm Diameter 2 mm Thick	2.5 Meter X 2 (Incl. Bends and Allowance for Welds)	
Nuts and Bolts	M10	4 X 2	

MANUFACTURING METHOD



COST

The values mentioned are for 1 cycle to be accommodated, one in each type of stand.

Step 1: Procurement of Materials

Component	Per Unit Cost (In INR)	Quantity		Total Cost (In INR)	
		Large Stand	Small Stand	Large Stand	Small Stand
Steel Pipes	150 per meter	2.5 meters	2.2 meters	375	330
Steel Plates	320 per square meter	NA	1.2 meters	NA	34.5
Nuts and Bolts	2 per set	4	4	8	8

Step 2: Bending

Stand Type	Radius of Bends (in mm)	No. of Bends	Cost Per Bend (In INR)	Total Cost (In INR)
Small Stand	R 95	4	50	200
Large Stand	R 95	4		200

Step 3: Welding

Stand Type	No. of Welds	Cost per Weld (In INR)	Total Cost (In INR)
Small Stand	4	30	120
Large Stand	5		150

PROCESS	COST	
	LARGE STAND	SMALL STAND
Materials	383	372.5
Bending	200	200
Welding	150	120
TOTAL COST	733	692.5

TESTING

Our model prototype was tested in the campus. The model accommodated **three cycles**. The ease of keeping cycles and placing them inside was analysed. This process happened for two weeks and all problems encountered by different cycles were observed and tabulated. Accordingly, the final design was made.

The setup for testing

RESULT

Our design is a **trapezium like structure, with ramps for the cycle to rest on**. **Two adjacent cycle stands have different lengths**, thus making the design look like a **zig-zag line from the top**. On **both sides** of the **central resting rod**, there are trapezium shaped structures, ensuring **more cycles** are parked **within one module**.

Our trapezium shaped cycle stand has specifically been **optimized to accommodate** a wheel with a **brake disc** while **not sacrificing** the primary purpose of **balancing** the cycle about the support **through its front wheel**. It also **considers varied tire widths**, with the **distance between the two trapezium pipes being 5.5 cm**, which is sufficient to **fit the front wheels** of all cycles in campus comfortably. The cycle will **not roll back** since there is a **stopper of height 17 cm** to support it from behind.

It can efficiently dock cycles without sacrificing the primary purpose of cycle stands, and without compromising convenience of the user when docking their cycle. Our stand is such that the **cycles are kept in a zig-zag fashion**, with the **adjacent cycles' handlebars not in the same line**. This allows us to **reduce the space between adjacent cycles** and over multiple segments of stands, it **significantly improves the efficiency of cycle docking**. The trapezium stands are simply placed such that **adjacent cycle stands have a 40 cm offset** between one another to **prevent consecutive cycles' handles from colliding**.

Some cycles have handlebars which curve upwards at their ends, much like racing cycles. The situation was analysed, and it was found that the **maximum height of the curved portion was 15 cm**. Subsequently, a **stopper of height 19 cm** was designed for the **inner stand** such that as the cycle goes over the stand at the maximum height of 19 cm, its **handlebars will cross over those of the outer cycles adjacent** to it, even if they had vertically extruded handle bars. The height was decided to be 19 cm to **provide a further allowance of 4 cm** beyond the height of the curved portion, to **prevent any mishap** if cycles of more extreme dimensions may be introduced into this system at a time after the installation is complete.

As per the calculations, we have found that around **6 cycles can be accommodated within a metre**. This is almost the same as the accommodation capacity of the current cycle sheds in the campus, without the cycle support. After testing the prototype, it was concluded that the cycle support accommodates a reasonable number of cycles within the given space and makes it easier for the users to park and take out their cycles from the sheds. It also reduces the cycle clusters and provides a methodical and organised way of arranging cycles.

In addition, the manufacturing can be done as a bulk with the entire system for a shed of 22. To sum up, the cycle stand ensures that the cycles are parked neatly in the hostels. In addition, it also brings feasible solutions to haphazard arrangement and space issues faced by the existing cycle sheds. It also eliminates several disadvantages of the existing models for the same problem, thereby solving one of the main issues in the campus of NIT Trichy.