

Sheffield bicycle stand in use



# Design and Development of an Improved Bicycle Stand

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## Background

With the recent rapid growth in cycling, there is now a much greater need for well-designed bicycle stands. Although stands are often provided outside buildings, not many are used because of their poor design and installation. The purpose of this project has therefore been to take bicycle stand design a step forward by developing and creating an improved product that cyclists will use.

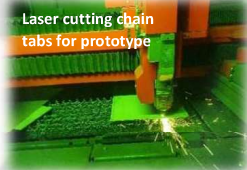
## Project Objective

The objective of this project has been to create a bicycle stand that meets the following design criteria:

- ✓ More secure
- ✓ Safe and easy to use
- ✓ Stable and rigid
- ✓ Durable and weatherproof
- ✓ Easy to install and low maintenance
- ✓ Cost-effective
- ✓ Versatile – compatible with virtually all bicycles types

## Design process

From the initial four logbook sketches, one was chosen using a scoring matrix as the most effective design option. This was then developed into an isometric sketch. Loading and stress calculations for this design were completed by hand and the design was then translated into CAD format on SolidWorks.



Laser cutting chain tabs for prototype

## Methodology

- Research the market
- Decide design criteria
- Create potential design options
- Choose most effective option
- Produce a detailed design
- Select materials of construction
- Manufacturing techniques
- Stress and loading analyses
- Finalise design
- Create prototype
- Evaluation



TIG welding on prototype stand

## Stress analysis of final design

The CAD design's individual components and then the whole assembly, were subjected to stress and loading tests using the SolidWorks FEA (Finite Element Analysis) function to ensure they met the required Factor of Safety. These tests checked that the calculations conducted previously were correct and, vitally, over several iterations, identified areas where the CAD model needed to be strengthened to allow a fully safe final design to be reached.



Prototype of final design



Prototype in use

## Prototype

Initially, it was planned to construct the prototype with tubular steel. However, due to the more difficult fabrication methods required, a switch to box section steel was necessary. The stand was therefore redesigned in SolidWorks with the FEA checks re-run to ensure the modified design would still be safe once constructed.

Gecko Metal Works at Chandlers Ford were then able to create a welded 304 stainless steel box-section prototype. Chains could not be welded to the stand as shown in the original logbook sketch, due to the Covid-19 lockdown, but detachable chains have been added for demonstration purposes.

## Evaluation

The prototype bicycle stand has been temporarily bolted to a paving slab to allow it to be tested with a real bicycle.

This practical test has proved that the stand has successfully met all the design criteria. It is stable, rigid, user-friendly and far more secure than most current bicycle stands in use.

## References

- <https://www.broxap.com/sheffield-cycle-stand-4.html>
- <https://www.stickpong.com/img/sports/rad-cycling/simple-bike-clipart>

## Materials of construction

Materials for the bicycle stand need to be affordable and available and be resistant to:

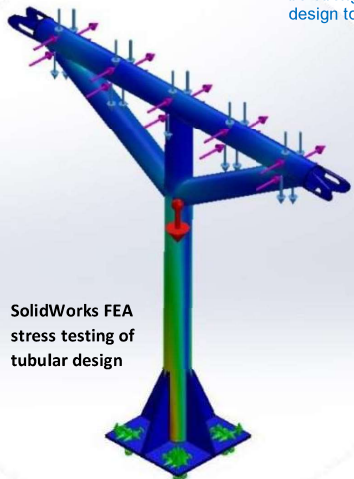
- 1) atmospheric corrosion and the weather
- 2) long-term physical wear

Stainless steel meets all these requirements and was therefore selected.

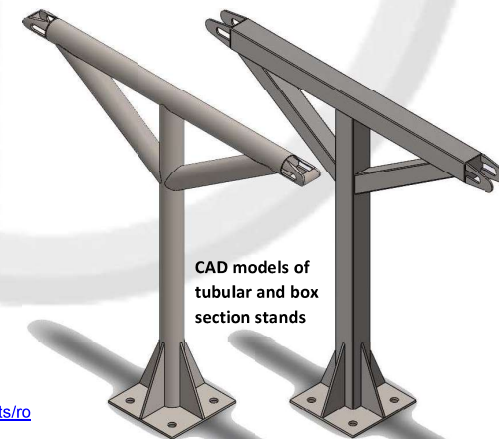
## Manufacturing techniques

The stand needs to be easily manufacturable so a simple stainless steel, welded construction using box section material was chosen.

This has therefore avoided fastenings and resulted in a strong, weatherproof and maintenance-free end product.



SolidWorks FEA stress testing of tubular design



CAD models of tubular and box section stands