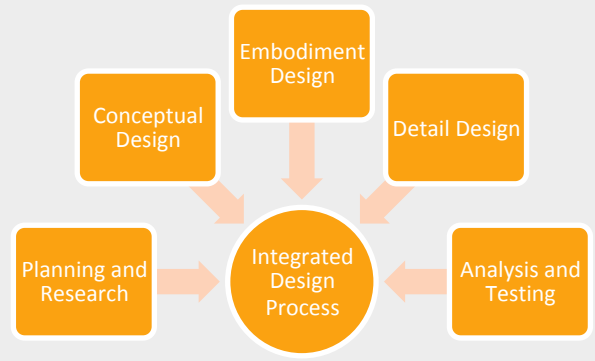
Design of an Open Source, Low Cost, DIY Cycle Kit

Student: Hannah Rosen
Supervisor: Jérémy Bonvoisin
Assessor: Sally Clift

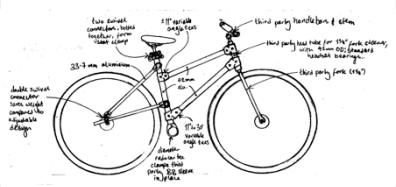
Aim: To design a flexible, open source, DIY cycle kit, with a focus on low-cost and ease of manufacture.

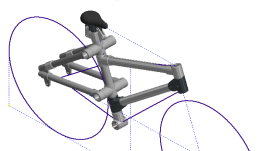
Objectives:

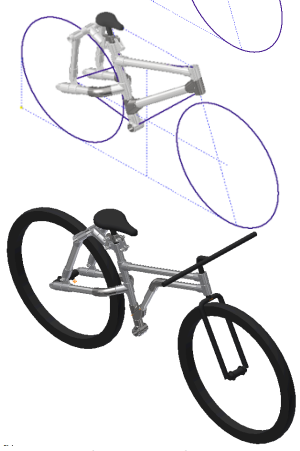
1. Carry out Product Planning and Research
2. Carry out Conceptual Design of the bicycle
3. Carry out Embodiment Design of the bicycle
4. Carry out Detailed Design of the bicycle
5. Document the project as Open Source Hardware

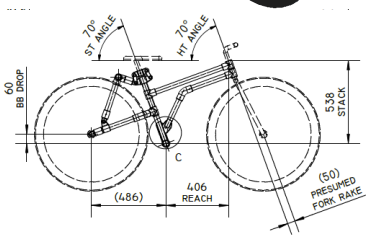


Design Evolution

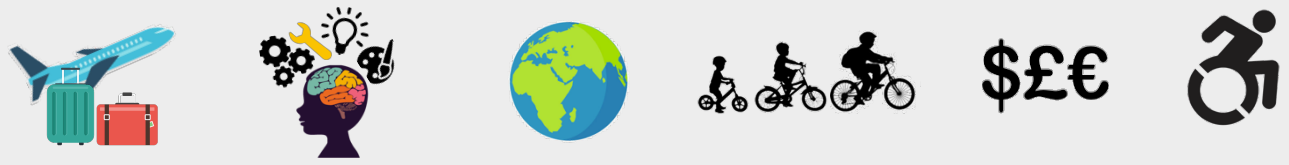








Motivation: Why would someone want to build a bike instead of buy one? There are many answers – to be eco-friendly and cost effective, as an alternative to buying a prohibitively expensive custom accessible cycle, or so that bulky geometries can be deconstructed for storage in small spaces. Besides which, there is a huge community of Makers around the world who would be interested purely for the DIY aspect.



Finite Element Analysis: The clamps were idealised as welded joints, and the tubes were modelled using a 1D beam element idealisation. The axial forces bending moments from the FEA results were compared with testing data from the manufacturer of the clamps to determine whether they could withstand the loads. Published data was used for the loads, to simulate starting to pedal up an incline. Analysis of the initial design gave a minimum safety factor of 4.7, so the design was optimised for weight and cost, resulting in a minimum safety factor of 2.6 (this was in an area which would be reinforced by a clamp, so the actual safety factor would be higher).

Open Source Hardware Documentation: The report, raw CAD files, STL and 3D PDF files, bills of materials with links to vendor websites, detailed technical drawings, and documentation of the entire design process are freely available at:

github.com/hannahrosen57/AdjustaBike-2.0

Care was taken to ensure that engineering knowledge is not required in order to understand the drawings.

Final Design: Size 6 Kee Lite aluminium handrail clamps wherever possible; size 6 Kee Klamp cast iron hand rail clamps where necessary (shown in darker teal); size 6 (33.4mm) aluminium tubing; third party bottom bracket shell, head tube, and fork.
Frame Cost Estimate: £276
Frame Weight Estimate: 8.4kg

Further Work: Prototypes; more FEA testing with more detailed models, dynamic loads, and fatigue analysis; design of other geometries such as recumbent tricycle and cargo bike; feedback from target audiences.

UNIVERSITY OF BATH