

Case Study

Recumbent cycle carbon fibre composite chassis

Project established the viability of manufacturing a carbon fibre composite chassis for the Wincheetah recumbent cycle.

Cheshire Cycle Components Ltd designs, develops and manufactures the Windcheetah recumbent cycle here in the UK (this was originally designed by Mike Burrows, the designer behind the superbike that helped Chris Boardman win Olympic gold in 1992).

They currently manufacture three models, and top of the range cycle is the 'Hypersport'. The chassis for this lightweight version is currently manufactured from carbon fibre tubes and aluminum castings; it also incorporates numerous technically advanced features.



Fig 1. The Windcheetah 'Hypersport'

In the world of recumbent cycles, the Windcheetah is widely acknowledged as the best of its type and the company has received a Millennium product award and a Windcheetah is currently on display at the Museum of Modern Art in New York.

Robert Dixon, company Managing Director, wished to explore the possibility of manufacturing the chassis as a single-piece moulding. To evaluate this, Robert turned to [Composite Engineering](#), a design consultancy specialising in the design and development of advanced composite structures, for advice.

The company is assisting Robert with the project and helped secure DTI support for both a Product and Process review and a Feasibility Study.

Product and process review

During this phase of the project we were asked by Robert to develop a concept model and to report on the manufacturing technologies that could be adopted to produce the chassis.

The company worked alongside AVD to develop the chassis design to enable it to be produced from carbon fibre composites as efficiently as possible and to enable volume production at relatively low cost. It was therefore essential to develop cost-effective advanced carbon fibre chassis moulding technology.

A 3D CAD concept chassis was developed empirically from carbon fibre composites and various manufacturing technologies were investigated, along with costings to assess both design and manufacturing iterations.

A final report was presented to Robert illustrating that a chassis developed from advanced composite manufacturing technology presented a very interesting commercial opportunity, not only did it have the potential to increase the performance of the cycle, it would considerably reduce the time to produce frames and dramatically reduce part inventory/stock levels.

Feasibility Study

Following on from the above study a manufacturing technology was chosen and we were asked to carry out a feasibility study to provide Robert with a report that enabled him to assess both the processes involved and the necessary costs of putting a carbon fibre Windcheetah chassis into low volume production.

Initially a detailed analysis of the current chassis was carried out. The main part of the existing chassis is assembled from six CNC machined LM25 heat treated aluminium castings and four tubes that are either produced from aluminium or carbon fibre depending on the particular model of Windcheetah specified, figure 1. The chassis is hand built and final assembly takes place in a bench mounted jig, this assembly is then bonded together with high performance structural adhesive.

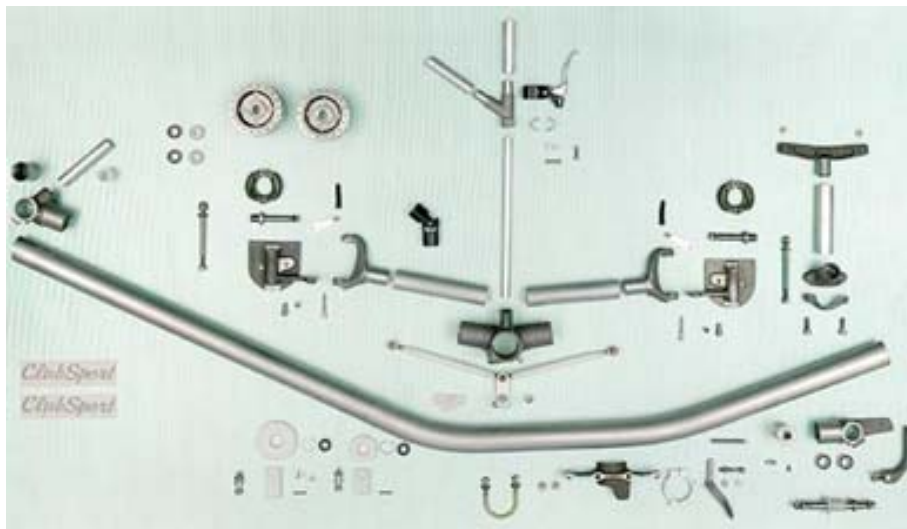


Fig 2. Windcheetah aluminium chassis components

A concept chassis has been developed to enable the production of a lightweight structure, not only as a weight saving exercise as the vehicle being human powered is very sensitive to such issues, but one that also incorporates as many of the component parts of the existing chassis as possible in an effort to offset the higher costs associated with carbon fibre construction.

The features this concept will offer are summarised as follows:

- A lighter chassis
- One piece moulding will replace numerous components
- Manufacturing process will provide for near identical chassis's
- Design and construction will reduce critical bonded joints
- Carbon chassis will update the model line and provide current technology
- Chassis's could be supplied on a 'Just in time' basis
- Develop further the Windcheetah brand and provide added value

A detailed step by step manufacturing process was developed together with 3D CAD models of the various components and necessary moulds and tooling. Additionally 2D CAD detailed engineering drawings were produced and these were subsequently supplied to several sub-contractors to enable detailed quotations to be received and subsequently analysed.

Conclusion

This study illustrated that it was technically feasible to produce carbon fibre chassis's for the Windcheetah at a commercially attractive price point.

The potential to further develop the Windcheetah brand with the introduction of a carbon fibre chassis is significant and this option is currently being considered for an ultra high performance model.