Development of the tyre tester

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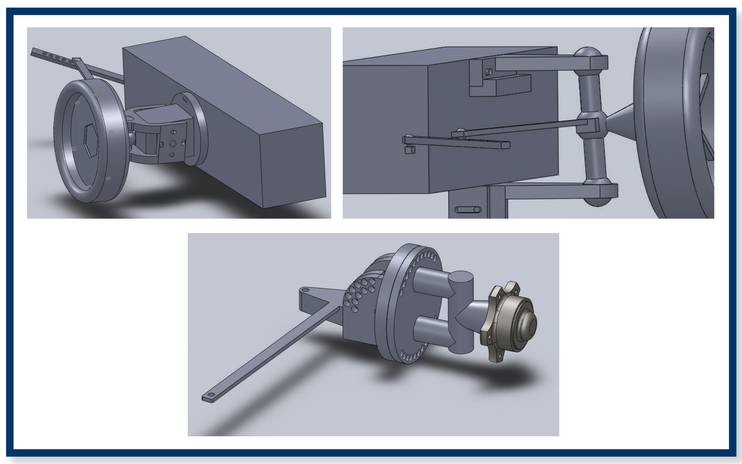
OBJECTIVE

An adjustable hub is to be designed and installed in this tyre tester, mainly to give the wheel its three-dimensional orientation, namely the camber, caster and slip angle. Current equipment does not take camber and caster into consideration. Firstly, it should be modified to have the necessary wheel orientation, especially for proper vehicle handling, and then to improve the lateral test data. We also need to measure the effect of camber on lateral forces, as well as the effect of caster on lateral forces and self-aligning torque. Lastly, we need to acquire valid data to do characterisation on different tyres and ensure more accurate modelling and simulation for future locally engineered vehicles.

DESIGN PROCESS

1. Conceptual design

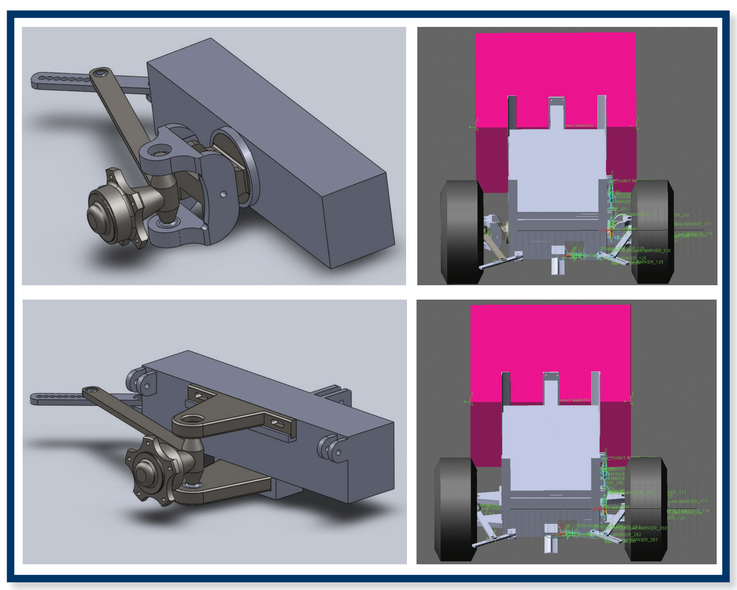
Here are some of the concepts that were generated before the final design.

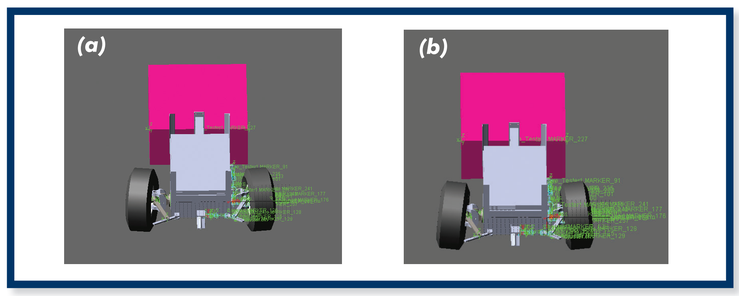


2. Detail design

2.1 Multi-body Dynamics Simulation

Firstly, the two final concepts were modelled on MSC Adams and simulated to get forces acting on crucial joints and parts.



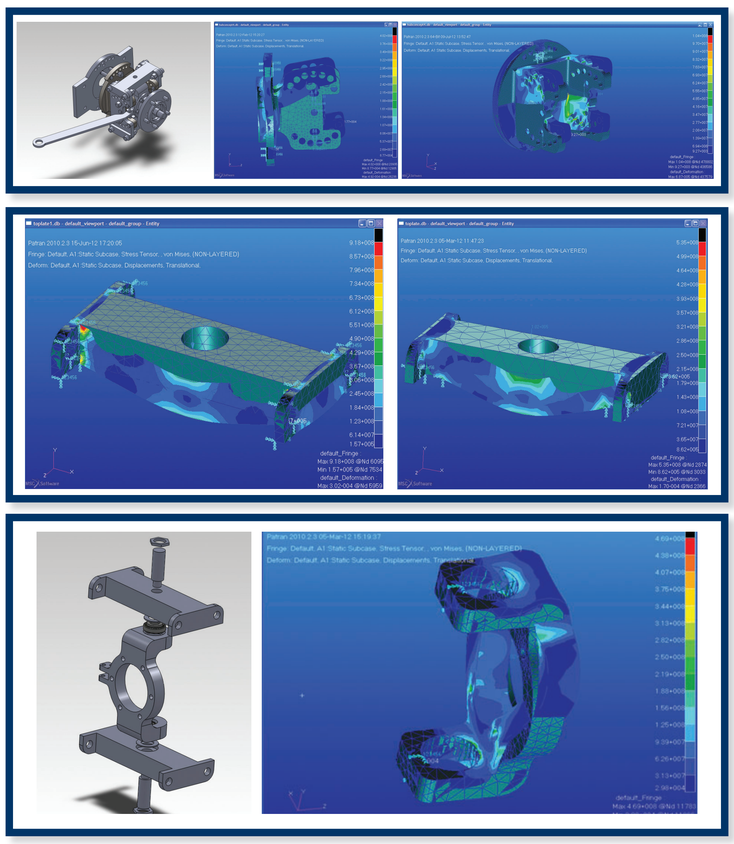


(a) Simulation of a 10 degree slip angle and (b) Simulation of a 5 degree camber and 5 degree slip angle

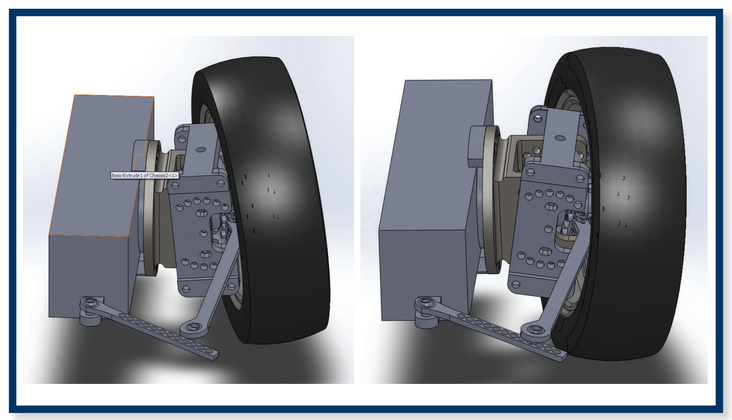
2.2. Finite element analysis

Then step two was to take the forces derived from MSC Adams and apply them on MSC Patran and Nastran for stress and stiffness analysis. We are, however, mainly concerned with stiffness, as we do not want parts to bend and change the set wheel angles.

After all the motion studies and simulations, a final concept was proposed. More simulations were done on crucial parts, accompanied by more CAD motion studies.



2.3 Solid works motion studies



3. Manufacturing

Improved mobility depends on simulating and analysing a vehicle's performance. Therefore, accurate and efficient tyre models for off-road vehicles are needed. But to get that, we need a tyre tester for adjustable slip, camber and caster angles for improved tyre lateral data.