

Exercise code: DP-1 (mechanical)
Exercise type: Group Design Project
Exercise title: Mechanical Detailed Design – Racing car axle and bearings

Exercise Assignment:

Task (Objective):

Produce a detailed design of a stub axle and a hub for a front wheel on a racing car. Select bearings, seals, bolts and connections for the assembly.

Specification:

Mass of the car is 1000 kg. The car has to take a 10 m radius turn at 100 km/h. Stopping distance at the maximum speed of 216 km/h should not be more than 120 m. Outer wheel diameter is 450 mm. Braking calliper is acting on the brake disk 90 mm from the axle centre. Assume one wheel takes 40% of the total load. Axle and a hub can be of the arbitrary shape but must fit with other components as shown in Figure. If not specified, required dimensions could be scaled from the figure. Assume factor of safety = 2. Bearing life required = 100 hrs.

WHAT and HOW to do:

1. Design process:

Form a group of 4 members. Conduct all phases of the design process (1 – 10) and refer to each of these in the report. This is group design exercise. All group members should contribute to the project equally both in calculations and drawings. During the process specify 4 criteria. The aim is to design a system with minimum weight.

2. Forces acting on wheel:

Based on specified data calculate forces that act on the car wheel. Consider weight, cornering and braking loads.

3. Bearing loads:

In the brainstorming phase of the design process outline at least 3 alternative solutions with different bearing types and positions. Based on forces that act on wheel, make a free body diagram of the axle and calculate bearing reactions for each of these solutions. Use that data to make a decision matrix. Aim for the solution with a minimum load on both bearings and axle and a minimum weight of the system.

4. Detailed design:

For the selected system, calculate bearing life rating and check shaft on bending load for material specified. Bear in mind that this is racing car whose bearing does not need to survive more than 100 hrs. Specify appropriate connection fit between the upright and the axle to ensure safe transfer of forces. Select type and size of the seal. Bearing is grease lubricated. Based on calculated values produce detailed drawings of an axle and the front hub.

WHAT a report should contain:

- A title page, index, several pages of main project, conclusion and bibliography. Report should be conveniently bounded.
- Results of the search, constraints, criteria, and sketches of all alternative designs and calculations of forces together with a decision matrix should be given on one or two A3 papers.
- For the selected solution shaft stresses, estimation of bearing life and other calculations and selection procedures should be given on one or two sheets of A3 paper.
- Detailed drawings of the stub axle and front hub on separate A3 sheets. These drawings should include all dimensions, tolerances and surface finishing.
- Assembly drawing of the whole system on a separate A3 sheet(s). Only functional assembly dimensions should be shown in this drawing. Drawing should also contain a table with catalogue numbers for bearings and seals, drawing numbers for other components and should have specified materials used for parts.

Exercise tips:

Always read the exercise assignment carefully and act accordingly. Scales, a compass and other drawing tools should be used for this exercise. Arrange the drawings neatly and ensure all letters and lines are in accordance with BS8888.

This is a three-week group exercise. It is worth 20 marks. The report should be written on as many A3 drawing papers as necessary and should have front page, index, main body, conclusion and bibliography. The report should be folded or stapled. All drawings may be made in AutoCAD. **Hand in finished report to U/G Mechanical & Aeronautical office, C108, in week 8** (check the deadline on the web).
Fill in all relevant data in the title block.

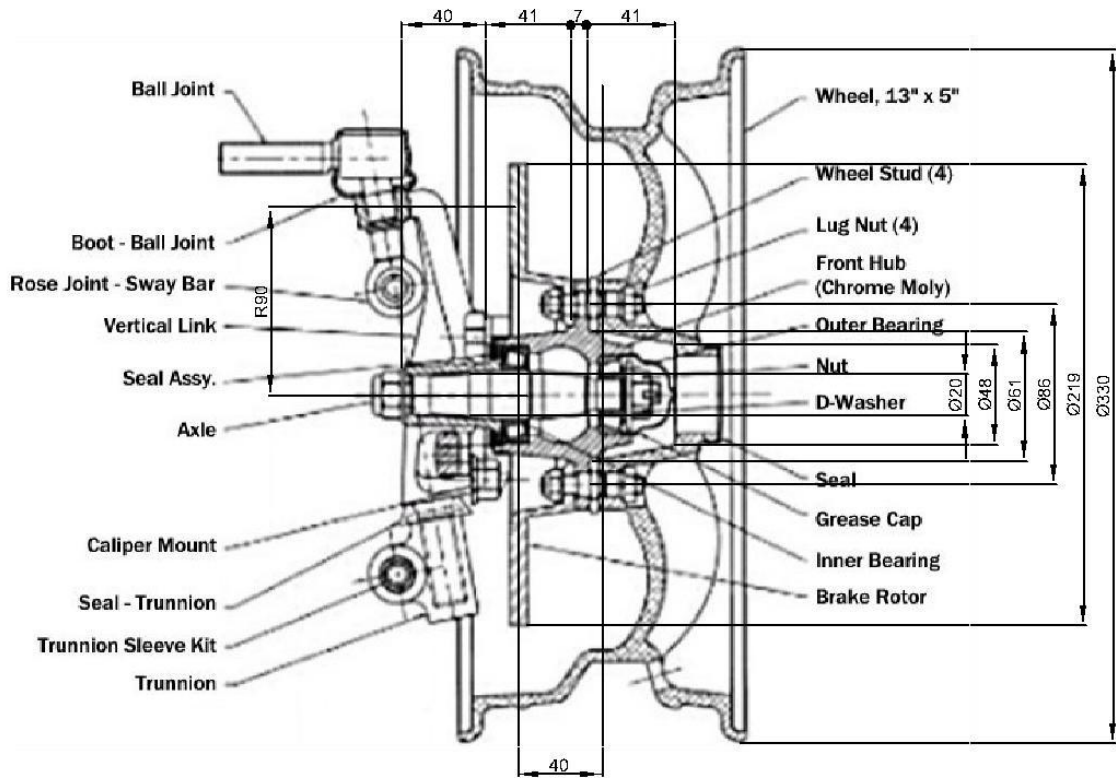


Figure Stub axle assembly