

MECH3460 Mechanical Design 2

Assignment 3

Shaft Methodologies – Chain Drive Mixer

Introduction:

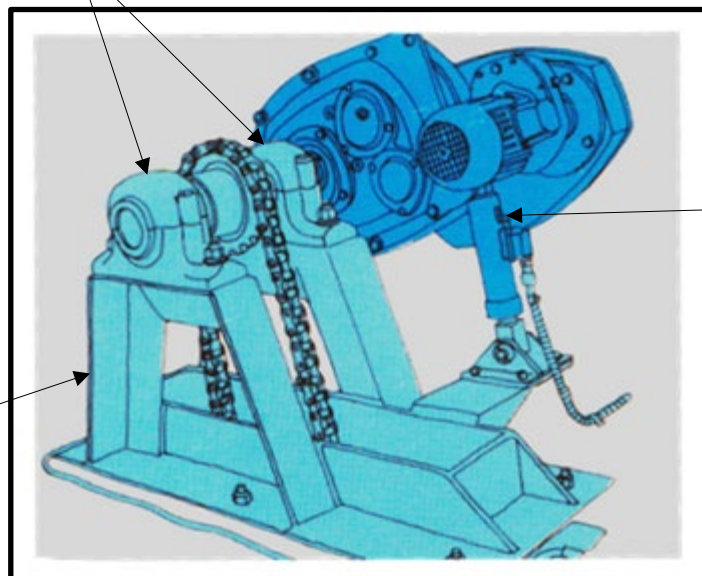
Assignment 3 focuses on the use of two analysis methods in order to arrive at suitable design of a shaft to suit the chain drive to a mixer. The layout of the drive is shown pictorially on Figure 1.0 below and in the SALA catalogue (compare old and new), available on CANVAS. Note the use of a shaft mounted gearbox.

Operating Environment:

It is intended to use an available appropriate synchronous motor rated to operate at 1440 rpm. The motor which weighs 40 kg will be directly coupled to the input shaft of the gearbox, (not using a belt drive as shown on Figure 1.0.) The output of the gearbox is to run at 100 rpm within about 5%. The pitch circle diameter of the chain sprocket is to be approximately 330 mm. The tension in the chain will vary with the volume and density of the material in the mixer drum, but it has been determined that the highest tension will be 15.0 kN and that the high-tension leg of the chain will be within 15° of vertical. The movement of the material within the mixing drum will produce essentially no shock loads. The SALA catalogue also specifies other factors to be considered. This installation will be operated for single shifts of 12 hours per day (i.e., 12 hours continuous operation), with less than 20 starts per hour and all starts will be carried out with an empty drum. The operating environment is quite dusty.

Plummer bearing block

Welded
steel frame

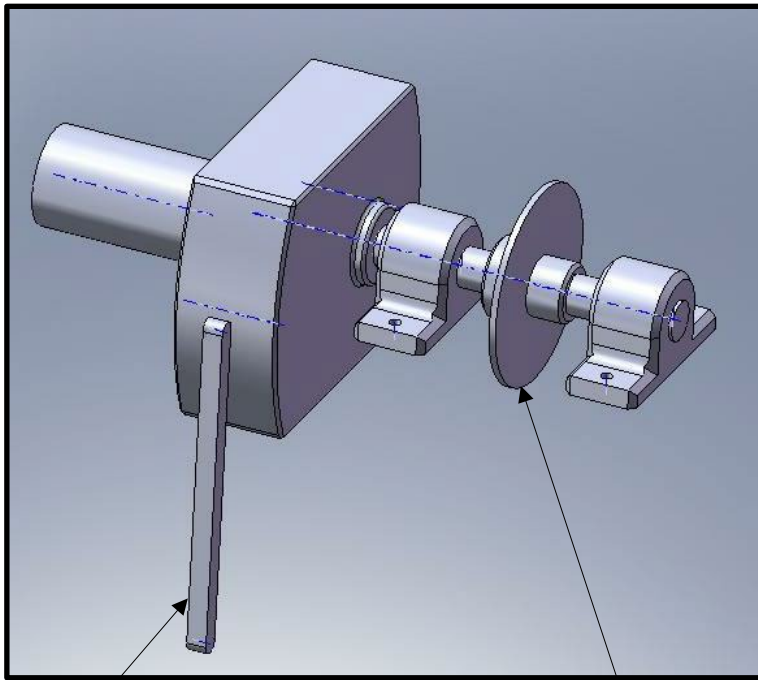


Torque reaction arm, here shown to include a load cell. Without the torque link the gear box would be free to rotate in the opposite direction to the load.

A load cell can allow monitoring over the life of the mixer and power cut-off in the event of an overload.

Figure 1.0

Figures 2.0 and 3.0 below, show views of the SW models of the proposed drive assembly. They show the gearbox, bearing blocks and shaft.



A pictorial view of a tentative arrangement of the drive assembly is shown at left.

Designers typically begin with a proposed layout which depending upon their experience may end up being close to the final arrangement.

The proposed layout provides estimated dimension which are used in initial calculations. Depending on the outcome of those calculations some or all of the details may be reconsidered. The design analysis is reiterated until a good practical outcome is reached.

Torque reaction arm

Figure 2.0

Chain sprocket mounted on boss

Minimum clearance between gearbox and bearing block to be 20mm.

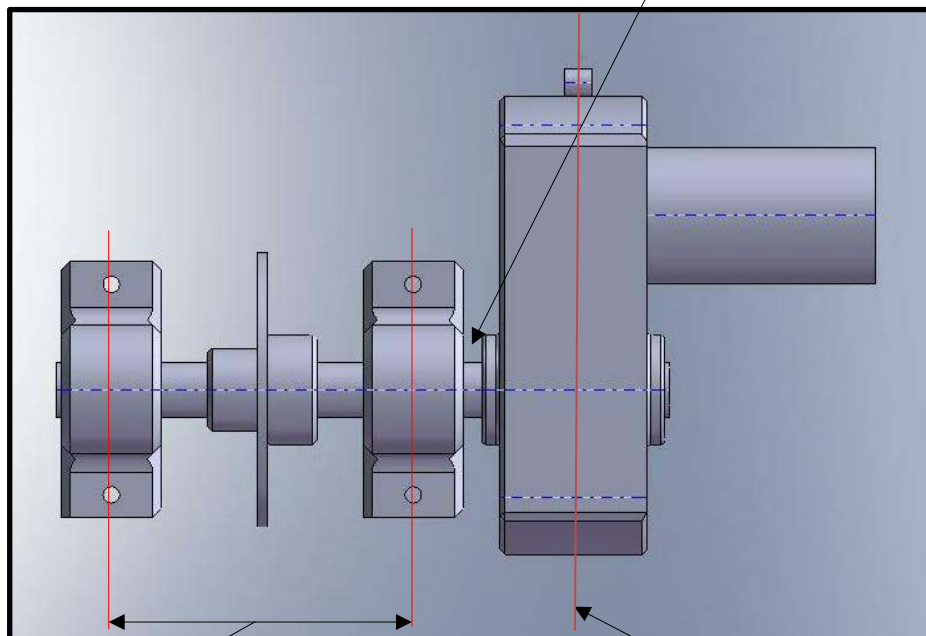


Figure 3.0

Possible top view of the proposed gear drive.

The bearing block width is estimated to be 110 mm and their mounting bolts CL separation (shown here) to be 330 mm.

The weight of the gearbox and motor, and the torque reaction by the link, may all be assumed to act through the mid-plane of the gearbox. The location for the attachment of torque link to the gear box is given in the catalogue. The C of M (center of mass) of the assembly may also be assumed to be at the

Assignment Requirements:

Shaft Material:

The initial expectation is that the shaft will be made from high quality shaft ground stock, of S_u 350 to 500 N/mm² grade. You will need to reference a suitable grade that you have selected. The shaft is initially expected to be a parallel sided cylinder bar (no steps).

Core Assignment Requirements:

You are to prepare an EXCEL spreadsheet for an engineering manager, showing step by step how you have arrived at:

- Design a suitable shaft diameter using **two** analysis methods covered within the course notes: AS1403, Gerber, Goodman or ASME.
- State the diameter and length of the stock material you are proposing to use to manufacture one off your shaft design and the material property.
- Select a gearbox from the SALA catalogue provided.
- Determine a suitable key between your shaft and the boss on which the chain sprocket is mounted.
- Produce a detail drawing of your shaft design on an A3 size drawing sheet to AS1100.
- Reference to APA7th or Harvard are to be included in your spreadsheet at each key point.

The EXCEL spreadsheet is to be easily read and also serve as a guide for new graduates that will learn from you and extend your design to other applications.

Your EXCEL spreadsheet is to be preceded by an executive summary. In it you must specify concisely what you propose to buy and what to make. This summary is not to be a general discussion, but brief and to the point. Higher level managers only read this summary, unless something goes wrong, then the details will be examined.

Additional Design Aspects to be Considered:

- Select bearings and bearing plummer blocks to suit this installation. To do this you must determine the angular misalignment of the shaft at the bearings, to allow bearings and or plummer blocks be selected that can function with that misalignment.
- Suggest tolerances for the coplanar alignment of the mounting faces for the two plummer blocks, and their deviation from the horizontal.
- Determine lateral deflection of the shaft at the sprocket and assess its effect.
- Produce a detail drawing of the steel frame to deal with the points above on an A3 size drawing sheet to AS1100.