8.3.4 Chain Drives

**This guide follows Mott and Shigley, but mostly Mott*

8.3.4.1 Chain Drives (Mott)

1. **To start off, you will be given the following information**:

   - H_{nom} [hp], nominal horsepower
   - n_1, input speed ($n_{driving}$)
   - n_2, nominal output speed (n_{driven})[26]
   - VR, velocity or speed ratio:

$$VR = \frac{V_{driven}}{V_{driving}} = \frac{D}{d} = \frac{n_{driving}}{n_{driven}}$$

2. **Find the design horsepower** H_d. Use

$$H_d = H_{nom} \times SF$$

   where SF is the service factor given in the figure below

TABLE 7–17 Service Factors for Chain Drives

Load type	Type of driver: Hydraulic drive	Type of driver: Electric motor or turbine	Type of driver: Internal combustion engine with mechanical drive
Smooth Agitators; fans; generators; grinders; centrifugal pumps; rotary screens; light, uniformly loaded conveyors	1.0	1.0	1.2
Moderate shock Bucket elevators; machine tools; cranes; heavy conveyors; food mixers and grinders; ball mills; reciprocating pumps; woodworking machinery	1.2	1.3	1.4
Heavy shock Punch presses; hammer mills; boat propellers; crushers; reciprocating conveyors; rolling mills; logging hoists; dredges; printing presses	1.4	1.5	1.7

3. **Use the tables in Appendix B to choose a chain** (No. 40, 60, or 80) given your H_d and n_1 values.[27]

   After choosing your chain type, you will also be given the the number of teeth on your driving sprocket[28], or N_d, from the same figure (left-most column).

   If you do not find the desired power rating, consider using multiple strands instead! The multiple strand factor is explained at the end of this guide.

[26] Usually a range. For VR calculations, take mid-point to be conservative

[27] Tip: you most certainly can never go wrong with choosing a No. 60 chain. No. 40 often does not work, and No. 80 is usually an overkill.

[28] 17 teeth or above is best

Also, note down the pitch[29], p [in.] for your chosen chain (from the figures) and the rated power value (H_r).

4. **Use N_d and your VR to calculate N_D:**

$$N_D = N_d \times VR$$

Round N_D up to the nearest whole number, and recalculate your VR and output speed, n_2[30].

5. **Calculate the pitch diameters**, PD_d and PD_D [in.] using the following equation:

$$PD_d = \frac{p}{sin(180°/N_d)}$$
$$PD_D = \frac{p}{sin(180°/N_D)}$$

6. **Next, find CD and L_c in pitches**. Start with a trial CD (30 - 50 pitches is a good)[31], and calculate L_c:

$$L_c = 2CD + \frac{N_2 + N_1}{2} + \frac{(N_2 - N_1)^2}{4\pi^2 CD}$$

Round up your L_c value to the nearest **even whole number**. Then recalculate CD:

$$CD = \frac{1}{4}\left[L_c - \frac{N_2 + N_1}{2} + \sqrt{\left[L_c - \frac{N_2 + N_1}{2}\right]^2 - \frac{8(N_2 - N_1)^2}{4\pi^2}}\right]$$

To find L_c and CD in inches, simply multiply by your pitch!

7. **After that, find the wrap angles** [degrees]:

$$\phi_d = 180 - 2sin^{-1}(\frac{PD_D - PD_d}{2CD})$$
$$\phi_D = 180 + 2sin^{-1}(\frac{PD_D - PD_d}{2CD})$$

Note: CD is in inches here!

[29] 0.5 in for No. 40, 0.75 in for No. 60, and 1 in for No. 80
[30] Once again, if the output speed was given as a range, make sure you are still within it
[31] I usually go for 40 pitches

8. **Finally, check how many strands you need**, which is given by:

$$\frac{H_d}{H_r \times Strand\ Factor} < 1$$

where the strand factors are:

- **Strand Factor = 1** for 1 strand
- **Strand Factor = 1.7** for 2 strands
- **Strand Factor = 2.5** for 3 strands
- **Strand Factor = 3.3** for 4 strands

Try them one by one, and see which one works, or rearrange for the strand factor:

$$\frac{H_d}{H_r} < Strand\ Factor$$

The calculator does this for you if you give it the H_r value as well.

You're Done, Good job! Check out the calculator for amazing magic!

Extra note: *When using Shigley, the process is very similar, you just need N_d to be 17 to not have to do too much work. Also, the H_r value requires to be corrected with two different factors*

8.3.4.2 Chain Drive (Shigleys)

Now looking more in-depth into Shigley's method of chain drive calculations

1. **Here we are starting at step X of the Mott Process**
2. **There are some differences in the calculation method for Nominal horsepower**