POWER IN ROLLING

Power is applied to the rolling mill by applying Torque to the rolls and by using roll strip tension.The total rolling load is distributed over the arc of contact. However, the total rolling load can be assumed to be concentrated at point along the arc of contact ata distance ‘a’ from the line of centers of the rolls.

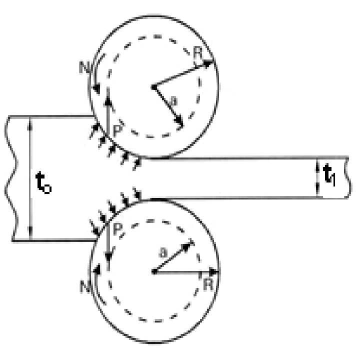
The ratio $\lambda = [\ a/L_p]\ = [a/\sqrt{R.\Delta t}]$ is used to calculate the moment arm ‘a’

λ =0.5 for hot rolling and 0.45 for cold rolling.

The torque is equal to the product of total rolling load and the effective moment arm.

Since there are two work rolls Torque $M_t = 2P.a$

Consider two high roll mill as shown in the figure. For one revolution of the top roll the resultant rolling load P moves along the circumference of a circle equal to $2\pi.a$



Since there are two work rolls involved, the work done is equal to Work done $=2\ (2.\pi.a).P = 4P.\pi.a$

If N is the speed of rotation of the rolls then

$$\text{Power} = \text{Work done/sec} = 4P.\pi.a.N/60$$

$$\text{Ie. Power} = (4P.\pi.a.N/60\text{x}1000)\ \text{Kw}$$

Where P=Load in Newton, a=moment arm in meters and
N=speed rollers
This gives the power required for deformation of metal only.

Power Distribution:

The power in rolling process is expended principally in four ways:
1. The energy required to deform the metal.
2. The energy required to over come frictional force in bearings.
3. The energy lost in power transmission system.
4. The energy lost in the form of electrical losses in the motor etc.,

Torque and Power in Cold Rolling

*Power is applied to the rolling mill by applying Torque to the rolls and by using roll strip tension.*The total rolling load is distributed over the arc of contact.

*However, the total rolling load can be assumed to be concentrated at a point along the arc of contact at distance ‘a’ from the line of centers of the rolls.

Power Loss in Bearings

Due to friction in the bearings that support the rolls, there will be some power loss.

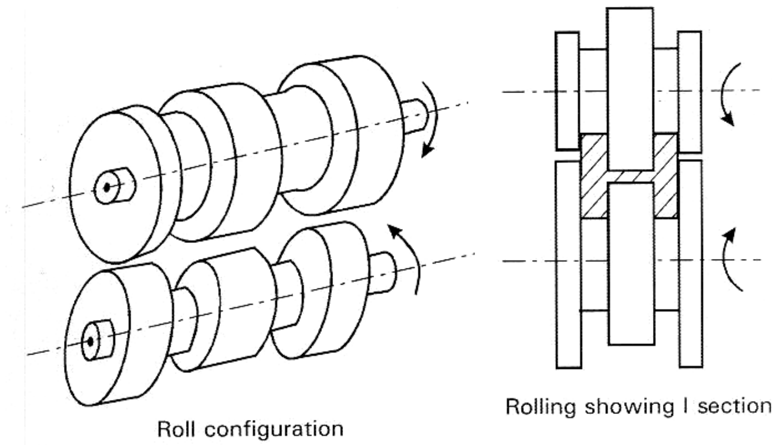
Since exact estimation of power loss in bearings is too complicated, approximate power loss estimation is done as shown.

Power loss in each bearings is given by:

$$P_{bearing} = \tfrac{1}{2}\, \mu . F_b . d . \omega$$

where μ= Coefficient of friction in the bearings
(typical values lies in the range 0.002-0.01)
F_b=Radial load for each bearing
=(1/2)x Roll separating force
=(1/2) x F(assuming rolls being supported on two bearings)
d=diameter of the bearing
ω=angular speed

Structural shapes such as I,L,U,V ..etc., are produced by hot rolling process using grooved or contoured rolls.



Rolling of I section

Usually 2 or 3 high mills are used for the purpose.
Reduction is carried out at several roll stands.
A tandem mill used for the purpose.
The design of roll pass is extremely complex and lot of experience is required for the purpose.
The contoured rolls will have half the shape of the section on each roll pairs. When assembled in the mill complete cross section is obtained. To control the lateral spread of the work it is turned through 90^0 after each pass before entering the next roll. The work passes through a series of such grooved rolls till the final size and shape is obtained. Grooves provide increased friction and large reduction in a short time is obtained effectively. The rolling of bars and other shapes is done in two directions ie., the CS is reduced in two directions by rotating by 90^0 between each rolling. Whereas rolling of strip and sheet is carried out in one direction ie., rolling is done without rotating the work piece.

Source : http://elearningatria.files.wordpress.com/2013/10/vtu-e-notes-mpiii-13.pdf