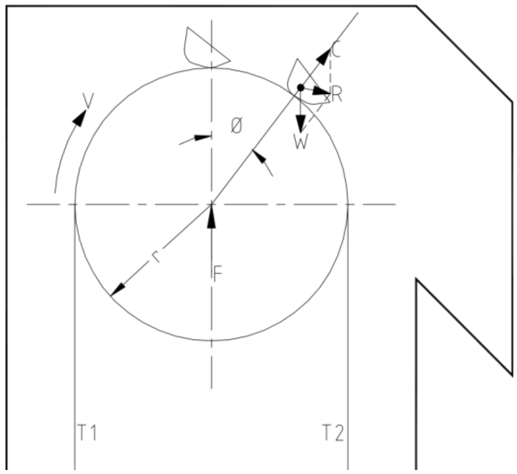
$v^2 = g \cdot r \cdot \cos\beta$ $\cos\beta = 1$ at top dead center.

Therefore $r = \frac{v^2}{g}$ and diameter $(d) = 2 \cdot r$



CALCULATE THROW INTO CHUTE AND CHUTE SIZE

Using the standard trajectory formula $s = u \cdot t + 0.5 \cdot a \cdot t^2$
Where s = displacement (m) u = initial velocity (m/s)
a = acceleration (m/s^2) = gravity constant g = 9.8 m/s^2
t = time (sec)

After the product leaves the bucket, the trajectory can be graphed, and the chute height can be determined.

The horizontal component at the top dead center of the pulley, where the acceleration due to gravity in the horizontal direction is zero, is given by $s_h = u \cdot t$ meters.

The vertical component at the top dead center where velocity in the vertical direction is zero is given by sv = $0.5 \cdot \cdot t^2$ meters.

The distance of the chute from the vertical center of the head pulley must be sufficient to allow the buckets to clear the elevator's wall on the downward leg.

The differential velocity of the inner and outer lips of the bucket must not be large, else the product at the outer lip may discharge too early when the bucket enters the centrifugal zone and hits the top to fall back to the bottom.

DETERMINE THE DRIVE ARRANGEMENT

With the head pulley size determined and the linear belt speed known, the RPM of the head pulley can be calculated.

$$= \frac{V(m/s}{2 \cdot \pi \cdot r(m)} \cdot 60 \quad) \quad RPM$$

Usually, a 4-pole motor at 1450 RPM with a reduction gearbox of a suitable ratio is selected to drive the head pulley. Depending on the available space and access, the gearbox can be a direct drive or shaft-mounted unit.

The belt velocity using a bucket spacing of 700 mm with a 1.7 bucket/sec removal rate x 0.7 m = 1.2 m/sec. The pulley diameter is now d = r.2 = (1.2^2 / 9.8). 2 = 300 mm. The diameter could be made slightly larger if necessitated by the discharge throw requirements.

CALCULATE THROW INTO CHUTE AND CHUTE SIZE

Calculate the horizontal and vertical position of the product for every 0.1 seconds of flight time.

TIME (sec)	HOR. DIST. (mm)	VERT. DIST (mm)
0.1	120	50
0.2	240	195
0.3	360	440
0.4	480	780
0.5	600	1220

The table shows that after 0.2 seconds of flight, the product has traveled 240 mm horizontally from the top dead center and 195 mm vertically. The pulley radius is 150 mm, meaning the product is clear of the pulley by 90 mm. However, the 270 mm radius circle scribed by the lip of the bucket is not yet clear (allowing for belt thickness).

This distance is reached shortly after 0.2 seconds. A satisfactory chute depth would be 600 mm, with the chute opening starting 350 mm from the vertical center of the head pulley. This makes the bucket elevator 700 mm deep. Because of the 150 mm width of the buckets, a 175 mm wide belt on a 200 mm wide head pulley will be used. To provide clearance to the wall the elevator will be 250 mm wide.

The inner lip of the bucket is at a radius of 150 mm, and the outer lip is at 250 mm. The inner lip travels at 1.2 m/sec around the pulley, and the outer lip travels at 2 m/sec (velocity is proportional to the radius). This is a speed differential of 1.7.

Depending on the product properties, this speed differential could be too significant. It would be acceptable to increase the pulley diameter to 600 mm. The inner lip now has a radius of 300 mm, and the outer lip has a radius of 400 mm. This is a differential of 1.33.

The trajectory and discharge chute size should be checked to see if the pulley diameter has changed.

DETERMINE THE DRIVE ARRANGEMENT

$$RPM = \frac{1.2}{2 \cdot \pi \cdot 0.3} \cdot 60 = 38$$

It will be necessary to select sprocket sizes for the motor and head pulley to produce the required rotational speed.

A gearbox can be selected to reduce from 1450 RPM input shaft speed to 38 RPM output shaft speed. Alternatively, the sprocket sizes can produce some reduction, and the gearbox can deliver the remainder. Limit reduction via the sprockets to a 3:1 ratio to not over-stress the chain.