Design Consideration of Bucket Elevator Conveyor

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Abstract

This paper is mainly based on the combination of belt conveyor and bucket elevator to move paddy within a short time and successfully in a cost effective way. An inclined bucket elevator conveyor was designed for this paper. This paper provides to design the conveyor system which includes belt speed, belt width, motor selection, belt specification with the help of standard model calculation. It is considered a labour saving system that allows large volumes to move rapidly through a process.
Keywords: Capacity, Speed, Bucket Conveyor

I. INTRODUCTION

Conveyor is almost universal in application. Bucket elevator is a type of vertical or inclined transport equipment that efficiently moves goods between floors, vessel or other structures. In the paddy post-harvest system, paddy is moved, transported, or conveyed from place to place. Traditionally, these have been hand operations. After harvest the paddy is placed in gunny bags and transported several times through storage and processing before the milled rice finally reaches the consumer. Paddy is often handled too much, resulting in high handling costs and excessive losses. Screw and belt conveyors move paddy horizontally or up small inclines.

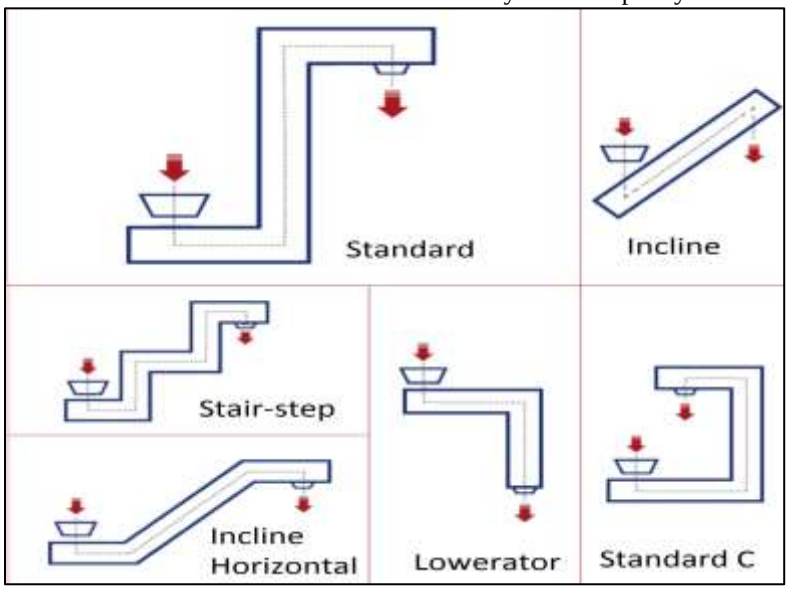

Fig. 1: Designs of Bucket Elevators

II. BUCKET ELEVATOR CONVEYOR

A. Types of Conveyor

Industrial transport must be classified an external and internal. External transport includes conveyance by rail, ship, truck and plane. Intershop transport serves to transfer loads from shop to shop, shop to store, shop to loading area. Generally they are classifying into three main categories.

- Pneumatic conveyor or air lifter
- Conventional screw conveyor
- Bucket elevator

B. Bucket Elevator

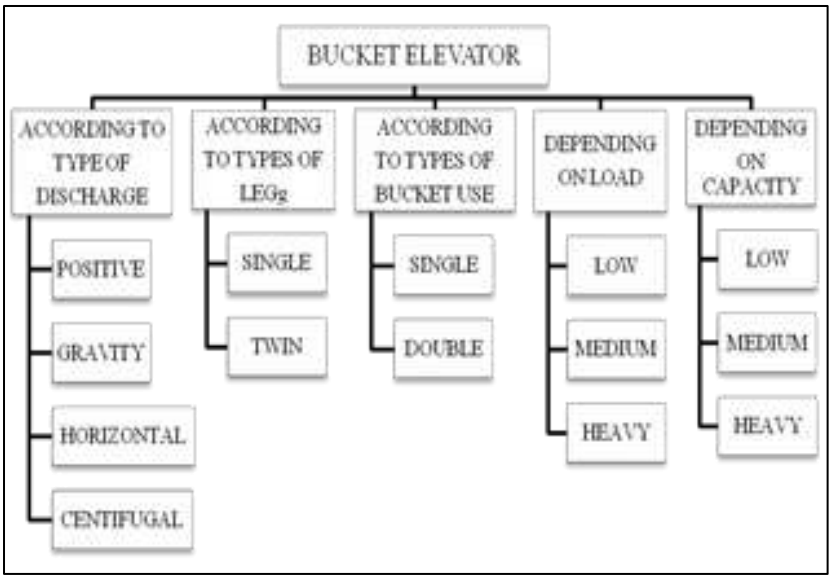

Fig. 2: Classifications of Bucket Elevators

III. DESIGN CONSIDERATION

The design of a bucket elevator conveyor system takes into account the followings:

- Dimension, capacity and speed
- Roller diameter
- Belt power and tension
- Pulley diameter
- Motor selection

A. Conveyor Belt Speed

$V = \pi D$
where, V = conveyor belt speed
D = diameter of roller (ft)

B. Conveyor Belt Capacity

$B.C = A \times V$
where, A = belt cross-sectional area (ft^2)
V = conveyor belt speed

C. Conveyor belt length

$L = [(\pi D / 2) \times 2] + 2c$
where, D = roller diameter (in)
C = center to center distance (in)

D. Horsepower for Inclined Conveyor

$HP = \{(P \times B) + [(P+M) \times F \times V]\} / 33000$
where, HP = Horsepower (hp)
P = Product weight (lbs)
B = Sine of angle of incline
M = Belt Weight (lbs)
F = Coefficient of friction (see table II)

E. Effective Tension

$E = F \times (P+M)$
where, E = Effective Tension (lbs)

F. Slack side Tension

$E_1 = E \times K$
where, E_1 = slack side tension (lbs)
K = drive factor (see table III)

G. Tide side Tension

$E_2 = E + E_1$
where,E_2 = Tight side Tension (lbs)

H. Operation Tension

$T = E_2/W$
where, T = operation tension (lbs)
W = conveyor belt width (lbs)

I. Conveyor belt rotation

$n=v/\pi D$
where, D = roller diameter
n = revolution
v = belt speed

IV. DESIGN CALCULATION

Input Data: D = 6 ″
W = 4″
M = 0.7lbs
P = 4.4lbs
Inclined angle, B = 30˚
C = 76″
F = 0.15
A = 4″ × 0.2″
K = 1.6

A. Motor Selection for Belt Conveyor Drives

The power requirement for a belt conveyor is a function of five components:
1) power required to run the empty belt,
2) power required to horizontally move the load
3) power required for vertical lift,
4) power required for friction
5) power required for acceleration
At present, all the motors are 1500 rpm

B. Pulley Diameter

Pulleys are manufactured in a wide ranges of size. The pulley diameter is obtained from standard value from the catalogue. Drive pulley can be lagged to increase friction and improve transmission belt and pulley.

C. Shaft Design

The values of belt width and pulley diameter helps in selecting the size of shaft diameter from conveyor hand book.

D. Tables

The followings are designed values were obtained of bucket elevator conveyor system for using 2 rollers.

Table – 1
Design Results for Bucket Elevator Conveyor

No	*Parameters*	*Values*
1	*Belt width (in)*	*4*
2	*Conveyor length(ft)*	*14*
3	*Belt and support (ft/min)*	*94*
4	*Conveyor capacity (ft^3/min)*	*1*
5	*Motor Power (rpm)*	*1400*
6	*No. of bucket (no:)*	*8*

No	*Parameters*	*Values*
7	*Belt Power (kw)*	*1*
8	*Power required by conveyor (kw)*	*1*
9	*Belt Thickness (in)*	*0.2*
10	*Conveyor belt rotation (rpm)*	*400*

Table – 2

Coefficient of Friction (f)

Belt	*Steel*	*Metal*
FS pulley side	*0.3 to 0.35*	*0.1 to 0.15*
BB side	*0.2 to 0.25*	*0.1 to 0.15*
Cover on pulley side	*0.5 to 0.55*	*0.1 to 0.15*

Table – 3

Drive Factor (k)

Belt on roller	*K*
180°	*1.6*
220°	*1.2*
240°s	*1.0*

V. CONCLUSION

This paper discusses the design calculations and considerations of belt conveyor system. This project focus on bucket elevator conveyor because this system is a labor saving that allows large volumes to move rapidly through a process, easy maintenance and high reliability operation. The purpose of this paper is to design the combination of belt conveyor and bucket elevator for paddy moved from place to place for Myanmar agricultural uses.

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