Suggestional & Fabricated Perpendicular Conveyor System

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ABSTRACT: The main aspect of making of this project stands in the material handling modern technology using the
mode of transportation from the set point from the specific set path and certain time. The main facing problems are the
tight turns specified as to be 90° for this project, the use of conveyor setup along the track which is to be cost efficient
and having the high load caring capacity. The suggested system is to be very accurate with ease in maintenance and
highly reliable which can be applicable in the Automobile Industry, FMCG, etc locations which involves material
transfer. This paper provides to design the conveyor system used for which includes belt speed, belt width, motor
selection, belt specification, shaft diameter, pulley, gear box selection, with the help of standard model calculation.

KEYWORDS: FMCG, Conveyor, Transportation, 90 Degree.

I. INTRODUCTION

This paper is the complete study for the transportation of material in the practical scenario in the Industry also with its
Proper Maintenance and some of the main required calculation for the Fabrication of the system, which involves the
selection criteria of materials and components. Modern gear drives designs cost provides quick reliable services and
high power intensities, which can be achieved only by raising the gears. So we made a brave step in manufacturing
such a 90 degree conveyor system for material handling at a very low-cost that is early affordable and economical.

Throughout the world bulk materials handling operations perform a key function in a great number and variety of
industries. While the nature of the handling tasks and scale of operations vary from one floor to another and according
to the industrial and economic base, the relative costs of transporting bulk materials are, in the majority of cases, quite
significant. It is important, therefore, that handling systems be designed and operated with a view to achieving
maximum efficiency and reliability with flexible material handling. The aim of this project is to redesign existing
conveyor system by designing the critical parts (pulley, belt, gear and Frame), to minimize the overall weight of the
assembly and to save considerable amount of material.

II. OBJECTIVE

Now in industries only fixed type belt conveyor is available. But we will make the conveyor belt such that it can be
rotate 90°and belt will be easy to turn at sharp corners with material. The handling systems be designed and operated
with a view to achieving maximum efficiency and reliability.
III. METHODOLOGY

DESIGN & CALCULATIONS OF THE PROTOTYPE

- We are designing the conveyor belt system for the industries. So first we put a prototype in front of them.
- So we make the design & calculations for prototype.

DESIGN OF PROTOTYPE

IV. CONSTRUCTION

SOFTWARE REQUIRED:

- CATIA
- AUTOCAD

V. HARDWARE / PARTS REQUIRED:

TABLE 1: SPECIFICATION CHART

<table>
<thead>
<tr>
<th>SR NO</th>
<th>COMPONENTS</th>
<th>Specification</th>
</tr>
</thead>
</table>
| 1     | Dc Motor   | - 30 RPM 12V DC motors with Gearbox  
         |            | - 6 mm shaft diameter with internal hole  
         |            | - 125 gm weight  
         |            | - Stall Torque = 0.5kgcm torque (0.04903325 N-m)  
         |            | - No-load current = 60 mA (Max), Load current = 300 mA (Max)  |
| 2     | Bevel Gear | Material – pp, Quantity - 30  
         |            | Module =1.25, No of teeth=23  
         |            | Bore dia. =6, Bevel gear Angle=45  
         |            | Boss dia.=17.3, Boss length=7  |
| 3     | Roller / Pulley | Material – nylon, Quantity – 30 |
VI. DESIGN & CALCULATIONS OF PROTOTYPE:

MATERIALS AND THEIR PROPERTIES:

The materials used in this project are detailed as follows

**Mild steel**
- EN – 4 to EN – 6
- Carbon – 0.15% to 0.35%
- Tensile strength –1200/1420MPAs
- Yield strength – 750/1170 MPA

**Aluminum**
- Young's modulus - 70 GPa
- Yield strength - 240 Mpa
- Shear modulus- 26 GPa
- Bulk modulus- 76 GPa
- Poisson ratio- 0.35
- Mohs hardness- 2.75
- Vickers hardness- 2.75
- Brinell hardness- 160–550 MPa
- Aluminum is the most widely used non-ferrous metal. The global production of aluminium in 2005 was 31.9 million tones

**Foam PVC**
- Density - 1.3-1.45 g/cm3
- Thermal conductivity- 0.14–0.28 W/ (m·K)
- Yield strength-4500–8700 psi – 640 Mpa
- Young's modulus-790000 psi
- Coefficient of thermal expansion- 5×10−5 mm/ (mm °C)

<table>
<thead>
<tr>
<th>Material</th>
<th>Size</th>
<th>Part size</th>
<th>Material</th>
<th>Quantity</th>
<th>Size</th>
<th>Part size</th>
<th>Material</th>
<th>Quantity</th>
<th>Size</th>
<th>Part size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Plate</td>
<td>Material – Acrylic</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>50 x 830 x 5 mm</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C – Turn Table Plate</td>
<td>Material – Acrylic</td>
<td>1</td>
<td></td>
<td></td>
<td>50 x 225 x 5 mm</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Motor Mtg. Plate</td>
<td>Material – Acrylic</td>
<td>6</td>
<td></td>
<td></td>
<td>50x 64 x 5 mm</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Roller Bush</td>
<td>Material – aluminum</td>
<td>3</td>
<td></td>
<td></td>
<td>20x 40 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn Table Bush</td>
<td>Material – Aluminum</td>
<td>3</td>
<td></td>
<td></td>
<td>20x 20 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roller Shaft</td>
<td>Material – MS</td>
<td>15</td>
<td></td>
<td></td>
<td>Φ6 x 165 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conveyor Drive Shaft</td>
<td>Material – M5</td>
<td></td>
<td></td>
<td>2</td>
<td>Φ6 x 800 mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turn Table Motor Shaft</td>
<td>Material – M.S</td>
<td>2</td>
<td></td>
<td></td>
<td>Φ6 X 200mm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg Support</td>
<td>Material – Foam PVC</td>
<td>4</td>
<td></td>
<td></td>
<td>80x130 X 5 Mm</td>
<td></td>
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PVC is supplied in two basic forms: rigid (sometimes abbreviated as RPVC) and flexible. The rigid form of PVC is used in construction for pipes and profile applications, such as doors and windows. It is also used for bottles, other non-food packaging and cards (for example, bank cards or membership cards). It can be made softer and more flexible due to the addition of plasticizers; the most widely used are phthalates.

VII. DESIGN CONSIDERATIONS

1. Designing the system for continuous flow of material (idle time should be zero).
2. Going in for standard equipment which ensures low investment and flexibility.
3. Incorporating gravity flow in material flow system.
4. Ensuring that the ratio of the dead weight to the payload of material handling equipment is minimum.

VIII. DESIGN CALCULATIONS

<table>
<thead>
<tr>
<th>Table2: Calculation Chart</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Belt calculations</strong></td>
</tr>
</tbody>
</table>
| **Belt Capacity**         | B.C = \(3.6AV\rho\)  
                          | Where, \(A=\) belt sectional area (m\(^2\))  
                          | \(\rho=\) material density (kg/m\(^3\))  
                          | \(V=\) belt speed (m/s)  |
| **Area of Belt**          | \(A = \text{Length x Width}\)  
                          | \(A = 815 \times 100\)  
                          | \(A = 81500\) mm\(^2\)  
                          | \(A = 0.081500\) m\(^2\)  |
| **Belt Speed**            | \(V = \frac{2mN}{60\pi}\)  
                          | \(V = \frac{2 \times \pi \times 10}{3600}\)  
                          | \(V = 0.01745\) m/sec  |
| **Density of Material:**  | B.C = \(3.6 \times A \times V \times \rho\)  
                          | B.C = 3.6 \times 0.081500 m\(^2\) \times \(1.1 \times 10^3\)  
                          | B.C = 4.5 Kg/sec  |
| **Roller calculation**    | **Diameter of Roller (Drive Pulley)** |
| **Material used for Belt is Rubber.**  | \(D = 34\) mm  |
| **Density of Rubber is 0.9 \times 10^3\) kg/m\(^3\)**  | **Pulley calculations** |
| **Roller calculation**    | **Power at Drive Pulley:** |
| **Diameter of Roller (Drive Pulley)**  | \(N = \frac{V \times 1000 \times 60}{D \times \pi}\)  
                          | Where, \(N =\) RPM of Belt  
                          | \(V =\) Speed of Belt  
                          | \(D =\) Dia. Of Roller  |
| The roller support belt and facilitates easy as well as free rotation of the belt conveyor in all direction. The correct choice of roller diameter must take into consideration the belt width. The relationship between the maximum belt speed, roller diameter and the relative revolution per minute is given as  | \(10 = \frac{0.01745 \times 1000 \times 60}{D \times \pi}\)  
                          | \(D = 33.22\) mm  
                          | \(D = 34\) mm  |
| **Pulley calculations**   | **Power at Drive Pulley:** |
| **Power at Drive Pulley:** | \(P_p = \frac{2mN}{60}\)  
                          | \(P_p = 20\) Watt.  
                          | \(P_p = 0.02\) Kw  |
| **Power Required for Conveyor to Produced Lift:** | \(P = 4.5 \times 0.3 \times 10^3\)  
                          | \(P = 0.004725\) Kw.  
                          | Where, \(P =\) Power required for Conveyor (Kw)  
                          | \(C =\) Conveyor Capacity (Kg/sec)  |
BELT TENSION Calculation

\[
T_{ss} = 1.37 \times F \times L \times g \times (2 \times M_i + (2 \times M_b + M_m) \times \cos \theta) + H \times g \times M_m
\]

\[
T_{ss} = 1.37 \times 0.02 \times 0.832 \times 9.81 \times \cos 30° \times 0.18304
\]

\[
T_{ss} = 0.035 \text{ KN.}
\]

IX. ON THE BASIS OF PROTOTYPE WE MANUFACTURED CONVEYOR IN COMPANY

CONVEYOR BELT CALCULATIONS:

- Conveyor belts are used in a wide variety of material transport applications such as manufacturing, food processing, and heavy industry.
- Belts - are the most common type of conveyors and are very versatile.
- The belt consists of one or more layers of material.
- An under layer-to provide linear strength and shape called a carcass(polyester, nylon and cotton)
- An over layer called the cover. (rubber or plastic compounds)

Conveyor belt types are following:
- Round Belts
- V Belts
- Flat Belts
- Timing/Toothed Belts

THE PARAMETERS FOR DESIGN OF BELT CONVEYOR:
- Belt speed
- Belt width
Absorbed power
Final Product passes through
Drive pulley shaft

X. INPUT DATA

Table 3: Input consideration

<table>
<thead>
<tr>
<th>SR.NO</th>
<th>CONSTRAINT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conveyor capacity (Cc)</td>
<td>1500*(t/h)=416.67 Kg/sec</td>
</tr>
<tr>
<td>2</td>
<td>Belt speed (V)</td>
<td>1.5 m/sec</td>
</tr>
<tr>
<td>3</td>
<td>Conveyor height (H)</td>
<td>20 m</td>
</tr>
<tr>
<td>4</td>
<td>Conveyor length (L)</td>
<td>250 m</td>
</tr>
<tr>
<td>5</td>
<td>Conveyor capacity (Cc)</td>
<td>1500*(t/h) = 416.67 Kg/sec</td>
</tr>
<tr>
<td>6</td>
<td>Mass of a set of idlers (m')</td>
<td>20 Kg</td>
</tr>
<tr>
<td>7</td>
<td>Idler spacing (l')</td>
<td>1.2 m</td>
</tr>
<tr>
<td>8</td>
<td>Load due to belt (mb)</td>
<td>25 Kg/m</td>
</tr>
<tr>
<td>9</td>
<td>Inclination angle of the conveyor (δ)</td>
<td>5°</td>
</tr>
<tr>
<td>10</td>
<td>Coefficient of friction (f)</td>
<td>0.02</td>
</tr>
<tr>
<td>11</td>
<td>Start-up factor (Ks)</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>Drive efficiency (Kd)</td>
<td>0.9</td>
</tr>
<tr>
<td>13</td>
<td>Friction factor (Cr)</td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>Breaking strength loss factor (Cv)</td>
<td>0.75</td>
</tr>
</tbody>
</table>

XI. PULLEY CALCULATIONS FOR COMPANY

- A conveyor pulley is a mechanical device used to change the direction of the belt in a conveyor system, to drive the belt, and to tension the belt.
- Modern pulleys are made of rolled shells with flexible end disks and locking assemblies.
- Conveyor belt pulleys vary in diameter and width on different applications.
- The diameter of the pulley must be large enough to prevent ply separation of the belt composition due to flexing over small pulleys.
- The pulley diameter is thus a function of the number of belt plies and material construction.
- Therefore, the standard rule is that the diameter of the drive head pulley should not be smaller than 125 times the number of plies in the belt.
Pulleys are made up of several components including the shell, end disk, hub, shaft and locking assembly.

- The end disk and hub may be on piece.
- The locking assembly may also be replaced with a hub and bushing on lower tension pulleys.
- The shell is also referred to as the rim in some parts of the world.

### XII. SELECTION OF A CONVEYOR PULLEY

When selecting a pulley for a belt conveyor application, specifications will be determined by addressing the following steps:

<table>
<thead>
<tr>
<th>Table 4: Standard Procedure Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STEP 1</strong></td>
</tr>
<tr>
<td><strong>STEP 2</strong></td>
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<tr>
<td><strong>STEP 3</strong></td>
</tr>
<tr>
<td><strong>STEP 4</strong></td>
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<tr>
<td><strong>STEP 5</strong></td>
</tr>
<tr>
<td><strong>STEP 6</strong></td>
</tr>
<tr>
<td><strong>STEP 7</strong></td>
</tr>
<tr>
<td><strong>STEP 8</strong></td>
</tr>
<tr>
<td><strong>STEP 9</strong></td>
</tr>
</tbody>
</table>

Pulleys are manufactured in a wide range of sizes. The selection of pulley takes into account the wrap angle (1800), belt speed (1.5 m/sec), method of belt strain, belt tension T, belt width (1200 mm) and type of splice of the conveyor belt. The pulley diameter is obtained from standard value from the catalogue. Once the pulley diameter is determined, the size of the coupling can also be decided from the catalogue.

### XIII. ADVANTAGES

- Low manufacturing cost of the equipment.
- Easy to handle.
- Less weight.
- Compact in size.
- Cost of checking the error is less.
- All kinds of material can the handled.
- Even a lay man can work in it.

### XIV. LIMITATION

- Accumulation difficult.
- Continuous or periodic monitoring of belt is necessary.
- Heat affects the material of belt

### XV. APPLICATIONS

- Used in automobile industry
- Can be applied in gear manufacturing unit.
- Used in airport.
Also used in stone crushing industry.
Used in both small scale industries as well as the large scale industries.
Its outcome can be utilized properly to a great executed in mechanical field as well as the automobile field.
Also used in Warehouses
In coal industry
Food and packaging industry

XVI. RESULT/FIBRICATION

XVII. CONCLUSION

This projects proves that this type of 90° perpendicular system can be fabricated and operated in the Industry which will be very beneficial for the users and also it’s easy to fabricate as per the requirement. The transfer of Martials at very small is also possible and this system is cheap to fabricate and operate in short time.

REFERENCES