

Belt Conveyor Design Calculations Report

Conveyor and Belt Parameters:

- **Length of Conveyor:** 400 mm (0.4 m)
- **Belt Width:** 300 mm (0.3 m)
- **Belt Type/Thickness:** PVC, 2.1 mm
- **Belt Density:** 2.3 kg/m²

Motor and Drive Parameters:

- **Motor Type:** DC Brushless Motor
- **Desired Linear Speed:** 0.33 m/s (300 mm/s)
- **Roller Diameter:** 25 mm (0.025 m)

Load Considerations:

- **Total Load on Conveyor:** 2 kg
- **Mass of Belt:** 0.69 kg
- **Total Mass:** 2.69 kg (including belt and load)

Friction Considerations:

- **Coefficient of Friction (μ):** 0.2
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Step 1: Power Calculation

Frictional Force

- **Normal Force (N)** = Total Mass \times g (acceleration due to gravity) $N = 2.69 \text{ kg} \times 9.81 \text{ m/s}^2$
 $= 26.38 \text{ N}$
- **Frictional Force (F)** = Coefficient of Friction \times Normal Force
 $F = 0.2 \times 26.38$
 $= 5.276 \text{ N}$

Power Requirement

- **Linear Speed** = 0.33 m/s
- **Power** = Force × Velocity

$$P = 5.276 \text{ N} \times 0.33 \text{ m/s}$$

$$= 1.741 \text{ W}$$

Convert to horsepower:

$$P = 1.741746 \text{ W}$$

$$= 0.00233 \text{ Hp}$$

- **Required Motor Power** with a safety factor of 1.5:

$$P_{\text{required}} = 0.00233 \text{ Hp} \times 1.5$$

$$= 0.0035 \text{ Hp}$$

So, the required motor power is approximately **0.0035 Hp** (or **2.6 W**).

Step 2: Motor Speed Calculation

Roller Dimensions

- **Roller Diameter** = 25 mm = 0.025 m
- **Roller Circumference** = $\pi \times \text{Diameter}$
 $C = 3.1416 \times 0.025$
 $= 0.07854 \text{ m}$

Motor Speed for Desired Linear Speed

- **Linear Speed** = 0.33 m/sec
 - **Motor Speed (RPM)** = (Linear Speed × 60) / Roller Circumference
 $\text{Motor Speed} = 0.33 \times 60 / 0.07854$
 $= 252.1 \text{ RPM}$
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Step 3: Torque Calculation

Angular Speed (ω)

- **Motor Speed** = 252.1 RPM
- Convert RPM to rad/sec:
 $\omega = 252.1 \times (2\pi / 60)$

$$=252.1 \times 0.1047$$

$$=26.38 \text{ rad/sec}$$

Torque (T)

- **Power (P)** = 1.741 W
- **Torque (T)** = Power / Angular Speed
 $T = 1.741 / 26.38$
 $= 0.066 \text{ Nm}$

Step 4: Moment of Inertia (MOI) Calculations

MOI of the Roller

For a solid cylinder (roller), the moment of inertia is:

$$\text{MOI roller} = \frac{1}{4} \times M \times R^2$$

Assume the mass of the roller is 0.4 kg, and the radius is half of the diameter (0.025 m / 2 = 0.0125 m):

$$\begin{aligned} \text{MOI roller} &= \frac{1}{4} \times 0.4 \text{ kg} \times (0.0125 \text{ m})^2 \\ &= 3.125 \times 10^{-5} \text{ kg.m}^2 \end{aligned}$$

MOI of Object in Linear Motion (Belt + Load)

$$\text{MOI object} = \text{Total Mass} \times (\text{Roller Circumference} / 2\pi)^2$$

Where:

- **Total Mass** = 2.69 kg
- **Roller Circumference** = 0.07854 m

$$\begin{aligned} \text{MOI object} &= 2.69 \times (0.07854 / 2\pi)^2 \\ &= 411.5 \times (0.02245)^2 \\ &= 4.203 \times 10^{-4} \text{ kg.m}^2 \end{aligned}$$

Total Torque Calculation

Belt Pulling Torque

$$T_{\text{pull}} = \text{Pulling Force} \times \text{Roller Radius}$$

$$T_{\text{pull}} = \text{Pulling Force} \times \text{Roller Radius}$$

$$T_{\text{pull}} = 5.276 \times (25/2) \times 10^{-3}$$

$$= 0.06595 \text{ Nm}$$

MOI Torque

- **Angular Acceleration (α)** = (Final Speed - Initial Speed) / Time
 Assume acceleration time is 1.5 seconds, and the final angular speed of the motor is 252.1 rad/sec**
 $\alpha = (250 - 0) / 1.5$
 $= 167 \text{ rad/sec}^2$

Now calculate the MOI torque using the combined MOI (roller + object):

$$T_{\text{MOI}} = (MOI_{\text{roller}} + MOI_{\text{object}}) \times \alpha$$

$$T_{\text{MOI}} = (3.125 \times 10^{-5} + 4.203 \times 10^{-4}) \times 167$$

$$= 0.0754 \text{ Nm}$$

Total Torque

The total torque is the sum of belt pulling torque and MOI torque:

$$T_{\text{total}} = T_{\text{pull}} + T_{\text{MOI}}$$

$$= 0.066 \text{ Nm} + 0.0754 \text{ Nm}$$

$$= 0.1414 \text{ Nm}$$

Final Results Summary:

- **Required Power: 2.6 W (0.0035 Hp)**
 - **Motor Speed (Desired Speed): 252.1 RPM**
 - **Required Torque: 0.1414 Nm****
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Motor selection:



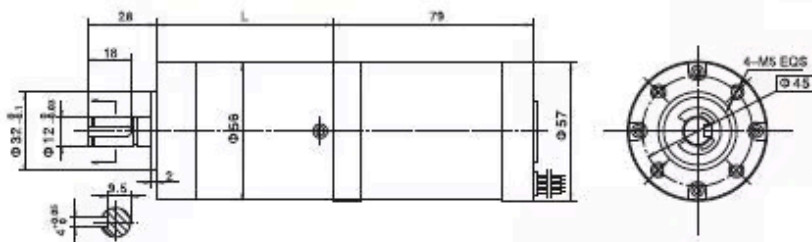
DC Planetary Gear Motor

PG56/57ZWN75

BLDC GEAR MOTOR



● 外形和安装尺寸 Dimensions



● 无刷电动机主要技术参数 Brushless Motor Technical Data

电机型号 TYPE	额定电压 Rated voltage VDC	空载转速 No-load speed r/min	空载电流 No-load current mA	额定转速 Rated speed r/min	额定转矩 Rated torque mN.m	输出功率 Output power W	额定电流 Rated current A
57ZWN75-2420	24	2000	450	1200	300	40	2.8
57ZWN75-2430	24	3000	400	2000	300	60	4.0

● 无刷行星齿轮减速电机主要技术参数 Brushless Gear Motor Technical Data

配置57ZWN75-2420无刷直流电机 (57ZWN75-2420 BLDC Motor)

减速比 Reduction ratio	3.6	4.25	13	15	18	32	47	55	65	76
减速级数 Number of gear trains	1	1	2	2	2	2	3	3	3	3
减速器长度(L) Length(L)	mm	41	41	53	53	53	53	64	64	64
空载转速 No-load speed	r/min	556	471	154	133	111	63	43	36	31
额定转速 Rated speed	r/min	333	282	92	80	67	38	26	22	18
额定转矩 Rated torque	N.m	1.0	1.1	3.2	3.6	4.4	7.8	10	12	14
最大瞬时允许负载 Max. permissible load in a short time	N.m	6	6	25	25	25	25	50	50	50

配置57ZWN75-2430无刷直流电机 (57ZWN75-2430 BLDC Motor)

减速比 Reduction ratio	3.6	4.25	13	15	18	32	47	55	65	76
减速级数 Number of gear trains	1	1	2	2	2	2	3	3	3	3
减速器长度(L) Length(L)	mm	41	41	53	53	53	53	64	64	64
空载转速 No-load speed	r/min	833	706	231	200	167	94	64	55	46
额定转速 Rated speed	r/min	556	471	154	133	111	63	43	36	31
额定转矩 Rated torque	N.m	1.0	1.1	3.2	3.6	4.4	7.8	10	12	14
最大瞬时允许负载 Max. permissible load in a short time	N.m	6	6	25	25	25	25	50	50	50

Ningbo Leison Motor Co.,Ltd. [Http://www.nbleisonmotor.com](http://www.nbleisonmotor.com) Tel:86-574-27950958

The PG56/57ZWN75 BLDC Planetary Gear Motor has two types:

1. 57ZWN75-2420 (24V, 200W)
2. 57ZWN75-2430 (24V, 300W)

Each motor comes with different gear ratios and specifications. Here are the options relevant to your needs:

Motor: 572WN75-2420 (24V, 200W)

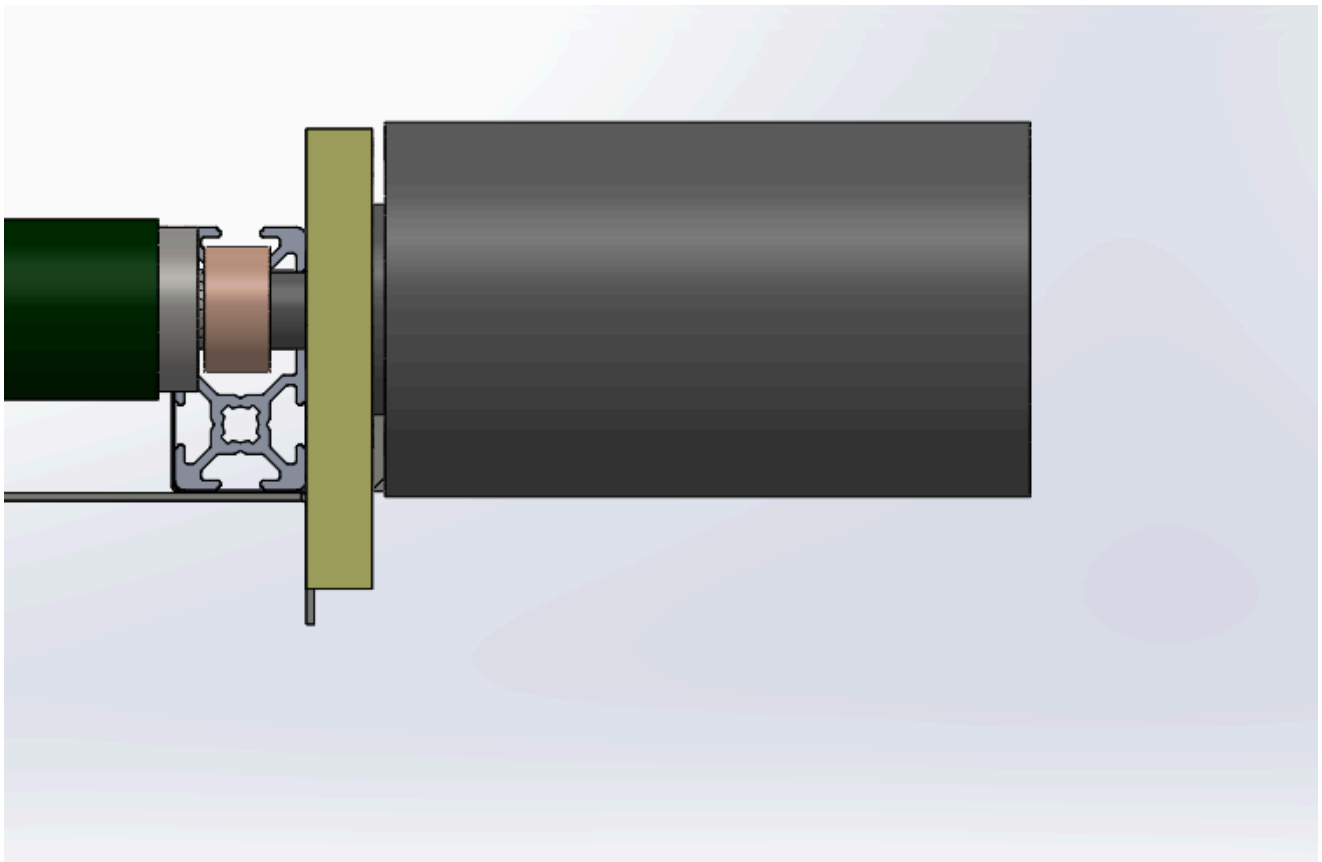
Gear Ratio	Rated Torque (Nm)	Output Speed (RPM)	Max possible load in short time (Nm) = peak torque
3.6:1	1	333	6
4.25:1	1.1	282	6
13:1	3.2	92	25
15:1	3.6	80	25

Motor: 572WN75-2430 (24V, 300W)

Gear Ratio	Rated Torque (Nm)	Output Speed (RPM)	Max possible load in short time (Nm) = peak torque
4.25:1	1.1	471	6
13:1	3.2	154	25
15:1	3.6	133	25
18:1	4.4	111	25

here 572WN75-2420 (24V, 200W)** with 4.25:1 Gear motor satizfied all my conditions so finally

572WN75-2420 Brushless 4.25:1 gear motor is finalized.

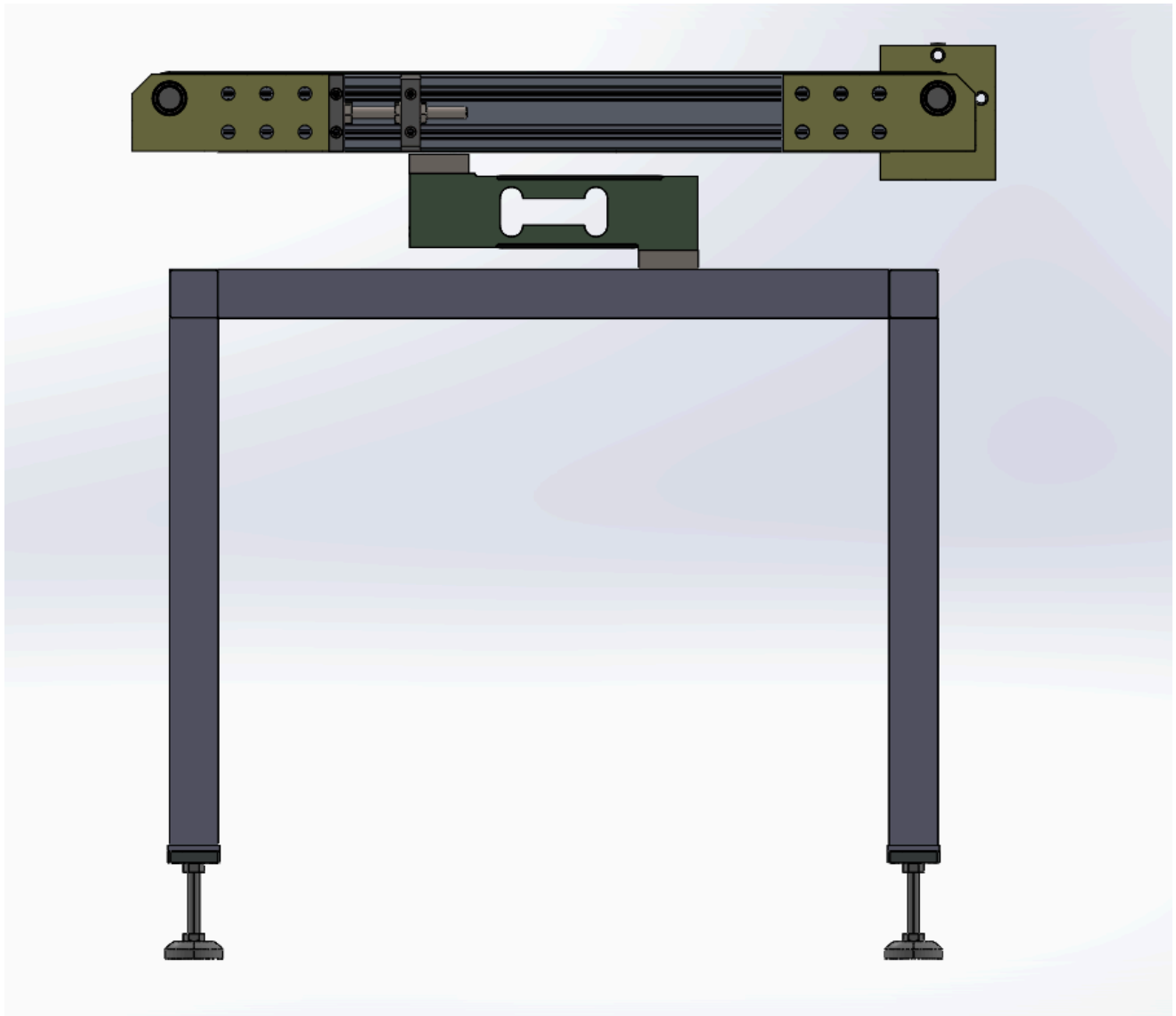


here motor connected with shaft through coupling

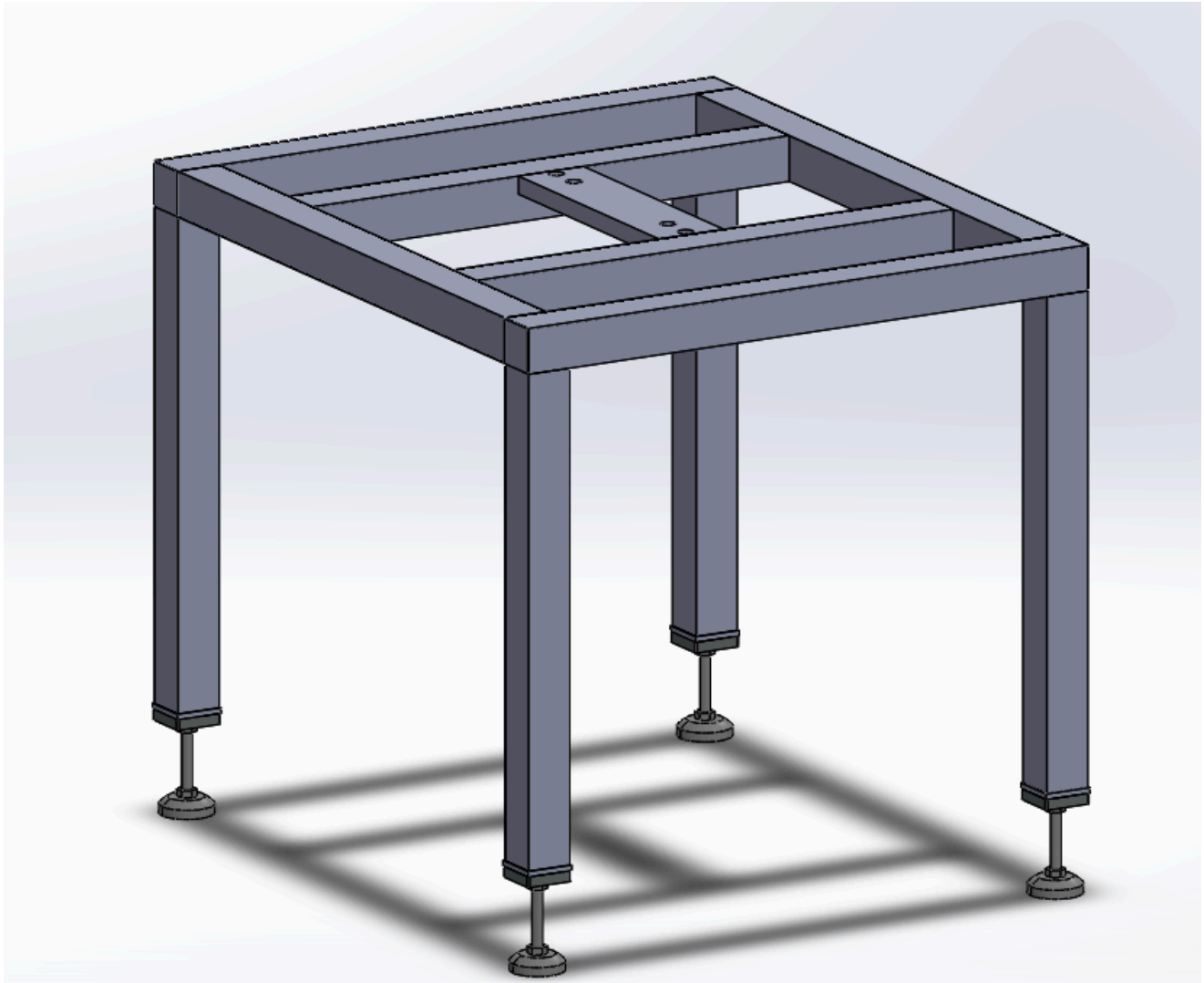
Load cell selection:

AZL30 : <https://www.laumas.com/en/product/azl-single-point-load-cells-for-platforms/?code=AZL30>

Load cell alignment



Base



Final Design

