

## 21. Steep Angle Conveying

Light Belt Conveyor Installation – Engineering Guidelines



The same principles of construction and belt guidance apply to the conveyance on inclined sections as discussed in the previous chapters. The following points should also be taken into account.

### 21.1 Steep angle conveyor installation

Head drive is recommended for inclined conveyance, while tail drive is preferable for declined installations as it acts as a brake when required. This illustrates the fact that, in both cases, it is best to install the drive station at the elevated end of the conveyor.

The maximum gradient on which goods can be conveyed without slipping or tilting depends on the following factors:

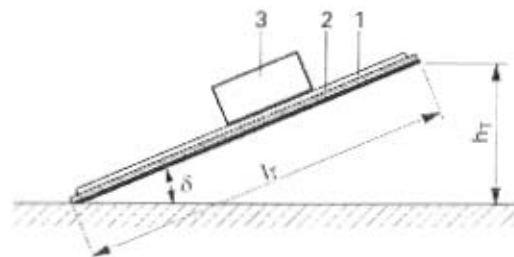
- ❑ Weight, surface finish (material, structure) and position of the center of gravity of the conveyed goods
- ❑ Surface finish (material, structure) of the conveyor belt
- ❑ Operation conditions (belt speed, stop-and-go, vibrations)
- ❑ External influences (humidity, temperature, soiling)

The choice of the correct conveyor belt is very important. As a general rule, belts with a smooth but adhesive surface can be used for installations with gradients of about  $\delta \leq 20^\circ$ .

Belts with a structured conveying side can be used for gradients of up to  $\delta \approx 40^\circ$  to  $45^\circ$ . From about  $\delta > 45^\circ$  transverse profiles are required. Extreme gradients are often managed by spiral conveyors, bucket elevators, or totally enclosed cleated belt conveyors.

The maximum possible angle of inclination  $\delta$  for the conveyance of product X with belt Y can be determined by a simple method. Fix a sample belt (1) on a rigid support, such as a wooden board (2) and place on it one or more of the goods to be conveyed (3). Now incline the support until the goods start to slide.

Measure the gradient height  $h_T$ , just before sliding starts and divide this height by the length of support  $l_T$ : in this way you obtain the maximal possible angle of inclination  $\delta_{\max} = \arcsin \frac{h_T}{l_T}$ .



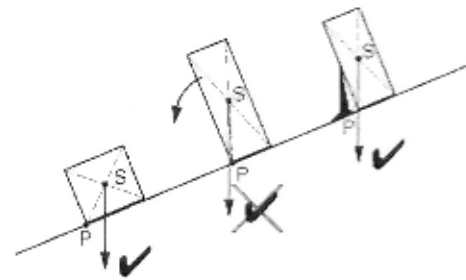
Of course the maximum angle of inclination will, in practice, be greatly affected by external influences such as temperature, humidity, and soiling, as well as by general operating conditions and belt age. These factors must be fully taken into account when determining the effective angle of incline  $\delta_{\text{eff}}$  for a particular installation: Always set  $\delta_{\text{eff}} < \delta_{\max}$ !

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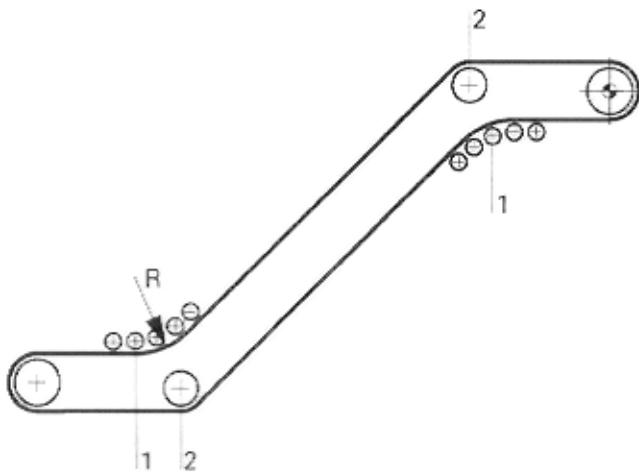
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Care must be taken that the goods do not overturn. In other words, it is essential that the center of gravity *S* of each conveyed piece on the elevated side of point *P*. This applies to belts both with and without short profiles.



### 21.2 Z-conveyor installations



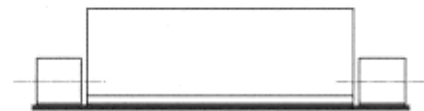
Due to its special appearance, the Z-conveyor is also commonly known as a goose-neck conveyor.

In general the same points apply for the Z-conveyor as for a simple steep angle conveyor. However, with the Z-conveyor one must also pay particular attention to the transition point due to the increased mechanical load in this area.

- Select the largest possible transition radius *R*.
- On each edge of the conveying side, install preferably 3 to 5 small supporting rollers (1). On the opposite side of the belt a deflection roller (2) with a diameter of at least  $d = 200 \text{ mm}$  (8 in.) should be installed.
- Select the widest possible transition rollers (recommendation  $B \geq 50 \text{ mm}$  (2 in.)), and



install them as close as possible to the transverse profiles and corrugated side walls.



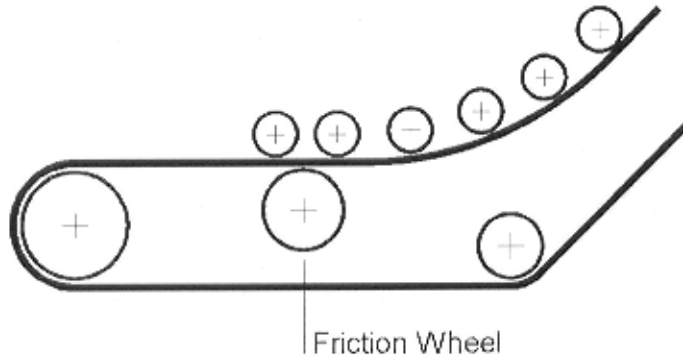
- As the supporting rollers have bearings on only one side, care must be taken to ensure that they are well supported and stable. The rollers must be installed at right angles to the belt running-direction and must not be affected by the tensile forces acting upon the belt.
- Specify a conveyor belt with the highest possible transverse rigidity to maintain a laterally flat disposition of the belt.
- To keep the belt tension as low as possible, it is advisable to lag the driving pulley so to minimize lateral bowing of the belt in the transition areas.

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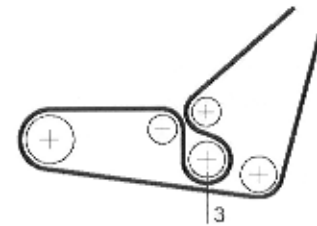
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- ❑ As an alternative to a typical pulley drive, friction wheels can be installed at the belt edges on running side of the belt, beneath the transition rollers (lowest belt tension).



- ❑ Belt tracking should be effected by means of a cylindrical-conical tail roller, and/or driving pulley, which can be assisted by pivoting the deflection rollers (2).
- ❑ With a special design, a solution with the smallest transition radius can be achieved. Negative effects associated with this method are chiefly an increased risk of belt soiling, increased belt load due to counter-flexion, tracking problems, or splice failure resulting from debris entrapped in the area of the diverting roller (3). Attention must be paid to pulley diameter sizes!



- ❑ Belts with longitudinally oriented guides (i.e., v-guide) bonded along each edge may also be incorporated to restrain the belt and keep it from bowing laterally at the transitions. Operating conditions, and design parameters as described in Chapter 15 must be fully considered.