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Skirting disaster with skirtboards

R. Todd Swinderman, Martin Engineering, explores proper skirtboard configurations for preventing dust and spillage in cement production.

Belt conveyors without an enclosure at the transfer point loading zone may still exist in some cement operations but are becoming a thing of the past due to dust violations and excessive spillage. Whether the transfer chute is a dead drop, rock box design, or sloped design, dust and spillage from dry bulk material will still exist and must be controlled. Spillage can limit access to a system for maintenance, foul rolling components, add to labour costs for clean-up, and reduce workplace safety.

A skirtboard on either side of the conveyor belt that is sealed with a cover certainly helps but operators have found that the air turbulence from loading still causes fugitive dust to escape if a wear liner and skirting is not applied. Moreover, there are nuanced details that conveyor engineers should consider when designing a conveyor transfer point.

While controlling belt wear and the release of fugitive materials, all components of a skirtboard system must work together to contain the load as it forms a stable profile in the centre of the belt. Several skirtboard system design approaches can be used based on industry historical practice and the application. This article covers some of the common approaches bulk handlers use to mitigate dust and spillage and ensure a safe and compliant workplace with a lower cost of operation.

Figure 1. This an example of a fabricated curved skirtboard, which are hard to maintain when replacing wear liners and skirting.

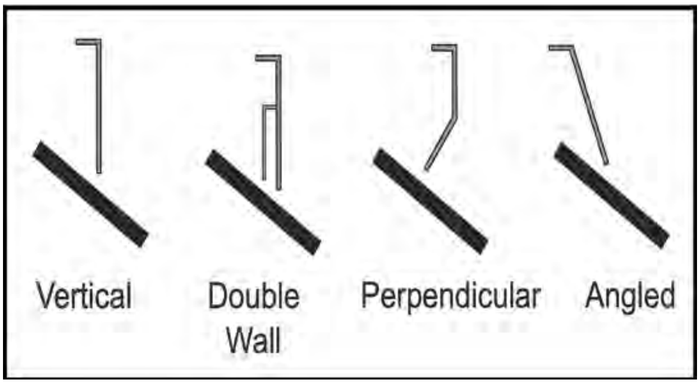

Figure 2. Skirtboard configurations.

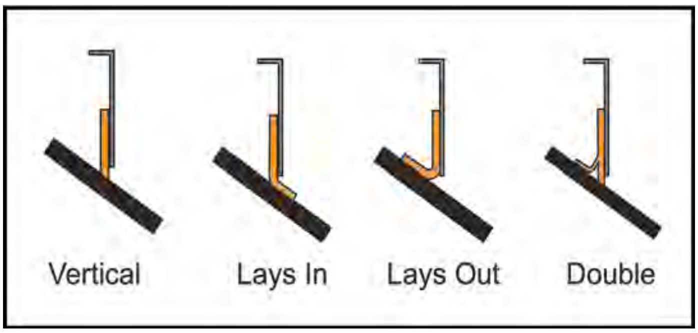

Figure 3. Skirt seal configurations.

Configuring the skirtboard

By far the most common configuration is the vertical skirtboard. It is the easiest to fabricate and is a common detail for most engineering design firms (Figure 2).The height of the skirtboard is based on the sealing system components and is commonly at least 300 mm high. The double wall skirtboard is sometimes used with dust extraction for very fine free flowing materials.

The perpendicular and angled configurations are used in some industries. Angled skirtboards are designed to allow the load to centre. Perpendicular skirtboards relieve side pressure on the skirtboard seal. In theory, the perpendicular arrangement should allow for light seal contact but in reality, the angle of attack of the seal is not nearly as important as having a running flat belt surface for the seal and liner system to function best.

Skirt sealing configurations

A vertical seal with a rubber or elastomeric material is the most common sealing system (Figure 3). The seal is held in place with a series of clamps which can be loosened to adjust the seal against the belt. The main drawback to the vertical seal is that an undulating or vibrating belt can break the sealing contact unless the belt is supported. The lay-in and lay-out seals are self-adjusting depending on the elastic nature of the sealing material. The double skirting configuration is the most effective in retaining a belt seal. Even if the belt profile fluctuates, the secondary seal rides softly on the belt, retaining the seal. Any material that gets in between the double seal strips is non-abrasive, being carried by the belt, and rolls back to the centre once the skirtboard ends.

It is a common belief that the seal material must be softer than the belt but the real property of concern is that the abrasion resistance of the seal should be less than the belt top cover. The seal should be considered sacrificial and designed for easy adjustment and replacement without the need for excessive sealing pressure. Over adjustment can cause excessive friction heat of the seal, leading to heat damage on the belt, as well as premature wear of skirting. In extreme cases, the heat generated can cause the seal to stick to the belt during shut down, which can prevent startup.

The sealing pressure should be light with the skirtboard or the liners designed to reduce pressure on the seal. There is not much published on seal pressure values. For the self-adjusting seals, use 15 kPa contact pressure. CEMA proposes added belt tension of about 4 kN/m per side without considering the seal thickness.

Wearliner configurations

The wearliner has two functions. Firstly, it is a sacrificial wear material protecting the skirtboard wall. Secondly, it reduces the side pressure on the sealing system. Not all systems require a liner. The most common liner is the internal liner made of abrasion resistant material such as AR plate or ceramic blocks. The liner is often attached with bolts through the skirtboard with some ability to adjust the space between the bottom and the belt for initial installation and to adjust for wear (Figure 4).

The deflector liner is a variation of the internal liner that is used to centre the load and reduce side pressure on the seal. The canoe liner performs a similar centring effect with a substantial volume of wear material and is often used in heavy duty applications like limestone mining essential to cement production. Canoe liners can be made from elastomeric materials or very hard cast metals.

The most important details for a liner are proper installation and ease of replacement. The external liner was developed to address these two issues. With the external liner, the skirtboard is raised above the expected depth of material rubbing against it and the liner is attached to the outer surface of the skirtboard. If there is concern over wear caused by full contact with the skirtboards, such as from constant overloading and plugging, the exposed upper portion of the skirtboard can be covered in wear resistant material. The external design eliminates the gap between the liner and the seal, created by the skirtboard wall thickness, that can trap materials and damage the belt.

Skirtboard cover configurations

Covers protect the cargo from weather but are used primarily for dust control. Covers enclose the loading zone and contain splashing material caused by significant drop distances from one belt to the other or process equipment such as rotary crushers. The most common cover is the rigid flat cover made from steel. When rain protection or buildup of fugitive materials is a concern, angled or semi-circular covers are often used (Figure 5).

Plastic covers are sometimes used to reduce weight. Regardless of the cover design, the most critical design feature is ease of access. When there is a lot of positive pressure in the enclosure, sealing the covers becomes an issue. Porous covers are sometimes used to reduce positive pressure, but the most common membrane applications are rubberised fabric with continuous grip edges that can connect between vibrating equipment such as screens and the skirtboard enclosure.

Unfortunately, in the rush to get back into production, covers that are removed during cleaning or maintenance are often not replaced in those areas that require frequent access. Maintaining the integrity of the covers is critical to the control of fugitive material. If it is possible that covers will be walked upon, load bearing work platforms should be incorporated into the design.

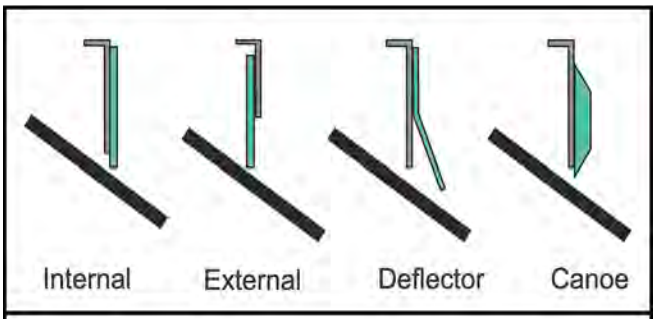

Figure 4. Wearliner configurations.

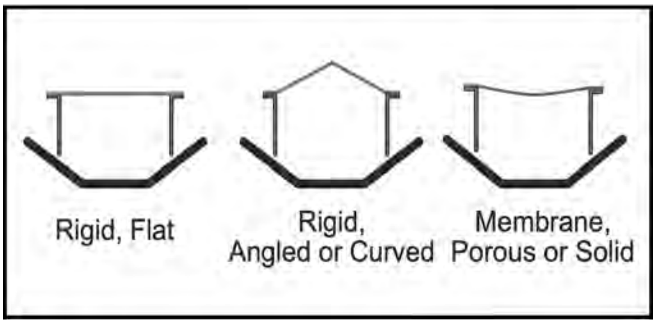

Figure 5. Skirtboard cover configurations.

Skirtboard design and installation

Skirtboards are most often installed vertically and parallel to the centreline of the belt. Misalignment of the skirt board system will contribute to pushing the belt to one side and can cause mistracking. Skirtboards for multiple load points, when it is not desirable to have continuous skirting, are often staggered widths with inlet deflectors to consolidate the material at the edges. For continuously skirted loading with multiple loading points, the feeds can be managed to gradually increase until the full cross-sectional area is utilised. Reversing belts must use skirtboards parallel to the belt (Figure 6).

In some cases, such as flat belt feeders, it is desirable to create a relief of the skirtboards in the direction of travel to help more uniformly feed the material from a bin. The notch opening wider in the direction of belt travel can be designed using mass flow techniques. Absent the notch (or 'V' design) material will tend to feed only from the rear and can result in segregation or bin plugging. Using this technique on troughed belts adds to the fabrication complexity so there is often a transition section from the bin to the skirtboards that accomplishes the same end result but simplifies the design and installation of the skirtboards.

The distance the bottom edge of the skirtboard or wearliner from the belt surface often varies by industry. Some designers keep the skirtboard high off the belt to facilitate idler changes but a better solution is to use retractable idlers. Installing the liner parallel to the belt is required for reversing belts. The primary issue is the flatness of the belt in the loading area. To achieve a good seal without damaging the belt's surface, the belt must be supported.

Some cement producers who use winged tail pulleys, load on the transition from flat to fully troughed or use widely spaced idlers in the load zone, will have a difficult time sealing the belt and preventing grooves made under the seal.

If the transition is incorrectly designed, the belt can lift off the idler when unloaded, requiring the liner to be too far above the belt, resulting in spillage and/or trapped material. Winged pulleys should be of the spiral design or wrapped to reduce dust pumping vibration. Common practice is to place the wearliner bottom edge parallel, but close to the belt, with approximately 25 mm of clearance for the skirtboard upright from the belt. The liner is then adjusted to be closer to the belt in the range of 10 – 20 mm and self-relieving in the direction of travel. Adjustment of the liner so there is a smooth surface presented to the belt without steps or gaps between liner sections is a must to prevent particles from being trapped and abrading the belt.

Conclusion

Each approach is unique to the application and the bulk handling environment, but preventing dust and spillage make the cost of the modifications easy to justify over the long run. It is worth considering installing an enclosed modular loading chute with an external wear liner and double skirting. Make sure that the skirtboard

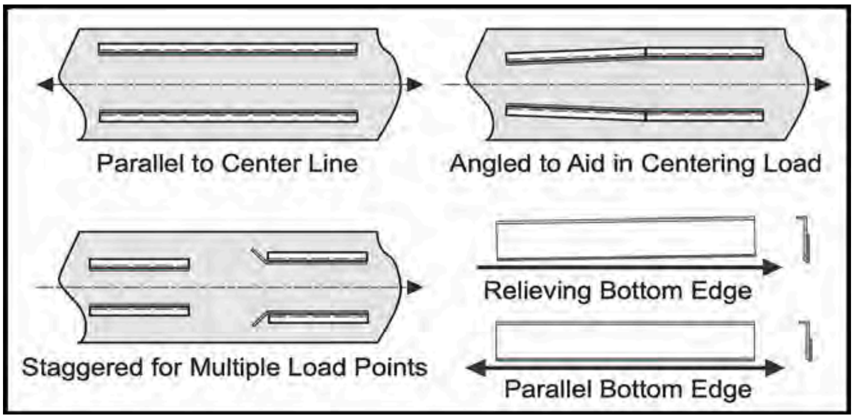

Figure 6. Skirtboard installation configurations.

and cover are long enough so that turbulent air can slow and dust can settle back into the cargo stream. The modular design allows the chute to be easily adjusted to changes in production, belt speed, or material and the seal and wear liner are adaptable to those changes. This lowers the cost of future modifications and improves the overall safety of the transfer point through the life of the conveyor. ■

Figure 7. The raised skirtboard allows room for the external wearliner to perform its function and be changed easily from outside the system.

About the author

R. Todd Swinderman earned his B.S. from the University of Illinois, joining Martin Engineering's Conveyor Products division in 1979 and subsequently serving as V.P. and General Manager, President, CEO and Chief Technology Officer. Todd has authored dozens of articles and papers, presenting at conferences and customer facilities around the world and holding more than 140 active patents. He served as President of the Conveyor Equipment Manufacturers' Association (CEMA) and was the Editor of CEMA's 6th and 7th editions of 'Belt Conveyors for Bulk Materials, The Design Guide for Belt Conveyors'. Todd is active on several CEMA committees including Chair of the Bulk Safety Committee and is a member of the ASME B20 committee on conveyor safety which set US conveyor safety standards. Swinderman retired from Martin Engineering to establish his own engineering firm, currently serving the company as an independent consultant.