Modular thinking

A recent EPC distribution terminal project, completed by PENTA Industrial Corp, highlights the benefi ts of modular design where components can be assembled at the factory without the need to use craft labor near the construction site, saving time. Modular thinking also places environmental control, efficient loading and steel bin storage at the centre of design requirements.

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For cement producers to be competitive in dynamic and changing markets, they must be able to upgrade and expand their cement distribution network quickly to respond to the customers' changing and time-sensitive needs. For example, the recent oil and gas boom saw demand for oil-well cement grow rapidly in just a few years with oil-well cement producers keen to take advantage of this market opportunity. This required a fast-track construction schedule for new cement distribution terminals. In some cases, where terminals are located in remote rural areas, this presents an additional issue as finding experienced craft labor to carry out such projects is both time- and cost-consuming.

Modular terminal design allows for the fast construction and installation of cement distribution termimals

Terminal construction

The cement distribution terminal typically consists of an unloading system (for rail, barge or truck), a filling system for bin (or dome) storage with appropriate dust collection and automated truck load-out with an automated weigh scale system. Other components can include a rail shed to cover the railcar at the unloading station for weather protection, office/control building, compressor and electrical room(s).

To optimize the construction of the distribution terminal by reducing project costs and schedule, components such as the office building can be prefabricated. In addition, the control room, compressor rooms and electrical rooms can be containerized and delivered to the site as 'plug-and-run' systems thereby supporting a fast-track schedule.

Unloading system and material transfer

For rapid railcar unloading, either a screw conveyor or air gravity conveyor system is used to receive and transfer cement from the railcar to the bucket elevator. The system includes an underground rail pit with gathering screw conveyors (or air gravity conveyors) that transports the material to the bucket elevator. A shed can be erected around the unloading system to minimize both dust and noise, as well as offer weather protection. The unloading system is partially enclosed, economical, low maintenance and designed to eliminate spillage. The screw conveyor can be arranged on an incline allowing the bucket elevator to be placed above grade and eliminate the elevator pit. Occasionally, the space limitations preclude this and a pit with rain cover is supplied.

For a marine unloading system, self-unloading barges with pneumatic conveying are often used. A pneumatic conveying system includes the same benefits of a screw conveying system. It is fully enclosed to avoid spillage but also requires less maintenance since there is less mechanical equipment involved. A screw conveying system should be considered when a fixed system can remain in place. A pneumatic system is a preferred option when dock space is limited and the conveying system needs to be mobile.

After the screw conveyor discharges cement into a collection hopper, a bucket elevator transfers the cement into the storage vessel. Bucket elevators used in distribution terminals in the past could have steel buckets attached to a chain. To reduce weight and provide more efficient operation with less power consumption, the buckets are fabricated out of a polyethylene material and attached to a belt. To increase the amount of cement transfer into the storage system, larger buckets can be considered, as well as spacing the buckets closer together. The entire bucket elevator is enclosed to eliminate any fugitive dust and spillage out of the buckets.

Storage

There are several options to consider for bulk terminal storage including flat storage, concrete dome, steel bin and concrete silo storage.

Flat storage is a low-cost storage option with several compartments enabling the storage of different cement types. Moreover, it is a flexible design that can be easily expanded. However, this set-up is labor intensive with material being reclaimed by front loader. Moreover, since flat storage can take up a large land area,

geographic location and area available for the storage facility should be taken into account.

Dome storage provides a large volume economical storage option that can be fully automated. Capital expenditure is higher than flat storage but less costly than silo storage. Reclaim can be carried out by mechanical screw auger or fluidised floor can be used. This option is generally used for a single cement type.

Steel bin storage is a versatile storage option for distribution terminals. Multiple bins can be constructed to house different types of cement and this system has a smaller footprint compared to flat storage or dome storage. Bins can be welded or bolted steel although most are of the bolted type. These are easily shipped and can be field erected more quickly compared to field-welded tanks.

Concrete silos are typically for the storage of 5000-15,000t and more of product. Compared to steel bins, they have a lower cost per stored tonne. As with steel bins, multiple silos are needed to store different types of cement.

Dust collection

To ensure the terminal meets local, state and federal air emissions regulations, a suitable dust collection system must be installed.

For terminals, the dust collector is typically located on top of the silo and vent hoods, and ducting collects dust from the top of the bucket elevator, as well as the dust from silo loading due to displaced air. The collected material is then deposited back into the silo, minimizing material loss.

Loading

The truck loading system consists of a slide gate, flow control gate and an air gravity conveyor with loading spout to discharge material into the truck. Dust collection will also be integrated into the system.

Once a truck is loaded, the automated loading system measures and registers the weight and confirms the required product volume has been loaded

This process can be automated to ensure proper material quantities are loaded. Once the truck is loaded, a unit scale, which is calibrated to local standards, measures and notes the weight of the truck to confirm the required material quantity has been loaded.

Auxiliary systems

Distribution terminals often include an office building with control room that houses automation systems, camera feeds, meeting space, restroom facilities, and electrical and compressor rooms. Alternatively, both electrical and compressor rooms can be containerized, shipped prewired to the site and erected on poured foundations.

Pavements, rail and storm water control systems are site specific and vary at each location depending on site arrangement.

Conclusion

With a modular terminal design and an understanding of distribution terminal systems and construction, the process of upgrading or building a greenfield distribution terminal can be carried out rapidly, efficiently and cost effectively.

Moreover, because some terminals are located in rural areas where experienced craft labor is difficult to find, modular designs allows for systems to be assembled at the factory.

PENTA understands how to plan and execute cement distribution terminal projects on a design/build basis, and has successfully completed numerous worldwide inland and marine cement distribution terminals as both upgrades/expansions and greenfield projects. ■

US greenfield case study

PENTA recently completed a confidential greenfield distribution terminal in the central United States on a design/build basis.

The client's planned throughput and the market conditions required a system designed to have two truck load-out spouts under two drive-through steel bins where cement trucks are loaded simultaneously. To accommodate maintenance shutdown of one of the silos, PENTA designed a system in which material can be conveyed from either of the silos to the other and keep one load-out operating at all times.

The terminal consists of a PENTA proprietary-designed rail unloading pit and system that uses air gravity conveyors to transfer the cement from the railcars to the bucket elevator. The auxiliary equipment to transfer the cement is designed for the same transfer rate. A rail shed, sided along the length of the building was also installed to minimize fugitive airborne dust. The bucket elevator transfers the material into an air gravity conveyor at the silo roof, which in turn feeds material into the two steel bolted silos. In addition, six-inch blow-off lines are provided to allow cement trucks to fill either of the silos.

Due to stringent regulatory emissions requirements, dust collection was carefully sized and integrated within the system to control emissions. Truck loading was carried out through an aerated bin bottom and dustless loading spouts. The load-out system was designed such that material from either of the silos can be transferred to the other load-out during periods of maintenance.

The system is fully automated and the control room is located in an office where the operator has a clear view of the loading process through strategically-placed cameras. The office is designed to accommodate the needs of the truck drivers and the terminal operating staff.