

Summary

Spillage occurs when unloading bulk material from bulk carriers with slewing grab-type ship unloaders to a quay hopper. Conventional means to reduce the amount of spillage include the mounting deflection plates at the top of the quay hopper. These deflection plates are however restricted in size because of their dimensions and their high mounting location. The goal of this design study is to find alternatives to these conventional deflection plates and develop a spillage reducing hopper configuration design using the common transshipment values of slewing grab-type ship unloaders.

The most important boundary conditions for the design process are:

- design of the hopper configuration for coal transport
- the restriction of the design to employment on Panamax and Capsize coal bulkers
- the dimensions and transshipment values of a common slewing grab-type ship unloader
- required hopper capacity and resulting hopper dimensions
- mounting of the spillage reducing configuration on an existing quay track

With these boundary conditions in mind several functions have been defined for the spillage reducing hopper configuration:

- internal & quay transport of bulk materials (including spillage)
- spillage handling (by a spillage handling peripheral)

Concepts have been developed for these functions and have been combined into a final design concept.

This final design concept has led to the design shown in: Figure 1. It uses a large, hoisted, deflection plate to direct spillage to an internal conveyor belt which in turn unloads the bulk material to a quay conveyor belt. The whole hopper configuration is mounted on the quay track with powered wheel sets to enable movement alongside the quay.

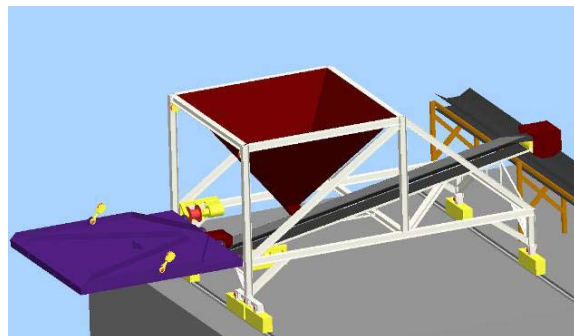


Figure 1: Design of a spillage reducing hopper configuration

A finite element method analysis has been applied during the design process of deflection plate to assure that it is strong enough to cope with the stresses of an entire grab load of coal being accidentally emptied onto it (the worst case scenario) while minimizing its weight.

A Failure Mode & Effects Analysis has shown that automatic control of the deflection plate is necessary. The deflection plate should always remain as close as possible to the ship hull/deck to avoid being in the path of the grab. Because of the relatively small resulting distance (about 1m) between the deflection plate and the ship automation of the deflection plate control is needed.

The deflection plate is sensitive to wind speeds above 21 m/s when it is in storage position. If higher wind speeds are expected it should be lowered into the horizontal position.

The movement control system of the hopper configuration over the quay track should only be activated when the deflection plate is in the storage position. This will make it impossible for the deflection plate to come into contact with ship protrusions when the hopper configuration is moved while the deflection plate is still extended beyond the quay wall.