THE UNIVERSITY OF NEWCASTLE AUSTRALIA

TUNRA BULK SOLIDS

DEM Analysis of Silo Eccentric Flow

Project Scope:

Bulk Solid Material: Coal

Equipment: Storage Silo

Problem: Cracks on Silo Wall

Aim: Analysis of Silo Asymmetry Normal Pressures due to Eccentric Discharge using DEM Simulation.

The eccentricities of the wall loads can cause bending stresses in the circumferential direction at various levels, which could have serious structural consequences. As such, understanding how the wall loads are affected by eccentric discharge is an important aspect of silo design.

The simulated silo in Figure 1 had two outlets with a capacity over ten thousand tonnes. Symmetrical filling and discharge with both outlets closed and open were simulated for the purposes of Discrete Element Modelling (DEM) model validation. The normal pressure results for symmetrical filling and discharge are shown in Figure 2. Although the silo capacity was very large, both results obtained by DEM simulation and Australian Standard AS3774 agree well with each other during filling and discharge.

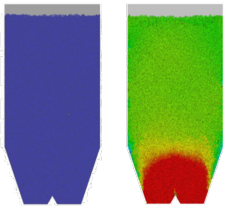

Figure 1: Silo symmetrical filling and emptying

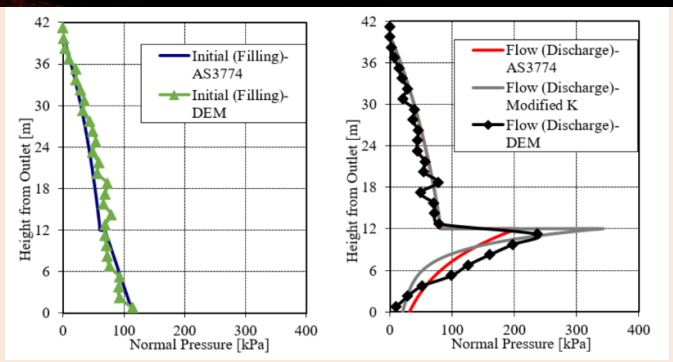

Figure 2: Normal loads during symmetrical filling and discharge

The wall loads during eccentric discharge were studied for the silo with only one outlet open. The discharge of material was via an offset flow channel which extended all the way to the top surface. The eccentric discharge of bulk solids from a silo has led to asymmetry in the material flow pattern. Figure 4 shows the normal pressure distribution around the wall at one meter up from transition where failure was observed in the silo. The normal wall pressure is much higher on the far side than that on the near side. The eccentric distribution in normal pressure around the silo walls would deteriorate

Therefore, when designing a silo with multiple outlets, it is necessary that the non-uniformity in wall stress caused by the eccentric discharge be given special attention. DEM provides an acceptable solution for analysing silo wall loads, which is particularly useful for silos with complex geometry not covered in Australian Standard AS3774.

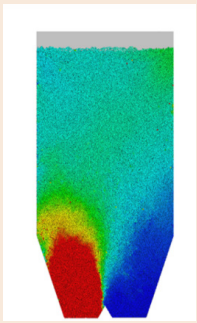

Figure 3: Silo eccentric discharge

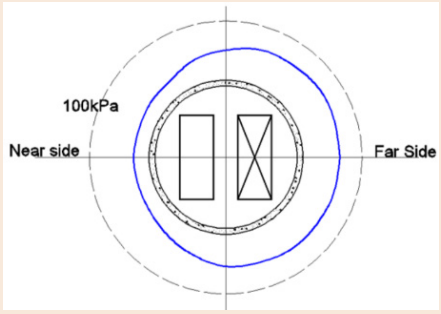

Figure 4: Normal pressure circumferential variation at 1 m above transition level

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