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MODELLING OF ECCENTRIC DISCHARGE IN THIN-WALLED METAL SILOS

ABSTRACT:

It has long been recognised that one of the most serious potential load cases for a slender metal silo storing a granular solids is the condition of eccentric discharge, a condition that has been responsible for many catastrophic buckling failures in the past. This unfortunate situation is a direct consequence of the enormous complexity inherent in accurately modelling the behaviour of granular solid flows, in translating these into realistic pressure patterns applied on the silo wall and in understanding the resulting highly nonlinear structural behaviour of the silo which must be treated as a thin-walled cylindrical shell susceptible to local buckling.

Recent years have seen a number of publications by the author which have attempted to shed some light on the phenomenon of eccentric discharge through sophisticated analytical modelling and nonlinear finite element analyses, many of which were the first of their kind. These studies explored many of the critical characteristics of this physical system, including varying shapes of flow patterns, varying granular material properties, varying silo geometries, silo designs and imperfection sensitivity, though much still remains to be done to fully understand this precarious phenomenon.

This presentation will offer a selection of a number of important results from these studies in addition to a number of more recent design recommendations, some of which have already gained a degree of exposure within the European engineering community.