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Structural behaviour of silos supported on discrete, eccentric brackets

M. Gillie ^{a,*}, J.M.F.G. Holst ^b

^a 38 Overdale Rd, Derby DE23 6AT, UK

^b School of Civil and Environmental Engineering, Crew Building, King's Buildings University of Edinburgh, Edinburgh EH9 3JN, UK

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Abstract

Supporting steel silos on discrete, eccentric brackets offers an attractive alternative to using traditional ring beam supports in terms of both cost and simplicity of construction. A range of silos of typical geometries are analysed and the structural behaviour presented. Collapse modes are found to include buckling, plastic collapse and combined mechanisms. The results of a finite element parametric study that considers the effects of bracket width, bracket height and geometric imperfections are then presented. It is found that the strength of bracket-supported silos is strongly but non-linearly dependent on bracket width. Increasing the bracket height also increases the silo strength. Bracket-supported silos are found to be generally imperfection insensitive. However, a weld imperfection placed above the bracket can result in significantly increased strength.

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Keywords: Silos; Bracket supports; Non-linear analysis; Structural behaviour; Buckling; Plastic collapse

1. Introduction

Granular solids storage containers such as silos are often discharged by gravity and so need a hopper with access space beneath. Where the silo is discharged into vehicles or conveyors, the clear space must be extensive and so most silos are supported on columns. Large silos generally require a heavy ring beam (Fig. 1) to redistribute the local forces from the columns into the silo shell. This design is expensive

* Corresponding author.

E-mail address: Martin.Gillie@penspen.com (M. Gillie).

Nomenclature

d	half width of bracket
h	height of bracket
e	bracket eccentricity
E	Young's Modulus of elasticity
F_y	plastic failure load
H	height of silo
l	distance from base of cylindrical shell to mid-height of bracket
n	number of bracket supports
r	radius of silo
t	thickness of silo wall
x	vertical deflection at the top of the silo on the zero meridian δ
δ_0	peak magnitude of imperfection
σ_y	yield stress
ν	Poisson's ratio

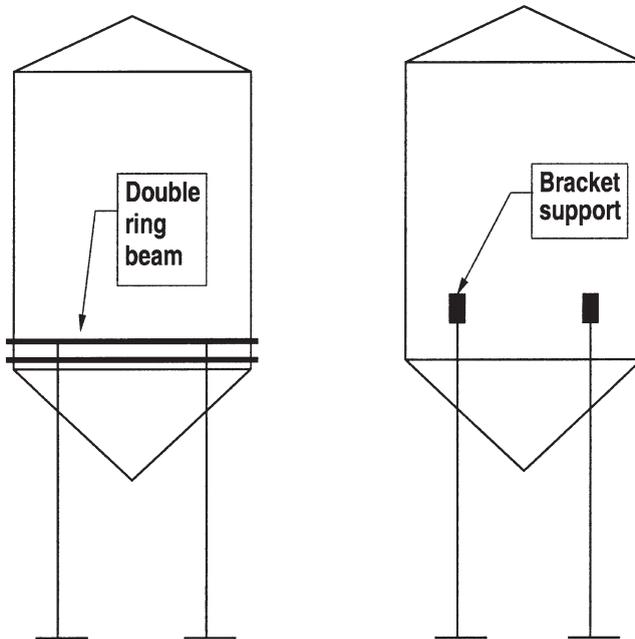


Fig. 1. Types of support for silos.

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