

# Structural stability maintenance of Silos

Practical Guidelines

( 1 )

# Why?

- Legal requirement according to OHS act – Department of Labour
- Extending the life span of the facility
- Challenges
  - Competing in a very competitive environment with easy access for role players via bunkers and silo bags putting the bottom line under pressure



- (2) An owner of a structure must ensure that—
- (a) inspections of that structure are carried out periodically by competent persons in order to render the structure safe for continued use;
  - (b) that the inspections contemplated in paragraph (a) are carried out at least once every six months for the first two years and thereafter yearly;
  - (c) the structure is maintained in such a manner that it remains safe for continued use;

Construction Regulation 2014

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A (d) the records of inspections and maintenance are kept and made available on request to an inspector.

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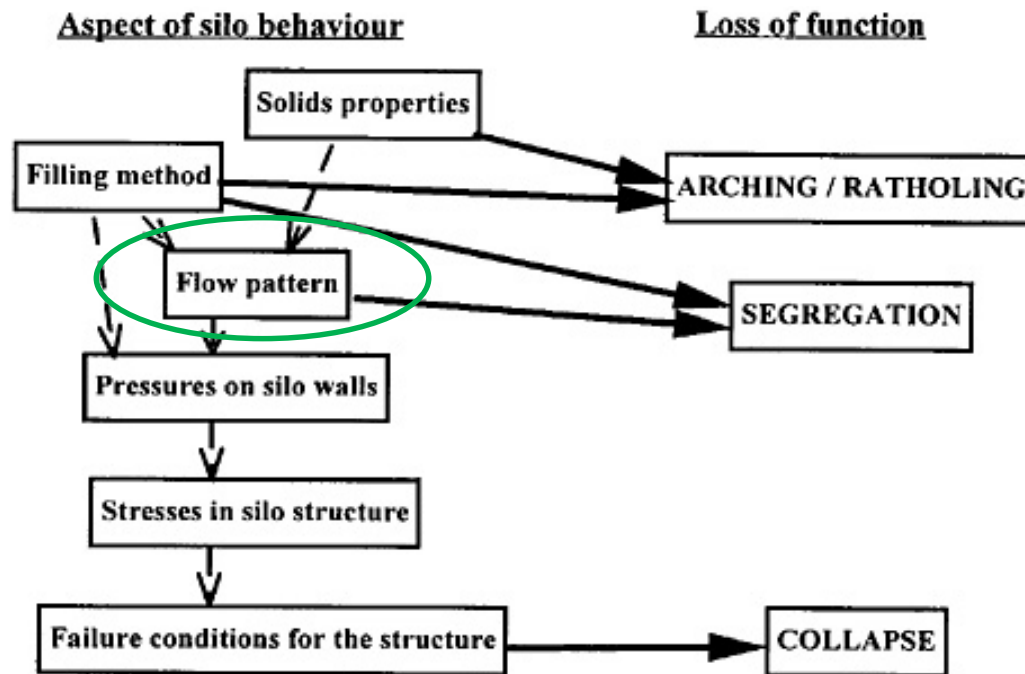
# Objectives

The objective of an audit is therefore to report on the structural stability of structures as well as to do recommendation if remedial work is required.

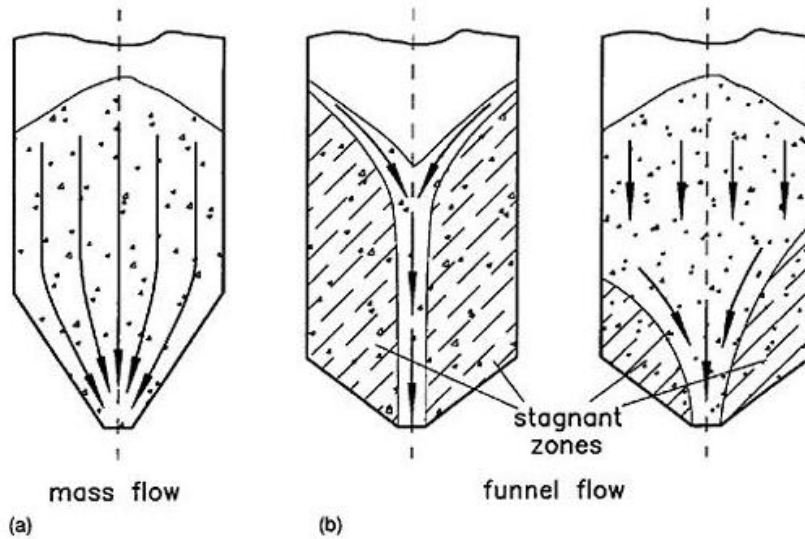
The most significant variables effecting structural stability and wear are

- Silo Dynamics which include
  - Flow patterns
  - Pressure on walls
  - Stresses in the structure

# Silo Dynamics

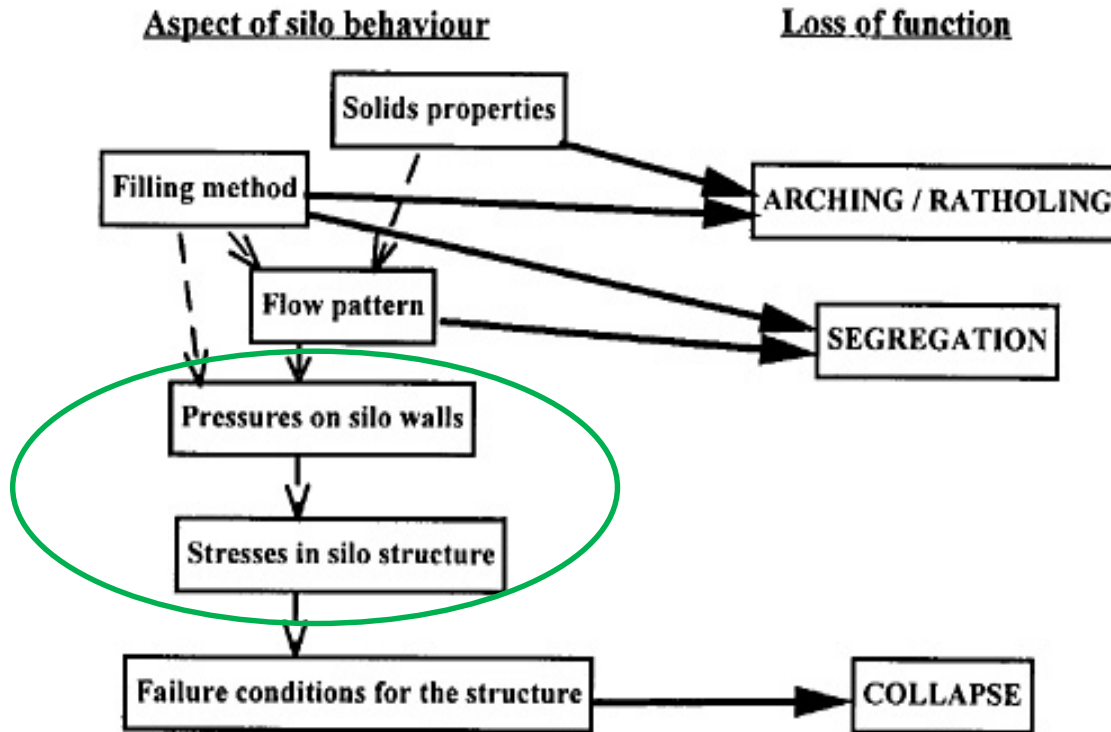


# Flow Patterns



A function of bin geometry and bin hopper characteristics

# Silo Dynamics



# Pressure and stresses induced

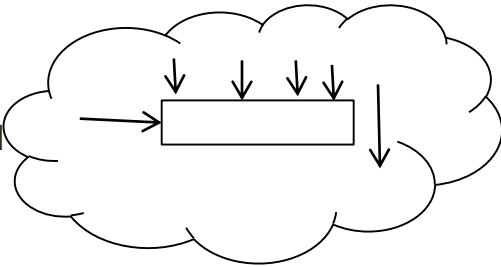
- Filling of silo
- Reclaim
- Variation in temperature
- Differential settlement i.e. geotechnical failure
- Earthquakes and pressure bursts due to mining
- Dust explosions
- Equipment by third parties on roofs and walls
  - Cell phone companies
  - Temperature monitoring



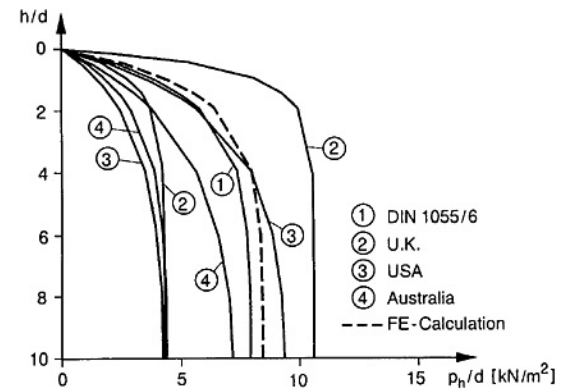
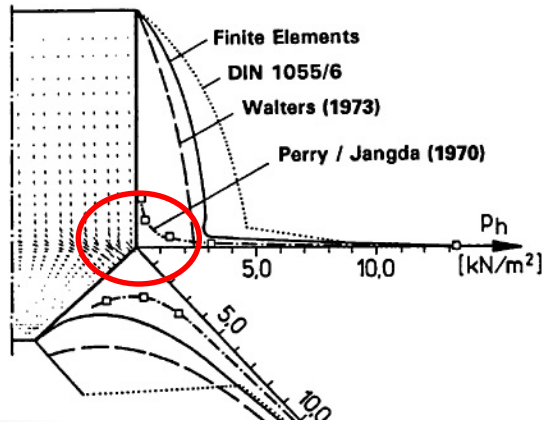
# Filling and Reclaim Forces

$$P_{vi} = pgRhCz/(kju)$$

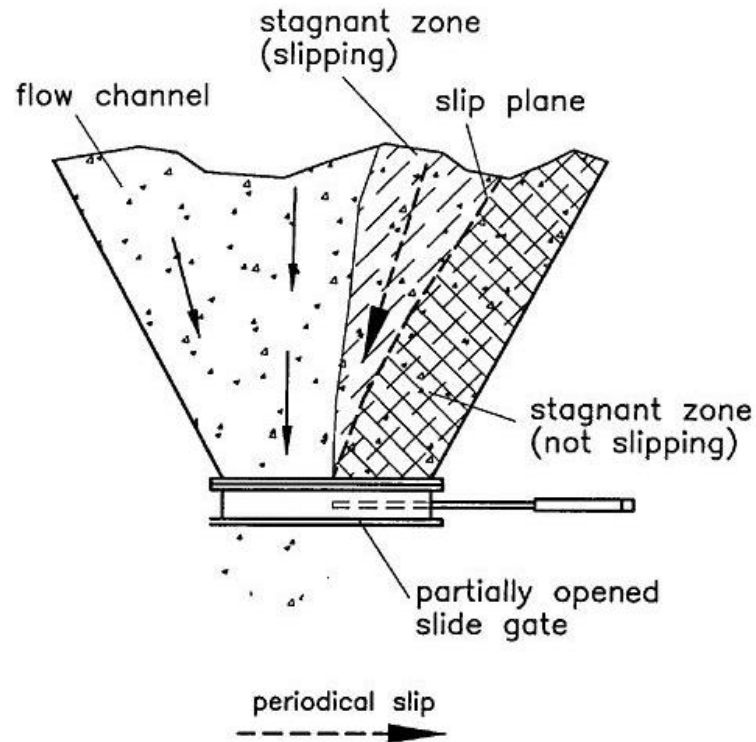
$$P_{ni} = pgRhCz/u$$



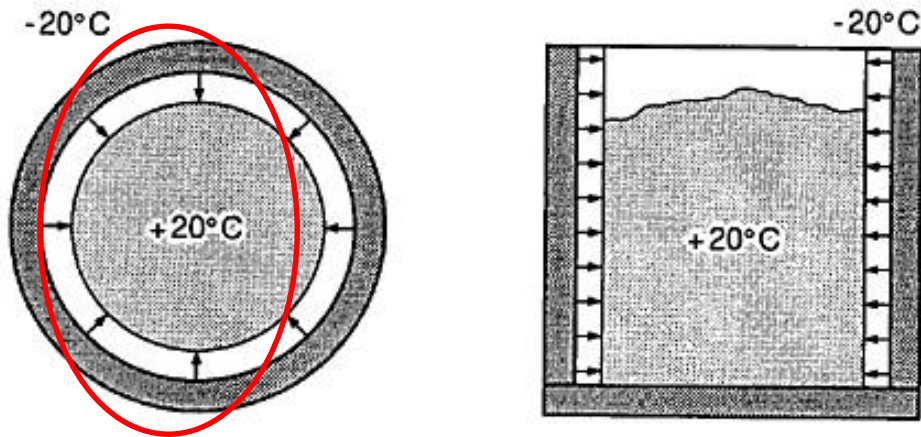
$$P_{wi} = uP_{ni}$$



# Effect of malfunctioning valves at reclaim



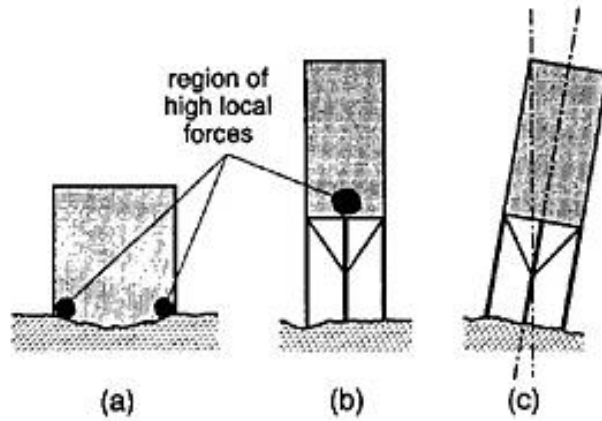
# Temperature variation



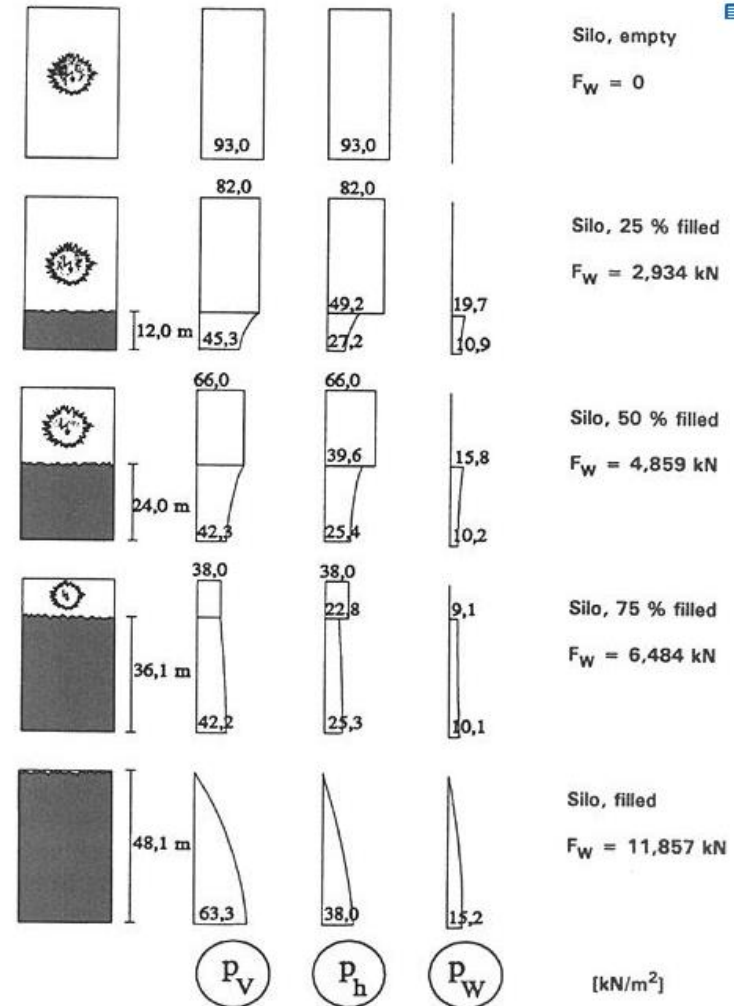
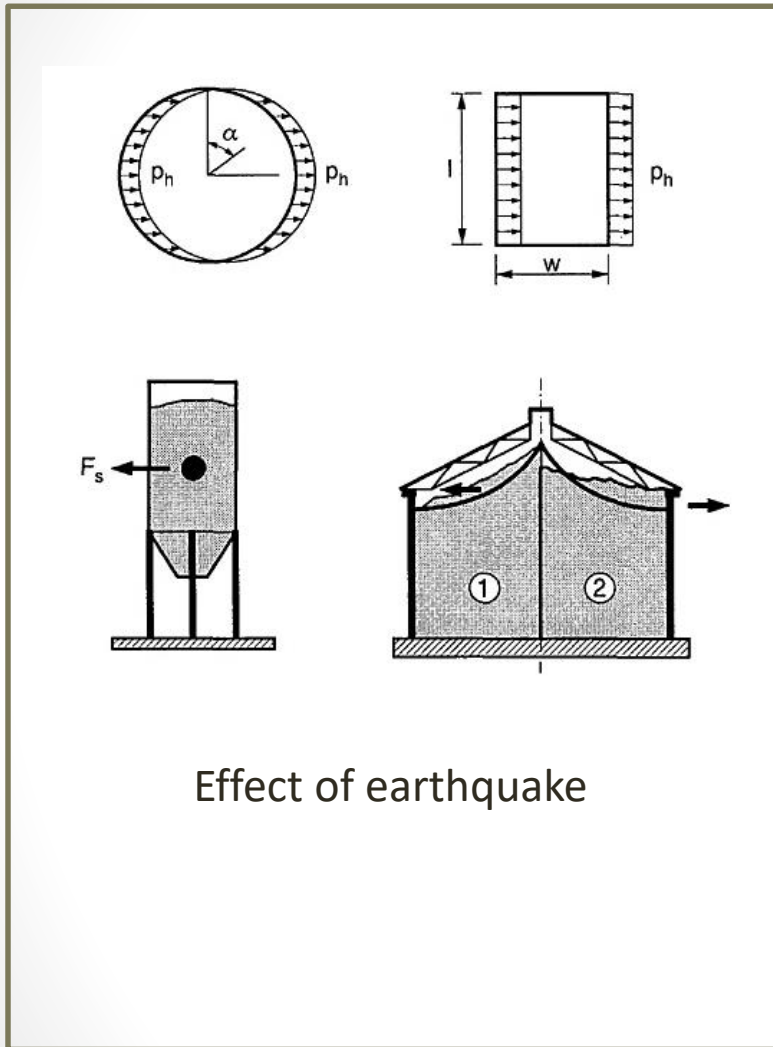
Critical to inspect welded plates if applicable



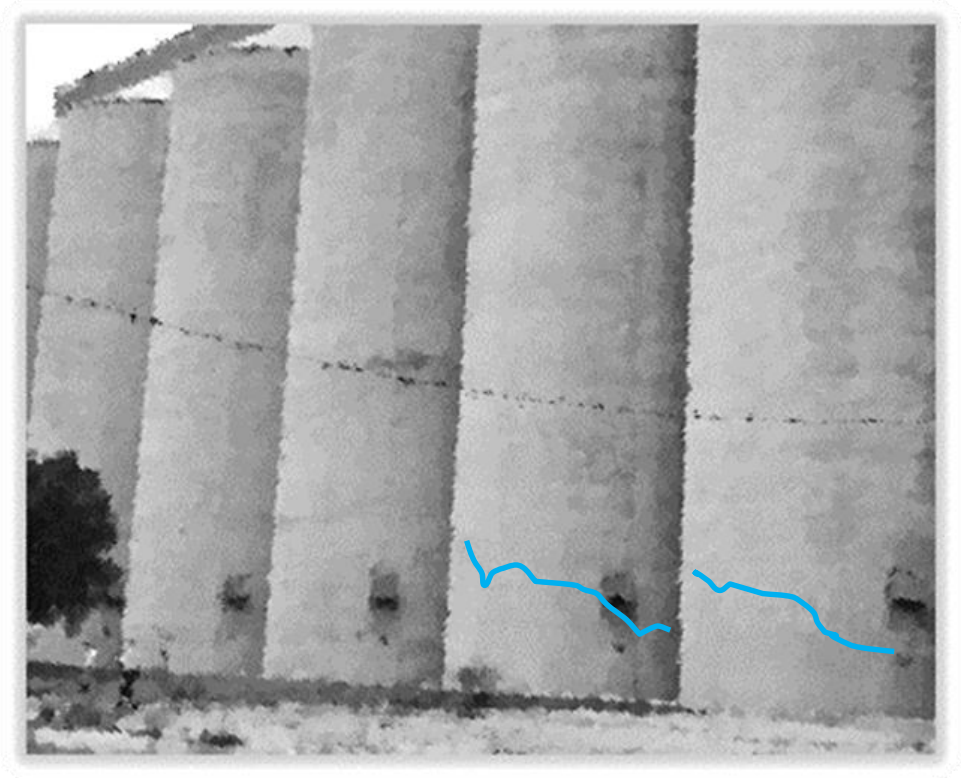
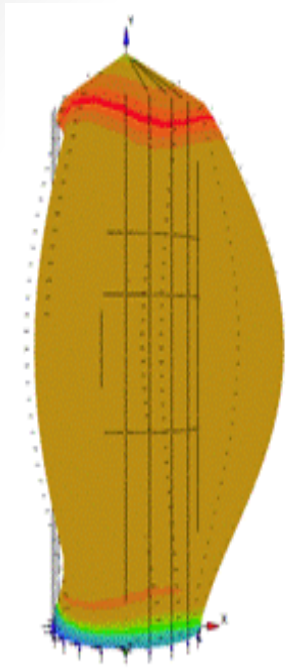
# Geotechnical failure



# Earthquake and dust explosion



Dust Explosion



# Installations by others

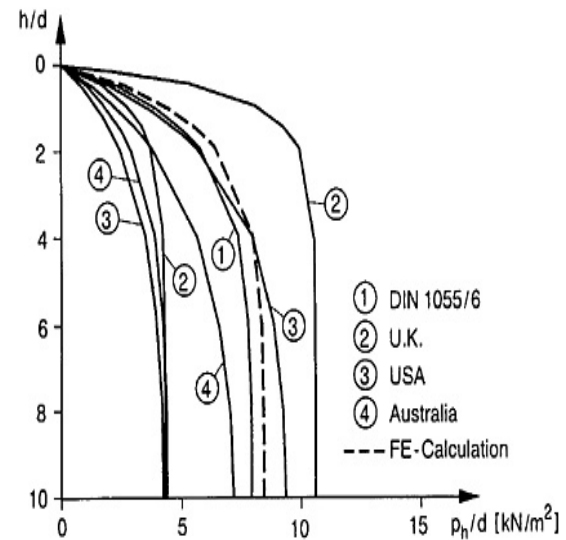
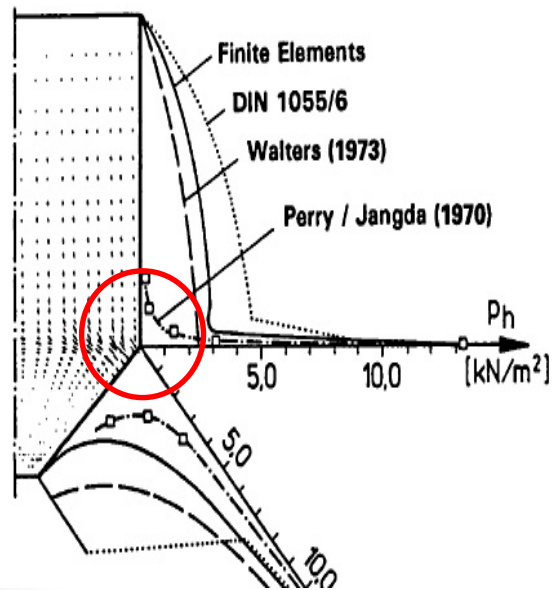




# Leaks into machine tower



# Inspection awareness

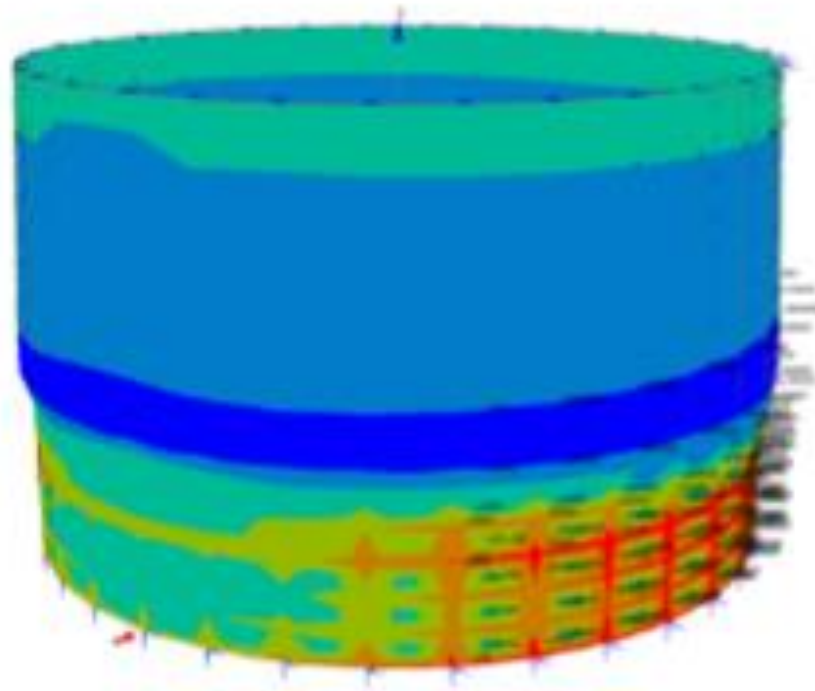
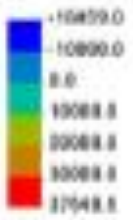


# General Maintenance





Maximum stresses (MPa)



Grade 4.4 bolts used  
Stiffener under designed





# In Summary

- Comply with legislation
  - Understand the design aspects of silos to look for possible areas of concern
  - Maintain to prevent collapse and ineffective operation
  - Operate according to the rules
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- Thank You