

Introduction (or Project Goals and Objectives)

- **Problem Statement (what is the problem to be solved/investigated)**

- Since the late 18th century multiple theories have been developed to account for lateral earth pressure against a structure. The Rankine, Coulomb, and Log Spiral theories have typically been utilized to calculate the lateral earth pressure for a linear retaining wall and Janssen Theory has been used to calculate the lateral earth pressure in silos. Coulomb Theory and Janssen Theory do not adequately address how the failure wedge interacts with the walls in large-diameter silos.
- The Janssen Theory incorrectly calculates lateral pressures in large diameter silos and greatly over predicts the pressure because it assumes that the lateral pressure is based on the principle of poisson's ratio. The reason that this doesn't work for large diameter silos is because the diameter is too large to cause arching and strain to develop. This makes it reasonable for silos with large aspect ratios but unreliable to predict lateral pressures with low aspect ratios.
- Coloumb and Rankine theories do better with large diameter silos but not as good at predicting lateral pressure in large aspect ratio silos. The theories predict pressures incorrectly because the failure wedge can extend past the wall of the silo which results in very conservative pressures. Both theories also incorrectly assume that the wedge of material is of uniform width when the wedge in a silo changes volume as it approaches the center of the silo. This will overestimate the lateral pressure simply because not as much material is pushing the wedge against the wall.

- **Goals and Objectives (what are we going to do about it)**

- The goal of this research is to come up with an equation that accurately describes the lateral earth pressure in a large-diameter silo.

- **Expected Outcomes (short summary of expected results/benefits - in essence, is this important research?)**

- Benefits that would come out of his research would be a better way to design silos in a way that makes them more economical and will decrease the amount of material needed.
- An expected result that will come out of this research is an equation and methodology that is proved by a numerical model should future research validate this empirically.

Literature Review (Background - what has been done already? how is what we are doing going to contribute/fit into past research?)

- History of Silos and Best-Known Theories For Design
- Types of Silos and Uses
 - Current Shapes
 - Utilization of Silos
- Loads and Pressures in Silos
 - Lateral Pressures
 - Active Earth Pressure
 - Passive Earth Pressure
 - Coulomb Earth Pressure Theory

- Ranking Earth Pressures
 - Janssen Earth Pressure Theory
- Loads on Silo Walls
 - Linear Retaining Structure with Vertical Walls
 - Linear Retaining Structure with Battered Walls
 - Linear Retaining Structure with Curved Walls

Project Description

- **Typically broken out into specific tasks, where each task is a subheading discussing what will be done (e.g. if you have 5 specific tasks, then there are 5 subheading sections talking about what you plan to do for each; i.e. Task 2 - Experimental Design... Task 3 - Specimen Construction... Task 4 - Structural Testing... Task 5 - Data Analysis or Modeling... etc.)**
 - Task 1
 - Outline current theories being utilized
 - Task 2
 - Derive a theory for a Modified Coulomb approach
 - Task 3
 - Provide geometrical and mathematical proof for the analytical model
 - Task 4
 - Show examples of the Modified Coulomb theory for various geometries
 - Task 5
 - Produce a Numerical Model that corroborates the Analytical Model
 - Task 6
 - Outline a Physical Model to corroborate the Numerical Model
- **Schedule and Timeline (anticipated, of course - this might change! but the best way to graduate is to make a plan and try to stick with it IMO)**
 - 3D Model to represent silo wedges
 - Prospectus
 - Literature Review
 - Develop modified equation that will accurately predict the lateral pressure against a silo wall
 - Rough draft of thesis
 - Submit final draft of thesis
 - Defend thesis

Assessment and Reporting (how will you know if your research is successful? how do you plan to disseminate/share it after it's finished?)

- My research will be successful by deriving and validating an analytical model that will produce different approaches to combat the same problem with a reasonably close correlation of results.

Project Impact (end strong with what kind of benefits this research will yield)

- If this research goes well it could very well change the way that we approach the design of silos and domes. This would help make a better model that will make building silos and domes more sustainable and economical.

