
USDA Subsurface Banding Implement Soil Trencher Improvements

Critical Design Review

Corp 10 – Fall 2010

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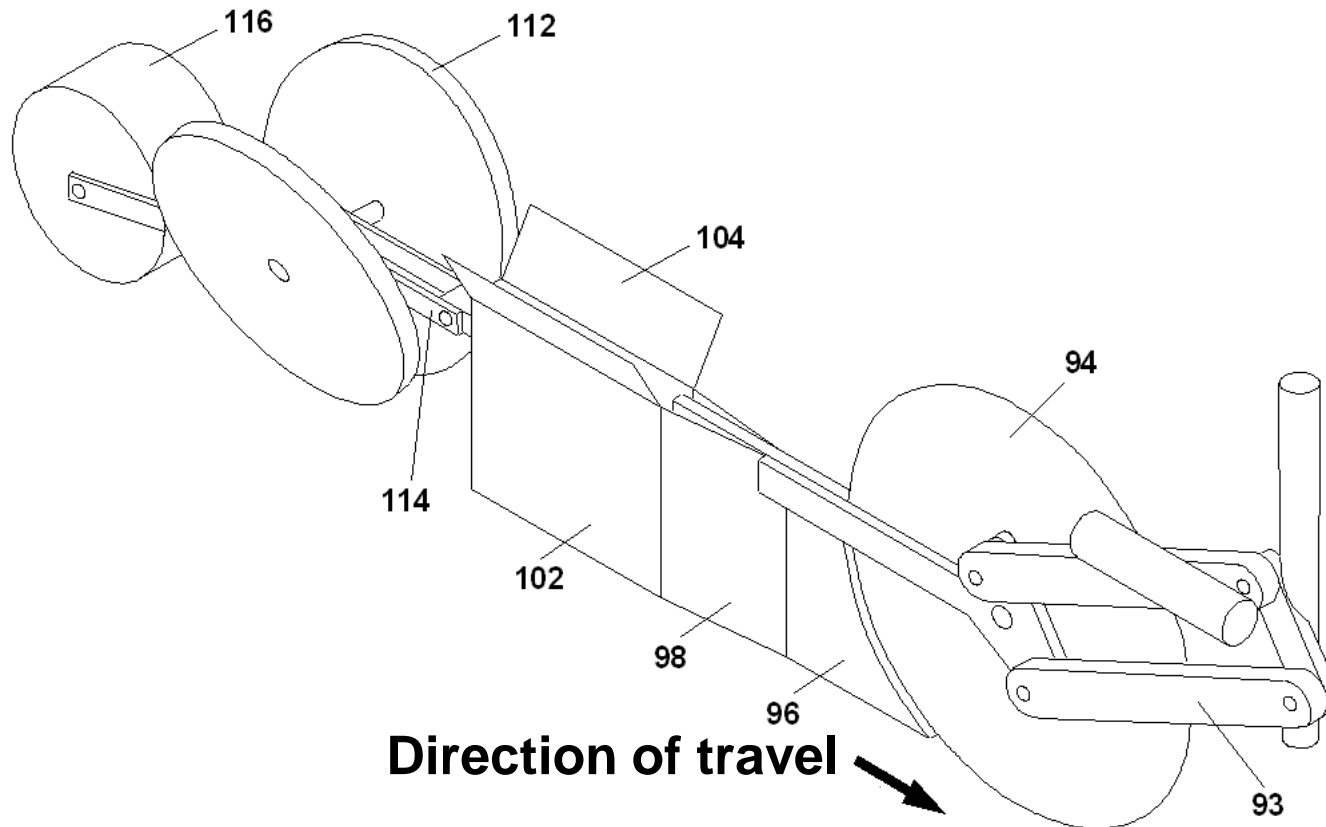
Matt Turberville



Outline

- Mission Objective
- Architectural Design
- Bill of Materials
- Comprehensive Analysis
- Questions

“The Trencher”



Way, Thomas et al. "Applicator System and Method for the Agricultural Distribution of Biodegradable and Non-Biodegradable Materials." Patent 7,721,662 B2. 25 May 2010

Mission Objective

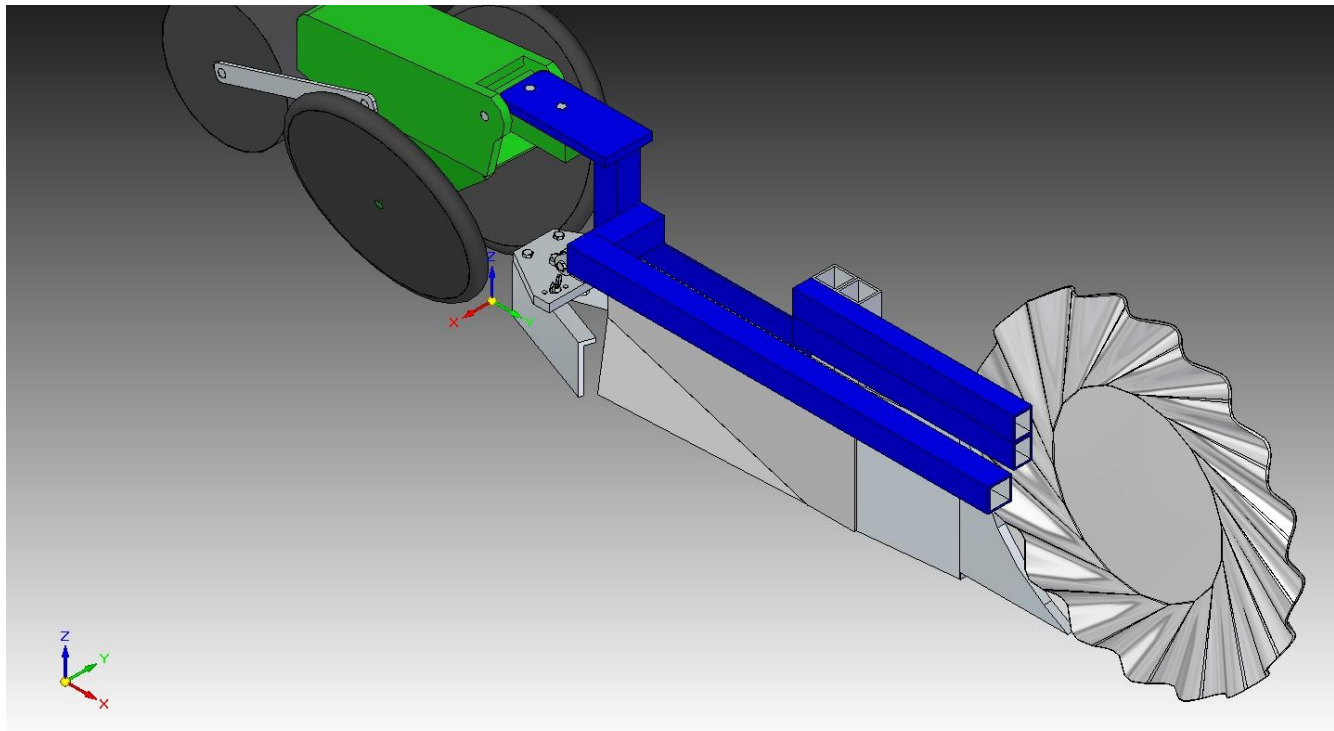
- Litter Application Component:

“To improve or redesign the walls of the poultry litter implement so that litter can be more effectively distributed to the soil, mitigating the clogging that currently occurs during normal operation”
- Dirt Recovery Component

“To improve or replace the current press-wheel system used on the implement for dirt recovery so that the extricated soil is more effectively replaced over the deposited litter band”

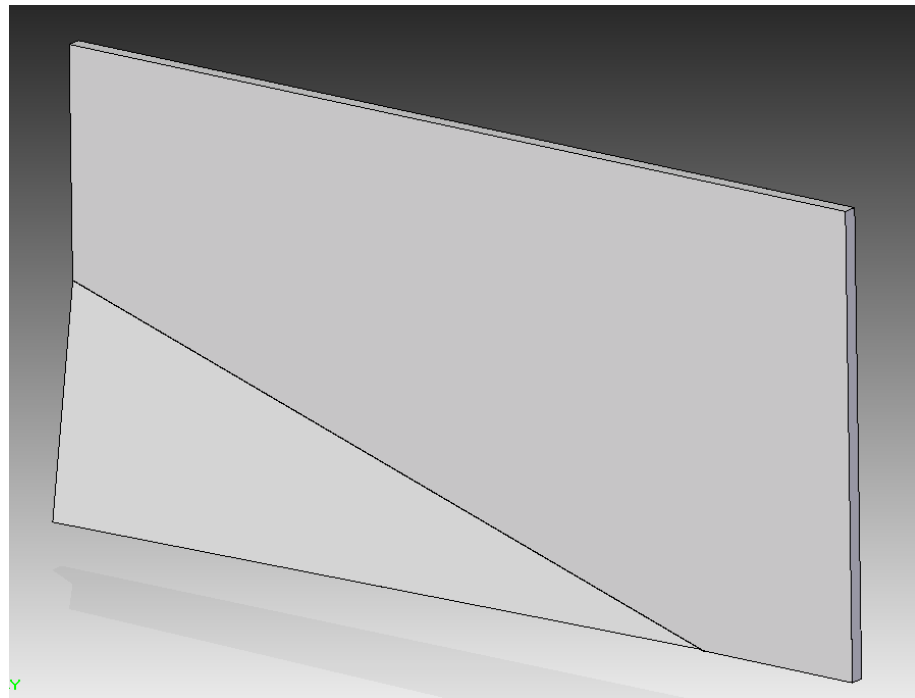
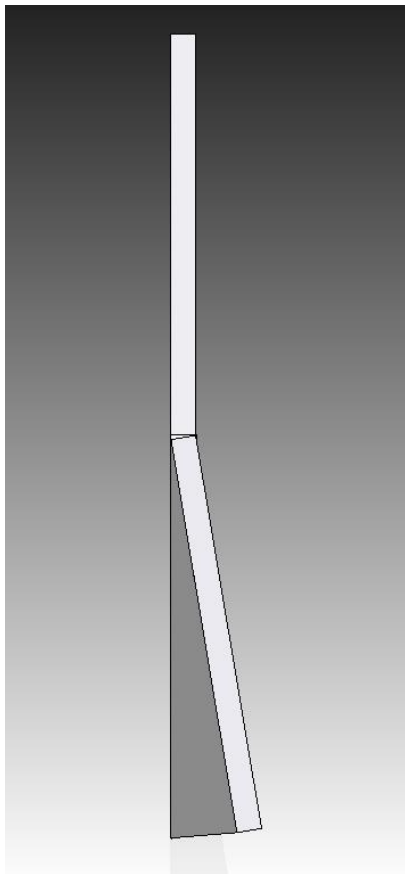
Architectural Design

- Final Concept



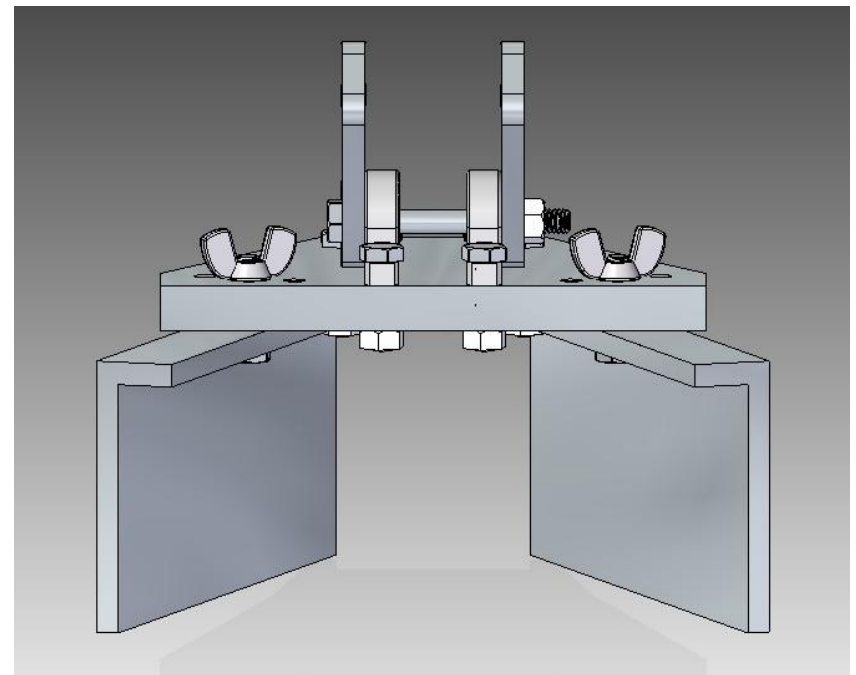
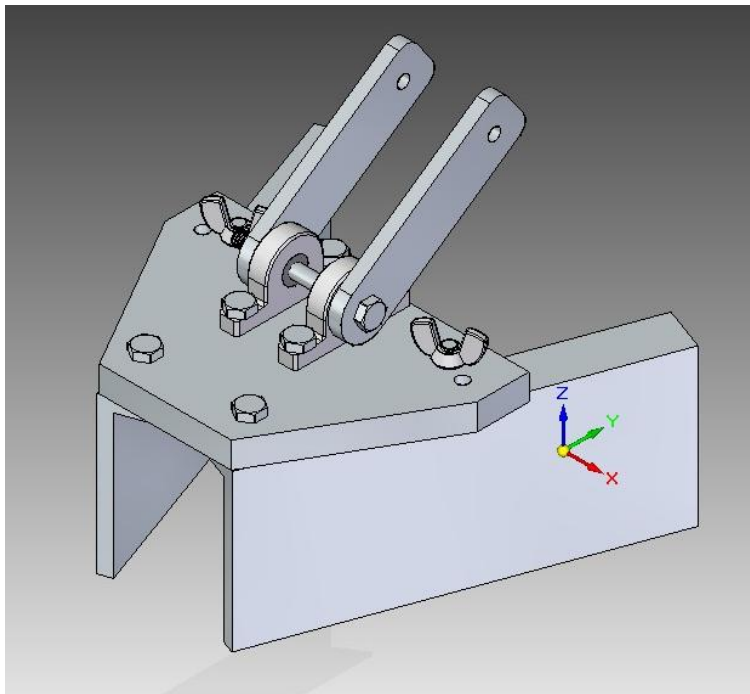
Architectural Design

- Trencher Wall



Architectural Design

- Soil Recovery Device



Bill of Materials

- Trencher Wall
 - Parts \$ 38.40
 - Labor \$ 70.00

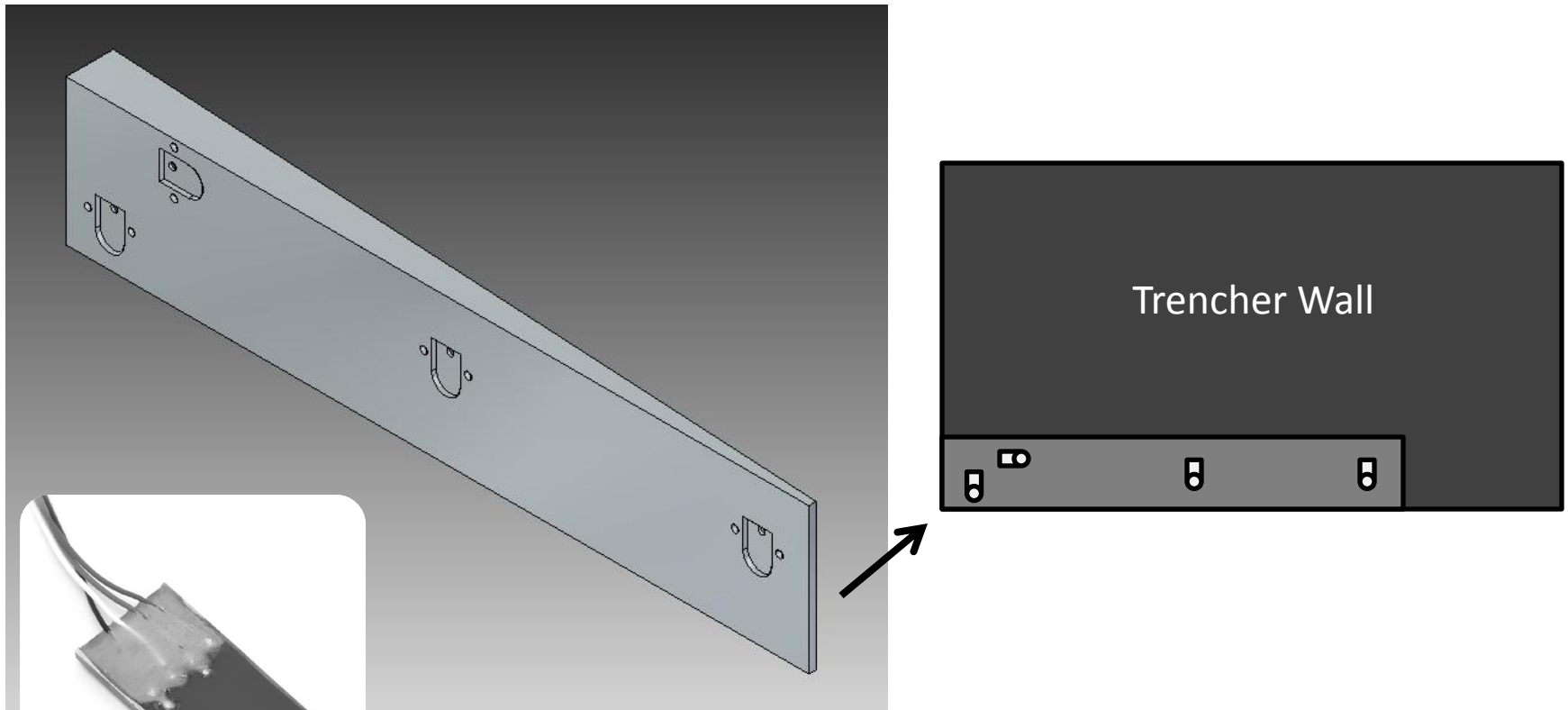
- Soil Recovery Device
 - Parts \$ 54.06
 - Labor \$ 140.00

Grand Total \$ 302.46

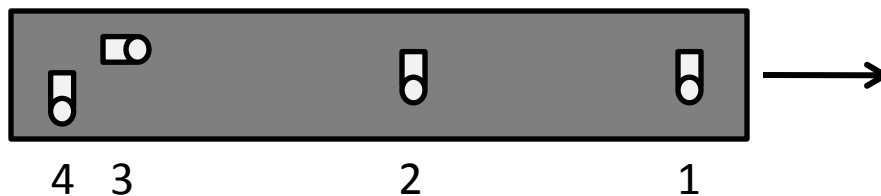
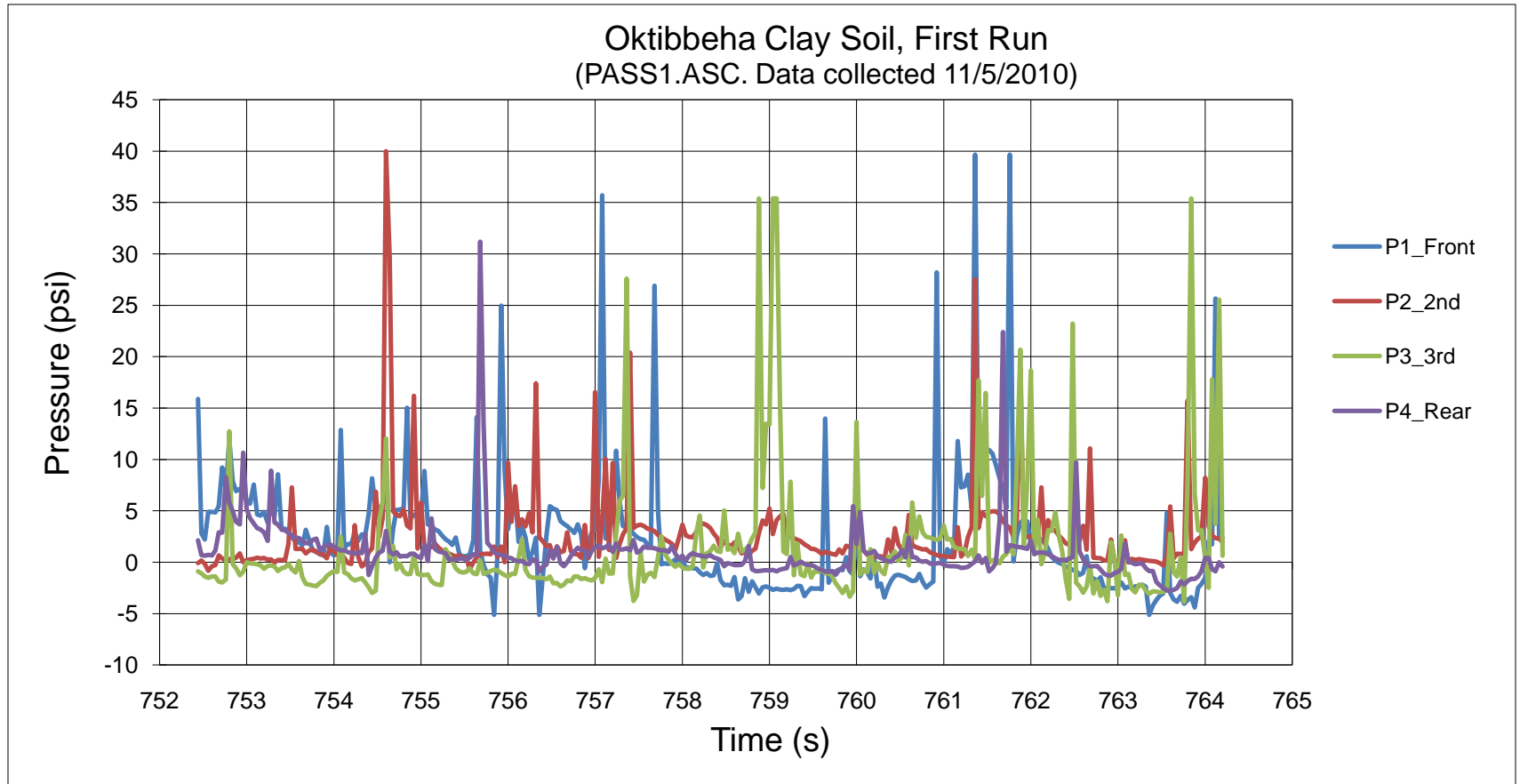
Comprehensive Analysis

- Trencher Wall Pressure Measurement
- Trencher Wall ANSYS Analysis
- Dirt Recovery Mechanism Analysis

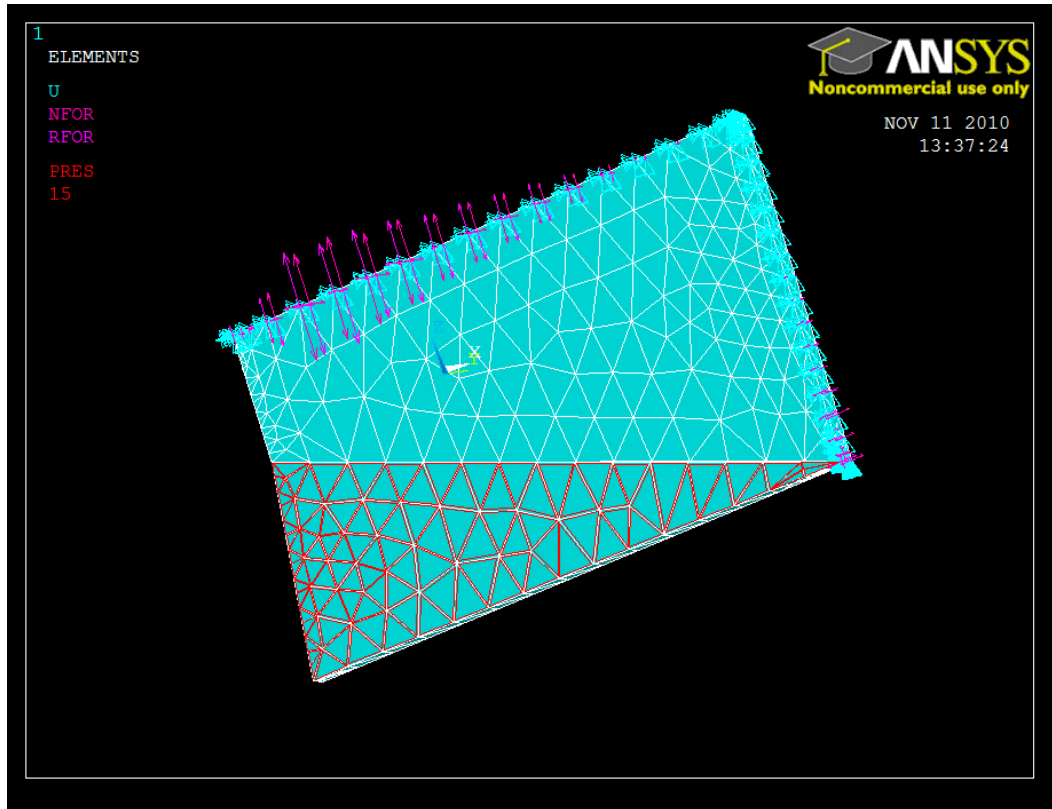
Trencher Wall Pressure Analysis



Trencher Wall Pressure Analysis



Trencher Wall ANSYS Analysis



Mesh

- Brick 8Node45 Tetrahedral

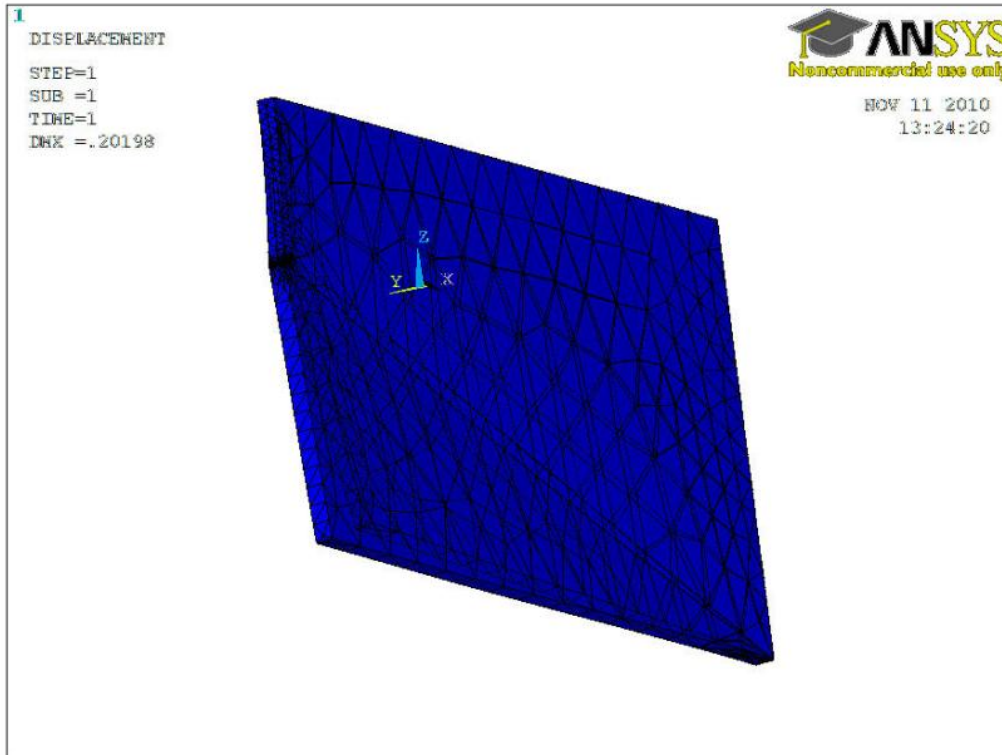
Boundary Conditions

- Structural Displacement
- Pressure on Bent Area

Pressure

- 15 and 30 psi

Trencher Wall ANSYS Analysis

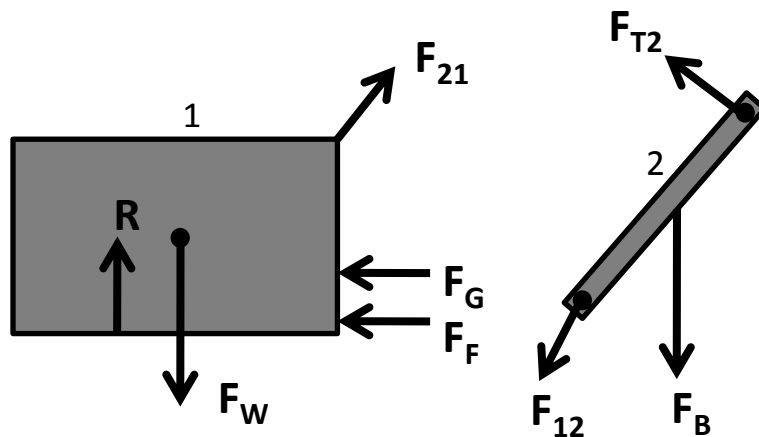
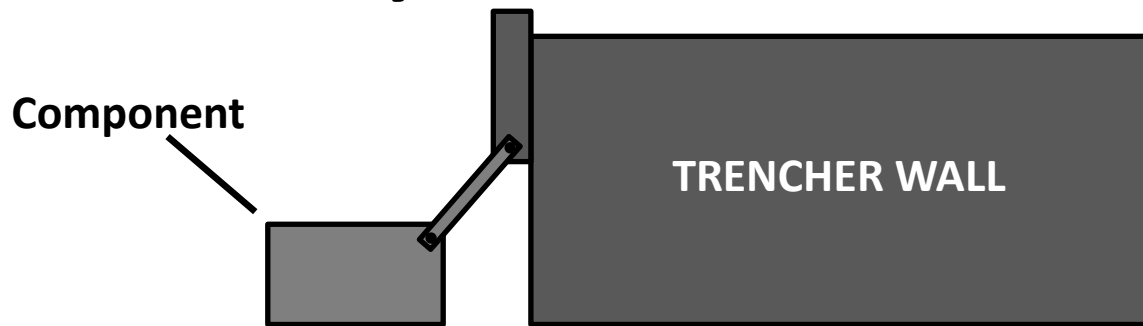


Results

- 15 psi \rightarrow 0.091 in deflection
- 30 psi \rightarrow 0.202 in deflection

Preliminary Analysis

- Dirt Recovery Mechanism FBD Analysis



$$\begin{aligned}\Sigma F_x &= ma_x \\ \Sigma F_y &= 0 \\ \Sigma M_{CB} &= 0\end{aligned}$$

Use MATLAB to solve force equations and find shear stress on pivots

Conclusions

- Redesigned Trencher Walls
 - Increase thickness to $\frac{1}{4}$ inch, flare outward at 10 degrees
 - As proven by ANSYS, deflection will not inhibit poultry litter flow
- Soil Recovery Component
 - Maximum shear in pivots is 14 lbs
 - Materials chosen are sufficiently strong for intended application

Questions?

