SUBSOILER-GENERAL OVERVIEW

1. Used in late Fall after harvest
2. Fractures soil “hard pan”
3. Reduces soil compaction
4. Allows air flow through soil during Fall, Winter, and Early Spring

ORIGINAL EQUIPMENT

Project Motivation

Original equipment consists of a rigid frame

1. Creates difficulty during transport on roadways due to the wide nature of the implement
2. The original implement is not adjustable to various field conditions (compacted soil vs. soft conditions)
3. Equipment is not adaptable to various soil types (clay soil)
4. Subsoiler does not have the flexibility to handle various horsepower ranges

Original Equipment Specifications

- 7 Shank Unit
- Approximate Weight: 4063 lb
- Transport Width: 19’ 6”
- Shank Spacing: 30.5”
- Required Horsepower: 210-350 HP
- Dual Bar Frame: 6”x6” & 6”x3”
- Coulter Down Pressure: 1500 lb
Design Phase

Design Parameters
- 9 Shank Unit (maximum)
- 6000 lb Trip Force per Shank
- Minimize Cost (< $5000)
- Quad-Fold Design (one of a kind)
- 30 – 50 Horsepower per Shank
- 2900 psi Hydraulic System

Project Objectives
1. Make subsoiler more suitable (safer, more convenient) for travel on roadways
2. Allow implement to adapt to various field conditions
   - Reduce fuel costs
   - Do a better job of fracturing the soil hardpan

Material Specification
ASTM A 500-8
SIZE: 6”x 6”, 6”x 3” structural tubing
Thickness: 5/16”
Tensile Strength: 58,000 psi
Yield Strength: 46,000 psi

Pro-Engineer Modeling
- Part Sizing and Design
- Spatial Layout
- Model for Frame Analysis

9 Shank Unit
- Used in Easiest Pulling Conditions
- All Shanks are Tilling
- Horsepower Requirement: 270 – 450 HP
- Total Width: 23.4’

7 Shank Unit
- Used in Moderate Pulling Conditions
- 7 Shanks are Tilling
- Horsepower Requirement: 210 – 350 HP
- Total Width: 18.6’

5 Shank Unit
- Used in Toughest Pulling Conditions (Heavily Traveled Areas)
- 5 Shanks are Tilling
- Horsepower Requirement: 150 – 250 HP
- Total Width: 13.5’

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Frame Analysis & Project Results

Finite Element Analysis (AN SYS)

- Determine Points of Maximum Stress
- Determine Factors of Safety
- Check Deflection

Safety Factor

Stress

Loading

- 6,000 lb per Shank
- 2.28 x 10^-5 in^2 lb per Shank

Points of Maximum Stress

Manufacturing

- Oxy-Acetylene Torch
  - Cutting Steel Plate
- Band Saw
  - Cutting Steel Tube
- MIG Weld
  - Assembly of Components

Results

Final Product

Impact

- $$$ - Cost of diesel fuel is high, so utilizing tractor horsepower is becoming more and more important to farmers
- Completion will allow the implement to do a better job
- Quad-Fold Design is the first of its kind, successful testing may lead to mass production
- A total project cost of $4,500 is cheap considering a brand new dual-fold, 9 shank unit costs $21,000

Engineering Skills Gained

- Learning of Pro-Engineer design program
- Organization skills required for leading engineering projects
- Implementation of a design into a manufactured product

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