DO-ALL ROBOTICS

Robotic Workcell Revitalization

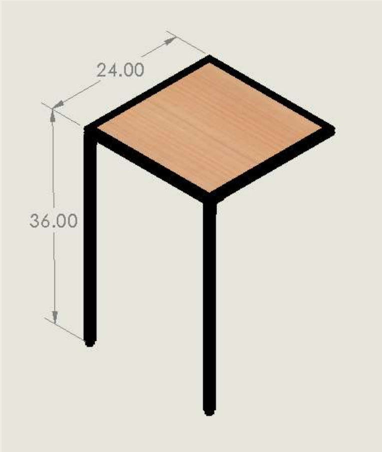
Problem Statement

- The ME Department requires a redesigned Robotic Arm Workcell.
- Incorporates a more modular design for flexibility in manufacturing
- Sturdier to accommodate a second DENSO Robotic Arm
- Reconfigurable for new manufacturing processes
- Standalone documentation for future teams

Current Workcell Design

- Oscillates when robot moves
- Limited to a single robot
- Inefficient use of space
- Difficult to reconfigure cell layout
- Limited access to the workspace

New Workcell



Standard sizing

- Design uses standard dimensions
  - *24” X 24” table modules*
  - *36” tall workspace height*
  - *84” tall workcell walls*
- Simplifies material purchases

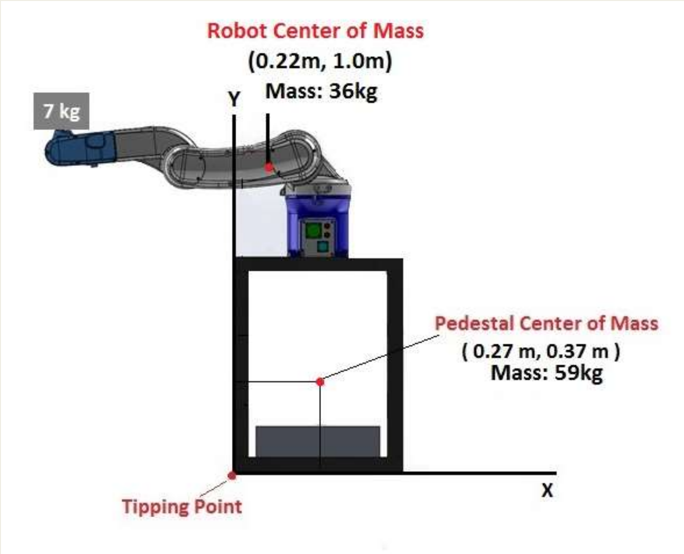
Modular design

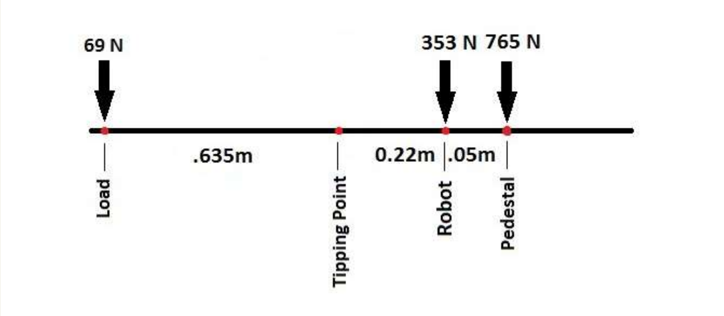
- Repeating modular table
- 8020 aluminum, plywood top
- Fastened together for flexible workspace which can be added to or removed from

Pedestal Stability Analysis

Pedestal Design

- 130 lb. Pedestal
- 79 lb. Denso Arm
- 42 lb. Controller





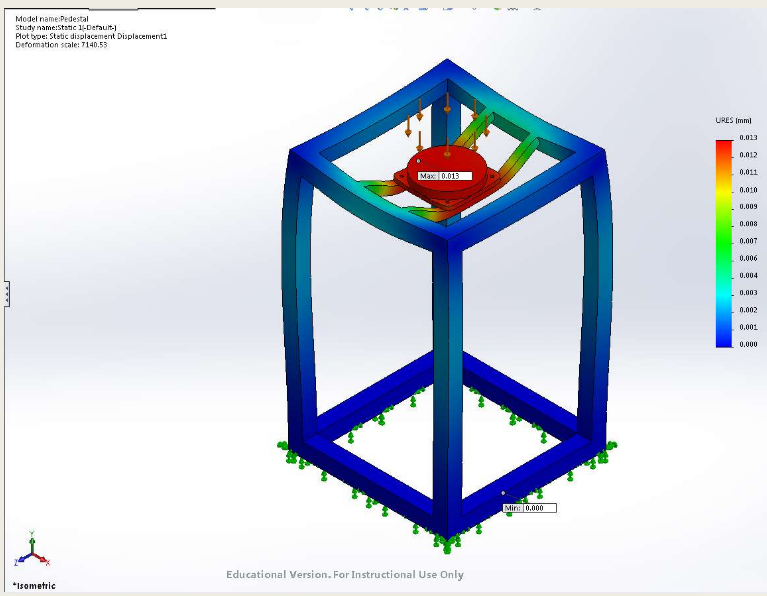
Toppling Force

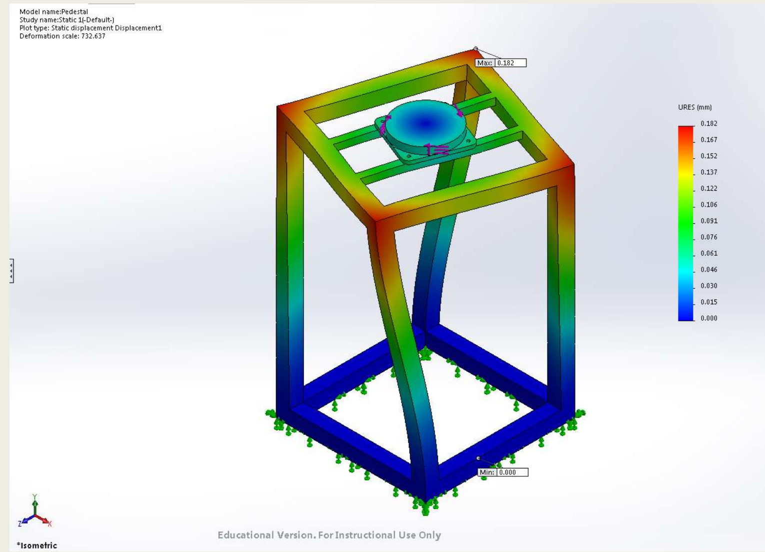
- Pedestal Moment
- $765N \times 0.27m = 206.55Nm$
- Robot Moment
- $353N \times 0.22m = 77.66Nm$
- Load Moment
- $-69N \times 0.71m = -48.99Nm$
- $\sum M = 206.55Nm + 77.66\ Nm - 48.99 = 235.22\ Nm$
- *TORQUE HOLDING THE PEDESTAL DOWN
- $\frac{235.22Nm}{0.91m} = 258.48N$
- *ADDITIONAL FORCE REQUIRED TO TIP ROBOT

FEA

Pedestal Load

- Assumptions:
  - *Robot with max payload*
  - *Uniform force distribution*
- Maximum Distortion: 0.013mm





Torque

- Assumption:
  - *Maximum allowable rotational speed*
  - *Deceleration in 0.1s*
  - *Maximum torque with load: 391N*
- Maximum distortion: 0.18mm

Detached Workcell Walls

- Workcell walls no longer attached to work surface
- 12' x 12' enclosure will not be affected by robot movement
- There will be room to move around the outside of the robotic work surface
- Area to walk around in workcell during maintenance
- Walls will be 7' in height
- Full sized door will be able to be utilized for entry

Second arm implementation

- Initial idea to use collusion avoidance software
  - *Needed to purchase $1,000s of hardware to achieve this*
  - *Required extensive controller I/O and optics*
- Field trips to SEL and Boeing
  - *Position robots so they cannot hit each other*
  - *Use logical programming and testing to avoid collusion*

Implementation of Second Arm

- Safety
  1. *Splice safety lockout and auto setting into both controllers*

- Communication Between Both Arms
  1. *Sending signals to each other through inputs and outputs*
  2. *Simultaneous start of programs to ensure no collusion*
  3. *Handshake operations to confirm robot positions throughout programming*

https://www.youtube.com/watch?v=cR-YlZ9NdIA

Workcell Literature

Current Issues

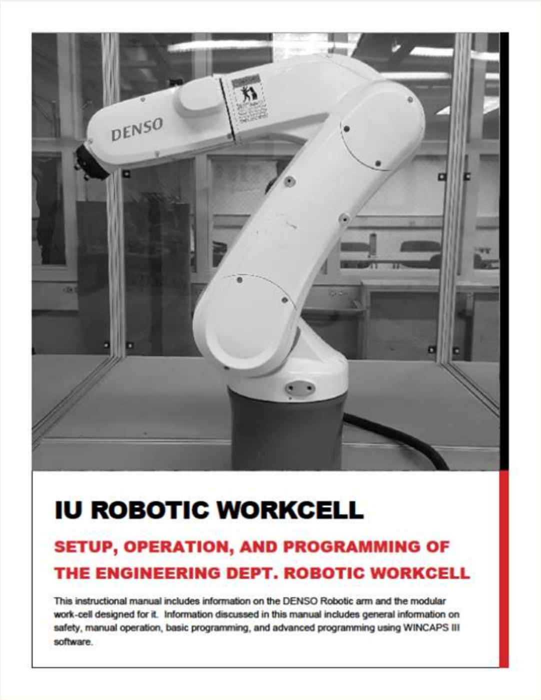
- The current workcell does not have an instruction manual to go with it
- New operators must look through previous groups' work and online to try to learn how to use the robot

Specs for New Manual

- Geared toward Junior Level ME Students
- Able to teach basic use in an afternoon
- 20 – 25 pages in content length
- Extensive use of pictures/diagrams to reinforce learning
- Natural progression through learning process
- Does not require use of outside sources

“How-To” Manual Layout

I. Introduction
II. Safety Precautions
III. Operating/Programming with Teaching Pendent
IV. Programming with WINCAPS
V. Appendix with common syntax



QUESTIONS?