68K Turbine Blade Handling
Final Spring Midterm Design

Team 14

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Sponsor

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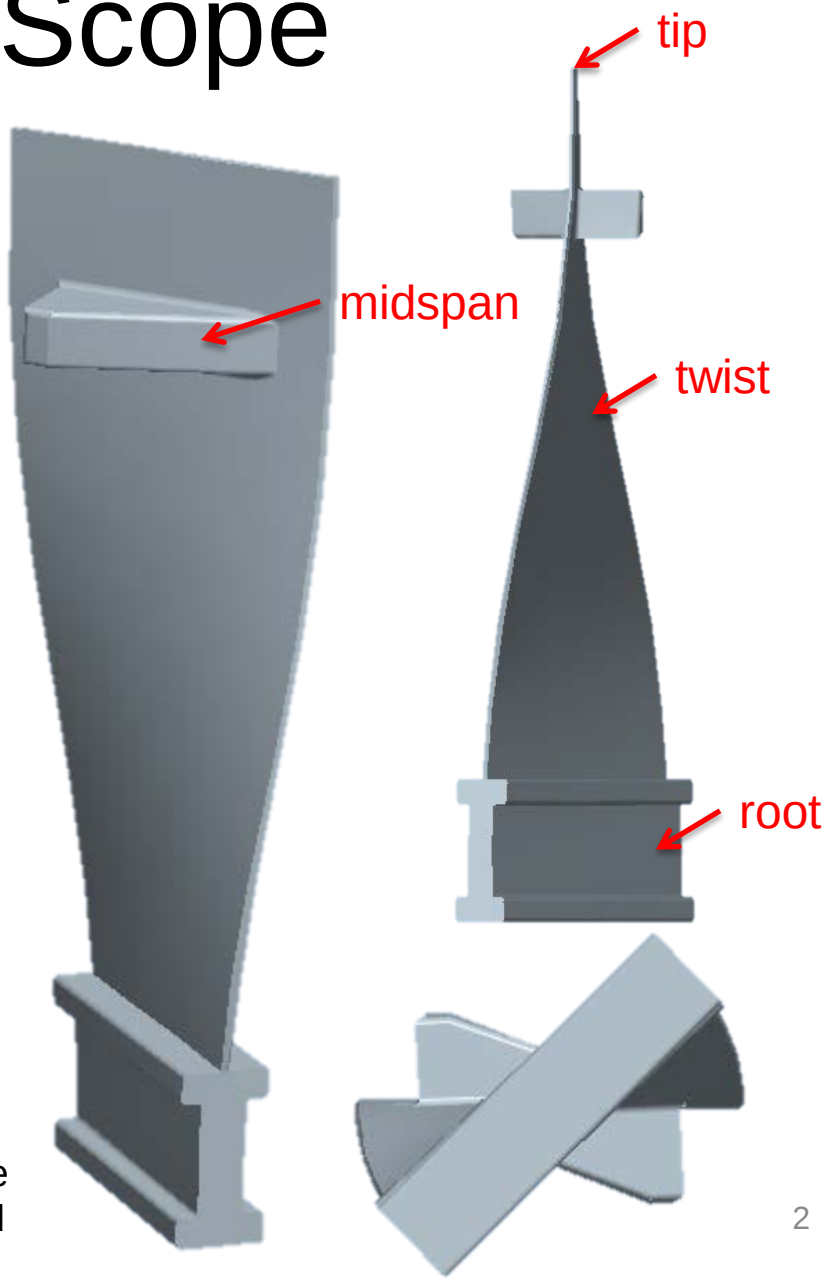
Project Scope

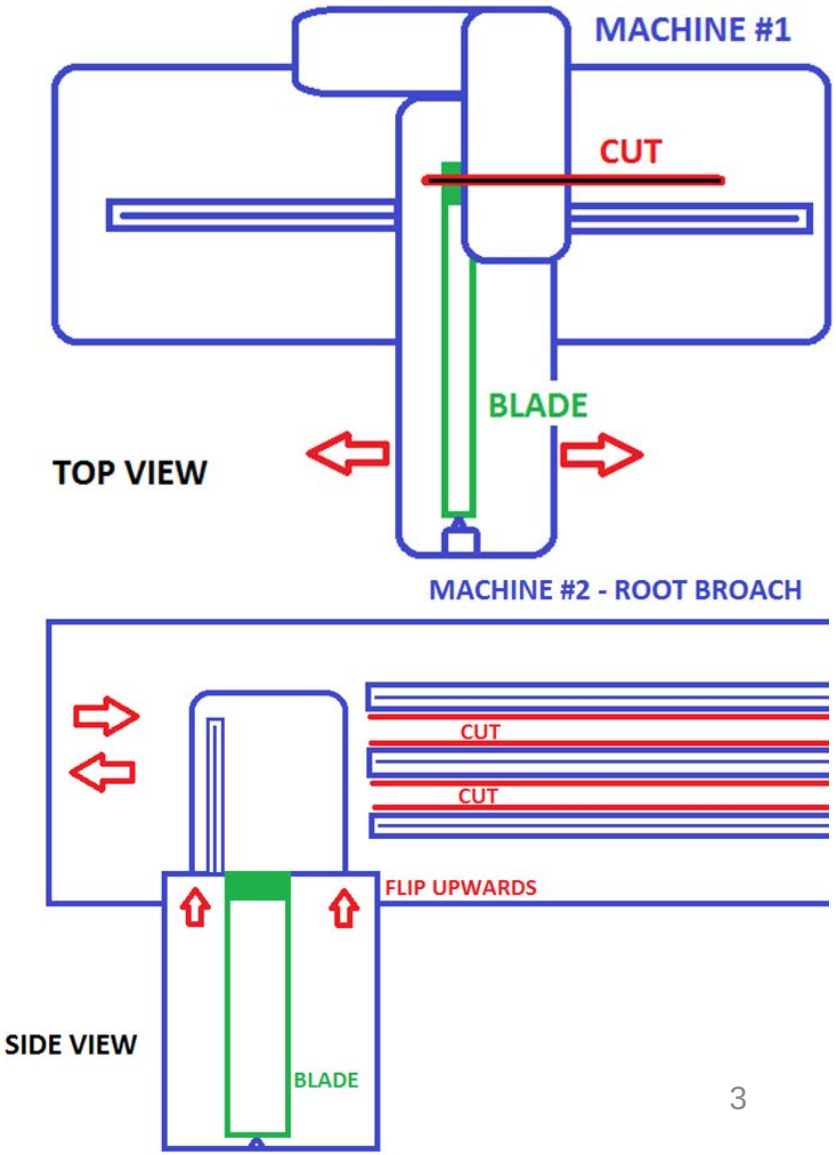
- The Blade
  - 45lb Titanium-aluminide
  - 3ft x 1ft x 0.125in
  - Received as a raw forging
    - Only basic geometry
- Goal
  - Must transport and orient for placement in machines
    - Multiple mills are in the root machining area
    - Differing angles and placement in machines



Figures – a representative model of the 68K blade with geometry labeled in red

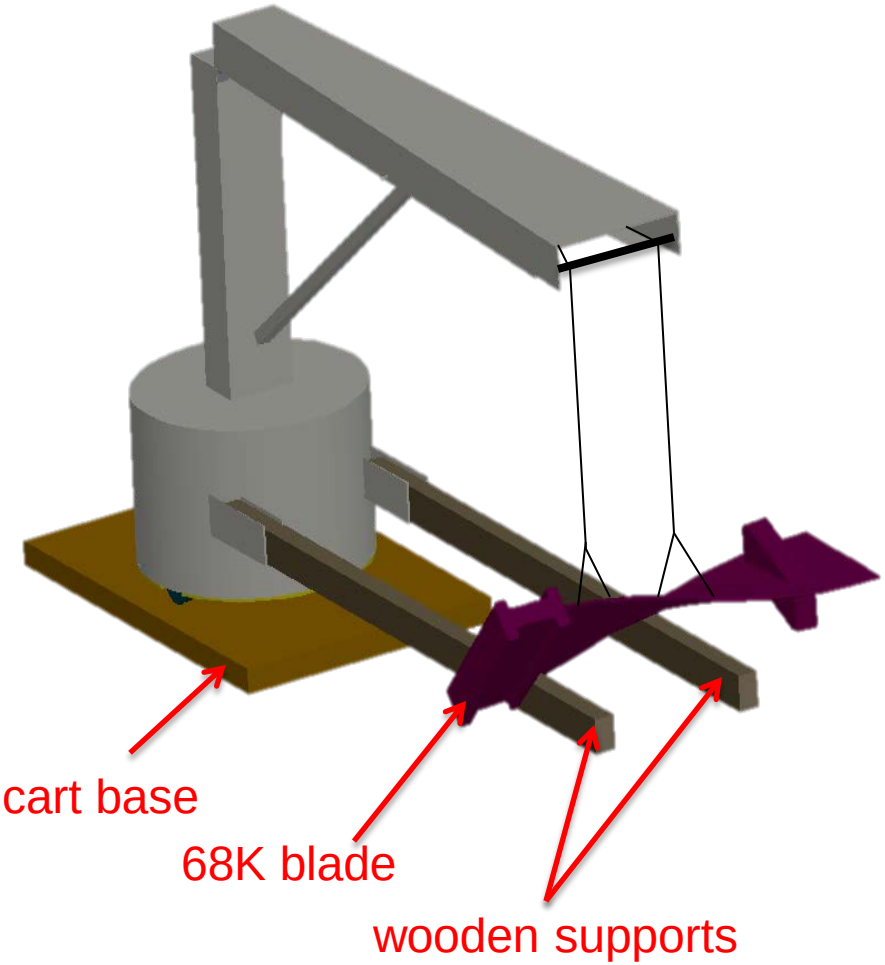
Problem

- Manual lifting of the 68K turbine blade
  - Risk of injury
  - Straining workers
  - Difficult for new workers
  - Needs to be **eliminated**
- The blade moves through several machines
  - Each machine unique
    - Obstructions
    - Placement
    - Orientation

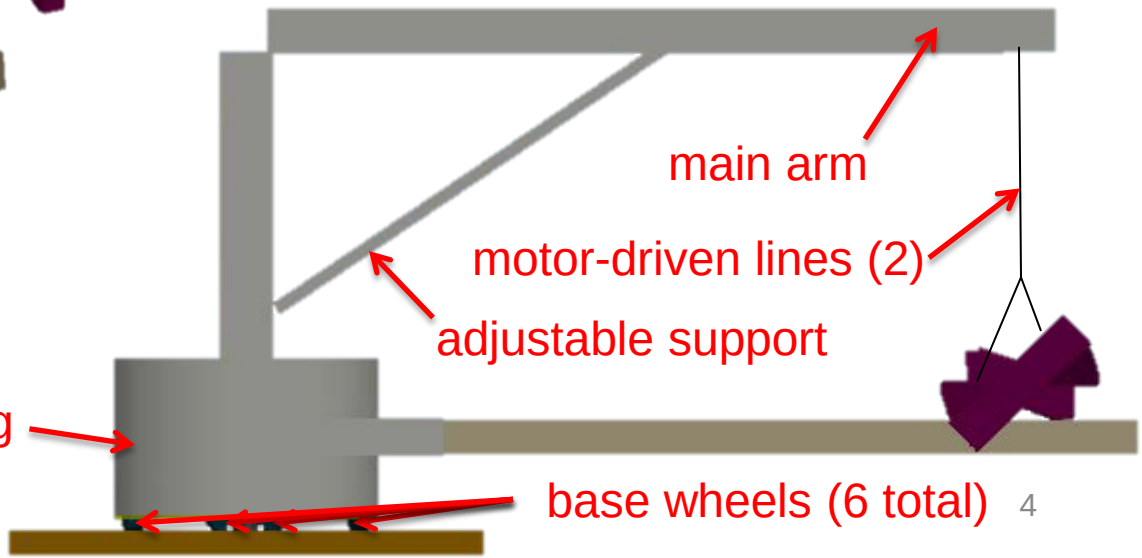


Figures – diagrams of two machines in the machining area (end-mill and broach wall)

Design Solution



- Design can accommodate all **7** machines in the desired area of operation
- Crane design with a total of **5 DOF** to manipulate the blade
  - Harness on blade supplements a DOF to yield 6
- Handles 1 blade at a time
  - Local storage fixtures available
- Includes wooden supports to rest blade on for reorientation



Figures – a model of the final design with labeled parts in red

How it Works

- **Mounted on hydraulic lift cart**
  - Can rotate about top
- **Two motor-driven lines**
  - Run down arm
    - Angle is *variable*
  - *Independently* driven
    - Wired controllers
  - Two connections on each
    - Attach to harness

- Blade can be held:
  - Horizontally
  - Vertically
  - At various angles

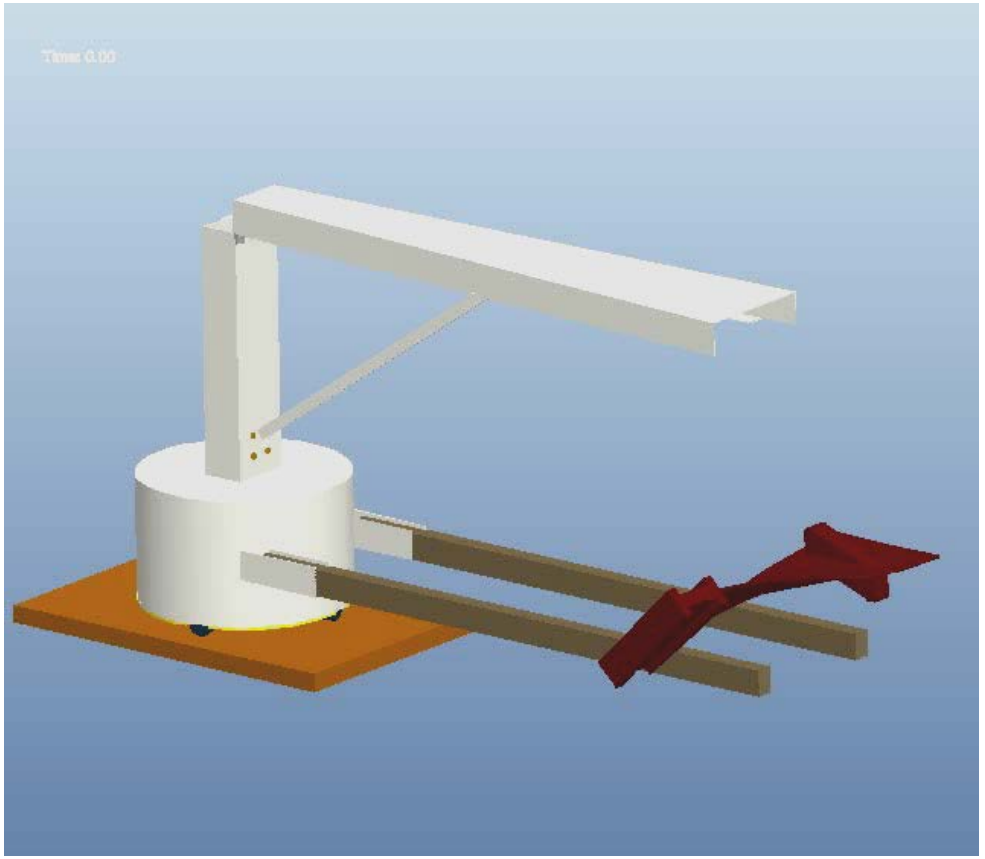


Figure – simulation video of the vertical lifting of the blade by the crane mechanism. (note: the motor-driven lines are nonexistent in the video)
The finished prototype will operate similarly.

Clint Kainec

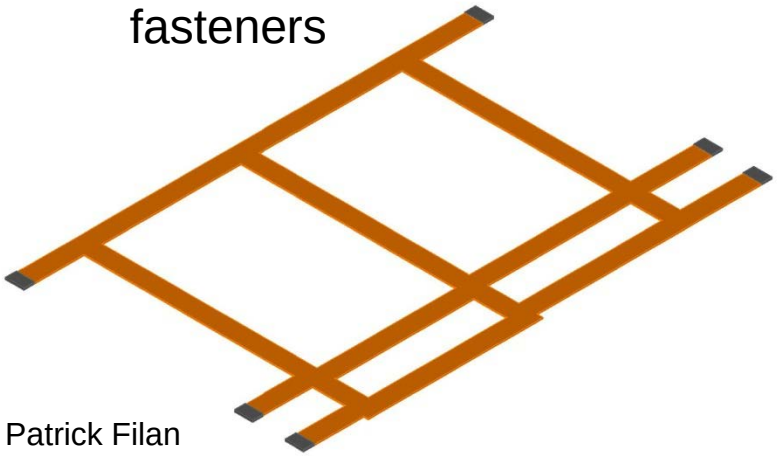
Harness Design

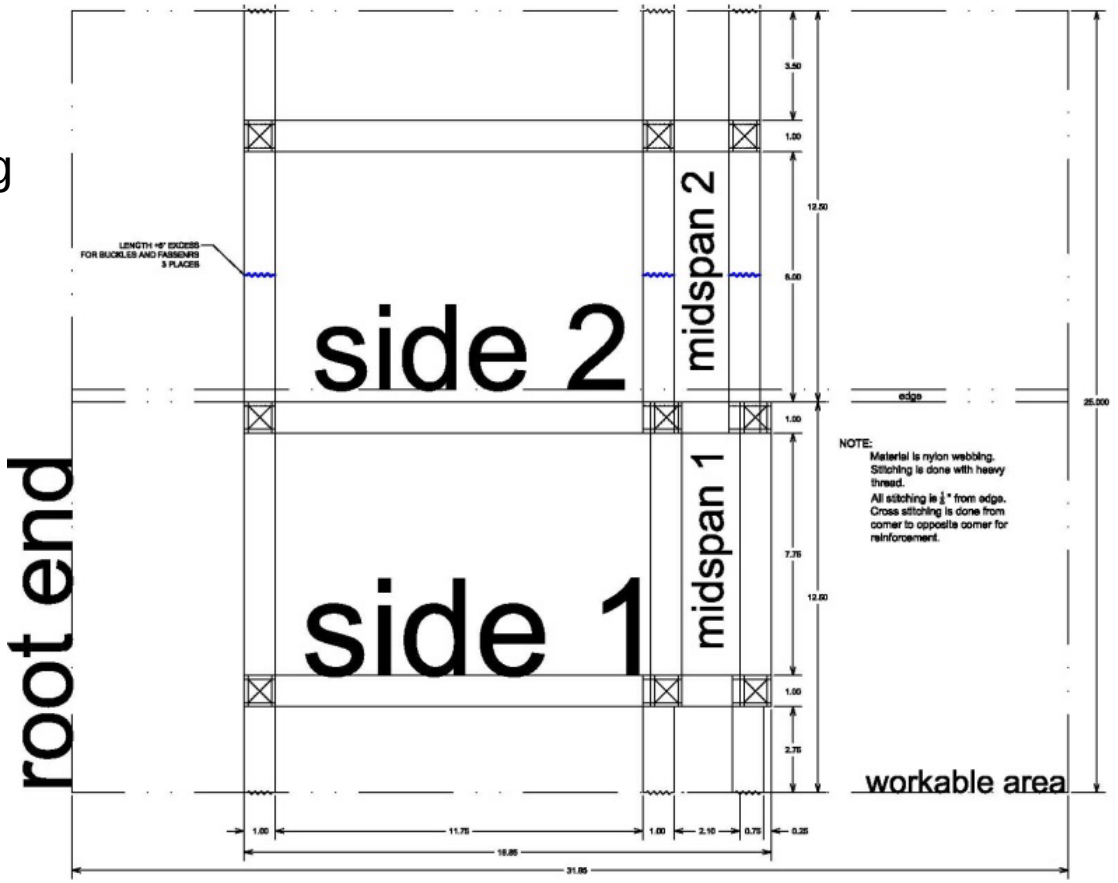
Purpose:

- Fits on the blade
  - Does not need to be removed during machining
- Adjust blade angle and orientation
  - Attaches around midspan and towards the root

Design:

- Nylon and leather
- Sewn with heavy thread
- Uses plastic buckles and fasteners





Figures – The sewing design of the harness (above) and a representative scale model of the harness with buckles (left).

Patrick Filan

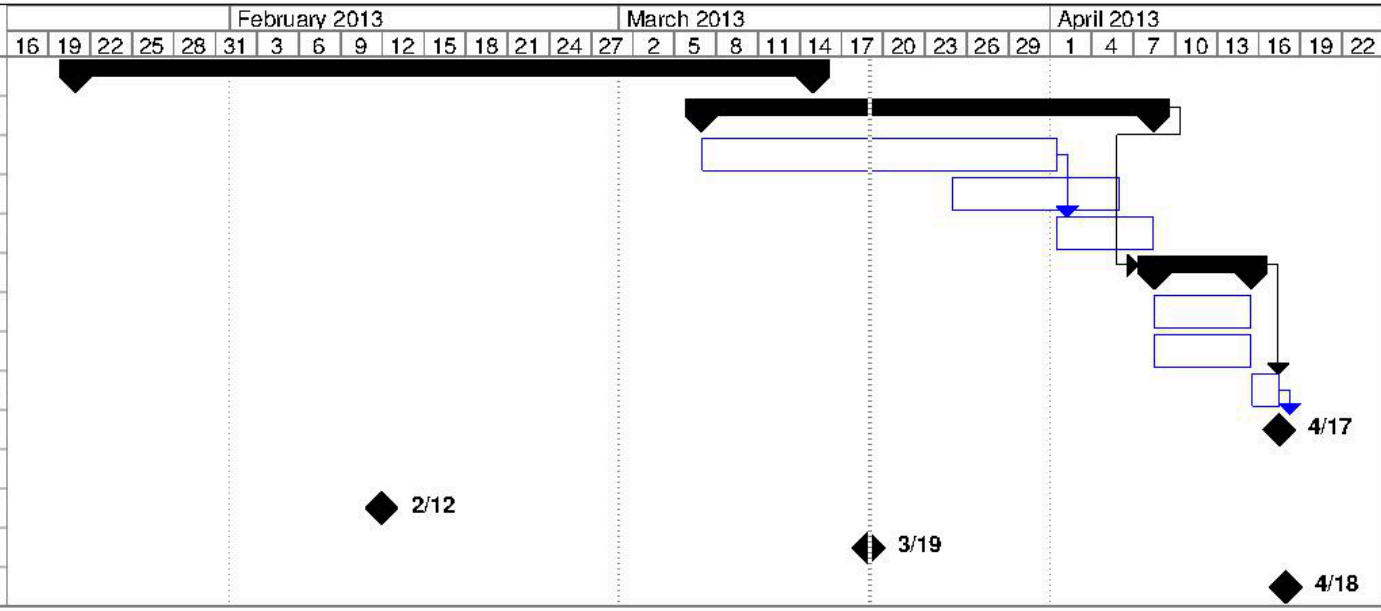
Current Project Status

- All parts received
  - Major structures
  - Small parts
  - Hardware
- To do:
  - Drill mounting holes
  - Fix parts together
  - Aesthetic adjustments
    - Sanding welds
    - Painting
  - Sewing harness

Figure – The cart at its fully-lowered (left) and fully-raised (right) positions with the main canister housing set on top.

Current Schedule

Task Name	Duration
Orders	**39 days**
Assembly	**22.5 days**
Structure Assembly	3.5 wks
Harness Assembly	2 wks
Electrical System Assembly	1 wk
Testing	**5 days**
Weight Testing	5 days
Orientation Testing	5 days
Painting	2 days
Prototype Finished	1 day
Presentations	**48 days**
Midterm Presentation 1	1 day
Midterm Presentation 2	1 day
Final Presentation	1 day



- Final adjustments and assembly underway
  - Assembly expected to be completed early April
- Testing will commence after assembly
- Painting and finishing will start after testing
- Finished prototype will be presented at the final poster session and presentation

Current Expenses

- **Foreseeable spending complete for required parts**
  - Under budget
    - Improvements and adjustments can be made after prototype completion
- Money saved by:
  - Using a friendly machine shop for the main structure
  - Using a friendly seamstress for the harness
  - Picking-up large parts instead of shipping

Alloted Budget	**$2,000.00**
Machined Structure	$675.00
Hardware	$90.00
Harness	$120.00
Winches	$240.00
Batteries	$110.00
Chargers	$60.00
Pulleys	$90.00
Wheels	$60.00
Travel expenses	$100.00
Remaining	**$455.00**

Project Summary

- The project is on-budget and on-time
  - Expected to finish below the allotted budget
  - Remaining assembly will complete in early April
  - Prototype will be completed before final presentation and poster session (April 18th)
    - This functional prototype should be ready for use at TECT Power's Thomasville facility after presentation of it to MEAC for its intended purpose.

Questions, Comments?

References

- Newton, Jason, et al. "TECT." n.d. *Team 9.* October 2012. <http://eng.fsu.edu/me/senior_design/2012/team9/>.

Special Thanks

- **Jason Newton**, Alumnus & Graduate Student at FSU
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- **Dr. Kamal Amin**, Adjunct Professor at FSU
- **Dave Morgan**, Lead Foreman at Westgate Sheet Metal