ENGINEERING PORTFOLIO

Alexander J. Wood

Mechanical Engineering · University of Pittsburgh

B.S. MECHANICAL ENGINEERING · EXPECTED APRIL 2027

I design and build mechanical systems and the tooling that makes them. My work runs from mold tooling, gauges, and FEA at Southco to personal robotics, structural analysis, and gear design at Pitt. I love building, testing, and iterating on a design.

alexwood0126@gmail.com · 484 557 3650 · Thornton, PA

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Southco Sustainability · disassembly, FEA, fixtures, automation

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Forklift gear train · Apollo 13 tank simulation

06 **Third Summer Internship**
Southco Sustainability · fixture tracker + cable configurator

—— 2023–2024

Freshman Year

First-Year Engineering Conference research and writing.

Stellarators as a Path to Cleaner Fusion Energy

Co-wrote a roughly 7,500 word research paper and a conference poster on how stellarator reactor designs improve magnetically confined nuclear fusion. The work was presented at the University of Pittsburgh First-Year Engineering Conference.

ROLE	TIMEFRAME	SCOPE
Co-author (team of 3)	Spring 2024	~7,500 words · 20+ sources

OUTPUT

Paper · poster · talk

Fig. 1 —*Presenting the paper at the First-Year Engineering Conference.*

Alexander J. Wood

alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

WHY IT MATTERED

The conference theme was sustainability. We chose fusion because it could meet rising energy demand without producing carbon dioxide during operation.

WHAT I DID

I researched and co-wrote the paper with two teammates. I organized our group meetings and professor check-ins and kept the project on schedule through drafting and revision.

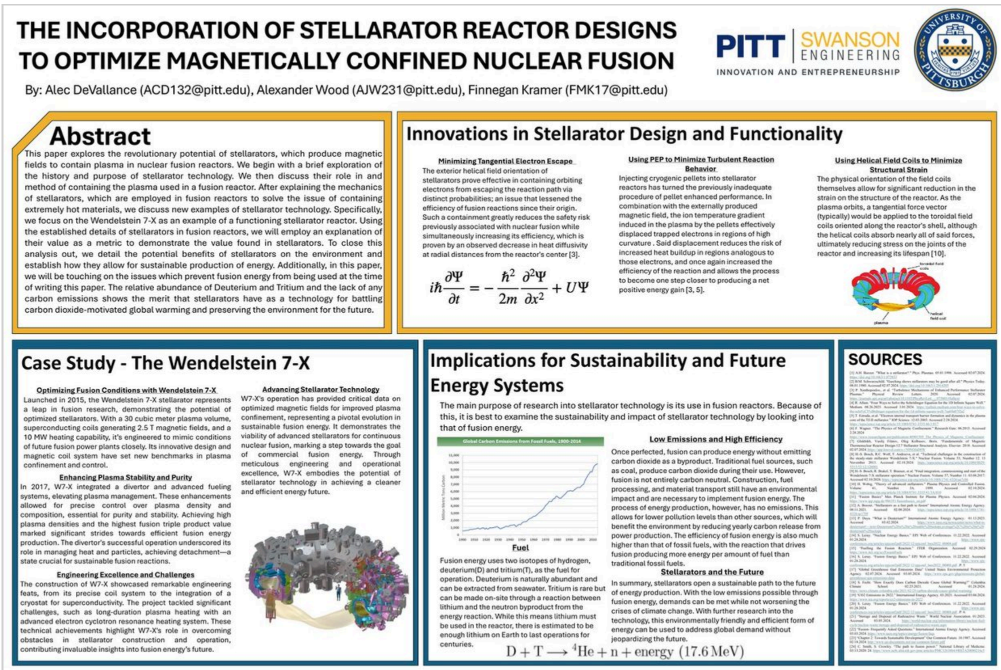

Fig. 2 —*The conference poster, covering the reactor design, the Wendelstein 7-X case study, and the sustainability analysis.*

HOW IT WORKS

A stellarator confines superheated plasma with twisted external magnetic coils rather than a current driven through the plasma itself. That approach holds the plasma more stably and avoids some failure modes of older tokamak reactors. Our main example was the Wendelstein 7-X reactor in Germany.

SKILLS APPLIED

Technical writing · Research synthesis · Engineering communication · Team coordination

SUMMER 2024

First Summer Internship

Southco Inc., New Product Development. Concordville, PA.

On a team of fourteen engineers I helped bring new products into Southco's line and supported specific customer requests. Two projects from that summer follow.

End-of-Arm Tooling for Two Molded Products

Designed and built two end-of-arm tooling assemblies from scratch, one for each of two products. End-of-arm tooling is the gripper that mounts on a machine and pulls finished parts off an injection mold.

ROLE	TIMEFRAME	TOOLS
Designer / builder	Summer 2024	SolidWorks

OUTPUT

2 working assemblies

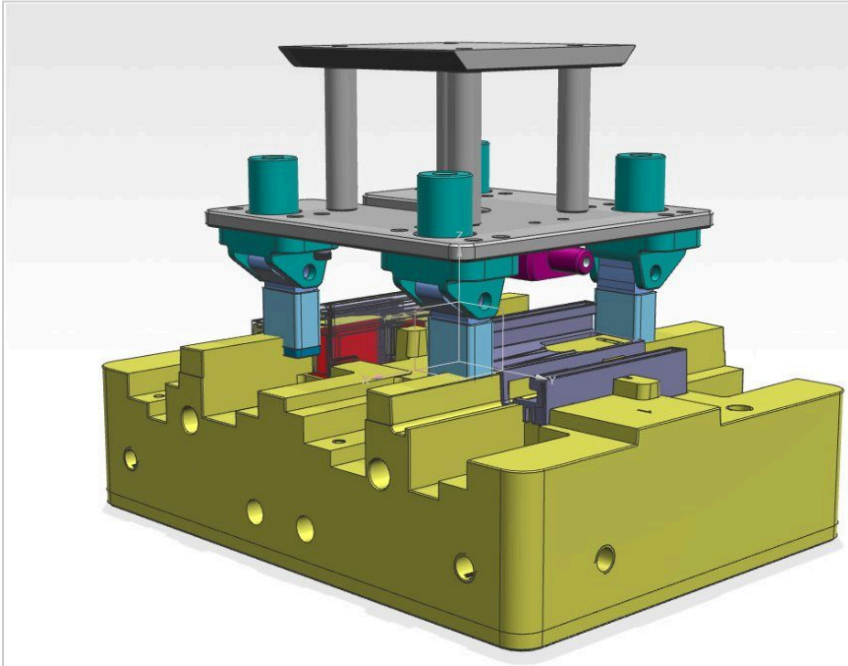

Fig. 1 —*Tooling for the first product. Grippers and locating features sit on a mounting plate above the open mold.*

WHY IT MATTERED

Each new molded product needs its own tooling to lift the part off the mold cleanly and without damage. An off-the-shelf gripper does not fit a new part, so the tooling has to be designed around the exact shape.

WHAT I DID

I designed both assemblies in CAD and implemented them on the molding machines. I matched the pickup features to each part's geometry and the mounting interface to the machine.

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

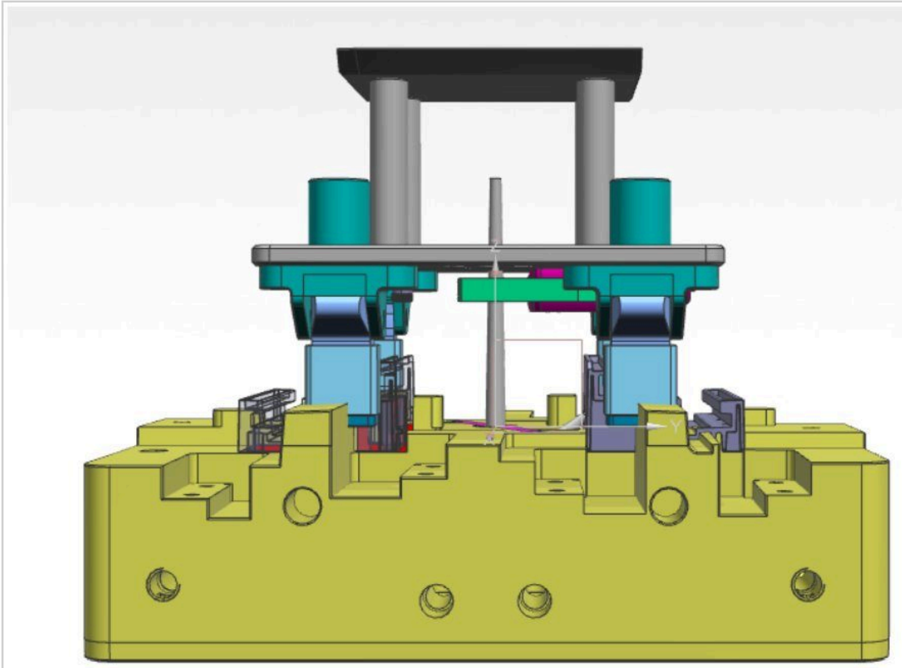

Fig. 2 —*Front view of the first assembly.*

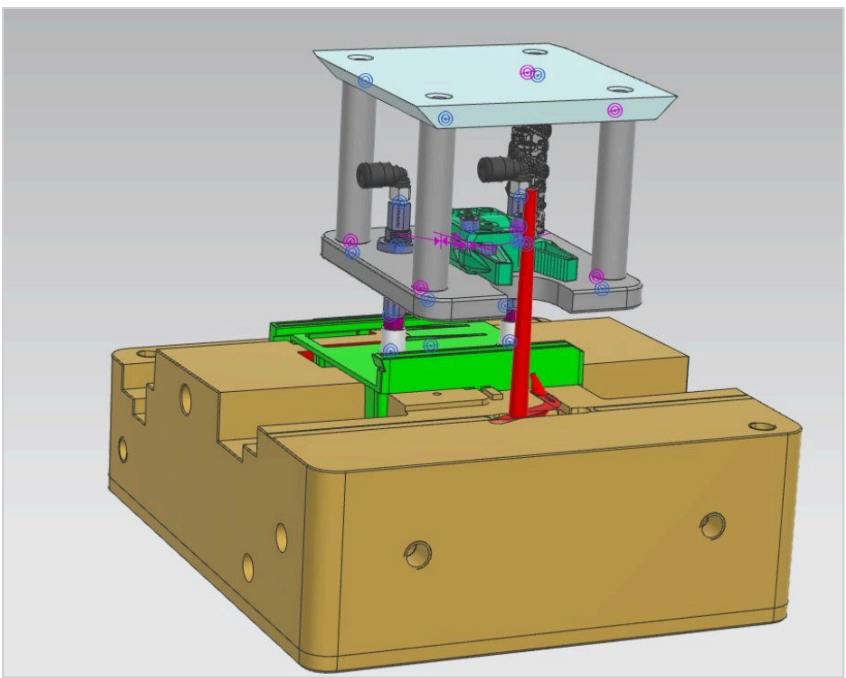

Fig. 3 —*Tooling for the second product, with a center pin and a flexible pneumatic line.*

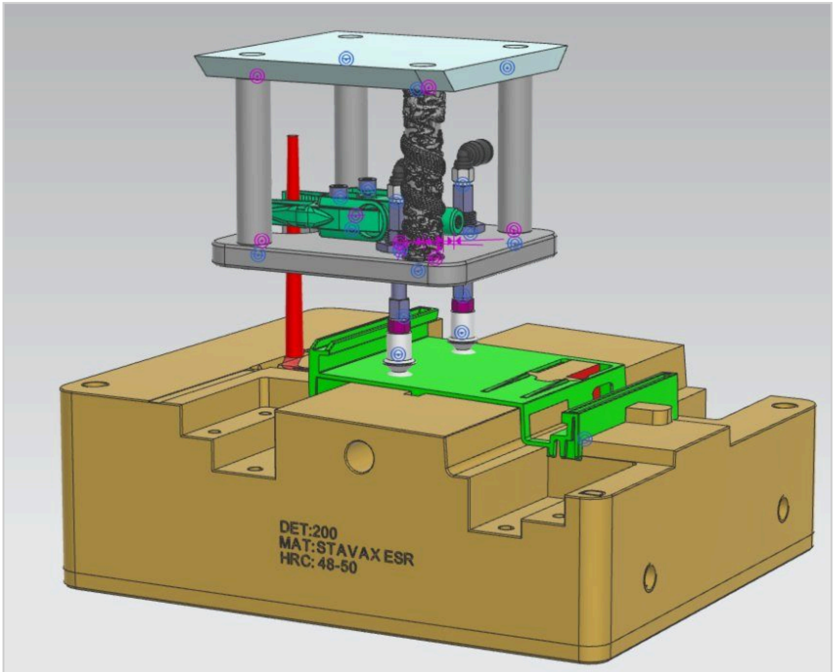

Fig. 4 —*The second assembly seated over the hardened mold tooling, marked Stavax ESR at 48 to 50 HRC.*

HOW IT WORKS

The tooling drops over the open mold, grips the molded parts with positioned features, and lifts them clear for the next step. Designing it against hardened mold steel meant the fit and clearances had to be exact.

SKILLS APPLIED

CAD assembly design · Design for manufacturing · Injection mold tooling · Hands-on installation

Inspection Gauges for New-Product Checks

Designed and made several gauges that check key dimensions on new products, including go and no-go style checks. I produced them with 3D printing and machining.

ROLE

Designer / maker

TIMEFRAME

Summer 2024

TOOLS

SolidWorks · 3D printing · machining

OUTPUT

Several gauges in use

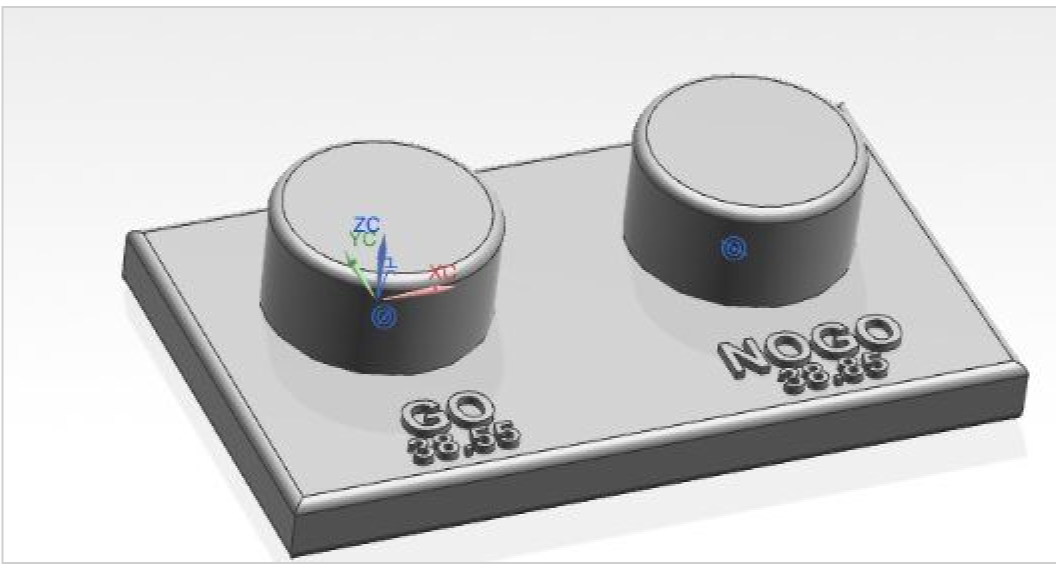

Fig. 1 —*A go and no-go gauge. The GO side must fit the feature and the NOGO side must not.*

WHY IT MATTERED

New products need fast and repeatable checks on the floor. A gauge confirms a part is in spec in seconds, which is much quicker than measuring every feature by hand.

WHAT I DID

I designed each gauge around the dimension it had to check and then 3D printed or machined it. I kept the gauges maintained while they were in use.

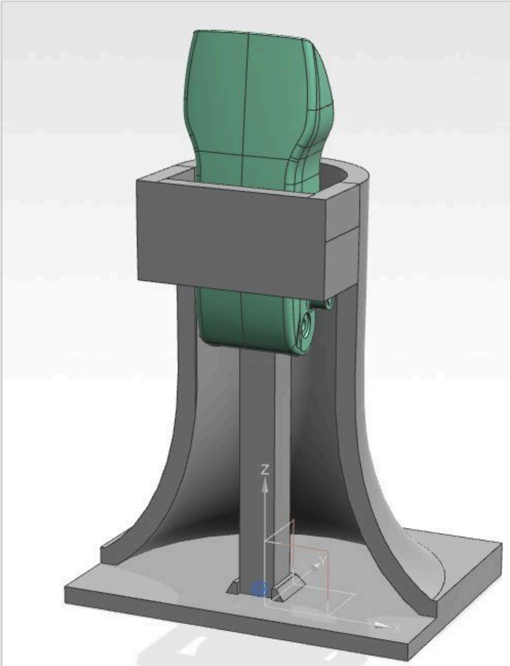

Fig. 2 —*A holding fixture that seats a part for inspection.*

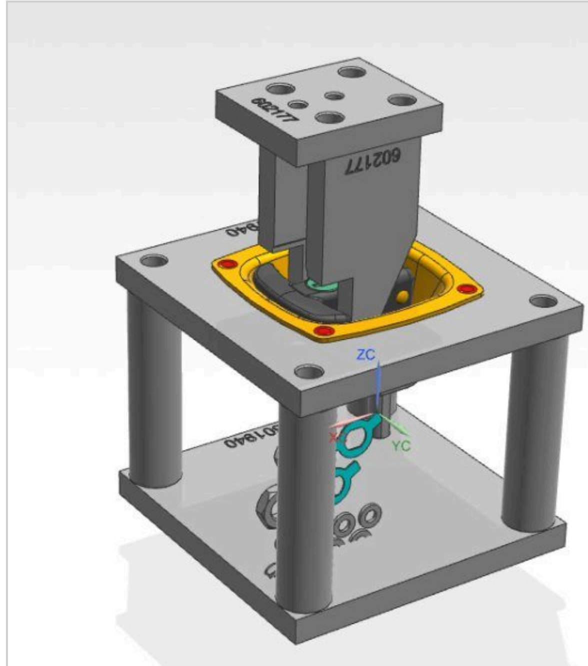

Fig. 3 —*A checking fixture built around specific part numbers.*

HOW IT WORKS

A go and no-go gauge has two checks. If a part passes the GO side and fails the NOGO side, the measured feature falls inside its tolerance band. No numbers are read, so the check is fast and hard to get wrong.

SKILLS APPLIED

Dimensional inspection · Go / no-go gauge design · 3D printing · Machining

2024–2025

Sophomore Year

Coursework in mechanical design and statics. A two-part rover competition where I was Team Lead (MEMS 0024) and a balsa-wood truss bridge (ENGR 0135).

Solar-Powered Mini Mars Rover

Led the design of a scale rover driven by a small solar panel and motor. It carried a 100 gram payload across the test course and was judged on speed, agility, and durability.

ROLE
Team lead (team of 5)

TIMEFRAME
Fall 2024

TOOLS
SolidWorks · laser cutting · 3D printing

POWER BUDGET
~0.2 W solar

Fig. 1 —*The finished solar rover. The panel sits on a mast above a light laser-cut frame.*

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

WHY IT MATTERED

The brief was a NASA-themed competition. The rover had to move a payload using only a low-power solar motor and survive repeated testing, all inside a 12 inch cube.

MY ROLE

As Team Lead I owned the CAD and the engineering decisions after our first sketches and did most of the build myself. The project taught me how to delegate work and how to fit my design together with other teams' designs.

Fig. 2 —*An early build during testing.*

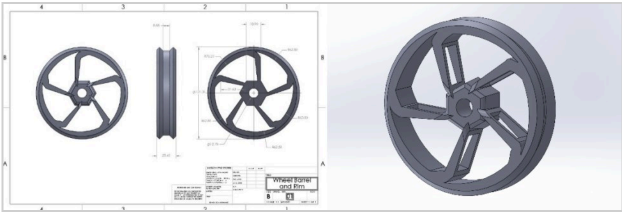

Fig. 3 —*Custom wheel drawing. The spoked design keeps the wheel light while a tread adds grip.*

Fig. 4 —*The four wheels modeled as an assembly.*

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

HOW IT WORKS

With only about 0.2 watts available, the design traded speed against torque through wheel size and gearing. I drew custom spoked wheels sized to carry the load without stalling the motor and kept the frame light by laser cutting it from MDF.

SKILLS APPLIED

SolidWorks · Drivetrain sizing · Lightweight structures · Laser cutting · Team leadership

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Retrofitting the Rover for a Mars Mission Relay

Retrofitted the rover to run on batteries and to trigger the next team's rover in a four-stage relay that ended by raising a solar array. The design had to keep working even with small misalignments between machines.

ROLE	TIMEFRAME	POWER
Team lead (team of 5)	Fall 2024	3x AAA

FOCUS

Actuation + integration

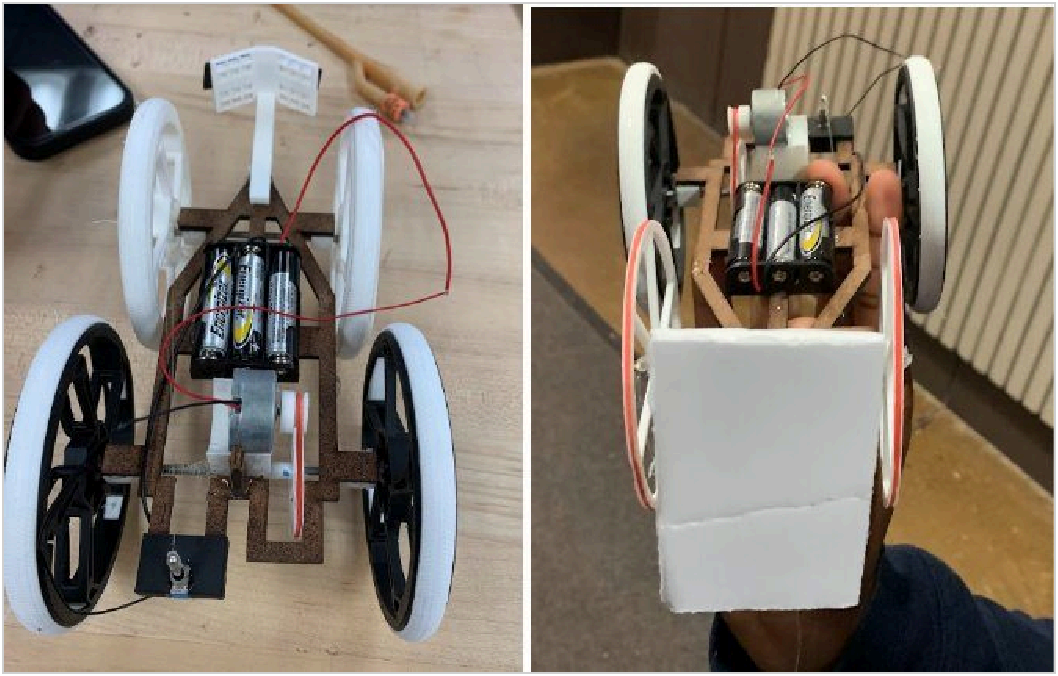

Fig. 1 —*The battery rover. The solar panel is replaced by a 3x AAA pack plus an actuation feature for the handoff.*

WHY IT MATTERED

Four teams' rovers had to chain together. Each rover runs one stage, switches on the next rover, then shuts itself off. My rover had to trigger its neighbor reliably and stop within ten seconds so a stalled motor would not burn out.

MY ROLE

I led the change from solar to battery power and designed the switch and actuation interface with the neighboring team. I also helped set the run order and the handoff requirements across the four teams.

HOW IT WORKS

I swapped the solar panel for a 3x AAA pack and added a switch that cuts power in under ten seconds. The handoff used a mechanical feature matched to the next rover's trigger, designed with margin so it still worked if a rover sat slightly off position.

SKILLS APPLIED

System integration · Actuation design · Fault-tolerant design · Requirements definition · Cross-team coordination

Balsa-Wood Truss Bridge

Designed a Parker truss bridge in balsa wood that held 408 pounds, which placed 16th of 50 teams for maximum weight held. I modeled the full bridge in CAD, verified every member force in MATLAB, and improved the design across three build iterations.

ROLE

CAD + analysis

TIMEFRAME

Fall 2024

TOOLS

SolidWorks · MATLAB · LaTeX

RESULT

408 lbf · 16th of 50

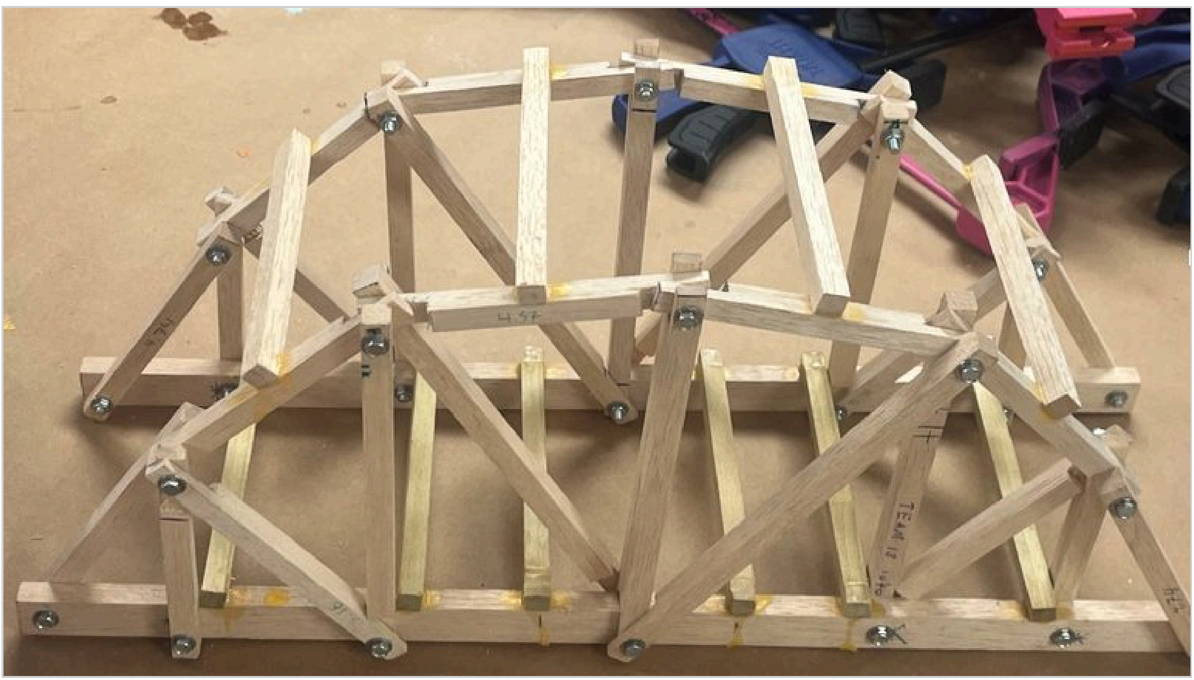

Fig. 1 —*The built bridge. Balsa beams joined with bolts and washers, with the polygonal top chord of a Parker truss.*

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

WHY IT MATTERED

Each team got the same fixed set of balsa beams, bolts, and glue and had to build the strongest bridge possible. Common trusses like the Pratt and Howe were off limits, so we picked the Parker truss and analyzed it ourselves.

WHAT I DID

I modeled the whole bridge in CAD and ran the force and stress calculations. I wrote a MATLAB script that solves the truss by the method of joints and used it to check every member against the SolidWorks model.

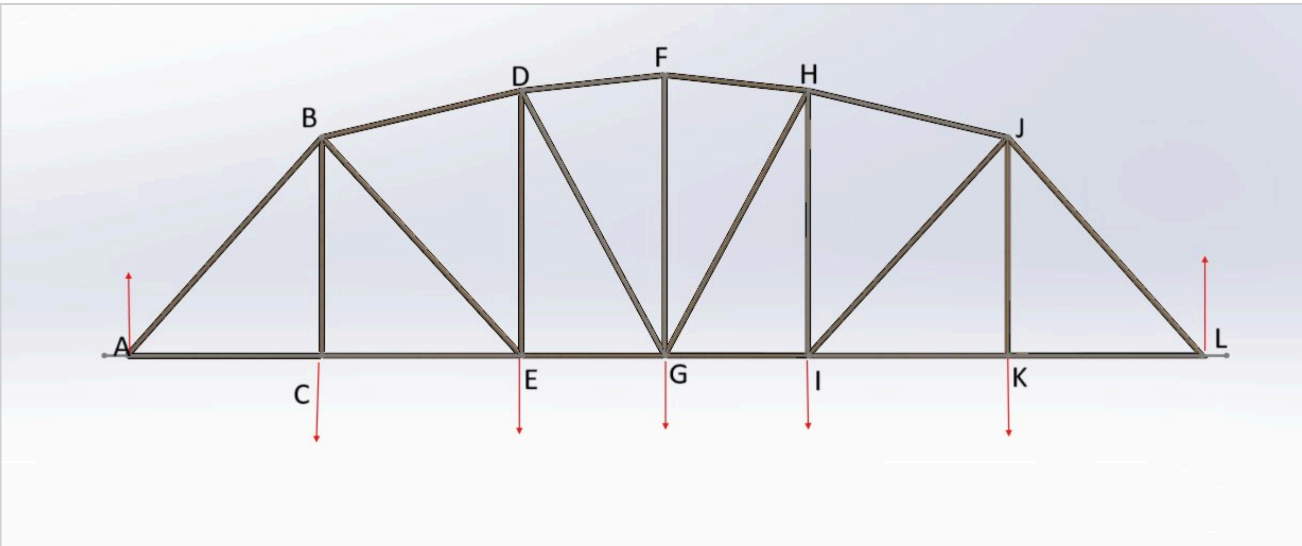

Fig. 2 —*The CAD model with the load case. Each joint is labeled and the red arrows are the applied loads and the support reactions.*

```
% method of joints, solved symbolically in MATLAB
syms AB AC BC BD BE CE DE DF DG EG
W = 111.206;            % load per joint [N]
Ay = 278.015 - AB*(3.40/3.98) == 0;
Ax = AB*(2.07/3.98) + AC == 0;
By = -AB*(3.4/3.98) - BC - BE*(3.4/4.4) + BD*(2.6/3.82) == 0;
Cy = BC + W == 0;
Ey = BE*(3.4/4.4) + DE + W == 0;
eqns = [Ay Ax By Cy Ey ...];
vars = [AB AC BC BD BE CE DE DF DG EG];
soln = solve(eqns, vars);
fprintf('AB = %.2f [N]\n', double(soln.AB))
```

MATLAB · solving member forces by the method of joints (excerpt)

THE REDESIGN

Our first bridge held 210 pounds and failed under the outermost members where the force was highest. I changed the member angles to spread the load more evenly, which dropped the peak member forces. The second bridge held 401 pounds. The third used the same design built with more care and held 408 pounds.

Place	Team	Weight of Bridge [kg]	Total Cost [$]	PI	Weight Held [lb]	Good/Bad	Bonus	
1	16 - 1020	272.1	17.83	64.88	693.67	GOOD	20.0	48
2	15 - 1040	312.1	20.52	42.70	602.67	GOOD	19.6	47
3	15 - 1020	250.1	16.36	57.61	519.67	GOOD	19.2	46
4	7 - 1040	228.1	14.89	69.26	518.67	GOOD	18.8	45
5	21 - 1020	276.1	17.98	47.22	516.67	GOOD	18.3	44
6	26 - 1020	294.1	19.34	39.37	493.67	GOOD	17.9	43
7	8 - 1020	246.1	16.06	54.36	473.67	GOOD	17.5	42
8	6 - 1020	216.1	14.14	68.26	459.67	GOOD	17.1	41
9	5 - 1040	314.1	20.60	32.09	457.67	GOOD	16.7	40
10	23 - 1020	230.1	15.06	57.69	440.67	GOOD	16.3	39
11	17 - 1020	300.1	19.64	33.76	438.67	GOOD	15.8	38
12	13 - 1020	240.1	15.66	52.46	434.67	GOOD	15.4	37
13	27 - 1020	308.1	20.22	31.59	433.67	GOOD	15.0	36
14	28 - 1020	250.1	16.31	47.90	430.67	GOOD	14.6	35
15	12 - 1040	304.1	19.80	31.70	420.67	GOOD	14.2	34
16	13 - 1040	224.1	14.68	56.37	408.67	GOOD	13.8	33
17	10 - 1040	272.1	17.85	37.90	405.67	GOOD	13.3	32
18	25 - 1020	320.1	20.99	27.06	400.67	GOOD	12.9	31
19	22 - 1020	292.1	19.10	32.25	396.67	GOOD	12.5	30
20	29 - 1020	588.1	39.40	7.75	395.67	GOOD	12.1	29
21	20 - 1020	202.1	13.21	66.03	388.67	GOOD	11.7	28
22	30 - 1020	294.1	19.29	31.08	388.67	GOOD	11.3	27
23	3 - 1020	306.1	20.16	28.43	386.67	GOOD	10.8	26
24	8 - 1040	216.1	14.19	56.76	383.67	GOOD	10.4	25
25	4 - 1020	284.1	18.64	31.67	369.67	GOOD	10.0	24
26	11 - 1020	256.1	16.76	37.91	358.67	GOOD	9.6	23
27	1 - 1040	192.1	12.48	67.50	356.67	GOOD	9.2	22
28	14 - 1040	232.1	15.20	45.75	355.67	GOOD	8.8	21
29	12 - 1020	212.1	13.76	54.38	349.67	GOOD	8.3	20
30	1 - 1020	226.1	14.76	46.72	343.67	GOOD	7.9	19
31	31 - 1020	218.1	14.28	50.07	343.67	GOOD	7.5	18
32	32 - 1020	262.1	17.20	34.29	340.67	GOOD	7.1	17
33	14 - 1020	270.1	17.69	31.68	333.67	GOOD	6.7	16
34	19 - 1020	270.1	17.71	30.50	321.67	GOOD	6.3	15
35	5 - 1020	290.1	19.05	25.59	311.67	GOOD	5.8	14
36	9 - 1020	278.1	18.15	27.48	305.67	GOOD	5.4	13
37	2 - 1040	214.1	13.97	45.14	297.67	GOOD	5.0	12
38	4 - 1040	268.1	17.58	27.70	287.67	GOOD	4.6	11
39	18 - 1020	238.1	15.60	34.05	278.67	GOOD	4.2	10
40	24 - 1020	224.1	14.62	38.59	278.67	GOOD	3.8	9
41	9 - 1040	246.1	16.09	31.35	273.67	GOOD	3.3	8
42	3 - 1040	278.1	18.04	24.39	269.67	GOOD	2.9	7
43	33 - 1020	250.1	15.16	32.15	268.67	GOOD	2.5	6
44	34 - 1020	216.1	14.13	39.91	268.67	GOOD	2.1	5
45	2 - 1020	220.1	14.40	38.02	265.67	GOOD	1.7	4
46	16 - 1040	296.1	19.45	20.61	261.67	GOOD	1.3	3
47	7 - 1020	270.1	17.93	24.05	256.67	GOOD	0.8	2
48	6 - 1040	214.1	14.03	38.47	254.67	GOOD	0.4	1
49	11 - 1040	220.1	14.43	36.37	254.67	GOOD	0.0	0

Fig. 3 —*Class results for maximum weight held. Our team's row is highlighted at 16th of 50, holding 408 pounds.*

SKILLS APPLIED

Statics · method of joints · MATLAB · SolidWorks · Stress analysis · Iterative design · Technical writing (LaTeX)

SUMMER 2025

Second Summer Internship

Southco Inc., Sustainability Department. Concordville, PA.

Back at Southco on the Sustainability team I led a large parts-recovery effort and took on several design and analysis tasks in Siemens NX. Four follow.

Recovering 1,700+ Returned Parts for Reuse

Led a project to disassemble and recover more than 1,700 customer-returned parts for reuse, which saved significant cost. I designed a 3D-printed press fixture that takes each part apart in one stroke, then set up three presses and trained operators across all three shifts to clear the full batch in about a week.

ROLE	TIMEFRAME	TOOLS
Project lead	Summer 2025	SolidWorks · 3D printing · arbor press

SCALE

1,700+ parts · 3 shifts

Fig. 1 —*The returned parts staged on pallets. More than 1,700 in total.*

WHY IT MATTERED

More than 1,700 returned parts were sitting on pallets. Taking them apart by hand would have been slow and inconsistent. Recovering the parts instead of scrapping them saved real money.

WHAT I DID

I designed a press fixture that holds a part and drives out its pin in one stroke. A rail lets each part slide in, get pressed, and slide out fast. I ran three presses, trained operators on first, second, and third shift, and managed the work so the whole batch was done in about a week.

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

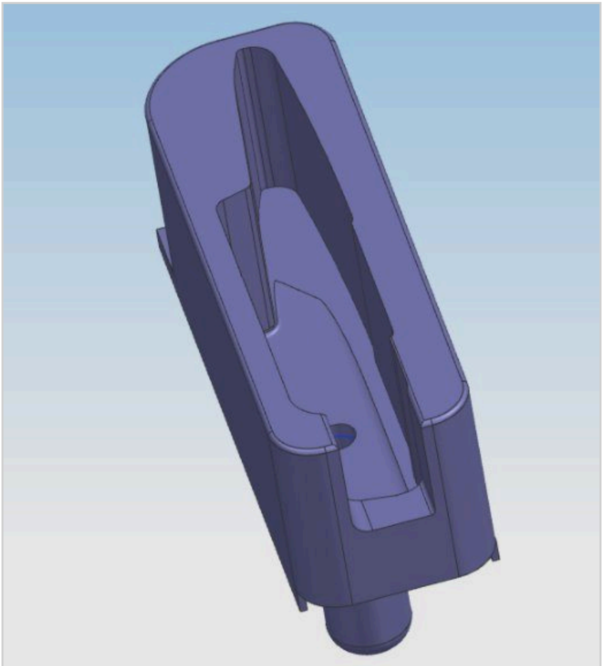

Fig. 2 —*The press fixture modeled in CAD.*

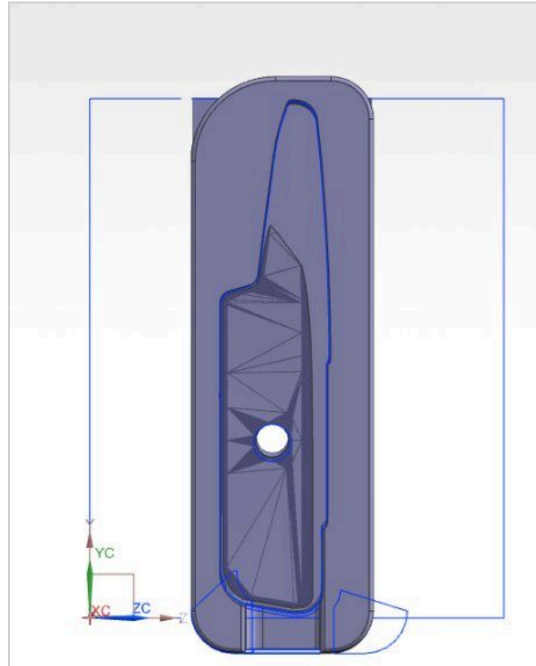

Fig. 3 —*A section view of the fixture, showing its internal walls.*

Fig. 4 —*An arbor press set up with the fixture.*

Fig. 5 —*A part in the fixture under the press.*

Fig. 6 —*The 3D-printed fixture. The rail guides each part in and out.*

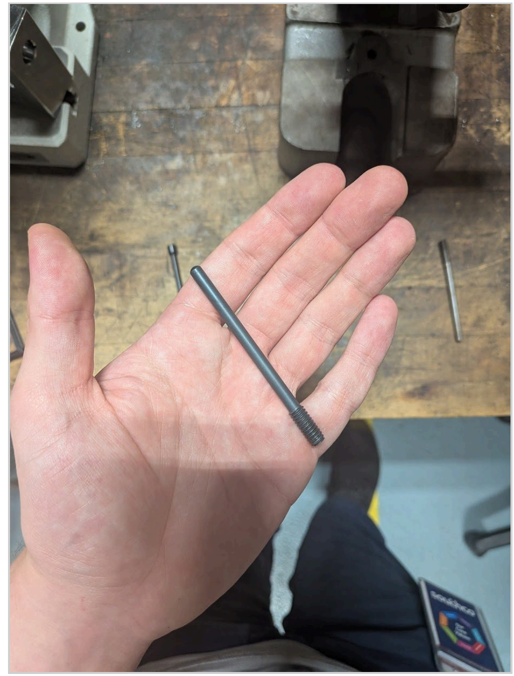

Fig. 7 —*One of the three press pins I made to mount on the arbor press and push the pins out of the parts.*

HOW IT WORKS

Each part seats in the fixture on a rail. One pull of the arbor press separates the part and pushes the pin clear. The rail lets the next part load right away, so the cycle stays short and stays the same across every operator and shift.

SKILLS APPLIED

Fixture design · 3D printing · Process setup · Production scale-up · Training + leadership · Cost reduction

Diagnosing a Nylon Plug Failure with FEA

Used finite element analysis in Siemens NX to find why a nylon snap plug was cracking when it was pressed into a lock. The study showed where stress peaked, and I gave two fixes: open up the plug dimensions, or soak the plug in water before assembly so the nylon is less brittle.

ROLE	TIMEFRAME	TOOLS
Analysis + redesign	Summer 2025	Siemens NX · nonlinear FEA

OUTPUT

Root cause + two fixes

WHY IT MATTERED

The plug was snapping during assembly into the lock, which scrapped parts and slowed the line. The team needed to know why before changing the part.

WHAT I DID

I modeled the plug and ran a nonlinear static stress study in NX. The von Mises results showed stress concentrating at the snap features as the plug deflects into place. From that I recommended either opening up the dimensions to lower the stress, or conditioning the nylon in water before assembly.

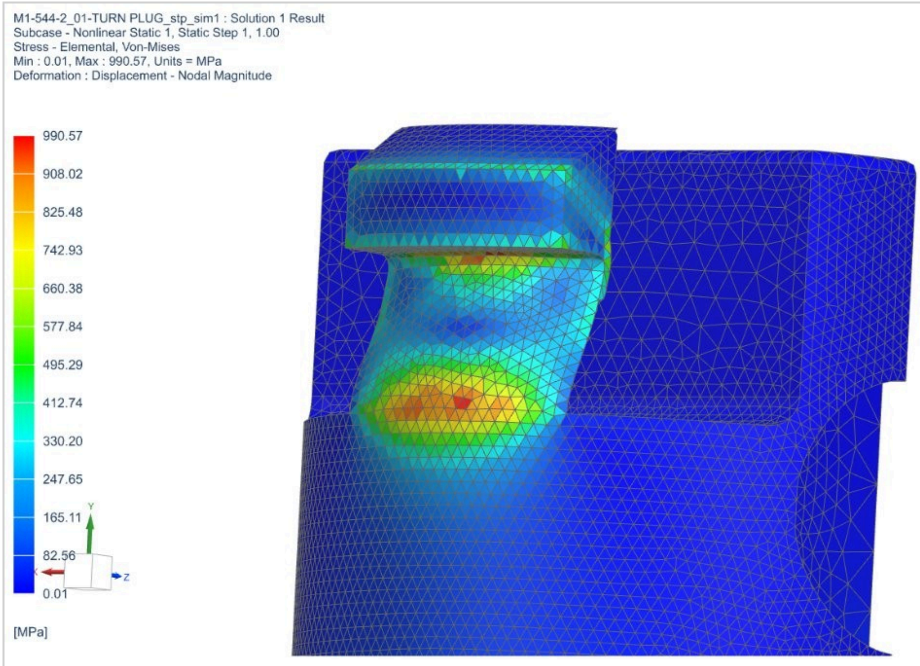

Fig. 1 —*The meshed result with the plug in its mating body. The colored band marks where stress climbs as the plug is pressed in.*

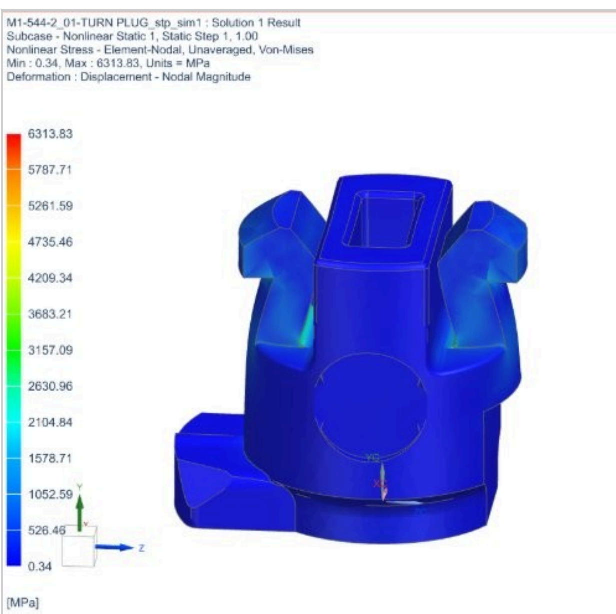

Fig. 2 —*Von Mises stress on the plug.*

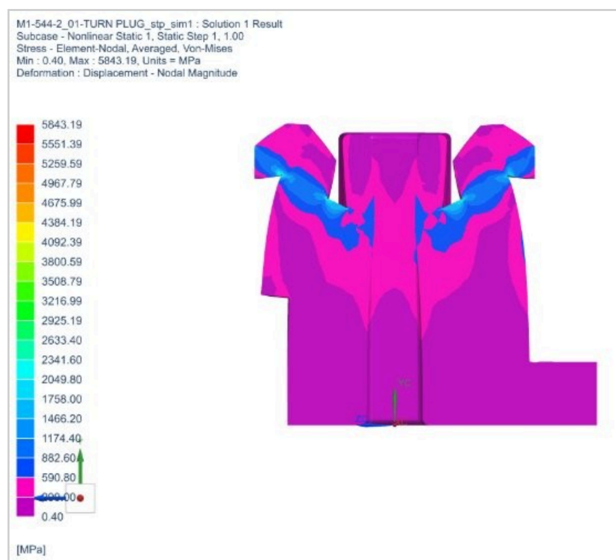

Fig. 3 —*The same study at a tighter scale, highlighting the peak regions.*

WHY THE FIXES WORK

Nylon is stiffer and more brittle when it is dry. The FEA showed the snap features hitting their highest stress at the moment of insertion. Adding clearance lowers that peak. A short water soak raises the nylon's moisture content so it bends through the same motion instead of cracking.

SKILLS APPLIED

Siemens NX · FEA · nonlinear static · Root-cause analysis · Material behavior (nylon) · Design for assembly

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A 2-in-1 Test Fixture for Door Hinges

Designed a single fixture that loads door hinges both radially and axially, built from scratch for an engineering team in Shenzhen. It clamps a range of hinge sizes and weights, so one fixture covers many parts and both load cases.

ROLE	TIMEFRAME	TOOLS
Designer (from scratch)	Summer 2025	Siemens NX

FOR

Engineering team, Shenzhen

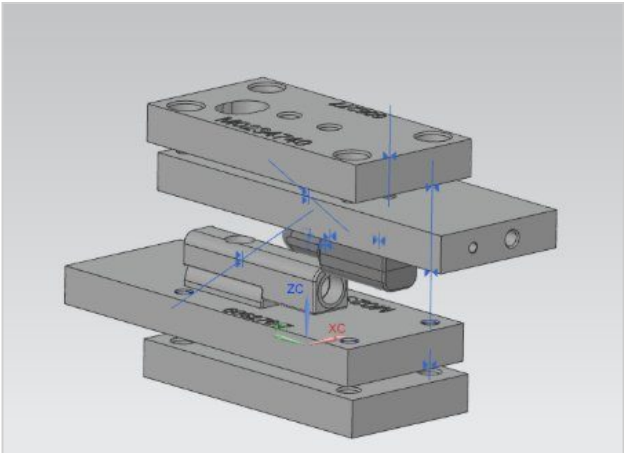


Fig. 1 —*The fixture shown in an exploded view.*

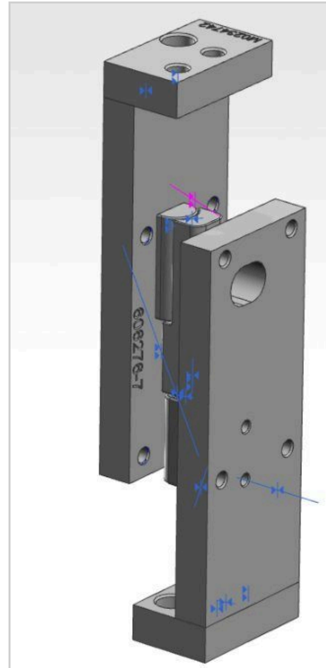


Fig. 2 —*The fixture clamping a hinge between its arms.*

WHY IT MATTERED

The Shenzhen team needed to test hinges in two directions. Separate rigs for radial and axial loading take more setup and bench space. One fixture that does both is faster to use and works across hinge sizes.

WHAT I DID

I designed the fixture in NX from a blank sheet. I built it to clamp different hinge sizes and to apply both radial and axial load without reworking the setup between tests.

HOW IT WORKS

The hinge mounts in the fixture once. From that single setup the rig pushes on it along its axis and across it, so both load cases run without re-fixturing the part.

SKILLS APPLIED

Siemens NX · Test rig design · Design from scratch · Design for a range of parts · Cross-site collaboration

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

Automating 20 Latch Variants with NX Part Families

Used part families in Siemens NX to generate 20 variants of an existing latch from one master model. Instead of modeling each combination by hand, the family builds every variant from a table of dimensions and part numbers.

ROLE	TIMEFRAME	TOOLS
CAD automation	Summer 2025	Siemens NX · part families

OUTPUT

20 latch variants

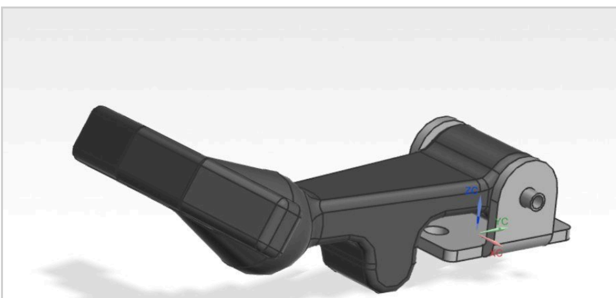
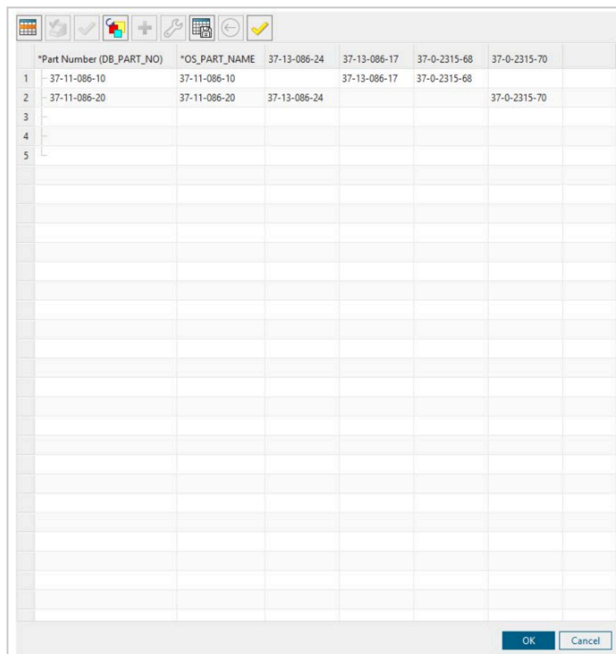


Fig. 1 —*The master latch model in NX.*



	*Part Number (DB_PART_NO)	*OS_PART_NAME	37-13-086-24	37-13-086-17	37-0-2315-68	37-0-2315-70
1	37-11-086-10	37-11-086-10		37-13-086-17	37-0-2315-68	
2	37-11-086-20	37-11-086-20	37-13-086-24			37-0-2315-70
3						
4						
5						

Fig. 2 —*The part-family table. Each row defines one variant by part number and dimensions.*

WHY IT MATTERED

The latch came in many size and feature combinations. Modeling each one by hand is slow and easy to get wrong. A part family makes every variant from one controlled model.

WHAT I DID

I set up a part family on the master latch model. Each row in the table sets the dimensions and part number for one variant, and NX builds the model from it. That produced all 20 variants from a single source.

HOW IT WORKS

A part family links a table to the CAD model. Change a value in a row and NX rebuilds that member with the new dimensions. One edit to the master updates every variant, so the whole set stays consistent.

SKILLS APPLIED

Siemens NX · Part families · design automation · Parametric modeling · Standardization

2025–2026

Junior Year

Machine Design (MEMS 1029) and Applied Simulation in Design (MEMS 1120). A team gear train for a hand-cranked forklift, and a solo ANSYS study that recreates the Apollo 13 oxygen-tank failure.

Gear Train for a Hand-Cranked Forklift

On a team designing a hand-cranked forklift that lifts 200 kg to 3 meters, I designed the gear train that turns crank effort into lifting force and built the cost budget for the whole machine. The gearing steps the crank down through several stages to the winding drum.

ROLE	TIMEFRAME	TOOLS
Gear train + costing (team of 4)	Spring 2026	SolidWorks

TARGET

Lift 200 kg to 3 m

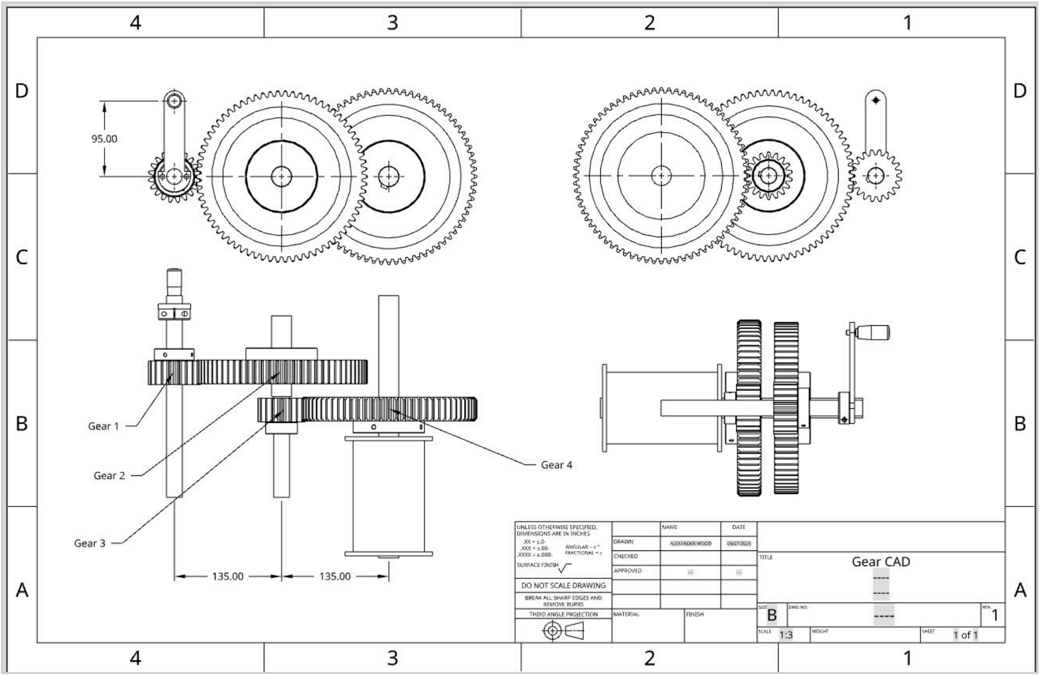


Fig. 1 —*The gear train drawing. The crank drives through staged gears to the winding drum, with center distances and the crank arm called out.*

WHY IT MATTERED

A person turning a crank cannot lift 200 kg directly. The gear train trades crank speed for torque so one operator can raise the load with a reasonable amount of force.

WHAT I DID

I sized and laid out the gears that connect the hand crank to the winding drum. I set the gear ratio to bring the crank force down to a level one person can hold, drew the train in CAD, and put together the cost budget for the materials and parts across the design.

HOW IT WORKS

Turning the crank drives a small gear into a larger one, and that step repeats down the train to the drum. Each stage multiplies torque and lowers speed. The drum winds the cable that runs over the pulleys to lift the forks, and the loaded parts are sized to a factor of safety above two.

SKILLS APPLIED

Gear train design · Power transmission · SolidWorks · Cost estimating · Teamwork

Recreating the Apollo 13 Oxygen-Tank Failure in ANSYS

For a simulation course, I rebuilt the oxygen-tank heater that started the Apollo 13 accident and ran a thermal study in ANSYS to qualify it against a pass/fail limit. The normal 28-volt case passes, the documented 65-volt off-nominal condition fails by a wide margin, and a cooling-only redesign barely helps, so the real fix has to be in the heater controls, not the surrounding tank.

ROLE
Analysis + redesign (solo)

TIMEFRAME
Spring 2026

TOOLS
ANSYS · steady-state thermal

OUTPUT
Qualify / reject decision

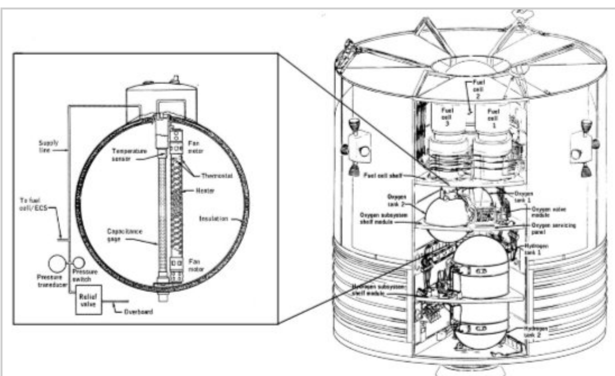


Fig. 1 —*The historical oxygen-tank subsystem from the NASA review-board materials. The heater, thermostat, gage, and fan motors sit inside the pressure vessel.*

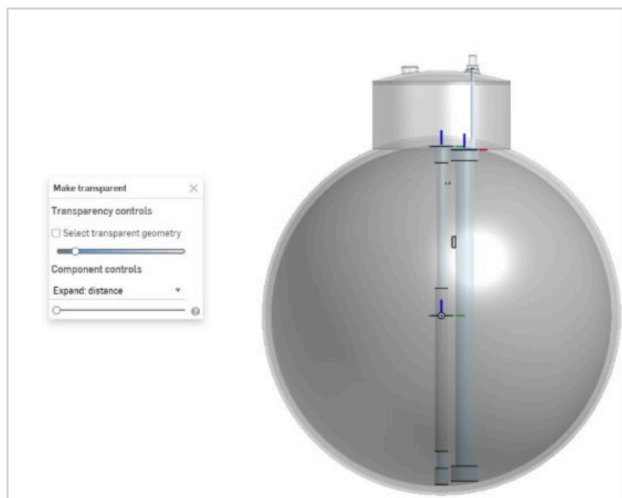


Fig. 2 —*The recreated subsystem in CAD, sectioned to show the heater tube and quantity probe inside the vessel.*

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

WHY IT MATTERED

Apollo 13 traces back to a heater and thermostat that ran far harder than they were rated for during a ground procedure. The course brief was to qualify a real subsystem against a thermal margin, so I rebuilt the exact part of the tank where that failure began rather than the whole spacecraft.

WHAT I DID

I modeled the tank subsystem in CAD (the pressure vessel, heater tube, quantity probe, and gage sleeve) and set up a steady-state thermal study in ANSYS with the inside of the vessel held at the cryogenic -300 °F. I then compared the normal 28-volt heater against the 65-volt condition the ground equipment actually applied.

```
% resistive heater power scales with voltage squared
P     = V^2 / R                 % same heater resistance R
ratio = (65 / 28)^2             % 65 V ground vs 28 V spacecraft
      = 5.39                    % off-nominal heat-input multiplier

q_nominal     = 0.00979         % BTU/(s·in^3)
q_offnominal  = 0.053           % = 5.39 x nominal heater input
```

The off-nominal heater load, set only by the voltage-squared scaling

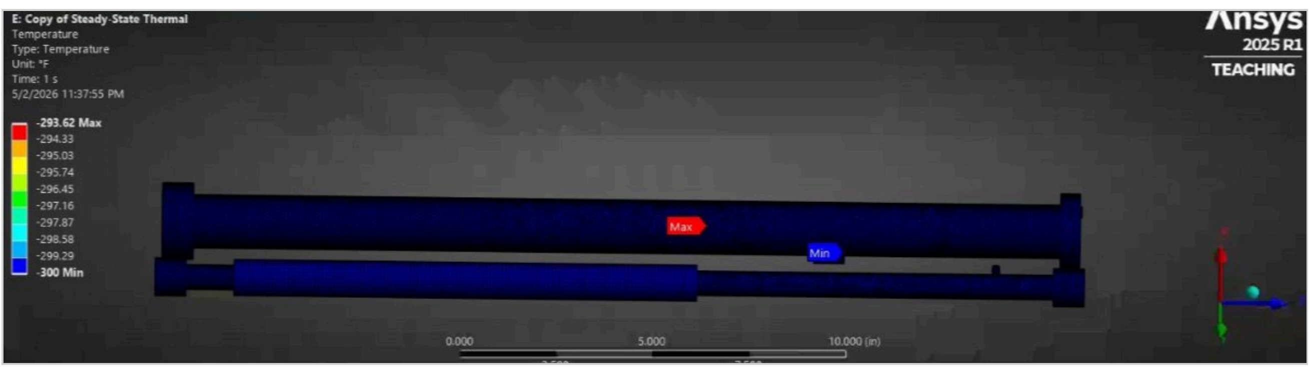


Fig. 3 —*Steady-state thermal result, nominal case. The peak reaches about -293.62 °F, roughly 6 °F above the -300 °F environment.*

WHAT THE MODEL SHOWS

The nominal case stays right next to the -300 °F environment, rising only about 6 °F. The 65-volt case rises 35 °F and its peak heat flux climbs about 5.4 times higher, the same factor the hand calculation predicts, which is a good check that the model behaves correctly. A redesign that improves only the heat rejection drops the peak temperature by about 2 percent, so cooling alone does not solve it. That matches the real lesson: the heater control, not the surrounding tank, is what had to change.

SKILLS APPLIED

ANSYS · Steady-state thermal FEA · Design qualification · Hand-calc verification · Failure analysis

SUMMER 2026

Third Summer Internship

Southco Inc., Sustainability Department. Concordville, PA.

Back at Southco on the Sustainability team for a third summer, I built two internal software tools that replace fragile shared spreadsheets with maintained databases. Both follow.

A Tracking System for 6,000+ Test Fixtures

Built a web-based system that tracks where every test fixture in the lab is and who has it — more than 6,000 fixtures that until now lived in one Excel sheet that was sorted by hand and often wrong. A user scans a fixture's QR label, picks check out, check in, or transfer, and confirms; the app records the move, logs it for history, and keeps the shared workbook in sync on its own.

ROLE	TIMEFRAME	STACK
Designer / developer	Summer 2026	Flask · SQLite · Excel sync · QR
SCALE		
6,190 fixtures · 3,654 in scope		

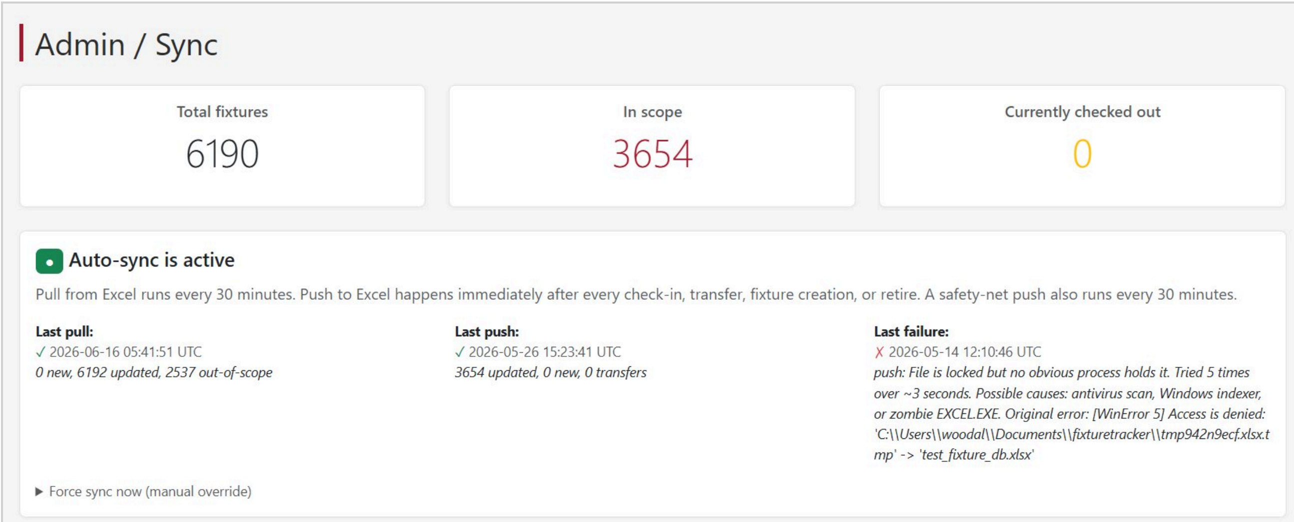


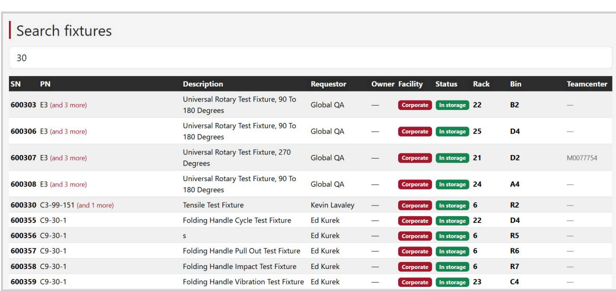
Fig. 1 —*The admin dashboard. It tracks the full count, what is in scope, what is checked out, and the health of the automatic sync with Excel.*

WHY IT MATTERED

The lab's fixtures were logged in a single spreadsheet that people edited by hand. Locations drifted, rows got sorted wrong, and finding one fixture among thousands meant searching the floor. There was no record of who had taken what.

WHAT I DID

I built the tracker as a web app with its own database and a printable QR label for each fixture. The four everyday jobs — check out, check in, transfer, and search — each became one short, guided screen. Every action writes to the database right away and is logged with the user's name, so the history is always there.



Search fixtures

30

SN	PN	Description	Requestor	Owner	Facility	Status	Rack	Bin	Teamcenter
600303	E3 (and 3 more)	Universal Rotary Test Fixture, 90 To 180 Degrees	Global QA	—	Corporate	In storage	22	B2	—
600306	E3 (and 3 more)	Universal Rotary Test Fixture, 90 To 180 Degrees	Global QA	—	Corporate	In storage	25	D4	—
600307	E3 (and 3 more)	Universal Rotary Test Fixture, 270 Degrees	Global QA	—	Corporate	In storage	21	D2	M0077754
600308	E3 (and 3 more)	Universal Rotary Test Fixture, 90 To 180 Degrees	Global QA	—	Corporate	In storage	24	A4	—
600330	C3-99-151 (and 1 more)	Tensile Test Fixture	Kevin Lavaley	—	Corporate	In storage	6	R2	—
600355	C9-30-1	Folding Handle Cycle Test Fixture	Ed Kurek	—	Corporate	In storage	22	D4	—
600356	C9-30-1	s	Ed Kurek	—	Corporate	In storage	6	R5	—
600357	C9-30-1	Folding Handle Pull Out Test Fixture	Ed Kurek	—	Corporate	In storage	6	R6	—
600358	C9-30-1	Folding Handle Impact Test Fixture	Ed Kurek	—	Corporate	In storage	6	R7	—
600359	C9-30-1	Folding Handle Vibration Test Fixture	Ed Kurek	—	Corporate	In storage	23	C4	—

Fig. 2 —*Search. Any field finds a fixture and shows its current status and rack/bin.*

Fig. 3 —*Printed labels. The QR encodes the serial number, so scanning it fills in the form.*

HOW IT WORKS

The app keeps the live state — status, current rack and bin, owner, and facility — in its own database, while the Excel workbook stays the shared file of record. It pulls from Excel on a timer and pushes back the moment anything changes, so the spreadsheet stays right without anyone editing it for routine moves. A transfer clears the rack and bin and reassigns the facility; a check-in sets the new location and brings ownership back to Corporate. If the workbook is open and locked, the app logs a soft failure and retries instead of losing the change.

PHYSICAL SETUP

The plan pairs the software with a few physical pieces: a QR label on every in-scope fixture, printed four to a sheet and cut apart; a label printer and a scanning station — a phone or webcam — at the lab; and the rack-and-bin locations the labels point back to. A user can scan straight off the fixture or upload a phone photo of the label, and only type the serial number by hand if a label is worn.

SKILLS APPLIED

Full-stack web app (Flask) · Database design (SQLite) · Excel automation / sync · QR labeling + scanning · Inventory + audit tracking

A Cable Part Configurator to Replace a Customer Spreadsheet

Rebuilt the tool customers use to configure a cable assembly and get back a valid part number. The old version was an Excel sheet handed out to customers; the new one is a clean configurator backed by a database that Southco engineers control, so the catalog can change without touching what the customer sees and without exposing how it works.

ROLE

Designer / developer

TIMEFRAME

Summer 2026

TOOLS

Database-backed web app

CATALOG

27 actuators · 26 latches · 10 fittings

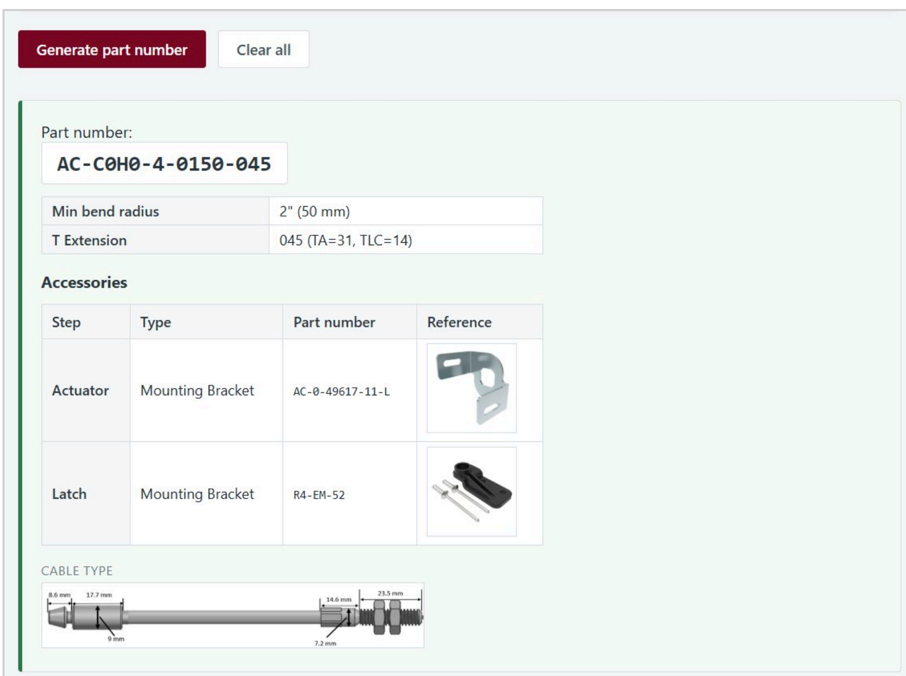


Fig. 1 —*What the customer sees. Their choices generate a part number, the matching brackets and accessories, and a dimensioned diagram of the cable.*

Alexander J. Wood alexwood0126@gmail.com · 484 557 3650 · Mechanical Engineering, University of Pittsburgh

WHY IT MATTERED

Customers were configuring parts from a spreadsheet that was hard to keep current and exposed the internal logic behind every part number. When the catalog changed, someone had to edit and resend the file, and a customer could see or break the formulas underneath.

WHAT I DID

I split the tool in two. Customers get a simple configurator that turns their selections into a part number and the right accessories. Engineers get a separate, hidden admin side where they manage the catalog — cable types, fittings, actuators, latches, accessories, and the reference diagrams — and the customer tool is generated from it.

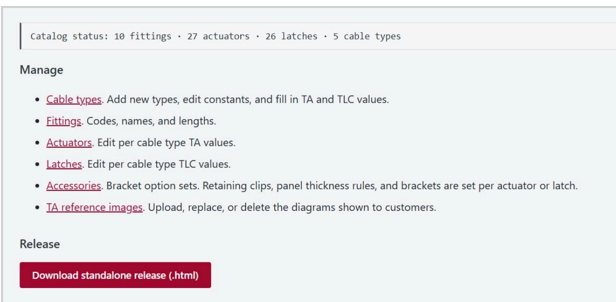


Fig. 2 —*The engineer side. Each part of the catalog is editable, and a release of the customer tool is generated from it.*

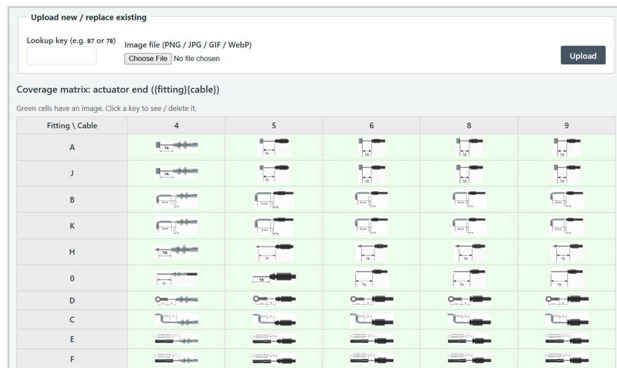


Fig. 3 —*The reference-image matrix. Every fitting-and-cable pairing maps to the diagram the customer sees.*

HOW IT WORKS

The catalog lives in a database on the engineer side: each cable type carries its own constants, each actuator and latch carries the values that set the assembly's dimensions, and each fitting-and-cable pairing maps to a reference diagram. When a customer makes their selections, the tool assembles the part number from those records and pulls the matching accessories and drawing. Engineers update a value once in the admin side and export a fresh standalone release; the customer never sees the database or the rules behind it.

SKILLS APPLIED

Database-backed web app · Configurator / rules logic · Admin tooling · Replacing spreadsheet workflows · Customer-facing UX

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