LAURA ANDERSON

industrial designer
mechanical engineer

CONTENTS

PROJECTS

GM NODE ENTRY SYSTEM

General Motors presented the concept of the NODE, a single-seat, autonomous, neighborhood electric vehicle (NEV), to my team of Georgia Tech senior capstone students. Our group was tasked with designing the ingress/egress system and the door system for the car.

This vehicle will allow both disabled and non-disabled users affordable, private transportation for everyday travel. Developing an optimal way for users to get into and out of the vehicle is the first step in getting GM's game-changing NODE vehicle into the hands (and garages) of consumers.

Our NODE concept vehicle

GM provided the following parameters for our design.

- Single seat
- Fully autonomous
- Inclusive (for disabled and non-disabled users)
  - -Wheelchair accessible
  - -ADA-compliant
- Cost less than $14,000
- Maximum speed less than 35 mph
- Neighborhood vehicle (low range)

KEY STAKEHOLDERS

PRIMARY	SECONDARY	TERTIARY
General Motors	Wheelchair Manufacturers	Americans with Disabilities Act (ADA)
Disabled users	Car Manufacturers	Federal Motor Vehicle Safety Standards (FMVSS)
Nondisabled users		SAE International

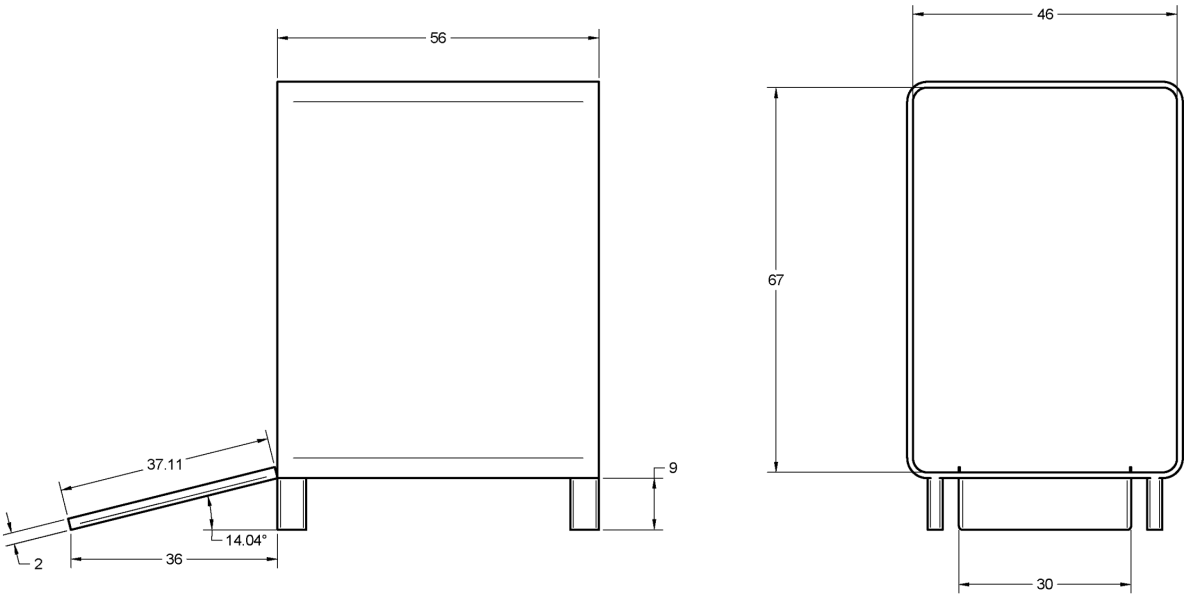
We divided our task into five distinct yet interdependent questions.

Where do users enter the vehicle? Where do they exit?	Front, side, or back of the vehicle
How do they enter and exit the vehicle?	Ramp, kneel, or lift
How does the door move? How many panels does it have?	Vertically or horizontally; one or two
How is the chosen mode of entry and exit achieved?	Pneumatics, hydraulics, gears, etc.
How is the chosen mode of door movement achieved?	Pneumatics, hydraulics, gears, etc.

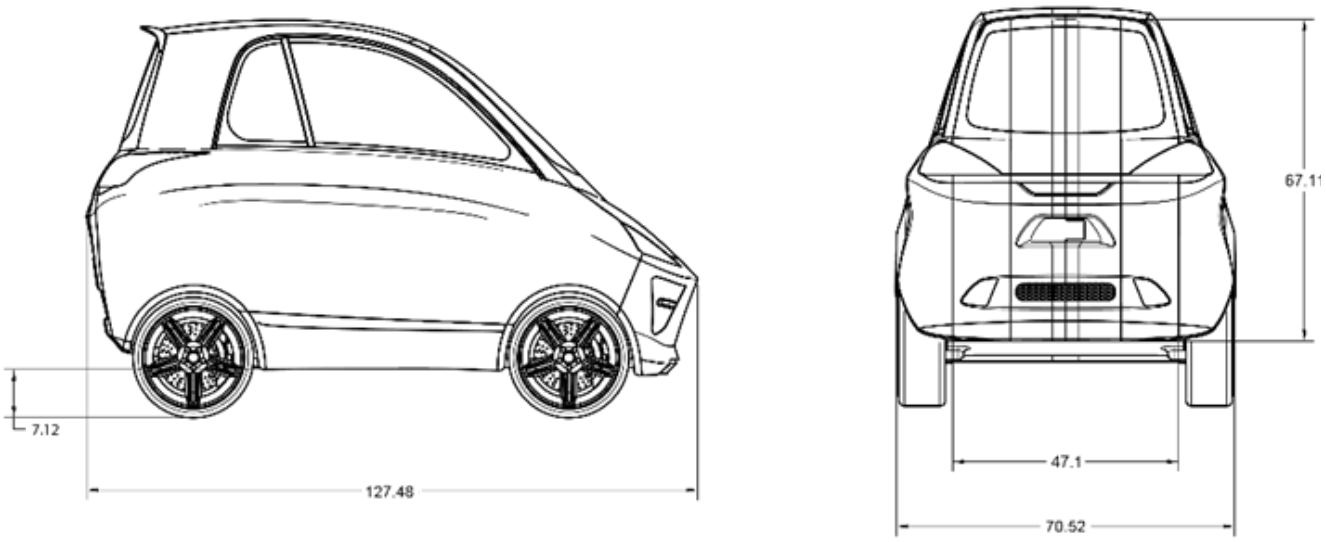
Within and between each of these stages, we collected data from tertiary sources, created prototypes and received feedback from user testing, and continuously revised and reevaluated our systems. We used evaluation matrices, Houses of Quality (HOQ), full scale prototypes, scale model prototypes, and 3D CAD models to iterate each improvement. We had disabled and non-disabled users test the system and provide feedback on the full-scale models, and our engineers conducted mechanical analyses on CAD and theoretical models. Ultimately, we settled on a geartrain-driven ramp and two horizontal folding doors on the rear face of the vehicle controlled by a system of gears, linear actuators, and slide rails, and track rollers.

NEEDS & MEASURABLES

fast	Time for door opening (s), time for ingress system deployment (s)
easy	Force required to activate the system (psi)
compact	Vehicle entryway dimensions (in), ingress system dimensions deployed & stored (in)
reliable	Fatigue lifespan, safety factor
safe	Failure modes



Prototype entryway, cabin, and ramp dimensions



Exterior car dimensions

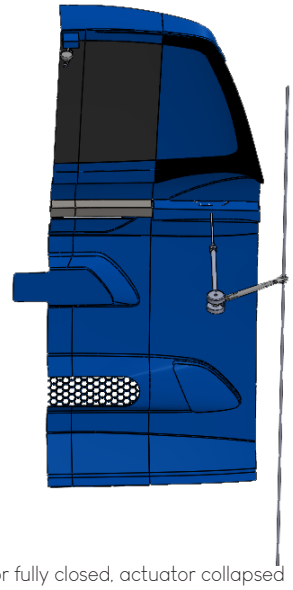
Mounted brackets on the inside of the outer door panels are attached to pneumatic linear actuators (an air compressor is housed inside the vehicle). The actuators are attached to a pivot which is itself attached to another rod, making a modified four-bar linkage. The rod is attached to a support rod mounted inside the vehicle. A gearmotor and geartrain atop this support rod power the system.

The inner door panels are affixed to the door frame on their innermost corners (along the midline of the vehicle) with track rollers that can move back and forth along the top edge of the doorframe. The panel is connected to the track roller by a self-closing drawer slide that is itself free to rotate about the y-axis on both ends. A hinge connects the outer corners of the inner door panels to the inner corners of the outer door panels.

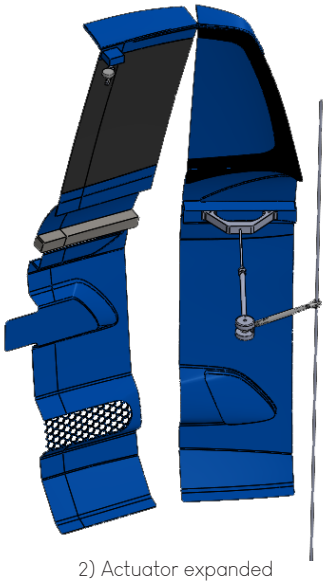
When the system controller is activated to open to door, locks are disengaged. Next, the linear actuators on the outer door panels engage, pushing the panel directly outwards __ inches from the doorframe. Then, the gearmotors affixed to the support rods rotate, turning the rod 90°. With this movement, the outer panels now extend beyond the side of the vehicle.
When the outer panels move laterally, the inner panels are pulled along. The track rollers slide as far as they can in the track, then the drawer slides extend, maintaining the connection between the inner panels and the vehicle body.

The ramp is controlled by a system of gears and gearmotors. Upon initiation of deployment, the gearmotors rotate, engaging a bevel gear attached to the base of the ramp. Stored upright, the ramp rotates 104° to rest on the ground. A proximity sensor on the bottom edge of the ramp detects the ground or curb and ceases motor rotation.

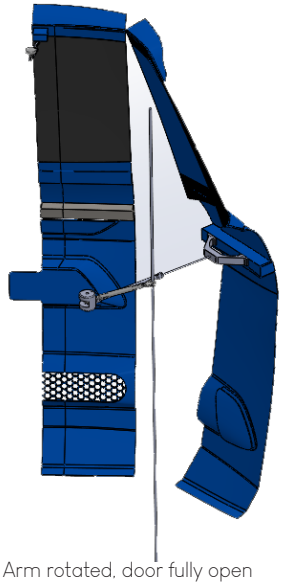
The same process happens in reverse to restore the ramp to its upright position, locked in place for travel. The gearmotors attached to the door support rods reverse direction, bringing the extended doors parallel to the doorframe. The self-closing drawer slides on the interior panels return to their compressed state by this motion, pulling the innermost corners of the inner panels back in line with the door frame. The linear actuators then retract, pulling the exterior panels and the exterior edge of the interior panels back to their starting positions. Locks reengage



1) Door fully closed, actuator collapsed

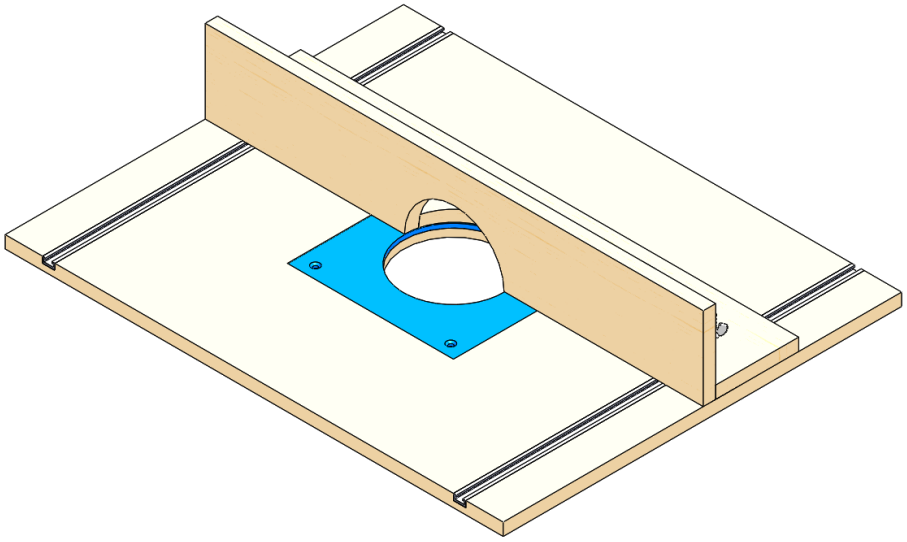


2) Actuator expanded



3) Arm rotated, door fully open

ROUTER TABLE ADAPTER



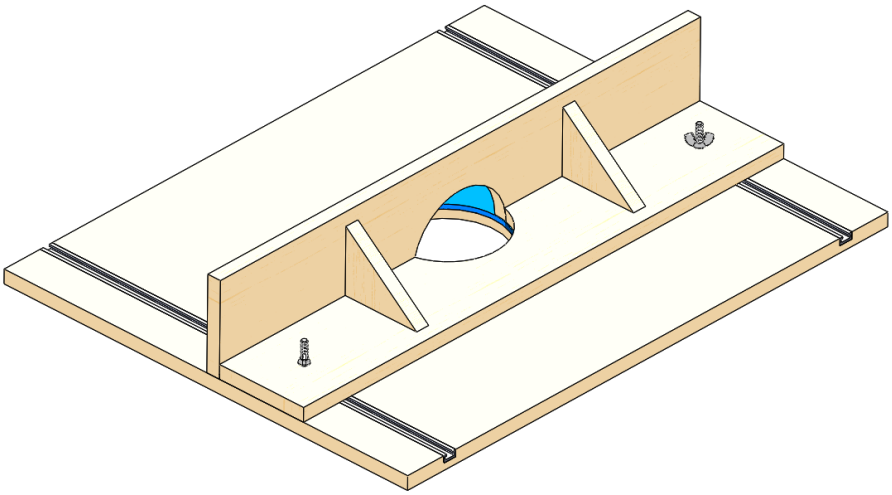
I invested in a compact router for cuts and grooves when I began to explore woodworking in earnest. However, I quickly discovered that it can be quite difficult to maintain a perfectly straight path, particularly in situations in which you cannot use an edge guide.

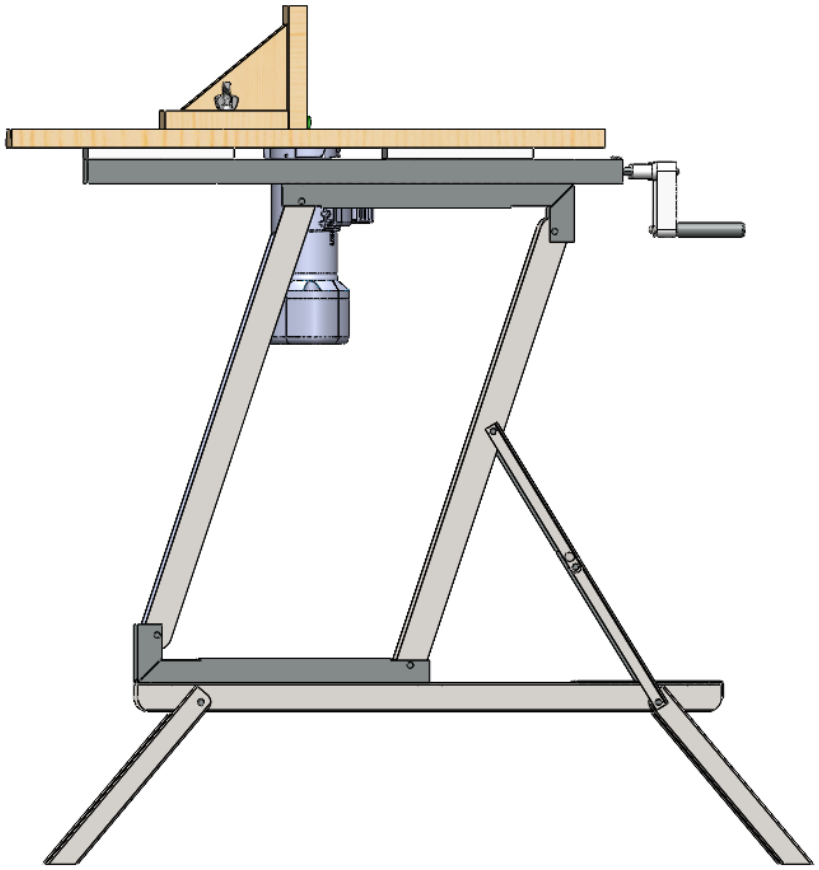
Enter: the router table.

I aimed to expand the functionality of my Makita Compact Router by mounting it in a fixed position. Routing tables on the market can be expensive, so I sought out my own solution using my router, common supplies, and a solid work surface.

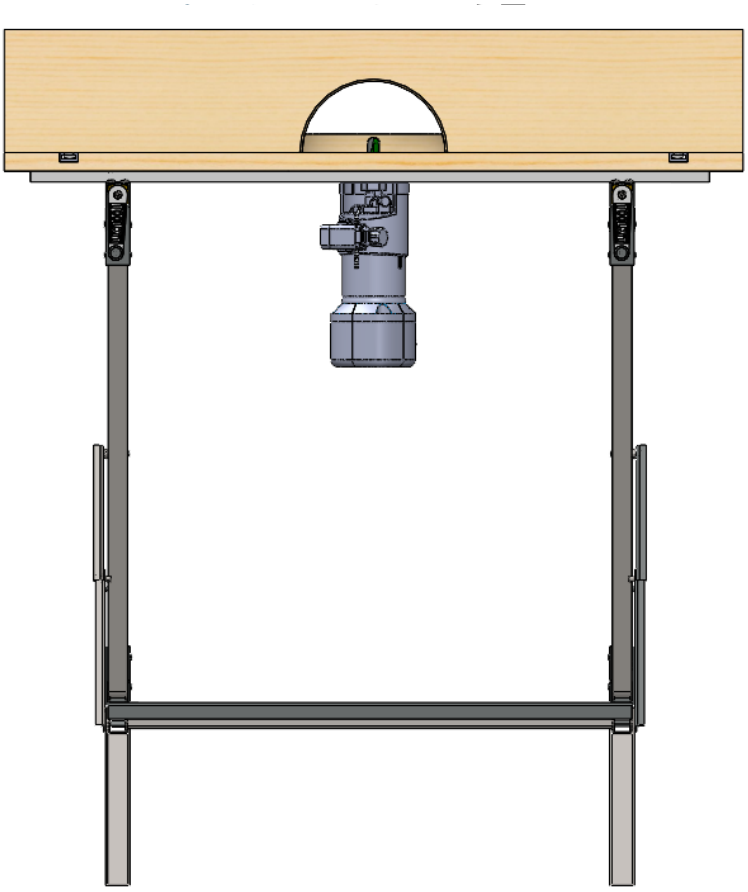
Preliminary research yielded several key observations:

- The top surface must be smooth for easy gliding of working material across the router bit.
- A fence should be incorporated to provide a guide for straight-path material movement across the router bit.
- The fence should be adjustable for greater usability.
- The router must be removable for use as a handheld router.
- The fence and the table must include space for the bit to rotate.
- The entire assembly should be easily mountable atop a standard work surface.





Affix the router base to the adapter with included flat head screws. Clamp the adapter to a stable work surface (Black and Decker Work-Mate used here; clamps not pictured). Loosen the wingnuts to adjust fence position.



When ready to cut, position workpiece against the fence. Apply steady pressure as you pass the piece over the router bit, keeping hands clear of the blade. When done, turn off the router and unclamp the adapter. Detach the router base from the adapter, and you're ready to move on to the next step of your project!

HOUSE NUMBERING

A client requested a unique house number sign that combined natural and artifical elements. He wanted the piece to be modern with clean lines and finishes, but he was also adamant that it be warm and inviting. Lastly, he wanted the piece, which would be mounted outside, of course, to withstand at least two years of Atlanta humidity, heat, and rain.

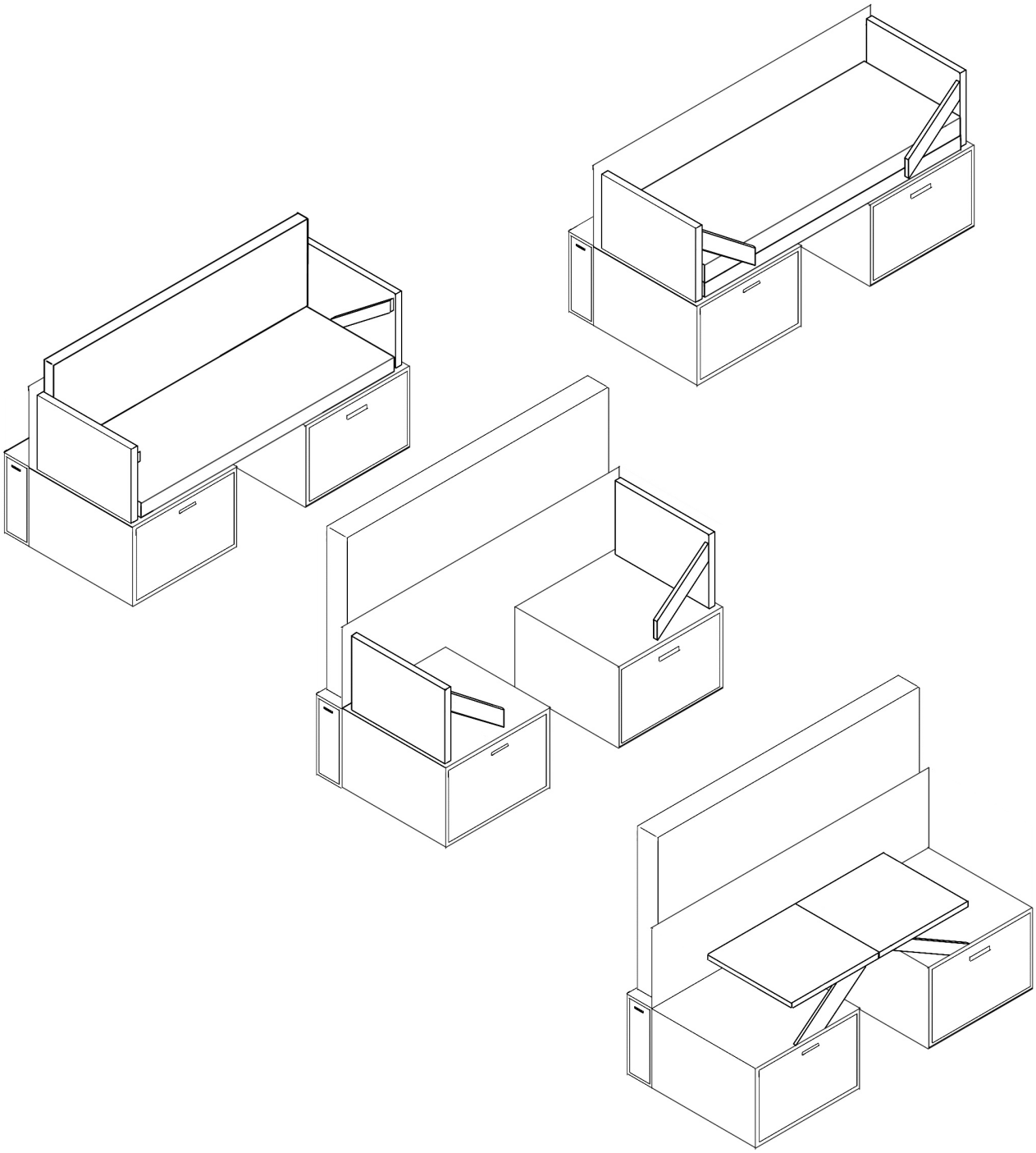
Limited by concerns about durability, I opted to use building materials for constituent parts where possible. After ruling out materials based on impracticalities and client preferences, I was left with wood and metal.

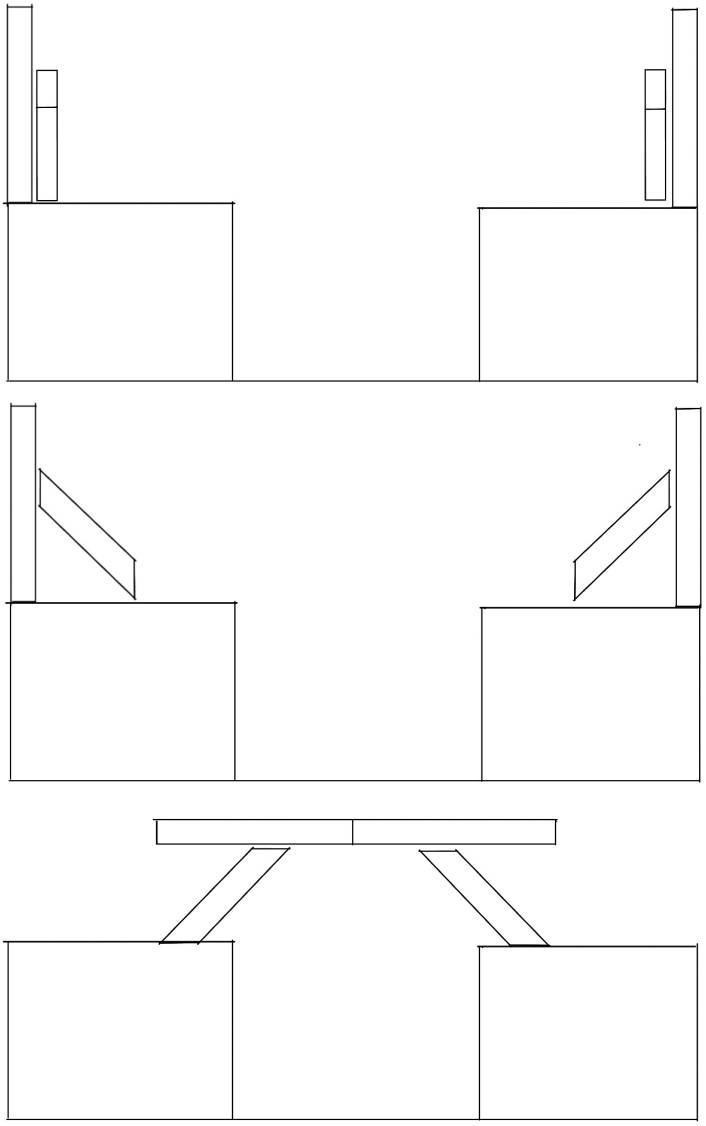
My primary concern with wood was rot. However, in my research I discovered shou sugi ban, a Japanese method of waterproofing wood by burning its surface. Feeling inspired, I burned several pieces of wood until black, then brushed the charred surface until the boards were smooth. I sealed the boards with beeswax and applied store-bought brushed nickel numerals in a modern sans serif font.

Burning and waxing the wood brought out a beautiful warmth and emphasized the contrast of the woodgrain. The waxed surface also offered the slightest reflection, catching the light from the numbers. The combination of sinuous natural curves in the wood and rigid straight lines of both the numbers and the piece's edge yielded a result that satisfied all of the client's aims.

IDEAS

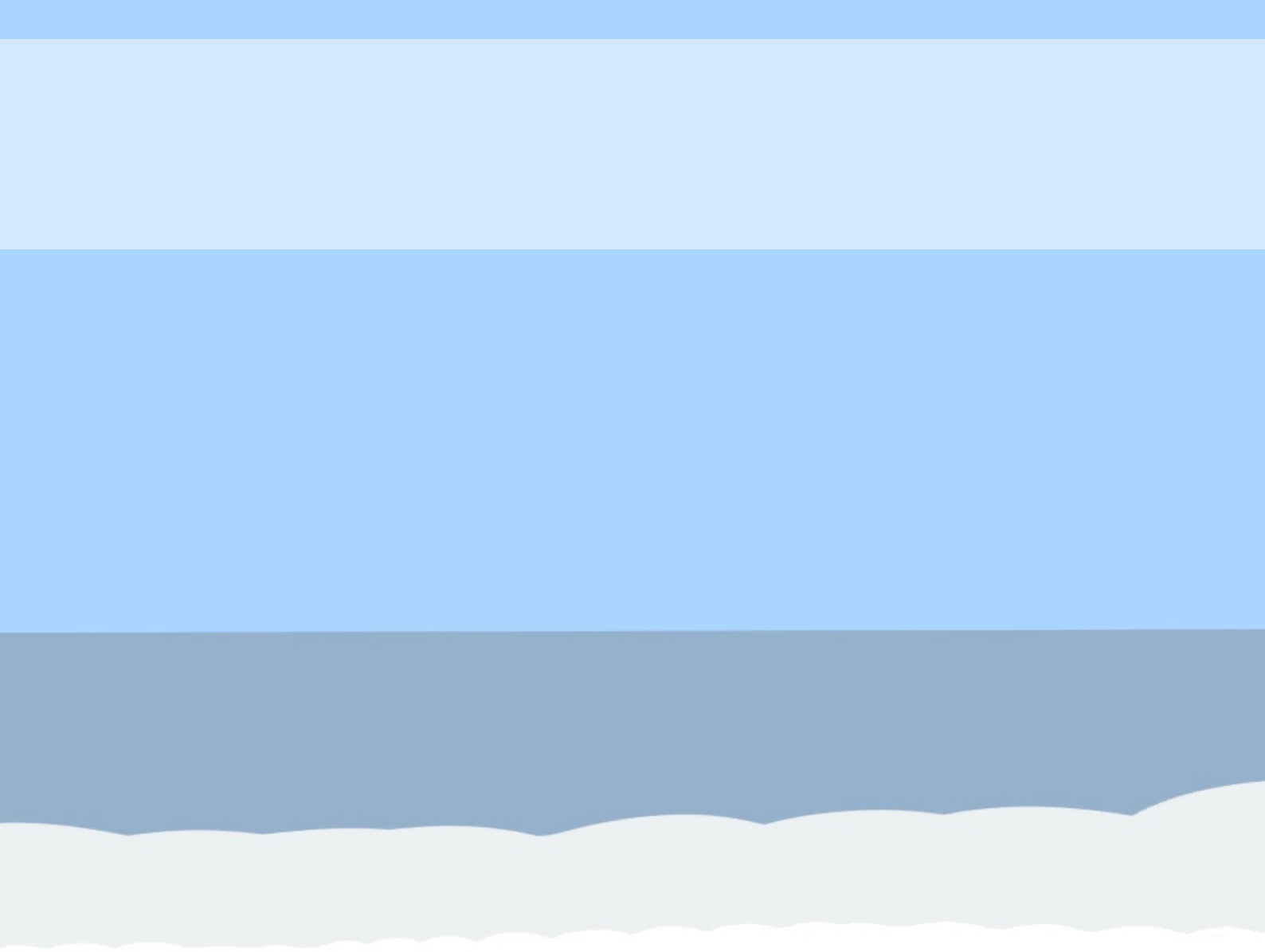
HOME IN ONE





This piece was designed with close quarters in mind, whether in a tiny home, a camper, or an apartment. When one space serves many functions, your furniture should too. Move seamlessly from sleep to lounge to dining and back again.

CAR CAPE



protects car exterior
makes snow removal easier
easy to store, easy to use

heating element melts snow
attaches to hood and liftgate to stay in place
insulated inner layer protects car exterior and keeps heat directed outwards
lightweight
compact--rollable and foldable
can function as a survival blanket or an interior warmer (if reversed) in an emergency
charge via USB

premium
-vibration mode to dislodge snow
-remote control

ABOUT

Dear reader,

I am a product design engineer with a background in psychology.

After graduating from Yale University in 2017 with a B.A. in psychology, I volunteered for 3 months in psychiatric facilities and in the communities in and around a village near Colombo, Sri Lanka. I travelled for several weeks before and after my time in Sri Lanka, circumnavigating the globe on my own.

By the time I returned to home to Atlanta, I had shifted my career focus from changing the world through individuals' psychology to affecting change using tangible objects. I spent one year at Boston University in the Late Entry Accelerated Program (L.E.A.P.) before returning to Atlanta in 2019 to finish my engineering studies at Georgia Institute of Technology.

In my studies, my work, and my hobbies, I aim to accumulate knowledge and skills from a range of disciplines whilst exploring some in depth. In other words, I strive to be a jack of all trades and a master of some. From waiting tables and learning new languages to scuba diving and product design, my curiosity has led me to places and people the likes of which I never dreamed; I can't wait to see what's next!

Thank you for your time,

Laura Anderson
she/her