ADAPTIVE SOLUTIONS:

Expanding Function for TiLite Wheelchairs

A grant-funded storage system for wheelchair users, designed to keep personal items secure and accessible on the lap through both a bag and a hold-down mechanism.

PROJECT TYPE: RESEARCH GRANT
DURATION: 12 MONTHS
YEARS: 2025-2026

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PROJECT BACKGROUND

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Developed through the Marcus Undergraduate Research Fellowship at San Francisco State University, this project began with outreach to people with disabilities, caregivers, and wheelchair users. These conversations helped shape the need for a lap-based storage system that keeps personal items secure, stable, and accessible throughout daily use. With support from the grant, I set out to design and prototype a bag system for TiLite wheelchairs, with the broader goal of creating bags that can be distributed to wheelchair users free of charge.

SAN FRANCISCO STATE UNIVERSITY

THE GEORGE AND JUDY MARCUS FUNDS FOR EXCELLENCE IN THE LIBERAL ARTS

Wheelchair user's solution to carrying luggage. (Image courtesy of Reddit user Dylan_42069nice)

THE PROBLEM

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Many people who use wheelchairs do not have a storage solution that is secure, stable, and easy to access throughout daily use. Belongings placed on the lap can shift, fall, or become difficult to reach, while many existing storage options are not designed around the seated position. This project responds to that gap by developing a lap-based storage system that supports access, organization, and stability without interfering with comfort or movement.

BACK:

Permobil

Pro: Keeps the lap clear.
Con: Hard to access while seated.

SIDE:

Permobil

Pro: Easier to reach than rear storage.
Con: May interfere with propulsion.

LAP:

Permobil

Pro: Most accessible during use.
Con: Can shift without support.

BOTTOM:

Permobil

Pro: Stays out of the way.
Con: Difficult to reach.

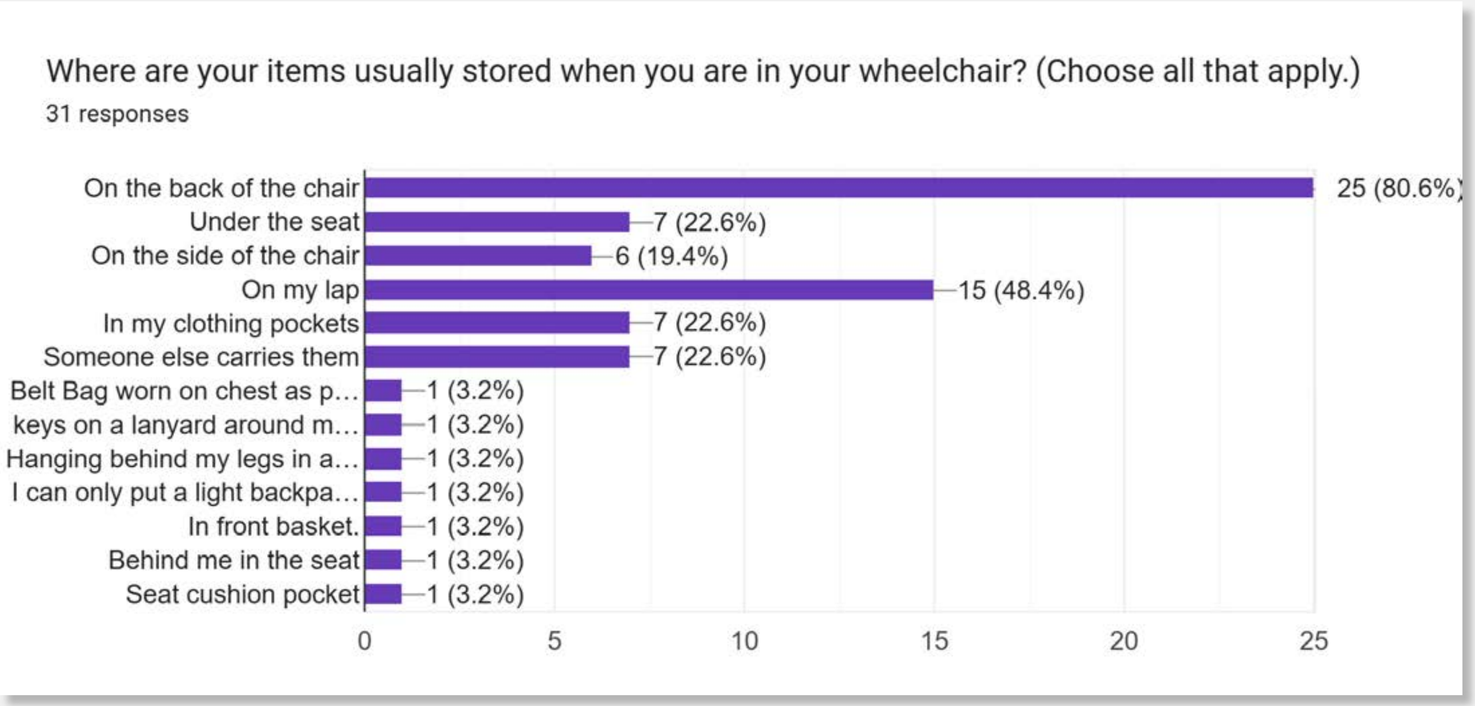
OUTREACH / RESEARCH

04

This project began with outreach to people with disabilities, caregivers, and wheelchair users. Through conversations, questionnaires, and ongoing feedback, I identified recurring challenges around access, stability, and organization. These insights helped shape the design direction from the beginning.

Many existing storage solutions are hard to reach, uncomfortable to use, or require outside assistance.

“It’s hard to find storage solutions that can help him be independent, that he can reach, will fit on his chair, and aren’t really, really expensive." Caregiver, questionnaire response



KEY TAKEAWAYS

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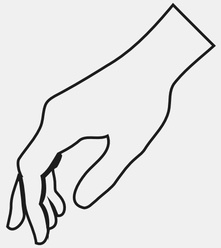
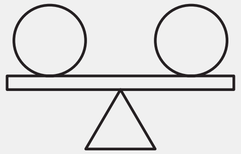


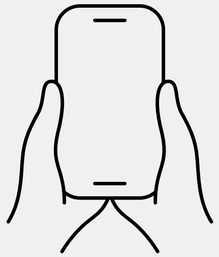
Access

Items are often hard to reach while seated.



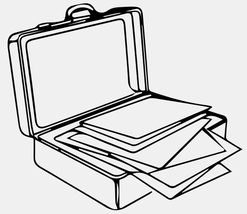
Stability

Storage must keep belongings secure during movement.



Independence

Essential items should remain within the user's control.



Organization

A good system needs intuitive, dedicated compartments.

Comfort

Reaching for stored items should not cause strain or pain.

Through outreach and research, I started to see a clear pattern in the problems people were having with current storage solutions. Many were hard to reach, unstable during movement, or uncomfortable to use over time. From that, five key needs emerged and helped guide the direction of the design.

WHY PERMOBIL?

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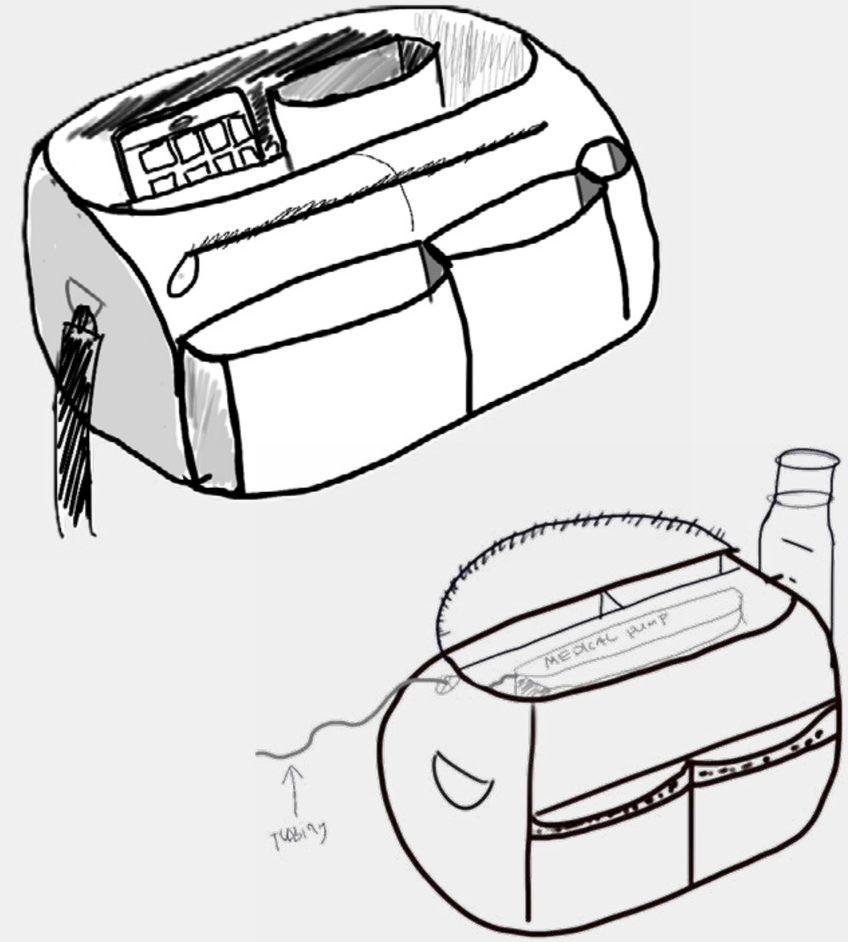
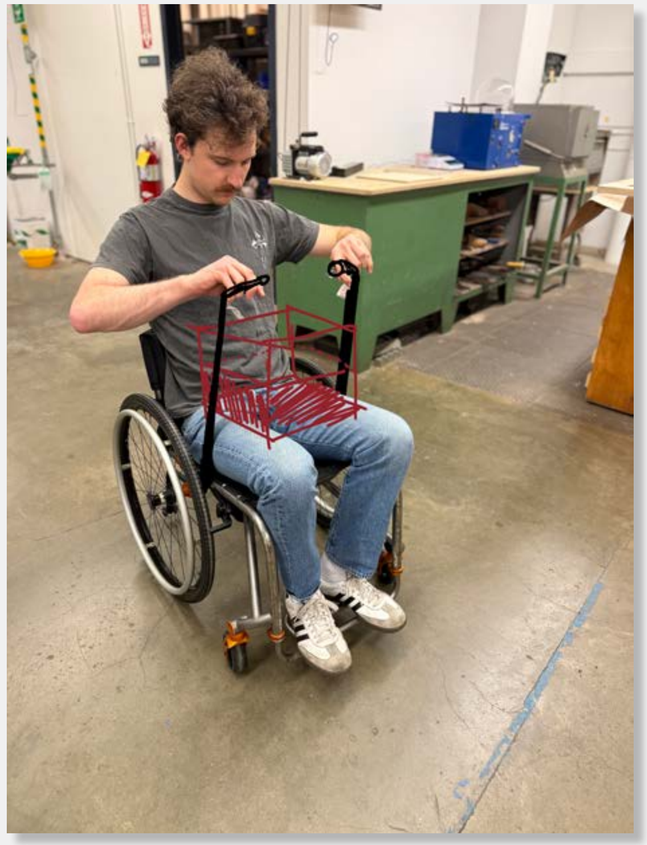
Permobil, through TiLite, became the focus of this project because they are a **major manufacturer of ultralight manual wheelchairs used by many active wheelchair users**. For this group, storage needs to support frequent movement, quick access, and the specific geometry of the chair. Rather than designing a broad universal solution, I chose to focus on one category and develop something more considered and effective. **A visit to the Permobil / TiLite factory in Pasco, Washington reinforced that decision.** Seeing the production process firsthand and speaking with the factory manager gave me a stronger understanding of the quality and care behind each wheelchair, and why the storage system should be designed with that same level of intention.

Permobil factory in Pasco, Washington. (Courtesy Dan L. / Yelp)

Custom TiLite wheelchair during production. (Courtesy Permobil)

SKETCHES





SKETCHES

SKETCHES

INITIAL PROTOTYPE

The initial prototype was used to test the bag at full scale and understand how the design worked in physical space. I first developed the pattern in CLO3D, which helped establish the overall form, proportions, and layout before moving into fabrication. From there, I worked with a local sewist who helped refine the pattern and build a higher-quality prototype. Once assembled, the prototype helped me evaluate how the bag sat on the lap, how the pockets were functioning, and where the design still needed refinement. It became clear that the next version needed better structure, stability, and access.

PAPER MOCKUP

FRONT

BAG INTERIOR

BACK

LOCAL USER FEEDBACK

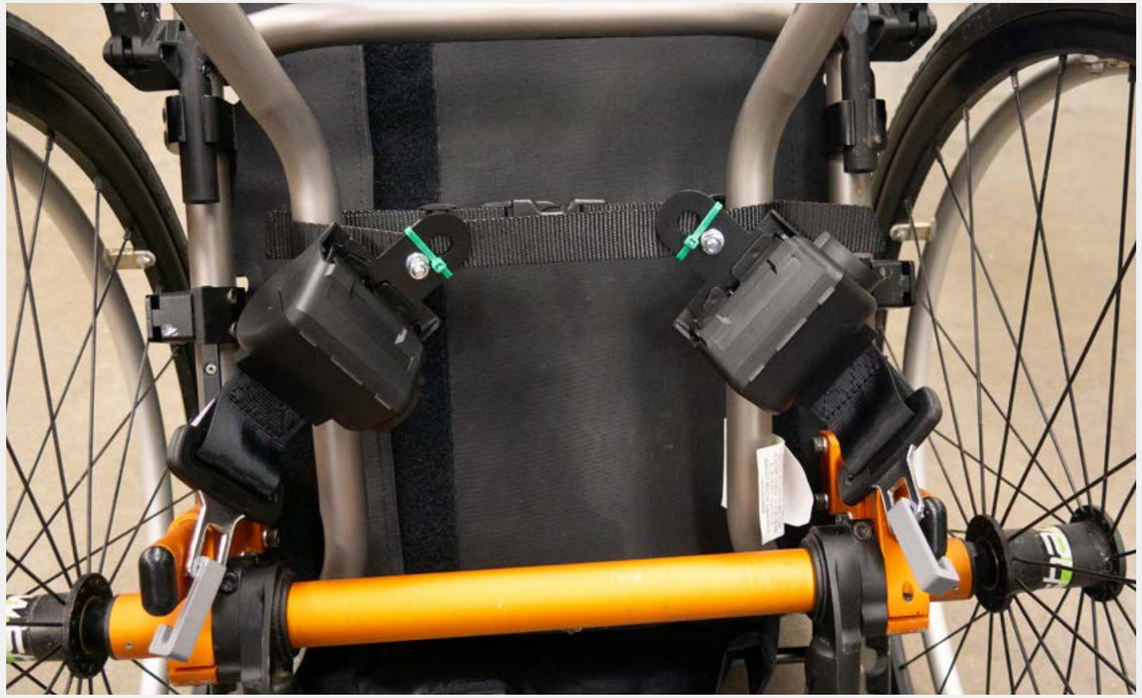
Feedback from a local wheelchair user helped push the project into more specific day-to-day use. Their comments brought up issues around opening the bag, keeping it stable on the lap, choosing the right materials, organizing essential items, and adding useful attachment points. Those points directly informed the next round of revisions.

	FEEDBACK	DESIGN RESPONSE
	**OPENING / CLOSING** The bag should be easier to open with limited dexterity or grip strength.	**MAGNETIC CLOSURE** The flap was updated to use a magnetic closure that is easier to grab.
	**MATERIAL PERFORMANCE** The bag should handle rain, spills, and regular cleaning.	**MATERIAL EXPLORATION** Future versions will explore more water-resistant and easy-to-clean materials.
	**STORAGE NEEDS** The bag should include dedicated space for a phone, wallet, and medication.	**EXPANDED STORAGE** Pocket design and internal organization were revised to better hold daily essentials.
	**ATTACHMENT TO CHAIR** The bag should work with clips, straps, or other chair attachment points.	**SECURING MECHANISM** The system moved toward a retractable hold-down mechanism beneath the chair.

SYSTEM OVERVIEW

The design is made up of two connected parts: a lap bag for storing everyday essentials, and a securing mechanism that helps keep it stable during use. Together, they are meant to make personal items easier to access, better organized, and more secure while seated in a wheelchair.

BAG



SECURING SYSTEM

MECHANISM DEVELOPMENT

The bag needed to do more than hold items. It also needed to stay in place while the user moved through daily life. This led to the development of a securing system designed to connect the bag back to the wheelchair and improve stability on the lap.

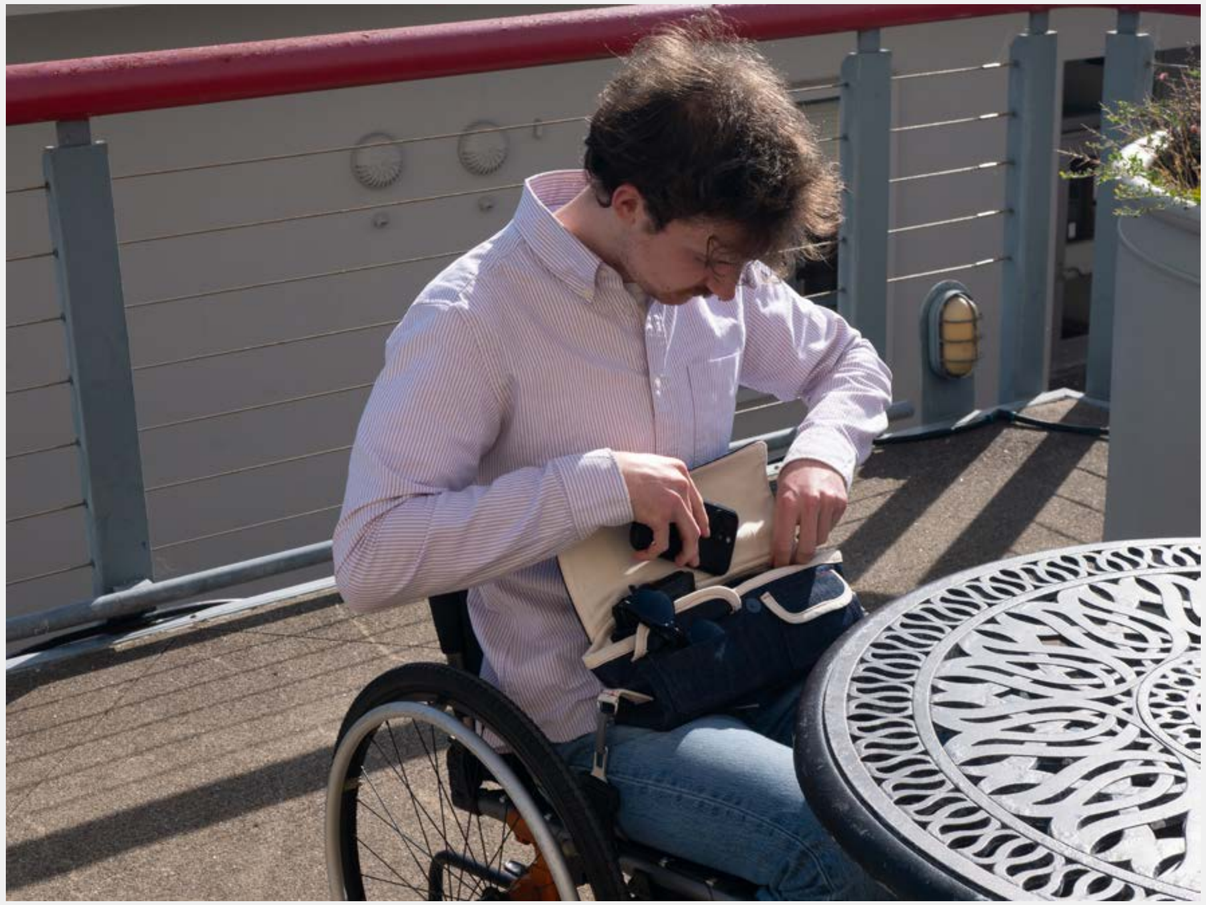
BAG CONNECTED TO SECURING MECHANISM

REPURPOSED SEATBELT MECHANISM PROVIDES RETRACTION

IN USE / HOW IT WORKS

The system is designed to keep essential items visible, organized, and within reach while seated. The bag sits on the lap for direct access, while the securing mechanism helps keep it stable during use and movement.

IN USE / HOW IT WORKS



IMPACT & NEXT STEPS

From the beginning, the goal of this project was to move beyond a single prototype. At its core, **the project is about improving day-to-day access, organization, and independence for people who use wheelchairs** by creating a storage system that feels more integrated into daily life. Rather than treating storage as an afterthought, it considers how personal items can remain visible, secure, and within reach while also working with the movement and structure of the chair itself.

Through the support of the Marcus Undergraduate Research Fellowship, the aim has been not only to design and test the system, but **also to move toward producing bags that can be distributed to wheelchair users free of charge.**