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### BUV Canopy

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# BUV Canopy

Nathan Johnson, Seth Ernest Nathanael Coyle

Faculty Mentor: Dr. Lew

# Agenda

- Background – BUV Ministry
- Problem Statement
- Design Objectives
- Functional Requirements
- Design Constraints
- Gantt Chart
- Design Alternatives
- Prototyping Materials/Build
- Testing and Validation
- Cost Analysis
- Challenges and Suggestions
- Conclusion



# BUV

(Basic Utility Vehicle)





# BUV Ministry

## Background

- Founded in 2000 by Will Austin
- **Mission:**
  - Reduce Poverty
  - Equip Workers with BUV Vehicles
  - Provide hope through the Gospel
- High Torque Capacity for rough terrain

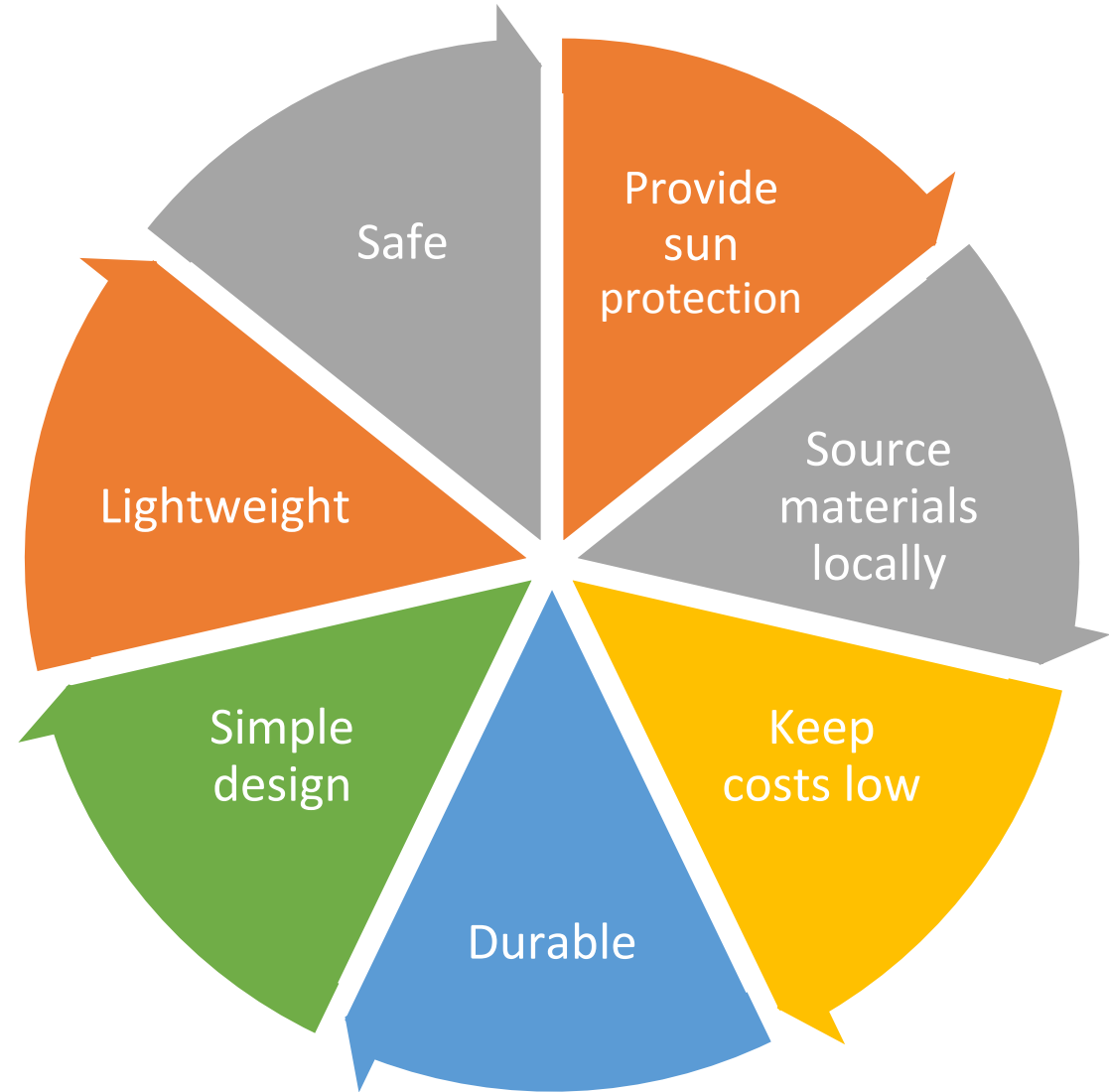


# Problem Statement

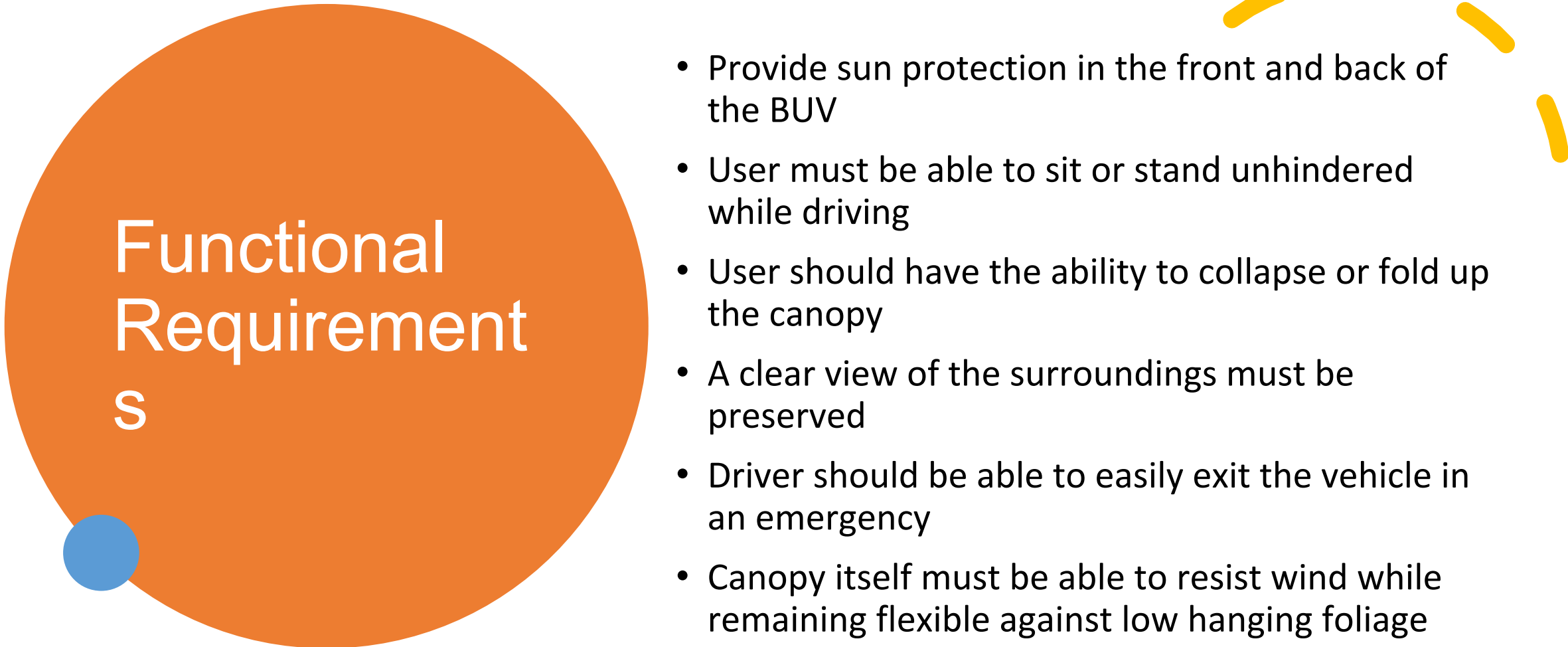


We need a covering that can provide sun protection, and stay durable against sun, wind, and branches.

# Design Objectives







# Functional Requirements

- Provide sun protection in the front and back of the BUV
- User must be able to sit or stand unhindered while driving
- User should have the ability to collapse or fold up the canopy
- A clear view of the surroundings must be preserved
- Driver should be able to easily exit the vehicle in an emergency
- Canopy itself must be able to resist wind while remaining flexible against low hanging foliage
- Must also be able to regain its shape to continue sun protection

# Design Constraints

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- Unit should cost \$90 or less
- Should not weigh more than 10 lbs.
- Must be only be mounted in the two vertical 2x2" square tubes that are positioned behind the driver
- Canopy should withstand driving speeds of 25 mph as well as top windspeeds of 45 mph while keeping its shape.



# Gantt Chart – Plan of Attack

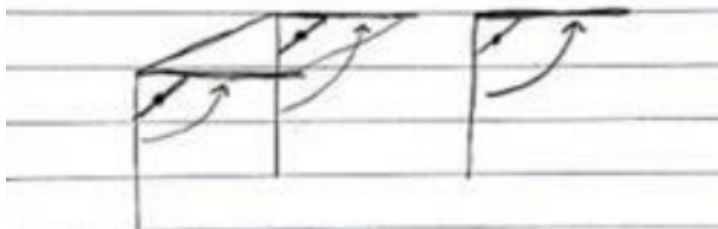
[illegible]



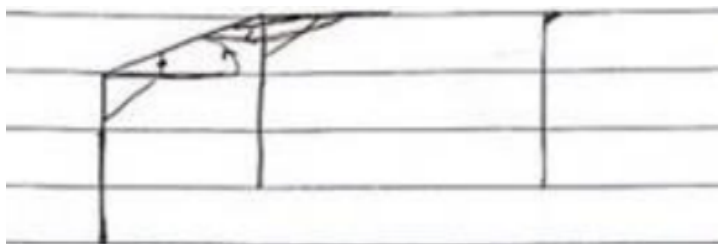
# Design Alternatives



Fold down



Fold up



Fold out



# Prototype Materials

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Pex Tubing

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**Wooden Dowels**

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PLA 3-D printed Parts

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**Steel** (Folding Arms)

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100% polyester fabric with PVC backing

# Prototype Build

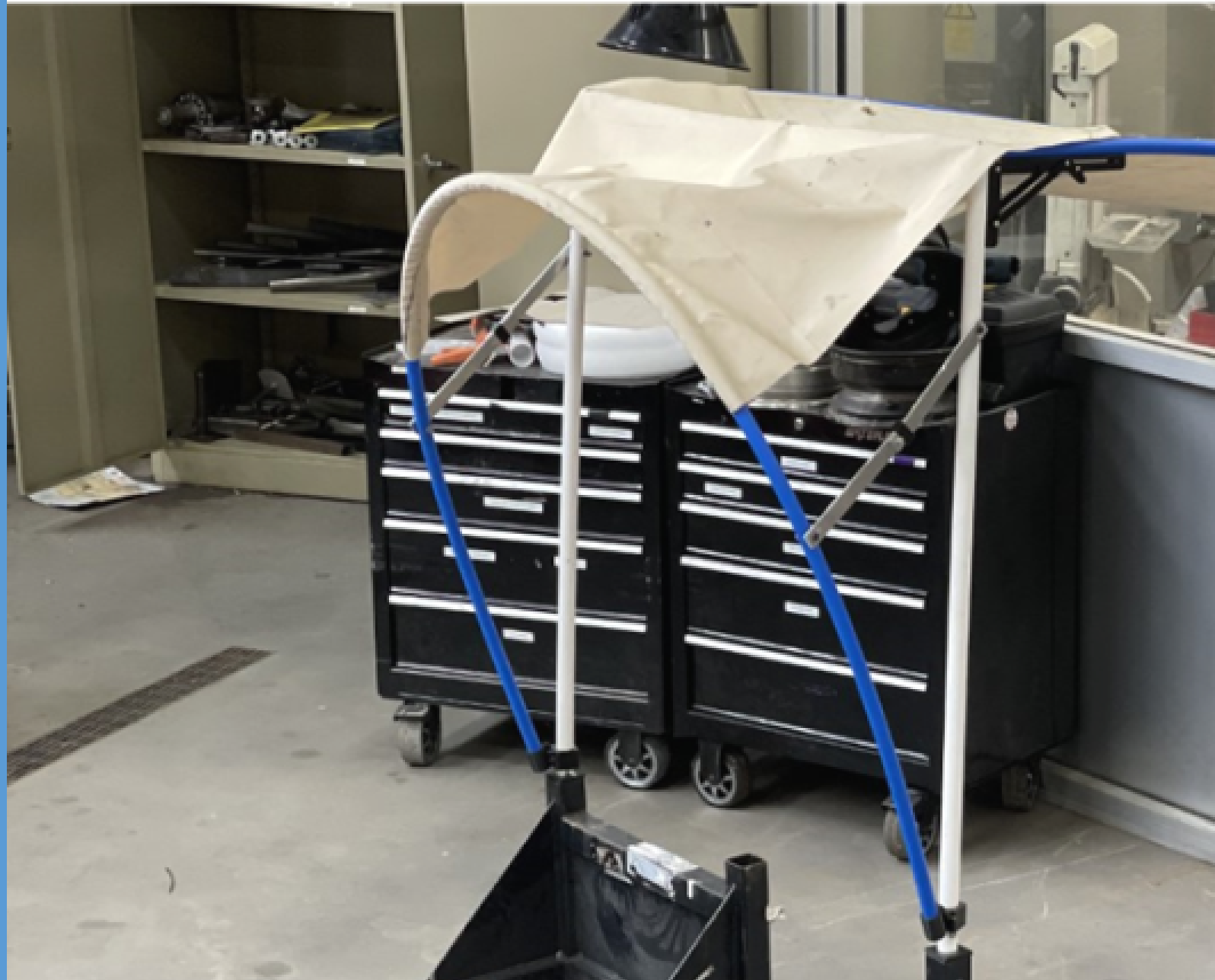
Main frame

Front folding assembly

Back assembly

Fabric mounting

Canopy installation





# Testing/Validation

Simplicity – Assembly and Usability

Wind Speeds up to 45 mph

Driving Speeds up to 25 mph

Weight up to 10 lbs

# Simplicity

- Created Building Instructions
- Measured time to Assemble Prototype
- 5 Participants
- Average Time to Assemble: **16:18**

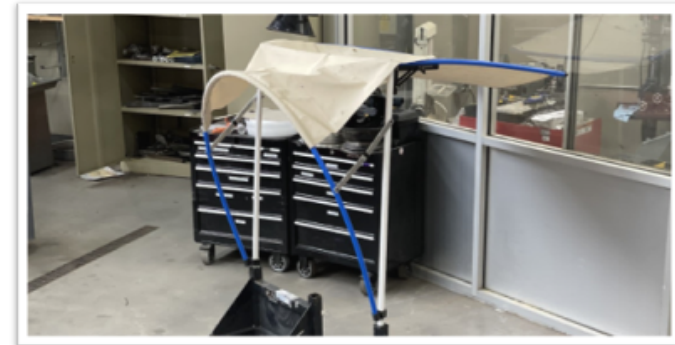
Recommended: 2 people to assemble  
Estimated: 20 minutes



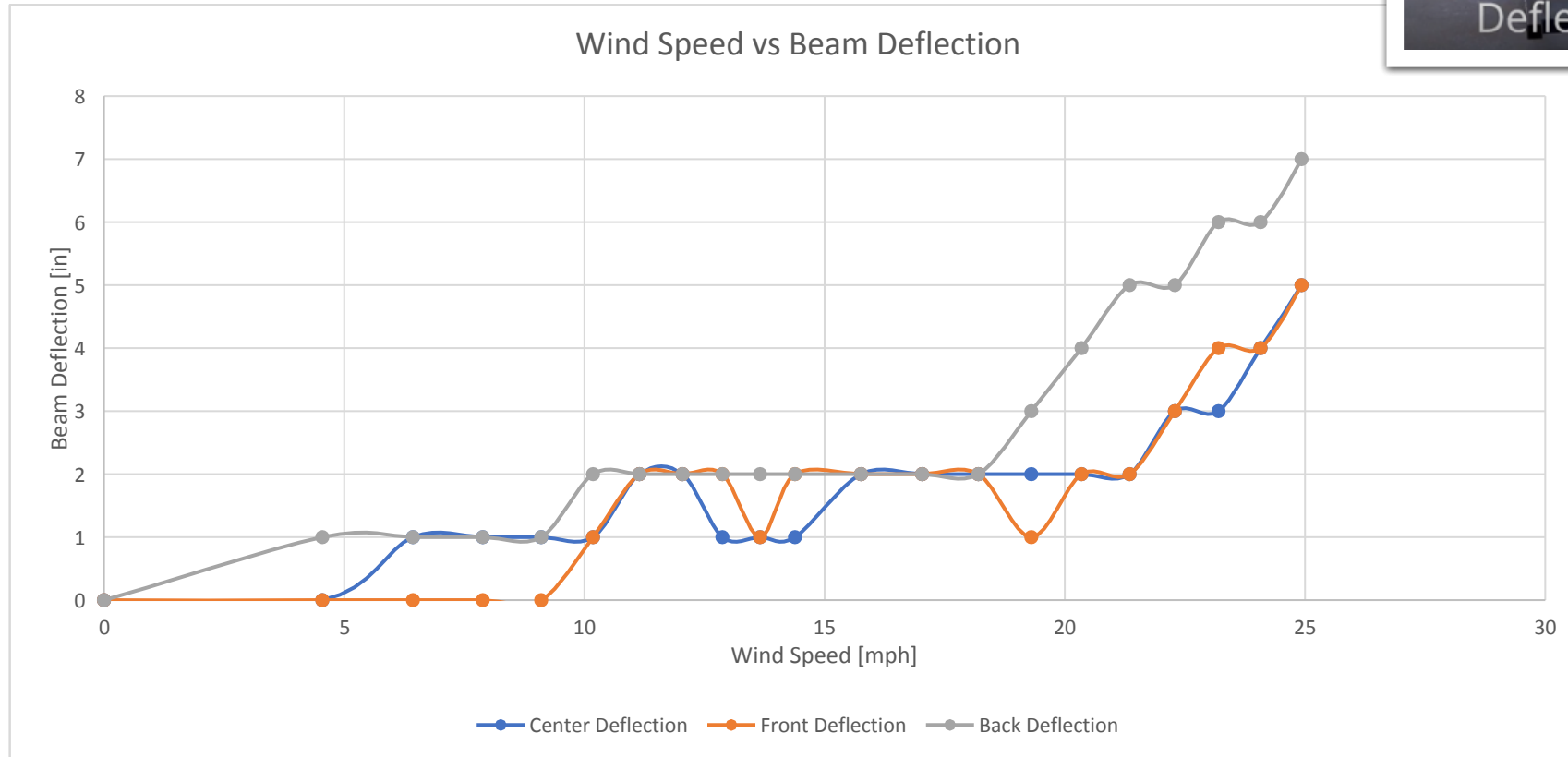
1

## BUV Canopy – Building Instructions

BUV Ministry



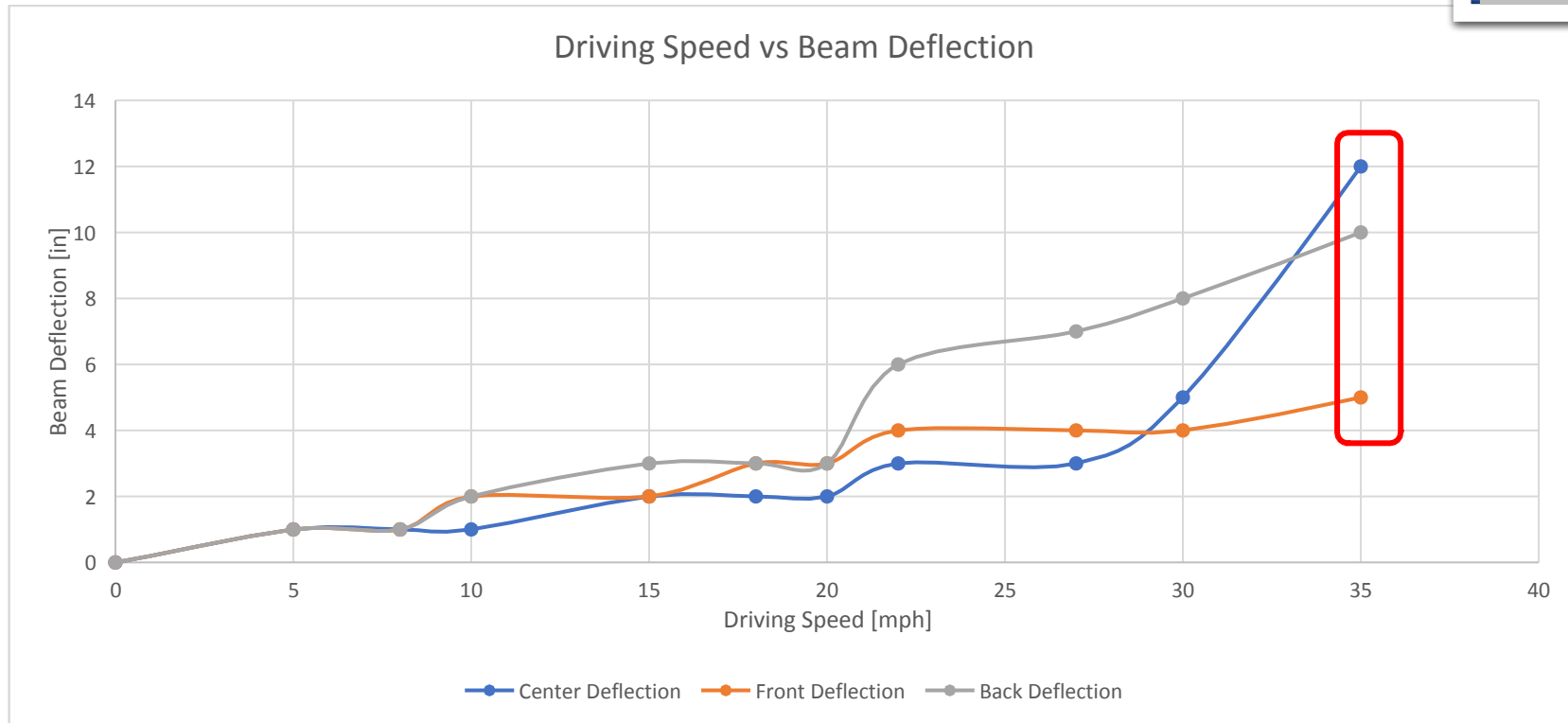
# Wind Speeds up to 45 mph



Less than 45 mph...



# Driving Speeds up to 25 mph



Greater than 25 mph! ✓

# Weight under 10 lbs



Part Name:	Weight (lbs)
Center Frame Assembly	2.27
Center Frame Assembly	2.21
Back Crossbar (3/4" PEX, 3' Long)	0.35
Top Crossbar (3/4" PEX, 3' Long)	0.31
Ottertex Waterproof Canvas Fabric (1 yd2)	1.58
Front Hoop (3/4" PEX Tube)	0.86
3D Printed Square Cap	0.04
3D Printed front hinge Assembly	0.06
Folding Arm Support (Front)	0.24
Folding Arm Support (Front)	0.25
<b>TOTAL:</b>	<b>8.19 lbs</b>

< 10 lbs! ✓

# Cost Analysis

## Design Constraint:

- Limit < \$90

## Prototype Cost:

- \$90.89

## Proposed Unit Cost:

- \$127.85
- Bulk (x10): \$94.54 unit

# Obstacles

- Choosing materials
- Deciding on hinge designs
- Mounting Fabric
- Balancing strength with flexibility
- Maintaining support with only two mounting points
- Adhesives
- SEWING!!!





# Deliverables

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Physical Prototype

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CAD Drawings (Creo)

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Building Instructions

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Bill of Materials

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Cost Analysis (Unit and Bulk Cost)





# Suggestions for Future Design

Purchased Folding Arms

Substitute Plastic Parts for 3-D Printed Parts

Attachment for Back Canopy

Fabric Shape

Front Canopy Shape

# Acknowledgements



- Will Austin: BUV Ministry
- Dr. Lew: ONU Engineering Faculty Mentor
- Valerie Haessig: Sewing Instructor
- Prototype Assembly Participants
  - Valerie Haessig
  - Grace Weiss
  - Emily Ragan
  - Sarah Johnson
  - Logan Reeves

# Topics of Discussion

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