

Team 11: Tricycle Adapted for Child with Spastic Quadriplegic Cerebral Palsy

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Background

Mrs. Amanda Frake has requested a tricycle that meets the specific needs of her seven-year-old daughter Zoe who has spastic quadriplegic cerebral palsy and cannot move her limbs or maintain her posture.

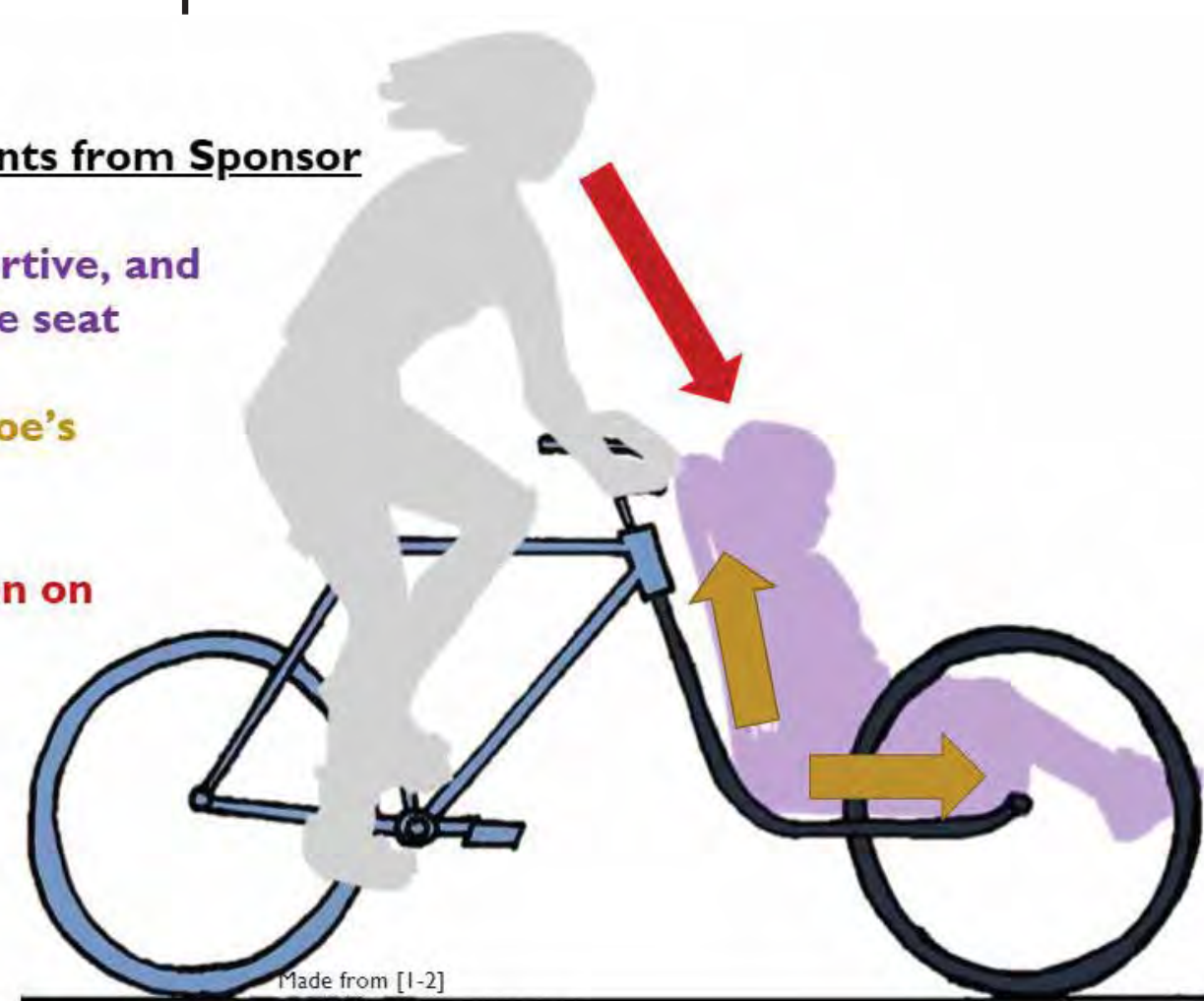
Requirements from Sponsor

Safe, supportive, and comfortable seat

Adapt to Zoe's growth

Direct vision on Zoe

Reliable



Design Objective

Design and fabricate a safe, stable, and reliable tricycle that can be driven by an adult, comfortably seat a child with cerebral palsy, and accommodate for the growth of the child.

Engineering Specifications

Measurable Specification	Achieved	Target	Units
Cost	2,904	< 2,938	\$
Steps to Seat the Child	4	< 8	#
Force to Steer	7	< 12	lbf
Force to Start Pedaling	22	< 50	lbf
Length	90	90	in
Width	38	50	in
Height	45	50	in
Weight	99	< 85	lbf
Braking Distance	17.6	< 20	ft

Qualitative Constraints

Aesthetics

Looks safe and professionally made

Safety

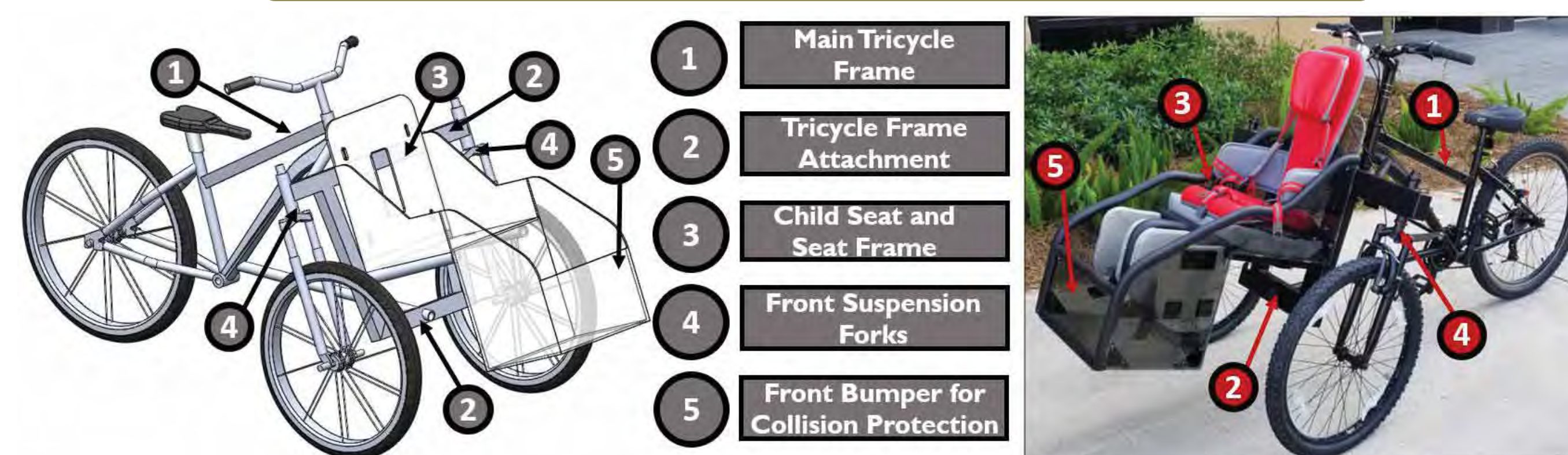
Provides direct line of sight to child

Comfort

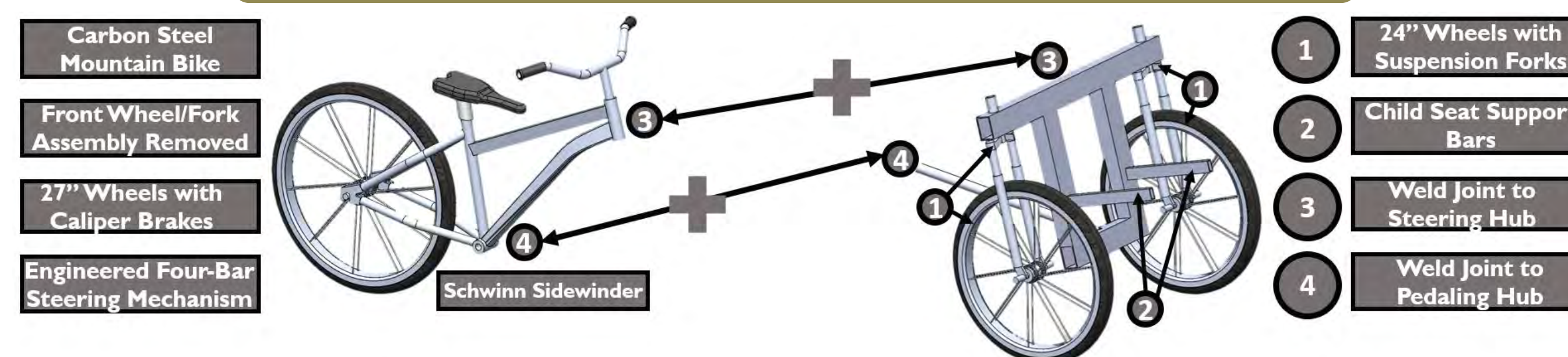
Rides smoothly over bumpy terrain

Design Overview

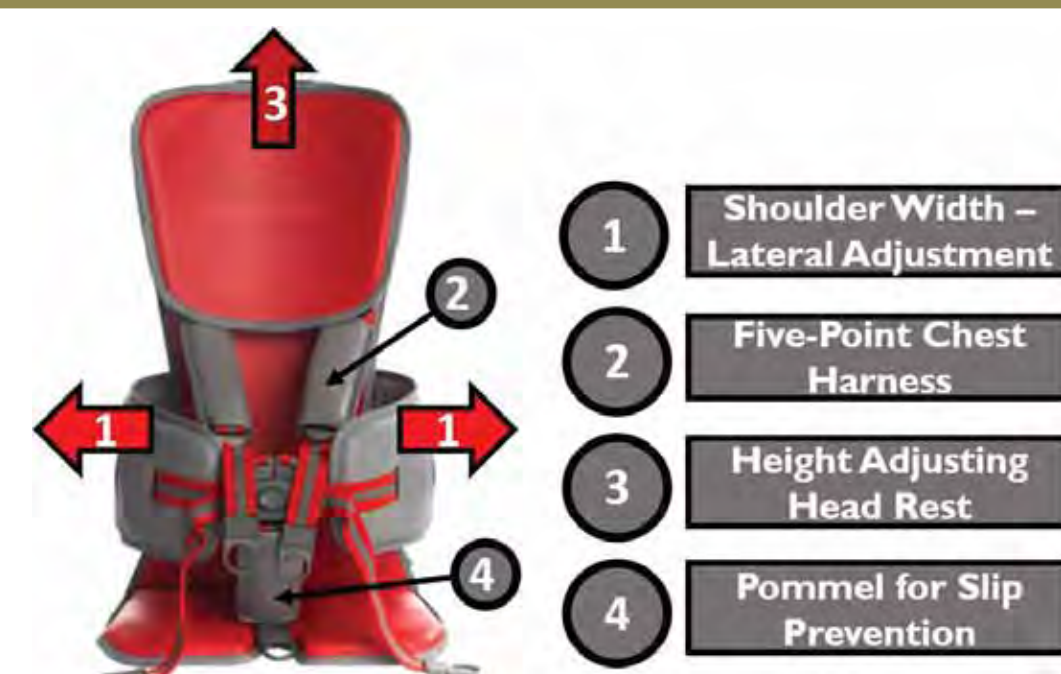
Final Design w/ Labelled Subassemblies



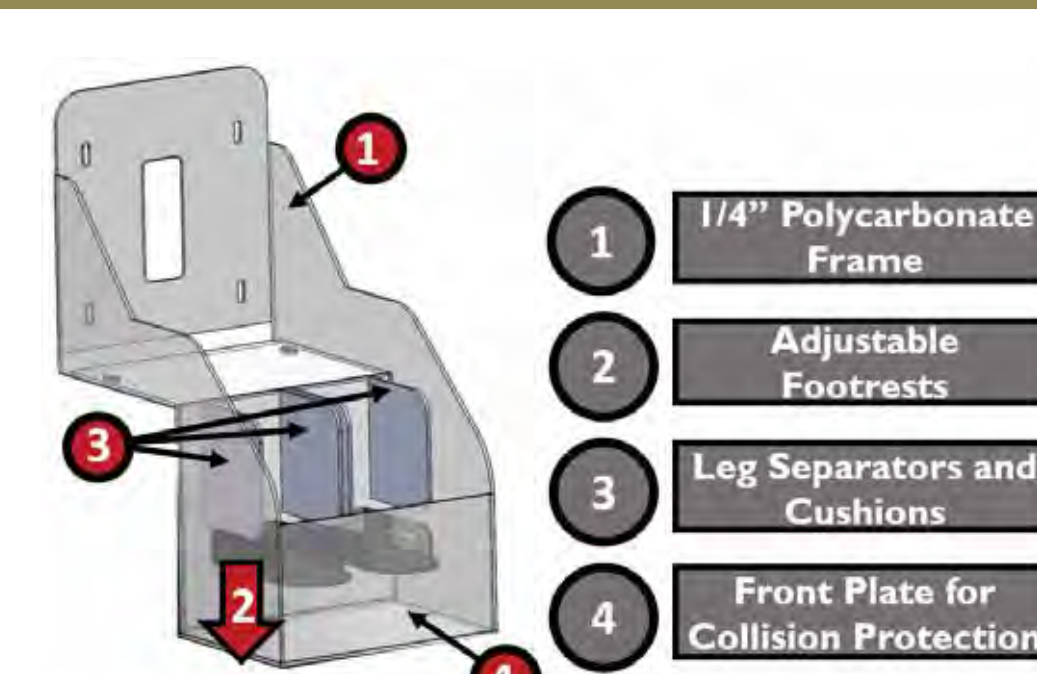
Main Tricycle Frame and Frame Attachment



Child Seat



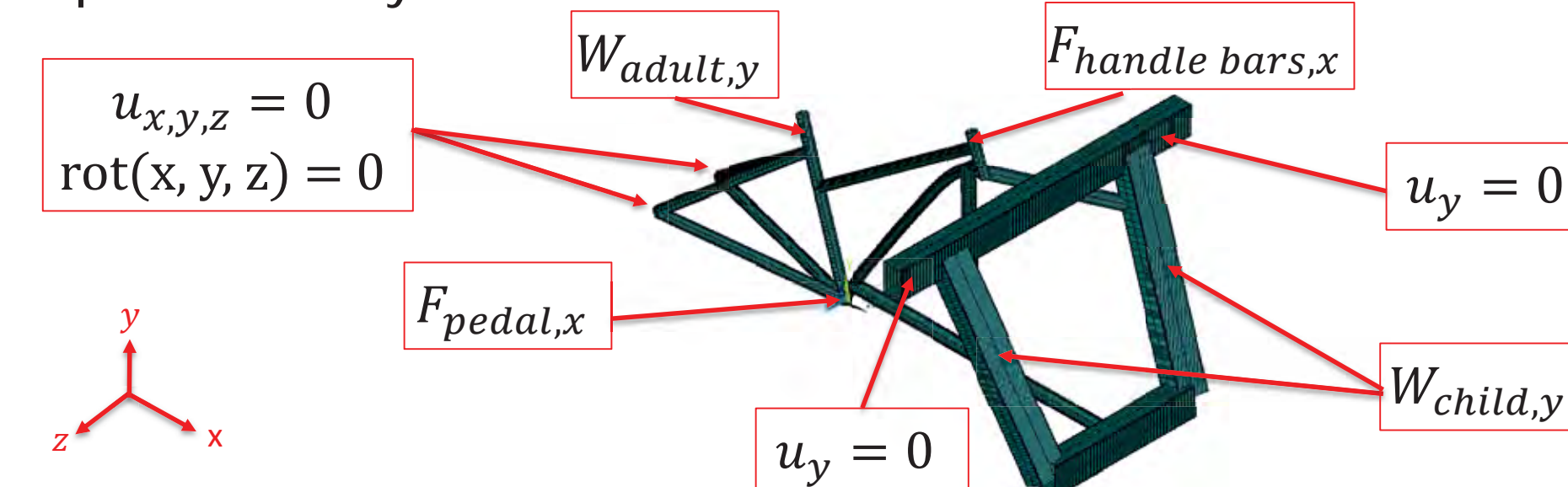
Child Seat Frame



Engineering Analysis

Stress Analysis Using Finite Element Analysis

Example Boundary Conditions with ANSYS APDL Beam-188 Elements



Additional Engineering Analyses

Frame Fatigue from Horizontal and Vertical Loading, Frame Buckling During Collision, Frame and Child Seat Material Selection, Front Attachment Cross-Section Selection, Bolt Sizing, Forward and Lateral Tipping, Turning Radius, Turning Force, Pedaling Force, Child Seat Frontal Collision

Testing and Validation

Collision Test



Action: Front impact simulated by swinging 20 to 200 lbf into child seat frame
Result: For an impact mass of 200 lbf, little permanent deformation but no fracture of child seat frame

Drop Test



Action: Child seat frame's reliability tested by dropping 20, 40, 60, and 80 lbf into the child seat
Result: No warping or fracture of child seat frame

Braking Test



Action: Braking distance measured after sudden braking from 12 mph on both a flat and downhill road
Result: Average braking distances on flat and downhill roads are 17' 7" and 19' 9" respectively

Safety

Proper head, knee, and elbow protection were worn at all times during tricycle testing

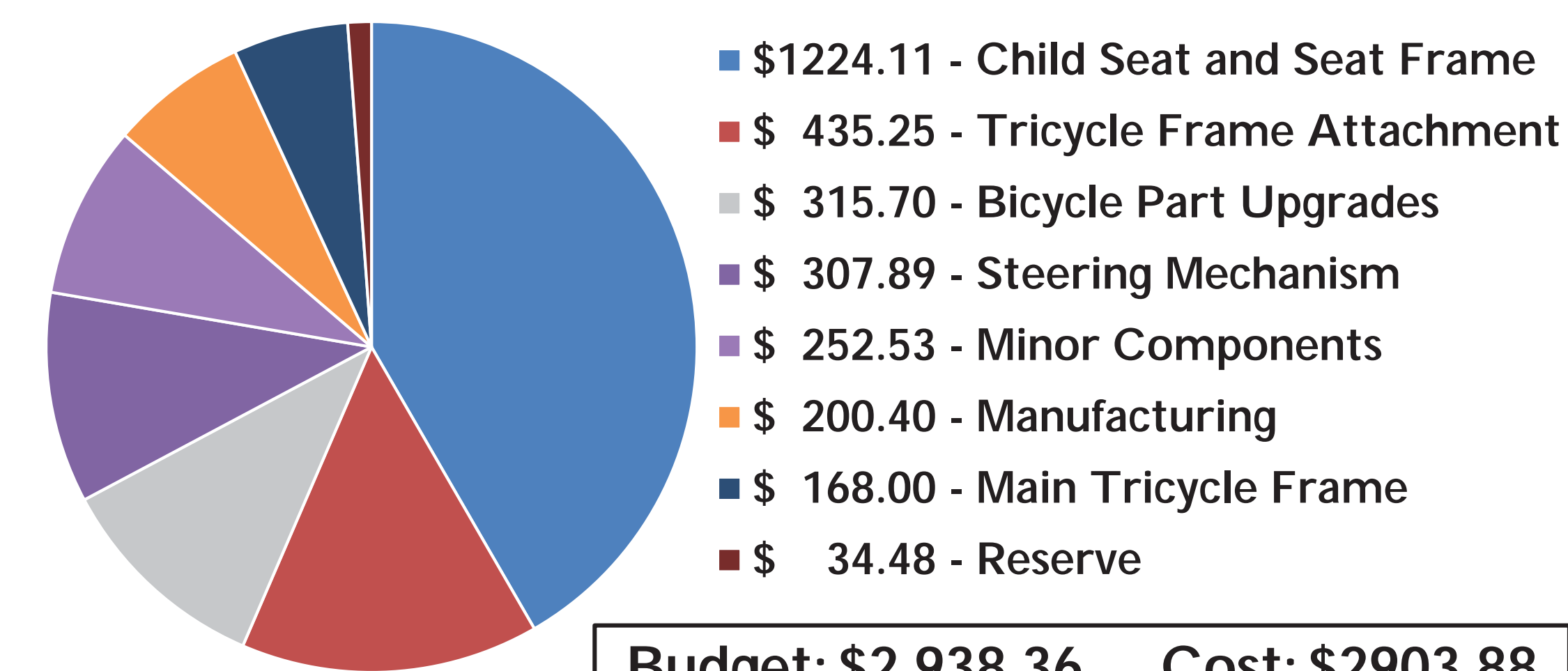
Tricycle frame and child seat frame were tested rigorously to ensure safety in case of collision

Safety guidelines were followed for all machinery used in manufacturing

An OSHA recommended 'Team Lift' warning was placed on tricycle frame

Project Management

Budget and Cost Breakdown



Budget: \$2,938.36 Cost: \$2903.88

References

- [1] "Vector Silhouette Child White Background." *Dreamstime.com*.
- [2] "Bicycle Riding Silhouette." *Bicycle Rider Silhouette*, lggypop.info.
- [3] "Firefly GoTo Vinyl Postural Seat." *fireflyfriends.com*

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Advisers: Dr. Glenn Sinclair