Basic Utility Vehicle

Design Competition

Agricultural & Biological Engineering

PURDUE UNIVERSITY

April 17, 2009

Designer	Design Area
Austin Bello	Front Frame/Suspension
Jacob Oswalt	Front Frame/Suspension
Ben Dietrich	Operator Station
Nathanial Kempfert	Operator Station

Challenge

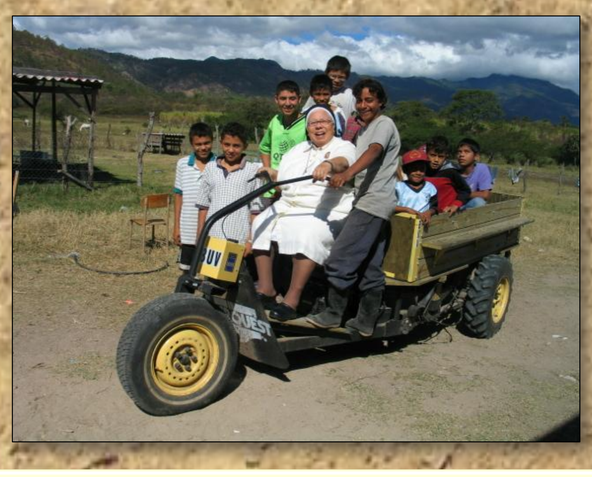
- Design a basic 3-wheel vehicle based on the rear clip of a *small* pick-up truck.
- Design the vehicle to accommodate an operator that does not have the use of their legs.
- Low cost, design emphasis is on the steering and front suspension.
- Design for small scale assembly operations in Africa.

What is BUV?

Mission
To improve lives in developing countries by facilitating the spread of simple vehicles that can be assembled *"almost anywhere, by almost anyone."*

Vision
The BUV will go:
...where the streets have no name
...where roads don't exist
...where people need hope
Basic Vehicles. Changed Lives.

Goal
To jumpstart an industry to bless the working poor



Design Objectives

Minimize Cost	Optimize Performance	Vehicle Safety	Manufacturability
•Minimize total lifetime cost of ownership. •Utilize off-the-shelf components or recycled components where possible. •Optimize design to allow for micro-factory, production factory, investments and sustainability.	•Simplicity of design to allow for performance and fewer failures in off-road terrain. •Versatile front suspension to allow for better travel over rugged terrain. •Allow for easy turning for increased maneuverability.	•Emphasize safety in all aspects of design. •Protect operator and passengers from all moving parts. •Minimize center of gravity to prevent overturn, but provide roll-protection in case of emergency.	•Simplicity of design to allow for easy assembly, maintenance, and repair. •Minimize the number of part numbers, part count, and number of common tools •Require only two people to assemble vehicle.

Acknowledgements

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Industry Support
•Yanmar
Others
•ABE Shop: Scott Brand & Gary Williams
•Purdue Quarter-Scale Team
•Purdue Sheetmetal
•John Gibson, ASM Team Member

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ABE (Machine Systems)
April 20, 2009

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YANMAR

BUV

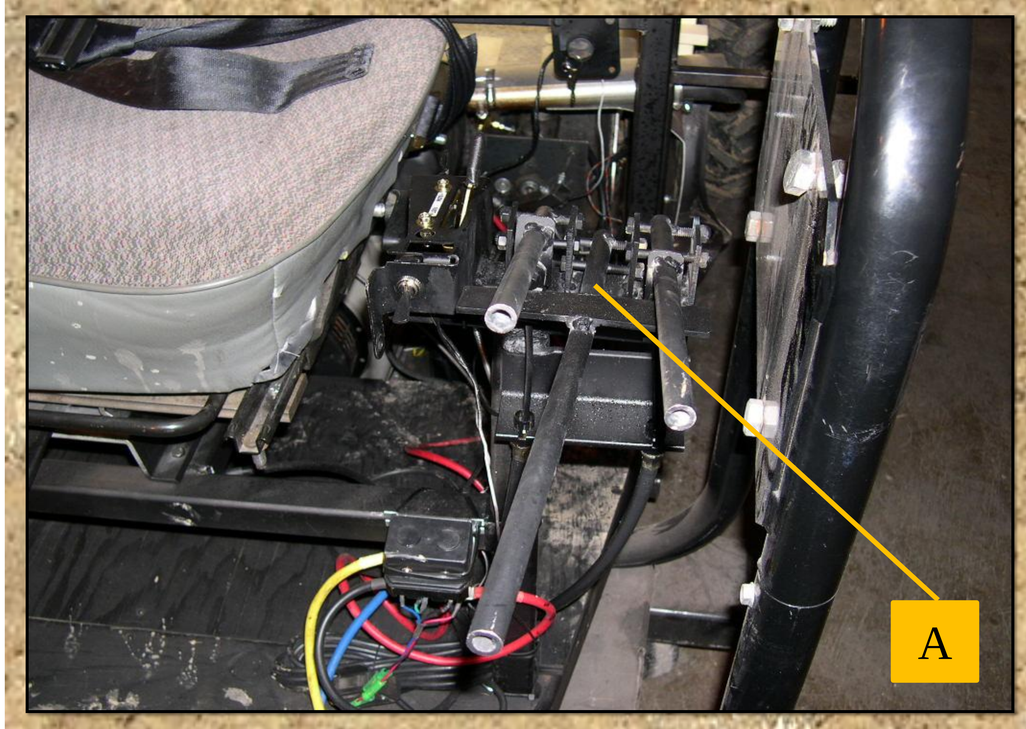
Operator Station

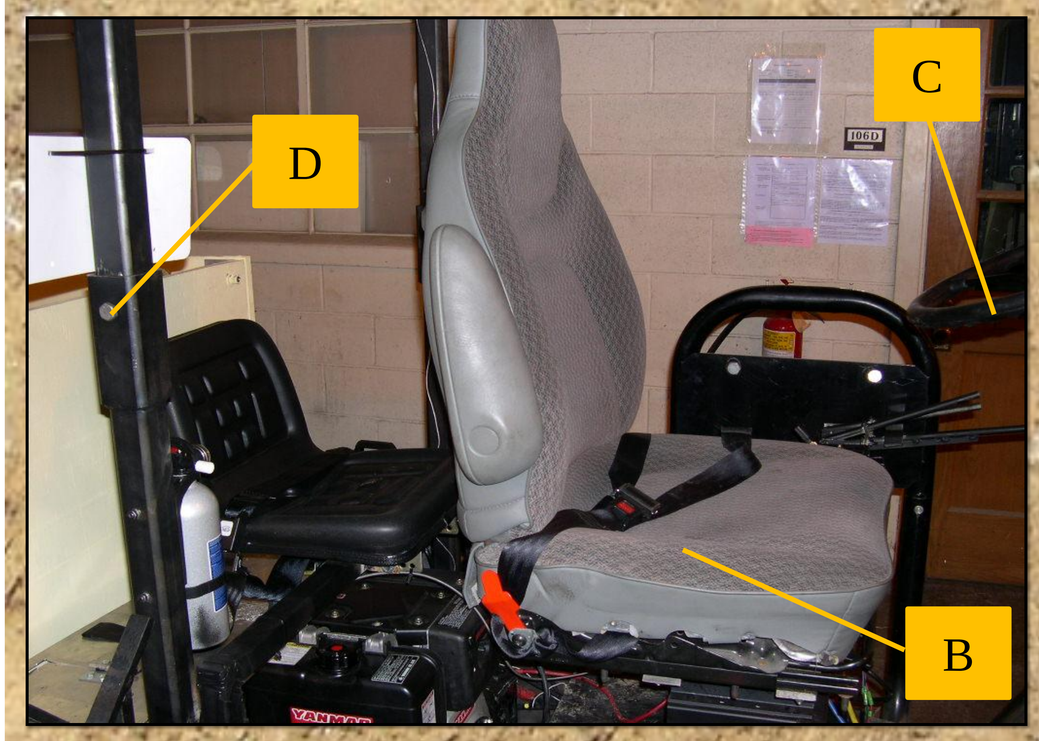
Design Criteria

Operator Station
•No foot throttle or breaks •Space for drivers assistant •Motorcycle seating arrangement

What are the most common BUV applications?

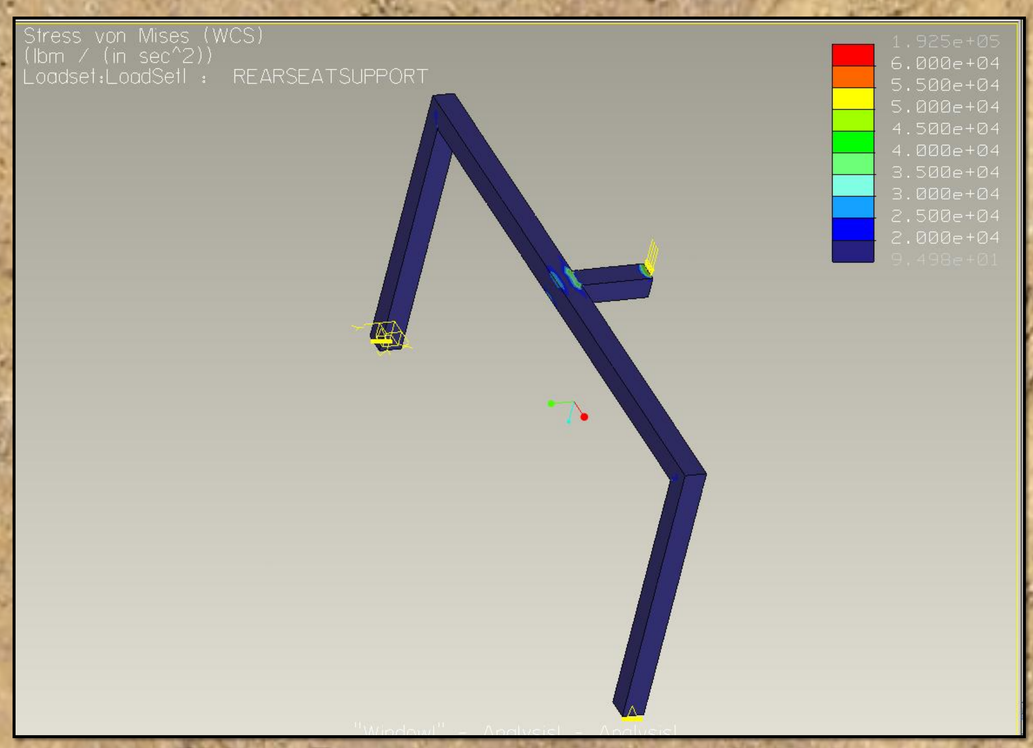
- •ambulance medical vehicle
- •mobile fogger / malaria fighter
- •farm commodities and delivery vehicle
- •material carrier to and from construction projects
- •water distribution (drip irrigation) / water purification
- •school bus for children and orphanages





Features

A.	Controls -Hand Brakes: Left activates left brake, Right lever activates right brake, center activates both -Throttle: Next to brakes to allow one hand ability to steer
B.	Seating -Seating for two -Automotive seat provides greater comfort and support for paraplegic driver -Front seat swivels, and is adjustable both forwards and backwards for easy access, and greater operator comfort -Rear Seat for passenger
C.	Steering Wheel -Use of steering wheel provides greater stability for paraplegic operator.
D.	Rollcage -Detachable to provide ability for going under low overhangs, provide easier storage, and greater ease of shipping.



Pro/Engineer and Mechanica were used in the modeling and analysis of the Operator Station. Stress analysis were run on the roll cage and the seat supports. The results of the seat support analysis are shown below. The load was chosen was 750 lbs. This was chosen by taken the weight of the 95 percentile man and multiplying by 3 to simulate a 3g load.

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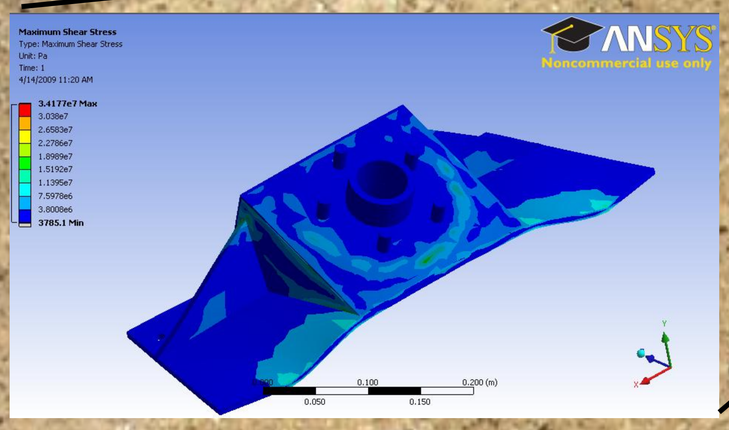
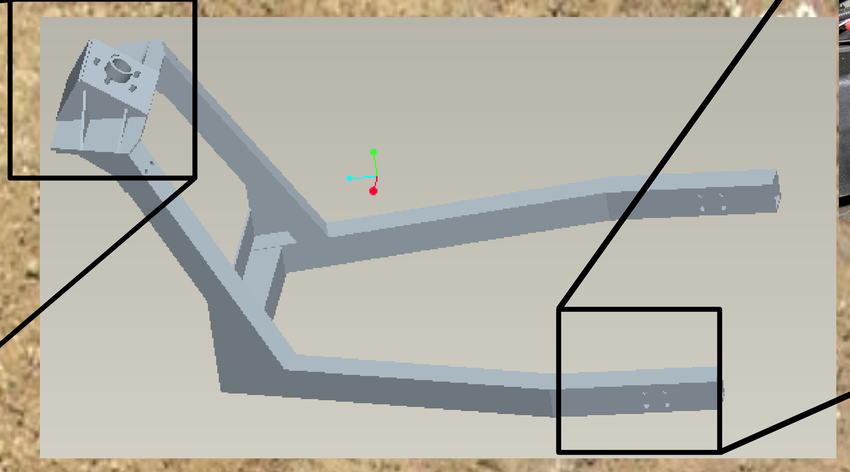
Front Frame





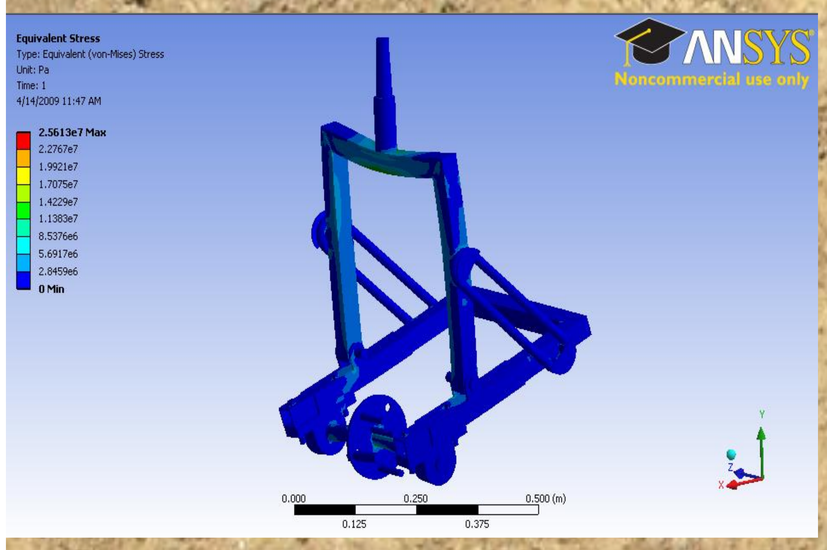
• ANSYS® Workbench was used to do stress analysis on the most important parts of the frame.

• Stress analysis was performed on the steering box under axial load created by the front axle through the steering shaft.

• Multiple iterations were completed of the models in ProEngineer® to determine the optimum amount of steel necessary to allow for rated loads under worst case scenarios.

The four bolt pattern highlighted here is the linkage between the front frame, rear frame and drive train enclosure. The reason for linking them all together is to improve efficiency of part manufacturing as well as increasing efficiency on the assembly line when linking these three sub assemblies.

Front Suspension



The analysis of the front suspension yielded results verifying the suspension frame will handle a worst case loading scenario. To reinforce the high stress areas, gussets were placed in corners of the frame. Once fabrication began, there were many changes to the initial front suspension design (pictured right).

Fabrication

- Disassembly of the Chevy S-10:
  - ➢The cab and bed were removed and all that remained was the rear frame, axle, and tires which will be utilized as the BUV rear frame.
- Construction of the front frame and the engine mounting box began.
- Once the front frame was completed, it was inserted into the rear frame and bolted in.
- The Yanmar diesel engine was mounted inside the drive train assembly box and the CVT transmission will be arranged within as well.
- The bed will be made out of wood and will have to be able to support a 1200 lb payload.
- The throttle and braking controls were ran to the operator station.

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