Basic Utility Vehicle Design Competition

Agricultural & Biological Engineering

PURDUE UNIVERSITY

April 20, 2009

Designer	Design Area
Craig Roberts	Front Wheel Drive
John Gibson	Front Frame/Suspension
Scott Riggins	Rear Frame/Bed
Jordan Cox	Rear Frame/Bed
Ed Malecki	Rear Frame/Bed

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. The vehicle will be utilized in Africa for a means of transporting goods and people. In addition to low cost, design emphasis is on the steering and front suspension. Design for small scale assembly operations in Africa. Volume is one vehicle per day. Minimize factory investment.

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 required to simplify purchasing, logistics, and serviceability. •Require only two people to assemble vehicle.

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•Purdue Quarter-Scale Team
•Purdue Sheetmetal

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Leadership through Global Engineering Program — Global Impact

Purdue Engineering

www.drivebuv.org

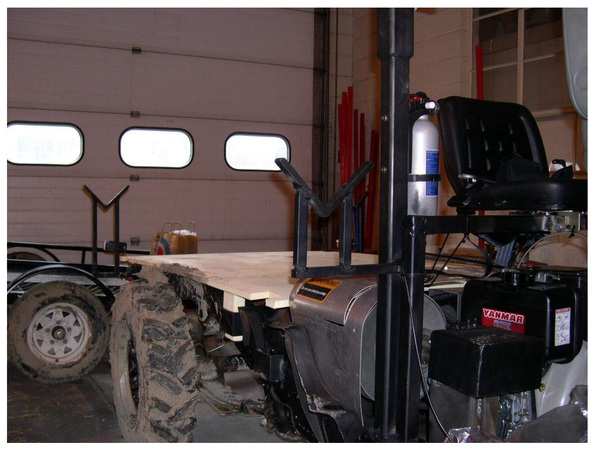
YANMAR

BUV

Rear Frame and Bed

Design Objectives

Frame	Bed	Uses	Manufacturability
•Use the existing rear portion of the frame from a small pick-up truck. •Have a ground clearance of greater than 10.5" except the differential, leaf springs, or lower shocks. •Class I hitch or similar, standard 4 wire connector, wiring, chains, etc. •Have hooks attached to the side of the BUV used to haul a 14 ft log.	•Manufacture from natural resources easily accessible in foreign countries. •Provide at least 2 cubic feet of easy-access storage under the cargo deck. •Provide storage under the load deck for 3 (6'x2"x10") boards used for emergency situations. •Easily removable side-boards for the use of a flat bed.	•Pull a trailer with gross weight of 500 lbs. •Haul materials used in Africa. •Haul a payload of at least 1200 lbs. •Use as a flat bed to haul different materials. •Haul long logs or other objects with the hooks on the side of the BUV.	•Simplicity of design to allow for easy assembly, maintenance, and repair. •Minimize the number of part numbers, part count, and number of common tools required to simplify purchasing, logistics, and serviceability. •Require only one person to assemble and disassemble the bed of the vehicle.



Bed Design Process:

Bed – The bed was made from common ¾" plywood. Sides were built 2' high on three sides. This allows for more cargo capacity.
The sides of the bed are removable to allow for the bed to be made into a flatbed. 2" x 4" boards were used on the sides of the bed as posts. 2" C channel was welded on the side of the frame to serve as pockets for the bed posts. There are eight pockets total, four for the flatbed, and four for the side walls.

Under Deck Storage Design Process:

Under the bed, steel was bend and welded to provide the ability to carry three 2" x 10" boards. Notches were cut from the existing cross members of the frame to allow enough space for the boards and to keep them from shifting during travel.

Side Hook Design Process:

Side hooks were designed and mounted on each side of the vehicle for a total of four hooks. Hooks were made from 1" steel square stock and 6" angle iron. The hooks were mounted 12' apart to allow the ability to carry a 14' pole.

Hitch Design Process:

A Class 1 hitch was designed from 2" x 2" square steel. Holes were drilled along the tubing to provide the ability for the hitch to adjust to different levels .

Ruggedly Simple.
Simply Rugged.

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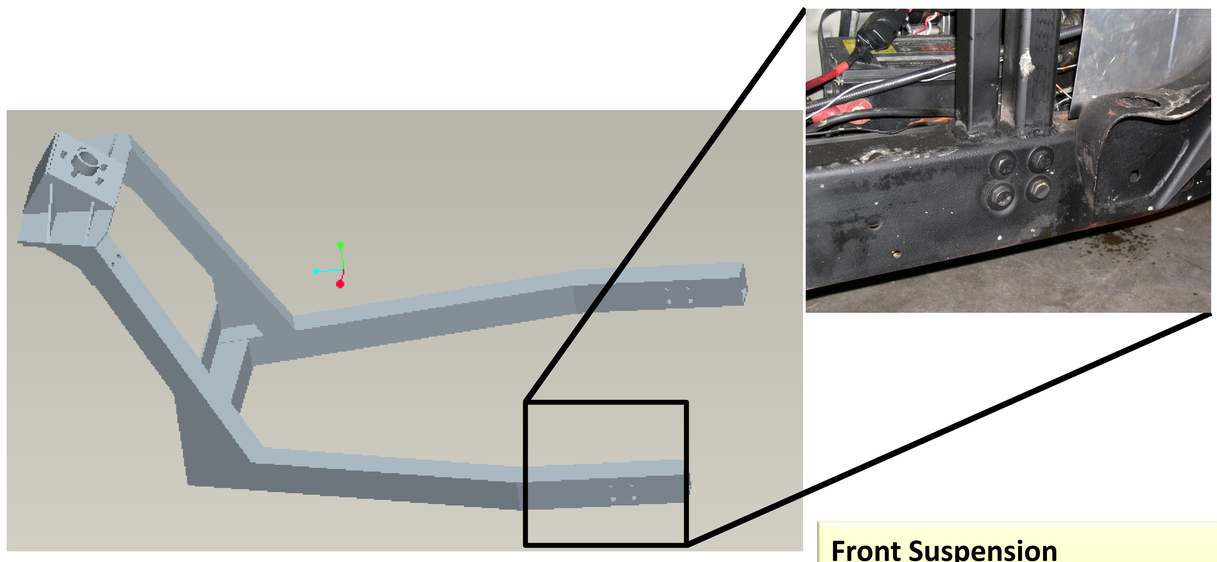
"Food. Shelter. Transportation...the BUV can be the 'car for humanity', meeting human needs and glorifying our Lord."
Millard Fuller, Founder
Habitat for Humanity

Front Frame & Suspension



Front Frame

This frame is designed to be compatible with the rest of the BUV design. The four bolt pattern highlighted here is what links 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. This also allows the vehicle to be separated into two pieces for shipping purposes.

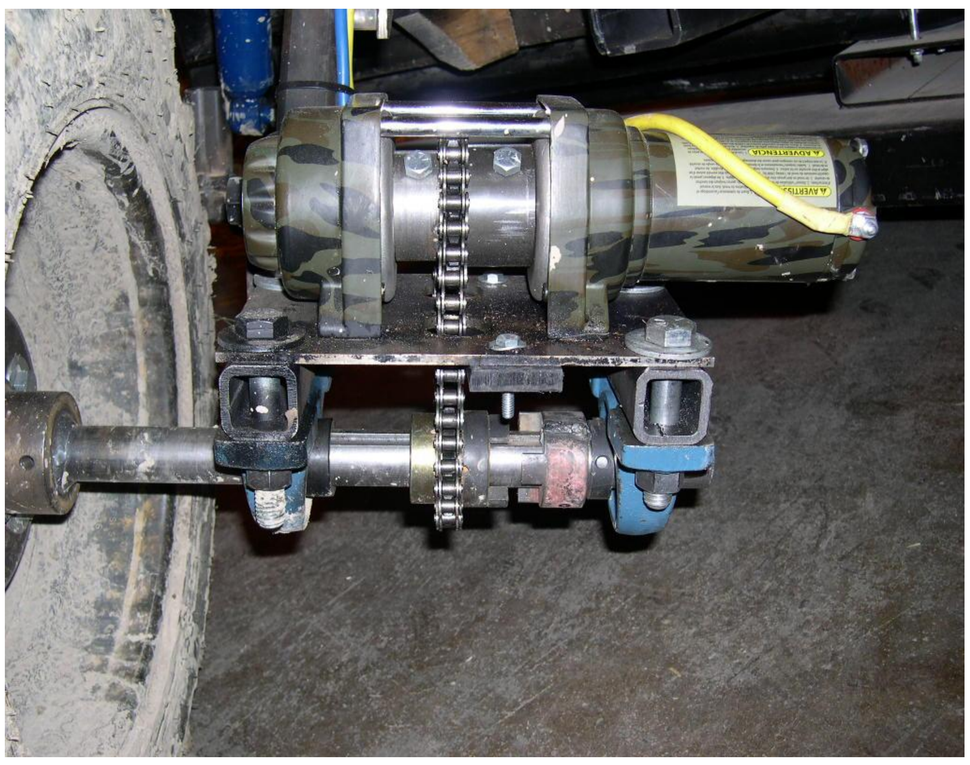
Front Suspension

The front suspension is designed to be simple with minimal maintenance. It utilizes a simple shock band and a general automotive shock absorber. These are both commonly found parts. The rest of the design is simple parts that can easily be manufactured and maintained.

Electric Front Wheel Drive

Winch

The electric front wheel drive was powered with a Trakker winch commonly used on ATVs. The winch is capable of pulling 3,000 lbs. The force produced by the winch was calculated to produce 125 ft-lbs of torque required to turn the front wheel.



Drive System

The drive sprocket was connected to the winch by cutting the drum in half and sliding a sleeve over the two halves. The sleeve was then bolted to the drum. The sleeve also acted as a hub for the sprocket. The driven sprocket rode on a lovejoy with a brass bushing pressed in. This allowed the winch to not turn when the FWD was not needed. Another lovejoy was keyed on the shaft and could slide to engage the driven sprocket.

Design Improvements

Design improvements could be made. During use the lovejoys that were used as the clutch continually broke. One resolution would be to find the same parts made of higher quality steel.

Design Objectives

Frame	Suspension	Front Wheel Drive	Manufacturability
•Build rigid frame •Have a ground clearance of greater than 10.5” •Allow for connection and disconnection of rear frame •Have accessible area for drivetrain enclosure	•Build with minimal cost •Provide at least 2.5 inches of suspension travel •Easy access to front wheel for maintenance and flat tires •Integrate front wheel drive with front suspension	•Move the vehicle 1 mph both forward and reverse •Try to build as economically as possible •Must be powered with an electric power source •Design so it can be installed on old and new BUVs	•Simplicity of design to allow for easy assembly, maintenance, and repair •Minimize the number of part numbers, part count, and number of common tools required to simplify purchasing, logistics, and serviceability •Minimize the amount of service and maintenance vehicle will need

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