BASIC UTILITY VEHICLE

PURDUE UNIVERSITY

Agricultural & Biological ENGINEERING

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Problem Statement:

• Achieving an affordable and reliable means of transportation can be a challenging task and a necessity in many parts of the under-developed world.

•The BUV is a durable, cost-effective all-terrain utility vehicle that is intended to be used and built in rural Africa.

• The Purdue ABE Department has partnered with the African Center for Renewable Energy and Sustainable Technology (ACREST) to provide a Basic Utility Vehicle (BUV) that meets the needs of villages such as Bangang, Cameroon.

•The goal is to design and build a BUV prototype for testing and analysis. The team will then take the design to Cameroon and build a fully-functioning vehicle for the rural village.

Impacts on Society:

•Since some members are afforded the opportunity to go to Cameroon and complete a BUV construction there, the village of Bangang, Cameroon will have a common-use BUV that they can rent to farmers at a cheap cost.
•The finished BUV will allow villagers to carry large amounts of goods to/from the village and allow mass transport of water to the village for washing, cooking, etc.
•The BUV will give ACREST a vehicle to bring to neighboring villages for training exercises and education on building their own BUV

Alternative Solutions:

• **Four-wheeled vehicle –** Allows for added stability but complicates the steering and increase the number of parts.
• **Dump bed –** Allows for ease in unloading various materials, but takes more parts and has a more complicated frame design.
• **Driveline Configuration –** Two other driveline layouts:
  • Side-by-side: Allows for both the engine and transmission to be set inside the frame, leaving more room for driver and passengers, but causes the driveshaft to sit at a larger angle and makes the driveline components less accessible.
  • Stacked: Allows the overall vehicle length to be shorter, but requires a chain drive system between the engine and transmission

Primary Design Criteria
• Durable- Traverse varied terrain with a considerable payload on a regular basis
• Inexpensive- Cost no more than $2000 U.S. dollars, less engine
• Manufacturable- Build with basic tools, little specialty equipment, and readily available components
• Adaptable- Utilize a wide variety of new and used automotive components

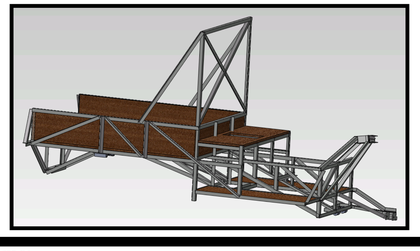
Vehicle Specifications	
Vehicle Dimensions	
Wheelbase	94.5 in
Length	142 in
Width	45.5 in
Height (top of roll bar)	74 in
Bed Height (bottom)	29 in
Cargo Bed Volume	17.4 ft^3
Unloaded Weight	1100 lbs
Rated Payload Capacity	2000 lbs
Engine	Honda GX 340, 11 hp w/electric start
Transmission	5 speed w/reverse, foreign car
Driveline	Single B-section belt reduction (4.7:1)
Clutch	Spring Loaded Idler Pulley
Vehicle Speeds (mph)	
1st	4.6
2nd	8.1
3rd	11.5
4th	16.1
5th	18.5
Reverse	5.0
Suspension	
Front	MacPherson Strut, foreign car
Rear	Coil over shocks, foreign car
Water Pump Flow Rate	120 gpm

Cost Analysis/Budget Report:

Item	Description	Cost
Frame		
Angle Iron	300 ft.	$300.00
Plywood	3 4X8 sheets	$ 81.00
Driveline		
Engine	1 Honda 11HP	$825.00
Transmission	1 5-spd manual	$ 35.00
Driveshaft	1 (matches trans.)	$ 50.00
Rear-Axle	1 S-10 rear axle	$ -
Tires	3 14" Titan Ag. Tires	$ -
Rims	3 steel rims	$ 162.00
Misc. Components	Pulleys, belts,bearings	$ 120.00
Suspension		
Front Strut	1 '83 Corolla front strut	$ 60.00
Rear Struts	2 Honda Civic front struts	$ 48.00
Ergonomics		
Brakes	1 Master Cylinder	$ 15.00
	2 Pedals	$ 26.00
Handle Bars	1 set+ grips	
Throttle	1 (hand throttle+cable)	$ 5.00
Clutch	1 push-pull cable	$ -
Misc. Expenses		$ 250.00
Pump	1 Northstar Freshwater Pump	$ 213.00
Hoses/Fittings		$ 65.00
	Total Cost	$ 2,255.00
Initial Budget Estimate ($2000 + engine & pump)		$ 3,000.00

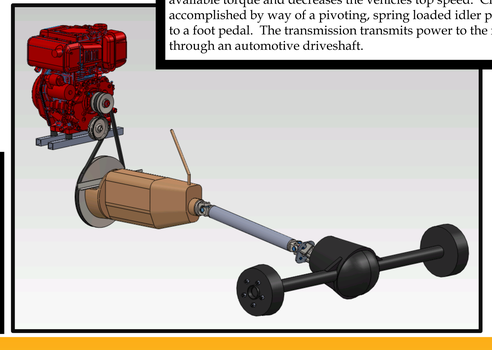
Water Pump:

An additional need that was incorporated into the BUV design was the ability to pump water for transportation. The vehicle was designed to allow for a water pump to be mounted next to the engine and powered through a belt drive connecting the pump to a second driver pulley on the engine. The second pulley on the engine serves as an accessory drive for various uses.



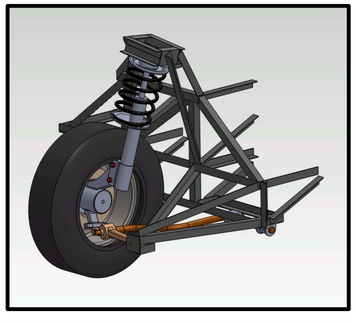
Frame:

A truss-style frame is used utilizing angle iron of a common size, which provides superior strength and minimal weight. The bed sides are integrated into the frame structure along with the seat and floorboards in order to reduce the number of angle iron pieces. Diagonal braces are lapped along the outside of the longitudinal members in order to eliminate as many mitered cuts as possible and provide improved ease of assembly. The front suspension attachment members are designed to be fully adaptable to various styles of automotive struts. The frame was designed to withstand a maximum load of 4000 lbs, twice the vehicles rated capacity.



Drivetrain:

Much like a rear wheel drive automobile, the primary drivetrain components are assembled about the centerline of the vehicle. The engine, which sets atop the main frame, drives an automotive 5spd manual transmission through a single belt reduction. This multiplies the available torque and decreases the vehicles top speed. Clutching is accomplished by way of a pivoting, spring loaded idler pulley connected to a foot pedal. The transmission transmits power to the rear differential through an automotive driveshaft.

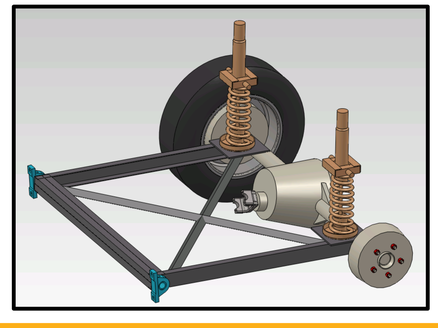


Front Suspension:

An automotive style MacPherson strut suspends the front of the vehicle. This component, while readily available, provides disk braking, steering, ample suspension travel, and shock absorption in an integral package.

Rear Suspension:

The rear of the vehicle is supported by two inverted car struts. These extend up through the bed of the vehicle in order to lower its center of gravity. The rear axle is rigidly attached to a swing arm which carries the torsional, transverse and longitudinal loads seen by the axle under varying driving conditions. This solution requires only four attachment points for the entire rear assembly.



Summary:

• A BUV prototype has been designed and built to meet the criteria of being low-cost, durable, adaptable, and easily manufactured
• The vehicle has been tested using 3D modeling software as well as undergoing extensive field tests
• Additional testing will take place during an upcoming endurance competition where the vehicle will be driven through a rigorous course for 9 continuous hours
• The team is currently preparing for the build in Cameroon through creating an assembly manual and collecting supplies needed for constructing the vehicle there

Sponsors: Purdue ABE Department
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