Qamel

Qamel Specialty Vehicle

A. Scott Howe, Bob Gelardi, Mark Borus, Darren Wolfberg
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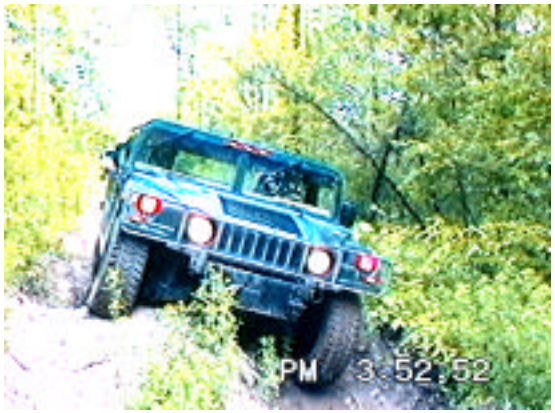
Introduction

The Michigan Integrated Design Initiative recently conducted a multi-disciplinary design project at the University of Michigan. The project generated concepts for a multi-purpose commercial off-road vehicle. The Specialty Vehicle project team leader was A. Scott Howe, architect, who worked with team members Bob Gelardi, Mark Borus, and Darren Wolfberg under the direction of Colin Clipson (Architecture), Tom Gillespie (UMTRI / Automotive Engineering), Sridhar Kota (Mechanical Engineering), and Shawn Jackson (Industrial Design). Special advisors included Rick Fanco, Chief Engineer for the Hummer (AM General). The vehicle has temporarily been named “Qamel”, partially in reverence to the strong, swift, load-carrying animal.

The team project, organized by A. Scott Howe, took place in Design Lab #1 of University of Michigan’s new Media Union building for seven weeks during the summer months of June and July. However, although the original concept was conceived during that time, the project is still ongoing. Due to the tight time constraints, a rigorous schedule was adhered to in which Mondays were set aside as brain storming sessions. The team would decide on a set of requirements and design features and would individually produce conceptualizations incorporating those features. The conceptualizations were sketched out on paper using a variety of techniques, or on the computer using Form Z modeling software. During the next brain storming session, the conceptualizations were presented to the rest of the team and the project proceeded by the selection of ideas. When certain features were decided upon by the team, the features were inputted into the computer at full scale. The computer model was then outputted and used as a base for further sketching. Early on in the project, two web pages were established as presentation space. When one of the team members went away to Japan for a couple of weeks, designs and images were posted via telnet through the Internet and the team was able to continue the rigorous schedule remotely. In this way, the team was able to produce an exceptional design in only seven weeks.

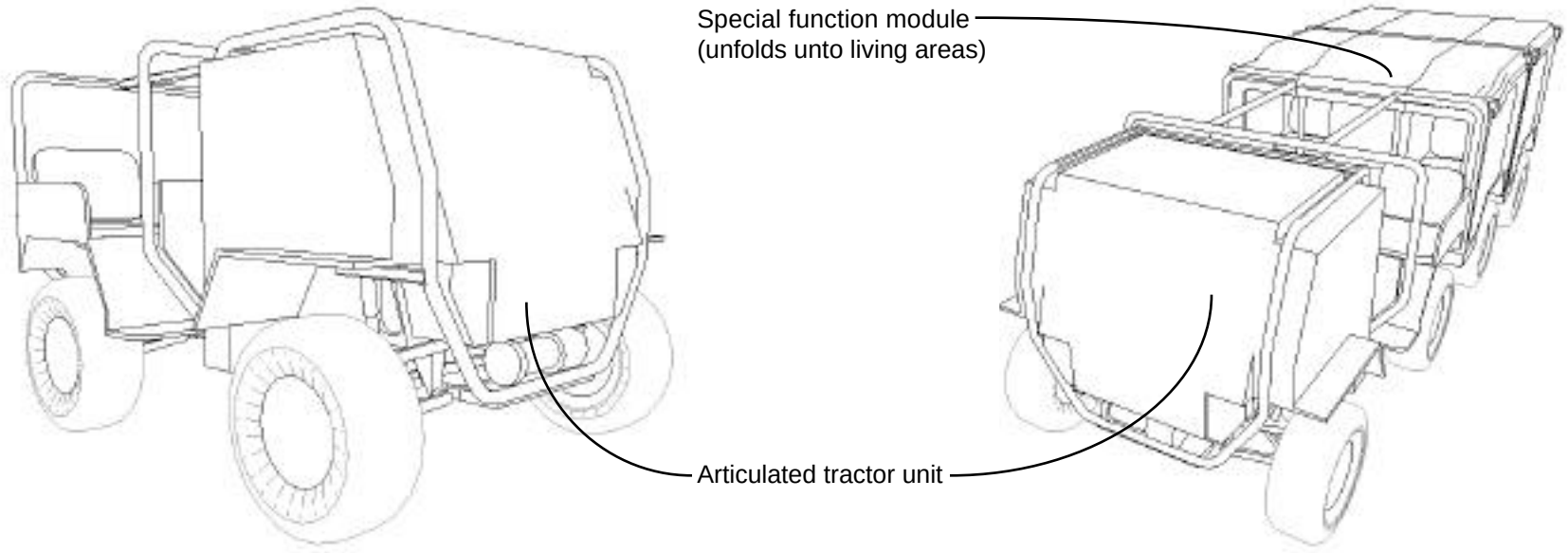


Tom Gillespie of University of Michigan Transportation Research Institute (UMTRI) provided many hours of instruction on technical issues. During the course of the project, AM General provided many educational opportunities and availed the team to the use of their Hummer-related facilities. Tours of the design center, Hummer assembly plant, and use of the off-road test drive course were included in the generous AM General support. In addition, numerous visits to the Qamel design studio by Hummer Chief Engineer Rick Fanco provided valuable insight into the design of high performance off-road vehicles.

Design Requirements

The goal of the team was to generate concepts for a modular commercial off-road vehicle which could be outfitted to function as an off-road “motorhome”. The problem was to design a vehicle for the United States Park Service or similar organizations that could function as a remote ranger station or scientific research outpost. Requirements included the ability to travel on-road, carry eight persons off-road, and contain living and storage space for four occupants. It was assumed that the vehicle would be used by forest rangers, geologists, or forestry industry personnel for specific projects in remote locations, such as the construction of a hiking trail, observance of a herd of animals, surveying of forests, mineral testing, etcetera. The length of stay of the outpost was assumed to be one or two weeks. Requirements for the living module included fold-down cots, food preparation area, chemical toilet, and shower. Support equipment for the living module included refrigerator, electric generator, water filtering equipment, field shower (for obtaining high pressure water flow from lakes and streams), and wireless communication equipment.

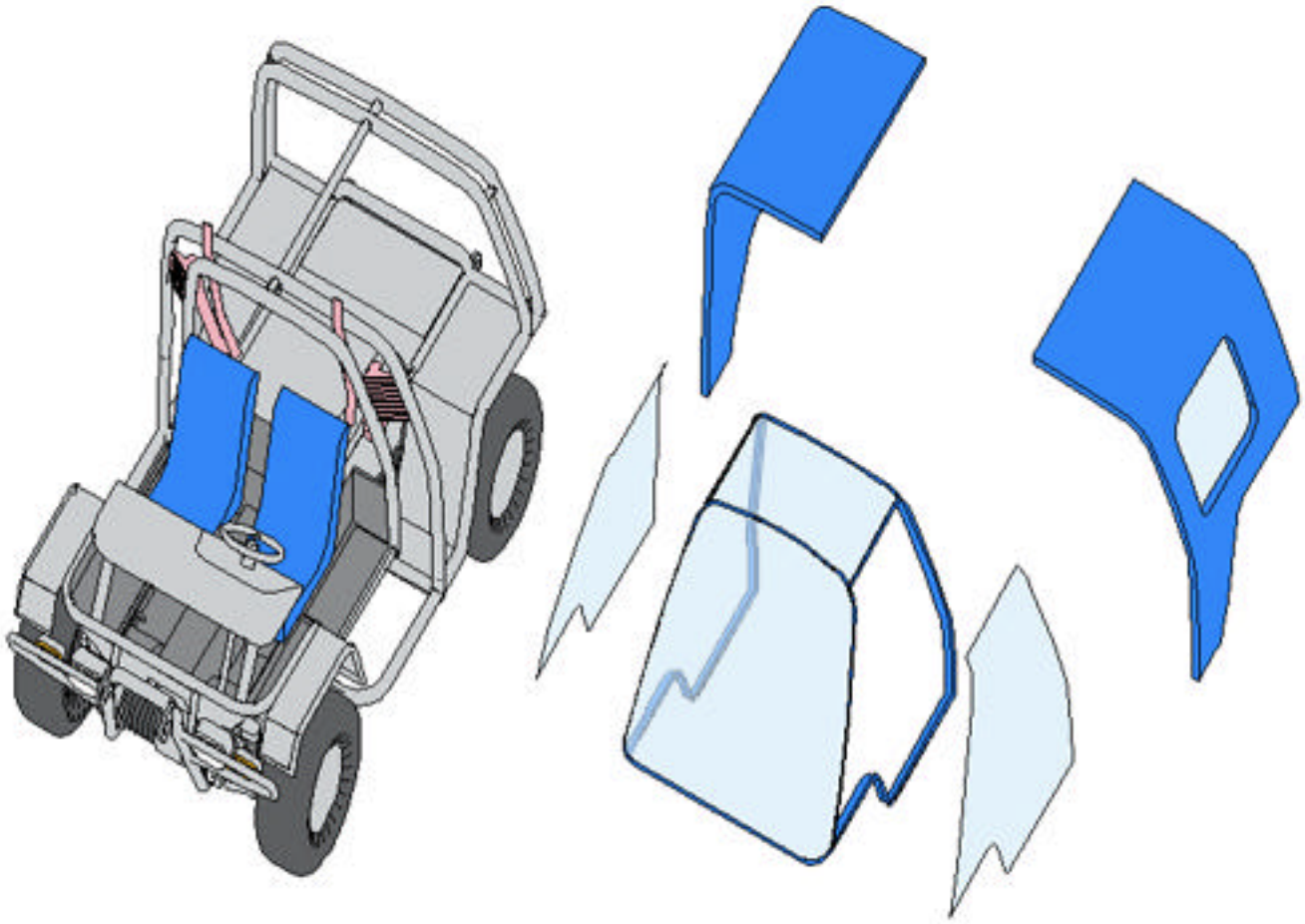
Though not within the scope of this project, the system was expected to accommodate the design of other specialty modules, such as field hospital, fire fighter base, satellite communications base, mobile office, and cargo transport.



Early designs included an articulated frame vehicle with multiple-wheel steering. A connector joint would include a mechanical drive connection in order to facilitate all-wheel drive. The early design was inspired by the US military’s Gamma Goat. The vehicle consisted of a tractor unit and a special function module which is deployable into a living area. Unattached, the tractor unit had a turning radius of a mere four meters. With the special function module, the turning radius was eight meters.

Qamel Concept

The Qamel continued with the overall modular vehicle concept. It was conceived that a standard tractor unit would be coupled with modular special function units specifically designed for various uses. Those uses may include portable living space, mobile hospital, and mobile communications center.



In the scope of this project, a portable deployable living unit was conceived.

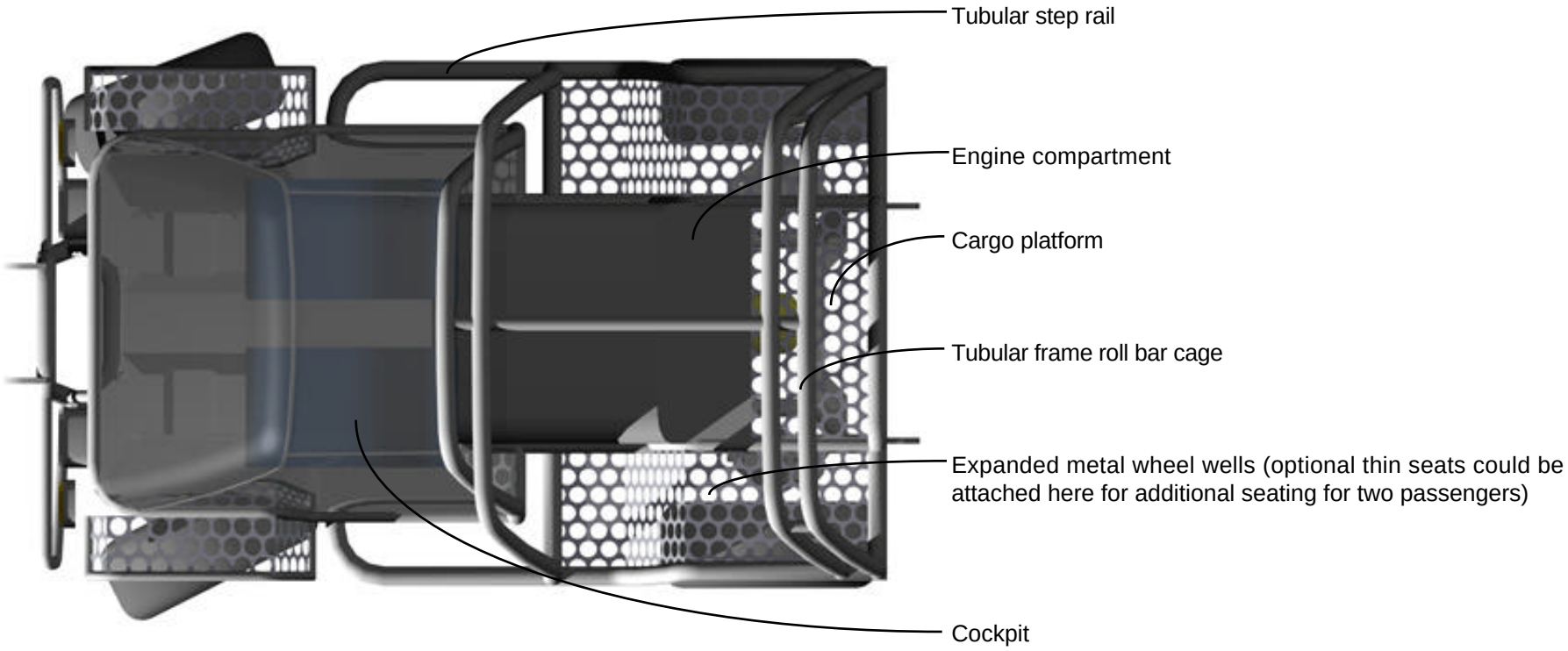
It was conceived that the vehicle could be used in various climates and terrain conditions, fitting to various terrain's. Desert, mountain, arctic, and swampy conditions present in the various remote areas required that the vehicle be flexible and have the ability to be quickly outfitted for the appropriate conditions.

As a result, the tractor unit was conceived as a skeletal frame similar to a "sand rail" or dune buggy. Even windshields and driver enclosures would be considered optional. The skeletal frame could be used as-is in desert climates, or be fitted with everything from canvas covers to insulated panels depending on the climate in which the vehicle is to be used. The panels and canvas covers would be snap-on / snap-off for easy installation and changeover.

The features which contribute to the Qamel's off-road ability include four-wheel drive, front and rear electric winches, geared hubs, central tire inflation, runflat tires, independent suspension, sealed engine compartment, stack exhaust, and standard snorkel. The Qamel's rear axle is fixed, with steerable front wheels. When mounted, specialty modules would not be considered trailers in the usual sense but would have specially designed coupling mechanisms which actually convert the vehicle into a single hinged body with one degree of freedom in pitch. Upon connection, the module's wheels would be steerable, hydraulically powered to respond to the tractor units steering controls. The module wheels would normally rotate freely, but through the power of an electric motor would provide additional push for all-wheel drive under certain low speed conditions.

Tractor Module

The tractor module was conceived to be a removable power plant. When the specialty module, whatever its function, is deployed, the tractor module would provide the rangers with mobility in their work. Using the specialty module as a home base, or as one independently functioning unit among many, the tractor would be free to tow other modules or transport the rangers to more remote locations.

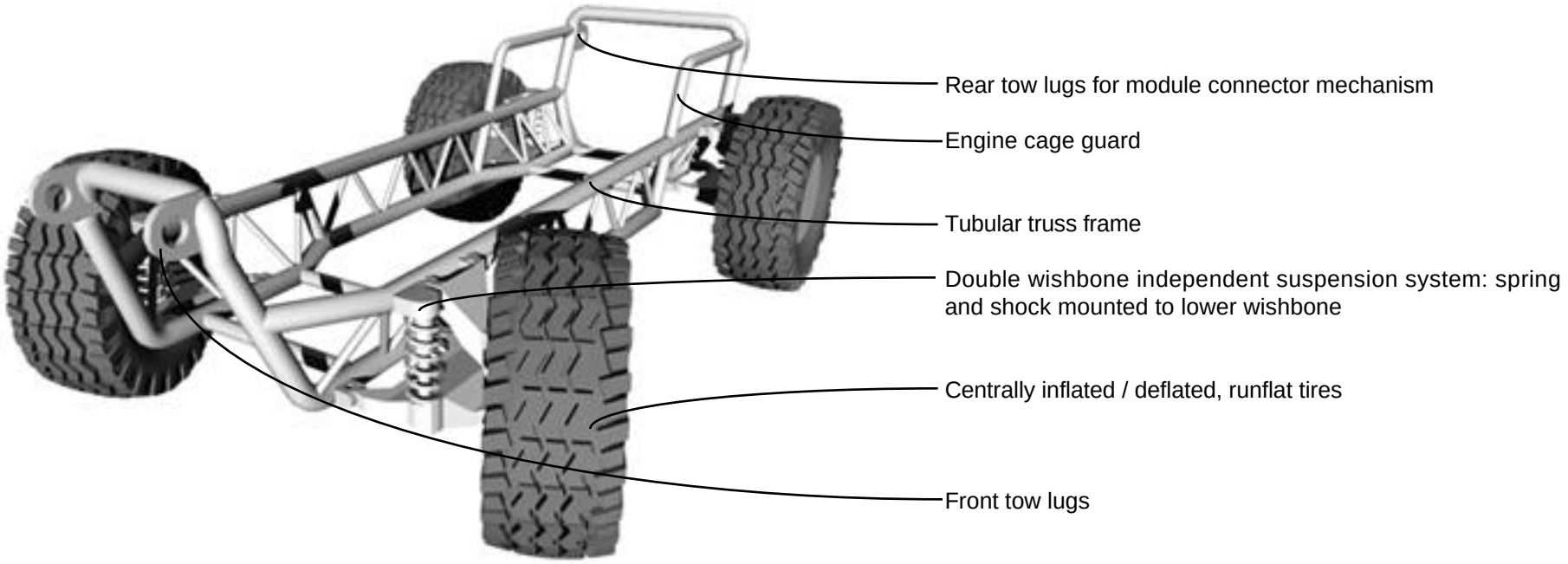


For example, in an emergency rescue situation such as a wilderness plane crash or multi-vehicle pileup, mobile hospital modules could be towed to the site and dropped off where needed. Immediately upon uncoupling, the tractor could return to fetch another module or reposition previously placed ones.

On the road, the tractor would legally carry two passengers in its cockpit. Off-road, additional detachable thin seats over the rear wheel wells would accommodate another two passengers on the outside of the vehicle. These exterior seats could facilitate drive-by tree marking, game observation, beach rescue, and other activities more easily conducted outside the envelope of the vehicle. The expanded metal decking utilized over the wheel wells and rear frame would also facilitate equipment lashing and the carrying of cargo. All body panels, including the cockpit enclosure, are snap-on to facilitate multi-purpose usage. In a beach rescue environment, a fold-down plate windshield may be appropriate, where a winter snow environment would call for a fully enclosed cockpit with environmental controls.

Structural System

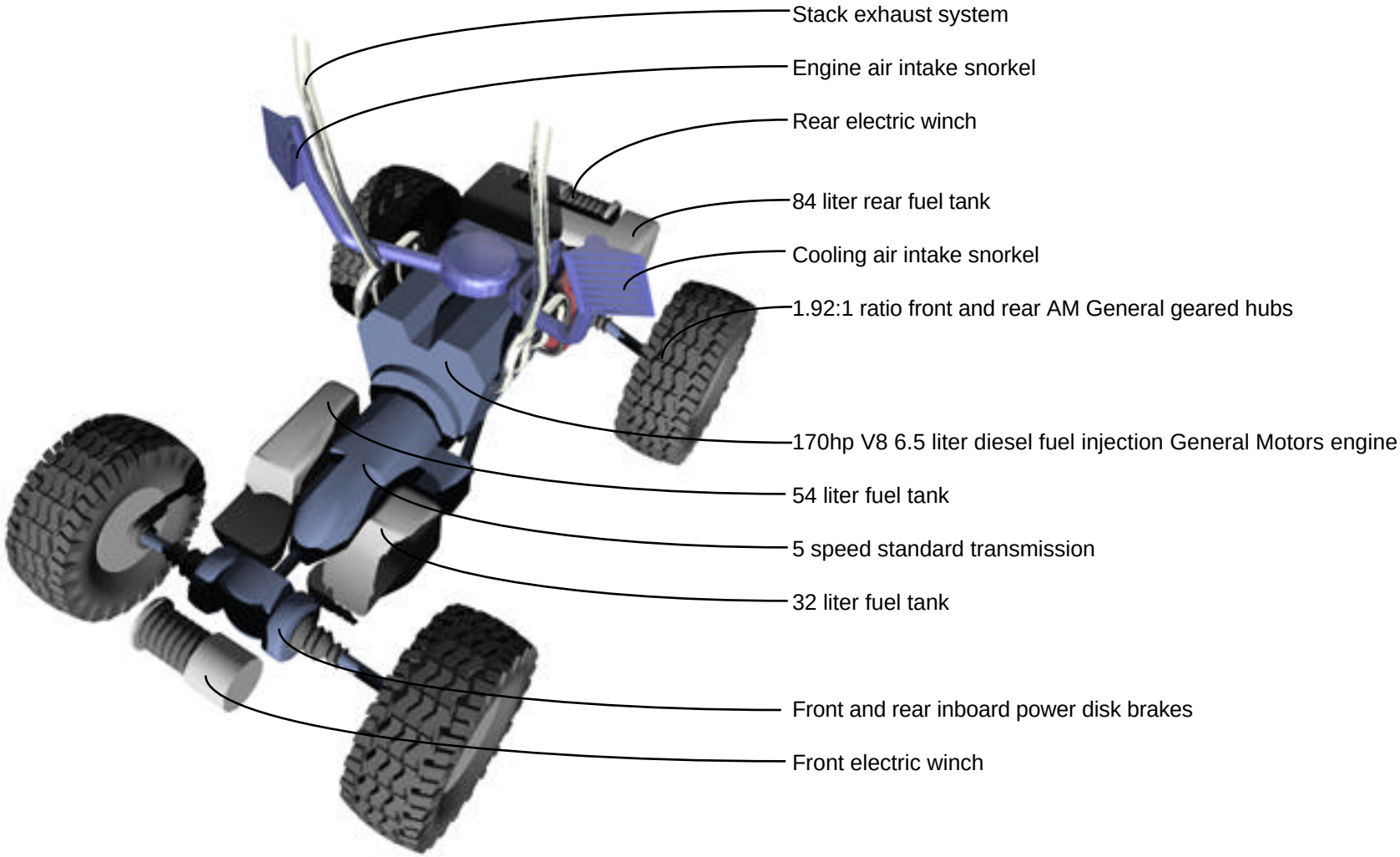
The original concept for the structural system was conceived to be extremely lightweight tubular stainless steel construction. As of this writing, the original structure is currently undergoing revisions, but basic concepts will remain similar to that which follows:



The frames joints are welded, with formed bent tubing. Front and rear tow lugs are welded directly to the frame, with the rear lugs providing a base for the module connector mechanisms to mount. The suspension system is a double wishbone mounted to the top and bottom chords of the tubular frame truss. The wishbone system in the rear mirrors that of the front, with spring and shock absorber mounted to the lower wishbone. The Qamel's approach angle is 67°, departure angle 75°, and ramp breakover angle 43°. In addition, specialty module departure angle is 38°, and the tractor / module joint has 26° of play above horizontal and 24° of play below horizontal. Turning radius with the tractor only is 6 meters, and 7.5 meters when specialty modules are attached.

Engine and Power Train

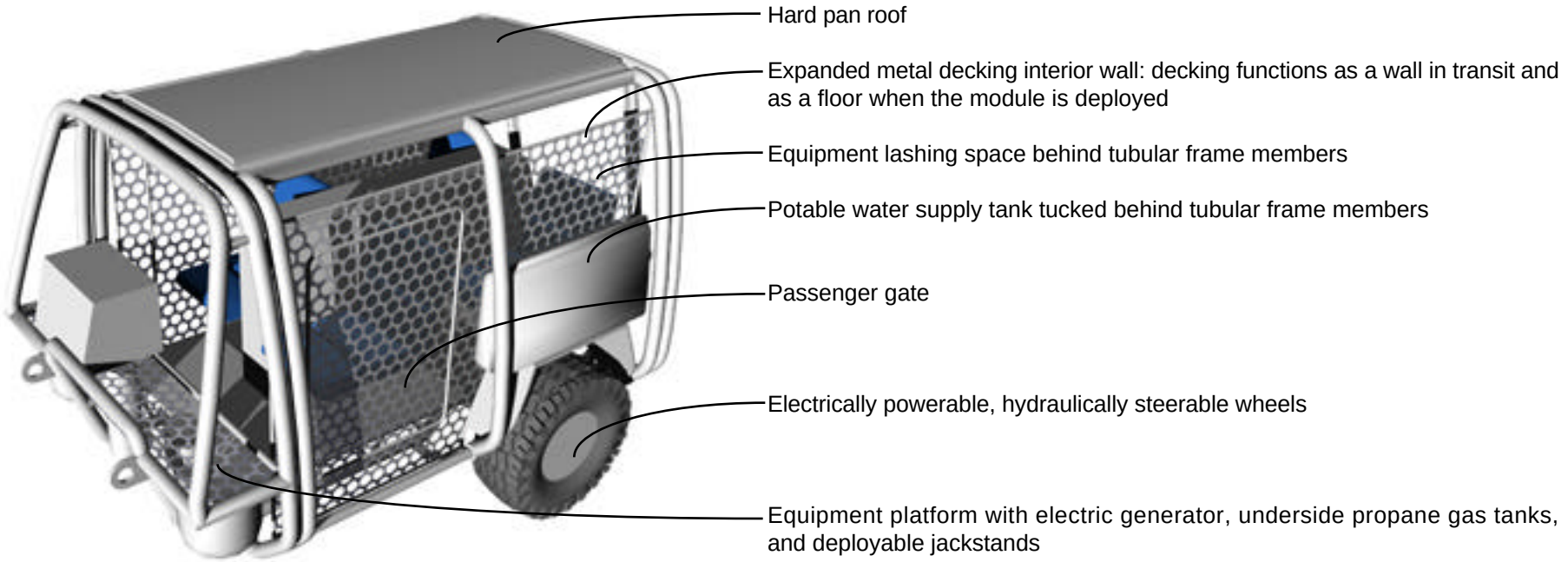
The engine is located slightly rear of center. As with the structural system, the engine and power train is currently undergoing revision in detail design, but should not vary much from the original concept as follows:



The 170hp diesel fuel injection engine has a fully sealed moisture proof electrical system. In conjunction with the engine air and cooling air snorkel system and stack exhaust system, the Qamel is designed to be able to ford depths of 1.6 meters (5 feet). Qamel has three fuel tanks for a total diesel fuel carrying capacity of 170 liters. The power disk brake system is located inboard for protection and to increase the ground clearance. Qamel is equipped with two electric winches, both in the front and rear.

Living Module

In the context of this project, a living module was designed. In order to meet the design requirements of having the ability to transport eight persons in an off-road situation, the module of necessity was required to accommodate passengers in transit. The living module was designed to transport up to four passengers in the sitting position, or two passengers laying down.

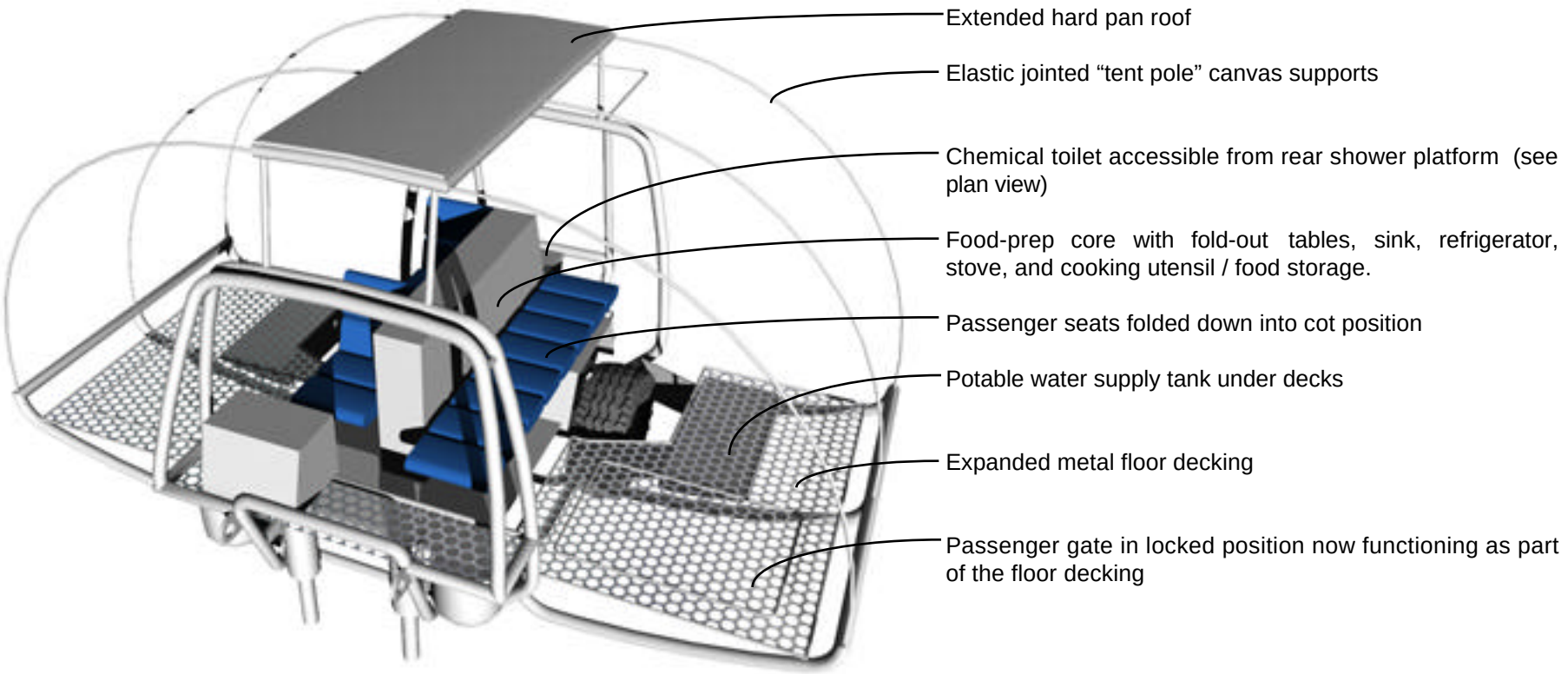


The frame is of the same tubular stainless steel construction as the tractor unit, and in its most basic form is conceptually skeletal. As with the tractor, a snap-on paneling system consisting of everything from canvas to thickly insulated panels would allow a flexible use in different climates. In the stowed position, the walls follow the same general profile as the tractor. An expanded metal inner wall would enclose the passengers to a certain extent, but real enclosure would be afforded by the snap on panels which are fastened to the outer tubular frame. In the space between the tubular frame and the expanded metal decking, equipment and supplies could be lashed to the decking. Permanent potable water tanks are installed in that zone.

Passenger seats fold down and double as cots, and also fold up out of the way. A single passenger gate on each side, piercing the expanded metal decking afford exit for the passengers when the module is in the stowed position. A passenger sitting in the rear seat (which is mounted on top of the wheel well) would fold up the front seat and swing it out of the way to open up an aisle to the passenger gate. Snap-on panels affixed to the frame would allow the passenger gate to function normally.

When the living module is deployed, it is detached from the tractor and the front hydraulic jackstands are locked into support position. The side walls which are hinged at the bottom swing out and become horizontal platforms. The expanded metal decking that formed the walls when the unit was in the stowed position becomes the floor decking for the living space. Passenger gates are locked into place, since they too have become floor. Canvas walls, attached

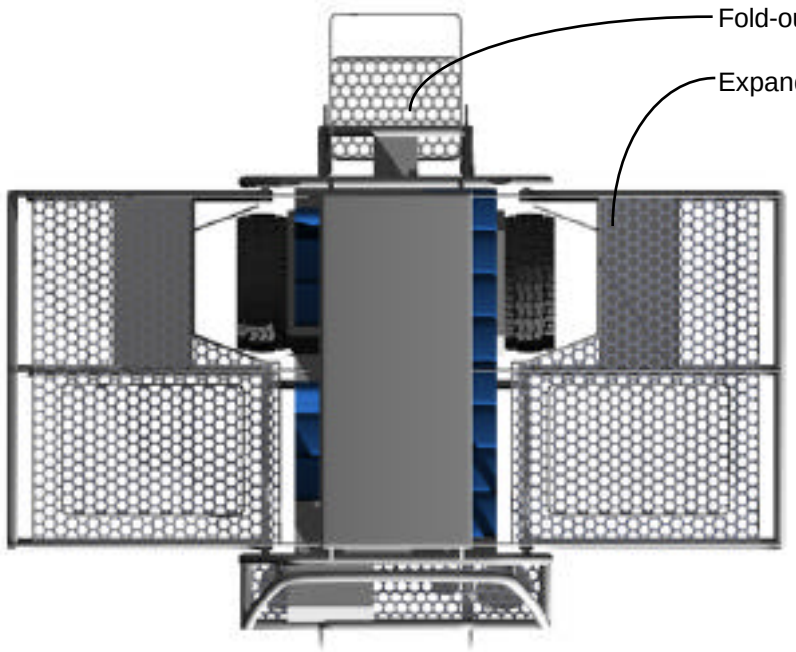
to the outer extent of the floor deck and the edge of the hard pan roof, sags out from the tucked-in storage position as the frame is opened. The hard pan roof then extends upward to locking position to provide full-height standing head room for the occupants. After the frame has been locked into place in the deploy position, elastic jointed aluminum “tent poles” are inserted into the outer edges of the floor deck and hard pan roof to support the sagging canvas into a taut membrane. Fold-out adjustable jackstands provide additional support at each of the corners of the floor deck. As with the skeletal frame and snap-on body panels, the bare expanded metal decking can be fitted with zip-in indoor / outdoor carpeting or other appropriate flooring.



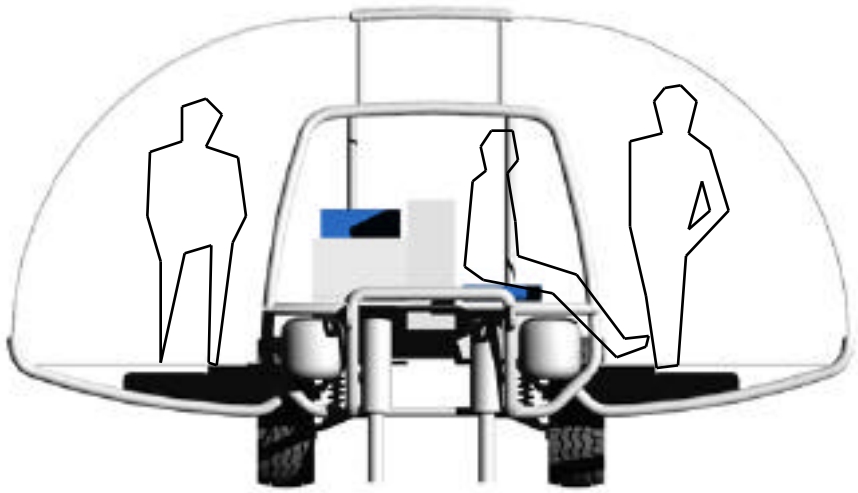
Entrance to the module is by zippered doors built into the end panels of the extended canvas membrane. Between the passenger seats running through the center of the module from front to rear, is a food-prep core. The food-prep core is packed with fold-out tables, a refrigerator, fold-out stove, vinyl sink, and cooking utensil storage cabinets. In the direct rear of the module, a fold-out shower platform opens directly to the rear and is accessible from the outside. A chemical toilet is located on the rear of the food-prep core and is actually inside the shower stall when it is fully deployed. Extending a special umbilical consisting of a pair of hoses and an electric wire, the field shower can be put into operation. One of the hoses, affixed with a push pump powered by the electrical wire, is inserted into a lake or stream, and the other hose is placed a certain distance away for channeling away the brown water for leaching (only brown water and *not* sewage).

In this example a living module was designed. Other special function modules would generally have the same overall frame, with slight modifications to the interior. A hospital module may have permanent medical equipment storage where the passenger seats are, with fold-down stretchers at the outer edge

of the floor deck. A communications module would have parabolas and antennas stowed on one side, which would fold out when the unit is opened up, using the floor deck as a mounting platform and the other side as an enclosed operator booth. A mobile office would have smaller antennas for connecting to the phone system and Internet, and would have desks and shelving for computers and peripherals. Emergency fire fighting headquarters may have lockers for equipment and cots or lounges for tired personnel to take needed breaks. Etcetera, etcetera.



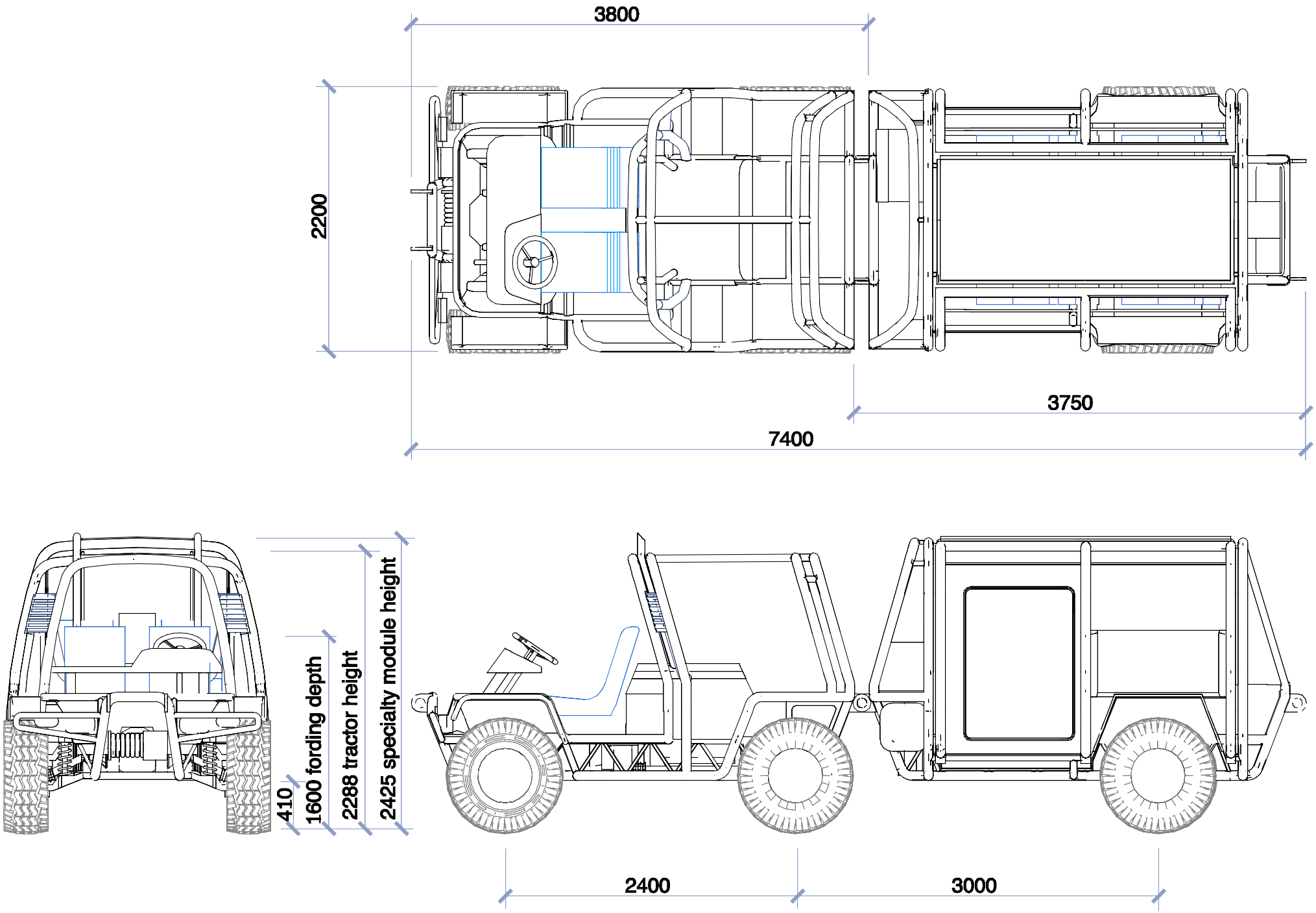
Living module plan view



Living module section

The Qamel project provided an outstanding opportunity for designers of different disciplines to come together and work on a common idea. Architects, industrial designers, and engineers were able to work together and pool their special knowledge. The project was extremely successful and has begun to attract interest in unforeseen quarters. The Qamel design is currently undergoing refinements by an increasing number of knowledgeable engineers and designers under the direction of the original team. It is possible that opportunities for prototyping may soon be availed to the Qamel design.

It is hoped that this project will be an example on the immense possibilities that multi-disciplinary designers can bring to a common project, even when it crosses the boundaries of traditional design methods.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2425 specialty module height
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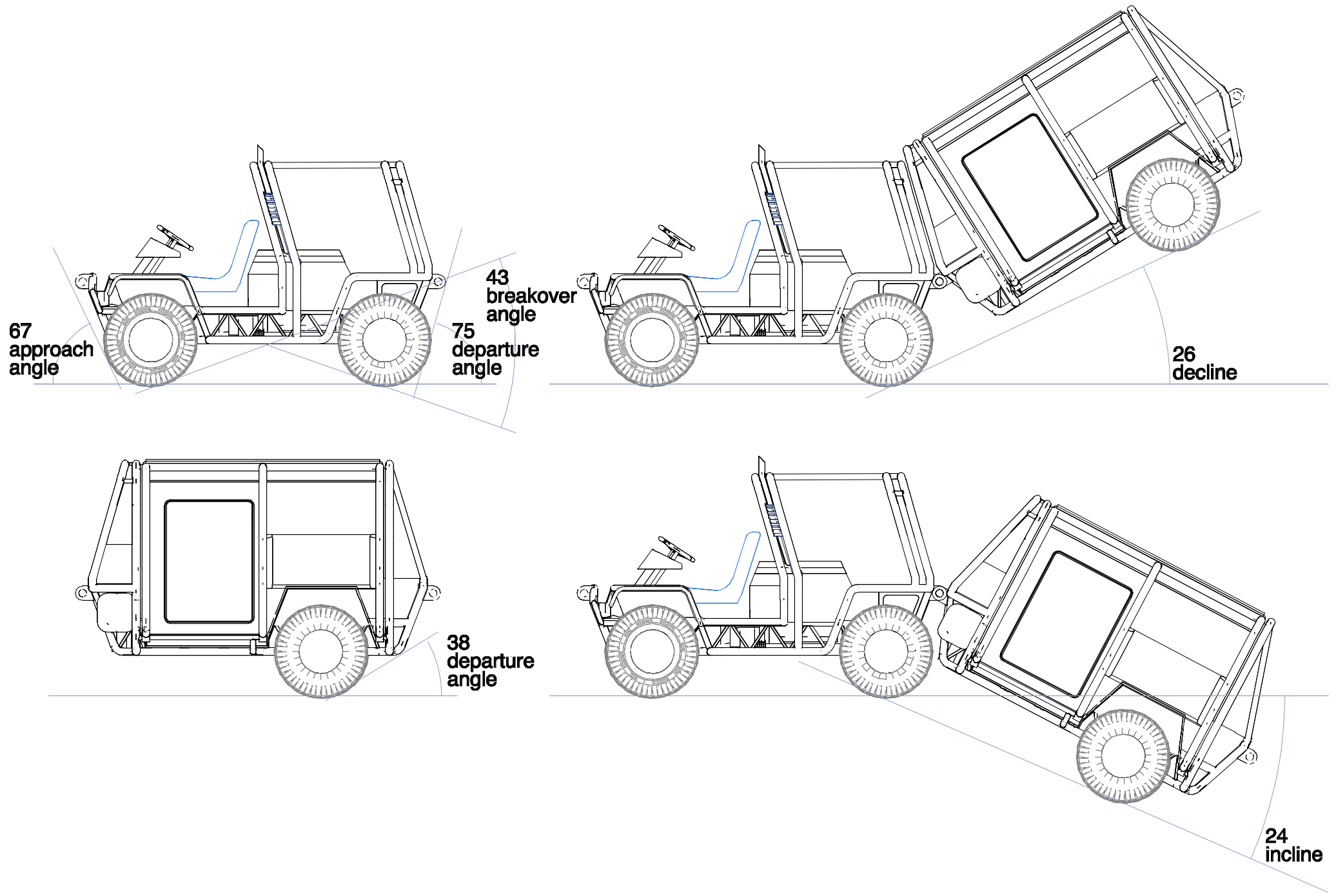
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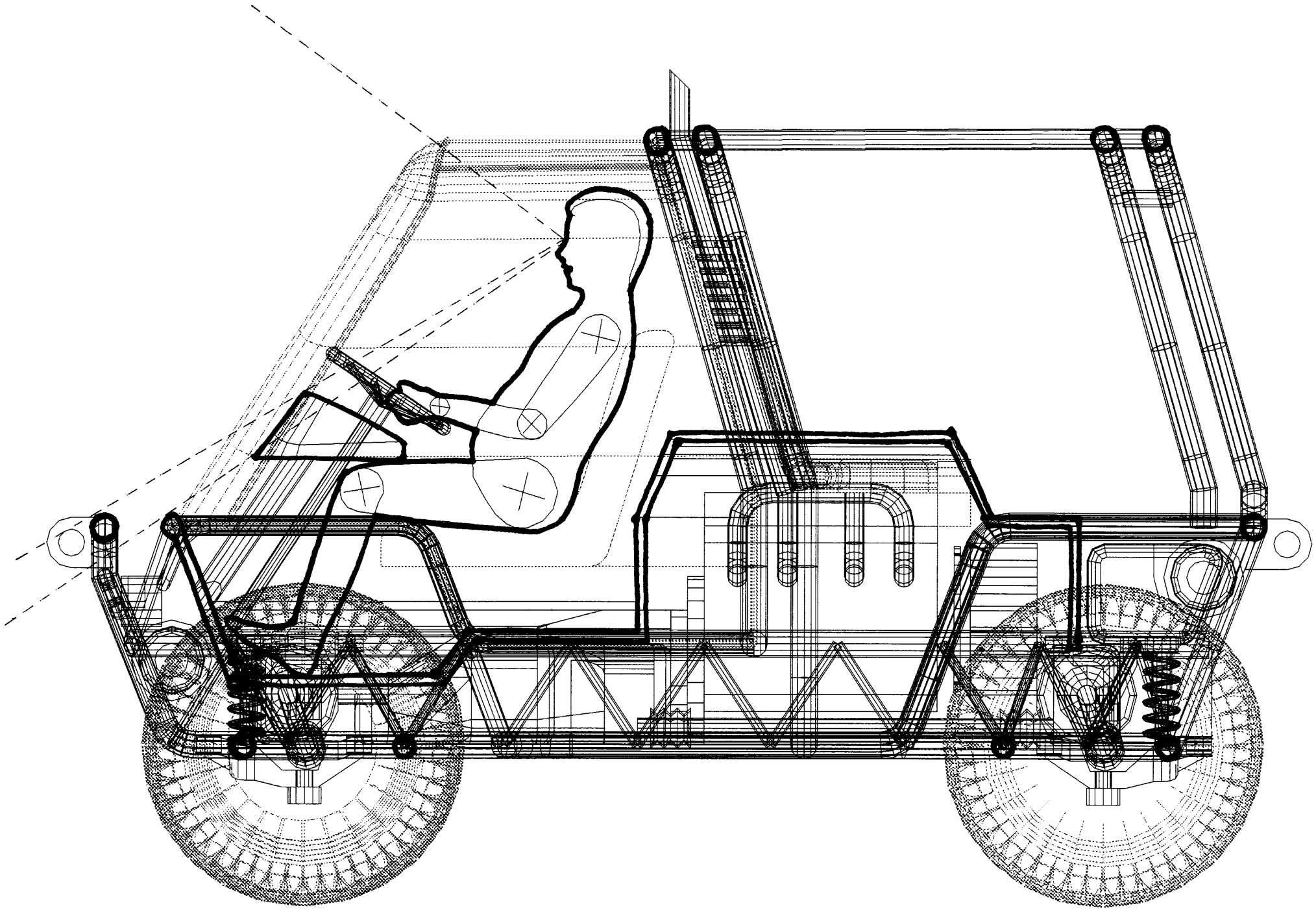
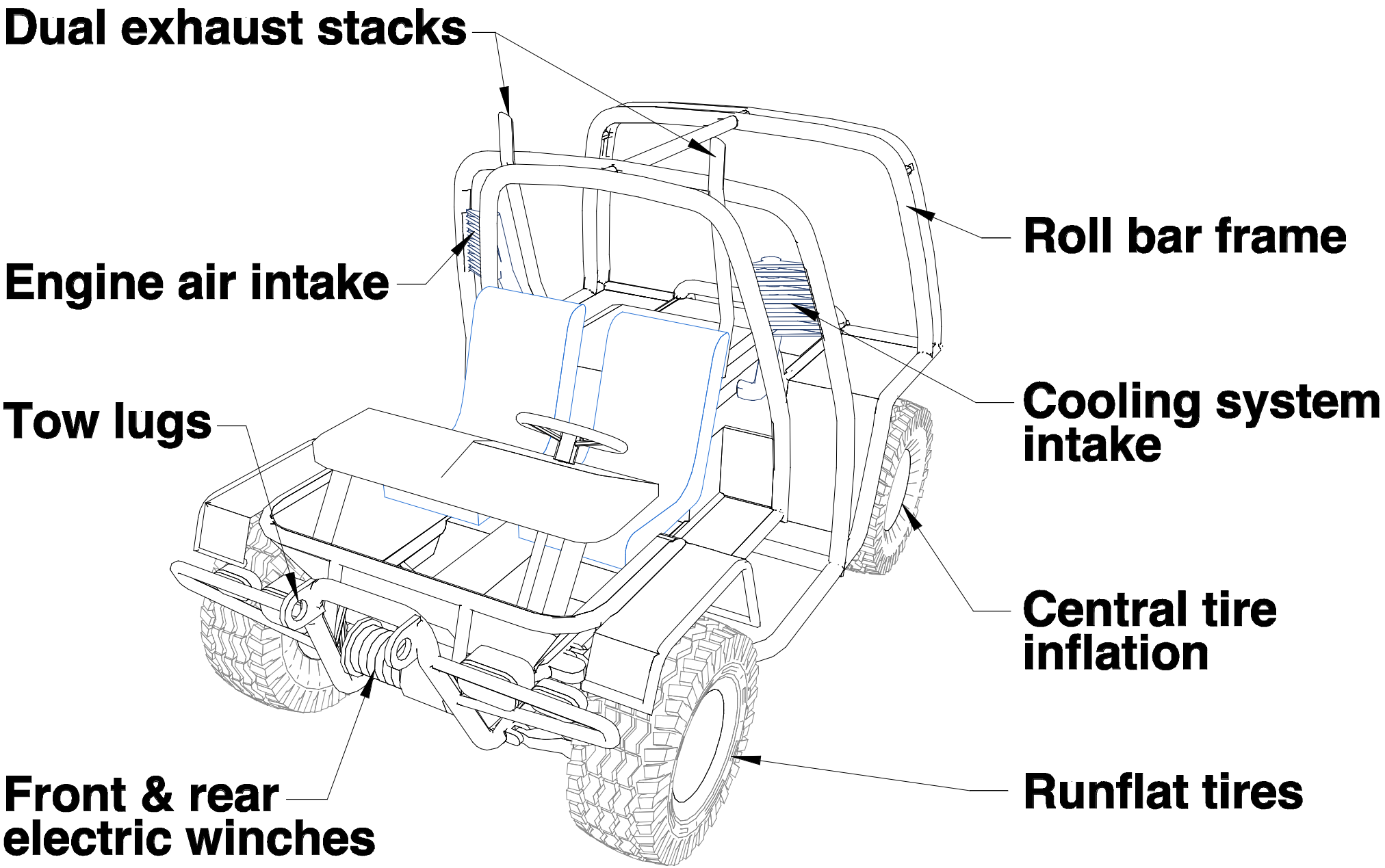
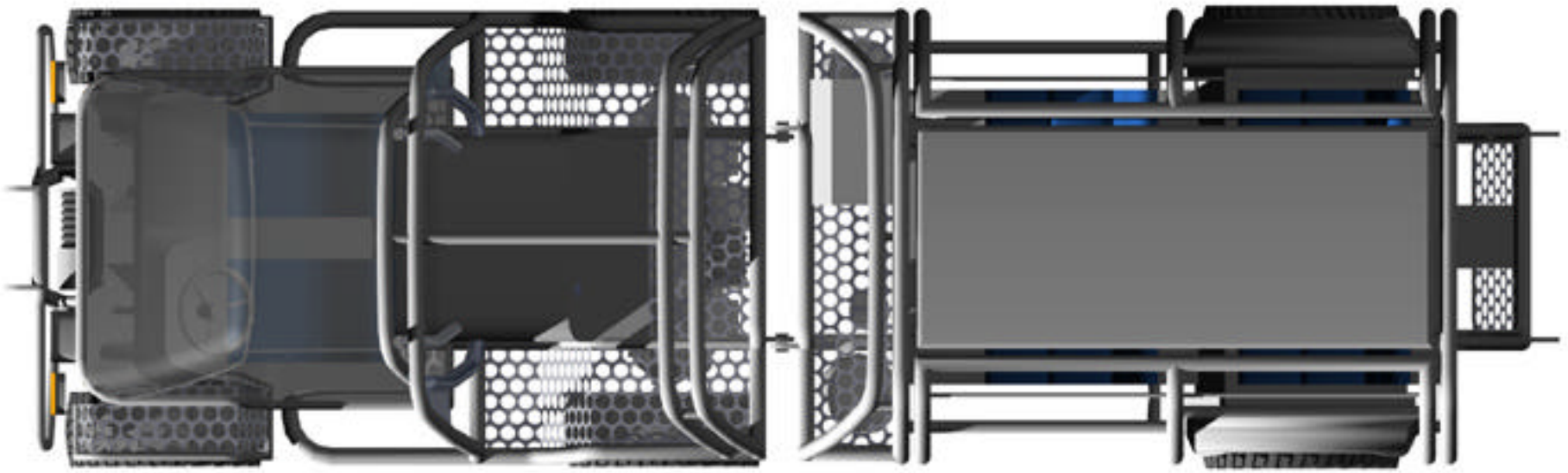
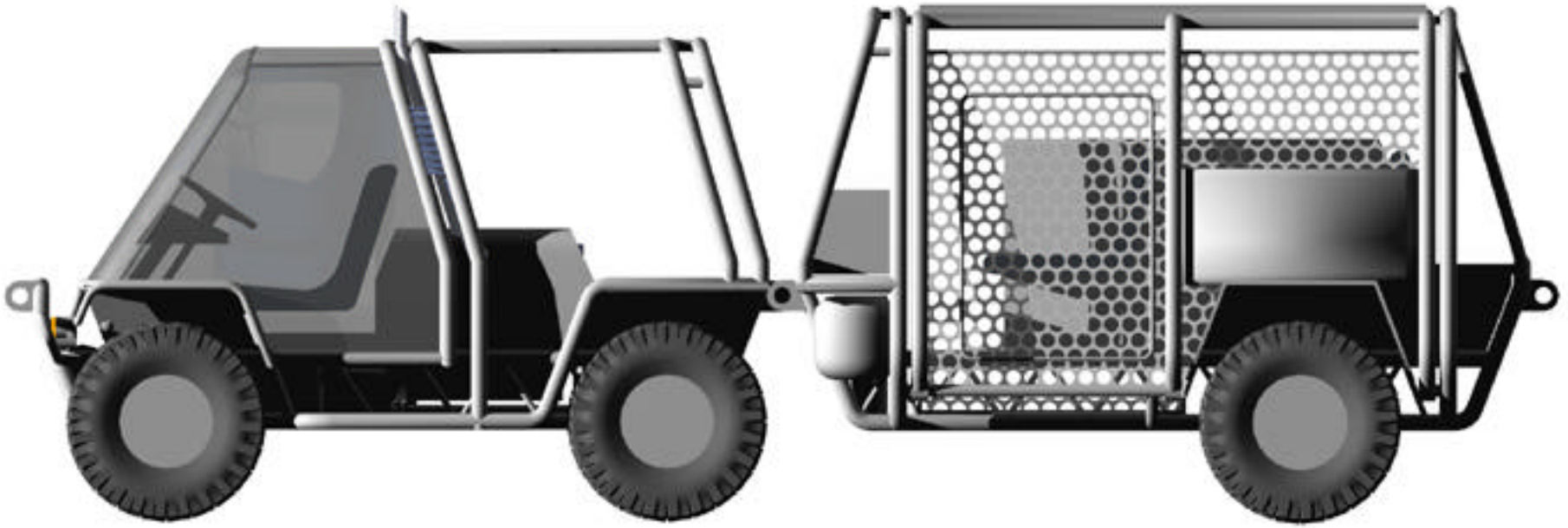
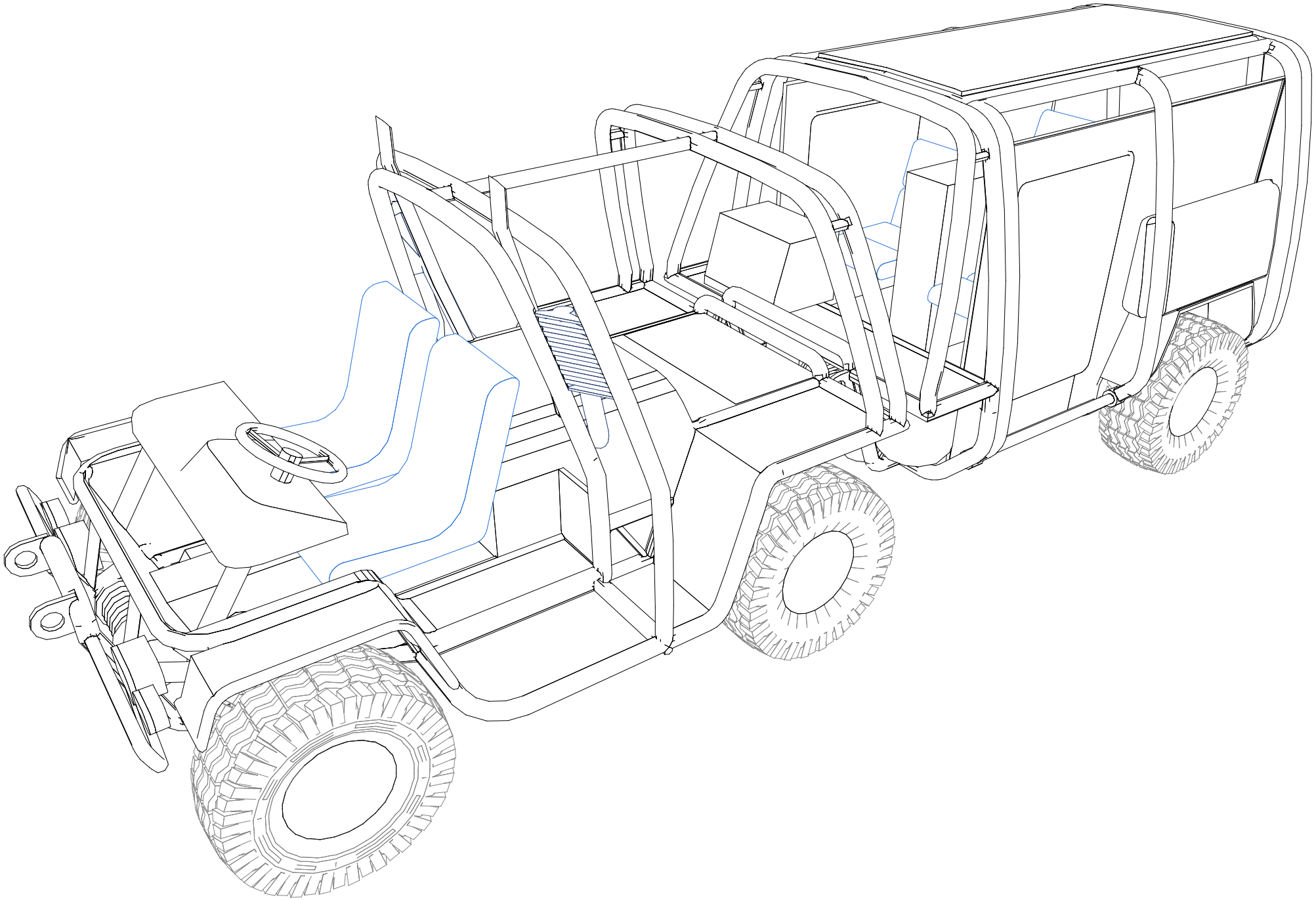
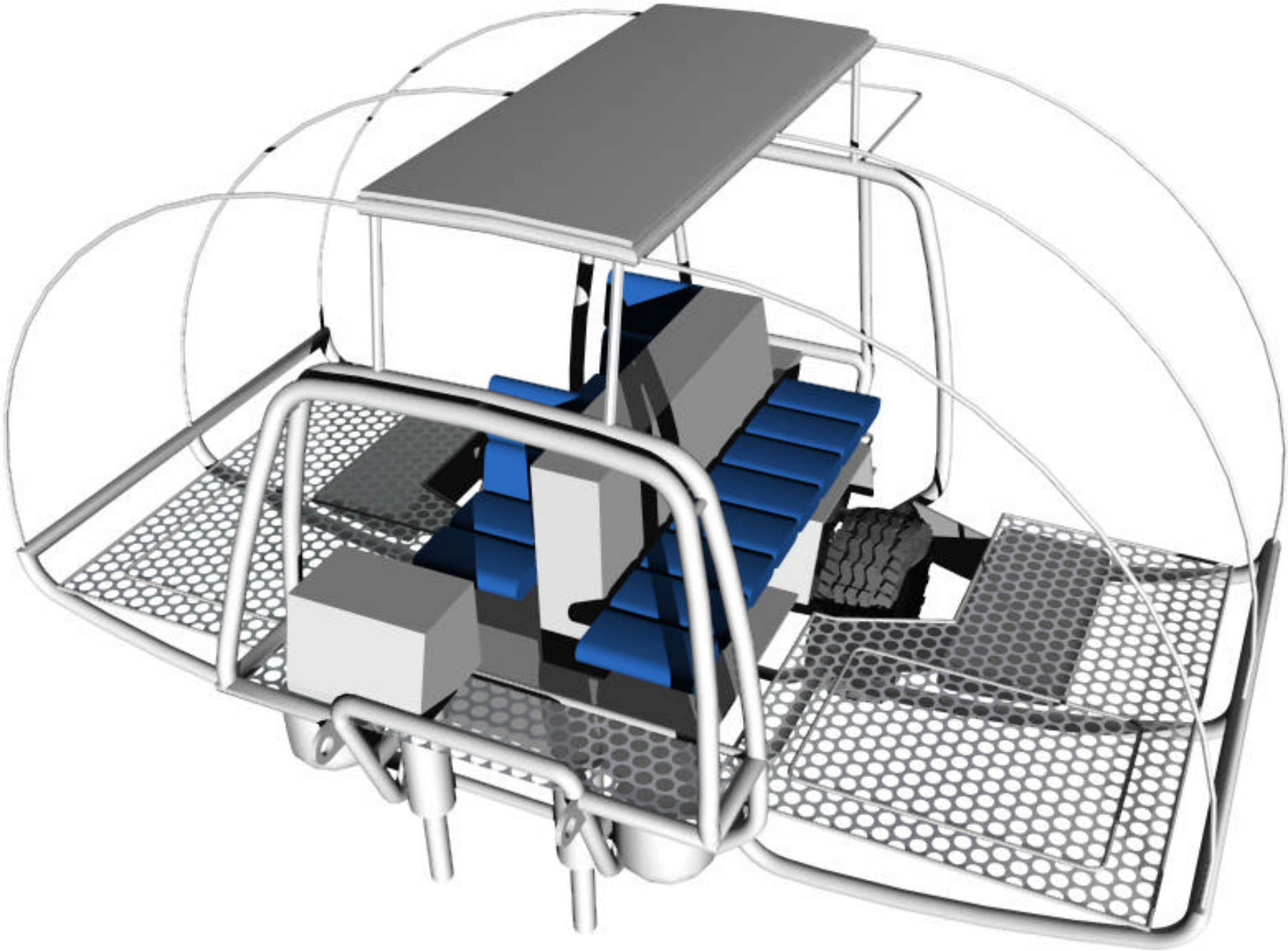


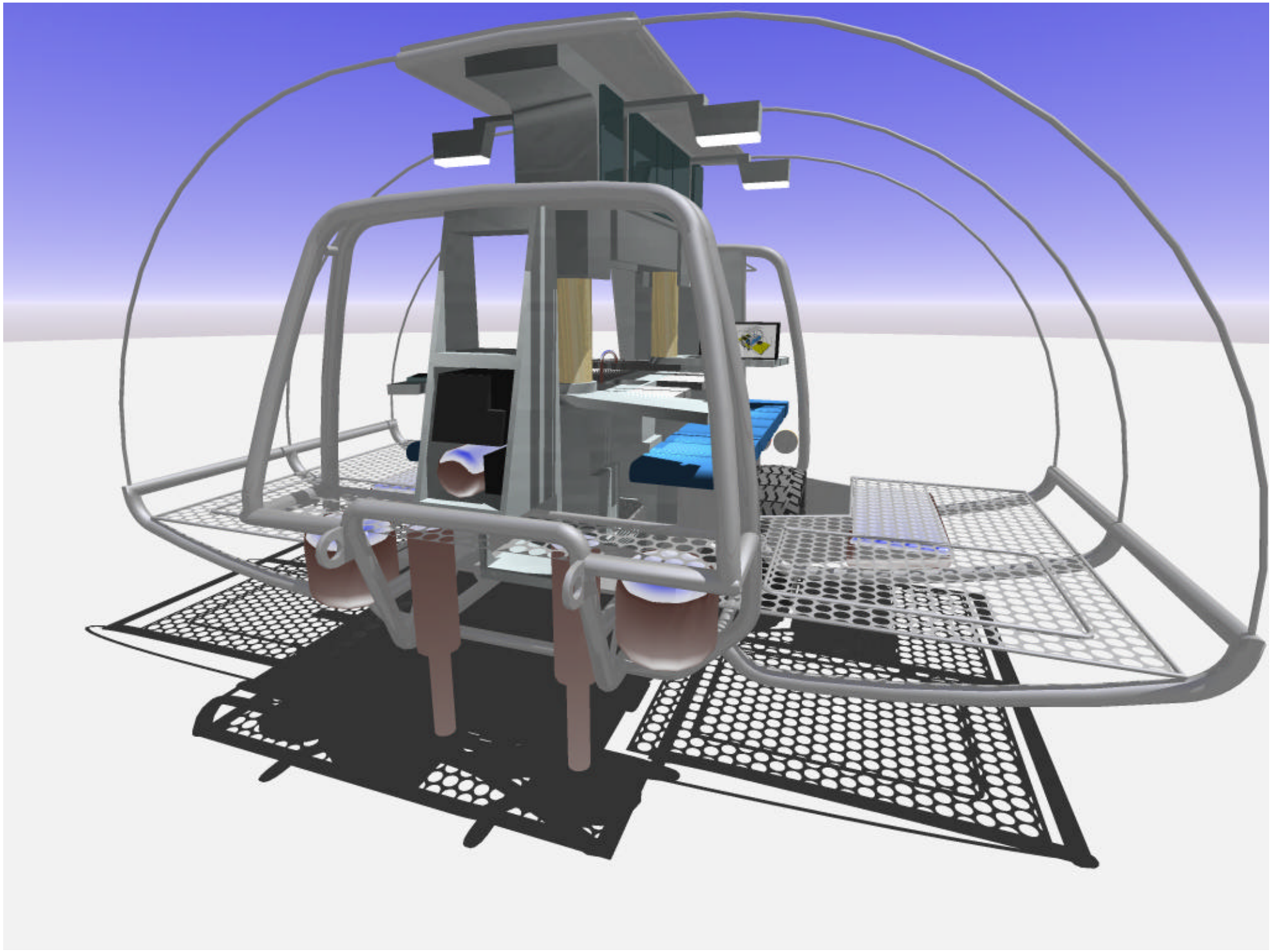

Dual exhaust stacks
Engine air intake
Tow lugs
Front & rear electric winches
Roll bar frame
Cooling system intake
Central tire inflation
Runflat tires



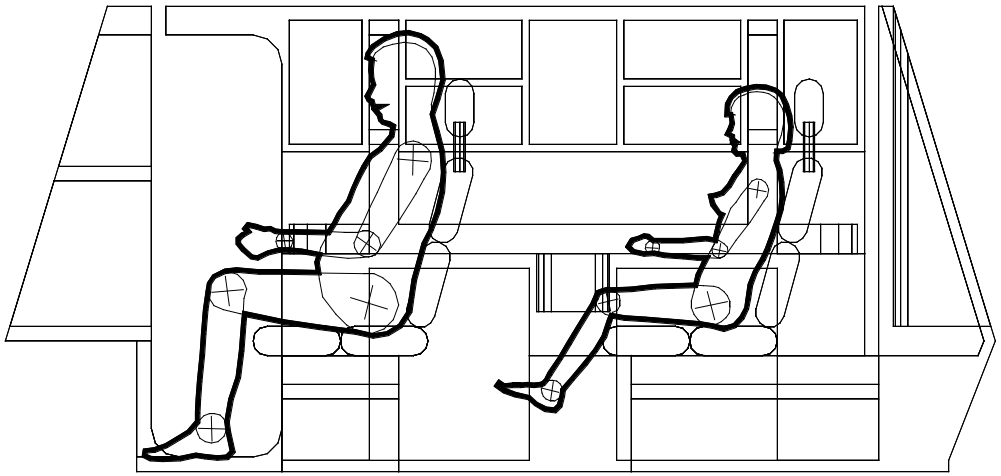




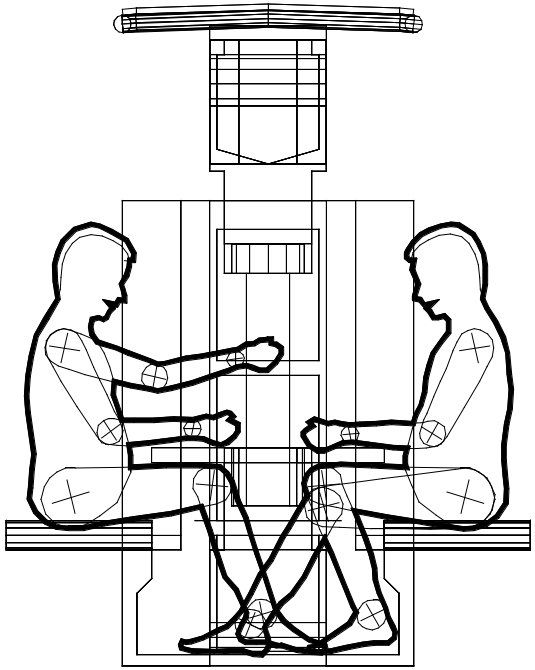




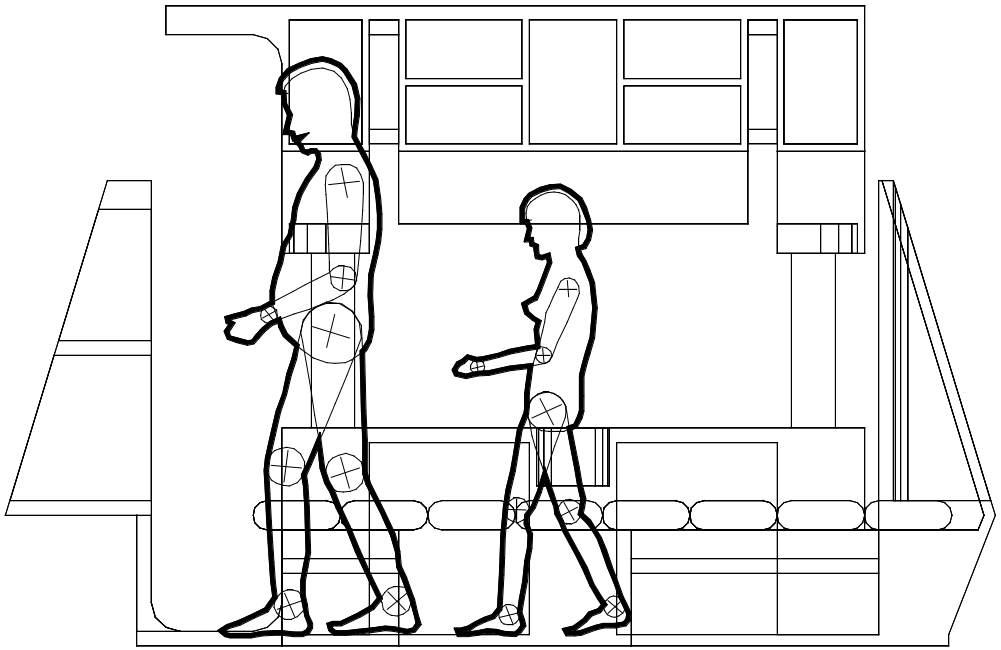
Specialty Unit Residential Core



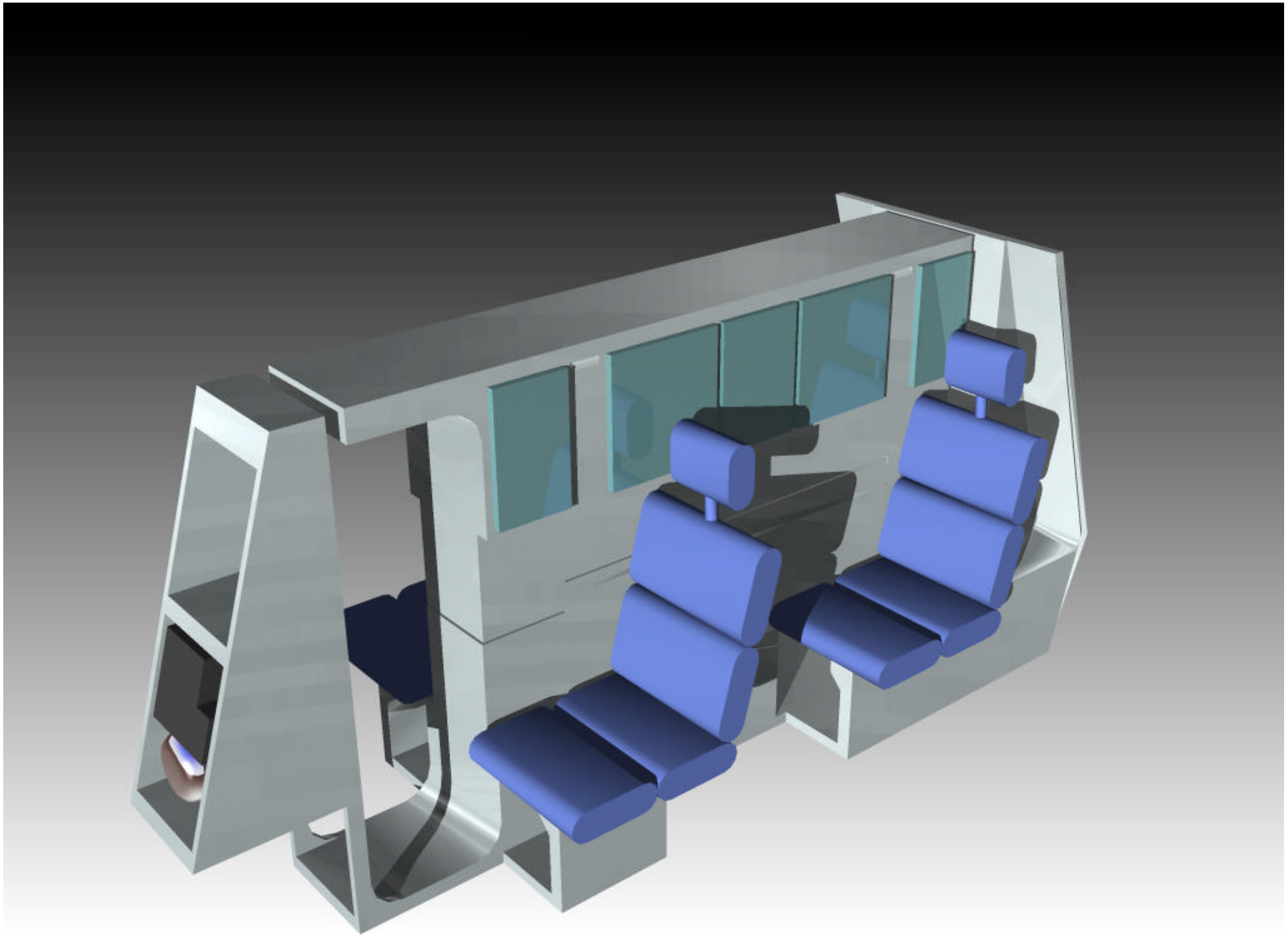
Stored: Side

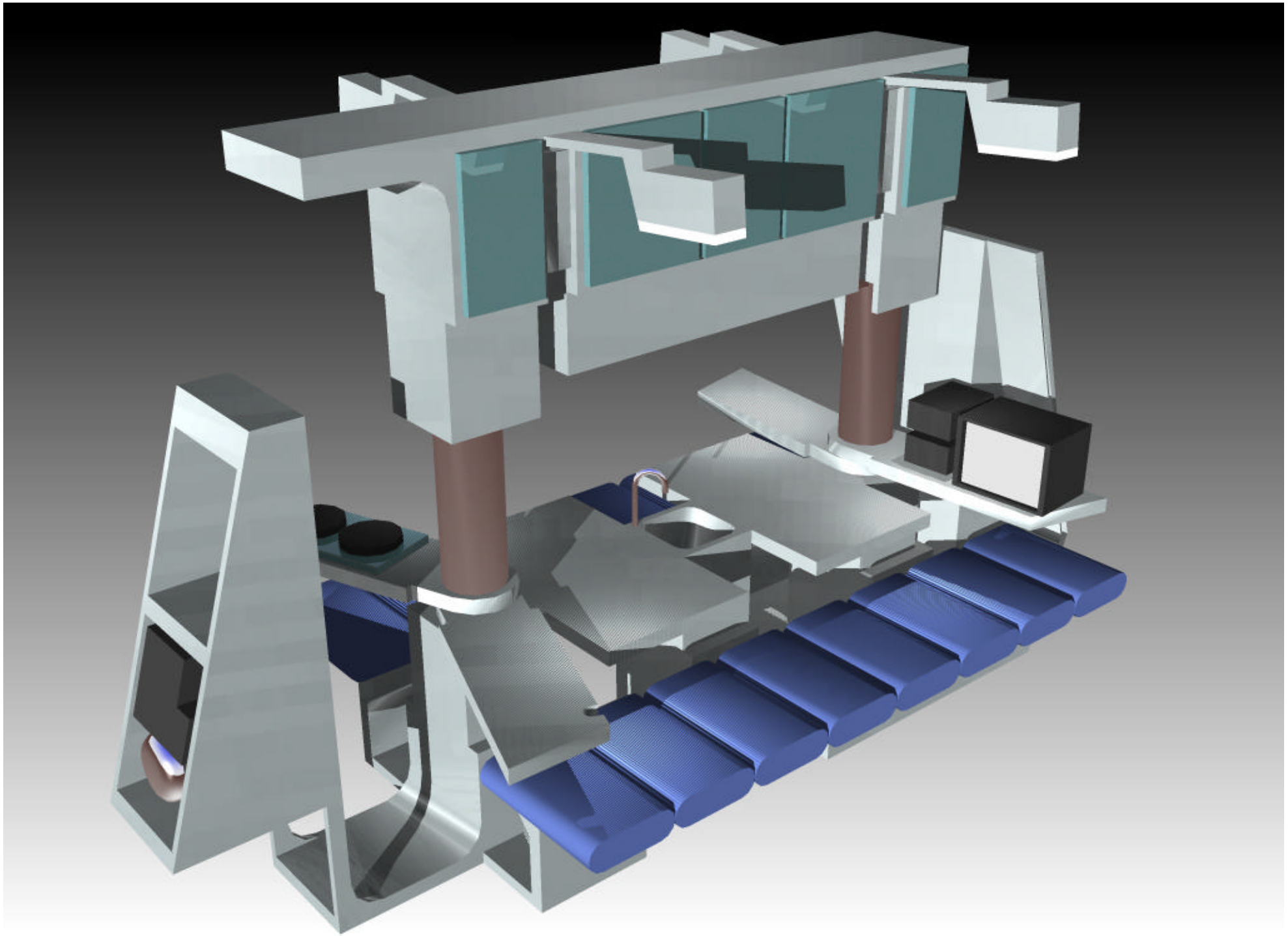


Deployed: Front



Deployed: Side



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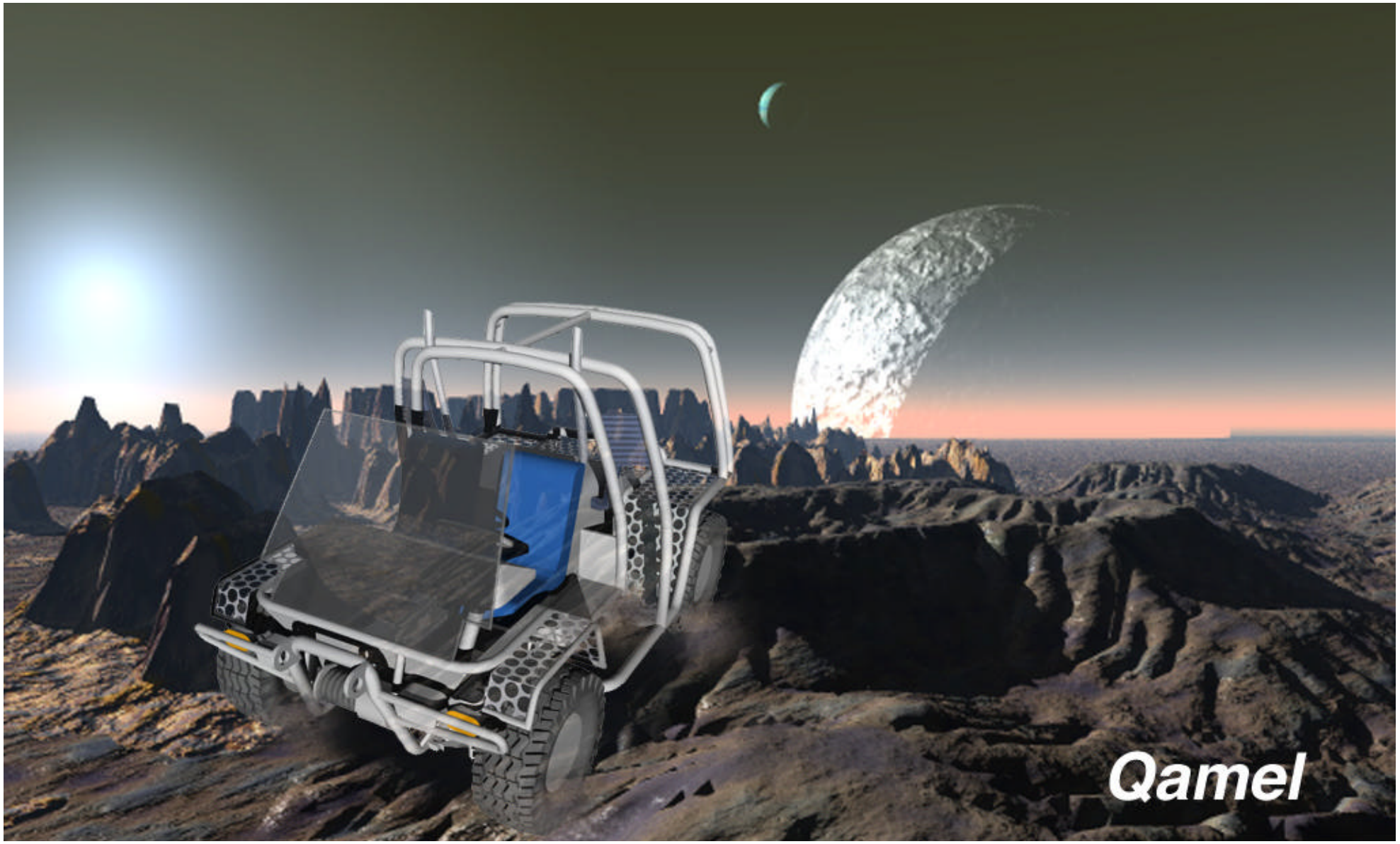
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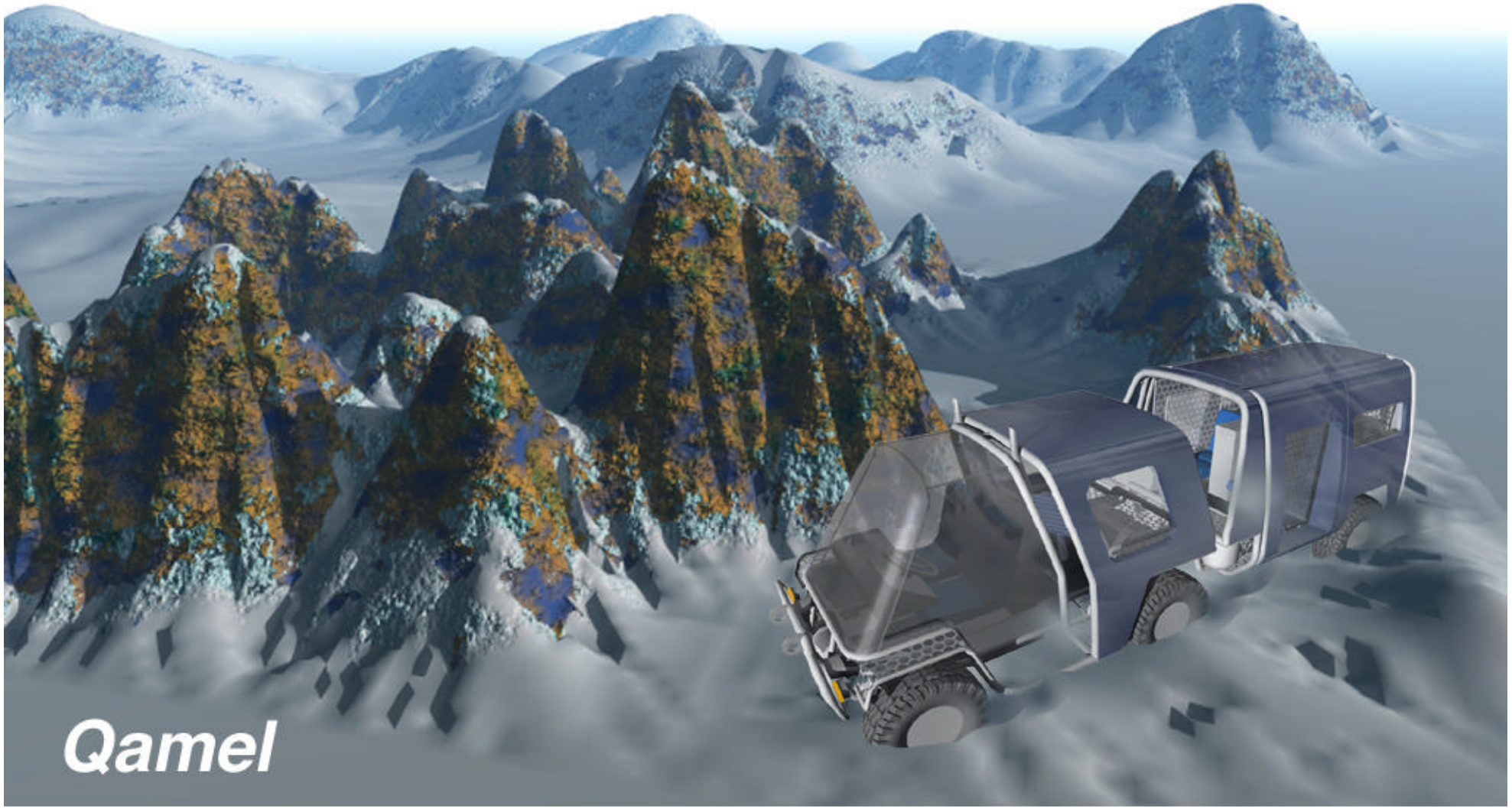
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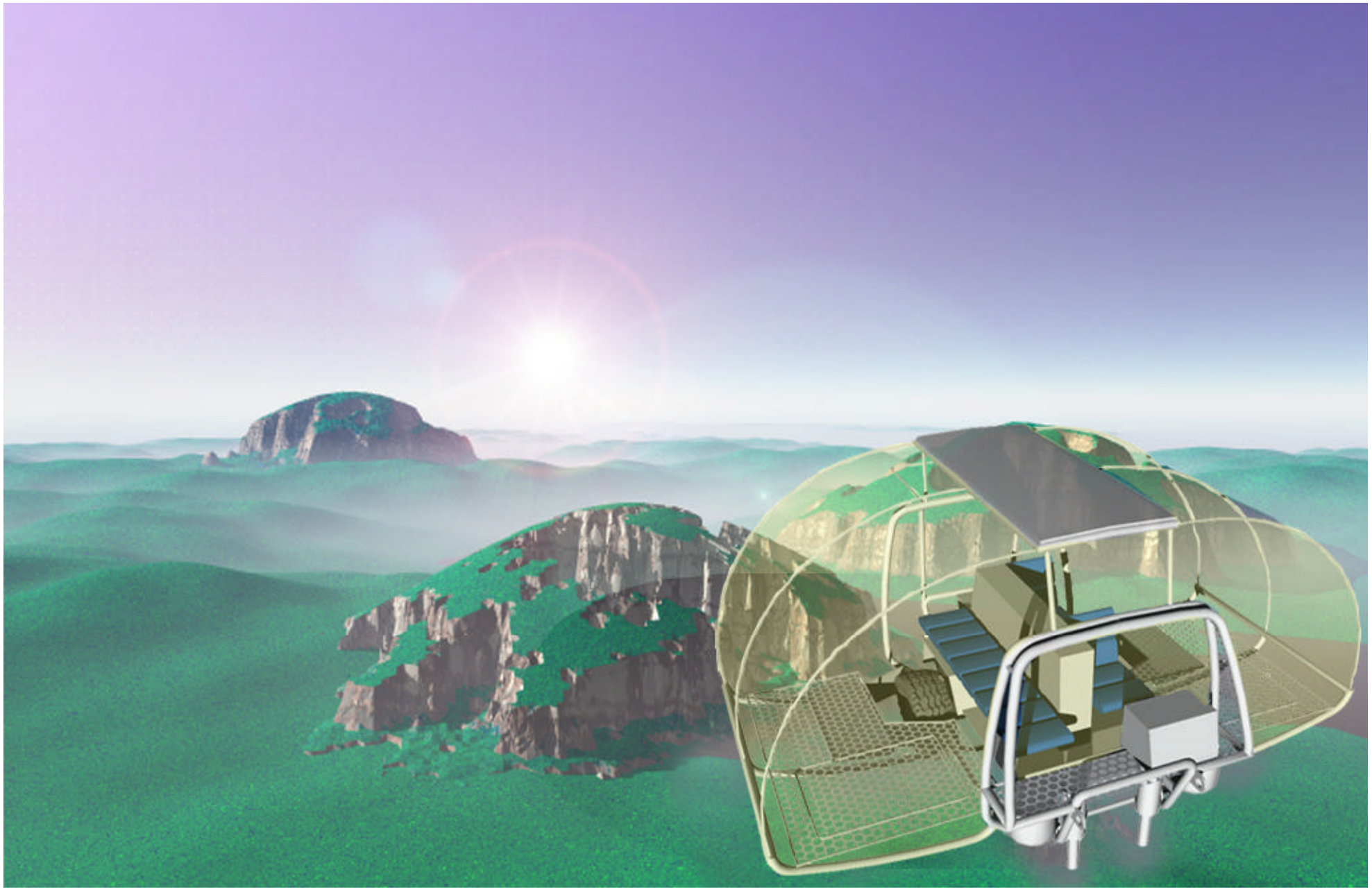

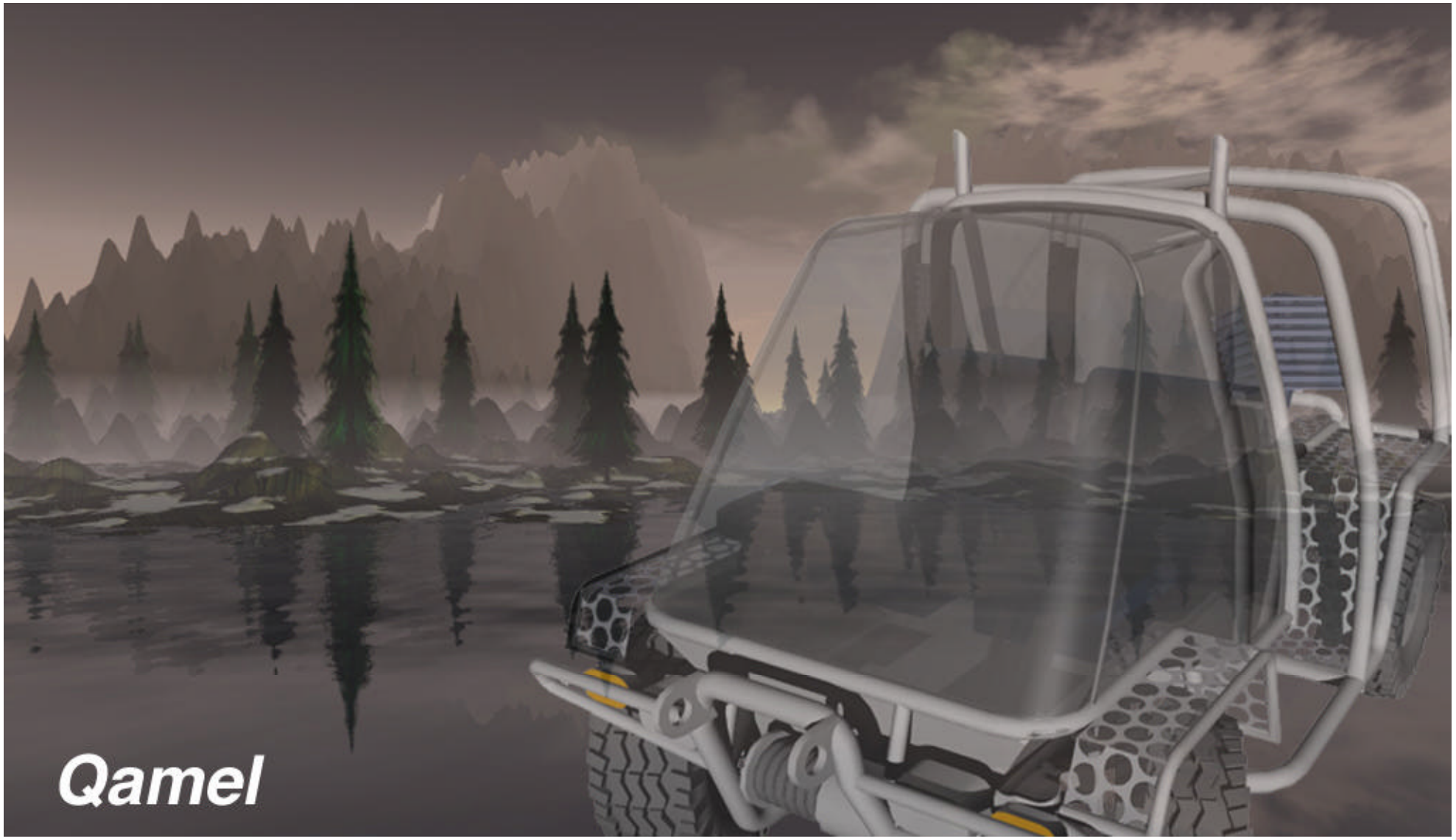
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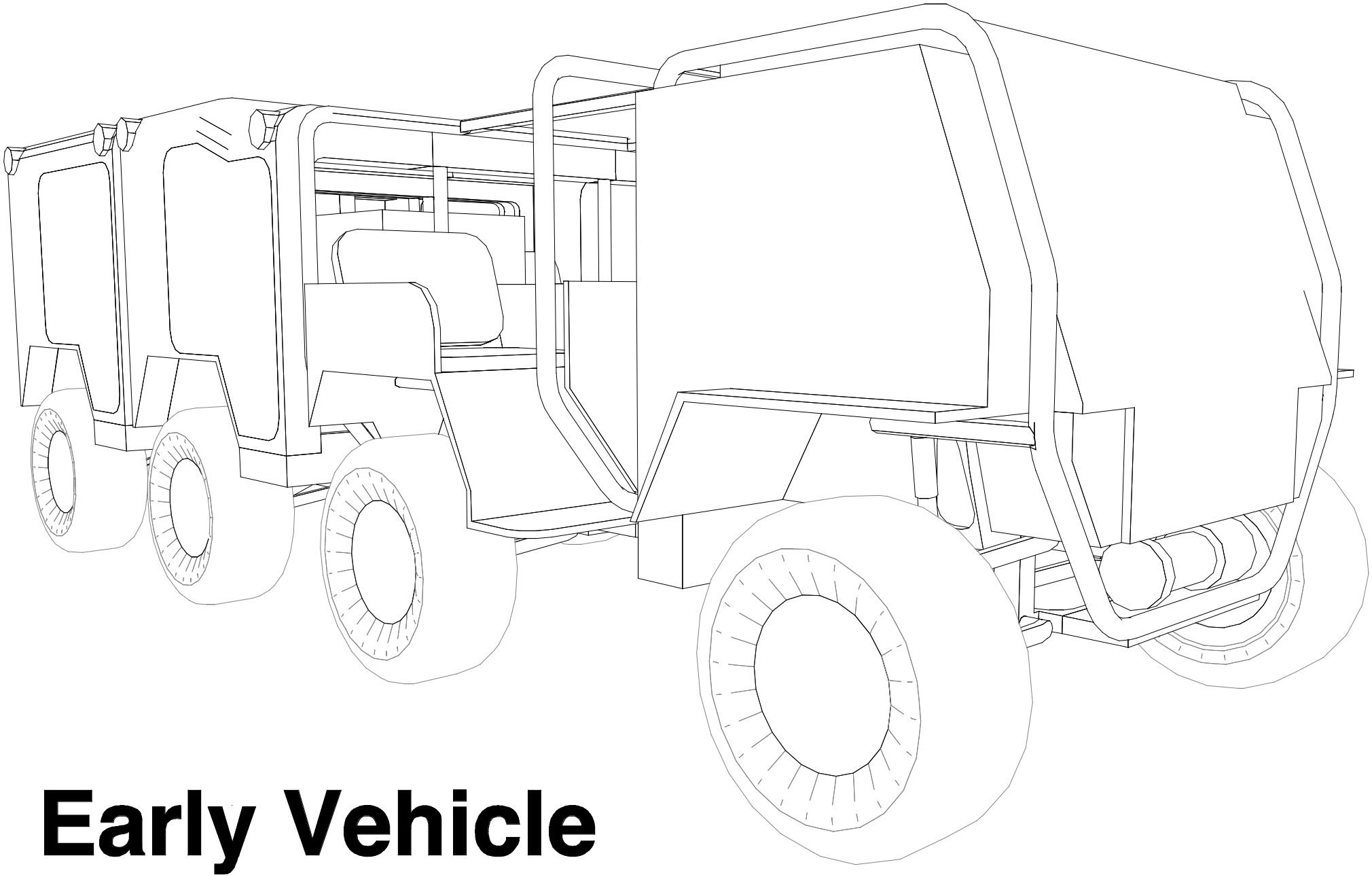
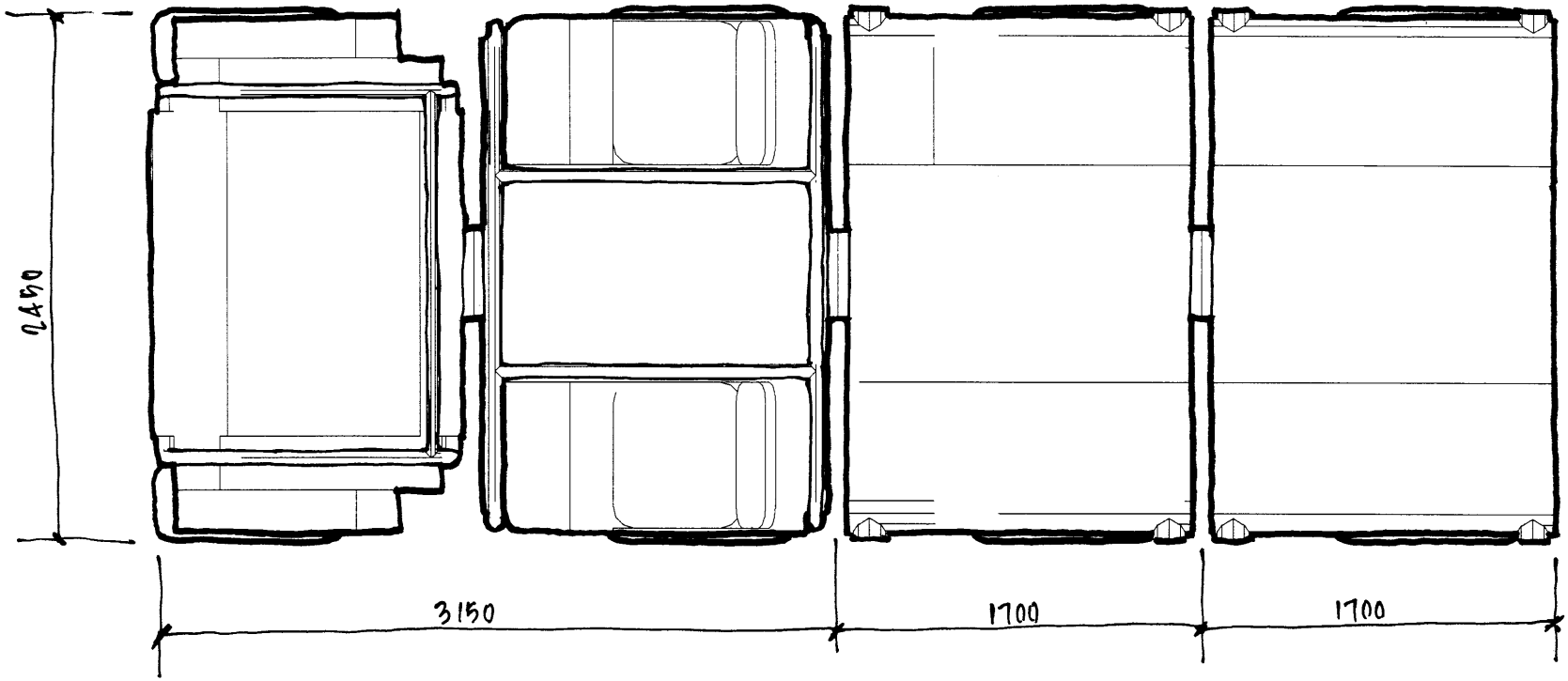


Early Vehicle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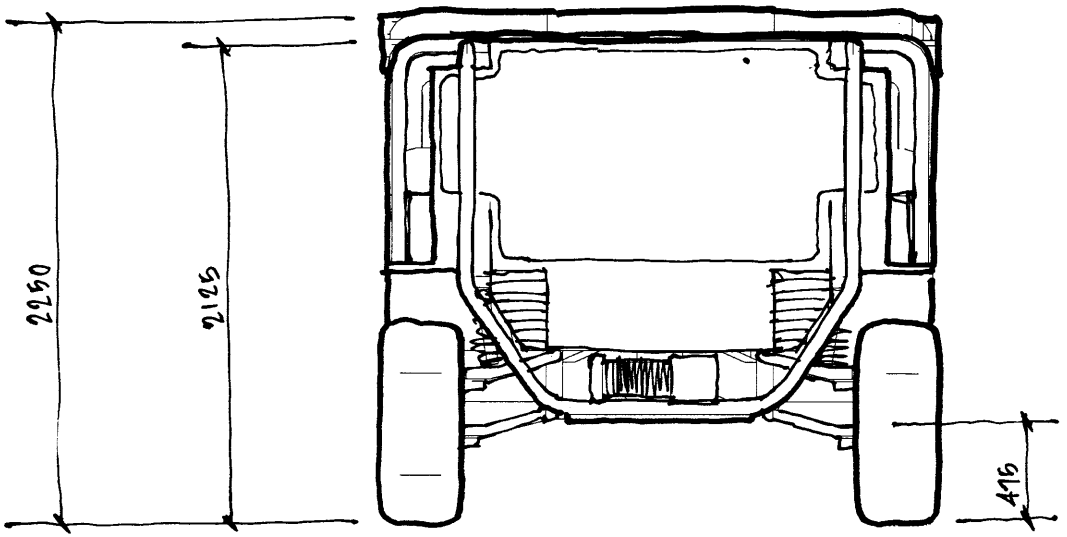
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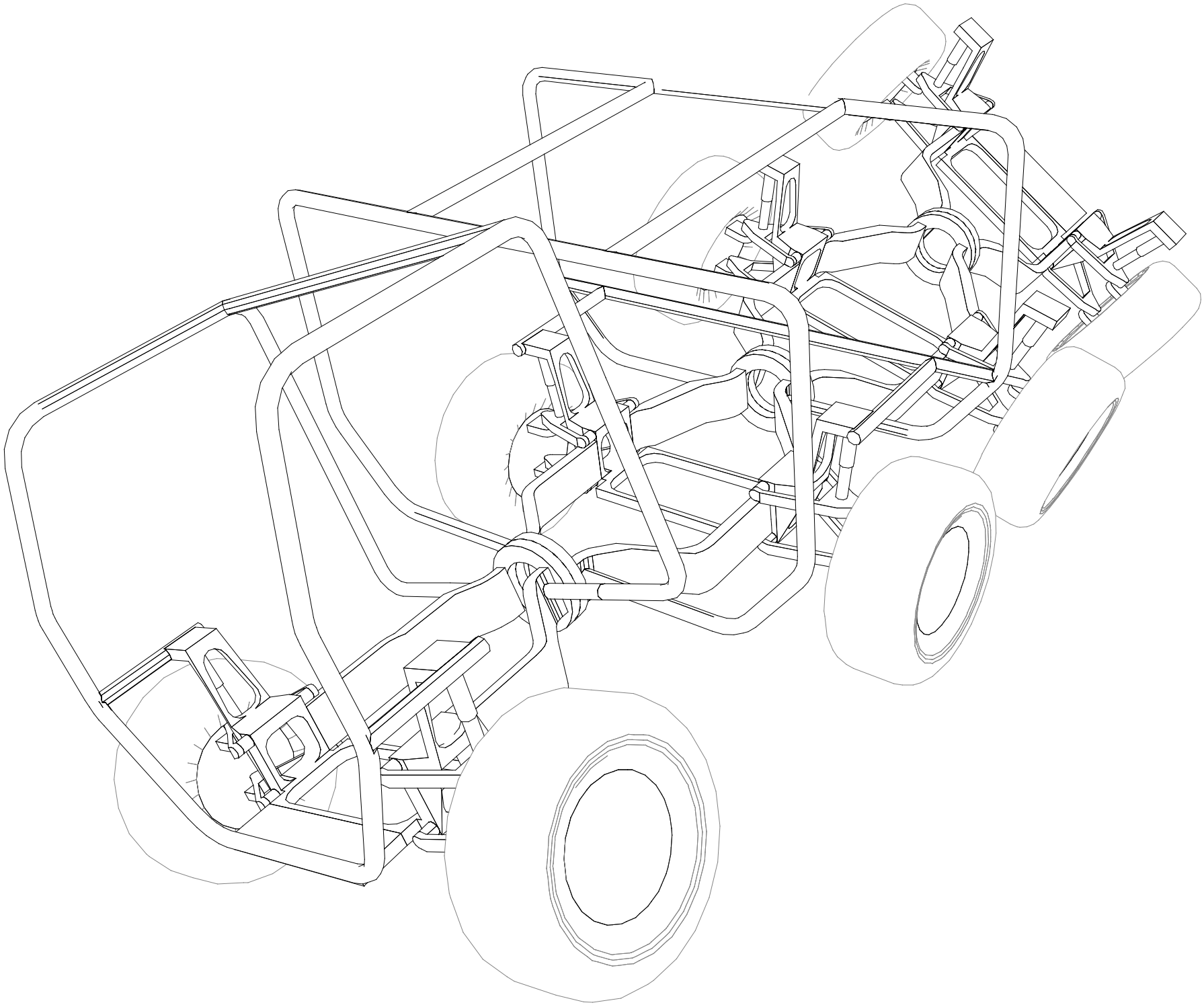
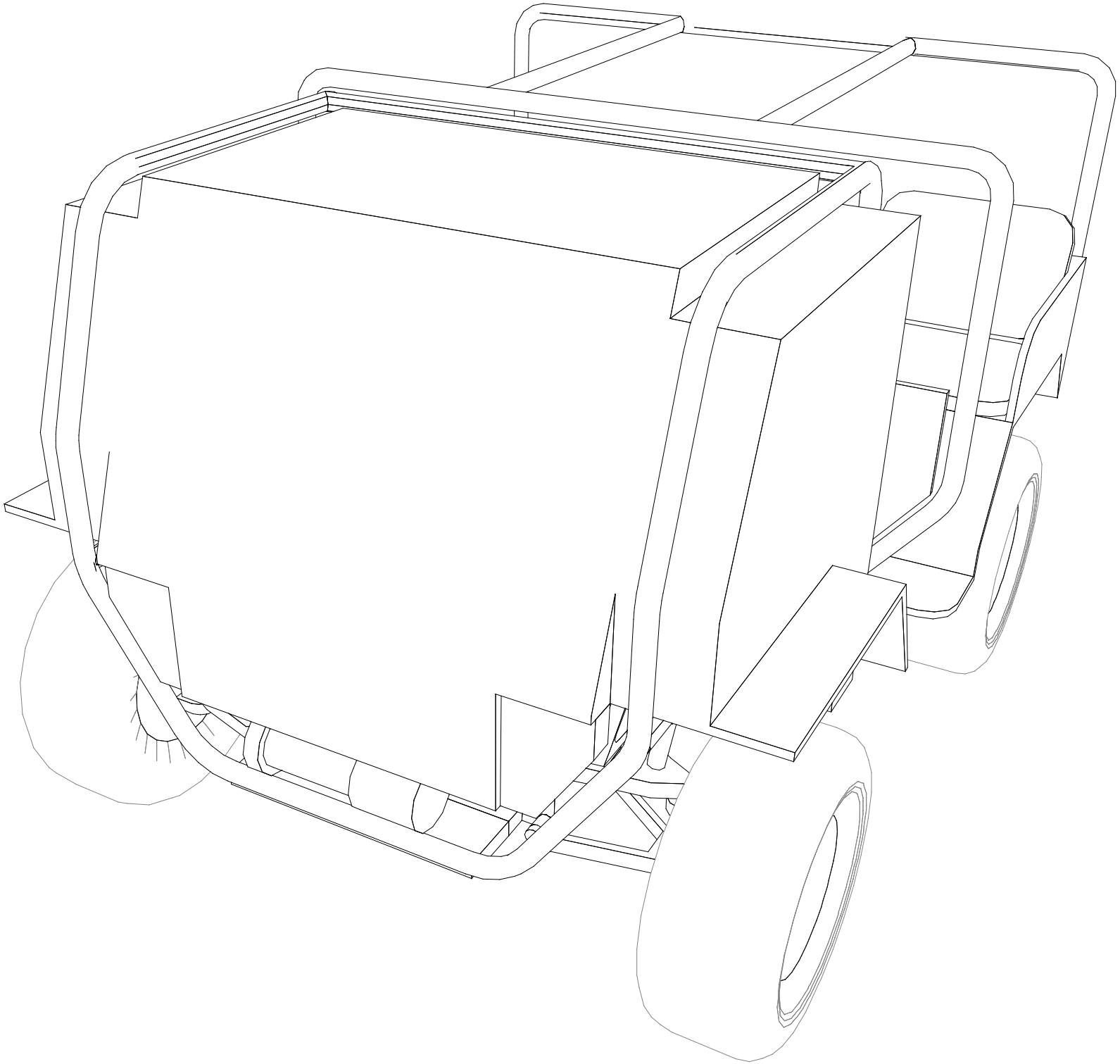
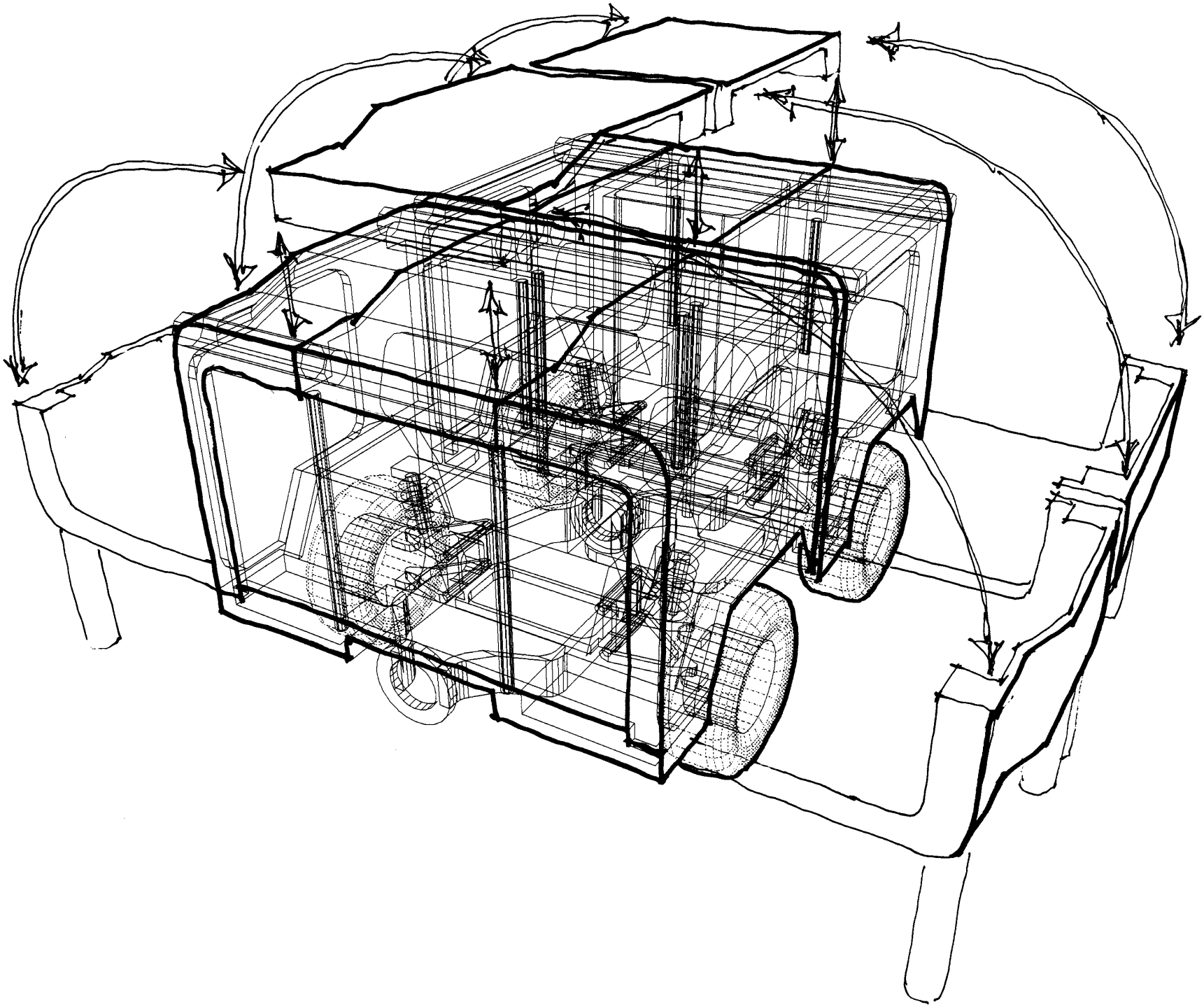
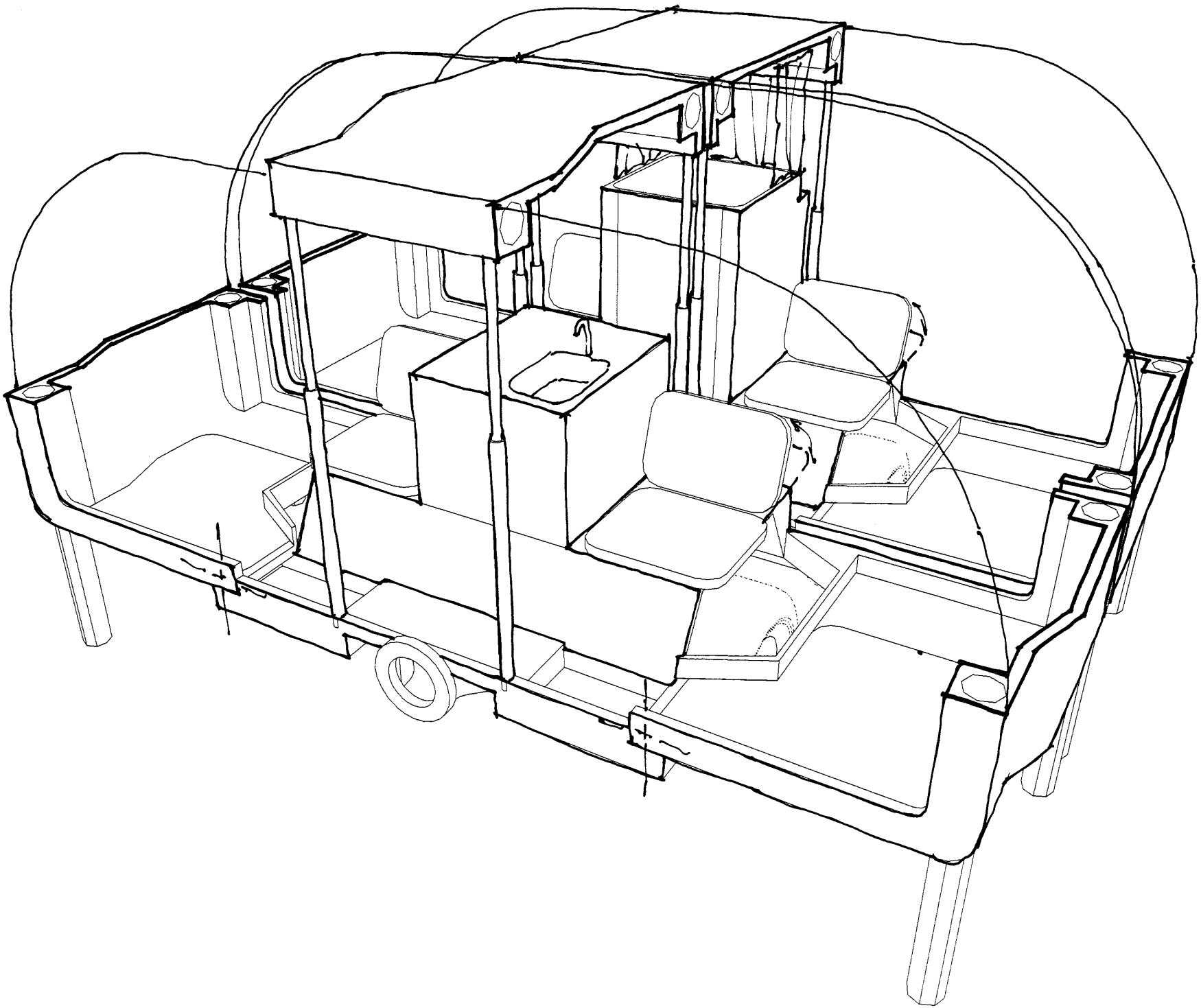
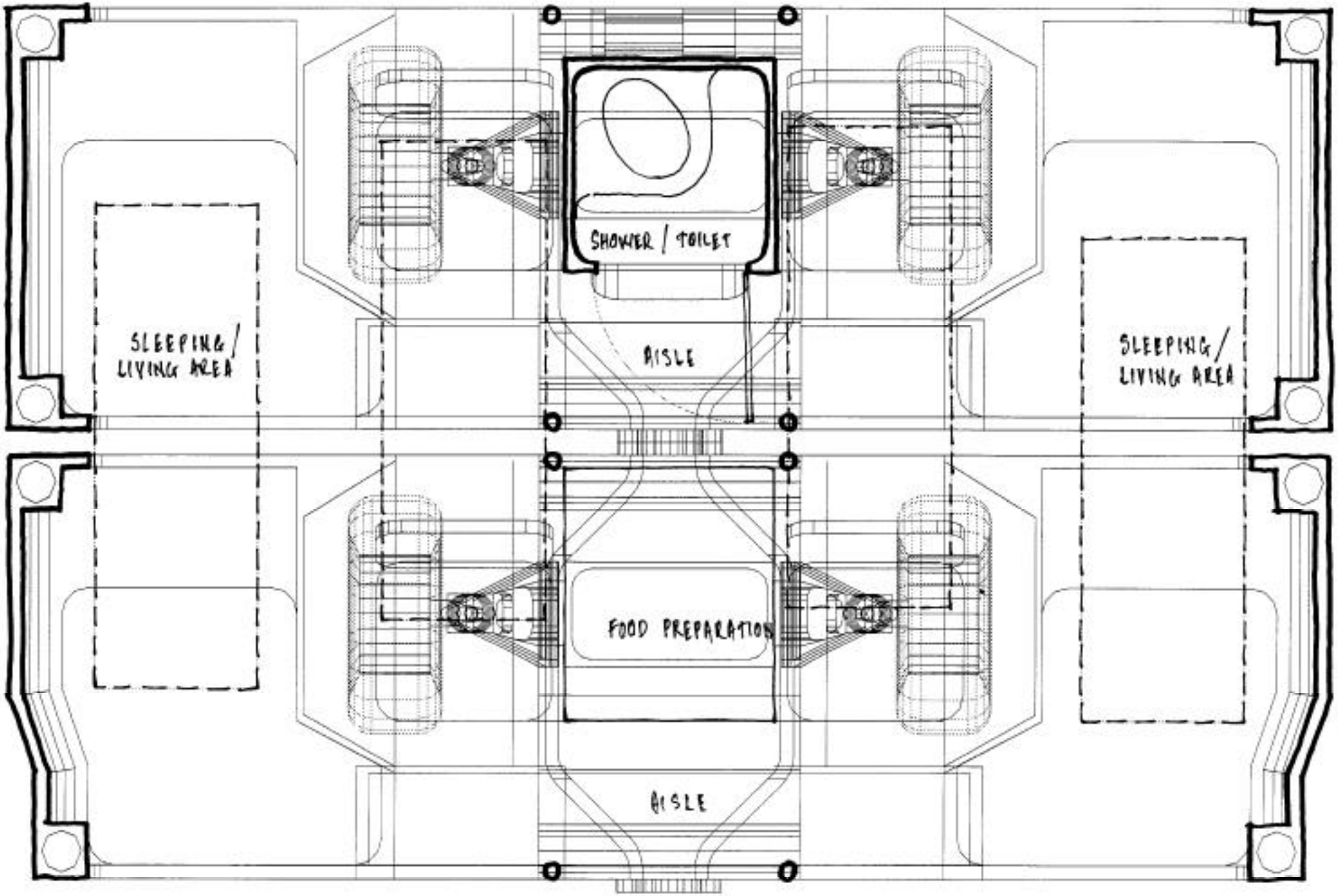
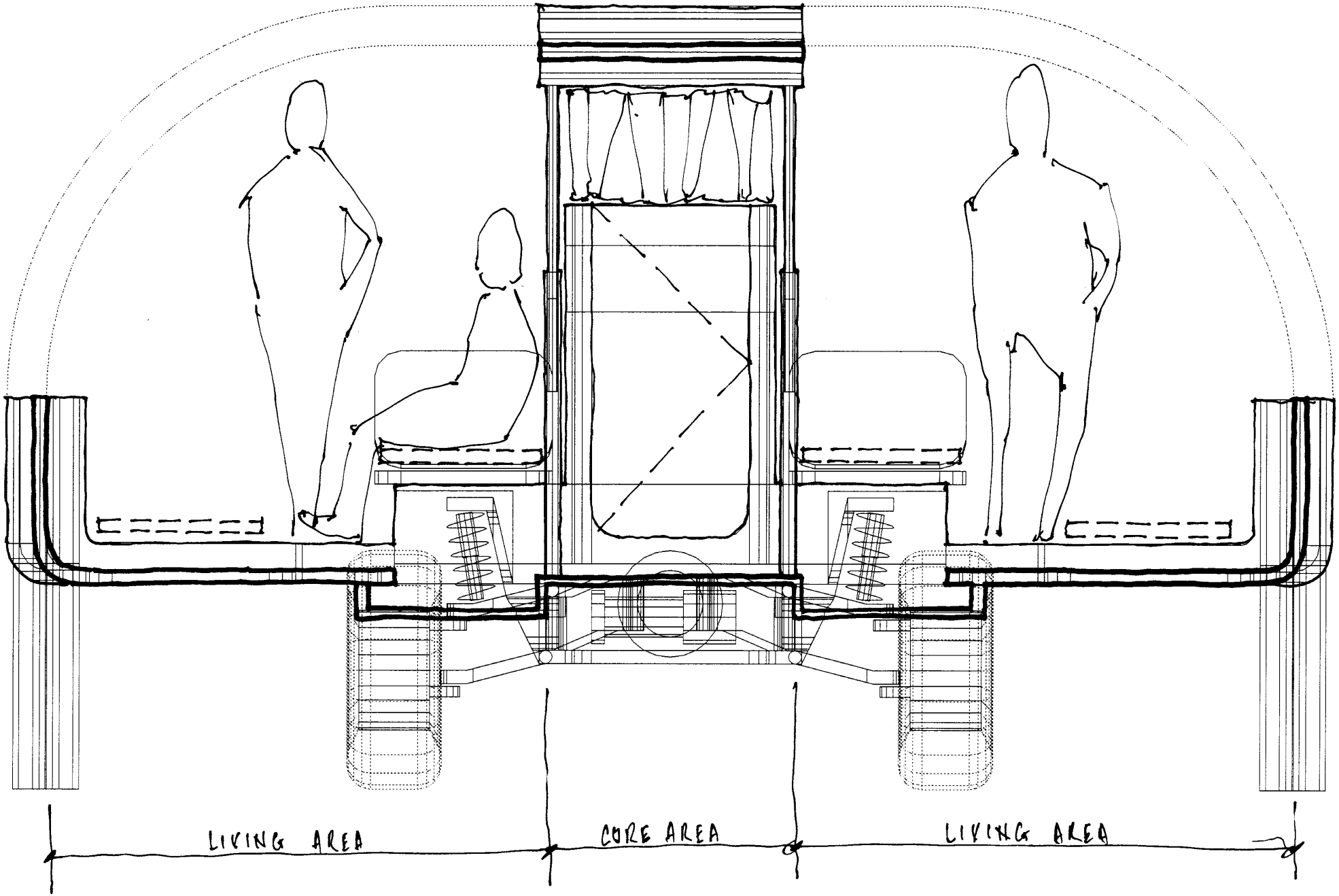









SHOWER / TOILET
SLEEPING / LIVING AREA
AISLE
SLEEPING / LIVING AREA
FOOD PREPARATION
AISLE


LIVING AREA
CORE AREA
LIVING AREA