# Mission Statement

**Homes On Wheels Alliance**, Inc. is a 501(C)3 nonprofit charitable organization whose primary focus is on helping senior citizens and the working poor who are either on the verge of becoming homeless or who are currently without shelter. **Homes On Wheels Alliance (HOWA)** assists those in need to achieve sustainable, personal and economic self-sufficiency by helping them obtain and/or maintain safe, secure, unconventional housing.

One of the programs within HOWA is Vehicle Operations. Through this program, HOWA plans to

1. acquire vehicles for people to live through donations and purchases,
2. make necessary repairs and upgrades to prepare the vehicle to live in, and
3. develop a network of mechanics across the country to maintain the vehicle once they are donated to our client base.

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# Introduction

The purpose of this manual is to provide an overview of the Homes On Wheels Alliance (HOWA) prototype minivan build that took place during June of 2019. This project is the very first van build attempted by HOWA.

The build was designed and carried out by caring and skilled volunteers using their own tools. The van and some materials were purchased by HOWA. In addition, many of the materials and items to outfit the van were purchased by generous donors through an Amazon Wishlist.

Part of the build was to document the process in photos and writing in order to help with future van builds by HOWA or others. Additionally, an environment of safety was encouraged and guidelines are included in this document.

# HOWA Worksite Safety Protocol

Worksite safety is a priority for HOWA. Keeping people safe, uninjured and alive, while working on HOWA projects is our primary concern. In this way, we'll be able to continue to provide safe and secure unconventional housing to those in need with the intention of helping them get back on their feet.

There may be times when an on-site team leader is not designated; therefore, it is even more important that we all follow basic guidelines in order to maintain as safe a work environment as possible. The items below should be viewed as minimum standards.

**Basic Safety Rules**

- Prior to beginning work, assemble tools, equipment and materials in a safe, central location.
- Wear the right clothes and protective equipment as appropriate for the job: i.e. eye protection, gloves, closed-toed shoes, long hair secured, etc.
- Use the right tools for the job: i.e. use a hammer to drive nails, not a wrench.
- Lift with your legs, not your back. Ask for help with anything you are not comfortable doing on your own (lifting large pieces of lumber, using heavy tools, etc.)
- Practice good housekeeping: i.e. don't leave tools and cords lying around on the floor or ground as trip hazards; when finished working, put things away and/or out of the "lane of traffic;" put extra screws/nails/etc. back in their containers.
- Flag/ribbon any stretched cords, uneven walking surface, tent/tarp lines, etc.
- Ensure equipment, supplies and van remain dry.
- Properly light work area if accessed during dark.
- If you are injured, take care of it immediately, even if it seems insignificant.
- Don't horse around.
- Have whistle available to blow for help in case of emergency.
- Items to be kept in a central location at the worksite at all times:
    - fire extinguisher
    - first aid kit
    - extra safety glasses/goggles and extra gloves
    - a safety session for all van build workers should be held before building begins covering these basic safety rules

# Prebuild Planning and Logistics

## Volunteers

A call for volunteers went out beginning in April for the June van build. Volunteers were chosen for their skills in carpentry, electrical, solar, mechanical, safety, and documentation. The resulting team consisted of eleven individuals. Some worked on the complete build while others participated part-time.

The van build took approximately 2 ½ weeks to complete. There were two days when no construction took place while waiting for additional supplies to arrive.

## Vehicle Acquisition

The minivan was purchased a week or two before the volunteers arrived. It was determined new tires were required and those were purchased and installed before taking it to the build site. Additionally, the battery and the shocks in the front and back were going to be replaced during the van build. The vehicle should be made dependable and road-worthy by the end of the van build.

The minivan title needed to be transferred to Homes On Wheels Alliance, Inc. This required auto insurance for the state to be titled in, a bill of sale, the official vehicle title signed off to HOWA, and a visual inspection of the VIN by the local DMV. All of the properly completed documents should be compiled to title the vehicle.

## Materials and Tools

### Materials List for Interior Build

| **Interior Build Materials - All items are available at Home Depot** | |
|---|---|
| **Qty** | **Description** |
| 2 | ½ inch x 4 feet x 8 feet plywood for underlayment |
| 3 | ¾ inch x 4 feet x 8 feet plywood, sanded one side, for bed and shelving. ½ inch too weak |
| 4 | 2 inch x 2 inch x 8 feet firring strip |
| 5 | 1 inch x 2 inch x 8 feet firring strip |
| 1 | pack assorted grit sandpaper 80, 150, 220 grit |
| 3 | quarts Varathane water-based polyurethane matte finish |
| 2 | foam brushes |
| 1 | 6 foot x 12 foot sheet of vinyl flooring |
| 2 | quarts mastic |
| 1 | trowel |
| 2 | 1/2 inch x 1/20 in x 96 inch aluminum angle |
| 20 | ½ inch flat head screws for securing aluminum angle to floor |
| 1 | 1 pound box 1 ¼ inch deck screws |
| 1 | 1 pound box 1 ½ inch deck screws |
| 1 | 1 pound box 2 inch deck screws |
| 1 | 1 pound box 3 inch deck screws |
| 3 | clear frame, clear lens safety glasses |
| 1 | small package disposable dust masks |
| 1 | large cardboard moving box to be used for templates |

## Basic Tools for Interior Build

The tools used were regular corded type but battery powered tools could also be used. A general assortment of hand tools such as hammers, screwdrivers, and pliers are handy to have available.

Jigsaw
Drill and bits
Sawhorses
Tape Measure
Straight Edge
Razor Knife
Serrated Knife or Electric Carving Knife
Power Source - generator or shore power
Circular Saw – good to have but not necessary

## Materials List for Solar and Electrical Installation

| **Solar and Electrical Installation Materials<br>Most Items Available from Amazon - https://www.amazon.com/shop/cheaprvliving** | |
|---|---|
| **Qty** | **Description** |
| 1 | Universal Power Group 12V 100AH AGM SLA Battery for RENOGY PV Solar Panels |
| 1 | Weatherproof ABS Solar Double Cable Entry Gland for All Cable Types 2mm² to 6mm² |
| 2 | ¾ " x 6' square aluminum tube for mounting panels |
| 1 | 15 oz can flat black spray paint |
| 2 sets | Renogy Solar Panel Mounting Z Bracket Set of 4 Units |
| 8 | 1/4-20x2 Stainless Steel Flat Head Machine Screws |
| 6 | #12-24x1 ½ Stainless Steel Flat Head Machine Screws |
| 14 | ¼ inch Zinc Nylon Lock Washers |
| 16 | #10 x 5/8-inch Stainless Steel Sheet Metal Screws |
| | RENOGY 8ft. 10 AWG Wire Copper Tray Cable Connect Charge Controller and Battery |
| | 5" x 20' Black Plastic Garden Edging |
| 1 | 150 Pc Terminal and Connector Set |
| | 150 Pc Terminal and Connector Set |
| | Assorted Shrink Tubing and Wire Ties |
| | Blue Sea Systems 300 Amp m-Series Battery Switch |
| | EPEVER 20amp MPPT Charge Controller 12V/24V Auto, 20A Solar Panel Charge Controller MPPT 100V PV Input Negative Grounded Solar Regulator with LCD Display |
| 1 | In Line Fuse Holder |
| 1 | Fuse Block |
| 2 | Linkstyle 4 in 1 Charger Socket Panel, 12V 4.2A Dual USB Charger Socket Power Outlet & LED Voltmeter & Cigarette Lighter Socket & LED Lighted ON Off Rocker Toggle Switch |
| 1 set | AIBOO Dimmable LED Under Cabinet Lighting, Counter Showcase Kitchen Lighting Fixtures with 12V Plug in adapter and Dimmable Wireless Remote Control, 6 Ultra Slim Puck Lights Kit |
| 1 | VertaMax PURE SINE WAVE 500 Watt (1000W Surge) 12V Power Inverter DC to AC Power |
| 2 | Ventline Vanair Trailer Roof Vent w/ 12V Fan - 6-1/4" Diameter – Smoke |
| | Dicor Butyl Seal Tape and Dicor Sealant |

## Basic Tools for Vent and Solar Panel Installation

Jigsaw
Drill and Bits
Wire Strippers
Terminal Crimpers
Screw Drivers
Sawhorses
Tape Measure
Straight Edge
Razor Knife
Small Wire Fish
Power Source - generator or shore power

## Items to Outfit the Minivan from Amazon Wish List

- ECOGARD XC15389 Premium Cabin Air Filter Fits Ford Windstar
- Tsumbay Air Compressor Tire Inflator 12V 150 PSI
- Coghlan's Axe
- Coghlan's Folding Camp Shovel
- First Alert Carbon Monoxide Detector
- First Alert Fire Extinguisher | Tundra Fire Extinguishing Aerosol Spray
- Double Bubble Reflective Foil Insulation (24 inch X 10 Ft Roll)
- Warner 5-Gallon Plastic Bucket, Luggable Loo Snap-on Toilet Seat with Lid
- Amazon Basics Microfiber Sheet Set - Twin, Light Grey
- 2 Bedsure Fleece Blankets Twin Size Grey
- LINENSPA 5 Inch Gel Memory Foam Mattress - Firm Support - Twin
- Gas ONE New GS-3400P Dual Fuel Portable Propane & Butane Camping and Backpacking Gas Stove Burner with Carrying Case
- Norpro Nonstick 3-Sided Splatter Guard
- 8 Butane Canisters
- Mr. Heater Portable Little Buddy Propane Heater
- Stansport Propane Cylinder Base Replacement
- Arrow Home Products 00743 2 Gallon Slimline Beverage Container
- Hudson Exchange 2.5 Gallon Hedpak Container with Cap, HDPE, Natural, 2 Pack
- Igloo Profile 16 Quart Cooler
- Sterilite 14958006 25 quart/24 L Latching Box with Clear Base, White Lid and Colored Latches, 6-Pack Luci Pro Series: Lux + Mobile Charging, Solar Inflatable Light
- Lusso Gear Car Front Seat Organizer | Fits Any Car/Truck
- Iron Hammer Portable Shower Camp Shower Rechargeable Shower

## Insulation

The space between the van exterior wall and the inside trim is too narrow to allow for the installation of insulation. Likewise, insulation in the floor or ceiling would cut into the living space; therefore, insulation was not installed. Some of the trim pieces must be removed or loosened to run electric wires but all of the trim pieces

at bed and shelf levels can be left intact.

# Planning and Design

A group of volunteers was selected and scheduled to attend the kick-off cookout at a secluded camping location. An after-meal design think tank session was held for everyone to share their ideas and experience with van designs and build outs.

The project team discussed all suggested van design layouts and ultimately chose a layout which has seemed most successful among experienced van dwellers, allowed driver indoor access to living quarters, ability to sit up straight on the bed, flexible storage set up and creating both indoor and outdoor kitchen options. The bed was made for a person approximately five foot ten inches. When a person of that height sat on the bed with a mattress, there would still be enough head clearance to be comfortable. It also still allowed for storage under the bed.

After much discussion about the advantages of turning the passenger seat around or removing it all together, the decision was to not alter it in any way due to electronic sensors and possible code considerations.

# The Build – 2000 Ford Windstar Minivan

## General Information

These plans are specifically for a 2000 Ford Windstar minivan. Although the plan can be followed for future builds, the dimensions will vary from van to van. As in any building project, measure twice and cut once.

Shelf units should be built to fit the dimensions of storage containers and common items to allow maximum use of the space.

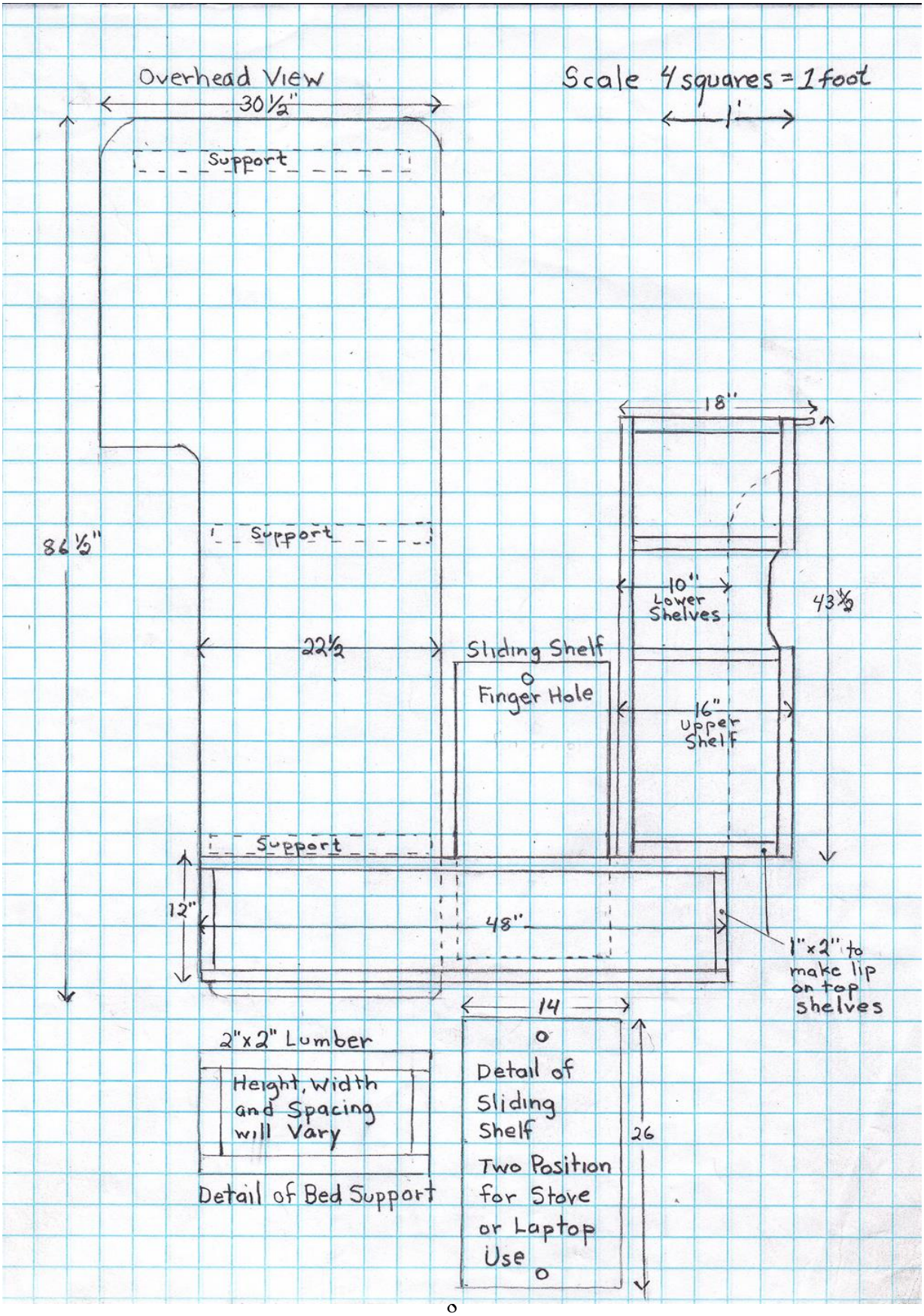
Vans with “Stow 'n Go” type seating would require a reworking of the floor plan to allow access to the storage wells.

Deck screws are used in most of the construction because they are rust resistant and cost efficient.

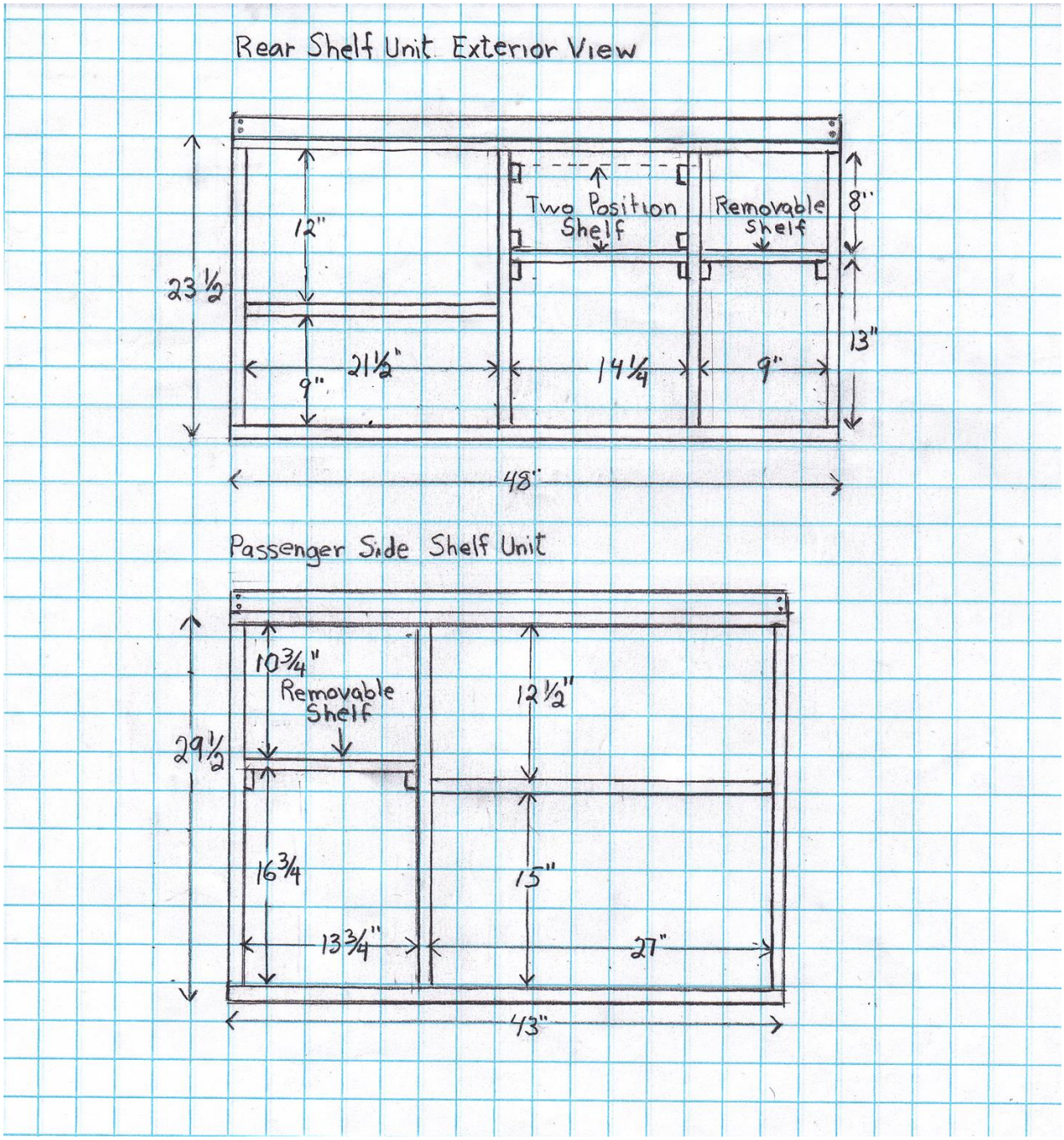
The floor plan follows a basic build design with a narrow bed positioned lengthwise along the driver's side wall leaving room for storage underneath. The passenger side wall features a shelf unit that contains the solar power components and additional storage. The shelf unit along the back can be accessed from the interior or exterior when the hatch is opened and is designed to be used as a kitchen and office area.

The build can be completed in approximately two weeks with three people contributing to the job. Minimal experience in carpentry is required. A working knowledge of electrical installation and solar panel installation is necessary.

# Floor Plan


Overhead View
30½"
Support
Support
Support
86½"
Scale 4 squares = 1 foot
1'
18"
10"
Lower
Shelves
43½
22½
Sliding Shelf
Finger Hole
16"
Upper
Shelf
12"
48"
1"x2" to
make lip
on top
shelves
14
2"x2" Lumber
Height, Width
and Spacing
will Vary
Detail of Bed Support
Detail of
Sliding
Shelf
Two Position
for Stove
or Laptop
Use
26

# Rear Shelf Unit and Passenger Side Shelf Unit




# Floor

Remove carpeting from rear cargo area to about four inches from the back of the driver and passenger seats.

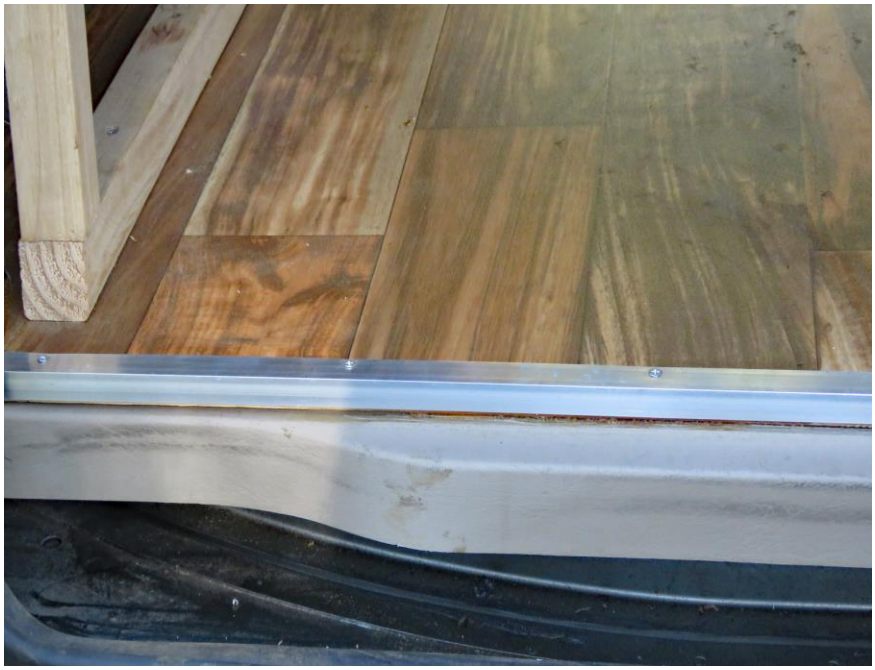
Use the large cardboard box as a template for cutting the 2 pieces of ½ inch x 4 feet x 8 feet plywood underlayment. Plywood should extend into the space along each sliding door. Use both pieces to make a lengthwise seam down the middle of the van to add stability to the floor. Cover the edge of the remaining carpet with the plywood. Floor may need to be shimmed in low spots. Screw the plywood to the van floor taking care that screws do not extend through the exterior of the van. Screws may need to be countersunk for a smooth

surface.

*View of the plywood underlayment from the passenger side sliding door*

To lay the sheet flooring over the plywood, remove the plastic trim at the rear hatch door floor. Be careful not to damage this piece because it will be put back in place. Sweep the underlayment to remove any dirt and apply mastic with trowel following manufacturing directions. Unroll the sheet flooring and carefully position it on the underlayment. Trim the edges and smooth with a plastic putty knife or a smooth piece of scrap wood. Replace the hatch door trim. Cut 1/2 in. x 1/20 in. x 96 in aluminum angle to size to finish the edges of the sheet flooring at sliding doors and behind the front seats. Drill evenly spaced holes in aluminum angle and use a countersink bit to chamfer the holes. Screw the aluminum angle on top of the flooring at the edges of the plywood.

*Plastic Trim in Place by Rear Hatch*



*Aluminum Angle in Place by Side Sliding Door*

Wood Finishing to Protect Surfaces

Varathane water-based polyurethane was chosen for the prototype because it's easy to apply and has little odor. The brushes can be stored in a zip lock bag and reused without washing.

Before beginning the rest of the van build, prepare the wood by sanding and applying two coats of Varathane according to the directions on the can. The first coat of Varathane will raise the grain, so lightly sand the wood between coats. Additional coats can be applied after the bed and shelving units are completed but it's easier to put a few coats on everything before assembly begins. Lightly round the edges of the finished units with sandpaper to remove any burs and smooth the surfaces. The Varathane is very thin and most surfaces should get at least four coats. Pay particular attention to the end edges of the plywood. Counter tops and heavy use areas may need more coats.

# Assembling Bed and Shelf Units

The bed and shelf units are built using the three ¾ inch plywood sheets. Use the better, pre-sanded side of the plywood for the top of the shelves, the top of the bed, and all the visible sides of the units. When attaching plywood to plywood make pilot holes before using screws to avoid splitting the wood.

## Bed

The bed is 22 inches wide near the wheel wells widening an additional 8.5 inches at the head which extends into the sliding door area. Use cardboard to make a template to cut the plywood. The bed is approximately 86 ½ inches long and actually extends into the rear shelf unit. The mattress does not extend into the rear shelf unit. Trim the last 12 inches at the foot of the bed ¾ inch on the driver’s side to accept the rear shelf unit side board. (see the photo below).

*Foot of the bed as it extends into the rear shelf unit. Note the notch around the shelf side board*

Determine the height of the bed by taking into account the headroom needed when sitting on the bed -with the addition of a 4-inch mattress - and the height of the storage containers that will fit under the bed. The height from the floor to the underside of the bed on the prototype build is approximately 12 inches. You should be able to sit on the bed without hitting the ceiling with your head.
Use the 2 x 2 firring strips to build rectangular frames to use as legs for the bed. Assemble the frames using 3-inch deck screws. One leg should be positioned at the head of the bed. The leg at the foot of the bed must be inset twelve inches to allow room for the rear shelf unit. Position the middle leg to allow room for the storage containers. The prototype was built with three legs. More may be added if desired.

Screw the legs to the floor using three 2-inch deck screws on each leg. Trim the corners of the bed surface to fit against the hatch door. Round the edges at the head of the bed surface to remove sharp corners and to allow the sliding door to close. Screw bed surface to legs using three 2-inch deck screws.

The mattress should be kept in storage until the build is complete to avoid damaging or soiling it. Remove the quilted cover and inner lining. Follow the configurations of the bed to cut the mattress to fit. A serrated bread knife or an electric knife very well for this. Take your time to get the smoothest cut. Both the thin inner lining and the quilted cover should be trimmed and basted to fit the mattress. This can be done by hand but using a sewing machine will result in stronger and neater results.

*Bed Under Construction – Note the rectangle legs for the bed*

*Bed with Mattress in Place*

## Rear Shelf Unit

Follow the floor plan to build the rear shelf unit. The prototype van has an air intake vent in the rear on the driver's side. Drill holes in the side of the shelf unit to allow air flow. The jack and wrench for the spare tire are located in an enclosure in the rear on the passenger's side. The side of the shelf unit must be cut away to allow access to this enclosure. Also, a hole must be drilled in the bottom shelf of the unit to allow access to the bolt that secures the spare tire under the van.

*Rear Shelf Unit Showing the Cutaway for Access to the Jack Compartment*

The bed surface extends through the rear shelf unit to form the shelf on the driver's side (see the photo below). Drill pilot holes through the unit side into the plywood edge of the bed surface and use 1 ½ screws to attach the two pieces.

The middle shelf of the rear shelf unit is 26 inches long and 14 inches wide with a finger hole at each end. It is removable and can be used inside or outside to support a stove. When moved to the upper position it can be used as a computer desk. In the stove position it sits between two 1x 2 firring strips. In the upper position, a 1x2 firring strip and the top of the shelving unit hold it in place. Attach the 1x2 firring strips to the plywood sides with 1 ¼ inch screws.

The passenger side shelf of the rear shelf unit is also removable to allow customization of the storage area and to provide access to the jack and wrench for the spare tire. Use 1x2 firring strips as used with the stove shelf.

A 1x2 firring strip along the top perimeter of the shelf unit using 1 ½ inches screws. Drill from the underside so that no screws show on the top. Use 1 ½ inch screws to join the corners.

*Passenger Side Shelf Unit- note the hole in the bottom to access the bolt holding the spare tire*

## Passenger Side Shelf Unit

Follow the floor plan to build the passenger side shelf unit. The top shelf of the unit must be trimmed to fit around the van trim. Use cardboard to make templates for cutting the proper shape. The height of this unit allows the top shelf to be 16 inches deep and extend to the window. The middle shelves are 10 inches deep. The bottom shelf curves around the trim and varies in depth. The shelf towards the front is removable to allow customization of the storage area. A 1x2 firring strip is used as support. Attach a 1x2 firring strip along the perimeter of the shelf unit to help keep items in place using the same method as with the rear shelf unit. Use 1 ¼ inch screws to join the rear shelf unit to the passenger side shelf unit.

*View of the Rear and Passenger Side Shelving Units as Seen from the Rear*

*View of the Passenger Side Shelf Unit as Seen from the Driver's Side Sliding Door*

# The Electrical System

The electrical system, with two 100-Watt solar panels and a 100 AH AGM battery, is designed to supply power for a beginning van dweller but also allows for additional future loads such as a small 12-volt refrigerator. Six LED lights were installed in the ceiling and are remote controlled. The two roof fans are located in the kitchen area near the rear hatch. The two socket panels have USB and cigarette lighter sockets. One is located on the shelf unit by the passenger side sliding door. The other is near the sliding laptop shelf. The inverter is pure sine wave with a USB port and two 110- volt outlets.

All of the electrical components and wiring, with the exception of the LED lights, are located on the passenger side of the van. Removing the original lights and some of the moldings may be necessary to allow fishing of the wires to the correct areas. Replace lights and molding when the electrical system is completed. Keep the location of the components as compact as possible to preserve the usefulness of the storage areas. Follow the manufacturer's instructions for all installations.

*Passenger Side Shelf Unit with Electrical Units in Place*

# Fans

The Ford Windstar van does not have enough flat interior ceiling space to allow for the installation of a square RV type fan, such as a Fantastic Fan or a MaxAire. Two small, round Ventline trailer vents fit near the rear hatch allowing enough room for installation of the two solar panels. After determining the best placement for the fans, drill a small hole through the van roof and headliner in the center location of each fan. Use a razor knife to cut the correct sized circle in the headliner and the jigsaw with a metal cutting blade to cut the holes in the roof. Use the Dicor Butyl Seal Tape and Dicor Sealant to make a waterproof seal around the vents. Position the drain holes towards the downhill slope of the roof and avoid plugging them with sealant. The vents installed in the roof could be replaced with small portable fans inside the van.

*Cutting the Headliner Inside the Van in Preparation for the Vent Installation*

*View of the Vents from Outside*

# Installing the Solar Panels

Two pieces of ¾ " x 6' square aluminum tube are used to mount the solar panels on the roof. The Ford Windstar van has a roof rack with adjustable rails which were moved to the best position to accept the aluminum tubes. Cut the tubes to size and paint with flat black paint before installing. Install the entry gland following the manufacturer's directions. The solar panels can be screwed together to add strength to the system. Install the solar panels on the aluminum tubes using the Z brackets and machine screws. Paint all metal pieces black. Black garden edging screwed to the sides of the finished installation provides some stealth (leave the front and back open for proper ventilation and reduce wind resistance).

Installing the Metal Tubes Across the Luggage Rack

*Screwing the solar panels together*

*Attaching the Brackets to Hold the Panels in Place*

The Ford Windstar with the Solar Panels Installed