Introduction

Over the years, the RV industry has experienced an evolution, of sorts, in the construction techniques and materials used on all types of RVs. Loose wall or “stick and tin” was state of the art in the early going. Bonded or laminated became a kind of high end or top of the line construction in the early 1970’s. As chemistry created newer and better bonding agents, bonded construction became even more popular as a method of making RVs lighter weight and more fuel efficient . The semi-bonded or “hung glass” method of construction, gave manufacturers the ability to give the exterior a bonded look without the more expensive laminating process and equipment.

Some manufacturers use a combination of a bonded sidewall and a lose or semi-bonded roof and floor. Some manufacturers use aluminum tube frame throughout the body structure and others combine aluminum framing in the sidewall with wood framing in the roof and floor.

Some types of construction allow for spot repair and refinishing, where others require exterior skin replacement or overlay. In some instances, complete wall or roof assemblies must be removed and replaced with a section built in its’ entirety by the manufacturer. A few manufacturers make it relatively easy to replace complete assemblies though, in most cases, shipping and packaging costs make it less expensive to rebuild the original.

There are even new ways of attaching walls to floors and roofs to walls, using lock joints or joiner rails. Different manufacturers use different types of aluminum extrusions or formed, stamped steel rails to create section edges that create a tighter fit and reduce movement in the body of a vehicle, which reduces body squeaks and rattles and helps keep seals and sealant from separating.

Material and labor costs differ with the types of construction. Some frames must be welded which requires more time than a frame that can be stapled together. Some types of construction allow a great number of exterior sidewall sheets to be used to cover the same area as a single sheet. In the case of a small area of damage, it may only be necessary to replace one or two small sheets as opposed to one large sheet, lessening material and labor costs.

Knowing the type of construction with which you are dealing is extremely important in determining how much material and labor will be needed to make repairs. Writing an estimate and knowing how the vehicle was built can make a difference in saving or loosing hundreds of dollars on repairs.

Another thing to consider is additional damage that may occur in an accident due to the type of construction. For example: in a collision where frame damage is sustained, a vehicle with a steel frame construction is more likely to transmit damage to another area than a vehicle with a wood frame, which absorbs most of the impact.

As I’ve said, knowing the construction can make a difference of hundreds of dollars in repair costs.

Note: Roof and floor construction may differ from sidewall. See Introductions to Roof (Section G) and Floor (Section H) for construction explanation.

Note: To understand the construction method of curved aluminum body vehicles, refer to page A-13 for information.

Loose Wall

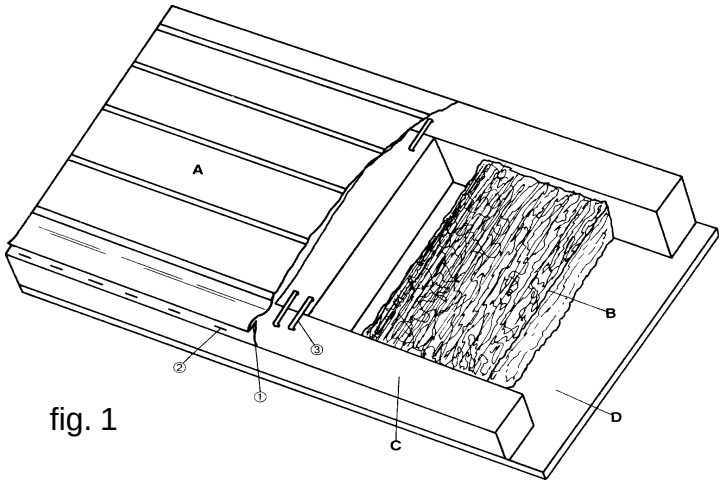


fig. 1

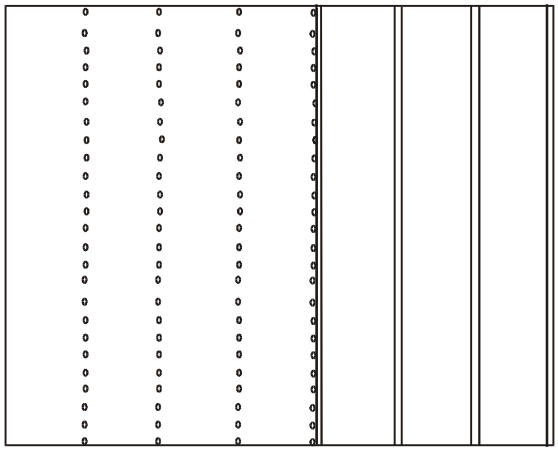
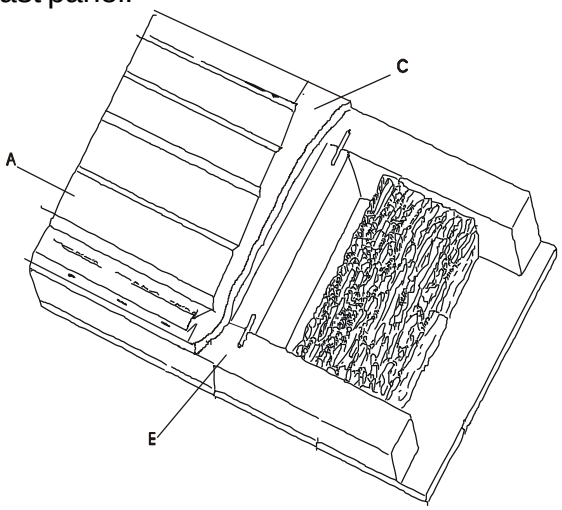


fig.2

Loose wall construction (fig. 1) consists of aluminum skin (**A**) mounted on wood or aluminum tube frame (**C**) by the use of staples, nails and occasionally, but rarely, rivets (**2**) and interlocking seams, where the top of a lower panel slides into a lock at the bottom of an upper panel NOTE: See Section C for mid, upper or single panel replacement technique. (**1**). The frame, if wood, is stapled together at joints (**3**). If aluminum tube, joints are welded.

Fiberglass insulation (**B**) is inserted between frame members. The interior panel (**D**) is stapled and/or glued to the frame.

Utility or car hauler trailers, cube van bodies, as well as some custom tow vehicle bodies, use a type of loose wall construction (fig. 2), where 4' wide panels run from top to bottom of the wall and are screwed or riveted at frame members. Each vertical edge either overlaps or underlaps the next or last panel.



Some manufacturers overlay the outside of the frame (**C**) with 1/4" plywood or thin insulation board (**E**) and then hang the skin (**A**), giving the wall more strength and lessening possible damage to the skin. On many loose hung, or stick and tin trailers, an F.R.P./plywood laminate skin is offered as an upgrade to the standard aluminum skin for the look of a higher end unit (See B-5).

Bonded or Laminated

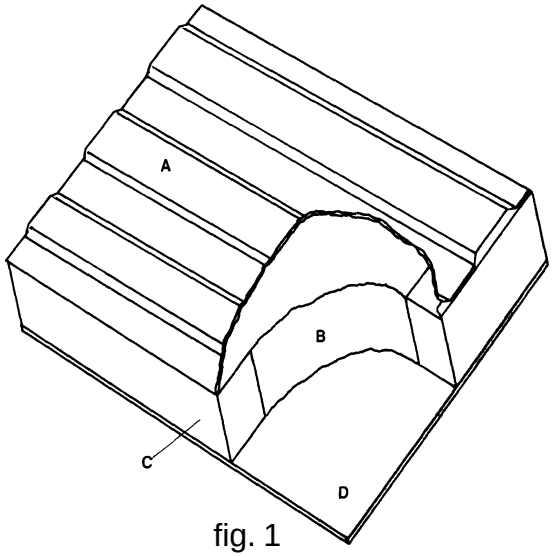


fig. 1

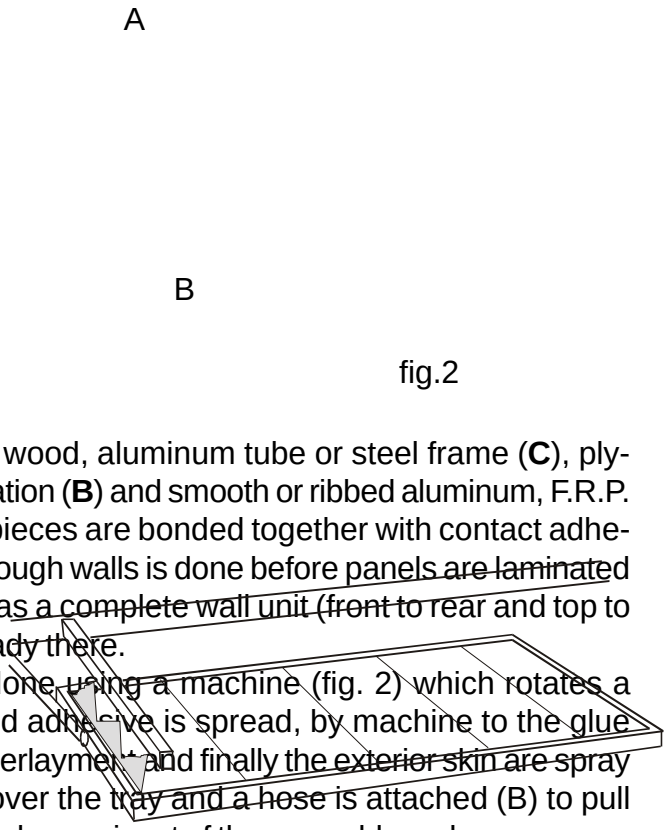


fig.2

The bonded sidewall (fig. 1) consists of wood, aluminum tube or steel frame (**C**), plywood interior panel (**D**), styrofoam sheet insulation (**B**) and smooth or ribbed aluminum, F.R.P. or fiberglass sheet exterior skin (**A**). These pieces are bonded together with contact adhesive forming one solid wall section. Wiring through walls is done before panels are laminated together. The wall is installed on the vehicle as a complete wall unit (front to rear and top to bottom) with window and door openings already there.

The bonding or laminating process is done using a machine (fig. 2) which rotates a series of trays. Panels are laid in the tray and adhesive is spread, by machine to the glue surface (A). Insulation, framing, additional underlayment and finally the exterior skin are spray glued and applied. A bag type cover is laid over the tray and a hose is attached (B) to pull vacuum to the tray and the assembly. Vacuum draws air out of the assembly and compresses the layers together. The assembly remains in the tray until the adhesive sets.

Depending on wall thickness, skin material and cost, many, if not most, add a layer of plywood (fig. 3, E) or a thin insulation board between the skin and frame/insulation sections. One manufacturer uses a F.R.P. type siding that is 3/16 of an inch thick which eliminates the need for a plywood underlayment. Moisture from leaks in sealants can be absorbed by plywood, which then delaminates or separates. (See B-7)

Bonded wall is a preferred method in the manufacturer of motorhomes especially on bus style units. With this type of construction, smooth gelcoat finished F.R.P. or aluminum sheet is used giving the vehicle a sleeker automotive look.

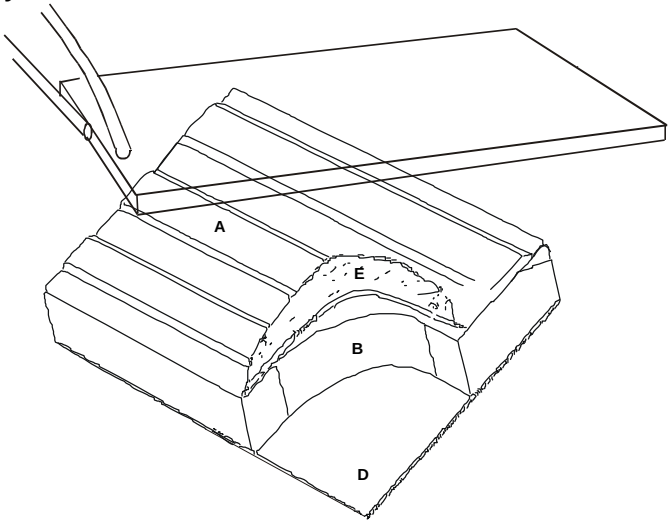
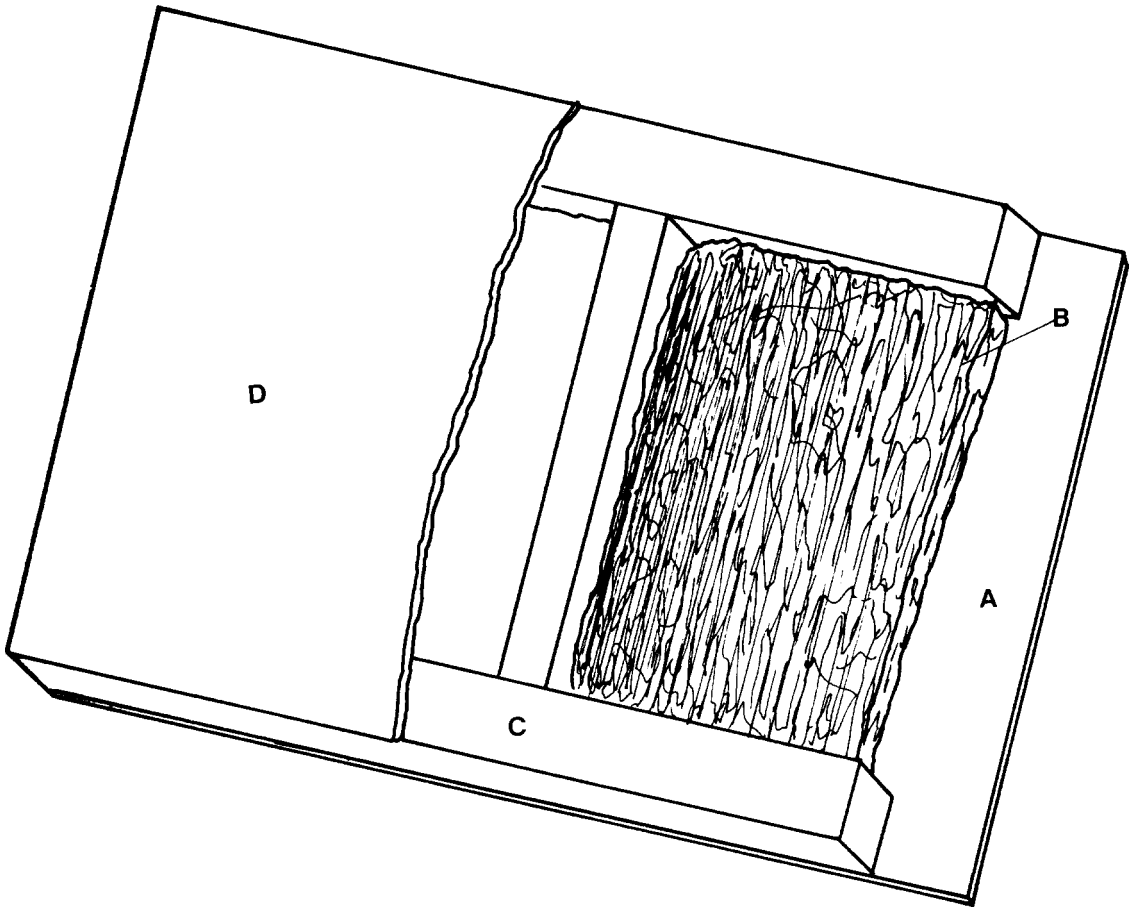


fig.3

Blown Foam

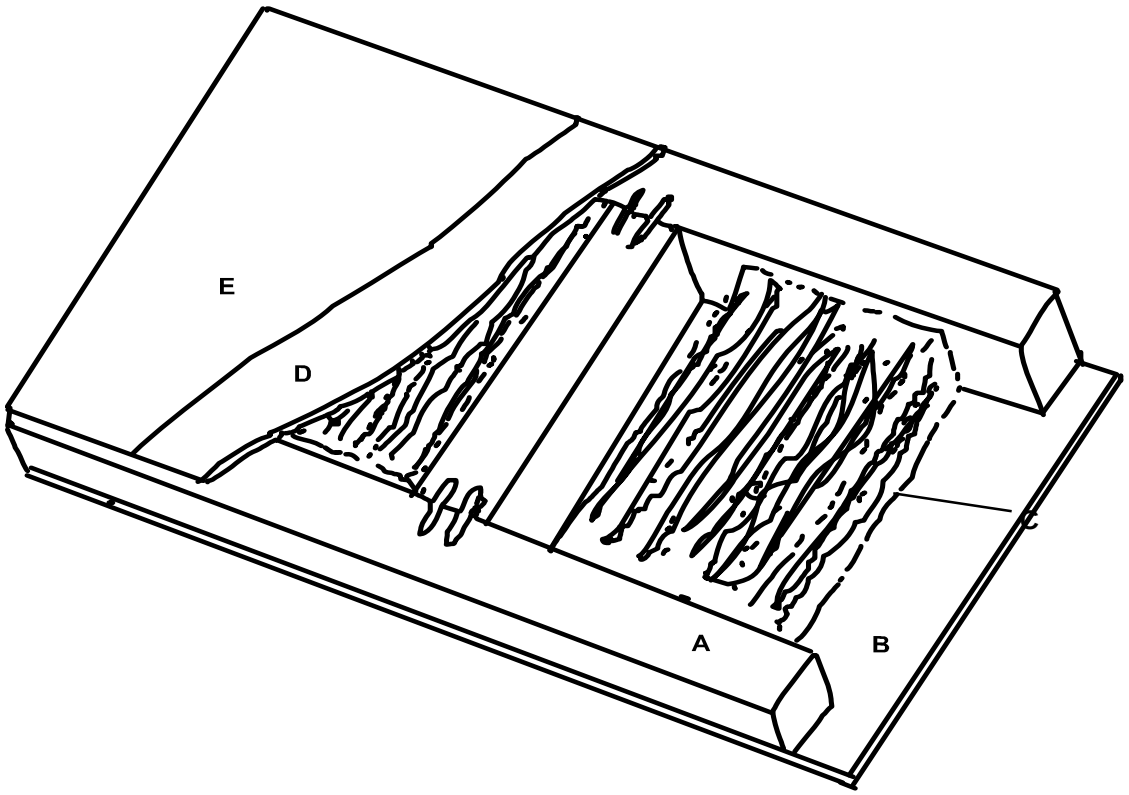


The blown foam method is a rarely used method by which the frame (**C**) is assembled, then exterior skin (**A**) is mounted to frame. A spray foam (**B**) is then applied to the inside of the skin between frame members, about 1/2" thick, and allowed to dry. The interior panel (**D**) is then mounted to the frame with screws. The frame can either be aluminum tube or u-channel steel. Repairs and panel replacement are more difficult due to the insulation replacement process.

Sidewall skin must be insulated before installation. Masking tape is applied to skin at frame contact areas. The entire panel is sprayed with foam. After the foam is allowed to begin setup, the tape is removed taking with it insulation from frame areas. The panel is then mounted and formed to the frame. Time for panel replacement is the same as on loose wall construction*, though additional time of about 4.0 hours per 1/2 side should be added to panel installation in order to allow for insulation procedures.

*See Section D for Curved Aluminum Body Panel Replacement.
*See Section A for more Curved Aluminum Body information.

Semi-Bonded or Hung Glass



A kind of cross between loose wall and bonded wall would be a semi-bonded or hung glass process. Frame work interior panel (**A** & **B**) are mounted together with staples or adhesive. Either styrofoam or fiberglass mat insulation (**C**) can be used. A layer of pre-laminated exterior skin and luan plywood or insulation board (D & E) is glued to the frame, using a caulk gun applied adhesive spread onto the outside of the frame members. The skin/underlayment assembly is held in place with lumber or other bracing until the adhesive dries. Although sometimes referred to as hung glass, the actual skin could be aluminum.

There are exterior skin suppliers who offer aluminum, F.R.P. and other fiberglass skins pre-laminated to insulation board, which can be mounted directly to a wall frame assembly without the need for spray adhesives. On many loose hung or stick and tin trailers, an F.R.P./plywood laminate skin is offered as an upgrade to the standard aluminum skin for the look of a higher end unit.

A more elaborate variation to this exterior is a material called fiberglass composite. Fiberglass composite is created on a flat mold. Gelcoat is applied to the mold first. A mixture of fiber and resin is sprayed over the gelcoat. Plywood is then laid over the wet mixture. A vacuum bag is then applied to the mold and the fiberglass outer is drawn into the plywood by vacuum.

This semi-bonded process gives an identical look to the bonded wall. It also makes the vehicle assembly process easier for some manufacturers because they can mount the walls to the floor and add appliances and wiring into and throughout the wall framing before the skin is applied. This creates less of a chance of exterior damage and easier construction problem repairs.

Siding Description and Roof/Wall/Floor Connection

The following is a sort of glossary of siding materials. Though section I will go into depth on sidewall material, this glossary should act as a quick guide and help identify materials used in the types of construction.

Aluminum - Aluminum sheet. Measuring approximately .024 of an inch in thickness. Smooth or corrugated for application and required strength. Can be laminated to plywood or directly to insulation. Can also be backed and reinforced by fiberglass.

Fiberglass - A combination of fibers and resins which can be molded into shapes or formed as a flat smooth sheet. Is embossed or pebble finished for look and strength.

Fiberglass composite - A type of flat molded fiberglass with a vacuum laminated luan plywood sheet backing. Usually designed as sheet large enough to cover a complete sidewall as one piece.

Filon - Brand name for F.R.P.

F.R.P. - Fiberglass Reinforced Plastic. Sheet plastic with fibers and color mixed throughout. Available in ribbed form or smooth. Can be gelcoted for smooth, fiberless appearance. Can come as pre-laminate with luan plywood.

Gelcote - Brand name finish coat for fiberglass.

Pre-laminated - Aluminum, F.R.P. or other sheet, laminated to plywood as an assembly that is made to fit an entire wall. Provided by material manufacturer and sold to the RV manufacturer for application over loose wall type frame.

Tuff Coat - Brand name for F.R.P. type siding. Supplied in 3/16" thickness, eliminating the need for plywood underlayment, which reduces the chance of underlayment delamination.

Note: Some of the names above are registered brand or trade names for the products they represent.

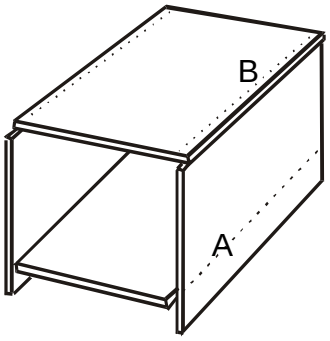


fig.1

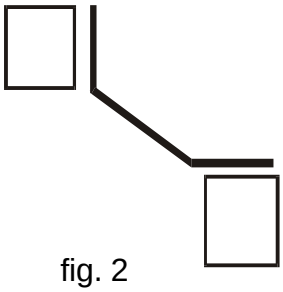


fig. 2

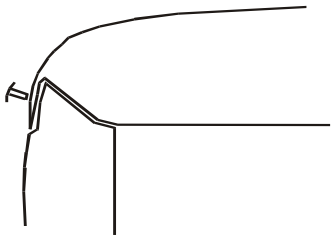
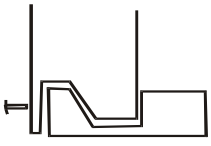


fig.3



Originally, (fig.1) the walls of the vehicle were screwed horizontally into the floor (A) and the roof edge was screwed down through the wall edge (B). Over time, these connections would loosen and the body would shift and squeak.

Some manufacturers used a metal plate/bar to run the full length of the roof to connect the roof and the walls (fig. 2)

Some manufacturers use lock type joints along the roof edge and floor edge (fig. 3).

Joints and plates are used to lessen movement in the body by making tighter connections where the roof meets the walls and the wall meets the floor.

Construction Problems

Water Damage: Water Damage is probably the most troublesome occurrence in RV construction, maintenance and repairs. It can destroy an RV. It can be caused by manufactural flaw, lack of maintenance, collision damage, wind and storms.

Insurance companies have had to lay out a lot of money in an area they aren't familiar with, as far as judging when and how the damage occurred. Shops have had nightmares finding rotted wood or steel they didn't count on when quoting what appeared to be a simple collision repair.

Water can travel several feet from where it actually enters a roof, wall or floor to get to where it will cause the most damage. Water can travel through open areas in roof cavities, framing and wiring channels. It can also travel by wicking its way through a material like plywood. Some manufacturers now use an anti-wicking material around all window and door openings. Water can cause different types of damage and create different problems as well. It may cause immediate damage or it may take months for damage to finally show through a ceiling or wall panel. It can cause cosmetic damage and severe structural damage.

Most water damage can be repaired like collision damage, replacing interior paneling or repairing framing in floors, roofs or walls. These areas are all covered in relative sections in this book.

Some things to consider when inspecting water damage are: Where did the water come from? If no physical collision, vandalism, storm or other specific reasons are evident, then more than likely the problem is built in or due to lack of maintenance.

Age of damage can usually be reasonably well determined by deterioration. Fresh damage usually just shades or discolors wood slightly and can usually be dried with no further damage. Dark colored or soft wood indicates long term saturation sometimes accompanied by mold or mildew with a musty smell. Severe delamination in plywood, or missing or crumbling frame members, usually mean that years of slow, constant leakage may be involved.

Steel, as we all know, rusts from moisture and aluminum corrodes by a process known as electrolysis, which shows up as slight pitting and develops into larger rotted holes with white powdered edges.

Bonded walls and roofs suffer the worst damage and most costly repairs. When a bonded area takes on water, the plywood under the skin delaminates (or comes apart) in layers. This causes side skin to bubble out and for whole areas to become soft even through the thickness of an area making the area very weak. When covered with aluminum skin, electrolysis develops hastening the overall damage. It has also been reported that the acid in adhesives used to bond aluminum sheet actually dissolves the metal and appears as electrolysis.

Roofs can be damaged to the point that the complete assembly must be replaced. One type of roofing material (TPO vinyl) carries a felt type backing. If a roof leak occurs or the roof gets torn or opened, the felt backing can act as a wick and water can filter through to damage much larger areas. Plywood underlayment under any skin, can wick water itself over time. With roof damage, the sooner the roof can be repaired, the better and anything that can be done to cover the damage and protect the roof immediately upon discovering damage is extremely important.

Construction Problems

Most water damage can be remedied by replacing only affected framing, insulation and interior panels although sometimes large areas of exterior covering or skin may need to be repaired or replaced.

Delamination: Materials such as plywood paneling and complete bodies of bonded wall vehicles are basically layers of materials glued or laminated together.

Delamination or the ungluing or separation of laminated materials is a condition that can literally cause a vehicle to fall apart. Delamination is mainly caused by moisture. In plywood, moisture causes the layers of wood sheet to swell and separate. With plywood used on interior and exterior areas of bonded sidewalls, this condition causes the complete wall to separate. Delamination can show as bubbles or air pockets in outside walls where the skin tries to hold the area together. Interior delamination shows as soft spots which are preceded by discoloring or stains. Other causes are vibration and manufactural defects.

There are a couple of ways to repair delamination. Sometimes it is possible to remove moldings, doors or windows to gain access to affected areas and reglue them. But many times it is necessary to replace the damaged materials and even reskin entire sidewalls.

Electrolysis: Electrolysis is a condition that occurs with aluminum sheet skin and aluminum tube frame. Like delamination, moisture is the primary cause of electrolysis.

Aluminum doesn't rust but it does corrode. Most vehicles give aluminum several reasons to corrode. Moisture from leakage, weathering and condensation or electrical current through lighting and other accessories which find their ground through sidewall skin and dissimilar metals (i.e. steel chassis to aluminum body panels).

Electrolysis shows up as pitting or bubbling in siding. On roofing it looks like dirt because roofing is usually not painted and expresses a black residue which stains the corroded areas.

As corrosion develops, it allows moisture to get through and behind the metal which accelerates the process and causes delamination in sidewalls. On roof situations, the small beginning pitting allows water to seep through and make its way through roofing to the ceiling interior.

Moisture is the common element in most body construction problems. Moisture gets in through moldings, ill fitting doors and windows and areas with old or insufficient sealants.

Bubbling F.R.P. : Recently, a problem has developed with Fiberglass Reinforced Plastic siding. Around late 2005, some manufacturers reported that the F.R.P. they were using was not holding with the adhesives that were being used. The same thing was happening in the aftermarket while replacing or overlaying F.R.P. It's not that the F.R.P. is not adhering, but it seems as though the adhesive is attacking the F.R.P. The siding will begin to develop bubbles (not just one or two). It bubbles until the complete panel looks like cottage cheese.

As of this printing, the manufacturer has no explanation for why the material is reacting like this, but has come out with a new generation of F.R.P. that they claim will not do this.

It's a good idea to check with the vehicle manufacturer or the F.R.P. supplier before using any F.R.P. sheet.