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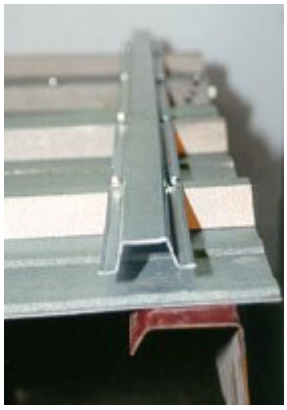
TECH ARTICLE: Alternative Framing Offered for Retrofit-Roofing Over Metal Panels

Metal building and metal roofing components manufacturers, suppliers and erectors are now aggressively pursuing the huge retrofit market, and rightly so. This is a rather recent emphasis, (the past five to seven years in particular) because of the ease and economy of retrofitting over existing metal roof sheets without the costs of removal and dumping.

The current technique in use (and rapidly spreading) is the installation of a light gauge hat section laid across the top of the high ribs and fastened to the underlying substructural purlins by means of a 2" to 3" long, self-drilling, self-tapping, #14 or larger, fastener.

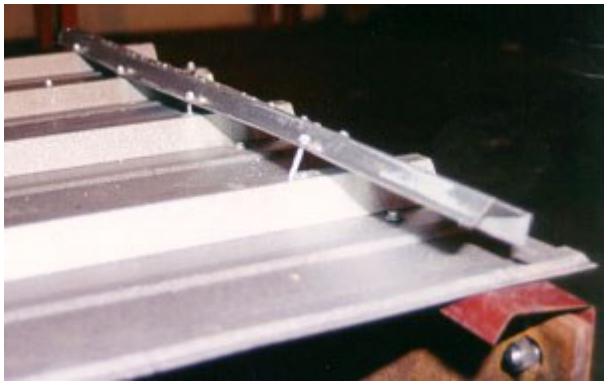


This method requires drilling through the side rails of the hat section which are 1/2" to 3/4" width and then "finding" the purlin flange below, thus firming the connection to the substructural. Engineering practices dictate that there should be two fasteners at each connection (one on each side rail straddling the hat) at maximum 2" o.c.

To accomplish this under field conditions where the flat top of hat section is 2 1/2" and the top flange of the existing substructural purlin is only 3" long fasteners would have to penetrate the very edges of the 3" purlin flange. One at the web break and one at the sloped, stiffener, out side edge of purlin flange.

Realistically this can be accomplished only in the laboratory. In the field the erectors are installing only one long fastener into the purlin and one more (if at all) standard self-drilling #14 x 3/4" screw into the sheet high rib metal which is often rusted out itself and provides little additional restraints to wind uplift. In some cases attachments are being made only to the old sheet itself and none to the purlin.

As bad as that situation is however, there are other conditions being created which need be closely examined.



The first is installing the hat section over the narrow, and often degraded, top ribs of existing sheets which can result in the crippling of the 45 degree web of sheet ribs under compressive live loads and pedestrian traffic of erectors laying on the new roof.

The second problem occurs in the skylight area. Old, dim and discolored skylights are removed, a new hat section is installed across the resulting opening and a bright, translucent skylight panel is reinstalled.

Sounds good on paper, but when the existing skylight is removed so is the support for the hat section. Typically what happens is the hat section "floats" across the skylight opening 1 1/2" above the purlin with no structural attachment at all! The resulting uplift as well as foot traffic risks are obvious.

The third and worst of all the infractions of good engineering practices is in ignoring the failures of roof in the 1960's, which led to the manufacturers' cancellation of the 2 1/2" and 3" "shoulder bolt" fasteners and their discontinuance of use in the metal building field.

In the attempt to achieve a slick interior roof appearance, a higher R-value insulation and elimination of the "bulging" or "sagging" look of blanket insulation between the supporting purlins, architects and engineers began specifying ridged, high density insulation board of 2" to 3" thickness.

Shoulder bolts were developed to exact lengths to fit the board thickness, by bottoming on the purlin while setting lightly but snugly on the covering rib sheeting without creating excessive "dimpling" or "oil canning" and yet seal the hole against leaks.

That was a very similar mechanical connection to that which we are utilizing today with the hat section over the high ribs. We are creating a "floating" rigid diaphragm of sheeting, precariously impaled to the sub-structural by up to 3" long fasteners that have little stability under the variety of movement by wind and elements. The rigid

"skin" moves considerably and independently of the structural system creating fatigue and breaking of the fastener points where shallowly embedded in the light gauge purlin while at the same time "wallowing" the sheet metal hole at the compressive head area.

This leaves the specifier, supplier, contractor, erector in a vulnerable position down the road when failures can occur over time. A severe wind could cause the whole roof structure to "peel".

We observed this in the dramatic reality in the aftermath of Hurricane Hugo. In particular, we made a detailed study with pictures of a 60,000 sq. ft. warehouse-office building which had a standing seam retrofit over a standard panel rib roof of a steel building. The retrofit was relatively recent.

This entire, expensive, roof system was torn off and "rolled" up from eave to ridge like lopsided carpet rolls. The underlying panel rib roof remained about 70% intact. This failure occurred with the system that was used to attach the standing seam to panel rib roof system. The retrofit system, as well as hat section retro-systems, share inherent design weakness in joining old and new roofs, allowing this potential for catastrophic failure.

There is a new product now on the market which addressed this problem head-on. The product is a miniature Zee purlin that utilizes a sophisticated computer punching operation to "punch out the profile" of the existing old panel rib sheeting in the flat. It then undergoes slitting and press breaking into a Z which now has a slotted bottom flange that "nests" into the valley pan of the old sheet. The Retrofit Zee purlin is then ready for fastening directly into the existing original roof purlins with only the sheet and/or old fastener head between the bottom flange of the Zee Purllin and the original structural,
thus creating a very firm and stable connection.

Retrofit Zee's vertical web is the height of the existing rib profile while the top flange (which is almost in contact with the top of existing high rib of the old sheet) is a continuous 2 1/2" or 3" flange which is now in position to accept the new roof sheeting in a standard manner much as the original roof sheeting was installed.

The net result is a solid connection with minimal independent movement of the top diaphragm and an uplift strength equal to or exceeding the original design. The complete assembly of old roof with new roof over is typically only 1 1/2" - 1 3/4" higher than the original roof profile.

All of this is achieved with standard fasteners, tools and expertise. Nothing special to be bought or learned. Retrofit Zees are formed from 1.25 oz. galvanized material to resist the "virus" of any existing rust from spreading to the new materials. Retrofit Zee fits over the existing roof profiles much like a template and contains punched out pilot holes in the lower flange for quick and easy fastening to the original purlin.

A final word of caution when retrofitting. A "free air" space is created between the two sheets. While this adds insulating value to the building it also creates serious condensation problems in some areas of high humidity and wide temperature differentials. You can, and probably should, install a 2" raw, unfaced fiberglass blanket insulation in this area to considerably enhance the insulation value of the structure and impede the condensation possibility with its resultant internal rusting problem.

The information contained herein is intended to aid participants in our dynamic industry in avoiding the pitfalls and liabilities that can be serious indeed, when a failure occurs on large roof and re-roof jobs. We must recognize and recall mistakes made in the past.

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