Stainless Steel Panel Fasteners – Long Life Fasteners for Long Life Panels

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A couple of months ago, I was in a meeting with the Manager of Technical Services for a major metal building component company. We were exchanging fastener misapplication stories when he said to me, "You know the problem is that your industry misuses the term 'long life'." It occurred to me that he is absolutely correct. I work for a major fastener producer and we alone use the term 'long life' to describe no fewer than four products or coatings. You can buy fasteners ranging from pure mechanical zinc plated, to organically coated, to plastic headed, all with the same claim of long life. While some of these processes may be reasonably called 'extended life', they should hardly be referred to as 'long life'. Add to this that other fastener manufacturers and distributors do the same thing and the specifier hasn't got a chance.

At the end of the day, there is only one true 'long life' panel fastener, and that is a fastener that is made of austenitic stainless steel – both on the head and on the threaded shank. Anything less is at the mercy of its environment. Zinc-Aluminum or stainless headed/capped fasteners do an outstanding job of eliminating visible rust and sealing out the whether for a very long time; however as panel coating technology has improved, it may be time to consider more than just the visible portion of the fastener. Keep in mind that it's the unseen part, the threaded shank, that's holding the panel tight against the head of the fastener.

Panel Life Evolution

The metal building systems and components industries have come a long way over the last 30 years. Not all that long ago, metal buildings were inexpensive alternatives for agricultural and small rural commercial projects. Steel sheet was galvanized with G-60 zinc and coated with a choice of a few polyester paint colors. It wasn't very difficult for fastener manufacturers to produce screws that lasted as long as the panels. A mechanically applied layer of zinc and a moderate coating of polyester paint would more than suffice.

The metal building industry evolved. Demand for growth grew as new competitors moved into the roll forming business. Naturally, this meant that metal building manufacturers had to look to a greater segment of the commercial construction industry. As a result, throughout the eighties and nineties, new technologies in steel and steel coatings were embraced, leading to such now common materials as Galvalume and Kynar. Today, steel panels are recognized for their supreme durability, longevity, and overall aesthetic life. So why are they held in place with fasteners that are basically made the same way that they were 30 years ago?

Certainly the major fastener manufacturers have invested in new coating technology. While softer materials such as Kynar don't work well on mechanically installed fasteners, other harder, long-life paints have been developed to provide similar corrosion protection to panels. Still, fasteners experience fairly severe mechanical abuse during installation – something to which panels are not subjected. It stands to reason that they would be more susceptible to localized corrosion resistance failures. Fastener manufacturers offer stainless steel or zinc-aluminum capped or molded head parts to provide a cost-effective solution to this concern. Many metal building manufacturers specify these parts for more severe applications such as roofs. These capped fasteners provide great resistance to the corrosive effects of the rain and sun, and as a result, the fastener life extension benefits are significant. Nevertheless, the part of the screw that really does the work of preventing a panel from falling off of a building is the threaded shank. This part of the fastener is virtually exactly as it was 30 years ago – carbon steel with mechanically or electrically applied zinc, and perhaps a plastic based coating that gets at least partially worn off during installation.

Why stainless steel shanks?

The one thing that can be said about carbon steel screws, regardless of the coating that has been applied to them, is that they will rust. It's Mother Nature – there is nothing that can be done about it. Superior coatings should not be discounted. They do add life – valuable life, to a building. But the question that needs to be asked by designers is whether the fasteners will last as long as the panels. Keep in mind that the fasteners will be installed, through steel and into steel or wood, with a driver that squeezes the coatings between two steel surfaces under tens of thousands of pounds per square inch. Further, the lesser corrosion resistant coating will have been heavily scratched under load by the jagged steel surface of the steel panel and substructure. In most cases, because of the higher demands on the fastener than the panel (due to installation) it is unlikely that the fastener will outlast the panel.

The head of a metal building screw has considerably more mass and surface area than the individual threads. As a result, even when some mild rusting does occur, there is generally plenty of metal mass left in place to retain the panel. Because threads are relatively small, it does not take a great deal of rust to dramatically compromise their individual holding power. The combined holding power of threads is only important when embedded in a substrate such as wood where more than one thread is engaged. In the case of the joining of two sheets of steel, one thread does all of the work, so when it loses its holding power, the fastening point is in failure mode. Clearly, no-one would argue that it is essential that the integrity of a steel fastener shank be maintained throughout the life of its application. But how can you know if you can't see it? How can an architect be certain that condensation, corrosive building materials, or improperly seated neoprene washers will not lead to fastener failure before end of the full life of a metal building? He can specify austenitic stainless steel. In fact, if he specifies carbon steel, regardless of the coating, he can be fairly certain that the fasteners WILL indeed corrode both on the head and on the shank, before the modern, high quality coated metal panels.

So why aren't all fasteners stainless steel?

Hardness: Austenitic Stainless Steel is by nature relatively soft. It can not be hardened in its corrosion resistant state to levels adequate for application in self drilling or piercing screw fasteners. The strength of the steel itself is quite sufficient for the holding power demands of metal building panel attachment; however, the significant cost of labor in metal building construction makes predrilling of pilot holes virtually prohibitive. Fortunately, fastener manufacturers have developed new technologies to combine stainless steel fastener heads and shanks with hardened carbon steel points through welded bimetal attachment or crimped blade attachment. Now a specifier can call for austenitic stainless steel fasteners without causing the builder to lose money on the labor portion of a project. In fact, modern bimetal fasteners install at speeds similar to all carbon steel fasteners.

Paint Adhesion: Austenitic stainless steel is notoriously difficult to paint. This is not a significant problem for many more traditional applications for these 300 series steels as they are commonly used in the unpainted condition. But when being used purely for its corrosion resistance characteristics, a stainless steel panel fastener has to be color matched to the building panels. The keys to paint adhesion for stainless steel fasteners are in the paint composition, and the cleanliness of the material just prior to coating. Both of these somewhat limit the pool of potential suppliers. Generally, modern, high tech coatings are developed by and for the larger fastener manufacturers and are less accessible to smaller producers. Further, careful management of unpainted fastener inventory is required to prevent a build up of chromium oxide on the stainless surface of stored product. Finally, adequate facilities space for the maintenance of a clean paint area is also essential. Again, all of this has the market effect of limiting viable suppliers of stainless steel fasteners to the larger producers. Nevertheless, the technology to successfully color match stainless steel fasteners, whether wet applied or powder coated, does exist.

Cost: Stainless Steel is expensive. Better stated, carbon steel is inexpensive. The material content, of a thousand carbon steel self drilling panel fasteners may be as low as $20 to the manufacturer. The material content of the same fasteners made from stainless steel could be over $100. Further, the processes involved in applying a drill point, whether welded or crimped, add appreciably to the final cost. Still, considering the overall small portion of the total cost of a metal building made up by the panel fasteners, it seems a rather viable consideration. Many modern building projects have become showcases for their owners and investors. Premium costs for upgraded details are commonplace. Most owners with an interest in value and longevity would undoubtedly chose stainless steel fasteners if they fully understood the cost versus the benefit.

What about Martensitic Stainless Steel (410)?

Martensitic varieties of stainless steel are popular because they are inexpensive and still considered stainless steel. The expression, "There's no such thing as a free lunch;" however, applies here. 400 series stainless steels are desirable because they are inexpensive and easy to work with. They work harden nicely and therefore make good wire for screwmaking. The problem is that they are not truly rust free in most building environments and they are highly susceptible to corrosion cracking. Corrosion cracking, also known as HIC or Hydrogen Induced Cracking is the result of corrosion occurring in the material grain boundaries under the stress of application. When this micro corrosion occurs, fractured grain boundaries propagate from one to the next, ultimately causing complete failure of the fastener, often at collar, just below the head. This phenomenon is why martensitic stainless steels are virtually never indicated for structural applications and should not be used for panel attachment.

ACQ (Next Generation Pressure Treated Lumber)

Certain components of some metal and post frame buildings are attached to pressure treated wood. Until last year, a builder was taking no more risk applying carbon steel fasteners in these applications than in any other application. With the institution of new EPA standards in 2004, however, this changed. ACQ and other modern EPA compliant pressure treatments contain high levels of copper among other potentially corrosive compounds. There has been a great deal of discussion over the severity of this corrosion threat. Opinions from fastener manufacturers cover all angles. Some believe that the addition of extra zinc is all that is needed. Others believe that new, untested coatings will provide the magic bullet. Again, there is one certainty here – carbon steel WILL rust and carbon steel in ACQ WILL rust sooner. The presence of copper as a dissimilar material in a moist environment, in contact with threads that have been scratched during installation WILL shorten the life of fasteners. Some tests indicate that the shortening will be substantial. Austenitic stainless steel will not rust under these conditions.

In some Western European and Asian nations, building codes require the use of austenitic stainless steel fasteners for exterior panel attachment. This is particularly common where land is scarce and building structures are viewed as extremely long-term architectural commitments. Here in the United States, we're probably a long way from making the complete conversion to austenitic stainless steels for metal panel attachment. Nevertheless, it is indeed probably time for greater exposure of this option to investors and building designers. Steel panel coating technology has driven this evolution. Fastener technology has responded. Austenitic stainless steel no longer means pre drilling pilot holes for installation. The material may cost more, but the growing demand for building life warranties, both written and implied, call for consideration of the only true 'Long Life' material for panel attachment fasteners – austenitic stainless steel.