FRAMING THE FUTURE.

SIX ARTICLES ON INNOVATION IN COLD-FORMED STEEL.

ClarkDietrich
BUILDING SYSTEMS

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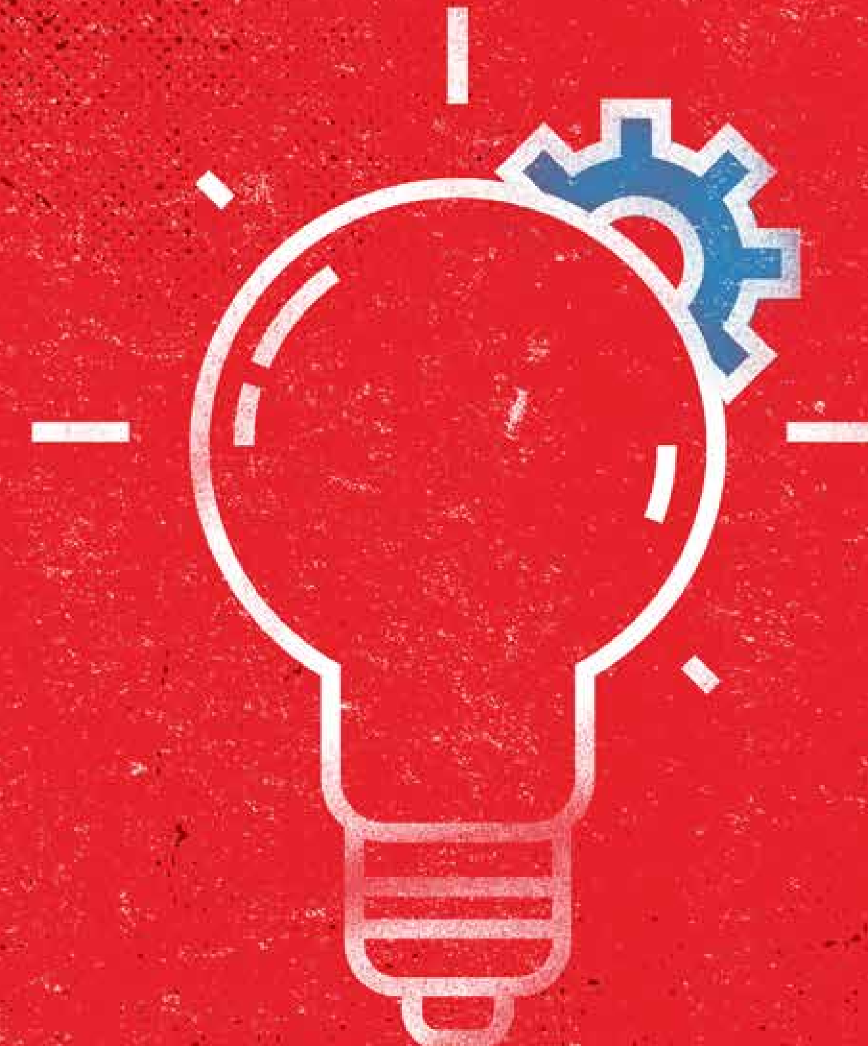


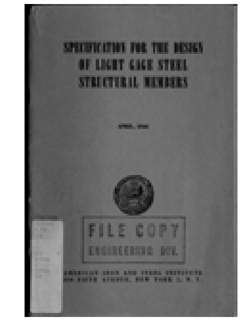
DO YOU KNOW WHAT OUR STEEL CAN DO FOR YOU?

IT CAN HELP YOU DESIGN AND CONSTRUCT HIGH-PERFORMANCE BUILDINGS IN MORE COST-EFFECTIVE WAYS. IT CAN HELP YOU MEET CODE AND SOLVE COMPLEX CHALLENGES ON THE JOBSITE. IT CAN RAISE YOUR PROJECTS TO NEW HEIGHTS AND OPEN YOUR MIND TO DIFFERENT POSSIBILITIES. CLARKDIETRICH HAS CREATED THIS COLLECTION OF ARTICLES IN ORDER TO OFFER YOU MULTIPLE PERSPECTIVES AND INSIGHTS ON COLD-FORMED STEEL FRAMING, AS WELL AS THE OPPORTUNITIES AND EXPERTISE THAT SURROUND IT. PROGRESSIVE PRODUCTS ALONE WON'T LEAD THE WAY TO THE FUTURE, WHICH IS WHY WE SEEK TO REMAIN ON THE FOREFRONT OF SHARING KNOWLEDGE WITH YOU.

ClarkDietrich.
BUILDING SYSTEMS

Cold-formed steel has come a long way since it was advertised for use in portable iron houses for the California Gold Rush in 1849. Its use in construction was limited back then, but it was an option nonetheless. The material, like many other aspects of modern life, evolved alongside the industrialization of North America. It was even on display by way of steel-framed homes and metal roofing panels in the 1893 Chicago World's Fair. This highly public demonstration coupled with a smattering of successful steel-built structures erected throughout the United States, are part of what helped the material gain ground in the building industry.

The growing interest in integrating cold-formed steel into construction practices prompted the first design



standards for the material—a critical component to the health and safety of any built structure. These were published in 1946 when the American Iron and Steel Institute (AISI) issued the first edition of its *Specification for the Design of Light Gage Steel Structural Members*.

Notably it was this era that also gave rise to the use of gypsum. By 1955, in fact, half of all new homes were built using gypsum wallboard while the other half used gypsum lath and plaster according to the Cold-Formed Steel Engineers Institute. It was not long before gypsum companies, whose gypsum products were naturally fire-resistant, commenced efforts to create a noncombustible substrate that could support gypsum board. Through some trial and error, the gypsum board and steel stud industries together developed the self-drilling screw that made way for easy-to-build noncombustible partitions, which was a major step forward for the gypsum, steel framing and even tool industries. The rest is history so to speak. Contractors now use cold-formed steel studs along with gypsum board to create fire-resistant wall assemblies as well as drywall systems. Such efforts have for decades gone hand in hand to the benefit of small and large buildings and continue on into today's more sophisticated building systems approach to construction.

As the market for steel framing grew strong in the mid-1900s, so too did the need for improved standards specific to cold-formed steel products. Enter ASTM C645, *Standard Specification for Nonstructural Steel Framing Members* first published in 1970, and ASTM C955, *Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases* in 1981. Though these guidelines attempted to define the standard properties of nonstructural and structural framing members, they were skeletons of what exist today. ASTM C645 was loose at best, offering no provisions for any protective coating on the steel sheet. It did not require any marking or identification of the members. There was no screw or spinout procedure. There were no performance requirements for alternative thickness products and no reference to limiting heights. As for ASTM C955, these standards specified that members were to be made from steel, yet there was no reference to any particular steel specification to which they were required to conform. That was then.

The current editions of C645 and C955 are much more robust. They now specify ASTM A1003 as the steel requirement for mechanical and physical properties of the steel that must be used to manufacture framing members. In addition, C645 now outlines coating requirements for products manufactured according to the standard. It also includes a detailed penetration and spinout test for stud and hat furring channel products. The standard further discusses alternative thickness EQ products and when it is permitted to use these materials. Marking and identification requirements, manufacturing tolerances, and illustrations for where and how to measure them are also detailed within the standard.

Both ASTM C645 and ASTM C955 are part of a code synchronization effort within the AISI Committee on Framing Standards. This initiative is intended to ensure that AISI and ASTM requirements are always aligned so as to avoid any confusion. As such, users of the ASTM standards will see references within C645 and C955 pointing to the relevant AISI documents.

Among the biggest advancements to cold-formed steel members in recent years is the change in paragraph 9.2 of ASTM C645. This section now permits the use of what have become known as EQ studs or EQ thickness studs. A redesign of the basic stud profile, coupled with

manufacturing advancements, resulted in products that attained the same or greater limiting heights as standard thickness members, but was produced to a thickness less than the ASTM-specified 18-mil. In addition, the members have better screw shear and pullout values per higher strength steel used in the manufacturing of the EQ thickness studs. Plus they are lightweight which makes them easier for contractors to handle and install. For these reasons, most manufactured interior drywall studs are now EQ thickness studs, thanks to this single change in ASTM standards.

Equivalent coatings are of course another huge step forward for the industry and are now being used on ASTM C645 interior framing members. When applied to steel sheet with a zinc-based coating, EQ coatings have demonstrated better corrosion protection than the traditional G40 coating. ASTM C645 requires members to have either a G40 hot-dipped coating or a coating that provides equivalent corrosion resistance; however, the standard does not indicate how to determine equivalent corrosion resistance.

It is possible to demonstrate equivalent corrosion resistance by conducting an apples-to-apples salt spray comparison test as outlined in ASTM B117-09. This procedure tests an EQ-coated specimen next to one with a hot-dipped galvanized coating until the specimen with the known G40 coating fails. Another way a manufacturer can demonstrate compliance with the equivalent corrosion resistance provision of ASTM C645 is to use a code compliance report issued by an independent International Accreditation Service (IAS). This third-party report would further attest that the EQ-coated member meets the requirements of the standard.

Needless to say, cold-formed steel has been an integral material in the growth of sophisticated building design. Manufacturers have become adept at meeting the intent of standards and innovating beyond them, such as with EQ thickness studs and EQ coatings. As a result, contractors are now working with lighter, stronger studs. So what's next? Energy-efficient studs? Possibly. Whatever the future holds for cold-formed steel studs, one thing is certain: manufacturers will continue to evolve to improve processes and provide labor-savings through products that are easier to handle and install. Stay tuned as advancements in cold-formed steel framing members are sure to come.

MAKING AN IMPACT ON ACOUSTICS: RC DELUXE® RESILIENT CHANNEL

Resilient channels have long been a popular, cost-effective component of acoustical design strategies in commercial and multi-family construction projects. They function as decouplers, permitting the attachment of gypsum board to the framing members without any actual contact between the two components. This separation of the gypsum board from the studs impedes the transmission of airborne sound waves through the wall assembly by breaking their path.

However, in order to achieve maximum acoustical performance from building assemblies that utilize resilient channels, a variety of factors must first be considered. Research done over the years by acousticians, such as Veneklasen Associates, of Santa Monica, Calif., has shown that resilient channel design selection and installation practices can significantly impact a wall, ceiling or floor assembly's overall acoustical performance.

COMPARING RESILIENT CHANNEL DESIGNS

Since the debut of the industry's first resilient channel, RC-1, by USG more than 50 years ago, the product's design has been extensively tested against other resilient channel designs to compare acoustical performance. Consistently outperforming its counterparts, it is now widely accepted as the benchmark for resilient channels in wall, ceiling and floor assemblies and in sound testing. Although USG stopped manufacturing resilient channels in the early 1990s, the RC Deluxe Resilient Channel, made by ClarkDietrich Building Systems, is identical to the original USG RC-1.

The average resilient channel is manufactured in a cross-section shape, appearing like half of a standard hat-shaped furring channel, but with

only one leg. The leg attaches to the wall stud and the gypsum board is attached to the channel face. The channel's leg has special holes for the screws that fasten it to the framing members. Traditional resilient channels that follow the original RC-1 design typically feature a long, slotted hole with circular ends that are wider at the ends than in the middle portion of the slot. Because of the unique shape, these holes are commonly referred to as "dog bones." Resilient channel products featuring various other hole shapes and configurations have consistently yielded lesser results when tested against the original USG RC-1 design over the years.

ACOUSTICAL TESTING FOR RESILIENT CHANNELS

Acoustical testing for resilient channels follows the protocols of: ASTM E336, *Standard Test Method for Measurement of Airborne Sound Insulation in Buildings*; ASTM E90, *Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements*; and ASTM E413, *Classification for Rating Sound Insulation*. They are incorporated into a wall assembly design and tested collectively with the other components. The sound measurement most often required for wall construction is sound transmission class—an integer-number rating of how well an assembly reduces airborne sound transmission. The higher the STC rating, the better the assembly is at reducing the transmission of sound.

By incorporating one brand of resilient channels in a particular wall assembly design and testing it against another brand installed in the same assembly design, acousticians can get an accurate picture of how the resilient channels affect STC ratings. Before choosing a resilient channel for a project, it is wise to research its performance in such tests.

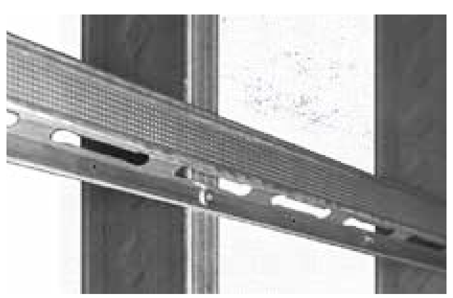
Now, let's look at common resilient channel installation errors, their impact on the acoustical performance of wall assemblies, and how to prevent them.

PREVENTING COMMON INSTALLATION ERRORS

It is important to ensure that resilient channels and the gypsum board are installed properly, as one seemingly minor error can derail the whole acoustical strategy. Let's talk about some of the most common resilient channel installation errors and how to prevent them.

IMPROPER SCREW LENGTH AND PLACEMENT

Screws that attach the gypsum board to the resilient channel must be the correct length and should be located within the space between framing members when the gypsum board is attached. They should never fall directly over a stud. The screw length should be the gypsum board's depth plus 3/8-inch. Acoustical problems arise when installers use screws that are too long, place them directly over a framing member, and allow them to make contact with, or penetrate, the framing member. This gives sound vibrations a direct path to the stud, which will then allow the stud to transmit the vibrations through to the next room. This installation error, known as "short-circuiting," nullifies the acoustical advantages of the resilient channel and significantly reduces the wall assembly's sound attenuation. Just a few "short circuits" will significantly reduce the effectiveness of the entire wall assembly. Installers must either use a screw that's no longer than necessary or guard the stud with a steel-resilient furring channel clip, which slides onto the resilient channel and acts as an impenetrable washer between the resilient channel and stud. Screws will not penetrate the clip because it's a heavier gauge product, adding extra protection from short-circuiting.



IMPROPER MOUNTING

The resilient channel should be mounted perpendicular to the stud framing, with the elongated dog bone holes centered directly over the framing members. This placement helps impede airborne sound vibrations, as the opening slot decreases the area of metal-on-metal contact. It is also important for the attachment flange to face downward. The open side of the resilient channel should face upwards, toward the top of the wall. This placement allows the weight of the installed gypsum board to lead the resilient channel away from the framing. Since the top of the resilient channel has no direct contact with the stud, sound transmission through the wall assembly is disrupted. Installing the open side of the resilient channel downward will press it into the framing, allowing sound waves to resonate through to the stud. When the channel is properly installed, the "RC Deluxe" name can be read. If the channel is installed incorrectly, the name will appear upside down.

There is an exception to this rule, however. The first resilient channel row, starting at the floor level, can be installed with the open side down to facilitate the connection of the resilient channel to the stud. When installing the resilient channel to the wall studs, it should not touch the abutting wall surface. This would result in a short circuit. The first horizontal piece of resilient channel should be installed so the centerline of the face is three inches or less from the floor. The last horizontal row of resilient channel should be no farther than six inches from the ceiling.

SANDWICH INSTALLATION

Another common misstep, known as a "sandwich installation," involves a resilient channel installed onto a solid surface—such as a plywood shear panel—in a way that sandwiches the channel between the gypsum board and the plywood panel. When tested, this installation is an acoustical catastrophe, as it results in a short circuit, negating the value of the resilient channel over the majority of the frequency range.

NEGLECTING TO OFFSET WALLBOARD SEAMS

Whenever the project calls for two layers of gypsum board for additional acoustic control, it is vital to offset the seams on these boards for each layer, as well from the seams on the opposite side of the wall. Vertical seams should also be offset whenever the gypsum board is installed either in a horizontal or vertical application. This blocks any direct sound transmission pathway through the wall assembly.

INSUFFICIENT PARTITION SEALING

Once the wall assembly has been constructed, all direct pathways for sound transmission should be blocked. Drywall installers should thoroughly seal any penetrations, such as electrical outlets, switch boxes or telephone boxes, etc. Avoid having more than one penetration in a stud bay whenever possible. Sealing the perimeter of the assembly with acoustical caulk after everything else is tightened up is also recommended to avoid "flanking," or the traveling of sound through gaps located at the perimeter of the wall assembly and its corners.

CONCLUSION

Wall assembles with properly installed USG RC-1-style resilient channels, sound-absorbing insulation and acoustical sealant can easily rival the acoustical performance of assemblies with premium noise-reducing gypsum board—and for a lower total install cost. They provide a cost-effective strategy for enhancing sound transmission loss, which helps contractors give their customers more performance for their money. By following the guidelines stated here and properly installing resilient channels, contractors can provide the client a high-STC wall assembly at a fraction of the price of those made with alternative materials.

DRYWALL FRAMING SYSTEM CAN SAVE TIME ON THE JOB

Think you can't teach old dogs new tricks? Well, sometimes you can. Think you can't finish an interior frame job 25 percent faster than usual? Sometimes you can do that, too. And, on a really good project, sometimes you can do both. At least if you are Cheyne Jackson you can.

It's true. Jackson, an estimator and project manager for Jackson Quality Drywall of Minden, Nev., did just that on the recent Northern Nevada HOPES community health center construction project in downtown Reno, Nev. Initially, the three-story job was bid using industry-standard metal stud framing that included a bottom track, slotted deflection track, and a full-length metal stud that would screw in at the top and bottom. It would have done just fine; however, Jackson had recently worked with an alternative framing system he thought might work even better for Northern Nevada HOPES. He was spot on.

The system he wanted and ultimately used was ClarkDietrich's TRAKLOC® Drywall Framing System, which can telescope or adjust in length according to variances in the slab. This means contractors can order one length member for the entire project and easily adjust its size as needed without having to stop, measure and cut each stud. This translates into very real time-savings for crews, which ultimately means more profits for the install team. Plus, contractors face none of the safety hazards that come with cutting steel studs and they don't have to fool with nearly as many screws either.

"This is the second time we've used TRAKLOC, and have had success both times. It's been a major labor-savings for us. The less time we spend building something, the more profitable we can be. Plus, it helps the general contractor out with the schedule. We get our work done faster so the trades get to fall in right behind us," Jackson says.

ACTION JACKSON

Everett VanCampen, construction superintendent with The Neenan Co. of Fort Collins, Colo., also has had success using the product. This was the first time he had used the system and is pleased with what he saw. "I think it's a good system. I like the way it works," he says.

VanCampen explained that many of the installers had to undergo a training process to learn how to use TRAKLOC since several, like himself, were unfamiliar with the system. "Even still it was faster than conventional framing," he observes.

Because this was only the second time Jackson had worked with the telescoping studs and the first time for most of his crew members, he acknowledges there was an initial learning curve to overcome. In fact, most of his contractors have been in the industry for years, some a quarter of a century, so the new framing system took a little getting used to. The crew took time during the weekly safety meetings to learn the system, and found that it was quite easy to learn.

"Once you get set in a way of doing something, it can be hard to teach a dog new tricks. But you can, even with new technologies and construction practices," Jackson says. Obviously, his crew was quick to adjust.

All told, the job required 60,000 linear feet of the telescoping stud system. Between two and three crews of two men, deflection studs were installed for floors one and two. The first floor was framed in one week and the second floor was done in three weeks on account of the number of small offices in that space. Floor three, which required elevator studs, took a crew of two men two weeks to complete. The teams easily kept up with the other trades on-site.

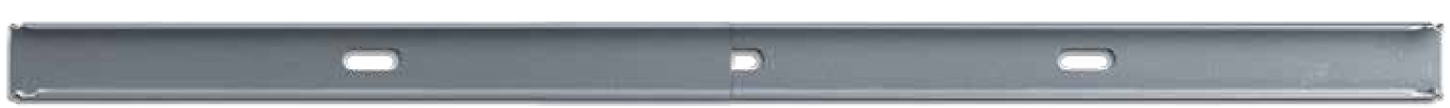
"It's a major labor-savings for us. The less time we spend building something, the more profitable we can be."

While the first two floors were constructed with straight measurements, the third floor was not. This floor, which was also the top floor in the building, was a challenge because the roof sloped to drain rainwater, which in turn caused a significant variation in the deck height. "I ended up using an elevator stud, which you typically use in high-rise buildings. We collapsed the members to eight feet and expanded as needed. This really helped us out because we did not have to cut every single stud," Jackson says.

While the third-floor crew had to screw the top of each member into a slotted deflection track, they saved an immense amount of labor by not having to cut every stud. Nor did they have to screw the bottom of each stud into the track. They simply had to twist and snap them into place.

In the end, Jackson says his crew completed the third-floor install nearly 20 percent faster than originally estimated when the work called for traditional steel studs. The first and second floors were framed an impressive 25 to 30 percent faster.

Jackson says he intends to use the framing system for more jobs down the line. In fact, he's already eyeing it for the next job he's been awarded.



For years, Heavy-Duty Stud, or HDS Framing System, has been used successfully as a high-performance stud for headers and jambs. Recently, Panel Systems Inc. of Woodbridge, Va., and ProBuild Gypsum LLC of Jessup, Md., saw broader potential for the high-capacity stud framing system.

and installs light-gauge framing components for walls, floors and roofs.

Mac McIntosh of the building materials supplier ProBuild concurs. He says Panel Systems, which works closely with his team, is constantly looking to bring innovative approaches

"When ClarkDietrich added punch-out capability to their HDS structural studs, it allowed us to smoothly incorporate them into our wall panels, greatly improving their load-bearing capacity compared to standard stud shapes. With that increased load capacity, we could engineer taller, stouter, light-gauge steel structures with a lot more confidence," says Barry Unger, president of Panel Systems, a company that engineers, fabricates

to cold-formed steel bearing structures and knew the HDS Framing System could play well into high-rise developments. "Upon our urging, the ClarkDietrich crew invested substantially in equipment and engineering to expand the possibilities for HDS," McIntosh says.

Unger and his crew got a chance to test their hypothesis when they won the opportunity to design and manufacture prefabricated wall systems for the massive Dalian on the Park development in Philadelphia. The design team for the project had utilized light-gauge bearing walls before and were impressed by the time- and cost-savings they had achieved on the project. The development of the new HDS stud weighed heavily in their decision to utilize the same structure for the new nine-story apartment tower. Importantly, the factory-made walls would also drastically minimize traffic disruptions in the bustling neighborhood since the walls would ship ready-made to the construction site. Structural engineers with the Harman Group of King of Prussia, Pa., vetted the idea and approved the development to proceed with the prefabricated, light-gauge structural system.

A TALL ORDER

Dalian on the Park was built atop the new Rodin Square, a $160 million mixed-use development that sits on a three-acre plot in a busy quarter of the city. The area features a 55,000-square-foot Whole Foods, a 5,000-square-foot café, office and retail space, 293 luxury apartments, and 30,000 square feet of residential amenity space. It has been a significant construction project to say the least, and Panel Systems provided the approved prefabricated walls for the nine-story residential portion of the development, which sits atop the high-end grocery store.

Most cold-formed framing engineers believe six levels is the maximum effective design to be used, but engineers at Harman Group saw greater potential.

"It's a fairly tall cold-formed load-bearing job, and ClarkDietrich's Heavy-Duty Studs helped us gain the capacity we needed to meet code," says Janis Vacca, principal at Harman Group and engineer of record.

Her team of structural engineers worked closely with Panel Systems to refine the panelized wall design before prefabrication occurred. Much of this involved engineers from Matsen Ford Design Associates of Waukesha, Wis., who tailored the Heavy-Duty Studs to fit the exact design and structural specification for the panelized walls. It was a two-year effort, but one that paid off and one that will likely be repeated on other tall structures built in the future according to all involved.

The wall components not only support nine floors of precast concrete plank; they provide the entire lateral bracing system, eliminating the need for reinforced masonry shafts or special structural steel elements. Moreover, the structural stud walls provide the backup for a significant amount of the interior drywall, saving the time and expense of an independent drywall framing operation.

> **"It's a fairly tall cold-formed load-bearing job, and ClarkDietrich's Heavy-Duty Studs helped us meet code."**

Unger further explained, "There are tremendous gravity loads on the first level of the residential tower. Many studs have to carry upwards of 50,000 pounds. The HDS studs can take these incredible loads. Normally at that load level, you'd be looking at structural steel, but with the HDS Framing System you are looking at a light-gauge steel member." All this strength without need for a masonry core.

GETTING IT DONE

Once the walls were built, they shipped direct to the jobsite where the construction crew methodically erected the stunning z-shaped nine-story residential tower one structurally sound wall at a time. It took a total of 36 flatbed trailers and 120 days to complete the 340,000-square-foot wall install, which was right in line with the construction schedule.

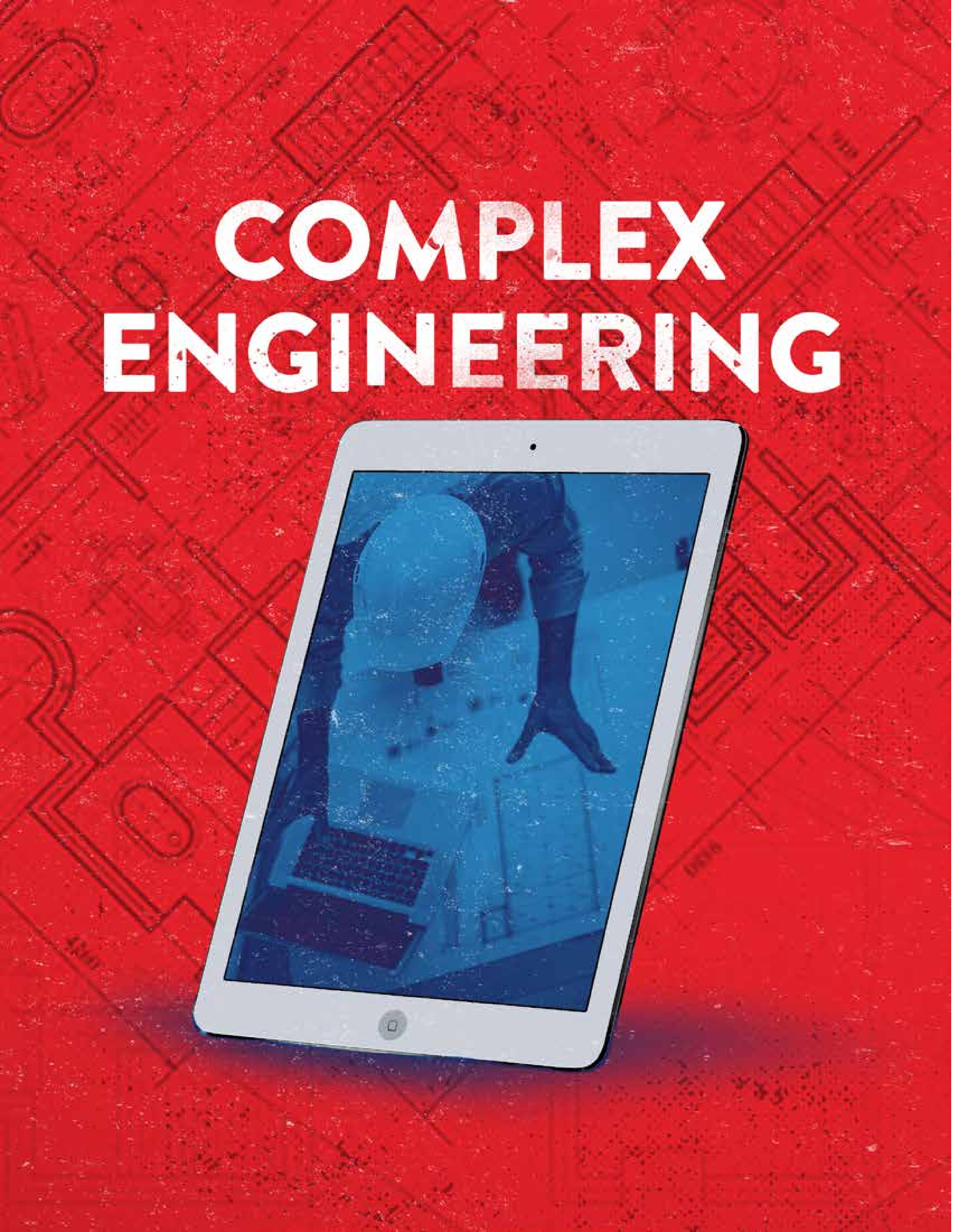
Each level of the building was divided into four sections, one trailer of wall panels per section. The panels were lifted off the trailers and set directly in place. Once the panels were completely installed and braced in one section, the precast plank was set while the walls continued to be installed in the next section. This resulted in no downtime between trades.

"I think the panelized walls turned out to be an economical solution for the residential portion of the development. It meets the design parameters of the project and is a good application," says Vacca.

It is a clever and cost-effective use of HDS sections that was made possible thanks to the ingenuity of Panel Systems and ProBuild's close association with the steel framing manufacturer.

For years, ProBuild has appreciated the innovative approach that Panel Systems is willing to bring to all project opportunities. The owners can get projects from foundation to roof more quickly and within budget.

"Delivering nine-story buildings using panelized HDS framing clearly delivers value in cycle times previously unattainable," says McIntosh.



CLARKDIETRICH ENGINEERING SERVICES TAKES FLIGHT AT HOUSTON'S HOBBY AIRPORT

Just outside the city limits of Houston, William P. Hobby Airport originated as the city's first and only commercial airport. This title held strong until 1969 when the George Bush Intercontinental Airport opened its doors to the public. Hobby Airport then became the secondary airport for local air travel in the region.

In 2013, Southwest Airlines took the opportunity to build their hub at Hobby Airport and make it a focal point to grow flights in this region. Wanting to expand their international flight offerings to the Caribbean and South America, Southwest Airlines called upon Greeley, Colo.-based construction firm Hensel Phelps to develop an expansion plan for its international terminal. This included five new terminal gates—four of which are used by Southwest Airlines for international flights—along with the construction of a parking garage to accommodate the heavier traffic flow. Hensel Phelps assembled a large group of unique subcontractors to complete the expansion. Houston-based Texas Exterior Systems LLC (TES) was among those selected.

TES TAPS THE RIGHT SUPPORT

TES was contracted to do all cold-formed steel stud framing on the interior and exterior of the terminal expansion. They faced several challenges including short construction deadlines, complex framing designs, and the completion of interior, exterior and roof framing for a building with a gross area topping 177,000 square feet.

To ensure the work was done efficiently and with expertise, TES tapped McDonough, Ga.-based ClarkDietrich Engineering Services—a team they have opted to work with on several occasions. They knew ClarkDietrich could help address these issues through building information modeling (BIM) and coordination, panel drawings, and detailed interior and exterior shop drawings including reference plans, section cuts, and framing details for all interior load-bearing and exterior framing conditions. West Chester, Ohio-based ClarkDietrich Building Systems also provided all cold-formed steel framing products for the project.

COMPLEX CHALLENGES NO MATCH FOR EXPERT ENGINEERING

The architectural design of the terminal expansion encompassed some complex engineering challenges. The project included a large radius roof wing with a detailed fascia and soffit

that was engineered and constructed primarily out of cold-formed framing. There was an exterior load-bearing vestibule that required shear walls with x-bracing and shear post design. Interior portions of the project required load-bearing design with engineering ceiling joists, girders and posts to provide a rigid roof structure with adequate capacities to support various quantities of mechanical equipment.

To help reduce construction time, the ClarkDietrich BIM team produced detailed panel drawings for all exterior curtain wall framing that was represented in the engineered shop drawings. Panelizing the framing into 10-foot segments allowed crews to construct the panels on the ground and erect them into the appropriate locations. Each panel drawing included a material schedule as well as a detailed layout of the exact dimensions to accurately assemble the panels before construction. ClarkDietrich's proprietary RedHeader RO™ Rough Opening System was also used at all the typical opening locations. This system, which uses one-piece headers and jambs that are easy to install and adjust, reduced labor and material by not having to assemble built-up members for most opening framing.

To complete the framing for such a large project in an accurate and timely manner, the BIM team coordinated and modeled every stud and track required to frame all the interior and exterior partitions and soffits. "We provided a panel elevation drawing of every wall to show how to lay studs out. We were able to place the studs in such a way that our crews could either miss the MEP trade elements or provide openings that enabled the trades to go through the walls," says Wesley Burghardt, PE, general manager for ClarkDietrich Engineering Services.

Proper coordination with other trades, as well as creating panel drawings with represented partition MEP penetrations, enabled TES to layout and frame large sections of interior framing prior to any MEP being installed. Being accurate and on time with the panel drawings afforded TES the luxury of framing without interference from any other trades while also eliminating any need for rework in the field. Likewise, the trades could use the ClarkDietrich drawings to help guide their own work as well.

A JOB WELL-DONE

"I was really impressed with the modeling and proactive nature of the team. They worked through every issue with a high level of detail. Their contributions were highly valued," says Roy Pinch, virtual design and construction (VDC) engineer with Hensel Phelps' Western district office in Phoenix.

The combination of hard work and coordination between the engineering team and the BIM team at ClarkDietrich allowed this project to be a successful reality. Construction of the William P. Hobby Airport international terminal was completed on Oct. 15, 2015, which brought international air service back to the airport for the first time since 1969, and transformed it into Southwest Airlines' international hub for South American and Caribbean travel.

EQ COATINGS: DISPELLING MISCONCEPTIONS THROUGH FACTS

Over the past few years, much has been written and said about equivalent (EQ) coatings for cold-formed steel (CFS) studs. Despite this, or perhaps because of it, there are lingering doubts and misconceptions harbored by some specifiers about these products' performance. However, they are code-approved coatings worthy of inclusion in project specifications.

This article seeks to dispel any still-lingering misconceptions about EQ coatings in an effort to help specifiers make factually informed decisions on the types of cold-formed steel framing members and their coatings to include in project specifications.

MISCONCEPTION NO. 1: EQ-COATED STEEL STUD FRAMING PRODUCTS ARE NOT RECOGNIZED BY THE IBC.

Simply put, EQ-coated products comply with the International Building Code (IBC) — a point proven in a recent lawsuit. (This is *Clark Western Dietrich Building Systems LLC d/b/a ClarkDietrich v. Certified Steel Stud Association, Inc. et al, case 1:2013cv00818, Ohio Southern District Court*, decided 2015). Specifiers will find a clear path in the building code for the approved use of these coatings starting with Chapter 25 of the code. This chapter sets forth the requirements for steel framing products used in wall assemblies.

Specifically, Section 2506.2 states in part that the materials for wall assemblies "shall conform to the appropriate standards listed in Table 2506.2 and Chapter 35." Figure 1, Table 2506.2 points to ASTM C645, *Standard Specification for Nonstructural Steel Framing Members*, as the required building code standard for non-loadbearing steel studs.

What does ASTM C645 require? Section 4.1 of this standard states the requirement for the steel sheet used to create nonstructural steel framing products, while Section 4.2 sets forth the coating requirements for the finished product. Section 4.2 explicitly states members shall have a protective coating: (1) conforming to ASTM A653, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-*

Coated (Galvannealed) by the Hot-Dip Process — G40 minimum; or (2) have a protective coating with an equivalent corrosion resistance. A G40 coating is a galvanized coating consisting of approximately 99 percent pure zinc applied to the base steel sheet utilizing a hot-dipped coating process. This process, in the simplest of terms, involves passing the steel sheet through a bath of liquid molten zinc, adjusting the thickness of the coating, and then drying the coating. An EQ coating is a supplementary coating applied to an already present zinc-based coating on the steel sheet through a process that creates a permanently bonded composite coating. The resulting composite satisfies the requirements of the building code because it provides corrosion protection equivalent to, or better than, a G40 coating.

As previously indicated, the requirements for coated finished products are found in the building code. The prevalent code that is in use today, the 2012 IBC, clearly recognizes EQ coatings as compliant through reference to ASTM C645 in Chapter 25. The 2015 version of IBC, which is currently beginning the adoption process (and which will eventually replace the 2012 edition), makes the acceptance of EQ coatings even clearer.

Chapter 25 in the 2015 IBC still references part of ASTM C645, but the path to equivalent coatings now goes through a newly revised Chapter 22 ("Steel"), which now includes requirements for nonstructural steel members. For nonstructural steel

members, Chapter 22 cites the American Iron and Steel Institute (AISI) S220, *North American Standard for Cold-Formed Steel Framing – Nonstructural Members.*

It should also be noted Table 2506.2 *(Gypsum Board and Gypsum Panel Products Materials and Accessories)* in the 2015 IBC specifies that for nonstructural cold-formed steel studs and track, the standards are AISI S220 and Section 10 of ASTM C645, thus making both Chapters 22 and 25 consistent with each other. AISI S220 unquestionably permits the use of EQ coatings.

Thus, the ASTM and AISI standards now have identical requirements for corrosion protection of nonstructural steel studs — both state nonstructural members utilized in cold-formed steel framed construction must have a protective coating that conforms to ASTM A653 G40 minimum or have a protective coating with an equivalent corrosion resistance. Accordingly, EQ coatings are approved for use under both the 2012 and 2015 IBC.

MISCONCEPTION NO. 2: EQ COATING IS A PAINT OR PRIMER.

Paints and primers lay on the surface of the steel and can peel or blister off. EQ coatings are not paints or primers. Rather, they form a permanent bond with the zinc-coated substrate. The bonded coating cannot be peeled off or separated from the zinc-coated steel substrate. Additionally, EQ coatings maintain their integrity when scratched, cut, drilled, or punched — commonly occurring conditions on a jobsite. This is because the combined coating offers both barrier protection (i.e., sealing off the steel substrate from moisture) and sacrificial protection (i.e., zinc in the coating sacrifices itself to keep the steel substrate from rusting). Painted coatings do not provide these additional levels of protection.

EQ coatings are not applied like paints and primers. Instead, they are applied to zinc-coated steel sheets through a precision, digitally controlled reverse-roll coating process. This reverse-roll coating process ensures complete immersion of the steel sheet in the EQ coating and ensures full coverage across the width of the coil so there are not any coating 'skips' or uncoated spots. The application process results in a chemical reaction that permanently bonds the EQ coating to the zinc-coated substrate. It also causes the EQ coating to penetrate and fill any cracks and voids in the existing zinc-coated substrate. This seals off the zinc layer and the carbon steel base metal beneath it to prevent formation of an oxide or rust layer. The steel is then cured at an elevated temperature to ensure completion of the bonding process.

MISCONCEPTION NO. 3: EQ COATINGS DO NOT MEET THE CORROSION PERFORMANCE OF G40.

Extensive accelerated salt spray testing in International Accreditation Service (IAS)-certified chambers shows EQ coatings provide corrosion protection equivalent to, or better than, a G40 coating. This testing was conducted in accordance with ASTM A1004, *Standard Practice for Establishing Conformance to the Minimum Expected Corrosion Characteristics of Metallic, Painted-Metallic, and Nonmetallic-Coated Steel Sheet Intended for Use as Cold-Formed Framing Members*, and ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus.*(ASTM A1004 sets forth the practice to be used in assessing the corrosion resistance of different coatings. It mandates an ASTM B117 salt spray test be used for that purpose).

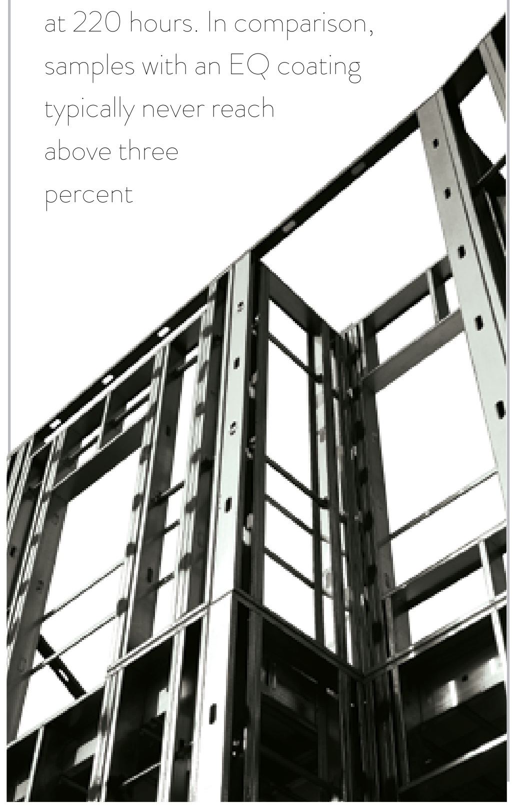
In an accelerated salt fog test, specimens are placed in a sealed chamber into which a fog of heated, salt-infused vapor is introduced. The temperature, humidity, salt solution mixture, and water used are all specified and controlled. Testing is monitored at 24-hour intervals and samples are examined for corrosion once per day. The chamber is only opened for inspection and recording of the condition of the specimens.

ASTM A1003, *Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members*, sets a 75-hour minimum duration for the test. A coating passes the test if it does not lose more than 10 percent of its coating after 75 hours. This criteria is used in the A1004 testing procedure as the pass/fail criteria. It is strictly an hourly requirement.

However, there is a more definitive way of proving equivalent corrosion protection. By utilizing the B117 testing procedure in a head-to-head (side-by-side) comparison of G40- and EQ-coated specimens, the most definitive determination of equivalent corrosion protection is demonstrated. The testing runs continuously until there is failure of the G40-coated specimen. If the EQ-coated specimen outlasts it, then it is a clear demonstration of equivalent corrosion protection.

There has been much discussion recently regarding how long a G40 coating will survive in a B117 salt spray test procedure before it meets the failure criteria. The Steel Framing Industry Association (SFIA)—the largest industry association of stakeholders in the cold-formed steel industry—has conducted a joint testing program with Architectural Testing Inc. (ATI) to determine how long a G40 coating could be expected to survive the B117 test. It was determined 96 hours was the most realistic expectation. This was based on steel samples tested without any additional oils, Chemtreat, or other forms of passivation protection commonly applied to prolong the time to failure.

When EQ coatings have been tested against G40 samples with additional passivation—such as a chromium passivation— it has been observed that on average, the G40 samples begin failing at 120 hours of exposure to salt spray, and rapidly reach the 10 percent surface rust failure threshold at 220 hours. In comparison, samples with an EQ coating typically never reach above three percent surface rust, even after 240 hours of testing.



Further, when the same group of specimens were tested with a scribe that cut through their coating down to the base steel, the EQ coating was shown in this particular test to outperform the G40. This is determined by measuring the amount of creep that occurs where the coating was scratched.

The requirement of ASTM A1003 is to achieve a '6' rating on a scale of 10, with 10 being the most desired rating. While the G40 specimens fail at the '6' rating, the EQ-coated specimens achieved a '9.5' rating. This scribe test shows the EQ coatings are bonded and not painted onto the surface.

Manufacturers of EQ coatings are also able to demonstrate their equivalent to a G40 coating by obtaining a code compliance report issued by an independent American National Standards Institute (ANSI)-accredited International Organization for Standardization (ISO) Guide 65 agency, as well as having their testing performed at an IAS-accredited laboratory. The publication of this third-party report will offer further validation that the EQ-coated steel stud meets the requirements of industry-approved codes.

MISCONCEPTION NO. 4: ALL EQ COATINGS ARE THE SAME.

All EQ coatings are not created equal. While high-performance EQ coatings have been referred to generically as "thin organic coatings," "inter-metallic coatings," or "reactive polymer coatings," they should never be referred to as "paint," "primer," or "veneer." (There is no specific definition for EQ coatings—the letters are generally accepted to mean "equivalent" or "equal." In addition, any other standard metallic coating other than a G40—such as the AZ50 or GF30 used by some manufacturers—is considered an EQ coating so long as it is not a G40 and provides equivalent corrosion resistance in accordance with ASTM C645, par. 4.2. Both ASTM C645 and AISI S220 require marking what coating is on the studs if it is not a G40). As mentioned, EQ-coated products are far more advanced than simple surface treatments.

Not only do EQ coatings provide superior protection, but they are also competitive in the marketplace. This is because manufacturers who use EQ coatings are able to employ excess steel coils with a zinc-based coating that is typically not a G40 coating. The coating on the less-expensive excess steel coils is then enhanced through the application of EQ coatings. This takes material that otherwise would not be usable and makes it into a new product, thus saving energy and removing material from the waste stream.

Additionally, EQ coatings are able to be used in all types of interior nonstructural partitions, whether fire-rated or nonfire-rated. The properties of the coating on a stud are not considered when the structural properties of the stud are calculated. The properties are calculated based on the steel alone without the coating.

HOW TO SPECIFY EQ COATINGS?

This article's purpose is to ensure design/construction professionals have accurate information regarding EQ coatings and their performance. If a specifier chooses to include EQ-coated steel studs in project specifications, here are the code-written rules to follow:

1. **The applicable product standards are ASTM C645 for the 2012 IBC, or AISI S220 for the 2015 IBC. These standards define the stud steel sheet requirements, including minimum return lip, minimum prescriptive thickness or performance, and minimum section properties.**

2. **Steel framing members must use an ASTM A653 G40 coating or a coating that provides corrosion resistance equivalent to a G40 coating. Any coating other than G40 must demonstrate it provides equivalent corrosion resistance. Code Compliance Research Reports (CCRRs) are one way to demonstrate equivalence.**

3. **Manufacturers of steel framing members with EQ coatings should be able to supply a code report from an independent ANSI-accredited agency that certifies the coatings do in fact meet the ASTM C645 and AISI S220 equivalent corrosion protection requirement.**

Following these guidelines will help ensure that the technical specifications direct contractors to use code-approved coatings and avoid the use of flimsy barrier coatings that, in all likelihood, get scratched, cut, and damaged on the construction site. EQ coatings have proven to be an innovation to embrace—one that is also clearly approved by the IBC.

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