by Valerie Bevens

Light Gauge Metal Magic

"I just saw it, but I don't believe it," said Joe Hawkins, P.E., while observing a series of performance tests on various types of door frames. He watched as a twisting force was applied to various steel frames simulating a force applied at an angle to the face of the frames. He had just seen an 18 gauge steel drywall frame torn from a wall with a minimal 120 pounds of force. He then watched as a 20 gauge steel frame anchored on the face of the frame into the wall withstood 200 pounds of force, 10 pounds more than a 16 gauge masonry frame tested previously. It was as if someone was creating an illusion defying all his previous knowledge and assumptions.

He was amazed to see the light gauge frame out-muscle the two hollow metal frames made of much heavier gauge steel. "I was sure the heavy steel frames would easily out-perform the light gauge frame," he said as he continued to write down his observations and corresponding values.

In further testing, the magic act continued. A door was hung in each type of frame and weight was added until the frame had moved out of alignment to the point that the door would no longer close. Once again, the light gauge frame out-performed the heavier frames. The 16 gauge frame failed at 254 pounds and the 18 gauge frame at 250 pounds. The light gauge frame withstood the maximum level of force available with the testing equipment used, 500 pounds, with no failure – the door was still fully operable. How is it possible to successfully hang a 500 pound (or heavier) door in a 20 gauge steel frame?

It's not magic, it's science.

The testing described above occurred in 1986 but the performance of light gauge steel still mystifies many construction industry professionals. It had always been assumed that "heavier" always meant "stronger." But, as has been demonstrated with so many other products commonly used in the building industry, engineered products can be designed using concepts that greatly reduce mass, space requirements and cost while out-performing

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their traditional counterparts. The key to the performance of these light gauge steel door frames was conceived in the early 1960s by an engineer, not by someone steeped in the tradition of the door frame business. By anchoring the frame around the full perimeter, a method not possible with traditional steel frames,

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outstanding performance was achieved. This performance has lead to numerous products that have adopted this concept. This "out of the box" idea remains a mystery to some, but to those who have discovered its advantages, using this door frame has become a true value-added choice for thousands of buildings throughout the world.

The physics of this door frame concept are actually rather simple. The frame sleeves over a finished wall and, using common drywall screws, the frame is fastened to the wall at 11" intervals corresponding to the location of each casing clip. As a result, the force created by the door, a downward lateral force on the hinge jamb, is borne by all the fasteners in a "shear" rather than "direct pull" configuration. As any engineer will confirm, it is much easier to pull a screw directly out of its location than to remove it using a lateral shear force. The quantity and positioning of the screws actually creates a "box" around the framing material making the frame a part of the structure instead of a "stand alone" component. To move the frame, you have to move the entire wall

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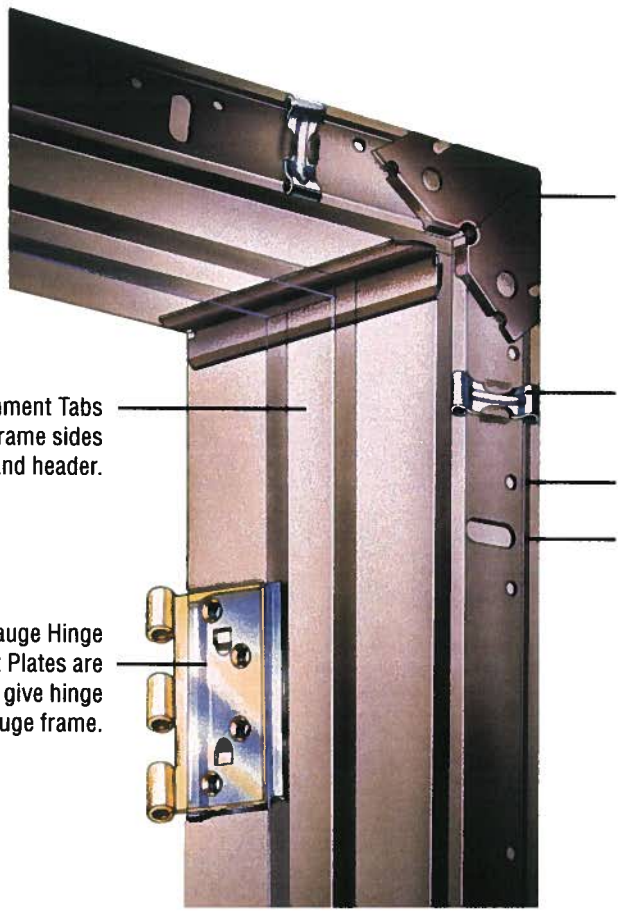
An Inside Look:



structure. With traditional steel frames, only 8 anchor points make it easy to separate the frame from the structure. Once the separation occurs, the frame is "on its own" and only has the thickness of the steel to support the door or withstand the applied forces.

But, the advantages don't stop with this anchorage system. A close examination of the hinge preparation reveals another design concept that leads to superior hinge application performance. Traditional steel frames use a 10 ga. (7 ga. for Grade 1) hinge reinforcing plate. The hinge is actually screwed to the plate and is not attached to the actual frame material. The reinforcing plate is attached to the frame material with 6 "spot" weld points providing a contact area of approximately 0.17 square inches on each plate. If the welding process is not properly controlled, the force of the door can possibly cause failure of the welds and subsequent failure of the door assembly. The welding process and contact area determine the ability of the frame to bear the load, not the thickness of the hinge plate.

The light gauge frame concept does not cut a "hole" in the frame to attach the reinforcing plate. The frame is embossed using specially

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configured dies in heavy presses allowing the hinge to be mortised into the surface of the frame. The reinforcing plate is mechanically attached to the frame and, when the hinge is screwed to the frame, a "sandwich" is produced with the hinge and the reinforcement plate tightening on the steel of the frame. There are no welds to fail. In fact, in order to fail, the actual steel frame material would have to be torn loose. To tear the steel, a force far exceeding the weight of even the heaviest door would be required. And, as a secondary guarantee, the reinforcement plate uses an extruded and tapped screw preparation guaranteeing more actual thread depth than the 7 ga. plate used on the heaviest of steel frames.

But, because of the unique anchoring system, the fasteners have to be concealed somehow. The simplest solution is just to cover them with a hollow casing. Casings on door frames have

	20 Gauge TIMELY		16 Gauge Hollow Metal Masonry		18 Gauge Hollow Metal Drywall	
	Wood Stud Wall	Steel Stud Wall	Wood Stud Wall	Steel Stud Wall	Wood Stud Wall	Steel Stud Wall
Twist: pounds of force required to dislodge anchors from wall or frame (simulates **lateral impact**)	200	180	190	200	120	145
Security: pounds of lateral required to spread jamb legs enough to unlatch door (simulates **forced entry**)	510	565	420	390	282	460
Total Load: pounds of force applied to frame casing causing enough distortion to impair door closing (simulates **door weight**)	500	500	254	205	250	280

Timely frames are always environmentally responsible:

- ***Factory-controlled processing of all by-products***
- ***Pre-finished door frames result in less debris from installation***
- ***Superior quality products without risk to the environment***

been part of the opening design for centuries and only recently have we encountered the flat face of traditional hollow metal frames. To create an exclusive appearance for the door frames and related millwork, heavy thickness wood or PVC moldings must be used to cover the return leg on these frames. With frames designed to accept casings, standard wood products that match other project profiles are used or, if acceptable, most manufacturers have several standard casing options available. The casings are held on with various clip systems designed to keep the casing in place even with the continued vibration of doors opening and closing. The same engineer who designed the

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original frame concept eventually settled on a unique heat-treated clip that is attached to the frame face. This clip maintains its positioning and tensile strength so the casing remains tight even if it is removed and re-installed several times. Other frame systems use similar clips but only those that can be heat-treated are guaranteed to perform satisfactorily over the life of the building. Loose casing can lead to one of the biggest complaints by architects and designers – open miters at casing joints. Heat-treated clips and mechanically-locked corner alignment brackets solve this problem completely.

Once the concept was working and people began to take interest, they needed a version that was fire-rated. Of course, we all knew that the tougher the fire rating requirements, the heavier the steel needed to be. How could a light gauge steel frame withstand the nearly 2,000°F. heat of a fire test? And, what about fire-rated sidelights and borrowed lights? With heavy gauge frames, stiffeners are often required to stabilize the units using the added thickness of the steel to overcome the forces caused by the test. It was assumed that the light gauge steel would be so thin it would easily melt and the test would fail. But, again, science ruled over perception. The 20 gauge frames easily passed a 90 minute positive pressure fire test. In addition, the same frames withstood the rigors of fire exposure for 45 minutes in a 10' by 10' sidelight frame. But, why did the light gauge steel pass these tests so easily? Again, physics explains it. In most cases, door and frame assemblies fail fire tests due to excessive bowing of the frame assembly. If the bowing is severe enough, the latching mechanism fails and the test fails. With heavy

gauge steel, the molecules heat up on the fire side of the frame but, because heat is transferred more slowly through the heavy steel, the molecules on the side away from the furnace are cooler. This differential makes the hot side of the frame "longer" than the cool side and the result is that the frame begins to bow. The thickness of the steel actually contributes to the potential for failure. Conversely, with light gauge steel, heat is transferred quickly from one side of the frame to the other greatly reducing the temperature differential and the subsequent possibility of bowing. The frame becomes a glowing hot, but stable, component with very little bowing. The secrets behind the illusion have been revealed.

Once design professionals understand the superior performance of this door frame, the additional benefits begin to appear:

- Frame is installed over finished walls avoiding jobsite construction damage and project delays
- Frames can be supplied pre-finished, eliminating jobsite painting costs for doors and frames
- Color options are limitless
- Numerous styles of casings are available allowing the designer to "decorate with frames"
- Door, frame and hardware are installed as a unit guaranteeing perfect fit of all components
- One trip to the opening greatly reduces jobsite labor for distribution and installation
- Preparation available for most standard hardware applications
- Application on numerous wall conditions providing uniformity of appearance throughout the project

Using light gauge, pre-finished frames with pre-finished doors results in total opening cost savings of up to 60% – for every opening. And, as was demonstrated earlier, no sacrifice in performance is experienced.

This is the true definition of value – no sacrifice of performance at significantly lower cost.

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