



RBD/HALE'S
Modularized Wall
Panel System
Overview

Insulated Metal Panel (IMP) Steel Framing Modularization

Topics of Discussion

Advantages of Using Modularization

Safety & Quality Control

Cost & Schedules Savings

Ability to Adapt

Connection Designs

Patent-Pending System

Proven Capability From Gray

STANDARD IMP ERECTION METHODOLOGY

Standard construction methodology for insulated metal panel (IMP) cladding over a steel stud wall involves labor-intensive aerial construction of the stud wall, followed by a similar construction process to achieve the installation of the metal panels. Almost 100% of this work must be performed by workers in boom lifts or other aerial working platforms, and the materials must be maneuvered into place with cranes.

Advantages of standard construction methodology:

- Established, tried and true method with known challenges and rate of work.

Disadvantages of standard construction methodology:

- Unsafe: Almost 100% work is done at a height that presents a serious fall risk.
- Inefficiency: Workers are encumbered with 50-75 pounds of gear while working and spend approximately 50% of their time getting into the position at which they can perform their work.
- Slow: The inefficiencies of working at a height requiring fall protection results in a prolonged schedule.

PANELIZED IMP WALL ERECTION METHODOLOGY

RBD/Hale Steel is proposing to modify the methodology for this type of construction with a panelized system that allows for entire wall modules to be constructed at ground level by workers not wearing fall protection. These panel modules will be assembled from prefabricated structural components and then finished and clad on the ground before being lifted into place and secured to the building infrastructure.

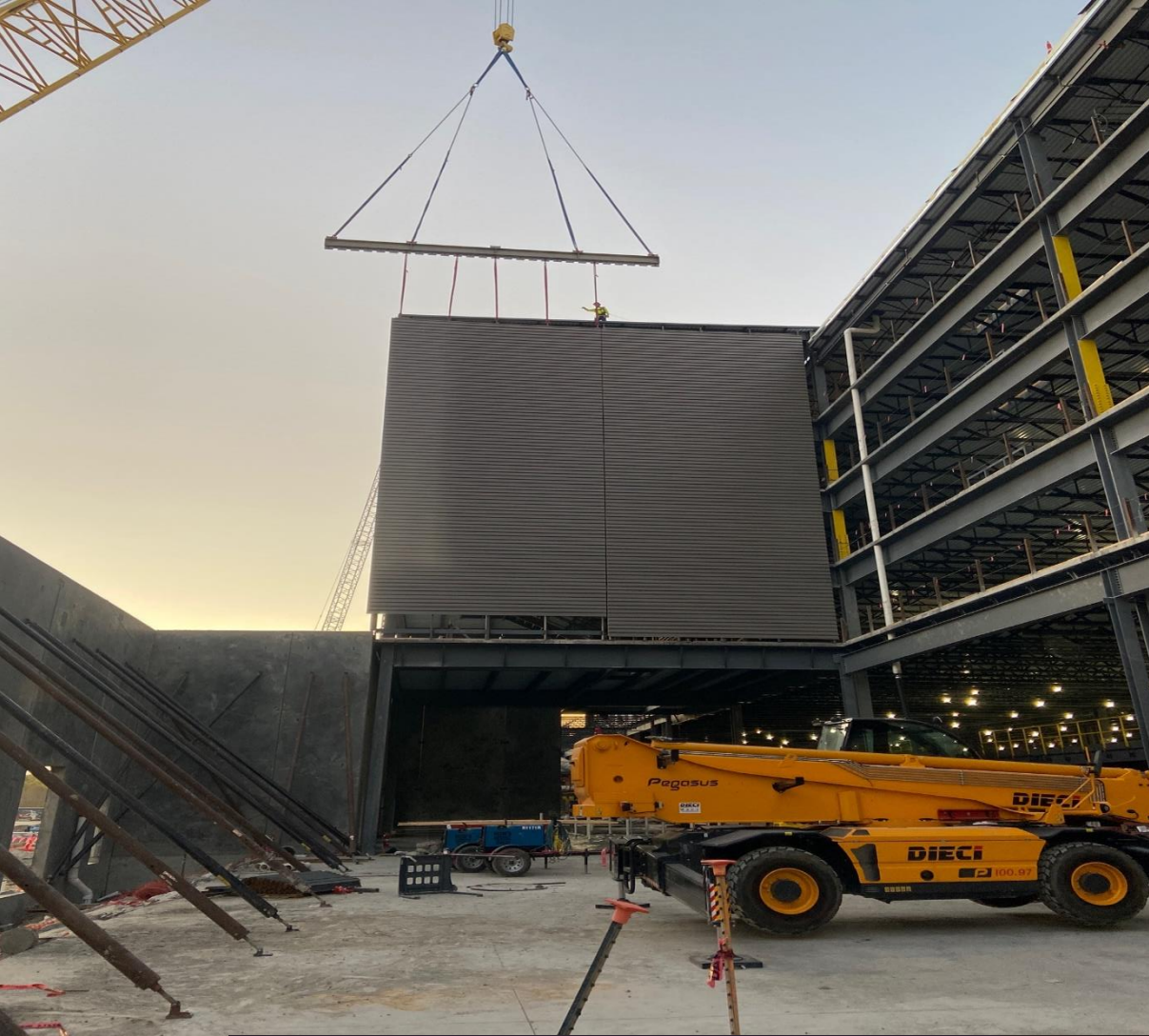
Advantages of panelized wall methodology:

- Safer: Almost 100% work is done at ground level, reducing the fall-risk to normal tripping hazards inherent to all construction activity.
- Efficient: Workers are not wearing heavy fall protection restraints or carrying their tools on their person and can get into position to do their work in seconds as opposed to minutes.
- Faster: The changes allow a portion of the structural work to be pre-fabricated into modular panels ahead of erection on-site.

Disadvantages of panelized wall methodology:

- New methodology that requires careful planning to prepare for risks and challenges

The following is a discussion of the different innovative aspects of this methodology.



Ability to
Install
Modular
Panels with
minimal
interference
with other
trades



Modular
Panels
installed in 3
days
This wall is
240'x 60'
14,400 sqf

Conventional
installation
would take
~ 2 weeks

MODULARIZATION OF STRUCTURAL STEEL SECTIONS

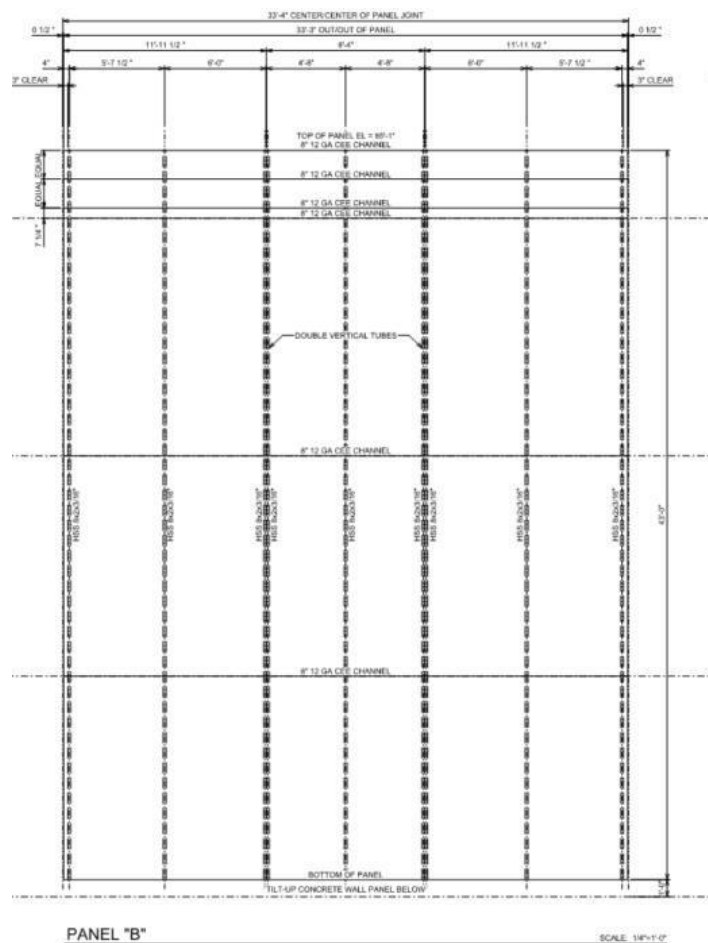
By substituting structural steel modules for steel studs in the wall frame, a new wall system is achieved that: 1) is stronger, delivering a better end product; 2) can be modularized and partially assembled on-site before installation, and 3) creates a more rigid platform that allows for the panelization methodology being proposed by RBD/Hale Steel.

To achieve this modularization, each module will be pre-assembled on site at ground level. The module will contain pre-fabricated pieces that will easily and quickly be bolted together. All welding is done in the shop. No welding is required for pre assembly of modularization.

Once the steel framing is assembled on the Lift Table, the insulated metal wall panels will be installed. This completed structural module can then be rigged up and lifted into place as a single wall section.

Advantages of Modularized Structural Steel Construction:

- Quality Control: Tolerances, welds, and alignment can be verified in a well-lit, covered shop environment.
- Availability for Inspection: GC can verify performance with an inspection at any point during the construction process without any special accommodations to access the work (boom lifts, fall protection, etc.) and prior to final installation.
- Safety & efficiency of work: minimalization of work performed by personnel at heights requiring fall protection.
- Efficiency of equipment use: Minimalization of crane rigging, hoisting and boom lift use.
- Allows for other innovative processes, such as panelization.



The most obvious disadvantage to this method is the material cost. However, this cost increase must be compared to other potential cost savings that can be generated by utilizing this method. For example, reduced labor costs, and, most significantly, the ability to shorten the construction schedule.



Example of Real Estate required to build modules



Demonstration of reduced fall hazards

GROUND-LEVEL INSTALLATION OF INSULATED METAL PANELS

The modularization of the structural steel sections achieves a strong, rigid frame that opens the door to additional innovations, the most significant of which is the opportunity to install the Insulated Metal Panels (IMP) at ground level.

Typically, the installation of such panels involves a minimum of an eight-man crew, two boom lifts, and a crane. Due to the complexities of working at such a height and the coordination required between all the equipment, the process is slow and laborious.

However, with the implementation of the modular system described above, these panels can be fastened to the structural steel frame and lifted into place with the structural module.



Advantages of Ground-Level Installation of IMP of Module:

- Quality Control: Panel work can be closely examined from ground level prior to lifting into place.
- Availability for Inspection: GC can verify performance with an inspection at any point during the construction process without any special accommodations to access the work (boom lifts, fall protection, etc.) and prior to final installation.
- Safety & efficiency of work: Minimalization of work performed by personnel at heights requiring fall protection.
- Efficiency of equipment use: Minimalization of crane rigging, hoisting, and boom lift use.
- Ability to maintain accurate alignment of panels.

Challenges of Ground-Level Installation of IMP of Module:

- Protection of panel facade during lifting and installation.
- Protection of panel from excessive deflection during lifting.
- Site conditions and available staging area.

The challenges of protecting the panels during lifting and installation required an innovation in the method used for picking and lifting the panels. These challenges will be addressed with the Tilt Table discussed in the next section.

The challenges related to the alignment require tight survey control. This control will be achieved using a Hilti robotic total station to survey the structural frame of the building and align points on the face of the panel accordingly.

RBD/HALE STEEL'S TILT TABLE

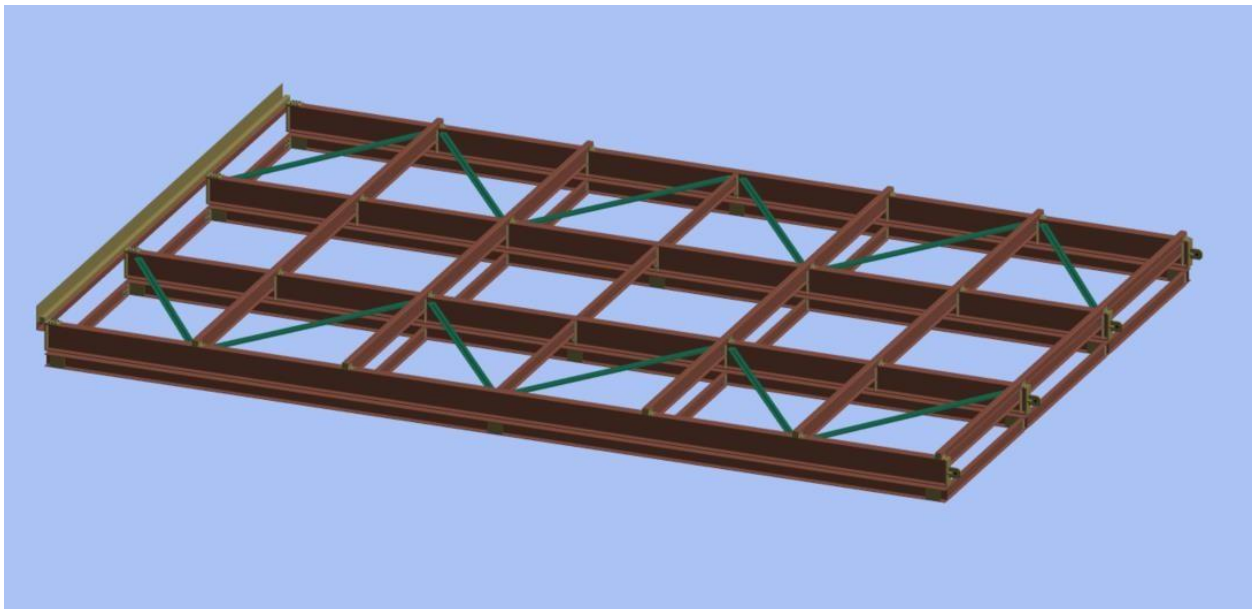
RBD/Hale Steel has designed and constructed a patent-pending Tilt Table to provide a safe, ground-level working platform on which to assemble the modules, install the IMP panels, and then to transition the module from a horizontal position to an 80° vertical position.

Typically, to transition a modular panel from a horizontal position to a vertical position, rolling blocks would be used to lift the panel from four points. This method, however, requires attachment points on the face of the panel, which would be incompatible with the panelization of the modules. Additionally, the process of lifting and rotating a module to vertical would create a bending moment in the structural elements of the panel that could create a deflection in excess of what the IMP connections can tolerate. Both of these problems are solved with the patent-pending Tilt Table.

Advantages:

- Minimizes stresses within module: limits maximum deflection to one inch
- Efficiency of rigging: panel is rigged only once at ground level for vertical lifting
- Protection of IMP facade: no rigging is required on or across the face of the module
- Provides level working platform at a safe height not requiring fall protection
- Accommodates the ground-level construction innovations previously discussed

The Tilt Table is constructed with bolted connections to allow for disassembly and reassembly on the project site. Additionally, it is constructed so that it can be leveled for each setup. Once on-site, the table is designed with integral pick points that allow it to be lifted with a crane. For this particular project, a crawler crane will be on site. This will provide the option to pick and carry the table to another location quickly and efficiently.



Tilt Table allows the ability to lift modules from a horizontal to vertical position with less than 1" deflection

VERTON REMOTE LOAD CONTROL SYSTEM

Standard load control methodology involves the use of tag lines. On a project of this nature, four people would hold tag lines attached to a completed module to control and stabilize the load during lifting. However, much of this project involves installation above a lower roof that will be installed at the time of construction. To effectively use taglines in this situation, four additional personnel would need to be stationed on the lower roofs to grab the tag lines and carry them across the roofs. This would require eight people just for tag lines!

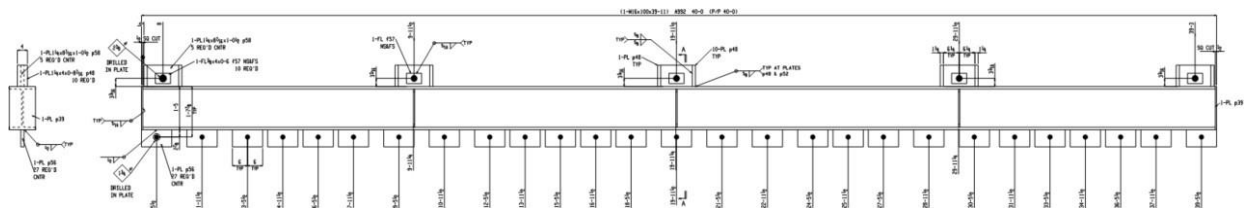
On this project, RBD/Hale Steel is using a **Verton Everest 6 remote load control system** in lieu of a traditional tag-line system. This system uses a self-contained unit that is rigged on the engineered lifting beam designed for this project. The Verton unit contains gyroscopic fly wheels that use angular momentum to keep the load stable or to orient the load while being lifted. The Verton system requires only a single remote operator who does not need to be underneath the load, providing a safer working environment and much more efficient access across obstacles.

Advantages of Verton Load Control over Tag-Line Method:

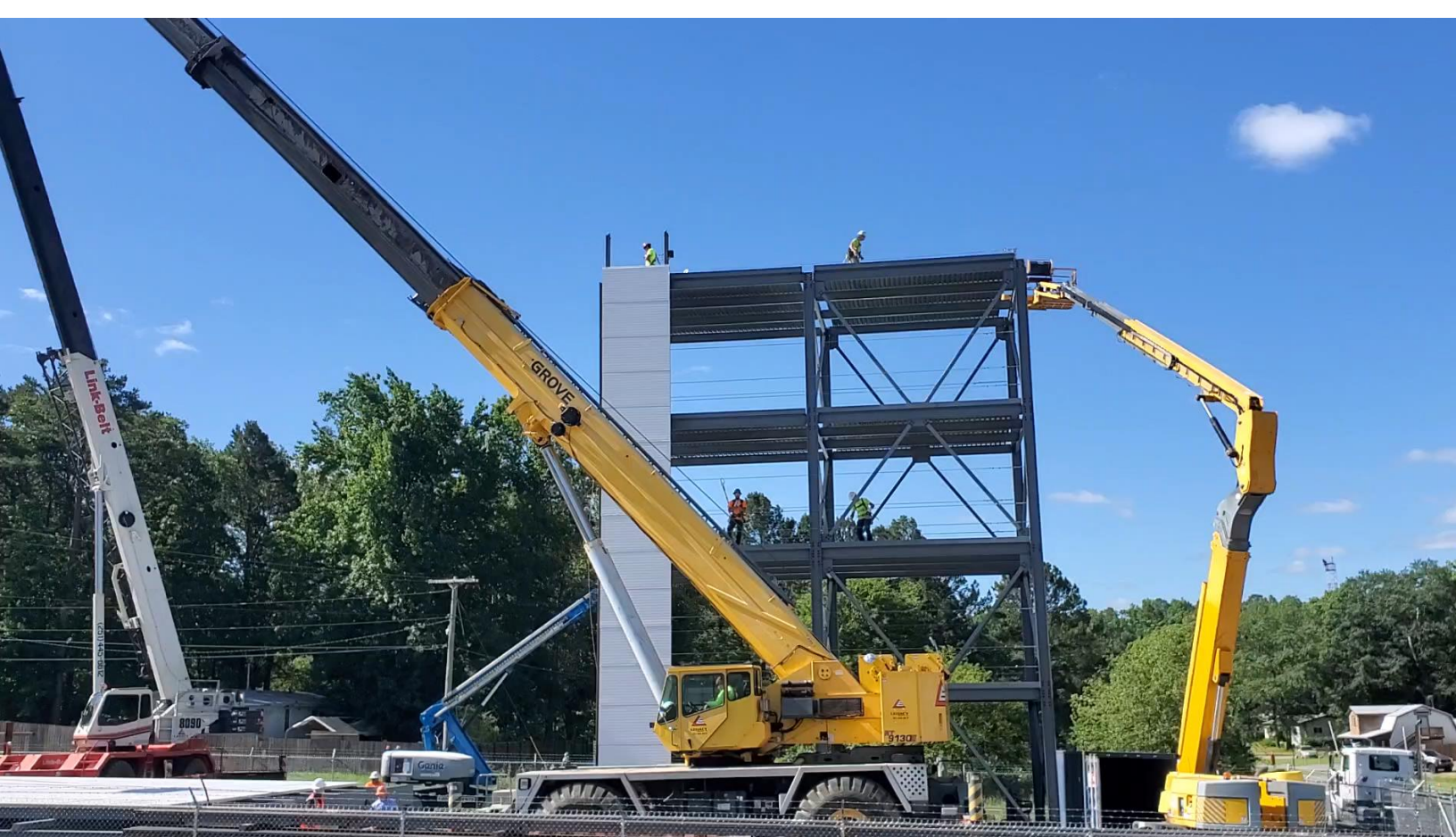
- **Personnel Safety:** No personnel working under the load.
- **Worksite Safety:** No total loss of load control in event of sudden wind gusts.
- **Maneuverability:** No tag-line hand-off needed at obstacles
- **Efficiency of work:** Minimal personnel needed to control load.



RBD/Hale Steel has personnel trained by the manufacturer in the use of the Verton Everest 6 remote load control system. *Please note: To conform to OSHA and Hale Steel company policy, two unmanned tag-lines will be attached to the modules during all lifting activities for redundant safety.*



Detail of Custom-Engineered Lifting Bar for this project.



QUALITY CONTROL OF PANEL ALIGNMENT – ROBOTIC TOTAL STATION

In any metal panel construction project, keeping the panel alignment consistent and aesthetically pleasing can be a significant challenge. Due to the scale of this project, simpler methods such as a plumb bob or level will not suffice. RBD/Hale Steel proposes to tackle this challenge in two ways.

The first critical step occurs on the ground. The panel alignment is carefully verified before, during, and after installation onto the module while it is being assembled on a level table at ground level. If desired, the alignment of the installed panels can be observed by the General Contractor’s personnel during this time.

The second critical step in the visual alignment of the panels relates to the aerial alignment of the panelized modules on the face of the building. To handle this challenge, RBD/Hale Steel will be using a **Hilti POS 180 robotic total station and PLC 400**

tablet to achieve three-dimensional survey control for module alignment. This equipment will allow the operator to verify the tolerances on the existing building structure, confirm that adjacent modules are square with one another, and plumb the modules against the face of the building.



AISC Steel Tolerances	IMP Tolerances
¼" in 20'	1/8" to 1/4 " in 20'
½" in 40'	1/8" to 1/4 " in 40'
¾" in 60'	1/8" to 1/4 " in 60'
1" in 80'	1/8" to 1/4 " in 80'

Method	Conventional	Modularization
Pieces to Align	~3000	~150



VERTICAL CONNECTION OF PANELIZED MODULE TO BUILDING INFRASTRUCTURE

One of the challenges of a modular system is connecting it to the load-bearing structure of the building. To address this challenge in the proven system, RBD/Hale Steel is using a connection system similar to those used in concrete tilt-up panel construction.

Prior to the concrete being placed for each floor, RBD/Hale Steel will weld in a continuous embed plate along the steel angle (pour stop) at the exterior edge of the concrete floor slabs. There will be a protruding 4 x 4 continuous angle on the back of the module that mechanically engages with these embed plates.

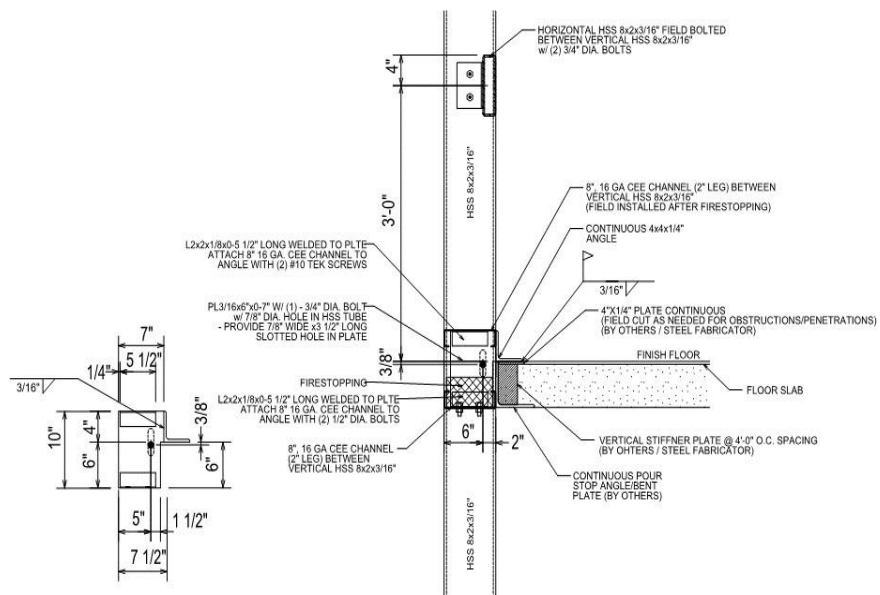
As the panelized module is lifted into place, the panel module will be aligned with the building approximately twelve inches high and slowly lowered into place until all connection points engage. After the panel alignment is confirmed using the total station survey equipment described above, the connection points will be securely welded on each floor and along the roof with the crane still holding the bulk of the module's weight. This welding will be performed simultaneously on all floors and on the roof by workers protected by using an approved fall restraint system. Once the welds are completed and checked, the crane rigging will be detached from the panel and the process is complete.

A unique component of this connection design is the lateral support members within the structural frame at the level of each concrete floor. This element consists of a steel plate shop welded to the protruding 4 x 4 continuous angle that is bolted to the vertical member of the structural module. The continuous angle piece, as noted above, is used for connection to the embed plates in each concrete floor.

The connection design of the steel plate weld to the 4x4 angle and bolted to the vertical elements of the structural module is specifically designed to meet and exceed required deflection allowances from deflection of floor slabs. The 4x4 angle is connected to the vertical frame of the structural module using a steel plate with a three-

inch-long vertical slot that will allow the channel to deflect downward with the concrete floor slab by as much as two inches. This achieves a "floating" connection that does not convey shear or bending moment (within reasonable limits of deflection), but still provides full lateral stability between the floor connection and the façade wall.

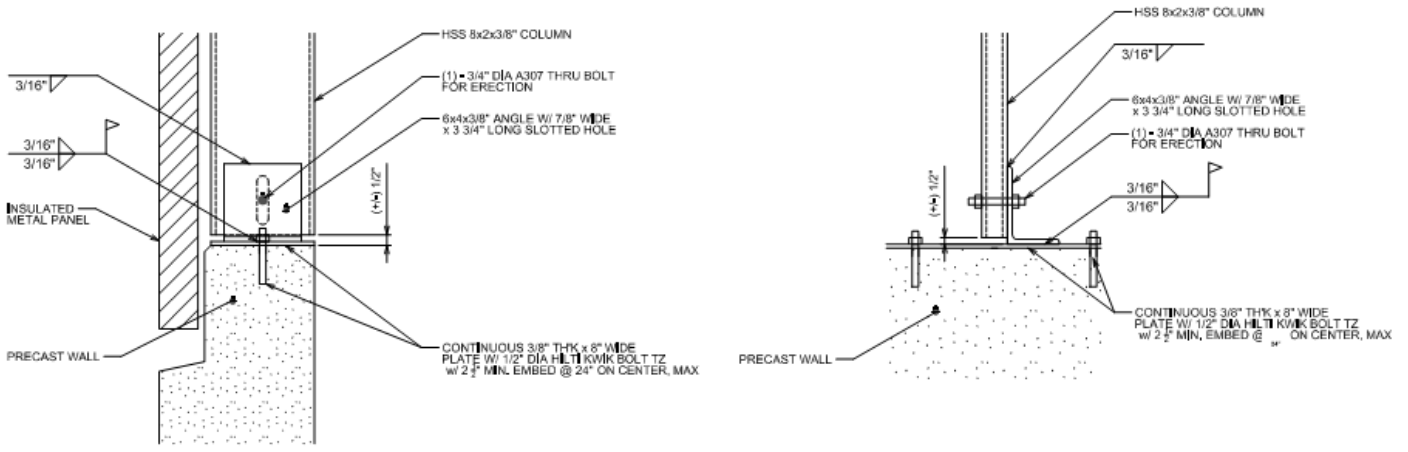
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ALTERNATE TYPICAL INTERMEDIATE FLOORS CONN'X PLATE w/(1) 3/4" BOLT

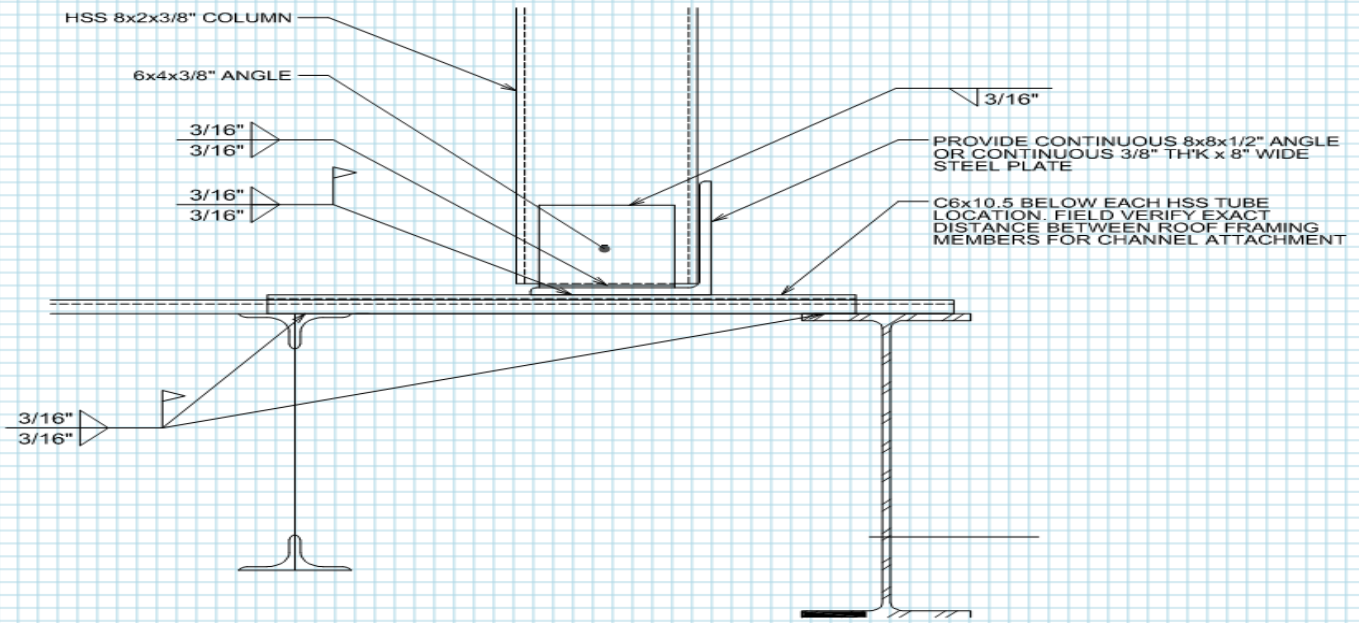


Connection Design allows for ~2" vertical deflection of the module.

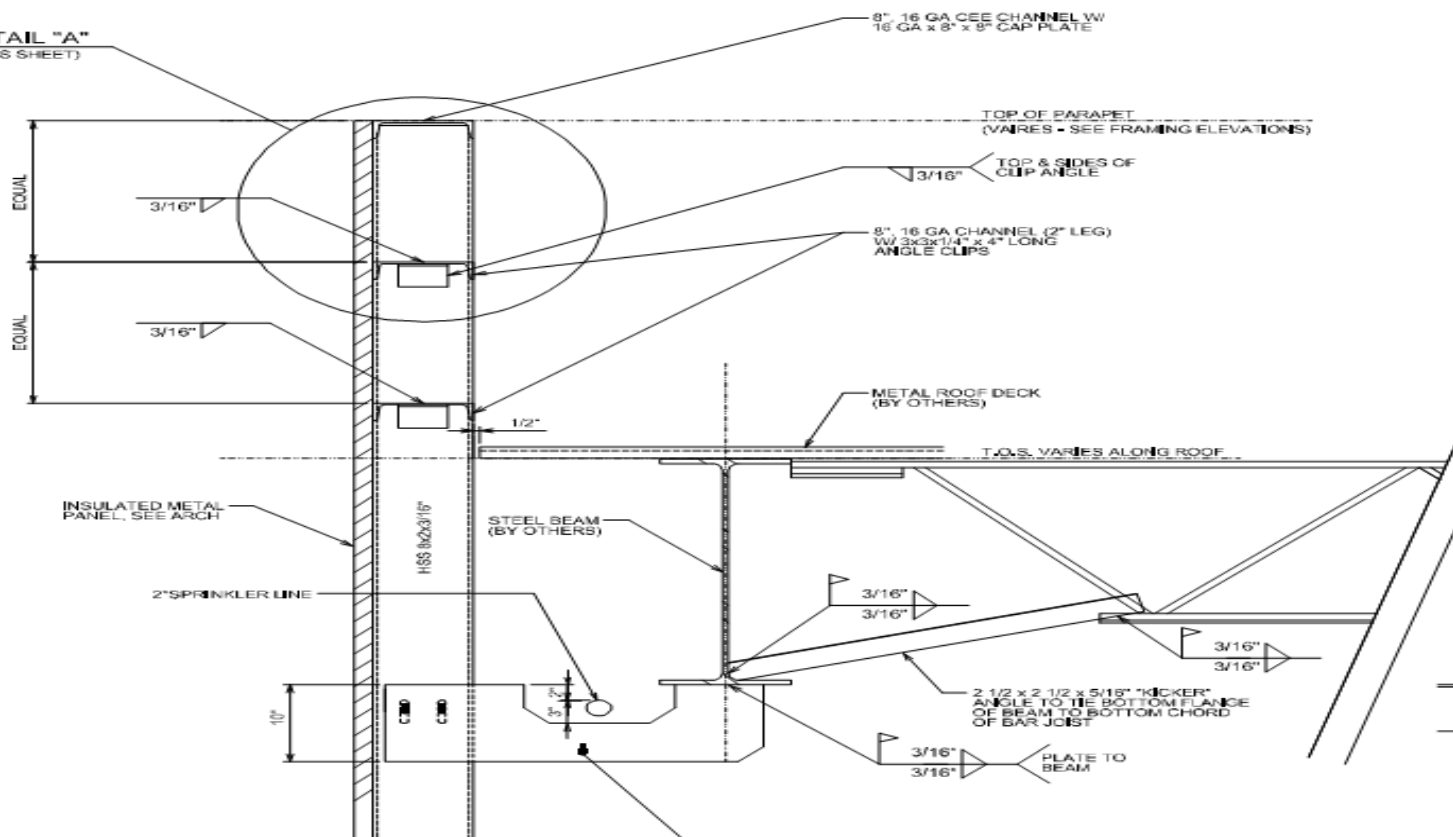


TYPICAL BASE CONN'X DETAIL @ PRECAST WALL

SCALE: 1/2"=1'-0"



DETAIL "A"
(THIS SHEET)





March 09 / 2021

Letter of Recommendation

To whom it may concern,

It is with great pleasure that I write to recommend RBD Construction/Hale Steel (RBD). We selected RBD as our metal panel contractor for a large multilevel sort facility in Little Rock, AR. It was clear that this company shared similar values to that of Gray. **RBD was competitive, punctual, accurate, responsive, but most importantly, innovative.** RBD had a vision of panelizing the exterior IMP walls with the secondary framing as a turnkey system in an effort to capture some of the efficiencies we have all seen in the steel/deck construction. Their engineering efforts, mock ups, trials and in person tests witnessed by the EOR's AOR's and other consultants illustrated that they had **developed a system that would perform.** Their process did come with a learning curve, but the project still recognized a lot of benefit that RBD brought to surface and certainly helped RBD improve their methods along the way, making them more efficient with every module. I can speak on behalf of the entire team and consider RBD a valued partner here at Gray. **We would not hesitate in similar circumstances to partner with them again.**

Best Regards,

Drew Romans

Regional Manager, Southeast
Gray Construction



gray.com

1728 3rd Ave. N
Suite 100
Birmingham, AL 35203

T: 205.380.1800
F: 205.380.1819

David

I would like to take a moment to thank you for the work that your entire team was able to accomplish here at LIT-1. To be honest the entire process was an exciting experience that we at Gray hope to replicate in the near future. I know that both [REDACTED] and our developer Panattoni were equally as excited to see your system role out and very happy with the finished product. On a recent visit, some senior level [REDACTED] representatives noted several of the benefits outside of the obvious general construction positives. Your system has them thinking about how they can now eliminate both time and materials from the overall construction scope while improving the building and its usability. Being able to configure the structural steel will allow for adding bump protection inside of the building and a strong substrate to attach cable trays and conveyor to. The safety aspect of having liner panel inside the building is a constant worry as it is subject to mishappenings over time and leaves edges that have to consistently be reworked. Using the horizontal "C" Channel supports in a guard rail elevation configuration was a huge plus to them. The smooth surface is something that they are taking back to World Wide design for use in [REDACTED] facilities where light gauge surfaces always take abuse. The main take away is that there is more that [REDACTED] can design into and around this system making their scope installation and then end use of the being last longer and fit into the ever evolving world of change that is Amazon.

I know that the Gray Team is now, as they say "woke" to the possibilities that we could apply this technique both in our Distribution Units [REDACTED] our other Divisions. We here have been brought into many conversations about upcoming projects with this system being used as a possible installation method. Now that we understand how flexible this system can be applied in to a multitude of evolutions within our ever constricting time tables. We love the ability to enclose the building and not being dependent on multiple structural attachments. Leaving out a panel or removing at certain points allowing access for equipment install was a huge hit for our industrial and food and beverage Divisions. Now that sequencing of your package is understood we can use the engineered panel book ahead of time and allow for a flow to be established ahead of time in the planning process our future projects, enclosing and protecting certain areas while the system and its installation is so mobile that the process can simply advance and continue. Being able to jump to problem areas as they are planned or arise keep the fluidity of the project moving in a successful manner.

Finally safety and this point should have been my first validation to your system. In a traditional method having multiple elevated working personnel in coincidence with cranes and the overall congestion of the projects that we are all apart of is now a very less appealing risk that we do not have to bestow on a team to manage. The ability to have both of our QC team safely able to be on the ground and review the entire assembly of each module before the erection of the module is a benefit that I cannot voice enough. Being able to remove barricades and land modules to the building while a crew safely works from the building elevations is perfect to mitigate the risk to your team but also to the other trades working within the same areas. I know that there were times that as a module was landed that we ha

crew mounting pre made modules of electrical panels. Decreasing time back from the other trades here as allowing for such large quantities clearly was a huge part of their planning and success. I do feel extremely confident in the front end planning phases that we can capture even more time to work to flow.

ward to working along the side of your team in the future but until the project from myself and the entire Gray Construction Project Team.



Matt Brown

SITE MANAGER

Gray
10 Quality Street
Lexington, KY 40507-1450
Office: 859.281.5000
Mobile: 859.475.2247
mbrown@gray.com
gray.com

[LINKEDIN](#) | [TWITTER](#) | [FACEBOOK](#)

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Job Completion of Modularization used on Project Diamond (Amazon)



