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Guide to the Performance-Based Nonstructural Partition Selection of Cold-Formed Steel Framing

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Questions relating to nonstructural applications of cold-formed steel framing continually arise including clarification of the role of the architect in performance-based specifications. What is the role and accountability of the contractor in this same scenario? Acknowledging the complexities of design in interior non-load-bearing drywall steel studs, should the architect contemplate using the process of *delegated design*? When should a structural cold-formed steel stud be considered for these applications?

This paper will focus on performance-based solutions and provide guidance on deciding when structural cold-formed steel studs are the appropriate design solution. A critical juncture in the path that leads to a completed construction project is where the architect must review and approve what the contractor has proposed. While this juncture is crucial in both delegated design and performance-based projects, this paper will target how the architect can make an informed decision on interior nonstructural partitions that have been proposed through the bid stage in a performance-based environment.

THE SELECTION PROCESS

All building projects go through similar phases in design and construction. The commonality occurs when the architect first starts the initial framework of design and concludes when the project is complete. In the design phase, as more information is obtained, the final solution comes into better focus with building materials selected and specified. BIM technology has the concept of *Level of Development*, or LOD, which describes the evolution in the design process.

The 2021 version of the *Level of Development (LOD) Specification* published by BIMForum, an organization that exists “to drive practical implementation of technology and processes to improve the future of the built environment,” has established five *Levels of*

Development specific to “Interior Wall (Cold-Formed Metal Framing).” The levels are listed as 100, 200, 300, 350, and 400. The higher the number the more information provided.

There are two types of specifications utilized in the process: prescriptive and performance-based. Nonstructural cold-formed steel applications, such as interior drywall stud partitions, are transitioning from prescriptive to performance-based. Performance-based design offers flexibility and innovation, which all parties in the construction process will find of benefit. The model code has shifted to this concept as it converts from ASTM to AISI as referenced Standards that define cold-formed steel framing. For these very reasons, the transition is supported by the Steel Framing Industry Association (SFIA).

Combining the concepts of *Level of Development* and performance-based specifications is the basis for understanding how the design and installation of nonstructural cold-formed steel framing should progress on a given project. In the BIM analogy, the architect lays the foundation for the final solution. The contractor then takes the model, which is in a lower *Level of Development*, and “fills in the blanks” of what is required. Time constraints predominate as the demand for the start of construction overshadows all decisions. If delegated design was the chosen model, it will most likely become an impediment to efficiency.

At this point, the architect should review what the contractor has proposed, and essentially approve the contractor’s interpretation of the design intent. Using the BIM analogy along with its *Level of Development* concept, this would equate to a Level 350 specification, which will be further defined later in this document.

In nonstructural cold-formed steel framing applications a direct comparison can be made. The architect provides the basis of design, and the contractor

transforms that basis of design into the final solution, which is subject to the architect's approval.

At this point, a walk through the various phases of design and construction is warranted to illustrate the

transition from one phase to the next in a performance-based environment.

The following diagram illustrates the various phases of a common construction project:

Phases of a Common Construction Project



The role of the architect is instrumental in schematics, design development, and construction documents. In the traditional design-bid-build construct, and utilizing a performance-based approach, the contractor assumes the role of interpreting what is described in the construction documents in submitting proposed solutions.

This step is analogous to an airline pilot repeating back the directive given by an air traffic controller as a means of confirming that the pilot understands the instruction. In the case of the pilot, the response is given in reverse order to prove comprehension. The architect then is charged with approving or rejecting. This process gets a little murky relating to liability under a delegated design scenario.

In the performance-based situation, the contractor's solutions must show compliance to the project and receive the architect's final approval.



When a project is in schematics there is very little defined as to partition types and partition layouts. Everything is in a state of fluidity and alternate design solutions are reviewed and are either adopted or

discarded. From a partition schedule development process, all decisions are made within the scope of work for the design professional. In the BIM LOD environment, this is considered Level 100.



The overall design solution has been selected. This is the stage where the role of the consultant should be considered. The construction industry has entered an age of specialization, where architects seek expertise in particular disciplines such as acoustics, fire science, code compliance, and specifications. This expertise is in the form of consultants who are hired by the architect and provide recommendations for the design team to consider. Delegated design is excluded in this discussion.

Targeting the interior partition, some of the important issues to consider include code compliance, fire resistance, acoustical performance, and structural expertise.

Architects could consider reaching out to consultants with expertise in the above disciplines. Cold-formed steel framing manufacturers and SFIA are also good

resources which, like many consultants, make architectural specifications templates available online.

A generalized partition schedule is starting to emerge. Sources of information to determine wall types are:

- SFA design guide – *A Guide to Fire & Acoustic Data for Cold-Formed Steel Floor, Wall & Roof Assemblies*. Located at www.cfsteel.org
- *GA 600 Fire Resistance and Sound Control Design Manual* from the Gypsum Association
- International Building Code® Table 721.1 Rated Fire-Resistance Periods for Various Walls and Partitions
- Individual cold-formed steel framing manufacturers
- Individual gypsum board manufacturers

Wall thicknesses are in the process of being determined. Partition layouts, wall heights are all still flexible. Building materials are being selected and integrated into the design. Initial construction budget numbers are generated, and primary partition decisions are within the scope of the design professional.

This is Level 200 in the *Level of Development Specification* for BIM.

Construction Documents

The partition schedule embedded in the construction documents is ready for contractor bids. Framing member size and depth are given. Fire resistance, acoustical performance, and wall height requirements are determined.

Architectural specifications are complete and should include language specific to performance-based requirements. These include:

- Fire ratings
- Allowable deflection limits based on intended finishes
- Acoustical ratings
- Wall hung fixtures

The partition schedule should only include wall types that meet the above performance requirements (fire, sound, structure, moisture, and aesthetics) and can be verified by acceptable documentation (third party witnessed testing or engineering evaluations). This third-party requirement should be clearly stated and become a necessary step in the submittal review process.

At this stage, exact wall heights should be determined, as well as how much the structure is designed to move based on building movement and deflection from loads, both dead and live. There should also be some determination of shrinkage from primary structural elements (for example, concrete or mass timber, CLT). This information is required to ensure the correct head-of-wall is utilized.

Wall height tables to determine the correct stud size and steel thickness are widely available. Individual framing manufacturers have their own proprietary tables. SFIA has published generic profile tables as well. At this stage, it should be decided if the wall heights can be determined using composite or non-composite tables. The composite tables recognize the contribution to stiffness (reduced deflection) of the wall that is derived when gypsum panels are installed in a certain manner on both sides of the stud.

In the BIM environment, this is LOD 300. The contractor at this point takes that information and expands the LOD to Level 350. LOD 350 is defined as:

The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, orientation, and interfaces with other building systems. Non-graphic

information may also be attached to the Model Element.

Extending this to interior partitions with cold-formed steel framing (as referenced in C1010.10.20 of the *Level of Development Specification*), the LOD specifications for LOD 350 state *cold-formed metal framing is developed with sufficient elements to support detailed interface coordination with other systems such as MEP. All penetrations are modeled at actual rough opening dimension.* In some cases, the hand-off from architect to contractor is at LOD 200. This is where generic wall objects are separated by type of material (gypsum or masonry). An approximate wall thickness is given, and layouts are still flexible. The architect proceeds to a certain *Level of Development* with the contractor completing the model (with approval from the architect).

In some cases, the framing must have the ability to support items that will be “hung” off the partition. If that is required, the architect must undertake extra analysis and answer some important questions: What is the additional load? Does the desired stud have the capacity to carry that load? The stud must also have the capacity to withstand the increased bending stress. Shear and pullout of the intended fasteners need to be considered. The role of the architect is to establish the

performance requirements that allows the contractor to select the appropriate framing member and fastener to meet the architect’s design parameters. The contractor’s solution is then communicated back to the architect through the submittal process.

Fasteners play a pivotal role in nonstructural applications. This is especially true for equipment to be supported by the nonstructural framing. Fastener load capacity must be analyzed when considering steel thickness of the framing member (and any accessory items). Steel framing thickness is a key consideration.

Table 1 below is taken from the *SFIA Technical Guide for Cold-Formed Steel Framing Products (2023)*.

In the table, nonstructural framing is in the 18 to 30 mil steel thickness range. The tensile value considers both “pull-out” and what is called “pull-over.” These values are not applicable to the new generation “equivalent” framing. The individual manufacturers of these proprietary products have data to support their product’s fastener performance. Given the weight of the item to be “hung” on the nonstructural cold-formed steel framing, the contractor is in the position to determine the proper framing member based on its fastener load capacity.

Table 1

Allowable Screw Connection Capacity (Pounds per Screw)										
Thickness (Mils)	Yield Strength, F _y (ksi)	Tensile Strength, F _u (ksi)	# 6 Screw		# 8 Screw		# 10 Screw		# 12 Screw	
			(0.138" Dia, 1/4" Head)		(0.164" Dia, 5/16" Head)		(0.190" Dia, 3/40" Head)		(0.216" Dia, 0.340" Head)	
			Shear	Tension	Shear	Tension	Shear	Tension	Shear	Tension
18	33	33	44	24	48	29	52	33	55	38
27	33	33	82	37	89	43	96	50	102	57
30	33	33	95	40	103	48	111	55	118	63
33	33	45	151	61	164	72	177	84	188	95
43	33	45	214	79	244	94	263	109	280	124
54	33	45	214	100	303	118	370	137	394	156
54	50	65	214	123	303	171	406	198	525	225
68	33	45	214	123	303	149	406	173	525	196
68	50	65	214	123	303	173	406	232	525	284
97	33	45	214	123	303	173	406	232	525	280
97	50	65	214	123	303	173	406	232	525	300
118	33	45	214	123	303	173	406	232	525	300
118	50	65	214	123	303	173	406	232	525	300

AISI S220 *North American Standard for Cold-Formed Steel Nonstructural Framing* defines a nonstructural

stud as one that is limited by the amount of total supported load (in addition to the clad wall self-

weight). A nonstructural stud, therefore, is limited to 100 pounds per lineal foot or 200 pounds axial load per stud. If the anticipated load exceeds this, then a nonstructural stud should not be a design consideration. Consequently, Architectural Specifications, Part 2, should be modified to include structural studs.

There will be situations where a nonstructural framing member is not suitable interior drywall framing. After reviewing the required height of the wall and loads the wall must accommodate, a structural framing member is then the required solution.

CONDITIONS WHERE STRUCTURAL FRAMING IS REQUIRED

1. Height of the wall exceeds nonstructural stud capacity
2. Height of the wall coupled with a maximum wall thickness preclude nonstructural framing
3. Wall hung equipment exceeds nonstructural stud capacity
 - a. Weight of equipment exceeds AISI S220 limits cited above
 - b. Weight of equipment induces bending stresses that exceed flexural capacity of nonstructural stud
 - c. Weight of equipment exceeds fastener capacity of steel in nonstructural stud

Should the design requirement determine that a structural stud is warranted then the architectural specifications in 092216 should/could read as follows:

2.3 COLD-FORMED STEEL FRAMING (based on [SFIA Guide Specifications](#), "SFIA 092216 Non-Structural Metal Framing" and its respective commentary)

A. Framing Members, General: Comply with AISI S220 or AISI S240 for conditions indicated.

B. Steel Sheet Components: Nonstructural framing shall comply with AISI S220 requirements for steel unless otherwise indicated. Structural framing shall comply with AISI S240, ASTM A1003/A 1003M, Structural Grade, Type H, metallic coated, of grade as required for structural performance.

1. Protective Coating: Nonstructural framing shall comply with AISI S220. Nonstructural stud coatings shall have a protective coating meeting the requirements of ASTM A653/A653M, G40, or shall have a protective coating with an equivalent corrosion resistance. Galvannealed products are unacceptable. Structural framing shall comply with AISI S240, CP60.
 - a. Nonstructural stud coatings providing equivalent corrosion resistance to a G40 shall demonstrate equivalent corrosion resistance with documentation acceptable to the authority having jurisdiction.

C. Studs and Track: Nonstructural framing shall comply with AISI S220. Provide manufacturers' steel studs and runners or steel studs and runners of equivalent gauge. Structural framing shall comply with AISI S240.

1. Minimum Base-Steel Thickness: As indicated in the physical properties table of the submitted manufacturers' literature, and cross referenced with the appropriate height determination table to meet required performance.
2. Depth: As specified on the Architectural Drawings and cross-referenced with the appropriate height determination table to meet required performance.

REVIEWING WHAT HAS BEEN SUBMITTED

What should the architect be looking for during the submittal process? A performance-based design, SFIA proposes, is the best option for the typical interior nonstructural partition. The next logical step is to have

an in-place submittal review protocol that results in the architect making an informed decision based on the merits of what has been submitted. SFIA has developed a template, Table 2, to help.

PARTITION DESIGN TEMPLATE

The architect should consider filling out Table 2 shown below. The completed table would then become part

of the construction documents. The goal is to list all wall types needed for the project and the performance requirements for each wall type.

Table 2 converts into a comparative device to evaluate what the contractor has submitted. What is shown here is one half of the document. The second half of the document, Table 3 (on the following page), mirrors this and must be filled out by the contractor.

Table 2

Wall Name	DESIGN											
	Wall Type	Fire Rating	STC	Cladding Side 1	Cladding Side 2	Insulation	Wall Height	Stud	Wall Thickness	Wall Deflection	Floor Deflection	Fixture Weight
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

Definition of terms:

Wall Name: This comes straight from the partition schedule, following the firm's protocol for naming individual partitions.

Wall Type: An example here would be something like masonry, steel, or wood framing.

Fire Rating: If the wall must be fire resistive, then declare the required hourly rating.

STC: If the wall must have acoustical properties, then declare the minimum acceptable Sound Transmission Classification, STC.

Cladding Side 1: The table assumes gypsum board on one or both sides of the partition. Declare how many layers per side, board thickness and type. Also declare if a resilient channel is part of the solution. For example: res (2) 5/8" X describes a resilient channel and two layers of gypsum board.

Cladding Side 2: Declare how many layers per side, board thickness and type.

Insulation: Thickness and type of cavity insulation that is required. Also note if the insulation is to be faced or unfaced, with or without vapor retarder.

Wall Height: The height of the wall is posted here. Contractor to assume simple span condition unless otherwise indicated.

Stud: Declare the stud that is the basis for this design. For example: 362S125-30 at 16" o.c. Include bridging, blocking, bracing, flange size/gauge, clips, etc. Also include tolerances for wall straightness and flatness.

Wall Thickness: Declare the intended overall wall thickness.

Wall Deflection: Based on the finish schedule, declare what is the allowable deflection, for example L/240 as suggested for interior gypsum panel finishes.

Floor Deflection: Declare anticipated floor deflection to determine the appropriate head of wall design.

Fixture Weight: This will help the contractor determine the appropriate framing based on the added load from any items that are hung on the wall. The analysis should consider the actual capacity of the framing member as well as the fastener capacity required to support the added weight. Fastener capacity is a function of the framing member’s steel thickness.

Submittal
Review

During the submittal process, the contractor provides Table 3 along with what is required in the architect’s

specifications. The table is a summary of the wall type the contractor proposes to use. The concept is to follow the architect’s basis of design table and provide specific information on the proposed solution.

Specific studs, stud spacings are called out to meet the design intent. Fire, acoustical, and structural implications are considered.

The suggested head-of-wall solution could/should go into the “remarks” column. It is important to mention if the cited fire/sound data is based on an actual test or by an engineering evaluation. For example, fire rating could read: “(2) U411 or by GA WP1450.” This means the wall is 2 hours based on UL Design U 411 or Gypsum Association GA WP1450.

Table 3

SUBMITTAL											Remarks	FIRE		SOUND		Status
Wall Name	Fire Rating	STC	Cladding Side 1	Cladding Side 2	Stud size	Insulation	Limiting Height	Stud Spacing	Bracing, Blocking	Wall Thickness		Opinion	Test	Opinion	Test	

The architect now has something to guarantee that the architectural specification requirements are met and that the proposed framing members will meet those performance requirements. The columns labeled *test*

and *opinion* are included to differentiate a performance requirement (fire or sound) based on actual testing or on a recognized third-party’s engineering opinion. Here is a summary:

Phases of Construction Using a Performance-Based Specification



CONCLUSIONS

Review of key points:

- Performance-based solutions should be considered both for 092216 (Non-structural metal framing – Masterformat®) and 092116 (Gypsum board assemblies – Masterformat®) applications.
- Stud selection should be based on fire, acoustic, structural, moisture, and aesthetics.
- Stud selection should commence in the Design Development stage. Further, this selection should be driven by the design professional (architect) with potential assistance from trusted advisors (consultants, building product manufacturers, and associations, such as SFIA).
- Based on intended wall height or the weight of wall hung equipment may require the use of structural studs.
- To ensure project compliance, a submittal review process should be undertaken with the architect retaining the requirement of approval.

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