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Magazine for the Structural Engineers Association of New York

2022 VOLUME 27 NO. 4

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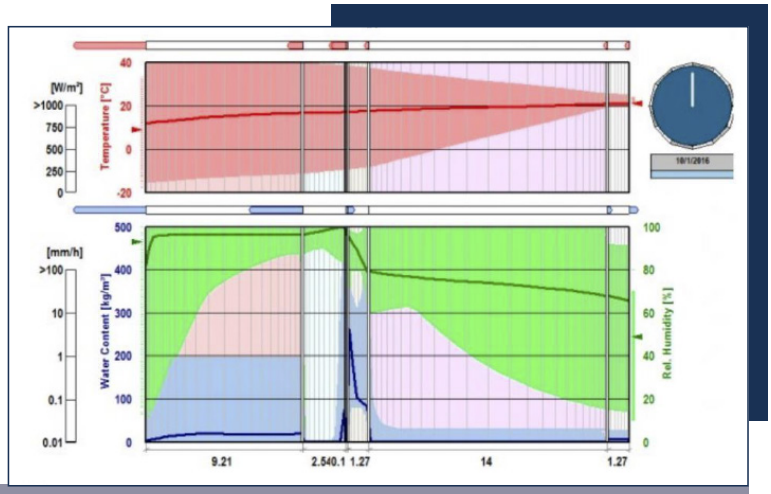

8 **STRUCTURAL ENGINEERS AS KEY PLAYERS IN PASSIVE BUILDING AND PHIUS CERTIFICATION**
by John Loercher, RA, CPHC

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MESSAGES

PRESIDENT'S MESSAGE

ERIK MADSEN, PE

As Engineers we seek efficiency. We're constantly striving for improvement in our industry. Each of our engineering non-profit organizations, such as SEAoNY, ACEC, NYSSPE and ASCE/SEI are all working towards the betterment of the industry. One of the recent difficulties that has come up in my experience is the organizational silos that form when institutions work toward individual goals that affect a whole community. This happens in many facets, and as SEAoNY President, I've faced it in the DOB Adams' Commission, in program planning, in fundraising, in legislation to promote engineering, and more.

Engineers owe it to each other to work together and cooperate, so that we can all achieve success. Individual success can often result from group success. When everyone in the group succeeds, everyone gains the benefit of increased recognition, satisfaction, and momentum.

Recently, we've begun outreach to connect with the other organizations better, including ACEC-NY, NYSSPE and hopefully soon the ASCE-Met section, to bridge this gap. We are identifying common goals, and hopefully we can combine resources to accomplish them.

We are also open to suggestions on how to do this better. We can learn from each other. Many SEAoNY members belong to multiple organizations and I encourage them to share knowledge across platforms. If you have ideas you'd like to share, please email me or admin@seaony.org and we will see how we can build our organizations better together.

Sincerely,
Erik Madsen, PE

EDITOR'S MESSAGE

RIYA MANIAR, E.I.T.

Happy holidays to all our readers from the Publications Committee, we hope you and your loved ones enjoy this celebratory time. This year has been filled with reasons to celebrate as we enjoy more in-person SEAoNY events as well as online or hybrid gatherings with our industry peers. This year also marks my first year as a member of SEAoNY. By actively participating in this organization, I have had the privilege of building a community with a variety of industry participants, attending informative conferences, and having the honor of being editor of Cross Sections. It has been a fun and insightful journey volunteering with SEAoNY, and I encourage all members to get involved with the many amazing committees and participate in the different events held by SEAoNY to broaden and unite our community.

Cross Sections has been the string that ties all the different functions of our organization together by bringing you news on relevant technical topics, industry innovations, SEAoNY events and committee updates. This issue offers a look into daily engineering tasks like drafting and detailing, as well as broader topics on structural considerations like building envelope and sustainability. If you have a topic related to structural engineering that you are passionate about and want to share, please feel free to reach out to the publications committee at seaonypubs@gmail.com. Thank you again to the publications team, contributors and, as always, our readers for your continued support of Cross Sections. We hope you enjoy this issue.

Thank you,
Riya Maniar, EIT

IMPORTANT CONSIDERATIONS FOR GOOD DETAILING AND DOCUMENTATION

BY SARAH SCARBOROUGH PE, SE ASSOCIATE AND OPERATIONS MANAGER, PES STRUCTURAL ENGINEERS

Sarah Scarborough, P.E., S.E. is an Associate and the Operations Manager at PES Structural Engineers. She is engaged in the company's development and implementation of internal processes and standards and assists in overseeing the company's continuing education and onboarding programs. Sarah is a licensed structural engineer and also serves as Project Manager on a variety of project types ranging from hotels and senior living facilities to high-end automotive dealerships.

A structural design is only as good as the set of drawings that convey it. This article speaks to several common gaps in structural drawings, provides lessons learned, and provides tips to elevate a set of structural drawings to improve a firm's QA/QC processes.

DO THE DRAWINGS MATCH THE DESIGN?

Regardless of the design software utilized or hand calculations performed, if the structural design does not make it into the contract documents or is not clearly communicated in the contract documents then the standard of care has not been met. Attention to detail and an effective QA/QC process is critical in our industry to ensure we are meeting the standard of care and fulfilling our ethical obligations to society.

One way to ensure cohesion between the design and the drawing is to utilize an internal peer review process. Another, more technical approach, is to leverage interoperability between design and documentation software. For example, CSI and Bentley both offer plug-ins to Revit that allow for bi-directional interaction between applications.

DO THE DESIGN AND DRAWINGS CONSIDER LOAD PATH?

It is easy to focus on the overall structural system at the beginning of a project, but it is equally important to draft details early to understand the load path and how each structural element interacts within the system. Preliminary details do not need to be fully developed, but some sketching and a basic understanding of load path will allow the engineer to confirm that the design captures the anticipated loading conditions and construction is feasible. For example, when laying out a lateral system and identifying shear wall locations, consider how load gets to the shear wall and be sure to think through load path where walls are adjacent to large openings or disconnected from the diaphragm.

Host internal project specific meetings during which junior engineers can benefit from the experience of senior staff and the project Engineer of Record to grow this skill.

ARE THE DRAWINGS COORDINATED WITH OTHER DISCIPLINES?

Collaboration between the structural engineer and other design disciplines is critical to ensure a well-coordinated set of documents. Be proactive; It is not solely the Architect's responsibility to communicate potential conflicts and ensure that structural information has been considered and coordinated into other trades scope. This will elevate the quality of the document package and make the construction phase of the project much smoother by reducing errors in the field, RFIs, and multiple rounds of submittals.

Provide an appropriate level of detailing for a well-coordinated design. For example, provide structural sections where architectural sections are cut and confirm that structural information has been provided

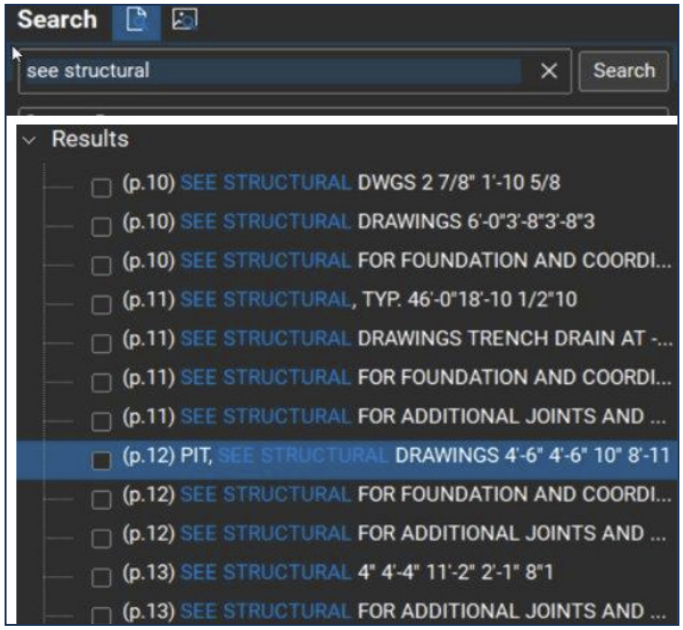


Figure 1: PDF search results to assist with coordination with other disciplines

when architectural, MEP, and civil notes refer to the structural drawings. Utilize the search feature in PDF software for phrases like "see structural" or "beam" to assist with quickly identifying these instances.

DO THE DRAWINGS PROVIDE ALL INFORMATION NEEDED?

A set of drawings should clearly flow between the general notes, framing plans, elevations, and details. All tags and call-out references must be clearly linked to the associated notes and details. All too often a plan references a detail, or vice-versa, for information that does not exist.

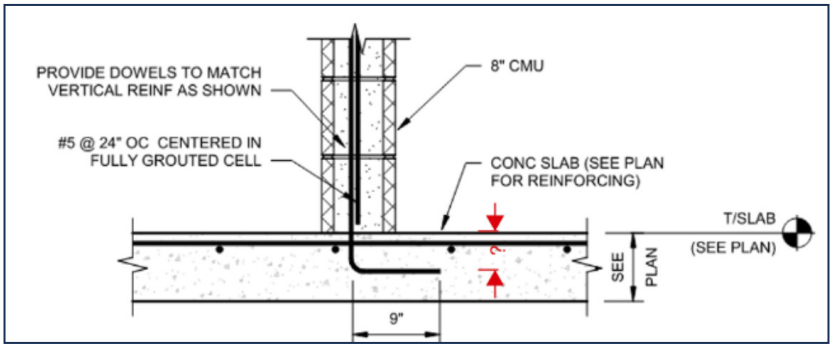


Figure 2: Critical dowel embedment missing

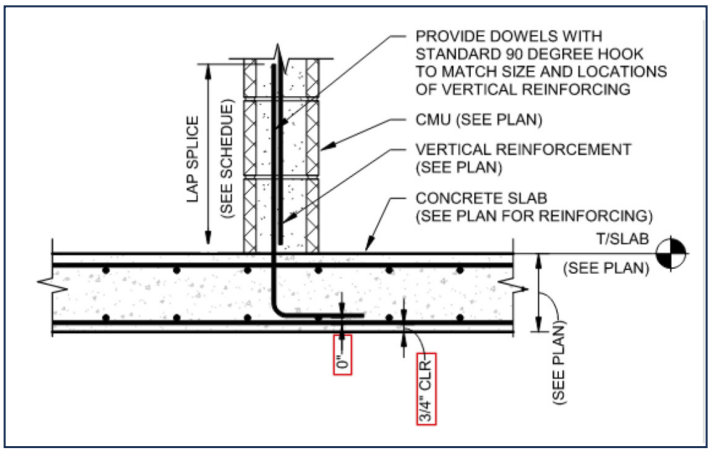


Figure 3: Critical dowel embedment clarified

Confirm that blank design criteria have been filled in when using place holders in company templates or typical details before issuing the documents. Ensure that all details are complete and contain all the critical information to the design, including all primary and secondary structural elements, geometric relationships between elements, geometric limitations, connection information (including welds, anchorage information, etc.), and any critical relationships or definitions of architectural or non-structural elements.

Develop an internal QA/QC process or checklist for drawing review to ensure that all plans and details are referenced and connected. Utilize a highlighter when reviewing the drawing set to highlight every detail and reference as it comes up. If any details are unfinished or missing, assess if the details apply and determine the appropriate place to reference them in the notes or plans.

The drawing review process should catch any blanks or "X's" in the drawing set, and consider using the search feature in PDF software with select key words or phrases to quickly identify if/where information needs referencing.

ARE THE DRAWINGS ORGANIZED, CONSISTENT, AND EFFICIENTLY DETAILED?

To ease interpretation for the drawing recipient, related content should be grouped. For example, locating material specific information on the same series of sheets.

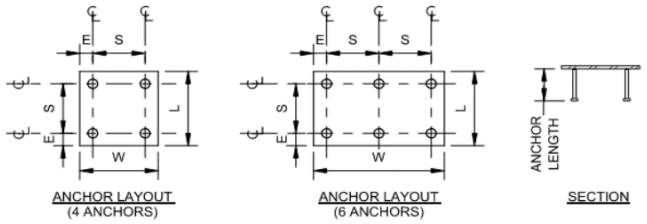
When appropriate, do not bog down details with repetitive information. Strike a balance between not repeating information and the number of steps it takes to find the information.

Use view references or callouts that refer to another detail to efficiently communicate a similar condition across multiple details. To detail repetitive elements, utilize detail groups or Revit families to increase drafting efficiency.

That way if the component changes, it can be manually changed once and automatically updated in all repeated locations. Leverage view templates and linked 3D models or CAD backgrounds to provide context, eliminate unnecessary drafting, and help with coordination.

STEEL EMBED PLATE SCHEDULE

MARK	PLATE GEOMETRY			ANCHORS			SPACING	
	LENGTH (L)	THICKNESS	WIDTH (W)	#	DIAMETER	LENGTH	E	S
EP88	8"	1/2"	8"	4	1/2"	4"	1 1/2"	5"
EP1010	10"	3/4"	10"	4	1/2"	6"	2"	6"
EP1212	12"	1/2"	12"	4	1/2"	6"	2"	8"
EP1220	24"	1/2"	16"	6	1/2"	6"	4"	8"



NOTES:

1. ANCHOR LENGTH INDICATED IS FINAL LENGTH AFTER BURNOFF.
2. SEE PLAN FOR LOCATION OF KEYED SECTIONS & DETAILS REFERENCING EMBED PLATES AND ATTACHMENT OF CONNECTING ELEMENTS.
3. FOR LAYOUTS WITH MORE THAN 6 ANCHORS, SEE KEYED SECTIONS & DETAILS FOR ANCHOR LAYOUTS.

STEEL EMBED PLATE SCHEDULE 6/S690

SCALE: 3/4" = 1'-0"

Figure 4: Steel Embed Plate Schedule

Use descriptive type marks to tag elements to better communicate information about that element.

For example, if you have multiple concrete beams, use a naming convention that communicates the beam dimensions ("RCB24x36" vs "CB1") consistently throughout the project.

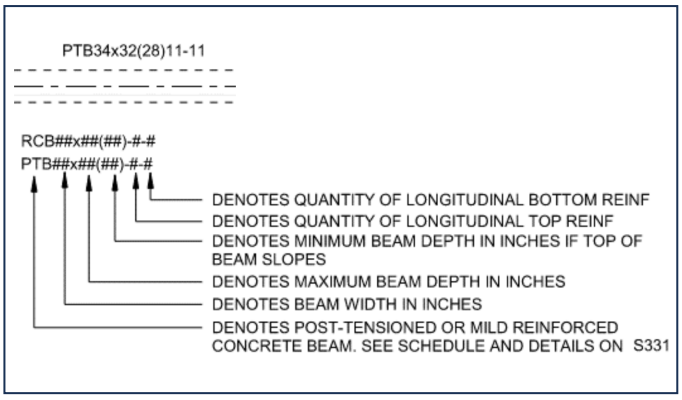


Figure 5: Example of a descriptive concrete beam tag and the associated legend.

Additionally, the following tips will clean-up and elevate a set of drawings:

- Align the heads and tails of adjacent section cuts on plan for visual simplicity
- Provide written descriptors in lieu of labeling each "Section" or "Detail" repeatedly
- Utilize consistent, industry standard language in details
- Utilize inset details to eliminate the need for additional details
- Ensure framing plans and plan notes are aligned in the same place from sheet to sheet
- Select the appropriate scale for plans and details
- Use a consistent scale for related details
- Use a grid organization on sheets to ensure a clean and readable detail sheet. Adjust the scale of details to fit within the grid format
- Draw details to scale to avoid conflicts

DO THE DRAWINGS HAVE AN APPROPRIATE LEVEL OF DETAIL?

Typical details are a great starting point for assembling a set of structural drawings and allow the engineer to focus on the design and detailing of unique conditions, but they must be used with caution. Avoid overusing "TYP" and "SIM" when a new version of a detail is needed to clearly convey the condition.

Utilize an internal drawing review process to confirm that all typical details have been coordinated and referenced, and all project specific details have been detailed and included in the drawing set. Ensure that a structural section is provided on every face of the building and a separate section is provided each time the condition changes.

DO THE DRAWINGS CONSIDER FINISH REQUIREMENTS, TOLERANCES, AND CONSTRUCTABILITY?:

As structural engineers, we must understand and educate the rest of the design team on the environmental impacts, exposure and finish requirements, tolerances, and constructability of elements to preserve the durability of the structure and do our part to adequately and efficiently design and detail to accommodate those conditions.

Compatibility of materials and adequate separation or isolation detailing is often critical. Certain structural finish requirements have significant cost implications and must be coordinated early and clearly detailed in the drawing set. For example, where steel requires galvanization or where a specific formwork finish for exposed concrete is needed should be communicated.

Special consideration must also be given to the required tolerances of various structural systems and materials. In steel framing, consider mill tolerances, fabrication tolerances, and erection tolerances. To connect steel framing to concrete framing, consider that each material has different tolerances that will impact the detailing and interaction of those elements.

Provide allowances for constructability when detailing to accommodate field adjustments and necessary flexibility of connections. Coordinate with individual product manufacturers on tolerance requirements for element deflections and structure drift to maintain the proper function of their component and attachments.

Repetition must be balanced with cost considerations, but can be leveraged for embed plates, post-installed anchors, rebar configurations, framing members, and more. While the design could be refined to provide a smaller diameter anchor, less reinforcing, or a more efficient steel beam size, consider the ease during construction and erection of being able to utilize the same element in multiple locations.

DO THE DRAWINGS PROPERLY DELEGATE DESIGNS OR CONNECTIONS?

Structural Engineers must consider the interaction and coordination with delegated design items and attachments. The design of elements needs to be effectively delegated and the structural feasibility of those designs and connections must be confirmed.

For example, when delegating cold-formed steel wall framing design, the SEOR is responsible for advising

the architect on the appropriate wall stud depth by giving consideration towards the loading, finishes, and deflection requirements that will yield economical wall stud designs and connections.

Ensure that any design limitations are also specified while being careful not to design and delegate. For example, when designing a steel roof deck diaphragm attached to pre-engineered cold-formed steel roof truss, clearly specify any minimum truss member gauge thicknesses necessary to achieve the required diaphragm capacity based on loading conditions and fastener limit states.

H. TRUSS TOP CHORDS SHALL BE 16 GAUGE (MINIMUM). SEE DIVISION 5 SPECIFICATIONS FOR ADDITIONAL MEMBER THICKNESS REQUIREMENTS.

Figure 6: Example specification

Similarly, list the basis of design (loads, expected geometry, manufacturer, etc.) on the drawings for a product or system that may not be selected at the time of design.

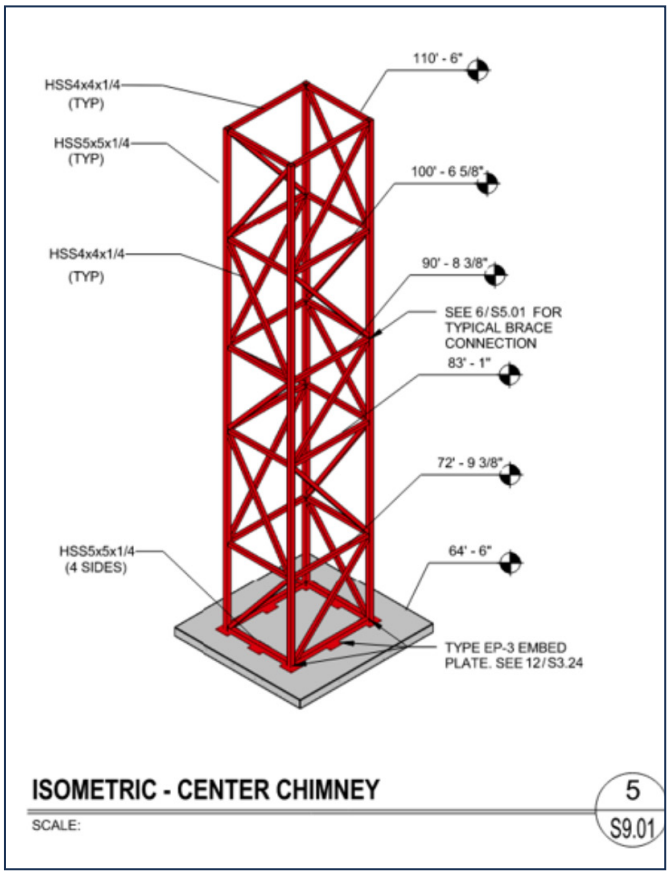


Figure 7: Example 3D Detail

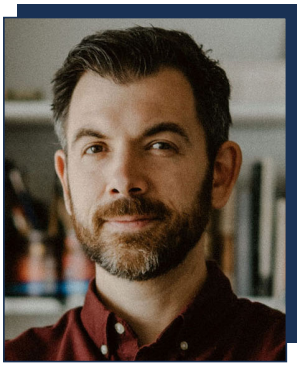
DO THE DRAWINGS WARRANT 3D INFORMATION?

Today, most engineers work in a 3D engineering and drafting environment, yet the final deliverable is still a 2D set of documents. Leverage the tools and capabilities of 3D software to supplement the structural drawings with 3D information. The addition of 3D views as references can go a long way towards quickly communicating the structure.

3D views that contain some detailing can also very efficiently communicate design information. For example, a 3D view of a simple steel tower with braced frames that includes elevations and member sizes could eliminate the need for several 2D brace elevations and more simply communicate the design intent.

Structural engineers must dedicate appropriate efforts towards the documentation of their designs to uphold their commitment to the profession and the public. The considerations outlined in this article will contribute towards improving the quality assurance and quality control measures to ensure the design of safe and efficient structures is effectively and efficiently documented.

STRUCTURAL ENGINEERS AS KEY PLAYERS IN PASSIVE BUILDING AND PHIUS CERTIFICATION



BY JOHN LOERCHER, RA, CPHC
TRAINER, PHIUS CERTIFICATION TEAM
PHIUS

Passive building is a construction method that achieves drastic reductions in building energy consumption through 5 primary tenets:

- Above-code-insulation
- Air-tightness
- Good window design
- Balanced ventilation
- Minimized mechanical systems

The Passive House Institute US, or Phius, is a construction certification system that formalizes passive building methods into a climate-specific standard applicable to multiple building types, sizes and climate zones. The standard relies on the uninterrupted continuity of insulation wrapping of buildings and, as such, participation of our structural engineers in the process is a critical element in delivering a successful project.

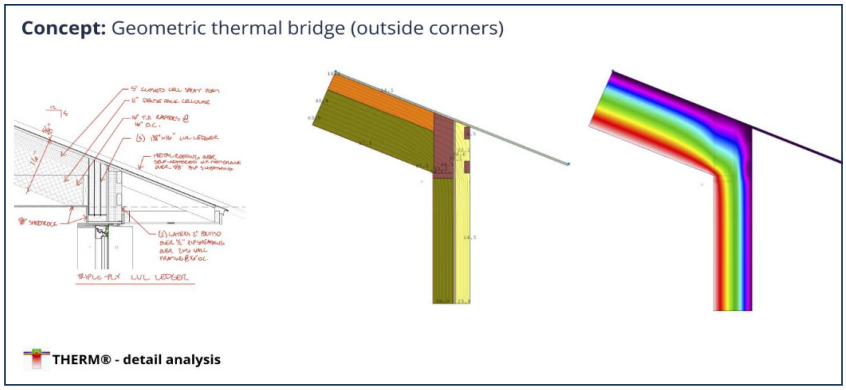


Figure 1: Geometric thermal bridge of outside corner

Whenever a break or reduction in insulation occurs, it is considered a 'thermal bridge'. This term describes any condition that has a higher thermal conductivity than its adjacent assemblies and is critical in designing a super-insulated building envelope. Thermal bridges most commonly occur at structural junctions in the building where high-density structural materials are directly adjacent to low-density, thermally resistant materials, such as foundations.

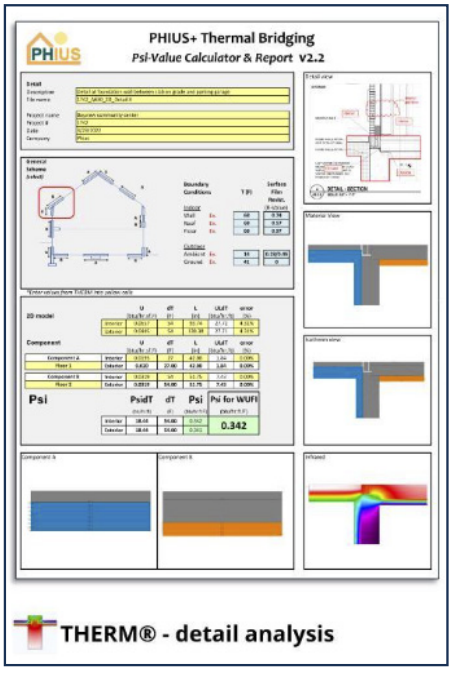
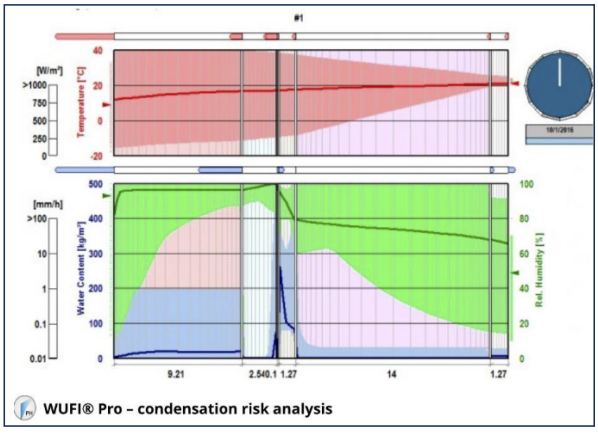


Figure 2: PHIUS Performance based modeling



In order to understand the importance of thermal bridge-free design in a passive building project, it's important to note that thermal bridges are not only areas of potential heat loss, but also areas highly susceptible to condensation risk. Both factors have a significant impact on the long-term durability of the buildings being designed and constructed. By designing high quality thermal bridge-free details, structural engineers can ensure the long-term durability of future building stock.

Based on over a decade of certifying passive building projects of all building types and in all climates throughout the continental United States, Phius has compiled a list of the top three most critical areas for the involvement of structural engineers outlined below:

FASTENING EXTERIOR INSULATION

On many passive building projects, exterior insulation thickness can be required in excess of 2 inches depending on the climate. If attention is not given to the thermal performance of the fastener and fastener pattern between the insulation and exterior, thermal analysis has revealed that the cumulative point thermal bridging of the fasteners can undermine the value of the additional insulation thickness. Structural engineers should favor thermally broken fasteners (plastic, stainless steel, composite) to avoid the cumulative heat loss brought on by a dense fastening pattern and highly conductive fasteners (steel).

CONTINUOUS INSULATION AROUND FOUNDATION FOOTINGS

In an ideal world, insulation would wrap completely around and underneath all concrete elements – including the footing. Unfortunately, this is not always possible as the structural capacity of the building is the first priority.

If insulation cannot be provided underneath a concrete footing, some design alternatives to minimize thermal bridging include:

- Thermal breaks between foundation walls and concrete slabs;
- Designing tall foundation walls to create distance between the interior space and the uninsulated footing; and
- Use of the "bathtub" technique: completely lining the interior face of all concrete surfaces.

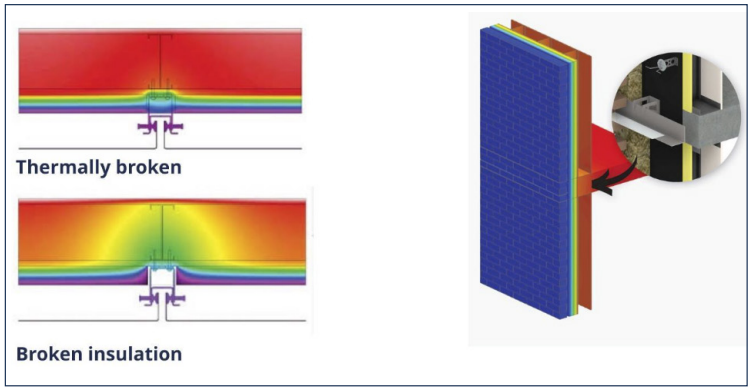


Figure 3: Fastening exterior insulation

CANTILEVERS SPANNING THROUGH INSULATION

There are many case studies available that investigate the massive energy loss associated with a thermally-continuous structural element spanning between the interior conditioned space and outside air. Two examples of cantilevers spanning through insulation include balconies and roof overhangs. In passive building, structural engineers should favor details that hang balconies and overhangs when possible or specify the use of a specialty thermal break product to minimize heat loss.

Although passive building is a multidisciplinary design and construction process, structural engineers can play a key role in contributing toward Phius certification and sound passive building design.

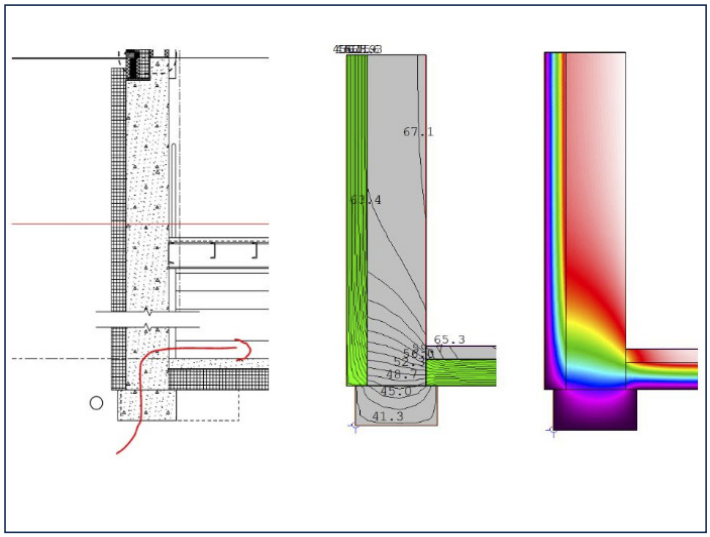
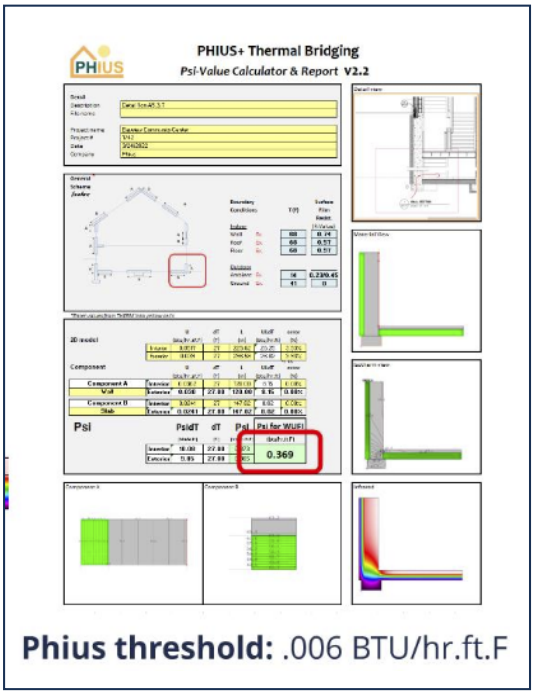


Figure 4: Footing details



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