BES500004

BIM-Driven Engineering: Structural Design Without Redundant Workload

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Learning Objectives

- Assess the hidden cost of manually bridging the gap between design platforms and documentation in the structural BIM model
- Identify ways that firms can work more efficiently and more profitably using a BIM-centric process for structural calculation
- Integrate analysis-friendly modeling best practices into daily BIM work to create a structural model fit for use in design
- Implement new design approaches with software tools that make BIM-driven structural engineering intuitive and efficient

Description

Structural engineers are quite familiar with the disconnect between our design & documentation tools. Construction documents have our engineering analysis in their DNA. Despite this connection, we create these documents using tools that don't share information. The impact of this disconnect ranges from mild inconvenience to profit-crushing time sink. What if our tools could "talk" to one another? Imagine structural modeling, inter-discipline coordination, engineering analysis, design, & final documentation creation on a unified platform. Given today's powerful BIM environments, this workflow isn't a dream. This class examines real-world collaborative tools for a BIM-driven structural engineering design process inside the Revit environment. What should structural design look like without the burden of parallel workflows? Case study: Revit-driven design of steel structures with real-time model updating using ENERCALC Structural Engineering Library design calculations.

Speaker(s)

Seth Roswurm, PE, SE
Senior Structural Engineer, API Integrations
ENERCALC, INC

Seth is a licensed structural engineer and software developer with structural design experience in a range of project types including governmental buildings, commercial and military aviation structures, higher education facilities, K-12 education facilities, multi-family residential structures, and ICC 500/FEMA 361 shelter projects. His experience spans the entire life-cycle of a project, from schematic design, to structural analysis, to structural detailing, and finally construction administration. In addition to structural design work, Seth has a broad range of expertise in developing and deploying both standalone and API-integrated custom software solutions. His specific area of interest is the creation of API-integrated applications which leverage existing commercial platforms to solve unique and challenging engineering problems.

Maher (Mack) Eltarhoni, PE, SE (OK)
Principal
ELTA DESIGN GROUP, LLC

Maher is a licensed structural engineer in the states of Oklahoma and Texas with tremendous experience in the design of low and mid rise structures. Over the years, he gained versatile knowledge by working with all traditional structural materials. Maher's experience spans all stages of project life from concept drawings, to construction administration. He developed special interest in the engineering of cold formed steel, and adopted it as a specialty. Currently, Maher is the owner of ELTA Design Group, a structural engineering firm that provides general structural engineering services and specializes in delegated design services for the cold formed metal framing industry in both Oklahoma and Texas where he partners with architects and contractors to engineer or value engineer light gauge framing systems.

Introduction

This industry talk examines modern structural engineering design workflows and the complex relationship between engineering design and BIM-modeling / Revit-based documentation. As structural engineering practice has evolved over time, the industry has overwhelmingly trended away from the 2D CAD programs of yesterday in favor of true 3D modeling of building structures. Many architecture and engineering firms alike now rely heavily on BIM platforms like Autodesk's Revit to create, coordinate, and document building designs.

While the advent of BIM for structural engineers brings a host of advantages, including inter-discipline coordination, model-based drawing creation, and many others, it also brings certain challenges. One of the foremost of these challenges is managing the workload of actually creating the BIM model and then maintaining agreement with the design calculations. The constant struggle to keep an evolving BIM model consistent with engineering calculations (and vice versa) is a frustration that many structural teams are familiar with. The purpose of this talk is to examine opportunities to reduce this burden on design teams by moving design calculations directly into the Revit BIM environment.

This handout is a companion reference to the full talk and is broken down according to the general learning objectives outlined above:

The Hidden Cost of parallel work

The first portion of the handout will introduce and discuss the concept of "parallel work". This term is used to describe the laborious process of manually bridging the gap between design and documentation tasks that are performed on various different platforms. In particular, the concept will be examined as a source of inefficiency that harms the profitability of a structural design firm.

Thinking BIM-centric and best practices

As with the full talk, a portion of the handout will focus on understanding and leveraging the full power of the Revit BIM environment in order to maximize your structural team's productivity. As a companion topic to understanding and using Revit to its full potential, the handout will also discuss common mistakes to avoid and best practices to use when building and managing Revit structural models.

BIM-driven design case study

The final portion of this handout will layout a case study of efficient and intuitive structural steel design performed from directly inside the Revit model. The case study will demonstrate how a 3rd-party integration that takes advantage of Revit's powerful API can provide structural engineers with an immersive design experience that completely eliminates the common frustrations of managing designs in outside platforms.

The Hidden Cost of Parallel Work

Throughout this talk, the term “parallel work” is used repeatedly to describe a common struggle familiar to most structural engineers and engineering firms. At its core, the term refers to the fact that a structural team has two significant tasks (rather than just one) to accomplish on any given building design project. In this talk, the two tasks are broadly labeled as “design” and “documentation”.

The design portion of a project is the “number crunching” work. This is the work that requires a design team to apply technical expertise, knowledge of governing codes, and computational tools to develop a set of calculations. The calculations determine the safety and efficiency of the elements and systems that make up the building structure. This often turns out to be a combination of hand calculations, spreadsheets or other proprietary custom tools, 3D analysis from commercial software, individual component design calcs, and foundation designs.

The documentation portion of the project is means by which the structural design is communicated to other design disciplines, code authorities, and ultimately the contractor who builds the structure. The foremost tool for producing this documentation is Autodesk Revit. Revit is used by each design discipline to produce 3D BIM models of their respective aspects of the project, and then individual disciplines are overlaid for coordination purposes. Typically, the documentation is the ultimate deliverable of a project and takes the form of signed and sealed structural drawings.

The constant struggle of a structural design team is to keep these two parallel and inter-related tasks moving forward and in agreement throughout the life of a design project. Since design and documentation are performed on a variety of separate platforms, the structural team is left to move information between platforms manually. In the talk, this taxing process is likened to walking across a tightrope – a delicate balancing act that is grueling to perform and yet demands flawless precision. Any misstep in a trip between the various environments spells disaster for the project. Any piece of information transcribed inaccurately or left behind becomes a source of disagreement between design and documentation. Applied loads, reactions forces, geometry, section sizes, capacity checks, code references, and many other factors must remain in perfect harmony for a successful project. Given the dynamic nature of an evolving building design, trips across the rope are expected to be inevitable and painfully frequent.

Whether performed consciously or unconsciously, this “tightrope” process typifies the structural engineer’s daily workflow. What some may not be conscious of, however, is the profit-crushing potential of such a non-ideal approach. Each and every trip across the gap drains away valuable time that could be allocated for more important design tasks. One of the foremost purposes of this talk is to challenge engineers to stop and consider the billable time at stake if a firm could eliminate the need for manual transcription, remove the risk of transcription errors, and put a permanent end to policing parallel workflows with daily and weekly “spot the difference” frustrations.

Thinking BIM-centric and best practices

With the challenges of parallel work in mind, most firms and engineering teams would love to find ways to work faster and more profitably. One of the most obvious ways to reduce or even eliminate trips to various outside platforms is to approach structural design work with a "Revit-centric" mentality. Critical evaluation of design workflows often indicates that a number of common design tasks could be performed in an intuitive and straightforward manner without ever leaving the Revit environment.

It's no secret that structural engineers invest significant time and effort in creating detailed and accurate structural Revit models. But when it comes time to perform design calculations, this massive store of data is all too often neglected and calcs are done by hand or in various outside platforms. Why not take advantage of the Revit model instead by performing design tasks inside Revit? Revit is an incredibly powerful platform with a wide array of capabilities that can serve the needs of structural engineers:

- Annotation: 2D drafting tools, detail items, dimensioning, smart tagging, etc.
- Modeling: Powerful 3D framing and dynamic model views
- Parametric: Robust parametric framework and intelligent scheduling
- API: Industry-leading programming interface for extending functionality

Getting the full advantage of these powerful features starts with understanding how to create a well-conditioned structural model that is fit for use in design work. All of the best practices highlighted here revolve around remembering that Revit is a very data-rich environment. In view of this, structural teams should always consider that they may be limiting the usefulness of their Revit models anytime they use workflows that are data-poor, non-parametric, or static (i.e., not easily modified). The best practices discussed below are applicable for a wide variety of different approaches to structural design and can aid in the completion of many different tasks, ranging from basic everyday model management, to scheduling and material takeoffs, and even Revit-driven design.

While some of these procedural topics may seem obvious, experience indicates that they are anything but. The issues discussed here are incredibly common across the industry. Experienced project managers, lead engineers, and BIM managers are no doubt familiar with the way non-optimal practices can sometimes persist beneath the surface even in tight-knit teams. The rapid pace of the industry and the stress of project deadlines leaves little time for exhaustive training and painstaking QA/QC reviews of Revit production. The points laid out here make a concise and manageable starting point for any structural engineering firm to manage BIM outcomes in Revit.

Linework drafting of framing elements

Without a doubt, the use of 2D line-based drafting is a core capability of any documentation tool. Certain tasks, particularly the creation of details, are easily and efficiently accomplished using linework and require nothing further. In the modern era of powerful BIM platforms, however, structural teams should think twice before using 2D lines on a plan as a substitute for actual modeling of primary structural framing. Even with the intuitive modeling tools available in Revit, time demands occasionally make it tempting to quickly sketch framing with lines.

While this approach may seem efficient in the short term, it carries several significant disadvantages that reach across the entire lifespan of the project:

- Lack of visibility in other views
- Lack of visibility to other design disciplines via model linking
- Lack of parametric data for scheduling and material takeoffs
- Lack of parametric data for element tagging
- Lack of dynamic geometry control via connection and join relationships
- Lack of physical representation of the element for analysis/design efforts

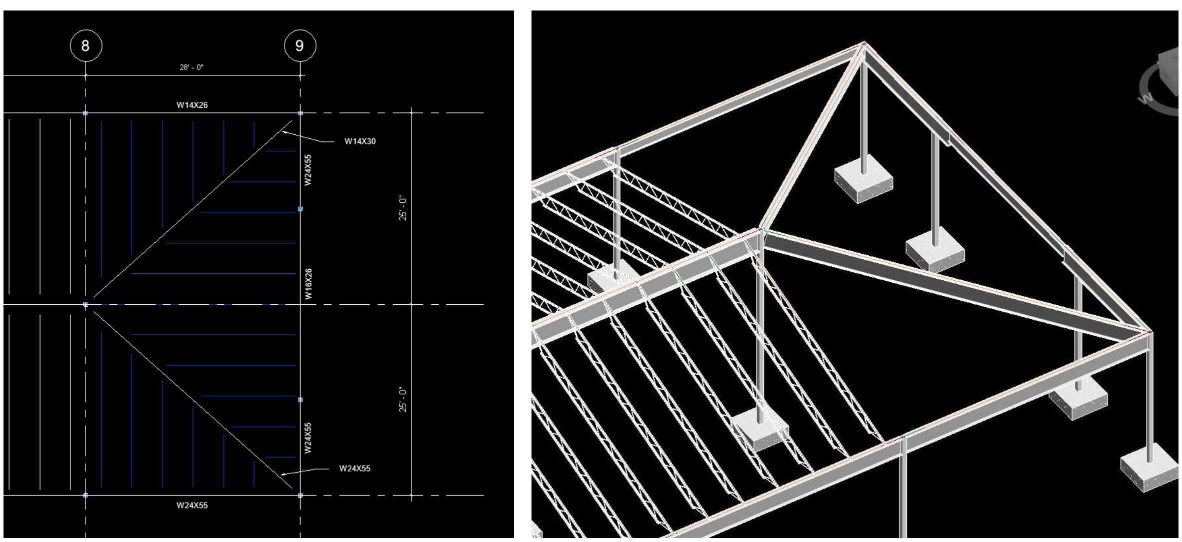

FIGURE 1: LINE-DRAFTED STEEL HIP ROOF FRAMING NOT VISIBLE IN 3D VIEW

Linework drafting of schedules

Similar to the above discussion of framing layouts, engineers occasionally encounter cases where it seems expedient to create a schedule using simple linework and annotation text rather than using a parametric schedule. While there may be niche scenarios where this approach is warranted, it often poses long-term productivity risks similar to those previously discussed:

- Lack of parametric relationship with model data
- Lack of dynamic updating to reflect model changes
- Lack of aesthetic and formatting control available for actual Revit schedules

It should be noted that Revit's parametric framework enables users to take advantage of tagging and scheduling even when the scheduled element is ***not*** a 3D modeled structural component. As an example, suppose a design team is using a 2D filled region family for plan representations of wood shear walls. The instances of the annotation object that denotes shear walls on plan can still be scheduled automatically rather than using a static schedule that was built manually using linework and textboxes.

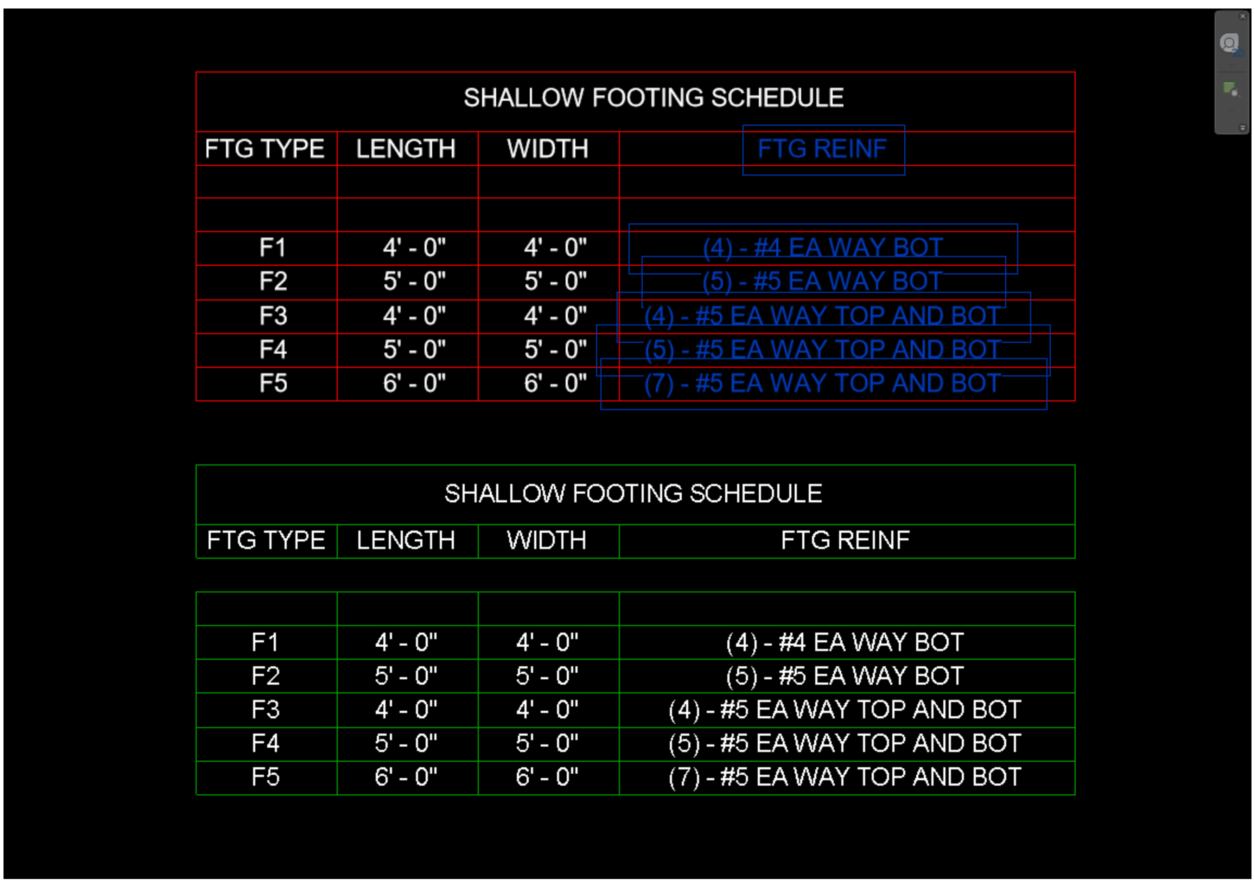

FIGURE 2: STATIC LINEWORK SCHEDULING VERSUS AUTOMATIC SCHEDULING

Joins, cutbacks, and Z-Offsets

Proper use of Revit geometry controls is a key factor for successful outcomes in a structural model. Joins, cutbacks, and z-offsets are used to establish the correct connective and spatial relationships between structural elements. A simple omission such as failing to join a beam directly to the supporting column can lead to gapping, improper standoff distances, and failure to update dynamically when the column is shifted. Similarly, incorrect use (or non-use) of z-offset controls for beams can result in undesirable positioning of connected elements or lack of connection. These issues can cause difficulty later not only in advanced efforts such as Revit-based structural analysis, but even in simple daily tasks such as drawing production and geometry updates in the model.

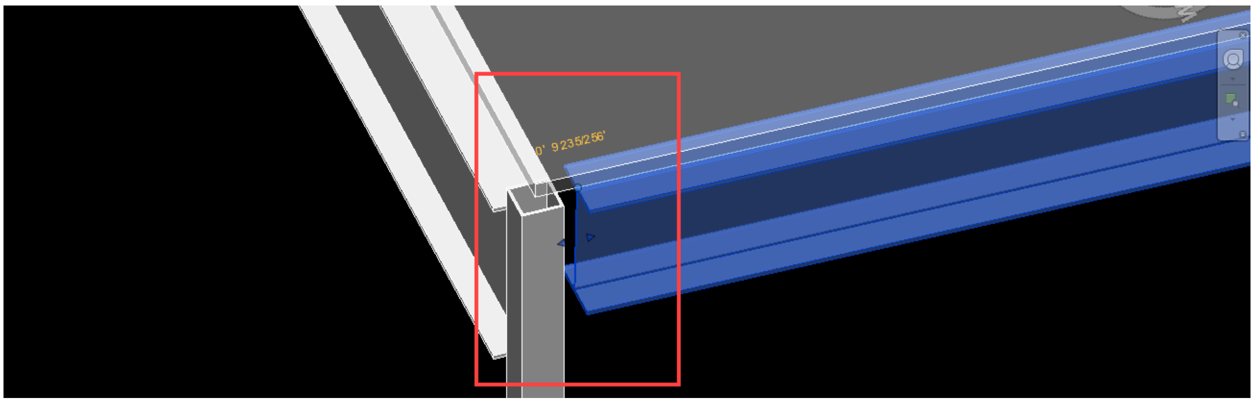

FIGURE 3: STEEL BEAM NOT JOINED TO COLUMN

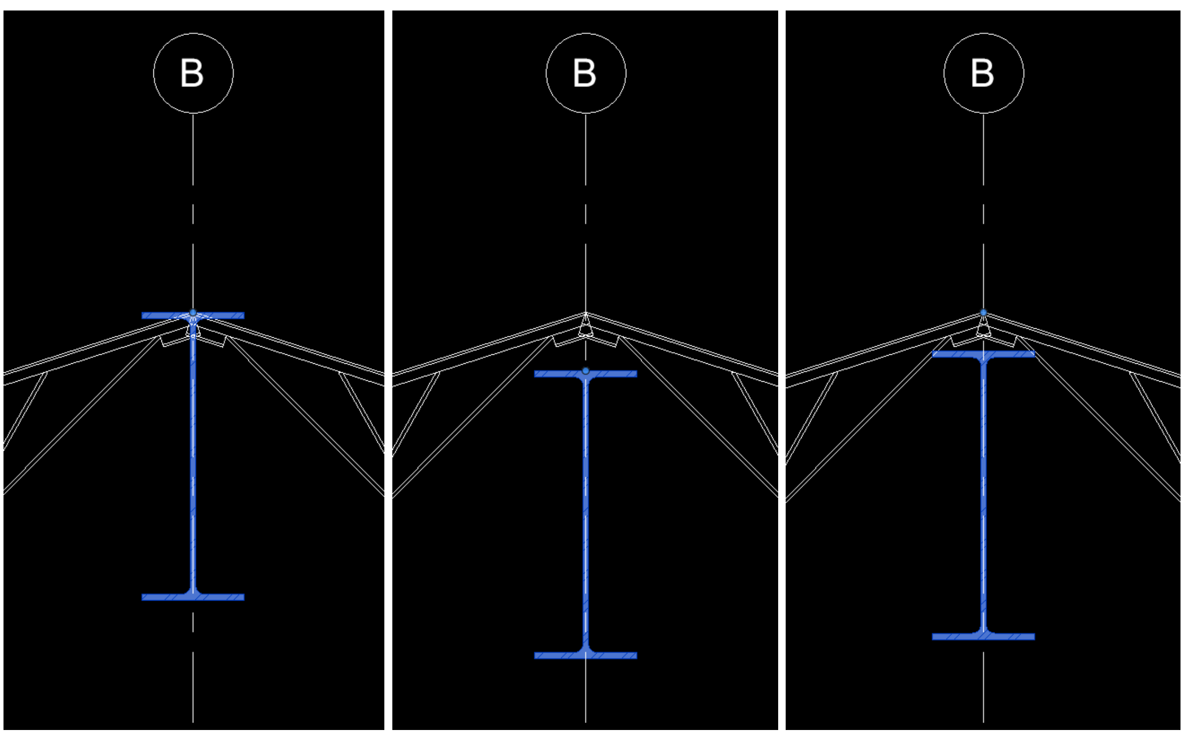

FIGURE 4: JOIST TO GIRDER CONNECTION WITH AND WITHOUT Z-OFFSET

Floor edge conditions

Revit modeling conditions where the edge or end of a floor element is to be supported by another element are another frequent source of both visual display problems and analytical difficulty. In general, it should be considered best practice to ensure that the physical extents of the floor actually reach over the intended supporting element. Failure to do so may result in undesirable display of the floor edge in plan views, as well as creating conditions that are difficult to interpret if the Revit model is later used as a basis for structural analysis and design.

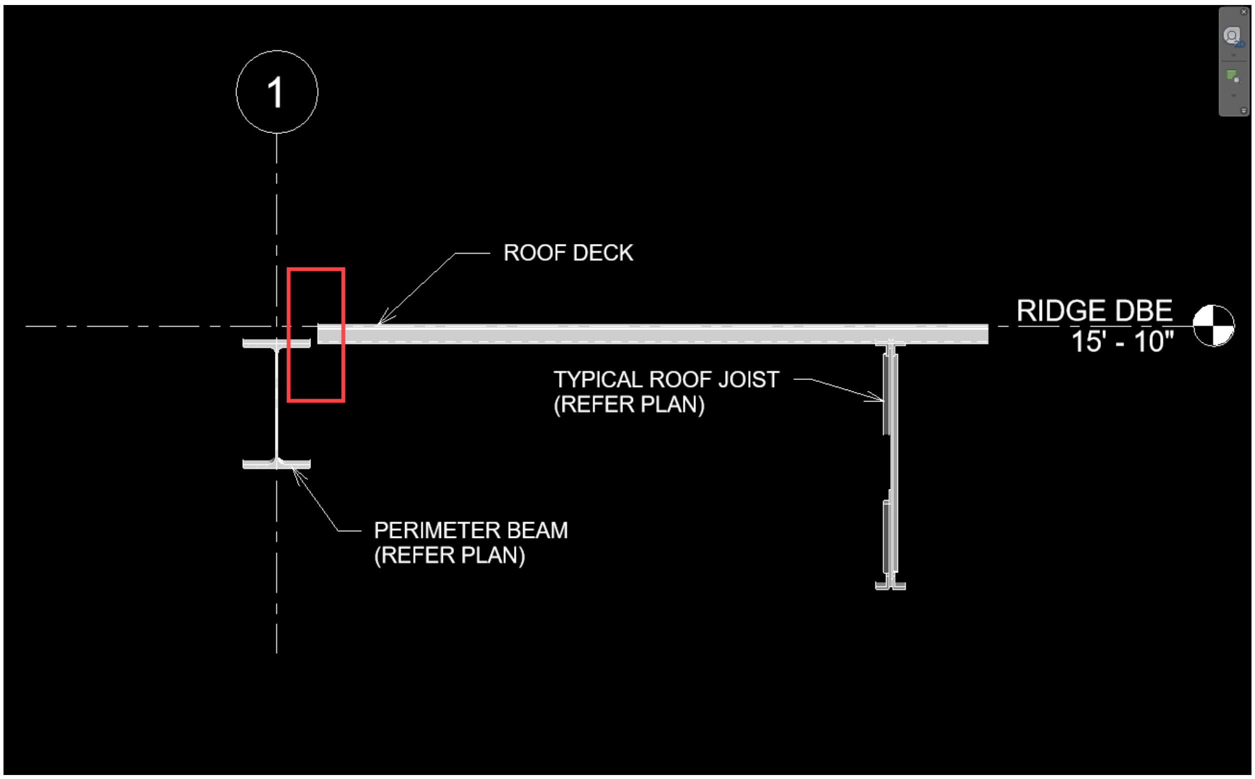

FIGURE 5: UNSUPPORTED DECK EDGE CONDITION

Structural types and usages

Structural types and usages assigned to various elements can also have an impact on managing a Revit model. The assignments can impact visual display graphics, scheduling, and interpretation of the element when later used for design. This is particularly important to be aware of when first creating elements. As an example, the image below shows a steel braced frame. In this case, the diagonals should be explicitly created as braces, rather than beams. In a similar manner, wall elements contain parameters that allow the user to choose whether the wall is structural and what type of structural behavior the wall will have.

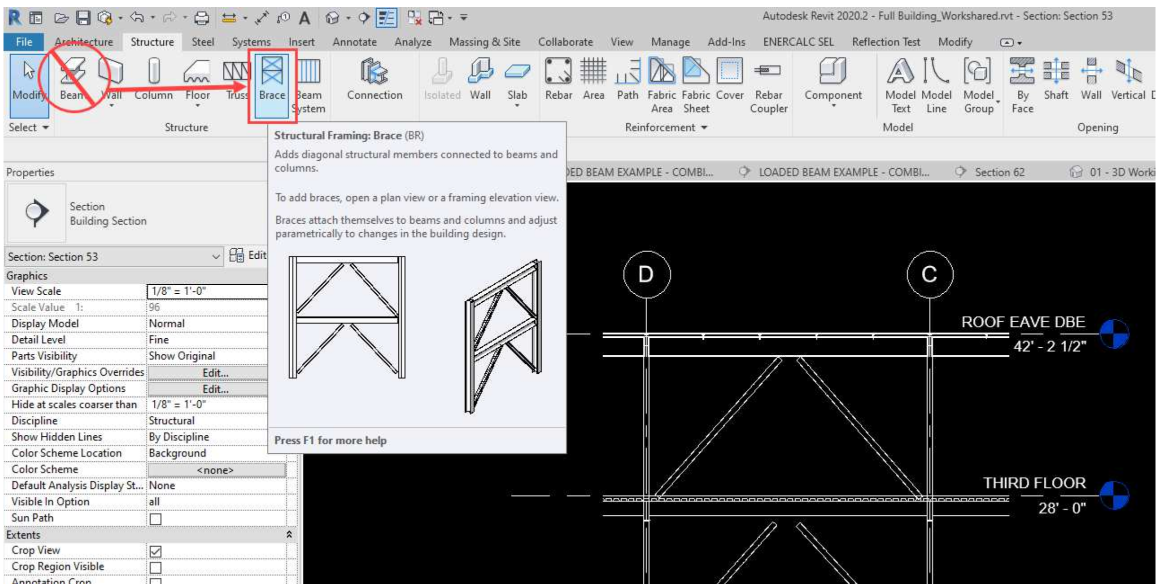

FIGURE 6: STEEL BRACED FRAME CREATION

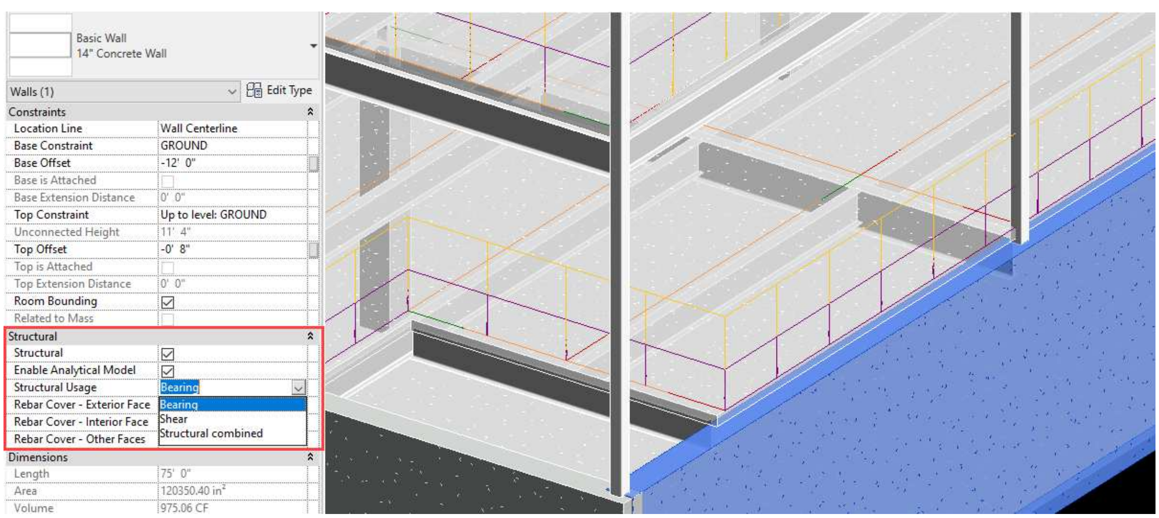

FIGURE 7: WALL STRUCTURAL USAGE

Structural materials

Structural material assignments are most likely an item that rarely receives attention because default materials are assigned on the fly. Verifying that appropriate materials are assigned is an important step in any project where the design team anticipates performing material takeoffs or launching analysis from the Revit model.

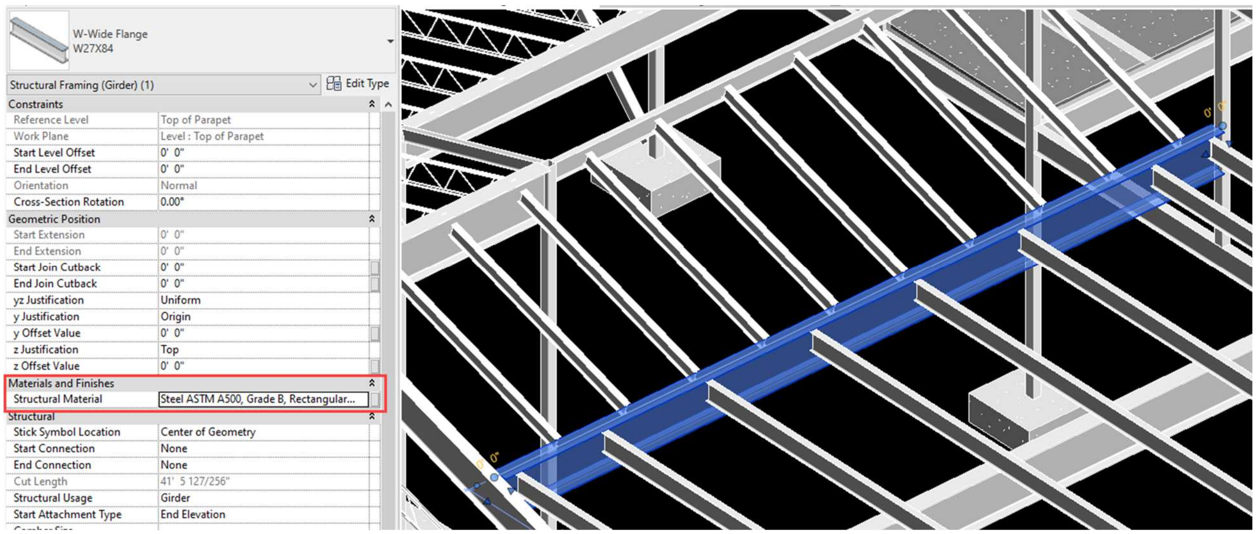

FIGURE 8: INCORRECT MATERIAL GRADE ASSIGNED TO A STEEL GIRDER

Revit-integrated design options

Once a structural team has created a well-managed Revit model, the task remains to select a design package or analysis workflow. Ideally, the chosen solution will take advantage of the Revit model by allowing the design team to leverage the hours already invested to curate it. Engineers who have previously worked with various commercially available Revit-connected design software will immediately recognize a number of challenges that come with these existing solutions.

These challenges include bulk import/export processes, managing data exchange files, managing parallel design and documentation models on opposing platforms, and lengthy troubleshooting when the exported model presents analysis errors. Experienced design teams who have attempted these workflows in the past often end up feeling that the cure is worse than the disease. Time saved by auto-exporting structural geometry to the analysis platform is easily consumed in resolving analysis errors and policing agreement with the Revit project. Instead of using some of these more traditional and laborious design workflows, the case study for this talk examines a new and radically Revit-centric approach driven by ENERCALC's Structural Engineering Library (SEL).

ENERCALC SEL is a powerful and widely used structural design program that consists of over 40 individual calculation modules for a number of different structural design tasks. These modules range from simple component designs (steel beam, concrete column, etc.) to analysis (i.e., rigid diaphragm torsion), earth retention, and even full 3D FEM analysis. ENERCALC SEL is commonly used in engineering practice for complete design of small and medium-sized structures, as well as for spot checks, verifications, and design of miscellaneous components on large-scale building designs. SEL has become the tool of choice for structural engineers all over the world due to its unique combination of powerful design capabilities and simple intuitive interface.

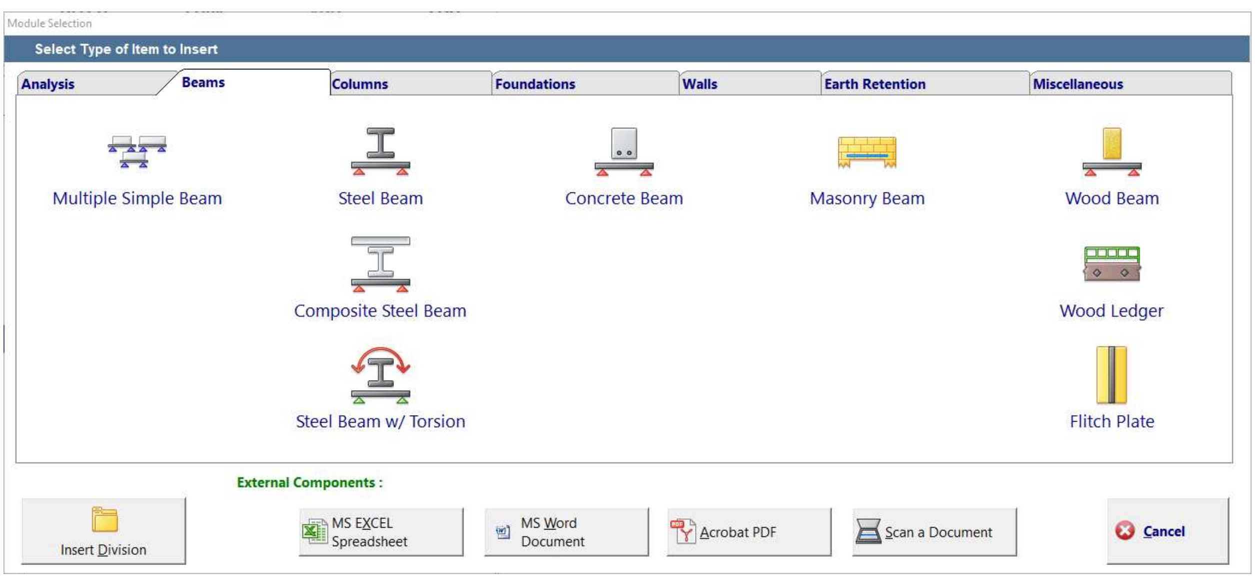

FIGURE 9: ENERCALC SEL CALCULATION MODULE MENU

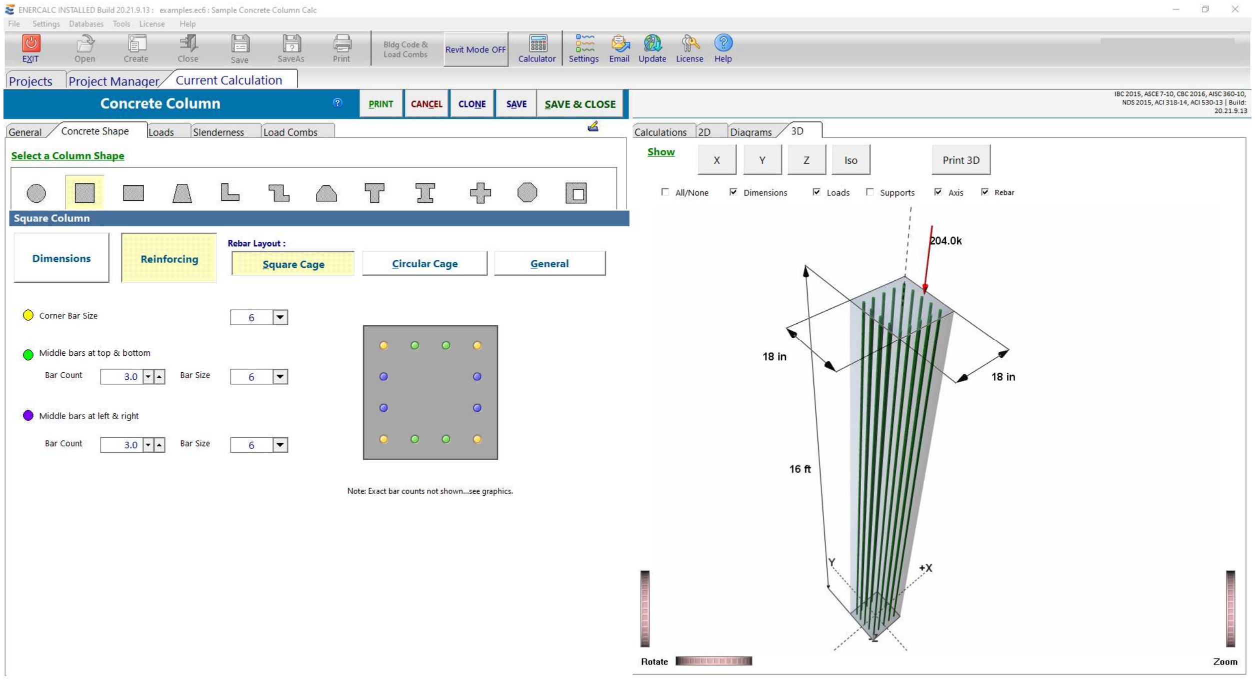

FIGURE 10: ENERCALC SEL CONCRETE COLUMN DESIGN MODULE

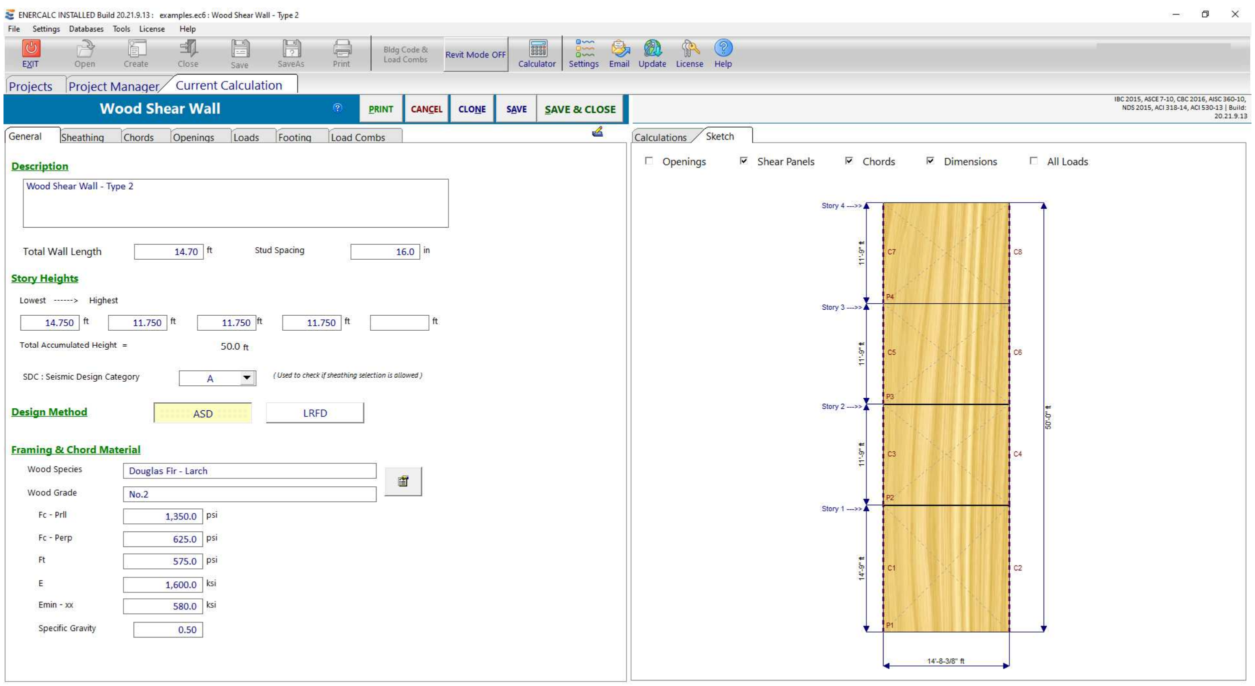

FIGURE 11: ENERCALC SEL WOOD SHEAR WALL DESIGN MODULE

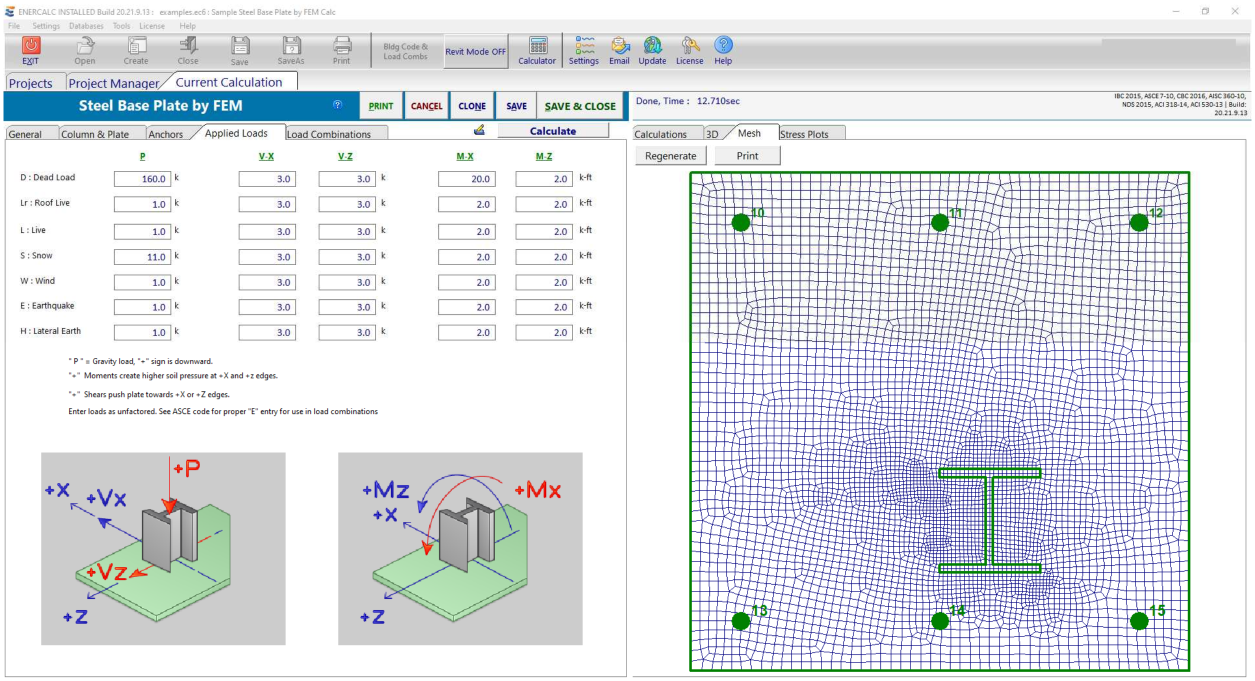

FIGURE 12: ENERCALC SEL STEEL BASE PLATE FEM MODULE

This particular case study will focus on the ability to launch and manage designs for individual structural components from directly inside the Revit model. This workflow is powered by the ENERCALC for Revit add-in, which provides users with a simple and intuitive set of ribbon bar tools in the Revit UI.

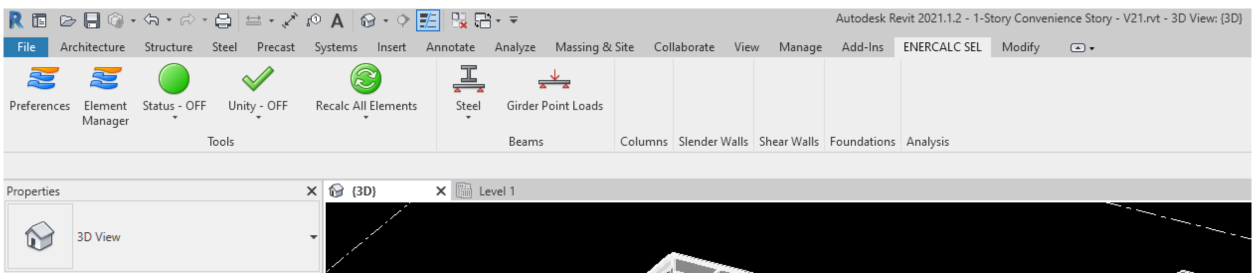

FIGURE 13: ENERCALC FOR REVIT TOOLS ON THE NATIVE REVIT RIBBON BAR

These tools enable engineers to launch a new structural calculation for a specific Revit element simply by clicking it in the Revit view. The program then automatically takes advantage of the vast data already stored in the Revit model to build a component calculation with accurate geometry, loads, section properties, etc.

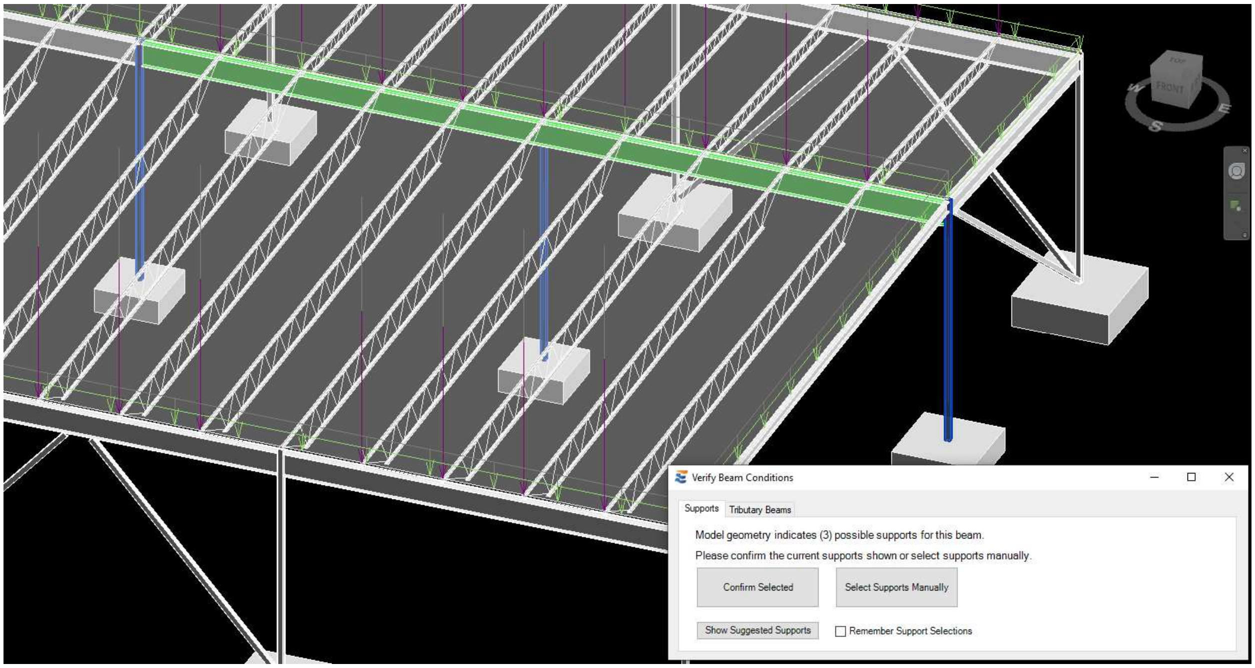

FIGURE 14: REVIT-BASED CALCULATION LAUNCHES LEVERAGE DATA FOUND IN THE MODEL

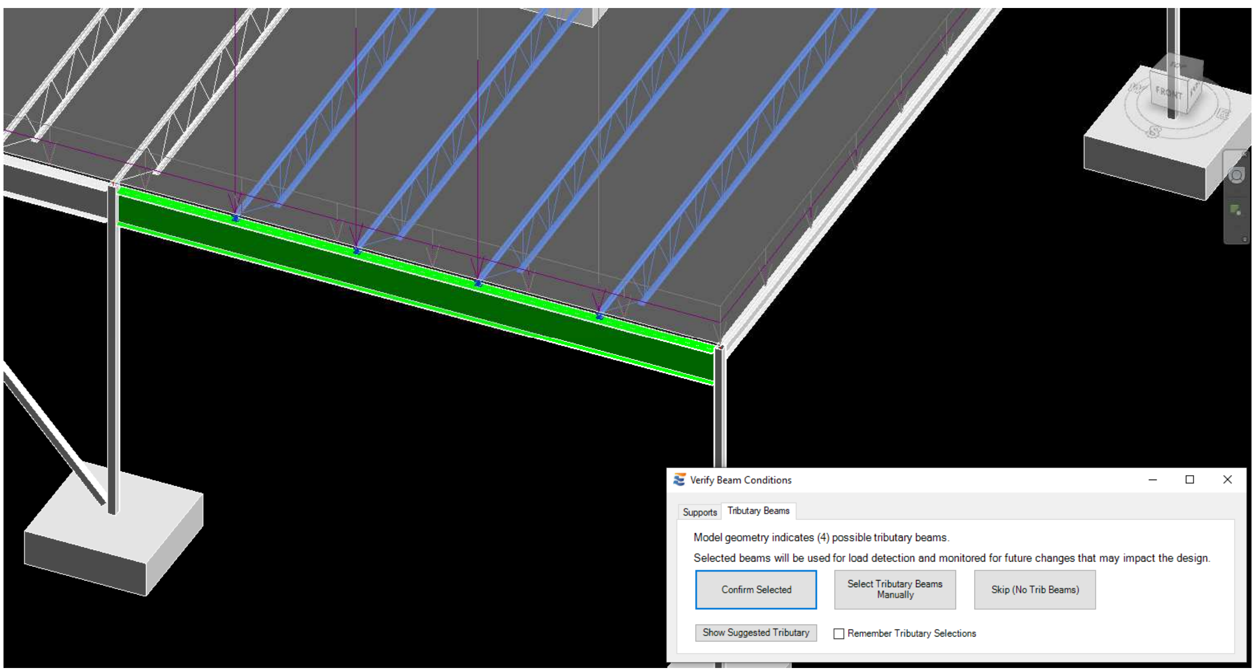

FIGURE 15: STRUCTURAL RELATIONSHIPS ARE DETECTED AND MANAGED DURING CALCULATION LAUNCH

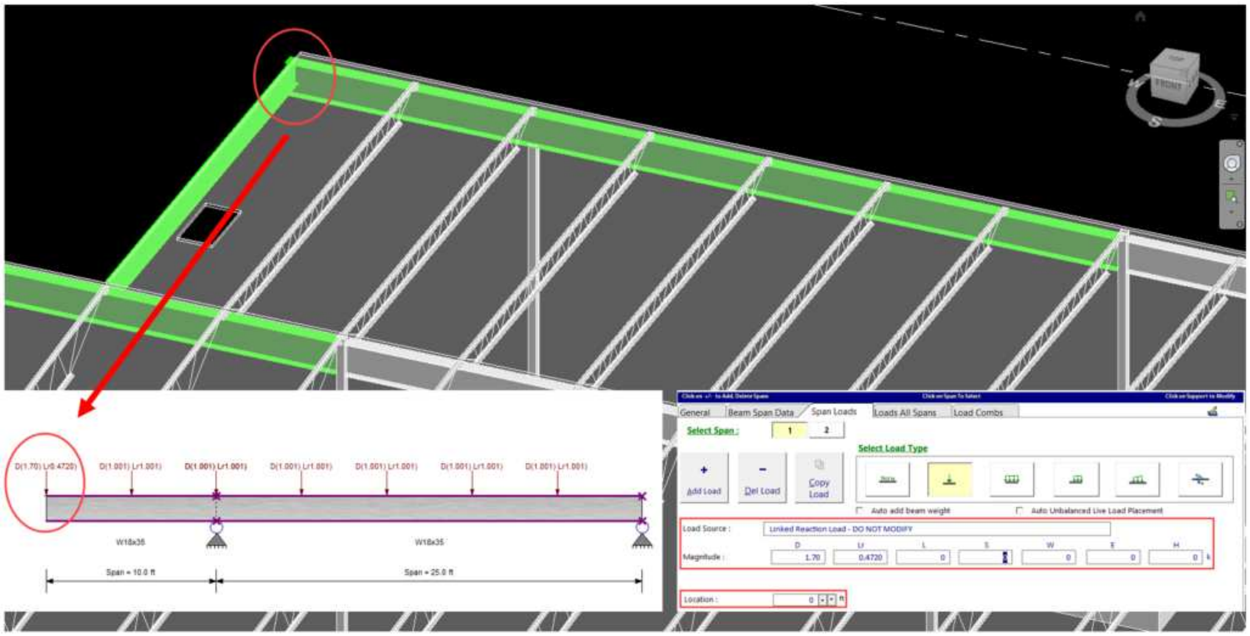

FIGURE 16: REACTION FORCES AUTOMATICALLY LINKED TO RELATED CALCS (I.E., FROM BEAM TO GIRDER)

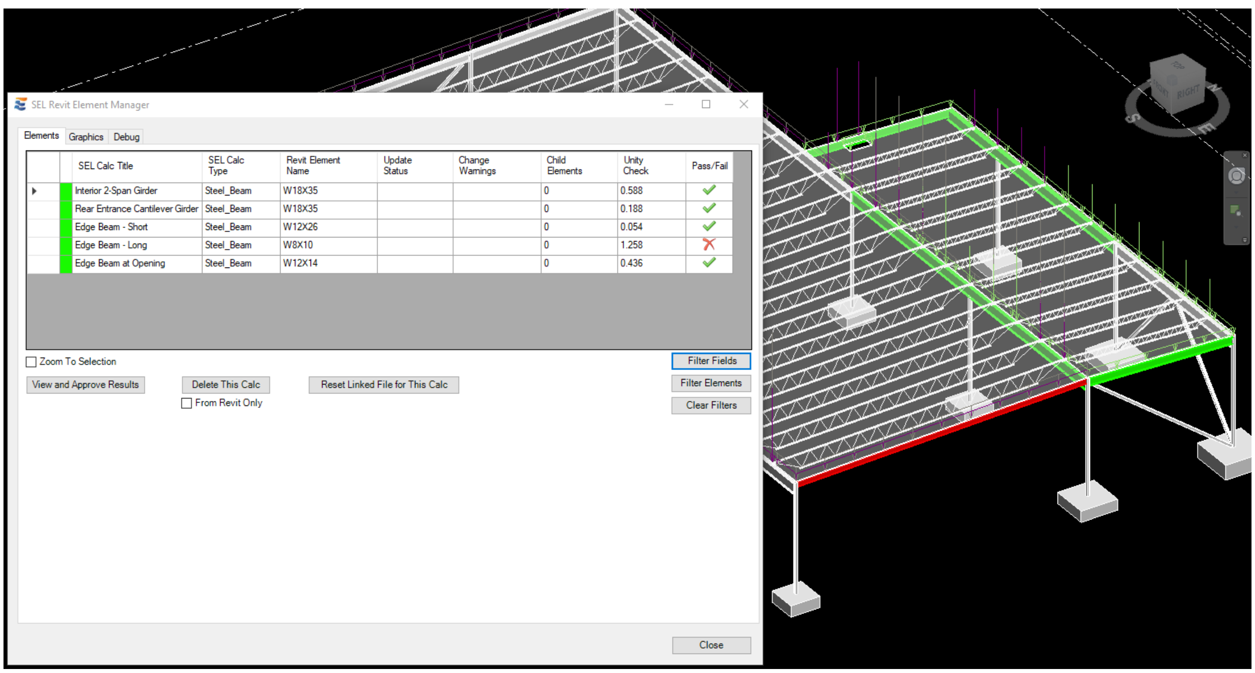

FIGURE 17: REVIT'S POWERFUL NATIVE GRAPHIC TOOLS ARE USED FOR VISUALIZATION AND OVERVIEWS

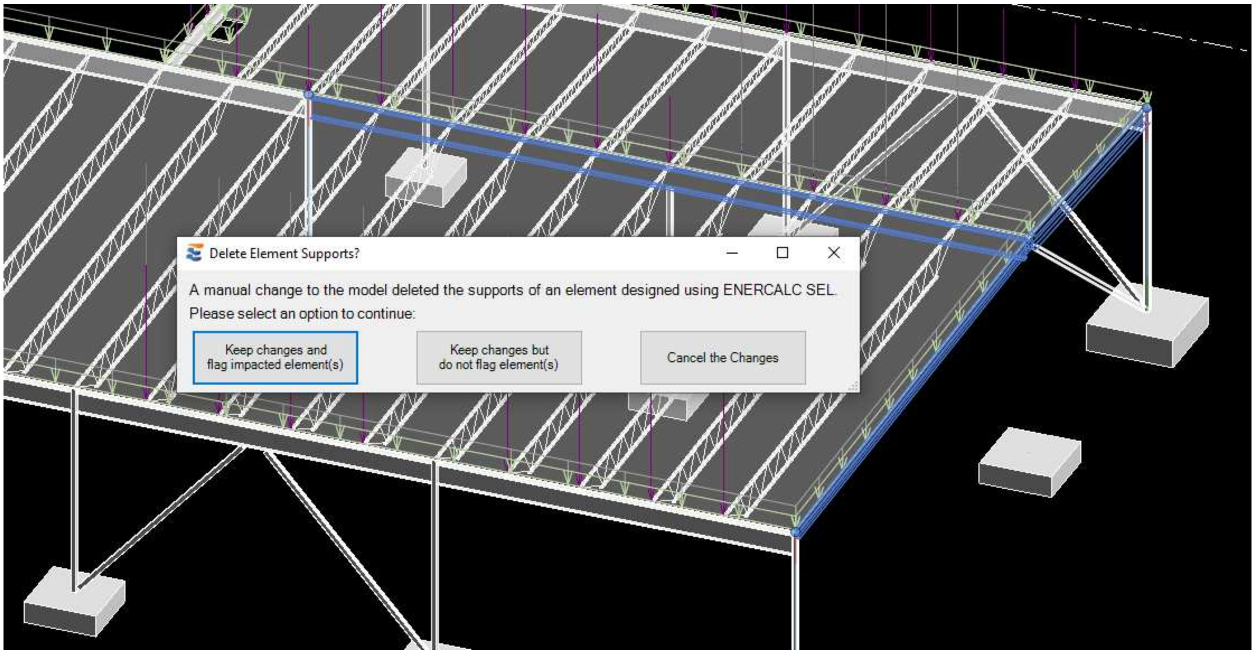

FIGURE 18: MONITORING TOOLS PROVIDE REAL-TIME OVERSIGHT OF SIGNIFICANT CHANGES TO THE DESIGN

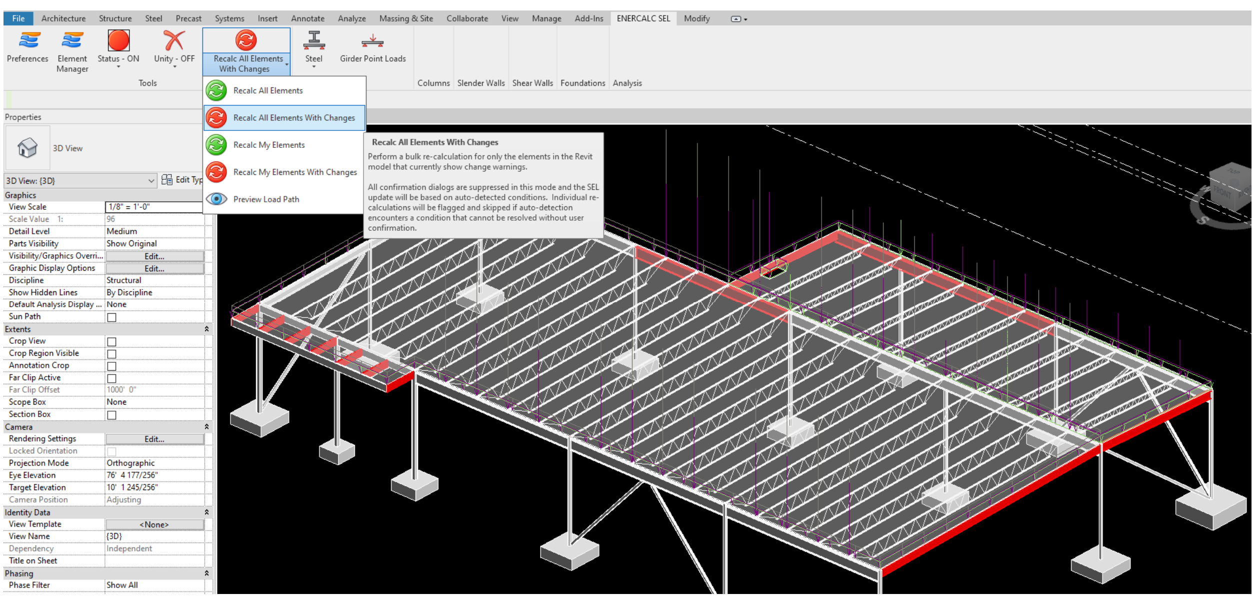

FIGURE 19: BULK RECALCULATION TOOLS ALLOW FOR RAPID UPDATING OF CALCULATIONS AS A MODEL EVOLVES

BIM-driven design case study

The final segment of the talk focuses on real-world applications of Revit-driven structural design. The case study consists of design of steel beams and steel girders in a single-story convenience store structure. The structure is laid out with metal deck and open web steel joists. Steel beams are used at deck edge conditions and as girders to support the joists. Rectangular tube steel (HSS) framing is used at the entrance canopy element and all columns are square HSS.

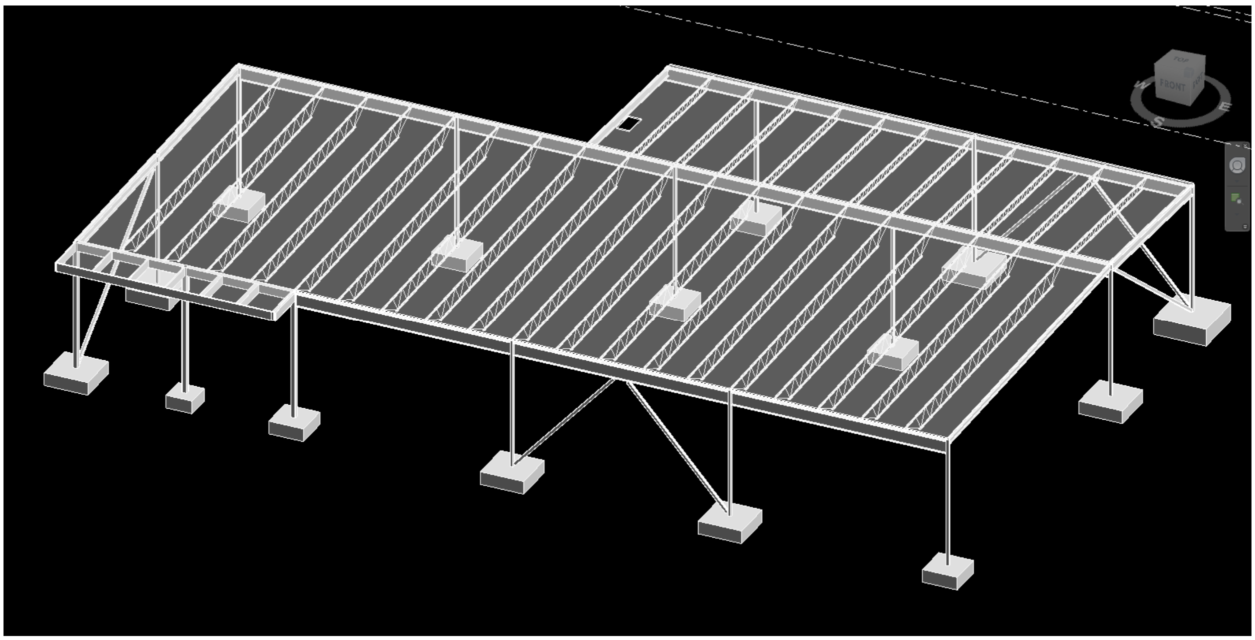

FIGURE 20: CASE STUDY SINGLE-STORY CONVENIENCE STORE STRUCTURE

The case study opens with a brief refresher on how quickly and easily hosted area loads can be applied to the metal deck in the project. The use of area loads is not mandatory when working with ENERCALC for Revit, but provides a number of time-saving advantages seen throughout the demo. Once the project has been introduced and loaded, the case study proceeds into a series of beam and girder designs ranging from simple to complex and showcasing increasingly powerful capabilities of both Revit and the ENERCALC for Revit add-in.

The first of these scenarios is the design of a simple-span perimeter beam. During the design of this beam, viewers will note the following capabilities in action:

1. ENERCALC for Revit automatically identifies the supporting columns that define the span geometry of the beam.

2. The supports are presented to the user for approval or intervention via manual selection to ensure that the design professional has the final say on all load path considerations.

3. After user approval, the beam design calculation loads fully populated in the ENERCALC interface. This includes all critical design information including span geometry, section size, steel grade, and loads.

4. Due to the presence of a deck with area loads, the tributary width of the beam has been automatically analyzed to obtain linear loads needed for beam design from the area loads present in the model.

5. Additional area loads may be added from inside the ENERCALC beam design interface and will populate automatically in the Revit project when the beam calculation is saved.

6. Upon completion of the calculation, design results are available directly in Revit by both tabular summary and color-coded pass/fail visualization in the Revit model views.

7. In the event that the beam section size changes during design, the size selected in the ENERCALC beam design interface is automatically loaded into Revit and assigned to the beam element when the calculation is saved.

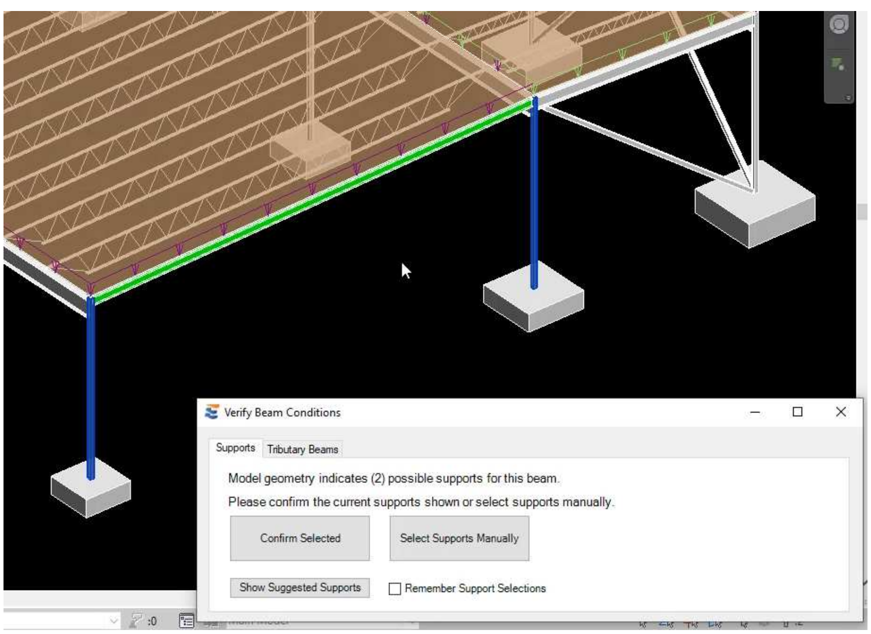

FIGURE 21: LAUNCHING SIMPLE EDGE BEAM DESIGN

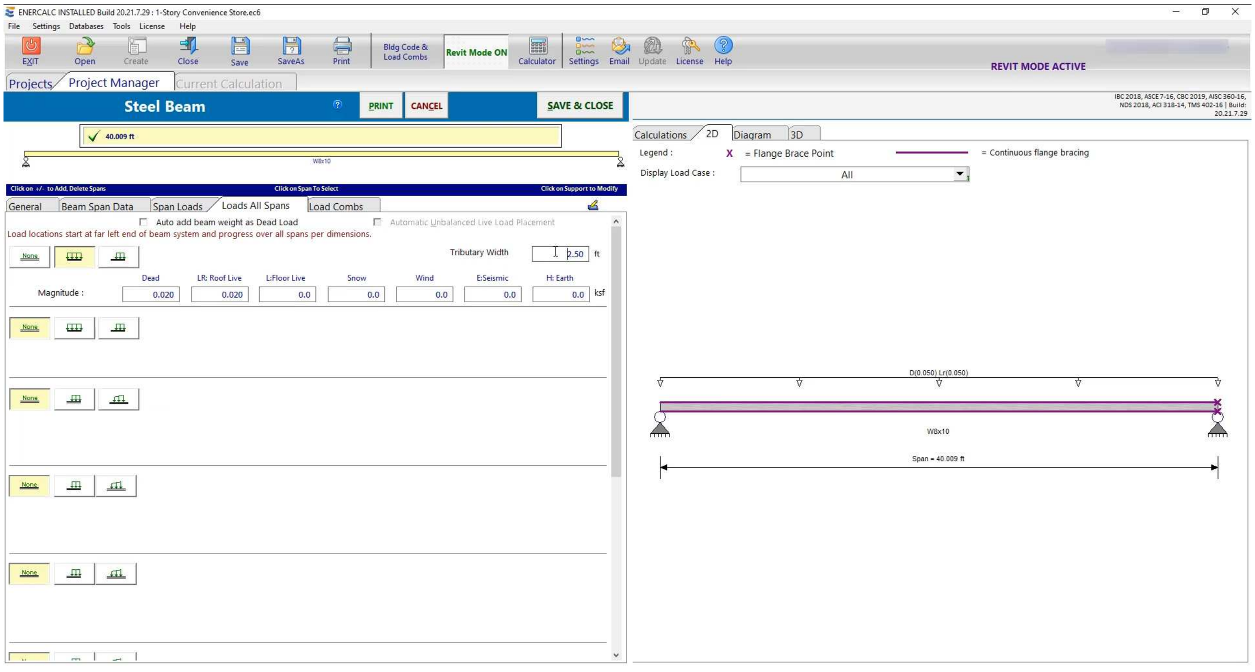

FIGURE 22: ENERCALC SEL SIMPLE BEAM LOAD CONTROLS AND LOADING DIAGRAM

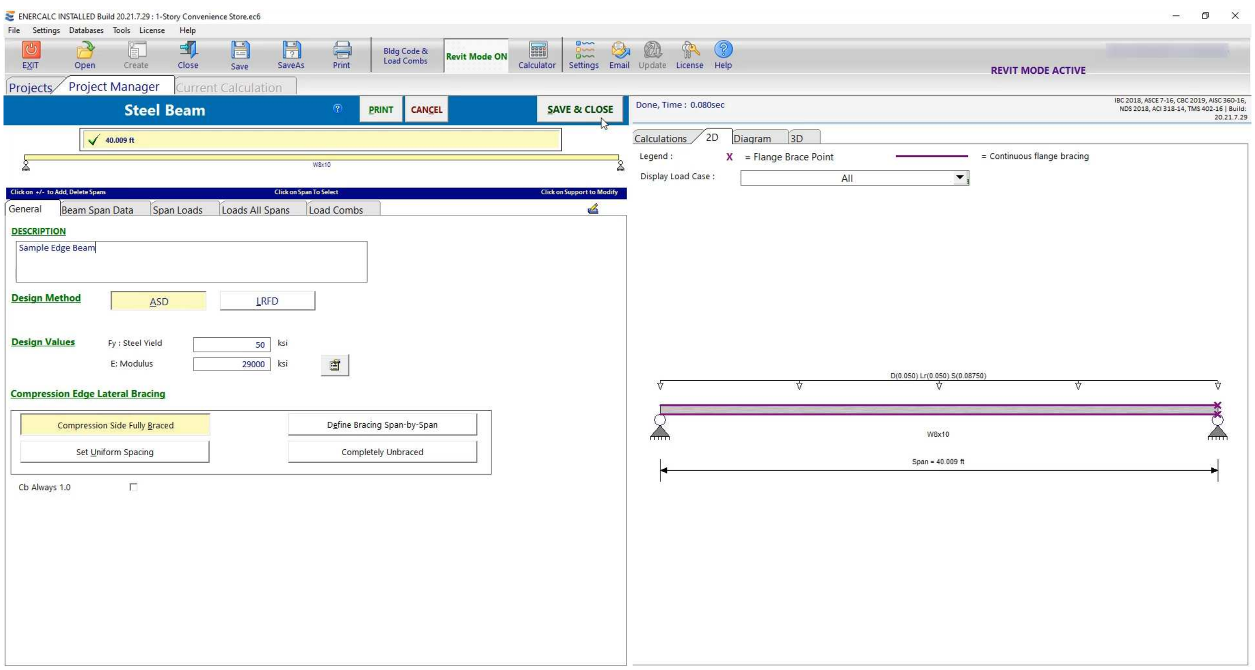

FIGURE 23: ENERCALC SEL STEEL BEAM GENERAL DESIGN DATA INTERFACE

The next example tackled in the case study adds a subtle twist. Rather than a typical edge beam, the second beam is adjacent to a roof opening in the metal deck. Beyond the core features shown before, viewers will note the following additional capabilities in action during the design of this beam:

1. ENERCALC for Revit automatically analyzes the variations in tributary width along the length of the beam and produces an accurate loading diagram that reflects the presence of the roof opening.

2. The user activates checkbox options to remember the support approvals to avoid repetitive prompting during future launches of the calculation for this beam.

3. After reviewing the calculation, the user manually applies rooftop unit loads at the edges of the opening in the ENERCALC beam design interface and these point loads are automatically stored in Revit upon completion of the calculation.

4. During subsequent re-launches of this beam calculation, approvals are bypassed and the point loads manually applied during the first interaction are automatically retrieved and included in the calculation.

FIGURE 24: LAUNCHING EDGE BEAM WITH ADJACENT DECK OPENING

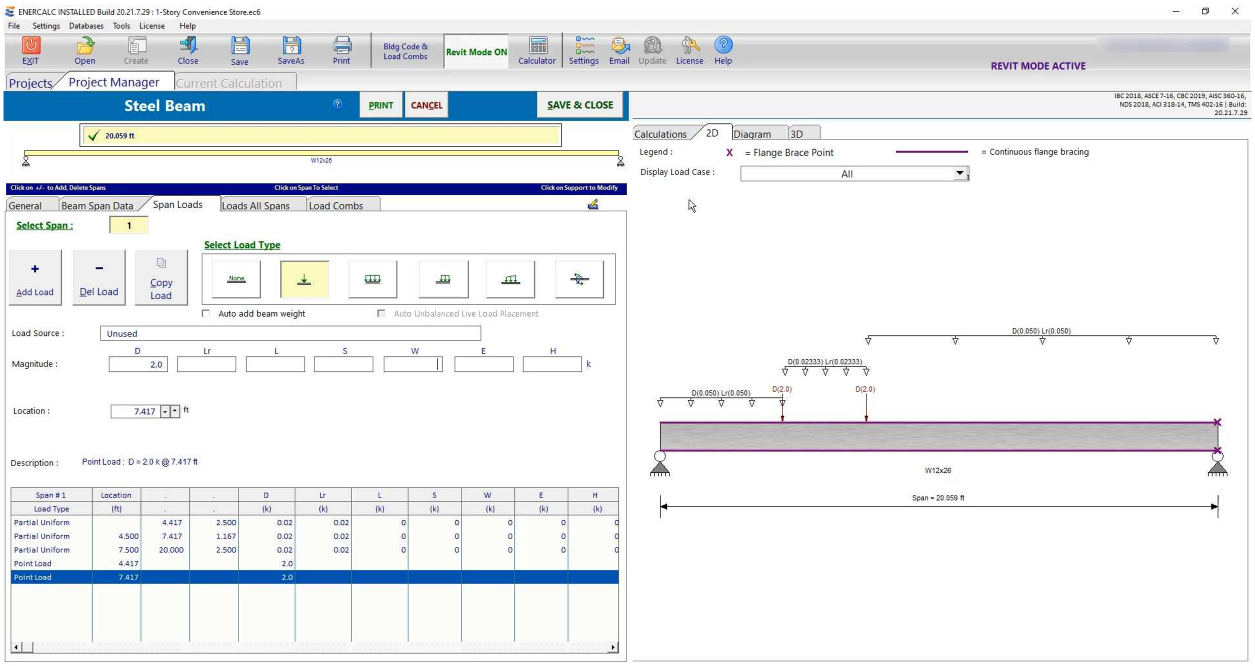

FIGURE 25: ENERCALC SEL DETAILED LOADING DIAGRAM WITH MANUALLY ADDED RTU LOADS

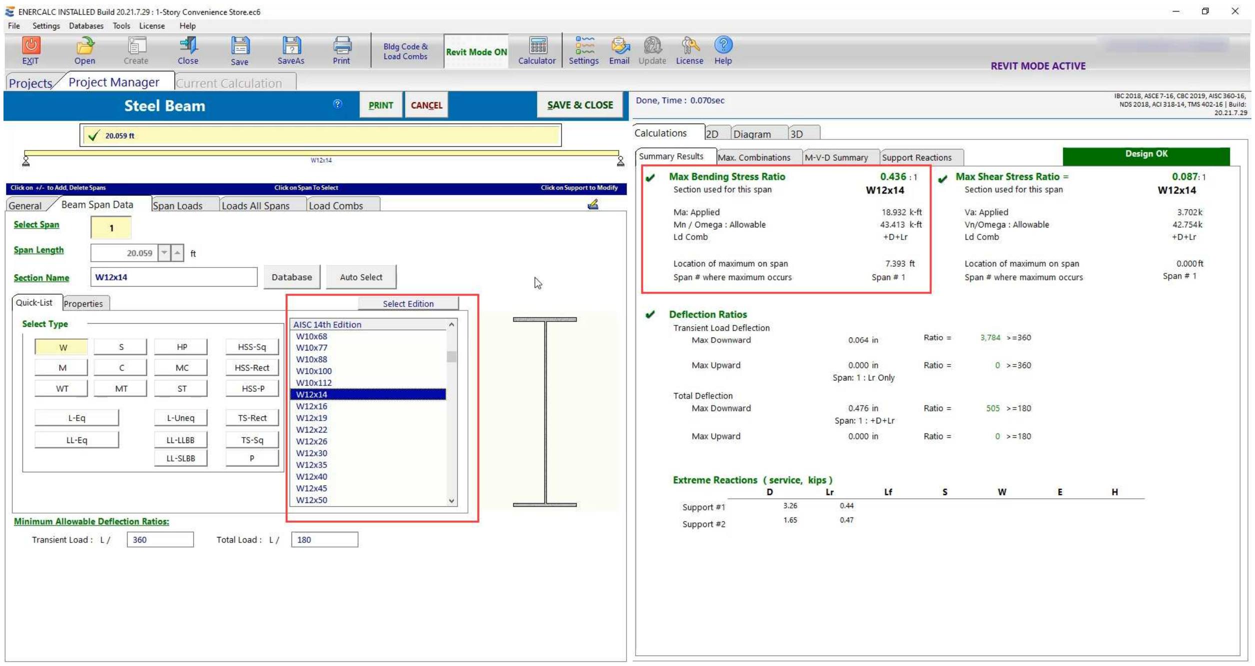

FIGURE 26: ENERCALC SEL STEEL BEAM SPAN DATA CONTROLS AND CALCULATION RESULTS

The third example in the case study shows the ability to progress beyond basic beams by tackling an overhang girder with roof joists supported on both the cantilever and the back-span. As with the preceding cases, this demo builds by using all of the core features plus the following:

1. The design starts with the launch of the "Girder Point Load" tool. ENERCALC for Revit automatically detects the joist and beam elements that are tributary to the girder. The girder point load tool allows the user to quickly and easily apply loading to the girder by leveraging the Revit model geometry to determine the appropriate area loads, tributary width, and spans for each of the joists the girder supports.

2. Girder point loads are summarized in a reaction table for review and approval by the user. For added convenience, the user retains full interaction with the Revit UI and model views while reviewing the reaction table. Upon approval, the point loads are automatically created in the Revit model.

3. In addition to the tabular joist loads, the end reaction from the edge beam completed in the previous step is automatically detected and incorporated as a point load on the tip of the girder cantilever. This "load-linking" ability allows the user to establish a real-time connection between individual structural component designs.

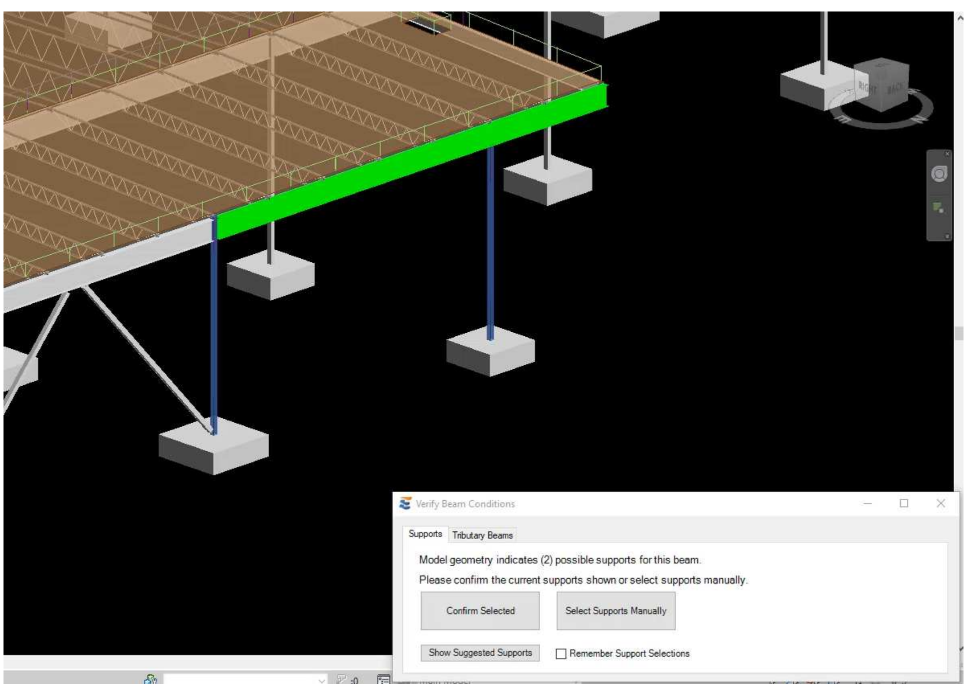

FIGURE 27: LAUNCHING OVERHANG GIRDER DESIGN

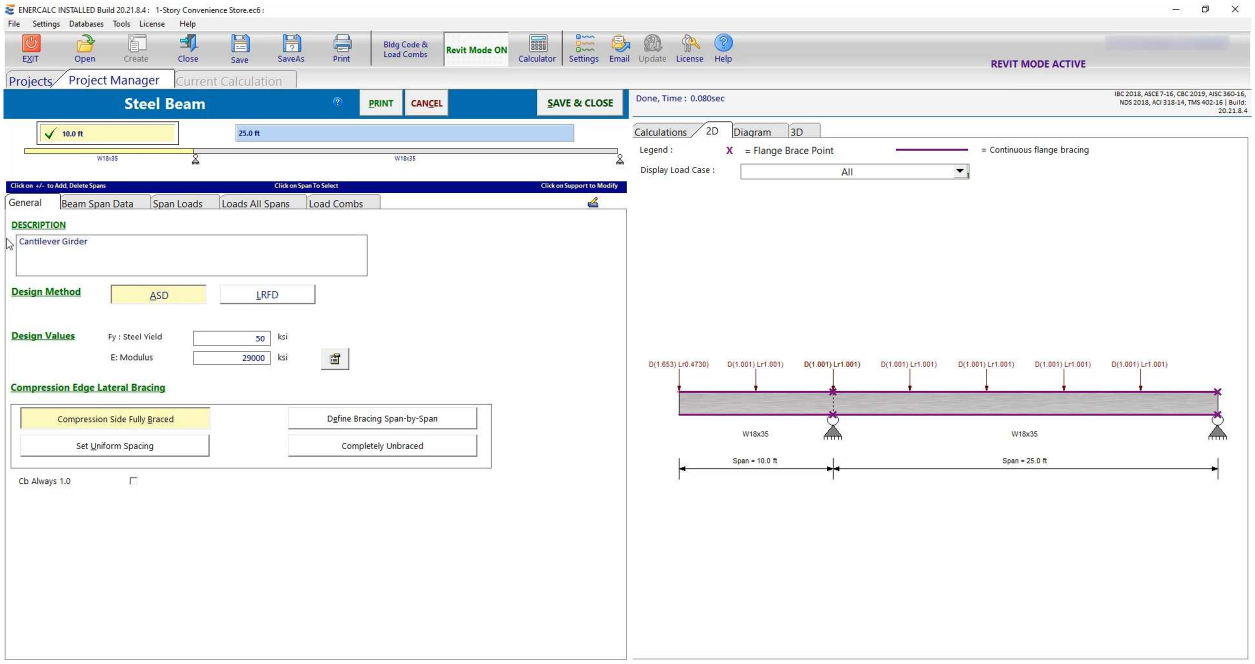

FIGURE 28: ENERCALC SEL GENERAL DESIGN DATA AND LOADING DIAGRAM FOR OVERHANG GIRDER

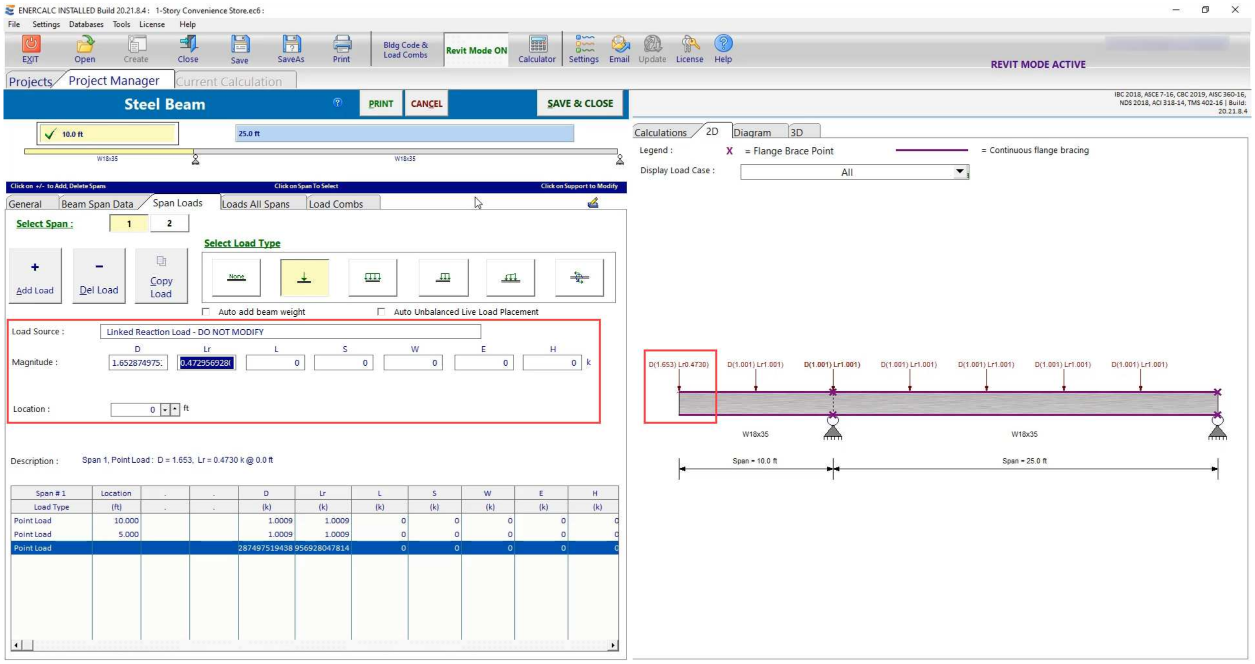

FIGURE 29: ENERCALC SEL AUTOMATICALLY DISPLAYS LOAD-LINKED REACTION FORCES FROM TRIBUTARY EDGE BEAM IN THE GIRDER DESIGN

The last element design examined in the demo showcases the ability to design a group of elements rather than a single isolated element. The entrance canopy beams in the case study structure are modeled as a Revit beam system, meaning that they have a parametric relationship with each other. The following features are seen during this design:

1. Rather than accepting the auto-suggested supports, the user takes advantage of the option to manually specify an alternate support condition (fixed-base cantilever).

2. ENERCALC for Revit automatically detects “beam system” parametric relationship on the fly and offers the option to tie all of the beams to a single controlling beam calculation.

3. Selecting this option creates a “parent / child” relationship where all other members of the beam system can easily be controlled from one calculation.

4. When the beam section size is modified in the ENERCALC calculation, all (7) canopy beams are automatically resized in Revit, due to the “parent / child” relationship.

5. The “parent / child” relationships can be managed from the Element Manager window if needed. In this demo, three children are manually dropped from the “Child Elements” list.

6. When the parent calculation is then relaunched and changed back to the previous section size, its (3) remaining children assume the new size, while the (3) former children do not. They are now independent and may be controlled by their own respective calculations if desired.

FIGURE 30: LAUNCHING BEAM SYSTEM CALCULATION WITH "PARENT / CHILD"

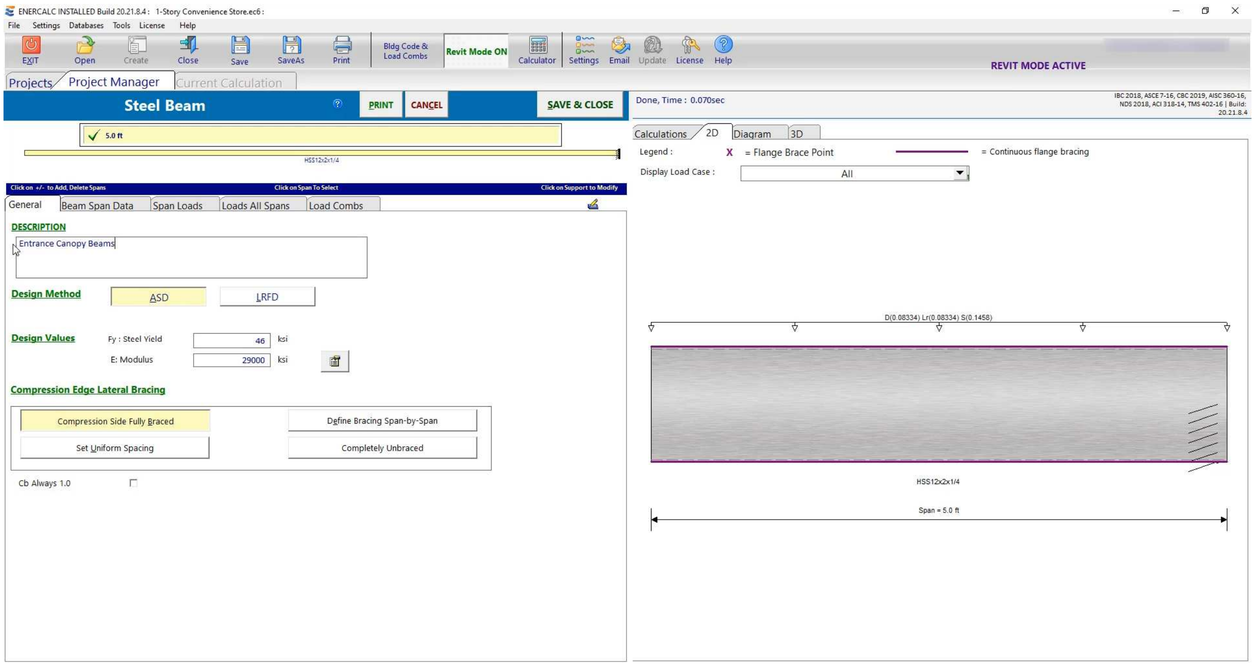

FIGURE 31: ENERCALC SEL FIXED-BASE CANTILEVER DESIGN FOR TYPICAL CANOPY BEAM

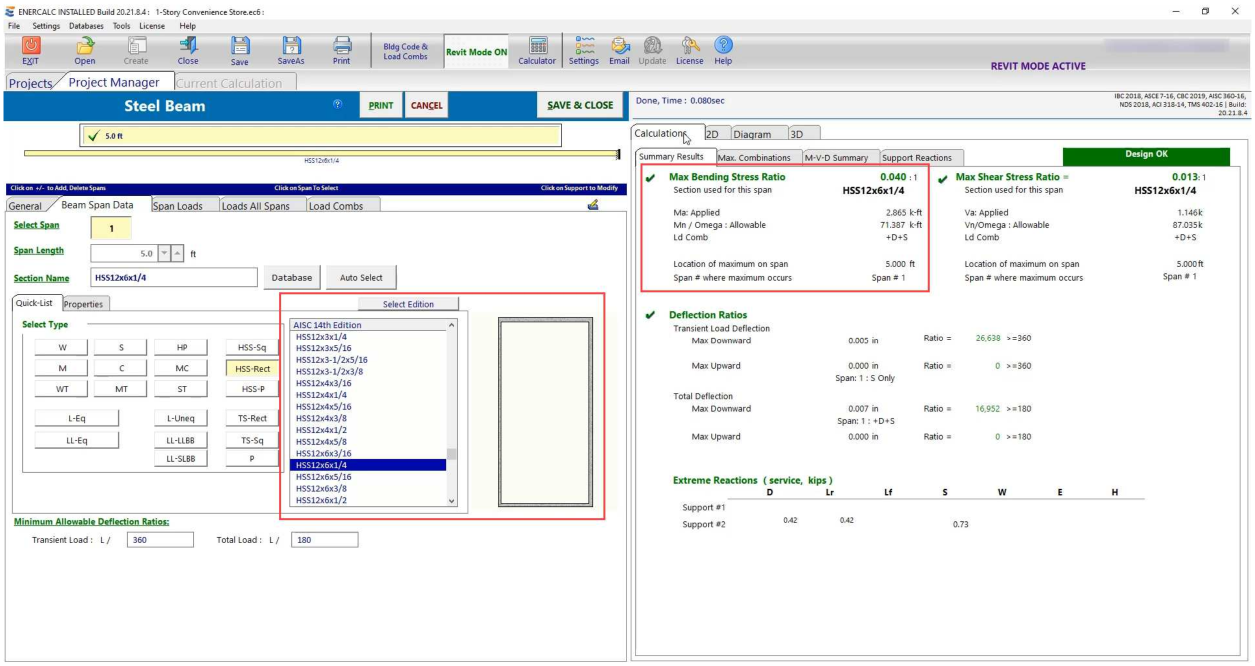

FIGURE 32: ENERCALC SEL CANOPY BEAM SECTION CHANGE AND UPDATED CALCULATIONS

The final segment of the case study examines the ability of ENERCALC for Revit to monitor changes in the Revit model, create notifications and warnings, and resolve warnings via bulk recalculation tools. The following features are seen during this portion of the demo:

1. While reviewing a Revit model with a number of completed beam and girder designs, the user manually changes the magnitude of an area load on the roof deck. This change triggers a warning that the modification will impact completed calculations.

2. Upon approval of the change, the element color highlighting in the Revit model automatically updates to indicate that various elements now carry warnings due to load modifications.

3. Details about the warning status of individual elements may be viewed via the Element Manager window.

4. Warnings are resolved by a bulk update of the calculations. This is done using the bulk recalculation tools on the ENERCALC for Revit ribbon bar. The bulk recalculation does not require any pop-up approvals and the order of recalculation is set dynamically to preserve the integrity of load-linking relationships in the structure.

5. Following the completion of the bulk recalculation, the user again changes the Revit model by shifting the column that supports the overhang girder designed previously.

6. Upon approval, this support modification results in a warning status only on the affected girder.

7. The warning on the girder is then resolved using a single-element recalculation, which refreshes the analysis of the girder for current loads and geometry without opening the beam calculation for editing in ENERCALC.

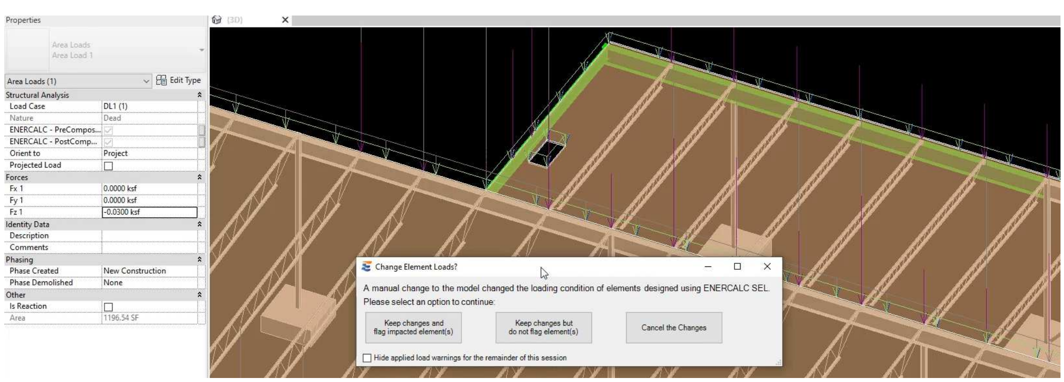

FIGURE 33: MODEL CHANGE NOTIFICATION TRIGGERED BY AREA LOAD CHANGE

The case study presented in this talk showcases the power of Revit-based design via ENERCALC for Revit to enhance and facilitate the daily work of structural engineering teams. Each of the progressively more complex designs discussed here highlights specific features that provide crucial advantages for a design team. In addition to the ability for structural engineers to instantaneously generate new calculations from Revit elements, ENERCALC for Revit users also gain the ability to easily edit and manage calculations with intuitive 2-way control over critical design information.

Revit-based design also saves time and effort for the design team by leveraging the power of Revit's native graphics options for overview and visualization of the design within Revit views via color-coding and other controls. It unlocks the ability to rapidly iterate a design with "what-if" scenarios without the difficulty of constantly reconciling two different models or platforms. The power of "load-linking" allows engineers to automatically move reaction data among related calculations, sparing both wasted time and the risk of inaccuracy. Using ENERCALC for Revit also serves to streamline the record keeping process, since calculations are easily created, reviewed, and managed.