

What's Wrong With A/E Drawings for Commercial Buildings?

From The Perspective of an Engineered Wood Products Manufacturer...

By Guy Brousseau, P.E., and John Saggiani

Do you want to save time and money on your next wood commercial building project? If the answer is *yes*, then why do problems still occur?

The answer is simple – architects and engineers want to quickly lay out a rough framing plan and hope that it is built according to plan. Then when the structure isn't built to plan, the offending building will be someone else's problem. In the end, though, it will be everyone's problem, including the architects, engineers, building department, trades, and product manufacturers.

In today's market, A/E drawings are increasingly flawed because of low fees, tight schedules, and staff shortages. Most of the flaws can be attributed to a lack of correct detailing and coordination between all design professional disciplines. These flaws then create costly delays during the construction process, and the possibility of having to redesign the plans after the permit is awarded and in order to receive final inspection approval.

Since A/E firms are pressed for time and money, floor and roof system plans are quickly designed. Instead of spending time up front in selecting the most efficient and economically available system, some A/E firms rely on a framing package from suppliers of engineered wood products to provide the design information. Engineered wood products include wood I-joists, open-web trusses (wood chords with steel webs), and laminated rectangular sections. The framing package is comprised of an engineered shop drawing and calculations provided by the manufacturer of the engineered wood products. The original intent of shop drawings was

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to provide a drawing informing the shop of the specific fabrication for the product specified. As time has evolved, product manufacturers have inadvertently let shop drawings extend beyond that original intent. The result has been that product application assurance (PAA) has become too extensive because of the poor A/E drawings that exist.

In the simplest terms, PAA is an honorable intention offered by the manufacturer to ensure that the products they provide will satisfy the intended needs of the application. However, it has become a common misperception that, because of the PAA, the structural engineer does not need to worry about what they specify on plans because the engineered wood manufacturer will resolve conflicts and provide design improvements. Because this model appears to be the perfect solution by A/E professionals, it has now become the expectation among many in the construction industry.

Relying solely upon the manufacturer's PAA at the end of the design process often results in a terrible mess that causes a long list of problems. Not to mention that everyone involved, including the owner, contractor, architect, engineer, and material supplier, will have to spend an incredible amount of non-billable time trying to preserve some form of profit. Design professionals must not let themselves slip into the trap of thinking that the manufacturer will solve their conflicts during construction, no matter how much they would like this to happen. Manufacturers simply do not have the capacity to effectively resolve all of the issues that arise from inadequate engineering drawings. Unfortunately,

the result of this complacency by design professionals speaks for itself and why the quality of engineering drawings becomes so important.

By simply involving the manufacturer at the beginning of the design process rather than the end of the process, the correct floor and/or roof system will be specified the first time. An adequate specification from the start will save everyone precious time and money throughout the process. Let's look at three common approaches to the design process—the ugly, the bad, and the good—and the challenges and advantages of each.

The Ugly

The ugly is better known as a "design build." In this situation, the engineer of record (EOR) is not sure what the owner has



These trusses were cut by a tradesperson in order to fit a piece of mechanical equipment in the ceiling of this structure. This is one example of how coordination between relevant parties can save time and costly repairs.

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We all want to avoid a structural collapse such as this. Fortunately, there were no injuries as a result of this collapse.

in mind for structural members, so he or she simply states, “joist or members by others”, which leaves the parameters blank in hopes that they will be resolved by someone later.

The advantage of a design build is to cut the up-front costs and decrease the time needed to design a building. The challenges are potentially abundant. Take for instance the loading of structural members. Since the joist members are called out by others, the shop drawing and calculations must check all gravity loads, point and line loads from walls above, tower framing, wall bracing, soffits, fascias, mechanical units, sprinkler lines, ceiling systems, and any axial loads due to wind or seismic conditions. Now honestly, is a shop drawing being reviewed by an EOR to ensure that all of these loading conditions are checked and that the manufacturers will get it right every time? Furthermore, does the drawing even get checked or does the EOR simply rely upon the manufacturer’s stamp and PAA?

Another stumbling block is when a plan calls out a floor live load of 50 psf, but the floor plan shows a storage area. A storage area requires the live load to be increased to 125 psf. Such a discrepancy will cause a redesign to be necessary, which increases the cost to the original plan because the members will need to be increased in size or have closer on-center spacing. These examples indicate that trying to find the most economical solution during the construction process will often result in changes, delays, and possible back charges.

Extreme real world example: In 1980, there was a project in California that had been planned and constructed with a future ceiling allowance of 5 psf. However, in the end, the actual ceiling was a baffled ceiling with a plastered surface that was extremely tall and had a heavy vertical load component. Regrettably, in 1987 the roof structure collapsed. One of the main contributing factors was that the actual ceiling weighed *significantly* more than the

original design allowed. Fortunately, no one was killed or injured, but the structural, legal, and financial mess took years to resolve.

The Bad

The typical approach we have classified as “the bad.” This is when an EOR goes to the manufacturer’s catalog or design software, and picks products that appear to support the “typical” conditions shown on the plans. However, issues can arise from this type of planning, including the following:

- Selecting non-economical products
- Selecting products that are not available
- Selecting products that do not support all loading conditions
- Details that do not match selected products
- Selecting products that do not match architectural requirements such as member height, details or configuration

The potential advantage for this case lies directly on the shoulders of the architects and engineers. If they have the competence and time to address the issues listed above during the planning stage, then few problems will occur with the project downstream. But, most architects and engineers don’t have the required time, expertise, or resources to do that. Instead, the EOR usually expects the supplier to comment on any discrepancies and process them during construction. Unfortunately, this often results in costly delays and unfortunate surprises to designers and those in the other involved trades.

Additionally, when an EOR selects a product, often the specified supplier will want to suggest a more competitive, readily available option. However, making changes requires a broad range of expertise and often results in ramifications to the entire project. As a result, many buildings suffer from the “over budget” blues, such as needless dollars being spent in dealing with changes after a permit is awarded and contracts are secured.

The Good

The good refers to the best-case scenario – when the architect and engineer have worked together with the product supplier at the beginning of a project. This approach ensures that the best products are selected for that specific job and that all (or as many as humanly possible) the load cases and detailing are complete and correct. It also promotes project coordination with all impacted trades, so there are no surprises once they arrive on the jobsite and before the building permit is awarded. With this goal in mind, we recommend that all specifiers search out manufacturers of engineered wood products and obtain their support during the design process, with a back-check at time of the final plan.

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One of the main advantages is knowing which products are the best choices. This knowledge only comes after years of product, labor, and experience in related design and construction issues. Suppliers usually have a wide range of member choices for any given condition and must check the following before making the best choice for the project:

- Framing members that are capable of supporting all horizontal and vertical loads
- Member heights and spacing
- Labor and material costs of each product type with required accessories
- Plant availability of each product type
- Plant and engineering lead time requirements
- Freight cost from each plant
- Compatibility with height restraints
- Fire rating and sprinkler concerns
- Horizontal and vertical mechanical requirements
- Local building customs
- Ease of construction and installation costs
- Wind and seismic connections

Unfortunately, there are no perfect solutions, and even the "Good" approach can cause some concerns regarding fees. One concern is that the manufacturer might require a contract prior to investing time and energy into a job that could end up going to a competitor. Many manufacturers however, will assist in the design stages, knowing that a properly specified job usually gives them a competitive edge. Alternatively, a manufacturer can ask the owner or architect to negotiate services based on a "if they don't get the job" fee arrangement. Overall, it's always recommended to accept design assistance, because it is wiser for A/E to draw the plans

as accurately as possible the first time and avoid future chaos, confusion, and increased liabilities later.

As members of a very dynamic industry, we *must* work closely together at an early stage in the design process to ensure that the proper floor and roof system – both structurally and financially – is selected for each commercial wood building project. Also, by working together early in a project, we can help eliminate the potential for delayed schedules, cost over-runs, the constant distractions caused by revisions, and the extreme scenario of a building fall down. ■

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