

# Reflections on Steel in Healthcare

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**FACILITIES DESIGNED FOR THE HEALTHCARE INDUSTRY** present distinct and demanding requirements to the entire project team. Representatives of AISC's Steel Solutions Center and the editors of *Modern Steel Construction* invited several industry experts to share their insights into the challenges and opportunities that working in the healthcare industry offers, including the important role steel plays.

## Q. What unique challenges does hospital construction bring to the design team that is not faced by other building types?

**Sterr:** Hospital construction is one of the most regulated building types. This results in multiple codes being applicable and often conflicting.

**Beall and Ioannides:** Hospitals are essential facilities. Therefore, the building codes dictate higher design forces, more stringent life safety requirements, an elevated level of fire protection, and many other design requirements not normally considered in typical commercial building types.

The layout of a hospital is also unique. Longer spans are required in areas such as patient wings—which have little layout flexibility due to the fixed size, required furniture, and architectural constraints. A large, single-story ancillary space with an irregular footprint often is found on the first floor past the boundaries of the main tower. Column locations and bays that are somewhat “erratic” usually are found in this single-story space, and thus framing challenges often arise. These areas also present challenges to diaphragm design and continuity, and special consideration must be given to the lateral force resisting system. Finally, these expansive ancillary areas present challenges to the number and locations of roof drains and there is often difficulty in either sloping the structure or insulation to optimize water egress.

Hospitals always have specialty equipment, which may require consideration of vibration mitigation, radiation containment, or strict deflection control in addition to supporting the unit's self-

weight. Operating rooms or areas for specialty procedures also often require the structure to support heavy exam equipment.

Finally, hospitals frequently undergo renovations, expansions, or modifications requiring new openings, framing modifications, or structural retrofits to suit the desired occupational use.

**Kruth:** Generally, most hospital construction is performed with very tight site constraints. The new buildings are either additions to existing buildings or placed in space that was previously a green space or a parking lot. At times the constraint can be on three sides of the new construction. In addition, due to the proximity to existing buildings, pedestrian traffic as well as emergency vehicle traffic often must be maintained through the construction area. This requires careful planning of onsite construction activities. Issues must be addressed such as safety of non-construction personnel, staging erection for access of emergency vehicles, and just-in-time delivery of structural steel due to limited onsite storage and staging space. Also, care must be taken for the venting of exhaust from construction equipment. Air intakes are present in hospital buildings. Exhaust from cranes, welders and other equipment must not enter these intakes, many times making it necessary to put scrubbers on the equipment exhaust. In addition, noise from construction activities may disturb patients recovering in the hospital, so care must be taken in this area as well.

**Q. The sustainable construction movement continues to gain momentum. Are you getting requests from hospital owners who are knowledgeable about sustainable construction and committed to a high-performance green structure? Do they recognize the benefit that a recycled steel frame brings to the table?**

**Beall and Ioannides:** More owners are becoming aware of the sustainable construction movement. While there may not be a high level of integration of sustainable construction in the healthcare industry as of yet, we are educating our clients about this issue—and certainly steel is a sustainable building product. There are other important considerations beyond the structural disciplines that determine whether a LEED certification will be attempted. But it definitely is being discussed more frequently on projects.

**Sterr:** Yes, we are getting more requests to incorporate more “green” features. Economics is still the primary driver in determining the final implementation. Owners are sometimes surprised to find out that virtually all structural steel is recycled material.

**Q. Serviceability issues such as vibration requirements may also come into play. In your experience, can those needs be satisfied with a steel frame?**

**Beall and Ioannides:** Generally speaking, sensitive equipment, such as an MRI, is located on a slab-on-grade in any type of structure to minimize vibration problems. When such equipment must be located on an elevated floor, a vibration analysis must be considered. We have successfully designed and consulted for other engineers and owners to incorporate sensitive equipment and rooms where sensitive procedures take place into an elevated steel-framed floor system.

**Sterr:** These needs can be met with steel frame construction. It is all about balancing the right combination of floor mass and frame stiffness.

**Q. Hospitals require a great deal of specialized equipment. Will a steel frame satisfy the need for tighter tolerances, levelness, clearances and deflection criteria that this equipment may impose?**

**Sterr:** Steel frames can certainly be designed to meet the needs of specialized equipment. Steel has advantages where tolerances and deflection are concerned, but can become more challenging where vibration is the driver of design.

**Beall and Ioannides:** We have been successfully designing primarily steel hospital structures for more than 25 years. With an experienced contractor as a team member, we have had little difficulty in meeting the required criteria.

**Q. Steel is by far the framing material of choice for office construction. One of the reasons is the flexibility that steel offers for current and future tenants to make changes in the structure. Does the hospital market require this same “flexibility for change”?**

**Kruth:** Most definitely! Medical equipment is changing daily. Hospitals want and need to have the most up to date equipment. Steel frames are more easily altered than concrete frames. If the equipment requires the reinforcing of the structure, a steel frame is more easily reinforced than a concrete frame.

**Beall and Ioannides:** It does even more. In the early days of hospital privatization, we were involved in some renovation design of hospital facilities that used construction materials other than structural steel. We discovered that when new openings were required in the floor slab, the use of the other materials made any required strengthening or retrofit of the slab more difficult. Due, in part, to that experience, almost all of our hospital designs are done in steel. Owner’s representatives frequently raise the possibility of expansions, renovations, and layout flexibility for the future during the design phase of new projects. Structural steel has been a useful material to satisfy these design objectives and it accommodates provisions for future build-out flexibility.

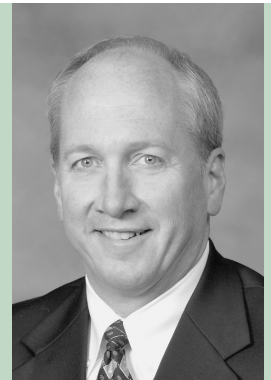
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**Lawrence Kruth**



**Martin Sterr**

**Q. Most construction projects are driven by both price and schedule. Is this the case for hospital construction as well or do long lead medical equipment items move the critical path away from schedule concerns to focus on cost alone?**

**Sterr:** It has been my experience that usually when a decision is made to purchase specialized equipment, initiating the need for the space to house it, there is rarely excess time for the construction of the space, especially considering the necessary regulatory approvals associated with these structures.

**Kruth:** The long lead time is usually offset by the HVAC, process gas and finish construction. Due to this fact the basic steel frame is on the critical path since the frame needs to be completed before the rest of the time intensive construction can begin.

**Beall and Ioannides:** It has not been our experience that equipment considerations modify or dictate the schedule pressures. We find that the urgent schedule pressures are even more critical for hospital projects. Many, if not most, of our projects require a “mill order” set of documents for the structural steel. If there are any specialized equipment or loading areas that arise after the mill order is placed, steel can generally still be supplemented, designed and constructed for these locations. Also, many specialty items dictate installation in an enclosed structure, so the schedule for structural completion is critical.

**Q. Hospital expansions are a significant part of the healthcare market. Weight is generally an issue when expanding vertically. When going horizontally, the ability to match floor-to-floor heights becomes critical. Does a steel frame satisfy these project constraints?**

**Beall and Ioannides:** Yes, it does. We once produced a design for vertical expansion where the original structure had been designed for two additional floors in concrete, but we were able to expand this into three additional floors in steel. For projects whose additions need to expand horizontally and match low floor-to-floor heights, low-profile steel systems are available. We also have found that a hasty renovation schedule is an important consideration to owners and occupants of the existing facility during expansion projects. Structural steel facilitates this desire for expeditious construction.

**Sterr:** On most vertical expansions we have found steel frames to be most efficient, especially when current codes require a seismic upgrade.

**Q. In hospital construction, especially expansions and in-fills, it is common to see tight construction sites with limited laydown area. Does steel have an advantage in these situations?**

**Sterr:** These situations are a construction challenge regardless of system selection.

**Beall and Ioannides:** If coordination by the general contractor is maintained between the various trades, the structural steel can be directly off-loaded from the truck and erected without encumbering the occupied space adjacent to the project site.

**Kruth:** Yes, due to the ability to deliver material to the job site just in time for erection. Whether the construction material is steel or concrete, a crane must be on site for construction. With concrete construction there needs to be space for storing forms. In addition forms need to be custom built on site, which is more labor intensive and takes up more space. Another advantage steel has over concrete is that conflicts or design errors are discovered in the shop drawing phase in steel construction and the discrepancies are resolved before the material arrives on site. With concrete construction, these discrepancies usually are not discovered until the forms are being built on site which can cause rework of premade forms, taking up valuable space on site, delaying the schedule, and costing more money to correct because the corrections will be done by onsite labor. During cold weather months in northern climates, steel can be erected without regard to temperature. Temperature has a detrimental effect on concrete construction.

**Q. According to many architects, steel-framed jobs seem to run smoother. Having fewer trades on site to complete the frame makes for a safer jobsite; and they find steel subcontractors very professional. In your experience, would you agree with that assessment?**

**Kruth:** Of course!

**Sterr:** No, in my experience the driver here is the experience and quality of the general contractor or construction manager.

**Beall and Ioannides:** We have been involved with many steel hospital projects, and so we are quite comfortable with steel. We do agree that steel-framed projects run smoothly. Our experience has been that steel subcontractors are very knowledgeable and professional throughout the design and construction phases of a project.

**Q. Is the spray-on fire protection used on structural steel a concern for hospital construction when using a steel frame?**

**Sterr:** Generally, no.

**Beall and Ioannides:** It has not been a major concern on any of our projects. SFRM has been incorporated into virtually every steel hospital project we have designed. Typically, the design is selected so that the structure incorporates a framing assembly that has been tested and rated by Underwriters Laboratory. We have usually found the most economical and constructible system to include a floor system design where the underside of the deck does not require fireproofing—only the beams receive SFRM. This type of system is less intrusive and allows utilities to attach directly to the underside of the framed slab or deck. This helps minimize conflict of the utility hangers and attachments and it also limits the amount of touch-up or reapplication of SFRM.

**Q. Is the use of full 3D modeling including the integration of the frame, MEP, and equipment becoming a more common request or requirement for projects? And if so, why?**

**Beall and Ioannides:** It is becoming increasingly more popular. Most of our recent projects incorporating 3D modeling have used the software primarily for utility conflict management, and maintenance and operation requirements.

**Sterr:** Yes, it is becoming more common, but the primary goal is often more thorough coordination between trades both in design and shop drawing phase with the goal being fewer field changes.

**Q. The structural steel industry is recognized as being a leader in BIM technology. Do you see more hospital owners requesting BIM technology to assist future facility maintenance and alterations?**

**Beall and Ioannides:** More discussion of its use is occurring and it is being implemented more frequently. We believe it is a technology that will continue to be developed and incorporated into the design and construction of future buildings.

**Kruth:** We have just completed six buildings for a hospital client. This client has required that the entire project be a BIM project. They have recognized the advantage of having the project modeled including the MEP since future alterations due to new medical equipment is inevitable.

**Q. Do you typically see specialty contractors such as steel fabricators brought in early in the design of a healthcare project? Is this more or less prevalent in healthcare than in other types of construction?**

**Beall and Ioannides:** Yes, we do. And it is probably more prevalent in healthcare than in other types of construction. Their early inclusion into the decision-making processes allows the design team to interact with the fabricator so the most efficient design preferences and construction techniques can be incorporated into the structure.

**Kruth:** Most definitely. Hospitals are recognizing the benefit of having a steel fabricator and erector involved early to help to refine the final design for economics, site accessibility, and schedule.

**Sterr:** Construction managers are definitely on board early but we have not seen specialty contractors brought in early, although there are certainly instances where it could benefit. We have found this typical for all of our markets, except for design/build situations.

**Q. Does the healthcare owner play an active role in deciding which material is best suited for the building frame?**

**Sterr:** They definitely have an active role in projects where matching existing floor to floor heights come into play. These situations often involve decisions on higher construction costs vs. operational issues.

**Beall and Ioannides:** On most of our projects, the project managers or owners' representatives are generally involved in the consideration of the correct structural system for their project. We provide them with structural design and construction information so they can make informed decisions about their projects.

**Q. Once you do one HC project, do you tend to work the same business model (steel team, BIM, or possibly sustainability focused) as you did on the previous job or does every job have its own owner-driven project delivery method requirements?**

**Beall and Ioannides:** Some projects do follow the same business model, which is good for us because it involves repeating of some aspects of the business. And if the team has worked together before, the number of unknowns can be decreased. At the same time, we are in a custom-design type of business, where even if the same team is retained, other factors make each project somewhat unique.

**Kruth:** In our experience, yes, we usually work with the same team for the same client. In fact, the team has stayed intact even when working for other clients.

**Sterr:** We see similarity in hospitals within a system, but even those situations are so fluid that there are rarely two that are truly the same.

**Q. What do you see for the future of healthcare—more public/private partnerships? More municipally centered/owned projects? More private development firms not previously in this market?**

**Sterr:** Right now it is a very competitive market. Healthcare institutions are being asked to deliver high quality care and to control costs. Institutions will likely remain the builders and owners of acute care facilities. Private development firms could play a larger role in non-acute structures, such as clinics, and medical office buildings. The future could be largely influenced by future decisions on the role of government in healthcare.

**Beall and Ioannides:** Most of our work has taken place in the private sector. But based on this experience we believe that:  
There will more public/private partnerships.  
There will be fewer municipally owned facilities.  
There will be more development by private firms.

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