

Steel Parking Structures: A 25-Year Perspective

An Interview with Charles Churches

Can steel framed parking structures stand the test of time? The answer is yes! Steel-framed parking structures are often the most durable option available to the potential parking garage owner. But how is that durability best demonstrated? What better way to answer this question than by examining some of the first steel-framed parking structures ever built, now approaching 25 to 30 years in service.

John Cross, AISC Marketing's National Project Director for Parking Structures, sat down with Charles Churches, President of Churches Consulting Engineers of Claysville, PA, to talk about parking garages. Churches' experience with steel framed parking dates to the early 1970s as an employee of Mulach Steel and eventually as a partner in and Vice President of Mulach Parking Structures.

Cross: Chuck, can steel framed parking garages stand the test of time?

Churches: Absolutely. I've been personally involved with over 60 steel framed parking projects that continue to perform well today.

Q: When did you work on your first steel garage?

A: I was with Mulach in 1973 when we did our first steel garage. It was the Crickelwood Hill Apartment garage in Pittsburgh right across from Duquesne

University. At Mulach we became involved in both the design and the construction of parking structures. I am a structural engineer, and I eventually became a partner and their Vice President of Construction.

Q: What was Mulach's background?

A: We were a steel fabricator, and Joe Mulach always encouraged us to be looking for new applications for steel. We started making castellated beams for clear-span construction and then began using them in parking garages. It seemed like a perfect application.

Q: What exactly is a castellated beam?

A: It's a beam that is cut through down the long axis of the web in a flat saw tooth pattern. Then it is offset and welded back together to form a deeper beam with hexagonal shaped web openings. The process creates a deeper, stronger beam with no increase in the weight of the beam. The net effect is that lighter beams can be used to span greater lengths. Actually, we often used lighter sections for the top portion of the beam and a heavier section on the bottom to further increase the capacity and reduce the weight.



Steel-framed parking structure at Duquesne University, Pittsburgh, PA, built by Mulach Parking Structures using castellated beams.

Q: And these worked well in a parking structure?

A: Yes, we used them in all of our garages. We usually panned the typical 60' parking bay with a 32" castellated beam with 21" hex holes. We also found they created a great forming system. We put joists through the hex openings, and laid steel deck on top of the joists. The deck was poured and post-tensioned and then the joists and steel deck were removed and reused.

Q: You speak of Mulach in the past tense. Are they no longer building parking structures?

A: When the company passed to second-generation ownership, there was a change in the company's focus from steel fabrication and parking garage construction to more of a development company. It had nothing to do with our steel parking garages. Mulach's last steel garage was completed in 1996. In fact, the garages have outlasted the company.

Q: Have you recently visited any of those early Mulach garages?

A: Oh yes. In fact, I recently was in our first project at Crickelwood Hill Apartments. It's nearly 30 years old, and no significant maintenance has been performed. It could use some touch up painting, and the deck needs resealing, but it is in better shape than many concrete framed garages of the same age.

Q: And this is a painted steel frame?

A: Yes, it is. We used a two-coat paint system. The first coat was a zinc rich, shop applied epoxy primer with an epoxy field applied topcoat. On our later garages, we changed to a field applied urethane topcoat for better UV protection.

Q: And you are getting 30-year performance?

A: Well, there is a little more to it than just the paint we chose. Careful surface preparation is the key to any high performance coating system. We shop blast cleaned all of our steel to the SSPC-6 standard. Then in the field we avoided all welding except for shear

studs. Our field painting topcoat covered everything including nuts and bolts.

Q: So you would say the paint system is the key to the durability of a steel framed parking garage?

A: It's just one of the keys. The most important part of a parking garage, whether it's framed in steel or concrete, is the quality of the concrete deck. Framing systems don't fail from deterioration; decks deteriorate and fail.

Q: So Mulach took responsibility for deck design and construction as well as the framing system?

A: Yes, on all but two of our projects we used post-tensioned concrete decks. Post-tensioned decks provide a high degree of crack control. All concrete decks are susceptible to chlorine ion penetration that results in problems with the concrete and reinforcing steel. All too often the end result is a costly deck rehabilitation project. Post-tensioning and the use of an admixture, sealant or membrane can help minimize the possibility of deck problems. And remember, deck cracks and joint leakage can lead to problems with the framing system—steel or concrete. In fact, one of the advantages of a steel framing system is that the deck is so exposed, so you can get a visual indication of deck problems. The problem doesn't hide for several years like it can with a concrete frame, only to be discovered when it is too late to be able to address.

Q: Which type of deck system, post-tensioned, pre-cast or conventionally reinforced on a stay-in-place steel deck, works best with a steel frame?

A: Actually, steel is a superior framing system for each of the various types of concrete deck. The frame needs to be designed and the connections detailed in a way that takes into account the type of deck you are using. But steel being more ductile than concrete makes a really ideal as a framing option. It can handle the volumetric changes of the large deck surface and transfer lateral loads in a much more efficient manner than concrete.

Q: Chuck, I'm aware that the Station Square parking garage in Pittsburgh was recently expanded. Was that originally a Mulach garage?

A: Yes, it certainly was. The Carl Walker Construction Group was responsible for adding two more parking levels to the existing garage. Actually, quite a few Mulach garages have been vertically expanded.

Q: Is this a coincidence or something you originally planned?

A: We actually designed and detailed for the option of future vertical expansion. It's another way we made sure our project would, to use your phrase, "stand the test of time." Because steel framed garages are lighter than their concrete cousins, it was easier and less expensive to design a foundation system that could handle the increased loads. We also detailed the steel at the original top tier with splice holes already in place. When it came time to add additional decks, the new columns were simply bolted to the old columns and up went the frame. The post-tensioned decks were then poured, and the garage was open for business. I think it took them less than 100 days to add the two decks.

Q: That easy?

A: Well, it still took some hard work, but because of the ease of erection of the steel frame, only the top level of these garages needs to be closed during the expansion. The remainder of the garage could, and did at Station Square, remain open for business.

Q: Easier than a pre-cast system?

A: Oh my yes. Pre-cast vertical expansion is very difficult because of the weight of the members and the increased foundation loads. It's also very hard to find a crane with enough capacity and reach to place pre-cast members in the middle of an existing parking deck.

Q: If someone wanted to see a good example of a steel framed garage that has performed well, where would you send him or her?

A: We built garages as far west as Wichita, KS, and as far east as Boston. Any of those garages would be a good example. I'm not saying that they are all in perfect shape. Every garage, no matter what material they are framed with, requires preventative maintenance, and that is the hands of the owner, not the builder or designer. Concrete decks need to be sealed; steel frames may need occasional touch ups. The garages that have been taken care of by their owners will look best. Maintenance is not a big job, but it is a job that needs to be done regularly, for both concrete and steel structures.

Q: Any examples you'd suggest?

A: Well, if you are in Pittsburgh you might want to visit Station Square, Duquesne University or Allegheny General Hospital. If you happen to be in New Jersey, check out Lefrek's south parking garage or the Pavonia Avenue parking garage in Jersey City.

Q: You seem to really have a sense of ownership and pride when you talk about these projects.

A: Absolutely. We built some great parking garages, and we did it all. We designed them, fabricated them and built them.

Q: Sounds like what we call design-build today.

A: You bet. We took responsibility for the entire project. It didn't take long for us to realize that the owner who wanted to build a parking garage didn't care about how many tons of steel we would fabricate or even what the cost of the steel was from us and what the decks would cost from a concrete contractor. They wanted us to be an expert on parking and tell them how much it would cost to build per parking space and how soon they could drive the first car in and park it. To be successful, we had to give them the entire package. We did, and we made good money doing it. It was great.

Q: So you are a proponent of design-build?



Recent photo of the 29-year-old Crickelwood Hill Apartments parking structure, Mulach's first steel-framed parking structure which still shows no signs of significant corrosion.

A: Definitely. We were way ahead of the game. I'm surprised a lot of fabricators haven't followed us. I mean, why fight all the change orders, extras and being shopped around like a commodity? Step up and take more of the responsibility; it gives you the opportunity to do real value engineering and control your own destiny. That's how Mulach got involved in developing the original design for end plates.

Q: But that's another story.

A: Sure is.

Q: In summary, what would you say are the three most important aspects of designing and building a parking structure?

A: I can't over emphasize the value of selecting the right deck and investing enough time in its design and construction; it is the only part of the parking structure that may fail. Second, seriously evaluate the use of a steel framing system. Too many parking garage designers overlook steel as a viable option. That's a big mistake. Steel has some great advantages over concrete. And third, if you choose steel, invest in a quality corrosion protection system. Use either a multi-coat high performance paint system

with a zinc-rich primer applied over a well-prepared surface or a good galvanizing system. Again, don't skimp on the surface cleaning and preparation.

Q: Are you still involved with parking structures?

A: Yes, but only on the design side. We've got several going right now in New Jersey along with several high-rise buildings. I'm also working on developing a design guide for steel framed open deck parking structures for AISC.

Q: Chuck, I want to thank you for sharing your experiences with us and for your leadership in the utilization of steel framing systems for parking structures.

John Cross, AISC Marketing National Project Director for Parking Structures, may be reached by calling 312.670.5406.



Mulach parking structure at Allegheny General Hospital in Pittsburgh, PA.