SZÉKELY ENGINEERING
EXPLANATIONS & EXAMPLES

Of Connections and Cantilevering, *or*, Sometimes Words Just Aren't Enough.

Having started my professional life as an electrical draftsman/designer, and having passed from there through HVAC, plumbing, and sprinkler design after I became licensed and began to practice as a one-person engineering shop, I crossed paths with structural engineering less than the average architect did in school and subsequent professional practice. Having said that, I do remember from my correspondence courses in statics and engineering dynamics that the sums of both the moments and of the forces in a structure must equal zero, and have on a few occasions done some structural design in connection with projects of mine.

A 'moment', for readers who may be a bit challenged with regard to the meanings of technical terms, is the product of a force (or weight) and the lever arm along which it acts. That is, to use the analogy of a seesaw or teeter-totter, if you're sitting on one side of such a device, with a person on the other side who weighs a bit more than you, the device can be balanced by the person on the other side moving closer to the pivot point (fulcrum) or you moving a bit farther away from it, or a combination of both, such that the moments on each side of the fulcrum are equal. The obvious direct use of this, going back to antiquity, is the analytical balance.

The lever arm is where we get the terms 'leverage' and 'cantilever', and this tale hangs by the latter.

To repeat a point I've made in earlier newsletters, one of the *raisons d'être* for architecture and engineering is that construction is of such complexity that it can neither be extemporized nor can it be explained in few words. While this should not be the case for individual components or segments of an entire construction project, it sometimes apparently is.

I have a project currently nearing completion where my drawing called for cantilevering an air conditioning condensing unit from one end of an existing L-shaped rooftop structural steel framework upon which a 'farm' of condensing units currently rests.

Some weeks back, when I was on site for a field visit, the job super took me up to the roof and asked if he could relocate the condensing unit to the end of the other leg of the L, closer to the ducted fan/coil units in the apartment. I told him I had no operational objection, but preferred it where I showed it because the existing steel framing extended a longer distance beyond the endmost condensing unit, and would thus require a shorter cantilever. Notwithstanding my stated preference, I looked at his proposed location and indicated he could slide a slightly smaller section 6 foot long channel into the web and flange of each of the existing I-beams cantilevering half of each channel beyond the end of the existing steel, and bolting the remaining 3 feet nestled into the I-beam at multiple locations along the flange.

Boy, was I surprised when I revisited the site to find a flanged butt-joint to the new steel, with the end of latter extended some 6 or 7 feet to the wall of the nearby penthouse unit and bolted thereto, with intermediate column supports down to the roof membrane at the approximate midpoint of the new steel.

Huh?

What we have here is not merely a failure to communicate, but an object lesson as to the reason that it's sometimes not enough to rely only upon the spoken word, with the latter apparently having been abridged by the time the steel fabricator heard it. That is, absent half the length of the new steel being bolted to the existing steel one would in fact require the other end of the new steel to be supported by something, or an intermediate support, or both.

But, that wasn't what I asked for.

Ductless-Spilt Air Conditioning Systems and Why Specifiers, Installers, and Manufacturers Don't Always See Eye-to-Eye.

Mitsubishi has of late been running an advertising campaign extolling the virtues of their ductless-split air conditioning systems, wherein they've been pushing the cost saving aspect of such when compared to ducted systems, but is it really true?

Why would one require a ducted system in the first place if not forced into a central system because of a load too large to be served by a single window unit or PTAC?

Since the 'split' portion of the argument for ductless-split systems which calls for separating the condensing unit and putting it outdoors for considerations of compressor noise and vibration is the same for split ducted systems, all that's left in favor of ductless-split systems is the cost argument being made by Mitsubishi. I mean you're saving all this ductwork, so it *must* be cheaper, right?

No.

While window AC units can be had in cooling capacities as large as 2½ tons and PTAC's can be had as large as approximately half of that, in either case so much cooling is delivered from the one location that it's uncomfortably cold to sit within a couple of yards of such a unit. The largest window units can be twice as large as the largest PTAC's because they can be installed in the upper sash of a double hung window, while PTAC's must be installed through the wall beneath a window sill, and 2½ tons of cooling delivered therefrom would not only be so cold as to force someone to sit at the other end of a large room, but the airflow and compressor noise could begin to become deafening.

So, if you're trying to cool large spaces or densely populated spaces (and this last is one of the reasons that, contrary to the information from do-it-yourself sources, you can't size air conditioning equipment based upon the area or volume of a given space – twenty moderately active persons generate enough body heat to account for a ton of air conditioning) a single source is a no-no. Direct sunlight, and dehumidification of fresh air are additional load components which must be accounted for, and these are among the reasons that Engineers and Architects may see things differently from Contractors and Manufacturers.

There are other reasons, and to get back to manufacturers in general and Mitsubishi in particular, serving large loads will therefore require one or more multi-zone condensing units, each with multiple fan/coils, or one or more ductless split systems dedicated to each room, or portion thereof in the case of larger rooms.

So if a load is large enough that delivering 2½ tons of cooling from a single outlet near the ceiling is undesirable for the previously stated reasons, how much duct would have to be run from a centrally located source for it to be more expensive for such to serve a second outlet than it would be to provide a second fan/coil unit?

Gee, I can't give you a number, but I can tell you that it'd take a whole bunch of galvanized steel ductwork to equal the cost of an additional fan/coil unit which is comprised by intake and discharge grilles, a finned coil, and an electric motor and fan, and has to be served by additional copper refrigerant tubing back to the condensing unit, an additional electrical connection to power the fan, and an additional control wiring connection to tell the fan/coil what to do.

But if I worked for Mitsubishi or a Contractor, or, to put a point on it, if I were a sales rep working on commission, it wouldn't necessarily be so bad, with the first making money for each item which is sold, the second applying a markup to each installed item, and the third (in some cases) only making money when sales are made. I don't begrudge them such, but have a real problem with my expertise, analysis, and resulting professional fee looked at as a cost line in a construction project no different from the material, labor, and overhead amounts.

They're selling *stuff* and *work* and I'm selling the expertise to allow the use of *less* stuff and work to achieve an equal or better result and you wonder why I may not always see eye-to-eye with them? The natural extension of this is that the stuff I specify is picked more for its suitability to the task at hand and its quality than it is for its initial cost or who's selling or installing it, with the initial cost not infrequently having the least adverse effect on the overall cost of a project.

But We've *Always* Done it This Way.

To err is human. To really foul up, requires a computer - or someone in a position of authority who is in over his or her head. Look, I really, really, do understand why Building Codes and enforcement agencies are necessary, but could someone please explain to me why so many agency line personnel so often appear to be totally devoid of anything which resembles the capacity to reason?

I'm convinced that Sainthood could be the reward for a cogent answer.