

Designing for Failure

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Lately I've been doing a lot of philosophizing over the world of HVAC mainly because of the countless hours spent in airplanes and airports with nothing but an imagination and a laptop. The ASHRAE meetings in Orlando was one more of those trips except it was shared with a great industry colleague, Wirsbo's Technical Service Manager, Tim Doran. Tim isn't like all my other fanatical HVAC friends. You see Tim started twisting wrenches with his dad at the age of twelve when most kids were out playing ball or hockey, well on his way to earning his first journeyman's ticket by time he was in high school. Enroute to the airport I asked what was it like growing up on Long Island and servicing the homes of well to do New Yorkers who invaded the little villages scattered along the 'isle of long' during the winter holidays. Each service call recounted with an ungrateful owner who didn't care that it was 3:00 a.m. on a statutory holiday. The worst trips were those where owners had inadvertently switched off burner power whilst mucking around the boiler room. "We've got no heat", says the customer, "get out here now before we freeze." "Yes sir", says Tim, "I'll be out after I finish up here"... "can't you get here sooner demands the client"... after a short pause to think about his wife and kids back home ... "I'll do my best" say the now choked up Tim...30 calls so far and the weekend just started...the gifts at home had been opened and the only thing Tim's wife and kids knew was daddy is out helping other folks stay warm...it doesn't seem right but the man heads out to the demanding homeowner who's system has failed. With the customer watching, it takes Tim maybe 2 minutes to figure out the power switch is off...a quick once over twice and he writes up the service call and hands it to the owner. "What...you want me to pay you for turning on the power - I could have done that!" Doran responds with a "yes sir - but if you could have, you would have - but you didn't that's why you called me - so here's the bill." Tim by the way is an ex. marine and has a

‘polite’ way of communicating with his sergeant major enforcer look atop of his pit bull frame...I’m guessing the customer paid on the spot.

That story took place a lifetime ago when the ratio of system to tradesman was a lot higher than it is now and I can’t help wonder what will it be like years from now when cold early holiday mornings find the next generation of tradesmen getting up to make another customer warm...missing the family opening of gifts and celebrations...will they be so lucky to just find a switch that crashed the system...or will it be a gazillion other things that will have been installed in every conceivable fashion like the setting of landmines for the next sorry soul who has to deal with a miserable customer.

Thinking about guys like Tim out on a cold winter morning makes me recall the messages in a great book by Henry Petroski called, “To Engineer is Human, The Role of Failure in Successful Design” ...and the basis for six rules applied to HVAC systems – Designing for Failure.

Rule #1 Design for People

Designing for what the customer knows and understands is a greater challenge than designing for what we know. If the point of design is to incorporate every zippy wizz bang device that comes along like a designer drug than when does the customer get addicted? Are we asking our customers to become user of something only we understand and break free from after we’ve moved onto the next job? I didn’t always share this opinion and am guilty as the next guy for the closet monsters created, but today I really believe great designers will be known for their ability to design for what the average accountant, teacher, receptionist and other lay people can understand and not for a legacy of complicated customization.

Rule #2 Design for Familiarity

One of my passions is the world of creativity and there is no better event than the annual Industrial Design Excellence Awards. This event conditions one to view the world of product design in terms of form and function without losing **the familiarity of a**

survival form. What does this mean? Well let's put it in terms of the evolution of motorcycles. The Honda Gold Wing and Harley V Rod share most of the familiar forms of a bike but unlike the majority of two wheeled road machines, they have gas tanks located under the seat. What would the Harley or Honda look like if it was void of the gas tank shape? Would bikers fork out the bone for two wheel road sleds which didn't look like a bike? Probably not – so bike manufacturers – customized or not still create machines that look like motorcycles and any person in the developed world can describe them. Have you ever asked a group of consumer to describe a hot water heating system...try it and see what happens.

Rule #3 Design for Simplicity

What makes something simple...a quick see through the Thesaurus describes simple as uncomplicated, straightforward, undemanding, plain, and minimal. Do any of these words paint the picture of a modern hydronic heating system? I think not. I once asked my 75 year old Dad and his fishing buddies to condense their collective wisdom into one sentence to describe the perfect product...guess what words they used?

Rule #4 Think Power Cords

One day a few of my colleagues were sitting around trying to fend off our wives verbal banter about our shop talk during visiting hours but hey what's the point of beer and buddies if you can't talk tools! During this robust discussion on the best designed stuff in our garages, my wife sticks her head out from around the corner and in a matter of fact tone says..."The best design is one which requires no instruction like the power cord attached to my iron." "Whoa wait a minute", I say "what do you mean by that?" She says, "Listen to you guys...I have to operate most of the so called machinery in this place and you keep thinking it takes a rocket scientist." "Explain yourself", says the boys, "what the heck are you talking about?" Karen's reply, "The washer, dryer, fridge, oven, microwave...all electromechanical devices plugged in one way or another and far more sophisticated than anything you guys play with and yet me, a professional social worker...can make any of them work. Why is it you guys want to make things so complicated? It's as if your pride was attached to the level of sophistication...it doesn't

need to be that way.” “Hmmm”, thinking to myself...“the modern power cord unlike the modern heating system can only be plugged in one way...male to female...and it doesn't come with instructions...almost everything in a HVAC system can be installed wrong and because it can - it does” Good point Ms. Social Worker.

Rule #5 Own your Own

After the great big epiphany my wife tossed onto our salad of sophistication, we started talking about the stuff in our boiler rooms. Making sure the girls weren't listening in on this mano a mano banter I ask... “So gents...if you could change three things in your boiler rooms what would it be?” Here we were industry diehard veterans and all of us would change one thing or more in our own systems...it seemed so bizarre that we had thousands of system out there but had we ever given thought to what it would be like owning the stuff we designed and installed - twenty years from now - knowing we would change our own systems in a heart beat today. In 20 years I'll be retired and given the exponential growth in technology and disappearance of skilled trades' people - will my system pass the test of time and if it doesn't will there be someone around to keep it running other than myself? I remember asking one 60 year old contractor such a question and was told it didn't matter for him what he was installing today...in 20 years time he'd be dead. (His exact words). I suppose that's one approach...another would be to ask, how would we approach design and equipment selection if we created lease benefit programs which sells what the system delivers (software) rather than the equipment (hardware)?

Rule #6 Inoculate for Failure

Inoculating for failure is about making improper things impossible which in turn forces designers to methodically identify, evaluate, prioritize, and document potential points of mechanical and electrical failure and ask, “what are the consequences of failure in a worst-case scenario?” The inoculation only becomes effective when one has built in the least amount of temporary or permanent solutions which require low or no skill and if required, readily available parts. This requires forms of consistency into the projects one designs and installs. Consider for every possible combination of equipment and

application, there is a need for a customized emergency plan, which is totally illogical when the right design approach provides a single plan to service all systems. Consistency reduces and contains the number of possible combinations of events leading up to failure.

Adopting a philosophy of designing for failure means approaching every project from the assumption that what can fail - will during the worst time of the year and during the middle of the night on a major holiday when we can't find anyone to help. Because of this belief, I have often been accused of being against solar, micro turbines, fuel cells, heat pumps, variable speed motor controls, new chiller technology and condensing boilers... which makes me chuckle since I have lived the bleeding edge of technology my entire life. In reality I love the zippy stuff but the older I get, the less I tolerate consumer dissatisfaction because a health, wellness and comfort system with one or more fancier wiz-bang devices decides to take a break at the worst time with parts and service a figment of some salesperson imagination.

Designing for failure encourages us to ask - what are the ramifications to a home alone mother with small children if a heating pump motor fails at minus 81.4 degrees F. (recorded at Snag in Canada's Yukon Territory, on Feb. 3, 1947) or what happens to an 80 year old grandma if a new technology compressor breaks down in plus 128 °F weather as recorded in Lake Havasu City, Arizona, June 29, 1994.

No doubt, much of the new technology is very robust and reduces energy consumption though it's important to remember the most efficient mechanical system is the one which never runs. Its paramount to understand when we adopt the designing for failure philosophy we must talk about the building – mechanical systems as one - because they are intricately linked and finding the right balance between building and mechanical performance and “system” reliability is the ultimate responsibility and challenge for a thermal environmental comfort technician.