The Local (Vermont) Need for Engineers with Heritage Preservation Training

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PERSONAL EXPERIENCE REGARDING THIS LOCAL NEED

Getting started - I have been a practicing engineer in Vermont for almost 30 years. This practice has been broad in scope within civil/site and structural engineering, although in the late 70's and early 80's as I was first developing a small consulting engineering practice from a scratch start, the opportunities were more narrow, and, for better or worse, historic preservation projects were an opportunity. I knocked on many doors looking for project work that would be appropriate for my background.

As the door knocking went on, some clarity arose as to the opportunities for civil engineering services, and particularly building engineering services in Vermont. There was a strong interest in some new approach. There was interest in a more broad perspective.

I found a welcoming reception at many architectural offices where architects were looking for a more progressive, open minded, collaborative approach to solving engineering problems than was generally being offered. These creative people were looking for creativity in the engineering design that was critical to their projects. They were also, in fairness, looking for less expensive consultants to help out on projects with tight budgets.

This clearly opened an opportunity for a start-up consultant to work on rehabilitation and renovation projects on existing buildings – in most cases these were historic buildings. Wood buildings. Timbers. Stone. Brick. Masonry. Heavy trusses. Post & beam. Traditional construction. Some in unrecoverable condition. Some already modified. Some in original sound condition. Some built poorly. Some built with absolutely amazing craftsmanship.

> **Example project – Public Building in Northfield** – An early project was a historic building with roof issues. Roof issues have been one of the most common structural problems encountered in Vermont on historic buildings. This was a project with a tight budget, and an allowance for only limited services. The roof was supported by Queen Post trusses, purlins, and rafters. Several elements were under capacity for the building code loads. Mortise and tenon connections typically were not visible. A report was prepared with suggested approaches offered. The follow through on a project like this, by the owner, is not often known.

Training - I had not had specific preservation training. My background was – a traditional BS in civil engineering, petrochemical plant design, an interdisciplinary and design oriented master's

degree, a seat on an historic district commission, some local planning/zoning/public works, and a position with a small, creative, funky and renowned design firm.

This was not clear training for historic buildings but there was some fundamental applicable experience…understanding, from the industrial work, of how easy it could be to fall prey to an easy and conservative approach to overdesigning structures… learning through the interdisciplinary education about thinking and appreciating in a broad and creative way… getting a glimpse at some exceptional historic building projects coming before a historic district commission in a picturesque small town… achieving some basic experience in the public arena…and an opportunity through a very innovative design office to work in an environment that took blank paper and turned it into blueprints for creative, artistic, functional projects. This collective experience led to an understanding that these historic building projects required a different approach.

Early projects and training need- These early historic projects that came along were captivating. Each one different. Great fun! Each time I thought I had seen it all, some new structural system, or material, or connection would appear on the next project. I have since become more cautious about thinking I've seen it all.

These projects drew me in, yet I knew that to understand why these buildings and sites were the way they were, I needed to know more about historical construction. I needed to know more to understand the options for taking these projects forward appropriately and with some respect and

sensitivity. I was on the scene of some worthwhile projects and there was a need for me to have some preservation training.

This training came over time through books, and very long nights in the UVM library, through working with knowledgeable architects, builders, and contractors, and through preservation officials at the state and local levels. It came through a UVM course on adaptive reuse of historic buildings taught by the late Roger Lang. It came through trial and error. It came from collaboration with many of the players involved in the project. It came from a mindset to do the right thing for these projects.

> **Example project – Public Buildings in Roxbury** – This project was debated by the town for years. The question was whether or not to completely demolish the project and build new, or whether to substantially gut and demolish, leaving mostly facia, trim, and exposed detailing. Two design development approaches were used to finally justify the second option.

As our firm grew in the 80's, and we did more historic building projects, we came to feel that if we could get enough of his work, we could completely specialize in this area. The more work we did in this area successfully, the more of this work came in. The more of this work that came in, the better known we became in this project area, so reputation grew and more of this work came in – and so on.

But realistically in northern Vermont, we found that a more reasonable business plan was to broaden our work, but to maintain a strong specialty in historic projects. Hence, I am not aware of any exclusively historic preservation engineering firms in Vermont.

Business plans responding to this need - As a result of this business plan, we have developed strong experience and reputation in historic buildings, and to some degree in historic sites. As the firm has grown (in some years by 50% leaps) we have been able to provide training ourselves to more and more staff along the way. Some remain with us. Some have moved on. Bob Neeld, President of our firm, and who is attending this Colloquium, has essentially trained through this process and has become a recognized leader in Historic Preservation - from local projects, to the Katrina coast, to a trip to Cuba. The training is not a simple or short task, and is in fact a process that takes place over many years, more or less like passing on a trade or a craft.

Other engineers on the same track - Other local engineering firms have gone through similar processes in training their staffs. We have seen the number of trained engineers increase, yet we also see a continuum of engineers coming along, taking themselves through a self learning process, and continuing to find opportunities to be awarded work on a price competitive basis.

I believe we would all welcome an opportunity to be able to hire both entry level and experienced engineers with preservation heritage training (as the economy rebounds). We really would like engineers with some flexibility to work on a wide range of projects, including historic building and site projects. We would welcome the opportunity for more formal continuing education for our staff. We can usually find a supply of graduate engineers, and there seems to

be a supply of historic preservation graduates, but it is a surprise to find someone with both specialties.

About two years ago, we did see such a surprise and a change afoot in college preparedness for this historic building work. We hired a recent graduate who had not only a BS in Engineering from RPI, but also an MS from UNH in Structural, and then a second MS back at RPI with an emphasis in historic structures. It is good to see some changes being made.

NEED ACROSS ENGINEERING DISCIPLINES

As we go forward let's not focus entirely on civil/structural engineering. In fact, there is an interesting distinction regarding engineering needs in historic buildings among the engineering disciplines.

In many cases the *mechanical and electrical* issues of our older buildings are such that complete replacement is necessary to meet current codes and needs. The challenge then is to integrate a modern system into an historic structure while being sensitive to the historic character and the historic fabric of the building. As we see rapid change in developing new energy systems, and we have yet to surmise what may be coming down the road. The challenges will be significant. How to deal with insulation, solar panels, natural light and passive solar, as well as locating and supporting/hiding/exposing equipment will be just some of the issues.

Conversely, when it comes to the *building structure, or the bridge structure*, it is appropriate to preserve, rather than replace, the building structure, albeit with reinforcing in many cases.

It is only in recent years that we have seen new innovations in manufactured wood, new codes and advancements for plain and reinforced masonry and concrete, wood reinforcing systems, increased technical research for heavy timber and post and beam design and traditional wood joinery, testing protocols, non-destructive investigation methods, other new materials, admixtures and structural systems that can play a role in restoration and rehabilitation projects. More and more structural solutions have become an important part of the total sustainability of the buildings.

Example project – Butternut Hill Bridge - This one lane, steel, pony truss bridge on the Mad River had been in negotiation between the State AOT and the Town and the neighbors for years. The dead end road served a small condominium project and several single family homes. Many options had been suggested. The State was set on a wide, two-lane concrete bridge with modern, self rusting highway railings, and a walkway – quite a modern look. This required clearing wooded approach areas on each end of the bridge for a separate temporary bridge. The Town and the neighbors wanted to maintain the single lane with more of a rural appearance, possibly just repairing and retrofitting the existing structure. There was a stalemate.

We were asked to review all work to date and try to negotiate an agreement. Within several months of meetings and mediation/negotiation, the parties agreed on a new single lane, prefab bridge with a similar appearance to the original bridge. Although the original bridge was lost due to cost and current load requirements, the site conditions and end conditions were maintained. The temporary bridge, with its impact, was eliminated

by creatively working out a scheme to limit the downtime for the bridge, and by addressing the need for emergency vehicles, partly by using lumber truck crossings along the river for emergency access.

Site/civil engineering is another discipline that certainly plays a role. Project sites are often the front door to projects. These sites portray the era of the project and can be a key factor in the overall historic property. In many cases there is no building – just an historic site. The civil engineering and landscape architecture may be the entire project.

To a greater degree than ever, *building science* is a factor that is leading the engineering on projects these days and this will continue to be a growing field, and it is coming to historic projects in new ways. There is a pronounced movement in the building industry for understanding the science of buildings to a more detailed degree in terms of how they really work and how they work better for a more sustainable future.

Surely this will have a real effect on the preservation of historic buildings as they serve as learning examples, and projects which are in need of being brought closer to current standards.

Example project – Industrial Site – Windsor – An historic industrial facility was evaluated. The project included brownfield investigations leading to a decision to demolish a substantial building, while maintaining numerous other buildings on the site.

NEED IN VERMONT TODAY

The need is strong, because *the buildings, bridges, and sites in need are bountiful*, and we are still depending on the few relatively trained engineers here. We have many old, well worn, and often deteriorated buildings. Communities and rural locations in Vermont and surrounding States are characterized by historic buildings and sites, and by our covered bridges, and many of these structures and sites by the very nature of their age are in need of preservation, rehabilitation, restoration, repair, or reconstruction.

Issues associated with the needs of these properties are often technical in nature and require technical investigation, evaluation, and creative technical solutions that respect the heritage involved and are sensitive to the concepts of preservation.

Even in the more prosperous parts of the state where private money has perhaps been more available, and where interest and commitment has led to many successful projects already, there are still huge numbers of examples of buildings in need of attention. Throughout this rural state there are numerous churches, public buildings, institutional buildings, farm buildings, industrial buildings, and residences that have preservation or rehabilitation needs.

I believe we have some *unique existing conditions* – styles and methods of construction, and materials, that relate to the influences of construction in northern New England, and that relate to the environment. This may have come from the influence of building in Europe, Boston, and New York, and from the development of the railroads and the building of bridges, and from the cultural spread of influences from the French, the British and later from the varied influx from Europe and elsewhere.

Example project – Hospital Building – Burlington – One of the oldest hospital buildings in Vermont had examples of basement floors of wood planks on wood sleepers, and upper structural floors of reinforced clay tile. While these elements could have been renovated, this building gave way to substantial new construction.

Additionally, in this locality of northern New England and NYS, we have primarily a *preponderance of small and medium size projects*. These projects in most cases can't support the cost of out of state services, as financial support for these projects is often limited. Local engineers also typically have *established relationships* with regulatory officials, and have an understanding of the standard of practice for these projects which has been developed through these relationships. There is a certain and appropriate trust established locally.

Example project – Historic Inn – Shelburne – This extensive project deserved some waivers from some code provisions. Well into the project a collaboration was held including the owners, the design and construction team, public agency officials, and local and state elected officials. Many issues were resolved through these relationships.

Further, projects often need *immediate on site attention*. The best attention to these projects, in most cases, would be provided by local available engineers. Out of state engineers may not be familiar with local conditions, codes, and guidelines, and the cost of travel time and ability to be attentive on short notice would just not be the same.

Example Projects – Public Building - Burlington, Public Building Lyndonville, and Historic Building - Burlington – Three examples of building needing immediate attention and close on-going attention for stabilization.

- The first building showed significant movement during construction and an independent opinion on engineering was needed without delay.
- The second was a good example of a partially burned building. Stabilization was required and an evaluation of what elements or portions of the history of the building could be saved.
- The third was a typical example of a street front building with façade issues that can be an immediate threat to public safety.

Also in many cases, *projects involve both preservation and new construction*. These projects have both preservation needs as well as new design and construction needs –all on the same project. For these projects there are local engineers quite capable for the new design. Having them also capable to tackle the historic engineering needs on the projects simply makes sense.

IMPROVING ACCESS TO MEET THE NEED

Because there is so much variety of systems and conditions in historic buildings and because quality solutions typically require considerable creativity, and an adaptive approach, training for historic building engineering should focus on problem solving and a design process, in addition to teaching fundamentals of typical design issues. As with any formal training, experience will ultimately play the most key role in developing a well trained engineer.

Training could come through formal courses for credit, seminars, webinars, and downloads, through CD based programs, video conferencing, central attended seminars and conferences, and on-site training. These elements can work together.

Through college engineering curriculum - Customary initial engineering training certainly comes through college level engineering programs leading to a Bachelor of Science degree. These programs are founded in science and then lead to practical applications of these scientific principles – this is, in fact, the definition of engineering. A trend for engineering is to follow the path of other professions that are moving toward at least a 5th year of education which is likely, or in some cases required, to culminate in a Master's degree. Engineering professional societies are establishing dates beyond which a 5th year or a Master's will be required for membership to these societies. Professional licensure requirements are expected to follow.

Many of these established engineering programs are traditional in nature and follow time honored curriculums on standard subject matter. Theory is fundamental – circuit theory, thermo dynamics structural analysis and theory. Then courses, such as steel and concrete in civil engineering, and hvac and motors in mechanical, for new construction and building are often standard, while wood, timber, stone, brick, and concrete masonry systems are typically not covered at all or only to a very superficial level. At the University of Vermont (UVM), our firm eventually found it important to offer a crash course in wood design to the civil engineering seniors, to help to fill this kind of gap. Outside evening, or brown bag lunchtime courses could target historic preservation.

Times are changing and we see the traditional approach to engineering education changing as well. At UVM, a movement has been growing to broaden the engineering curriculum. This comes with conflicting values. On one hand engineers need certain basic training that has historically been provided through a traditional curriculum. On the other hand, engineers are facing an increasing need to have a more broad perspective. Systems in which projects are accomplished are becoming more complex and interdisciplinary.

I believe we need to maintain the traditional basics while weaving and integrating a more broad perspective through these very courses, and by adding a 5th year to the basic engineering education to accomplish the wider subject matter. Another option may be to expand the concept of a 3-2 program with a more liberal education followed by a more technical program in the final years. T raditional faculty may need some shift in thinking and practice – the education needs to start with the educators

While at UVM there is interest in tying into engineering some education in business, the life sciences, the natural and environmental sciences. There is also specifically a great opportunity to bring heritage preservation exposure, training, and education into the picture as well. Again, UVM has made headway in just this kind of effort. They have brought a historic preservation professional into a relationship with the engineering school to integrate just this kind of thinking and training. The effort is to broaden the traditional, solve the problem efficiently engineer, to someone who sensitively balances a brought array of issues including aesthetic and historic values in an overall problem solving process. Students are ready for this kind of socially conscience application of engineering.

Norwich and Vermont Technical College (VTC) can surely get into these new approaches to curriculum. The Norwich on-line Masters Program in Civil Engineering could be a mechanism for improving the issues at hand. VTC is change to a 4 year BS in Engineering Technology also provides more opportunity for broadening their offerings.

Champlain College and St. Michaels College could also become involved through related programs. The possibilities appear great! What about the full Vermont State College System, and Marlboro, Landmark, Goddard, Bennington, Green Mountain …and other colleges in the state.

Through Professional Licensing - Professional licensing is required for engineers offering services to the public and specifically for work on public buildings and sites. In its basis to protect the health, safety and welfare of the public in the practice of professional engineering, the profession requires that engineers practice only in areas where their experience and capability allows them to make sound technical engineering decisions. As we look at the broadening of the profession, the responsibility should broaden as well. Engineers will be responsible for a more broad range of social and economic decisions within their responsibilities. The new emphasis on sustainability will support the reuse of existing buildings which could be a key leg for historic buildings to stand on. These buildings and properties are part of the underlying infrastructure upon which the economy is built – from the local small town grange hall to the aging industrial GM manufacturing facility.

Continuing education is required by surrounding states but not (yet) by Vermont. NYS requires as much as 12 hours of technical training per year. If our colleges and universities are expanding curriculum, they could follow up by extending the curriculum into a continuing education program.

Certification for many areas of engineering practice has been instituted in Vermont, and further use of this kind of requirement has been discussed to raise the specific training and experience requirements for practice. Colleges and universities could provide the education for these programs.

Through advancing theory and follow up training – Engineering practice has been hard to change. However, new codes and design methods have been developed which can be of benefit in analyzing historic projects. For instance, concrete, steel, and wood design have become less conservative by changing the approach to design – basically from Working Stress methods to Ultimate Strength and Load Factor methods. Putting these newer methods into practice has been a slow process in each case, as conservative engineers lean toward their practiced methods. Training here can help tremendously and can be tied to licensing requirements.

Colleges and Universities have changed curriculum for these newer methods, but graduates are finding that firms are still using older methods. These same institutions could be providing the continuing education required to bring the practicing professional along to the newer methods.

Training through Partnering with Campuses and State Agencies, Publically Funded Entities – Preservation Trust of Vermont, Department of Historic Preservation, the Vtrans/Agency of Transportation historic staff and bridge division, the National Transportation Center, the Vermont Business Center, the Chamber.

Training through Partnering with Campuses and Professional and Industry Sources – Associated General Contractors, Timber Framers Guild and their Business Council, Brick and Masonry Institute, Green Building Council, Structural Engineers Association, NSPE, ASHREA, IEEE, CSI.

Many of these groups bring seminars to local venues. Local firms are also paying to bring in this training. In many cases, this training can be utilized by a larger crowd. For instance, sometimes the cost of a webinar is for one location, but with as many attendees as can fit in the room! Where can these best be held for the greatest exposure? Possibly at local colleges and universities.

For profit training - Seminars are being taught within Vermont by training companies, for profit. These firms are seeking opportune topics and typically use local speakers, or a mix of local and outside experts. These firms are filling a need that is not now being met locally within the State.

Standard references – Local college libraries could be strengthened with greater availability made to engineers.

IMPLEMENTING MORE TRAINING

Yes, there is a local and ongoing need for engineers with heritage preservation training.

Changing curriculums and creating more training opportunities as discussed above is a good step. But, actually, implementing more training will require a combination of raising the understanding about the value of this training, raising the interest, and possibly raising the requirements for this training.

This training needs to be marketed and sold. Who are the users of the engineering services for historic projects? These people need to be reached so they are more likely to choose these trained and experienced engineers. Then the students and engineers will recognize the need to take the training. Or do the students and engineers get this training and market the higher level of training to the clients? The answer is probably a combination of both.

It takes time to change old habits, but most of the dogs I know can certainly learn new tricks, and when the new tricks are seen as tasty for all parties, then there are treats for all in the end!