

Construction History across a Transformed Construction Management Curriculum

Jamie R. Metzinger, Ph.D., Randy R. Rapp, D.Mgt, PE, CCP, Mark Zimpfer, MCSC., and Jessica A. Cabral, Ph.D.

Purdue University
West Lafayette, Indiana

Research on the study of history of construction within construction management programs is largely absent. This may lead one to question whether this absence indicates a lack of instruction within these programs. Given the influence of culture, technology, politics, and social constructs on today's construction industry, appreciating historical construction projects can provide insight to the structures the industry builds today. While the study of construction history satisfies no accreditation requirement for CM programs, such as ACCE or ABET, accreditation is about minimum acceptable performance, not the excellence toward which many CM programs strive. Thus, integrating construction history builds towards that excellence. There are numerous ways the study of construction history may be incorporated into a construction management curriculum. This paper establishes the importance of including construction history, the method in which one construction management program has chosen to integrate history into its curriculum, and the reasoning behind determining which historical projects to include. The integrated construction history program will commence with the incoming freshmen in the fall of 2017.

Key Words: history, construction, curriculum, integration

Introduction

For any construction management (CM) program to keep up with the ever evolving construction industry, instructional content and methodologies must also evolve. Although construction management programs are either based in technology or engineering, effective management and leadership benefits from recalling an integrated liberal arts education. Liberal arts help to expand the breadth and depth of knowledge and perspective from which the construction manager can reliably draw. Biographer of renowned innovators, Walter Isaacson (2014) "was struck by how the truest creativity of the digital age came from those who were able to connect the arts and sciences... The people who were comfortable at this humanities-technology intersection helped to create the human-machine symbiosis..." (p. 5) essential to having computers and the internet. It is no great leap to see that such innovation is also essential in construction, since innovation for any kind of endeavor is enhanced by standing on both humanities and technology. This is further cultivated by the study of past construction, especially its challenges, techniques, and leaders. Similar to common mechanisms for imparting written communication and ethics instruction, integrating construction history across the CM program can enrich instruction to prepare its students to lead and manage successful projects.

The study of construction history satisfies no accreditation requirement for CM programs, such as American Council for Construction Education (ACCE) or Accreditation Board for Engineering and Technology (ABET), so why devote resources to the subject? A review of literature shows that deliberately including history for humanities, as part of CM programs seems uncommon. This is possibly due to time constraints as educators are constantly balancing all of the material that needs to be included versus the time allotted. However, accreditation is about minimum acceptable performance, not the excellence toward which many CM programs strive. Thus, while redeveloping the entire Purdue University CM curriculum, the faculty decided this was the best opportunity to integrate several additional areas of education, including history, throughout the entire four-year plan of study. Further, integrating the humanities into the CM program meets one of the 10 elements of transformation implemented by the Purdue Polytechnic Institute Dean. The faculty recognized that the right construction history lessons can be beneficial to budding professionals in a number of ways. Morley (1987) explains the reach of construction and its history:

[Construction history has many themes]: a concern with technology and how it is defined by the various groups involved in practice; basic materials, tools, and techniques, the role of knowledge, skills, traditions, and experience; the culture of practice and its historically changing division of labor, and finally, the sources of innovation within the culture and outside of it, and the effects of these innovations generally on thought and practice. (p. 24)

Acknowledging the broad influences of construction, it would be a mistake to ignore the impacts construction has made on society as a whole. Learning from the history of construction only helps to understand the issues of today.

By integrating history instruction students can place the current, routine learning into better context to appreciate its value; not just *what* but *why* we do things as we do. Students are curious as to why things are done a certain way and are not hesitant to ask (Coleman, 2001). Additionally, it has been the authors' experience that students' curiosity revolves around valid reasoning as well, to ensure that the reason is just and not a waste of time. As Rolfe (1990) points out, learning history is important to become a competent manager, not just a technician. Moving beyond a technician involves recognizing that construction is multi-faceted and contractors are people; both influenced by "technical, economic, social, political, cultural traditions, conditions" (Lorenz, 2005-6, p. 35). However, Picon (2005-6) argues that engineers have been hesitant to recognize that construction decisions are heavily influenced by cultural aspects of the time. Understanding the influences of culture upon these decisions better prepares managers for proactive actions as opposed to reactive. Diekmann (2007) showed that current industry practices, such as "alternative project delivery methods, public private partnerships, and globalization" (p. 659) and influences are actually not new ideas. For example, the motivations and politics swirling around the authorization, financing, and construction of the Erie and Wabash-Erie canals two centuries ago read much as media stories about current major infrastructure projects (Bernstein, 2005; Shaw, 1990). Differences matter, but people behave much the same in many important ways despite different times, places, ethnicities, and cultures.

Forgotten ideas of the past can be innovatively applied to the needs of today and help anticipate future changes (Rolfe, 1990). When one understands the past, patterns are revealed, similar to those of the Erie and Wabash-Erie canals. Although a different time, the nature of the issues is the same. However, recognizing this pattern is not enough, the real value comes into play when this information can be transferred to current issues for resolution (Lorenz, 2005-6); applying lessons from the past to now (Dunkeld, 1987). With a better grasp of history, especially if interesting lessons about the past and its leaders inspire lifelong study, students become better citizens at less risk of succumbing to false communication and bankrupt ideas.

However, when learning construction history, as in any historical subject, it is important to understand the inherent bias in the writing of history. As the old adage goes, "history is written by the winners." Morley (1986) points out that history recounts the Greeks' point of view because they won the war, not the Trojans. Dunkeld (1987) continues in stating that construction data is provided based on one class level. Lower levels of social classes did not learn to read or write, thus their history was passed verbally. Yet it is this history, the history of the common people that provides the nuances explaining culture and experiences, not the higher level politics (Morley, 1987). In whichever method was used to share history in the past, there will have always been a bias included as the person or persons providing the story can only provide a certain point of view. It is important to keep in mind this point of view when studying history as specific details may be left out or overstated as a result, as in the present when several people are involved in an event. Even with inherent bias, there are invaluable lessons learned from history.

When teaching construction history, there are various areas of primary focus to instruct; one of those areas is structural design. The history of structural design emphasizes the evolution and complexity of engineering and the related scientific approaches (Lorenz, 2005-6). Before the 18th century, when the industrial revolution started, structures did not have to support such immense weight; therefore, builders were motivated to learn history in order to imitate or best previous builders' works (Morely, 1987). However, the industrial revolution brought about more substantial industry and machines requiring more engineering sciences rather than "rule-of-thumb" designers to account for increased loads (Morely, 1987). Since then, history of structures has been used to learn from past projects to avoid structural failure. Understanding this evolution and the motivation of the builders and designers helps those learning about the craft and methods improvement.

Another area of construction history focus is the evolution of construction practice. This naturally follows structural history as engineering innovations influence practice (Summerson, 1985). Practices include both materials and

methods; which Summerson (1985) adds, includes recruitment of labor, material selection, transportation, drawings, payments, and so on. All of these factors of construction practices build upon each other; if one factor evolves, it can bring along with itself some of the other factors. For example, as transportation evolved, projects were easier to access, and recruitment of labor became easier as well. Often, there is no single variable that affects construction practices and its subsequent factors. Thus, Summerson (1985) impresses the importance of the extensive relationship of the ‘building world’ to society and its holistic effect rather than having a small, isolated effect.

At the heart of construction, in the past, present, and future, are people. Because construction is one of the few technologies that still requires complex human activities to complete, understanding the motivations of builders lends to factors creating new innovations. In fact, Lorenz (2005-6) argues that people, specifically builders, are the cornerstone of the entire construction history, regardless of time. However, history has often overlooked this: naming the architect instead of the builder (Ruth, 2010), failing to recognize builders’ creativity and resourcefulness throughout history (Diekmann, 2007), and the impacts that builders and developers have on the community (Dunkeld, 1987). However, if recognized, the history lessons from builders can be priceless in helping to understand current motivations. Lorenz (2005-6) suggests some questions to get to the point of learning from builders’ perceptions, organization, and attitudes –

What other problems, questions that may seem remote to us, did they confront in their time and how did they resolve them?

Why did they, in their time, in their circumstances, with the materials at their disposal, come to approach, to question and to respond as they did? (p. 35)

Answering these questions will provide a better perspective of the builder and reasoning for choices made. This perspective of history gives insight to how the built environment was created; how builders dealt with industry, technology, labor, and economy (Dunkeld, 1987).

A very critical construction history focus is its emergence from culture. Culture includes everything within the community: individuals, groups, organizations, practices, and products (Morely, 1987). Initially, the culture influencing buildings such the Great Wall, Pyramids, and St. Paul’s, revolved around religion, military, or monuments (Diekman, 2007). Culture also influences ornamental designs, material selection (Picon, 2005-6), training of labor, cash flow, and types of contracts (Diekmann, 2007). For example, when brickmaking and bricklaying was introduced in Middlesex, construction hierarchy changed with the emergence of brick makers and builders employing labor (Dunkeld, 1987). Similarly, new technologies, which allowed for standardization of materials, changed the cost of materials and labor (Picon, 2005-6). It is impossible to ignore the effects of culture on construction as people are the key to construction – both constructing, occupying, and using buildings. The influences on their beliefs and attitudes result in influences of design, materials, and construction processes.

Methodology

After establishing the need for integrating construction history across the curriculum, a team of faculty was then tasked with determining what this integration should look like and how the instruction should be delivered. The faculty on the team came from various construction backgrounds and even included one faculty with a Bachelor’s in History. The determination was made to bring in a faculty member from the History Department at Purdue University to act as a consultant on the project. Two weeks of summer funding was provided to all team members including the consultant from History to research and develop the integration model. Work on this project took place during the summer of 2017.

The main objectives for the summer were:

1. Determine the general framework for how the history lessons will be delivered
2. Choose the history projects to be integrated in each construction course
3. Develop lesson plans for first two semesters (Fall 2017 & Spring 2018)
4. Identify resources required for delivery of history lessons

The transformation of the CM curriculum provided the framework for the delivery of the history lessons. The intent will not be to drill in memorization of dates and names relating to the history projects. Nor will the lessons be

delivered in the traditional 50-minute lecture periods. Students will not be expected to read long textbooks relating to the history projects. A reading list of additional resources will be provided for any student who is motivated to learn more on their own time. Instead, the faculty will teach the history topics in short vignettes throughout the entire semester. These vignettes will be approximately 10-15 minutes long and the topic of the vignette will coincide with the topic of the day's instruction for the class. For example, if the scheduled topic focuses on building codes, then a lesson relating to how the historical project impacted building codes of the time would be pertinent. Students are required to do additional prep work outside of class such as watch short videos, listen to podcasts, and/or read articles/chapters relating to the lesson in preparation for class discussion. In this regard, the history faculty proved to be a vital resource, as anticipated. They provided ideas for resources common to the history field of study but seemed outside the box for CM students.

Determining which historical construction projects to use was the second objective of the team. The faculty member with the undergraduate degree in history was charged with the task of identifying six time periods from which to draw the projects. In the transformed curriculum, the students will take one large project course per semester. It was determined the first semester would include a general overview of construction history. The last semester would include history of construction projects on Purdue University campus. This left six semesters requiring construction projects. The time periods were identified as:

1. Ancient History; Greco-Roman/Classical Antiquity
2. Post Classical; Middle Ages, 200 ad – 1600s ad, Western Roman, China, Renaissance
3. Machine Age; 1760-1900, Oil, railroad expansion, Industrial Age
4. Conflict; 1914-1945, Roaring 20's, Depression, two World Wars
5. Atomic Age; 1945-1969, post-war rebuild, space race, Cold War
6. Information Age; 1970-Present, computers, globalization

Using the time periods, the faculty brainstormed possible historical projects, which would be large enough to span the course of a semester. This list included such projects as (the number included references the time period of the project):

- Interstates; covers multiple time periods and continents (1, 5)
- Great Wall; 2000 years under construction, 13,000 miles of wall (1, 2)
- Dubai/Middle East; man-made islands, world's tallest building, world's largest airport (6)
- Panama Canal; changed trade forever, multiple countries attempted before US success, medical implications (3)
- Greco/Roman; highways, ports, aqueducts, supply chain to far flung outposts, in-floor heat, heated baths (1, 2)
- Empire State Building; 410 day completion time for world's tallest building, Indiana limestone, world's tallest LEED building, off site panelization and prefab (4)
- South to North Water Diversion (China); will be the most expensive project in history, when complete will move more than 40 billion cubic meters of water per year (6)
- Taj Mahal (2)
- Portland Cement; crucial to massive sewer project in London at the same time, sewer helped eliminate two major diseases in the world's largest city (3)
- Brooklyn Bridge; caissons, caisson disease, world's longest bridge, project was run by the chief engineer's wife, Emily Roebling, after he became sick from caisson disease (3)
- Railroad expansions in US (3)
- Hoover Dam; hardhat invention by workers, new concrete pour method, government provided materials, completed two years early (4)
- Levittown; first suburb, used techniques learned from military construction during WWII, 30 houses built per day, changed building code to allow use of slab construction, plan had 26 steps to build a house (5)
- Japan rebuild from WWII damage/nuclear bomb (5)

As the team discussed possible options for projects and began narrowing the list into the final version, it became apparent having a diverse representation of industry sectors was just as important as diversity of time period. The team determined the final list would include:

CM 10000 – Overview of construction history
CM 15000 – Levittown
CM 20000 – Bridges, focusing on the Brooklyn Bridge
CM 25000 – Canals, focusing on the Panama, Erie, and Wabash-Erie Canals
CM 30000 – Portland cement concrete and applications, focusing on usage in the industrial sector
CM 35000 – Highways, focusing on the Eisenhower Interstate System
CM 40000 – Skyscrapers, focusing on the Empire State Building and steel construction
CM 45000 – Campus Construction History

The final list was determined due to their multiplicity of analytical approaches. The intent of integrating history goes beyond the construction aspects of the project. The projects chosen provide opportunity to discuss economic, cultural, social, political, and other challenges faced at the time.

With the implementation of the transformed curriculum starting Fall 2017, developing lesson plans for the first year was imperative. The overview of the history of construction has already been included in the introductory course. The additional instruction would include introducing the students to the historical projects they will encounter throughout their undergraduate CM courses and what they may expect in terms of delivery of these projects. Lesson planning for the Levittown topic required more new material. One team member identified resources for the students to utilize such as short videos, articles, and interviews. Another team member developed a list of additional reading materials, which mainly included novels written on the racial issues surrounding the development and construction of Levittown. From these two lists, the team members compiled a list of topics to tie into the existing content of the CM 15000 course.

The topics would focus on the construction aspects throughout the semester. The more controversial topics would be introduced towards the end of the semester. The intent of including these topics later in the semester is to build interest in the historical project amongst the students first. Students will not be formally assessed on their retention of the historical projects; instead, they will be assessed on their participation in the class activities and preparedness for the discussions.

Lastly, the team began compiling a list of resources relating to the specific historical projects of the integration as well as additional resources for history of construction in general. This last item is proving to be an ongoing task and the history faculty continually sends links, texts, articles, etc. as they come across them. During the summer work, the team realized two components needed for the successful integration of construction history into the CM curriculum. First, there needed to be a history champion who would ensure continuity from course to course in how the different projects were delivered as the curriculum progressed. The CM faculty with the Bachelor's in History volunteered to lead this challenge. Second, each historical project would need a faculty expert. Two of the faculty on the team have a strong interest in Residential construction and volunteered to share the load of the Levittown material. Another faculty showed interest in both the Canals and Interstates projects. The rest of the CM faculty were invited to express interest in any of the projects. A few have started to lay claim on the projects.

The next steps include implementing the history integration into the first year during the current academic year. Lessons learned and best practices will be compiled for the future CM courses and construction projects. The second year lesson plans will be developed over the next year for implementation in fall 2018. After the first full round of the four-year curriculum, the historical projects will be assessed for potential changes. The integration will only be successful if the students are interested in the course material.

Conclusion

The sweep of history offers a fascinating picture of humankind's trials and tribulations in the quest to develop civilizations to improve their lives. Those civilizations grow from social, political, economic, technical and cultural traditions that determine and may be influenced by the act of construction. Altering Petroski (1985), "To construct is human." Studying the history of construction can broaden student and faculty understanding of mankind's past, generally, and its influence on the present state of the industry, specifically. Thus, it may empower construction managers' lives and careers.

Critical leadership and management skills are further cultivated by exposing the constructor to different venues, people, constraints, and requirements. The vicarious experience offered by good history supplements actual involvement to provide the reader a better “database” for decision-making. Knowledge of history can therefore be of greater value to the novice or minimally experienced professional than it might be to people with extensive professional experiences upon which to reflect - although smart managers of any seniority can find history to be instructive. Some knowledge from historical sources may be directly applicable to current situations, while other lessons from history can more broadly inspire new alternatives and lend confidence to make decisions. Some stories are just captivating tales of the instinctive drive to bend the physical environment to people’s needs and desires, as well as they acquaint the reader with human and physical constraints that make those processes so challenging.

Study of past builders, their projects, and their times, coupled with industrial management experience, can impart broader and deeper knowledge than either academia or work experience alone. Construction history vignettes efficiently reinforce common CM learning objectives to make them more meaningful. The context that relevant historical perspectives provide can help make CM education better, offering both more learning and more enjoyment of that process. Such outcomes justify delivery of carefully integrated construction history as a good technique for ASC educators who want to lift their program to a higher plane. Edmund Burke put it best; “in history, a great volume is unrolled for our instruction, drawing the materials of future wisdom from the past errors and infirmities of mankind.”

References

- Bernstein, P. L. (2005). *Wedding of the waters: The Erie Canal and the making of a great nation*. New York: W. W. Norton & Co.
- Burke, Edmund (1790). *Reflections on the Revolution in France* as cited in Bromwich, D. (2017), Edmund Burke, *Reflections on the Revolution in France*, in *A Companion to Romanticism* (ed D. Wu), Blackwell Publishing Ltd, Oxford, UK. doi: 10.1002/978105165396. Ch 10
- Coleman, J. D. (2001). History in the age of technology: An approach to providing context in a technical course. *Proceedings of the 37th Annual Conference of the Associated Schools of Construction*. University of Denver, 67-76.
- Diekmann, J. E. (2007). Past perfect: Historical antecedents of modern construction practices. *Journal of Construction Engineering and Management*, 133(9), 652-660.
- Dunkeld, M. (1987). Approaches to construction history. *Construction History*, 3, 3-15.
- Fine, L. and Remington, J. (1989). Airfields for very heavy bombers. In *The Corps of Engineers: Construction in the United States* (pp. 614-649). (The U.S. Army in World War II: The technical services). Washington, D.C.: Center of Military History, U.S. Army.
- Isaacson, W. (2014). *The innovators: How a group of hackers, geniuses, and geeks created the digital revolution*. New York: Simon & Schuster.
- Lorenz, W. (2005-6). Stories to history, from history to histories: What can construction history do? *Construction History*, 21, 31-42. Retrieved from <http://www.jstor.org/stable/41613893>
- Morley, J. (1987). Building themes in construction history: Recent work by the Delaware Valley Group. *Construction History*, 3, 17-30.
- Petroski, H. (1985). *To engineer is human: The role of failure in successful design*. New York: St. Martins Press.
- Picon, A. (2005-6). Construction history: Between technological and cultural history. *Construction History*, 21, 5-19.
- Rolfe, G. R. (1990). Why teach history? *Proceedings of the 26th Annual Conference of the Associated Schools of Construction*, Clemson University, 67-72.
- Ruth, L. C. (2010). The construction history textbook project: A case study of scholarship and study abroad. *Proceedings of the 46th Annual Conference of the Associated Schools of Construction*, Wentworth Institute of Technology, 1-8. Retrieved from <http://ascpro0.ascweb.org/archives/cd/2010/paper/CEUE224002010.pdf>
- Shaw, R. E. (1990). *Canals for a nation: The canal era in the United States 1790-1860*. Lexington, Kentucky: The University Press of Kentucky.
- Summerson, J. (1985). What is the history of construction? *Construction History*, 1, 1-2.