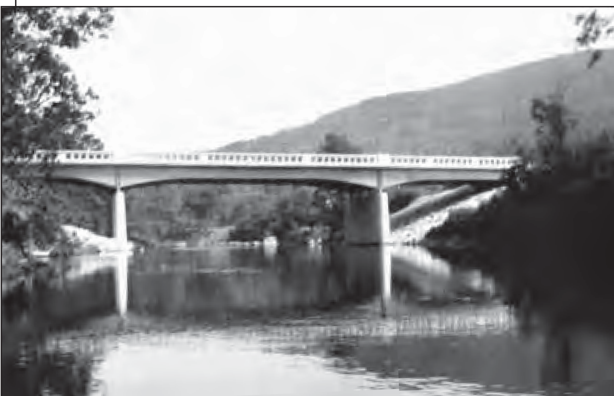
GORDON RUSSELL WHITTUM
A Monograph



HUNTER RESEARCH, INC.
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Principal Historian

Table of Contents

Introduction

Gordon Russell Whittum (1910-1986) was a civil and mechanical engineer who made significant contributions to New Hampshire engineering over the course of a brief period in the mid- to late-1930s. Specifically, he worked for the New Hampshire State Highway Department (SHD) as a bridge designer from 1934 to 1937 and as a construction engineer on the Cannon Mountain Aerial Tramway from 1937 to 1938. Following these accomplishments, he began a 34-year career with the American Steel and Wire Company, a division of United States Steel Corporation (U.S. Steel). While at U.S. Steel, he took out several patents related to tramways and wire production and managed operations at wire-drawing plants in Trenton, New Jersey, and Worcester, Massachusetts.

During the brief time that Whittum was employed by the SHD's Bridge Division, he contributed to the design of at least 19 bridges (see Appendix A, Bridge Portfolio) under the supervision of Assistant State Bridge Engineer Harold E. Langley. Whittum was a graduate of Worcester Polytechnic Institute (B.S. 1933, M.S. 1934) and had little experience outside of college when he joined the SHD. Unsurprisingly, most of his assignments were typical of those that might be given to any junior engineer and included many short-span bridges and culverts. He also spent time in the field providing engineering oversight at bridge construction sites.

A handful of Whittum's New Hampshire bridge designs rose above the ordinary. Two bridges of note were a pair of handsome stone-faced reinforced-concrete rigid frames in Peterborough over the Nubanusit River (State Bridge Nos. 057/108 and 087/087, both extant), completed in 1936. Whittum's signal accomplishment as a bridge designer, however, was the Winchester-Swanzey Bridge (State Bridge No. 152/181, scheduled for replacement in 2014) carrying N.H. Route 10 over the Ashuelot River south of Keene. This bridge, designed and built in 1935, was an unusual haunched steel multi-girder with three continuous spans of 180-foot total length. New Hampshire was among the earliest states in the nation to make use of this bridge type, and the Winchester-Swanzey Bridge was only the third example built in the state. It was also the first to make use of rolled 36-inch-deep wide-flange beams, the deepest then available, as opposed to fully riveted girders. It was a challenging project to assign to Whittum, then only 25 years old, and it represented an important step in the technological evolution of continuous steel girder designs, which were economical to build, yet also good-looking bridges due to their clean lines. With further refinements, continuous steel girders became a signature bridge type of the SHD Bridge Division during the middle decades of the 20th century.

In August 1937, Whittum resigned from the SHD to accept a position as an engineer with the American Steel and Wire Company on the construction of the Cannon Mountain Aerial Tramway in Franconia Notch State Park. The tramway was widely regarded as the first passenger tramway in the United States, patterned after precedents in the European Alps. Whittum's contributions to the tramway project were to provide construction oversight and manage the paperwork under supervision of Chief Engineer Gordon Harold Bannerman. The engineers successfully completed the tramway in less than nine months and on time to open for the summer season of 1938. The original tramway of 1938 was replaced in 1980, but the experience of riding it remains one of the signature attractions of a visit to the White Mountains.

Early Life, Influences and Education

Gordon Russell "Buck" Whittum was born in Worcester, Massachusetts, on June 4, 1910. He was the second of four children, three boys and one girl, born to Frederick E. and Maybel Grace (née Warren) Whittum (Figure 1). The family home at 23 Nelson Place was located in the northern section of Worcester, about one mile from downtown, in a setting that was only beginning to suburbanize in the early 20th century. Gordon's father Frederick, born in 1881, had grown up on a nearby farm. Frederick and Maybel were married in 1907, but sadly Maybel died in 1917, age 31, of tuberculosis, shortly after Gordon's younger sister Ruth was born. After Maybel's death, Gordon, along with his sister and two surviving brothers, Warren and Howard, was raised by his father's extended family. His spinster Aunt Ellie lived with them, helping Frederick with the children and housekeeping, while a separate section of the house was occupied by the children's elderly paternal grandmother Sarah, two adult uncles and a female cousin.[1]

Figure 1. Whittum Family Portrait. Circa 1912. Gordon Whittum, age about 2, is seated (center) on his grandmother Sarah Whittum's lap. Gordon's mother, Maybel Whittum (left), holds cousin Raymond, while Gordon's father, Frederick (right), has Gordon's brother Warren on his lap (Whittum Family Papers, Private Collection).

[1] U.S. Bureau of Census, Worcester, Massachusetts, 1900, Enumeration District 1717, Sheet 11A; 1900, Enumeration District 1718, Sheet 7A, online www.ancestry.com [accessed January 2014]; Massachusetts Vital Records (Marriages), City of Worcester (Boston, Mass.: New England Historic Genealogical Society), 1907, p. 159; Massachusetts Department of Public Health, Registry of Vital Records and Statistics, Massachusetts Vital Records Index to Deaths, 1917, Volume 73, Reference No. F63.M363, online www.ancestry.com [accessed January 2014]; Whittum Family Papers.

Gordon's male role models growing up were engaged in manufacturing and skilled crafts, and this seems to have influenced his education and later career path in engineering. His father Frederick worked as an envelope cutter at the Worcester Envelope Company, established in 1893, a manufacturer of paper goods and paper-folding and handling machinery; he would eventually become a plant foreman.[2] Gordon's uncle Herbert was a carpenter, and his uncle Warren was a draftsman at one of the local ironworks, most likely American Steel and Wire, a division of U.S. Steel, where Gordon would one day find employment.[3] Beginning in 1916, Gordon attended North Pond grammar school, the local public school, and at age 13, followed his older brother Warren to the Worcester Boys Trade School, which had been established *circa* 1909 to provide technical training to adolescent boys in pursuit of careers in trades, industry and engineering. The curriculum offered classes in cabinet-making, carpentry, drafting, electrical shop, machine shop, painting, pattern-making, power generation and printing.[4]

Students who attended Worcester Boys Trade School graduated at age 16 prepared to join the industrial workforce, but those who were judged to have aptitude were encouraged to consider attending college with the option of completing their high-school degrees with a more academic course of studies. In 1926, Gordon took this path toward college, once again following in his brother Warren's steps, to North High School in Worcester. There Gordon took classes geared toward fulfilling the entrance requirements to college, including English, French, history, algebra, geometry, physics, chemistry and mechanical drawing.[5]

In the spring of 1929, Gordon Whittum graduated from high school with plans to attend Worcester Polytechnic Institute (WPI) beginning in the fall semester (Figure 2). Having an excellent high school record and scoring high on WPI's entrance examination, Whittum was offered a $200 matriculation scholarship, which was intended to cover his first year's college expenses.[6] WPI was in the mold of 19th-century technical colleges geared toward preparing young men for professional careers in engineering and science. As such, it certainly of-

Figure 2. Gordon R. Whittum. Circa 1929 (Whittum Family Papers).

[2] Worcester Envelope Company, "Our History," n.d., online at www.worcesterenvelope.com [accessed January 2014].
[3] U.S. Bureau of Census, Worcester, Massachusetts, 1920, Enumeration District 197, Sheet 15A; 1930, Enumeration District 14-1, Sheet 36B; 1940, Sheet 6A. online www.ancestry.com [accessed January 2014]; Whittum Family Papers.
[4] Massachusetts Department of Education, *Massachusetts Independent Vocational Schools in Operation, July 1, 1920*, Bulletin No. 7, Whole Number 116 (Boston, Mass.: Wright & Potter Printing Co., 1920), pp. 111-12; Whittum Family Papers, State Board of Registration of Professional Engineers, Application for Registration, *circa* 1955.
[5] Whittum Family Papers, Worcester Polytechnic Institute (WPI), Gordon Russell Whittum, Transcript, 1933.
[6] Whittum Family Papers, Ralph Earle to Gordon Whittum, 10 October 1929.

fered Whittum, and his brother Warren, who also preceded Gordon at WPI, an opportunity for upward social mobility. Most of the men who attended WPI pursued degrees in engineering. WPI's engineering courses stressed real-world problem solving while not overlooking higher-order mathematics and theory. Reflecting on college many years later, Gordon Whittum was remembered as saying, "At WPI, we learned that you can design something, but you can't always make it."[7]

During the summer of 1929, between graduating from high school and attending his freshman year at WPI, Whittum worked as a counselor at Camp Morgan, a Young Men's Christian Association (YMCA) summer camp in Washington, New Hampshire. Quite possibly, this experience was the spark for a lifetime interest in outdoor activities and an affinity for New Hampshire. Perhaps more importantly, Whittum made a positive impression on the camp's directors, for his upbeat attitude and his problem-solving abilities. Of note was his initiative in taking on a sanitation problem when one of the camp's latrines failed. He quickly designed a new concrete structure and drainage system, and then constructed the latrine with only simple tools in less than three days. By way of this project and recommendations from the YMCA's general secretary and the principal of North High School, Whittum came to the attention of WPI alumnus Henry J. Fuller, chairman of the Fuller "Yankee Ingenuity" Scholarship Committee. Fuller, a mechanical engineer and banker associated with the Fairbanks Morse Company (pumps and engines) and the Gorham Company (silverware), had established the scholarship the year previously. He was in the process of seeking out college students who possessed inventive minds and aptitude exemplary of "Yankee ingenuity." Following an interview with Whittum and three other potential candidates, the committee, which in addition to Fuller included the vice president of the Gillette Safety Razor Company and the president of the Gorham Company, selected Whittum for an $800 scholarship, described as "the most generous scholarship awarded at any college."[8] This scholarship superseded the $200 scholarship that Whittum had already secured from WPI for his freshman year. Whittum graciously returned the $200 so it could be used by another student.[9]

Worcester Polytechnic Institute (1929-1934)

As a freshman at WPI, Gordon Whittum (Figure 3) enrolled in the Course in Civil Engineering leading toward a Bachelors of Science degree. The freshman and sophomore-year civil engineering curriculum included prerequisites such as English literature, mathematics (trigonometry, geometry and calculus), physical education, physics, chemistry and a foreign language (Whittum took German), but there were also introductions to basic engineering skills such as surveying and mechanical drawing. Beginning in the summer after the sophomore year, civil and mechanical engineering classes became the primary focus of course work. Students were taught topographical and railroad surveying at a summer field school, followed by junior-year courses in railroad engineering, highway and municipal engineering, stereotomy (drawing of masonry structures),

[7] WPI, *Course Catalogue* (Worcester, Mass.), 1929-1933; Jeanne Willis, personal communication, December 2013.
[8] Whittum Family Papers, "Another Ingenious Yankee," *The Journal: Worcester Polytechnic Institute* (November 1929), pp. 9-10.
[9] Whittum Family Papers, "Henry J. Fuller Ingenuity Scholarship," n.d.; Earle to Whittum, 10 October 1929; "Yankee Ingenuity Recorded," *Circa* 1929; "Another Ingenious Yankee," *Circa* 1929; "Worcester Boy Award Winner," *Circa* 1929; "Ingenuity Wins Youth Education," *Circa* 1929.

Figure 3. Gordon R. Whittum. Circa 1929, in an unidentified lab (Whittum Family Papers).

electrical engineering, applied mechanics, geodesy and practical astronomy, graphical statics, least squares and materials of construction. In the senior year, course work focused almost exclusively on civil engineering topics with classes in framed structures, structural design, masonry and foundations, arches and bridges, sanitation engineering and water supply. Whittum passed all of the classes, achieving high marks in surveying, structural design, electrical engineering and applied mechanics.[10]

Aside from course work, the influences of WPI's civil engineering faculty on Whittum's development as an engineer are more difficult to gauge. Long-time head of the civil engineering department was Professor Arthur Willard French, best known for a classic textbook on stereotomy, co-authored with Howard Chapin Ives, and published in 1902. Judged by the classes taught by French, known as "Pa" to the students, the professor's interests lay mostly in very traditional engineering skills of drawing and surveying. By the time Whittum encountered French's classes, the professor was nearing retirement. French took a leave of absence during Whittum's senior year, and French's teaching and administrative duties were taken up by Professor Jerome W. Howe, a WPI alumnus and retired U.S. Army officer, who would become WPI's Dean of Admissions in 1938. Other engineering courses were taught by Professor A.J. Knight, who also served as WPI's head of buildings and grounds. While highly respected professors and teachers, none were known as innovators or leading researchers in engineering.[11]

Figure 4. Gordon R. Whittum (standing) with the WPI Indoor Track Team. Circa 1933. Whittum was the team manager. (WPI, *The Peddler* 1933, p. 113).

Extracurricular activities played a major role in Whittum's college experience. In the field of sports, he was the manager of the indoor-track and cross-country teams (Figure 4), and a member of the Goats Head Committee, a WPI tradition established in the 1890s to inspire school spirit.

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[10] WPI, *Course Catalogue 1932-33*, pp. 101-02; Whittum Family Papers, WPI, Gordon Whittum Transcript, 1933.

[11] WPI, *Course Catalogue 1932-33*, pp. 23-26, 101-02; Herbert Foster Taylor, *Seventy Years of the Worcester Polytechnic Institute* (Worcester, Mass.: WPI, 1937), p. 361; Mildred McClary Tymeson, *Two Towers* (Worcester, Mass.: WPI, 1965), pp. 137-138.

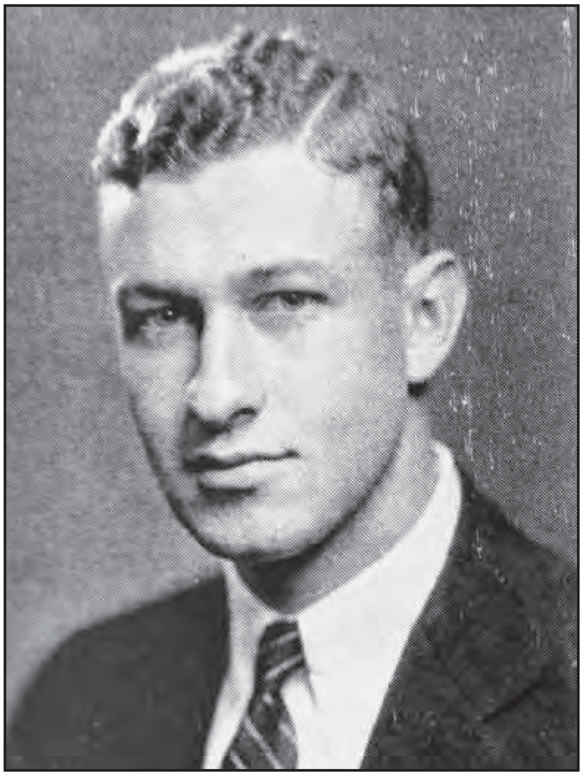
Figure 5. Gordon R. Whittum. 1933. (WPI, *The Peddler* 1933, p. 82).

As a member of that committee, Gordon, known as "Buck" to all of his college mates, organized competitions, like rope pulls, usually pitting the freshman against the sophomore classes. The winning class earned the right to display a small bronze goat statuette, which the losing class then sought to re-capture. In a similar spirit of building class unity, Whittum was a member of the Tech Bible Board, responsible for publishing a handbook for incoming freshmen, providing them with information about the history of WPI, campus life, freshman rules and points of interest on campus and about town. Additionally, Whittum was a member of the Sigma Alpha Epsilon fraternity, which had a house near campus.[12]

In the spring of 1933, Whittum graduated with a B.S. in Civil Engineering and second honors (second highest G.P.A. in his graduating class) (Figure 5). He was also awarded with membership in Sigma Xi, a national honorary research fraternity, and in Tau Beta Pi, a national honorary engineering society. The WPI yearbook, *The Peddler*, commented, "Few fellows at Tech have made a wider circle of friends than has Buck. He has not confined his friendship to his own fraternity or class. The whole college has been his field and is a brighter, happier place because of it."[13] The yearbook also hinted that Whittum was an avid listener to radio, and despite the time he devoted to that hobby, was very likely to have a successful engineering career.[14]

Whittum's stellar undergraduate record earned him one final honor from WPI. Upon graduation, he was offered a one-year graduate fellowship to complete a Master of Science in civil engineering. This was the first time in the history of WPI that graduate fellowships were offered, and it inaugurated a new policy meant to promote more advanced course work and research in engineering. Whittum was one of six students selected for the fellowships, which covered all tuition costs. Although this delayed Whittum's entering the workforce by one year, the graduate fellowship may have been a welcome relief, given the difficulties of finding work during the Great Depression.[15]

For his master's thesis, titled "Stress Analysis by the Beggs Deformeter," Whittum chose a practical topic that allowed him to hone his skills in structural analysis and design. The Beggs

[12] WPI, *The Goat's Head Committee, Goat History* (2012), online, http://users.wpi.edu/~goat/history.html; WPI, *Tech Bible* (2011), online, http://www.wpi.edu/academics/library/history/techbible/index.html.
[13] WPI, *The Peddler*, 1933, p. 82.
[14] Ibid.
[15] Whittum Family Papers, "Tech Awards Fellowships to Graduates" and "Establish Awards for Worcester Tech Grads," 1933.

deformeter was a tool introduced to the engineering field by Professor George E. Beggs of Princeton University in 1922. It consisted of a kit of micrometer microscopes, clamps and gauges, which with practice and controlled conditions (particular temperature and humidity) could be used to measure minute stresses in models of bridges, buildings and other structures. The deformeter was probably only recently acquired by WPI, given an advertising brochure that Whittum included in his thesis, which did not list WPI among about 50 universities having already purchased an instrument from Beggs. Whittum paid careful attention to describing the apparatus and how to use its component parts, also an indication that the machine was probably new to WPI and its faculty. The deformeter was, and still is, considered a useful instrument for modeling structural behavior, particularly those structures that were statically indeterminate (i.e., those that could not be analyzed using traditional static methods because the variables were more numerous than the known independent conditions of equilibrium). This was a significant area of interest among early 20th-century bridge engineers who recognized the technological advantages of continuous beams and other types of statically indeterminate structures, but who were wary of the uncertainties, complications and time required to calculate the stresses. The deformeter offered a relatively inexpensive, yet exceptionally accurate, alternative method for carrying out this type of analysis, as long as a researcher was confident that the behavior of the model approximated that of the actual full-sized structure under real-life conditions. Whittum's thesis was mainly geared toward illustrating his proficiency with the Beggs deformeter. He demonstrated an ability to build models of arches, beams and cantilevers using sheet celluloid and then, with precision, to subject the models to stresses to measure deflections, and then graph and present the results. The thesis was a fitting conclusion to his WPI education, illustrating an ability to conduct an independent research project requiring higher order mathematics and hands-on skills.[16]

Early Engineering Career in New Hampshire

New Hampshire State Highway Department (1934-37)

Following graduation from WPI in 1934 with an M.S. in Civil Engineering, Gordon Whittum was hired by the New Hampshire State Highway Department (SHD) for the position of Bridge Designer. This was an opportune time to be joining the SHD's Bridge Division under the leadership of State Bridge Engineer John W. Childs and Assistant State Bridge Engineer Harold E. Langley. With the inflow of federal and state public works dollars, meant to offset the economic impacts of the Great Depression, the Bridge Division's work load was expanding with the completion of from 25 to 30 bridges, and many dozens of small culverts, each year. Not only was this work considered critical to an economic recovery, but it was part of New Hampshire's long-range goal of creating a modern system of "trunkline" roadways to carry automobiles and trucks safely and quickly

[16] Gordon Russell Whittum, "Stress Analysis by the Beggs Deformeter," Master's Thesis, Worcester Polytechnic Institute, 1934; T.P. Ganesan, *Model Analysis of Structures* (Hyderguda, Hyderabad, India: Universities Press, 2000), p. 44.

across the state. It created many opportunities for a young engineer to gain experience in the field of bridge engineering.[17]

Whittum took up lodgings in downtown Concord in a house at 15 North State Street, about four blocks from the SHD's offices in the Patriot Building at the corner of North Main and Park Streets.[18] He immediately joined a cadre of about a dozen bridge engineers, mostly younger men in their 20s or early 30s, among them Robert J. Prowse, Clifford Broker and Henry C. Newell, under the supervision of Harold E. Langley, who served as the head of bridge design. Many of these men, including Broker and Newell, were WPI graduates. Together they worked in a third-floor drafting room among the T squares, triangles, compasses, scales, pencils, erasers and slide rules that were the engineers' tools of the trade.[19]

Harold E. Langley, who joined the division in the early 1920s, served as a mentor to the young men. He had a strong influence on the technical aspects of the state's bridge program, moving it away from the days of wood and iron bridges to more modern designs of reinforced concrete and steel. During the 1930s, he developed a reputation as an expert on the design and analysis of steel-arch bridges. Langley received national recognition for the Beecher Falls Road Bridge over the Connecticut River between Beecher Falls, Vermont and Stewartstown, New Hampshire (1930, State Bridge No. 054/163, scheduled for rehabilitation). This two-hinge steel deck arch won the American Institute of Steel Construction's first ever Most Beautiful Steel Bridge award in 1931. Langley won the award again in 1937 for the West Chesterfield-Brattleboro steel through-arch bridge over the Connecticut River (1937, State Bridge No. 040/095, extant). Langley was a contributor to the second edition of Hool and Kinne's *Movable and Long Span Bridges*, published in 1943. It was one of the most widely used bridge engineering textbooks of the mid-20th century. His participation in preparing the text was an indication of Langley's interest in training young engineers. During the 1930s, he recruited college-educated talent to the Bridge Division, and Whittum fit the mold with a record of strong academic skills and high potential.[20]

As a junior engineer, Whittum was expected to learn the procedures and methods used by the Bridge Division, including those codified in the SHD's *Specifications for Highway and Bridge Construction and Reconstruction*, which had first been published in 1927 and were updated every few years, including in 1931 and 1935. A bridge designer's responsibilities included calculating loads, determining quantities and dimensions, and ensuring that the design met the appropriate standards and specifications. As a design became progressively refined, the information was systematically transferred to plan sheets (drawings). Depending on the size and complexity of the

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[17] Patrick Harshbarger, "Winchester-Swanzey Bridge, NH Route 10 over Ashuelot River, NH Bridge No. 152/181," 2013, pp. 6-7, on file, New Hampshire Department of Historical Resources (NHDHR); Laura B. Driemeyer, "Clifford Broker, Sr., A Monograph of his Career as a Bridge Designer with the New Hampshire State Highway Department, ca. 1933-ca.1945," 2010, p. 9, on file NHDHR.

[18] H.A. Manning Company, *Manning's Concord and Pembroke (New Hampshire) Directory* (Springfield, Mass., 1935), p. 257.

[19] Patrick Harshbarger and Ingrid Wuebber, "Robert John Prowse, A Monograph," 2009, p. 11, on file NHDHR.

[20] Harshbarger 2013, p. 6; Driemeyer, 2010, pp. 3-5; James I. Garvin, "New Hampshire Good Roads Projects, 1904-2004," 2003, p. 14, on file NHDHR; Richard M. Casella, "Bartlett Bridge 189/129, NH State No. 637," 2005, on file NHDHR; Glenn A. Knoblock, *Historic Iron and Steel Bridges in Maine, New Hampshire and Vermont* (Jefferson, NC: McFarland & Company, 2012), p. 59.

project, the number of sheets ranged from one to several dozen or more. Each sheet was recorded with the initials of the designer, the drawer and the tracer, the latter two capacities often filled by a junior engineer who refined and transferred the designer's rough drawings onto the final sheets. In Whittum's first few months in the Bridge Division, his initials often appear as a drawer or tracer of other engineers' designs. This was considered an appropriate way for less-experienced engineers to gain experience, demonstrate their competency and learn the senior engineers' preferred methods.[21]

In June 1934, among Whittum's first assignments was tracing the plans for a 65-foot-long haunched reinforced-concrete T beam bridge on N.H. Route 101 over the Exeter River in the Town of Exeter (State Bridge No. 103/073, extant), quite probably the longest simple-span T-beam bridge ever constructed by the SHD.[22] Shortly thereafter, he was given his first design, a much more modest T-beam span of about 30 feet, carrying Brentwood Road over the Little River in Exeter (State Bridge No. 075/078, extant) (Figure 6). This T-beam bridge was an example of a common type of highway bridge from the 1910s to 1950s, usually used for spans between 20 and 50 feet, and one that Whittum would have been familiar with from bridge engineering textbooks. Whittum prepared four plan sheets detailing the superstructure and the substructure.

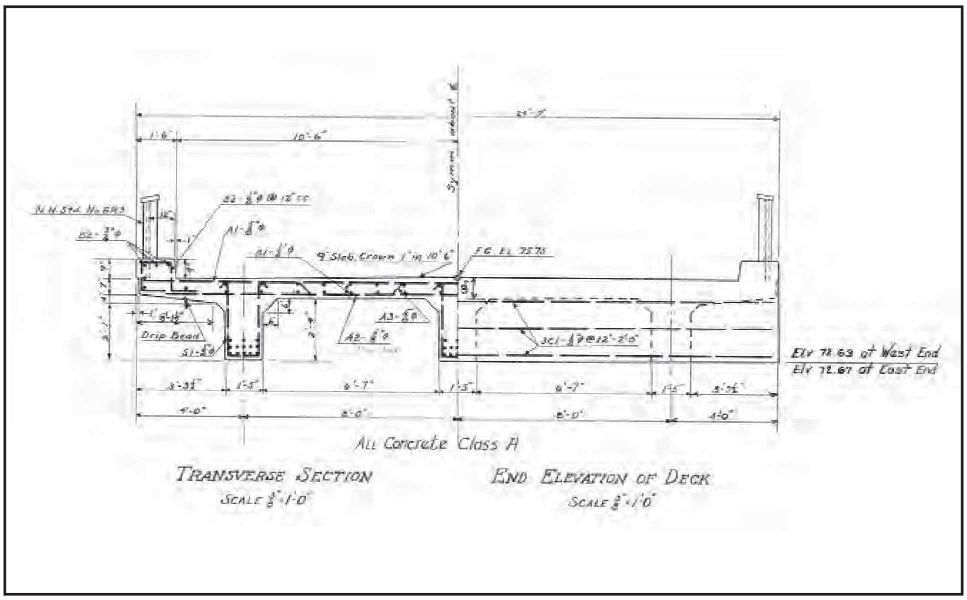

Figure 6. Detail from a plan for a T-beam Bridge Carrying Brentwood Road over Little River, Town of Exeter (State Bridge No. 075/078). July 1934. This was Whittum's first design for the SHD. It was typical of the projects assigned to him during the first six months of employment (NHDOT Bridge File P23).

[21] Harshbarger and Wuebber 2009, p. 12.

[22] NHDOT Bridge Division, T-Beams (Simple), 35' to 65', n.d. On file, NHDOT, Concord, N.H.

Between August and December 1934, Whittum worked on a variety of bridges, mostly involving short-span crossings and design problems of a relatively straightforward nature. These included a 36-foot-long haunched T-beam bridge on N.H. Route 11 over Backwater Creek in Andover (State Bridge No. 053/092, replaced 1997) (Figure 7); a 27-foot-long reinforced-concrete slab bridge on South Side Road/N.H. Route 44 over Robbins Brook in Marlborough (State Bridge No. 089/127, extant); a 10-foot-long reinforced-concrete box culvert on N.H. Route 101 over Robbins Brook in Marlborough (State Bridge No. 113/132, extant); and a 28-foot-long reinforced-concrete rigid-frame bridge on Mammoth Road over Beaver Brook in Londonderry (State Bridge No. 116/021, extant). These were the type of projects that probably did not require the full attention of more senior engineers and were considered suitable for a new hire with little experience beyond college.

Figure 7. Construction of the N.H. Route 11 over Backwater River Bridge, Town of Andover (State Bridge No. 053/092). Circa 1934. This photograph shows the falsework in place (Whittum Family Papers).

Whittum received a more challenging design project in early 1935. This was for a bridge on the Dartmouth College Road/N.H. Route 10 in Croydon, where a replacement bridge was to cross the Croydon Branch River (State Bridge No. 112/069, non-extant) (Figure 8). It involved designing a bridge in a village setting with one end of the bridge wider than the other, crossing a stream at a skew, as well as at a vertical grade of slightly less than three percent. Whittum's design solution was for a T-beam bridge with haunched beams, the upstream beam flared to account for the variable width with the fascia deck slab and concrete balustrade curved to the highway's profile. The balustrade was a standard design, with Art Moderne-style influences, of a type frequently used by the Bridge Division during the 1930s. The overall visual effect was pleasing, and an example of fitting a standard bridge type to the requirements of a highway and its setting, at a site that easily could have resulted in a less thoughtful approach. In all, this was in keeping with the vast majority of bridge designs then being produced by the Bridge Division's engineers, who no doubt reflected the approach that Langley wished to instill within his staff.

Figure 8. T-beam Bridge Carrying Dartmouth College Road/N.H. Route 10 over Croydon Branch River in Croydon (State Bridge No. 112/069). Circa 1935. Designed by Gordon Whittum (NHDOT Bridge Card).

Following on the heels of the bridge in Croydon, Whittum was assigned a new project, the Winchester-Swanzey Bridge over the Ashuelot River on Dartmouth College Road/N.H. Route 10 (State Bridge No. 152/181, scheduled for replacement in 2014) (Figures 9 and 10). This bridge was part of a project to realign a section of the highway, bypassing a covered bridge and the rural village of Westport. The selected design was for a three-span, 180-foot-long continuous steel multi-girder bridge. The bridge's steel girders featured 36-inch-deep wide-flange beams with nearly 6-foot-deep built-up haunches added over the piers, economically achieving depth where it was needed most in a continuous design (Figure 11). The method of fabricating the haunches relied on traditional riveting techniques, but butt welding was also employed portending the smooth all-welded designs that would become the hallmark of the Bridge Division in the postwar years.

Whittum, as a young bridge designer, faced challenges with the Winchester-Swanzey Bridge far beyond those that he had encountered in his prior designs. Foremost was performing the difficult analysis of the stresses in a continuous design, and secondarily was detailing the fabrication of the haunched steel girders. This was particularly demanding work considering Whittum had not previously designed a continuous-span bridge or even a steel girder. Speculatively, it seems very likely that the concept for the bridge originated with a more senior engineer, most likely Langley, who had played a role in the design of New Hampshire's first two continuous haunched girder bridges, built in 1934-35; the Littleton Bridge over the Connecticut River (1934, State Bridge No. 109/134, extant) and the Ledyard Bridge over the Connecticut River at Hanover (1934-35, State Bridge No. 026/056, non-extant) were both three-span structures measuring respectively 366 feet and 352 feet, as compared to the shorter Winchester-Swanzey Bridge's 180-foot length. Nonetheless, the Bridge Division showed a high degree of confidence in Whittum's abilities by assigning him the work. He began the design no later than March 1935 and had completed a full set of drawings a few months later in July 1935, at which time the bridge project was let for contract. Construction began no later than September 1935 and was completed before year's end.[23]

[23] Harshbarger, "Winchester-Swanzey Bridge," 2013, pp. 7-8.

Figure 9. Winchester-Swanzey Bridge, Oblique View of Bridge's Western Elevation, Looking South. September 2013 (Photograph by David Haas in Harshbarger, "Winchester-Swanzey Bridge," 2013).

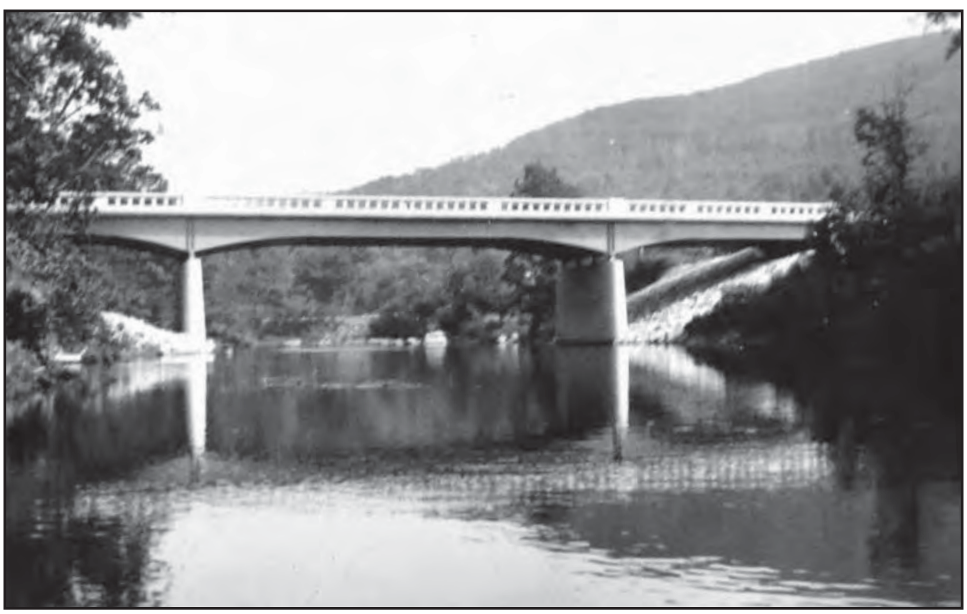

Figure 10. Winchester-Swanzey Bridge, State Bridge No. 152/181. Circa 1936. In later life, Whittum kept a photograph of the bridge near his desk at the American Steel and Wire Company (Whittum Family Papers).

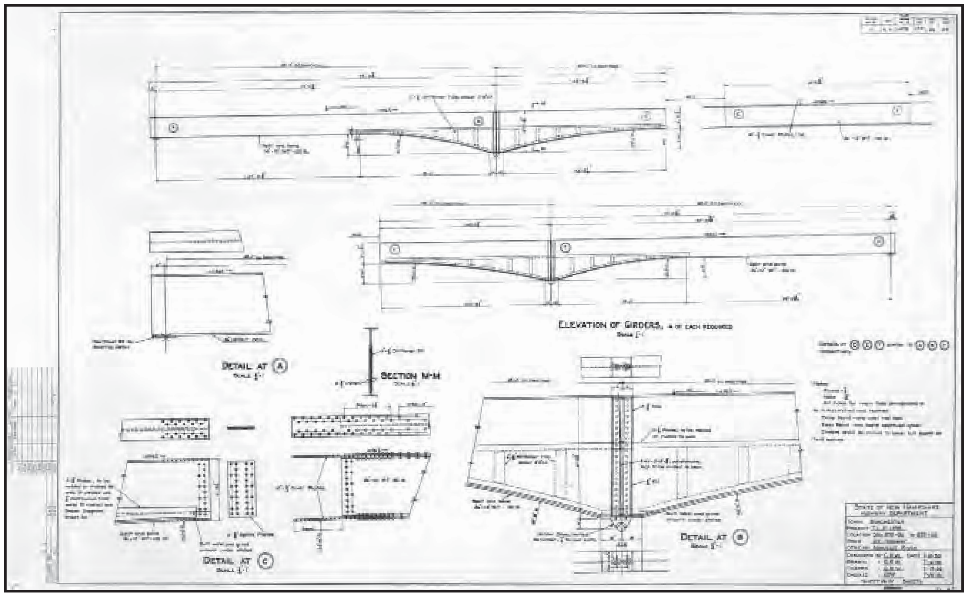

Figure 11. Elevation of Girders and Details (Sheet 26), Winchester-Swanzey Bridge, State Bridge No. 152/181, State of New Hampshire Highway Department. 1935. Plan designed, drawn and traced by GRW [Gordon R. Whittum].

In historical perspective, the Winchester-Swanzey Bridge is one of New Hampshire's most important and early examples of a continuous-design steel-girder bridge. It represents a transitional phase in the technological development of a highway bridge type that was introduced in New Hampshire during the mid- to late 1930s and used widely through the 1950s and 1960s. Continuous designs are where the beams continue uninterrupted over one or more piers. They have significant economic advantages because they use less material (smaller section beams) for a given span length than simple spans (those where the beams do not continue over the piers). Prior to the 1930s, with very few exceptions, primarily for very long-span truss bridges, bridge engineers in the United States designed for simple spans. This was particularly true for the most common types of highway bridges, including steel girder bridges. Engineers' reluctance to take advantage of continuous designs was primarily related to a lack of proven methods to adequately analyze structures that were statically indeterminate, i.e., when equations of static equilibrium were insufficient for determining the internal forces and reactions in a bridge. These were concepts that Whittum had no doubt encountered during his years at college; however, the Winchester-Swanzey Bridge was the first time that he is known to have applied this knowledge to an actual bridge design.[24]

[24] Harshbarger, "Winchester-Swanzey Bridge," 2013, pp. 7-8; U.S. Department of Transportation, Federal Highway Administration, *America's Highways, 1776-1976* (Washington, DC: U.S. Government Printing Office, 1976), p. 432; B. D. Hanhilammi, "Continuous Bridges, The Ohio Experience," *The Second Ohio Historic Bridge Inventory* (Columbus, OH: Ohio Department of Transportation, 1990); Louis Berger Group, Inc., "Atkinson Depot Overpass (NH Bridge No. 105/028), NH State No. 517," 2000, pp. 14-16. on file NHDHR; Lichtenstein Consulting Engineers, *Historic Bridge Inventory Update Non-Technical Report* (Atlanta, GA: Georgia Department of Transportation, 2001), pp. 67-74; James I. Garvin, "NH Bridge 111/115 (Merrill's Marauders Bridge), NH State No. 585," 2005, pp. 9-11, on file NHDHR.

The design of the Winchester-Swanzey Bridge was a signature accomplishment and a highlight of Whittum's three years working for the SHD. Although the reasons are not entirely clear, Whittum designed very few bridges during the second half of 1935. This was likely a result of having been sent into the field, probably to provide engineering oversight at construction sites, possibly even at the Winchester-Swanzey Bridge. Familiarity with construction management was an important component of a young bridge engineer's career development, even if he planned to be a designer. By early 1936, however, Whittum was back in the Bridge Division's Concord drafting room, once again designing bridges, and having moved his place of residence to 46 School Street, which was about one block closer to the office than his first in-town lodgings on North State Street.[25]

In February 1936, Whittum completed a design for a 30-foot-long T-beam bridge on N.H. Route 11-A over Poor Farm Brook in Gilford (State Bridge No. 138/137, extant). This bridge was similar to T-beam bridges he had designed in 1934 and was standard in every respect. The Great Flood of March 1936 placed the SHD in the position of responding to a statewide emergency that wiped out dozens of bridges and washed out miles of roadway. Whittum and his co-engineers were immediately set to work assessing the damage and designing repairs and replacement bridges. The loss of bridges was so great that the federal government provided New Hampshire and other New England states a special appropriation for flood bridge replacement under the Works Progress Administration.[26] Whittum's next assignment, therefore, involved two very handsome stone-faced reinforced-concrete rigid-frame bridges in the Town of Peterborough, designed to replace stone arch bridges that had been damaged by the flood. The first of the bridges, on South Side Road/Union Street over the Nubanusit River in the village of West Peterborough (State Bridge No. 057/108, extant) (Figure 12), involved finishing a design that had been started two years earlier by other engineers but not completed. Whittum detailed the 65-foot-long bridge's deck, abutments and wingwalls. The second of the bridges, on Grove Street over the Nubanusit River (State Bridge No.

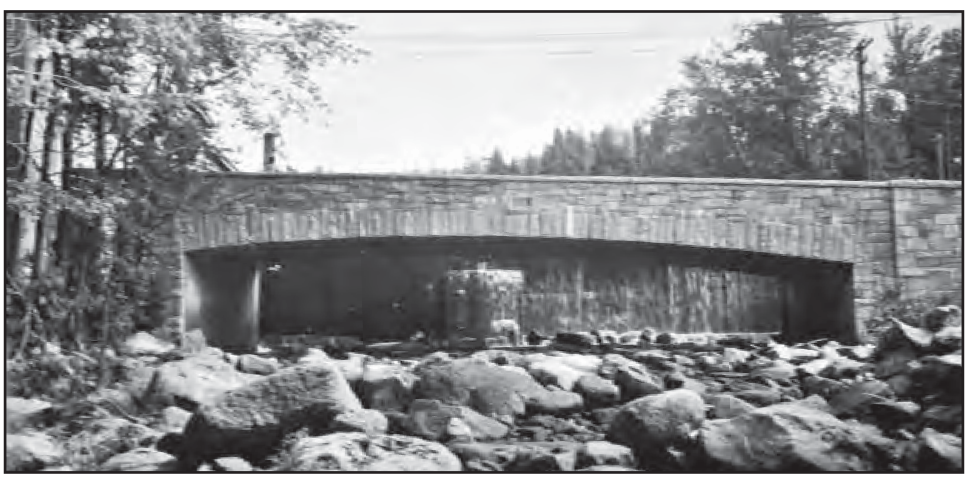

Figure 12. South Side Road (Union Street) Bridge over the Nubanusit River, Town of Peterborough. State Bridge No. 057/108. Circa 1936. Designed completed by Gordon R. Whittum (NHDOT Bridge Card).

[25] H.A. Manning Company, *Manning's Concord and Hopkinton (New Hampshire) Directory* (Springfield, Mass.: 1936), p. 257.

[26] James I. Garvin, "100th Anniversary Series Part II: High Water: Rebuilding Bridges after the Floods of 1927 and 1936," *New Hampshire Highways* (March/April 2004), pp. 26-31; Works Progress Administration, *Raging Rivers and the WPA, New Hampshire* (October 1936).

Figure 13. Grove Street over the Nubanusit River, Town of Peterborough. State Bridge No. 087/087. Circa 1936. Design by Gordon R. Whittum (NHDOT Bridge Card).

087/087, extant) (Figure 13), was for a 46-foot-long span, similar in most respects to the bridge on South Side Road. Both of these bridges, with their pleasing shallow-arched lines and high-quality masonry veneers, illustrated the reasons that the rigid-frame bridge type was considered ideal for settings where an aesthetically pleasing, yet economic-to-construct bridge, was desirable. The rigid-frame bridge type was used widely in New Hampshire and nationally during the second quarter of the 20th century.

During the remainder of 1936, Whittum continued to assist the flood relief effort, completing the design for another rigid-frame bridge carrying Main Street over the Souhegan River at the village of Columbian Mills in the Town of Greenville (State Bridge No. 071/101, extant). He also worked on components of two major steel through-truss bridges over the Connecticut River – the Lebanon (N.H)-Hartford (Vt.) bridge carrying U.S. Route 4 (State Bridge No. 058/127, scheduled for replacement) and the Lyme (N.H.)-Thetford (Vt.) bridge carrying Lyme Road (State Bridge No. 053/112, scheduled for rehabilitation). In both instances, Whittum prepared substructure (abutment and pier) details, either rehabilitating stone units from earlier bridges damaged by the flood or designing all new reinforced-concrete units.[27]

In late 1936 and the first half of 1937, Whittum was engaged in construction supervision, designing only a small handful of bridges. His scrapbook included a large number of photographs of the Bellows Falls Bridge (non-extant) over the Connecticut River between Bellows Falls, Vermont and North Walpole, New Hampshire, suggesting he probably spent much of this time supervising the repairs for this landmark steel through-arch bridge, which when completed in 1905 was the longest arch bridge in the United States at 540 feet. The Great Flood of 1936 severely damaged the bridge, bringing it to the brink of collapse and leaving it leaning into the river. The Whittum

[27] Richard M. Casella, "Lebanon-Hartford Bridge, NH Bridge No. 058/127," 2008, on file NHDHR.

scrapbook also included photographs of a temporary suspension bridge that was built over the Merrimack River at Manchester, suggesting he may have had involvement with it as well.[28]

In July 1937, Whittum resigned from the SHD in anticipation of a new job working for his hometown of Worcester's American Steel and Wire Company on a high-profile job constructing the Cannon Mountain Aerial Tramway at Franconia Notch State Park. This may have also coincided with a personal desire to find a career path leading back to Worcester where he could be nearer to family. It was at about this time that Whittum proposed to Katharine (Kay) Howell of Worcester, who had attended North High School at the same time as Whittum and had been reintroduced by a mutual college friend. The couple were married in 1938 and honeymooned in Nova Scotia (Figures 14 and 15).[29]

Figure 14. Gordon R. Whittum. 1937. This photograph was taken at Henry Newell's place in Francestown, New Hampshire, about the time Whittum had decided to leave the SHD for a job with the American Steel and Wire Company. Newell, a respected New Hampshire engineer who also worked for the SHD, remained a lifelong friend (Whittum Family Papers).

Figure 15. Katharine (Kay) Howell married Gordon R. Whittum in 1938 (Whittum Family Papers).

[28] Whittum Family Papers, Whittum Scrapbook.

[29] Jeanne Willis, personal communication; *Massachusetts Marriage Index, City of Worcester*, 1938, p. 397, online *www.ancestry.com.*

Cannon Mountain Aerial Tramway (1937-38)

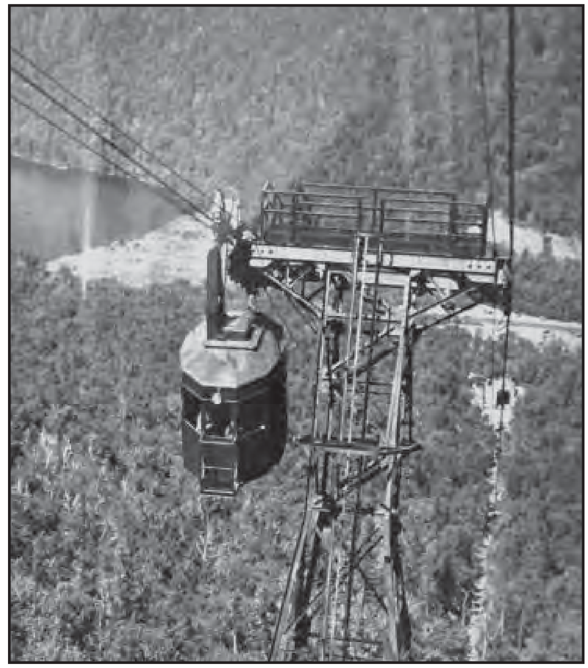

Figure 16. Cannon Mountain Aerial Tramway. Circa 1938 (Whittum Family Papers).

In September 1937, Gordon Whittum arrived in Franconia Notch to work as an engineer for the American Steel and Wire Company supervising construction of the Cannon Mountain Aerial Tramway (Figure 16). This was to be the first step in Whittum's 34-year career with American Steel and Wire, an operational division of U.S. Steel. The Cannon Mountain Aerial Tramway legitimately claimed to be the first passenger-carrying aerial tramway in the United States, patterned after European precedents, mainly located in the Alps, some of which dated to as early as the last quarter of the 19th century. The idea was promoted by Alexander Bright, an American winter sports enthusiast, who was an ice-hockey star at Harvard University in the late 1910s and early 1920s, and later a highly ranked amateur skier who was a member of the U.S. Olympic ski team in 1936 and a member of the U.S. Olympic Committee in 1948. It seems to have been Bright who contacted American Steel and Wire Company about the technical feasibility of the tramway and in 1934 the company dispatched its engineers to Franconia to survey possible routes and develop conceptual plans. The company probably saw passenger tramway design and construction as a new market for its wire-rope products.[30]

With the work judged feasible at a cost of approximately $250,000, Bright and others, including community leaders from Franconia, began the process of lobbying the state legislature for support. This lobbying effort must have attracted the attention of Gordon Whittum while he worked for the SHD in Concord, and when the state government approved the project in July 1935, it was heralded by newspapers statewide. State authorization, however, was conditioned on federal financing, which was not forthcoming, delaying construction until June 1937 when a new bill passed the legislature and was signed by the governor, this time authorizing a bond issue in lieu of federal funds. In August 1937, American Steel and Wire was awarded the construction contract and work began immediately.[31]

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[30] Harvard University, *Harvard Athletics Renames Hockey Facility to Bright-Landry Hockey Center, Beings Year-Long Construction Project* (2010), online www.gocrimson.com/sports/mice/2013-14/releases/IHM130122Bright
construction; Sarah N. Welch, *A History of Franconia, New Hampshire, 1772-1972* (Littleton, N.H.: Courier Printing Co., 1972), pp. 164-65; *Cannon Mountain Aerial Tramway II* (Franconia, N.H.: Franconia Notch State Park, 1980), pp. 2-4.

[31] *Cannon Mountain Aerial Tramway II* (1980), pp. 3-4.

Whittum's ties to the aerial tramway project were rooted in his Worcester connections. The chief engineer was Gordon Harold Bannerman, a WPI graduate and fellow Sigma Alpha Epsilon fraternity member who headed the Tramway Division of American Steel and Wire. Although Cannon Mountain was American Steel and Wire's first aerial passenger tramway, the company was well-experienced with the technology having participated in the construction of over 600 freight tramways in North America, typically found at mines, quarries and construction sites to transport ore and other bulk materials. In September 1937, Bannerman and a three-man engineering team, consisting of E.S. Vandervoort as construction superintendent, McKenzie Johnson as engineer in charge of steel erection and concrete work, and Whittum as the junior engineer charged with handling the paperwork, took up residence in Franconia with a goal of completing the project before the summer of 1938 tourist season. Approximately 40 laborers were also recruited.[32]

Over the course of nine months from September 1937 to June 1938, Whittum played an integral role in the rapid progress of the tramway's construction. The work began with clearing a nearly mile-long pathway from the base of the mountain to the top, a change in elevation of 2,022 feet. Then, the contractors built a temporary freight tramway capable of carrying construction materials to the top, barely completed before a hard and very cold winter set in. Working in temperatures that regularly dipped below zero degrees Fahrenheit and with up to six feet of snow on the ground, the construction team persevered, using hot water and antifreeze to mix concrete and keep it from freezing, an idea that was credited to Whittum. The overall design of the tramway followed European precedents, including deep pits with concrete counterweights to balance the cables and keep them in constant tension. In addition to the steel towers and tramway cars, American Steel and Wire built attractive wood-shingled stations at either end of the tramway, one known as the valley station and the other as the mountain station. Operations were controlled by electrical circuitry, as opposed to mechanical systems, designed by Westinghouse Electric.[33]

On June 28, 1938, the State of New Hampshire held a grand opening for the Cannon Mountain Aerial Tramway with Governor Francis P. Murphy presiding. Gordon Whittum attended the ceremony, and although not ranking high enough to be officially recognized in the day's printed program, he was heralded in his hometown and college newspapers as one of the WPI-graduate engineers who participated in the "Transportation Conquest of Cannon Mountain". During its first summer season, the tramway transported an average of 1,000 passengers per day, far exceeding expectations. It went on to become a highlight of any visit to Franconia Notch. Whittum collected many mementos of his nine months of work in Franconia, including two dozen or so construction progress snapshots (Figure 17) and his official invitation and badge to the dedication ceremony (Figures 18-19). Another legacy of a winter spent in Franconia, Whittum remained an avid skier for the rest of his life. Some 42-years later, Whittum traveled to Cannon Mountain to see Tramway II, which opened in 1980 to replace the first tramway of 1938. The old tramway was replaced for reasons of increasing passenger-carrying capacity and the difficulty of finding replacement parts.[34]

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[32] Whittum Family Papers, "The Story of the Transportation Conquest of Mount Cannon by Worcester Engineers and Worcester Industry," *circa* 1938; "Mountain Tram Ready in Summer," *circa* 1938; "Sigma Alpa Epsilon Engineers of America's First Aerial Tramway," *Circa* 1938; "North America's First Aerial Tramway, They Carried Equipment Up the Mountain by Hand to Build America's First Aerial Tramway, *Circa* 1938.

[33] Ibid.

[34] Ibid.

Figure 17. The Temporary Freight Tramway at Cannon Mountain. Circa 1937-38. The figure on the tramway is unidentified (Whittum Family Papers).

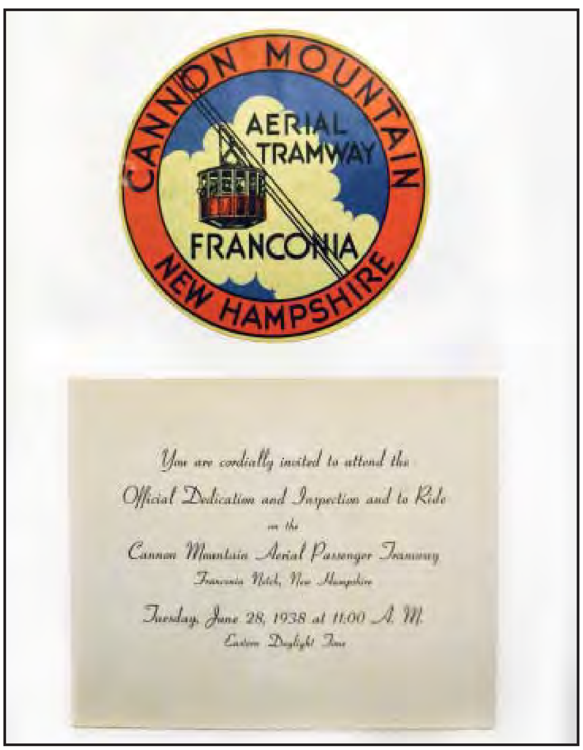

Figure 18. Invitation to the Cannon Mountain Aerial Tramway Dedication. June 28, 1938 (Whittum Family Papers).

Figure 19. Badge and Round-trip Ticket for Opening of the Cannon Mountain Aerial Tramway. June 28, 1938 (Whittum Family Papers).

An Engineering Career at American Steel and Wire Company (1938-1971)

Gordon Whittum's involvement with New Hampshire engineering came to a close with the completion of the Cannon Mountain Aerial Tramway in June 1938. The next month, Gordon and Kay Whittum moved to Hamden, Connecticut, so Gordon could be near the headquarters of the Aerial Tramway Division of American Steel and Wire Company, which was located in New Haven. This opened a new chapter in Whittum's life, one that would see him move up the engineering and managerial ranks of the American Steel and Wire Company and eventually return to his hometown of Worcester as senior management.

American Steel and Wire Company, known as "the Wire Trust," was a monopoly established in 1898-99 by John W. Gates, who consolidated the works of 12 wire and nail manufacturers located mostly in the Northeast and Midwest. Over the course of his career, Whittum would be employed at three of these works: the former New Haven Wire Company in Connecticut, the Trenton Iron Company wire works in New Jersey, and Washburn & Moen Manufacturing Company in Worcester. American Steel and Wire was formed with the financial backing of J.P. Morgan and Company, and in 1901 Morgan and his investment partners in turn merged American Steel and Wire into the giant United States Steel Corporation (U.S. Steel). At the time of its creation, U.S. Steel was the largest corporation in the world with a capitalization of $1.4 billion and control of over two-thirds of the productive capacity of the American steel industry. It remained the industry's standard bearer well into the mid-20th century.[35]

Figure 20. Gordon R. Whittum in the Drafting Room of the Aerial Tramway Division, American Steel and Wire Company, New Haven, Connecticut. Circa 1940-42 (Whittum Family Papers).

[35] Clifford W. Zink, *The Roebling Legacy* (Princeton, N.J.: Princeton Landmarks Publications, 2011), pp. 102, 110.

Whittum's first four years at American Steel and Wire, from July 1938 to July 1942, were spent as a tramway designer at the New Haven Works (Figure 20). Following on the heels of the Cannon Mountain Aerial Tramway and the publicity stemming from skiing in the Winter Olympics of 1932 and 1936, ski resort development was a booming activity, and Whittum seems to have concentrated on helping to expand this area of the company's business. In April 1940, Whittum even applied for a patent covering an improvement in the hanger used to suspend tramway cars from the cables (Figure 21). Specifically, this hanger was intended to reduce the shock and noise of passenger tramways, making for a more comfortable ride. This was achieved through the use of rubber sleeves and increasing the number of lug nuts connecting the hanger to the traction rope.

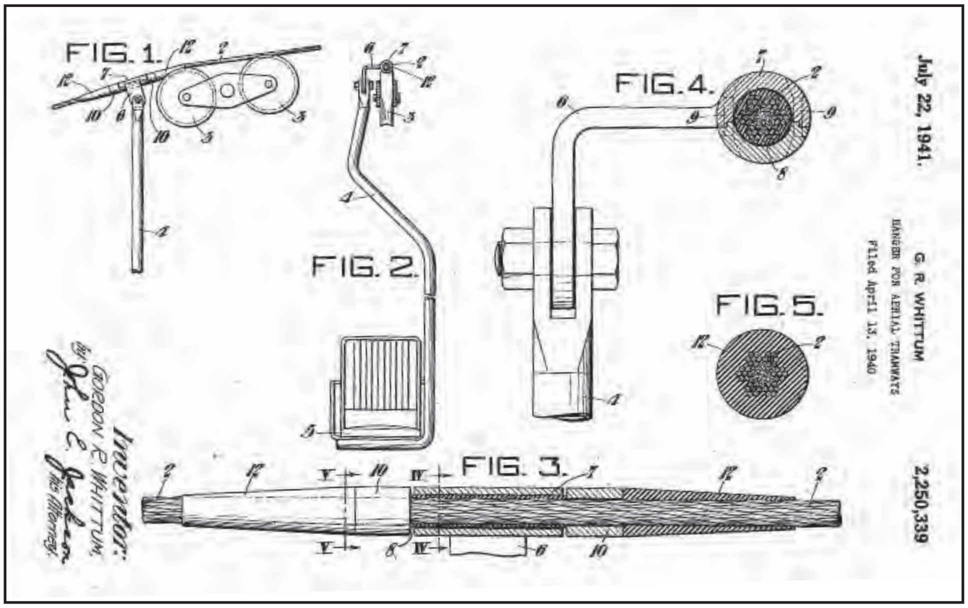

Figure 21. Gordon R. Whittum's Patent for an Improvement in Aerial Tramway Hangers.
Filed 1940, Patented Granted 1941.

The patent was a successful technical solution and was referenced by nine subsequent patents from 1956 to 1995, indicating that it remained influential for nearly a half century.[36]

By early 1941, U.S. Steel's operating divisions, including American Steel and Wire, were beginning, in concert with the federal government, to press the corporation's manufacturing might into wartime service as military conflict raged in Europe and was spreading to other parts of the globe. From January to June 1941, Whittum attended classes in engineering defense training offered by Yale University. These classes, authorized by the U.S. Office of Education and tuition free, were intended to prepare professionals for defense activities, especially in engineering where a shortage of qualified individuals was anticipated. Specifically, Whittum took a class in "advanced machine design," which, in his case, likely meant training specifically geared toward military applications of steel wire. Later in the war, he would also take a class in industrial electronics.[37]

[36] Gordon R. Whittum, "Hanger for Aerial Tramways," U.S. Patent Number 2,250,339, filed April 30, 1940 and issued July 22, 1942.

[37] Whittum Family Papers, "Engineering Defense Training," 1941 and "Engineering, Science, and Management War Training Program," 1945; Jeanne Willis, personal communication.

Figure 22. Testimonial Dinner for Gordon and Kay Whittum upon Leaving the American Steel and Wire Company's Trenton Works. 1947. Whittum and his wife Kay are seated in the background between the two windows (Whittum Family Papers).

On August 30, 1941, Kay Whittum gave birth to a son, Allan, and less than a year later in July, 1942 the family moved to Morrisville, Pennsylvania, across the Delaware River from Trenton, New Jersey, where Whittum had been transferred as an assistant master mechanic at American Steel and Wire's Trenton Works. In October 1943, he was promoted to master mechanic, a somewhat anachronistic job title that essentially designated a senior mechanical engineer at the works and a higher level of managerial and operational responsibility. In addition to manufacturing wire and cable, a critical wartime material, Whittum was also engaged with the development of aircraft carrier arresting gear, which used cables stretched across the decks to capture planes upon landing. It seems likely that the U.S. government considered Whittum's engineering skills so specialized and critical that military service was not an alternative. In 1944, the Whittums welcomed their second child, a daughter, Jeanne.[38]

In May 1947, with the war over, Whittum was transferred to American Steel and Wire's Worcester Works. The move was bittersweet, as it meant leaving Trenton and many good friends and colleagues, who provided the Whittums with a departing "testimonial dinner" (Figure 22), but it also meant returning to extended family, including an aging father, in Worcester. The Whittum family took up residence in Auburn, a suburb of Worcester. Although Whittum retained the title of master mechanic, the move was also a promotion since the Worcester Works had about twice the capacity of the Trenton Works, and was widely considered a flagship of U.S. Steel's American Steel and Wire Division. Over the next several years, Whittum advanced rapidly up the managerial chart with a promotion to Division Superintendent of Engineering and Maintenance in February 1949 and to Works Engineer in June 1950 (Figure 23).[39]

Figure 23. Gordon R. Whittum. Circa 1950, about the time of Whittum's promotion to Works Engineer at American Steel and Wire's Worcester Works (Whittum Family Papers).

[38] Jeanne Willis, personal communication.

[39] Whittum Family Papers, Whittum Scrapbook, "City Men Promoted," American Steel and Wire Company, "Announcement Gordon R. Whittum Is Appointed General Master Mechanic," February 1, 1949, and "Gordon R. Whittum, Works Engineer," June 9, 1950.

In November 1953, Whittum applied for two patents related to the improvement of high-speed wire processing operations (Figures 24 and 25). The first of the patents was for a coiling apparatus that employed electrically operated brakes, as opposed to the older method of using mechanical dead blocks. The second patent, with Roger H. Bryant as co-patentee, was for a traverse mechanism for improving the winding of wire and other materials evenly on spools making use of a photoelectric scanning head. Both patents were assigned to U.S. Steel.[40]

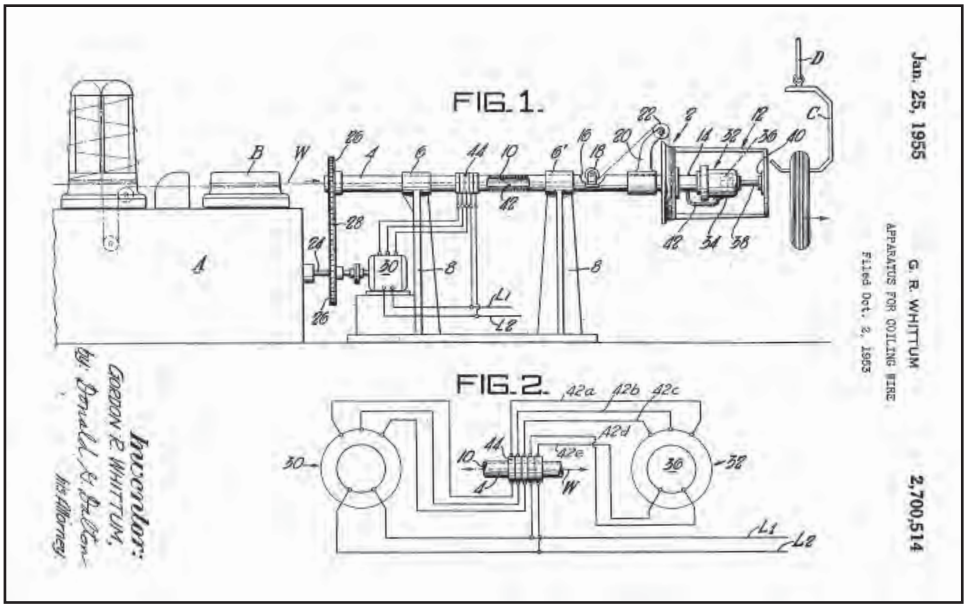

Figure 24. Gordon R. Whittum, Patent for an Improvement in an Apparatus for Coiling Wire. Filed 1953, Patent Granted 1955.

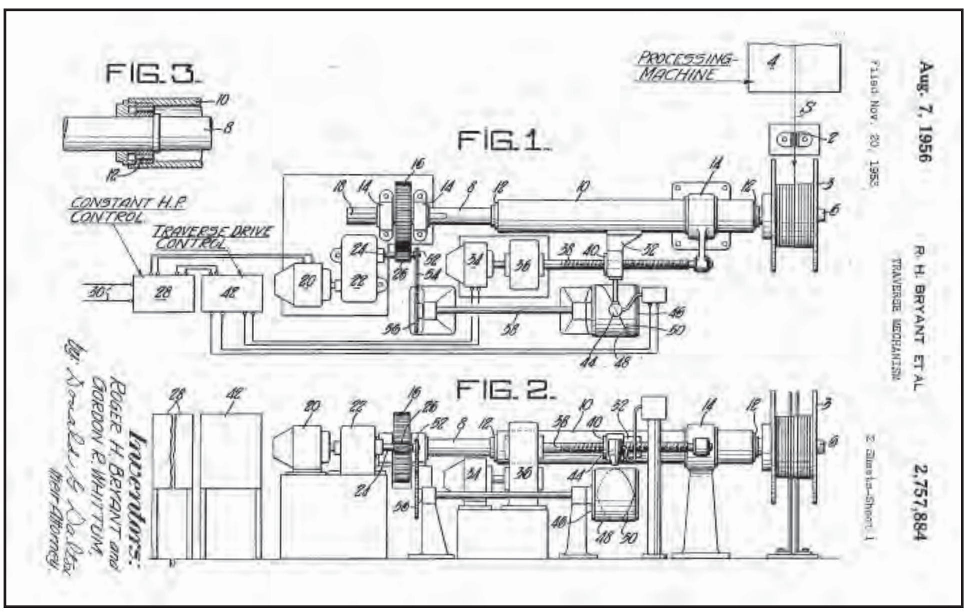

Figure 25. R. H. Bryant and Gordon R. Whittum, Patent for an Improvement in the Traverse Mechanism for Spooling Wire and Other Materials. Filed 1953, Patent Granted 1956.

[40] Gordon R. Whittum, "Apparatus for Coiling Wire," U.S. Patent No. 2,700,514, filed Oct. 2, 1953, issued Jan. 25, 1955; Roger H. Bryant and Gordon R. Whittum, "Traverse Mechanism," U.S. Patent No. 2,757,884, filed Nov. 20, 1953, issued Aug. 7, 1956.

U.S. Steel promoted Whittum to Division Superintendent of Engineering and Maintenance in charge of all engineering activities related to production at the Worcester Works in January 1957. At about the same time, Whittum enrolled in evening classes in Worcester Polytechnic Institute's School of Industrial Management, honing his managerial skills and graduating with a certificate of completion in 1961. The 1960s were a tumultuous period at U.S. Steel and in the steel industry in general, which in the wake of its peak production years began to restructure and consolidate operations in an attempt to increase efficiency and remain competitive, especially against foreign imports. The final decade of Whittum's career reflected these organizational changes; as the Worcester Works downsized and shut down outdated equipment, he was shuffled through a series of job titles including Chief Engineer in 1963 and Department Manager of Engineering and Maintenance in 1968.[41]

The final stage in Whittum's career was to oversee the closing and liquidation of the Worcester Works. In 1970, U.S. Steel began phasing out the wire-drawing plant and Whittum was transferred to the local office of U.S. Steel's Realty Development Division, which was charged with finding new owners or tenants for vacant property. In November 1971, Whittum, age 61, retired from U.S. Steel after 34 years of service. U.S. Steel completed a shutdown of all operations in Worcester in 1978.[42]

Figure 26. Gordon R. Whittum and Restored Model A Ford. Circa 1980 (Whittum Family Papers).

In 1972, Gordon and Kay Whittum retired to Eastham, Massachusetts on Cape Cod where Gordon immersed himself in local activities, including becoming a member of the U.S. Coast Guard Auxiliary and a member of the town's bikeway committee that developed the Cape Cod Rail Trail. Tragedy struck the family in 1976, when the Whittum's only son, Allan, age 34, was killed in a bicycle accident in Montana while biking across the country to celebrate the Bicentennial. Whittum pursued many retirement activities, including restoring a Ford 1930 Model A (Figure 26) and exploring Cape Cod's waters with a 17-foot outboard runabout. In 1983, he attended his 50th college reunion at WPI. Whittum passed away on July 28, 1986, age 76, following a long illness. He was survived by his wife Kay Whittum and daughter Jeanne W. Willis of Auburn, Massachusetts.[43]

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[41] Whittum Family Papers, American Steel and Wire Division, United States Steel, "Announcement, Gordon R. Whittum, Division Superintendent," Jan. 1, 1957; "Worcester Men Are Promoted by AS&W," *circa* 1957; "Certificate, WPI School of Industrial Management," 1961; Jeanne Willis, personal communication.

[42] Whittum Family Papers, Whittum Scrapbook, "Local Realty Head Named by US Steel," *circa* 1970.

[43] Whittum Family Papers, Whittum Scrapbook; Jeanne Willis, personal communication; Montana Department of Public Health and Human Services, Office of Vital Statistics, *Montana Death Index, 1868-2011* (Helena, Montana: 2011), online www.ancestry.com [accessed January 2014].

Conclusion

Gordon Whittum's career followed an arc that began with an upbringing in a blue-collar family, followed by a record of accomplishment in college and then several years of finding his way through a formative professional experience with the New Hampshire State Highway Department. Eventually he settled into a stable job at a major American corporation, and then, over time, was promoted through the ranks of that corporation to positions of greater responsibility. While a better part of Whittum's career was spent managing industrial operations of U.S. Steel's American Steel and Wire Division, he also demonstrated talent in bridge, tramway and machine design, with much of that work occurring early in his career and in New Hampshire. He designed one of the state's most important bridges of the 1930s, the Winchester-Swanzey Bridge. He was among a small team of engineers who built the Cannon Mountain Aerial Tramway, America's first aerial passenger tramway and a milestone in the development of tourism and the ski industry in the White Mountains.

Acknowledgments

This monograph was researched and written from October 2013 to January 2014 to mitigate the replacement of the Winchester-Swanzey Bridge (State Bridge No. 152/181), which was determined eligible for the National Register of Historic Places. Replacement is currently scheduled to take place in 2014. The documentation fulfills a stipulation of a Memorandum of Agreement among the Federal Highway Administration, the New Hampshire Department of Transportation (NHDOT) and the New Hampshire State Historic Preservation Officer.[44]

This monograph would not have been possible without the support of the staff of NHDOT. Jill Edelmann, Cultural Resources Manager, provided administrative support and coordination. Lynn Paquette and the staff of the Bureau of Bridges provided access to bridge plans, photographs and inspection reports, and scanned drawings that had not yet been digitized.

Staff of the New Hampshire Division of Historical Resources was welcoming and provided access to their files. Of particular usefulness were New Hampshire Historic Property Documentation forms for bridges designed by the New Hampshire State Highway Department from the 1920s to 1950s. These provided an important context for evaluating Whittum's designs.

A special thanks is owed to Jeanne Willis, Whittum's daughter, who graciously participated in an interview. She gave researchers access to family papers, particularly three of her father's scrapbook binders that included detailed information about his education and work history.

A number of repositories were consulted for archival information regarding the education and professional career of Gordon Whittum. Valuable assistance was provided by the staffs of the Baker Library at Harvard Business School, the George C. Gordon Library at Worcester Polytechnic Institute, the New Hampshire Historical Society Library, the New Hampshire State Library, the Worcester Historical Museum, and the Worcester Polytechnic Institute's Archives and Special Collections Department.

[44] FHWA *et al.*, Memorandum of Agreement, Winchester-Swanzey, DPR-BRF-X-0111(0005), 12906, 2012, on file, NHDOT.

With regard to Hunter Research, Inc. staff involvement, the project was conducted under the overall direction of Patrick Harshbarger. Research assistance was provided by Alison Haley. Graphic design work and report layout were completed by Elizabeth Cottrell under the direction of James Lee. This report was written by Patrick Harshbarger with editorial assistance from Richard Hunter.

Opportunities for Further Research

Research for this monograph yielded some unanticipated results. At the outset, Gordon Whittum had been identified as an engineer of historical interest due to his involvement with the Winchester-Swanzey Bridge (State Bridge No. 152/181), and to a lesser extent with the two Peterborough rigid-frame bridges (State Bridge Nos. 057/108 and 087/087). The sophistication of these bridges suggested that Whittum was an individually significant bridge designer who might be associated with other important bridges either in New Hampshire or other states. Contrary to this supposition, no other important bridges were identified and Whittum's career as a bridge engineer was remarkably short, lasting barely three years.

In historical perspective, as it turned out, Whittum was more accurately a junior bridge engineer who was provided opportunities by the New Hampshire State Highway Department's Bridge Division to undertake a challenging project, but mostly completed the type of work that would be expected of a recent hire. While the Winchester-Swanzey Bridge was a significant New Hampshire engineering achievement in which Whittum played a critical role as the principal designer, there was remarkably little in Whittum's biography to support the idea that he was a driving force behind the design. Rather, the Winchester-Swanzey Bridge fits far more comfortably within the Bridge Division's body of work and the evolution of the continuous steel girder technology as it was being developed under the leadership of Assistant State Bridge Engineer Harold E. Langley and the other engineers within the division.

The major finding of this research is that Langley's role in setting the direction of the state's bridge program and in the development of new bridge designs during the 1920s to 1940s is currently not as well understood as it could be. It seems quite likely that Langley was consciously hiring junior engineers of a high caliber in whom he could entrust advanced bridge designs because they had the necessary educational backgrounds and analytical and organizational skills. Possibly, they also did not have prior experience that would inhibit their ability to absorb new ideas. Whittum, for instance, fits the mold of other SHD bridge engineers hired during the late 1920s to 1930s including Robert J. Prowse, Clifford Broker and Henry Newell. Some of these men, like Prowse, built long-term and influential careers with the SHD, while others like Broker and Whittum did not. Much about how the men of the Bridge Division worked together, however, is mere speculation without some greater in-depth understanding of Langley. The lack of a good biography of Langley is currently a significant limitation on the ability to place these other engineers and their bridges in a statewide context. Langley should be given high consideration as the focus of the next monograph in this series on New Hampshire highway bridge engineers.

A highlight of the research on Gordon Whittum was his association with the Cannon Mountain Aerial Tramway. While a couple of good histories placed the tramway within a state and local context, there wasn't much found that placed the tramway into a larger national or engineering context, particularly with regard to the key players who worked to transfer the technology from Europe and the role of American Steel and Wire Company in developing this and other tramway projects. A repository that was not consulted due to time and budget constraints, as well as restrictions on use, was the private U.S. Steel corporate archives. The Cannon Mountain Aerial Tramway is a topic that would benefit from further research.

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[These papers are the most extensive source on Whittum's educational background and professional career development. It also includes a large number of photographs, particularly of Whittum's work on New Hampshire highway bridges and the Cannon Mountain Aerial Tramway during the 1930s. Most of the newspaper clippings are not identified as to the publisher or exact date of publication.]

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