Pathways to the Past

Transportation, Heritage, and the Twenty-First Century

Edited by
David A. Poirier
Bruce Clouette

Connecticut Department of Transportation • Connecticut Commission on Culture and Tourism

Pathways to the Past:

Transportation, Heritage, and the Twenty-First Century

Edited by

David A. Poirier
Bruce Clouette

The Connecticut Department of Transportation

and

The Connecticut Commission on Culture and Tourism

in cooperation with

The Federal Highway Administration

2007

CONTRIBUTORS

Carl Bard (retired), **Will Britnell,** and **Simone Cristofori** are engineers with the Connecticut Department of Transportation.

Bruce Clouette is the staff historian for Public Archaeological Survey Team, Inc.

Mary Guillette Harper is the director of Public Archaeological Survey Team, Inc.

Jim Klein is a landscape architect with Lardner/Klein Landscape Architects, P.C.

J. Howard Pfrommer is an engineer with Nathan L. Jacobson & Associates, Inc., and **Michael S. Raber** is an archaeologist with Raber Associates.

David A. Poirier is staff archaeologist with the Connecticut Commission on Culture and Tourism's State Historic Preservation Office.

Pamela Rackliffe is retired from the Connecticut Department of Transportation, where she worked as a Transportation Planner.

Cece Saunders is an archaeologist with Historical Perspectives, Inc., and **Robert Moore** is a photographer with the Connecticut Department of Transportation.

Robert Stewart is director of Historical Technologies, which specializes in industrial archaeology.

R. Kenneth Wassell is the Town Engineer for the Town of Canton.

Unless otherwise indicated, photographs are by Public Archaeology Survey Team, Inc.

CONTENTS

Caring for Connecticut's Historic Resources: A State Partnership

DAVID A. POIRIER AND PAMELA RACKLIFFE

The Connecticut Department of Transportation, in partnership with the Federal Highway Administration, is responsible for the design, construction, and maintenance of Connecticut's transportation system. Providing safe and efficient interstate highways and local roads that meet 21st-century demands is a complex and difficult task: planning transportation improvements requires professional consideration of diverse environmental, scenic, aesthetic, historic, archaeological, and community-based resources. In particular, the National Historic Preservation Act mandates that the Connecticut Department of Transportation consider important historic, architectural, and archaeological properties in the course of its planning and development processes.

The Connecticut State Historic Preservation Office is responsible for the identification, evaluation, and protection of Connecticut's heritage resources. The State Historic Preservation Office, in partnership with local communities, has undertaken numerous town-based inventories of historic and architectural properties in order to precisely identify those buildings, structures, districts, landscapes and other features that define Connecticut's communities. Working with the offices of the State Historian and the State Archaeologist at the University of Connecticut, the State Historic Preservation Office strives to preserve Connecticut's unique historical and archaeological resources. The listing of historic buildings and archaeological sites on the National Register of Historic Places and the designation of sites as State Archaeological Preserves are two of the tools employed by the agency for protecting the state's significant heritage properties.

The Connecticut Department of Transportation and the Connecticut State Historic Preservation Office regularly consult with each other regarding the professional identification and consideration of Connecticut's historic, architectural and archaeological resources vis-à-vis the state's highway planning process. Despite clearly different missions and goals, the Connecticut Department of

Transportation and the State Historic Preservation Office have developed a positive working partnership that strives to balance the preservation of significant historic resources and the effective furtherance of transportation-related improvements. Understandably, conflicts will occur. Historic preservationists often view transportation initiatives as irrevocably diminishing the character and ambiance of Connecticut's communities. Conversely, highway advocates and transportation engineers sometimes view historic preservationists as inflexible naysayers and obstructionists.

The Connecticut Department of Transportation and the State Historic Preservation Office concur that the fundamental challenge is to develop creative solutions and seek reasonable compromises. Connecticut's highway system must keep pace with 21st-century traffic volumes and safety requirements, and, to the extent feasible, preserve the state's centuries-old architectural and archaeological resources. Indeed, heritage tourism requires delicately balancing these different objectives.

Pathways to the Past highlights specific transportation projects that illustrate unusual creativity and a willingness to explore novel approaches. In addition, *Pathways to the Past* demonstrates various alternatives which are achievable through interagency dialogue and cooperation. These case studies represent thought-provoking examples that can guide town officials, neighborhood groups, and concerned citizens in their efforts to improve local transportation needs while maintaining the historic character and quality of life of their respective communities.

Pathways to the Past has been organized into Preserving the Past, Learning from the Past, and Documenting the Past. In general, these sections reflect differing approaches and possibilities which range from modifying the concept and design of a proposed transportation project, to minor redesign to accommodate the character and aesthetics of the community, to professional documentation as an alternative to conserving particular historic resources.

Preserving the Past

The replacement of the Town of Durham's Mill Bridge offers a case study of creative thinking and flexibility by the Connecticut Department of Transportation, the State Historic Preservation Office, and town officials to resolve the unanticipated discovery of an important historic resource. Structural condition and safety requirements required demolition of a l920s concrete bridge on Route 17 with a modern wider structure. However, the bridge replacement project proved less than straightforward and required an out-of-the-ordinary solution. As the construction company was attempting to install sheet piling, an impediment was encountered. The Connecticut Department of Transportation was immediately informed and subsequently requested technical assistance from its cultural-resource-management consultant, Public Archaeology Survey Team, Inc. On-site investigation and historic research revealed that a 19^{th}-century stone arch survived beneath the current concrete bridge. The Connecticut Department of Transportation consulted with town officials, the Federal Highway Administration, and the State Historic Preservation Office in order to develop appropriate measures for documenting the earlier bridge prior to its proposed removal. The State Historic Preservation Office and concerned community residents viewed the 19^{th}-century bridge as a significant archaeological resource and strongly advocated consideration of alternate design concepts that would retain the stone arch. As a result, the Connecticut Department of Transportation designed and implemented an innovative strategy that preserved the earlier bridge as an integral component of the replacement structure. In addition, the Connecticut Department of Transportation developed an adjacent walkway and platform where the original stone arch can be safely viewed up-close.

Connecticut has been blessed with a long history, varied topography, and many visually arresting water views. Beautiful and picturesque roads abound throughout the state. Preservation of state-designated scenic highways and vistas has been recognized by the Connecticut Department of Transportation and the State Historic Preservation Office as being an important priority. Through the assistance and support of the Federal Highway Administration, the Connecticut Department of Transportation contracted with Lardner-Klein, a landscape architectural firm, in order to establish corridor management plans for protecting Connecticut's scenic roads. The foremost objective was to preserve important natural and cultural landscapes that retain a strong sense of time and place. Since economic development is frequently inevitable, a collaborative approach among property owners, road-users, and pertinent state and federal agencies to best manage growth is in everyone's interest. Creation of the scenic road master plans required consultation and cooperation among local governments, local shareholders, conservation and preservation groups, and recreational organizations. The overall purpose of these plans is to balance more effectively safety and beauty. Jim Klein's essay provides several specific examples of how this process works.

Context sensitive design, a relatively new approach to highway planning, emphasizes flexibility and creative approaches in the application of roadway-design guidelines by state transportation departments. Quality of life and preservation of community are to be embraced in the planning process. People care about farmland, open space, greenways, and alternative transportation. Context sensitive design promotes historic, scenic and aesthetic considerations without compromising safety and capacity. In addition, context sensitive design includes outreach to all interested shareholders and encourages transportation initiatives that are in harmony with community character and expectations. Connecticut was chosen as one of five pilot states to implement and institutionalize these new design principles. The Connecticut Department of Transportation has conducted educational workshops and public meetings to promote and illustrate the potential benefits of context sensitive design. In the third essay in this section, Connecticut Department of Transportation officials further describe this design concept and its application within Connecticut.

Federal legislation and regulations support the relocation and adaptive use of historic truss bridges that are eligible for the National Register of Historic Places as an integral component of the highway planning process. However, poor structural condition, incompatible dimensions, and lack of readily available off-site locations frequently pose substantial obstacles to the adaptive use of historic bridges. Nonetheless, Connecticut has witnessed the successful preservation of several important truss bridges through their relocation and subsequent reuse.

As R. Kenneth Wassall explains in his essay, creative vision and the community need for pedestrian-oriented structures combined within the Town of Canton to facilitate the adaptive use of two historic truss bridges, one for continued highway use and one for a town-park hiking trail. Pursuant to federal regulations, the Connecticut Department of Transportation and the Federal Highway Administration developed a marketing plan for several truss bridges that were scheduled for demolition and replacement. The Town of Canton responded positively and, through subsequent consultation and negotiation with, and assistance from, the Connecticut Department of Transportation, rehabilitated two early 20th-century pony-truss bridges that otherwise would have vanished from the Connecticut landscape.

Learning from the Past

The Town of Coventry's Depot Road bridge project, recounted here by J. Howard Pfrommer and Michael S. Raber, illustrates the possibilities for replacing an obsolete bridge with a sensitive new design. The existing stone-arch bridge on Depot Road was 160 years old and carried a town road over the Mill River. The Depot Road crossing is located in a rural area of Coventry that is distinguished by its unspoiled charm. The original bridge was of straightforward vernacular masonry arch construction. Unfortunately, the bridge had reached the end of its useful life and needed to be replaced by a new structure that would be consistent with current transportation safety requirements. The Depot Road stone-arch bridge possessed historic and engineering merit and was eligible for listing on the National Register of Historic Places.

The Connecticut Department of Transportation and the State Historic Preservation Office concurred that the loss of the historic bridge could be appropriately mitigated through documentation of the structure before it was demolished and development of a community-sensitive design for the new bridge. The revised design mandate was to retain the appearance of the historic stone-arch bridge and preserve community character, while maintaining the Connecticut Department of Transportation's responsibility to meet 2lst-century safety standards and minimize long-term maintenance. The replacement structure was constructed using a stone masonry form liner, which was subsequently tinted through the application of an on-site staining process in order to simulate an exterior stone appearance. In addition, a timber and weathered-steel guide rail was selected. Less conspicuous than standard guide rail, this choice further enhances the visual character of the Depot Road crossing. The Depot Road bridge replacement project was completed on time and under budget and successfully demonstrates the compatibility of new bridge design with neighborhood sensibilities.

Connecticut's landscape reflects its diverse and complex cultural history. Native Americans have explored, adapted, and survived within the state's boundaries for 12,000 years. Likewise, Connecticut has witnessed nearly 400 years of Euro-American settlement, expansion, and technological development. Buried within the state's soils and beneath its waters, archaeological sites provide important insights for understanding the ever-changing and evolving transformations of Connecticut's lands and its peoples. Archaeological resources are fragile and irreplaceable sources of significant information about our cultural past that the State Historic Preservation Office attempts to protect through listing on the National Register of Historic Places and designation as State Archaeological Preserves.

Early coordination between the Connecticut Department of Transportation and the State Historic Preservation Office ensures the identification, evaluation, and professional consideration of Connecticut's archaeological heritage as part of the highway planning process. All proposed transportation improvements are reviewed for prehistoric, historic, and/or industrial archaeological sensitivity by the State Historic Preservation Office. Technical guidance is provided to the Connecticut Department of Transportation which undertakes appropriate project-specific historical research and archaeological investigations. The Office of the State Archaeologist at the University of Connecticut and Connecticut’s two federally recognized Native American tribes, the Mashantucket Pequot Tribal Nation and the Mohegan Tribe, are critical consulting partners regarding the state's archaeological heritage.

The State Historic Preservation Office and the Connecticut Department of Transportation advocate the in-situ conservation of archaeological resources as the preferred preservation approach. However, project redesign and the avoidance of important archaeological sites are sometimes not feasible due to transportation safety requirements, design constraints, or other significant environmental factors. In such circumstances, the professional archaeological investigation and documentation of archaeological resources represents an appropriate mitigative measure.

Recent transportation improvements have required intensive archaeological studies as a prelude to road construction. Subsurface archaeological studies undertaken for highway projects in the towns of Andover, North Branford, and Waterford discovered three heretofore-unknown house foundations and associated remains that date back to the early 18th century; the analysis of archaeological data from the house sites has significantly enhanced our understanding of the lifeways of rural families in early New England. Similarly, a collection of 6,000-year-old Native American sites found during a wetland mitigation project in Canterbury highlights the early human occupation of Connecticut. Mary Guillette Harper of Public Archaeology Survey Team, Inc. explains in her essay how these sites constitute an unseen treasure trove for understanding the state's past.

Documenting the Past

Despite extensive consultation, regulatory flexibility, and the examination of alternate design concepts, the demolition or destruction of significant historic, architectural or archaeological resources may be an unavoidable consequence of transportation improvements. In this regard, the State Historic Preservation Office, in partnership with the Thomas G. Dodd Research Center at the University of Connecticut, established and maintains on an ongoing basis the Connecticut Historic Preservation Collection. An integral component of this unique collection is the long-term conservation and public accessibility of narrative text and photographic documentation undertaken to professionally document historic properties threatened by federal or state-assisted projects. Artifacts, field notes, photographs, and other data obtained from archaeological investigations sponsored by the Connecticut Department of Transportation are curated by the Office of the State Archaeologist at the University of Connecticut pursuant to Connecticut General Statutes Section 10-383.

The documentation of soon-to-be-demolished historic resources offers the final opportunity to record important information for future researchers and the interested public. The finality of the documentation process necessitates a high degree of professional responsibility and difficult decision-making. In order to improve and guide these important last-chance documentation efforts, Cece Saunders of Historical Perspectives, Inc. and Robert Moore of the Connecticut Department of Transportation have developed a comprehensive research approach and technical guidelines for properly documenting Connecticut's historic sites, architectural resources, and industrial complexes. Although interpreted with some flexibility, these guidelines are the professional standards advocated by the State Historic Preservation Office for federal and state-assisted projects. For most projects, the State Historic Preservation Office's documentation standards are more appropriate than the documentation requirements of the National Park Service's Historic American Buildings Survey and the Historic American Engineering Record.

Occasionally the national importance of an historic property will warrant its pre-demolition documentation to the professional standards of the National Park Service. Greenwich's Cos Cob Power Plant, the New Haven Railroad's primary electrical-generating facility for its New York to New Haven route, was an important and technologically innovative landmark in electrical engineering. Historical documentation, which consists of narrative text, original construction drawings, black-and-white photographs, field notes, and transcriptions of interviews with individuals who worked at this important facility, has preserved critical aspects of this industrial-heritage resource. Scholars, researchers, and the public can access, review and use this documentation, which has been deposited with the Library of Congress by the National Park Service. Although the Cos Cob Power Plant has been demolished, a comprehensive archival record exists for the future.

Documentation of the Connecticut State Pier in New London represents another example of a case study for which the National Park Service standards were applicable. The State Pier, at one time an important state-of-the-art cargo-loading facility, reflects the City of New London's extensive maritime heritage. However, 21^{st}-century requirements necessitated the significant upgrading of its basic structure and the removal of its warehouses. Documentation by Public Archaeology Survey Team, Inc., consisting of narrative text and pertinent photographs, provided a comprehensive chronology of the pier's historical development, changing uses, and technological improvements. The documentation is now part of the Historic American Engineering Record collection at the Library of Congress.

⌘ ⌘ ⌘

Despite different missions, the Connecticut Department of Transportation and the State Historic Preservation Office strive to balance the often-conflicting objectives of transportation planning and historic preservation. Innovative and / or unusual solutions can frequently be found that avoid or minimize potential project-related impacts upon the state's cultural heritage. The case studies presented in this volume will facilitate meaningful community participation, flexible decision-making, and creative thinking for future transportation projects.

Preserving
The Past

Dealing with Surprises: The Case of Durham's Mill Bridge

BRUCE CLOUETTE

Flexibility is one of the greatest virtues in cultural resource management. The past can never be perfectly known and therefore it continues to surprise us in ways that are often amazing and delightful, but also potentially disruptive to ongoing construction projects. Only by maintaining a high degree of flexibility with regard to schedule and design can an agency be ready to deal successfully with the unexpected. The decisions of the Connecticut Department of Transportation regarding the replacement of the Route 17 bridge in the Town of Durham provide a case study of flexibility in action. As a result, a heritage resource of great interest was recovered and incorporated into a modern, functional bridge that will serve the town and region for many years to come.

The bridge-replacement project was intended to address the deficiencies of the deteriorated concrete bridge, constructed during the 1920s, that carried Route 17 over Allyn's Brook (also known as Mill Brook), just south of the village center of Durham. The existing bridge was relatively narrow and was located in a valley between two steep hills. The plan was to replace the bridge with a wider concrete bridge that would raise the roadway to a higher level, thereby ameliorating the grade of the existing approaches. Final plans were prepared, the contract was bid, and work began in the summer of 1994.

The contractor was installing sheet piling for temporary traffic lanes when the first indication occurred that something was amiss. Instead of simply penetrating the fill which was anticipated to exist under the roadway, the sheet piling kept hitting something hard. A backhoe operator began removing earth in order to expose the obstruction, and it soon became apparent that a brownstone masonry wall lay not far beneath the surface of the road. Exploratory trenches revealed that the stonework extended quite far into the ground as well as running horizontally parallel to the bridge. At this point, the Department of Transportation suspended work and consulted with the State Historic Preservation Office, with Public Archaeology Survey Team, Inc.,

Exploratory excavation for the new bridge exposed sections of brownstone masonry just below the surface.

its on-call archaeological consultants, and with Town of Durham officials.

What the contractor had inadvertently discovered was an intact stone-arch bridge dating from 1823. Subsequent research by local historical society members yielded postcards and other images from around 1900 which showed the newly uncovered bridge to be a large semicircular arch, spanning 30 feet, with cut ring stones and an iron railing along the roadway. Nothing in the Department's inspection reports or bridge maintenance files hinted that a buried structure might exist underneath the 1920s bridge, though a later check of old construction drawings revealed what had been done. Instead of removing the old bridge, the Department (then known as the Connecticut Highway Department) inserted a large concrete box culvert through the arch, extending many feet both up and downstream beyond the old bridge, and then deposited loads of fill on top that completely obscured the stone-arch bridge. The result was a wider and somewhat higher crossing with only a small loss of hydraulic cross-section compared with the earlier arch bridge. It was a good, low-cost solution that met the transportation needs of the road, which at the time was the major link between New Haven and Middletown.

As fill was removed, more of the original stone arch came into view.

A concrete box culvert, here shown being removed, was inserted into the stone arch in the 1920s.

The Connecticut State Historic Preservation Office recommended that the Department of Transportation consider the buried stone-arch bridge as a significant industrial archaeological resource and to professionally document its appearance as it was unearthed during the course of construction. In addition, local officials urged the Department to re-evaluate its original concept for the project and to explore the possibility of preserving the arch. After technical re-evaluation of its construction plans, the Department agreed to retain and adaptively use the historic stone-arch structure. Although construction was delayed for a year, the final result was a new bridge that incorporated the old stone arch and allowed it to see the light of day for the first time in seven decades. The revised design was a new concrete-beam structure that spanned the site at a level substantially higher that its predecessor, thereby allowing what remained of the old stone-arch bridge to be visible underneath. The 1920s concrete culvert was removed, the stonework repaired as needed, and a walkway built from the roadway so that pedestrians could safely walk to a viewing platform and inspect the old bridge close up. The new bridge is much wider than the arch, making it difficult to see the stone arch when driving in a car, but this circumstance has the effect of sheltering the historic masonry from the elements and thereby promoting its long-term survival. The new bridge also recalls its predecessor with its metal-lattice pedestrian railings that were modeled on the pattern of those added in the 1890s, when the stone arch was spruced up as part of the village's streetscape improvement efforts.

A walkway on the west side, here shown nearing completion, allows pedestrians to get up close to the old stonework.

As an additional public-education enhancement, the department arranged for a bronze interpretive marker to be installed along the pedestrian walkway which explained the bridge's history and significance. In addition to an artist's sketch of what the bridge looked like around 1900, the marker recounts the history of the bridge using both ordinary letters and Braille.

Although a traditional bridge-building technique, stone arch construction was not commonly used in the early 1800s because it was very expensive in comparison to wooden bridges. Stone arches tended to be reserved for extraordinary circumstances where important roads were threatened by frequent washouts. Durham was just such a situation. Like most fast-moving New England streams, Allyn's Brook was extensively dammed to power small industrial enterprises; immediately upstream of Mill Bridge was the dam for a tannery. Not only was Route 17, then known as the Middletown, Durham, and New Haven Turnpike, an important road for those particular communities, but stagecoaches making their way between Boston and New York also used the road as part of their regular route.

On February 21, 1822, a disaster occurred. Heavy rains and an early thaw created both ice floes and rising water in Allyn's Brook, weakening the wooden bridge that then crossed the stream. Around noon, a stage from Hartford approached the bridge and, despite protests from the passengers, tried to make it across. The first two horses were successful, but then the bridge gave way and the remaining horses and the coach itself plunged into the icy waters. Two people from Boston drowned, John Palmer and Isaac Prentiss, and several soaked bags of mail had to be pulled from the brook.

Thus, the townspeople of Durham had good reason to seek a more robust structure for the bridge's replacement. After considering another timber structure, which typically could be expected to last no more than 25 years, the town meeting voted on June 4, 1822 to replace the Allyn's Brook bridge with a stone structure. They hired Silas Brainerd, a stonemason from nearby East Haddam, to build the bridge using the abundant brown sandstone found throughout the greater Middletown area. (Since his sons operated the E. & S. Brainerd brownstone quarry in Portland, Connecticut, at the time, it may well be that they provided the material for the bridge). In addition to an active business building fireplaces, foundation walls, and chimneys, Silas Brainerd was a prolific gravestone-carver and is today regarded as a master of that distinctive New England folk art. The bridge cost $1,000 to complete, a sizeable sum in those days, but it proved to be a good investment, surviving the many floods that occurred throughout the rest of the 19th century. From the number of postcards, paintings, and other images that survive, it seems that the bridge's arched form and fine stonework made it something of a scenic vista as well. Thanks to creative thinking and design flexibility within the Department of Transportation's bridge-replacement program, the historic and aesthetic qualities of Durham's old stone-arch bridge will be enjoyed by generations of Connecticut residents in the years ahead.

The old stone bridge was considered a scenic setting when this postcard was made, ca. 1910.

Preserving Connecticut's Scenic and Historic Roads

JIM KLEIN, ASLA

Connecticut is blessed with an exceptionally strong sense of time and place. Its bustling towns and quiet villages are linked by a web of roads, some of which began many years ago as trails and paths linking Indian settlements. Today, an increasing number of people are driving or cycling these roads because they seek a quieter route, a glimpse of the picturesque, a brief respite from the hectic pace of modern life. Whether local resident or visitor to the state, many drivers know the experience of the journey, whether a weekend getaway, or just running errands, can be a lot more than just getting from point A to point B.

Recognizing the importance of scenic roads to its residents and to a growing number of appreciative visitors, the Connecticut Department of Transportation launched an ambitious partnership in the Fall of 1994. With funding support from the Federal Highway Administration, the Connecticut Department of Transportation worked in collaboration with local governments, conservation, preservation, and recreation organizations, and many others to create management plans for some of the state's most scenic roads. This effort was known as the Scenic Roads Corridor Management Project.

A question posed to people early in the planning process for each corridor was, "What should this road be like two decades or so from now?" Inevitably, the passionate answer was, "We want to keep everything just the way it is now!" Moreover, each time, "we" learned how complicated it is to do this. Sometimes change happens dramatically, but most often, it comes incrementally, over time. Managing its impact means anticipating change and preparing for it.

Over the last few years, as a result of this four-year effort, the Connecticut Department of Transportation has learned it can use more sensitive methods for safety and maintenance-related improvements along scenic roads. People from each of the fourteen towns that participated in the corridor-planning effort now understand an array of more sensitive ways that towns, property owners and civic-enhancement groups can take better care of the lands and buildings beyond. This essay is intended to summarize some of the lessons learned as part of the planning process.

The Context for Connecticut's Scenic Roads

The Connecticut landscape is one of great diversity. There are very few places in the country where you can see such varied and distinctive landscapes all within a two-hour drive. Connecticut has mountainous and rolling uplands dropping down to broad agricultural plateaus, dissected by rocky, fast-moving streams. Connecticut has broad and fertile river valleys framed by distinctive landforms that have supported most of the urban population for its recent history. Connecticut has distinctive coastal plains separated by rocky outcrops and extensive salt marshes.

View of the Shepaug River from Route 67 in Roxbury (Lardner/Klein photograph).

Beyond exceptional natural landforms, the state is blessed with a similar range of diversity in the ways people have inhabited the land. As was the case along much of the eastern seaboard, people settled Connecticut in a series of episodes that adapted to conditions of the land and changes in technology. In much of its early history, Connecticut's economy was agrarian, and the landscape was covered with small farms and homesteads. These landscapes shifted as technology evolved and industrialization began.

Rural dwellers migrated to towns and cities, attracted by the new economic opportunities, and added to the growth of urbanized areas. In the 20th century, suburban development occurred as the automobile's influence on the landscape became dominant. Now, at the start of the 21st century, telecommunication advances are enabling urban dwellers to reverse the pattern and relocate to rural areas, attracted by the hope of a small town lifestyle. With all of these changes, it is not surprising that the visible links between Connecticut's people and its landscape have become harder and harder to find.

As a result of these episodic transformations, progressive Connecticut leaders have placed greater and greater emphasis on preserving the landscapes that retain a strong sense of time and place. Whether it is the rolling rural countryside dotted with tidy hamlets and farmsteads, or the distinctive character of mill villages and factory towns, preserving the pattern of Connecticut's towns and countryside remains a huge challenge.

Broadly speaking, there are two distinct regional landscape types in Connecticut. The first is the urban megalopolis. Much of Connecticut is influenced by the sprawling Boston-to-Washington Interstate 95 corridor and the connecting Interstate 91 corridor that travels up the Central Valley to Hartford and beyond. This megalopolis is embraced and separated by a second regional type that is rural. It is composed of distinctive upland areas to the east and west of the Central Valley.

There are scenic places in both of these landscape types. Within the urban regions, the scenic qualities are a result of tenacious efforts by citizens to preserve what is left of the visible links between the land and people. Here, the scenic qualities are a result of relative scarcity. In the more rural regions, the scenic qualities are a result of tenacious efforts at making a living from the land. Scenic qualities are a result of continuous stewardship and care.

In Connecticut, scenic qualities have several common themes resulting from the way that they are experienced. In the more settled and urbanized places, scenic qualities emerge when certain conditions exist:

- There is an obvious distinction between what is urban and what is rural and between what is natural and what is cultural. The edge of town is clearly visible. The natural systems are preserved.

- The periods of change are visible in a community. Once can see how the place was settled and how it adapted to major economic and technological forces.

- Modern forms, such as new roads, houses and commercial development, respect the original pattern of human settlement. They fit comfortably within the traditional patterns, framed by the relatively small scale of Connecticut's towns and transportation routes, and the presence of large areas of open space surrounding settled places. Even new roads lie lightly on the land.

In the more rural areas, scenic qualities emerge when a different set of conditions exist:

- There are extensive views of rolling farms and forest, ponds and wetlands unfolding to tell a story of centuries of stewardship, where there is much to look at and where it appears that nothing much has changed as far as the eye can see. These places are often painted and photographed.

- There are focal views framing objects of great natural beauty or historical interest. The framing elements might be steep landforms as seen in the narrow valleys perpendicular to the Housatonic River or man-made contributions such as a canopy of mature street trees framing the view of a church steeple or the town hall.

- Distinctive features can be found. Examples include objects of natural beauty such as streams, rock outcrops, a prominent landform, a specimen tree, or a unique plant community. Built examples include an historic house or public building, a town green, or an historical artifact such as an old iron furnace or mill.

- Seasonal changes are dramatically evident—a wooded hillside is aflame with fall colors, or a stream is jammed with ice in an early spring thaw.

Connecticut's Scenic Roads Are at Risk

Scenic roads provide a glimpse of all these places – many of which are at risk of losing their special character as incremental change inevitably happens. Scenic-road planning activities present the opportunity to focus a community's attention on finding ways to preserve the patterns of town and countryside. Keeping beloved roadsides and beautiful places "just the way they are today" requires more work than simply allowing growth to continue according to market forces. It also requires an understanding of the issues and a willingness to develop a collaborative approach among the owner and users of the road and the many "owners" of the view.

Preserving open fields adjacent to villages such as Roxbury's "Pickin' and Fiddlin' Field" is becoming more difficult (Lardner/Klein photograph).

Roadside lands are subject to constant change as market forces drive development. Occasionally, change happens dramatically, but more commonly small accretions over time — a row of trees here, a widened intersection there, a field that sprouts a subdivision, a poorly sited strip shopping development – result in an accumulated effect that can be startlingly different, especially when it happens to a road that is noteworthy for its scenic values.

To get ahead of change takes proactive planning, stepping back from the day-to-day and looking at those elements that make up the distinctive scenic character. Getting ahead of change means understanding the potential pressures for change, forming approaches to dealing with them, developing consensus among the range of stakeholders, and forming partnerships to take conscious care of special places.

With a well articulated plan in place, communities stand a greater chance of guiding change, of shaping the way modern needs are met along scenic roads. It won't stay "just the same," but there is a greater probability of the changes being gentler in their impact.

Lessons Learned: Emerging Strategies for Conserving Connecticut's Scenic and Historic Roads

The goal from the start of the scenic byway planning process was to develop workable approaches for managing change along scenic roads. The scenic roads in question traverse each of the distinct landscape types — along the coast of Long Island Sound, through the Litchfield Hills, along the Housatonic Valley, through picturesque mill villages, and across the rural countryside of northeastern Connecticut. These beautiful places are coping with strong development pressures. Road conditions are equally diverse and challenging, involving such potentially conflicting goals as safety versus beauty, accommodating pedestrians as well as vehicles, and balancing sensitive maintenance with fiscal realities.

The corridor plans were conducted by a multi-disciplined planning team led by landscape architects, with strong support from community planners, preservationists, and civil engineers who understood Connecticut's particular road design issues and practices. The team's approach was to foster collaboration, actively involving in the effort those organizations, road-users, major landowners, and Connecticut Department of Transportation officials whose motivation would be essential to long-term success.

Participants in the four-year, fourteen-town planning process raised a consistent set of issues. These recurrent concerns formed the basis for five lessons in developing strategies for the conservation and planning of scenic roads: preserve the beauty spots, gently guide land use, preserve and enhance village character, balance safety and beauty along scenic roads, calm the traffic in rural hamlets so as to regain community character, and improve pedestrian safety.

Lesson #1: Preserve the Beauty Spots

Whether the qualities of a scenic road are defined by scenic beauty, natural resources, historical features or cultural continuity, finding innovative ways to preserve the view from the road is perhaps the most difficult task that must be accomplished as part of any scenic-corridor planning and implementation effort. One important lesson learned during the course of the scenic roads study is that not every property can be conserved. Conservation goals can be achieved at reasonable cost if priorities are established to focus attention on the most important parcels. For those areas that cannot be preserved outright, efforts have to focus on guiding future uses of the land in a manner that is appropriate to preserve the character and quality of the view. The following steps describe one way to identify conservation priorities:

- Make a map of what is important – farms, visually prominent hillsides, one of a kind views, historic homes, village greens, etc.
- Make a map of what is preserved – existing public land, conservation easements, other known conservation properties.
- Identify areas that are unlikely to be developed – steep slopes, soils that don't support septic tank drainfields, regulated lands (wetlands and floodplains).
- Overlay the protected lands map and regulated lands map on the top of the resource map – resource areas without protection become conservation priorities.
- Advocate appropriate measures with conservation groups and town governments.

Some conservation priorities are obvious. The view from Route 41 to Mudge Pond in Sharon is one of the most beautiful views in New England. This often-painted scene, called the "Twin Oaks" property, was purchased by a real-estate agent who intended to subdivide the parcel and build a house for himself. Then the Sharon Land Trust stepped in. Through the coordinated efforts with the well-established neighboring Salisbury Association, approximately half of the $300,000 needed was raised to save the farm. The remaining half of the funds was raised through a sale of a 99-year agricultural lease of the property to a longtime resident, Robert E. Blum, who donated the easement to his son and daughter in-law, Jack and Jeanne Blum, the owners of the neighboring Fairfield Farm, so they could increase the size of their agricultural operations.

The win-win situation keeps the land in agricultural use and preserves the view in perpetuity. The community stayed ahead of change, and with a plan that spells out priorities, they are prepared the next time such as issue arises.

Lesson #2: Gently Guide Land Use

Not every vista can be preserved like the "Twin Oaks." Much of Connecticut's scenic quality is derived from the habitation of the land – distinctive farmsteads, tightly-knit rural hamlets along highway cross-roads, and historic villages oriented around a public common space. More recent growth patterns, however, are gradually eroding the historic settlement pattern, forever changing the character of the hamlets and villages, as well as the rolling farmlands and woodlands.

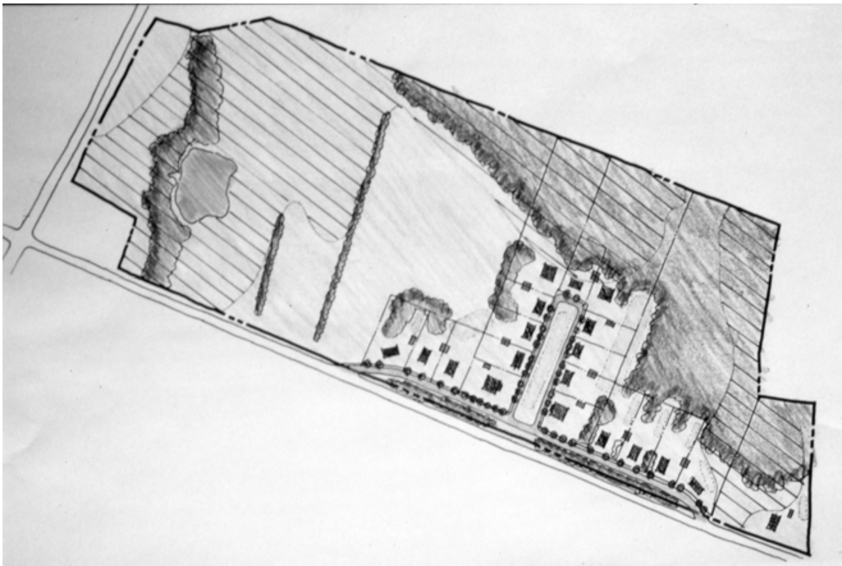
If an area cannot be protected through conservation easements, purchase of development rights, or outright purchase, rural character can be conserved by guiding land use to the most appropriate places available – sometimes referred to as "open-space design". In Connecticut, this is primarily accomplished through cluster development or open-space design regulations administered through zoning ordinances.

"Which techniques will best preserve the view while allowing development?" is a question often asked as part of the corridor-planning process. An example from the Sharon Corridor Management Plan illustrates the threat from the gradual erosion of vistas and open space. Ellsworth Farm, a beautiful tract of open fields and woods, was put up for sale midway through the corridor planning effort. The public expressed a high degree of concern about what might happen there. The visual effect of following typical building practices would be evenly-spaced houses and yards that would completely replace rural open space with a much more suburban appearance. Such an "as-of-right" plan for the Ellsworth Hill Farm site can be legally constructed under existing regulatory practices in Sharon.

An alternative approach is to develop a small and more neighborly grouping of houses, along the lines of a rural hamlet, with open space used to structure the building pattern. In this case, the existing road would be split into two narrow lanes divided by a common open space, serving as the "front yard" of the entire hamlet. Drainfields would also have to be shared, requiring appropriate legal arrangements similar to shared driveways. Housing types would be matched with the lot size and position, with larger lots (and larger houses) at the corners and focal points of the neighborhood. Building types would also reflect local building customs, with similar proportion of height to width, similar fenestration, similar roof pitches, and similar materials.

Existing view of the Ellsworth Farm, Sharon (Lardner/Klein photograph).

The result would be community architecture in an identifiable place rather than just a subdivision of land. Most of the view would be saved, and the property owner could build the same or even more houses as allowed by existing zoning regulations.



Hamlet design preserves the views (Lardner/Klein drawing).

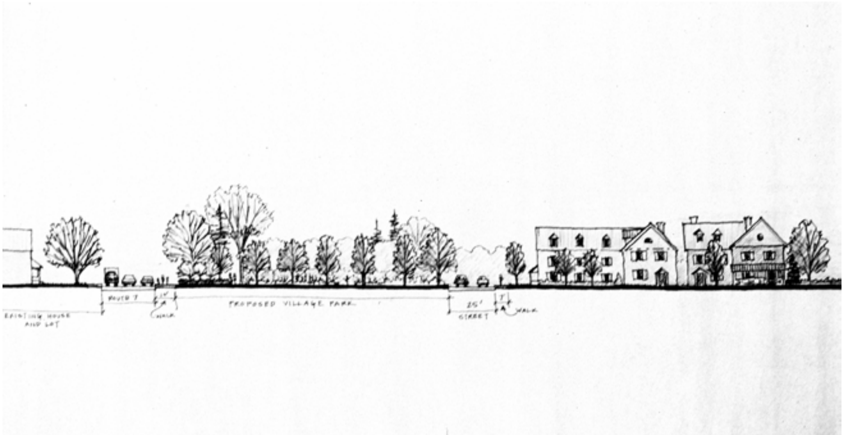
Lesson #3: Preserve and Enhance Village Character

The concept of "building in town" is often suggested as an approach to preserving open countryside, but it is sometimes difficult for residents and neighbors to imagine what it might be like. Many village centers are blessed with great views of the rural countryside while at the same time being within walking distance to schools, shopping, restaurants, or other town amenities. These town centers have a visual quality and friendly spirit that are highly valued and seldom, if ever, found in contemporary strip developments and shopping malls. How Connecticut's many villages and rural hamlets grow over the next decade will have a tremendous impact on the scenic and rural qualities of the state. Encouraging growth within existing villages can be accommodated without creating congestion and putting pressure on nearby roads and streets. The following principles could help Connecticut avoid rural sprawl by encouraging appropriately scaled development within the existing infrastructure of the state's villages and towns:

- **Create Redundancy in the Street System**. The now standard practice of cul-de-sacs leading to a single main artery has created increased pressures on the traffic capacity of Connecticut's scenic and other rural roads. The difficulty of this cul-de-sac street pattern, from a traffic standpoint, is that every movement from one development to another, from one part of town to another, must be accomplished by way of the main street.

- **Improve Pedestrian and Bicycle Connections**. In the past, most New England towns had their public buildings grouped around a common, or town green. It was easy to walk from business to business or from home to school. Today those connections have been lost. Improving connections for people and bicycles can encourage people to leave their cars in one location, or even at home. This can be accomplished by improving walking connections between nearby homes and the commercial core of the village and by improving pedestrian safety in shopping areas so that pedestrians feel more comfortable parking their car in one place and walking from shop to shop. The result is that there are two or three fewer car trips every time a resident goes out on an errand.

- **Improve the Visual Quality and Character of the Village Center and Rural Hamlet**. Making more people-friendly spaces in villages and hamlet is another important strategy. The accompanying example illustrates how a new walkway with associated "outdoor rooms" for relaxing, dining or just people-watching can be inserted into an existing village (Kent) to connect Main Street with the more recent village shopping center. These visual and physical connections help to knit the old together with the new and often create new development opportunities for building in town (for example, along a pedestrian spine or a new street).



New walkways enhance Kent's Main Street (Lardner/Klein drawing).

- **Develop Guidelines for New Construction**. The insertion of new development into the fabric of a village center requires sensitive care. The following simple guidelines, excerpted from the Route 7 Corridor Management Plan, can guide property owners, public officials, and others in proposing, reviewing and proactively facilitating appropriate new development:

    1) The massing and scale of new buildings should match their neighbors.

    2) The setback of new buildings should reinforce the street context.

3) Materials should exhibit both consistency and variety.

4) Parking and automobile circulation should also provide for pedestrian ambiance.

Lesson #4: Balance Safety and Beauty

Connecticut's scenic roads are particularly significant in their relationship to recreation and leisure travel — attracting visitors to the state who see the act of getting there as important as being there. The characteristics of the road itself are just as important as the rural or historic character of the place where the visitors are headed. In each of the corridor plans, a high degree of concern was expressed about balancing the need for a safe driving experience with the need to preserve the beauty of the roadside environment.

The most important approach to balancing safety and beauty is to establish a cooperative working relationship in which all of the interested points of view are included from conception to implementation. The process must be sure to include the following points:

- **Set the Stage for Flexibility**. Sometimes more sensitive approaches require the Connecticut Department of Transportation to grant a waiver or exception from established guidelines. This process goes more smoothly when there is a clearly established context for the proposed exception. Establish a set of goals for the project that fairly represent all the aspirations of the various participants. The project description, based on these goals, should enumerate the full set of design constraints, which can form the basis for any future design exceptions or waivers that may be required.

- **Select Relevant Guidelines**. Most work on scenic roads will fall into the category of maintenance or rehabilitation, usually referred to as 3R (Resurfacing, Restoration and Rehabilitation). Maintaining clear lines of communication about the degree of impact that is acceptable for any particular project can help the Connecticut Department of Transportation justify the use of more flexible design approaches as a means of creating a more context sensitive design for safety improvements. Communities wanting to preserve the character of the village can use the Connecticut Department of Transportation's normal design waiver to achieve more flexible approaches. Communities may refer to and cite Transportation Research Board (TRB) Special Report 214.

- **Utilize Design Strategies That Improve Safety While Preserving Scenic Quality**. The intent of the guidance of TRB Special Report 214 is to begin with the existing conditions and performance of the road, rather than to design by attempting to meet the numerical design guidelines of the American Association of State Highway and Transportation Officials Green Book. The Connecticut Department of Transportation addresses the impacts of highway upgrades on scenic roads by using the "careful-fit" approach, which seeks to ensure that the proposed cross section of a highway improvement "will not look substantially different from the match of the project limits."

The standard methods of trying to improve safety on state highways may not be possible or appropriate for scenic roads. These methods have concentrated on physical modifications to the roadway and roadside such as widening lanes and shoulders, adding guiderail, cutting trees, and changing the vertical and horizontal geometry. These techniques will often destroy the visual qualities that led to the scenic designation. In addition, by creating a more wide-open look to the road, these techniques reduce the apparent dangers for the driver and result in higher operating speeds.

Even carefully guided growth results in some increase in the volume of traffic along scenic and other rural roads. Increases in volume and speed often lead to increases in the number of accidents. There are a number of measures that can be taken to improve the safety along a scenic road without significantly changing roadside character:

- If a slope needs to be laid back to improve sight-lines, the grades of the slope can be designed to match more closely the existing shape of the landform.
- On lower-volume roads, it is possible to use narrower lane and shoulder widths, thereby reducing the amount of cut and fill that may be required.

- More attractive roadside details can be used to minimize the visual contrast created by guiderails and the back of signs. For example, a good design might use a color-galvanized weak post box beam or a cable guiderail with a weathered steel post.
- The backs of regulatory signs can be painted brown to reduce contrast.

Rhythmic plantings (in this case, flowering crabapple trees) can narrow the look and feel of the road entering curves, thereby giving drivers a cadence from which they can feel the travel speed (Lardner/Klein drawing).

The example of Route 67 in Bridgewater shows how traffic can be slowed down along curves. As Route 67 approaches Roxbury from Bridgewater, the road gradually descends a hill and the driver is faced with a series of curves that can be dangerous, especially at night or at speeds above the posted limit. Responding to local concerns, the Connecticut Department of Transportation proposed widening and straightening the road. However, if the Bridgewater curves were straightened to achieve a 45-mile-per-hour design speed, then the problem of driving too fast for conditions would only be shifted to the next intersection. This would also require an extensive taking of private property, including the only remaining working farm in the area.

An alternative approach would be to develop management strategies that 1) slow drivers before they get to the curves and 2) make slight improvements to the road alignment, superelevation, and sight-lines so as to improve the visibility of the upcoming curves and intersections, without actually removing the curves. The planning team's suggestions reflected research about how drivers subconsciously sense conditions and alter their behavior accordingly.

Lesson #5: Calm the Traffic in Rural Hamlets so as to Regain Community Character

Traffic speed through villages and crossroads is one of the biggest issues affecting the quality of life and the visitor experience in Connecticut towns. Consideration of the behavior of drivers and the visual clues that are given by roadside details can provide guidance to more sensitive design approaches that slow down drivers.

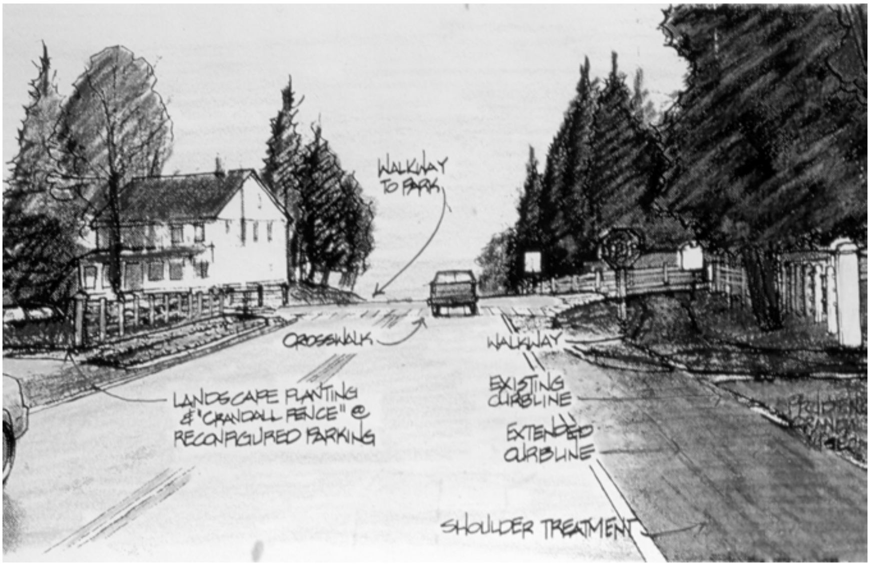


Illustration of proposed traffic-calming techniques, Route 169 and Route 14 intersection, Canterbury, as they would appear to the driver (Lardner/Klein drawing).

Intersections that have historically been a crossroads of activity should be marked by a pause in the visual and operating character of the road. This sense of identity can reinforce the historic fabric (churches, greens, and old houses) and the contemporary utility (shopping and places to eat) of such crossroads. Highway design details can actually be chosen and installed to heighten the awareness and functionality of these spaces. Techniques that give drivers clues, well ahead of the intersection, that they are entering an historic, pedestrian-oriented village, and subtly signal they should slow down, include:

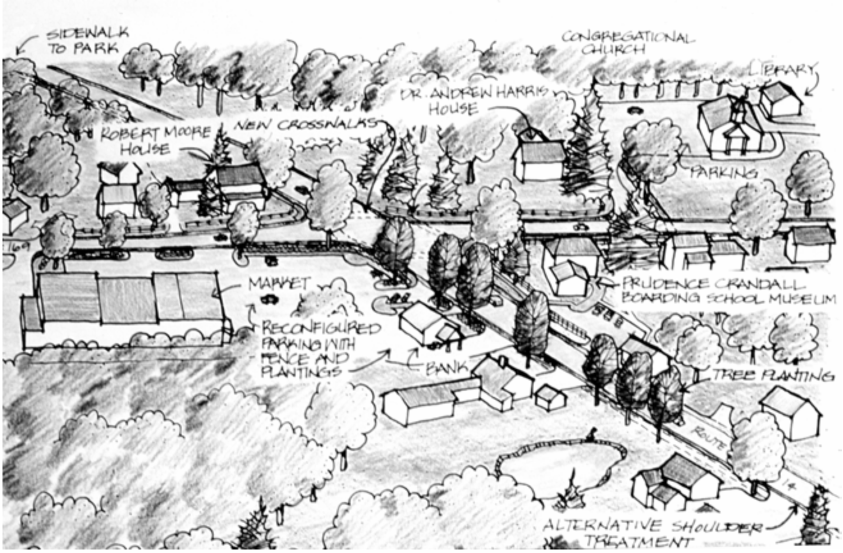
- Alternative shoulder treatments that clearly define the travelway as separate from the shoulder
- New planting and landscape features that increase the "visual friction" perceived by the driver
- Entry signs, entry plantings, and continuous decorative fencing that enhance village identification

⌘ ⌘ ⌘

The scenic-road project resulted in a series of pragmatic and balanced plans in which responsibilities are shared among several parties. Implementation of priority projects included successful grant applications for waysides, pedestrian and bicycle facilities, interpretive information, and signage for community entrances. Local governments have incorporated the goals and objectives of the scenic-road plans into their official town plans. A number of towns have adopted regulatory mechanisms, including urban design overlays. Land trusts and other civic groups have become proactive partners to town governments and the Connecticut Department of Transportation, and are taking on many joint preservation projects. Working relationships between towns and the Connecticut Department of Transportation have improved as dialogue has fostered broader understanding of the challenge of balancing safety, beauty, and maintenance costs. Within the Connecticut Department of Transportation's design division, the scenic road project has been a factor in the emerging climate for flexibility in achieving the agency's mission of safe and effective roads. The lessons of the project are being widely shared via *Preserving Connecticut's Scenic Roads: A Handbook for Collaboration on Corridor Management*, produced by the design team for the Connecticut Department of Transportation.

One unexpected additional benefit of the Scenic Roads Corridor Management Planning Project has been heightened public awareness about the links between land-use and transportation policies. Since land use policy is the purview of local jurisdictions, and transportation policy is largely controlled at the state level, there are few opportunities to explore these naturally linked worlds in an integrated manner. By participating in the scenic-road project, key state and local officials active in the state's "smart growth" leadership have greatly enhanced understanding of the need for coordinated measures to check sprawl and conserve the character of town and countryside.

No one agency or group can turn back the forces of change. Yet, working in collaboration, much progress can be made as partners step forth to take part in conscious caring for the exceptional character of Connecticut's scenic towns, countryside, and roads. It takes a coalition to save a village, to calm traffic, to implement more sensitive road maintenance practices. Fortunately, Connecticut towns are blessed with many committed and skilled local leaders, and more and more citizens are expressing support for taking measures to assure our children a beautiful and safe driving environment.



Proposal for improving pedestrian safety and enhancing community character in Canterbury at Routes 169 and 14 (Lardner/Klein drawing).

The Connecticut Department of Transportation's "Context Sensitive" Approach to Roadway Design

CARL BARD, WILL BRITNELL, AND SIMONE CRISTOFORI

The Connecticut Department of Transportation is implementing a new methodology pertaining to the design of roadway improvements. It incorporates a philosophy commonly referred to in the engineering community as "context sensitive design." Context sensitive design is a new approach to the planning and designing of highway projects, one that considers the land uses and the environment adjacent to the roadway and involves extensive public participation.

In the early 1900s, roadway construction typically consisted of paving over dirt roads that in some cases were nothing more than old cow paths. Beginning in the 1930s, state highway officials recognized that in order to provide a reasonable level of safety, there was a need to establish a consistent approach to highway design. In the late 1930s, national committees were formed to develop appropriate design criteria to guide highway engineers, which culminated with the publishing of nationally-accepted design criteria in the 1950s. During this period, conflicts with nearby land uses and environmental resources were not considered as much as they are today, and they were not viewed as design constraints that required modification of accepted design criteria. In the late 1960s, the public became more concerned with environmental and socio-economic considerations and began to oppose what was perceived as the proliferation of roads and the negative environmental affects associated with them.

Gradually, the Connecticut Department of Transportation became more responsive to the concerns and desires of the local communities. Following the 1983 collapse of the Mianus River Bridge in Greenwich, the Connecticut Department of Transportation embarked on an extensive infrastructure improvement program, a major component of which was the reconstruction of the Hartford-area expressway system. Rebuilding the expressways serving the capital city required a major commitment to keeping the public informed of the proposed improvements as well as the changes in traffic patterns. The success of this public information program, as well as demands from the public, led to increased public involvement during the Connecticut Department of Transportation's design and planning phases.

Through the 1980s, environmental concerns often became a major constraint driving the design process. The public became more concerned with preserving their communities and opposed projects they felt would reduce the quality of life. Citizen advisory groups were formed and began to influence project designs and procedures. One such group was the Merritt Parkway Working Group (MPWG), which was a multi-disciplinary group with representatives from both the public and private sectors. The MPWG was formed by the Connecticut Department of Transportation to establish guidelines for the historic and nationally recognized Merritt Parkway. The Connecticut Department of Transportation made a commitment to participate in and cooperate with the MPWG, whose efforts produced guidelines for future roadway, landscaping, and bridge projects. At this time, a series of reconstruction projects on the Parkway are underway.

The success of the Connecticut Department of Transportation with the Merritt Parkway and other projects, such as the reconstruction of Route 6 through the historic village of Brooklyn in eastern Connecticut, led the Federal Highway Administration to recommend that Connecticut be one of five pilot states to participate in an initiative to implement "context sensitive design" nationally.

So what exactly is "context sensitive design"? Essentially, it involves making the road blend in with the surrounding environment and community. It allows (if not requires) designers to make design decisions based on the impacts to the community, rather than blindly following design criteria. It requires designers to be aware of the environment in which the road sits and the qualities of the area that the community feels are important. It is as much an attitude adjustment as a design technique. The designer needs to ask, "How would I want this road designed if I lived here?" Designers need to understand that the community is a partner in the decision-making process and to learn to be open to constructive comments and compromises.

The ultimate goal of a context sensitive design is to provide a facility that meets the needs of the motoring public and addresses the concerns of the community that the road passes through. To meet this goal, the designer and the community need to identify the concerns of the community and establish consensus on the purpose and intent of the project. The designer's job is to strike a balance between the intent of the project and the desires of the community.

It is imperative that the designer involves the community at an early stage in the development of the project. Public involvement used to be limited to one meeting held after the preliminary design was complete. A context sensitive design may include several meetings with local officials and the public before the project is initiated, at several points during the design process, and continuing through construction.

Perhaps the most important aspect of a context sensitive design is making the road blend in with the area. This is where the expertise of the designer is critical. There is no one single correct design for any given road. The designer needs to recognize that certain road attributes are not appropriate for certain area types. For example, a long, straight, flat, wide design may not be appropriate for a road passing through a rural village, just as winding roads may be out of place in an urban environment. Designers may have to create several iterations of a design to achieve the most desirable results.

When laying out an alignment, designers must determine which design criteria should be met and which are not critical to achieving the purpose and intent of the project. This flexibility requires engineering judgment and an understanding of the purpose of each design criterion. The Connecticut Department of Transportation has procedures for obtaining exceptions to design criteria that allow a designer to use judgment in providing an appropriate and reasonable design. The designer must present a case justifying the requested exception, including an analysis of the accident history, prevailing speeds, sightlines and projected traffic growth. The designer must also consider the effects on private property, environmental resources, and any items of concern to the community. It should be noted that a context sensitive design might not require an exception to design criteria; roads can match the topography of the area and still have acceptable geometry without having to be straight, flat, and expansive.

What are the benefits to the designer of using context sensitive design techniques? When community members understand the purpose and need for the project, they will be more willing to accept the required changes to their environment. Additionally, designers who understand the community issues will be better able to justify any required exceptions to design criteria. Conversely, by a systematic design-development process, the designer will be better prepared to explain and defend any determinations made that are contrary to the identified desires of the community. Early coordination with the public will also tend to reduce redesign efforts.

Despite these benefits, some engineers still resist the context sensitive design philosophy. Concerns include excessive costs (both design and construction costs), maintaining an appropriate level of safety, potential liability and public requests that are unrelated to the goals of the project. These are all legitimate issues, but designers need to recognize that design costs will be minimized with early coordination. Using context sensitive techniques does not guarantee that the design of a project will proceed smoothly. The designers need to recognize that there will always be negative reactions no matter how sensitive they are; however, the majority of the people will at least appreciate their efforts, even if they may not accept the final determinations.

With regard to construction costs, the designer must be aware that items such as landscaping and other aesthetic treatments will increase the cost of the project without adding any increase in safety or capacity. However, they will improve the appearance of the community and in many cases encourage private investment. Still, the designer and the community need to realize that transportation funds are not limitless and the department is responsible for using these funds cost-effectively to improve safety and efficiency.

Requests to utilize design criteria that are not consistent with accepted practice or to include non-typical treatments, such as traffic-calming devices, often raise liability and safety issues. The Connecticut Department of Transportation is responsible for providing a safe and efficient improvement. Any deviations from normal design criteria must be justified, documented, and approved by the Department, which should alleviate any potential liability concerns.

Simply put, in applying context sensitive design the designer is being asked to give fair consideration to community input and be prepared to provide a reasonable explanation for those requests that cannot be accommodated.

An Example of Context Sensitive Design: Route 6, Brooklyn, Connecticut

Route 6 travels the width of Connecticut from Danbury through Killingly. When a proposed expressway connecting Hartford and Providence was rejected in 1986 due to environmental concerns, a series of improvement projects were initiated to address the 23-mile portion of Route 6 between Windham and the Connecticut-Rhode Island state line. The last to be constructed was the five-mile section through Brooklyn. Route 6 includes a number of different configurations as it crosses the state, from a multi-lane expressway to a two-lane road. In Brooklyn, Route 6 is a two-lane road, bisecting the town green as it passes through the historic town center. Residents of Brooklyn were concerned about the effects that changes to Route 6 could have on the character of the town center. The Connecticut Department of Transportation, its consultant, and the town could not agree on a scope of work. Alternatives, including construction of a bypass, were reviewed and rejected. In 1996, the scope of the project was reconsidered and the project was reassigned to the Department's highway design section.

Brooklyn Town Green as it existed before the project (Connecticut Department of Transportation photograph).

The designers took a fresh look at the entire length of the project. They met with town officials, a number of residents, an architectural/planning group hired by the town, the regional planning agency and the State Historic Preservation Office. The designers listened to their concerns and modified several aspects of the project. They reduced the width of the paved shoulders in the vicinity of the town center, essentially eliminating any widening of the pavement in this sensitive area. The designers reevaluated the design speeds chosen for the project and determined that lower design speeds would be more appropriate for the area. They eliminated both a previously proposed intersection realignment that would have conflicted with an attractive stone wall and a proposed climbing lane just west of the town center. The alignment of the road was revised to better match the terrain and provide visual clues to drivers that they are entering a village area and should be slowing down. A number of significant historical and scenic constraints were identified, including a large copper beech tree, a well house, and the town green. The designers were not only able to avoid these resources, they even eliminated two town roads that crossed the green, thereby forming a larger, contiguous area of open space. The revised design achieved the project goal of reconstructing the road, providing roadside drainage, and upgrading the guardrail systems. In addition, a sharp horizontal curve with very limited sight-lines was flattened; the total of five property takings was acceptable to area residents.

A public hearing was held and this time the project was strongly supported by the town and the public. The Department's presentation included a photo-rendering of the project through the town green and a video presentation of the project plans that allowed the presenters to zoom in on the particular portion of the plans being discussed. An open house was held prior to the formal hearing to allow residents and representatives of the Department to speak informally and review specific concerns. The outcome of the hearing was that the Department was able to proceed with the design of the project, ending many years of impasse, and most members of the public were supportive of the work to be performed.

The design of this project taught the Connecticut Department of Transportation some valuable lessons. First, a design does not have to follow the "straighter-and-flatter-is-better" philosophy in order to be safe. A road can be designed to fit the terrain and still have acceptable geometry. Second, coordination and cooperation with the community will lead to a relationship of trust and allow for productive discussions. In this case, the Connecticut Department of Transportation's willingness to consider and carefully examine the town's proposal for an alternative intersection design showed an honest attempt to work with the community and value their opinions. Finally, designers must carefully examine the character of the area and the effects of the proposed design in order to determine the appropriateness of the design. The designers were able to recognize that the character of the center of Brooklyn did not fit with the design speed of the adjacent sections of this road.

Photo-rendering of the Town Green after construction, showing removal of bisecting town roads (Connecticut Department of Transportation).

Pick-up Sticks: The Reuse of an Historic Truss Bridge

R. KENNETH WASSELL

By working closely with state and federal transportation officials, the Town of Canton, Connecticut, was able to save *two* historic truss bridges in the course of upgrading the Powder Mill Road-Nepaug River crossing—the original Powder Mill Road bridge, an 1890s wrought-iron and steel truss, and a 1920s steel truss that originally carried U.S. Route 6 over the Pequabuck River in nearby Farmington. The older bridge was disassembled and put into storage, awaiting re-use on a town-park trail, with the Route 6 bridge now taking its place on Powder Mill Road. The Route 6 bridge was acquired by the Town of Canton in 1993 by gift from the Connecticut Department of Transportation under a historic bridge reuse program sponsored by the Federal Highway Administration. The program matches historic bridges with new owners for reuse rather than demolition.

The bridges are both three-panel Warren "pony" trusses. The Powder Mill Road bridge was constructed by the Berlin Iron Bridge Company for the Canton Board of Selectmen in 1892 and is typical of the catalog bridges that the company offered for sale throughout the United States. The Route 6 bridge was constructed by the Berlin Construction Company in 1927 from contract drawings prepared by the Connecticut Highway Department in 1926. (The Berlin Construction Company was organized by the former principles of the Berlin Iron Bridge Company after its acquisition by the American Bridge Company in 1900).

The Route 6 bridge replaced a much smaller masonry arch bridge when the road was widened, realigned, and paved with concrete to accommodate the increase in traffic volume and vehicle weight that occurred in the early part of the twentieth century. Based upon the 1926 Connecticut Highway Department Bridge Standards, the bridge was designed for two 15-ton trucks on the structure at one time. The design reflects the state of the art of highway bridge building in the early 20th century and shows the influence of late 19th-century railroad bridge designs. The Route 6 bridge consists of two Warren "pony" trusses with interconnecting floor beams. The trusses and floor beams are made up of steel angles, plates, and channels riveted together to form the major load-bearing structure of the bridge. The steel floor stringers are made up of rolled "I" beams that supported a poured-in-place concrete deck. The connections are riveted together with plates, unlike the pinned connections that characterized earlier bridges.

The Route 6 bridge in its original location in Farmington, 1990 (HRC photograph).

The Route 6 bridge was well maintained by the Connecticut Highway Department and all major structural members were in near original condition. It was partially rehabilitated in 1987, but no changes were made to the trusses, floor beams, or stringers. However, in order to accommodate continuing increases in traffic volume, it was determined that the roadway width needed to be increased. The replacement design called for a prestressed precast reinforced-concrete structure with four traffic lines.

During the planning for the removal of the Route 6 Bridge, the Town worked with the Connecticut Department of Transportation’s consultant engineer, Purcell Associates, and the contractor, White Oak Corporation, to determine the best practical method to disassemble and transport the bridge from Farmington to Canton. Early in the planning, it was found that the trusses could be moved as individual units after the floor beams, deck, and stringers were removed. However, the Route 6 Bridge had to remain in place to maintain traffic until one lane in either direction was constructed alongside the old bridge. This required staged construction, with workers operating from a barge placed in the Pequabuck River. Rivet heads were sheared off, rather than burned off, to prevent distortion of the steel members. The trusses were lifted by two cranes, one on each end, and placed on a truck trailer for transportation to Canton. Upon arrival, the trusses were lifted onto timber cribbing on property owned by the Collinsville Volunteer Fire Department on Powder Mill Road and stored until needed.

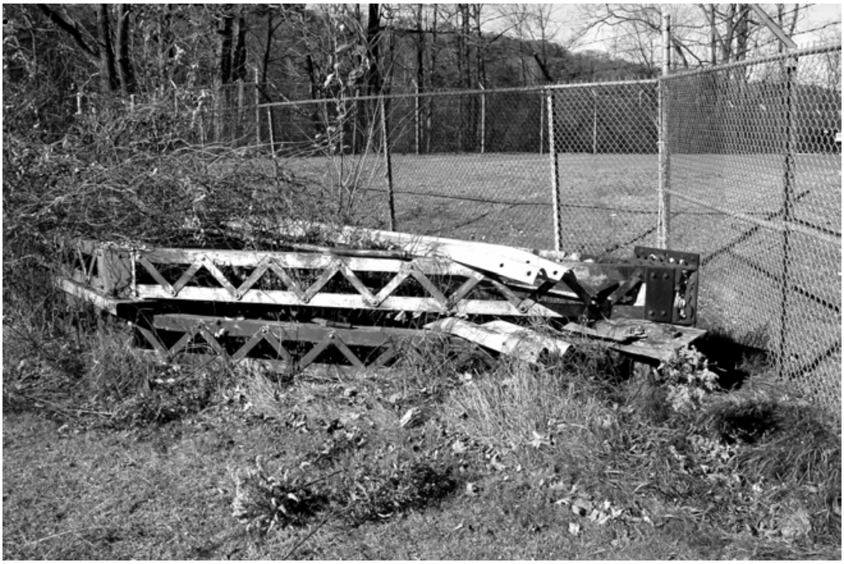
The final phase of the project was begun in 1995 when the Town contracted with the firm of A. G. Lichtenstein & Associates to create a design that would use the Route 6 bridge as a replacement for the existing Powder Mill Road bridge. The Powder Mill Road bridge over the Nepaug River was a classic single-lane "farm to market" structure typical of hundreds of similar structures sold by the Berlin Iron Bridge Company during the late 19th century. These catalog bridges were sold to replace aging wood bridges with modern low maintenance steel bridges in many communities in Connecticut. As a result, the state lost almost all of its earlier wooden bridges in a brief period at the close of the 19th century, as the metal-truss bridge building frenzy swept the countryside.

The Powder Mill Road bridge, 1990, closed to traffic (HRC photograph).

After sale of the bridge to the community, the Berlin Iron Bridge Company would contract with local tradesmen for the labor to erect the new bridge under the supervision of a representative of the company. The bridges would be shop-fabricated and assembled and then knocked down for shipping to the construction site. The knocked-down sections would than be assembled upon wooden falsework with rivet-bolts. The rivet-bolts had splines on the unthreaded portion and were driven by hand tools into the factory-punched assembly holes. The splines would bite into the steel surrounding the holes and clamp together the steel pieces when the bolt was tightened with a wrench. The rivet-bolt method eliminated the skilled labor required to hot-rivet the bridge together in the field and was a forerunner of mass-production techniques now common in heavy industry.

The Powder Mill Road bridge was constructed in the transition period from wrought iron to steel and both materials are found on the bridge. The plates and angles used in the construction of the two Warren trusses and floor beams are steel while the floor stringers are wrought iron "I" beams. The Powder Mill Road bridge is very lightly constructed and when built had a safe working load of six tons. The bridge has a number of features that span the two periods of highway bridge construction. The top chord is comprised of two light angles without a cover plate, with only steel lacing holding the angles apart. The floor beams are suspended from the two trusses by "hair pin" bolts. The north abutment has a roller assembly under each truss end to provide for movement due to loading or thermal expansion. Panel points are riveted or bolted to gusset plates without any pins to provide for rotational movement in the members.

During the flood of 1955, the Powder Mill Road bridge was swept from its abutments after debris caught under the bridge. The southerly abutment was also washed away. The bridge was lifted back into place in 1956 under the direction of the U.S. Army Corps of Engineers. An H-pile grill-work and armor-stone facing replaced the southerly abutment. In 1966, the bridge was further modified by the replacement of the wooded plank deck with a corrugated steel plank deck welded to the wrought iron floor stringers. Bituminous concrete paving was placed on top of the steel deck as a wearing surface. Traffic guiderails and a pedestrian rail were added at that time. Due to deterioration of the bottom panel points, the bridge was supported by heavy timber trestles at the panel and half-panel points, thereby eliminating the load-bearing function of the trusses.



The trusses from the original Powder Mill Road bridge are in storage, awaiting re-erection on a park trail.

Initially, it was proposed to reuse the granite ashlar abutments of an 1862 railroad bridge that stood immediately to the east. The railroad bridge had exactly the same span as the Route 6 bridge, and so the abutments offered a perfect match. Using the railroad bridge abutments also had the advantage of eliminating an "S" curve in Powder Mill Road. However, during the course of construction in 2001, it was found that the abutments were not structurally adequate to support the relocated truss. Instead, some of the large cut stones were incorporated into the new concrete abutments as ornamental accents.

Upon completion of the installation of the Route 6 bridge at the Nepaug River, the existing Powder Mill Road bridge was disassembled and placed in storage at the Canton wastewater treatment plant. Current plans call for its reuse in the near future as part of a walking trail at Mills Pond Recreational Park.

The Route 6 bridge in its new location on Powder Mill Road in Canton.

Learning From

The Past

Managing Site Aesthetics and Historic Resources: The Depot Road Bridge Project

J. HOWARD PFROMMER AND MICHAEL S. RABER

The Depot Road bridge over Mill Brook in Coventry, Connecticut, was in use for over 150 years before structural deterioration made its replacement advisable. The bridge, a dry-laid stone arch with an eleven-foot clear span and a seven-foot rise, began to exhibit signs of impending failure during the early 1990s, including loss of arch stones, deformed retaining walls, split and crushed stones indicating movement and redistribution of forces between individual arch stones, and undermining (scour) of the footing stones. Traffic across the two-lane bridge was reduced to one lane, and the structure was load-posted. An inspection by the Connecticut Department of Transportation indicated the bridge was structurally deficient and no longer wide enough to serve vehicular traffic. The Town of Coventry requested remedial recommendations and preparation of construction contract documents from its consulting engineer, Nathan L. Jacobson & Associates, Inc. of Chester, Connecticut.

Although largely funded by the town, the bridge-replacement project involved work in the brook requiring a permit from the U.S. Army Corps of Engineers, New England Division. Because the bridge had been determined to be eligible for the National Register of Historic Places, the federal permit authority brought the project under the purview of Section 106 of the National Historic Preservation Act of 1966 and other regulations intended to avoid or mitigate adverse project effects on significant cultural resources. To meet requirements emerging from these regulations, the town retained Public Archaeology Survey Team, Inc., which in turn subcontracted with Raber Associates to conduct a variety of research and documentation tasks. This essay discusses the efforts of the engineering and cultural resource consultants to address problems of site aesthetics and significant archaeological features within a single work program.

Documenting Historic and Archaeological Resources

The State Historic Preservation Officer determined that there was no feasible alternative to removal of the bridge, but also concluded that removal would be an adverse effect on a National-Register-eligible historic engineering resource. In addition to the bridge itself, the site included a 19th-century underground stone-arch tailrace culvert, associated with former water-powered industrial enterprises that ran beneath the roadway and bridge. Reconnaissance archaeological investigations by Raber Associates, based in part on information provided by the consulting engineer and the Town Historian, concluded that the tailrace culvert was also an historic engineering resource eligible for the National Register of Historic Places. Working with the Corps of Engineers and the town, the State Historic Preservation Officer developed a Memorandum of Agreement with a number of stipulations to mitigate the adverse effects of removing the bridge and part of the culvert, including documentation of the bridge to standards of the Historic American Engineering Record (HAER) prior to demolition, archaeological monitoring and documentation of the bridge foundations and tailrace culvert sections removed during construction, and preparation of a brief article on the history of the Depot Road bridge for the Society for Industrial Archaeology New England Chapters' Newsletter. The HAER documentation was completed in 1995 and accepted by the National Park Service in early 1996.

Documentation of the tailrace culvert and bridge footings during construction required careful coordination among the consulting engineer, Raber Associates, and the contractor to secure photographs, detailed measurements, transit survey data, and descriptive notes on features exposed beneath the stream bed by de-watering operations. The consulting engineer interviewed abutting property owners and conducted field investigations, including ground-penetrating radar studies, geometrical probes, and test pits. Field visits were made to areas where the culvert is exposed at the surface of the ground and to the existing stone-arch culvert beneath an adjacent railroad embankment a short distance downstream of the apparent culvert terminus. These initial investigations allowed the engineers to prepare drawings of the culvert’s probable profile and cross-section.

Culvert cross-section, as photo-documented during construction activities (Raber Associates photograph).

The contractor used the culvert to carry part of the stream flow, excavating into the culvert northeast of the bridge and inserting a 60-inch pipe. Bridge foundations were exposed and recorded under both sides of the channel. Two culvert cross-sections were recorded at the upstream and downstream points of culvert removal. The upstream cross-section, at the east side of the channel, was a complete exposure of the undisturbed culvert and associated fill material using excavating machinery and hand-powered cleaning. The downstream cross-section was partly disturbed by contractor excavation for insertion of the 60-inch pipe. In addition to work within the immediate bridge vicinity, field investigations included taking transited horizontal and vertical measurements along the upper culvert centerline exposed under the stream prior to culvert removal and at other exposed points of the tail-race system. The additional data helped to establish alignment, estimate slope, and interpret the design and probable hydraulic function of the culvert.

Results from all phases of investigations indicated that the bridge and the tailrace culvert had similar materials, almost identical foundation systems, and closely-related histories. Mill Brook falls about 250 feet in two miles from Lake Wangumbaug to the Willimantic River. By the early 19th century, the brook powered a number of industrial enterprises, and eventually supported fourteen small mills making a wide range of products including silk, woolens, satinet, and metallic cartridges. At the lowest privilege on the brook, immediately above the Depot Road crossing, a sawmill, dam, and pond were in place by about 1806, with a fulling mill added ca. 1812-1818. Local entrepreneurs formed the Coventry Satinet Manufactory and improved the site in the early 1830s to make satinet and cassimere. Construction activities probably included raising the dam located about 200 feet upstream of the bridge, building the culvert, and replacing an earlier timber crossing with the stone-arch bridge. The decision to build a stone bridge probably reflects the crossing's position on an important local road and the location of the bridge just below the mill dam, failure of which would have seriously threatened a less durable structure.

Footings of original Depot Road bridge, as photo-documented during construction activities (Raber Associates photograph).

The Depot Road bridge was an excellent example of the most basic type of vernacular masonry arch construction. The bridge stones were locally-available gabbro. Carrying the roadway over Mill Brook for a distance of about 35 feet, the bridge had an 11-foot-wide semi-circular arch of unmortared flat stones and mixed-size, flat rubble spandrels retaining rubble fill. Many of the arch ring-stones were at least partly cut or finished. The 28-foot-long arch rose 6 feet above platforms of large, flat, 6-to-12-inch-thick rubble slabs that were set 9.5 feet apart in the brook. The coarse-textured bed of Mill Brook in the bridge vicinity, consisting primarily of deep sand, gravel, and cobble deposits, provided a firm bed for flat-bottomed rubble slab footings. Although seated only about a foot below the stream channel, the bridge footings remained sound for the approximately 160-year history of the bridge.

The tailrace culvert was the most unusual component of the waterpower development at the satinet works. The present dam, a 140-foot-long, concrete-faced rubble structure, dates from a ca. 1908 episode of rebuilding. An opening in the dam, probably once equipped with a gate or flashboards, leads to the top of what appears to be a concrete-lined turbine bay or seat. The turbine probably represents a replacement for one or more undocumented water wheels. The tailrace system begins below the turbine with an open, 33-foot-long, l0.5-foot-deep rubble stone channel, about 9.5 feet wide at the bottom and 11.5 feet wide at the top. At the bottom of the downstream end of the channel, a rectangular opening, 4.2 feet wide and 2 feet high, marks the start of the tailrace culvert.

The culvert carried water from the wheel pit not into Mill Brook but rather downstream of the brook, directly into the Willimantic River. The culvert, a rubble-stone-arched structure built of the same materials as the bridge, ran about 760 feet underground to an open ditch, which then ran another 700 feet into the Willimantic River. The 10-foot-wide, approximately 3-foot-high culvert had a gravel-bottomed channel 6.4 feet wide, 10-inch-high vertical sides of rubble blocks, and a low arch of split boulders rising to a point about 1.8 feet above the culvert bottom. The top of the arch was about 2 feet below the Mill Brook stream channel bottom, at a point very near a corner of the bridge. Archaeologically-exposed culvert sections proved to be shallower than predicted by the pre-construction engineering studies.

The purpose of the culvert probably was to avoid erosion and backwater problems. In addition to the mill itself, the satinet company had other structures in the immediate area and was probably concerned about damage from flooding and erosion. Running the tailrace directly into Mill Brook would have risked backwatering during periods of high water, thereby reducing the amount of power available (as the lower part of a water wheel becomes increasingly immersed, the energy used to move the backwater is no longer available to power machinery). Finally, introducing a strong tailwater flow into the brook at this point could have contributed to erosion of the upstream bridge abutments.

Analysis of probable power requirements and culvert capacity suggested the culvert was the most constricted component of the tail-race water system at this site. By 1870, when Mill Brook manufacturing was at its height, the lowermost privilege was running a waterwheel generating 15 horsepower at a head of 18 feet. Although more horse-power may have been generated with a turbine, the relatively high head suggests that mill operators used a wooden overshot or high breast waterwheel at the time of tailrace construction. The dimensions of the area between the dam and the open tailrace channel suggest a vertical wheel of about 10-foot diameter. Using a standard formula relating the horsepower developed by a wheel or turbine to the flow and fall of the water, the satinet mill's wheel produced approximately 12.2 horsepower. Several estimates of culvert capacity were made, based on observed dimensions of the documented culvert sections and possible culvert slope as suggested by an elevation in a visible culvert opening about 460 feet northeast of the stream. At a minimum, the culvert was probably designed to carry water in a section 6.4 feet wide and .8 feet high, the 5.35 sq. ft. section below the arch which comprised about 57% of the total section. The unfinished arch masonry and large-aggregate backfill were probably not seen as an acceptable conduit for full-section flow, and culvert flows can be estimated by means used for open channels. It appears that the culvert discharged about 12 cubic feet/second, just enough to discharge the minimum flows needed to run the earliest waterwheel installed at this privilege, as calculated from known head and horsepower data. Variations in Mill Brook flow data affecting the available power at this mill have never been calcu-lated closely, and are complicated by the undocumented but undoubt-edly complex history of Mill Brook water management.

By chance, calculation, or experience, the Coventry Satinet Manufactory built perhaps the smallest culvert possible to provide one or more of the advantages suggested above. The culvert probably had several disadvantages, however. Limited openings made maintenance difficult and the culvert prone to accumulation of silt, decreasing the flow capacity. Even when fully open, the culvert's small size made it prone to backwater if headrace intake controls failed to stop high water and an abrupt rise in water surface occurred as flow was retarded. With enough velocity, water pressure could have also damaged the culvert. The culvert builders probably minimized the culvert slope to reduce velocity, carefully weighing tailrace requirements against potential high-water damage. The open tailrace channel just below the presumed wheelpit location may represent an attempt to release some of the pressure from such an event, as may two small culvert openings between the open channel and Mill Brook.

The culvert is an example of vernacular hydropower engineering which appears to have provided some short-term advantages, but which also may have inhibited subsequent power arrangements. The satinet mill ran under various owners until an 1880 fire, and was rebuilt ca. 1908 as a fiberboard mill which operated on a somewhat occasional basis until 1940, when the site again burned. The earlier complex was powered by water and steam before 1870, and at some point a turbine replaced what was probably a wooden overshot or high breast wheel. Survival of the culvert for over 160 years in operable condition attests to the empirical wisdom of its builders and subsequent users. If water supply allowed for use of more than about 12 cubic feet/second during much of the year, however, culvert size may have inhibited waterpower development at the site. It is unclear if the introduction of steam power here reflected a need to run more equipment than first installed in the 1830s, a desire to overcome the seasonal under-supply of water inherent in the original site design, or both.

Bridge Replacement Issues and Design Selection

Because of the historical importance of the bridge, a number of alternatives for structural rehabilitation were investigated, including:

Option 1 Excavating to the top of the arch and pouring a concrete cap over the arch, as well as pouring a concrete floor and placing riprap in the brook.

Option 2 Similar to Option 1, but including mortaring stone joints within the arch and creating a "low-low" channel within the concrete floor.

Option 3 The use of "Insituform" to line the entire bridge waterway, thereby structurally reinforcing the arch.

Option 4 Spanning over the arch with a new bridge.

In addition to structural problems, the existing bridge did not meet current criteria for hydraulic capacity and scour protection. Some of the factors considered in making a decision on rehabilitation or replacement of the bridge included:

- safety issues associated with the tailrace culvert
- the need for an effective guiderail
- the narrow roadway width of the existing structure
- non-compliance with the American Association of State Highway and Transportation Officials (AASHTO), the Connecticut Department Of Transportation, and the Connecticut Department of Environmental Protection hydraulic and scour design standards
- bridge aesthetics

The consulting engineer investigated all viable rehabilitation options that would satisfactorily address each of these concerns and then recommended a complete bridge replacement as the most prudent and cost-effective alternative, including removal of the tailrace culvert within the limits of the town 's right-of-way. The town, the Connecticut Department of Transportation, and the State Historic Preservation Officer concurred with this recommendation. Due to the distinct historic character of the bridge, the town requested that the design of the replacement structure include maintaining the aesthetic appearance of the existing bridge site, while meeting current design criteria.

After considering several bridge types, including a timber bridge, the consulting engineer selected a precast, reinforced-concrete rigid-frame structure with a clear span of 20 feet, a rise of 10 feet, and a traveled width of 26 feet. This bridge type was selected not only for speed of construction and long-term durability, but also because its arched design most closely resembled the historic bridge. The dimensions of the new bridge represented an increase in the waterway opening, thereby providing improved hydraulic capacity. Cast-in-place reinforced concrete was selected for the parapets and wingwalls. A cast-in-place reinforced-concrete footing supported on timber piling was included in the design to prevent scour during periods of high stream-flow. A new granular base and bituminous concrete pavement were placed on the bridge and its roadway approaches, and stone riprap was placed along the stream embankments in the immediate vicinity of the bridge to protect them from erosion. It was also recommended that the new structure be placed in the same location as the existing bridge to minimize the impact on the existing stream and adjacent properties, although relocating the bridge could have improved its hydraulic efficiency during high- flow periods.

New bridge on Depot Road, completed in 1996.

The most important choice in maintaining site aesthetics was selection of a simulated stone masonry form-lining and color-staining process for the exposed faces of the cast-in-place parapet wails and wingwalls, resulting in an appearance in keeping with the bridge being replaced. This process was selected over facing with actual stone to minimize long-term maintenance problems such as the re-pointing of joints or re-positioning of dislodged stones. Among available form-lining and color-staining processes, one by Custom Rock International, St. Paul, Minnesota, was selected because of its random-looking patterns and a staining process that involved coloring of individual stones for a realistic masonry appearance. The specified form-lining pattern was selected based upon its resemblance to the stones in the original bridge. A referee panel of the specified pattern and color-staining was prepared and approved prior to the start of construction and served for comparison of the work as it was underway.

The stone-masonry texture was formed on vertical surfaces and hand-carved on horizontal surfaces. The bridge date of completion was carefully cast into a large "stone" over the center of the channel in the exposed face of both parapet walls. Smaller-than-usual-size aggregate was specified for the parapet and wingwall concrete to help ensure that placement defects in the finished formed concrete surfaces, such as honeycombing, would be minimized. Curing compounds and solvents to clean forms were not permitted due to their negative effect on the staining process. Limitations were also placed on the type of form release agents allowed, for reasons of compatibility with the stain. After the necessary preparation work, the staining process began with a uniform spray-on base coat. Individual "stones" were then sponge and spray-stained using a series of seven shades to match the color and appearance of existing site masonry. This was the first use of the "Custom Rock International" process of form-lining and staining for a Connecticut bridge project.

Steel-backed timber guide railing, designed to AASHTO criteria, was specified for the bridge and roadway approaches to further enhance site aesthetics. Timbers were treated with an oil-borne preservative, selected over a water-borne preservative to minimize checking and maximize long-term durability of the timbers. The type of steel chosen for the backing plates will weather to a light brown color, matching the weathered appearance of the timbers.

Successful Construction and Design Recognition

The contract for construction of the bridge was awarded to Milton C. Beebe & Sons, Inc. of Storrs, Connecticut, and was completed in five months during the summer and fall of 1996. The precast rigid frame was provided by Concrete Systems, Inc. of Hudson, New Hampshire, under license from CON/SPAN Bridge Systems, Dayton, Ohio. The simulated stone masonry form-lining and color-staining process was supplied by Connecticut Bomanite Systems, Inc. of Newtown, Connecticut, under license from Custom Rock International, St. Paul, Minnesota.

The guiderail of the new bridge was designed to complement its rustic surroundings.

Construction of the bridge was completed on time and under budget for approximately $348,000. Town officials are pleased with the final appearance of the new bridge, which has drawn considerable interest from Connecticut Department of Transportation engineers, several consulting engineering firms, and officials from other communities who have come to view the completed bridge. The Depot Road bridge was featured by the Connecticut Department of Transportation’s Chief Engineer during a presentation at a recent public forum, entitled "Designing Roads and Bridges to Preserve Community Character" and sponsored by the Connecticut Rural Development Council and the Connecticut Trust for Historic Preservation, as an example of a structure designed in accordance with AASHTO standards while enhancing the aesthetic characteristics of the surrounding environs. Articles about the bridge construction have appeared in a number of local newspapers and numerous trade journals, and a photograph of the finished bridge appears on the front cover of the Connecticut Department of

Transportation Local Bridge Program's fiscal year 1998 report. The Portland Cement Association honored the bridge with an Award of Excellence in a nationwide competition (also including Canada) that recognizes creativity and imagination in the aesthetic design of concrete bridges.

Sites Unseen: Archaeological Resources Reveal Connecticut's Hidden History

MARY GUILLETTE HARPER

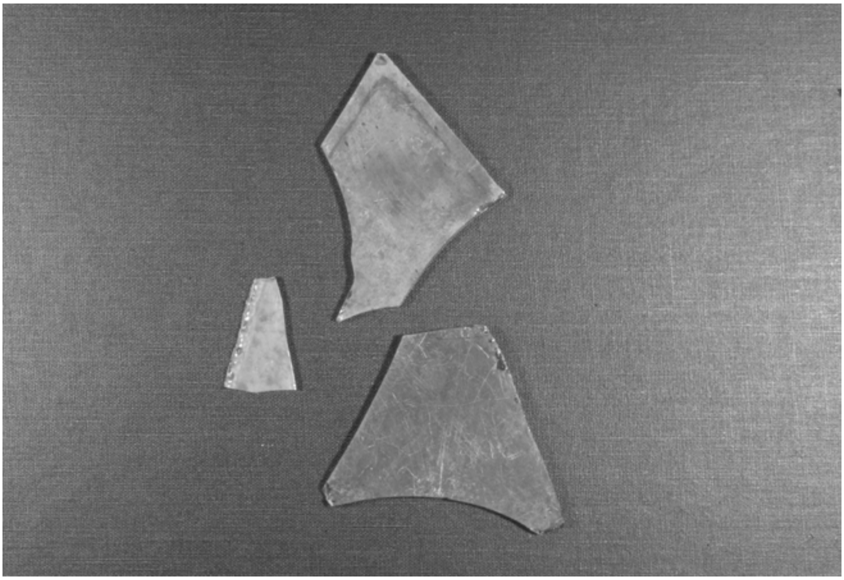
Perhaps the least visible resources that require professional consideration by the Connecticut Department of Transportation are Connecticut's archaeological sites, the diverse remnants of the state's past that lie hidden beneath the ground's surface. Historic buildings, bridges, cemeteries, and engineering features; rural, village and urban landscapes; and scenic roads of natural beauty are all important to preserve for present and future generations to enjoy and appreciate. These cultural resources are readily visible and recognizable and therefore form part of the consciousness of town governments, historic preservationists, concerned citizens, and transportation planners. However, beneath our feet and our wheels, within small villages, in urban and industrial centers, along rural roadways, and in agricultural fields, fascinating stories from our 12,000-year-old history lie waiting to be revealed.

For thirty years federal legislation has been in place to identify and protect America's archaeological heritage, yet most people are unaware that archaeological research often precedes transportation projects. Indeed, the general public seems amazed to learn that there are important archaeological resources in Connecticut - they think archaeological studies are only undertaken in exotic or obviously historic places such as Jamestown and Williamsburg. In actuality, hundreds of archaeological sites, discovered through Connecticut's transportation archaeology program, reflect every facet of the state's past, from post-glacial Paleo-Indian campsites to l9th-century industrial complexes, and readily demonstrate the unequivocal significance of our buried "treasure." Archaeological sites are critically important for the specialized information they bring to Connecticut's cultural history, information that is not accessible through the study of old buildings, maps, diaries, museum collections, and other historical sources. It is important that we properly identify, preserve, and learn from our state's fragile and irreplaceable archaeological heritage. Planners and the general public need to understand how significant archaeological resources are, the vast diversity of forms they can take, and what actions are necessary for protecting these resources for the benefit of everyone.

The following case studies of transportation-related archaeology highlight both the diversity of Connecticut's archaeological resources and their potential to provide us with information about people's lives in the past.

The excavated cellar at the Ephraim Sprague House in Andover.

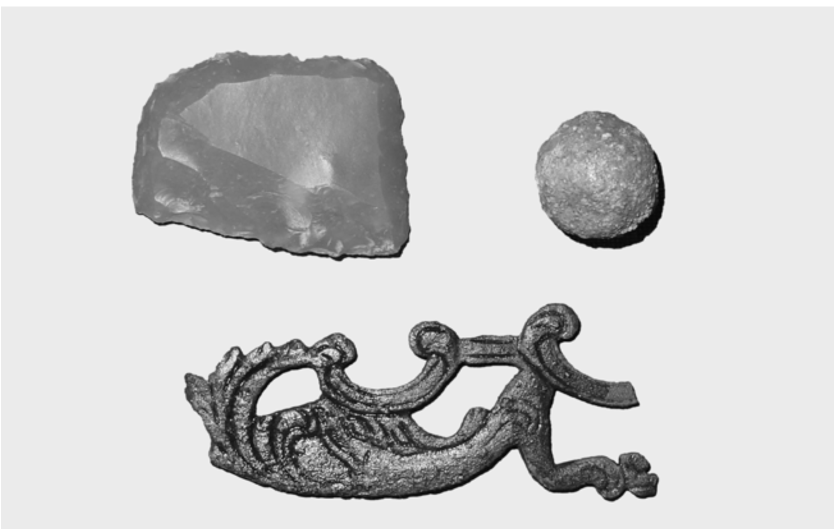
The sites of three 18th-century homesteads were recently discovered and professionally excavated in advance of Connecticut Department of Transportation highway improvements. Hidden beneath cultivated fields and surrounded by suburban and commercial development, these archaeological sites have produced enlightening information on everyday life in rural 18th-century Connecticut. Archaeological data from Andover's Ephraim Sprague house (occupied from 1705-1750s), North Branford's Samuel and Lydia Goodsell house (1737-1797), and Waterford's Thomas and Hannah Daniels house (1712-1770s) are changing our previous perceptions of 18th-century architecture, land-use patterns, and the lifeways of the "middling" sort, that is, the day-to-day lives of individuals and families who comprised the majority of Connecticut's population (yet are underrepresented in traditional historical documents). Archaeology provides a voice for the ordinary people who quietly formed the backbone of colonial society.



Fragments of glass recovered at the Daniels site indicate that the house (1712) had diamond-pane windows.

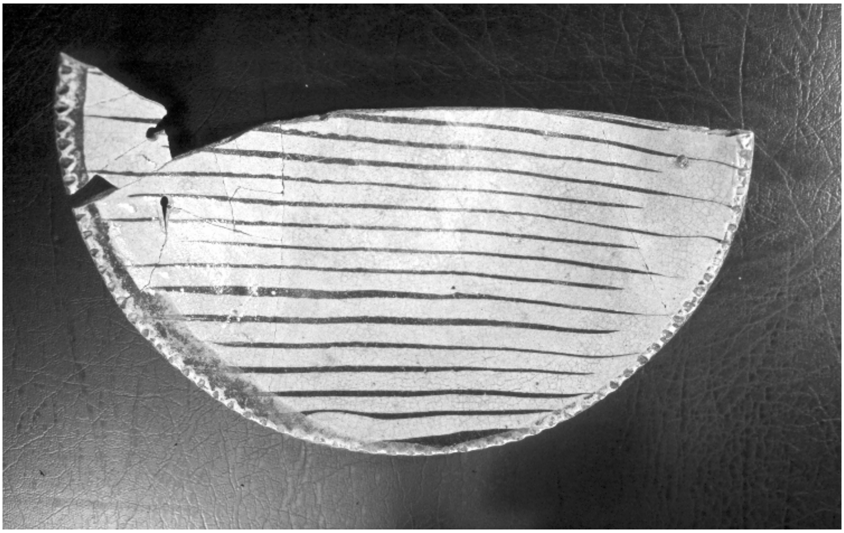
All three homestead excavations revealed that these families' houses were different from what we today think of as traditional New England Colonial architecture. The houses all had medieval-type leaded casement windows, and the plan of one was relatively long and narrow, like an English "long house." All three houses were framed with sills which sat at least in part on the ground surface or with posts set into the ground. Such medieval-English-style architectural features were thought to have been abandoned by Americans by 1660 or so, but these house sites suggest that New Englanders were very conservative, keeping old-country building technologies well into the 18th century. The three archaeological sites show that the range of colonial architecture was much broader than what one would guess based upon surviving examples of historic houses. Most surviving historic houses were the homes of fairly wealthy people and thus were larger and more substantially built than the houses of average people.

The archaeological investigations at the Sprague, Goodsell and Daniels homesteads produced large quantities of tools, clothing items, food remains, ceramics, and other household objects. These finds help us to understand the families' material possessions and the way they lived. For example, we know from documents that Ephraim Sprague was a locally prominent leader in his community; he was a militia captain, a deacon in the church, and a delegate to the Connecticut general assembly. Archaeology confirmed his exceptional social status: we found finely tooled buttons and cufflinks and a fine tea set imported from England, indicating he and his family engaged in the newly fashionable ritual of tea-drinking. At the same time, the archaeological discoveries also show a frugal, plain-living man who mended broken milk pans and made his own tools and implements from cut-up brass kettles and deer antlers. Food storage pits cut deeply into the sandy floor of Sprague's cellar point to a man who had the foresight to build his house over a sand vein, indicating how well colonial farmers understood the land.



Gun flint, musket ball, and musket sideplate recovered at the Sprague site in Andover.

Archaeological discoveries offer similar glimpses at the lives of the other two families. The Danielses lived not far from the Niantic River estuary, and we can tell that fish and other seafood formed a substantial part of their diet; they too had food-storage pits, some outside their house. The Goodsell site presents a rare opportunity to understand how single women lived in 18th-century Connecticut; the house was occupied for most of its life by a widow and her unmarried daughter. As with the Spragues and Danielses, objects recovered from the Goodsell homestead show clear evidence of repair and re-use, indicating they too practiced the Yankee frugality for which New England is famous. One bottle from the site had the initials "M. G." scratched into it; it must have been incised by Martha Goodsell, the daughter who lived there so many years with her aged mother. This level of detail rarely appears in the written historical record, which like museum collections, is heavily biased towards wealthy or famous people.



The small holes drilled into this plate from the Goodsell site indicate it was mended and re-used after it first broke.

Archaeology also helps us distinguish between what people said should be done and what actually occurred. To take but one example, Jared Eliot's *Essay upon Field Husbandry* (published over the period 1748-1759) recommended that farmers living within ten miles or so of the coast use ground-up shells to fertilize their fields. Did anyone take his advice? At the Goodsell site, a large cache of West Indian coral (probably brought to Connecticut as ballast) was found buried near the house, suggesting that the technique was indeed known and practiced by colonial farmers.

A group of pre-European sites indicating ancient occupation by Native peoples were discovered during the course of a highway improvement project in eastern Connecticut. An existing wetland had to be filled in and a new wetland created to take its place; a location in the floodplain of the Quinebaug River in Canterbury was chosen for the replacement wetland. Floodplain areas are ideal locations for wetlands construction because the soils are usually wet and amenable to the growth of important wetland plants and the consequent attraction of animals. But floodplains were also attractive to prehistoric peoples for the rich subsistence resources offered by a riverine location: fish, waterfowl, and the forest animals that drank from the river and, in later times, the rich alluvial soils for crop cultivation. The nearby river provided a steady supply of water, of course, and served as an easily accessible transportation route. Native Americans in canoes could quickly travel the Quinebaug River and its many tributaries to trade, hunt, make seasonal camp moves, and communicate with other Native groups.

Among the hundreds of artifacts recovered from the wetland replacement area in Canterbury was this Squibnocket-type projectile point dating from the Late Archaic Period.

Archaeological research over the last thirty years has firmly established a strong connection between rivers like the Quinebaug and the presence of prehistoric sites nearby, and the Canterbury replacement wetland area was no exception. Prior to construction, an archaeological survey was undertaken, resulting in the identification of a cluster of prehistoric sites within and around the wetland and beneath the proposed construction access road. Previous archaeological studies of the Quinebaug River area simply noted the presence of prehistoric sites but did not investigate them intensively; many have now been destroyed by development or other means and so are no longer available for study. The Canterbury wetlands archaeological survey has helped to fill the gap, both providing some long-missing information and preserving sites for the future.

The several sites within the Canterbury wetlands area are primarily occupations from the Late Archaic period, around 6,000 years ago. Artifacts and deposits found there include stone tools of various types and evidence for the production and reworking of tools. The sites cover much of the floodplain and several lie within the proposed access road. To create the wetlands, total avoidance of this large area of archaeological sensitivity was impossible, but a comprehensive archaeological investigation would have been prohibitively expensive. The Connecticut Department of Transportation, the State Historic Preservation Office, the Connecticut Department of Environmental Protection, and Public Archaeology Survey Team, Inc. developed a multi-component action plan that included the in-situ protection of three archaeological sites located along the access road through the use of protective geotextile fabric and the intensive archaeological study of two unavoidable areas of archaeological sensitivity in the floodplain. The new wetland was created in the areas that were excavated by archaeologists, thereby avoiding substantive impact to the rest of the archaeological resources.

The collection of sites, known as the Quinebaug River Prehistoric Archaeological District, was formally designated by the State Historic Preservation Office as a State Archaeological Preserve, which will ensure the sites' long-term protection. Public education components will include an Internet Web site, a public-oriented booklet, and interpretive signage. Creative solutions and a cooperative attitude among the various agencies resulted in the conservation of the Quinebaug

River Prehistoric Archaeological District. Visitors to this peaceful riverside area will be able to form an appreciation that goes beyond nature and makes them aware of the importance of natural resources to prehistoric peoples.

Remnants of early roadways are another example of important but often overlooked historic resources that have an archaeological component. Over the last several years, the Connecticut State Historic Preservation Office has nominated to the National Register of Historic Places several road segments that retain their l8th-century character. These surviving historic routes, located adjacent to Route 6 in Bolton, Route 14 in Scotland, and at other rural locations, have no doubt often been mistaken for simple logging roads or old farm lanes, but their actual significance is far greater. They are former public highways that are described in detail in the diaries of 18th-century travelers and especially in the written accounts of our French military allies who marched across Connecticut in 1781 and 1782 in order to assist America in the Revolutionary War. Standing on the now-abandoned remnant of 18th-century Breakneck Hill Road, located in the Town of Middlebury, one can envision the misery of the French soldiers' trek through a drenching rain. The steep switchback in the woods off Bailey Road in Bolton makes one understand how difficult a task travel was in the 18th century, even if one was fortunate enough to have horse or oxen power. These seemingly insignificant "paths" (frequently old roads that were bypassed by 20th-century road-straightening) should be looked at in a new light, as potentially important remnants of our colonial history which can serve as "viewfinders" for understanding life in the past.

These vestigial roadways help to provide an understanding of our transportation history and related social and economic developments. Roads, even if mere paths through the woods, were integral to commerce, communication, and settlement, and opened the way to the growth of colonial New England. Today we can stand in these few remaining old roads and see how farmers built stone walls to mark their property boundaries, how areas of ledge were filled to create a more level surface, how simple drainage systems were built by carrying run-off channels under stone-slab culverts, and how the winding geometry of the roads dealt with the need to ascend steep grades. These fast-disappearing remnants of our cultural landscape deserve our attention; preserving some of these ancient and relatively unchanged road segments will allow Connecticut residents to pull off the main highway once in a while and visit the pathways that both literally and figuratively lead back into the past.

A steep, winding, and long-abandoned road in Bolton recalls the difficulties faced by the French in their march across Connecticut during the American Revolution.

Archaeological remains have also proven useful in illuminating Connecticut's industrial heritage. Sawmills, grist-mills, tanneries, woolen mills, silk mills, firearms factories, and numerous other enterprises from the 18th through the 20th centuries lie buried, waiting to reveal their stories. Connecticut's industrial archaeological remains vary from small-scale craft industries to once-nationally-prominent l8th-century industrial complexes. Indeed, industrial archaeological sites can be discovered in virtually every community if one looks carefully.

The Connecticut Department of Transportation has been responsible for the identification and documentation of several important industrial sites, including the recent excavation and photographic documentation of an 1870 railroad roundhouse located within the New Haven rail yard, a 19th-century carriage parts factory in Hamden, and a l9th-century commercial pier in New London harbor. Archaeological research at these industrial sites provided important information that was unavailable through traditional research methods. The rail yard investigation, for example, showed that the railroad had rebuilt parts of the roundhouse at least twice, even while retaining portions of the original structure. The carriage-parts factory survey strongly suggested that the owners diverted water from the defunct Farmington Canal as a supplementary source of waterpower. The Connecticut Department of Transportation has made information on these important sites available to the local community, historical societies, and interested citizens through public presentations and lectures, the creation of Internet Web sites, and papers contributed to popular publications and professional journals.

Archaeological monitoring during the construction of the Church Street overpass in New Haven exposed foundation remains of the 1870 Spring Street Roundhouse.

What have we learned from archaeological investigations undertaken as part of transportation projects? The answer is twofold: 1) archaeology has repeatedly provided important information about Connecticut's prehistoric and historic past that is unavailable from traditional archive-based research, and 2) archaeological sites can indeed be located anywhere, even though they may not be obvious from casual inspection. Every town in Connecticut potentially possesses a wealth of archaeological secrets. The empty lot in a suburban neighborhood, a paved city parking lot, a historic house's back yard, a rural country landscape, historic agricultural fields along a scenic road, and the small side roads that one passes every day should be reexamined from a new perspective, one that envisions the existence of a “history bank” within the ground. This bank’s assets are our collective history; if those assets are carefully protected and managed, they can help inform the public and even enrich their transportation experience. Imagine how much more a driver can see traveling a scenic road, if he or she realizes the road follows the very same route our Continental Army traveled during the Revolutionary War. And, imagine a quiet floodplain in Canterbury where people are fishing on the same spot where Native Americans fished thousands of years ago. When highway planners, historic preservationists, town governments, private developers, and the general public can fully realize that the state’s landscape is full of unseen archaeological resources, then a new appreciation for the richness of the past will be our reward.

Documenting

The Past

Documentation Standards for Connecticut's Cultural Resources

CECE SAUNDERS AND ROBERT MOORE

"Have you finished all that writing and picture taking? Can we tear the bridge down, now?"   It is a critical moment of second thoughts and nagging doubts. Unnerving questions hang in the air as the demolition contractor awaits your answer. . . .

Introduction

Connecticut's heritage resources, which date from its early days as a colony up to the recent past, are often in danger of being removed from the landscape in order to accommodate 21st-century needs: safer and wider bridges, additional housing, water and sewer improvements, and commercial development. Despite extensive consultation and inter-agency efforts to examine alternatives, significant buildings, structures, objects, and sites from Connecticut's past may be lost. Historic houses and factories may face demolition, and picturesque narrow bridges may be threatened with replacement. The Connecticut State Historic Preservation Office has established specific standards for ensuring appropriate written and photographic documentation of important cultural resources before the contractor swings a wrecking ball. Adhering to these professional standards will ease the burden of responsibility when State Historic Preservation Office-sanctioned destruction is imminent. In addition, these standards represent a good approach for documenting threatened historic properties irrespective of state and / or federal involvement.

The following documentation guidelines provide for a comprehensive written and photographic record that will ultimately be deposited by the State Historic Preservation Office with the University of Connecticut's Thomas J. Dodd Research Center as part of the Connecticut Historic Preservation Collection. Once properly accessioned by the Dodd Center, these narrative and photographic materials will be publicly available to be retrieved for students, concerned citizens, and others.

When a state agency proposes actions that would alter or destroy a potentially significant resource, and no feasible or prudent al-

ternative exists, the State Historic Preservation Office evaluates the project and decides upon an appropriate level of documentation. The State Historic Preservation Office's decision is based upon numerous considerations, among which are the following:

- Is the property of local, state, or national significance?
- Is the property individually eligible for the National Register of Historic Places or a contributing component of an eligible historic district?
- What is the property's overall degree of integrity?
- How does the property compare to similar resources within the community and the state?
- Does the property convey important associations with the community's historical development?
- Does the project propose total demolition, major alterations, or minor modifications of the resource?
- Are there nearby associated historic properties or an historic landscape that will be radically altered by the proposed undertaking?

If the State Historic Preservation Office decides to mandate professional completion of state-level documentation rather than recordation to the National Park Service's standards, the following guidelines will ensure a consistent level of quality in reports filed with the Connecticut Historic Preservation Collection.

Connecticut's documentation requirements are based on the well-established standards of the National Park Service's Historic American Buildings Survey (HABS) and the Historic American Engineering Record (HAER). Starting in the 1930s, the National Park Service, in coordination with state and local sponsors, has undertaken numerous HABS and HAER projects to document nationally-significant historical resources. The projects have created important archival materials that preserve a record of the nation's residential, commercial, public, monumental, religious, military, and industrial buildings, sites, and structures. This method of saving our collective past through professionally implemented and extensively-detailed studies, which are deposited with the Library of Congress for permanent archiving and public accessibility, has been very effective in preserving information on our nation's cultural heritage.

Over the last two decades, the overwhelming majority of HABS and HAER documentation efforts have been the direct result of federally-mandated cultural resource reviews undertaken in accordance with the Section 106 process of the National Historic Preservation Act of 1966. These environmental review submittals currently constitute one-third of all HABS-HAER submissions to the Library of Congress.

The Connecticut State Historic Preservation Office believes that not all threatened cultural resources warrant the considerable expense and professional effort required by the National Park Service's HABS-HAER documentation standards. Consequently, the State Historic Preservation Office has developed its state-level documentation requirements as a viable alternative that provides an appropriate degree of professional recordation for properties of state and/or local importance. Equally important, the State Historic Preservation Office's partnership with the Dodd Research Center at the University of Connecticut provides greater and easier public accessibility and ensures long-term archival preservation of the documentation for soon-to-be-demolished cultural resources.

State-Level Documentation Standards

All written and photographic state-level documentations must be submitted for review by the State Historic Preservation Office. If accepted, the State Historic Preservation Office will transfer the materials to the Dodd Research Center, which will then include the document title, author, date, and location in its *User's Guide to the Connecticut Historic Preservation Collection* (http://chpc.lib.uconn.edu). The collection expects these documents will be used by both present-day and future researchers. Consequently, all submitted materials must be both archivally stable and user-friendly. Because of the Dodd Research Center's storage and retrieval requirements, all components of the documentation must be consistently labeled with the name of the property and its town and properly cross-referenced with other parts of the documentation package.

Each submittal must include a brief explanatory cover letter which indicates the specific project and agency that generated the submitted materials. In addition, there are four primary components which compose the total documentation package required by the State Historic Preservation Office. Discussed in greater detail on the following pages, these components include narrative text, photographs (including negatives or electronic media), an index to the photographs, and a photographic site plan.

Narrative Text

The narrative text serves to describe the physical condition and historic use(s) of threatened properties and in effect becomes an archival epitaph. As such, the descriptive text that accompanies the photographs should be comprehensive, yet succinct. The actual number of pages of written text will vary depending upon the importance and complexity of each historic property. The text should include a brief statement of purpose for the documentation study; that is, an explanation or identification of the proposed project and the future use of the property should be provided. While it is unnecessary and undesirable to present a lengthy discussion and/or justification for the proposed demolition or other alterations, a brief recapitulation of the site-specific federal or state review and consultation process is required.

There is no preferred or predetermined format for the narrative text, but it should follow a logical presentation and include sufficient material to fully describe the site history, physical environment, and context of the threatened cultural resource, including a discussion of comparable properties. When safe and accessible, both the exterior and interior conditions of historic structures must be described and evaluated. The State Historic Preservation Office strongly recommends that the historical and archival research for the narrative text should precede the photographic documentation process in order to give the photographer a clear understanding of what is critical to capture on film, such as any particular views, architectural components, or small-scale details that may have been identified as important. Although it is inappropriate to duplicate existing reports, pertinent documents should be referenced and repositories for original plans, shop drawings, historic photographs, and similar archival documents should be listed by full name and address.

Checklist for State-Level Written and Photographic Documentation Submission:

- ❑ **Cover letter to State Historic Preservation Office of the Connecticut Commission on Culture & Tourism.**
- ❑ **Narrative text**
- ❑ **Site location noted on appropriate portion of USGS topographical quadrangle map**
- ❑ **Original photographs**
- ❑ **Negatives or electronic image files on CD-ROM**
- ❑ **List of photographs**
- ❑ **Photographic site plan**

☞ **Property name and location must be appear on all materials and be consistent; no abbreviations allowed**

The text should reference the accompanying photographs by number (see Index to Photographs) in order to guide the reader through the narrative. If available, at least one historic map, reproduced on archival paper with the project area clearly annotated, should also be included. Historic newspaper accounts and photographs can also be included as a supplement to the narrative text.

Production specifications for the text are straightforward. A title page should clearly identify the historic (and common) name of the property, its specific location (street address and town), the preparer of the narrative text (name, affiliation, and address), and the responsible agency with address, date, and town; abbreviations should not be used. Text must be printed, on one side only, on 8 1/2" x 11" archival paper (a list of suppliers of archival materials is included with this essay). Each page of text should contain an appropriate footer and/or header that includes the name of the property, the town name, and a sequential page number. A bibliography should include, where appropriate, repositories of archival sources (cited and non-cited) and identification of individuals who provided pertinent observations or personal recollections. The property's location must be clearly noted on an acid-free 8 1/2" x 11" photocopy of the appropriate U.S. Geological Survey quadrangle map, with the name of the quadrangle clearly indicated.

Binding

Do not use staples, paper clips, or any adhesive products. If the documentation package is less than 50 pages, submit the material unbound in an acid- free archival folder. If the documentation text exceeds 50 pages, front and back covers should consist of acid-free card stock with the addition of clear plastic protector pages over the covers; bind the text and covers with a plastic comb.

***NEVER* USE:**

- ⃠ **staples**
- ⃠ **paper clips**
- ⃠ **ballpoint pen**
- ⃠ **glue/adhesive/tape products**

Photographs

There is no prescribed maximum or minimum number of photographic views that are required for any particular resource, whether a one-lane rural iron-truss bridge, an isolated farmstead, an urban streetscape, or a multi-structure industrial complex. Simply, the photographic recordation must be adequate to convey the important elements of the historic resource. The sequence of views should be organized in a logical pattern, such as beginning with wider contextual (exterior) perspectives and ending with specific details.

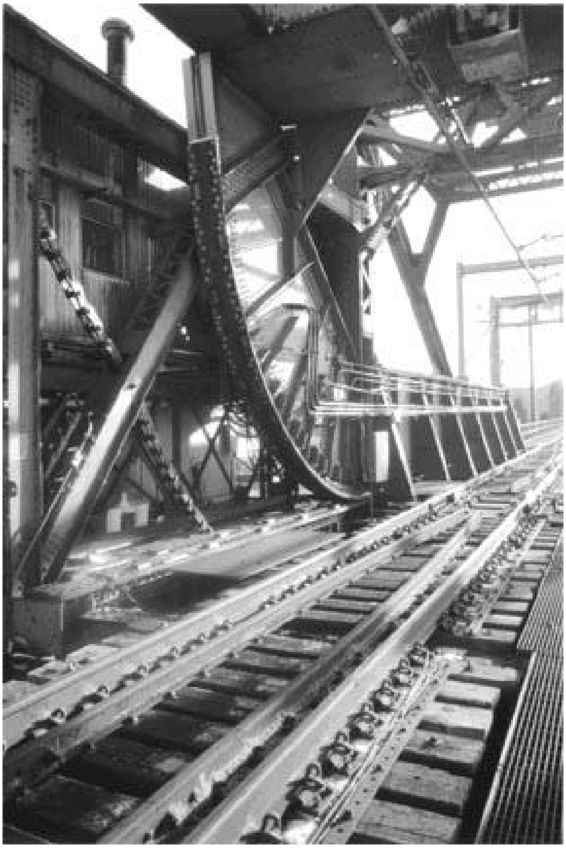
Excessive and redundant photographs are to be avoided; well-focused and properly-centered perspectives showing all elevations are usually sufficient for a simple historic property. The physical context of the historic resource, e.g., streetscapes, significant landscape components, and other associated environmental or cultural features, can often be conveyed with one or two views. Two views (opposing perspectives) should be sufficient to document sculptural ornamentation. However, once in the field, the photographer should select as many views and details as seem appropriate. Although undeveloped as actual prints, redundant views should be retained on the negative strips (if applicable); these will become an integral component of the final submission of documentation materials.

Connecticut River Railroad Bridge, Old Lyme - Old Saybrook, camera facing northwest (HPI photograph).

Exterior photographs should include general views of the resource (e.g., streetscapes and related landscape settings) as well as detailed views of functional and/or decorative design elements that are of engineering, industrial, or architectural interest. Particular attention should be addressed to both out of the ordinary elements and the overall character that identify the historic resource, i.e., its period of construction, its massing, size, and materials, and its unique use(s) through time. One should also not overlook the small-scale details that serve to define the character of a historic property.

Cultural material encountered during research and/or field investigation can humanize the story of any soon-to-be-demolished resource. For example, in the case of an historic industrial property, photographs that capture time clocks, safety signage, inspection records, manufacturer's plates, extant machinery, and historic graffiti can contextualize the resource in its time and place and connect it with its local community.

Questions concerning the extent of the photographic documentation effort can arise when archival research has revealed a wealth of architect's plans, construction or shop drawings, postcard collections, business management papers, etc. In this situation, the State Historic Preservation Office should be contacted to decide whether it would be best to include text notations on the extent and location of original archival materials or, alternatively, photographic reproductions of all or a sample of the archival materials. The State Historic Preservation Office should also be contacted regarding appropriate guidance and decision-making on the possible retention and donation of archival materials.



Detail of chain drive and roller segment, Niantic River Railroad Bridge, East Lyme, camera facing southwest (HPI photograph).

Photographic Specifications

A major goal for documentation standards is the permanence of the photographic record. Black-and-white images taken with a 35mm camera and printed on specific silver-emulsion paper have been acceptable for decades. New technology now affords options in the type of camera used in documentation. Digital color images that meet a permanence standard of 75 years are now acceptable. Specifications for both types of cameras are presented below.

35mm Cameras. Traditional black-and-white film, such as Kodak Plus X™, should be used. At present, popular chromogenic black-and-white films, which share more similarities with color films than with traditional black-and-white films, do not meet an acceptable permanency threshold. Archival acid-free photographic paper and archivally-stable chemicals are required for the photo-development process.

Fixed spans of the Connecticut River Railroad Bridge, Old Lyme - Old Saybrook, camera facing southwest (HPI photograph).

Digital Cameras. Digital cameras must be capable of producing an image size of 6 megapixels, with 7 megapixels (or greater) preferred. A camera of this capability will allow some cropping without dropping below the minimum final image size. Equally important is the quality of the camera's lens; a camera with a low-quality lens will produce poor images regardless of its image size.

Black-and-white prints from digital cameras can be printed in-house without going to a special production lab, as long as a combination of archival inks and premium photo paper is used. Currently, Hewlett-Packard Vivera™ ink cartridges can be used with HP Premium and Premium Plus Glossy photo paper to meet the 75-year permanence standard, as can Epson UltraChrome™ pigmented inks with Epson Premium papers.

Electronic images corresponding to the submitted photographs must also be submitted. Electronic image files must be saved as uncompressed .TIF (Tagged Image File format) files on CD-ROM media, in keeping with guidance on digital photographic records issued by the National Archives and Records Administration. The minimum size of each image must be 1600 x 1200 pixels saved at 300 ppi (pixels per inch). It is recommended that digital images be saved in 24-bit RGB or 32-bit CMYK color format, which provides maximum detail even when printed in black-and-white. The CD-ROM label must reference the Town and Property Name. The file name for each electronic image must include the photograph number corresponding to the number in the index and the number written on the back of the printed photograph.

One set of original photographs is required. The preferred format is 3" x 5" black-and-white prints (4" x 6" is also acceptable, but nothing larger). Each photograph should be slipped into an individual archival sleeve. Each archival sleeve must be annotated with the name of the historic property, its specific street address and town, and its corresponding photograph number. Photographs must be numbered in a logical and sequential series. Numbers should be noted on back of each photograph with a soft #2 or softer pencil and must be consistent with the assigned numbers on the photographic site plan and the index to photographs. When labeling the back of the photographs, place individual photographs on a hard surface and press lightly, so that the emulsion on the front surface is not broken.

If 35mm photography is used, one full set of uncut negatives stored in archival quality, multiple-strip sleeve sheets is also required. The sleeves are to be annotated, prior to inserting negatives, using a soft pencil, with the town and property name and/or street address.

Negatives are extremely fragile and should be kept in their sleeves. If negatives must be handled, it is imperative to limit contact to their edges and use lint-free archival gloves (the body acids from a finger-print can destroy the archival stability of photographic negatives).

Index of Photographs

An index, or list, that identifies all the printed photographs must be included. The list should be dated and labeled by town, location, project number (if any), and the photographer's name. An identifying footer and/or header must be on each page of the list, but the margins are not regulated. As with the narrative documentation, the Index of Photographs should be printed on only one side of acid-free, 8 1/2" x 11" paper. Each photograph must be numbered in logical and sequential order and must include a short descriptive caption (see accompanying photographs). The direction of the view, or camera angle, must also be provided. In addition, simple orientation cues may be helpful (e.g., “Main Street in foreground”).

Photographic Site Plan

Coordinated with the Index to Photographs, the Photographic Site Plan literally depicts the position of the photographer when taking each specific view of the threatened historic resource. A simple plan, or footprint, of the historic property, whether a bridge, single family residence, commercial block, industrial complex, or streetscape, is the basis for the Photographic Site Plan. An existing drawing or plan may be used and annotated with appropriate photograph numbers and directional arrows. Directional arrows serve to depict the photographer's perspective. The Photographic Site Plan should include a north arrow and identify at least two landmarks, such as adjoining streets, nearby structures, or prominent environmental features.

All annotations should be completed prior to reproduction on acid-free, 8 1/2" x 11" paper. In addition, the Photographic Site Plan must be dated and labeled by town, location, project number (if any), and the photographer's name. An identifying footer and/or header must be on the key map, but the margins are not regulated. Figure 1 provides an acceptable example of a Photographic Site Plan.

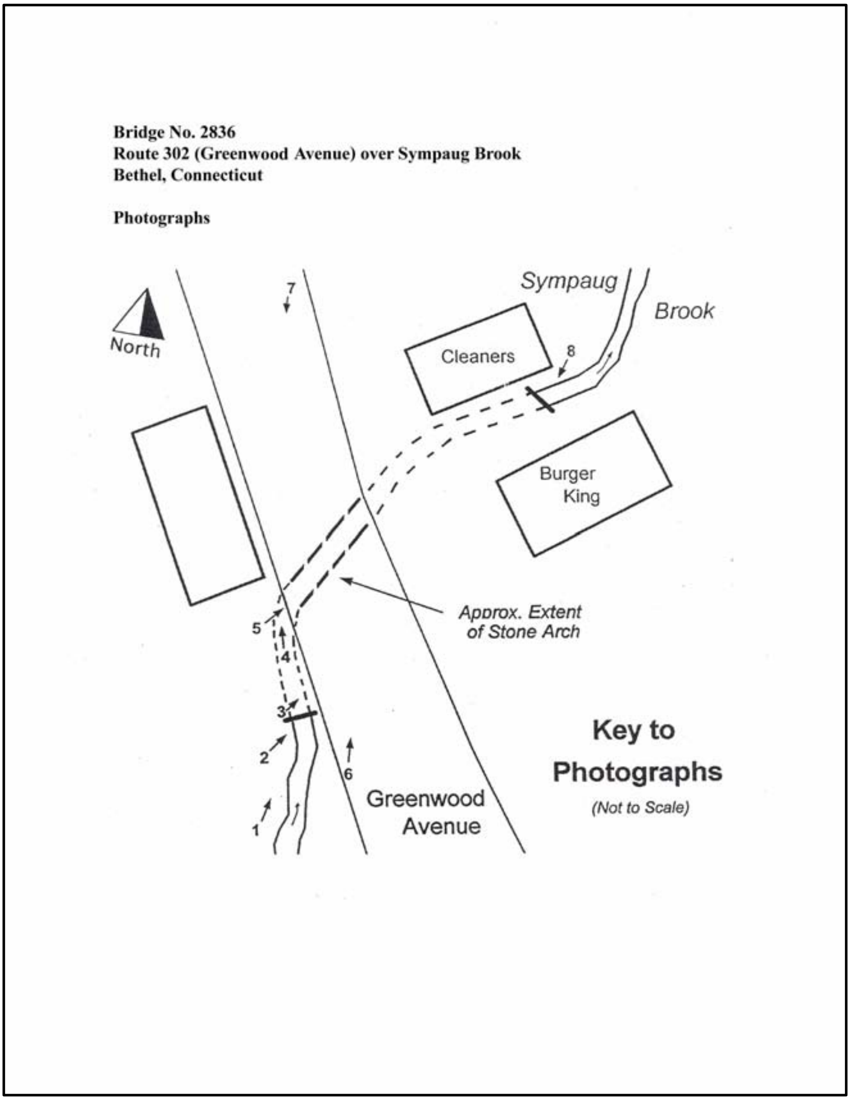


Figure 1: Example of Photographic Site Plan.

Sources for Archival Materials:

Conservation Resources International LLC
5532 Port Royal Road
Springfield, VA 22151
800-634-6932, 703-321-0629 (fax)
www.conservationresources.com

Gaylord Brothers, Inc.
P.O. Box 4901
Syracuse NY 13221-4901
800-448-6160, 800-272-3412 (fax)
www.gaylord.com

Hollinger Corporation
P.O. Box 8360
Fredericksburg, VA 22404
800-634-0491, 800-947-8814 (fax)
www.hollingercorp.com

Light Impressions Corporation
P.O. Box 787
Brea, CA 92822-0787
800-828-6216, 800-828-5539 (fax)
www.lightimpressionsdirect.com

Printfile, Inc.
P.O. Box 607638
Orlando, FL 32860-7638
800-508-8539, 800-546-4145 (fax)
www.printfile.com

Pohlig Bros., Inc.
8001 Greenpine Road
Richmond, VA 23237
804-275-9000, 804-275-9900 (fax)
www.pohlig.com

TALAS
20 West 20th Street – 5th Floor
New York, NY 10011
212-219-0770, 212-219-0735 (fax)
www.talasonline.com

University Products
517 Main Street
Holyoke, MA 01040
800-628-1912, 800-532-9281
www.universityproducts.com

Documenting the Cos Cob Power Plant for the Historic American Engineering Record

ROBERT C. STEWART

Connecticut's surviving industrial structures and transportation network bear witness to the hard work, perseverance, creativity, and imagination of the state's engineers, manufacturers, inventors, entrepreneurs, builders, and workers. Although historians have recognized and explored the significance of industry on American life, the physical heritage of industry is always in danger. Technological progress inherently jeopardizes the survival of sites, artifacts, structures, machines, and the material culture associated with the industrial revolution. The free market's drive for ever greater efficiency and the most profitable use of property forces the demolition and replacement of obsolete factories and equipment. Improved, more cost-effective technology displaces the infrastructure that was vital to earlier industry and transportation systems.

In addition to academic interest in technology and the industrial revolution, there is a practical reason for studying and preserving our industrial heritage. Learning how engineers, technicians, and artisans of earlier centuries solved their problems can save their successors time in developing new methods. Historical knowledge helps contemporary technologists avoid repeating costly errors of the past. Preservation of the records of these technologies is as important to the education of aspiring engineers and an informed society as it is to historians of technology. Additionally, examination of exceptional artifacts, machinery and structures from the period of industrialization inspires greater ingenuity and creativity among engineers and inventors.

Preeminent among the organizations that support the preservation of America's industrial heritage is the Historic American Engineering Record (HAER). HAER is a companion organization to the Historic American Building Survey (HABS), which was founded in 1933 to preserve America's architectural heritage. An agreement among the National Park Service, the American Society of Civil Engineers, and the Library of Congress established HAER in 1969. Later the American Society of Mechanical Engineers, the Institute of Electrical and Electronic Engineers, the American Institute of Chemical Engineers, and the American Institute of Mining, Metallurgical and Petroleum Engineers ratified the original compact. The National Park Service administers HAER, using government and private funding. State historical commissions, municipalities, museums, foundations, and private corporations financially support and sponsor HAER projects.

HAER sets qualitative standards for documenting historic industrial buildings, structures, objects, including bridges, transportation and transmission systems, warships and commercial vessels, and machinery. It organizes and provides staff for projects and designates sites for survey and recordation. The Library of Congress archives HAER records, provides public access and produces reprints for researchers. The engineering societies serve as a source of professional counsel.

Recordation can include creation of measured and interpretive drawings, large-format photographs, and written historical reports. These elements provide a detailed record that describes and interprets a site's significant features. Archival preservation procedures safeguard the HABS/HAER collections. The drawings, field records, and photographs can provide the information needed for repair or reconstruction of a historic building if there is a fire or natural disaster. In cases in which the property is to be demolished, HAER documentation represents a means of preserving for future generations useful information that otherwise would be lost.

A Connecticut project that clearly illustrates the value of HAER documentation is the recordation of the Cos Cob Power Plant in Greenwich (HAER No. CT-142). Cos Cob, the New Haven Railroad's primary electrical-generating facility, was constructed on the west bank of the Mianus River in Greenwich between 1905 and 1907. It was the first generating station built exclusively to supply trunk-line railroad electric-traction power in the United States. The plant also served as an advanced experimental facility where engineers from Westinghouse and the New Haven created the standards for the electrification of major American railroads.

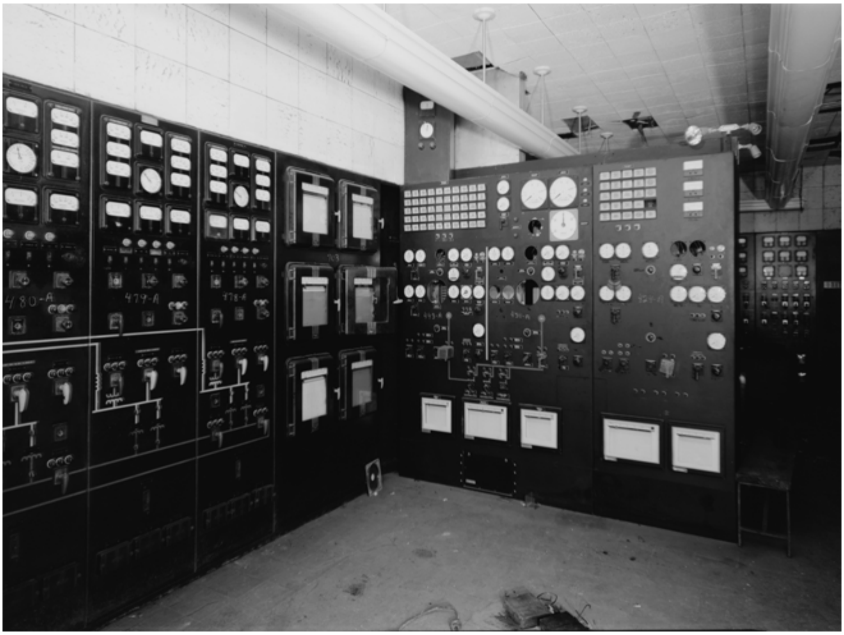
The systems developed at Cos Cob were technologically innovative and reliably powered the railroad for almost eighty years. Railroad bankruptcies and subsequent lack of capital funds for replacement and modernization of machinery resulted in the utilization of the early 20th-century generating equipment long after its obsolescence.

North elevation of the Cos Cob Power Plant (HAER photograph by Jet Lowe).

After the New Haven Railroad entered bankruptcy in 1968, the venerable plant continued operating under the Penn-Central Railroad and Conrail until 1983. In that year, Connecticut and New York organized the Metro North Commuter Railroad to provide rail service in the northern part of the New York City metropolitan area and Connecticut. Cos Cob continued to provide power to Metro North until September 8, 1986, when the rail corridor was converted to 60-cycle public utility power. The state conveyed most of the plant and its site to the Town of Greenwich, which planned to demolish the plant and redevelop the site for residential and recreational use.

Connecticut's State Historic Preservation Officer, concurring with an earlier recommendation for HAER documentation, convinced the town of the site's historic engineering significance. Unlike many HAER recordations, this project was not triggered by the proposed use of federal funds. Instead, it was initiated and paid for by the Town of Greenwich with the co-sponsorship of the State Historic Preservation Office.

Fortunately, the Connecticut Department of Transportation preserved the original Cos Cob power plant drawings, which were abandoned at the deserted facility. The old prints enabled HAER delineators to create a detailed set of interpretive drawings and minimized the need for field measurements. The original plans are now archived as part of the railroad collections of the Thomas J. Dodd Research Center at the University of Connecticut, which also include extensive other holdings related to the history of the New Haven Railroad.



Cos Cob Power Plant control room (HAER photograph by Jet Lowe).

Eric N. DeLony, Chief of HAER, organized a team of professionals and students during the summer of 1993 to undertake the Cos Cob recordation. The recording team consisted of Robert W. Grzywacz, architect and team supervisor; architectural technicians Dale O. Waldron Jr. and Thomas Cirillo; Robert C. Stewart, industrial archaeologist, responsible for the production of the written historical report; and Jet Lowe, HAER photographer.

Historical Context of the Cos Cob Power Plant

In the late 19th and early 20th centuries, the New York, New Haven and Hartford Railroad (commonly called the New Haven or the Consolidated) was a huge holding company that achieved a nearmonopoly on rail, streetcar, and steamship service in southern New England. J. P. Morgan and William Rockefeller controlled the company and used it as a personal resource for backing various financial schemes. They increased the railroad's capitalization from $93 million to $800 million by issuing additional stock, a considerable amount of which was "watered" stock not backed by tangible railroad assets. Almost two-thirds of the new capital went for non-railroad investments or benefited inside investors and favored contractors.

In addition to enriching his inner circle, Morgan's program provided substantial capital for the New Haven's expansion and development. In the 1890s, the public was becoming increasingly irritated with the smoke and gasses associated with steam-powered railroads operating within densely populated areas. A fatal accident in the tunnel leading to Grand Central Station resulted in the banning of steam-powered lines from New York and forced electrification on metropolitan railroads.

Turbine-generator sets (HAER photograph by Jet Lowe).

During this period the New Haven employed a dynamic and creative engineering staff eager to work on the advanced technology of the period -- electricity. The New Haven had been the first railroad to electrify a standard branch line, the Nantasket Beach route, which served a recreational area southeast of Boston. On June 30, 1895, the New Haven began running trains on the branch with electric power (beating by a few days the Baltimore and Ohio's electrification of a 7,200-foot-long tunnel under the city of Baltimore). The New Haven continued its experiments with electric traction, and by 1907, when the Cos Cob power plant started generating, the company was successfully operating eight sections of electrified railroad in Connecticut. These lines and the New York Central Railroad's electrified lines in the New York City area ran on direct current at 500 to 600 volts.

As early as 1895, George Westinghouse had proven the cost advantage and technical superiority of high-voltage alternating current over direct current, especially for long-distance operation. The New Haven, intending ultimately to electrify its lines from New York to Boston, decided on an alternating-current system to be engineered and built by Westinghouse. The joint efforts of Westinghouse and New Haven engineers, led by Calvert Townley and William Murray, produced a design that set standards for long-distance railroad electrification based on alternating-current power.

In 1905, the New Haven announced that it would electrify its main line from Stamford, Connecticut, to Woodlawn, New York, the first trunk-line electrification in the United States. The radical plan used single-phase 25-cycle alternating current at 11,000 volts distributed through an overhead catenary system. The overhead transmission wires offered more positioning flexibility than a third rail and reduced the possibility of accidental contact and electrocution of workers.

The announcement astonished the engineering community. Conservative engineers considered the proposal a reckless departure from the standards and proven components of the period. Alternating-current locomotives and railroad transmission systems did not exist in the United States. To operate on the New York Central's third-rail, direct-current system from Woodlawn to Grand Central Terminal, the New Haven's locomotives would need a complex dual power ac/dc system.

In 1905 the low frequency 25-cycle power necessary to electrify the railroad was not available from commercial sources. The railroad had to design and build its own plant independently of public utilities.

Typically, the New Haven did everything from heavy construction and maintenance to timetable printing within its own organization; building and operating the Cos Cob power plant was in keeping with this practice. The proposed system was a significant advance in railroad electrical technology which set the standards for electrification of the Pennsylvania and other railroads.

The plant site was in a prime residential area next to an attractive harbor, and Cos Cob residents objected to having a power plant in the vicinity. To blunt opposition, the architects designed a building that was aesthetically pleasing and in harmony with the surroundings. After considering a purely functional plan typical of early 20th-century mills, the design evolved through a Spanish Romanesque form to a final motif patterned after the Spanish California Mission style. A red Ludowici tile roof helped to soften the industrial aspect of the plant. Plain-faced concrete blocks made on site formed the plant walls. As the site's gneiss bedrock was excavated for the foundation, it was crushed and used as aggregate for the blocks. A monitor roof provided light and ventilation to the boiler room and turbine hall. The architects gave the turbine hall an ornamental touch with a wainscoting of Faience tile. Strategically placed trees, shrubs, and flower beds enhanced the landscape around the plant.

The 11,000-volt, 25-cycle alternating current produced at the plant was stepped down by transformers in the locomotives to 660 volts for the specially designed Westinghouse driving motors. Today, technological advances have reduced the advantages of 25-cycle power and the New Haven's successor, Metro North, uses lower cost 60-cycle power provided by public utilities.

HAER Team Methodology

The HAER team surveyed Cos Cob and prepared eight drawings based on original building plans, blueprints secured from original equipment suppliers, and field measurements. The historical report relied on articles that appeared in technical journals, records from the Westinghouse Electric & Manufacturing Company archives, and period electrical textbooks. Other sources included special engineering libraries, railroad records, reports of government agencies, equipment operating manuals, and interviews with electrical engineers and surviving workers or the families of workers. The team determined how

Firing aisle, east boiler room (HAER photograph by Jet Lowe).

the plant originally operated by closely studying the coal-handling systems, boilers, generators, turbines, electrical equipment, and ancillary machinery extant on the site. Public archives and private collectors generously supplied historical photographs.

The project added over one hundred and thirty large-format new photographs and photocopies of historical materials on the Cos Cob plant to the HAER collection. Recordation of the New Haven's catenary system for supplying overhead power to the trains, the circuit breakers that protected the system, and the Cos Cob plant's water supply system required supplementary HAER reports.

Working Life at Cos Cob

The personal memories of Cos Cob employees helped give a human dimension to the plant's history, enabling the recordation team to appreciate and visualize the plant as a dynamic functioning entity, instead of a collection of drawings and archived records that provide factual but colorless information. Employee memories also illuminate the day-to-day problems involved in running a plant based on an emerging technology. Sidney Withington, electrical engineer for the railroad, recalled that there were six different electrification systems developed and tried before the system worked properly. From 1907 until about 1924 the engineers developed innovative modifications to advance the technology and provide additional power for a growing system. W. S. Murray, chief engineer for the New Haven, claimed his records provided a "how-not-to-do-it manual" that helped other railroads electrify with relative ease.

Exploring the underground passages of the plant shed light on the unwritten side of work culture at Cos Cob. An overstuffed easy chair found in a remote corner could be used for a quick nap away from the chief's supervision. Worker accounts of fishing from the east windows of the 1906 plant were corroborated by the discovery of places to tie lines on the window sills. Ash disposal later extended the shoreline and eliminated the convenient fishing spot.

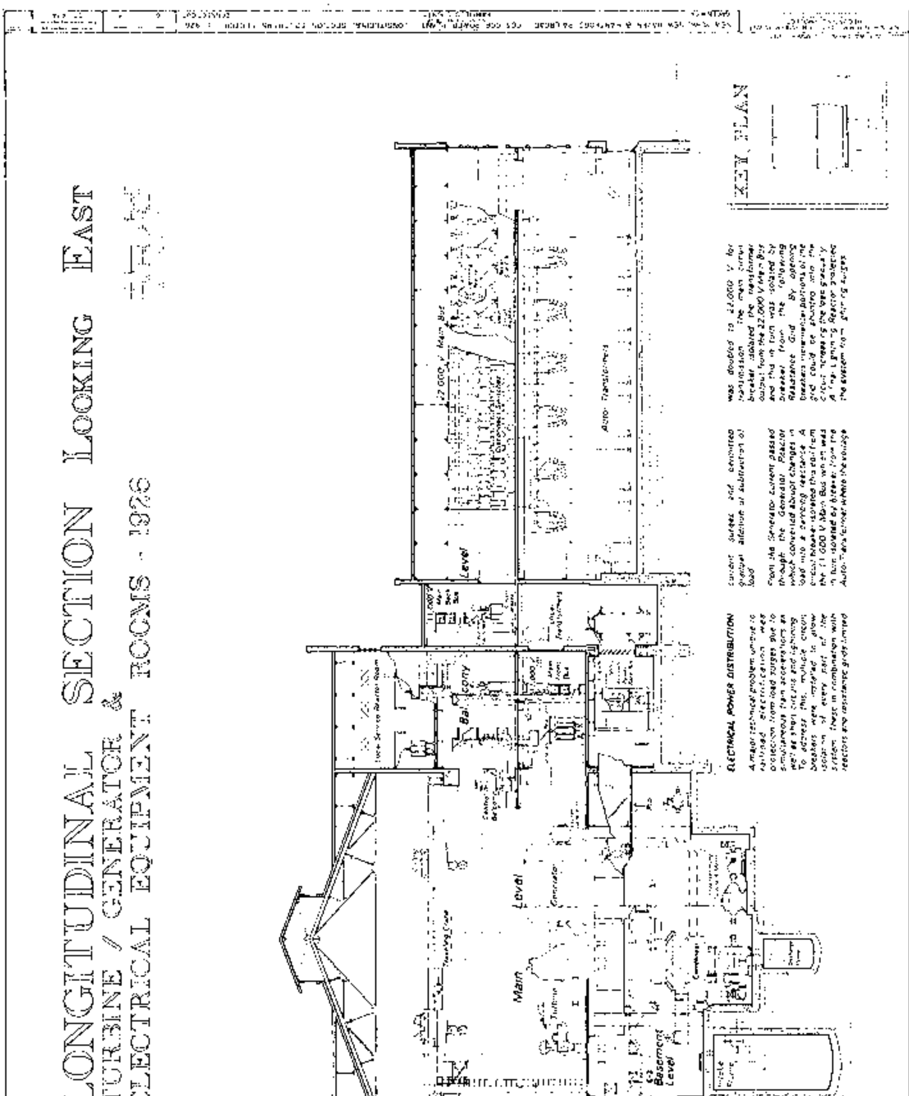
The team discovered a small steam-powered laundry in the west basement. The equipment was similar to steam-powered laundry equipment used on ships before World War II. A retired employee explained that it was an amenity that was not officially sanctioned by the railroad. Worker's wives complained that their husbands messed up the house when they came home in soot-stained clothes. In answer to their complaints, the plant manager put in a laundry so employees could have their work clothes cleaned at the plant. The operation of the laundry was assigned to a volunteer, who traditionally received an occasional carton of cigarettes for his extra service.

The oral history undertaken by the recordation team suggests that the plant ran under a system of benign paternalism, with little supervision from railroad management. The Cos Cob power plant had a familial character. Sons replaced fathers, and there was a strong tradition of management personnel coming up from the ranks. Worker loyalty focused on the plant instead of the railroad. This sense of loyalty kept the plant running during the railroad's financial difficulties. Workers "didn't let the plant down any more than they would let their family down."

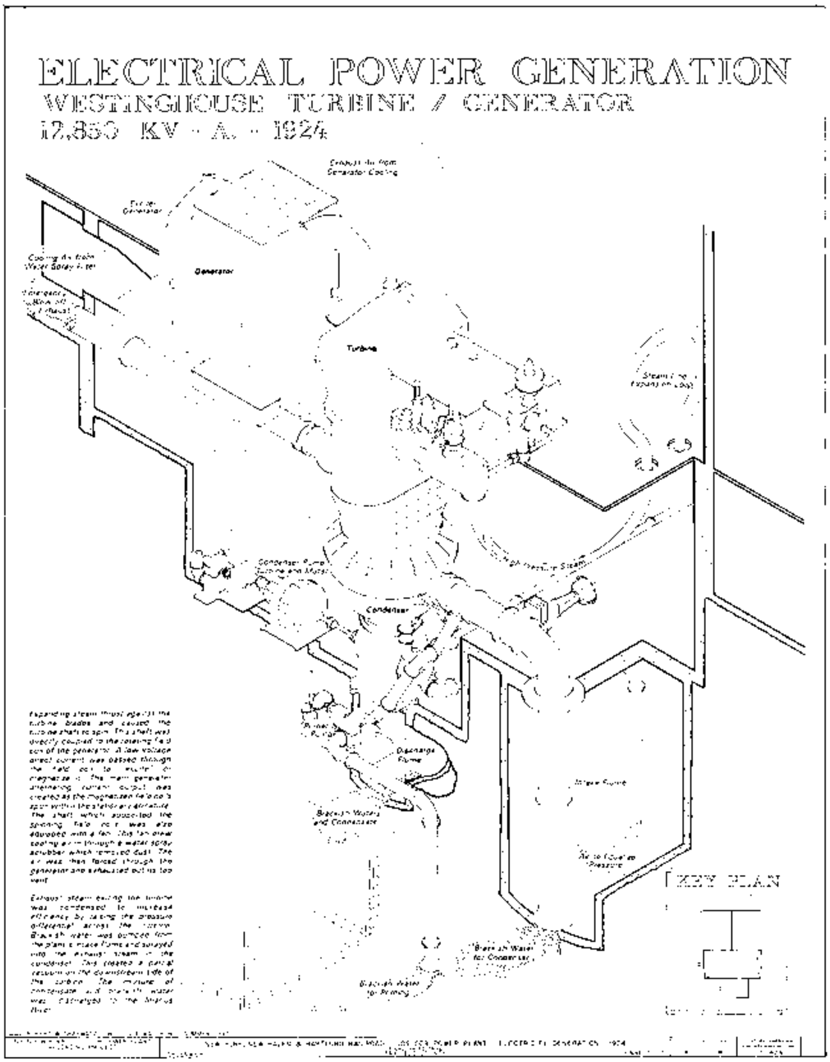
The success story of Lewis Grant O'Donnell coincides with the history of the Cos Cob plant from construction through its heyday. Westinghouse, Church, Kerr & Company hired him to work on the Cos Cob project. The New Haven then employed O'Donnell as a boiler room engineer on June 1, 1907, just about the time the first electric revenue service began. O'Donnell eventually rose through the ranks to become chief engineer before he retired in 1940. O'Donnell developed several devices to make the work around the plant safer and easier. He patented an air-pressure lubricator. But railroads all over the world still use his best-known innovation: O'Donnell originated the idea of loading truck trailers onto railroad flatcars. This system delivers economical long-distance hauling with the flexibility of local door-to-door trucking. His wife dubbed the scheme "piggybacking" after a game she had played as a child in England. Railroad officials acknowledged his invention of the piggybacking plan in a letter dated March 6, 1933.

Artifact Analysis Adds to the Record

A combination of information in period textbooks, interviews, and artifact analysis enabled the HAER team to reconstruct several coal-handling systems that evolved over the plant's lifetime. The original design stored all coal in inside bunkers that provided only a three-day reserve. This proved inadequate, and as early as 1910 expansion of



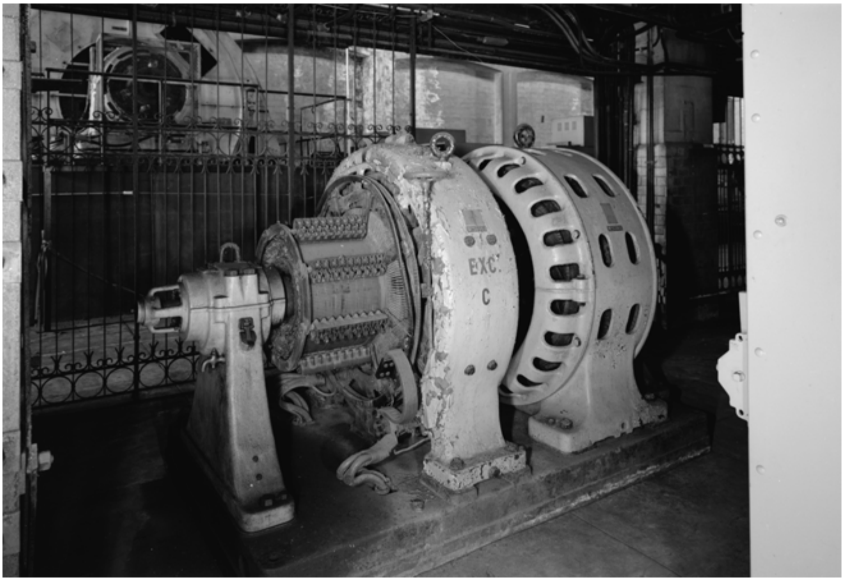
Example of the detailed drawings of the Cos Cob Power Plant produced by the Historic American Engineering Record (drawing by Dale Waldron).



Graphic explanation of the plant's power generation system (HAER drawing by Robert W. Grzywacz).

the coal-handling systems began to intrude on the plant’s architectural treatment. Eventually, changes resulting from improved coaling systems and space requirements for new boilers almost totally concealed the original building lines. The HAER team located the original indoor coal bunkers, the remains of overhead flight conveyors, and underground coal crushers. The team's historian found the buried remains of a circular track that marked the limits of a radial bridge coal conveyor.

Ingenious electro-mechanical devices controlled electrical power before the arrival of computerized equipment. HAER workers located several of these mechanisms and their operating manuals. One example, the Tirrill voltage-control device, constituted the key to maintaining constant voltage on the system. The Tirrill regulators controlled voltage on the exciter generators. Tirrill-type controls were still in use when the plant shut down in 1986. An interesting feature of the earliest Tirrills was the method of adjusting the calibrating weight. An operator added or removed pieces of shot to a miniature bucket until the balance stabilized. Electrical voltage regulation on the whole system hinged on a simple mechanical balance beam and a bucket of lead shot. A shot-balanced Tirrill was still in use when the plant closed in 1986.



Exciter Generator "C". Exciter generators made direct current to energize the field coils of the main generators (HAER photograph by Jet Lowe).

Several other artifacts contributed to understanding plant operation. A Lincoln Thermal Converter monitored total plant power output. Fly-ash removal from stack gasses required a six-gap mechanical rotary rectifier to generate an 88,000-volt electrostatic field in a Cottrell precipitator. An ingenious arrangement of notching relays and mechanical timers detected out-of-synchronization conditions in the exciter generators.

⌘ ⌘ ⌘

The Cos Cob plant was an operating facility that had a major impact on American railroading. Producing much of the power to move 30,000 to 40,000 people a day in and out of New York City was, and remains, no small accomplishment (Amtrak's current *nationwide* average daily traffic is 70,000 passengers). The electrification of the New Haven railroad was technologically imaginative, bold, and daring. Because technical information on the plant was widely disseminated by Westinghouse and New Haven Railroad engineers, Cos Cob and its transmission system served as a pilot project for electrified railroads all over America. The result was the evolution of a reliable transportation network and workable electrification standards. That Cos Cob continued in service for almost eighty years is a tribute to solid engineering design and practice. It is also a tribute to dedicated workers who kept the obsolete equipment functioning while government agencies developed plans for its replacement.

The history of the Cos Cob power plant might have turned out differently if the New Haven Railroad had not stagnated for many years, as various managements plundered the company and twice drove it into bankruptcy. Instead of substantially upgrading or replacing the plant, the railroad was forced by its chronic shortage of capital to use and maintain obsolete equipment that dated back to the early 1900s. Paradoxically, the New Haven's financial problems enabled the survival of the historic plant and its machinery, making it possible for the HAER team to describe, delineate, and analyze it. The recordation materials, preserved in the Library of Congress's HAER collection, assure that the historical information inherent in the plant and its equipment will be available for future generations of scholars and others interested in industrial history.

The Connecticut State Pier: Boon or Boondoggle?

BRUCE CLOUETTE

Documenting the engineering features of the past is useful not only for preserving their inherent information about historic technology, but also because understanding their social and economic contexts can illuminate issues facing our society today. A case in point is the Connecticut State Pier in New London. Built in 1914, it was heralded as the economic savior of the city, but it never fulfilled the expectations of its proponents. Despite its limited commercial success, the pier proved to be an important resource during World War II and the subsequent Cold War years. The story of the Connecticut State Pier can serve as a cautionary tale when considering present-day schemes for economic development and also as a reminder that even apparent failures can have a silver lining.

The construction of the Connecticut State Pier came about largely through the efforts of Bryan F. Mahan, the affable and energetic mayor of New London. Mahan, a lawyer and real estate developer, was a tireless promoter of parks, sidewalks, and economic development projects that would benefit his home city. Responding to his requests, the State Legislature established a commission in 1909 to study the question of how state-funded harbor efforts could promote Connecticut's economy. Not surprisingly, the commission concluded that New London was one of the prime locations for improved port facilities. In 1911, with Mayor Mahan now a state senator, the Legislature made the commission a permanent body, gave it the power of eminent domain, and provided it with $1 million to begin work in New London. The State Pier was Connecticut's first sizeable state-funded transportation project.

The economic purpose of the pier, as explained by its promoters, was to provide a way for sugar, hides, and other products bound for eastern Canada to be unloaded in New London, then carried north on the Central Vermont Railway, which ran to Montreal. The chief export would be Canadian grain. The local newspaper headlined its editorial on the pier's approval "Cause for Great Rejoicing" and predicted that New London would soon be one of the busiest, most populous, and most desirable cities in the state. The pier itself, measuring 1,020 feet long and 200 feet wide, was completed in 1914, with the large timber-framed two-story warehouse that sat on top of it completed three years later. The name "State Pier No. 1" was placed on the parapet above the huge main doors of the warehouse, reflecting the promoters' hope that it would be the first of several such facilities that would accompany the city's growth. A private contractor operated the pier under the supervision of Connecticut's Rivers and Harbors Commission.

West side of the Connecticut State Pier, with bales of waste paper awaiting loading on the ship* Odigitria B *(HAER photo by Robert Moore, 1993).

Technologically, the pier and its warehouse were state-of-the-art for 1917. The earth-filled center portion of the pier was contained by masonry walls that rested on poured concrete footings. Surrounding the filled part was a timber-pile structure 50 feet wide. Except for the outermost six feet, which was planked, the pile parts of the pier were capped by pre-cast concrete deck units, designed to be removable to facilitate pile replacement. Railroad tracks ran down the center of the pier into the warehouse, with additional tracks serving the one-story sheds that flanked the main part of the building. The length of the pier was chosen to allow it to accommodate two 500-foot vessels on each side, which was then a common length, as well as handling newer and larger ships up to 1,000 feet long by devoting one entire side of the pier to such a ship. Along each side of the pier, on the roofs of the side sheds, was steel framing for a traveling hoist system, called a "New York hoist" because it was first developed for the narrow, crowded piers in New York harbor where there was no room for a traveling crane. The system allowed two men to unload a ship equally as fast as a crane and much more rapidly than by hand labor. Since almost all cargo was shipped in bales or crates or on small skids, the hoist’s four-ton capacity was more than adequate.

Railroad tracks entered at the north end and ran the whole length of the building. The tracks were depressed below ground level so that the floors of boxcars on the tracks would be at the same level as the warehouse floor (HAER photo by Robert Moore, 1993).

The warehouse building was also innovative for its time. Standard practice in American ports was to have only limited storage on the pier itself in the form of "transit sheds," where goods stayed for only a short time before being moved to warehouses further inland from the waterfront. By combining the functions of the transit shed and warehouse, the New London pier eliminated the expense of one whole cycle of loading, transit, and unloading, along with associated losses from damage and theft. Rail access was also particularly well thought-out, with tracks running the whole length of the pier, interior crossovers to allow flexibility, and construction of the warehouse's concrete floor at the same height as that of the boxcars, eliminating the need for ramps. The building was planned to be completely fireproof. Asbestos shingles covered the outside and asbestos board was used for all interior partitions. All exterior and interior doors were clad in sheet-metal, and firewalls divided up the interior space so that any outbreaks of fire could be contained. The building was also protected by a full sprinkler system. The warehouse's heavy timber framing, while seemingly anachronistic, was actually more fire-resistant than any material then available except for reinforced concrete. Although timbers will char in a fire, they typically do not burn very far through and therefore maintain their structural integrity. In contrast, steel framing twists and warps in a fire, pulling the structure down upon itself, an effect that can still be seen today in the ruins of burned piers along the Hudson River in New York. (Steel framing survives as a construction technique only because of the perfection of protective fireproofing).

The Connecticut State Pier was featured in Carleton Greene's engineering text, *Wharves and Piers: Their Design and Construction,* and in a number of articles in engineering journals of the period that devoted considerable space to the pier's various features. Its design resulted from the close collaboration of two engineers, Waldo E. Clarke and William T. Donnelly. Clarke and Donnelly both signed all the engineering documents for the pier and appear to have had equal roles in developing the overall concept. As the local engineer on the scene, Clarke may be credited with the pier's particular details. Clarke had briefly been New London's city engineer before departing for Panama to supervise construction projects for the United Fruit Company. He was appointed resident engineer for the State Pier project in 1912 and continued on as its superintendent, under various titles and operating entities, until his death in 1953. Clarke was a prominent man in New London, serving two years as mayor and thirty years on the city's finance board. He is credited with playing a key role in bringing both the Coast Guard Academy and Connecticut College to New London.

Interior, upper level, showing the warehouse's wooden framing (HAER photo by Robert Moore, 1993).

William T. Donnelly, the child of Irish immigrants, had no formal education but rather learned engineering on the job, working for machine shops and manufacturers. He became a partner in the engineering firm of Faber, Dufour & Donnelly in 1897, established his own practice ten years later, and became nationally known. Over the course of his career he designed numerous marine-related structures, including 26 major dry docks. He also held patents for coal-slurry pipelines and a method of making ships unsinkable though the use of buoyancy containers.

The pier had a slow start due to the war in Europe. One intended use, berthing the large cargo-carrying submarines then under development by the Germans, vanished into thin air as soon as hostilities broke out, and later the United States Navy needed the pier for military operations. After the war, the pier enjoyed several years of prosperity, as large amounts of cargo were shipped to the still-recovering countries of Europe. In response, the state undertook further improvements to the pier's road access, electric lighting, and sprinklers. By 1924, however, the boom was over, and the volume of cargo handled at New London declined dramatically, leveling out at an average of about one ship a week in the 1920s and 1930s. Most of the movements were imports of wood pulp and canned goods from the intercoastal shipping system. The Canadian trade never amounted to much because Canadian ports fought what they perceived as competition from New London. Since the Central Vermont Railway was Canadian-owned, the Connecticut State Pier had its fortunes tied to a company more likely to respond to the needs of Canadian ports than New London's.

Some of the pier's equipment: a pallet truck (left) and a portable scale (right) (HAER photo by Robert Moore, 1993).

During World War II the Navy again acquired the use of the pier, and following the war, the Navy berthed submarines and a submarine tender on the east side under a long-term lease. The commercial side of the pier continued to operate at a low volume, serving a few dozen vessels a year. As shipping technology moved to self-unloading bulk carriers and container ships, cargo piers like New London's increasingly found themselves limited to low-value products such as waste paper, scrap metal, and potatoes. The decline in use and ongoing damage to the pilings by marine borers, including the collapse of much of the warehouse floor, led state officials to conclude that the warehouse should be demolished. A photographic record of the pier as it existed in 1993 was undertaken by Connecticut Department of Transportation photographer Robert Moore; along with written documentation, the photographs were made part of the permanent archive of the Historic American Engineering Record held in the Library of Congress.

Why did the pier fail to meet its proponents' expectations? It was strategically placed, with good access to the harbor channel and easy docking, and, as noted above, it was completely modern when it was built. The answer is that successful pier operations are far more dependent on favorable economic circumstances than on technological innovation. It was well known at the time, for example, that ports could not grow unless they balanced their imports with an equal quantity of exports. Ship operators would always prefer to spend an extra day at sea and dock in New York because once unloaded, the likelihood of finding an immediate outgoing cargo somewhere in the ports of New York and New Jersey was very high. In contrast, New London was heavily weighted toward imports. A ship operator would discharge a cargo in New London and then still have to go to New York to find an outbound cargo.

Secondly, the pier suffered from being connected to only one railroad. Although New London was also served by the New York, New Haven, and Hartford Railroad, the dominant carrier in southern New England, the New Haven, as it was known, did not connect directly with the pier. Instead, shipments on the New Haven had to be interchanged with the Central Vermont for the short trip to the pier. Moreover, the New Haven Railroad operated its own pier facilities in New Haven, and through related terminal-railroad operators it also serviced the ports of Boston and New York, leaving the railroad with little incentive to route shipments through New London. Most successful ports had access to two or more competing rail carriers, either through trackage rights or by means of terminal railroads that served the needs of all the rail companies on a reasonably equitable basis. Boston, for example, was served by three separate railroad companies: the New Haven, the Boston & Maine, and the New York Central. In contrast, when the Central Vermont Railway proved unable to make good on the promise of extensive Canadian trade, the State Pier in New London had no alternative to fall back upon.

In short, the Pier by itself should never have been expected to be an engine of development for New London. If the region had strong export-oriented industries or large-scale bulk products shippers, such as cement makers or grain farmers, the pier would have been much more attractive to ship operators. If the pier had received the whole-hearted support of both railroads, it might have been able to link together enough small shippers to compensate for its lack of critical mass, compared with Boston and New York. On the other hand, perhaps the pier would never have been built had its prospects not been exaggerated. Could even the persuasive Bryan F. Mahan have convinced the State Legislature to part with an unprecedented $1 million in 1911 had he promised only modest success? Do public improvements always have to be oversold to ensure their initial approval?

Viewed apart from the expectations of its proponents, the State Pier can be regarded as a steady if unspectacular performer. Surely New London benefited from having two to four large ships dock in the city each month that otherwise would have gone elsewhere, and structurally the pier far outlived the 25-year lifetime anticipated by its engineers when it was built. Moreover, the pier proved to be a substantial military asset in World War I, World War II, and the Cold War period. Even today, we can look forward to some worthwhile re-use of the structure that has served New London and the surrounding region for 90 years.

Pathways to the Past

Transportation,
Heritage,
and the
Twenty-First Century

The Connecticut Department of Transportation and the State Historic Preservation Office strive to balance the often-conflicting objectives of transportation planning and historic preservation. Innovative and / or unusual solutions can frequently be found that avoid or minimize potential project-related impacts upon the state's cultural heritage. The case studies presented in this volume will facilitate meaningful community participation, flexible decision-making, and creative thinking for future transportation projects.

- from the Introduction

Connecticut Department of Transportation • Connecticut Commission on Culture and Tourism