Renovating a National Icon

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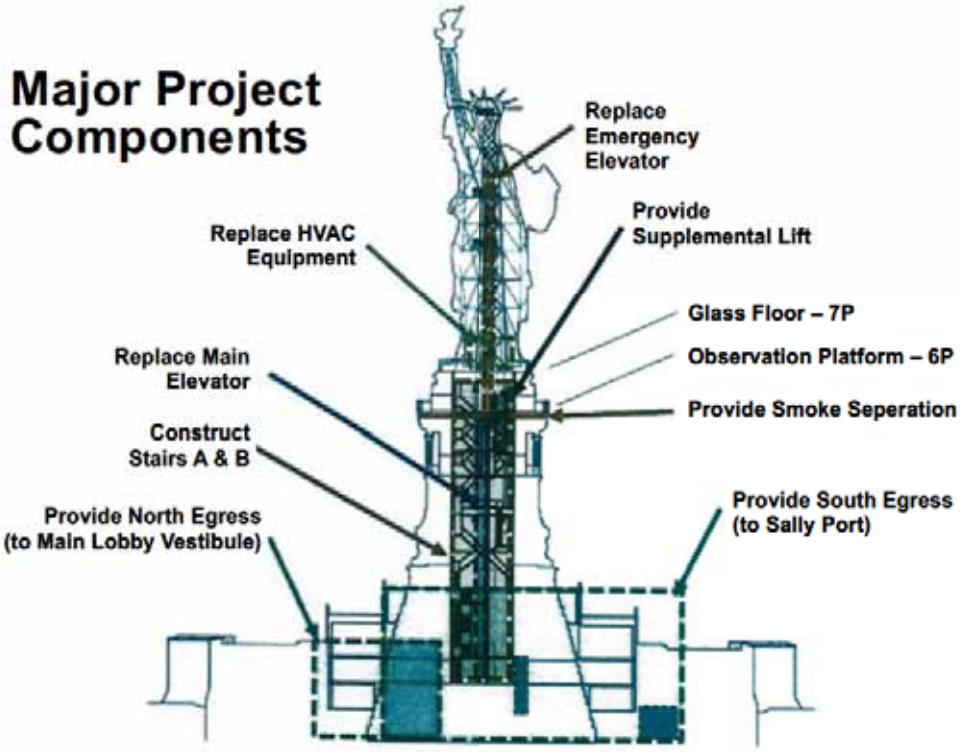
By the time this article is published, work will have begun on the $27 million renovation project at one of our most endearing national monuments, The Statue of Liberty. Most people are familiar with the major restoration of the Statue's copper skin and torch in the centennial year of 1986. Regular news stories appeared of the surrounding scaffolding, and of all the deserved pomp and ceremony at its rededication. What wasn't seen at that time was an infrastructure badly in need of modernization to meet current ADA, energy efficiency, fire protection, and security requirements.



Several years ago, the National Park Service began planning and design of needed infrastructure renovations to the Statue of Liberty national monument. In order to meet the ceremonial end date of Labor Day, 2012, and to allow the necessary time for construction work, the project had to be ready for bid by mid 2011. The National Park Service (NPS), like most federal agencies, is very thorough in the design development and review process for all of its projects, and doubly so for this iconic national symbol. ***The project RFP for construction management services required an estimator with 20 years experience and Certification by ASPE or AACE.*** Fortunately, my employer, Alpha Corporation qualified and was selected to prepare the independent government estimate, a constructability review, and a CPM schedule for this important project.

Under the terms of its existing IDIQ contract, Alpha had previously prepared estimates for historic NPS projects at Ford's Theater and the Lincoln Memorial Reflecting Pool among many others. Alpha Corporation is a full service construction management and engineering consultant firm included in ENR's annual Top 50 listing. As Senior Cost Estimator for this firm, the author had the honor, and sole responsibility of preparing the design development and final construction cost estimates for the project. With the project insight that estimating provides, major input to the constructability review was also possible.

Background and Scope of Work

The required renovation work, takes place not in the Statue itself, but in the approximately seven story pedestal upon which it stands. The pedestal in turn, sits atop the star shaped Fort Wood, a Revolutionary War era harbor defense. The Statue, also seven stories high, was a gift from the people of France to the people of the United States. It arrived in 1885 in 204 crates, was erected upon the completed pedestal, and dedicated October 28, 1886. To those of us that are construction and engineering oriented, the inside view of Gustav Eiffel's framework and Bartholdi's copper skin is still a wonder to behold. All of it done over a hundred years ago without the aid of computers or modern design software.

To last another one hundred years however, the following major work had to be done (see Figure 1):

- *Replacement of perimeter stairways top to bottom to meet current 2 hour egress fire code requirements.*
- *Replacement of pedestal main elevator, Statue emergency elevator, handicapped lift, and bathrooms to meet current ADA access and egress requirements.*
- *Replace end-of-service life mechanical systems to conform to modern comfort and energy standards, and to reduce maintenance costs.*
- *Upgrade existing and add new electrical switchgear to carry current and future electrical loads.*
- *Install new, high-tech security systems mandated by the events of 9-11 and Oklahoma City.*
- *Provide new fire sprinklers and smoke separation barriers throughout the pedestal.*
- *Repair and waterproof the exterior plaza (known as the terreplein).*
- *Build new concrete retaining walls and exterior stairs at the north and south plaza level for new egress requirements.*
- *New elevator lobbies and finishes at all levels, including glass floors at two levels.*

Challenges to Constructability – Access and Special Costs

Constructability is defined as the capacity of a certain design to be developed into construction. That design should facilitate the most cost effective, safe, and time efficient manner of construction. It is pretty much impossible to do a complete estimate for a project without simultaneously becoming aware of the constructability of the particular design. As the estimator examines and quantifies each trade, he makes mental or written notes of the unique challenges for that work, its impact on overall project costs, and to other trades.

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Site Access

The first and most obvious challenge for this project was that it was on an island. This means that all men, materials, and equipment must be transported to and from the island on water borne crafts. The water craft typically used for construction transport to and from both Liberty and Ellis Islands, are motorized barges. Even in New York harbor, these resources are limited (2 or 3 contractors) and quite expensive. The trip to Liberty Island on these barges takes 20 to 30 minutes depending on the point of embarkation, either New Jersey or Manhattan. Consider what this does to your equipment mobilization costs, your material delivery costs, and most importantly, your labor costs and productivity.

Davis-Bacon wage rates were mandated for the project, and in the New York / New Jersey area, they are the highest in the country. Complicating the matter are stringent security procedures to protect this unique national monument. Full airport type screening is required both coming onto the island, and leaving the island. In addition to the usual shoes, belt, and body scan procedures, all tool and lunch boxes have to be opened and inspected. Only after this, are the trades ready to start their daily work. Pardon the vernacular but, "Ka-Ching, Ka-Ching".

"The first and most obvious challenge for this project was that it was on an island."

Adding to equipment mobilization costs are increased insurance premiums. Owners or leasers of large equipment such as cranes or transit mix trucks cannot allow their equipment to be transported over open water without a prior inspection of the barges by their insurance underwriters. This inspection, and the added risk of water transport, increases the equipment owner's insurance premiums. The increased premiums must then be added to the job cost. Material delivery costs are increased by virtue of the double or triple handling of materials that becomes necessary. Very little lay-down or storage area is available to the Contractor on Liberty Island; tourist views of the entire Statue must be maintained. Therefore, a dockside marshalling area is required where materials can be off-loaded, stored or laid out if necessary, and then loaded onto the barge for transport to the island where it must be off-loaded again.

On-Site Work Access

Once the resources are on the island, they need to be moved into position to do the actual work. For the exterior work of retaining walls, stairway construction, and plaza waterproofing, hoisting and movement of materials was restricted by the star shape and height of the Fort Wood base. No heavy equipment (e.g. crane or concrete pump) was allowed on the terreplein or plaza level since it was constructed over occupied space or rubble fill. The terreplein elevation is some 27 feet above grade, and 52 to 112 feet horizontally wide from the pedestal to the parapet wall. This extends the reach (hence the size and cost) of a crane or concrete pump to place concrete and materials above the terreplein level.

Most of the replacement and renovation work for the Statue project takes place inside the pedestal core. It is here that work access difficulty increases exponentially. The basic footprint of the pedestal core is 27 feet square and 122 feet high, excepting one 14 foot vertical section known as the "pinch point" that is only 18 foot square. In this confined space, seven floor decks, two full-height perimeter stairways, the main elevator/shaft, and mechanical work have to be demolished, removed, and replaced with new. Once these restrictions are understood, considerable thought must be given to the sequence of work, particularly as it relates to meeting the overall project schedule. If you remove the old stairs and elevator first, how do you get your men and materials to the upper levels, how do you get your demo out? If you build the new custom elevator first, do you sacrifice construction time to its long order lead time, or risk damage to it if used as a construction transport? A third option of erecting a temporary material hoist/elevator in the vacated elevator footprint was rejected for cost and because it would require attachment to "historic fabric" that was strictly forbidden (Ed. note – everything inside the core of the pedestal is considered historic fabric). Our decision was to use the existing elevator for construction purposes as long as possible. Fortunately, the new elevator footprint was in a different location. As is always possible, the selected Contractor may figure out a better way.

Special Costs

Special and hidden costs of many types may, or may not appear in historic renovation projects. They may include structural modifications, marine construction, and archeology among others.

Two special cost factors that play a large role in the Statue of Liberty renovations are jobsite security

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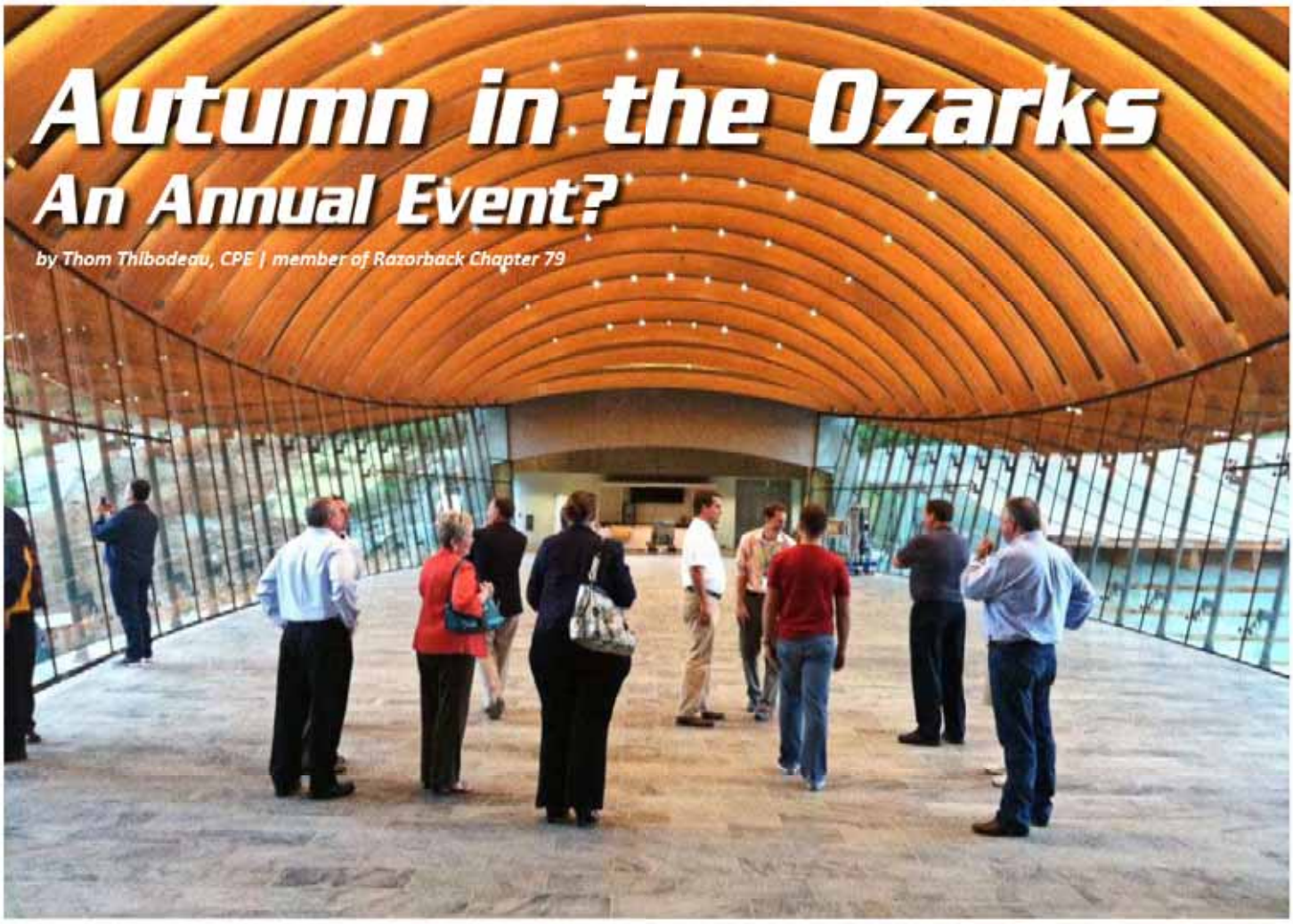
Autumn in the Ozarks
An Annual Event?

by Thom Thibodeau, CPE | member of Razorback Chapter 79



It was sunny and clear with a nip in the morning air and a rainbow of deciduous color beginning its annual appearance when ASPE Razorback Chapter 79 hosted the SE Regional Governors conference and "Autumn in the Ozarks Professional Development Workshop" October 7th in Bentonville, Arkansas. Located in the Northwest part of the state, Bentonville is the county seat, the location of the Walmart Home Office and according to the latest census one of the fastest growing areas in the country. Because of the growth there are still construction opportunities and the chapter has been able to maintain a stable diverse membership.

This is the first Governors conference we've hosted but the third year of workshops and each year attendance increases. With a humble beginning our first workshop had 16 attendees, the second was double that with all participants from the local area. Our attendees this time numbered 67 and came from a dozen states including Florida, Pennsylvania and Idaho. In addition to National President Keith Jones, CPE and Third Vice-President Doyle Phillips, CPE, we were honored to have ASPE Director of Administration Patsy Smith, Chapter Presidents Chris Peace, David Battle, CPE, Jack Fuller and Vic Lamastus, CPE. Also attending was Central Plains Governor Daniel Frondorf, CPE and Southeast Regional Governor Mark Puente. Former Northwest Governor Marcene Taylor, CPE who lives in Boise, Idaho would've gotten the prize for longest distance travelled. >>>

This year's program was designed for the professional community of Architects, Engineers and Estimators, and offered information about the emerging collaborative technologies available today or developing on the horizon. The days of working with a legal pad and two dimensional blueprints are fading fast; the future of design and estimating is working in three dimensions with nearly instantaneous clash detection cost/budget analysis. Topics presented covered the "Virtual topics" of design, construction, civil prototyping and Cloud Computing. These subjects were especially significant because one of the latest examples of this new way of building and thinking is represented by Crystal Bridges Museum of American Art in Bentonville which opened in November. Two highlights of the event for our out of town guests were a behind the scenes visit to Crystal Bridges and of course, authentic Ozark barbecue. A pleasant surprise at the event was two of the attendees became members of Razorback Chapter 79.

Our workshop was an all day event held at Northwest Arkansas Community College (NWACC) with a break for lunch catered by Beef O'Brady's Restaurant and featuring a lunchtime talk titled "Sustainable Success" presented by Brian Blanchard with PepsiCo. In addition to the Governors meeting, our program workshop consisted of three tracks: Technical, Estimating and Professional.

The Technical Track featured Jason Dodds and Kevin Ellis with Autodesk, who presented "Leveraging the Autodesk Construction Tools," explaining the transition from paper-based linear processes to a collaborative digital approach using Building Information Modeling (BIM). Joe Viscuso, VP with Stantec, demonstrated "SiteOps," a software program that allows the user to perform real-time feasibility simulations for site designs and estimate probable costs. And from the Flintco Companies, Kevin Bromenshenk and Bobby Goldsberry presented "BIM – Cradle to Grave," highlighting real world experiences from a General Contractor who uses BIM every day.

The Estimating Track had Clay Freeman and Ian Turner with Vico Software, who presented "Understanding and using 5D BIM for Construction." Ron Covarrubias, CPE from Alberici Constructors talked about "The hidden battle zone of General Conditions," and Mark Terrill, a Construction Management Professor with John Brown University, taught "Scheduling for Estimators."

The Professional Track featured Maxie Carpenter from MVC Advisory Resource, Inc., whose topic was "Building a High Performing Team: A process that is most misunderstood." Also presenting was James Benham from SmartBidNet, with "Social Networking for Construction Estimators: The how, when and where for connecting and collaborating." Mark Puente wrapped up the Professional Track with the Regional Governors meeting in the afternoon.

The only negative comments we heard about our program was that attendees had to make choices about which presentations to attend.

Since a purpose of ASPE is to promote education, revenues from this event will be used to establish a scholarship in the field of construction management starting in 2012 at John Brown University.

A special thanks is due Mike Gardner, Vice President of Architecture and Jason Cantey, Director of Estimating, both with Walmart, for their support of their team members and Chapter 79. We also thank Simmons Suites Hotels and Crystal Bridges for their hospitality.

And of course, to complete a perfect weekend the Razorbacks beat the Auburn Tigers 38 to 14.

Wooooooooooo, Pig! Sooie! Razorbacks!" ET

See all event photos at: http://www.razorbackaspe.org/ASPE79/Photos.html

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and protection of historic fabric. One element of jobsite security that wasn't previously discussed was control of the debris chain. All demolition debris down to the smallest chunk of concrete had to be accounted for from point of origin to disposal in a certified landfill. This wasn't done for the usual environmental reasons as one might think, but to protect against profiteering. Previous renovation projects at the Statue had seen small pieces of debris go home in lunch and tool boxes, only to appear the next day on E-Bay under the heading, "Own a Piece of the Statue". A somewhat finite cost element to be sure, but an added cost nevertheless.

At historic sites like the Statue of Liberty and Ford's Theater in Washington, every part of the structure or building is considered "historic fabric" and is to be preserved at all costs. First, it must be determined if the historic fabric will be allowed to be used for construction purposes. This means drilled, cut, braced against, attached to for equipment support, or be removed and replaced without permanent damage. Extraordinary protection measures may be required to preserve the historic elements.

At the Statue of Liberty, a 15 foot high, two-sided ¾" plywood box was required to completely enclose the original Liberty Torch on display in the entrance lobby. The original torch was so fragile that it couldn't be moved. At Level 7P, actually within the Statue structural framework, were five large air handlers that had to be removed and replaced. Close examination of the existing HVAC unit frames revealed that they were notched or slotted to allow Eiffel's original iron framework to pass through. It wouldn't be unreasonable for one to think it would be the other way around on an ordinary retrofit project. This goes to show the extraordinary measures that the Contractor will have to take to protect the historic fabric.

Finally, there are cases where there is no alternative to removing or damaging the historic fabric. At the pedestal's Level 3P elevator lobby, the design plans called for excavating a 3 foot deep trench in the "historic" concrete floor to allow placement of HVAC duct. In its constructability review, Alpha Corporation proposed an alternate route for the duct that wouldn't require demolition of the floor. The alternative was to place the duct in the ceiling space of one of the four identical exit ways to the outdoor balcony. These exit ways featured unfinished, arched, concrete ceilings that were part of the original design. Even though one of the four exit ways had already been co-opted for use as a mechanical room, the Designer decided that a drop ceiling in the floor trench area would compromise the viewing opportunity of the historic vaulted ceiling. In this case, historic view won out over historic fabric. This occurs frequently in designs where a mechanical retrofit is involved, as it was in this case. The added costs for all these special cases must be estimated in accordance with good construction practice, and included in the final summary.

Constructability and Value Engineering

At an early constructability review meeting at the jobsite, we were asked what we felt was the most significant driving cost factor for the Statue renovation project. Without hesitation we responded that it was the concrete construction. The structural design included over 500 cubic yards of poured in place concrete, much of it in the 114 foot high new elevator shaft. Also included were seven floor plates, two retaining walls, and two new concrete stairways. This raised the question of whether the difficulties of the island site, placing the concrete in the pedestal core, and the impact on the tight project completion schedule had been thoroughly considered. The Designers indicated that they had considered alternatives to the

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elevator shaft construction of CMU masonry or framed shaft wall but had rejected them for structural reasons. After its initial constructability review and value engineering analysis, Alpha Corporation recommended the alternative of precast concrete (PC) construction. Structurally feasible precast panels could be used for the elevator shaft walls. Floor plates could be pre-stressed hollow core type planks. Even some of the retaining walls could be engineered in precast panels if necessary.

During the remaining design development process the precast concept was vigorously debated. At first glance, poured-in-place concrete (PIP) appeared to be cheaper per cubic yard than precast. For the project location (NY/NJ), Means unit pricing for PIP was $690.00/CY and for PC it was $2,322.00/CY (extrapolated from the S.F. unit price for comparison purposes). The Means PIP unit price included the concrete, reinforcing, forms and placement. What it did not include was the manufacture of the concrete at a site batch plant and pumping or bucketing it into the pedestal core.

"It is most important to realize that Architects, Engineers, and Owners are ultimately responsible for controlling project costs."

To determine the added costs for the on-site batch plant production and pumping of concrete, a local contractor with the requisite equipment and harbor experience was contacted. It is important to note that due to space and protection limitations, the batch plant could not be physically located on Liberty Island. The batch plant, aggregate storage, and cement storage all had to be on dedicated, separate barges anchored at the construction pier. The local, harbor- experienced contractor quoted a budget unit price of $5,000.00/CY. This included production, placement, all materials, equipment, and in-place complete. As is apparent, this is quite a premium ($690 vs. $5,000) for on-site production. The cost of ordinary, daily construction transport barges and hoisting had already been included in the General Conditions, so the only added cost for PC was some special rigging and handling equipment to move the pre-manufactured panels through the pedestal core. Additionally, precast had the advantages of superior quality control, shorter production/erection time, less wastage, and easier constructability.

The net result of Alpha's detailed analysis of the concrete work revealed potential cost savings of well over $2 million and up to 24 weeks construction time depending on which elements would be selected. These are not insignificant amounts for a tightly scheduled and budgeted project. Alpha's CPM scheduling analysis revealed that the mix design for the elevator shaft wall concrete would have to be "high/early" to meet the job end date schedule, if the poured-in- place method were used. Ultimately, the final decisions would be made by the NPS and the design engineers, but our due diligence as the estimate/constructability consultant was completed.

Epilogue

With all the special challenges presented by this unique project, preparing the independent government estimate, the constructability review, and the schedule was quite interesting. We were fortunate to be able to make two site visits during design development to meet with the project team, and to see firsthand the conditions that faced the Contractor. While trusting our renovation experience to develop construction strategies, it was important to keep an open mind and realize there's always more than one way to build a construction element. Historical renovation projects require a constant balancing of cost vs. risk vs. schedule vs. design intent. Anticipation, identifying hidden costs, and reading between the lines skills are paramount. It is most important to realize that Architects, Engineers, and Owners are ultimately responsible for controlling project costs. Estimators can only help facilitate that control.

The construction contract for the Statue of Liberty infrastructure renovations was awarded in August, 2011 with scheduled completion by the Labor Day, 2012. The construction award was made for the Contractor's base bid only, while seven add alternates were still being considered. Actual construction was scheduled to start October 31, 2011 after the prime tourist season and the 125th Anniversary celebration. For more information on this important project, attend the ASPE Estimating Academy at Reno, Nevada in July, 2012. ET

>> For live web-cam videos of the Statue of Liberty and construction progress, go to Earthcam.com on the Internet.

Looking up in statue

Torch in the lobby

Contractor's Pier