A Project Delivery Technique for Historic Structures: A Case Study

Sonya L. Cooper
New Mexico State University

Abstract

As managers and superintendents utilize improved delivery systems, successful construction projects are increasingly delivered ahead of schedule and under budget. Historic preservation differs from new construction in that it utilizes several prescriptions for arresting deterioration while retaining original materials and workmanship. Preservation techniques used in tandem within a single project may include protection, stabilization, rehabilitation, restoration, and reconstruction. Primavera Project Planner® is used to plan and manage the adobe Socorro Mission Preservation Project currently underway in Socorro, Texas. Constructed in 1843, this remarkable National Register of Historic Places site exhibits Native American, Spanish Colonial, and European influences. The introduction of cement-based products in the mid 1920s hastened structural deterioration through moisture entrapment. The return to traditional materials and techniques, including on-site brick making, and the application of lime plastering, presents unique scheduling and training challenges. This paper details the benefits of using Primavera Project Planner® as a powerful project delivery tool for this historic structure, including the additional advantages it serves in the arenas of public education and grant solicitation.

Introduction

Project delivery systems in the form of software have become necessary tools in the construction industry. These tools vary in ability and complexity, and their use varies widely with companies and managerial methods. In general, without a project delivery tool, the project coordinator manages in a reactive mode verses a proactive mode. There is simply no time to forecast the future. Some projects still succeed today based on this method; however, it can be strongly argued that project delivery tools have succeeded in bringing projects to completion under budget, and within the preliminary schedule, well ahead of margins allowed by traditional methods of managing.

General Contractors and their project managers have become very knowledgeable about materials and methods used in their construction specialties. The exercise of loading information into a software program becomes just that, an exercise. The task is not that simple for preservation projects. In the area of historic preservation, typical ‘for profit’ general contractors

are more likely to bid on reconstruction or rehabilitation projects (these terms are defined later), and consequently are not required to use traditional methods. Scheduling, then, becomes a much easier task because availability and type of resources are known. Non-profit companies are more likely to undertake preservation projects. Ideally, project managers in charge of preservation projects are trained in preservation techniques used in their region. Unfortunately, this may be the only known information in the planning stages. The workforce will most certainly contain a crew supervisor, however the number and skill of the workforce personnel will not be known. This uncertainty is no excuse for not developing a comprehensive schedule and budget. In fact, it is even more necessary to provide early documentation of a schedule and budget, not only to support grant requests, but also to document early intentions. Project delivery tools force the project manager to obtain some of this knowledge before the project begins, due to input necessary to set up the preliminary schedule. Project delivery tools force the project manager to investigate the scope of activities that ordinarily would be left alone at this stage and dealt with when they happen.

This paper presents a case study of a project delivery tool, *Primavera Project Planner*®, which is helping maintain control of the preservation of The Socorro Mission in Socorro Texas. A summary of the Mission precedes preservation terms and specific efforts that fall into respective categories defining the construction philosophy for preservation projects. *Primavera Project Planner*® (P3) is introduced and a discussion on how P3 has helped this project so far, with a comment on the future use of this tool, follows.

The Socorro Mission Project

In 1998, the staff at Cornerstones Community Partnerships (Santa Fe, NM) was invited by the La Purísima Restoration Committee (Socorro, TX) to lead the effort to conserve its revered *Nuestra Señora de Limpia Concepcion de Los Piros de Socorro del Sur*, now more simply referred to by its parishioners and the surrounding community as 'Socorro Mission.' The Socorro Mission site, including a rectory (c1840), cemetery (1891), and parish hall (1984), are located at 328 South Nevarez Street, Socorro, just southeast of El Paso, TX.

Socorro Mission was formally dedicated for services in 1843. The Mission is listed on the National Register of Historic Places (1972) and is a Recorded Texas Historic Landmark (1963). It is commemorated by a Centennial Marker (1936), and two Texas Historical Commission Markers (1983). The Office of the State Archaeologist, Texas Historical Commission, identifies the complex as archaeology site 41EP38. This site was documented using large-format photographs, written research, and measured drawings by an Historic American Buildings Survey (HABS) in 1936. An addendum to the original HABS survey was provided in (1983).

The ongoing preservation of Socorro Mission (Socorro, Texas) represents a community-wide and regional collaboration between numerous dedicated individuals and organizations. The project is administered by the Restoration Committee of the Catholic Diocese of El Paso, Texas, in conjunction with the Historic Missions Restoration, Inc. consortium. The project has been planned and is supervised by preservationist Patrick "Pat" Taylor, Regional Coordinator for

Cornerstones Community Partnerships. Recently, Cornerstones received national attention for its work helping communities in the Southwest preserve their historic buildings and cultural traditions. “Save America’s Treasures,” a public and private consortium between the White House Millennium Council and the National Trust for Historic Preservation, singled Cornerstones out in a formal acknowledgment of its outstanding leadership in the field of preservation.

Several years of prodigious planning and fund-raising efforts preceded the current preservation project. Texas State Senator Eliot Shapleigh, an oversight committee integrated into the Mission Trail Organization, and others, have coordinated efforts with Cornerstones Community Partnerships; the City of Socorro, Texas; the Catholic Diocese of El Paso; the Parish of Las Purisma; the Socorro Independent School District; and the University of Texas at E Paso (UTEP). Funding from the El Paso Quadricentennial Commission, the Texas Department of Transportation, the City of Socorro, the La Purisima Restoration Committee, Chase Bank, the Meadows Foundation, the Texas Historical Commission, and the Houston Endowment has enabled the project to move from planning to implementation.

Students enrolled at K.E.Y.S. (“Keep Every Youth in School”) Academy, a Socorro Independent School District disciplinary alternative school, are participating in the preservation project at Socorro Mission as part of their curriculum. The goal of the KEYS program is to instill in students the interpersonal skills necessary to cope with academic, family, and social challenges; allowing each student to improve his or her self-image, and self-control. The Houston Endowment sponsors five full-time employees. The Texas Workforce Commission funds an adult training component at Socorro Mission as part of its ongoing welfare-to-work program. The Socorro Mission preservation project is rooted in community involvement. Thanks to generous donations from a variety of private, local, and state funding sources, area youths and adults alike are acquiring marketable job skills in traditional building techniques. While learning adobe brick making and laying; mud and lime plastering; carpentry techniques, and other trades, they are at the same time contributing firsthand to the conservation of one of the region’s most significant historic buildings.

Preservation Philosophy and Definitions of Terms

A property is considered to be “historic” if it is either listed on the National Register of Historic Places, or if it is deemed eligible for listing on the National Register. Criteria for eligibility are detailed in National Register *Bulletin 16A: How to Complete the National Register Registration Form* available free of charge from the National Park Service, Department of the Interior. To be considered eligible to the National Register, properties must demonstrate historic significance, and historic integrity.

Briefly, a property is historically **significant** if it:

- Is associated with events that have made a significant contribution to the broad patterns of American history, or

- Is associated with the lives of persons important to an understanding of our past, or
- Embodies distinctive characteristics of a type, period, master craftsmanship, or method of construction, or
- Has the potential to impart, or has yielded information, important to the realms of prehistory or history.

A property embodies historic **integrity** if it retains most or all of its original location, design, setting, materials, workmanship, feeling, and association.

The Socorro Mission is listed on the National Register of Historic Places. Project collaborators and the Socorro community thus share in a responsibility to properly conserve this distinctive building using accepted historic preservation practices. The goal of preservation is to retain the original materials and workmanship to the greatest extent possible while conserving the building for future generations.

Any work undertaken at Socorro Mission requires special planning and consideration by virtue of its designation as a significant historic building. Historic preservation encompasses many prescriptions for arresting deterioration while retaining original materials and workmanship. Preservation may take many forms, each with its own level of intervention. Preservation techniques include protection, stabilization, rehabilitation, restoration, and reconstruction:

Preservation is that act or process of sustaining the existing form, integrity, and materials, of an historic property. Preservation includes the initial stabilization work, as necessary, and addresses the ongoing maintenance and repair of historic materials and features. The most important aspect of the current effort to *preserve* Socorro Mission is the decision to remove the concrete collars, and the cement stucco. Because they entrap moisture, the impervious cement-based products are being replaced with traditional (permeable) materials including adobe mud and lime plaster.

Protection is that act or process of safeguarding the historic character of a property by defending it or guarding it against deterioration. Usually, a "protection" treatment is temporary in nature, in anticipation of future historic preservation work. Religious icons, and interior furnishings at Socorro Mission were removed and placed in safe storage for *protection*. The main altar was protected using plywood prior to any work at the interior. Cardboard padding has been placed between the scaffolding and the hand-painted designs at each viga to protect the artwork from damage. Throughout the course of this project, measures will be taken to protect the mission from further deterioration or harm.

Stabilization is that act or process of reestablishing the stability of an unsafe, damaged, or deteriorated, property while retaining that property's essential form and character. Temporary 6" x 6" shoring was erected at the interior right transept to *stabilize* the weakest corner. This stabilization measure was later replaced with extensive scaffolding to support the roof load during the wall documentation and repair process. Patches of spalling adobe at the north exterior mortuary wall have been stabilized using two coats of adobe mud plaster. Plaster has been

removed in sections at both the interior and the exterior in a stabilizing effort to allow the adobe bricks to dry out.

Reconstruction is that act or process of reproducing in new construction, the exact form, features and details of a vanished building, structure, landscape, or object as it appeared at a specific period of time and on its original site. An example of an appropriate reconstruction for a mission might be the replacement of architectural features associated with a nearby cemetery such as fencing, or statuary. Although reconstruction *per se* is not envisioned during the course of the current project, discussions are underway regarding the possibility of *reconstructing* an original bell frame made of wood to replace the existing metal bell frame.

Restoration is that act or process of accurately recovering the form, features and details of a property as it appeared at a particular period of time. This often entails the removal of later work, or by the replacement of missing earlier work. The technique of restoration will be used sparingly at Socorro Mission. The mission as it looks today represents changes accrued over the last 160 years; each of these changes is imbued with cultural value. Although it would be possible to select a time period and recreate the building as it looked during a particular time span by removing subsequent design elements, that process in this case is neither practical nor desirable. Attempts will be made, though, to *restore* certain architectural elements, such as damaged corbels, or faded viga paintings, to their original appearance.

Rehabilitation is that act or process of returning a property to a state of utility, through repair or alteration, to an efficient contemporary use. Unlike "remodeling," which generally attempts to "modernize" or "improve" old buildings, rehabilitation respects the architectural character of the building, and seeks to preserve those attributes that contribute to a property's historical and cultural significance. A successful rehabilitation exhibits the compatibility of new uses and design elements, with historic components.
A system of heating and cooling added to the flat roof recently represents one (eventually unsuccessful) effort to rehabilitate the Socorro Mission for contemporary use. A decision to remove the heating and cooling units for practical and aesthetic reasons will be addressed during the course of this project. A ramp will be installed at the interior of the mission to *rehabilitate* the front entrance for use by persons unable to maneuver easily up and down the existing steps. The Secretary of the Interior's standards for rehabilitation will be adhered to during the entire process.

The preservation activities currently underway at Socorro Mission may be divided into several broad phases, including:

- Initial conditions assessment and moisture tests
- Floor removals and temporary shoring
- Basal (foundation) stabilization
- Wall stabilization
- Repair of architectural features including vigas and corbels
- Clerestory replacement

- Exterior and interior plaster work
- Parapet and roof repair
- Provision of services including an electrical system

Work within each phase is undertaken in a manner that satisfies the following important conceptual guidelines. Each activity will:

1. Adhere to the Secretary of the Interior's Standards for Rehabilitation

2. Be preceded by archaeological documentation at those areas adversely impacted by the preservation process

3. Be preceded by architectural documentation (through measured line drawings) of original features and workmanship as necessary

4. Be included in a comprehensive photographic record of the entire project

5. Be included in the collection of archival records related to Socorro Mission and the surrounding community

6. Return to the use of traditional materials and techniques, including adobe brick making, and mud and lime plastering to prohibit further deterioration caused by the use of materials incompatible with natural adobe (e.g., wire mesh; cement-based stuccoes; and concrete collars at the foundation)

7. Adhere to the access guidelines offered in the Americans with Disabilities Act

8. Proceed within a safe; drug- and alcohol-free, work environment

Unlike typical new construction, extensive wall documentations (measured drawings) and archaeological investigations are conducted in response to any preservation activity that uncovers original features. Once the cement-based stucco was removed at the nave interior, for example, several early wall nicho features were discovered. Detailed drawings of these and other features were made for the benefit of future researchers. The replacement of deteriorated adobe bricks at the foundation has meant that sections of the original hard-packed clay and yeso-finished floor have been penetrated. Prior to this unavoidable adverse impact, extensive archaeological investigations have been conducted at the right nave, right transept, right sacristy, baptistery and mortuary.

Hundreds of artifacts have been located during the on-going archaeological investigations, including handmade wooden matches; buttons; rusted nails; rosary beads; small tokens including *milagros*; American coins and Mexican centavos; game marbles; and native pottery sherds. These items are, for many Socorro parishioners, the small things lost and forgotten by their own distant relatives. The artifacts will be inventoried, analyzed, and archived under the supervision

of University of Texas (El Paso) archaeologists. The results of the wall documentation procedures, and the archaeological investigations will be included in the Socorro Mission Preservation Project Historic Structures Report and Preservation Plan compiled by the project coordinators.

Primavera Project Planner® (P3)

According to the above descriptions, it is no wonder that the initial planning of this project, even including the use of a project delivery tool, would be less than impossible. However, the recognized complexity gives even more a need for a scheduling tool to help manage such a project.

Simple scheduling software use linear logic able to generate a bar chart schedule. This is sufficient for a total duration and activity block time frames only, and has sufficed in the financing of a project. The manager cannot use these to monitor and control the project, however, because there is no interconnecting logic. Today, managers use more sophisticated tools that have the capability of controlling schedules and budgets throughout the project, and utilize comprehensive report writing capabilities. Managers experienced with these software programs are able to control projects by forecasting resource and cost availability. This forecasting is possible using the schedules that are generated from precedence logic.

P3 uses precedence logic, meaning activities and their durations and predecessors or successors are entered into the software, which then performs forward and backward calculations of early and finish times for all activities in the project. Information on activity type, resources required (i.e. labor, materials, equipment, subcontractors), costs, and more should be entered at the preliminary stage also. The more that is known about the activity, the more accurate the schedule will be, and the easier to track it later. A powerful option included is the ability to input resource availability. The Project Coordinator (PC) for this project can schedule constraints incumbent in these particular projects. This is extremely important in a preservation project, when methods and climate affect activities, for example, time required to slake lime, cure adobe bricks, and ideal months for lime plastering.

The power of this software is the quickness in which calculations can be made with changes, so the key is to provide as much information as possible for each activity, correct or not. In the preliminary planning stages then, the project manager can input worst-case scenarios to view schedules and determine whether these scenarios are realistic or unrealistic. At this stage, the PC can develop detailed logs explaining specifics of each activity, to back up assumptions.

The Original Plan

This project started with a comprehensive list of 153 sequenced activities developed by the PC based on the conditions assessment findings. Although P3 was not utilized at the preliminary stage, the project proceeded admirably due to the experience and knowledge of the PC. Initially, the project was broken down into five phases: I) floor removal and shoring, II) basal

stabilization, III) wall stabilization, IV) exterior and interior plaster work, and V) floor and woodwork. The original plan for phase II was to move along the exterior wall counterclockwise in sections. Each section consists of removing the exterior concrete collar, removing interior cement plaster from the base to a height of approximately four feet, wall documentation of the wall sections, repair/replacement of basal adobes, and mud plastering the base of wall. After basal stabilization is finished at a particular section, wall stabilization could start at this respective section. This includes removing concrete door and window surrounds, replacing these voids with adobe, installing wood lintels above the doors and windows, removing adobe below and between roof vigas and corbels, inspecting corbels and vigas, repairing deteriorated corbels and vigas, installing wood sills below the corbels, and placing new adobe in voids. Once all walls are stabilized, lime plastering can begin, followed by floor and trim woodwork.

A substantial cost associated with this project is the scaffolding rental. The PC originally sequenced activities carefully to fully utilize this resource in the shortest time possible. In P3, this resource would later become a driving resource, meaning that the resource availability determines the activity's remaining duration. Once the wall stabilization is finalized, the scaffolding can be removed.

As Construction Progressed

As floor removal progressed in the interior, and removal of the concrete collar started on the exterior, the extent of basal erosion became apparent. The original systematic phasing of this work was disrupted and removal of interior plaster at the main nave and left and right transept began in order to uncover the extent of the damaged adobe from the base of the wall up. The original sequencing was also disrupted due to a delay receiving archaeology grant money, therefore a delay in wall documentation. The number of archaeologists and their time available were not known in the beginning of the project. P3 was incorporated during Phase II, when extensive adobe basal and wall deterioration was noticed. As these resources became available, the PC could input these resources and times available and recalculate the schedule. P3 allowed the PC to forecast future delays (early starts) for repair and replacement of basal adobes, which follows wall documentation. From this information, he adjusted the order of repair to include the most deteriorated sections of the foundation first and simultaneously removed interior plaster in the baptistry, an activity planned much later, knowing the same problems would occur. Once sections of basal adobes were stabilized, crews were placed on interior and exterior plaster removals in other areas to compensate for lost time with wall documentation.

As mentioned above, the Socorro Mission project involves volunteers as part of community outreach. This project has incorporated adobe brick making as a volunteer effort. These times and number of people are rarely known at the beginning of a project. However, once the activity has occurred, the PC can easily adjust the information in P3 to see how it affects the remaining activities. In this case, 1000 bricks were made on a volunteer day December 7, 2001. Knowing these bricks would be ready to use March 7, 2002, and knowing actual basal stabilization finish dates from updating the project, the PC was able to look at the schedule and adjust early starts on wall stabilization activities in the sacristy and altar nave.

Besides the unknowns of the state of hidden building components, the workforce and skill level for this project is undoubtedly the most complex scheduling area. Because of unknowns associated with this, the PC was able to only 'best guess' productivity rates and crew sizes to determine durations. The Texas Workforce Commission personnel are only available for certain times, and the number that shows up during these times varies. There is a full time crew supervisor and a part time assistant project coordinator whose availability remains constant. In addition, there is a minimum of five workers a day. This information is adequate to enter into P3 to determine where resources are overloaded. If there is an overload on a critical activity, the PC is able to assign K.E.Y.S personnel or level resources to better utilize float activities.

The software has been utilized to produce relevant reports to aid with grant requests and to update program managers. The ability to annotate milestones and hammocks has made graphics very useful for presentations.

Conclusion

Phase II, basal stabilization, is currently 95% complete. The wall stabilization phase is currently 50% complete. The PC originally estimated completion to be November 2004. This final completion date would not be realistic now, knowing the uncertainties of funding and the workforce. With P3, this date may be realistic. With the knowledge of activities better known and entered into the software, the PC has been able to manipulate future activities to make up several weeks of work. The PC is able to update the schedule 1-2 times each week to better understand how future activities are impacted, and consequently react. The project is currently at the stage where roof vigas and corbels will be inspected. It is anticipated that at least 50% of these load-carrying members must be spliced with new wood using epoxy and fiberglass reinforcing. Also, a new wood sill will be installed below the corbels throughout the interior. Although the PC is very knowledgeable about the methods that will be used, the production rate for this kind of work is somewhat unknown. As this phase progresses, however, the PC will be able to enter the actual information into P3 and recalculate the schedule to determine how to best handle succeeding activities.

This software has served as a valuable tool to monitor and control this project, and also as a support mechanism for funding requests and briefings. Not only will this software help guide this project to completion, but also just as important, it will serve as a database and true case study to be followed by similar future projects.

A Note on Concrete Use with Adobe

Extensive moisture retention causes adobe bricks to fail. Adobe, after all, is clay and sand mixed with straw and water, formed into sun-dried bricks. Capillary action draws moisture from the ground like a sponge upwards into the adobe brick walls. In other cases, the protective surface coating, originally of mud or lime plaster, has deteriorated, and rainwater and snow have eroded

the exposed adobe bricks. If the percentage of moisture consistently reaches 12% or greater, the bricks will, over time, lose their structural integrity.

After World War II, cement plasters replaced mud and lime plaster on many of the region's adobe buildings. Cement-based plasters are somewhat impervious to water. If water penetrates into the wall behind the plaster by capillary action, or through cracks, or broken flashing, it cannot escape and the adobe bricks become saturated. Another method that was intended to repair damage to damp walls was to add a protective concrete apron around the base of the wall called a *contra pared, contra cemiento,* or concrete collar. This also tends to trap moisture in the wall, and becomes another 'remedy' that causes more damage than it prevents.

Leaks in the roof or roof flashing, ground contact with the base of the walls, and the presence of other weak points guarantee that moisture will eventually penetrate the walls. The re-application of permeable wall coatings, such as mud or lime plaster, provides protection while allowing moisture to escape. The biggest challenge at Socorro Mission is the replacement of cement-based features with adobe bricks, including the removal of the poured concrete floors; the removal and replacement of the concrete collar poured at the foundation perimeter; the removal and replacement of the large concrete surrounds at the transept doors and windows; and the removal and replacement of the cement-based stuccoes at both the interior and the exterior.

References

1. *Secretary of the Interior's Standards for Rehabilitation.* U.S. Department of the Interior, National Park Service. (Washington D.C.: Interagency Resources Division, Revised 1990)

2. Conversations with Patrick Taylor, Socorro Mission Project Coordinator

3. Conversations with Jean Fulton, Assistant Project Coordinator

Biographical Information

SONYA L COOPER
Dr. Cooper is an Associate Professor and Civil Program Coordinator in the Department of Engineering Technology at New Mexico State University. She has over 15 years of industry experience in the design and construction of infrastructure, commercial and industrial projects and extensive hands-on experience in historic preservation projects.