RUNNING HEAD: TUSAYAN TRANSIT SHELTERS DESIGN PROJECT

Grand Canyon National Park:
Tusayan Transit Shelters Design Project
Final Report

Proposed Tusayan Monument Sign; Source: Arizona (2006)

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1.0 Project Background

1.1 Project

The Tusayan Transit Shelters Design Project anticipates the construction of four shuttle bus shelters with amenities in Tusayan, Arizona, the gateway to the South Rim of the Grand Canyon. The design project provides amenities important for completion of a safe and energy efficient alternative means of transportation between the Grand Canyon National Park's Visitor Center and the community of Tusayan. The project will offer many environmental benefits such as protection of natural, cultural, and historic resources, and reduced pollution. These shelters are anticipated to be integrated into a major Tusayan streetscape upgrade project. The streetscape project will blend the proposed shelters into the future multiuse paths and landscaping upgrades. Project personnel developed a conceptual design for a green, comfortable, open-air shelter with interpretive signage to showcase Grand Canyon's commitment to sustainability (US Department of Transportation 2009). The potential locations of the bus stops and shelters can be found in Figures 1 and 2, indicated with a red square. These locations were approximately located from the concept study map provided by the Grand Canyon National Park. The potential stop locations are located between the meandering multi-use path, dark lines, and Highway 64. The exact locations of the bus stops and shelters will be determined by Arizona Department of Transportation (ADOT) personnel.

Figure 1: Map of Potential Bus Stop Locations (Southern Side)

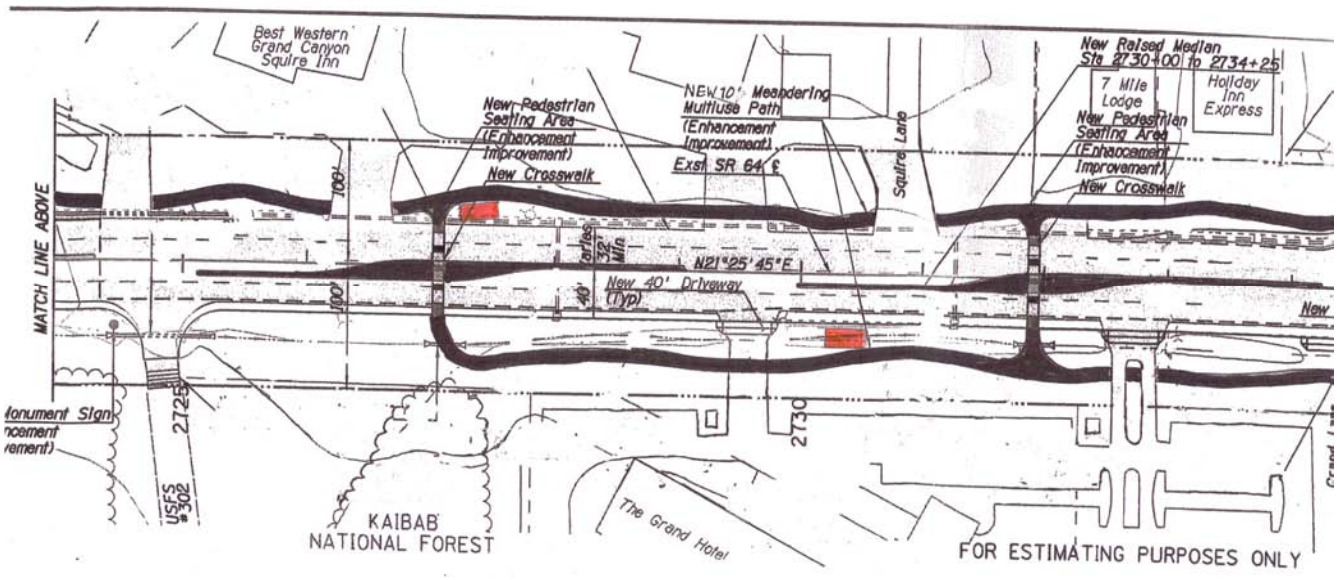
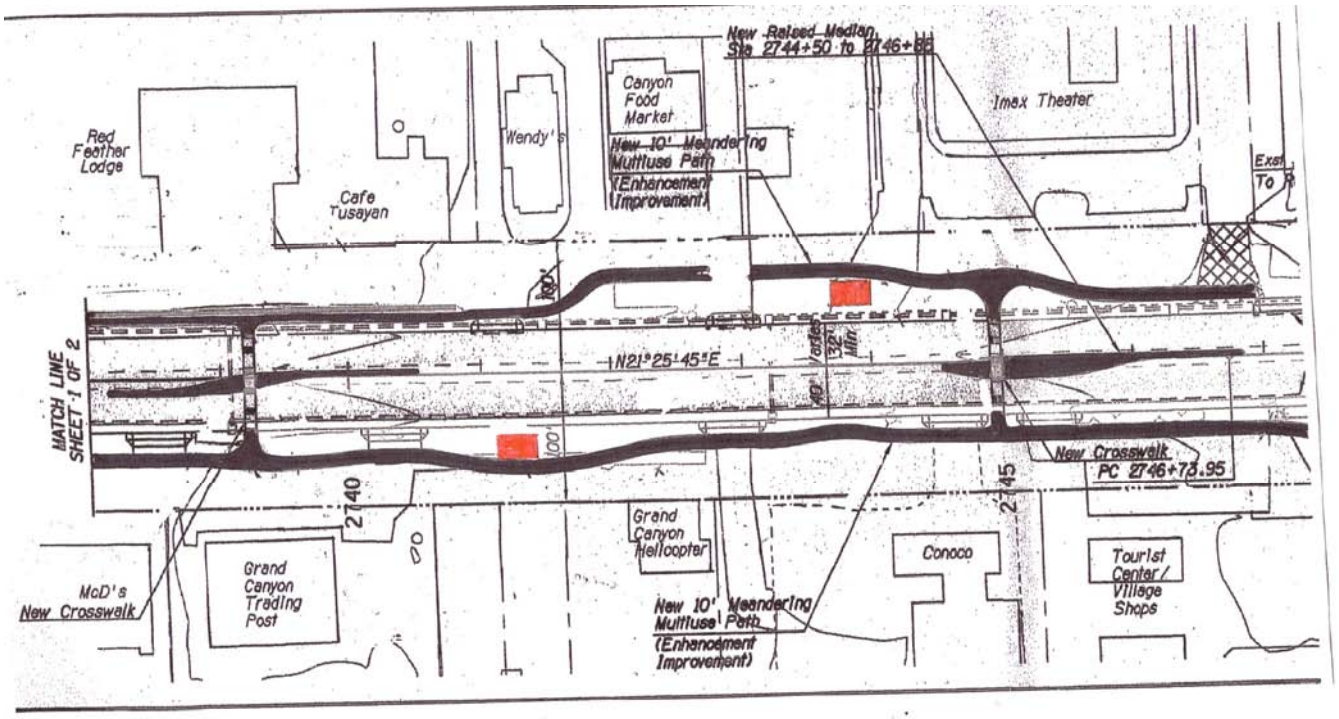


Figure 2: Map of Potential Bus Stop Locations (Northern Side)



1.2 Personnel

The personnel working on the Tusayan Transit Shelters Design Project includes two summer interns from Northern Arizona University (NAU) along with two faculty mentors. The two summer interns are Michelle Mallett, College of Arts and Letters, and Leslie Ayres, College of Engineering, Forestry and Natural Sciences. Michelle Mallett is an affiliate of NAU with a Bachelor of Science degree in Interior Design and is working on a post graduate internship focusing on design and sustainability at NAU. Leslie Ayres is a senior at NAU and will graduate in May 2010 with a Bachelor of Science degree in Environmental Engineering. The two NAU faculty mentors are Helen Peterson and Susan Thomas, each a L.E.E.D. accredited professional. Helen Peterson is a lecturer for Interior Design and Susan Thomas is a lecturer for Construction Management.

1.3 Design Development Schedule

The Tusayan Transit Shelters Design Project was conducted from early May through the end of September. Final reports and presentations were completed in the fall before the end of the 2009 year. For a breakdown of major tasks and deadlines, see Table 1.

Table 1: Timeline of Tusayan Transit Shelters Design Project Tasks

Deadline	Task
May 18	Site visit with Victoria Stinson and ADOT project personnel at Tusayan.
June 1 and June 18	Conceptual design progress review with faculty mentors (weekly informal check-ins or more as needed through duration of project)
June 19	Three or more concept alternatives—sketches, renderings, plan views and elevations with elements of design 'tool kit' and design criteria standards—delivered to park liaison for review
July 10	Comments back from park personnel on concept alternatives
August 3	Refinement of concept delivered to park liaison for review
August 28	Final draft conceptual design and report delivered to park liaison for review
September 11	Comments back from park personnel on final draft report
September 30	Final report delivered to park liaison
December 31	Presentation to Park Management Team

A site visit to Tusayan marked the beginning of the project on May 18th. At that time, project personnel reviewed the existing and proposed Highway 64 corridor. Project Manager Victoria Stinson represented the Grand Canyon National Park's interests. Arizona Department of Transportation (ADOT) interests were relayed by George Wallace and John Dalby. The preliminary report deadline was presented to Victoria Stinson for review. Comments on the preliminary report were returned to project personnel on July 10th. The final draft of the design report was submitted to Victoria Stinson for review on August 28th, with comments returned two weeks later by September 11th. The final report was then delivered by September 30th to Victoria Stinson. The presentation of the project will be completed on or before December 31, 2009, to the Grand Canyon National Park Management Team.

2.0 Basis of Design

2.1 Project Criteria

Multiple criteria were identified during the Tusayan Transit Shelters design process. The criteria were influenced by the Grand Canyon National Park and Arizona Department of Transportation (ADOT) personnel as well as the federal, state, and local regulations. A few of the design criteria include the design vernacular of the Tusayan area and the Grand Canyon National Park, the Americans with Disabilities Act (ADA), ADOT standards, the Federal Highway Administration (FHWA), and local codes of Coconino County.

2.1.1 Area Details

Tusayan is located on the Coconino Plateau, within Coconino County, in the Northern section of Arizona. The elevation is approximately 6,700 feet above sea level. The average high temperature for the year takes place in July with 84 degrees Fahrenheit. Tusayan has an average low temperature for the year taking place in January with a temperature of 19 degrees Fahrenheit. There is on average 21 inches of precipitation a year, with an average snowfall of 71 inches per year (2008 Grand Canyon Arizona). The prevailing wind direction is either from the northeast or the southwest in Tusayan with

most constant winds in the calm to 13 miles per hour range. Occasional wind gusts were measured in 2008 at speeds of over thirty miles per hour (2009 Tusayan Arizona).

2.1.2 Preliminary Tusayan Shuttle Evaluation Study Results

During the summer of 2008, a pilot shuttle service from the Grand Canyon Visitor Center to various points in Tusayan was operated every day from June through September. Over the four month course of the shuttle service, 102,501 passengers boarded the buses with an average ridership of over 850 passengers a day. The week of the Fourth of July was the busiest week of the summer with a total of 8,641 passengers. The average number of passengers per hour was approximately 21 people. Peak hours of passengers were found to be at the beginning and end of the day.

In August of 2008, a passenger study was conducted on the Tusayan Shuttle Bus. The study was completed by the passengers of the shuttle bus. The survey questioned when the passengers arrived in the area, how long were they staying in the area, and how many were in their party. Passengers were also questioned about their experience with the shuttle. For instance, what could be improved, what they liked, what they disliked. When asked why the passenger took the shuttle that day, the most common response was ease of getting around the park. Other popular answers included saving money on gas and avoiding parking congestion in the park. Most passengers, 98 percent, responded that they would use the shuttle again while the other two percent answered they possibly would use the shuttle again. The question, “What three improvements would make you more likely to use the shuttle again in the future?” evoked responses including later evening service, earlier morning service, more frequent service, and finally better amenities (US National Park Service 2009).

2.1.3 Federal Standards: Americans with Disabilities Act (ADA)

ADA standards were created to allow all people access to public facilities. The ADA Standards for Accessible Design report is an appendix to the Title 3 Regulations published by the Department of Regulations. The following points are the standards that must be met and are applicable to the building of the Tusayan Transit Shelters as found in the 28 CFR Part 36, revised July 1, 1994 (United States Department of Justice 1994).

Interior Space Requirements

- One wheelchair designated area for an assembly area of 4-25 people
- Clear floor wheelchair designated area of 30 inches by 48 inches
- Minimum width for single wheelchair passage is 32 inches at a point and 36 inches continuously
- Minimum width for two wheelchairs passing is 60 inches
- Space required for a wheelchair to make a 180 degree turn is 60 inches diameter of clear space
- Vertical requirement of 114 inches at passenger loading zones measured above the sidewalk to the roof cover

Bus Stop Requirements

- Lift or ramp area made of firm, stable surface 96 inches long measuring from roadway and 60 inches wide along roadway
- Pathway from designated wheelchair area to loading area must allow for single wheelchair passage
- The route for those with disabilities to travel must be minimized in length and coincide with that of the general public
- Stations cannot be designed as to make persons with disabilities board at a location other than where the general public boards
- Illumination must be uniform and minimize a glare on surfaces
- Passenger loading zones must have access isle of 60 inches wide by 20 feet long along the vehicle pull up space
- Surfaces must be stable, firm, and slip resistant
- Changes in level up to ¼ inch can be vertical, above that need sloped grade

2.1.4 Arizona Department of Transportation (ADOT) Policies and Procedures

ADOT has compiled a policies and procedures document that provides guidelines for bus stop placement along Arizona roadways. Included in the document is an application and permitting process for building new bus stops, the procedure for placing bus stops, and a list of the required information. The criteria for bus stop placement, bus stop signage, and shelter placement can be found below according to ADOT Policies and Procedures (Arizona 2007).

Bus stop placement:

- Bus stops are permitted only along streets with speed limits of 45 miles per hour or less
- Bus pullouts may be required if the speed limit is over 35 miles per hour, there are less than three travel lanes in the direction the bus is traveling, or there is a bicycle facility adjacent to the travel lane
- If bus stop is located on a road without traffic signals or stop signs the bus stop must be located based on a sight distance evaluation
- Bus pullouts are highly desirable on major highways, but design and implementing costs for pullouts were not budgeted within this specific project and will need to be negotiated between ADOT and the Grand Canyon National Park

Bus stop signage:

- The bottom of a bus stop sign should be seven feet above sidewalk level
- Sign or post should be a minimum of two feet and a maximum of eight and a half feet from the curb
- Avoid installing sign post in middle of the sidewalk maintaining a four foot clear pedestrian access way
- Mount signs in a flag position perpendicular to the street

Bus shelter placement:

- Sidewalk connections must be made from shelter pad to existing sidewalk
- Passengers and bus driver must have a clear view of each other
- If a pullout is created, the width of the pullout must be minimized for other motorists along the roadway to have visibility of the stopped bus
- Passenger loading area should be within ten feet of shelter and bus stop sign
- Provide enough clear space for wheelchair lift deployment (60 inches parallel to roadway and 96 inches perpendicular to roadway)
- An access route from the wheelchair space under the shelter to the wheelchair lift is required
- Seven foot vertical clearance between underside of shelter and sidewalk surface
- Two foot horizontal clearance between shelter canopy and curb face required
- Bus stop signs shall meet all ADA regulations

2.1.5 Coconino County: Building Code Requirements

Coconino County has adopted building codes for designing structures in the area. The county requires that a minimum of five plan sheets be submitted with building permit applications with all required information and scaling. These plan sheets include the foundation plan, framing plans, floor plans, electrical plans, and elevation plans with cross sections and details on more intricate objects.

The pertinent code criteria relevant to the shelter design include:

- Snow loads of 55 pounds per square foot
- Wind speed of 90 miles per hour and 105 miles per hour for 3 second wind gust
- Frost line of 30 inches
- Ice barrier underlayment required in roofing substrate
- If clay soils are encountered, a footing design must be completed by a licensed engineer for the state of Arizona and a geotechnical report submitted to the building department with the engineered footprint design

2.2 Design Development

2.2.1 Design Hierarchy

After detailed discussions with Grand Canyon National Park personnel, ADOT personnel, and faculty mentors, it was determined that a design hierarchy of characteristics would be helpful to summarize the varying elements of the individual shelter designs. Characteristics and features were broken down into essential, important, and desired features as shown below.

Essential

- Shade and weather protection
- Minimum size of 20 feet by 12 feet
- Pleasant, comfortable waiting space
- Seating areas
- Seat wall
- Lighting inside of shelter
- Use of sustainable and green building materials
- Use of low maintenance materials
- Trash and recycle area
- ADA accessible
- Integrated walkways and streetscape leading to and from shuttle stops
- Route and information signage
- Budget

Important

- Use of material that is compatible but distinct to connect the park and Tusayan
- Common themes between shelters but subtle differences

Desired

- Bike amenities
- Educational components
- Bus pullouts
- Park information distribution site

2.2.2 Minimum Requirements

As shown in the design hierarchy above, there are essential characteristics for the transit shelters. These essential items make up the minimum amenities and other requirements of the transit shelters. In order to meet the standards and requirements, lighting must be supplied in the shelters for the safety of the passengers. A concrete pad base must be used in order to accommodate the ADA standard of a firm, stable ground surface. The concrete pad will also prevent erosion of the base and make for easy cleanup of the area. According to the ADA guidelines, seating must be provided to the passengers. Signage must also be provided so that the passengers may understand the basics of the transit system. Times of the shuttle, months of use, and route information are a few examples of needed information. Shelter in the form of a roof must be provided for protection from the elements.

2.2.3 Upgraded Features

The basic, minimum, essential requirements can easily be upgraded to include many other options for passenger satisfaction. These upgrades include those items listed under the important and desired sections of the design hierarchy. Some upgrades that can be incorporated into the shelter design take place in the shelter itself and some in the surrounding area. Upgrading the standard concrete pad to a colored concrete, or even a stamped colored concrete, would separate the transit shelter from the surrounding area. Landscaping with local flora around the shelter would integrate the shelter into its surroundings. The addition of bike racks would allow alternate vehicles to be locked up and protected while the owner participates in local Tusayan activities. Vending machines were considered as a possible feature that could be incorporated into the design, but after a discussion with ADOT personnel they are no longer considered in the design.

2.3 Meeting Summaries

The Tusayan Transit Shelters Design Project has resulted in multiple meetings in order to communicate with all personnel involved. Summaries of the meetings are provided here.

2.3.1 Initial Meeting: April 10, 2009

The first meeting of project personnel was conducted on April 10th. The Ecological Monitoring and Assessment Program (EMA) project coordinator, Shawn Newell, organized the meeting and was present. Also present were the Grand Canyon National

Park liaison, Victoria Stinson, the NAU faculty mentors Helen Peterson and Susan Thomas, and the NAU summer interns Leslie Ayres and Michelle Mallett. After introductions, a history and description of the project was presented by Victoria Stinson, followed by a question and answer session between Victoria and the project personnel. Afterward, the timeline of the project was developed and agreed upon by all members.

Victoria Stinson's presentation of information provided a large amount of necessary details and desires of the Grand Canyon National Park. The history of the project and how the project had been developed was discussed. It was anticipated that the funding for the project would be provided by grant money. Visual plans of the Highway 64 enhancement project were also displayed for project personnel. Appendix A includes copies of the preliminary maps of the enhancement project concept study maps. On a second copy of the enhancement project plans, possible bus stop sites were highlighted for reference. Shelters with amenities are desired by the park. The Tusayan Transit System will be run seasonally during the three to four summer months of the year, including the monsoon season. The buses will be used by the local community commuting to work and by tourists visiting the Grand Canyon and Tusayan. The capacity of the stops is not definite at this point and is only estimated by the preliminary survey work of the summer of 2008.

The buses currently in use are forty feet in length and possibly need a 90 foot long pullout length. The exact length of the pullout area will need design approval by ADOT. Busses have a capacity of fifty people. There is an anticipated wait of fifteen to twenty minutes between buses on the route with approximately twenty passengers per hour expected. The buses are anticipated to run from eight AM to ten PM, requiring a lighting system to be incorporated into the design. The park uses solar lighting and this would be appropriate for the shelters as well as being a sustainable feature. As an example of a possible transit shelter design, a copy of the Zion National Park bus stop design was provided. Stone masonry, flagstone, and other local materials were discussed as possible materials for use. Using materials that would connect the shelters to the Grand Canyon Visitor Center would also be preferred.

2.3.2 Site Visit: May 18, 2009

A site visit to Tusayan was conducted on May 18th. Project personnel Helen Peterson, Susan Thomas, Leslie Ayres, and Michelle Mallett, park liaison Victoria Stinson, ADOT engineering specialist John Dalby, and ADOT Senior Project Manager George Wallace were present for the site visit. Project personnel viewed the potential shelter locations in Tusayan, as well as the architecture materials that make up Tusayan buildings. A tour of Tusayan was conducted with photos taken to document the existing architecture and bus stop locations. Appendix B includes example pictures of Tusayan architecture and the three current bus stops. A roundtable discussion followed the tour and

included the discussion of the future enhancement project of the road, Highway 64, and a question and answer session.

Information on the transit shelter project was clarified with the understanding that the landscaping would not be planned by the project personnel and the buses are front handicap loading. Further identified during the discussion was that the enhancement project will mainly be taking place on the east side of the road with minimal impacts taking place on the west side because of the limited area and existing landscaping already in place. The multiuse path planned for the project will be made of asphalt or concrete. For further details on the Highway 64 enhancement project, see Appendix A. Park personnel requested a minimum requirement list of necessary amenities and then an additional list of the upgraded amenities and special features possible. Walls were not a major requirement, with seating available outside of the shaded area a possibility.

2.3.3 Concept Alternatives Comments: July 10, 2009

After the submission of the preliminary report to Victoria Stinson, park liaison, comments on the report and the design concept alternatives were explained in person during a meeting on July 10th. At this meeting all project personnel; Leslie Ayres, Michelle Mallett, Helen Peterson, and Susan Thomas; park liaison Victoria Stinson, ADOT engineering specialist John Dalby, and ADOT Senior Project Manager George Wallace, were present. The meeting began by discussing Victoria Stinson's comments for the preliminary report. John Dalby and George Wallace also addressed their comments throughout this discussion. A question and answer session was then conducted between project personnel, park liaison, and ADOT professionals.

Further information was clarified and discussed throughout the meeting by park and ADOT personnel. The schedule for the project was adjusted for concept refinement and final report draft submittal dates. It was stated that the Grand Canyon National Park uses 110 foot bus pullouts, and the length of bus pullout for Tusayan will be determined by ADOT. Even though bus pullouts have not been decided upon, they most likely won't be used on the west side of Highway 64, but could possibly be used on the east side. When discussing amenities, it was stated that vending machines could not be placed in the bus shelters. Also, on the subject of amenities, trash receptacles would be placed on the busses and therefore would not be necessary in the shelters. It was clarified that the current sidewalks of Tusayan would not remain after the enhancement project was completed and only the multi-use path would be used, adjusting the placement of the shelters between the path and the highway.

Design concepts were discussed to integrate different architecture styles of the Tusayan community together, while maintaining a similar look between the stops for identifying the structure as a bus stop. While thinking about the foreign visitors that

could possibly use the bus stops of Tusayan, it was important to maintain a visual continuity between the stops for recognition purposes. The footprint of the shelter was also discussed resulting with an emphasis to be as compact as possible. This would prevent excessive impacts on the existing landscaping. Seating for the shelters was desired to serve a minimum 6 people under cover and 4 people outside of the cover. Bike racks were discussed as a possible upgrade to the shelter.

Of the four design styles submitted, Tusayan Architecture, Grand Canyon National Park Architecture, and Modern Architecture, the Tusayan Architecture was preferred. More information on the preliminary design styles can be found in section 3.0 of this report. It was of concern that the preliminary Tusayan Architecture design style was too large and it was suggested to use a two or three post structure to decrease the layout's size. The roofing material desired by the park was standing seam metal roofing. It was also mentioned that the Grand Canyon has stockpiled limestone from development in the park that has a possibility for use at the Tusayan Transit Shelters. If use of the stockpiled limestone is desired, it would need approval from the Grand Canyon National Park. There were also requests for the final report to include multiple sources of the materials to possibly be used by the contractors of the transit shelters. This request is addressed by the incorporation of a Toolkit in section 5.0 and extended information in Appendix E.

2.3.4 Additional Meetings

Beyond the initial meeting, site visit, and concept alternatives comments, multiple meetings have occurred between project interns and mentors. These meetings have not been formal, but check-ins between the members, to share findings and research ideas. Questions and clarifications on what had and what had not been accomplished to date also occurred during these meetings. One suggestion was to research completed transit shelters around the state of Arizona for inspiration and ideas on how transit shelters have been designed in the past. These photos of in place, completed structures can be found in Appendix C.

3.0 Preliminary Design Concepts

Four distinct design concepts were developed for consideration during the conceptual phase of this project. The following sections summarize the preliminary design concepts used for evaluation and selection by Grand Canyon park personnel. These design concepts included architecture that reflected the current architecture found in Tusayan, the architecture style of Grand Canyon National Park, a twenty-first century modern architectural style, and a basic architecture style that can be prefabricated. Each of the designs includes multiple pros and cons that determined the design selected for Tusayan's Transit Shelters Project. A description and an example sketch of each of the architectural design styles are listed below. All sketches are from the perspective of the road looking toward the shelter.

3.1 Tusayan Architecture

Tusayan architecture shelter prototypes reflect the existing architectural style found in Tusayan. The purpose of this style is to integrate the proposed shelters into the established style of Tusayan, Arizona. Proposed shelters could consist of a single design style found in Tusayan or each of the four shelters could be slightly unique, each featuring one of several architectural styles found in the Tusayan area. The following is a list of the pros and cons for the Tusayan architectural style.

Pros

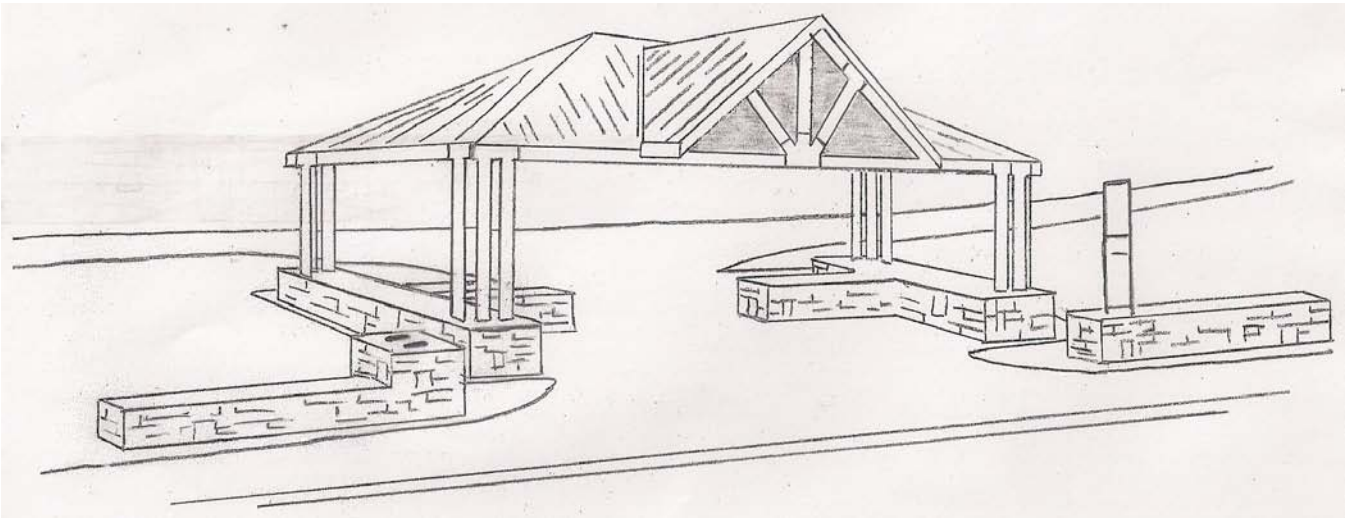
- Shelters would blend seamlessly into the existing architecture found in Tusayan
- The proposed materials are already being used on existing architecture demonstrating durability and quality

Cons

- Design style repeats the architectural style found in Tusayan and does not engage the visitor
- Design does not have a learning component integrated into the architectural style

The suggested materials for these shelters would include recycled steel beams, exposed timber beams or reclaimed logs, corrugated metal roofing, and stacked stone facades. Figure 3 below shows an example of the Tusayan architecture transit shelters.

Figure 3: Tusayan Architecture Transit Shelter Example



3.2 Grand Canyon National Park Architecture

Grand Canyon National Park shelter prototypes were inspired by many of the parks historical buildings, some designed by Mary Jane Colter. Historical building designs such as the Grand Canyon Lodge, El Tovar, Hermits Rest, and the Desert View Watchtower, could be used as inspiration for the various proposed shelters. The purpose of this style is to engage the visitor before entering the park by introducing them to the Grand Canyon's architectural style and to give them a glimpse into what awaits them beyond the park entrance. The following is a list of the pros and cons of the Grand Canyon National Park architectural style.

Pros

- Style would engage the visitor by being unexpected and different from the Tusayan existing architecture
- Style would have an educational component and give the visitor a preview of Grand Canyon National Park architecture
- Style would be easily recognizable as a bus shelter due to its unique look
- Materials will require minimal maintenance due to the rugged nature of the style

Cons

- Possibly difficult to construct due to unique materials and shapes used in the design
- Shape of Watchtower design and Hermit's Rest may be too costly or difficult to recreate
- Replication of historic national monument architecture is prohibited

The suggested materials for these shelters include concrete block covered by stacked stone that would mimic the stone found in the Grand Canyon, fiberglass composite shingles, and reclaimed timbers. An example of the style of the Grand Canyon National Park architecture transit shelters can be found in Figures 4 through 6 below. Figure 4 was inspired by the Desert View Watchtower, Figure 5 was inspired from Grand Canyon Lodge entrance, and Figure 6 was inspired by Hermit's Rest with a Puebloen ball court and kiva influence.

Figure 4: Grand Canyon National Park Architecture Transit Shelter Example (Watchtower)

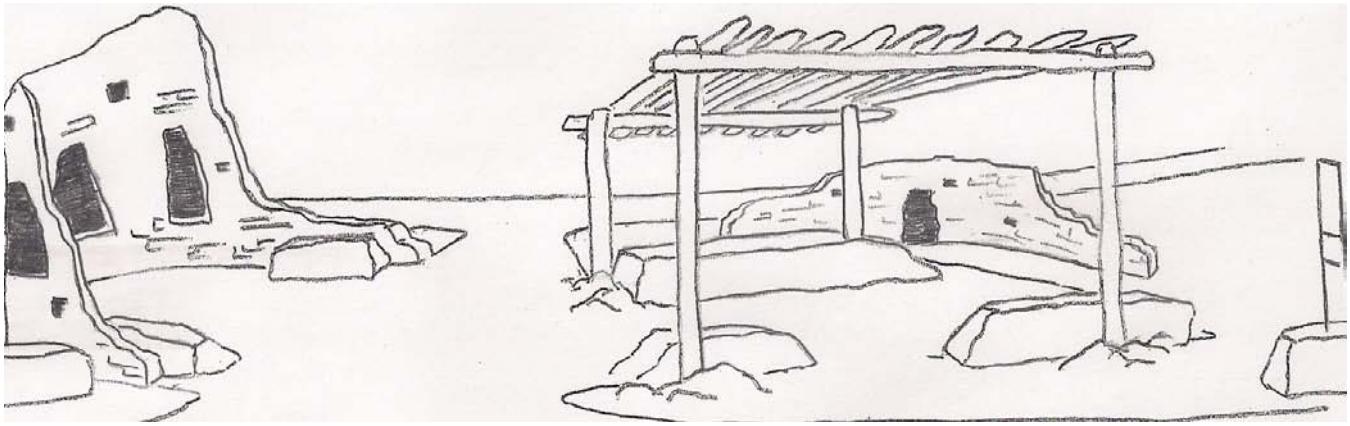


Figure 5: Grand Canyon National Park Architecture Transit Shelter Example (Grand Canyon Lodge)

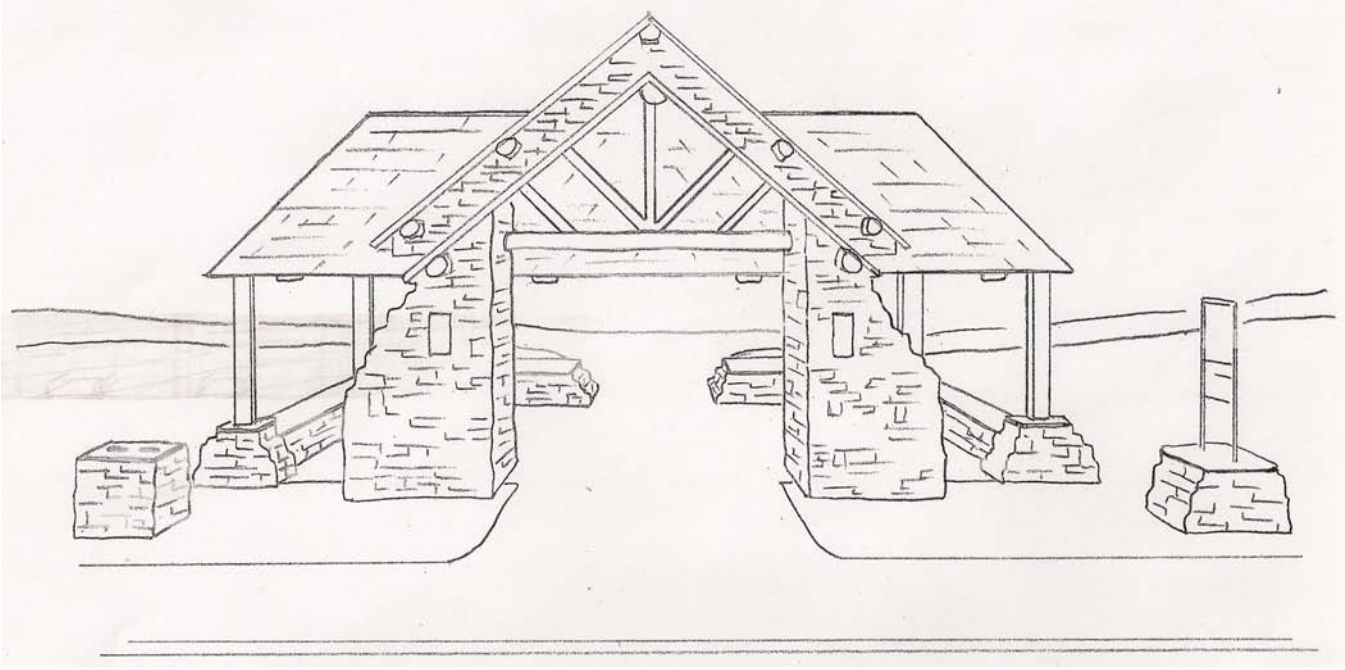
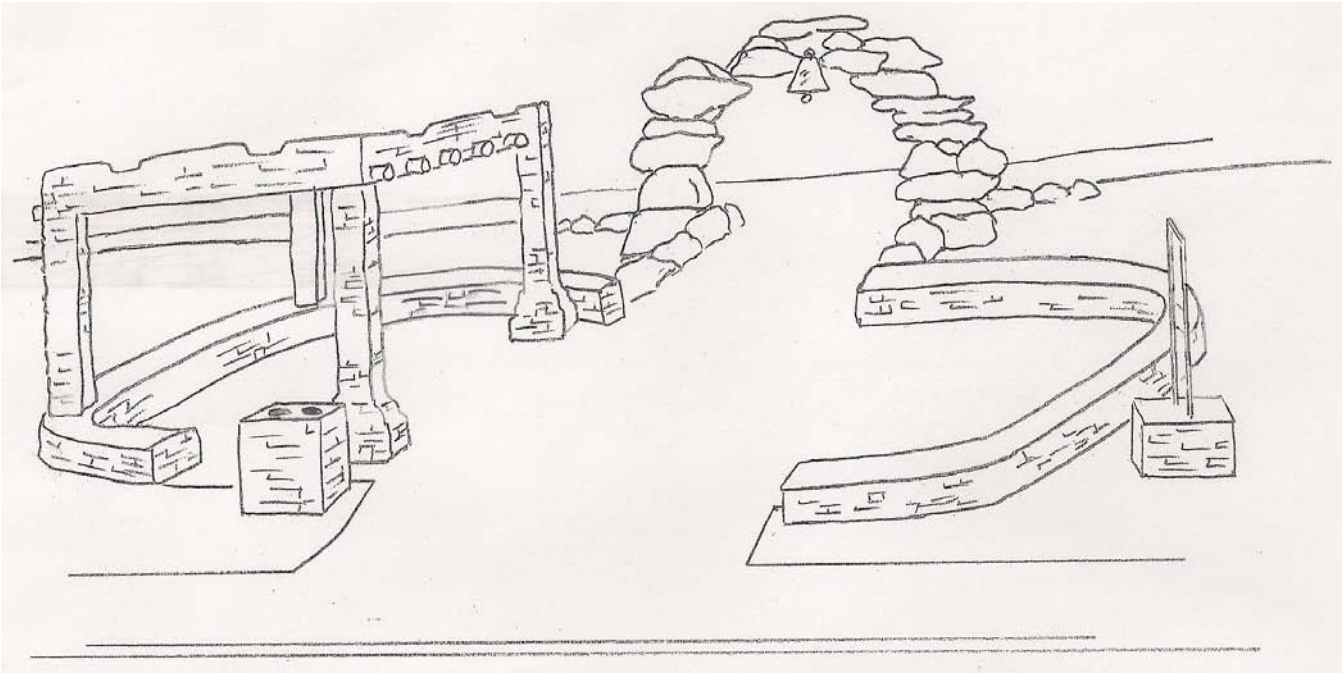


Figure 6: Grand Canyon National Park Architecture Transit Shelter Example (Hermit's Rest)



3.3 Modern Architecture

Modern architecture shelter prototypes evoke a clean lined functional design concept. Inspired by twenty first century design, these shelters feature state of the art structures that are very distinct from the architecture found in Tusayan. The purpose of this unique design style is to offer a modern sense of space that is very minimal and simple. The following is a list of pros and cons for the Modern architectural style.

Pros

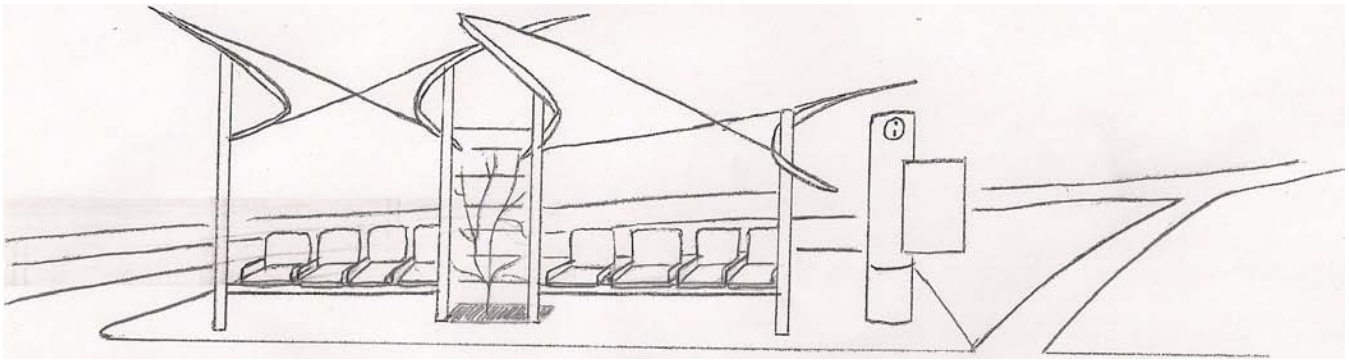
- Simple, clean line construction
- Minimal use of suggested materials

Cons

- Proposed materials are diverse from the materials used in Tusayan and the Grand Canyon National Park
- Design for the shelters is typical of a transit shelter and expected by the visitor
- Seating areas are confined to one area making all visitors sit in that area
- Proposed materials require maintenance

The suggested materials for these shelters include recycled steel beams, corrugated metal roofs or high density polyethylene shade cloth. Figure 7 below shows an example of the Modern architecture transit shelter design.

Figure 7: Modern Architecture Transit Shelter Example



3.4 Basic Architecture

Basic architecture is typically prefabricated and constructed to provide the minimum requirements of the transit shelter. Those minimum requirements include shade and weather protection and a seating area. The following is a list of the pros and cons for the Basic Shelter architecture style.

Pros

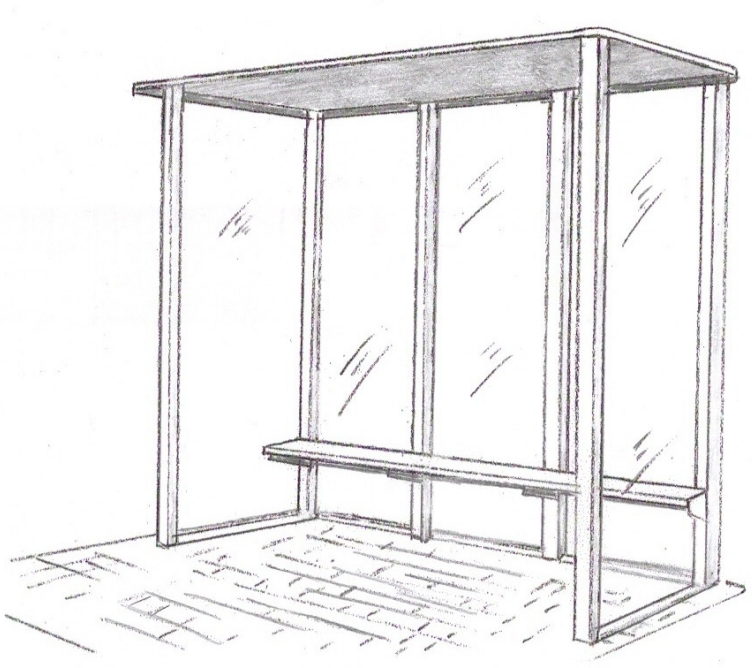
- Style meets the basic requirements of the transit shelter project
- Style is recognizable as a standard transit shelter
- Easily installed due to prefabrication

Cons

- Style is expected architecture for a transit shelter
- Style is generic and lacks character

The suggested materials for the Basic architecture style are either aluminum or steel and tempered safety glass. Figure 8 below is an example sketch of the Basic architecture design style.

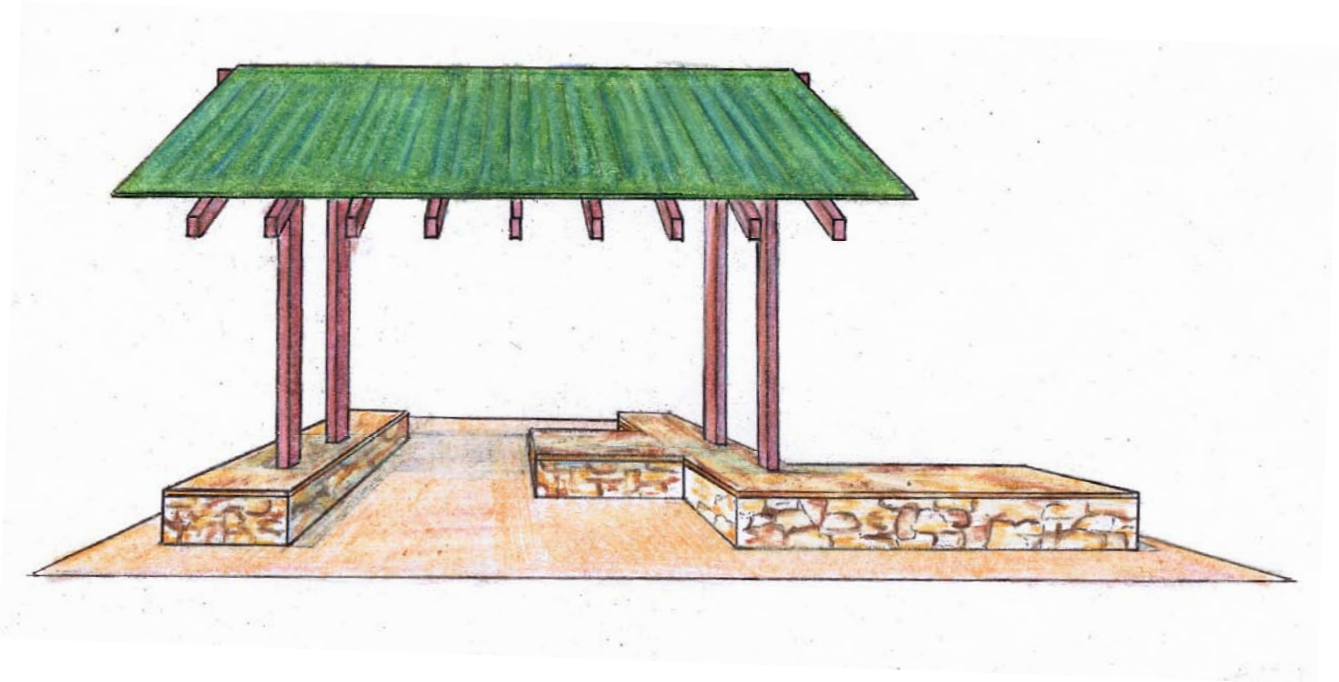
Figure 8: Basic Architecture Transit Shelter Example



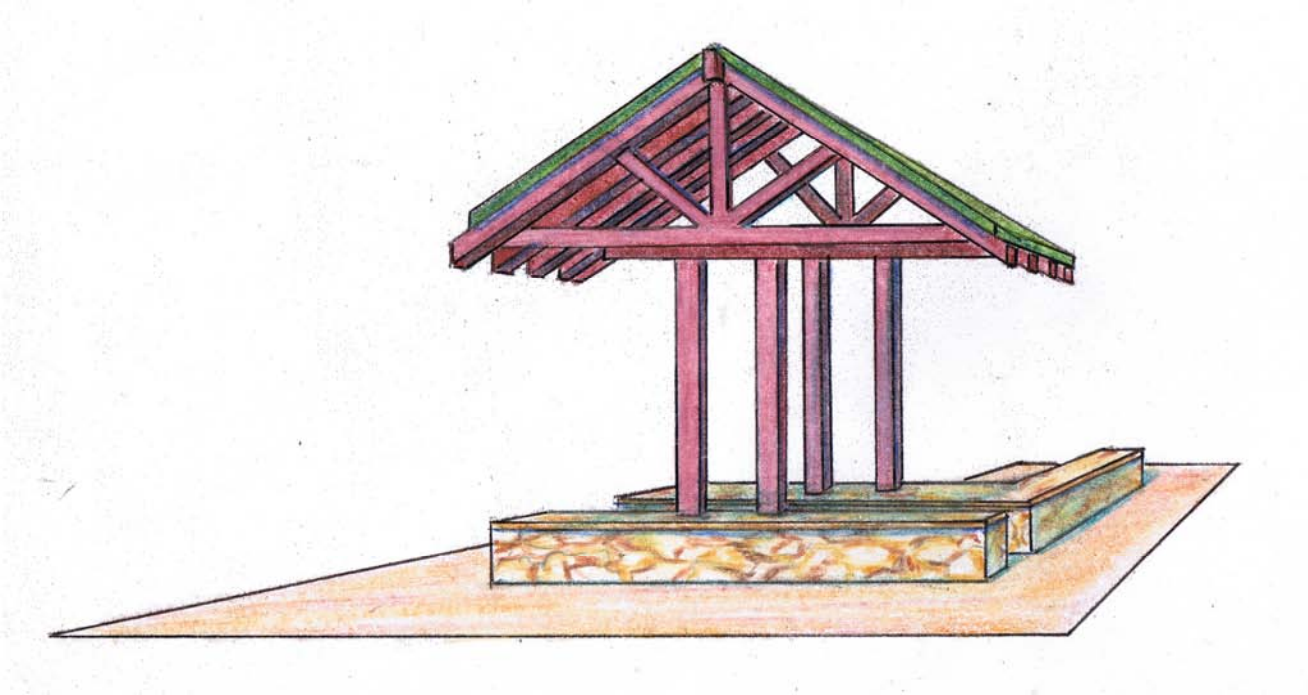
4.0 Design Concept Refinement

It was recommended by project personnel to design and expand upon the Grand Canyon National Park architecture style. This recommendation was supported because it engaged the visitor, it was an unexpected design for a bus stop, a significant Grand Canyon learning component would be integrated into the design, and the stops would work as a preview to the different areas of the park they could visit after entering the park. After discussing the design, it was found that reproduction of historic, national monument components was prohibited. Therefore, the chosen design style was the Tusayan architecture design concept. The Tusayan style was then focused on by the project personnel for further design after discussions with park personnel and ADOT professionals. Conceptual views are provided in order to picture the concept to scale as it would be after construction. The floor plan and elevation views give the dimensional views of the concept, and were completed using AutoCAD with a 0.25" = 1' scale. The following perspectives and drawings are from the interim submittal of the Concept Refinement report submitted August 3rd, 2009. Comments on the Concept Refinement report can be found in Appendix D.

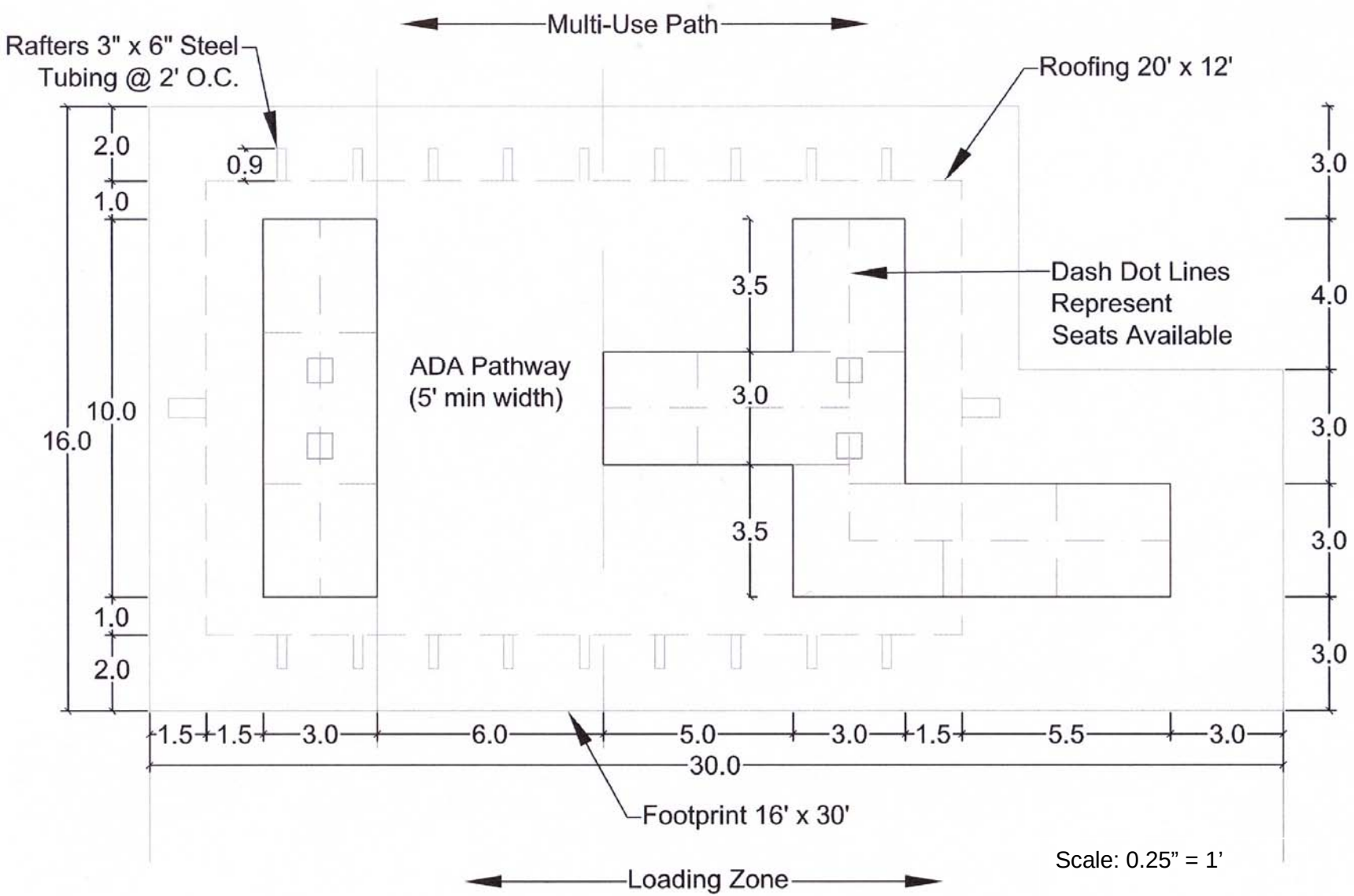
4.1 Conceptual Perspective Front View



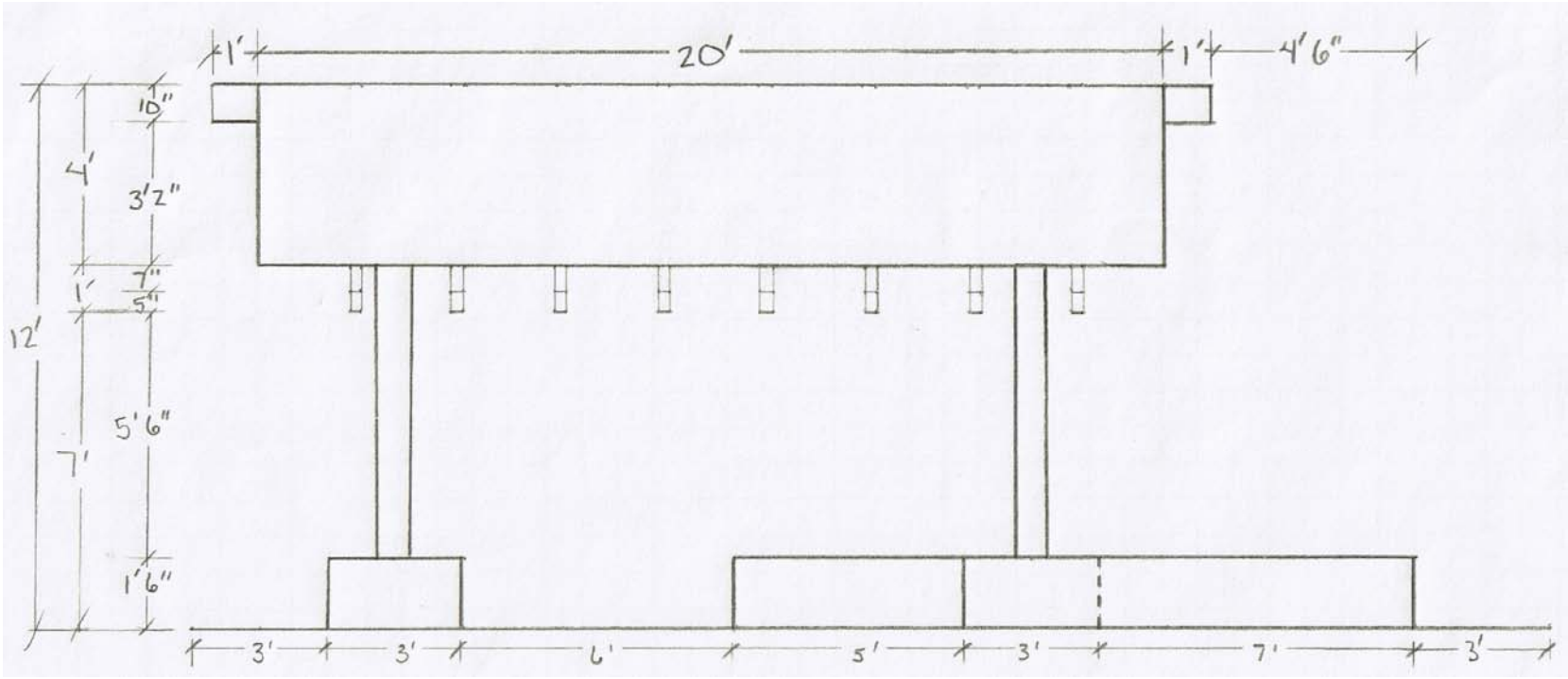
4.2 Conceptual Perspective Side View



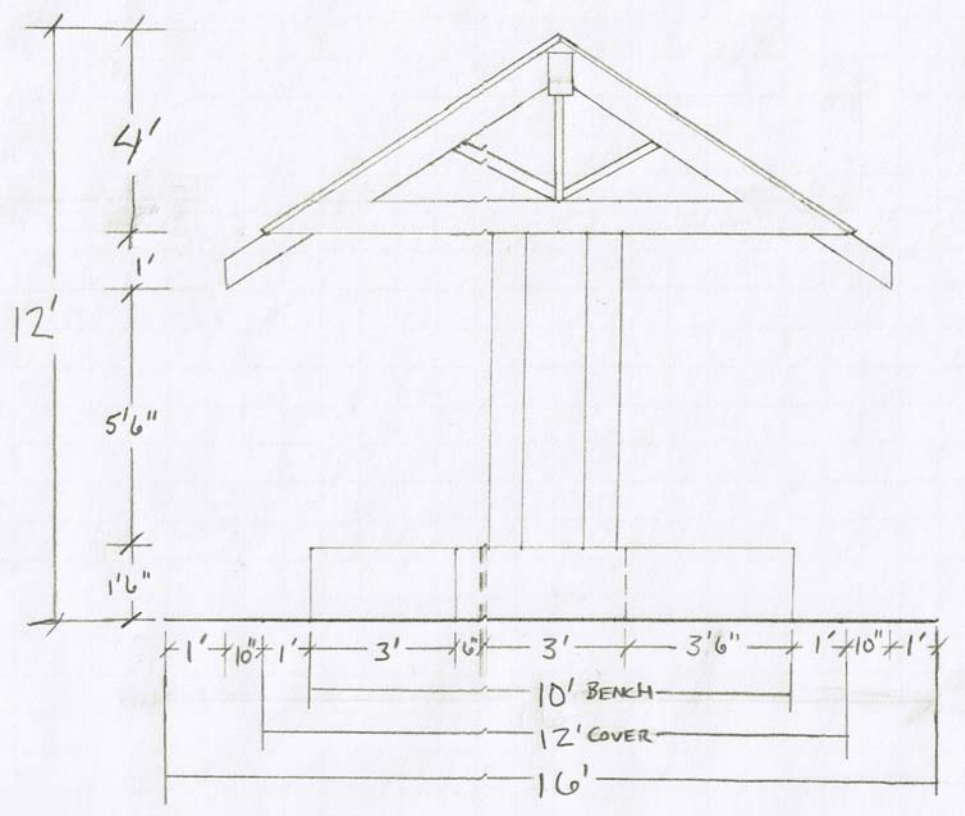
4.3 Conceptual Floor Plan to Scale (0.25” = 1’)



4.4 Conceptual Front Elevation



4.5 Conceptual Side Elevation

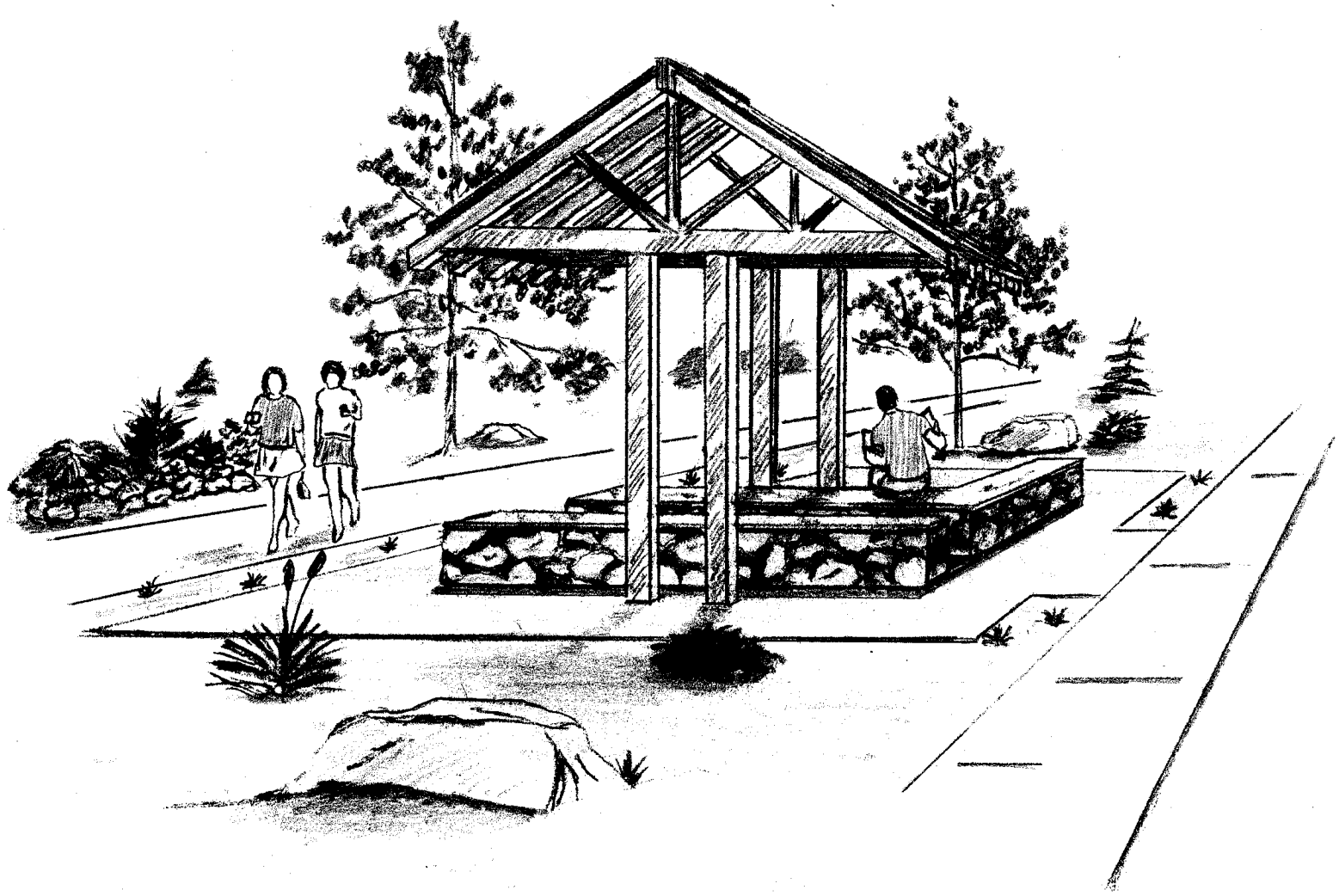


5.0 Tusayan Architecture Final Design Concept

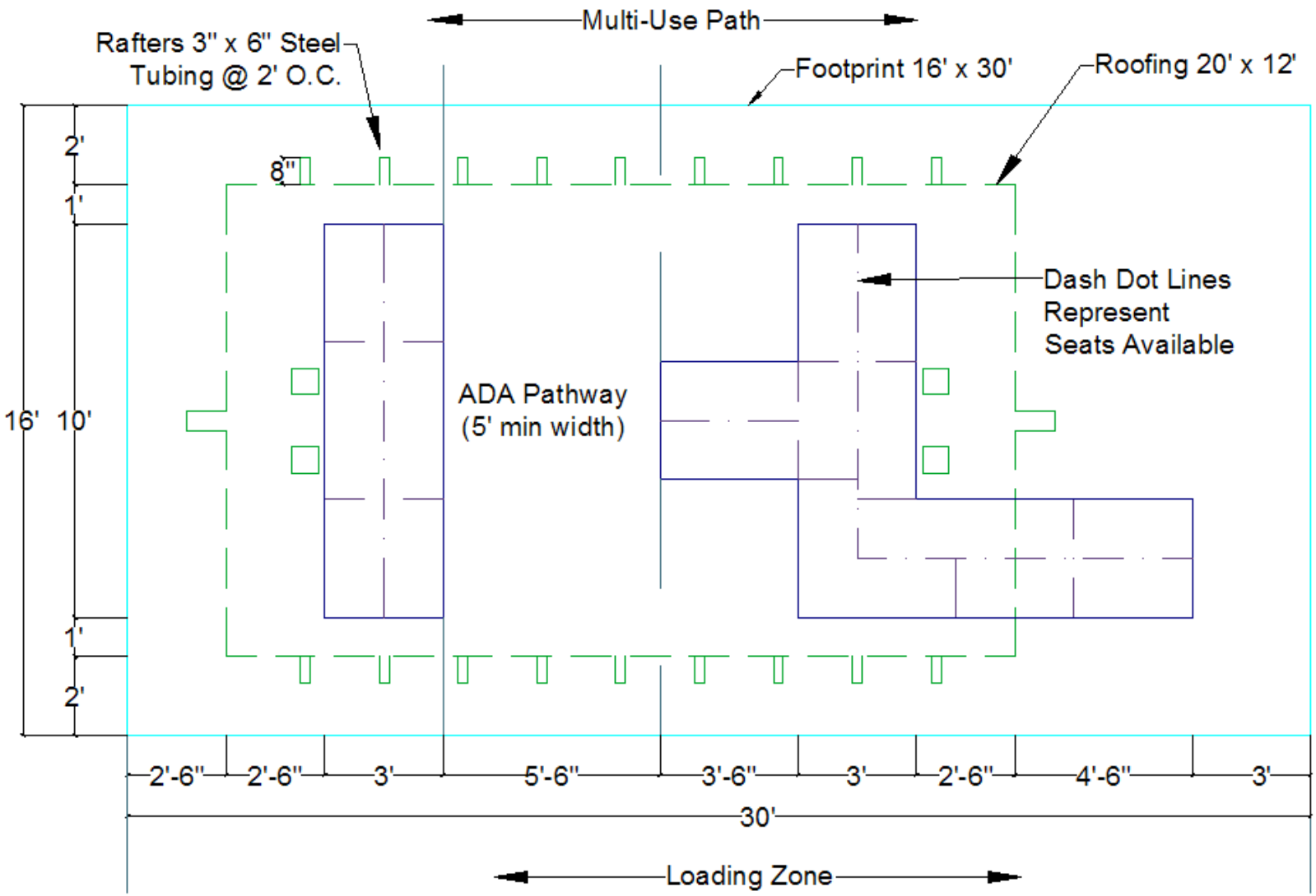
The provided conceptual, plan, and elevation views of this section have been slightly adjusted from the conceptual design report, previous section, to accommodate several building factors. In order to incorporate the truss of the roof with the outermost rafters of the conceptual drawings, the vertical support beams had to be moved out from the center of the structure. This moved the beams to the edge of each of the benches, eliminating one of the assigned seats per bench. Another issue was then found involving the freeze and thaw properties of metal support beams versus the rock and concrete benches. To avoid possible problems with this aspect of the building, the project personnel shifted the benches toward the middle of the structure to allow for the vertical supports to only contact the foundation. Benches were shifted into the structure to keep the footprint of the shelter the same size as well as the dimensions of the roofing. The ADA pathway then became too narrow for the ADA regulations requiring another alteration of the plans. The protruding bench was then decreased in size allowing the pathway to remain within codes of the Americans with Disabilities Act. The final renderings and scaled drawings can be found in sections 5.1 through 5.6. The resulting design now allows for complete freedom of moving the benches within the footprint of the design.

5.1 Final Front View to Scale

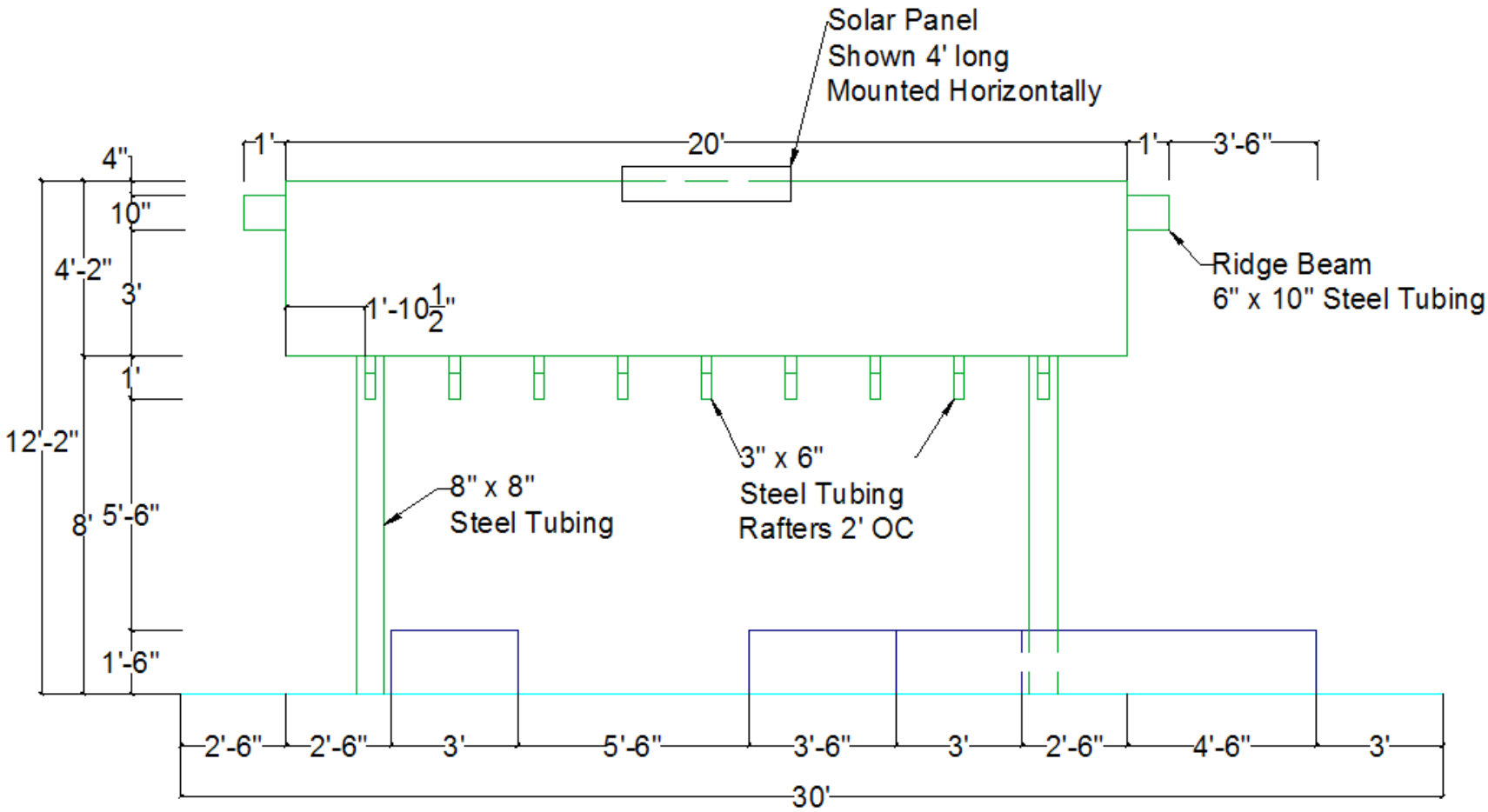
5.2 Final Side View



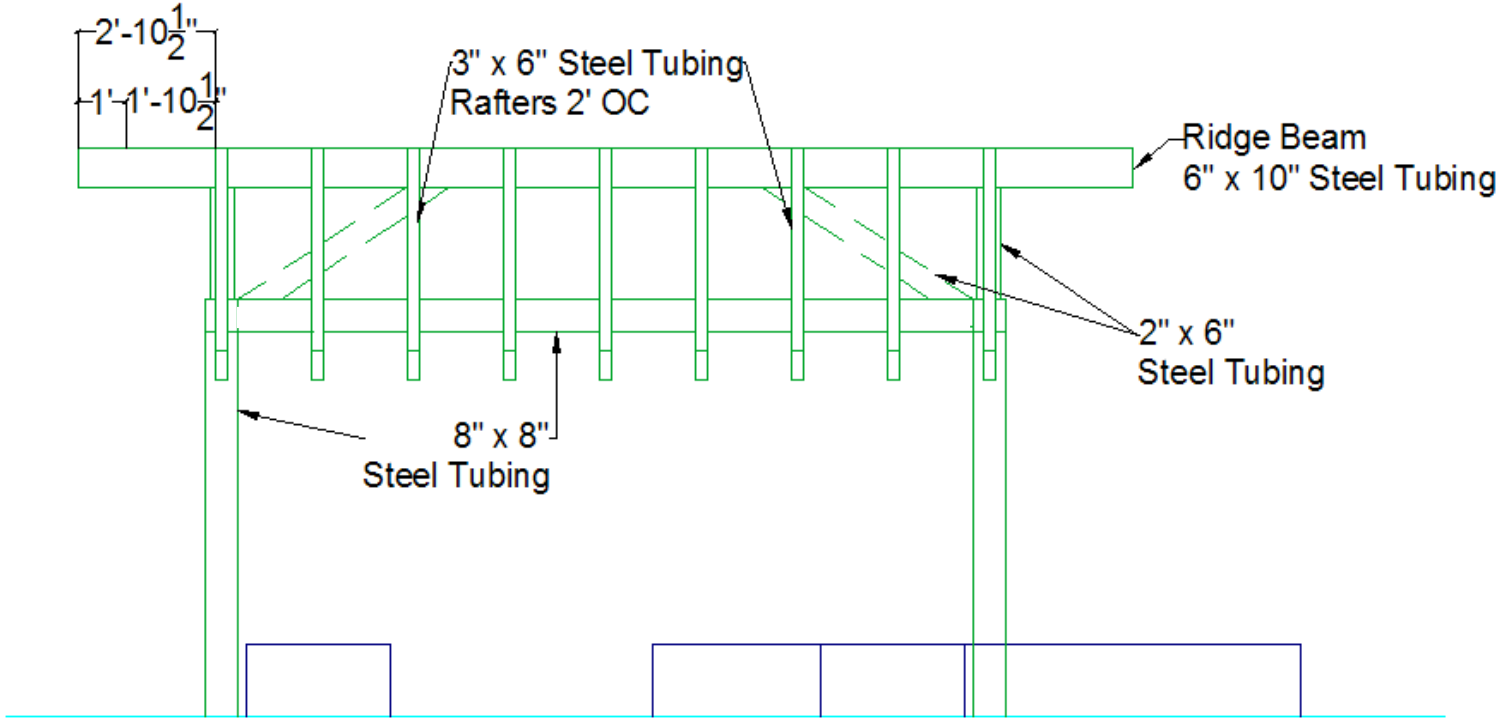
5.3 Final Floor Plan to Scale



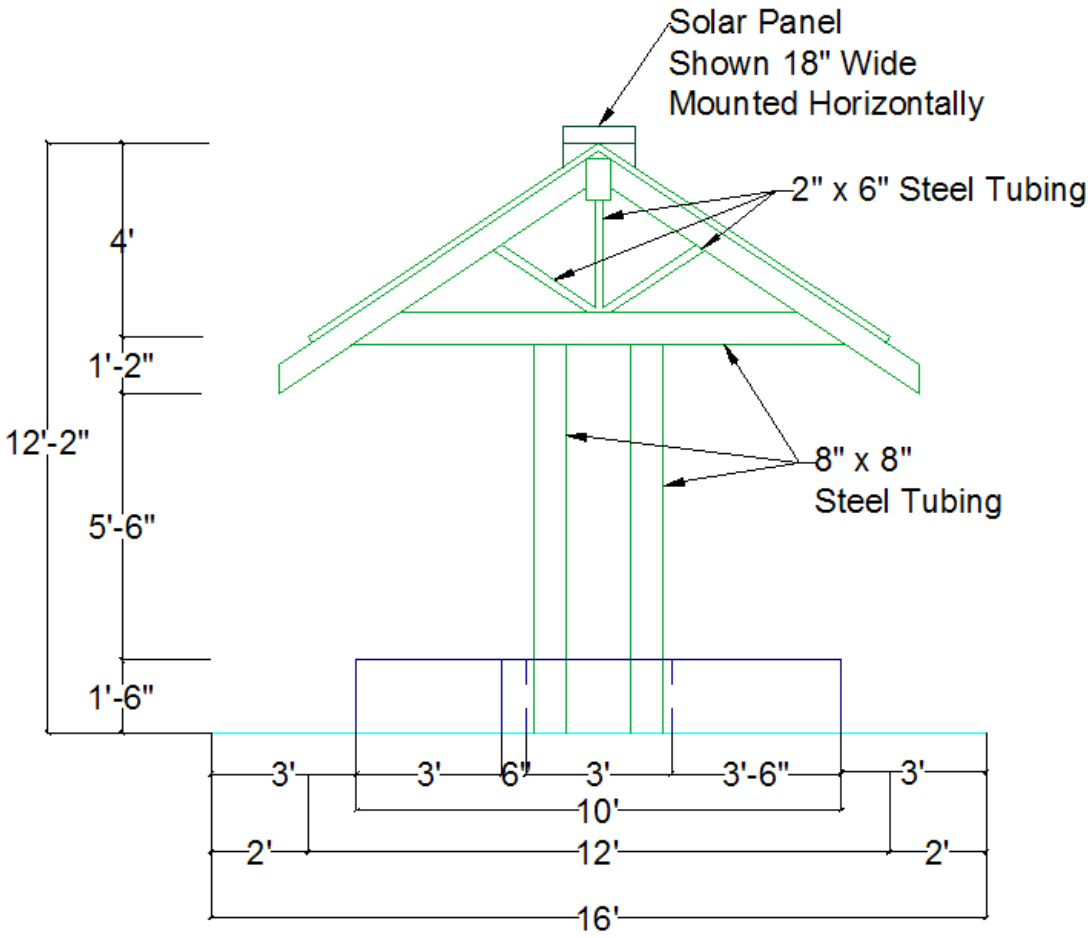
5.4 Final Front Elevation to Scale



5.5 Final Front Elevation Beams to Scale



5.6 Final Side Elevation to Scale



6.0 Tool Kit

The tool kit describes the Tusayan architectural design style materials and suggested manufacturers. The manufacturers stated here are examples of companies that can provide the materials needed to construct the shelters. Most are located within a five hundred mile radius of Tusayan, which complies with LEED certification as a local material. Business contact information and any brochures that have been collected from the companies can be found in Appendix E under the appropriate category.

6.1 Aesthetic Detailing

The Tusayan Architecture transit shelter style is will blend with the style of Tusayan architecture as well as the Grand Canyon National Park Visitor Center. In order to blend the shelters with the local architecture, similar materials will be used, such as metal roofing, stone veneer, and steel beams. All four shelters in Tusayan will be similar in design and detail to be recognizable by tourists as bus stops.

6.2 Structure

The Tusayan Architecture design style includes the use of rectangular steel tubing and concrete with metal roofing, decking, and stone veneer. The roof will be supported by two sets of two square tubing steel beams on either side of the structure as seen in the elevation and conceptual views of the final design concept, section 5.0. These support beams will be eight inch square weathering steel tubing. All steel tubing throughout the structures will be made of a type of weathering steel. Weathering steel is a low maintenance material requiring little to no maintenance and made of recycled materials. Using recycled structural steel allows this project to gain L.E.E.D. certification credits and falls under the Materials and Resources category in the L.E.E.D. project checklist under Recycled Content. One brand name of weathering steel is Cor-ten steel. Three suppliers of the steel beaming to be used throughout the structure are AGATE steel manufacturers of Scottsdale, Arizona, Page Steel, and Mayorga Welding of Flagstaff, Arizona. The company contact information can be found in Appendix E under the Weathering Steel section.

6.3 Foundation

The foundation will consist of concrete and rebar. The local concrete companies in Flagstaff, Arizona, are Arrow Redi-Mix, Cemex, and Flagstaff Concrete. Concrete company contact information can be found in Appendix E under the Concrete section. The materials that go into the concrete are extracted or mined locally from around the state and recycled making the concrete an excellent L.E.E.D. material for use. The minimum requirement would be the basic grey concrete poured into a slab. If upgrades are desired they can be in the form of using colored concrete. Another upgrade would be to stamp the concrete to add texture and interest to the bus stop. The colored and stamped concrete will also separate the bus stop from the multi-use path.

The concrete color and stamping will enhance the look of the transit shelter. The color of the concrete is supplied by Davis Color to the local concrete companies described in the foundation

section of the tool kit. The recommended colors of concrete to be used from Davis color include San Diego Buff, Spanish Gold, and Salmon. A Davis Color brochure of the colored concrete options is available in Appendix E under the Concrete section. Stamping the concrete surface would add texture and interest to the transit shelter. Some stamps are available for rent, but can also be bought for use by the concrete contractors. Of the stamps supplied from Brickform, the seamless skins category was desired. Of the seamless skins patterns available, it is recommended that Sanded Slate Texture, the Renaissance Slate Texture, or the Elk Mountain Texture be used for the Tusayan Transit Shelters Project. See Appendix E under the Concrete section for examples of these stamped concrete finished looks.

Using regional concrete suppliers and choosing concrete colors that are lighter in color allow this project to be eligible for L.E.E.D. certification credits under several categories. Credits can be achieved under the Sustainable Sites category on the L.E.E.D. checklist under Heat Island Effect – Non-roof. Choosing concrete colors that are lighter in color and have an SRI (Solar Reflective Index) of at least 29 is required for this credit. Additional credit is also available under the Materials and Resources category in the L.E.E.D. project checklist under Recycled Content and Regional Materials. This credit can be achieved by using regional concrete suppliers within a 500 mile radius of the construction site.

6.4 Roof Materials

The roof of the Tusayan Transit Shelters will consist of standing seam metal roofing. Two gauges of standing seam metal roofing are available, 22 and 24 gauge, with the 22 gauge being thicker. It is recommended to use the 22 gauge standing seam metal roofing. Fabral Metal Wall and Roof Systems provide different color options for the standing seam metal roofing. The color choices for the standing seam metal roofing recommended include Pewter, Surrey Beige, or Hardford Green. Fabral company contact information and metal roofing color examples are provided in Appendix E under the Roofing section. Roofing companies that provide Fabral standing seam metal roofing include Century Roofing Inc. of Phoenix, Arizona, Western Metal Deck of Phoenix, Arizona, and direct from the Fabral manufacturer though the Home Depot Contractor's Desk. Contact Information on these companies can be found in Appendix E under the Roofing section.

Choosing lighter colors for the metal roof create a high SRI (Solar Reflective Index) value. In order to obtain a L.E.E.D. credit for the metal roofing heat island effect for roofing that SRI value must be equal to or greater than 29. The L.E.E.D. credit falls under the Sustainable Sites category in the L.E.E.D. checklist under Heat Island Effect – Roof and also under Materials and Resources in the Regional Materials category.

Beneath the metal roofing will be a decking supportive material of either tongue and groove wood treated with a veneer finish or Hardie Board. Hardie Board is a material that is green and sustainable, made of recycled wood pulp, sand, cement, and water. The James Hardie Company has many regional manufacturing plants, including Fontana, California. Both Hardie Board and tongue and groove wood can be ordered and / or purchased from Home Depot or Lowe's.

Hardie Board can also be ordered through the James Hardie Company. Hardie Board examples and contact information on the James Hardie Company can be found in Appendix E under the Roofing section. The decking material does have a possibility of vandalism by permanent marker or carving. These materials are consistent with green sustainable materials and meet the design requirements of the county.

Weathering steel tube beams will be used throughout the roof of the structure as the base support. The rafters of the roof will be three inches by six inches and spaced two feet on center across the length of the structure. There will be a roofing overhang on each end of the structure of one foot ten and a half inches. The end trusses will be made of two inch by six inch beams, also including an angle supporting beam from the bottom of the truss to the ridge beam. The ridge beam will consist of six by ten inch weathering steel tubing. Around the base of the roofing will be an eight inch square beam attaching all the rafters and trusses with the supporting uprights. These supports can be seen in the elevation beam drawing of the design concept, section 5.5. The weathering steel tubing will also be from the same steel manufacturers as the structural steel tubing of the shelter as found in Appendix E under the Weathering Steel section.

6.5 Amenities and Seating

Amenities for the transit stops include minimum items, such as seating, with possible upgraded components such as bike racks. Seating areas will be included in the design and will be made of poured concrete covered with a stone veneer. The stone veneer can be from the Grand Canyon National Park limestone remnants or gathered from a local rock quarry. The cap of the seating area will also be made of a larger limestone pieces. Beyond the shelter seating, uncovered seating could also be in the form of large limestone boulders placed in the area surrounding the shelter foundations, depending on the availability of limestone bolders from the Grand Canyon National Park or surrounding areas. Upgrades on the amenities that can be considered include bike racks which can be made out of sculptured steel or the basic loop design.

It is possible to attain L.E.E.D. credits by reusing salvaged material. By choosing to use limestone that will be provided by GCNP, credit can be achieved under the category of Materials and Resources under Material Reuse. If the Grand Canyon National Park limestone is not used, a local masonry company can provide local stone veneer from around the state of Arizona. Two companies that would provide local rock veneer are Border Construction of Flagstaff, Arizona, and Maverick Masonry of Flagstaff, Arizona. Contact information on the two masonry companies can be found in Appendix E under the Stone Veneer subsection.

6.6 Lighting

Lighting is a requirement of all transit shelters for safety purposes. In order to incorporate lighting that will be easily maintained and sustainable, solar lighting is the preferred option. The battery and components of the lighting system could be mounted on the underside of the roof structure away from the traffic areas of the shelter. The solar panel can be mounted on the peak of the roof line or on an optional pole mount if desired. The design concept drawings illustrate a

generic solar panel size of four feet long, eighteen inches wide, and three inches deep. Two manufacturers that supply solar lighting kits include Sol Inc. of Solar lighting USA and Solar One Solutions. Brochures from these companies can be found in Appendix E under the Solar Lighting section along with their company contact information. Architectural and Environmental Associates (AEA) is a company in Flagstaff, Arizona, that could also construct a lighting system, but it would not be in the form of a kit like the other two companies. AEA's contact information can be found in Appendix E under the Solar Lighting Section.

Solar lighting will make this project eligible for L.E.E.D. certification credits under the Energy and Atmosphere category in the L.E.E.D. project checklist under prerequisite 2 Minimum Energy Performance section. Adding a sensor that controls the solar lighting from dusk to dawn earns the shelters a credit under the Indoor Environmental Quality category under Controllability of Systems – Lighting.

6.7 Signage

Signage is a requirement of a bus stop which provides passengers information on route schedules and stop information. The minimum requirements include route times and schedules, but can be upgraded to include general park and educational information. The signage can be attached to the roof support beams. Any signage must conform to the requirements of the project and any federal and state policies in placement and design.

7.0 L.E.E.D. Checklist

L.E.E.D. is an internationally recognized certification system that measures how well a building or community performs across all the metrics that matter most; energy savings, water efficiency, carbon dioxide emissions reduction, improved indoor environmental air quality, and stewardship of resources and sensitivity to their impacts. The transit shelters would be certified under the new construction category. Each of these aspects is broken down into credits each with a point value associated with them. This rating system is in the form of a checklist for evaluators to see if the new construction project is eligible for certification and possibly eligible for silver, gold, or platinum ratings. A total of 110 credits are possible from the rating system. If a new construction project earns 40 to 49 credits it can be a certified green, sustainable building, for 50 to 59 credits it receives a silver rating, for 60 to 79 credits it receives a gold rating, and from 80 to the total 110 credits earns a platinum rating.

This project may be eligible for a total of 46 out of a possible 110 credits which would qualify the shelters for a Certified L.E.E.D. building. Table 2 shows the 2009 L.E.E.D. for New Construction project checklist filled out as determined by project personnel for the Tusayan Transit Shelters Design Project. Some of the credits require some explanation as to the interpretation of the credit. Other credits require specific actions and accomplishments of the contractor to accomplish in order to obtain the credits. The lines of the checklist where this is applicable are marked with a letter and are described further at the end of the checklist in the notes section.

Table 2: L.E.E.D. 2009 for New Construction Checklist

LEED 2009 for New Construction and Major Renovation

Project Checklist

Project Name: Tusayan Transit Shelters

Date:

Y	N	?			
0	0	0	**Sustainable Sites**	Possible Points:	26
Y			Prereq 1	Construction Activity Pollution Prevention	
X			Credit 1	Site Selection	1
X			Credit 2	Development Density and Community Connectivity	5
	X		Credit 3	Brownfield Redevelopment	1
X			Credit 4.1	Alternative Transportation—Public Transportation Access	6
	X		Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
X			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
		X	Credit 4.4	Alternative Transportation—Parking Capacity	2
X			Credit 5.1	Site Development—Protect or Restore Habitat	1
		X	Credit 5.2	Site Development—Maximize Open Space	1
	X		Credit 6.1	Stormwater Design—Quantity Control	1
	X		Credit 6.2	Stormwater Design—Quality Control	1
X			Credit 7.1	Heat Island Effect—Non-roof	1
X			Credit 7.2	Heat Island Effect—Roof	1
X			Credit 8	Light Pollution Reduction	1
0	0	0	**Water Efficiency**	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
X			Credit 1	Water Efficient Landscaping	2 to 4
			[ ]	Reduce by 50%	2
			[X]	No Potable Water Use or Irrigation	4
	X		Credit 2	Innovative Wastewater Technologies	2
	X		Credit 3	Water Use Reduction	2 to 4
			[ ]	Reduce by 30%	2
			[ ]	Reduce by 35%	3
			[ ]	Reduce by 40%	4

A

B

0	0	0	**Energy and Atmosphere**			Possible Points: 35
C						
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems		
Y			Prereq 2	Minimum Energy Performance		
Y			Prereq 3	Fundamental Refrigerant Management		
D						
		X	Credit 1	Optimize Energy Performance		1 to 19
					Improve by 12% for New Buildings or 8% for Existing Building Renovations	1
					Improve by 14% for New Buildings or 10% for Existing Building Renovations	2
					Improve by 16% for New Buildings or 12% for Existing Building Renovations	3
					Improve by 18% for New Buildings or 14% for Existing Building Renovations	4
					Improve by 20% for New Buildings or 16% for Existing Building Renovations	5
					Improve by 22% for New Buildings or 18% for Existing Building Renovations	6
					Improve by 24% for New Buildings or 20% for Existing Building Renovations	7
					Improve by 26% for New Buildings or 22% for Existing Building Renovations	8
					Improve by 28% for New Buildings or 24% for Existing Building Renovations	9
					Improve by 30% for New Buildings or 26% for Existing Building Renovations	10
					Improve by 32% for New Buildings or 28% for Existing Building Renovations	11
					Improve by 34% for New Buildings or 30% for Existing Building Renovations	12
					Improve by 36% for New Buildings or 32% for Existing Building Renovations	13
					Improve by 38% for New Buildings or 34% for Existing Building Renovations	14
					Improve by 40% for New Buildings or 36% for Existing Building Renovations	15
					Improve by 42% for New Buildings or 38% for Existing Building Renovations	16
					Improve by 44% for New Buildings or 40% for Existing Building Renovations	17
					Improve by 46% for New Buildings or 42% for Existing Building Renovations	18
					Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovations	19
X			Credit 2	On-Site Renewable Energy		1 to 7
					1% Renewable Energy	1
					3% Renewable Energy	2
					5% Renewable Energy	3
					7% Renewable Energy	4
					9% Renewable Energy	5
					11% Renewable Energy	6
					13% Renewable Energy	7
		X	Credit 3	Enhanced Commissioning		2
	X		Credit 4	Enhanced Refrigerant Management		2
	X		Credit 5	Measurement and Verification		3
	X		Credit 6	Green Power		2

	0	0	0	**Materials and Resources**	**Possible Points:**	**14**
E	Y			Prereq 1	Storage and Collection of Recyclables	
		X		Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
					[ ] Reuse 55%	1
					[ ] Reuse 75%	2
					[ ] Reuse 95%	3
		X		Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
F	X			Credit 2	Construction Waste Management	1 to 2
					[X] 50% Recycled or Salvaged	1
					[ ] 75% Recycled or Salvaged	2
G	X			Credit 3	Materials Reuse	1 to 2
					[X] Reuse 5%	1
					[ ] Reuse 10%	2
	X			Credit 4	Recycled Content	1 to 2
					[X] 10% of Content	1
					[ ] 20% of Content	2
	X			Credit 5	Regional Materials	1 to 2
					[ ] 10% of Materials	1
					[X] 20% of Materials	2
		X		Credit 6	Rapidly Renewable Materials	1
		X		Credit 7	Certified Wood	1

	0	0	0	**Indoor Environmental Quality**	**Possible Points:**	**15**
	Y			Prereq 1	Minimum Indoor Air Quality Performance	
H	Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
		X		Credit 1	Outdoor Air Delivery Monitoring	1
		X		Credit 2	Increased Ventilation	1
		X		Credit 3.1	Construction IAQ Management Plan—During Construction	1
		X		Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
I	X			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
		X		Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
		X		Credit 4.3	Low-Emitting Materials—Flooring Systems	1
		X		Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
		X		Credit 5	Indoor Chemical and Pollutant Source Control	1
	X			Credit 6.1	Controllability of Systems—Lighting	1
		X		Credit 6.2	Controllability of Systems—Thermal Comfort	1
		X		Credit 7.1	Thermal Comfort—Design	1
		X		Credit 7.2	Thermal Comfort—Verification	1
	X			Credit 8.1	Daylight and Views—Daylight	1
	X			Credit 8.2	Daylight and Views—Views	1

0	0	0	**Innovation and Design Process**	**Possible Points:**	**6**
X			Credit 1.1 Innovation in Design: Specific Title		1
	X		Credit 1.2 Innovation in Design: Specific Title		1
	X		Credit 1.3 Innovation in Design: Specific Title		1
	X		Credit 1.4 Innovation in Design: Specific Title		1
	X		Credit 1.5 Innovation in Design: Specific Title		1
X			Credit 2 LEED Accredited Professional		1
0	0	0	**Regional Priority Credits**	**Possible Points:**	**4**
X			Credit 1.1 Regional Priority: Specific Credit		1
X			Credit 1.2 Regional Priority: Specific Credit		1
X			Credit 1.3 Regional Priority: Specific Credit		1
X			Credit 1.4 Regional Priority: Specific Credit		1
0	0	0	**Total**	**Possible Points:**	**110**

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

J

K
L
M
N

L.E.E.D. Notes

A. Heat Island Effect – Non-roof: Colored concrete used for the project must have an SRI (Solar Reflective Index) of at least 29.

B. Heat Island Effect – Roof: The SRI of the roof material must be equal to or greater than 29. The material color should be lighter in color to achieve this LEED credit.

C. Fundamental Commissioning of Building Energy Systems: There are several requirements that must be met in the project in order to be considered for LEED certification. Persons that are not involved in the shelter project, i.e. a certified LEED AP, must verify that energy systems perform as claimed. If the GCNP chooses to attempt LEED certification, they must find someone who can fulfill this position.

D. Optimize Energy Performance: The possible number of credits that the project could receive would be determined by establishing a baseline. The baseline must be calculated by an electrical engineer that would be identified by GCNP.

E. Storage and Collection of Recyclables: This is a prerequisite that must be fulfilled to be considered for LEED certification. This requirement may be fulfilled by using signage to state where recycling is located i.e. on the bus. Another consideration for this prerequisite would be to have recycling containers on site at each shelter location.

F. Construction Waste Management: States that you must recycle or salvage at least 50% of construction debris. This is measured by either weight or cubic yards. These two measurement methods may not be combined to achieve 50%.

G. Material Reuse: Determined by what the replacement cost of the material is, i.e. limestone from GCNP, of an equivalent new item. This number is compared to the total cost of the structure.

H. Environmental Tobacco Smoke (ETS) Control: This prerequisite states that a smoking area be provided away from the structure.

I. Low-Emitting Materials – Adhesives and Sealants: Low emitting materials must be used while constructing the shelters (SCAQMD Rule #1168)

J. Innovation in Design: On site renewable energy. Each shelter is providing its own power i.e. solar lighting.

The following Regional Priority Credits must be awarded:
K. Regional Priority: SSc 5.1: Protect and restore habitat.

L. Regional Priority: WEc 1 option 2: No potable water is used for landscape.

M. Regional Priority: EAc 2: (3%) on site renewable energy.

N. Regional Priority: MRc 5: (20%) use of regional materials.

8.0 Budget

The total budget for the four Tusayan Transit Shelters was predetermined and estimated to be $495,000. That budget is broken down into shelter and site amenities cost. Each of the four shelters has a unit cost of up to $100,000. Site amenities for all shelters can cost up to $95,000, bringing the total to $495,000. The budget for the Tusayan Transit Shelters was a major factor in determining the design style architecture.

A budget was created based on the Tusayan Architectural design as an approximate expected value to construct the four transit shelters in the community of Tusayan. The total approximated amount found was $140,746, for all four shelters to be constructed. Using a fifteen percent range of project cost put the total cost at between $119,633 and $161,857. See Table 3 for the breakdown of costs for the transit shelters. Both construction and non-construction costs were considered along with professional fees in the total amount for costs. These totals all fall far below the approximated budget of the Tusayan Transit Shelters that was of the amount $400,000 for four constructed shelters in the community of Tusayan.

Table 3: Cost Analysis – Summary Report for Tusayan Transit Shelters

CLIENT:		Grand Canyon National Park
CLIENT CONTACT:		Vicky Stinson Project Manager
PROJECT NAME:		Tusayan Transit Shelter Design Project
REVISION DATE:		**August 28, 2009**
STUDENTS:		Leslie Ayres, Michelle Mallett
PROJECT DESCRIPTION: Construction of four new transit shelters in Tusayan		
DESCRIPTION OF PROJECT COSTS		
BASE CONSTRUCTION COSTS (per S.F. Cost projection times four)		
Clearing and grubbing $2000/ shelter times four		$8,000
Foundations	(1.)	$6,000
Grading and excavation $750/ shelter times four		$3,000
Pads $12.50/sq ft.	(2.)	$24,000
Structural supports		$12,000
Roof structural members		$8,000
Limestone decoration and seating		$12,000
Metal roof and substrate		$20,760
Revegitation and hardscape $2300/ shelter times four		$9,200
Subtotal:		$85,760
Construction Change Allowance (10%)		$8,576
SUBTOTAL: BASE CONSTRUCTION COSTS		**$94,336**
NON-CONSTRUCTION COSTS		
Equipment - Solar Lights		$8,000
Bike Racks		$2,400
Seating		$6,000
Signage $2500/ shelter times four		$10,000
Remote site factor	(3.)	$8,576
Plan, Permit & Environmental Fees	(4.)	$2,000
SUBTOTAL: NON-CONSTRUCTION COSTS		**$36,976**
PROFESSIONAL FEES		
A/E Fees @ 7%		$6,604
LEED Accreditated Professional/Certification @ 1%		$2,830
SUBTOTAL: PROFESSIONAL FEES		**$9,434**
PROJECT TOTAL COST		**$140,746**
PROJECT BUDGET		**$400,000**
PROJECT BALANCE		**$259,254**
PROBABLE RANGE OF PROJECT COSTS:	**Low**	**$119,633.76**
(+/- 15% of Project Total Costs)	**High**	**$161,857.44**

(1.) Two each shelter times four shelters

(2.) Based on the following assumptions: 16 feet wide by 30 feet long

(3.) This reflects the fact that transportation and lodging costs have historically created a bidding premium on projects at the Grand Canyon

(4.) This number reflects an allowance only, no basis for permitting fees was given.

9.0 References

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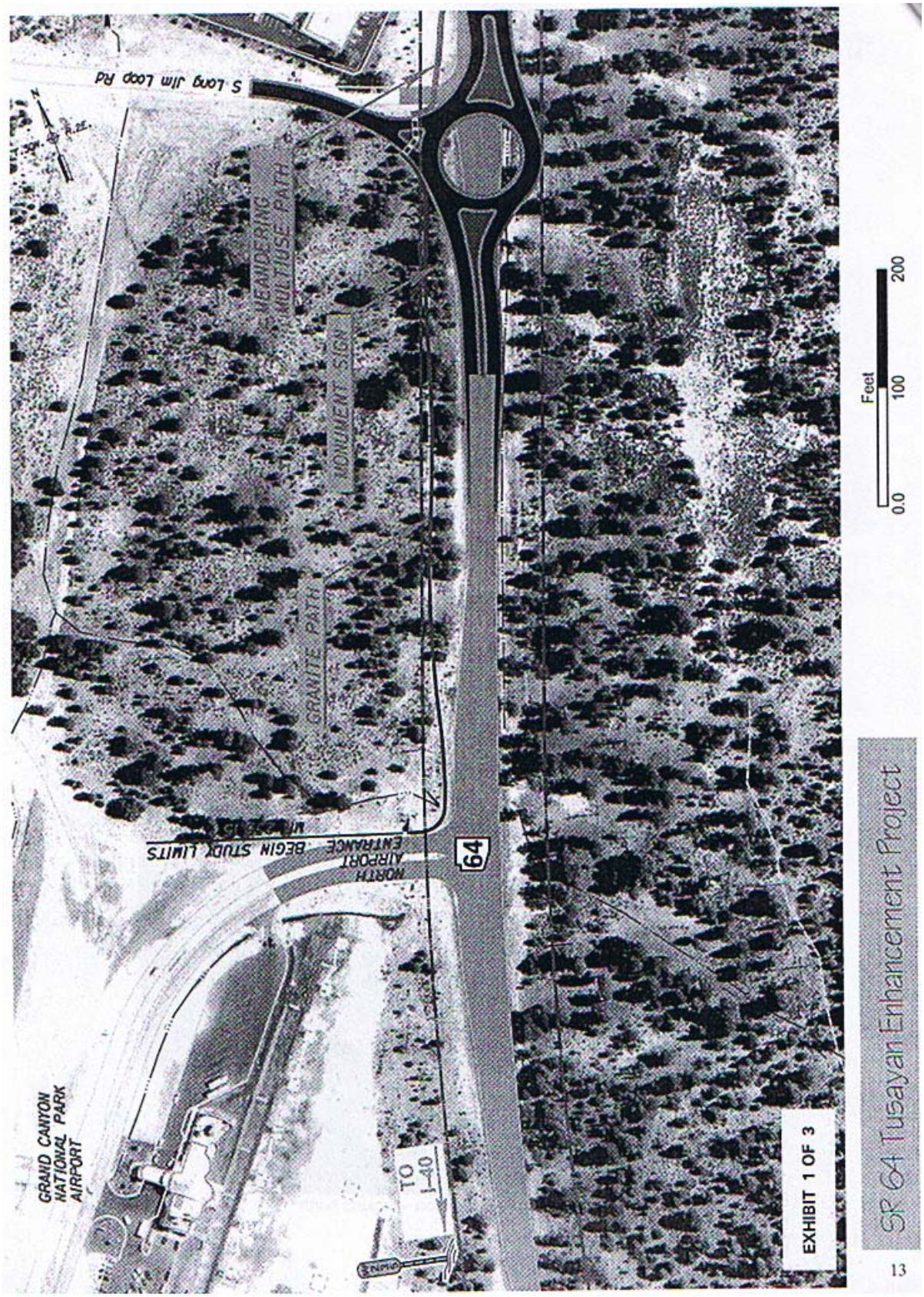
"Stamped Concrete Patterns and Designs." *Concrete Products*. 2009. ConcreteNetwork.com. 1 Aug 2009 <http://www.concretenetwork.com/concrete/stamped_concrete/patterns.htm>.

US Department of Justice. (1994). *Regulations 28 CFR Part 36 ADA Standards for Accessible Design* (5-58, 67-71).

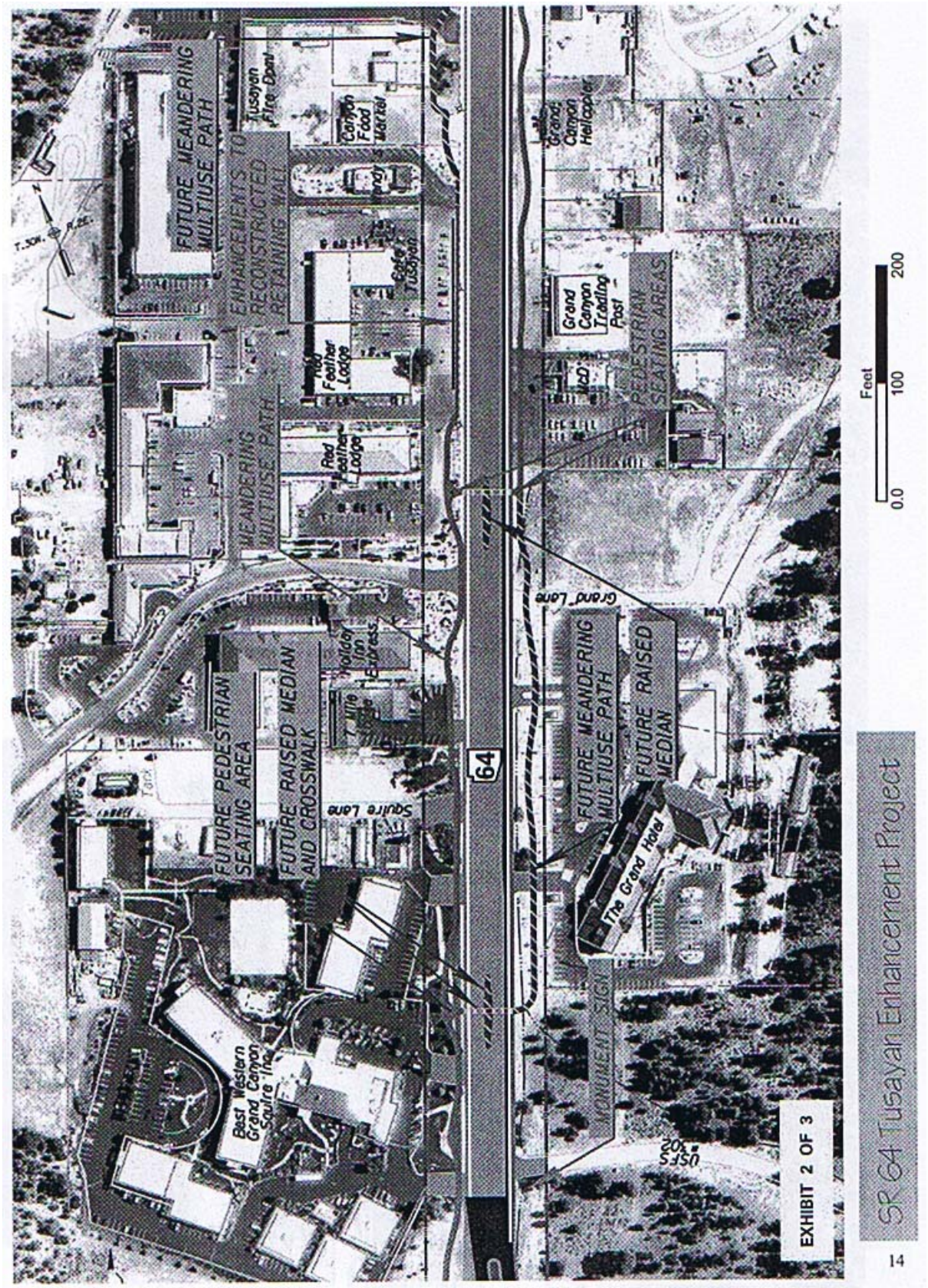
US Department of Transportation. (2009). *Paul S. Sarbanes Transit in the Parks Program Project Proposal for Fiscal Year 2009 Funds* (1-12).

US National Park Service. (2009). *Grand Canyon National Park Tusayan Pilot Shuttle Evaluation* (3-33).

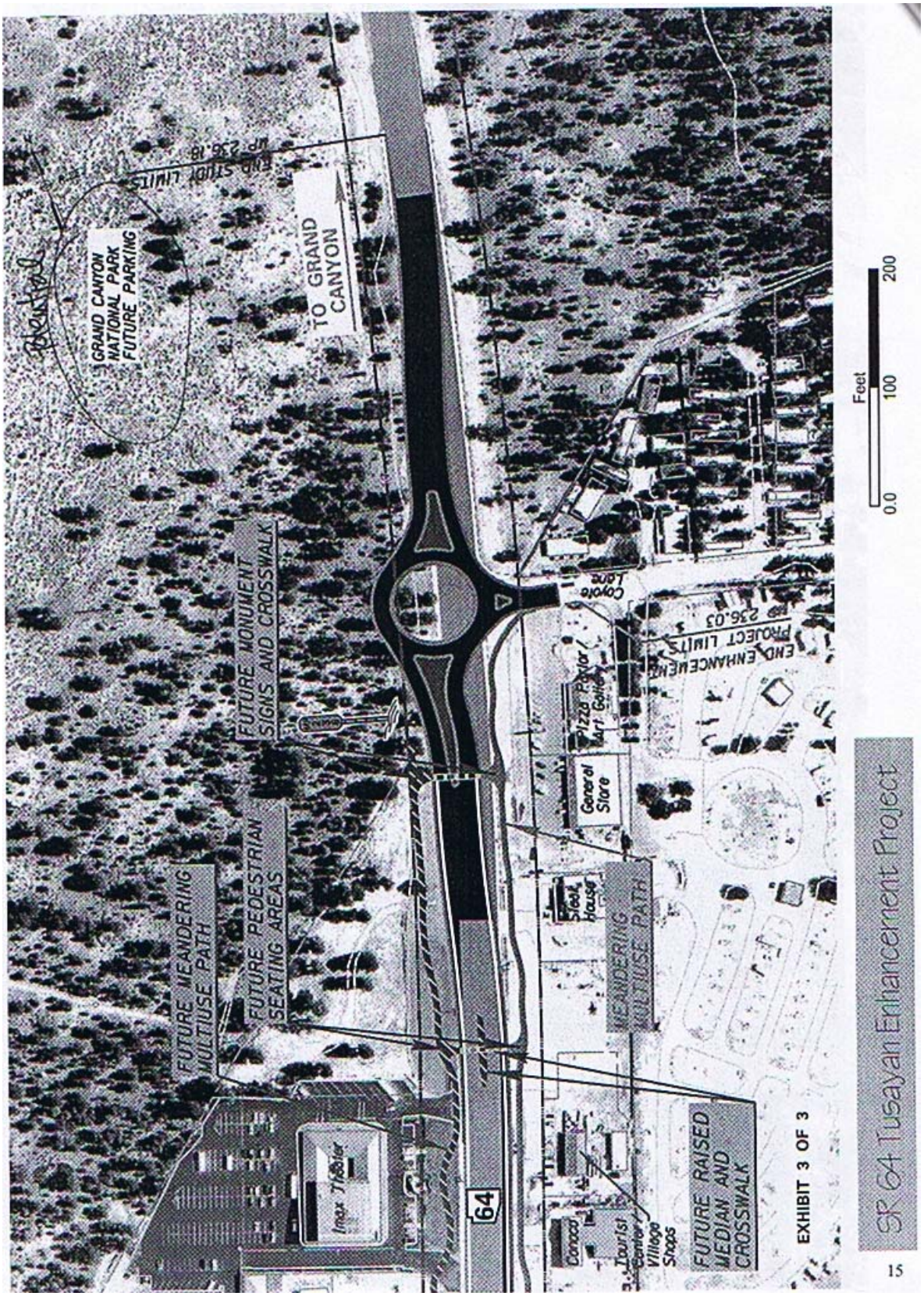
Appendix A: State Route 64 Tusayan Enhancement Project Maps



Appendix A: State Route 64 Tusayan Enhancement Project Maps



Appendix A: State Route 64 Tusayan Enhancement Project Maps



Appendix B: Tusayan Photos

Local Tusayan Architecture

Appendix B: Tusayan Photos

Current Bus Stops: IMAX

Appendix B: Tusayan Photos

Current Bus Stops: Canyon Flight

Appendix B: Tusayan Photos

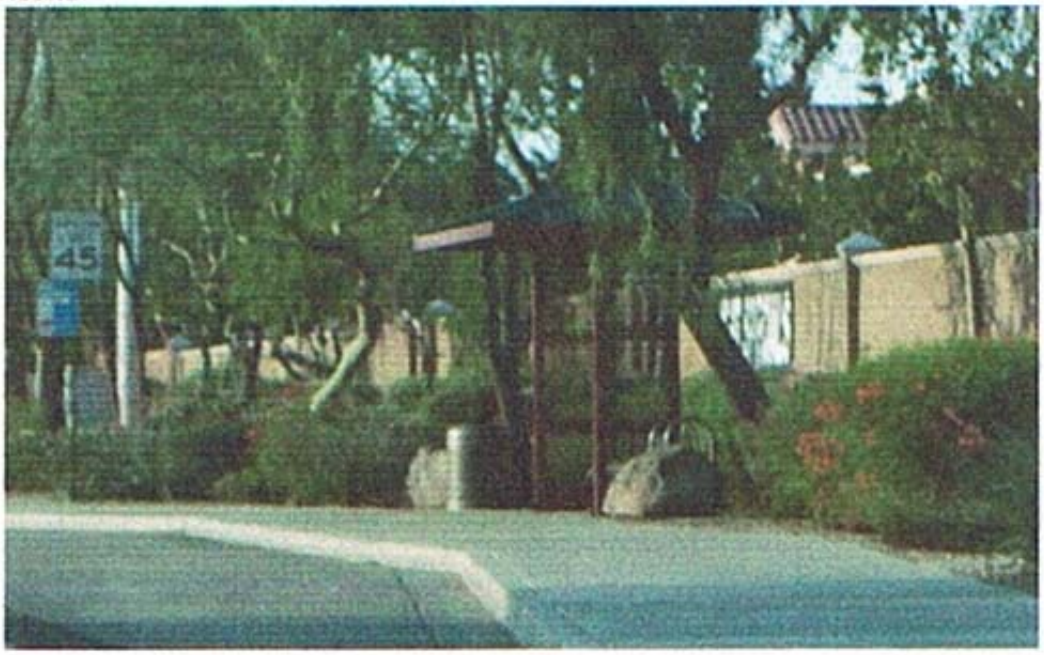
Current Bus Stops: Squire Inn

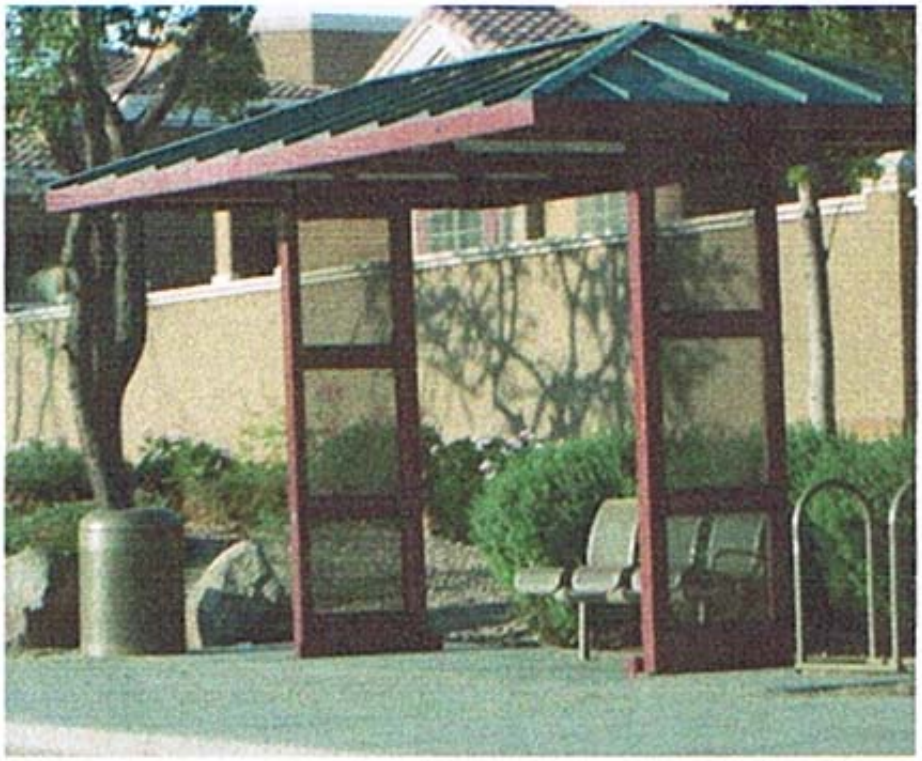
Appendix C: Arizona Transit Shelters: Complete Representative Projects

Flagstaff, Arizona

Appendix C: Arizona Transit Shelters: Complete Representative Projects

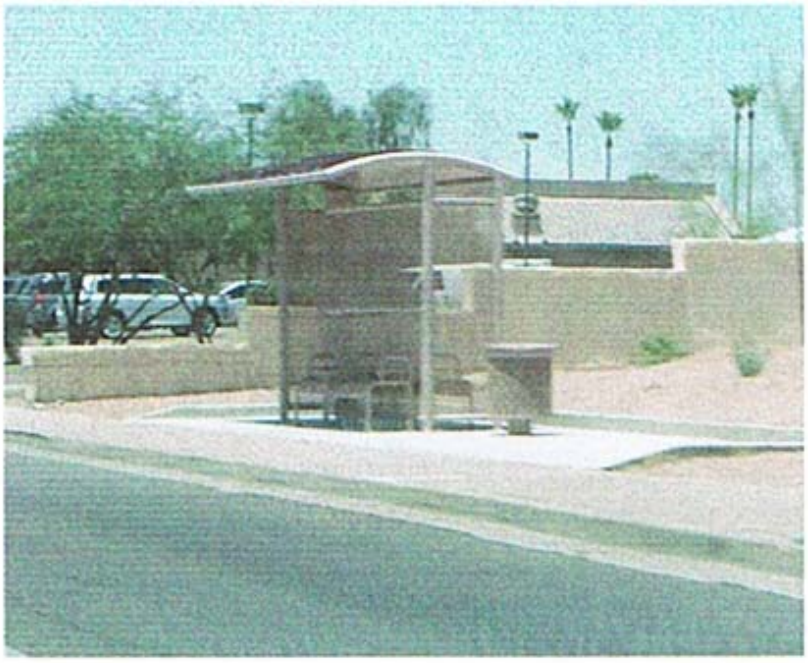
Scottsdale, Arizona





Appendix C: Arizona Transit Shelters: Complete Representative Projects

Scottsdale, Arizona



Appendix C: Arizona Transit Shelters: Complete Representative Projects

Sedona, Arizona

Lake Havasu, Arizona

Appendix D: Comments on Submissions

Preliminary Report Comments: Victoria Stinson

Grand Canyon National Park:
Tusayan Transit Shelter Design Project Preliminary Report
NPS Comments 7-8-09

1.1 Project: Change 'city' city of Tusayan to 'community' of Tusayan; it's still unincorporated

Table 1: Timeline: Since we are late on comments, I'd like to see if we can still work in an interim review prior to the final (July 30?). I have my schedule and can commit to a quick turnaround, and we can agree on the content for the interim review.

Let's discuss potential times to review concepts with the community, per ADOT design review.

2.2 Design Development:

- Essential: add 'Budget' to the features listed.
- Important: Common themes between shelters but subtle differences – there can be subtle differences, but I wouldn't consider these important to achieve
- Desired: We don't think the vending machines are desired.

2.3.1 Initial Meeting – 3rd paragraph: We need to have ADOT confirm the overall length needed for the pullout areas. Is 90', including the taper, adequate?

2.3.2 and 2.3.3: Appendix A and C are referenced, but appear to be unattached.

3.0 Preliminary Design Concepts:

General:

- We have an opportunity to provide some visual continuity to the streetscape in Tusayan through implementing shuttle stops and accompanying shelters in four key locations along Hwy 64. Visual continuity will not only help to provide some unity and identity to the community, but also helps shuttle system users (especially foreign visitors) to easily identify where to catch a shuttle bus. Using design styles that borrow from park shuttle bus stops may also add to the concept easily identifiable shuttle bus stops and further provide continuity for the shuttle bus system.
- The footprint of the shuttle bus stops, while accommodating all standards and codes, should be relatively compact and/or linear to accommodate walkways, landscaping and existing development.
- If a learning component is desired, a suitable topic would be sustainability. NPS would like to see the design of the shelters respect green technology to the extent possible. Low / no maintenance would also be an aspect of sustainability that could be highlighted. Use of the shuttle bus system (which is run on compressed natural gas) promotes a low carbon footprint, decreases emissions, and enables the park to postpone or eliminate the need for providing additional parking spaces.

Appendix D: Comments on Submissions

3.1 Tusayan Architecture

- Structure looks large for the available spaces; consider simplifying with a 2 or 3 post structure to make the footprint a little more linear. Simplify roof lines?
- Learning component could be the use of sustainable materials.

3.2 Grand Canyon National Park Architecture

- Re-creations or replication of historic architecture found in National Parks conflicts with NPS cultural resource preservation practices. Although these would not be located within the national park, the shelters would be supporting an NPS system and would likely be maintained by the NPS. We would prefer that visitors see the actual structures and learn about them on site.
- Having 4 separate design themes would be confusing to users (not easily identifiable) and would add to lack of continuity that currently exists in Tusayan.

3.5 Recommendations

- We would recommend using either a modified Tusayan Architecture design or something similar to design styles used at CVIP, only with sustainable materials.

4.1 Structure

- Although the reclaimed timber is an excellent green product, I would be concerned about the maintenance that would be required, if it's exposed to the elements. One possible location would be, for example, tongue and groove decking on the roof structure, which could be seen on the underside, bout would be protected by roofing.
- Are recycled steel beams easily obtainable? And would it be possible to get standardized sizing (for continuity among the shelters)?
- What is the expected life cycle of high density polyethylene?

4.4 Roof Material

- We like the idea of using either corrugated metal or standing seam metal roofing (which would blend well in Tusayan). Do you know of a green option for standing seam metal roofing? We also like the look of weathering steel – for posts, beams and roofing.

Appendix D: Comments on Submissions

Preliminary Report Comments: Audra Merrick, District Development Engineer

A few comments upon review of this report.... Biggest one is no sales of services or things allowed in the right-of-way.

1. Please insert a map identifying the proposed shelter locations in the report

2. Page 4, Section 1.1: I don't believe Tusuyan is designated a City

3. Page 4, Section 1.1: This section states that the shelters with amenities will be integrated with ADOT's Project. It should be clarified that these projects will be integrated if funding is successfully attained for the "shelter project".

4. Page 5, Section 2.1: Acknowledgement of ADOT Standards should be mentioned

5. Page 7, Section 2.1.3: ADOT has criteria for this section as well in ADOT Policy Eng-2.01. Reference should be made to this policy.

6. Page 8, Section 2.1.4: Under "Bus stop placement".... Has ADOT agreed to pay for the cost of designing bus pullouts? Who is paying for the construction of them?

7. Page 9, Section 2.2: Park Service is responsible for maintenance of facility. This will need to be addressed in an IGA. This should include but not limited to such items as trash collection, solar maintenance, graffiti removal and overall maintenance/upkeep of shelters.

8. Page 10, Section 2.2.1: Vending machines of any type will not be permitted within ADOT ROW. Sales of any services or things are not permitted in State ROW per R17-3-502. This is not a legal encroachment.

9. Page 10, Section 2.2.1: I'm not clear what the Educational components or park distribution site consists of at the moment. This should be clarified. Again as in number 7 above, sales of any services or things within state row is not permitted.

10. Page 10, Section 2.2.2: Details of all signage will need to be reviewed and approved by ADOT's Regional Traffic Section. Some of the signage is "standard" signage.

11. Page 10, Section 2.2.3: Again vending machines not permitted. Landscaping will need to be approved by ADOT.

12. Page 11, Section 2.3.1: Facilities must be maintained during off season hours. This will be the responsibility of Park Service and needs to be addressed in an IGA. See number 6 above.

13. Page 12, Section 2.3.2, second paragraph: Material for multiuse path should match with ADOT Project. I believe the ADOT pathway to be concrete at the moment not asphalt.

14. Page 12, Section 3.0: I didn't see any mention of amenities being located outside the clear zone. Clear zone requirements for amenities will apply.

15. Page 20, Section 4.7: My initial thought is a maximum of 40 feet seems extreme.

16. Page 20, Section 4.8: Again Sales in the righ-of- way is an issue and is not permitted.

17. Page 20, Section 4.9: Again park service will be required to maintain any type of lighting system and this needs to be addressed. Also if electric instead of solar is used, who pays for the electric costs needs to be discussed and resolved.

18. Page 21, Section 5.0: Any references to adot documents should be made here. Ie. ADOT's Traffic PGPs (Policy, Guidelines, and Procedures.

Appendix D: Comments on Submissions
Concept Refinement Report Comments: Victoria Stinson

Progress Submittal
Grand Canyon National Park: Tusayan Transit Shelters Design Project
NPS Comments 8-6-09

General: I think you've done a nice job of putting together a concept that can work well in the community of Tusayan, and that could also be flexible to a variety of site conditions.

Design Concept:

1) Based on this concept, I would assume that the shelter design would remain the same through all stops, but that the paving and seat wall layout could be flexible to work with new path layouts and existing conditions. For example, the 10' seat wall sections aligned with the posts might be the same for all shelters, but the center wall section (that aligns with the ridge line) could be on the right or the left, and the seat wall section near the loading zone could be on the right or left, or even placed on the front or back.
2) I like the looks of the materials. In the final submittal, can you get into how these materials would be meet LEED criteria?
3) Page 3 – Conceptual Perspective – Can you add the solar panels to this concept? Also, where would the battery be placed?
4) Page 6 – Side Elevation – Is it possible to integrate the truss structure into the overall spacing of the rafters, so that the truss is in lieu of one of the rafters? Not sure how this would look from the front elevation, but something to consider.

Expanded Keynotes:

1) I may have missed it, but I'm not certain what the Type B decking is.
2) D-H: We would prefer a weathering or Cor-ten Steel. Paint, even if powder coated, can wear over time.

Other Keynotes:

1) If stamped concrete is appropriate with the streetscape concepts for the rest Tusayan, I would prefer use of the seamless skins, as opposed to slate/brick/creative textures; the seamless skin patterns can be scored prior to stamping.

Cost Analysis:

1) Costs seem somewhat low. We're using $12 SF for stamped, colored concrete pads. Also, please add line item amounts for clearing and grubbing, and site work, such as grading and excavation.
2) Does the metal roof include the decking?
3) Do the solar lights include the solar panels and batteries?
4) Assume about $2500 for signs for each shuttle bus stop.

Appendices

1) We like the idea of solar lights for each of the shuttle bus stops. A couple of things to consider: Light fixtures should conform to night sky standards (low foot candles and shaded light source; a programmable timer would be preferable so that they don't need to stay on all night.

Nice Job!

Appendix E: Tool Kit Manufacturers and Company Information

Concrete Companies, Colored Concrete, Stamped Concrete

Concrete Companies

Arrow Redi-Mix

5600 E Railhead Ave
Flagstaff, AZ 86004-2422
(928) 522-9388
arrowredimix.com

Cemex

www.cemex.com
5200 East Railhead Avenue
Flagstaff, AZ 86004
Phone 928-526-5250
Fax 928-526-0597

Flagstaff Concrete

2150 E Huntington Dr
Flagstaff, AZ 86004-8929
(928) 773-9139
(928) 773-9142

Appendix E: Tool Kit Manufacturers and Company Information

Colored Concrete Brochure-Davis Colors

Appendix E: Tool Kit Manufacturers and Company Information

Stamped Concrete Brochure-Brickform

Appendix E: Tool Kit Manufacturers and Company Information

Brickform Concrete Stamps Brochure (continued)

Appendix E: Tool Kit Manufacturers and Company Information

Roofing and Decking

Metal Roofing

Century Roofing Inc.

Mailing Address:
Century Roofing, Inc.
2615 W. Lone Cactus Dr.
Phoenix, AZ 85027

General Information (623) 582-0508
New Construction Roofing Sales (623) 516-0440
Customer Service (623) 582-8563
Fax: (623) 582-8330
e-mail: steves@centuryroofinginc.com

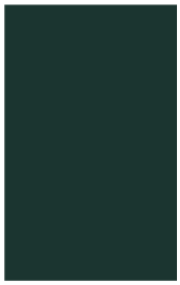
Fabral Metal Wall and Roof System
Fabral Corporate Office

3449 Hempland Rd.
P.O. Box 4608
Lancaster, PA 17604-4608
800-477-2741
Fax: 800-283-4289
Email: info@fabral.com

Color Options

Pewter

Surry Beige



Hardford Green

Western Metal Deck

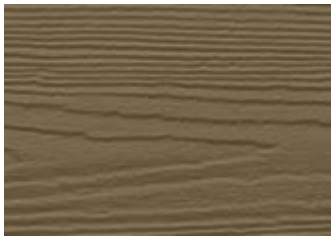
www.metaldeck.com
901 W. Watkins St.
Phoenix, Az 85007
Phone 602-495-0048
Fax 602-261-7726

Appendix E: Tool Kit Manufacturers and Company Information

Decking

Hardie Board Examples

Select Cedarmill©



Thickness: 5/16"
Weight: 2.3 lbs./sq. ft.
Length: 12' planks

[illegible]	5.25	6.25	7.25	8.25	9.25	12.00
[illegible]	4.0"	5.0"	6.0"	7.0"	8.0"	10.75"
[illegible]		✔	✔	✔	✔	
[illegible]	✔	✔	✔	✔	✔	✔

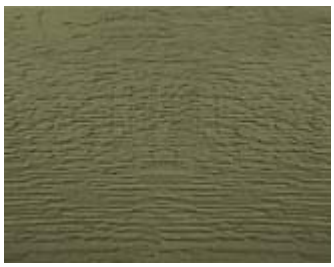
Beaded Cedarmill®

Weight:
Length:

Thickness: 5/16"
2.3 lbs./sq. ft.
12' planks

[illegible]	8.25"
[illegible]	7.0"
[illegible]	✔

Rustic Cedar



Weight:
Length:

Thickness: 5/16"
2.3 lbs./sq. ft.
12' planks

[illegible]	6.25"	8.25"
[illegible]	5.0"	7.0"
[illegible]	✔	✔

James Hardie Contact Information

USA/Canada

26300 La Alameda, Suite 400
Mission Viejo, California 92691
1-888 J-HARDIE
1-888 542-7343
info@JamesHardie.com <info@JamesHardie.com>

Appendix E: Tool Kit Manufacturers and Company Information

Solar Lighting

Architectural and Environmental Associates

3955 Lake Mary Road
Flagstaff, AZ 86001
Toll Free: (877) 602-0008
Flagstaff: (928) 214-0005
Email: contact@aeapower.com

Solar One Solutions

Sales & Administrative Offices
354 Waverly St.
Chestnut Place, 1st Floor
Framingham, MA 01702
Tel: 508.620.7652
Toll Free: 877.527.6461
Fax: 508.620.7657
www.solarone.net

Sol Inc. (Solar Lighting USA)

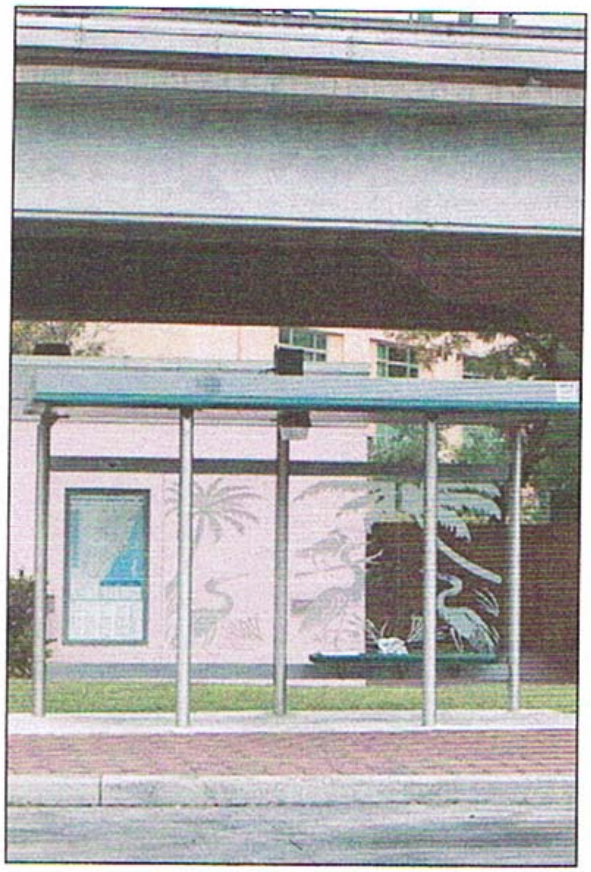
3210 S.W. 42nd Avenue
Palm City, FL 34990
Phone 772-286-9461
Fax 772-286-9616
www.solarlightingusa.com

Appendix E: Tool Kit Manufacturers and Company Information

Solar One Lighting System Information

LSB - Shelter Series Overhead Lighting System

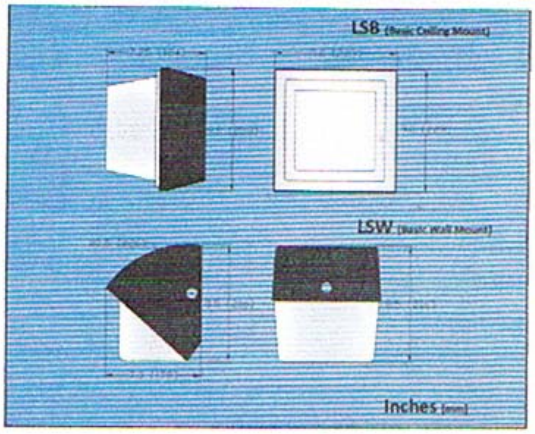
SolarOne®



SolarOne's® Shelter Series lights provide high-brightness LED lighting to all types of shelters. Installs quickly and easily, and unlike grid-tied lights, no trenching or pavement cutting is required.

Ideal for retrofitting existing shelters. Every SolarOne® system uses **SO-Bright™** Technology to provide lighting that is brighter, more efficient, more versatile and more reliable than the competition.

Choose from a ceiling mounted fixture (**LSB**) or wallpack fixture (**LSW**). Roof-top and top-of-pole mounting options available for Solar Panels. South-facing orientation for roof-top mounted panels recommended. Roof-top mounting not recommended for sites with high average snowfall.



Standard Configurations

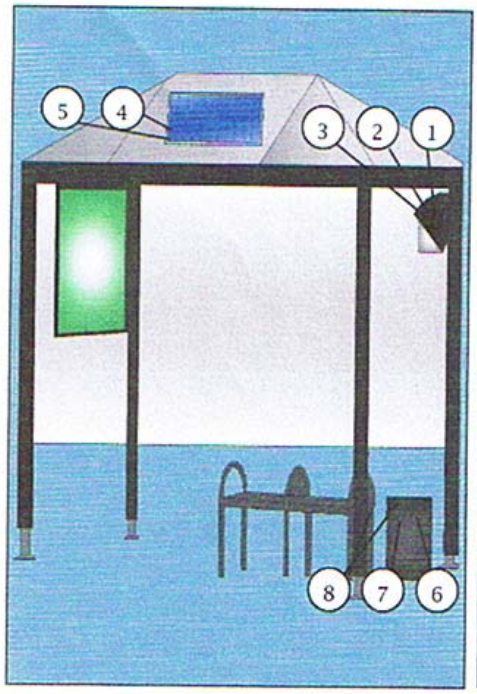
LSB	- 2HL600	- 2MCD	- MPT	- 12V	- P130	- Z	- 2118CA	- EL2	- R5.0	- BLK	- EGW
Series	Lamps	Driver	Control(s)	Voltage	Panel(s)	Mounting	Battery	Enclosure	Pole Fitting	Finish	Options
LSB-1HL600-MCD-MPT-12V-P50-TP-B118CA-EM1							LSW-1HL600-MCD-MPT-12V-P50-TP-B118CA-EM1				
LSB-1HL600-MCD-MPT-12V-P80-TP-B118CA-EM1							LSW-1HL600-MCD-MPT-12V-P80-TP-B118CA-EM1				
LSB-1HL600-MCD-MPT-12V-P130-TP-2B118CA-EL2							LSW-1HL600-MCD-MPT-12V-P130-TP-2B118CA-EL2				
LSB-2HL600-2MCD-MPT-12V-P50-TP-B118CA-EM1							LSW-2HL600-2MCD-MPT-12V-P50-TP-B118CA-EM1				
LSB-2HL600-2MCD-MPT-12V-P80-TP-B118CA-EM1							LSW-2HL600-2MCD-MPT-12V-P80-TP-B118CA-EM1				
LSB-2HL600-2MCD-MPT-12V-P130-TP-2B118CA-EL2							LSW-2HL600-2MCD-MPT-12V-P130-TP-2B118CA-EL2				
LSB-3HL600-3MCD-MPT-12V-P50-TP-B118CA-EM1							LSW-3HL600-3MCD-MPT-12V-P50-TP-B118CA-EM1				
LSB-3HL600-3MCD-MPT-12V-P80-TP-B118CA-EM1							LSW-3HL600-3MCD-MPT-12V-P80-TP-B118CA-EM1				
LSB-3HL600-3MCD-MPT-12V-P130-TP-2B118CA-EL2							LSW-3HL600-3MCD-MPT-12V-P130-TP-2B118CA-EL2				

Appendix E: Tool Kit Manufacturers and Company Information

Solar One Lighting System Information (Con't)

LSB - Shelter Series Overhead Lighting System

SolarOne®

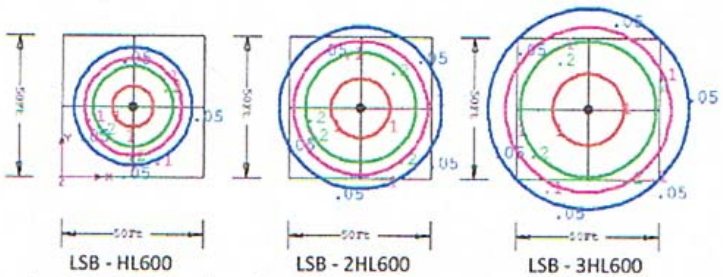


1. White LED Lamps –The lamps offer high brightness, high color rendering, and 50,000hr life at 70 lumens per watt. One, two or three fixtures may be used depending on the size of the shelter and light level desired.
2. LED Driver – Constant current driver precisely controls light levels with up to 256 digital states. One driver per lamp.
3. Fixture – Choose wall or ceiling mount. Die cast aluminum construction with polycarbonate refractor. Holds 1 lamp and driver. Note: Hardware not included for shelters.
4. Solar Panel – Poly-crystalline solar panel in 50, 80, 95 or 130watts. Twenty year power output warranty.
5. Panel Mounting – Aluminum Z-bracket for mounting to any shelter roof. Optional pole mounting available.
6. Battery Enclosure –NEMA 3R rainproof, vented, aluminum enclosure with cover and mounting holes and padlock hasp. Mount to the wall, under a bench or up in the ceiling.
7. Batteries – One or two sealed 118amp-hour, 12volt, spill-proof, maintenance free AGM batteries with fused battery harness.
8. SO-Bright™ Controls – The smartest, most versatile solar lighting controls available. Set timing, light-levels, and other features using a remote control.
9. Motion Detector (Optional) – Optional vandal proof motion detector is available. Brings the lights from Dim to Full.

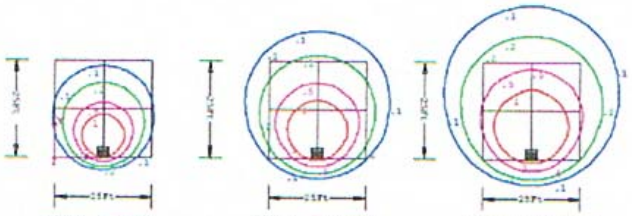
Accessories:
Grounding Kit
Vandal proof Motion Detector
Data Logger

For more information see:
High Lumen LED Lamp Spec Sheet
Power Package Spec Sheet
SO-Bright™ Controls Spec Sheet

Photometrics



LSB - HL600 (mounting height = 12')
LSB - 2HL600 (mounting height = 16')
LSB - 3HL600 (mounting height = 20')



LSW - HL600 (mounting height = 12')
LSW - 2HL600 (mounting height = 16')
LSW - 3HL600 (mounting height = 20')

Appendix E: Tool Kit Manufacturers and Company Information

Sol Inc Lighting System Information

Solar LED Transit Shelter Security Light

The eco-smart choice for a secure waiting experience

FEATURES

- Modular design
- Plug-in components
- Vandal resistant
- All night lighting
- Constant light levels
- Easy to install or relocate
- 5-year warranty
- National Electric Code Article 690 Compliant

SPECIFICATIONS

System voltage	12V DC
System solar panel*	40 to 80 watts
Batteries	6V 12 AH Gel cell maintenance free
Battery reserve	5 day minimum
Light source	Sol's LED Uni-Light
Light color temp	6500 K
LED per fixture	2
LED life span	100,000 hours
Operating temperature	-20 F to +120 F
Storage temperature	-40F to +180 F
Operating humidity, non-condensing	100%
Storage humidity, non-condensing	100%
Operating hours	Dusk to dawn
Color	Exterior powder coated to customer specification
Dimensions, L (including mounting) x H x D	50.5" x 3" x4"
Enclosure	Aluminum
Weight	50 Lbs

*Solar panel specifications may vary by manufacturer and system size will vary with location.

Sol®

Reliable. Renewable. Remarkable.

Sol Inc. | Palm City, Florida | 772.286.9461
info@solarlighting.com | www.solarlighting.com

Solar LED Transit Lighting Systems from Sol
Outdoor lighting. Off the grid.

0908 MRKT-TSSL-001

Appendix E: Tool Kit Manufacturers and Company Information

Stone Veneer

Border Construction

3515 E. Industrial Dr.
Flagstaff, AZ 86004
928-773-0005

Maverick Masonry

3100 N. Caden Ct.
Flagstaff, Az 86004
Phone 928-522-5922
Fax 928-522-5923
Email: flagstaff@maverickmasonry.com

Appendix E: Tool Kit Manufacturers and Company Information

Weathering Steel

AGATE Steel Manufacturer
www.agateinc.com

Visit Our Corporate Offices, Manufacturing and Fabrication Facilities and Steel Sales Yard
Northeast Corner of Oak St. & Country Club Dr.
Salt River Indian Community
Scottsdale, AZ 85256

Mailing Address
P.O. Box 117
Scottsdale, AZ
85252-0117

Phone (Call for directions)
800-778-9455
480-994-9455
Fax: 480-994-4296
E-mail info@agateinc.com

Page Steel
www.pagesteel.com

By Phone
(800)874-0184
(928)645-8826

By Fax
(928)645-3641

By Mail
Page Steel, Inc.
PO Box 1687
2040 Industrial Drive
Page, Arizona 86040

By Email
sales@pagesteel.com

Doug Gardner - President and CEO
Email: doug@pagesteel.com

Mark Cochran - Sales
Email: markc@pagesteel.com

Steven Childs - Sales
Email: steve@pagesteel.com

Rock Luster - Sales - CAD Programming
Email: rock@pagesteel.com

Stacy Jourdain - Dispatch
Email: stacy@pagesteel.com

Mayorga Welding
120 E. Elden St.
Flagstaff, AZ 86001
928-774-2636