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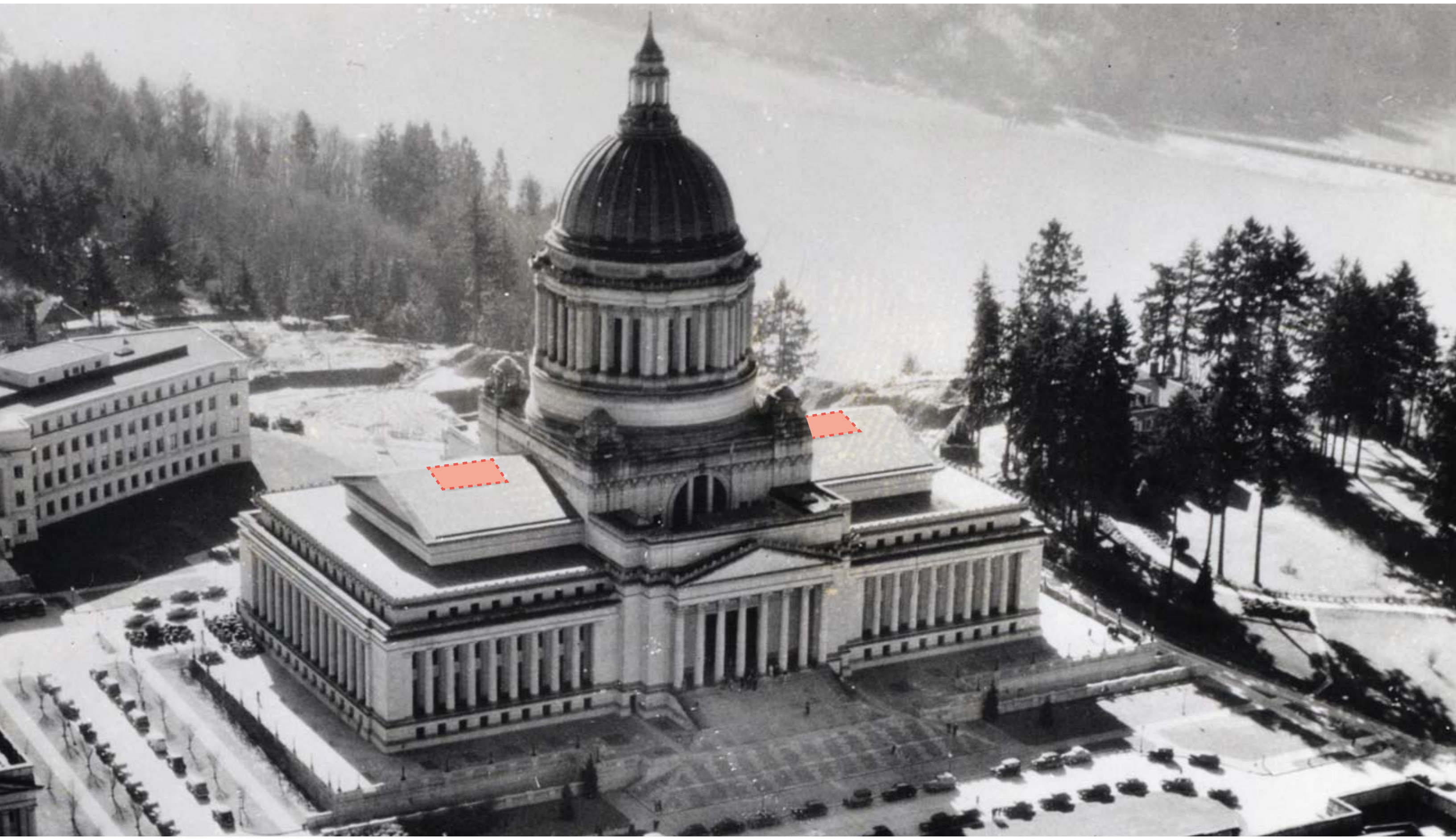

Legislative Chambers
Skylight Restoration Feasibility Study

Washington State Legislative Building

Prepared for

Washington State Department of Enterprise Services

Prepared by

Architectural Resources Group, Inc.
Portland, Oregon

April 4, 2017

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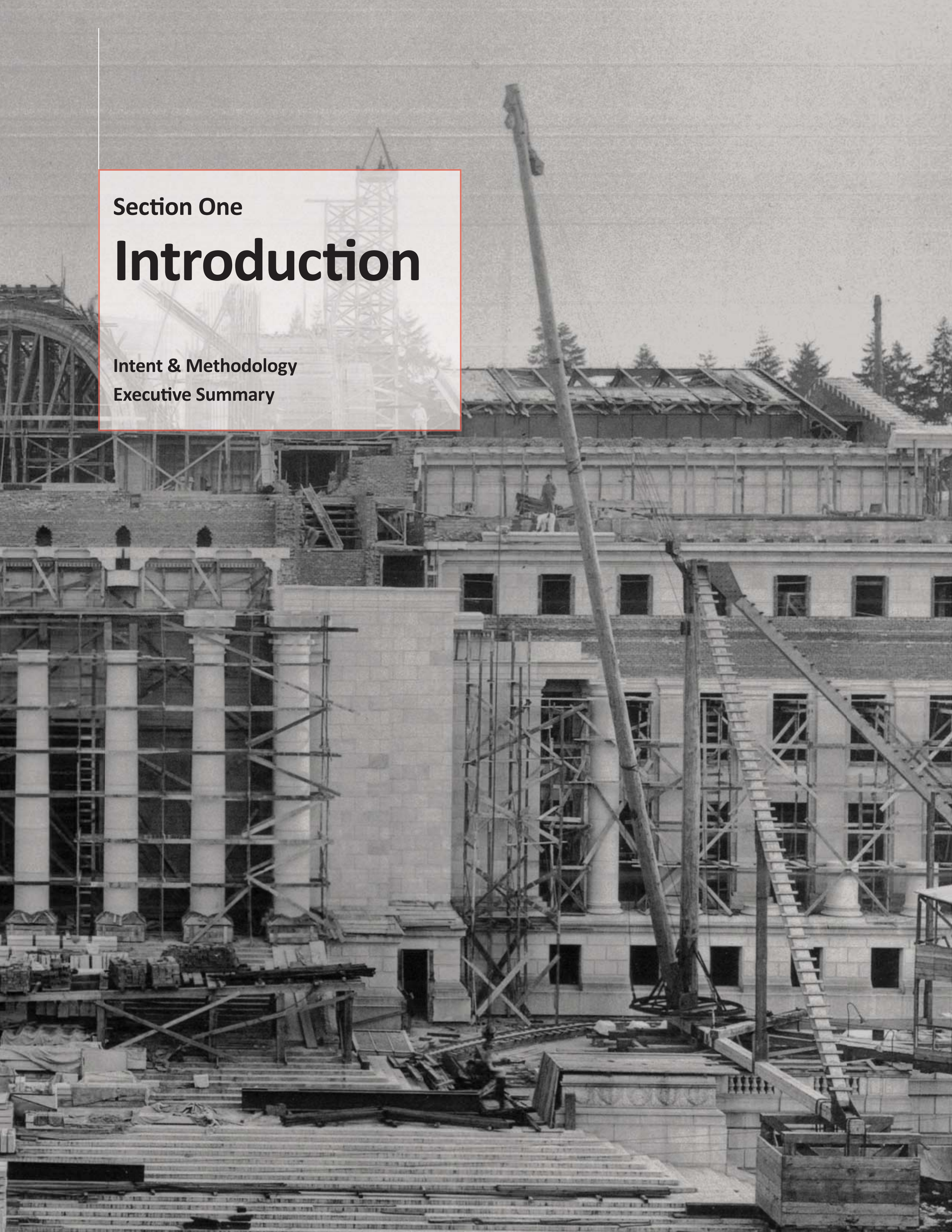

1.1 Intent & Methodology

This report provides an analysis of the feasibility of restoring the skylights and ceiling laylights that are located above the House and Senate Chambers in the Legislative Building in Olympia, Washington. The skylights were part of the original 1928 construction but were removed in the 1970s and roofed over. The only remaining components are the bronze ceiling laylight that once allowed light to pass into the Chambers and which has undergone various modifications as well.

Architectural Resources Group (ARG) was commissioned by the Washington State Department of Enterprise Services to complete this study in response to Section 1104 of the 2015 State Capital Budget bill as stated below:

"The appropriation in this section is provided solely for a study to determine the feasibility and requirements of replacing the materials covering the original skylight openings that are located above the house of representatives and senate chambers in the legislative building with safety glass to allow as much natural light as possible into the chambers as originally intended. The study must determine the cost, including relocation of existing equipment; the impact upon the sound, HVAC system(s) and light levels within each chamber; any other requirements needed to replace the materials with safety glass; and an estimated schedule needed for the work. The replacement glass must be of a quality that will provide for a reasonable assurance of safety in the event of an earthquake."

This report includes a discussion of background and history, an assessment of the existing condition of the roof, skylight attic space, and ceiling laylight, a thorough analysis and recommendations for reinstating the skylights to the chamber, a summary of the anticipated risks, and cost estimates.

The report concludes with the next steps to be taken to make the project a reality.

To complete the report, ARG performed the following tasks:

- Conducted archival research at repositories including the Washington State Archives, the General Administration Building Records Center, the University of Washington Special Collections, and the Washington Historical Society Collections.
- Conducted a site visit along with Sazan Group and Catena Consulting Engineers to examine and photograph the existing conditions of the bronze ceiling laylight, the skylight attic space above the ceiling laylight, and the roofs at the House and Senate Chambers on 12/09/2015.
- Conducted a site visit along with The Greenbusch Group, Inc. to measure current acoustical reverberation and coverage of the sound systems, which also included a qualitative assessment of speech intelligibility and inspection of existing surface finishes and audio equipment in each of the House and Senate Chambers on 04/05/2016.
- Reviewed previous project construction documents including:
    - "Legislative Building – State Capitol Group" original project documents (drawings and specifications), dated March 28, 1923 and revised May 12 1925, prepared by Wilder & White Architects.
    - "Legislative Building Remodel, 1967-69 Biennium" project documents (drawings and specifications), dated July 1967, prepared by Walker & McGough.
    - "Re-Roofing, Sheet Metal, & Sealant Work, Legislative Building" project documents (drawings and specifications), dated May 4, 1971, prepared by the Division of Engineering and Architecture, Department of General Administration for Washington State.
    - "Roof Repairs, Legislative Building" project documents (drawings and specifications), dated February 21, 1978, prepared by Sitts and Hill Engineering.
    - "Legislative Building Rehabilitation" project documents (drawings and specifications), dated March 7, 2003.

1.2 Executive Summary

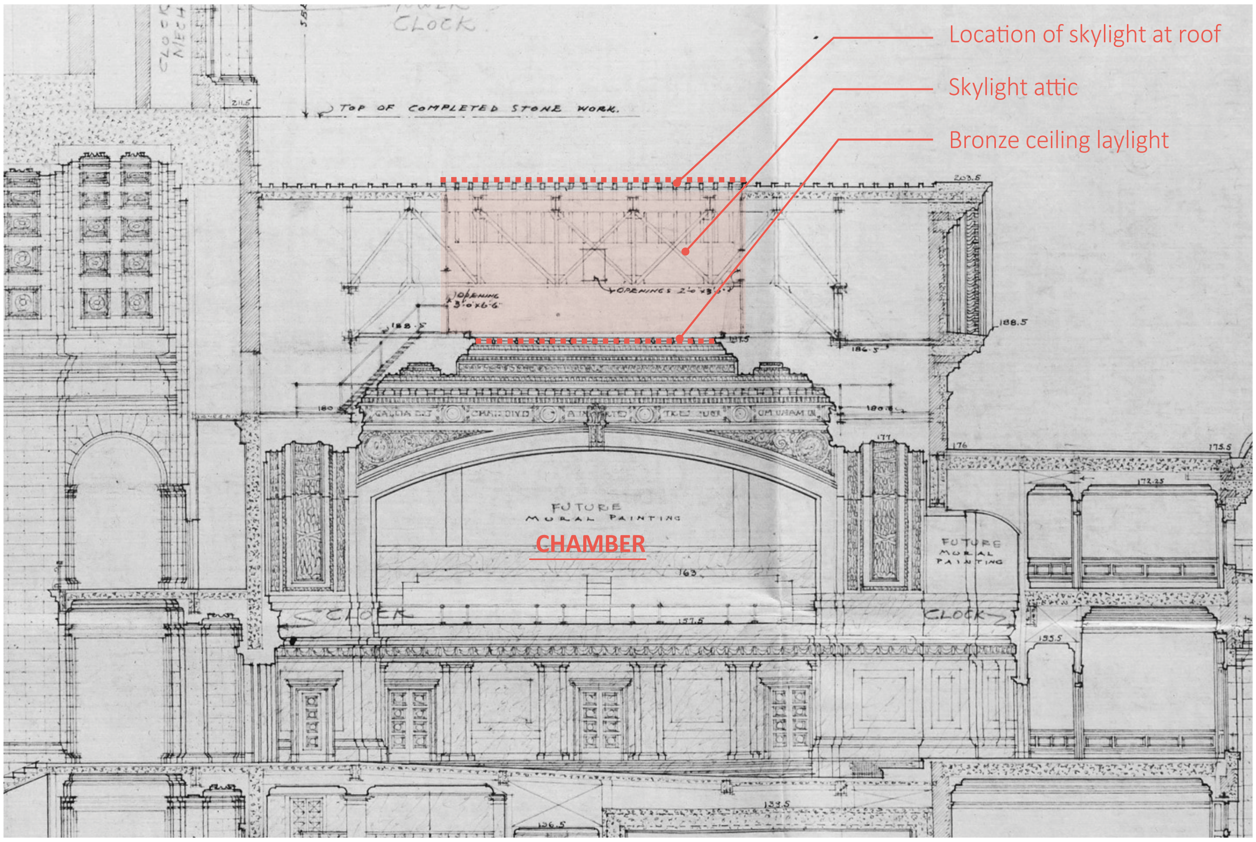

Figure ES01: 1923 Construction Documents, partial Longitudinal Section with skylights highlighted. *Courtesy of Washington State Archives.*

The objective of this report is to understand the scope of work and financial commitment required to restore the skylights of the House and Senate Chambers of the Legislative building to re-create lighting conditions as originally designed when the building opened in 1928.

The original skylights illuminated the Chamber spaces by allowing light into the skylight attic that was filtered to the Chamber floors through amber-tinted opalescent glass set into the ornate bronze grille of the ceiling laylights. They were removed and the openings roofed over between 1971 and 1975.

Were it only a matter of re-opening the roof for installation of a new skylight, the project would be fairly simple. But numerous renovations over the lifetime of the building add additional complexity to the project. See Figure ES02 for a timeline of these modifications.

Reconstruction of the skylights affects the lighting, sound, smoke detection, and security systems for the Chambers below. It will require careful attention to the acoustical performance of the Chamber spaces, the heating and cooling of the skylight attic between the skylight and the ceiling laylight, and current life safety code requirements. All of these items must be addressed in a thoughtful and sensitive way to preserve and enhance the existing historic materials and surrounding fabric.

The scope of work required is summarized here in four sections addressing the major components of the skylight system as shown in Figure ES01:

- Bronze Ceiling Laylight
- Skylight Attic
- Roof and Skylight System
- Chambers/ Acoustics

1.2 Executive Summary

A more complete and technical discussion of these components is found in the chapters that follow this Executive Summary. Code Compliance and Acoustics are also explored in detail, and later sections address risks and estimated costs associated with this undertaking.

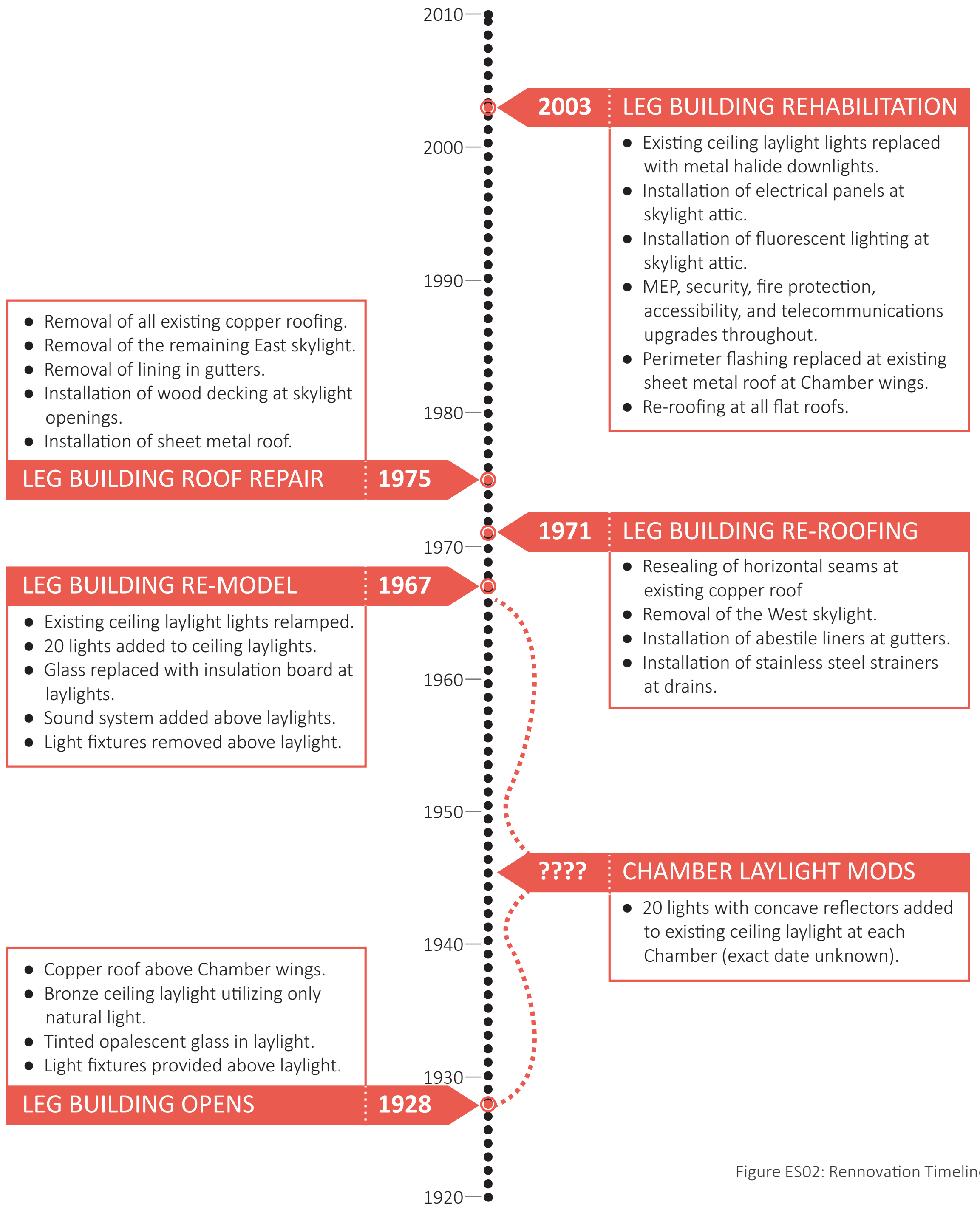

Figure ES02: Rennovation Timeline

1.2 Executive Summary

Figure ES03: House bronze ceiling laylight

BRONZE CEILING LAYLIGHT

The bronze ceiling laylight has been adapted over the years to incorporate various systems required for program and life safety needs. The laylight has been modified to incorporate:

- 40 light fixtures which have been replaced and upgraded with new lamps to meet changing demands of videography in the Chamber spaces (1930-2003).
- A smoke detector (2003).
- A security camera (2003).
- 2" thick acoustical insulation in lieu of the original opalescent glass panels - partially due to safety concerns of a seismic event as well as for acoustical improvement (1967).
- A large speaker cluster above the center portion of the laylight (1967).

All of these items currently block daylight from entering the Chamber spaces below and would be affected by reconstruction of the skylights. To maximize the amount of daylight and to restore the laylight as closely as possible to the original configuration, the following actions are recommended:

- Reduce the number of light fixtures in the laylight from forty to twenty. Utilize energy efficient LED fixtures with a high light output. The smaller diameter LED fixtures will be aesthetically more pleasing and historically more appropriate than the existing metal halide fixtures.

1.2 Executive Summary

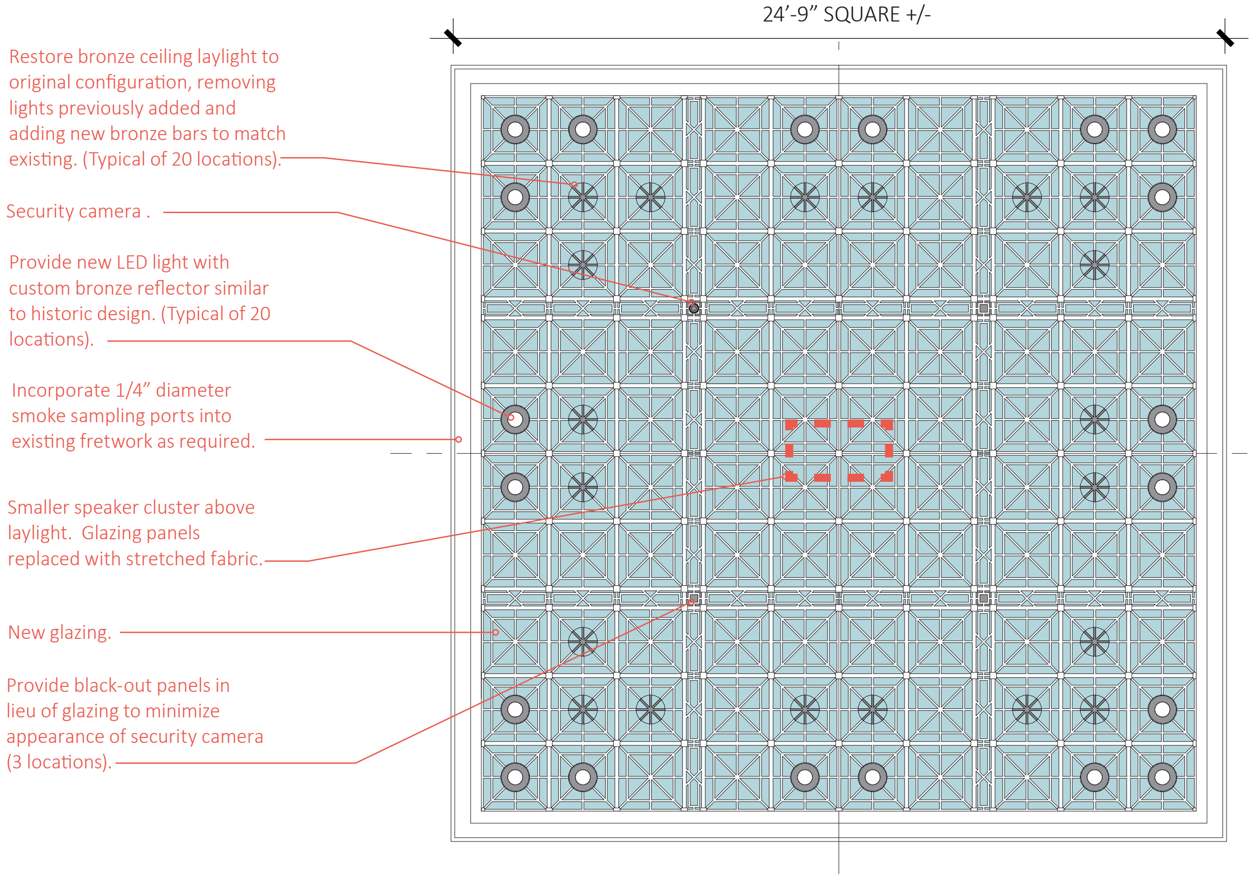

Figure ES04: Proposed restoration of ceiling laylight

- Restore the 20 laylight bronze panels that once held light fixtures back to the original ornamental pattern.
- Replace the existing security camera with a smaller security camera, carefully locating it on the fretwork in the least obtrusive location.
- Replace the smoke detector with a smoke sampling system connected to the existing fire alarm system that will be installed above the laylight. Conduit to run tight to the framework for the laylight to eliminate shadowing. Number of air sampling ports to be determined with the Fire Marshall during design.
- Remove and replace the insulation panels that block the openings in the laylight with either historically appropriate 1/8” amber-tinted opalescent glass with a safety film OR light-transmitting resin panels. Further assessments should be done during design to determine the best solution that meets the safety glazing requirements of the building code. The glazing panels shall be clipped into the existing fretwork to prevent falling during a seismic event.
- Replace the current speaker cluster at the center of the laylight with a considerably smaller cluster OR move the speaker cluster to the front of the Chambers and incorporate it into the existing plaster wall. Further assessments should be done during design to determine the most appropriate solution from an acoustical, visual, daylighting, and historic preservation approach.

1.2 Executive Summary

Figure ES05: House skylight attic showing top of bronze ceiling laylight with speaker cluster at the center. A perimeter catwalk provides access.

SKYLIGHT ATTIC

The attic space above the Chambers is currently utilized to run various pipes and conduit and to provide mounting locations for electrical and control panels. Moving these systems to another location would be costly and difficult due to the spatial requirements.

It is recommended to paint everything (conduit, pipes, structure, walls, railings, etc.) with a highly reflective white paint to create a light box in the skylight attic space. This will allow light from the skylights to bounce from surface to surface minimizing any shadowing from the various objects in the space. To complete the lightbox, doors or sliding panels will need to be added at the existing entry points to other areas of the attic.

The skylight attic will see a significant increase in heat gain from the skylight above (even with the use of high performance glazing in the skylight system). Since there are lights and other electrical equipment in the attic space, mechanical systems will be needed to cool the space when temperatures rise, typically during the peak of summer.

To address this heat gain, one option is to install a vent in the attic. The fan can also be programmed to blow warm air into the skylight attic to offset heat loss during times of cold outdoor air. The fan would only operate when temperatures in the attic exceed set points. The fan should include a sound trap so that its sound is minimzed in the Chambers below.

Another option is to provide a fan coil unit at each skylight attic in lieu of a cooling fan. The fan coil units would draw air from a high level in the skylight attic, and recirculate it to a lower level in the skylight attic. Air would be filtered at the fan coil unit intake, and careful equipment selection might allow for equipment that does not require sound traps to be provided.

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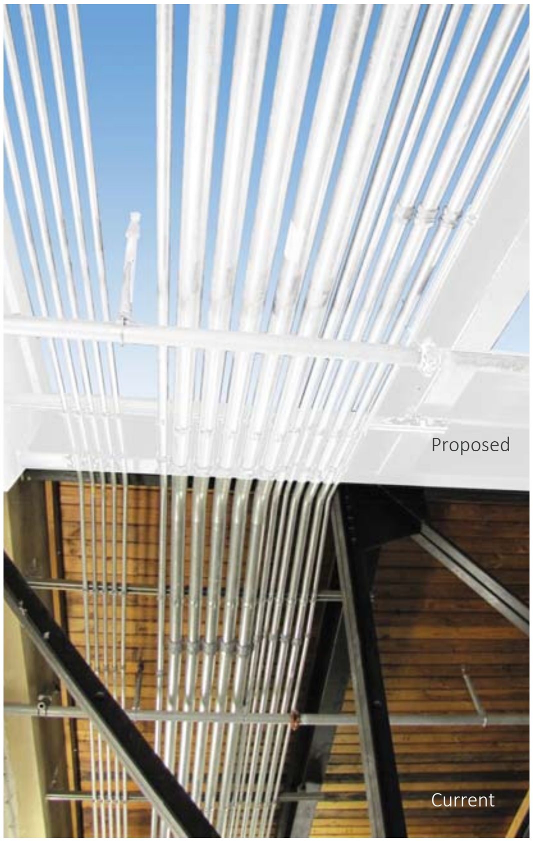

Figure ES06: Photo showing proposed reflective white paint on all surfaces of the skylight attic with glazing above

Figure ES07: Wood decking shown replaced the original skylights.

ROOF & SKYLIGHT SYSTEM

From research of the original construction drawings and historic photographs, it appears that the architects of the Legislative building, Walter Wilder and Harry White, wanted to integrate the skylight as seamlessly as possible into the adjacent gabled metal roof surface. The vertical lines of the batten seams of the original copper sheet metal roofing system aligned with the framing members of the skylight system. The skylight also had a minimal curb so it was almost flush with the adjacent roof surface as shown in Figure ES08: Construction photo of original skylight.

In 1971, the west skylight above the Senate Chamber was removed and some repairs were done to the existing copper roof.

In 1975, the east skylight above the House Chamber was removed. The skylight openings in both roofs were infilled with wood decking as shown in Figure ES07 and the original copper roof was replaced with a terne-coated stainless steel batten seam roof, eliminating any trace of the skylights from the exterior.

The current roof system is still the terne-coated stainless steel roof that was installed in 1975. Terne-coated stainless steel sheet metal is a superior product known for its durability, low maintenance, and high cost. In 2003, the perimeter flashing was replaced and at some point a roof-tie off system was installed, but no other major roof work has occurred.

Considering the high quality and condition of the roof material (which would be very expensive to replace with an equivalent system), it is recommended to modify rather than replace the existing roof system for the new skylights.

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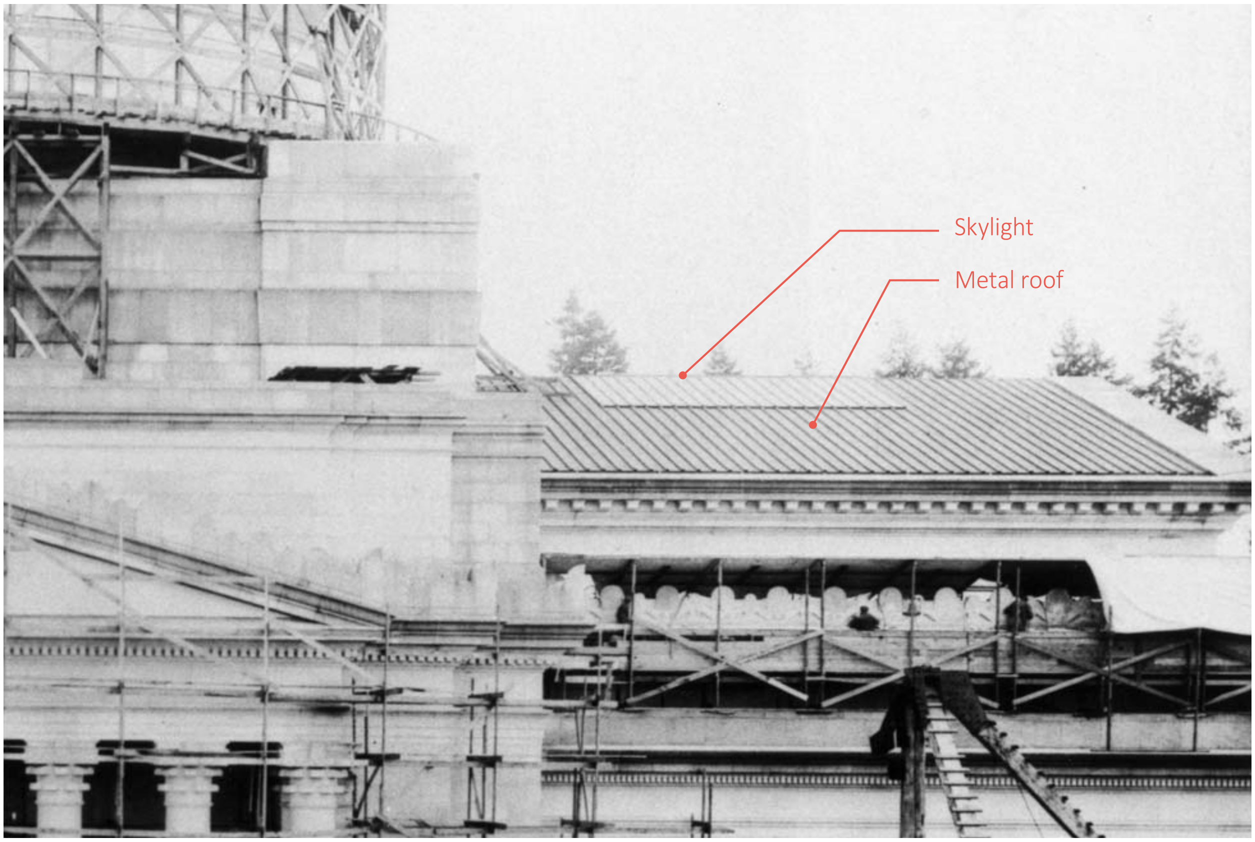

Figure ES08: Construction photo showing skylight at the gabled metal roof.

ROOF & SKYLIGHT SYSTEM (Continued)

Since terne-coated stainless steel is solderable, it is possible to cut a new opening in the existing roof, peel back the sheets as necessary, install the new skylight curbs, install a new waterproof membrane lapping over the existing roof membrane and over the new skylight curb, and then solder new terne-coated stainless steel flashing from the skylight to the existing roof system.

The current roof tie-off system should be replaced with a more appropriate modern system that has mounting brackets that allow for the free-passage of water and a cable line that does not rest on the surface of the roof. This work should be completed whether or not the skylight project moves forward.

The new skylight system should meet the design intent of the original skylights while implementing modern technologies and meeting current building and energy codes.

It is recommended to design the skylight framing to align with the existing batten seams of the roof and to keep the skylight as low to the roof as possible by minimizing the new insulated curb required around the perimeter while still meeting recommended flashing requirements for water tightness.

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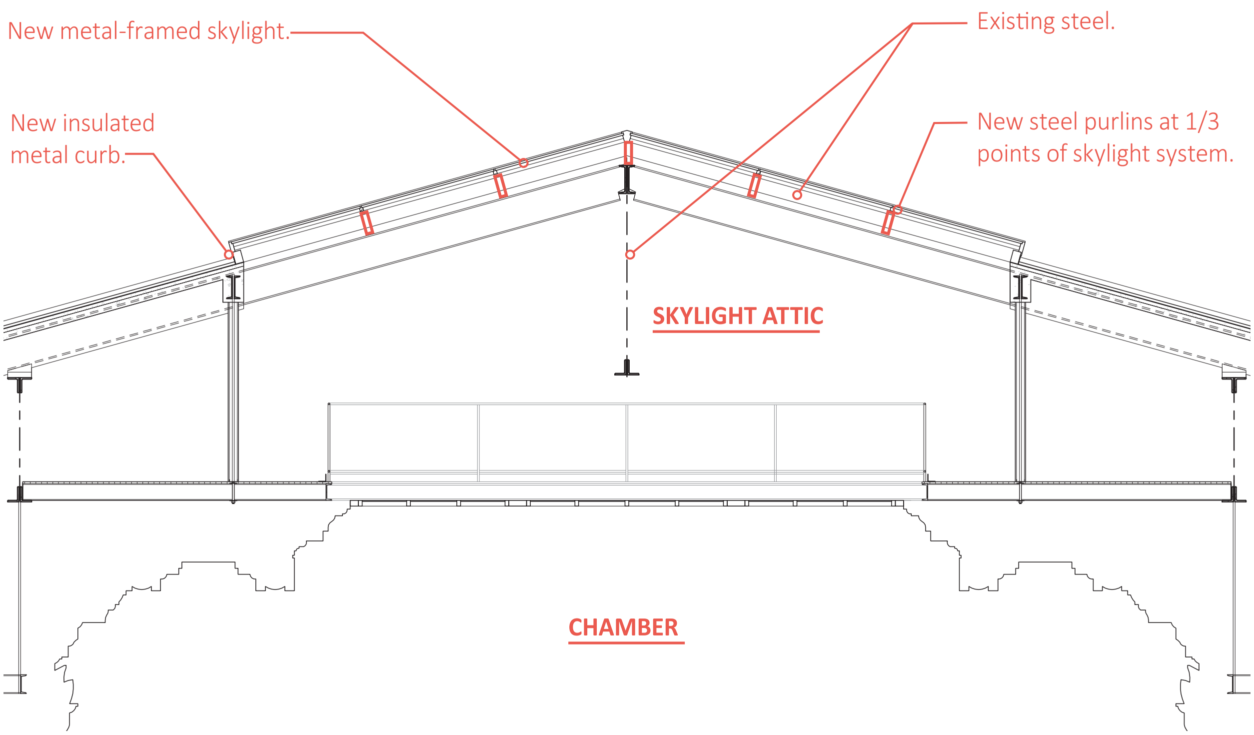

Figure ES09: Proposed skylight section

New steel purlins at 1/3 points of the spans may be necessary to minimize the depth of the skylight framing as shown in the section above. This will also result in a less expensive and lighter skylight system.

The glass selected for the skylight needs to find an appropriate balance during design between light transmittance, solar heat gain (SHGC), U-value, and aesthetics.

The higher the percentage of light transmittance the more daylight will enter the space. It is especially important to allow high light transmittance since the daylight must enter through the skylight and then another 12 feet or so to the ceiling laylight which will then diffuse the light as it enters the Chamber spaces below.

It is recommended to select a glass that performs better than the minimum Washington State Energy Code requirements since it will impact the mechanical system cooling requirements.

Additionally, the skylight glass should either be clear or tinted gray to blend into the dark gray of the roof system and recall the look of the original skylights with careful consideration for low-e coatings to improve the performance of the glass.

Laminated glass will need to be utilized per the building code since safety glazing is required. The laminated glass will also block 99.9% of all UV-rays through the skylight, protecting the interior finishes of the Chambers.

1.2 Executive Summary

CHAMBERS/ ACOUSTICS

Restoration of the bronze ceiling laylight will result in the removal of the 2” rigid insulation boards currently in place. It is essential to understand the potential acoustical impact this will have on the Chamber spaces.

The existing insulation boards provide a high degree of acoustical absorption, blocking both light and sound. Most of the sound energy that rises to the attic space is absorbed before it is reflected back into the Chambers, reducing reverberation.

Testing of each Chamber was undertaken and it was discovered that the current acoustical character of each Chamber is slightly more reverberant than ideal, yet still supports an acceptable degree of speech intelligibility for the sound system. Removing the 2” thick insulation boards and replacing with un-perforated translucent glass or resin would reduce the amount of acoustically absorptive material in the space and increase the reverberation time in both the House and Senate Chambers to a degree likely to be noticeable to most users of the spaces.

In order to compensate for increased reverberation, additional absorption would be needed in the Chamber spaces. The amount of material required would be likely be at least 2,000 sq. ft. and would need to be highly absorptive. Careful selection of absorptive material would be needed to maintain the historic aesthetic of the Chambers.

One obvious option is to restore the draperies that once hung from the front and back of the Chambers as shown in Figures ES12 and ES13 The draperies were part of the original acoustic design of the space.

Another possibility is to install acoustical plaster or a stretched fabric material at the plaster areas highlighted Figures ES10 and ES11 that would have minimal visual impact on the Chamber space (if any at all).

A perforated glazing material may also be installed in the ceiling laylight that has at least 30% open area. This would allow sound to enter the attic and be absorbed before being reflected back into the Chamber. A mock-up of the material should be done during design to better understand the visual impact from the Chamber floor.

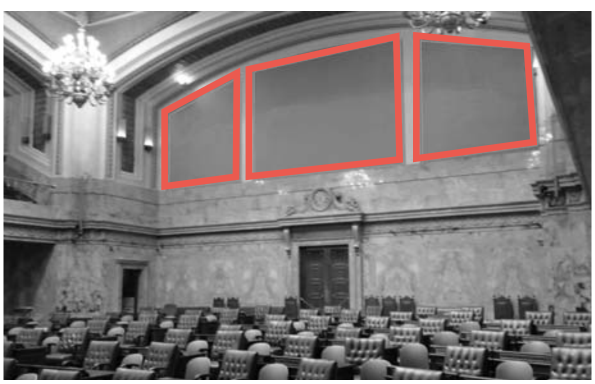

Figure ES10: Acoustical absorption at back of Chamber

Figure ES11: Acoustical absorption at front of Chamber

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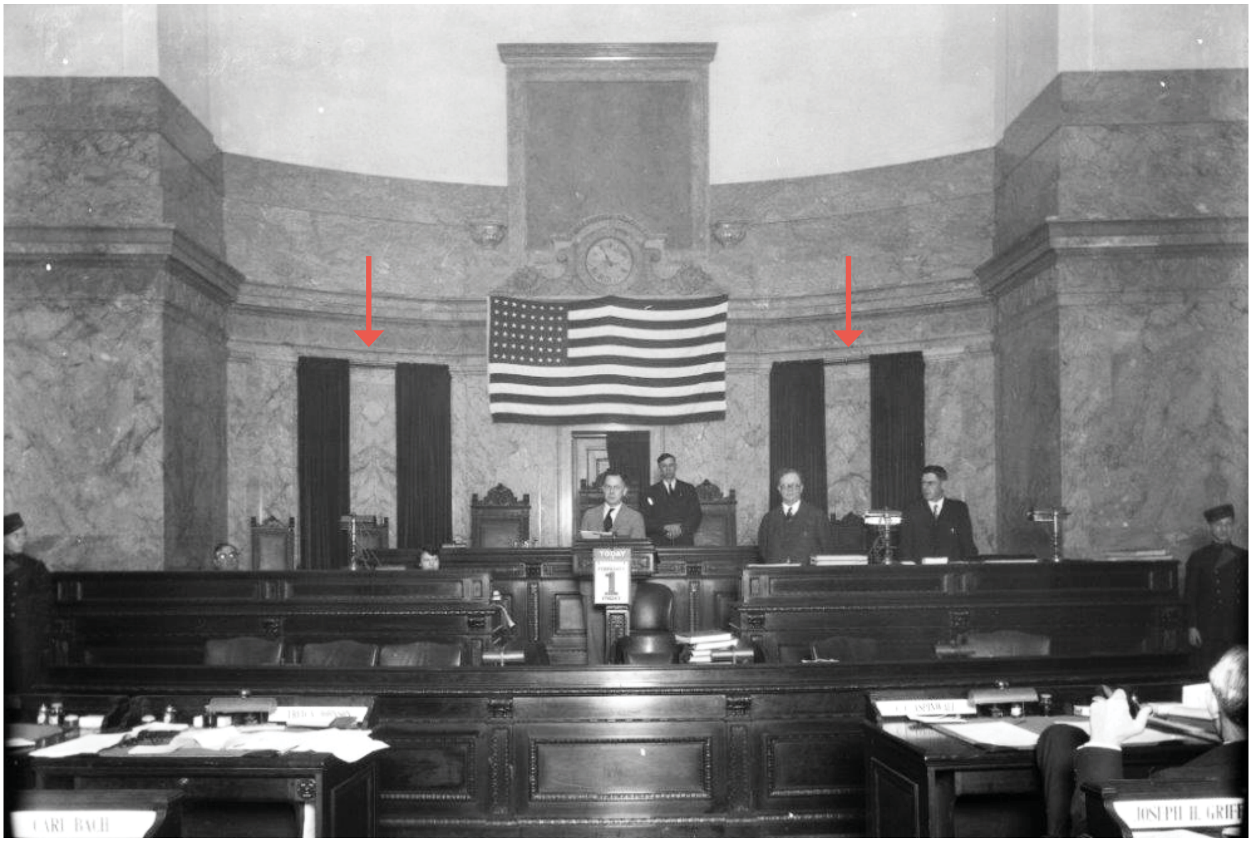


Figure ES12: Original draperies at front of Chamber

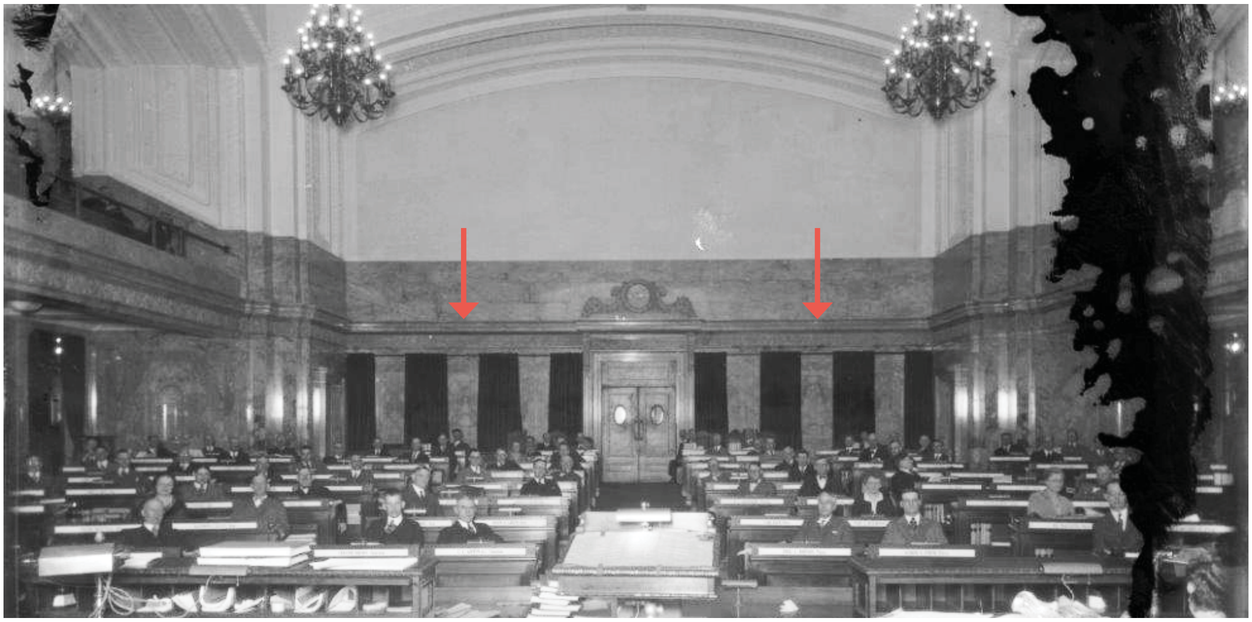


Figure ES13: Original draperies at rear of Chamber

1.2 Executive Summary

CONCLUSION

The removal of the skylight systems and the subsequent modifications to the ceiling laylight changed the spatial quality and character of the Legislative Chambers. The soft ambient glow of the filtered daylight through the skylight and ceiling laylight has now been entirely replaced by electric lighting.

Most of the modifications undertaken were the result of new programmatic and code requirements. Even the initial removal of the skylights was a response to safety and acoustical concerns. But with today's advances in technology, it is now possible to meet those requirements while restoring the original design intent of providing natural daylight into the Chambers.

The reconstruction of the skylights over the House and Senate Chambers is a complex project that involves new lighting, upgrades to the sound system, upgrades to the fire and life safety systems, restoration of the bronze and glass ceiling laylight, acoustical upgrades to the Chambers, and some additional mechanical and structural work.

Due to the number and extent of the systems that are affected, schedule/access constraints, weather constraints and additional costs working on a historic building, the total project cost for both Chambers is estimated to be approximately $5.9 million. This cost includes all architect and engineer design fees, permitting, construction materials and labor, inspection and testing fees, sales tax and other project costs. A summary of the cost estimate is provided on page 19 and additional detail is provided in Appendix A.

It is also recommended that the state use a "Progressive Design Build" process to procure the design and construction services for restoration of the Legislative Building skylights, rather than a traditional design-bid-build delivery method.

The progressive design-build method compresses the design and construction phases in a way that will best respond to the significant restraints this complex project presents in terms of scheduling: access restricted to the limited months in between Legislative Sessions, dry weather conditions necessary for roof construction, and the timing of funding within the biennial budget process.

In a progressive design-build process the design consultant and contractor are selected as a team, and work together from the beginning on project design and delivery solutions. Following a qualifications review, three competing teams submit initial designs that propose their technical design approach and schedule for delivery. A winning team then is selected to continue to completion.

Compressing initial design and scheduling into the selection process, and running early construction phases parallel to ongoing design work, potentially allows the project to target a two-year completion schedule, although it is possible that a third construction season would be necessary.

The following steps are recommended moving forward:

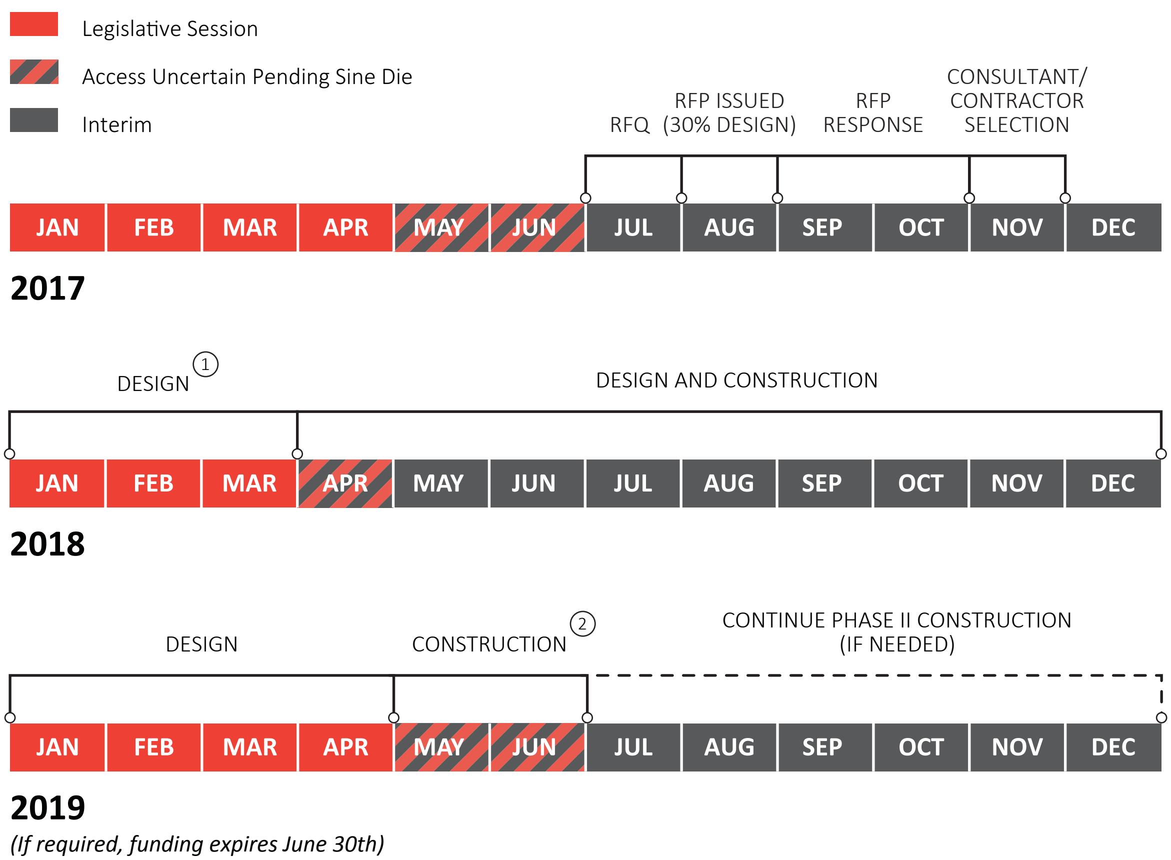
- Produce an RFP and select a design/build team. The team should have experience in historic structures and conservation to ensure sensitive solutions that will enhance the historic fabric. An estimated project schedule is shown below in Figure ES14 on page 20.
- Meet with the City of Olympia building department with the design team to discuss the project and the corresponding code issues as well as the review and permitting process.
- Meet with the Department of Archaeology and Historic Preservation early in the schematic design process to discuss scope and approach.
- Review current report with the key stakeholders of the project so there is a shared understanding of the complexity, cost, and expected outcome of the project moving forward.

The Chamber skylights were a historically significant and carefully designed feature of the Legislative Building.

1.2 Executive Summary

COST ESTIMATE SUMMARY	
Consultant services	$963,242
SUBTOTAL	**$963,242**
Maximum Allowable Construction Cost (MACC)	**$3,458,178**
Construction Contingency	$964,018
Sales tax	$389,154
SUBTOTAL	**$4,811,350**
Project Administration, Project Support, Permits, Plan Review	$207,480
SUBTOTAL	**$207,480**
ESTIMATED TOTAL PROJECT COST	**$5,982,072**

1.2 Executive Summary



NOTES:

① Assume no construction possible during Legislative Session. Design work only.

② Project may not be possible to be completed in this time.
A second phase of funding and construction may be required.

Figure ES14: Project Schedule

Figure ES15: Washington State Legislative Building shortly after construction completed. *Courtesy of Washington State*

Section Two

Background

History

Existing Conditions

2.1 History

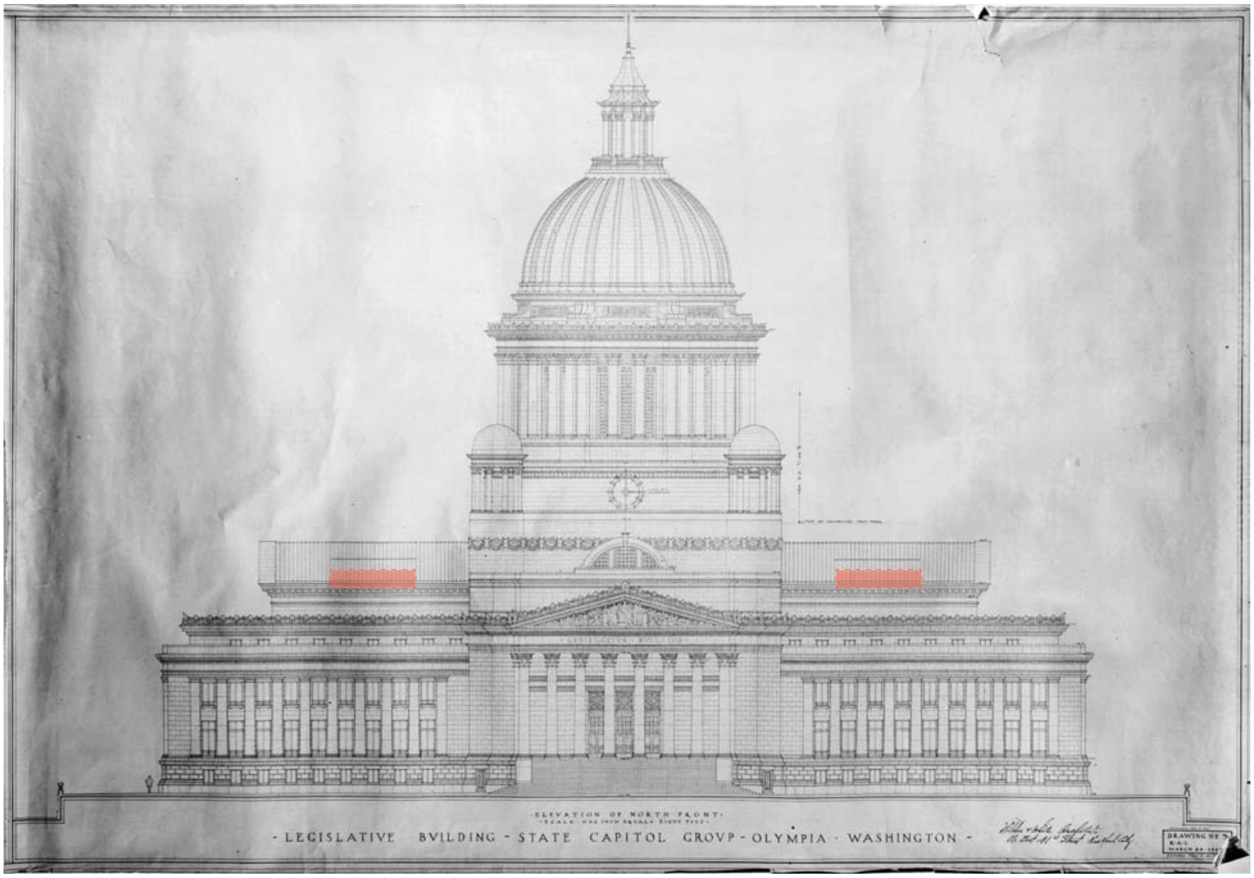


Figure 01: 1923 Construction Documents, elevations with the skylights highlighted. *Courtesy of Washington State Archives.*

ORIGINAL CONSTRUCTION

Though it is impossible to tell today by looking at the Washington State Legislative Building, there were once two additional skylights at the roof that brought daylight into the House and Senate Chambers. Even from reviewing the original 1923 construction documents, they are almost easy to miss since there is very little text and no details that are referenced but rather subtle cues in the line work of drawings as shown from the image above. It is only after careful examination and review of the construction documents as well as the in-process construction photos (as seen on the facing page) and additional aerial photography, that the original construction detailing and design intent becomes more apparent.

The historic configuration of the skylights as it relates to the interior spaces of the chambers is very similar to the State Reception Room. If you are in the State Reception Room and look up at the ceiling, you do not have direct visibility to the skylight, rather you see an intricate grid work of ornamental bronze with illuminated amber-tinted opalescent glass referred to as the ceiling laylight. Above the ceiling laylight there is an attic space that has been used to run utilities, and above that is the roof where the exterior skylights used to be (Figure 02).

2.1 History

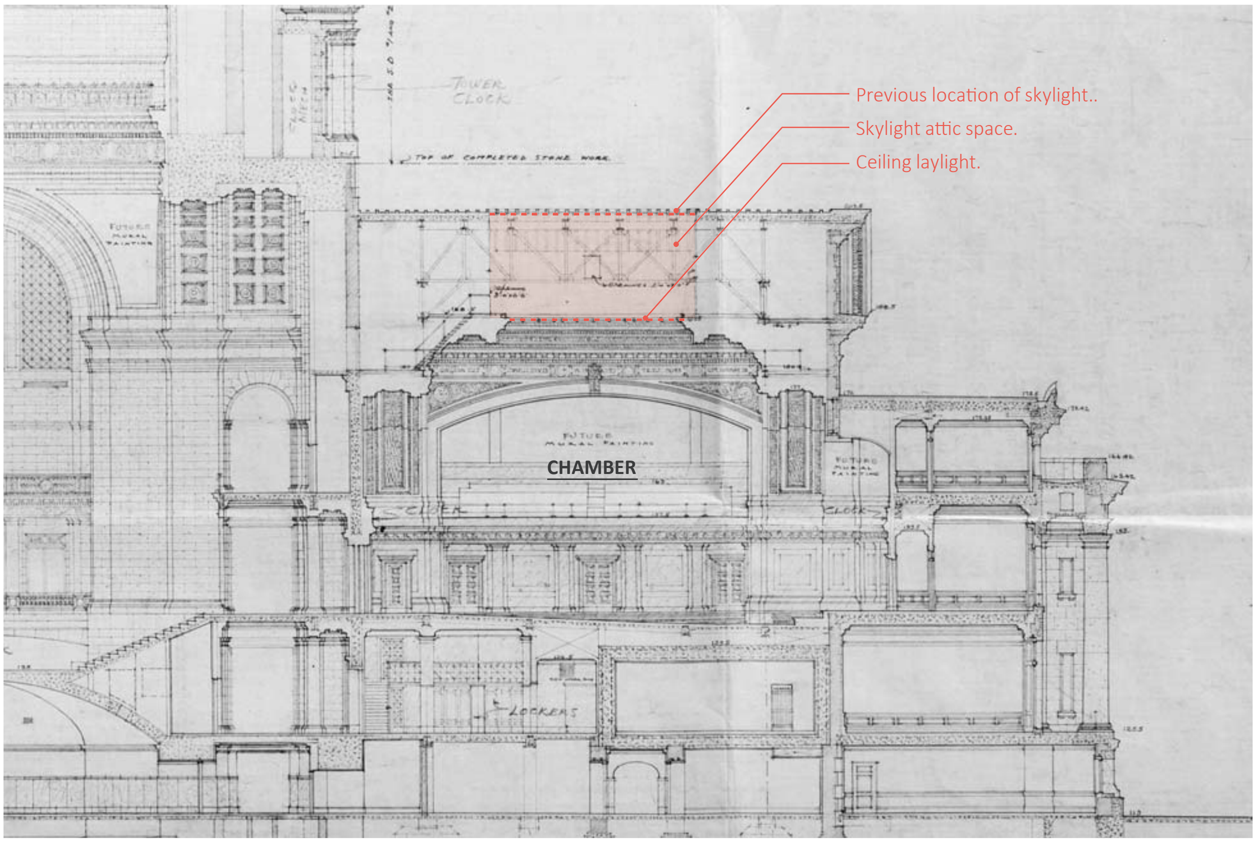


Figure 02: 1923 Construction Documents, partial Longitudinal Section with skylights highlighted. *Courtesy of Washington State Archives.*

This configuration was important for light and heat control for the skylights at this time. The ceiling laylight would diffuse the light coming through the skylight above, creating a softer more pleasant illumination of the space. The heat gain from the skylight, would be captured in the attic space above with minimal impact to the room below.

The section above is from the 1923 construction drawings and shows the original configuration of the skylight above the chamber. Both the House and Senate Chambers have the same configuration: skylight is located at the roof level, there is an attic space, and a ceiling laylight below. Unlike the skylights at the state reception room which sit on top of a flat roof without being visible from the ground, the skylights at the chambers are a gabled profile that matches the gabled metal roof on both the east and west wings and therefore are more visible (Figure 03 and 04).

2.1 History

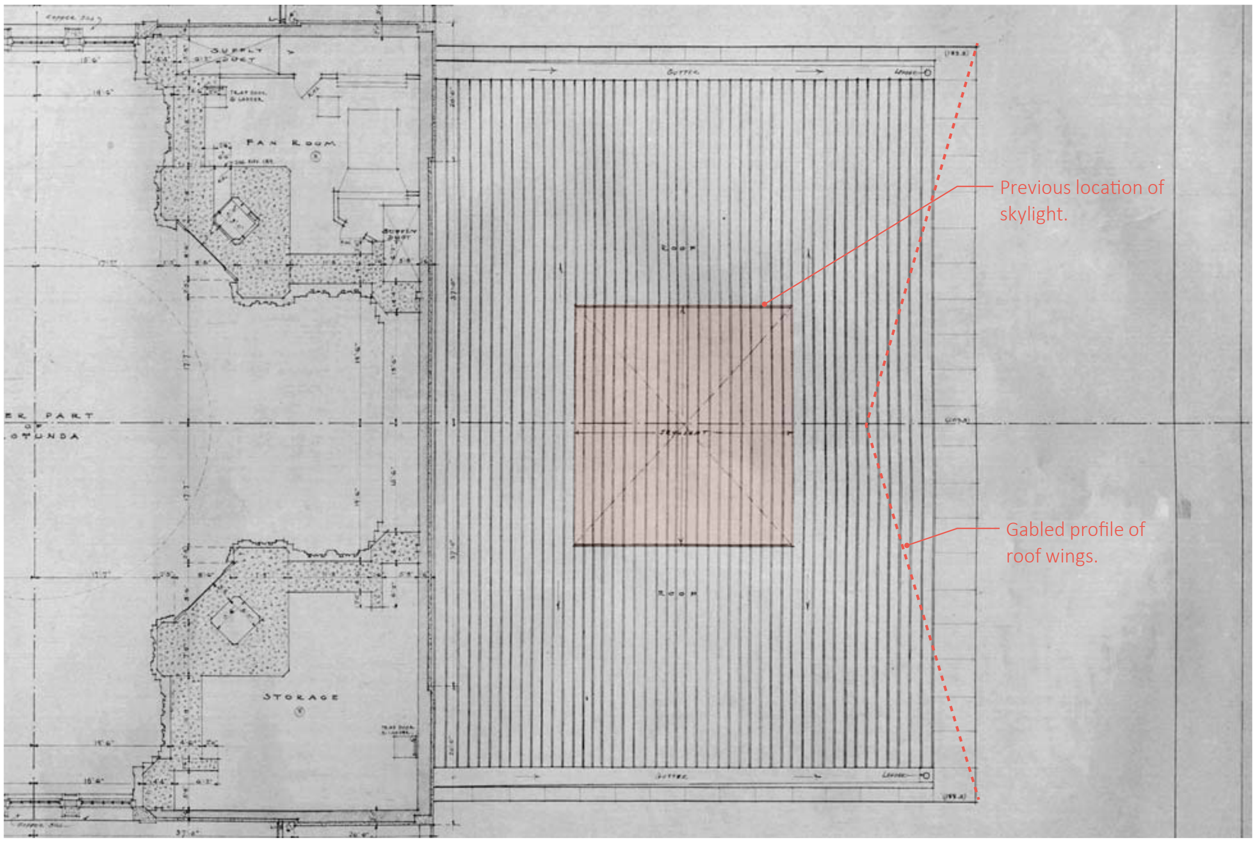


Figure 03: 1923 Construction Documents, partial sixth floor roof plan with skylight highlighted. *Courtesy of Washington State Archives.*

It appears that the architects, Walter Wilder and Harry White, wanted to integrate the skylight as seamlessly into the gabled metal roof as possible so it appeared similar in appearance to the adjacent roof surface. This can be seen most clearly by reviewing the 1923 roof plan (Figure 03). The vertical lines of the batten seams of the sheet metal roofing system continue through the skylight area. The only way to see the difference between the roof and skylight is the 'X' and the note "skylight".

Photographs of the finished skylights show that the skylight sat almost flush to the metal roof and the skylight rafters aligned with metal roof batten seams to create one simple clean roof form (Figure 04).

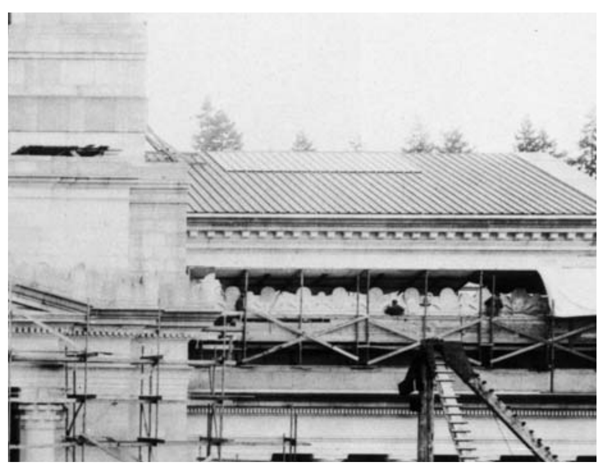


Figure 04: Construction photo. *Courtesy of Washington State Archives.*

2.1 History

The 1923 construction drawings describe a “glass and metal ceiling light (laylight)” in the partial reflected ceiling plan shown in Figure 06. The construction of the ceiling laylight is further described in the “Ornamental Bronze” specifications:

The main bars are to be *“made up of two molded 2-1/2” x 4” bars with molded 1-1/2” x 2” bars between. Panels to be divided into squares with rails of three molded 1-1/2” x 2” bars with square ornamented rosettes at intersections. Diagonals to be 1” x 1-1/2” molded with ornamental rosettes at intersections.”*

The glass in the ceiling laylight is described in the 1923 “Glazing” specification:

“The following work is to be glazed with tinted and opalescent glass, same to be of shades selected by Architects and fitted to bronze frames specified under ‘Ornamental Bronze’ without bending: The ceiling lights over the Entrance Vestibule, State Reception Room, and Senate and House Chambers.”

Therefore, it is possible to ascertain that the opalescent glass was most likely the same as the amber-tinted State Reception Room ceiling laylight shown in Figure 06.

The construction drawings do not show any lighting integrated with the bronze work in the ceiling laylight. (See Figure 07). There were originally 20 incandescent down lights shown located above the ceiling laylight as seen in the Fourth Floor Electrical Plan (Figure 06). These lights would have been utilized to light up the ceiling laylight when it was too dark in the room to essentially create a large light fixture out of the ceiling laylight.

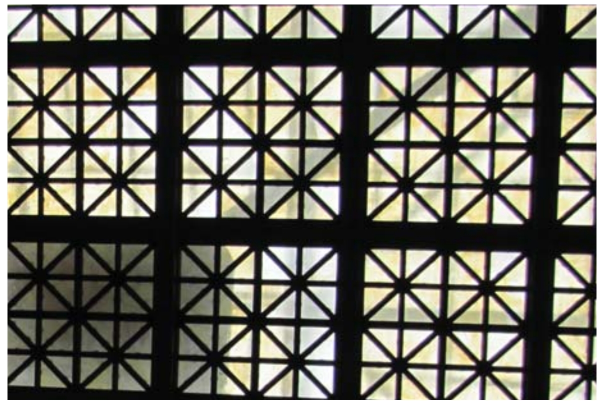


Figure 05: Bronze ceiling laylight with opalescent tinted glass in State Reception Room.

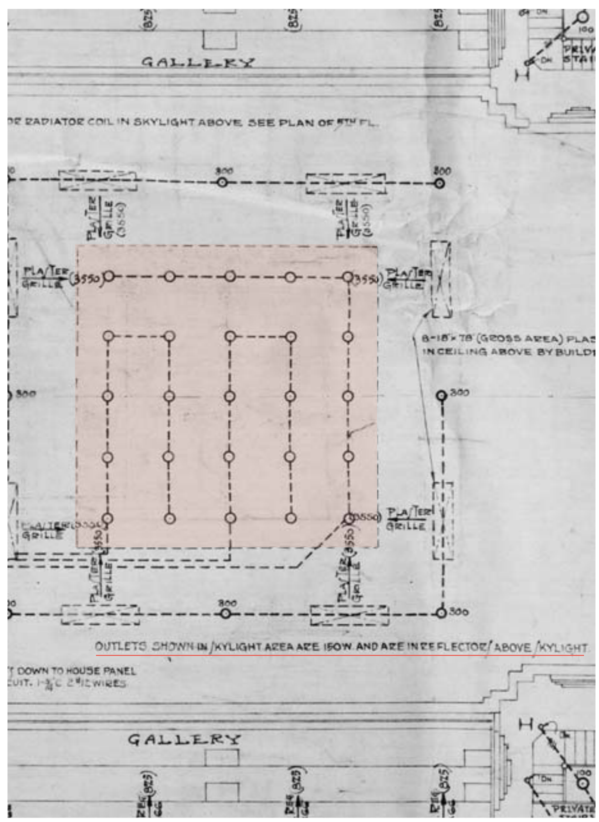


Figure 06: 1923 Construction Documents, Fourth Floor Electrical Plan showing lights. *Courtesy of Washington State Archives.*

2.1 History

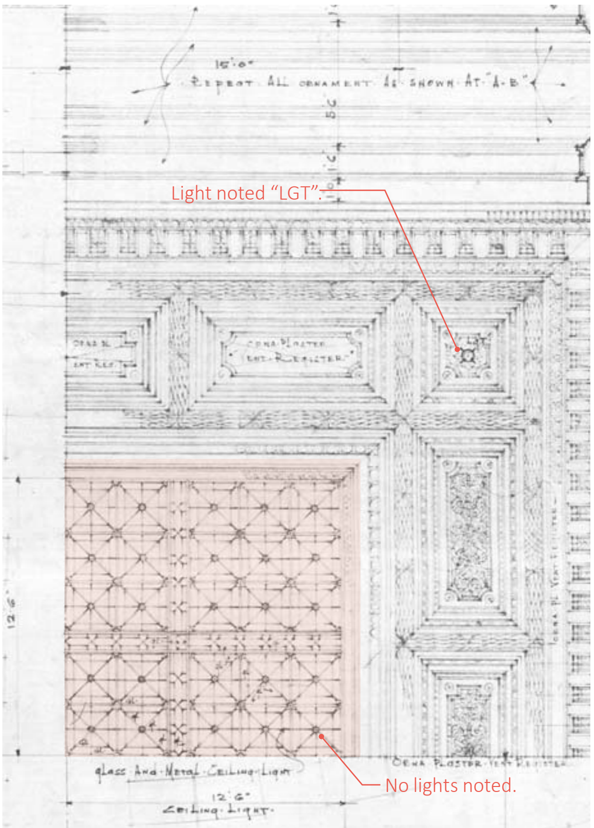


Figure 07: 1923 Construction Documents, partial Reflected Ceiling Plan showing ceiling laylight *Courtesy of Washington State Archives.*

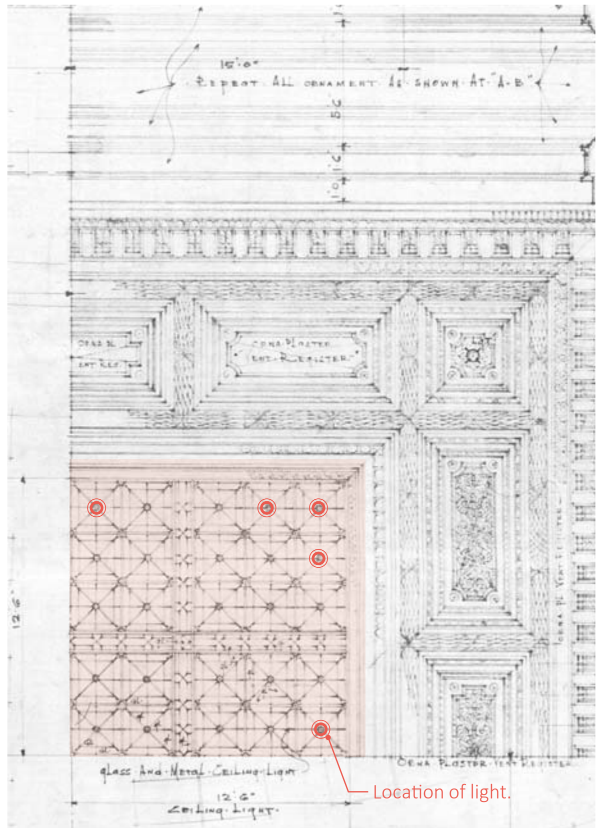


Figure 08: 1923 Construction Documents, partial Reflected Ceiling Plan showing ceiling laylight with additional light locations.

1923 - 1967 CHAMBER CEILING LIGHT MODIFICATIONS

Some time between 1923 and the 1967 Legislative Building remodel, additional downlights were added to the ceiling laylight as shown in Figure 08. No drawings or documents were found in this time period to indicate when the work was completed. The 1967 drawings do reference the existing lights in plan as shown in Figure 10 as well as in the specifications where they direct the general contractor to re-lamp the existing 750 Watt bulbs.

The design of the light, as shown in Figure 09, worked well with the intricate bronze laylight due to the smaller diameter light and the elegant transition from the bronze grille work to the light with the concave bronze reflector.

Figure 09: Light fixture at Chamber ceiling laylight, 1983
Courtesy of Washington State Archives.

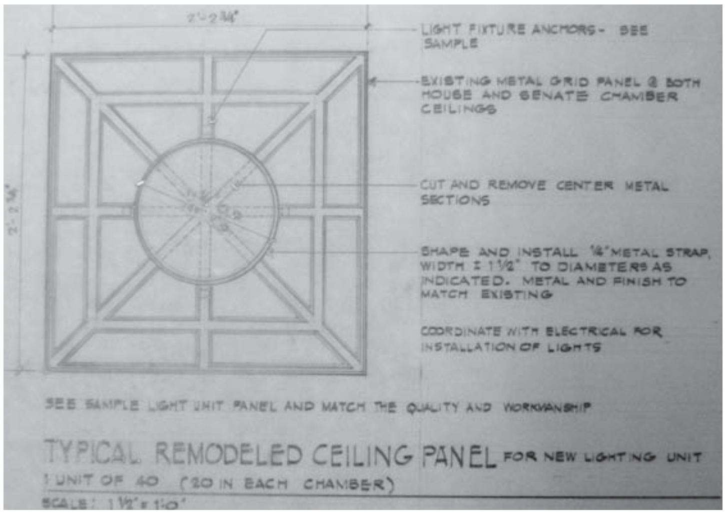


Figure 10: 1967 Construction Documents, detail of remodeled ceiling panel

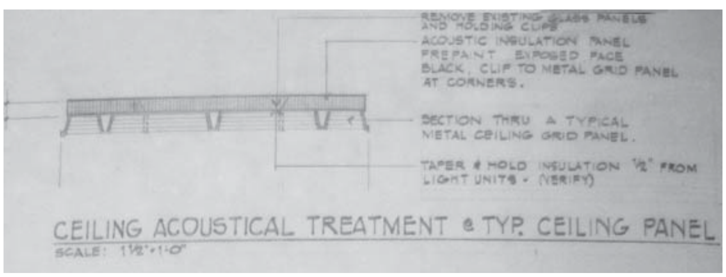


Figure 11: 1967 Construction Documents, detail of ceiling acoustical treatment

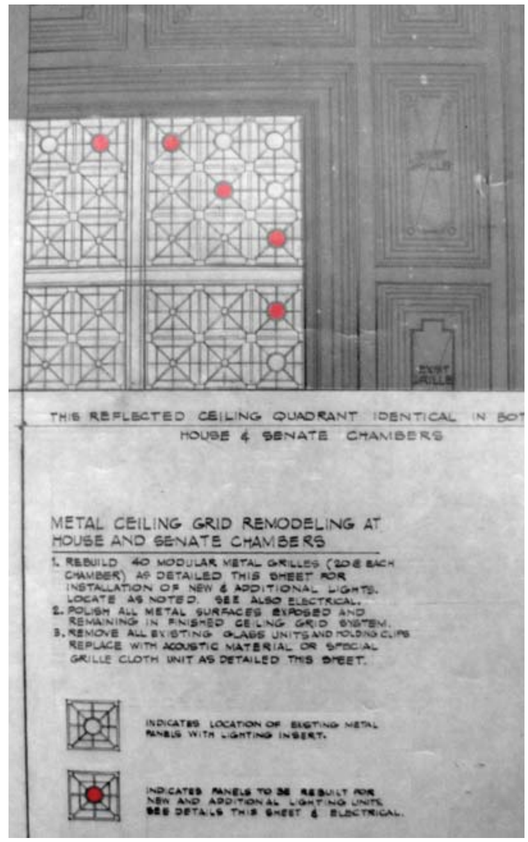


Figure 12: 1967 Construction Documents, partial Reflected Ceiling Plan showing additional light fixtures

1967 LEGISLATIVE BUILDING REMODEL

Most of the modifications to the bronze ceiling laylight occurred in a 1967 remodel. The existing 750 W incandescent bulbs were re-lamped with 1000W quartzline lamps. Twenty of the bronze squares were also modified to add additional 1000W quartzline high bay fixtures to the chamber space as shown in Figure 10. While the drawings indicate that the House and Senate Chambers were to have an identical lighting layouts as shown above in Figure 12, during construction this was changed so there is a slight variance of layout between the two Chambers. During this remodel, the light fixtures utilized to back light the ceiling laylight at night were removed.

Acoustics were the main driving factor for many of the additional modifications. A preliminary report prepared by architects Walker & McGough dated May 3, 1968 provides recommendations for “acoustical correction” of the Chamber spaces. This included the removal of the historic opalescent glass from the ceiling laylight and installation of insulation boards in lieu of the glass (Figure 11). The bottom side of the insulation was painted black to eliminate any views through the ceiling laylight from below. It is believed that the historic glass panels were salvaged, but at the writing of this report they have not been located.

2.1 History

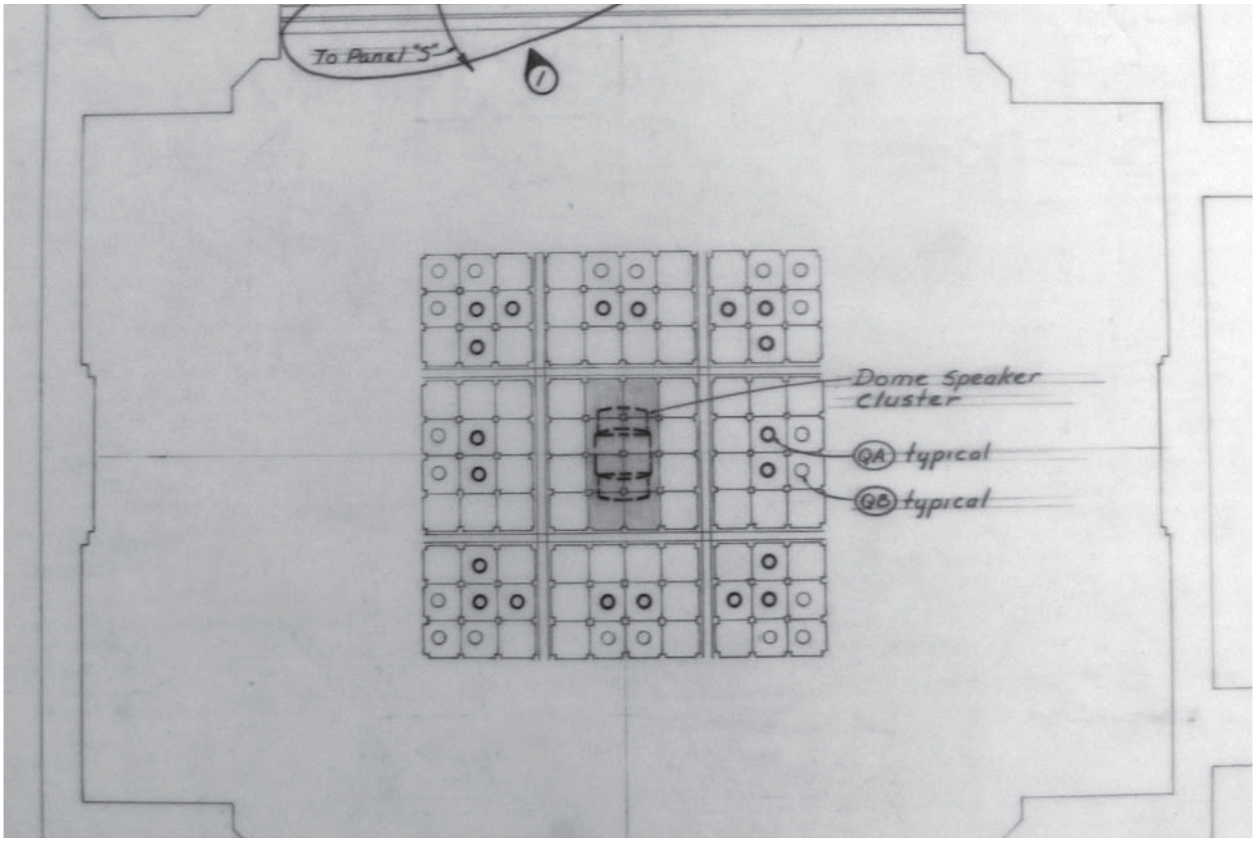


Figure 13: 1967 Construction Documents, showing additional lighting and the new dome speaker above the ceiling laylight.

The final major change to the space was the addition of a new sound system to further improve acoustical issues. A large "dome speaker cluster" was installed above the ceiling laylight, directly in the center as shown in Figure 13 above. Since the glass had been replaced with the black-painted insulation, this location was ideal due to the central placement and lack of visibility. The main loudspeaker is still in use today. The electronics head-end, microphones, controls, and peripheral speakers have been recently upgraded.

1971 LEGISLATIVE BUILDING RE-ROOFING SHEET METAL & SEALANT WORK

The 1971 project resulted in the removal of the west skylight over the Senate Chamber. The original copper sheet metal roof over the Senate and House wings had all of the horizontal joints at the sheet laps resealed, new asbestile liners were added to the gutters and new stainless steel collars and strainers were provided at all existing roof drains.

2.1 History

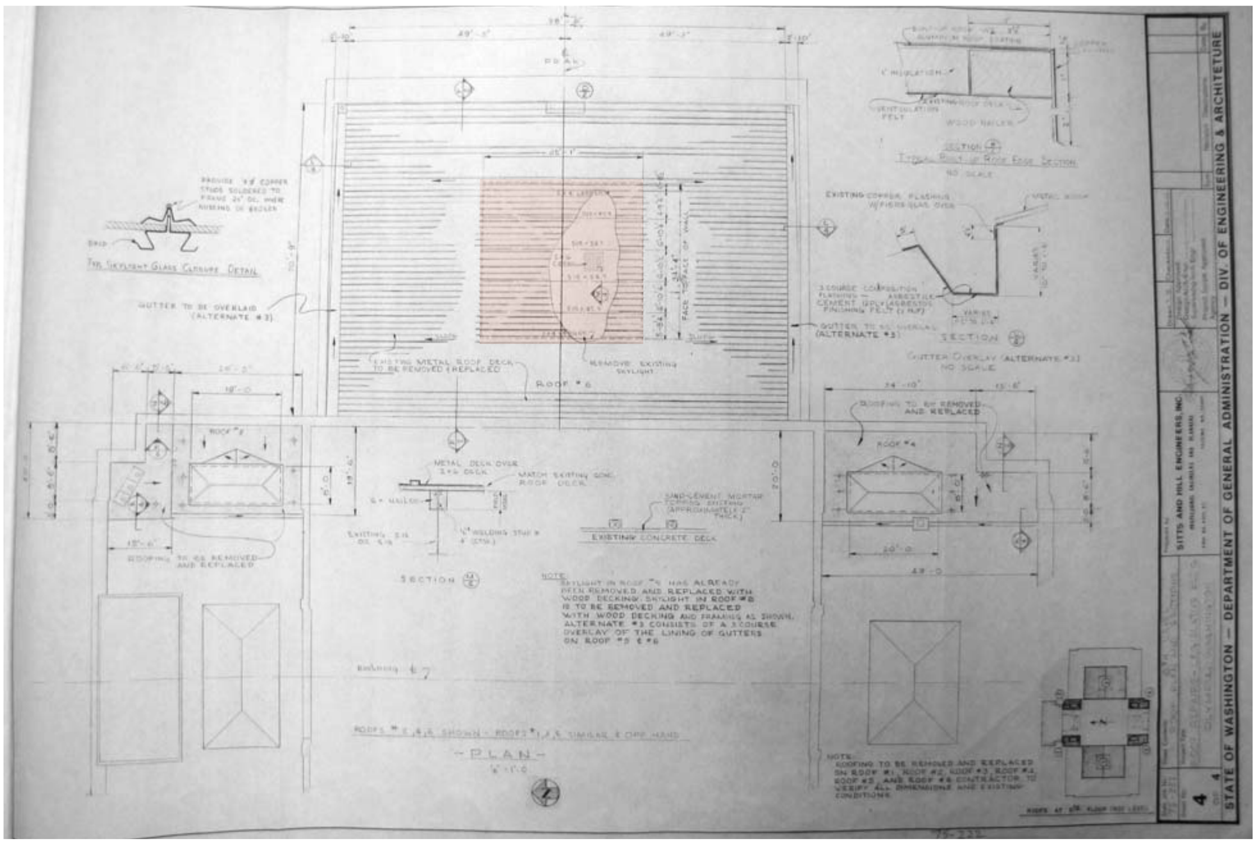


Figure 14: 1975 Construction Documents, west wing roof plan. *Courtesy of General Administration Records Room*

1975 LEGISLATIVE BUILDING ROOF REPAIR

A major roofing project was undertaken a few short years later which included the following scope at the Senate and House Chamber wings:

- Removal of all existing copper roofing and wood nailers.
- Removal of the remaining existing skylight on the west wing (at the House Chambers).
- Removal of lining in gutters.
- Installation of new treated wood decking in place of the existing skylights.
- Installation of vapor barrier, new treated wood nailers, and sheet metal roofing.

The specifications state that the roof material installed was a terne-coated stainless steel (TCS), 26 gauge sheet metal with wood batten seams at approximately 22 1/2" on center. Terne-coated stainless requires minimal to no maintenance and is a solderable material.

There have been no other major roof projects at the House and Senate Chambers since this project so it is assumed that the current roof installed is the 1975 terne-coated stainless steel roof system.

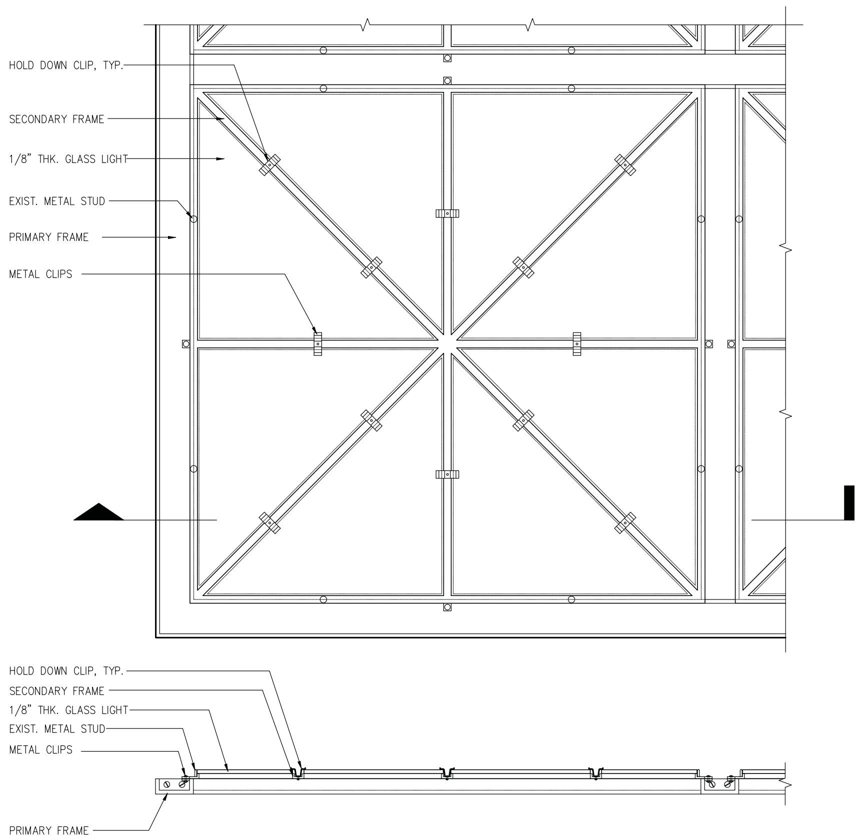


Figure 15: 2003 Construction Documents, State Reception Room ceiling laylight restoration detail showing hold down clips at glass

2003 LEGISLATIVE BUILDING REHABILITATION

The 2003 Legislative Building Rehabilitation project included new membrane roofing; repointing of facades; waterproofing of plaza deck; new air conditioning, ventilation; storm water; sanitary; fire protection; power and lighting systems; upgraded telecommunications systems; elevator repairs; egress and accessibility improvements; minor plan changes; and associated refinishing due to the work above.

It important to note that the historic ceiling laylight in the State Reception Room was modified to address safety concerns of glass falling during a seismic event. At each glass panel, hold down clips were installed per Figure 15.

Five new roof mounted air handling units were added to provide heating, cooling and ventilation. Heating and chilled water distribution piping appears to have been updated at the same time. A new roof mounted air cooled chiller with remote indoor bundle was installed to provide chilled water at the building. Existing ductwork serving terminal grilles were retained and reused.

In the House and Senate Chambers, the existing quartz downlights were replaced with 250 watt metal halide downlights. Shortly after that, the lamps were changed to 5000k temperature lamps to aid in lighting for television broadcast of the Chambers. New fluorescent lighting, was also added around the perimeter of the skylight attic in addition to new electrical panels and lighting control panels.

2.1 History - Summary

2003 LEG BUILDING REHABILITATION

- Existing ceiling laylight lights replaced with metal halide downlights.
- Installation of electrical panels at skylight attic.
- Installation of fluorescent lighting at skylight attic.
- MEP, security, fire protection, accessibility, and telecommunications upgrades throughout.
- Perimeter flashing replaced at existing sheet metal roof at Chamber wings.
- Re-roofing at all flat roofs.

LEG BUILDING ROOF REPAIR 1975

- Removal of all existing copper roofing.
- Removal of the remaining East skylight.
- Removal of lining in gutters.
- Installation of wood decking at skylight openings.
- Installation of sheet metal roof.

1971 LEG BUILDING RE-ROOFING

- Resealing of horizontal seams at existing copper roof
- Removal of the West skylight.
- Installation of abestile liners at gutters.
- Installation of stainless steel strainers at drains.

LEG BUILDING RE-MODEL 1967

- Existing ceiling laylight lights relamped.
- 20 lights added to ceiling laylights.
- Glass replaced with insulation board at laylights.
- Sound system added above laylights.
- Light fixtures removed above laylight.

???? CHAMBER LAYLIGHT MODS

- 20 lights with concave reflectors added to existing ceiling laylight at each Chamber (exact date unknown).

LEG BUILDING OPENS 1928

- Copper roof above Chamber wings.
- Bronze ceiling laylight utilizing only natural light.
- Tinted opalescent glass in laylight.
- Light fixtures provided above laylight.

2.2 Existing Conditions

Architectural Resources Group (architecture), Sazan Group (mechanical/ electrical), and Catena Consulting Engineers (structural), reviewed the existing conditions of the ceiling laylight, the skylight attic space and the roof system from below in the skylight attic and minimally from above utilizing an access ladder.   The following conditions were observed.

CEILING LAYLIGHT

Architectural

The ceiling laylight was reviewed from below in the chamber space and from above in the skylight attic space. It is evident that the bronze bars have been modified to incorporate larger light fixtures with a thinner metal ring (see Figure 16 & 17). In general, the bronze material appears to be in good condition though a full assessment will be required once the insulation boards are removed.

The dark areas between the skylights are where the bottom of the insulation is seen from below. It is possible to see through the six open squares at the center of the skylight where the sound system is located (see Figure 18).

Structural

The ceiling laylight consists of a primary metal frame that was visible even with the insulation installed, with secondary decorative metal inserts. The metal frame is hung with 1-1/4” diameter metal rods to the main roof structural steel wide-flanged beams (see Figure 18 and 25).

Figure 16: House bronze ceiling laylight

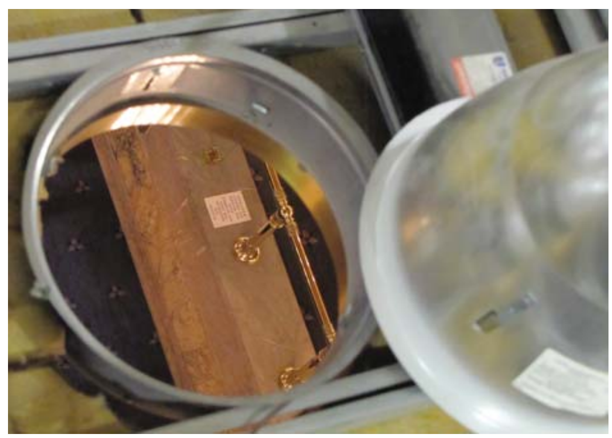


Figure 17: Metal ring added for larger light fixture

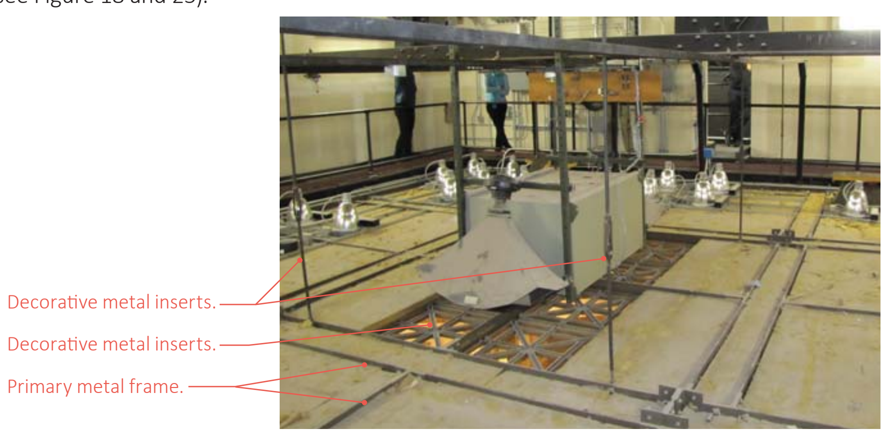


Figure 18: Ceiling laylight from above, showing support hangers

2.2 Existing Conditions

Electrical - Lighting

The House Chamber has had some of the existing downlights "de-lamped" and only about 33 of the 39 fixtures in the ceiling laylight are operational. All 39 downlights in the Senate Chamber are operational.

The existing downlights do provide adequate light levels to both Chambers for their current use. Foot-candle readings were taken for both Chambers at the desk level with the metal halides and the historic chandeliers on. The foot-candle level for the House Chamber was around 30 foot-candles around the perimeter of the ceiling laylight and 35 foot-candles in the center. The foot-candle level for the Senate Chamber was around 40 foot-candles around the perimeter of the laylight and 45 foot-candles in the center.

The installed downlights were not designed for the current application and do not fit properly in the openings of the grid. The rings/ downlight reflectors do not line up, creating light leaks around the grid system (see Figure 21). Color shifting, which is when the color of the lamp changes (for instance from more of a warm tone to a greenish or bluish tone) was also present as seen in Figure 19 which is common for metal halide lamps as they age.

Electrical - Lighting Controls

The existing ceiling laylight downlights are controlled by a lighting control panel located in the skylight attic space. A low voltage switch is located in a small room off of the Chamber floor level. Only an ON/OFF control is available for the existing downlights, which are not dimmable.

Electrical - Fire Alarm System

There are currently smoke and heat detectors located above the ceiling laylight for both of the Chambers (see Figure 22 and 23). There are detectors located on each corner of the laylight.

Electrical - Audio Speaker

In the 1960's a large loud speaker assembly was installed in the skylight attic space above the ceiling light in both the House and Senate Chambers (see Figure 18).

Electrical - Security Camera

A security camera has been installed in the ceiling laylight in both Chambers. The camera is located where a light fixture was once located (see Figure 24).

Figure 19: House ceiling laylight, showing downlight configuration

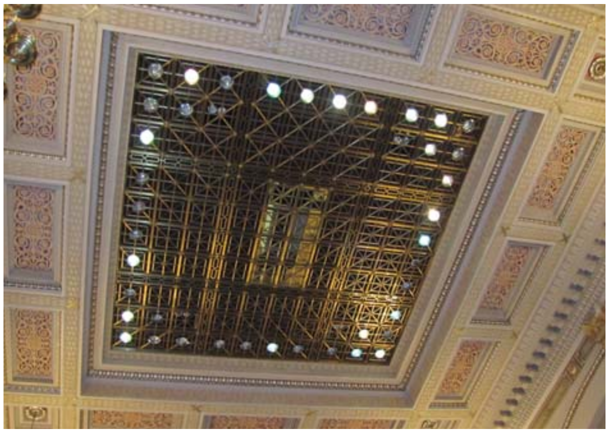


Figure 20: Senate ceiling laylight, showing downlight configuration

Figure 21: Light leaks / misalignment of downlights

Acoustical

The insulation boards at the ceiling laylight are approximately two-inches thick and provide a high degree of acoustical absorption. The Attic and Chamber spaces are coupled acoustically, allowing sound energy to pass from the Chambers into the Attic. Most of the sound that enters into the Attic space would be absorbed before it is reflected back into the Chambers, which also contributes to the removal of acoustic energy from the Chambers, reducing reverberation.

Reverberation time is a method of describing how sound decays over time in a space. Longer reverberation times mean that sound takes longer to decay, or is reverberating through the space for a longer time. Some early reverberation helps support speech intelligibility, but longer reverberation times muddy speech and makes it less intelligible. The amount of reverberation appropriate for a space depends mostly on the intended use and volume of the space.

Reverberation is mainly controlled by the amount of acoustical absorption in a space. Existing absorption in the House and Senate Chambers is in the form of carpeted floors, heavy drapes, upholstered furniture, and the insulation boards at the laylight. Acoustically coupled spaces also influence reverberation by either capturing sound and releasing it later into the space, creating longer reverberation, or by capturing and absorbing the sound, which reduces reverberation. Little of the sound entering the acoustically coupled Attic spaces returns to the Chambers and so this serves to reduce reverberation within the Chambers.

Mid-frequency (500 Hz) reverberation time in the House Chamber was measured at 1.4 seconds. Mid-frequency reverberation time in the Senate Chamber was measured at 1.6 seconds. The volume the House Chamber is estimated at approximately 200,000 ft3 and the Senate Chamber at 160,000 ft3. For volumes of this size, a mid-frequency reverberation time of approximately 1 second is ideal to support speech. Thus, each space is slightly more reverberant than ideal; however speech intelligibility is still well supported in each space.

Figure 22: Smoke and heat detectors from Chamber floor

Figure 23: Smoke detector location in skylight attic

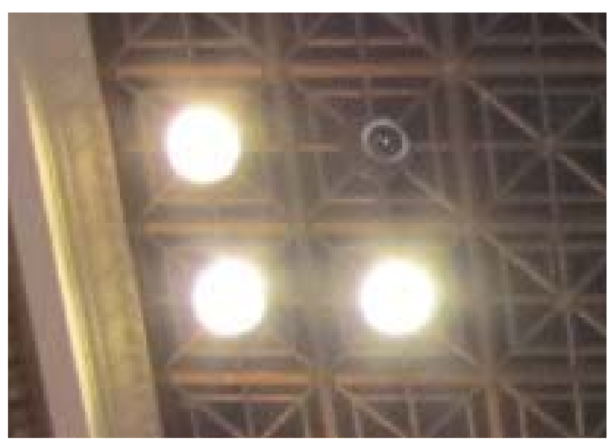


Figure 24: Security camera from Chamber floor

2.2 Existing Conditions

Figure 25: Skylight attic space above the House Chamber (Senate Chamber similar)

Figure 26: Wood decking above exposed steel beams.

SKYLIGHT ATTIC SPACE

Architectural

The skylight attic space consists of a catwalk approximately 4'-0" wide which surrounds the ornamental ceiling laylight. A metal pipe rail and toe kick is provided for fall protection. The walls of the space are unpainted gypsum board with the seams taped and sealed.

The insulation boards on top of the ceiling laylight are clipped into place except where modifications have occurred for new systems. No insulation boards are provided under the large speaker (see Figure 25).

Structural

The skylight attic is framed with a steel framed truss spanning across the middle of the skylight opening. Each end of the truss is supported by a steel plate girder which spans to steel columns encased in unreinforced masonry. The top chord of the truss supports steel wide flange beams which span towards the north and south to the existing roof framing. When the skylights were removed in the 1970s, the opening was infilled with wood decking. This wood deck currently spans between the roof beams (see Figure 26).

The catwalk is framed with steel channel, angle, and expanded metal lath. Catwalk handrails consist of round pipe sections.

2.2 Existing Conditions

Figure 27: Conduit and piping runs along one of the bays

Frame support for original lights above laylight.

Figure 28: Catwalk and pipe rail around ceiling laylight

Electrical

There are several items of existing electrical equipment located in the skylight attic space. The equipment includes several electrical panelboards, lighting controls, and a dimming cabinet. The electrical panels in the attic are used to power light fixtures for the roof, attic space, and the Chambers. The panels also power the attic space receptacles and some of the smaller mechanical equipment loads.

A conduit mounted rack runs through the space. These conduits contain feaders for the panelboards (see Figure 27).

Lighting is accomplished by wall mounted fluorescent fixtures (see Figure 28).

The metal framework that was utilized as the support system for the original 20 light fixtures above the ceiling laylight is still present (see Figure 28).

Mechanical

The skylight attic space is currently unconditioned. It communicates with the remainder of the attic via a floor grate, and man door openings. There is limited heat gain to the space other than lighting control panels, which total about 600w, and a small amount of roof solar heat gain.

The skylight attic is protected by a dry pipe sprinkler system with four branch pipes that route east-west just below the roof structural steel. The sprinkler heads are rated at 155 degrees Fahrenheit.

2.2 Existing Conditions

Figure 29: Existing batten seam roof. Corrosion is visible at the perimeter flashing.

ROOF

Architectural

Per the 1975 specifications, the current roof is a terne-coated stainless steel sheet metal batten seam roof. The material was provided by Follansbee Steel Corporation who were the main manufacturers of terne-coated stainless steel in the United States (their plant closed in 2012). Terne-coated stainless steel sheet metal is a superior product known for its durability, low maintenance, and high cost. After forty years, it will still behave like new since it does not deteriorate, rust, or become brittle over time.

ARG was able to view the existing roof from one vantage point which is shown in Figure 29 above. From this view, the roof panels appear to be in excellent condition with no rust visible. However, the perimeter copper flashing that was added in the 2003 rehabilitation project is showing some minor spot corrosion. The corrosion appears to be a direct result of water run-off from the main roof as seen by the drip pattern created and is not localized to fasteners.

While this is separate scope from the skylight, it should be noted that the roof tie-off system is not the ideal installation. The bracket mounted flat between the battens creates a water dam at that seam which may lead to potential issues over time, especially at the bolt penetrations. The steel cable should also be lifted off of the roof. The sagging cable rubs the roof battens which will lead to erosion of that surface over time (though not visible currently).

2.2 Existing Conditions

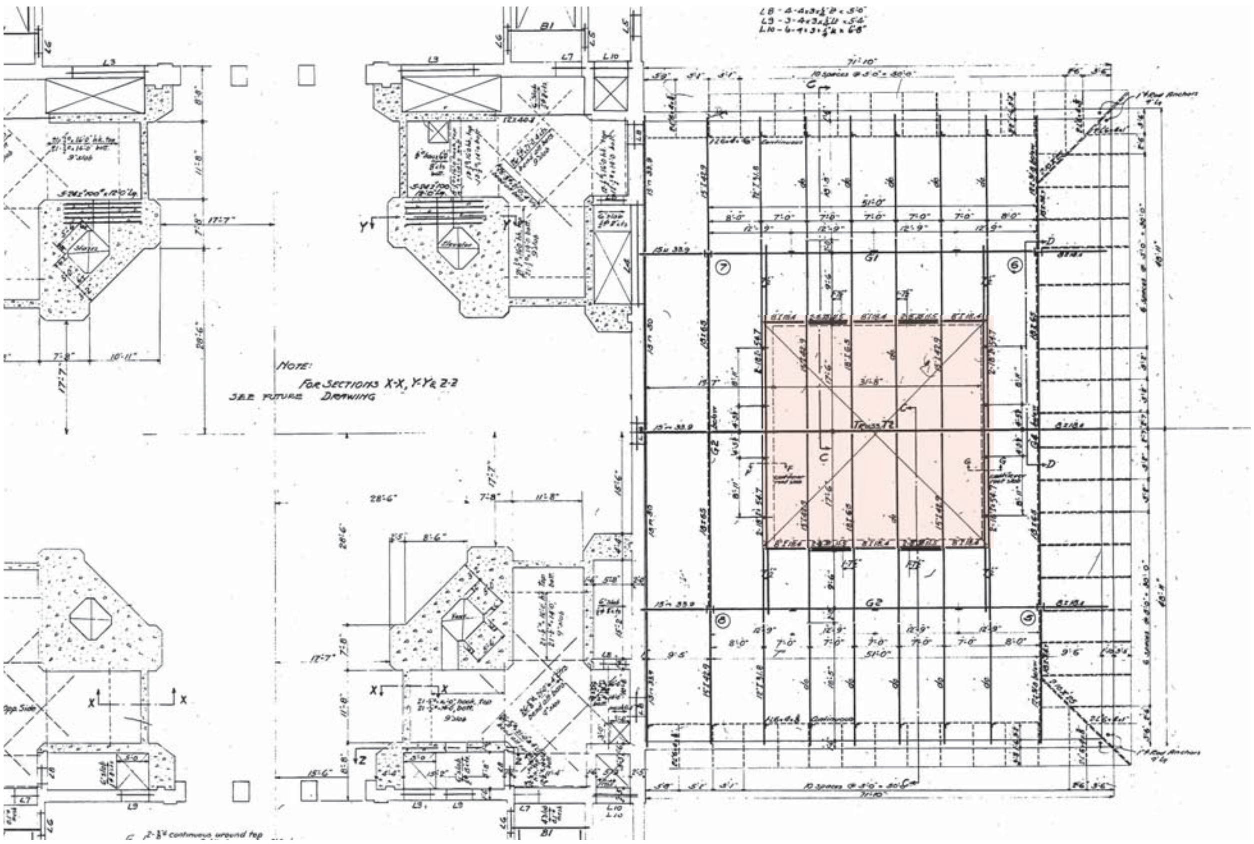
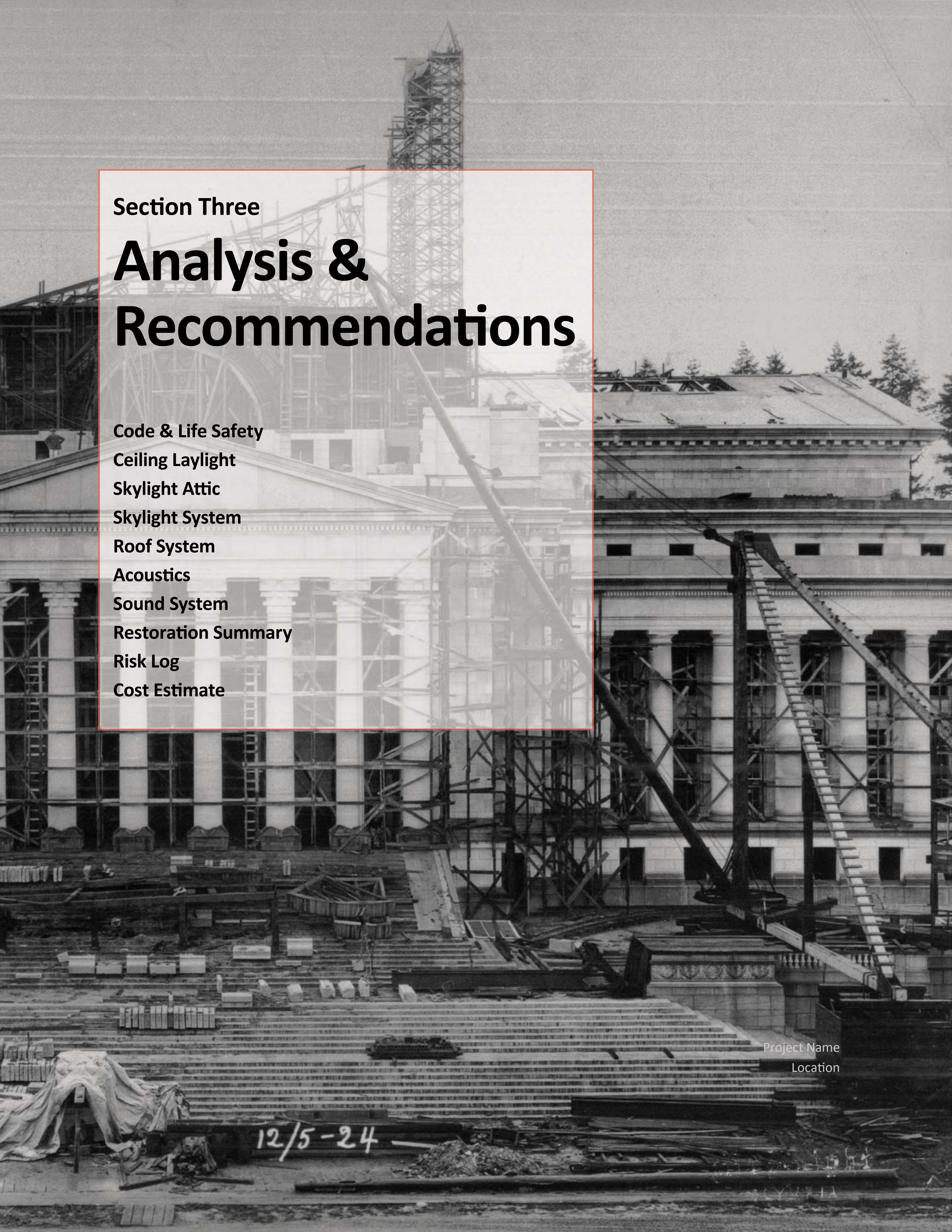


Figure 30: 1923 Construction documents, sixth floor and roof framing plan

Structural

The skylight framing is shown in Figure 30 above. The lightly shaded square represents the original skylight opening. This is a square of approximately 35 foot each side. The 9'-4 ¾" foot deep truss spans 50 feet, bisecting the skylight and forming the ridge of the roof. The truss continues equally beyond each edge of the skylight and is supported by the 5'-6" plate girder on each end. The 18" deep roof beams are spaced at 7 feet, dividing the roof into 5 equal bays over the laylight. The east and west edge beams are doubled 18" steel beams with a concrete haunch that supported the skylight. The width of these haunches reduced the physical skylight opening to 31'-8" in the east-west direction. The width of the skylight opening in the north-south direction remains 35 feet. Back to back steel channel purlins span between the 18" steel beams to terminate the north and south edges of the skylight opening.

The existing structural elements appear to be in good condition, and do not exhibit signs of wear or environmental deterioration (see Figure 25 and 26).



Section Three

Analysis & Recommendations

3.1 Code & Life Safety

GENERAL

The Washington State Building Code was reviewed and analyzed for the restoration of the skylights. The three codes referred to are the 2012 International Existing Building Code (IEBC), the 2012 International Building Code (IBC) and the 2012 Washington State Energy Code (WSEC). All three of the codes have specific sections of compliance as the code relates to historic buildings. It is generally understood that the correct solution for a historic preservation project is not necessarily the same for new construction. Since the project is fairly minimal in scope and does not involve an occupancy change, complying with the current codes will not be difficult.

2012 INTERNATIONAL EXISTING BUILDING CODE AND INTERNATIONAL BUILDING CODE

Architectural

The restoration of the ceiling laylight and the addition of the skylight falls into the *"Level 2 - Alterations"* category of the International Existing Building Code. These alterations include *"the addition or elimination of any door or window, the reconfiguration or extension of any system, or the installation of any additional equipment."* All new elements, such as the actual skylight and any new systems being proposed must still follow the International Building Code as adopted by Washington State, but existing elements of the building are not required to be brought into compliance. This becomes very important as it relates to Energy Conservation.

While it is always ideal to have the most energy efficient building possible, many energy upgrades will result in the loss of historic fabric and are very expensive to implement. An example would be replacing all of the existing single pane glass with insulated glass. Per section 811 *"Energy Conservation"* of the IEBC, "*Level 2 alterations to existing buildings or structures are permitted without requiring the entire building or structure to comply with the energy requirements of the International Energy Conservation Code. The alterations shall conform to the energy requirements of the International Energy Conservation Code as they relate to new construction only."* Therefore the new skylight framing and glazing must comply with the current building and energy codes, but the code does not trigger a major upgrade for the entire building.

The code elaborates further on historic buildings in Chapter 12, stating that "*Repairs to any portion of an historic building or structure shall be permitted with original or like materials and original methods of construction, subject to the provisions of this chapter."* Chapter 12 in the IEBC also discusses the replacement of historic features which is directly pertinent to the restoration of the skylights and ceiling laylights at the House and Senate Chamber roofs. Per IEBC section 1202.4, the *"replacement of existing or missing features using original materials shall be permitted. Partial replacement for repairs that match the original configuration, height, and size shall be permitted. Replacement of glazing in hazardous locations shall comply with the safety glazing requirements of Chapter 24 of the International Building Code."* Both the skylight and the ceiling laylight glass are in "hazardous locations" since they are above walking surfaces. Therefore, both locations will require safety glass. Hold down clips will aslo be required for the glass to prevent dislodging during a seismic event.

It should also be noted that per *Chapter 8 - Interior Finishes* of the IBC, any new ceiling materials in the Chambers must be Class C or better. Class C materials have a flame spread index of 76-200 and smoke developed index of 0-450.

2012 IBC and IEBC SUMMARY

- Classified as a "Level 2 Alteration".
- Only the alteration has to be code compliant.
- Original and/or like materials and original methods of construction may be utilized for historic buildings.
- Replacement of glazing in hazardous areas to be safety glass which encompassses the skylight glazing and ceiling laylight glazing.
- Ceiling interior finishes to be Class C or better.

3.1 Code & Life Safety

Structural

The intent of the skylight restoration is to recreate the original appearance of the skylight. There will be no new openings through the roof diaphragm as the tongue and groove decking does not currently complete a diaphragm. Rather, the tongue and groove roofing forms an isolated covered lid within the remaining diaphragm of the Legislative roof. Therefore, considering the removed mass of the current framing and roofing to be nearly equivalent to the replacement skylight, and maintaining the original diaphragm opening, there are no code requirements for seismic strengthening. The new skylight will need to be properly connected to the existing framing and gravity capacities will need to be confirmed and verified during design.

Electrical

The new downlights will be connected to normal (non-emergency) power. Existing chandeliers, which are connected to the generator, provide the emergency egress lighting in the Chambers currently.

Mechanical

There are no life safety issues related to the mechanical systems.

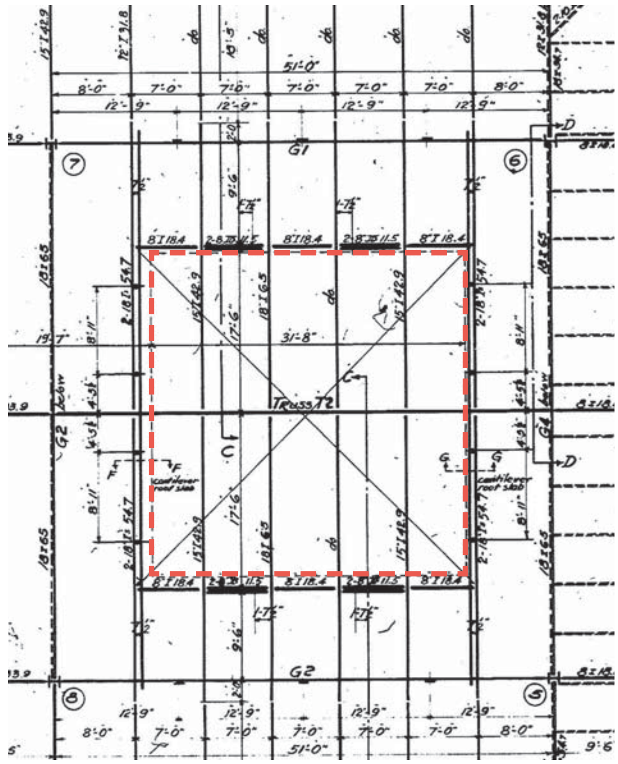


Figure 31: 1923 Construction documents, existing skylight opening

2012 IBC and IEBC SUMMARY

- Since the existing opening in the roof will be utilized, and the mass of the system will be similar to the mass of the existing wood decking, no additional seismic upgrades will be required.
- Existing chandeliers currently provide the emergency egress lighting in the Chambers.
- New electrical and mechanical will meet current Building Code requirements.

CITY OF OLYMPIA DESIGN REQUIREMENTS

- Engineering Design & Development Standards
- Design Wind Speed: 85 mph (IBC Figure 1609)
- Roof Snow Load: 25 psf
- Rain on Snow Surcharge: 5 psf added to low-slope roofs if slope is for carport (roof slope <1/2”) otherwise, rain on snow surcharge: 5 psf added to flat roofs if slope is <1/2” (IBC 1608.1 & ASCE 7-10)
- Seismic Zone: D (IBC 1613)
- Rainfall: 1 inches/hour for roof drainage design

3.1 Code & Life Safety

2012 WASHINGTON STATE ENERGY CODE

Architectural

Since the skylights are new, they will need to meet the requirements of the Washington State Energy Code with a couple of exceptions discussed further below.

The energy code states in Table C402.3 Building Envelope Requirements - Fenestration, the maximum U-Value for new skylights is 0.50 and the maximum Solar Heat Gain Coefficient (SHGC) is 0.35. The U-Value is the rate of heat loss for the skylight. The lower the U-Value, the greater a skylight's resistance to heat flow and the better its insulating properties. The SHGC is the fraction of incident solar radiation admitted through the skylight, both directly transmitted and absorbed and subsequently released inward. The lower the number the less solar heat it transmits which will result in a lower cooling load mechanically.

Section C402.3.1 Maximum Area states that "*the skylight area shall not exceed 3 percent of the gross roof area.*" Per Section C402.3.1.2, "*the skylight area shall be permitted to be a maximum of 5 percent of the roof area provided automatic daylighting controls are installed.*" Currently, the existing skylights are approximately 3% of the gross roof area. When the Chamber skylights are restored, the percentage will be at 5.8% which exceeds what's permitted by code. There are exceptions allowed for historic buildings per C101.4.2 Historic Buildings:

"The building official may modify the specific requirements of this code for historic buildings and require in lieu of alternate requirements which will result in a reasonable degree of energy efficiency."

ARG discussed this item with the code enforcement official at the City of Olympia to confirm whether or not this would be a potential issue. Since the building is historic, it is the restoration of an element that was previously there, utilizes the ceiling laylight to diffuse the daylight in the spaces below, and is only minimally over the 5% allowed, the city official supported the restoration of the two skylights and said the intent of the code would still be able to be met.

If it is determined that the existing roof needs to be replaced, the new roof will need to include insulation above (R-30 continuous insulation) or below (R-49) the roof deck per Table C402.2 though this direction is not recommended.

No other energy upgrades are required architecturally. It is recommended that the future design team meet with the City of Olympia building department early in the design phase to ensure everyone agrees with the code approach moving forward.

Electrical

The project will be replacing more than 60% of the light fixtures in the space which requires that all of the light fixtures be taken into account for the energy code lighting power density calculations. Even though the new downlights will use about 80% less energy than the existing downlights, by adding the existing historic chandeliers (which utilizes high energy-consuming incandescent bulbs) to the calculation will put the space over the allowable power density. However, the same exception in the energy code that may be used for the skylights may also be applied for the lighting calculations since the chandeliers are historic fabric and do not have to meet current energy requirements.

Mechanical

Any equipment that is installed will meet be required to meet WSEC requirements for efficiency and control.

2012 WSEC SUMMARY

- Skylights System Requirements:
  - Maximum U-Value: 0.50
  - Maximum SHGC: 0.35
- While the skylights will exceed the maximum area allowed of 5% of the roof (5.8%), an exception is allowed since it is a historic building and they were there at one time.
- New electrical and mechanical will meet current Energy Code requirements.
- Existing historic chandeliers are exempt.
- Re-roofing will require insulation to be added above or below the roof deck.

3.2 Ceiling Laylight

Figure 32: Current ceiling laylight at House Chambers

ANALYSIS AND RECOMMENDATIONS

Architectural - Laylight Frame

The goal of restoring the skylights is to re-introduce natural daylight to the Senate and House Chambers. Currently, the ceiling laylight is a dark object in the ceiling due to the black insulation boards resting on top of the bronze grille. It is difficult to view the intricate ornamental bronze design that is a significant historic feature of the Chambers. The current large diameter metal halides also appear out-of-place and clunky, especially when the lights are turned on.

Figures 33, 34, and 35, show how the light fixtures changed over time at the ceiling laylight. The early light fixtures added some time between 1923 and 1967 were a smaller diameter with a concave bronze reflector (see Figure 35). This minimized the visual impact of the light in the bronze ceiling laylight while also creating a more elegant design with the soft curve of the bronze reflector. The added lights in 1967 maintained the same proportions, but eliminated the concave reflector. In the 2003 rehabilitation project, the lights were modified again to fill the full diameter of the ring, becoming the main focal point of the ceiling laylight design.

3.2 Ceiling Laylight

CURRENT LIGHTING

Large diameter metal halides
are full diameter of metal ring.

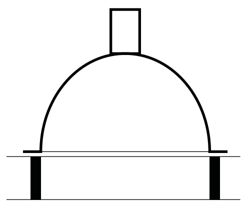


Figure 33: Current lights

1967 LIGHTING ALTERATION

High bay lights added in 1967
show a smaller diameter light
with a flat bronze housing.

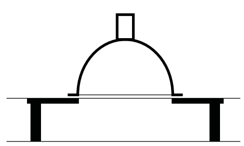
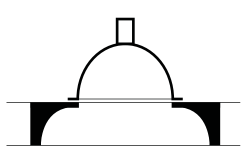


Figure 34: 1967 Lights

INITIAL LIGHTING ALTERATION

Early incandescent lights show a
smaller diameter with a concave
bronze reflector.



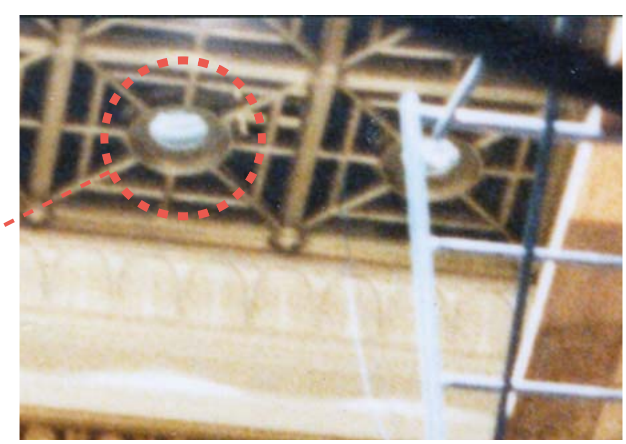


Figure 35: Early Lights added between 1923 and 1967

3.2 Ceiling Laylight

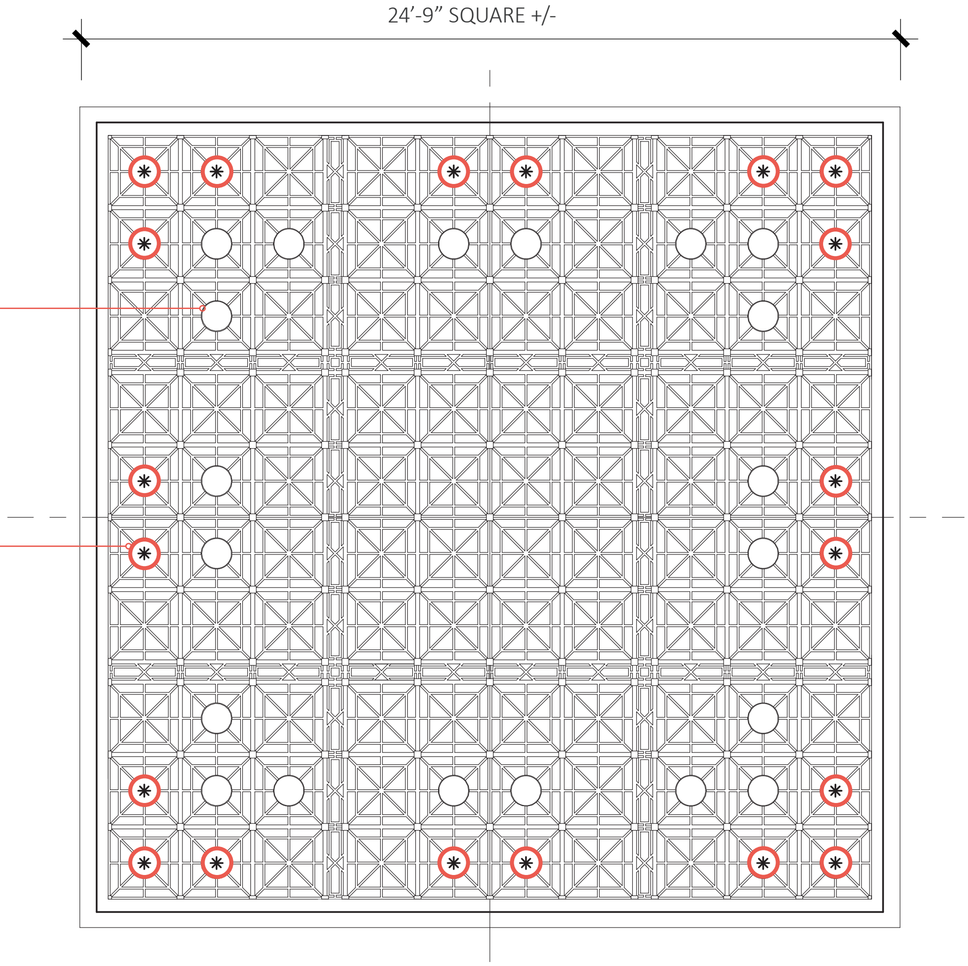


Figure 36: Existing ceiling laylight at House Chamber (Senate Chamber similar)

It would be ideal to restore the ceiling laylight to its original condition which would eliminate all lighting from the metal laylight frame. Unfortunatley, due to the current foot-candle requirements, this is not feasible (see Electrical section). Therefore, the lighting needs to be minimized as much as possible. With today's advances in lighting technology, it would be possible to reduce the lighting quantity to the twenty light fixture locations that were added with the first modficaiton of the ceiling laylight as well as provide a smaller diameter fixture to minimize the appearance and still provide adequate lighting. (See Figure 36 and 37).

The existing metal ring that the current fixtures are mounted on would be removed. For the twenty original light fixture locations, a custom concave bronze reflector would be welded to the existing frame (see Figure 38). For the twenty light fixtures that will be completely removed, new molded bronze barstock would be brazed to the existing frame to complete the original "star" design.

The insulation currently installed above the ceiling laylight would be removed. At this point, it is recommended that a full assessment of the existing bronze ceiling laylight would be performed.

Upon completion of new work, the entire ceiling laylight frame would be cleaned.

3.2 Ceiling Laylight

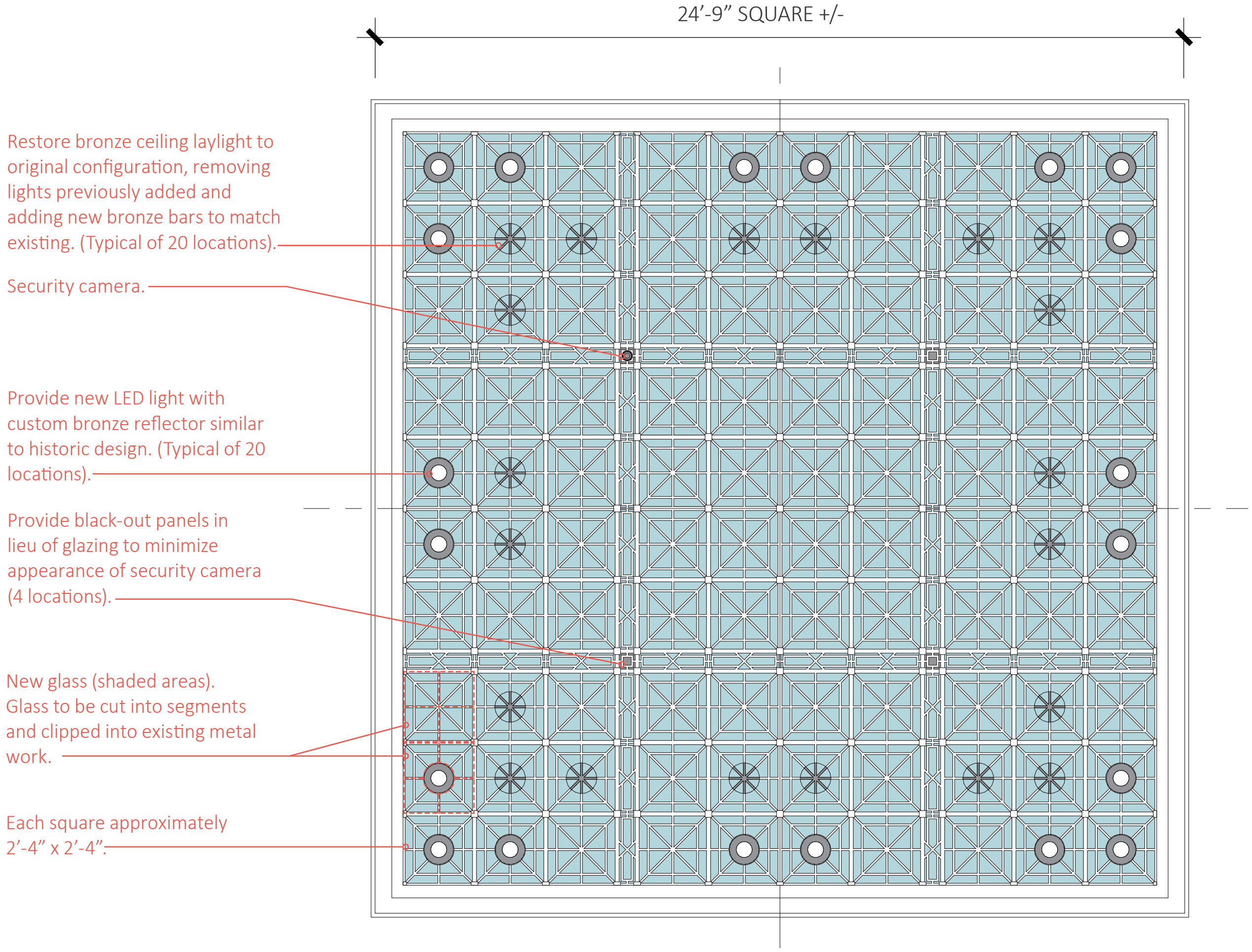


Figure 37: Proposed ceiling laylight restoration for House and Senate Chambers

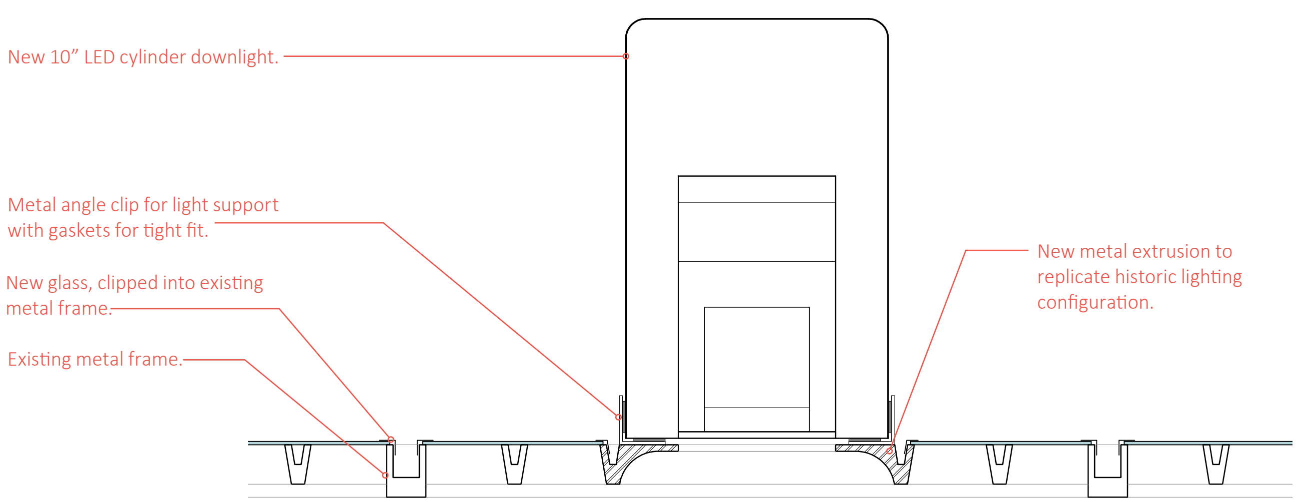


Figure 38: Proposed ceiling laylight restoration for House and Senate Chambers

Figure 38: Ceiling laylight modifcations and restoration

3.2 Ceiling Laylight

Architectural - Laylight Glazing

From the specifications we are able to ascertain that the glass in the House and Senate Chamber ceiling laylights was the same as the glass in the State Reception Room which is an amber-tinted, somewhat transparent, opalescent glass an 1/8" thick as shown in Figure 39. The goal would be to restore the glass with a similar material but it also needs to meet safety glass requirements per the International Building Code. The following glass types were assessed:

- 1/8" Tinted opalescent glass with a safety film applied to the surface (Figure 40).
- 5/16" laminated glass (Figure 40).
- 3/16" fully tempered colored glass (Figure 41).
- 1/4" light-transmitting resin panel (Figure 40).
- 1/4" perforated light-transmitting resin.

OPTION 1 - 1/8" Tinted Opalescent Glass

Glass companies still exist that produce the same style of opalescent glass that was utilized when the Legislative building was built. It is a hand-rolled glass, 1/8" thick, that even comes in the amber tones similar to the State Reception Room. This glass is an art glass though, not a safety glass. To provide additional protection, one approach would be to apply a safety film on the surface of the glass. The clear safety film consists of tear-resistant micro-layers and provides impact resistance to the glass (holding the glass together). It is often utilized in situations where historic glass must now be safety glass. Safety film is not specifically allowed in the Washington State Building Code as a way to meet the safety glass requirements, though. It is possible to submit to the Authority Having Jurisdiction (AHJ), an Alternate Means and Methods to prove compliance. It would then be up to the AHJ to determine if the safety film meets the safety intent. The City of Olympia has stated that they are willing to review this as a viable option.

OPTION 2 - 5/16" Laminated Glass

Laminated glass provides the best protection for overhead glass and may still be historically accurate in appearance by utilizing two sheets of 1/8" thick hand-rolled glass and

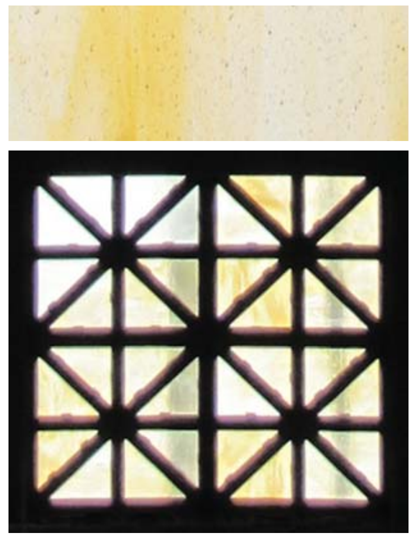


Figure 39: Original glass at State Reception Room

laminating them together with a minimum 30-mil polyvinyl butyral interlayer. The problem with utilizing laminated glass is the extra weight. The current bronze laylight was able to hold 1/8" thick glass. The 5/16" thick glass now more than doubles the weight. This will add additional stress to the historic frame. To even consider laminated glass, a specialist in bronze laylight frames would need to assess the laylight and provide recommendations for providing additional strength and stability to the frame.

OPTION 3 - 3/16" Fully Tempered Glass

Fully tempered glass is another option for safety glass where the glass is processed by thermal or chemical treatments to increase its strength. When broken, the glass shatters into small granular chunks. It is not possible to obtain tempered glass with the opalescent pattern. The best alternative would be to utilize two colors of glass to somewhat imitate the feeling of the historic glass.

There are numerous complications with utilizing tempered glass making it an unlikely option. It must be 3/16" thick minimum (which adds some additional weight to the frame); many glass companies will not supply tempered glass for overhead use (due to liability issues); and the building code requires a screen to be under the glass to catch any granules if the glass breaks, which would not be acceptable aesthetically or from a preservation standpoint.

3.2 Ceiling Laylight

OPTION 4 - 1/4” Light-Transmitting Resin

Light-transmitting resin is a potential glass alternative that combines durability, safety, and aesthetics. It has high impact strength, does not deteriorate over time, and is half the density of glass, making it a lightweight alternative. It is also possible to create a similar effect as tinted opalescent glass by utilizing a high-resolution digital film layered between two layers of resin. UV stabilizers may be added to the resin for color stability though the laminated glass in the actual skylight will provide the most protection, blocking 99.8% of all UV rays prior to hitting the resin panel. The resin panels are also a Class B interior finish per the IBC exceeding the Class C requirement making it a viable option (See Section 3.1 *Code & Life Safety*).

OPTION 5 - Perforated Light-Transmitting Resin

A perforated material would allow the continued acoustical coupling of the skylight attic space and Chamber spaces. The perforated material can be made with the same aesthetics and durability as in Option 4. A perforation pattern with at least 30% open area would be required to maintain acoustical coupling of the spaces. The perforation pattern may be slightly visible looking up from the floor below. Alternatively a micro-perforation pattern can provide inherent acoustical absorption without additional absorptive backing. The micro-perforation pattern would be much less visible or even undetectable from the Chamber floor.

Option 1 and Option 4 are recommended moving forward. Option 3 is not acceptable due to the additional screening requirement. And while Option 2 provides the appropriate aesthetics and safety, the additional weight and subsequent strengthening measures required at the laylight would be a costly undertaking. Option 5 may be viable but should be studied further during the next design phase with mock-ups of the material to better understand the visual impact.

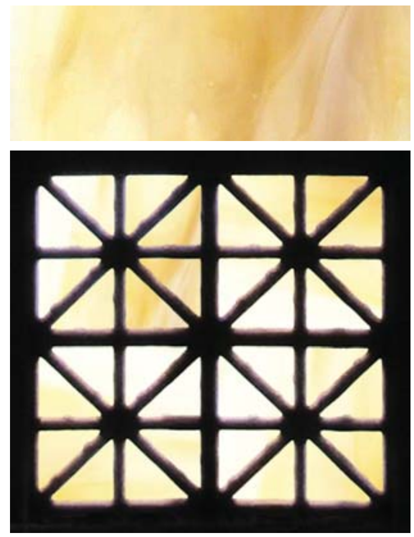


Figure 40: Option 1, Option 2, & Option 4

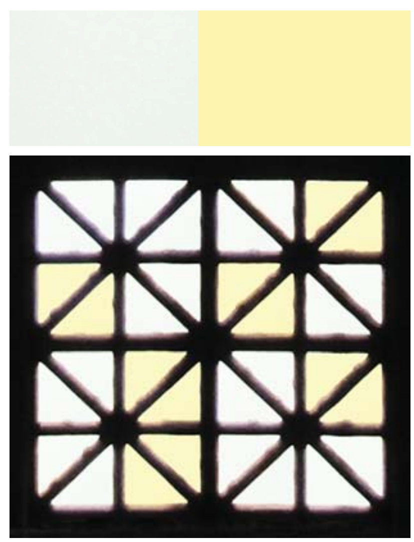


Figure 41: Option 3

Structural

The 2’-4” square glazing panels will need to be connected to the existing laylight framing. Spring clips with allowances for movement to accommodate lateral adjustment while maintaining position retention will be required. At this stage, we anticipate the need for one such clip each side of each glazing panel.

3.2 Ceiling Laylight

Electrical - Lighting

To better understand the requirements for lighting in the Chambers, a basic understanding of lighting terminology is essential:

FOOT-CANDLE

A unit of illuminance or illumination, equivalent to the illumination produced by a source of one candle at a distance of one foot and equal to one lumen incident per square foot. In simpler terms, the amount of light illuminating a surface.

The measured foot-candles in the Chamber spaces is currently averaging about 35 foot-candles at desk level. This is a typical illumination level for work surfaces.

COLOR RENDERING INDEX (CRI)

CRI is a quantitative measure of the ability of a light source (e.g. lamp) to reveal the colors of various objects faithfully in comparison with an ideal or natural light source (e.g. northern light).

Figure 42a best illustrates CRI.

COLOR TEMPERATURE

The temperature at which a black body would emit radiation of the same color as a given object. In simpler terms, it is a method of describing the color characteristics of light, usually either warm (yellowish) or cool (bluish), measured in degrees of Kelvin (°K).

Figure 42b best illustrates color temperature.

LIGHTING RECOMMENDATIONS

- CRI 80-90+ (Good - Excellent range)
- 4,000K color temperature (warmer)
- 35 foot-candles at the work surface

Note: These items are discussed in greater depth in the following pages

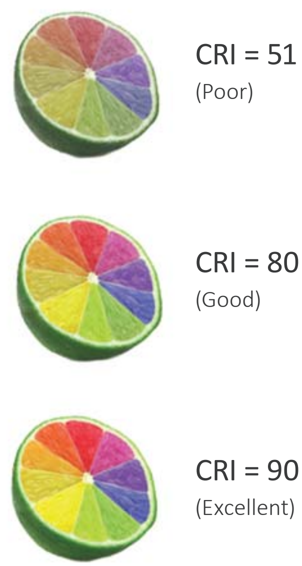


Figure 42a: Color Rendering Index

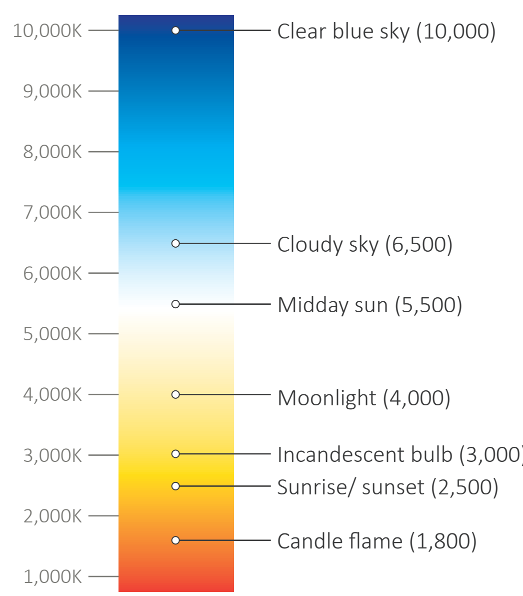


Figure 42b: Color Temperature

3.2 Ceiling Laylight

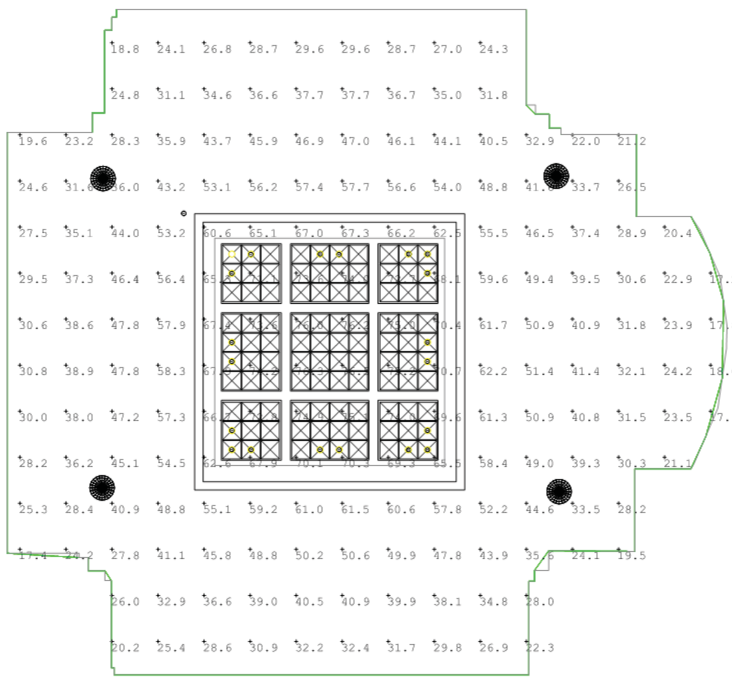


Figure 43: Foot-candle levels of House Chamber with LED down lights and existing chandeliers

Electrical - Lighting

While the restoration of the skylight and the ceiling laylight will bring natural daylight to the Chamber spaces, the daylight alone is not enough to provide the required foot-candles for performing the essential tasks at the work surfaces when the Legislation is in session. This is partially due to the fact that the skylight is so far above the Chamber floors as well as the fact that the light is diffused as it goes through the opalescent translucent laylight glass. There are also additional lighting requirements due to the videography that occurs in the Chambers which makes it impossible to completely eliminate the lighting from the bronze ceiling laylights. The goal of this restoration is to minimize the visual effect of the required lighting as much as possible.

The current metal halide light fixtures were the best lighting option available when they were installed in 2003. However, in recent years LED lighting sources have surpassed the metal halide as being the best lighting source for most applications.

LED sources have a better Color Rendering Index (CRI) than metal halide sources. The CRI for a LED fixture is 80-90+ compared to a metal halide fixture which has ratings of 60-80 resulting in duller color renditions (Figure 42a). LED also other advantages such as longer lamp life (50,000 hrs. for LED vs. 20,000 hrs. for metal halide), quick start time (instant on for LED vs. 2-5 min start time for a cold MH lamp, 10 minutes for a hot MH lamp) and are more energy efficient than the metal halides. Most LED fixtures can be dimmed easily, and the function is built into the LED drivers. Dimming of metal halide lamps is very difficult and expensive. Metal halide lamps also color shift at the end of life of the lamp, LED do not have this problem.

The proposed LED light fixtures will help meet a couple of the project objectives. LED can produce enough light output to reduce the quantity yet produce the same level of light as the current light fixtures, with a smaller fixture size.

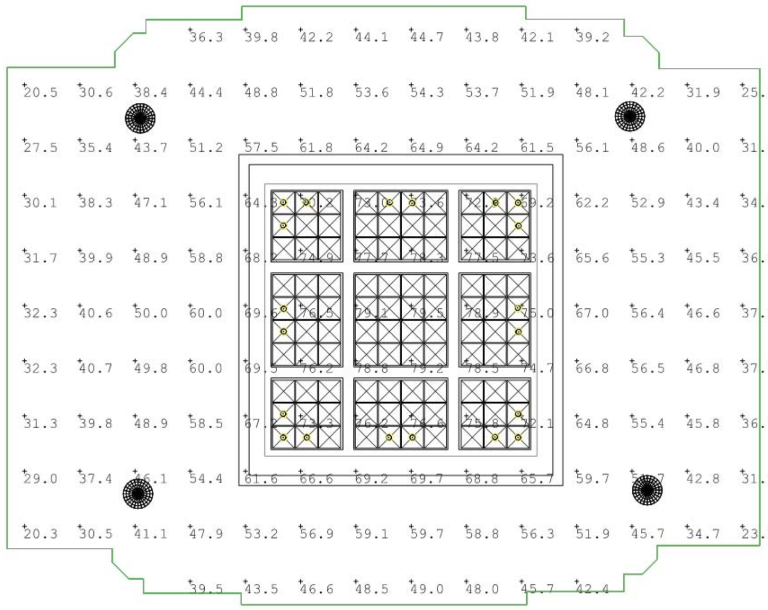


Figure 44: Foot-candle levels of Senate Chamber with LED downlights and existing chandeliers

Electrical - Lighting (Continued)

Foot-candle calculations using the LED cylinder fixture mounted above the ceiling light were performed. The calculated foot candle readings at the desk level slightly exceeds the measured foot-candle readings at the desks (Figures 43 and 44). Calculation were performed with just the downlights and with the downlights and the four chandeliers.

Since no IES files are available for the chandeliers, a close representative fixture type was used. IES stands for Illuminating Engineering Society and is a photometric file that contains data on light used for analysis in architectural and lighting software programs to better understand light levels in a space. The calculations were performed with AGI32 software. The light fixture used for the calculation was the Peachtree Lighting C10HLRF 10" LED Cylinder with a 6" aperture opening producing 8528 lumens with an 80 degree beam spread and a color temperature of 4000 degrees K.

Refer to Figure 42b for a comparison of different light source temperature ratings. The lower the temperature, the warmer the light source is (more red). The higher the temperature, the cooler the light source is (more blue). Temperature numbers in the middle of the spectrum, 3500K to 5000K, creates a more neutral light source (white), providing better color rendering.

Cylinder type fixtures were used instead of a typical downlight to ease mounting of the fixture in the grid and to reduce the amount of components on the outside of a typical downlight that could create shadow on the glass panes in the ceiling light (see Figure 38).

Additional LED fixtures will be installed above the ceiling laylight to back light the laylight as described on page 44.

3.2 Ceiling Laylight

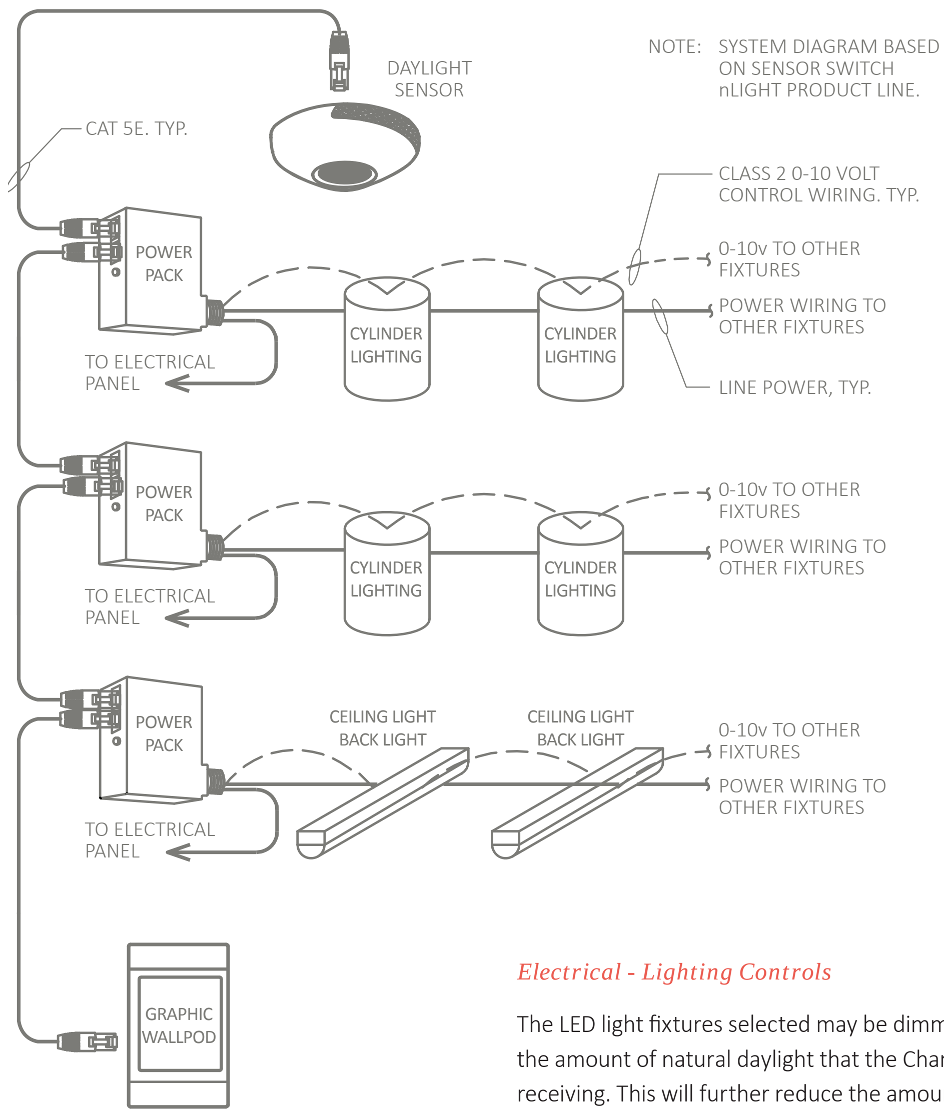


Figure 45: Daylighting controls

Electrical - Lighting Controls

The LED light fixtures selected may be dimmed based on the amount of natural daylight that the Chambers are receiving. This will further reduce the amount of energy that is used to light the chambers.

A daylight sensor can be located in the attic space between the ceiling laylight and the new skylight to control the ceiling laylight fixtures, thus preserving the historic appearance in the Chambers. The existing on/off toggle switch can be replaced with a dimmer switch to be able to manually dim the lights from the Chamber floor. (See Figure 45).

3.2 Ceiling Laylight

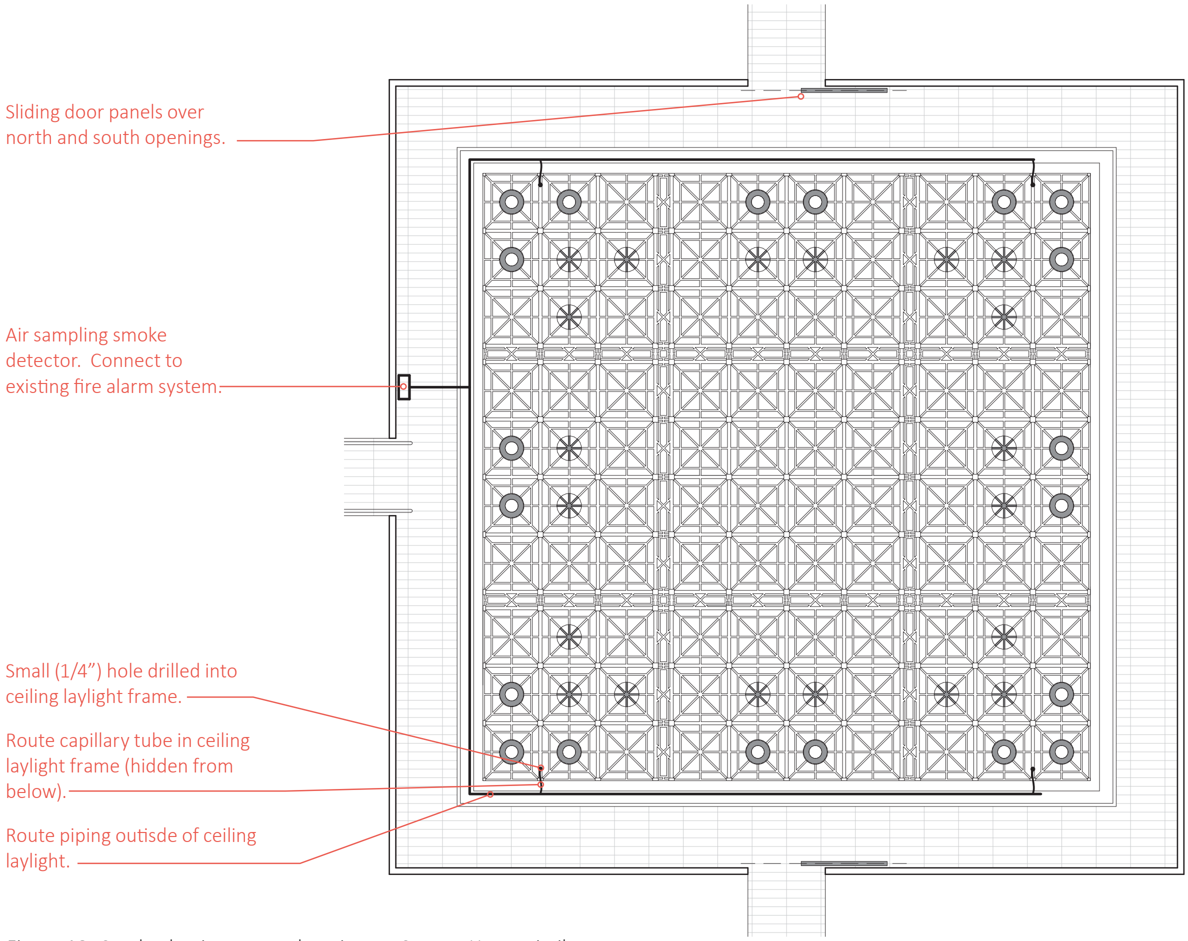


Figure 46: Smoke dection system locations at Senate, House similar

Electrical - Fire Alarm System

With glass panels being installed in the ceiling laylight, the smoke detectors will no longer function as needed and will need to be relocated. Relocating the smoke and heat detectors to the underneath side of the ceiling laylight would detract from the historic appearance of the Chambers and is undesirable.

An air sampling smoke detection system could be used in lieu of the standard smoke detectors. Air sampling ports would be located next to the laylight with minimal visibility or in the grid of the ceiling laylight itself. The associated piping and actual detector would be located in the attic space outside of view (Figure 46). The new detector would be connected to the existing fire alarm system. The fire alarm designer will need to work with the local Fire Marshall to determine the number of air sampling ports required for this application.

Electrical - Audio Speaker

The speaker assembly is located in the center of and approximately a foot above the laylight. The speaker assembly can currently be seen from the Chamber floor. After the new skylight is installed and glass panels are installed in the laylight, the existing speaker assembly will be much more noticeable from the Chambers floor by blocking the light from the skylight and creating shadows on the laylight (see Figure 47).

Options to address this issue are detailed in Section 3.7 Sound System

3.2 Ceiling Laylight

Electrical - Security Camera

The security camera needs to be re-located to be as unobtrusive as possible. The ceiling laylight is still the best location since it does not disturb the adjacent historic plaster ceiling. It is recommended to utilize a smaller "mini dome" security camera as shown in Figure 48 and place it at the laylight grid intersection as shown in Figure 37 in lieu of glass. The remaining three square intersections will have black-out panels in lieu of glass to keep the design symmetrical and not attract attention to the camera. This approach requires no modifications to the laylight frame which is preferred.

Electrical - Energy Savings

The baseline for energy savings is based on having 39 250W Metal halide light fixtures used during the Senate and House sessions. Each of the existing metal halide fixtures uses 310 watts per nameplate data on the ballast. The total kwh for each chamber is 12.09 kilowatts per hour (kwh). The yearly of the two Chambers vary from year to year, but average use would be 850 hours a year. For a total use of 10,276.5 kwh per year.

The first energy saving measure is to change the metal halide light fixtures to LED fixtures. Using the same LED fixture that was used for the foot-candle calculations, each fixtures uses 112 watts. The total energy use for each chamber would be 2.24 kilowatts per hour. Using the same number of hours as the baseline, the total energy use would be 1,904 kwh for a year. A savings of nearly 80% can be achieved by switching to the high output LED light fixtures. Based on $.0567/kwh and $ 9.38 per kW demand charge the saving would be approximately $1,583 per Chamber per year.

The second energy saving measure would be to dim the LED fixtures based on the amount of daylight being delivered into the Chamber. When the LED fixtures are on, the lights could be operating anywhere from 100% to 10% output. The savings from the daylight dimming would be approximately 380 kWh per chamber.

Figure 47: Loud speaker seen from skylight attic space

Figure 48: Mini-dome security camera

Based on $.0567 a kwh and $9.38 per kW demand charge there would be an additional saving of approximately $260 per Chamber per year.

3.3 Skylight Attic

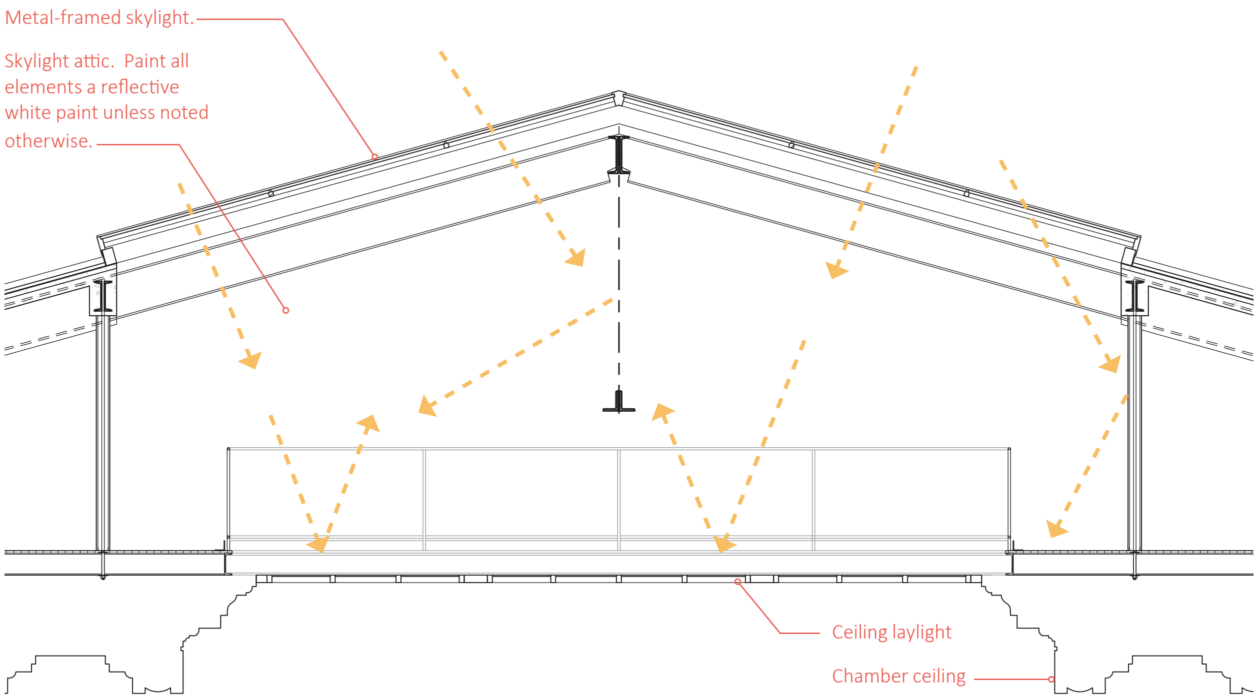


Figure 49: Skylight attic - Light bouncing diagram

ANALYSIS AND RECOMMENDATIONS

Architectural

The current skylight attic has many utilities and existing structural steel running through the space that have the potential for casting shadows on the laylight below. The goal of restoring the skylights is to provide as much unobstructed daylight through the ceiling laylight as possible. One way to accomplish this, is to create a "light box" at the skylight attic. By painting all of the surfaces a reflective white paint, (including walls, steel members, and utilities) when light enters the space through the skylight, it will bounce off of the surfaces to fully illuminate the skylight attic, minimizing shadows (Figures 49, 50, and 51). It is also recommended that any existing openings into the space have a new door installed to fully enclose the light box.

Electrical

The existing panelboards and conduits should also be painted with the same reflective paint as the walls to help bounce the light around the chamber. The dimmer panel located in the attic space should not be painted since it may have negative effects on the dimmer functionality.

Additional LED fixtures will be installed above the ceiling laylight in the skylight attic space. These fixtures will back light the laylight to simulate daylight during evening hours as well as provide supplemental illumination when there is not enough daylight due to overcast conditions. The light fixtures will be mounted to the existing historic channels located directly over the ceiling laylight.

3.3 Skylight Attic

Figure 50: Steel and utilites in Skylight Attic

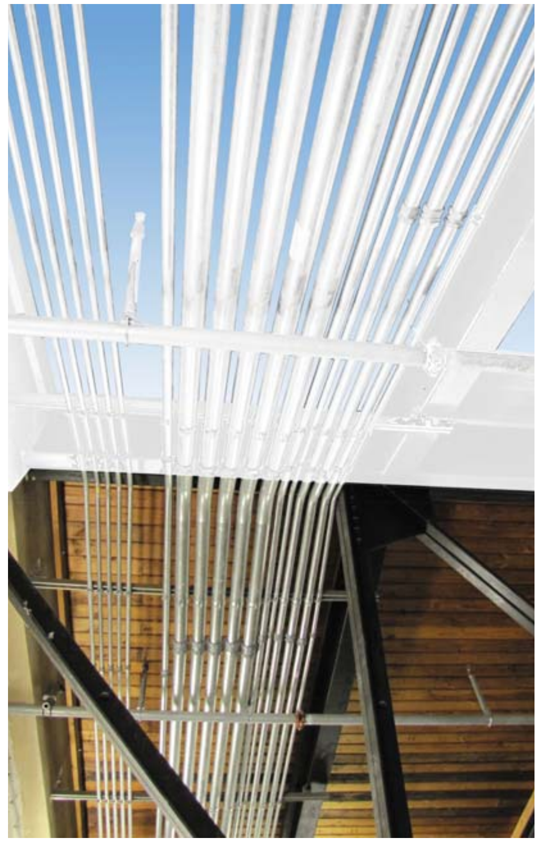


Figure 51: White paint at utilites and steel

Mechanical

The existing ceiling laylight has openings that will be filled in as part of this project. This will not affect the mechanical for the Chambers below as the Chambers have a seperate supply and return air feed from areas above.

Replacing five panels of roof decking with glazed skylight panels will substantially increase the heat gain to the skylight attic even though the proposed glazed skylight panels are high performance, having a U-Value of 0.26 and a Sensible Heat Gain Coefficient (SHGC) of 0.28. Preliminary calculations show that the solar heat gain will raise the air temperature in the skylight attic to levels much higher than existing conditions to a level above where electronics can function. This could lead to failure of lighting controls, as well as being too hot for personnel to perform periodic maintenance tasks. Electronics can function up to approximately 104 degrees Fahrenheit, however the environment must be kept cooler for short term personnel access. Though not comfortable, an air temperature of 90 to 95 degrees Fahrenheit should allow for acceptable short term personnel exposure at peak cooling conditions. This will typically occur during the summer months when the sun shines directly on the skylights and at times mid-season when there are warmer days with full sun.

3.3 Skylight Attic

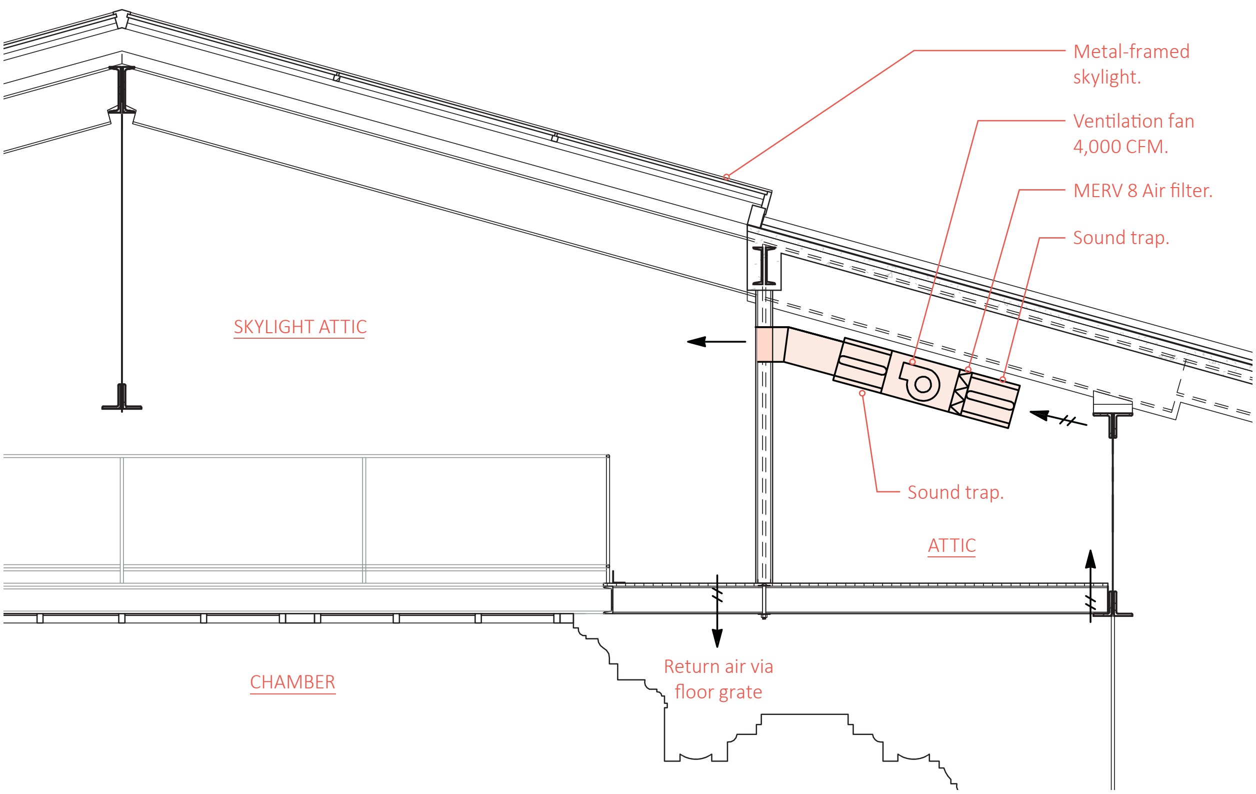


Figure 52: Vent fan diagram

Mechanical - Option 1: Vent Fan Option

The problem of increased heat gain in the skylight attic causing the existing electronics to fail must be addressed. The electrical panels could be relocated outside the skylight attic, but would require approximately 30 lineal feet of wall for mounting and 48" of depth to allow for code required clearances. This would require a large section of catwalk to be added with the inherent high construction costs. The simpler solution is for the skylight attic to be mechanically cooled during times of high solar heat gain. Preliminary calculations show that a fan blowing filtered air from the attic space into the skylight attic can maintain 95 degrees Fahrenheit or lower when moving 4,000 CFM. This is based on an assumed attic space air temperature of 80 degrees Fahrenheit. The fan would only operate when temperatures in the attic become elevated.

The fan will require a sound trap at intake and discharge to keep noise levels within the skylight attic down to NC35, so that noise breakout via the ceiling laylight does not create problems within the House or Senate Chambers. Air filters with an efficiency of MERV 8 will be provided in front loading filter frames at the inlet sound trap. The fan would be thermostatically controlled from a temperature sensor within the skylight attic, and would be linked to the Building Automation System (BAS), so that temperatures can be logged, and high temperature alarms provided.

The fan can also be programmed to blow warm air into the skylight attic to offset heat loss during times of cold outdoor air.

3.3 Skylight Attic

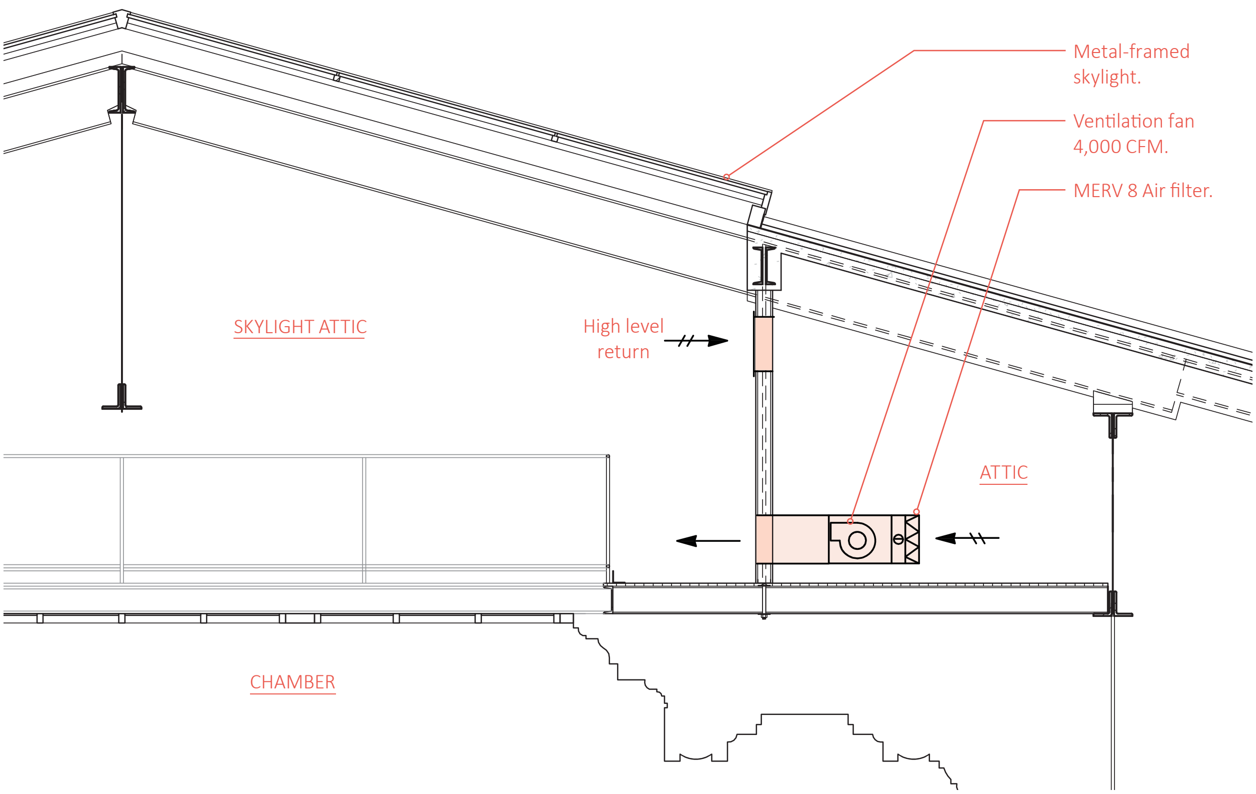


Figure 53: Fan coil unit diagram

Mechanical - Option 2: Fan Coil Unit

If it is deemed that a peak skylight attic temperature of 95 degrees F is unacceptable, in lieu of a cooling fan, a fan coil unit would be provided at each skylight attic. The fan coil units would be located in the attic space, and would draw air from high level in the skylight attic, and recirculate it to low level in the skylight attic. Air would be filtered at the fan coil unit intake, and careful equipment selection might allow for equipment that does not require sound traps to be provided.

Chilled water for the fan coil unit serving the Senate skylight attic would be drawn from the 4” diameter process chilled water piping close to air cooled chiller ACCH-1. Chilled water for the fan coil unit serving the House skylight attic would be drawn from the 2” diameter chilled water piping at fourth floor level in the NE shaft, routed via the shaft to the attic space, and fan coil unit. Additional design is required to verify that the process chilled water, and chilled water loops have sufficient capacity to serve the skylight attic cooling loads. The fan coil units would only operate when temperatures in the attic skylight become elevated.

The fan coil units would be thermostatically controlled from a temperature sensor within the skylight attic, and would be linked to the Building Automation System (BAS), so that temperatures can be logged, and high temperature alarms provided.

3.4 Skylight System

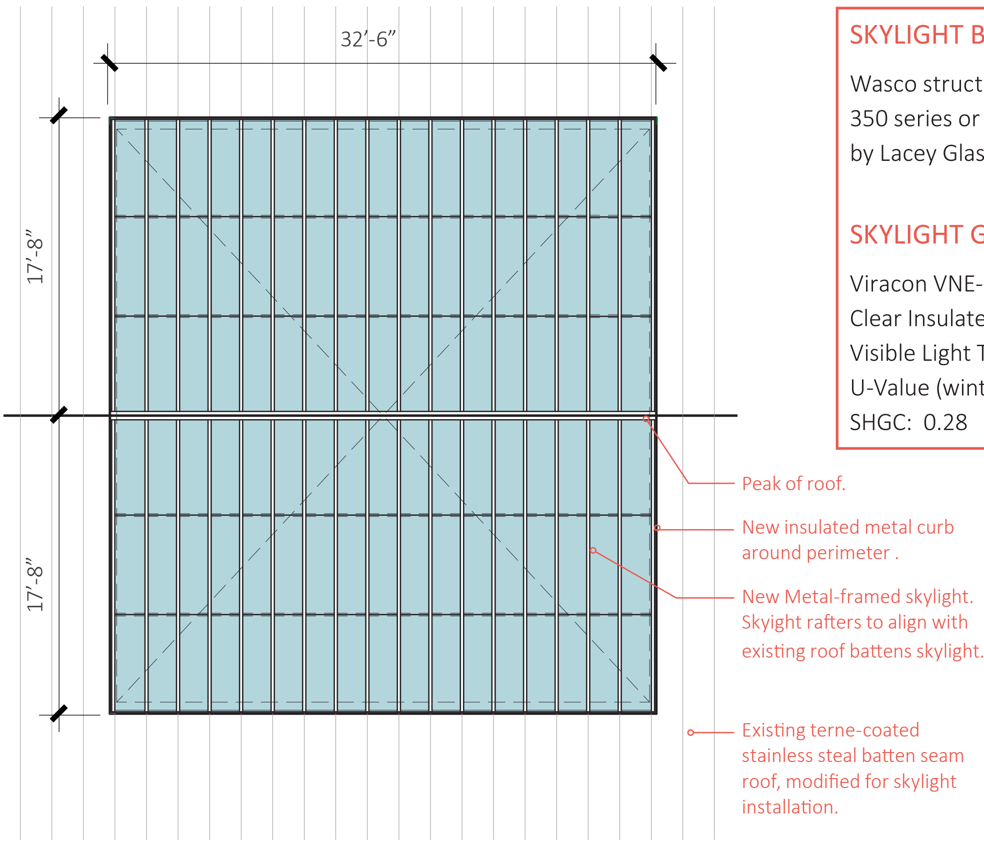


Figure 54: Roof plan: Proposed skylight

SKYLIGHT BASIS OF DESIGN (BOD)

Wasco structural metal-framed skylight 350 series or historic skylight replication by Lacey Glass

SKYLIGHT GLASS (BOD)

Viracon VNE-63
Clear Insulated Laminated Glass
Visible Light Transmittance: 60%
U-Value (winter): 0.29
SHGC: 0.28

ANALYSIS AND RECOMMENDATIONS

Architectural - Metal-framed skylight

From the original roof plan and old photographs, it appears that the historic intent was to have the skylight integrated into the roof as much as possible. The skylights barely extended above the adjacent roof surface and the skylight rafters aligned with the metal roof batten seams. The roof plan of the skylight above illustrates the recommended size and layout of the restored skylights above each of the Chambers taking this into account. The rafters of the skylight align with the existing batten seams at approximately 22 1/2" on center with purlins provided at the 1/3 points to reduce glass spans (see Figure 54 AND 57).

The metal-framed skylight should be shop-fabricated from extruded aluminum members to reduce the weight of the structure and to provide improved quality control. The rafter height should be as small as possible while meeting the required design loads to keep the skylight profile low. Condensation channels and sills with weep holes must be integrated in the system for leak protection. A thermally-enhanced or broken system is ideal for improved thermal performance. Finish should be selected with the longest warranty available with minimal maintenance, color to match roof.

An insulated metal curb should be provided around the perimeter for new flashing to wrap up. The curb height should be the minimal necessary for proper water-tight flashing.

3.4 Skylight System

Figure 55: Glass coatings as it relates to color and energy perfromance.

ANALYSIS AND RECOMMENDATIONS

Architectural - Glazing

The glass selected for the skylight needs to find an appropriate balance between light transmittance, solar heat gain (SHGC), U-value, and aesthetics.

The higher the percentage of light transmittance the more daylight that will enter the space. It is especially important to allow for more light transmittance since the daylight must enter through the skylight and then another 12 feet or so through the ceiling laylight which will then diffuse the light as it enters the Chamber spaces below.

Per the Washington State Energy Code, the maximum solar heat gain coefficient is 0.35 and the maximum U-Value is 0.50. It is recommended to select a glass that performs better than the minimum requirements since it will impact the mechanical system cooling requirements. The skylight basis-of-design utilizes Viracon VNE-63 insulated laminated which has a U-value of 0.29 and SHGC value of 0.28 as noted in Figure 54.

That being said, the glass should either be clear or tinted gray to blend into the dark gray of the roof system. Many energy efficient coatings will result in a dark-greenish tint which should be minimized as much as possible to complement the existing historic fabric (see Figure 55).

Laminated glass will need to be utilized per the building code since safety glazing is required. The laminated glass will also block 99.9% of all UV-rays through the skylight, protecting the interior finishes of the Chambers.

3.4 Skylight System

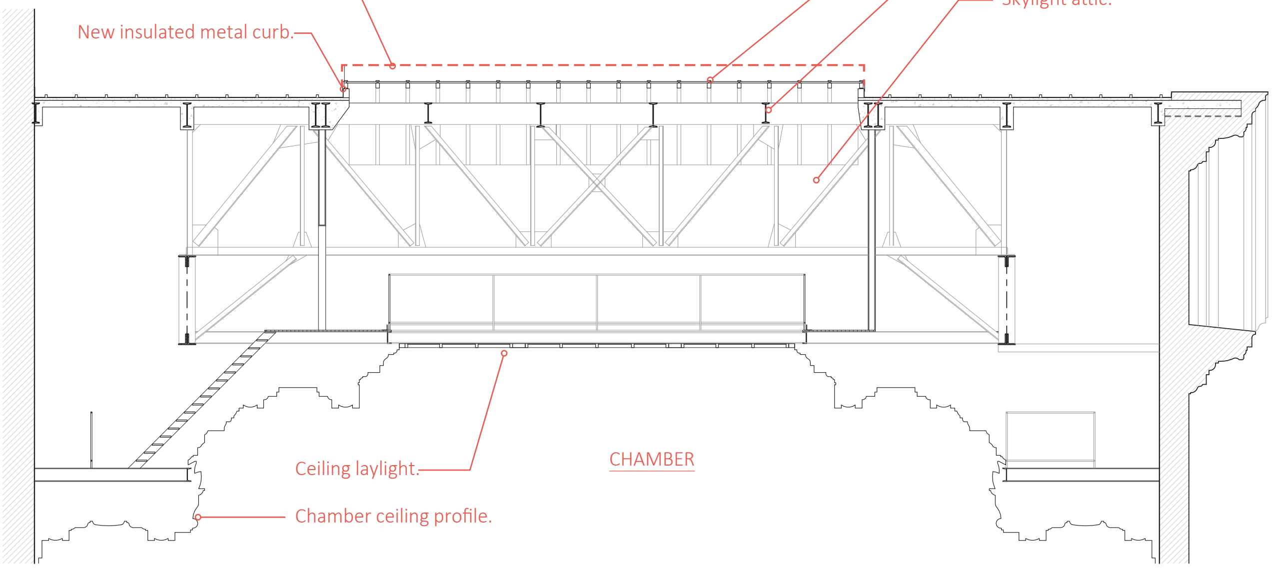


Figure 56: Proposed skylight east/west section

Structural

The direction of the restoration is to replicate the original skylight. To that end, we do not anticipate major structural modifications to the geometry, size or weight of the existing structural members.

New steel purlins may be added to the existing roof framing to support the skylight at third points. With a tighter spacing of the structural supports, a lighter weight, lower profile and less expensive model of skylight could be used. This new steel framing would be connected to the existing steel framing. Before this direction is decided upon, we recommend a testing and inspection agency review the weldability of the existing steel framing. If the existing steel is not suitable for welding, then it is possible that bolted connections could be used.

3.4 Skylight System

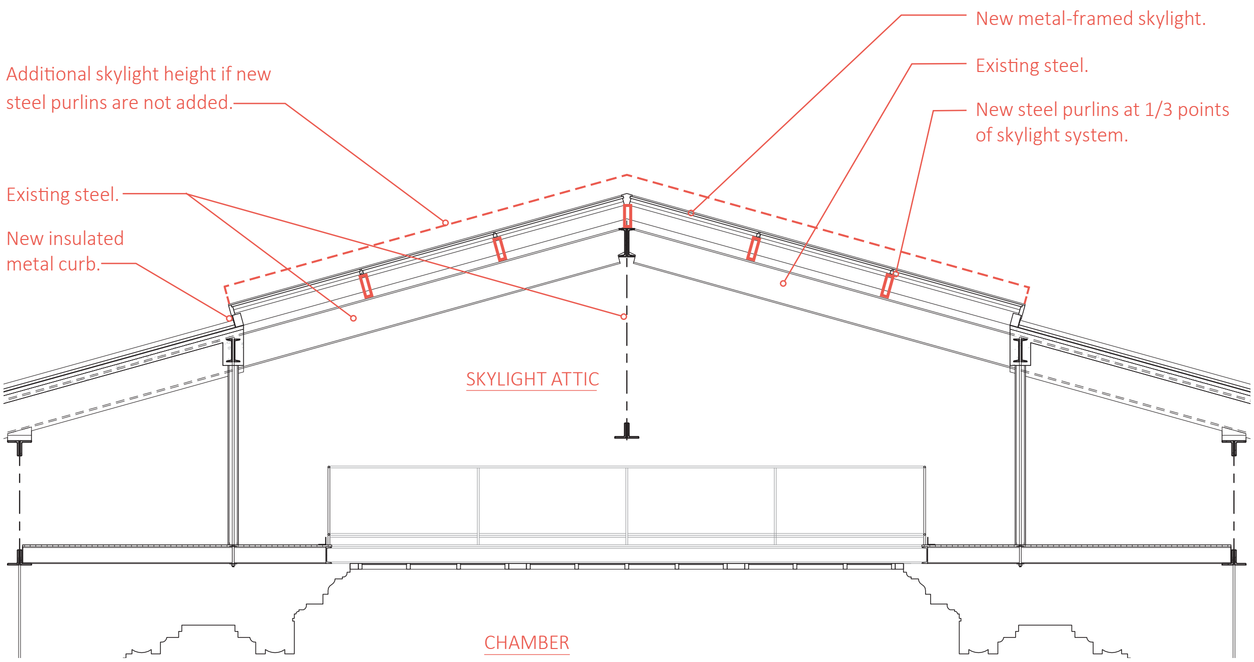


Figure 57: Proposed skylight north/south section

Structural - Seismic Impact

The existing structural elements appeared to be in good condition, and do not exhibit signs of wear or environmental deterioration. Should the replacement skylight framing closely match the existing weight of the current decking and roofing, the seismic reactive mass remains unchanged.

We understand the restoration will not alter the existing structure. Should the existing structure be altered, an engineering evaluation and analysis that establishes the structural adequacy of the altered structure should be prepared by a registered design professional and submitted to the code official.

Based on our current assumptions and understanding of the skylight replacement, it appears the seismic impacts are minimal.

Structural - Gravity load impact

A goal of the restoration design should be to match or reduce the existing weight of the current decking and roofing. The existing structural framing may need strengthening should the skylight weight exceed the capacity of the trusses. The skylight designer will engineer mullions to span to the existing steel trusses. We anticipate the need for a new light gage metal framed perimeter curb around the skylight. The addition of new elements (lights, speakers, security cameras, etc.) will need to be evaluated for their weight, size and location.

3.5 Roof System

Figure 58: Existing roof at House and Senate Chambers

ANALYSIS AND RECOMMENDATIONS

Architectural

The existing terne-coated stainless steel roof is in excellent condition with no reported leaks. It is made from a highly durable "lifetime" material that requires minimal to no maintenance. It is also a solderable material with similar metals. Considering the high quality and condition of the material (which would be very expensive to replace with an equivalent system), it is recommended to modify the existing roof system for the new skylights.

Since terne-coated stainless steel is solderable, it is possible to cut a new opening in the existing roof, peel back the sheets as necessary, install the new skylight curbs, install a new waterproof membrane lapping over the existing roof membrane and over the new skylight curb, and then solder new terne-coated stainless steel flashing from the skylight to the existing roof system. It is recommended that only an installer that has worked on terne-coated stainless steel roofs for a minimum of five years be utilized. The proper soldered joint will create the most ideal watertight condition.

The corrosion at the perimeter flashing is most likely cosmetic in nature, created by water runoff from the main roof which is creating an uneven weathering of the flashing or from leaching of the main roof underlayment to the flashing.   With the passage of time, the weathering should even out to a uniform coloration though the flashing should be continually assessed to make sure no significant

3.5 Roof System

Figure 59: Detail or roof tie-off system and staining of perimeter copper flashing

corrosion or thinning of the material is occurring. Since there is minimal to no visibility of the flashing from the ground, it is not recommended to replace at this time.

The roof tie-off system should be replaced with a more appropriate modern system that has mounting brackets that allow for the free-passage of water and a cable line that does not rest on the surface of the roof. The current roof tie-off system is creating a water damn between the battens which may lead to eventual penetration of water at the weak points (the bolt connections). The steel cable resting on the metal roof will continue to abrade the surface, eventually leading to a thinning of the material. This work should be completed whether or not the skylight project moves forward.

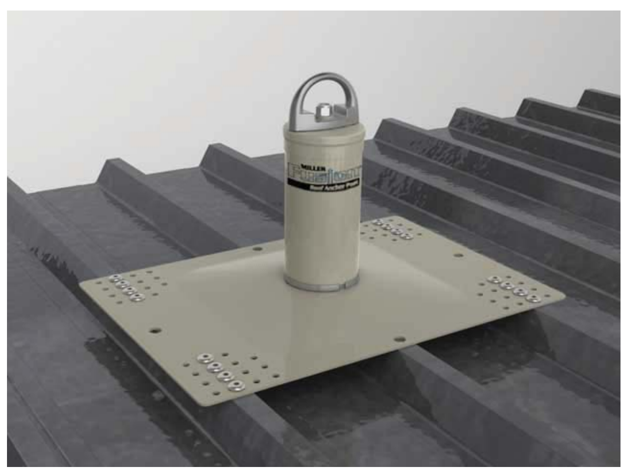


Figure 60: Raised roof tie-off connection (recommended)

3.6 Acoustics

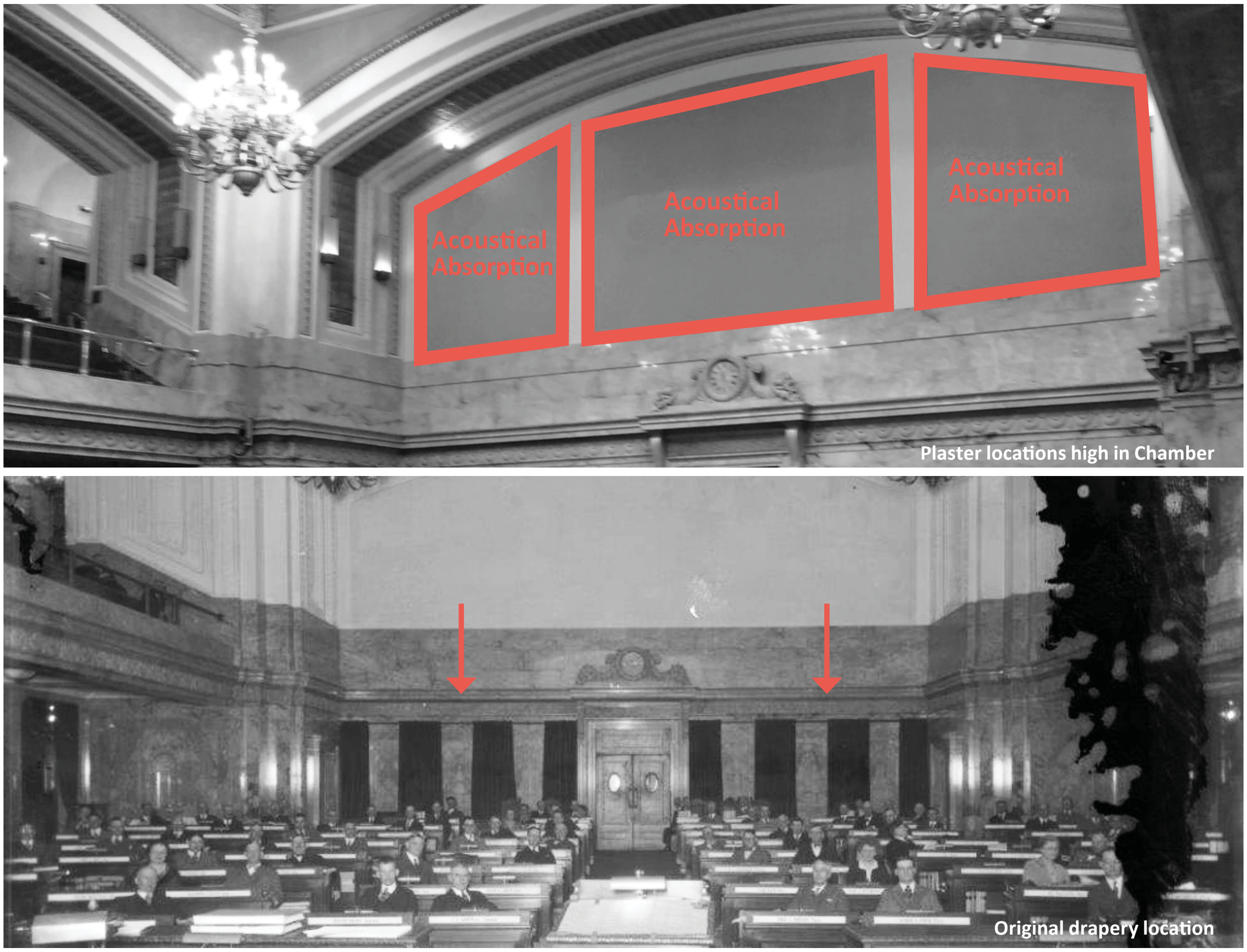


Figure 61: Areas to add acoustical absorption at back of Chamber

GOALS

Maintain current level of reverberation or less to support the current level of speech intelligibility within the House and Senate Chambers.

ANALYSIS

The current acoustical character of each Chamber is slightly more reverberant than ideal, yet still supports an acceptable degree of speech intelligibility for the sound system. Removing the 2" thick insulation boards and replacing with un-perforated translucent glass or resin would reduce the amount of acoustically absorptive material in the space as well as acoustically decoupling the Attic and Chambers. This would increase the reverberation time and reduce speech intelligibility. The increase in reverberation time in both the House and Senate Chambers is projected to be 0.3 seconds, bringing the House reverberation time to 1.7 seconds and the Senate to 1.9 seconds. This increase would likely be noticeable to most users of the spaces.

OPTION 1 - Add Absorptive Material in the Chambers

In order to compensate for increased reverberation time, additional absorption would be needed in the Chamber spaces. The amount of material required would be likely be at least 2,000 sq. ft. and would need to be highly absorptive. An obvious start would be to restore the draperies that once hung from the front and back of the Chambers as shown in Figures 61 and 62. The draperies were part of the orginal acoustic design of the space. The draperies will probably not be sufficient on their own, so careful selection of additional absorptive material would be needed to maintain the historic aesthetic of the Chambers.

3.6 Acoustics

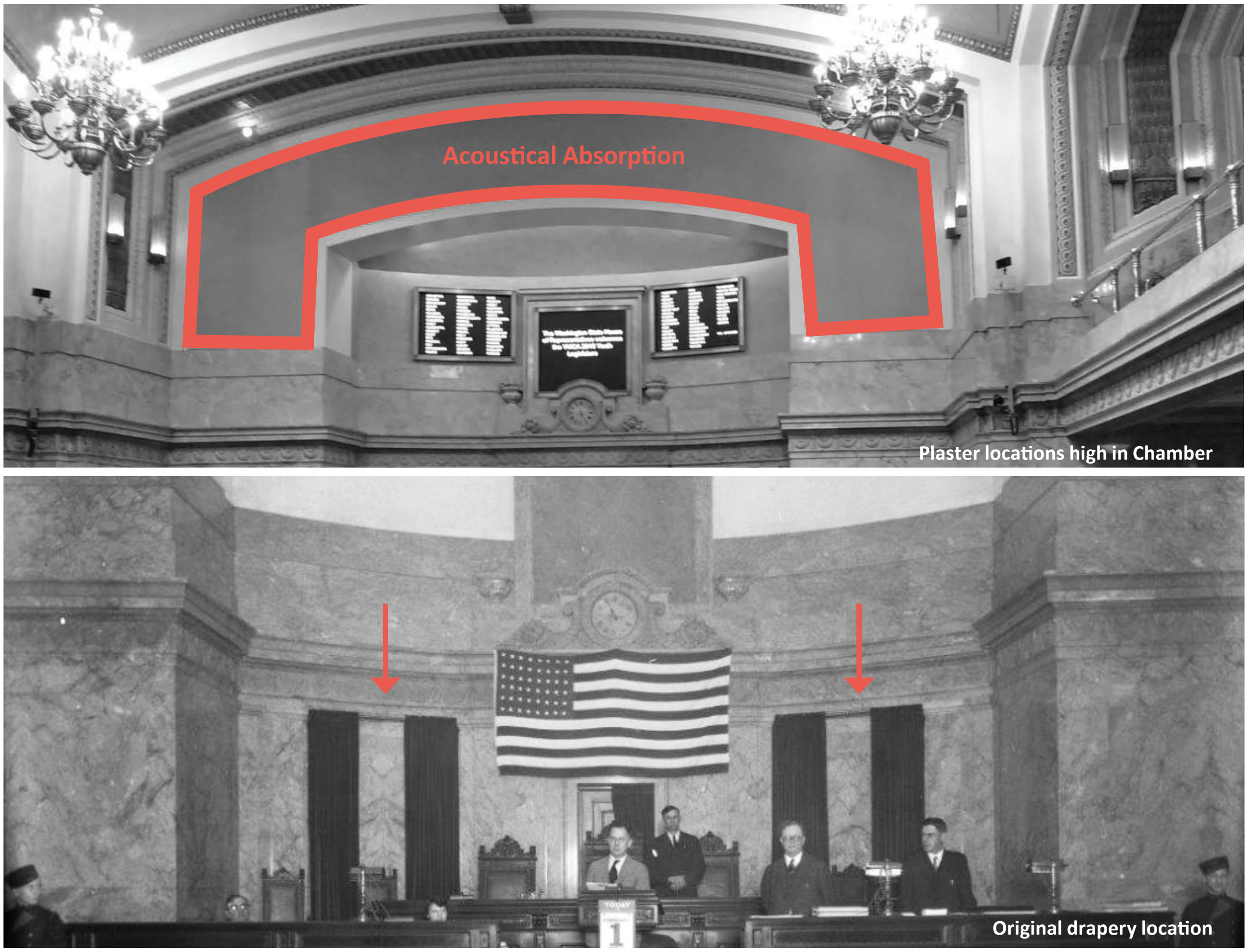


Figure 62: Areas to add acoustical absorption at front of Chamber

A product such as acoustical plaster or stretched fabric material can maintain the current appearance. Areas where material could likely be applied are shown in figures 61 and 62 along with the original drapery locations.

OPTION 2 - Perforated Laylight

If the glazing material in the laylight were perforated, acoustical coupling between the Attic and Chambers could remain intact. This would allow sound to enter the Attic and be absorbed before being reflected back into the Chambers. Some additional absorption may also need to be added to the Attic. This material could be white and reflective to light in order to meet natural lighting needs. In order to maintain coupling, the perforation pattern would need to be at least 30% open. The perforations may be visible from below.

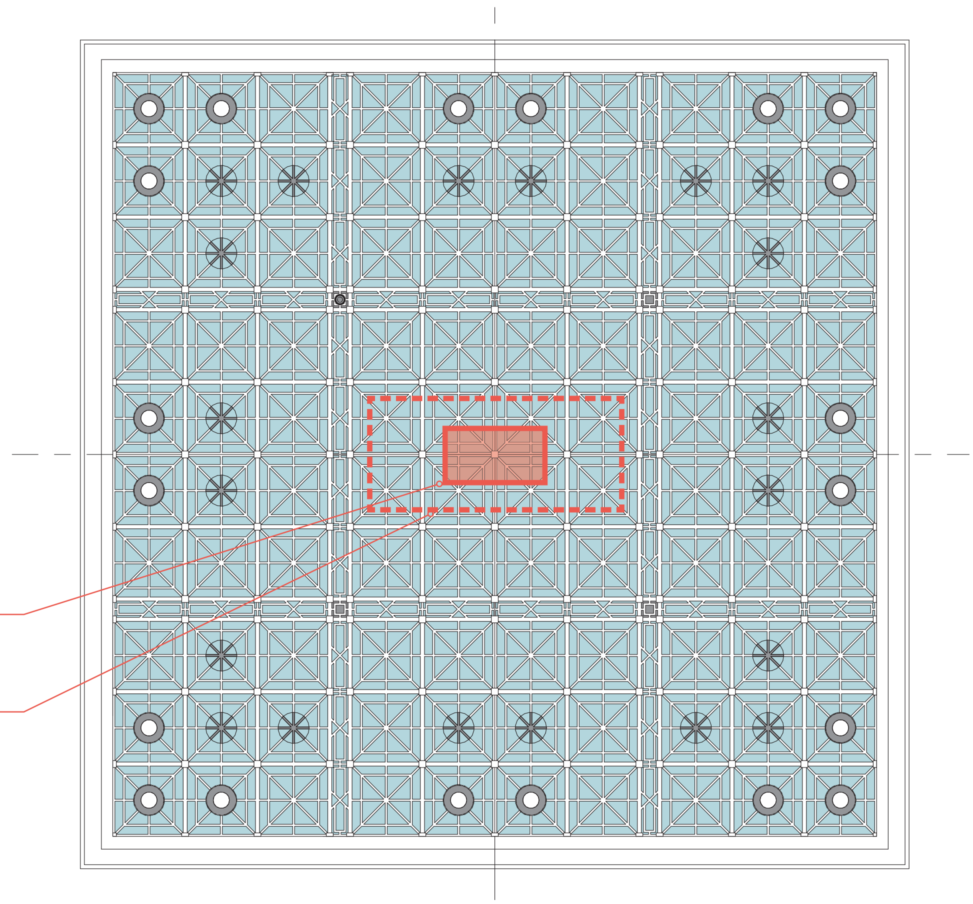
Alternatively, a micro-perforation pattern has inherent acoustical absorption without the need for additional absorption in the Attic. The coupling between the Attic and Chambers would be less with a micro-perforation, so some additional absorption could be needed in the Chambers. The micro-perforations would likely be visually undetectable from the Chamber floor.

RECOMMENDATIONS

Either option is acoustically viable. Options 1 and 2 may also be implemented in tandem, or to a limited extent, allowing a small increase in reverberation but still maintaining an acceptable degree of speech intelligibility. Further analysis during design would be needed to determine the extent and location of acoustical materials.

3.7 Sound System

Figure 64: Example of speaker assembly (rough dimensions 36"H x 24" W)



Footprint of proposed speaker cluster. See Figure 64.

Existing footprint of speaker cluster.

Figure 63: Existing speaker cluster compared to new speaker cluster

GOALS

Replace existing main speaker to accommodate new skylights for Senate and House Chambers. Other ancillary speakers are to remain. Pending user meeting, there is no known need to update existing head-end equipment or microphones. Design modeling and calculations would be necessary to determine if these options are viable solutions.

ANALYSIS - SPEAKER OPTIONS

OPTION A - Maintain speaker's current location, but minimize overall footprint

This option would replace the existing speaker system with one that is smaller in size thereby reducing the impact to the skylight feature. The existing speaker system is comprised of two older 1960s vintage horns along with a large boxed speaker assembly. Upon preliminary research, Greenbusch believes this can be redesigned and simplified reducing the overall footprint by 50%. The speaker system could remain in its current location and just above the skylight's lattice structure. It can be hidden from view using acoustically transparent fabric or perforated metal, but a dark area of roughly 36" x 24" (refer to figure 63 and 64) will occur directly center of the skylight feature.

From a cost perspective, this remains the most affordable as the infrastructure and cabling pathways already exist.

3.7 Sound System

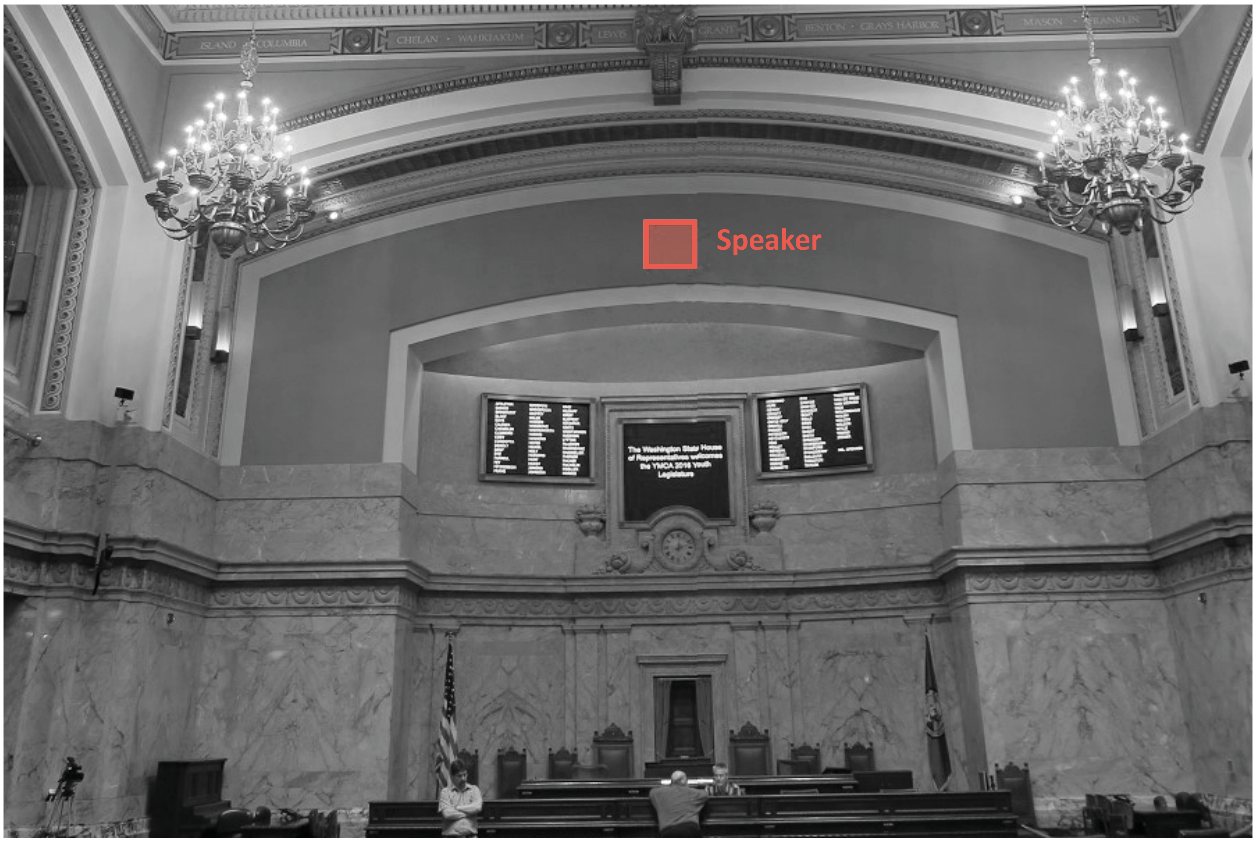


Figure 65: Alternate speaker location

OPTION B - Place new speaker system outside of skylgiht

This option proposes removing the speaker system from the skylight entirely. One possible location would be on the wall as shown in figure 65. The speaker system could be painted to help blend in, but it would be plainly visible.

Cost would be slightly higher than Option A to accommodate new cabling pathways. The wall structure will need to be assessed to determine the best way to support the speaker. It is anticipated that the speaker system would not exceed 250lbs in weight.

OPTION C - Provide local speaker at each member's desk

This option proposes eliminating the overhead speaker system by adding a single 4" loudspeaker at each desk. The architectural space and skylight would be free of any obstructions associated with the sound system. This solution would be the most costly due to the amount of additional equipment and cabling.

Speaker cabling requires a dedicated pathway per code requirements. Powered speakers (speakers with built-in amplifiers) can accommodate signal cabling that can be shared pathways. Recommendations should be provided during preliminary design. Coordination with architect will be necessary to verify that such pathways are viable.

RECOMMENDATIONS

Option A and B should be explored further as potential solutions. Design modeling and calculations as well as light studies would be necessary during the design phase to determine what option is more viable.

3.8 Restoration Summary

CEILING LAYLIGHT		
Architectural Scope	*Quantities/ Percentage*	*Report Reference*
Remove bronze metal ring housings at existing light fixture locations.	40 12" dia. Rings	Fig 33, 37
Repair and restore bronze ceiling grille at 20 locations to return to original "star" pattern design. Metal stock to match materiality and profile of existing grille. Braze to match existing joints.	4 LF of metal "V" extrusions, approximately 2" deep at 20 locations. Note: Original specs state material is bronze.	Fig 37
Repair and restore bronze ceiling grille at 20 locations to return to original light fixture design. Metal stock to match materiality of existing grille with new concave reflector extrusion. Full welds to match existing (assume finish level #2 per the National Ornamental & Miscellaneous Metals Association (NOMMA).	12" diameter extruded concave reflectors at 20 locations. Note: Original specs state material is bronze.	Fig 37, 38
Provide angle clips and rubber gaskets at new cylinder downlights for attachment to ceiling laylight.	Four 2"x2" metal angles with rubber gaskets at 20 locations	Fig. 38
LAYLIGHT GLASS OPTION 1 - 1/8" TINTED OPALESCENT Install 1/8" tinted opalescent art glass above ceiling laylight. Glass to be cut into quarter segments and clipped into existing metal work at each grille square. Apply safety film to glass surface. (BOD: Kokomo glass, amber tinted 11 with 3M Impact Attachment System film).	Assume 612 square feet of glass 320 clips at 80 rectangular glass segments 1600 clips at the 400 square glass segments	Fig. 37, 40
LAYLIGHT GLASS OPTION 4 - 1/4" LIGHT-TRANSMITTING RESIN Install 1/4" ecoresin panel above ceiling laylight. Panels to be made of two 1/8" panels with high-res image interlayer, cut into full square segments and clipped into existing metal work at each grille square. (BOD: 3-Form ecoresin with custom image).	Assume 612 square feet of glass 160 clips at 40 rectangular glass segments 336 clips at the 84 square glass segments	Fig. 37, 40
Clean all metal and glass surfaces of ceiling laylight.	Area of ceiling laylight is 612 sf	Fig. 33
Electrical Scope	*Quantities/ Percentage*	*Report Reference*
Remove existing metal halide fixtures.	39 locations	
Install New LED downlights/cylinders and branch circuits to existing lighting control panel in attic space.	20 locations	Fig 38
Provide new daylighting controls.	One located in attic space. System Senor FAAST 8100 series	Fig 45
Remove existing security camera to install new security camera.	BOD HD Mini Dome Network Camera DCS-6004L by D-Link installed on laylight frame	Fig 37 & 48
Provide new speaker system for Chambers.	One location, paint speaker	

Note: Quantities are for one Chamber. Double for final quantities.

3.8 Restoration Summary

SKYLIGHT ATTIC		
Architectural Scope	*Quantities/ Percentage*	*Report Reference*
Paint all walls with a 90% reflective white paint.	1540 sf	Fig 49, 50, 51
Paint all exposed utilities and steel at roof level and piperail at catwalk with a 90% reflective white paint along with catwalk pipe rail. Protect ceiling laylight and catwalk during painting.	Room area is 1156 sf.... Not sure best way to quantify this.	Fig. 40. 41, & 42
Provide painted sliding panel at existing openings into skylight attic.	Two 7'-0" x 3'4" sliding panels with top track	Fig 42
Electrical Scope	*Quantities/ Percentage*	*Report Reference*
Install new LED ceiling light fixtures for illumination of ceiling laylight.	20 locations, similar to HE William LLMS series 4' fixture with 2600 lumen output & 5000K CCT	
Install smoke detection system.	Four 1/4" diameter holes in laylight frame, new panel to be provided in attic space	Fig 46
Mechanical Scope	*Quantities/ Percentage*	*Report Reference*
OPTION 1 - VENTILATION AIR FAN		
Provide ventilation air fan at each of two skylight attics.	Two in-line fan 4,000 CFM at approximately 1" ESP	Fig. 52
Provide sound traps.	Estimate four sound traps, each 72" long x 34" x 34"	Fig. 52
Provide short section sheet metal.	Approximately 300 sf sheet metal ductwork. Two side wall grilles 34" x 34"	Fig. 52
Provide temperature control linked to DDC control system.	Two DDC temperature sensor linked to fans and central control system. Enables fans on temperature rise. Alarms central control system on high temperature.	Fig. 52
OPTION 2 - FAN COIL UNIT		
Provide chilled water fan coil unit.	Two chilled water fan coil units, each with approximately 49 MBH sensible cooling capacity.	Fig. 53
Provide chilled water piping.	Approximately 1,000 linear feet of copper chilled water piping, 1-1/4" diameter. Complete with fiberglass piping insulation. Allow for eight ball valves, two strainers, and 30 elbows. Provide two 2-way control valves with DDC actuators (estimated size 1")	Fig. 53
Provide short section sheet metal.	Approximately 300 sf sheet metal ductwork. Four side wall grilles, each 34" x 34"	Fig. 53
Provide temperature control linked to DDC control system.	Two DDC temperature sensor linked to fan coil units and central control system. Enables fan coil units and opens chilled water control valves on temperature rise. Alarms central control system on high temperature.	Fig. 53

Note: Quantities are for one Chamber. Double for final quantities.

3.8 Restoration Summary

SKYLIGHT SYSTEM		
Architectural Scope	*Quantities/ Percentage*	*Report Reference*
Install custom structural metal-framed skylight. BOD: Wasco 350 Structural Ridge series with Viracon insulated laminated glass VNE1-63.	32'-6" x 35'-5" +/-	Fig 54
Structural Scope	*Quantities/ Percentage*	*Report Reference*
Remove T&G infill decking for skylight installation. Repair any damage to the perimeter boundary.	1,151 sf decking; 136 LF +/- for perimeter (recommend carrying a $/LF for boundary repair - best estimate is $10,000 per skylight)	
The lower profile model skylight requires additional structural steel framing for its support. New steel members will be required along the ridge (within the area of the skylight) and at the third-points down each sloped side.	We assume these new members to be rectangular HSS members, with supplemental angles to attach to the existing steel framing. All members (for both skylights) will be approximately 35ft to 36ft long and 12" deep. The angles will be located at discrete points along each member, at each side. The existing structural steel from 1923 should be tested to verify its weld-ability. If it is not weldable, mechanical fasteners will need to be used to connect the new steel elements to the existing steel framing.	Fig 54, 57
ROOF SYSTEM		
Architectural Scope	*Quantities/ Percentage*	*Report Reference*
Cut opening in existing terne-coated stainless steel batten seam roof to accommodate skylight.	32'-6" x 35'-5" +/-	Fig. 54, 56, 57
Provide new 6-8" insulated light gage metal curb around perimeter of skylight attached to existing concrete deck.	136 LF +/-	Fig. 54, 56, 57
Install water resistant barrier, lapping existing membrane and wrapping over metal curb.	136 LF +/-	Fig. 54, 56, 57
Solder new terne-coated stainless steel flashing to existing roof system and wrap up insulated metal curb (6" lap on roof, 4" lap up curb).	136 LF +/-	Fig. 54, 56, 57
Provide additional 6" of SS flashing at sill of curb, lapping over roof flashing.	136 LF +/-	Fig. 54, 56, 57
Replace existing tie-off system with new system.	(2) 66'-0" lines	Fig. 58

Note: Quantities are for one Chamber. Double for final quantities.

3.8 Restoration Summary - Risk Log

RISK LOG			
#	*Risk*	*Discussion*	*Level*
01	Water penetration due to addition of skylights to existing roof.	Any time you add a hole to the roof, there is the potential for leaking. To minimize the risk, it is essential to have clear detailing and to hire well-qualified contractors that have experience in the existing roof system and skylights. The risk will increase based on the level expertise of the installers.	Low - Medium
02	Ceiling laylight glass Option 1 - Tinted opalescent with safety film is not accepted by the AHJ as an Alternative Means and Methods to the building code.	If the AHJ does not accept utilizing the safety film, the project can proceed with installing resin panels as detailed in Option 4, or look into utilizing laminated glass and have the bronze ceiling laylight structurally strengthened to handle the additional weight (see Item 05).	Medium
03	During a seismic event, stone from the dome way fall and crash through the skylight to the Chambers below.	The utilization of laminated glass and safety glass at the skylight and ceiling laylight as well as the steel frame will help reduce the danger, but definitely not necessarily stop large pieces of stone or the dome from falling completely through.	Unknown - too many factors
04	Depending on final weight of the new skylight, additional strengthening could be required.	Material tests would be needed to determine the weld-ability of the existing steel. It is unlikely that the new strengthening would shade/obscure the lighting.	Low
05	Laminated glass (at 5/16” thick) is required at the ceiling laylight in lieu of historically accurate 1/8” glass or resin panels.	Thicker glass at the laylight will essentially guarantee that the layight would need to be replaced with a steel or aluminum system. The current bronze laylight is unlikely capable of supporting additional loading. Structural analysis of decorative bronze framing elements would require substantial infield testing to determine the material properties and even more substantial field investigation to develop the geometric properties.	Unknown - too many factors
06	Acoustics become unfavorable.	The current chambers seem to work well from an A/V and acoustics standpoint (though additional feedback from stakeholders is required to confirm). Restoring the skylight will necessitate changes to the A/V systems and will result in the loss of insulation. This report only begins to touch on these items to ensure that there is a feasible solution. A full acoustical model should be utilized in the future design phase to make sure the solution taken is appropriate.	Low (with proper design studies taken)
07	The utilities chosen to remain in place and get painted create a shadow.	The current approach in the feasibility report relies on reflective paint to bounce light off of the surfaces of the walls and remaining utilites to reduce the chances of shadows being perceived from the Chamber below. During the design phase, realistic modeling and daylight studies should be utilized to better understand this approach and make adjustments as necessary to minimize shadowing.	Low (with proper design studies)

3.9 Cost Estimate

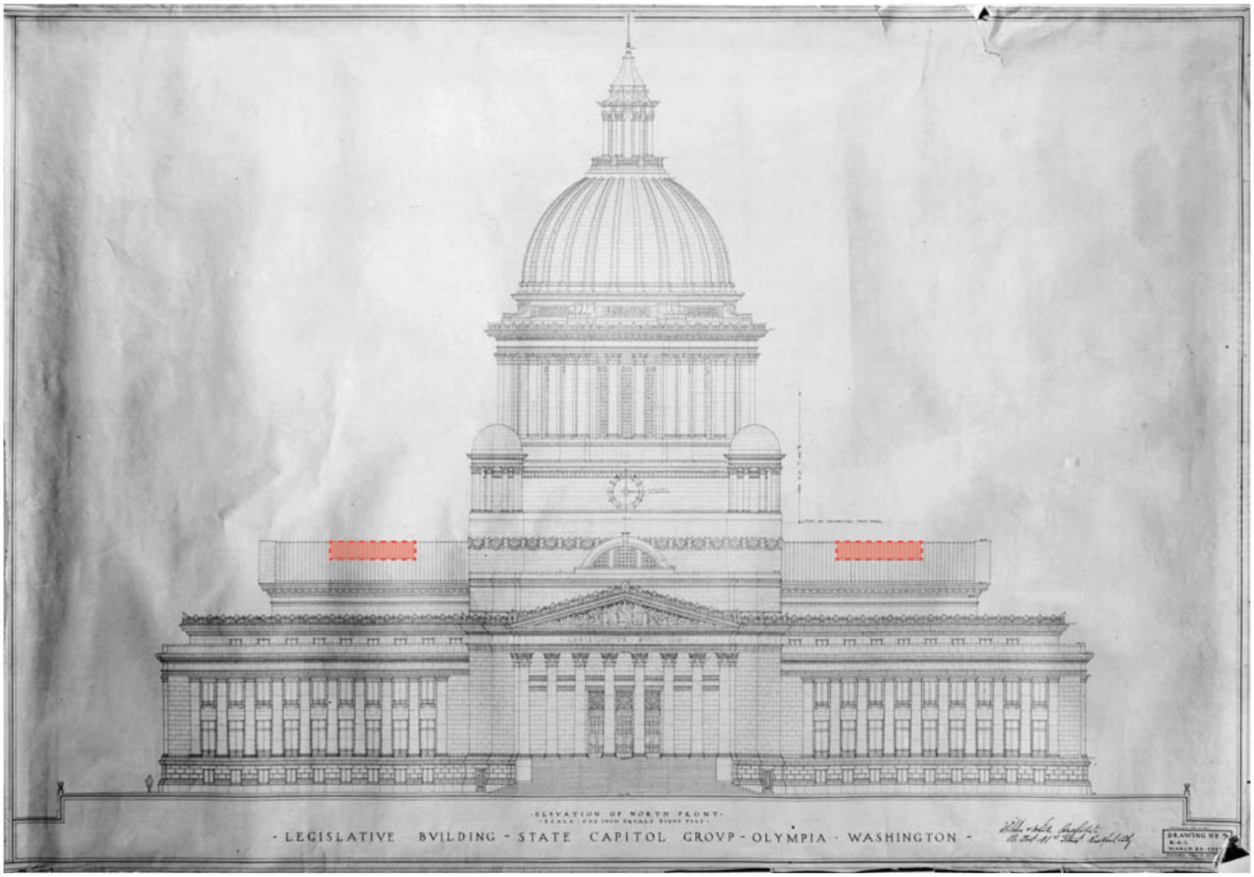


Figure 66: 1923 Construction Documents, elevations with the skylights highlighted. *Courtesy of Washington State Archives.*

COST ESTIMATE SUMMARY

The following page is a summary from the State of Washington Capitol Budget Request C100 Form, which can also be found in Appendix A. This form incorporates the direct construction cost information from the consultant reports found in Appendix A and produces an estimated full project cost including architect and engineer design fees, inspection and testing fees, sales tax, hazardous material testing and removal (if necessary), and other project costs.

3.9 Cost Estimate

State of Washington

AGENCY / INSTITUTION PROJECT COST SUMMARY

Agency	Department of Enterprise Services
Project Name	Legislative Building Chamber Skylight Restoration
OFM Project Number	N/A

Cost Estimate Summary

Acquisition			
Acquisition Subtotal	**$0**	**Acquisition Subtotal Escalated**	**$0**

Consultant Services			
Predesign Services	$0		
A/E Basic Design Services	$345,526		
Extra Services	$200,000		
Other Services	$230,236		
Design Services Contingency	$142,576		
Consultant Services Subtotal	**$918,339**	**Consultant Services Subtotal Escalated**	**$963,242**

Construction			
Construction Contingencies	$909,193	Construction Contingencies Escalated	$964,018
Maximum Allowable Construction Cost (MACC)	$3,274,289	Maximum Allowable Construction Cost (MACC) Escalated	$3,458,178
Sales Tax	$368,146	Sales Tax Escalated	$389,154
Construction Subtotal	**$4,551,628**	**Construction Subtotal Escalated**	**$4,811,350**

Equipment			
Equipment	$0		
Sales Tax	$0		
Non-Taxable Items	$0		
Equipment Subtotal	**$0**	**Equipment Subtotal Escalated**	**$0**

Artwork			
Artwork Subtotal	**$0**	**Artwork Subtotal Escalated**	**$0**

Agency Project Administration			
Agency Project Administration Subtotal	$0		
DES Additional Services Subtotal	$0		
Other Project Admin Costs	$0		
Project Administration Subtotal	**$0**	**Project Administation Subtotal Escalated**	**$0**

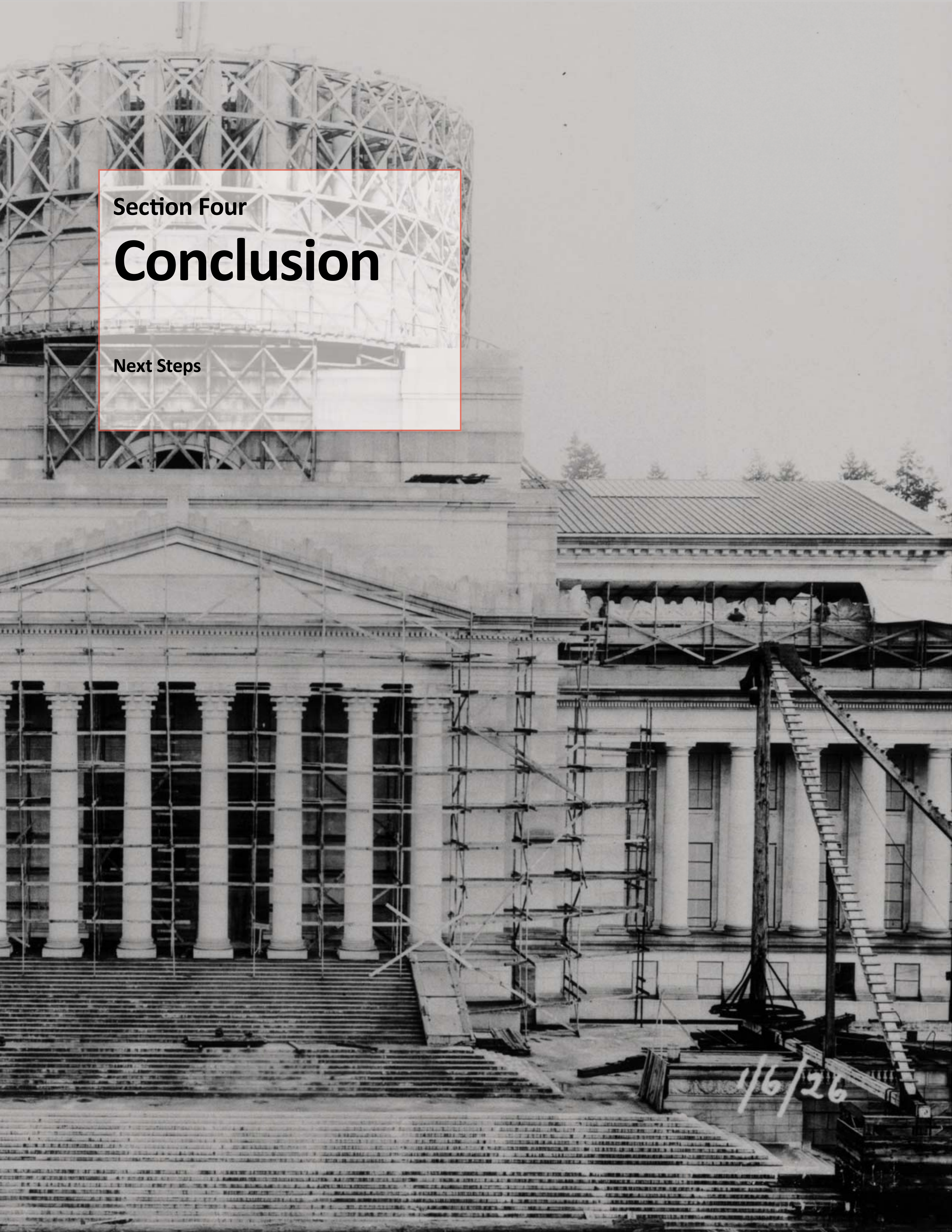
Other Costs			
Other Costs Subtotal	**$200,000**	**Other Costs Subtotal Escalated**	**$207,480**

Project Cost Estimate			
Total Project	**$5,669,967**	Total Project Escalated	**$5,982,072**
		Rounded Escalated Total	**$5,982,000**

Section Four

Conclusion

Next Steps



4.1 Next Steps

The reconstruction of the skylights over the House and Senate Chambers is a very complex project that requires careful consideration moving forward. This project goes beyond just installing new skylights and involves new lighting, upgrades to the sound system, updated fire and life safety systems, restoration of the metal and glass ceiling laylight, acoustical upgrades to the Chambers, and some additional mechanical and structural work. The result of performing the work will be a more pleasant space with modernized sound and lighting systems that work with the historic fabric as well as natural daylight penetrating into the Chambers as it was originally intended.

It is recommended that the state use a "Progressive Design Build" process to procure the design and construction services for restoration of the Legislative Building skylights, rather than a traditional design-bid-build delivery method.

The progressive design-build method compresses the design and construction phases in a way that will best respond to the significant restraints this already-complex project presents in terms of scheduling: access restricted to the limited months in between Legislative Sessions, dry weather conditions necessary for roof construction, and the timing of funding within the biennial budget process.

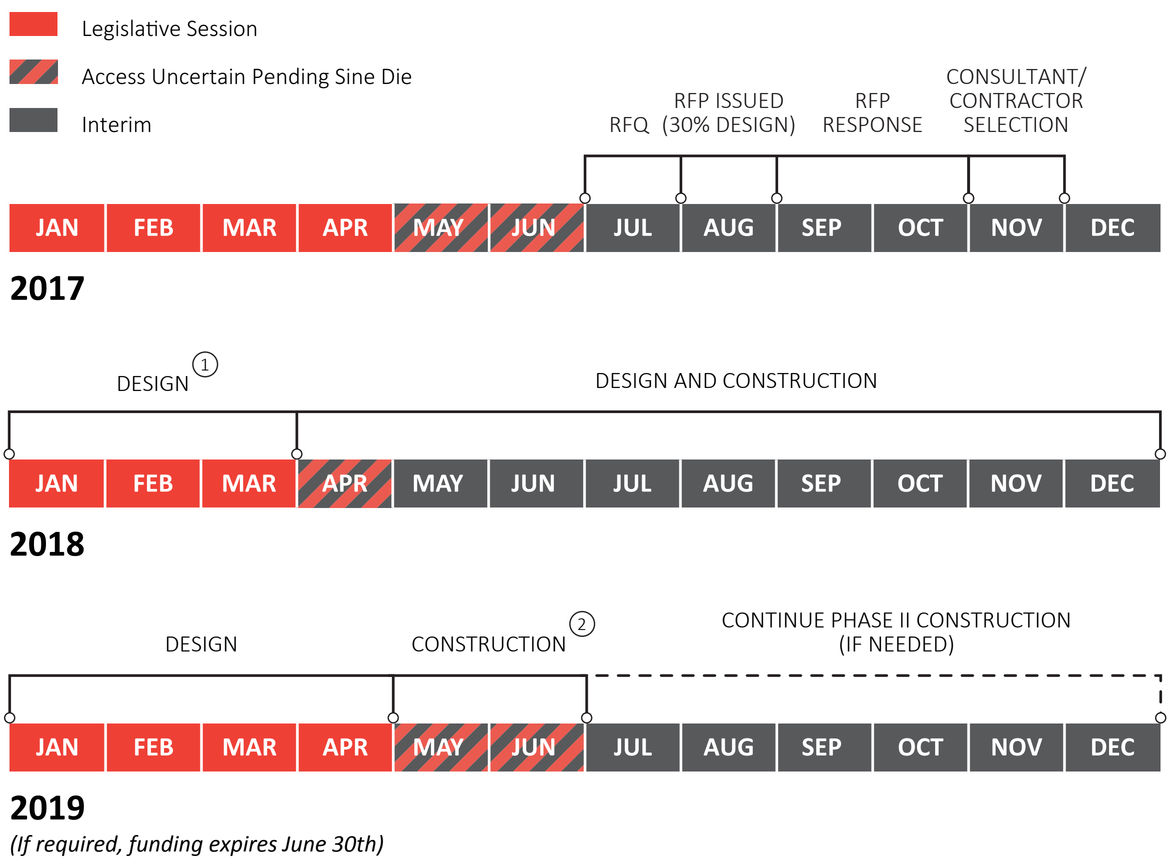
In a design-build process the design consultant and contractor are selected as a team, and work together from the beginning on project design and delivery solutions. Following a qualifications review, three competing teams submit initial designs that propose their technical design approach and schedule for delivery. A winning team then is selected to continue to completion.

Compressing initial design and scheduling into the selection process, and running early construction phases parallel to ongoing design work, allows the project to potentially target a two-year completion schedule, although it is possible that a third construction season would be necessary.

The folllowing steps are recommended moving forward:

- Produce an RFP and select a design team. The team should have experience in historic structures and conservation to ensure sensitive solutions that will enhance the historic fabric. An estimated project schedule is on page 78.
- Meet with the City of Olympia building department once a design team has been selected to discuss the project and the corresponding code issues. It is also important to understand the full review process for historic buildings to properly schedule the project and meet key milestones in a timely matter.
- Meet with the Department of Archaeology and Historic Preservation early in the schematic design process to discuss scope and approach
- Review current report with the key stakeholders of the project so there is an understanding of the complexity of the project moving forward.

4.1 Next Steps



NOTES:

① Assume no construction possible during Legislative Session. Design work only.

② Project may not be possible to be completed in this time.
A second phase of funding and construction may be required.

Figure 67: Project Schedule

Figure 68: Washington State Legislative Building shortly after construction completed. *Courtesy of Washington State Archives.*

Appendix A

Cost Estimate

Appendix A

COST ESTIMATE SUMMARY	
Consultant services	$963,242
SUBTOTAL	**$963,242**
Maximum Allowable Construction Cost (MACC)	**$3,458,178**
Construction Contingency	$964,018
Sales tax	$389,154
SUBTOTAL	**$4,811,350**
Project Administration, Project Support, Permits, Plan Review	$207,480
SUBTOTAL	**$207,480**
ESTIMATED TOTAL PROJECT COST	**$5,982,072**

State of Washington
AGENCY / INSTITUTION PROJECT COST SUMMARY

Agency	Department of Enterprise Services
Project Name	Legislative Building Chamber Skylight Restoration
OFM Project Number	N/A

Contact Information

Name	Jordan Friedberg
Phone Number	360-407-8279
Email	jordan.friedberg@des.wa.gov

Statistics

Gross Square Feet	255,564	MACC per Square Foot	$13
Usable Square Feet	124,668	Escalated MACC per Square Foot	$14
Space Efficiency	48.8%	A/E Fee Class	B
Construction Type	Office buildings	A/E Fee Percentage	11.97%
Remodel	Yes	Projected Life of Asset (Years)	30
Additional Project Details			
Alternative Public Works Project	No	Art Requirement Applies	No
Inflation Rate	2.80%	Higher Ed Institution	No
Sales Tax Rate %	8.80%	Location Used for Tax Rate	Olympia
Contingency Rate	10%		
Base Month	January-17		
Project Administered By	DES		

Schedule

Predesign Start	September-15	Predesign End	February-17
Design Start	January-18	Design End	December-18
Construction Start	May-18	Construction End	December-19
Construction Duration	19 Months		

Green cells must be filled in by user

Project Cost Estimate

Total Project	$5,669,967	Total Project Escalated	$5,982,072
		Rounded Escalated Total	$5,982,000

STATE OF WASHINGTON

AGENCY / INSTITUTION PROJECT COST SUMMARY

Agency	Department of Enterprise Services
Project Name	Legislative Building Chamber Skylight Restoration
OFM Project Number	N/A

Cost Estimate Summary

Acquisition			
Acquisition Subtotal	**$0**	**Acquisition Subtotal Escalated**	**$0**

Consultant Services			
Predesign Services	$0		
A/E Basic Design Services	$345,526		
Extra Services	$200,000		
Other Services	$230,236		
Design Services Contingency	$142,576		
Consultant Services Subtotal	**$918,339**	**Consultant Services Subtotal Escalated**	**$963,242**

Construction			
Construction Contingencies	$909,193	Construction Contingencies Escalated	$964,018
Maximum Allowable Construction Cost (MACC)	$3,274,289	Maximum Allowable Construction Cost (MACC) Escalated	$3,458,178
Sales Tax	$368,146	Sales Tax Escalated	$389,154
Construction Subtotal	**$4,551,628**	**Construction Subtotal Escalated**	**$4,811,350**

Equipment			
Equipment	$0		
Sales Tax	$0		
Non-Taxable Items	$0		
Equipment Subtotal	**$0**	**Equipment Subtotal Escalated**	**$0**

Artwork			
Artwork Subtotal	**$0**	**Artwork Subtotal Escalated**	**$0**

Agency Project Administration			
Agency Project Administration Subtotal	$0		
DES Additional Services Subtotal	$0		
Other Project Admin Costs	$0		
Project Administration Subtotal	**$0**	**Project Administation Subtotal Escalated**	**$0**

Other Costs			
Other Costs Subtotal	**$200,000**	**Other Costs Subtotal Escalated**	**$207,480**

Project Cost Estimate			
Total Project	**$5,669,967**	Total Project Escalated	**$5,982,072**
		Rounded Escalated Total	**$5,982,000**

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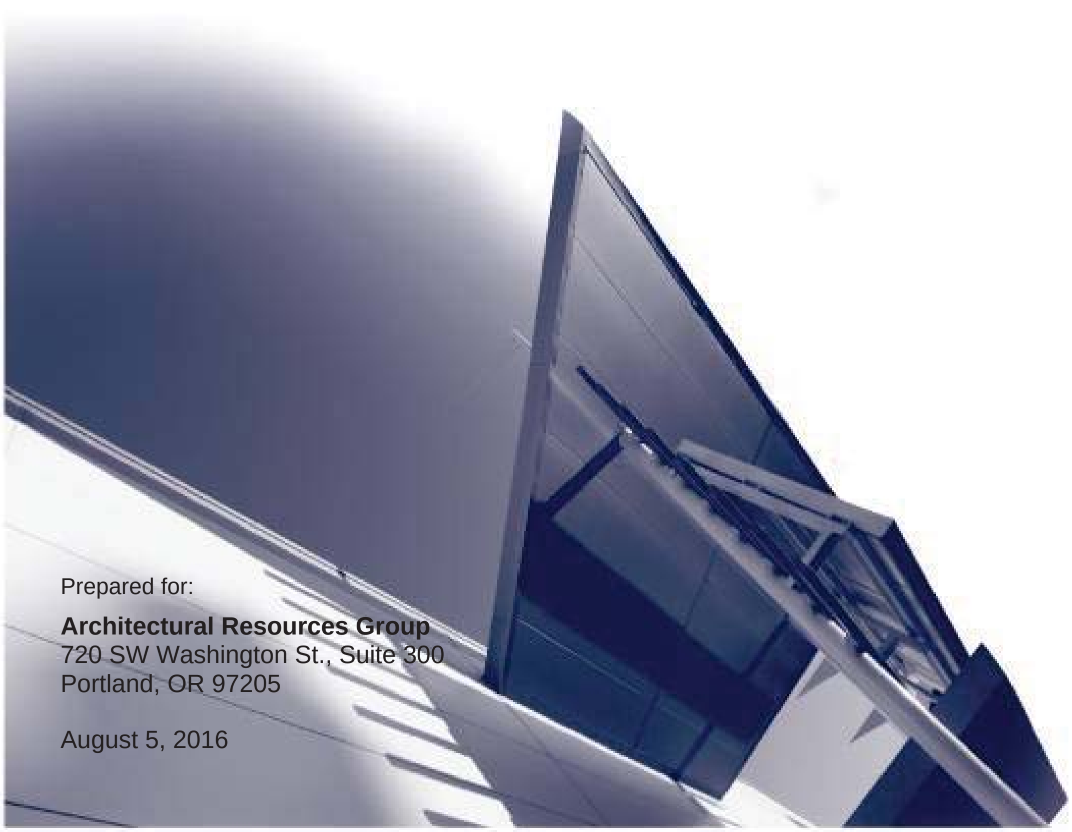
Conceptual Cost Model
Washington State Legislature Skylights

Olympia, WA



Prepared for:

Architectural Resources Group
720 SW Washington St., Suite 300
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August 5, 2016

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WA State Capitol Building Skylight Restoration

Concept with consultant input

House Summary

HGFA: House GFA
Rates Current At March 2016

Location		HGFA SF	Cost/SF	Total Cost
H HOUSE		**6,829.0**	**155.84**	**1,064,227**
	ESTIMATED NET COST	**6,829**	**$155.84**	**$1,064,227**
MARGINS & ADJUSTMENTS				
Estimating contingency	20.0 %			$212,846
SUBTOTAL		**6,829**	**$31.17**	**$212,846**
General Conditions	10.0 %			$127,707
Phasing/Staging	10.0 %			$140,477
Subcontractor bonds	1.5 %			$23,178
SUBTOTAL		**6,829**	**$42.67**	**$291,362**
GC/CM Risk Contingency	5.0 %			$78,423
SUBTOTAL		**6,829**	**$11.48**	**$78,423**
GC/CM Fee	8.0 %			$131,748
	ESTIMATED TOTAL COST	**6,829**	**$260.45**	**$1,778,606**

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WA State Capitol Building Skylight Restoration

Concept with consultant input

House Items

HGFA: 6,829.0 SF Cost/SF: $155.84

H HOUSE

Rates Current At March 2016

Description		Unit	Qty	Rate	Total
B1010	**Floor Construction**				
1	Attic floor deck - reinforce & repair	SF	4,320.0	15.00	64,800
2	Skylight attic walkway floor deck - reinforce & repair	SF	1,707.0	15.00	25,605
	Floor Construction			***$13.24/SF***	***$90,405***
B1020	**Roof Construction**				
4	New steel members supporting skylights - HSS members with welded angles	Lb	11,646.0	8.00	93,168
6	Repair damage at perimeter of existing T & G roof decking	LF	136.0	75.00	10,200
	Roof Construction			***$15.14/SF***	***$103,368***
B2010	**Exterior Walls**				
7	Form openings in existing exterior walls to accommodate new wall intake vents - by location	EA	1.0	1,000.00	1,000
	Exterior Walls			***$0.15/SF***	***$1,000***
B3010	**Roof Coverings**				
8	Install new insulated metal curbs at perimeter of new skylights	LF	141.0	50.00	7,050
10	Repair and flash perimeter of existing roofing at perimeter of new skylight	LF	141.0	100.00	14,100
	Roof Coverings			***$3.10/SF***	***$21,150***
B3020	**Roof Openings**				
11	New metal framed skylights	SF	1,151.0	90.00	103,590
	Roof Openings			***$15.17/SF***	***$103,590***
C1010	**Partitions**				
14	Form openings in existing skylight attic perimeter wall for new supply & return air registers - per location	EA	1.0	500.00	500
16	Paint existing skylight attic railings	LF	141.0	25.00	3,525
17	Protection for laylight and catwalk during painting operation within skylight attic	SF	2,994.0	1.50	4,491
19	1/8" opalescent glazing to laylight - placeholder for large sheets rather than individual pieces	SF	612.0	270.00	165,240
21	Clean all surfaces of ceiling laylight	SF	612.0	18.00	11,016
	Partitions			***$27.06/SF***	***$184,772***
C1020	**Interior Doors**				
18	New, custom sliding panel doors accessing skylight attic - 3' x 7' leaves	EA	2.0	5,000.00	10,000
27	Add new black out panels to existing laylight at camera positions	EA	1.0	500.00	500
	Interior Doors			***$1.54/SF***	***$10,500***
C3010	**Wall Finishes**				
22	Paint walls of skylight attic	SF	1,540.0	2.50	3,850

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WA State Capitol Building Skylight Restoration

Concept with consultant input

House Items

HGFA: 6,829.0 SF Cost/SF: $155.84
Rates Current At March 2016

H HOUSE (continued)

Description	Unit	Qty	Rate	Total
58 Absorptive material in chambers	SF	2,000.0	50.00	100,000
Wall Finishes			***$15.21/SF***	***$103,850***
C3030 Ceiling Finishes				
23 Paint ceiling space utilities and steel members	SF	1,156.0	5.00	5,780
Ceiling Finishes			***$0.85/SF***	***$5,780***
D3050 Terminal & Package Units				
39 Allowance to supply and install [N] 4000 cfm ventilation fan coil unit--Merv 8 filtration, sound attenuation----Bird screen on intake, suspended from structure, with sidewall supply air grill to skylight attic space	LS	1.0	10,500.00	10,500
Terminal & Package Units			***$1.54/SF***	***$10,500***
D5020 Lighting and Branch Wiring				
30 Remove existing metal halide fixtures	EA	39.0	140.00	5,460
31 Install new LED fixtures (bronze reflector measured elsewhere)	EA	20.0	520.00	10,400
32 New daylighting controls--Includes daylight sensor and power packs	LS	1.0	2,200.00	2,200
36 Install new "backlight" LED fixtures in attic space	EA	20.0	380.00	7,600
49 Allowance for conduit modifications and undesigned electrical work	LS	1.0	5,000.00	5,000
Lighting and Branch Wiring			***$4.49/SF***	***$30,660***
D5030 Communications & Security				
33 Remove existing security cameras	EA	1.0	200.00	200
34 Install new security cameras	EA	1.0	1,570.00	1,570
35 Allowance to provide [N] speaker system for chambers--Per Acoustical concept design narrative dated 6/29/16--Base option is Audio Option A	LS	1.0	38,000.00	38,000
37 New air sampling smoke detection system	LS	1.0	3,000.00	3,000
38 Remove existing smoke detection system	LS	1.0	400.00	400
Communications & Security			***$6.32/SF***	***$43,170***
E1090 Other Equipment				
12 New roof tie off system	LF	132.0	100.00	13,200
Other Equipment			***$1.93/SF***	***$13,200***
F1010 Special Structures				
24 Remove bronze metal ring housings at existing light fixture locations	EA	40.0	250.00	10,000
25 Add new star pattern grillage at location of former light fixture locations	EA	20.0	1,650.00	33,000
26 Add new metal extrusions in laylight grille to accommodate new light efixtures at existing light fixture locations - incl new concave light reflectors	EA	20.0	2,000.00	40,000
28 Remove existing insulation at existing laylight	SF	612.0	10.00	6,120

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WA State Capitol Building Skylight Restoration

Concept with consultant input

House Items

HGFA: 6,829.0 SF Cost/SF: $155.84

H HOUSE (continued)

Rates Current At March 2016

	Description	Unit	Qty	Rate	Total
29	New bronze custom reflector at new lighting locations including new clips and gasket - incl in line item 26	Item			Incl.
	Special Structures			***$13.05/SF***	***$89,120***
F2010	**Building Elements Demolition**				
5	Remove existing T & G roof decking	SF	1,151.0	10.00	11,510
9	Remove existing metal roof system	SF	1,151.0	10.00	11,510
13	Remove existing roof tie off system	LS	1.0	2,500.00	2,500
	Building Elements Demolition			***$3.74/SF***	***$25,520***
GC	**General Conditions**				
50	Temporary scaffold - dance floor above retained seating - per month for first month	EA	1.0	32,000.00	32,000
51	Temporary scaffold - per day after first 28 days	EA	28.0	124.00	3,472
52	Finishes protection - per chamber	SF	6,839.0	10.00	68,390
53	Finishes protection - north entrance, hallway and rotunda	SF	12,378.0	10.00	123,780
	General Conditions			***$33.33/SF***	***$227,642***
	HOUSE			***$155.84/SF***	***$1,064,227***

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Senate Summary

SGFA: Senate GFA
Rates Current At March 2016

Location		SGFA SF	Cost/SF	Total Cost
S SENATE		**6,557.0**	**161.87**	**1,061,407**
	ESTIMATED NET COST	**6,557**	**$161.87**	**$1,061,407**
MARGINS & ADJUSTMENTS				
Estimating contingency	20.0 %			$212,281
SUBTOTAL		**6,557**	**$32.37**	**$212,281**
General Conditions	10.0 %			$127,369
Phasing/Staging	10.0 %			$140,106
Subcontractor bonds	1.5 %			$23,117
SUBTOTAL		**6,557**	**$44.32**	**$290,592**
GC/CM Risk Contingency	5.0 %			$78,214
SUBTOTAL		**6,557**	**$11.93**	**$78,214**
GC/CM Fee	8.0 %			$131,399
	ESTIMATED TOTAL COST	**6,557**	**$270.53**	**$1,773,893**

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Senate Items

SGFA: 6,557.0 SF Cost/SF: $161.87

S SENATE

Rates Current At March 2016

Description		Unit	Qty	Rate	Total
B1010	**Floor Construction**				
1	Attic floor deck - reinforce & repair	SF	4,320.0	15.00	64,800
2	Skylight attic walkway floor deck - reinforce & repair	SF	1,707.0	15.00	25,605
	Floor Construction			***$13.79/SF***	***$90,405***
B1020	**Roof Construction**				
4	New steel members supporting skylights - HSS members with welded angles	Lb	11,646.0	8.00	93,168
6	Repair damage at perimeter of existing T & G roof decking	LF	136.0	75.00	10,200
	Roof Construction			***$15.76/SF***	***$103,368***
B2010	**Exterior Walls**				
7	Form openings in existing exterior walls to accommodate new wall intake vents - by location	EA	1.0	1,000.00	1,000
	Exterior Walls			***$0.15/SF***	***$1,000***
B3010	**Roof Coverings**				
8	Install new insulated metal curbs at perimeter of new skylights	LF	141.0	50.00	7,050
10	Repair and flash perimeter of existing roofing at perimeter of new skylight	LF	141.0	100.00	14,100
	Roof Coverings			***$3.23/SF***	***$21,150***
B3020	**Roof Openings**				
11	New metal framed skylights	SF	1,151.0	90.00	103,590
	Roof Openings			***$15.80/SF***	***$103,590***
C1010	**Partitions**				
14	Form openings in existing skylight attic perimeter wall for new supply & return air registers - per location	EA	1.0	500.00	500
16	Paint existing skylight attic railings	LF	141.0	25.00	3,525
17	Protection for laylight and catwalk during painting operation within skylight attic	SF	2,994.0	1.50	4,491
19	1/8" opalescent glazing to laylight - placeholder for large sheets rather than individual pieces	SF	612.0	270.00	165,240
21	Clean all surfaces of ceiling laylight	SF	612.0	18.00	11,016
	Partitions			***$28.18/SF***	***$184,772***
C1020	**Interior Doors**				
18	New, custom sliding panel doors accessing skylight attic - 3' x 7' leaves	EA	2.0	5,000.00	10,000
27	Add new black out panels to existing laylight at camera positions	EA	1.0	500.00	500
	Interior Doors			***$1.60/SF***	***$10,500***
C3010	**Wall Finishes**				
22	Paint walls of skylight attic	SF	1,540.0	2.50	3,850

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Senate Items

SGFA: 6,557.0 SF Cost/SF: $161.87

S SENATE (continued)

Rates Current At March 2016

Description	Unit	Qty	Rate	Total
58 Absorptive material in chambers	SF	2,000.0	50.00	100,000
Wall Finishes			***$15.84/SF***	***$103,850***
C3030 Ceiling Finishes				
23 Paint ceiling space utilities and steel members	SF	1,156.0	5.00	5,780
Ceiling Finishes			***$0.88/SF***	***$5,780***
D3050 Terminal & Package Units				
39 Allowance to supply and install [N] 4000 cfm ventilation fan coil unit--Merv 8 filtration, sound attenuation----Bird screen on intake, suspended from structure, with sidewall supply air grill to skylight attic space	LS	1.0	10,500.00	10,500
Terminal & Package Units			***$1.60/SF***	***$10,500***
D5020 Lighting and Branch Wiring				
30 Remove existing metal halide fixtures	EA	39.0	140.00	5,460
31 Install new LED fixtures (bronze reflector measured elsewhere)	EA	20.0	520.00	10,400
32 New daylighting controls--Includes daylight sensor and power packs	LS	1.0	2,200.00	2,200
36 Install new "backlight" LED fixtures in attic space	EA	20.0	380.00	7,600
49 Allowance for conduit modifications and undesigned electrical work	LS	1.0	5,000.00	5,000
Lighting and Branch Wiring			***$4.68/SF***	***$30,660***
D5030 Communications & Security				
33 Remove existing security cameras	EA	1.0	200.00	200
34 Install new security cameras	EA	1.0	1,570.00	1,570
35 Allowance to provide [N] speaker system for chambers--Per Acoustical concept design narrative dated 6/29/16--Base option is Audio Option A	LS	1.0	38,000.00	38,000
37 New air sampling smoke detection system	LS	1.0	3,000.00	3,000
38 Remove existing smoke detection system	LS	1.0	400.00	400
Communications & Security			***$6.58/SF***	***$43,170***
E1090 Other Equipment				
12 New roof tie off system	LF	132.0	100.00	13,200
Other Equipment			***$2.01/SF***	***$13,200***
F1010 Special Structures				
24 Remove bronze metal ring housings at existing light fixture locations	EA	40.0	250.00	10,000
25 Add new star pattern grillage at location of former light fixture locations	EA	20.0	1,650.00	33,000
26 Add new metal extrusions in laylight grille to accommodate new light efixtures at existing light fixture locations - incl new concave light reflectors	EA	20.0	2,000.00	40,000
28 Remove existing insulation at existing laylight	SF	612.0	10.00	6,120

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Senate Items

SGFA: 6,557.0 SF Cost/SF: $161.87

S SENATE (continued)

Rates Current At March 2016

Description		Unit	Qty	Rate	Total
29	New bronze custom reflector at new lighting locations including new clips and gasket - incl in line item 26	Item			Incl.
	Special Structures			***$13.59/SF***	***$89,120***
F2010	**Building Elements Demolition**				
5	Remove existing T & G roof decking	SF	1,151.0	10.00	11,510
9	Remove existing metal roof system	SF	1,151.0	10.00	11,510
13	Remove existing roof tie off system	LS	1.0	2,500.00	2,500
	Building Elements Demolition			***$3.89/SF***	***$25,520***
GC	**General Conditions**				
50	Temporary scaffold - dance floor above retained seating - per month for first month	EA	1.0	32,000.00	32,000
51	Temporary scaffold - per day after first 28 days	EA	28.0	124.00	3,472
52	Finishes protection - per chamber	SF	6,557.0	10.00	65,570
53	Finishes protection - north entrance, hallway and rotunda	SF	12,378.0	10.00	123,780
	General Conditions			***$34.29/SF***	***$224,822***
	SENATE			***$161.87/SF***	***$1,061,407***

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Alternate Summary

Rates Current At March 2016

Location			Total Cost
ALT1	**FAN COIL UNIT ATTIC VENTILATION CONCEPT**		**85,580**
ALT2	**LAYLIGHT GLASS OPTION 2**		**1,224**
AVOPTB	**AUDIO OPTION B--PLACE NEW SPEAKER SYSTEM INSIDE CHAMBER ON WALL**		**96,000**
AVOPTC	**AUDIO OPTION C--PROVIDES NEW 4" SPEAKER TO EACH DESK**		**215,000**
		ESTIMATED NET COST	**$397,804**
MARGINS & ADJUSTMENTS			
Estimating contingency		20.0 %	$79,561
SUBTOTAL			**$79,561**
General Conditions		10.0 %	$47,737
Phasing/Staging		10.0 %	$52,511
Subcontractor bonds		1.5 %	$8,665
SUBTOTAL			**$108,913**
GC/CM Risk Contingency		5.0 %	$29,313
SUBTOTAL			**$29,313**
GC/CM Fee		8.0 %	$49,248
		ESTIMATED TOTAL COST	**$664,839**

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Alternate Items

ALT1 FAN COIL UNIT ATTIC VENTILATION CONCEPT Rates Current At March 2016

Description		Unit	Qty	Rate	Total
C1010	**Partitions**				
15	Form openings in existing skylight attic perimeter wall for new supply & return air registers - per location	EA	4.0	500.00	2,000
	Partitions				***$2,000***
D3030	**Cooling Generating Systems**				
42	HVAC System--Cooling--1 1/4" CHWS/R Distribution Pipework [Type L Tube, 95/5], includes fittings and hangers	LF	1,000.0	38.00	38,000
43	HVAC System--Cooling--Chilled Pipework insulation--Nominal 1 1/4" (1 1/2-2"thick)	LF	1,000.0	12.00	12,000
44	HVAC System--Cooling--Chilled Pipework--Nominal 4" (Assumed) tap-in to [E]	EA	4.0	250.00	1,000
45	HVAC System--Cooling--Chilled Pipework--Nominal 1 1/4" isolation valve	EA	4.0	120.00	480
46	HVAC System--Cooling--Chilled Pipework--Chilled water coil line set--includes strainer and circuit setter and 1" control valve	EA	4.0	325.00	1,300
47	HVAC System--Cooling--allowance to run drain line to nearest exit	EA	2.0	600.00	1,200
	Cooling Generating Systems				***$53,980***
D3050	**Terminal & Package Units**				
41	Allowance to supply and install [N] 4000 cfm fan coil unit--with sound traps at supply and discharge, each 72" long--Bird screen on intake, suspended from structure, with sidewall supply air grill to skylight attic space	EA	2.0	12,500.00	25,000
	Terminal & Package Units				***$25,000***
D3060	**Controls & Instrumentations**				
48	DDC Connection to unit/line sets	Pt	4.0	1,150.00	4,600
	Controls & Instrumentations				***$4,600***
	FAN COIL UNIT ATTIC VENTILATION CONCEPT				***$85,580***

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WA State Capitol Building Skylight Restoration

Concept with consultant input

Alternate Items

ALT2 LAYLIGHT GLASS OPTION 2 Rates Current At March 2016

Description	Unit	Qty	Rate	Total
C1010 Partitions				
20 1/4" light transmitting resin to laylight	SF	1,224.0	1.00	1,224
Partitions				***$1,224***
LAYLIGHT GLASS OPTION 2				***$1,224***

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WA State Capitol Building Skylight Restoration

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Alternate Items

AVOPTB AUDIO OPTION B--PLACE NEW SPEAKER SYSTEM INSIDE CHAMBER ON WALL

Rates Current At March 2016

Description	Unit	Qty	Rate	Total
D5030 Communications & Security				
54 Allowance to to replace [E] speakers in skylight with new speaker cluster on chamber wall in House chamber--(Undesigned allowance per consultant estimate)	LS	1.0	48,000.00	48,000
55 Allowance to to replace [E] speakers in skylight with new speaker cluster on chamber wall in Senate chamber--(Undesigned allowance per consultant estimate)	LS	1.0	48,000.00	48,000
Communications & Security				***$96,000***
AUDIO OPTION B--PLACE NEW SPEAKER SYSTEM INSIDE CHAMBER ON WALL				***$96,000***

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