DFCM

UTAH DEPARTMENT OF
ADMINISTRATIVE SERVICES
DIVISION OF FACILITIES CONSTRUCTION & MANAGEMENT

UTAH VALLEY UVU UNIVERSITY

Basis of Design

Schematic Design Package

Utah Valley University Performing Arts Complex

Orem, Utah
DFCM Project No. 15125790

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Utah Valley University Performing
Arts Complex

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DESIGN TEAM

SECTION ONE: DESIGN TEAM

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GENERAL

SECTION TWO: GENERAL

1. PURPOSE

The purpose of this basis of design is to describe to the reviewer how the proposed design will meet the functional and technical requirements of the project in compliance with the appropriate technical criteria.

2. AUTHORIZATION

2.1 DFCM PROJECT NO. 15125790

2.2. SCOPE:
UVU Performing Arts Complex **130,700 s.f. gross**

Estimated Programmed Amount **$ 42,500,000.00 construction budget**

3. CRITERIA

DFCM Design Criteria, dated June 11, 2009

4. PROJECT DESCRIPTION

4.1 CONSTRUCTION SITE

The UVU Performing Arts Complex (PAC) is located on southeast corner of campus, directly east of Campus Drive, and immediately north of Wolverine Way. The complex will connect to the existing Gunther Technology Building, adjacent to the Noorda Black Box Theatre. The Faculty Annex, currently located within the parking lot zone east of the Gunther Technology Building, will be removed to facilitate the site and relocation of parking. Access to the complex will occur off of Campus Drive, with loading and services located off of Wolverine Way. Service access will need to be maintained through construction, as the University Print Shop utilizes this route for deliveries and maintenance. Additionally, performances in the Noorda Black Box theatre will continue through initial stages of construction, and access from the north, and through the Gunther Technology building will need to be coordinated with the School of Arts.

4.2 FUNCTION

The proposed project is for the construction of approximately 130,000 combined square feet of performance venues, classrooms, practice rooms, and performance support spaces. The program spaces include: 900 seat concert hall, 501 seat proscenium theatre, 150 seat dance venue, small dual purpose recital halls/ensemble rooms, scene shop addition, and teaching/practice rooms. The building will also contain administration offices and administrative support spaces, warming kitchen, conference room, and a multipurpose rehearsal room that will convert into an assembly space.

4.3 PERSONNEL

The type of building occupancy is determined by the IBC 2015, and any Utah amendments to the IBC. The number of occupants is determined by the IBC 2015, the programming document, review of the occupant loads, classification with state and local code officials, and the architect of record during the design process.

4.4 CONSTRUCTABILITY

The proposed building is two stories in height, not including fly tower or performance venue volumes, and not including pit/tech levels within the performance halls. The structural system includes solid grouted concrete masonry units (CMU) for the performance hall venues, reinforced with masonry pilasters at tall, unsupported walls. Steel columns will be utilized to support

floor and roof loads where possible for increased efficiency and metal decking will be used for the roof framing. All minimally sloped roof areas will have a single ply membrane over polyisocyanurate rigid insulation and metal roof decking. Exterior walls other than CMU walls will consist of brick on metal studs, paper-based fiber resin panels, storefront or curtain wall glazing.

CIVIL

CIVIL NARRATIVE

SECTION THREE: CIVIL

1. DEMOLITION

The existing site contains surface improvements and utility infrastructure which will need to be demolished prior to proposed building construction. Demolition of curb/gutter, sidewalk, asphalt paving, park-strips, water, sewer, storm sewer and dry utilities will be required. Below is an outline of anticipated scope of work items.

- Removal of existing 8-inch water line.
- Removal of existing irrigation line (size unknown; our best guess is that it's an 8" main line).
- Removal of existing sanitary sewer line.
- Removal of storm drain catch basins/manholes and storm sewer line.
- Removal of existing hardscape/landscape area.

2. UTILITY INFRASTRUCTURE

Water, sewer and storm sewer are available to the site. Modifications to utility infrastructure will be required per the included drawings. Below is an outline of anticipated scope of work items.

- Installation of water line. Size will need to be determined, but, is anticipated to be either an 8" or 12" diameter service.
- Installation of irrigation line. Size will need to be determined.
- Installation of 2 new Fire Hydrants.
- Electrical and communications lines/conduits will need to be modified/re-routed at the northeast portion of the proposed building.
- Installation of storm sewer.
- Installation of storm drain catch basins/manholes.

3. GRADING

The site slopes from east to west. Attached is a drawing which shows anticipated grade changes. Building will act as a retaining wall; refer to attached drawings for additional information.

- Retaining walls and/or graded slopes will likely be required to accommodate the grade change from east to west. These are still being finalized and will be affected by the final FFE's of the proposed building. We've provided an exhibit for schematic design review.
- Stairs and ramps will be required for pedestrian travel from parking areas to/from the proposed building.

4. STORM WATER DESIGN CONSIDERATIONS

The storm water runoff from the existing site drains to the west beneath I-15.

- No detention systems are currently used at this site and are not anticipated to be installed as part of this project. This approach may need to be modified at a later date to incorporate on-site detention.
- A portion of Campus Drive to the east and the entire existing parking lot around the east side of the proposed building area drains through the proposed building site. This will require a variety of drainage solutions including: trench drains, slot drains, drain boxes, swales, yard drains, etc.
- A footing drain will likely be required. The native ground slopes steeply towards the building and we will want to provide a conduit for ground water to make its way around the building.

5. SITE AND PHASING CONSIDERATIONS

- Project phasing must coincide with ongoing campus functions. This includes maintaining utility services.
- Pedestrian access around the east and south sides of the project must be maintained throughout construction.
- Vehicular access to the south side of the existing building must be maintained throughout construction.

6. DESIGN DOCUMENTS

- Specifications for site related work will be per the 2012 edition of the American Public Works Association (APWA) Standards and Specifications unless there is a more stringent DFCM/UVU specification available.
- Plan and profile sheets for gravity utilities will be provided as we move forward into design development.

LANDSCAPE

LANDSCAPE DESIGN NARRATIVE

SECTION FOUR: LANDSCAPE

1. INTRODUCTION

The landscape should elevate the human experience and enhance the connection to the community and existing campus. A grand lobby experience to the new building or Gateway to the University design may be integrated seamlessly with the existing UVU campus and adjacent community neighborhoods.

The site should create a cohesive identity, sense of place, and arrival for the new Performing Arts Complex site by reiterating the theme that UVU is the destination for performance in Utah Valley.

Connections between new parking areas and new campus buildings will be clear, obvious, and open as a welcoming gesture to community and campus visitors, encouraging clear site lines for safety and high visibility.

Landscape will consider ways to sensitively integrate the existing elements of the UVU campus and blend them with the new Arts Center site.

All landscape and irrigation design is to comply with UVU campus standards and shall be reviewed and approved by UVU officials.

2. OUTDOOR SPACE DESIGN OF AMENITIES AND FEATURES

Important physical elements in the architecture will be extruded into the landscape to strengthen and enhance the lines and themes of the Performing Arts Complex forms. These connections will reference the surrounding campus landscape and adjacent neighborhoods with the new building.

Appropriate vegetation will be selected in the context of existing campus landscape. It will play an important role integrating the new Performing Arts as the plantings weave through the outdoor spaces, creating interesting edges, contrast, and framing areas for sculpture.

Pedestrian links from campus and adjacent neighborhoods will be created or enhanced in order to clarify safe routes of travel. This will strengthen the connection between the new Performing Arts Complex building and existing buildings.

The vehicular experience with respect to views and circulation patterns will be designed to promote efficiency of travel along designated pathways. Design will focus on important views, connections, and features of the new building. Safety of travel along these pathways will be addressed through sound design guidelines and definitive material transitions from landscape and hardscape treatments in paving, walls, and plantings.

3. PLANT MATERIAL FOR HIGH PERFORMANCE STANDARDS

Use of indigenous and/or water efficient plant materials is encouraged and should be a majority of the plant palette. Vegetation selections should be able to withstand drought tolerant conditions during the high heat of the summer months, integrate into well into existing landscape design, or tolerate shade created from large deciduous and evergreen trees as required.

Deciduous trees are encouraged along pedestrian corridors, walkways, and plaza areas to provide shade which reduces the heat island effect in parking lot areas.

Ornamental and flowering trees are encouraged at main entryways, plazas, and important spaces that people will use and be traveling through. This will make a clear distinction between primary, secondary, and tertiary areas. Limit patio trees to those that make a direct impact on users' comfort and maximize functionality of patio(s).

Shrub plantings will avoid creating a security hazard by obstructing views and light along pedestrian corridors, walkways, entries, etc.

Between roads and parking lots, natural earth and turf berming may be used to screen negative views of parking lot areas. The design focus may also be enhanced by plant massing which will draw visitors toward the new Performing Arts Complex.

Turf grass is not permitted on any slopes greater than 3:1 ratio. These sloped areas must have plantings and mulch. This is subject to review and approval by UVU facilities management. Limit turf grass to those areas can be deemed to have a designated recreational or other use as agreed upon or requested by UVU and that coordinates with High Performance Standards.

Trees will be planted to provide shade and enhance view of campus and the surrounding vistas from the building.

All landscape plantings are to comply with UVU campus standards and shall be reviewed and approved by UVU officials.

4. IRRIGATION DESIGN FOR HIGH PERFORMANCE STANDARDS

Irrigation system will be designed to deliver maximum watering efficiency while minimizing the use of water on the site.

Native vegetation and more drought tolerant material will be selected for a majority of the site. Colorful flora and textures of plant material will be intensified and massed at important pedestrian and vehicular pathways, at entryways, and around signage to enhance, delight, and direct users.

The irrigation system may be the primary source of plant sustainability. Other methods may be incorporated to ensure that plants get the necessary water requirements.

Drought tolerant turf areas will be incorporated in limited areas to offer usable recreational space and visual contrast from native planting areas.

Water wise and xeriscape irrigation design will be incorporated and coordinated between installing contractors and landscape maintenance providers.

All irrigation is to comply with UVU campus standards and shall be reviewed and approved by UVU officials.

5. SITE ACCESSIBILITY

Main entrance and plaza entrances to building shall meet ADA criteria for slope and landings. Wherever possible all other site paths shall meet ADA criteria. If an ADA-accessible path is unfeasible in a particular location, elevator access will be provided

within the UVU Performing Arts Complex that will allow wheelchair users to transition around the non-compliant grade condition.

6. CONSTRUCTION LIMITS OF DISTURBANCE AREAS

Areas that are disturbed by earthwork will need to be appropriately connected to the existing landscape in a seamless transition.

ARCHITECTURAL

ARCHITECTURAL NARRATIVE

SECTION FIVE: ARCHITECTURAL NARRATIVE

1. ARCHITECTURAL CONTEXT

1.1 CAMPUS ARCHITECTURAL CHARACTER

With its roots in the trades and its trajectory as the largest college in the state, Utah Valley University has certainly evolved in size and character. The recent growth and transformation is evidenced by the buildings that populate this active campus. The distinctive brick, 30' grid, and exposed concrete language have matured to incorporate glass facades, solar shades, and metal panels. The new components have elevated the original palette while remaining true to an identity. Stepped buildings and terraces navigate the steady slope to the east, and the interior concourse has become an important and well-known UVU feature, flowing through campus to connect nearly all buildings.

Utah Valley University was originally an institution founded on marketable skills and excellence in trades; happily, this vision of a truly adept workforce has not been lost with the expansion into liberal arts. This emphasis on the latest technology in every discipline certainly translates into its architectural character. While it is expected that the University materials palette is to be acknowledged in the design of new campus buildings, innovation and creativity are certainly encouraged.

2. BUILDING DESIGN

2.1 APPROACH + VISION

This new Performing Arts Complex will include music and theatre instruction departments, and dance performance. The main building entrance into the lobby/atrium should have visual prominence and an obvious sense of entry for students and patrons while the building itself acts as gateway to the campus at the east. The new building is envisioned to be a 2 story + basement structure with a strong architectural presence that reflects and respects the contextual elements of the Utah Valley University, while simultaneously establishing a recognizable community performance venue.

Throughout schematic design, the architectural vision of the project was discussed at length with the UVU Steering Committee. This project was recognized early on as having the potential to create a new standard for performance spaces in the valley, and to become an icon for the University and the rising presence it has in the community.

The location for this new PAC building is northwest of the intersection of College Drive and Wolverine Way. The PAC will be connected to the Noorda Theater and adjacent to the Gunther Trades Building, extending into the parking lot to the east. As part of the Performing Arts Complex, it is understood that the Gunther Trades Building will be remodeled and will continue to house some arts functions, effectively providing a modern, contiguous location for the School of the Arts. The Steering Committee prefers a modern and contemporary aesthetic as demonstrated throughout the campus' newer buildings. This design language visually indicates the University's tradition of preparing their students with the most innovative experiences in their respective fields.

All DFCM design requirements will be met. In addition, UVU design standards will also be followed. It is desired that while respecting campus and DFCM standards, exterior form and finishes reflect the program elements and spaces housed within.

2.2 BUILDING MASSING

Massing should consider the immediate adjacencies of Noorda Theatre and the Gunther Trades Building, while also acknowledging the campus master plan and potential future buildings. The design of the facility will take advantage of opportunities to break up the massing of the building and provide articulation to the facades. This can be done both horizontally and vertically with the massing, fenestration, or architectural detail of the elevations. The campus is built to a strict 30 foot grid with all buildings at 90 or 45 degrees. This base may be acknowledged in both the massing and orientation, but some softening of these parameters is acceptable given the performance venues and residential adjacency considerations.

The building height and massing has been carefully scaled to work with adjacent neighborhoods, site grades, and view corridors. Consideration has also be given to stepping the building and breaking the massing up into wings to address scale. The schematic design features a 2 story (not including performance hall pits/basements, or performance hall interior volumes) maximum height.

2.3 ORIENTATION

The building is oriented to not only meet the goal of serving as a gateway to this southeast edge of campus and (hub for both students and the public), but also to take advantage of sustainable practices in response to solar orientation, wind, views, and natural daylighting. Strong consideration has also be given to existing buildings to remain, the campus grid and connections, existing utility infrastructure, pedestrian and vehicular circulation, grading, and proximity to parking. Pedestrian circulation, patron and student parking, and location of the primary building entrance have been conceptualized in order to establish a sense of gateway to the campus, while efficiently connecting to existing routes. Programmatic adjacencies with outdoor spaces are an important component of the students' experience of the Performing Arts Complex and have been considered throughout schematic design.

Because of the steep grades toward the east, the selected building site is effectively the highest point on campus. The new PAC will have exceptional view opportunities of the Wasatch Mountains to the east and Utah Lake to the west.

2.4 NATURAL LIGHT AND VIEWS

Every opportunity to utilize natural light and maintain/enhance view corridors have been considered in the design of the facility. In particular, the lobby and instruction spaces not sensitive to glare and heat gain will maintain access to natural light and views as much as possible. This affects both the comfort and well-being of the occupants as well as the building's energy efficiency. Views to the mountains and lake have been considered wherever possible.

In an effort to achieve these goals, the design has incorporated the use of large windows, clerestory windows, skylights, and other potential transparent and/or translucent materials. Window openings and curtain walls have been oriented to take

advantage of soft northern exposure. Windows on the west side of the building will be controlled for heat gain but have been exploited specifically for views and daylighting to office spaces.

2.5 EXTERIOR MATERIALS

The architectural response has considered the campus context and the surrounding area. The design has explored a palette of materials that respect UVU building standards, including brick and metal panel, with potential for further exploration of concrete or GFRC. The building has been designed to be warm and inviting to students, faculty, visiting performers, patrons of the arts, and all who interact with the University.

2.6 INTERIOR MATERIALS

The design of the interior spaces will be detailed further in Design Development, but should create a welcoming learning environment that is warm, bright, inviting, and promotes good health. Particular care should be taken in the design of spaces with multiple uses which serve many user groups. Selection of interior finishes and materials should be responsive to the use of each of the spaces as outlined in this program document. Consideration must be given to texture, color, sustainability, and light reflectance. Exceptional care must be taken in the design of acoustics in all performance and rehearsal spaces. Generally, in regard to durability and maintenance, the selection of materials within reason should consider a 50 year building standard, and should correspond to the amount of traffic and anticipated use of each space.

Note that all materials will be presented to the University committee and personnel in a series of meetings following Schematic Design. Options for colors, finishes, and materials will be reviewed for appropriateness and applicability. As previously noted, all campus standards will be respected and incorporated at all locations as directed.

2.7 ORGANIZATION AND ADJACENCY

Due to the dynamic programmatic needs and goals of the Performing Arts Complex, adjacency and general building organization has been critical to the overall design of the plans. Over the course of schematic design, building organization and specific adjacencies have been discussed and studied at length with the School of the Arts and the University.

3. SPACE DESCRIPTIONS

3.1 PUBLIC SPACE

3.1.1 Lobby/Atrium

The grand lobby is the most important interior public space. It acts as a multi-use lobby/atrium and is the hub of all building activity with the primary purpose of connecting students and patrons of the arts to learning and performance spaces. This area also supports pre- and post-function for performance venues; zones for a variety of potential activities and receptions need to be considered individually as well as how they interact with the performance spaces themselves.

The School of the Arts has expressed strong interest in creating collaborative student study zones and nooks throughout the lobby in order to encourage cross-pollination between departments. These collaborative student study and learning zones will help to expand learning opportunities and encourage impromptu interaction between faculty and students.

The scale and level of finishes in the lobby should continue the theme of the exterior building in creating a visual landmark for the arts and extend throughout the entry space. Way-finding should be established in this area by creating strong visual connections to major performance spaces, while simultaneously allowing circulation paths to flow into and around performance entrances. Large crowd dynamics (intermission and exiting) need to be considered in multiple spaces where there may be simultaneous performances. It is anticipated that the building may have all performance spaces in operation at the same time.

3.1.2 Box Office and Supporting Spaces

The Box Office is another important public space. This ticketing location has been set back far enough to allow a line to form without impeding on the main entry or other important circulation paths. Restrooms and vertical circulation paths (stairs and elevators) have also been located prominently and easily accessible from the Grand Lobby space. In addition to the primary public areas, functional consideration has been given to public support spaces such as the warming kitchen, front of house staff rooms, and dimmer and technical rooms. These spaces have been located off of the Grand Lobby and adjacent to the spaces they support.

3.2 PERFORMANCE

For criteria including the Proscenium Theatre, Concert Hall and Dance Venue, please refer to Section 9.

3.3 PERFORMANCE VENUE EQUIPMENT

For performance equipment criteria, please see Section 9.

3.4 PRODUCTION SHOPS

The Scene Shop will have two main components: a remodeled portion beneath the existing Noorda Theatre, and a new addition directly adjacent. Due to existing height restrictions in the remodeled space under the Noorda, the Scene Shop addition directly adjacent will have a 20' clear ceiling height (minimum) required. The scene shop will provide a wide variety of construction needs for all departments and productions. Each of these areas may also serve as instructional space. The taller addition is needed for taller stage set assembly; a paint frame and pit will be included. The Scene Shop is required to be located directly adjacent and under the Noorda Theatre. The new Proscenium Theatre, stage vestibule, and service corridors will be located at a level higher than the renovated scene shop area and will be accessed through a freight platform lift or freight elevator. The loading dock and receiving area will also be directly adjacent. For set and scene construction, the scene shop will

have wood working, welding and metal working, paint and finish equipment, and materials storage. The shop will house a tool storage room, manager office, a saw dust extraction system for wood working tools, compressed air system, storage rooms and racking for paints, metal, wood, electrical, lighting, and miscellaneous set and scene supplies.

3.5 INSTRUCTION

3.5.1 Ensemble Rooms

Unique to this facility is the idea of multi-use ensemble space. The Choral Ensemble Room and the Instrument Ensemble Room are designed to be flexible with enough support facilities to accommodate many uses. It is anticipated that the Instrument Ensemble Room will serve as a scoring stage, symphony rehearsal, wind symphony rehearsal, university band, conducting class, instruction classroom, and a recital hall for evening performances. Portable risers are required to allow for a variety of room configurations to support the various programmatic needs.

For scoring and recording purposes the Instrument Ensemble Room is directly adjacent and connected to the Control Suite. The next primary adjacency for this room is the Concert Hall; this allows for ease of movement to and from the rehearsal room to this primary music performance space. Percussion storage, percussion suite, and keyboard storage rooms are also adjacent to the Ensemble Room. Secondary adjacency consideration has been given for instrument lockers, and practice rooms.

The Choral Ensemble room is another multi-purposed, flexible space. It serves as a choral rehearsal room, vocal practicum, group voice, sectionals, basic conducting class, advanced choral conducting, auditions for solos and ensemble placement, green room for choral concerts, recording space, instruction classroom, and recital hall. This Ensemble Room will have large, fixed risers with portable, intermittent risers to allow for a variety of room configurations. This space is more flexible in its adjacencies than the Instrument Ensemble room so is located slightly more removed from the Concert Hall and music instruction spaces while still located directly off of the Lobby.

Both Ensemble Rooms will have overhead projectors and drop down motorized projector screens with associated A/V and IT controls to help transform the spaces into a more traditional classroom environment. The finishes for these spaces need to be more formal than regular instruction space since they will be used for performance recitals; they should have similar look and feel to the concert hall, but at a much smaller scale. Dynamic, variable acoustics are required in both spaces in order to give the rooms flexibility for a variety of activities.

3.5.2 Practice Rooms

Practice rooms are fundamental learning environments. They need to be easily accessible, functional, and comfortable to students developing their musical talents and preparing for performances. Multiple sized practice rooms will be provided in the new facility to accommodate a variety of individual and group needs. It is desired by the School of the Arts that

these rooms be acoustically isolated from each other but allow some degree of sound to transfer into corridors to activate those environments and encourage cross-pollination of learning. Practice rooms have been located below grade and have been clustered together for economic purposes in order to make use of similar acoustic and construction requirements. They are near ensemble rooms, instrument lockers, and the concert hall. The architectural finish level will be comfortable for long practice periods but also be minimal and durable. Moveable sound panels on the walls are required to allow for a variety of sound control.

3.5.3 Teaching Studios, Office, Administration, and Instruction Support Spaces

Faculty and adjunct studios and the music chair office are teaching studios for private lessons, small ensemble rehearsal spaces, and meeting spaces. These are important spaces in the new facility, connecting the faculty to the students, and assisting in the transfer of knowledge from expert to novice. The acoustical quality of these studios and offices will be similar to the practice rooms, however the finishes need to allow for student interactions and serve as a comfortable office environment when students are not present. Studios have been sized to accommodate a variety of instrumental and small ensemble needs. Natural light is desired and has been incorporated as much as possible.

Similar to faculty studios, department chair offices are multi-purpose, each facilitating staff meetings and student meetings while serving as the primary office space for the Chairs. These spaces need to be welcoming, provide a safe place for students, and remain comfortable for meetings and long office hours.

Chair offices have been located close to standard faculty offices, conference room, and support spaces. Proximity to learning and performance spaces has also been considered. Standard offices, office support, instruction support, and conference rooms should have a similar welcoming feel to these department chair offices. Natural daylight is also highly desirable for all offices and has been incorporated wherever possible.

3.6 SERVICES

The loading dock will be required to accommodate deliveries for the scene shop, proscenium theatre, and concert hall. This will include both in-house production needs and visiting productions including the Utah Symphony.

A dock leveler and dock bumpers will be needed in order to accommodate all potential delivery types. The dock has been designed with an oversized coiling door to allow large material intake with consideration for large stage sets. The dock will need an oversized apron to allow multiple activities to occur at the same time. The dock is adjacent to the receiving are, directly off of the scene shop, and the stage vestibule.

Mechanical rooms have been located as far from performance spaces as possible, remaining acoustically isolated and minimizing performance disturbance. The main mechanical room is located above the scene shop zone with a secondary

mechanical room at grade servicing the east side of the facility. Each will be easily accessible for personnel through adjacent elevators, and will ensure proper conditioning of spaces and minimize energy costs by efficiently maintaining equipment.

STRUCTURAL

STRUCTURAL NARRATIVE

SECTION SIX: STRUCTURAL SYSTEMS

1. INTRODUCTION

The structural design for this project should provide a building which will integrate with the program requirements for space layout, architectural and service needs, while meeting current code standards for vertical and horizontal load carrying capacity. User needs in terms of current flexibility of the spaces and future adaptability of use will be considered. The level of user comfort as determined by the acoustic and vibration sensitivity of the structure will also be addressed.

The facility has a wide variety of program spaces that must be accommodated including performance halls with a fly loft, orchestra pit lift, lighting platforms and catwalks, and acoustically isolated music practice spaces. Structural requirements for each have not been determined yet.

2. STRUCTURAL / SERVICE / THEATRICAL / ACOUSTIC COORDINATION

Layout of the structural grid will reflect the use and location of key architectural, mechanical, and other components. Distribution of HVAC, plumbing and electrical services will be carefully coordinated with the structural elements, particularly at framing intersections and major crossover points. Detailed coordination with the theatrical consultant to establish loading criteria and system requirements associated with theatrical production rigging such as the fly gallery, lighting platforms, etc. will be critical to the structural design.

Acoustical requirements must also be integrated with structural requirements. Currently, there are two schemes that address acoustical concerns where physical structural separation is needed, which are the concert hall and instrument ensemble room. Special details such as slab isolation joints adjacent to sound separation walls are critical to the acoustic performance of the facility.

3. CODES AND STANDARDS

Codes and standards that apply to the design of this building are:

- 2015 International Building Code
- DFCM Design Criteria for Architects and Engineers, May 25, 2005
- American Institute of Steel Construction (AISC) with Commentary
- ACI 318 Building Code Requirements for Reinforced Concrete
- ACI 530 Building Code Requirements for Masonry Structures
- American Iron and Steel Institute (AISI) Specifications for the design of Cold-Formed Steel Structural Members

- American Welding Society (ANSI/AWS) D1.1 Structural Welding Code
- Steel Joist Institute (SJI) for open web Joists and Girders
- Steel Deck Institute (SDI) for Metal floor and roof Decks

4. GEOTECHNICAL CRITERIA

A geotechnical investigation report was provided for our use, by AGEC, dated November 12, 2015. The report states that spread-type footings may be used on native soils or compacted fill extending to native soils. The allowable bearing pressure varies based on the depth and width of footing but not to exceed 4000 psf. Lateral earth pressures for basement-type construction were provided.

5. DESIGN CRITERIA

The structural systems in the facility shall be designed to meet the requirements of the 2015

International Building Code (IBC) and the Design Criteria Manual adopted by the Utah State Building Board. The following minimum requirements should be anticipated:

Risk Category Category III (Buildings and other structures, the failure of which could pose a substantial risk to human life)

Wind Loads

Wind Velocity:	120 mph, (3 second Gust)
Exposure Type:	"C", for the building structure, as appropriate to the site.

Seismic Loads

Short Period Mapped Acceleration	Ss = 1.23g
Long Period Mapped Acceleration	S1 = 0.42g
Site Class	D
Seismic Design Category	D
Seismic Importance Factor, Ie	1.25

Roof Loads

Ground snow, pg	43 psf

Calculate roof snow load as specified in the Utah Uniform Building Standard Act Rules R156-56 issued January 1, 2002. Design for snowdrift where appropriate. Roof live loads shall not be less than that specified in IBC 1607.11.

Snow Importance Factor, Is 1.10

6. FLOOR LIVE LOADS

Floor design live loads shall be in accordance with the 2015 International Building Code and as follows:\

- 60 psf for fixed seating areas.
- 150 psf for stage floors.
- 100 psf for platforms, bleachers, or other assembly areas.
- 100 psf for lobbies, corridors, stairs, and balcony walkways.
- 50 psf for practice rooms, control rooms, and offices, unreduced, except for column and footing designs plus 15 psf movable partition load or weight of sound isolation walls, whichever is greater.
- 40 psf for catwalks.
- 125 psf for storage areas.
- 125 psf for mechanical equipment rooms minimum or as required by actual equipment.
- Theatrical support areas – as indicated by theatrical consultant.

Note: The more stringent requirement between the theater consultant and the loads given above shall govern.

7. FLOOR VIBRATION CRITERIA

It is not anticipated that any activities or equipment that are sensitive to floor vibrations will be located within this facility on suspended floor structure. This should be verified as part of the final design. Should vibration sensitive activities or equipment become necessary within the facility then structural system compatibility should be carefully evaluated. Control of suspended floor and roof structure vibrations due to human and mechanically induced excitation forces will be considered in the selection of the building structural floor framing systems.

8. ANTICIPATED CONSTRUCTION

The building will be supported on conventional reinforced concrete spread footings. The footings will bear on native undisturbed soils or compacted structural fill extending to native undisturbed soils. Reinforced concrete retaining walls and/or foundation walls will be used to resist lateral earth pressures on sides where the building extends below exterior grade. Concrete foundation walls for the east side where the structure is below grade will be at least 12” thick.

The suspended floor areas will consist of 3-1/2" of normal-weight concrete on 3" deep, type "W" composite steel deck supported by steel wide flange floor framing and tube or wide-flange steel columns. The floor framing will incorporate welded studs to make the floor slab composite with the beams. The typical roof framing for areas outside of the larger spaces will consist of open web steel joist and wide flange beams supporting 1-1/2", 18 or 20 gauge type "B" steel roof deck.

Many of the interior spaces within this facility will require acoustic isolation. A wall system consisting of solid grouted concrete masonry units (CMU) is a cost effective method to help provide this acoustic isolation. Acoustic isolation walls will serve a dual purpose and act as vertical load bearing elements in key locations. Steel columns will be utilized to support floor and roof loads where possible for increased efficiency.

The lateral force resisting system for the structure including most of the performance halls will be a reinforced masonry shear wall system, which will also be utilized for acoustic performance, thereby providing a cost-effective, efficient structural system. In order to provide architectural flexibility potentially at the north dance hall it may be necessary to augment shear walls with steel braced frames or moment resisting frames in strategic locations.

9. CONCERT HALL AND INSTRUMENT ENSEMBLE CONSTRUCTION

9.1 CONCERT HALL AND INSTRUMENT ENSEMBLE CONSTRUCTION OPTIONS

The Concert Hall and Instrument Ensemble areas will be structurally separated from the rest of the building using an expansion joint and completely independent gravity and lateral supporting elements on each side of the expansion joint. Areas of roofs over the Concert Hall and Instrument Ensemble will consist of one of the following three options:

- 4-1/2" of normal weight concrete on 3" type "W" deck (7-1/2" total), with supporting open web steel joists or wide-flange beams at approximately 10 feet on center. We anticipate the steel weight for this assembly to be 15 lbs per square foot.
- Two to three inches of normal weight concrete on 3" type "W" deck (7-1/2" total), with supporting open web steel joists or wide-flange beams at approximately 10 feet on center. We anticipate the steel weight for this assembly to be 10 lbs per square foot.
- Untopped type "N" deck, with supporting open web steel joists or wide-flange beams at approximately 10 feet on center. We anticipate the steel weight for this assembly to be 8 lbs per square foot.

Tall, unsupported walls for the concert hall will consist of 24" x 32" reinforced masonry pilasters at 15 feet on center maximum and 8 inch masonry wall infill between pilasters. Balcony seating at the concert hall side walls will cantilever from the pilasters. Tall unbraced walls around the instrument ensemble room will require 12" masonry walls without pilasters.

9.2 CONCERT HALL AND INSTRUMENT ENSEMBLE CONSTRUCTION- ALTERNATE

As an alternate, cost-saving design option, the floor and roof surrounding the Concert Hall and Instrument Ensemble areas could be connected and the expansion joint eliminated. The reduction in structure would be a significant cost savings and design simplification but may not meet the acoustical goals of the facility. Areas of roofs over the Concert Hall and Instrument Ensemble would still consist of one of the three options presented above.

Tall, unsupported walls for the concert hall will consist of 16" x 24" reinforced masonry pilasters at 15 feet on center maximum and 8 inch masonry wall infill between pilasters. Balcony seating at the concert hall side walls will cantilever from the pilasters. Where a masonry wall is less than 20 feet tall unbraced such as at the corridors and rooms, the walls will be 8 inch masonry. Unbraced walls up to 30 feet tall such as at the exterior of the instrument ensemble room will require 12" masonry walls without pilasters.

10. THEATER AND DANCE HALL CONSTRUCTION

Long span open web joists or custom steel trusses are the most likely structural system for this portion of the building. Tall, unsupported walls for the concert hall and theater will consist of 24" x 32" reinforced masonry pilasters at 15 feet on center maximum and 8 inch masonry wall infill between pilasters. Balcony seating at the concert hall side walls will cantilever from the pilasters. Where a masonry wall is less than 30 feet tall unbraced such as at the instrument ensemble room, 8", 10" or 12" masonry walls without pilasters will be used. The typical roof framing will consist of open web steel joist and wide flange beams at approximately 8' to 10' on center supporting 3", 18 or 20 gauge type "N" steel roof deck.

11. EXISTING BUILDING MODIFICATIONS

The existing Noorda Theater will require masonry wall modifications to accommodate large elevator and man-door openings through the walls. Such modifications will include new jambs either constructed of CMU or of steel tubes. Footings may also be affected by new footings adjacent to the existing footings. In the existing scene shop extension of the Noorda Theater, new CMU shear walls will be required for lateral stability once the Noorda lobby is demolished.

It is recommended to keep roofs at the same elevation as the existing Noorda building and Gunther Trades building to avoid induced snow drifts on existing framing. If roofs project above either existing building, supplemental framing and/or strengthening of existing framing will be required.

12. FUTURE BUILDING EXPANSION

The A/E designers of the building shall not consider potential future horizontal and/or vertical expansions because

- Future vertical expansion is not anticipated.
- Future horizontal expansion of the structure is not anticipated.

13. TESTING AND INSPECTIONS

RE+A will perform periodic construction observations. RE+A will list all required special inspections on the contract drawings, and perform periodic construction observations as required. A qualified testing and inspection firm is anticipated to perform testing and special inspections, as outlined in the DFCM Design Criteria for Architects and Engineers. Costs for special inspections and testing services will be paid for directly by DFCM.

MECHANICAL

MECHANICAL NARRATIVE

SECTION SEVEN: MECHANICAL SYSTEMS

1. CODE & STANDARDS

The mechanical systems will be designed in accordance with:

2012 IBC
2012 IMC
2012 IPC
2012 IFC
2012 IECC
ANSI/ASHRAE Standard 55-2010
ANSI/ASHRAE Standard 62.1-2010
ASHRAE Standard 52.2-1999
ANSI Z9.3-2007, Spray Finishing Operations – Safety Code for Design, Construction, and Ventilation
DFCM Design Standards, current as of completion of Design Development

2. BUILDING PERFORMANCE

HVAC systems will be designed to help the project meet the requirements of DFCM's High Performance Building Standard. Acoustical performance of the HVAC system is equally important. Refer to the Air Distribution paragraphs for more information.

3. AVAILABLE UTILITIES

Connect to the existing central plants through the campus-wide chilled and heating water piping system in Gunther Trades
-Assume chilled water pipes are 8" diameter.
-Assume heating water pipes are 4" diameter.
Connect to municipal domestic water mains on site – 3" for building and 6" for fire protection.
Connect to the existing central plant domestic hot water and circulating lines in Gunther Trades
Connect to municipal sanitary sewer, 6".
Connect to municipal storm sewer, two locations, 8" each.
There will be no natural gas in the Performing Arts Center

4. GENERAL REQUIREMENTS

Site Elevation 4,500 ft ASL

Outdoor design temperatures: winter: 9 deg F
(Provo Airport Weather Station) summer: $95_{DB}/63_{WB}$ deg F
dew point: 59.4 deg F

General Indoor Design Conditions: (See Room Data Sheets for Specific Requirements)

	Temperature			
	Summer		Winter	
	Occ*	Unocc	Occ*	Unocc
Circulation	72/75	85	72/69	55
Classrooms	72/75	85	72/69	55
Performance Halls	72/75	85	72/69	55
Rehearsal Rooms (1)	72/75	85	72/69	55
Private Offices	72/75	85	72/69	55
Shops	72/75	85	69/67	55
Restrooms	75/75	85	72/69	55
Storage	80/NA	85	60/NA	55

* setup/setback temperature when space is temporarily unoccupied during occupied period, as determined by space occupancy sensor

(1) Active humidification/dehumidification **will not be provided** in any rooms that are part of this project. The performing arts department will purchase and maintain unitary humidity control devices in any rooms where they desire humidity control.

Active humidification is not provided in any space. Indoor relative humidity throughout the Performing Arts Center will vary from a low of 4% during the winter, to a high of 60% during the summer.

Noise Limits: Refer to room data sheets.

5. VENTILATION/INDOOR AIR QUALITY

Comply with the minimum requirements of ASHRAE Standard 62.1-2010, Ventilation for Acceptable Indoor Air.
Reset outdoor air intake flow and/or space or zone airflow as operating conditions change, in accordance with Section 6.2.7 of the Standard, for zones that require Demand Controlled Ventilation (DCV).

Design the ventilation system for an air change effectiveness of 0.8, as determined by ASHRAE Standard 62.1-2010. Implement a Construction IAQ Construction Management Plan that includes the use of high efficiency filters (Minimum Efficiency Reporting Value (MERV) = 8, as determined by ASHRAE 52.2-1999), at each return air grille for systems used during construction.

Provide MERV 13 final filters at the air handling equipment, without pre-filters.

Space	Exhaust Rate Criteria
Toilet Rooms	100 cfm/fixture public 75 cfm/fixture private
Janitor Closets, Copy Rooms	0.5 cfm/ft^2, or larger as required to maintain at negative pressure of 0.02" w.c. relative to adjoining spaces
Warming Kitchen	See system descriptions

6. COMMISSIONING

Commissioning plan will be developed by the commissioning agent hired by DFCM.

7. SUSTAINABILITY/ENERGY EFFICIENCY

Building energy cost is required to be 20% less than a baseline building in accordance with ASHRAE 90.1-2010, Appendix G. Energy performance to be assessed through energy modeling and life cycle cost analysis.
The only metrics to apply to building performance is life cycle cost analysis, and he related cost-effectiveness of potential performance improvements.

8. MEASUREMENT AND VERIFICATION

Energy meters to provide local as well as remote readouts, using BACnet protocol
Continuous metering equipment for the following uses (as applicable):

System	Meter
Heating Water, Chilled Water	Insertion turbine flow meter similar to Onicon F-1200, with Onicon System 10 Btu meter providing the following information: fluid flow rate, supply and return temperature, instantaneous energy flow rate, totalized energy flow rate

Skyspark will be the analytics program used for continuous commissioning

9. OPERATIONS AND MAINTENANCE

HVAC maintenance performed by on-campus UVU personnel.
Approximately 40 hours of training will be specified to be provided, as well as DVD of the entire training demonstrations.

10. SYSTEMS: GENERAL REQUIREMENTS

10.1.1 Air Handling:

Ventilation, cooling and heating to be provided by two factory-built variable volume air handlers built by ClimateCraft or Huntair. These air handlers will be located in two mechanical rooms on the second floor. Assume one air handler is sized for 120,000 cfm, and the second air handler is sized for 40,000 cfm. Air handlers shall include air-side economizer, filter bank using 4" deep MERV 13 filters, a supply/return fan array, preheat coils, indirect evaporative cooling coils, and direct evaporative air washers. Additional air handler features include:

- 4" double-wall casing.
- Airflow measuring station for all outdoor air
- Dedicated glycol loop for preheat coil
- Leak detection on floor of air handler downstream of air washers
- Water detectors in overflow drain pipes serving the air washers
- Weather hoods in addition to storm louvers on outdoor air intakes
- Fan array with fan wheel diameter not smaller than 18".

10.1.2 Air Distribution:

All duct systems will be constructed in accordance with the 2012 IMC and the SMACNA HVAC Duct Construction Manual. All ductwork will be constructed with galvanized steel. Medium pressure ducts (from air handler to VAV box inlets) constructed to 6" pressure class. Low pressure and exhaust ductwork constructed to 2" pressure class.

Medium and low pressure ductwork will be designed to minimize airflow-generated noise. Assume the pounds of ductwork used in this building will be **approximately 50% greater than on a typical building**. Also note that double-walled medium pressure mains will be used extensively throughout the building. Noise reductions in low pressure ductwork downstream of VAV boxes will be achieved by using sound attenuators installed in ductwork above all noise sensitive spaces.

In order to reduce vibration and noise at the point ducts enter the Proscenium and Concert Hall spaces, flexible duct connectors will be used at those wall penetrations.

Supply air will be ducted to cooling-only VAV boxes, and duct-mounted reheat coils will be located immediately downstream of the cooling-only VAV boxes. Duct-mounted reheat coils will be selected to achieve a 15°F heating water temperature differential.

Audience seating areas for the Concert Hall will be served by displacement diffusers located beneath every other seat in the audience. Supply air will be fed to diffusers through double-wall direct buried ductwork. Direct buried ductwork will be made from galvanized steel, will include a bitumastic coating to prevent corrosion, and will be encased in 4" of concrete.

All other areas of the building, including the Proscenium and dance theater, will be served by overhead diffusers.

10.1.3 **Building Pressure Relief:**

Multiple variable speed relief fans will be used to maintain the building interior at a constant positive pressure with respect to the outdoors. Outdoor reference pressure to be measured on four sides of building at ground floor ceiling elevation and averaged by connecting pneumatic tubing from all four sides. Indoor reference pressure to be measured at a point approximately 9 feet above the lower level floor slab in the main lobby.

10.1.4 **Exhaust**

Two central exhaust fans will provide exhaust in all restrooms, janitor's closets, locker rooms, and other spaces are required by code. Exhaust will be discharged above roof of building at a location it will not be entrained in the outdoor air intakes.

Generator exhaust will be ducted above the roof. The generator duct termination will be vertical and at a location that generator exhaust gasses will not be entrained in the outdoor air intakes.

10.1.5 **Dust Collector**

Permanent connections at equipment where identified on room data sheets. Discharge air will be filtered and returned to the building. We will work with UVU to determine system size.

10.1.6 **Heating and Chilled Water Requirements:**

All coils and terminal devices will be selected to comply with the following requirements.

System	Supply Temperature (°F)	Min. Delta T Across Coil (°F)
Heating Water	100	15
Chilled Water	45	14

10.1.7 **Chilled Water:**

Chilled water piping will be designed to run from existing campus piping mains in the Gunther Trades building to the Performing Arts building. Pipes will be routed overhead inside the building. Design will include two chilled water pumps, one lead and the other redundant, each sized for 100% of the chilled water demand at the air handlers. A second set of lead and redundant chilled water pumps shall be designed to serve chilled water fan coil units that operate 24 hours a day. All chilled water pumps will be equipped with variable frequency drives, and pump speed will be modulated to satisfy pipe differential pressure setpoint.

10.1.8 **Heating Water:**

Heating water piping will be designed to run from existing campus piping mains in the Gunther Trades building to the Performing Arts building. Pipes will be routed overhead inside the building. Design to include two heating water pumps, one lead and the other redundant, each sized for 100% of the heating water demand of the air handlers, duct mounted reheat coils, and unit heaters. These main heating water pumps will be equipped with variable frequency drives, and pump speed will be modulated to satisfy pipe differential pressure setpoint.

Design to include a glycol preheat loop and dedicated pump to serve the preheat coil in each air handler. Design will include a plate-and-frame heat exchanger to separate the heating water system from the glycol loop.

10.1.9 **Tower Water:**

Design shall include a cooling tower sized for a 3°F approach to outdoor wet bulb temperature. This water will serve the indirect cooling coils inside the air handlers. Design to include two tower water pumps, one lead and the other redundant, each sized for 100% of the demand of the indirect evaporative cooling coils in the air handlers.
Water treatment for the tower water system to be coordinated with the University. Moving water treatment chemicals to the penthouse will require one elevator to have a stop in the penthouse.

10.2.1 **Continuous Loads:**

Spaces requiring continuous conditioning, 24 hours a day, 7 days a week, will be cooled by chilled water fan coil units. We currently anticipate serving the following room types with fan coil units:
-Telecom/data server rooms
-Control rooms associated with theater and concert spaces.
-Dimmer rooms associated with theater and concert spaces.
-Amplifier Rack rooms associated with theater and concert spaces.
Note that no rehearsal spaces or instrument storage rooms will be designed with stand-alone HVAC systems. All such spaces will be served off the central air handlers, and will be subjected to the same night/weekend temperature setbacks as all other rooms served by the central air handlers.

10.2.2 **Snowmelt**

There will be no snowmelt system.

10.2.3 Controls System

Controls will be TAC StruxureWare BACnet compliant, and shall be provided by Utah Yamas controls. The design team will organize a controls system review meeting with Utah Yamas and the UVU facilities group during the Construction Document phase to coordinate details of the controls system before final CDs are issued.

11. PLUMBING SYSTEMS

11.1 Domestic Hot Water:

Domestic hot water piping served by existing water heaters in the upper central plant shall be extended to the Performing Arts Center, and will be used to meet all domestic hot water needs for this project..
The central domestic hot water circulating system will be extended to the building and will be used to keep water hot in pipes during periods of low demand.

11.2 **Plumbing Pipe:**

Water supply pipe shall be type L hard-drawn copper tube with soldered joints and fittings.
Drainage, waste, vent, and storm drain pipe shall be schedule 40 or service weight cast iron pipe with no-hub joints and fittings. Above-grade joints shall use medium-duty couplings rated to 30psig. Below grade joints shall use heavy-duty couplings with stainless steel bands.

11.3 **Fixtures:**

Faucets shall comply with UVU design standards. Lavatory faucets shall be Moen Model 8413F03 with pivot action single lever handle, and must include lifetime ceramic cartridge coverage by the vendor. Coordinate sink faucets with UVU facilities staff.

Water closets shall be wall-hung and use manual flush valves by Sloan.

Urinals shall be wall-hung and use battery-powered sensor flush valves by Sloan, max 1 pint/flush.

Water coolers to be wall hung with refrigeration compressors, with stainless steel backsplash. Multiple locations with bottle fillers (location and quantity to be determined as design develops)

Freeze-proof sillcocks will be located on the outside of the building – locations will be determined with input from UVU.

12. FIRE PROTECTION

Design-build/performance based criteria will be developed for a wet sprinkler system to protect entire building in accordance with NFPA 13. DFCM will commission a flow test for water sources on site. A copy of flow test report will be included with the fire sprinkler system specification for reference by contractor. Freeze protected sprinkler systems will be required to protect areas subject to freezing. All wet sprinkler pipe will be schedule 40 black steel. Single-Interlock Preaction Fire Sprinkler Systems: At this point in the design phase, the following room types will be specified to be protected by single-interlock predation fire sprinkler systems:

-Stage and Wing areas of the Proscenium Theater
-Concert Platform, Platform Wings, and Backstage Assembly areas of the Concert Hall.
-All control rooms, dimmer rooms, and audio rack rooms associated with the Proscenium Theater and Concert Hall.

Preaction system pipe and fittings will be schedule 40, galvanized.

ELECTRICAL

ELECTRICAL NARRATIVE

SECTION EIGHT: ELECTRICAL SYSTEMS

1. CODES AND STANDARDS

Codes and Standards which are applicable to the design of the electrical systems are listed below. Comply with each of the latest adopted publications.

ASHRAE 90.1, Standard for Energy Conservation in New Building Design
BICSI, Building Industry Consulting Services International
Division of Facilities Construction and Management (DFCM), Design Criteria
Division of Facilities Construction and Management (DFCM), High Performance Building Standard
UVU University Design Standards
UVU Audio/Visual Design Guide
UVU Technology Infrastructure Design Guide
UVU Telecommunications Distribution Design Guide
EIA/TIA, Electronics Industries Association/Telecommunications Industry Association
IBC 2012, International Building Code
IECC 2012, International Energy Conservation Code
IESNA, Illuminating Engineering Society of North America, The Lighting Handbook, 10th Edition
NFPA, National Fire Protection Association (applicable sections including but not limited to):
NFPA 70, National Electrical Code
NFPA 72, National Fire Code
NFPA 101, Life Safety Code
Standard Broadcast Wiring and Installation Practices", as excerpted from "Recommended Wiring Practices," Sound System Engineering, (2nd Edition), D. Davis
UL, Underwriter's Laboratories
Utah State Fire Marshal Laws, Rules and Regulations

2. SITE ELECTICAL UTILITIES

2.1 MEDIUM VOLTAGE DISTRIBUTION

The new building shall be fed from the existing 15 kV campus distribution system and connected to maintain a feeder loop. There is an existing abandoned 15 kV feeder that originates in the Upper Central Plant 15 kV switchgear (located in the Computer Sciences building) and heads east towards 400 west (this was originally an incoming feeder from RMP but has since been abandoned). This feeder can be intercepted in an existing manhole near the intersection of 960 South and Campus Drive. There should be sufficient length in the cable to pull the cable out and re-pull it through a new duct bank running towards the new building.

Provide a new 6-way, 5" concrete encased duct bank from the existing manhole heading south along Campus Drive towards the intersection of Wolverine Way, where a new 6-way switch shall be provided. The switch shall be VFI type with either solid-dielectric or less flammable edible see oil insulating medium. The switch shall have at least two 200A protected ways that UVU shall use for other buildings. All unprotected ways shall be 600A. From this switch the feeder loop shall continue to the new Performing Arts building where a 5-way switch shall be required with a protected way to feed the transformers for the building, and one spare way for a future adjacent building. To complete the loop, the feeder shall continue to an

existing 15 kV switch in the Gunther Trades building. The existing switch is currently fed on one side from the Upper Central Plant; this feeder shall need to be disconnected in order to connect and complete the loop from the new building.

Due to the large load of the performance lighting systems, the new building shall require two transformers, one at 277/480V and one at 120/208V 3-phase4-/wire. The exact size of the transformers shall be determined during the design phase based on the connected loads and NEC diversity. The transformers will be located outdoors as close to the building and main switchboard as possible. UVU prefers that the transformers be in a weather-protected enclosure. The transformers shall contain less-flammable edible see oil such as FR3.

Conductors used for 15 kV loops shall be #4/0 CU EPR. All conduits shall be minimum 5". When run underground, include at least one spare conduit. When run indoors, conduits shall be rigid metal run as high as possible, and painted red.

The 15 kV distribution system modifications up to and including the 15 kV switch for the building may be part of a separate project. Therefore, cost estimates relating to this scope of work shall be broken out as a separate line. The building transformers and all downstream power distribution shall be part of the Performing Arts Center cost estimate and budget.

2.2 TELECOMMUNICATIONS SERVICE

Comply with UVU IT Infrastructure and Cabling Specifications and coordinate all design and installation with the UVU campus Office of Information Technology Staff.

The data fiber optic service shall be obtained from the data center located in the Computer Science Building room 608, and copper voice service come from Gunther Trades 617A IDF room. These shall terminate in the new MDF room of the new Performing Arts Building. The following backbone service lines are required:

- 800 pair copper voice backbone cable to MDF
- 144 strand single mode fiber to MDF
- 100 pair copper voice backbone from MDF to each IDF
- 48 strand single mode fiber from MDF to each IDF
- 24 strand single mode fiber from MDF to each performance space AV room.

Provide pathways for the telecommunications service using a minimum of (3) 4" conduits from the new MDF room to existing cable tray in the Gunther Trades building. From there, sufficient pathway should exist to install the cabling indicated above.

Depending on the final location of the new building, an existing underground telecommunications duct bank with cabling may have to be relocated. It is run from the Facilities Annex building to Gunther Trades. Verify with final building site and actual location of this existing line if relocation is required.

3. BUILDING ELECTRICAL SERVICE AND DISTRIBUTION.

3.1 MAIN SERVICE AND DISTRIBUTION

The main electrical room shall be close to the medium voltage transformers for the building. Service voltage shall be both 277/480V and 120/208V. Service size is anticipated to be 3,000 amps for the 277/480V service, and 4,000 amps for the 120/208V service, but this shall be verified with final loads. The 120/208V service shall be dedicated primarily to the Performance Lighting system and other loads related to performance spaces. The purpose of this is to 1) meter these loads

separately from the other building loads, and 2) to provide electrical separation from the high-harmonic producing loads to minimize power quality problems for the other loads in the building. The main switchboards shall be provided with digital metering with network connections back to the campus central metering system as well as the building BAS.

In addition to the meters at the main service, provide metering to monitor energy usage for lighting, plug loads and HVAC. Separate metering for performance spaces shall also be considered. Connect meters to the BAS with communication protocol compatible with the BAS.

Dry-type step-down transformers and distribution are required to for the non-performance building loads requiring 120/208V, such as convenience outlets, small motors, etc. These transformers shall meet the latest federal energy efficiency requirements and have an appropriate K-rating based on the harmonic content of the loads served. Dedicated isolation transformers shall be required for power quality to serve performance sound and video systems, which are described in the performance portion of the narrative.

Distribution and branch panelboards shall be provided in electrical rooms on each floor of the building and located to minimize branch circuit conductor lengths. The electrical rooms shall be centrally located as much as possible, while taking into account other building and architectural considerations. Ease and accessibility of running new and future conduits out of each room shall be an important consideration in defining the location of the rooms. Panelboards serving normal lighting and outlet circuits shall be located on the same floor as the circuits they serve. All branch panelboards shall have hinged front covers, as opposed to screw-on or latching covers.

Motor control centers may be used for areas where 3 or more motors are grouped that required starters. All 3-phase motors shall be provided with phase-loss protection. Provide disconnect switches within sight of all motors. Provide variable frequency drives (VFD's) where required for mechanical equipment in compliance with DFCM and Campus requirements, and sized at least 10% over the connected motor load. Minimum total harmonic current distortion when measured at the input terminals of the VFD shall be not greater than 15%. The design electrical engineer may evaluate the variety of harmonic filtering and mitigation techniques and choose the best method to achieve this performance.

Switchboards, panelboards, transformers and other distribution equipment shall be provided with 25% spare capacity and spaces/spares for future growth and flexibility. Electrical equipment rooms shall have 25% additional space for future equipment.

Branch circuits are to be loaded to no more than 80% of what is allowed by NFPA 70. Where outlets are intended for a specific piece of equipment, the load of the outlet shall be based on the equipment nameplate. Otherwise, no more than 6 convenience outlets per circuit or 4 outlets per circuit serving workstation computer terminals, on average, shall be used. Sufficient capacity for plug-in task lights and other peripherals typical of desk items shall be provided. Outlets with dedicated branch circuits (one outlet per circuit) are provided for lab equipment, vending machines, copy machines, break room counters, refrigerators, dishwashers, A/V cabinets and other locations likely to have equipment requiring dedicated circuits. Each branch circuit homerun shall have no more than 3 circuits per raceway. Dedicated neutrals for each phase conductor shall be provided.

All conductors shall be copper and installed in conduit. Conductors for branch circuits shall be sized to prevent voltage drop exceeding 3% at the farthest load. The total voltage drop on both feeders and branch circuits shall not exceed 5%.

All raceways shall be minimum ¾"C for power, and larger for voice/data and other low-voltage systems. MC cable is not allowed. Conduit is not allowed to be embedded in elevated concrete slabs. Cable tray system shall be installed such that raceways do not extend more than 50' (approx.) to cable tray. For voice/data and other low-voltage cabling, conduits shall be stubbed to the cable tray and contain pull strings. Raceway shall be included for all security, audio/visual, and technology systems whether furnished as part of the construction contract or furnished by the Owner.

A fault current and coordination study shall be performed to indicate available fault current at all points in the distribution system. New equipment shall be rated for the amount of available fault current. Fuses or breakers shall be selected to ensure minimum system outage due to overloads or fault currents. Set breakers with adjustable long time, short time, instantaneous and/or ground fault settings for optimum system coordination. Per the NEC, emergency systems shall be selectively coordinated.

All feeder and branch circuit raceways shall include an insulated equipment grounding conductor. Provide a grounding riser system throughout the telecommunications and AV closets, with grounding bus bars mounted accessibly in each closet. In computer or server rooms with raised access flooring, provide a signal reference grounding grid in accordance with IEEE standard 1100-1999. All grounding systems shall be bonded together per NEC requirements.

Surge protective devices (SPD's) and "noise" protection shall be provided at service equipment (each main) and on main 120/208V distribution panelboards in the facility which serve computer terminals. SPD units shall be integral to the panelboard or switchboard. It is recommended that additional surge strips be provided under the furnishings and equipment budget on an as-needed basis. The surge strip should be commercial-grade quality and have at least 26 kA per phase maximum surge rating.

A lightning protection system is recommended for the building and shall be LPI-certified.

Outlets shall be 20A, minimum. The program and space data sheets shall be used as a guideline, but user input will be required during the design. Outlet locations shall be coordinated with the design team and end user. Where requirements cannot be identified, the following shall be used as a general guideline. Where the term "outlet" is used, this refers to a 20A duplex receptacle outlet (unless otherwise noted).

Classrooms and other Instructional Spaces: Provide outlets for instructor's station, audio/visual equipment and on each wall. Where student tables are permanent or pre-wired, then provide outlets for each student seat. Ensure that there is at least one outlet for each 10' of wall space. Provide floor outlets, poke-throughs or underfloor duct where stations or equipment cannot be served directly from the wall without crossing aisle space and where no access floor is provided.

Offices/Workstations: For each workstation, provide one outlet dedicated to computer terminals and one normal outlet, and one additional normal outlet for every 10' of wall space.

Commons Areas and Lounges: Provide power outlets for laptop computers, at least one duplex for each group of 4 seats, but no less than one outlet per each 12' of wall space. Provide floor outlets where stations or equipment cannot be served directly from the wall without crossing aisle space.

Conference Rooms: One outlet for every 10' of wall space, plus one outlet dedicated to computer terminals on two walls. Include at least one floorbox underneath conference room table for power and data.

Multi-Purpose Rooms: Outlets for audio/visual equipment, plus one outlet for every 10' of wall space.

Vending Rooms: One dedicated power outlet for each vending machine, plus one data outlet for each group of 4 vending machines.

Breakrooms: Outlets on dedicated circuits every 4' on counter top plus dedicated outlets for refrigerator, microwave, and disposal (switched at counter top), plus one outlet for every 10' of other wall space in room.

Counter tops (in general): One outlet every 4'; GFI where within 8' of a sink.

Restrooms: One GFI outlet near sink.

Telephone/Data Closets: At least 6 quad outlets on emergency power with circuit density to allow for at least 50 VA per square foot.
Electrical Rooms: At least one outlet on emergency power.
Corridors, Lobbies: Provide at least one outlet every 25', on alternating sides of the corridor or lobby.

Stairs: One outlet at the landing of each level.

Storage Rooms (small), Janitors Closets: One outlet on each wall.

Building Exterior: One WP/GFI outlet near each entrance

Performance Spaces: For performance and related spaces, refer to the space data sheets and the performance portion of the narrative for requirements.

3.2 EMERGENCY SERVICE AND DISTRIBUTION

An emergency diesel generator shall be provided for the new building. Generator shall be outdoors in a screened area with weather-protective, sound-attenuating housing and skid-mounted, double-walled tank. Fuel supply shall be minimum 18 hours at full load. Two transfer switches are required: one for emergency and one for non-emergency ("stand-by") loads. The following shall be provided with emergency power.

Emergency egress and exit lighting
Fire Alarm
Elevators
Smoke control
Communications and Server rooms – outlets, lights and air conditioning
Electrical rooms – lights and outlets
Security systems
Building automation systems

4. LIGHTING

4.1 GENERAL REQUIREMENTS (NON-PERFORMANCE LIGHTING)

The basis for design shall be the IES and its Recommended Practices, such as RP1-93 "Office Lighting", RP3-00 "Lighting for Educational Facilities", and RP-33-99 "Lighting for Exterior Environments". For exterior lighting, indirect lighting, and other specialized task lighting, a point-by-point plot of illuminance establishing conformance with the Recommended Practices shall be furnished. Ballasts shall be 10% THD to minimize system harmonics. The amount of different lamp types shall be minimized, making replacement and maintenance easier. Comply with UVU design standards for technology preferences. Lamps shall comply with EPA TCLP requirements. Consideration shall be given to LED sources as the predominant light source.

ASHRAE 90.1 requirements shall be met and exceeded to meet the overall project requirement to beat this energy code by at least 10%. Compliance is also required with the State High Performance Building System. Energy savings design techniques such as daylighting control, occupancy sensors, centralized and de-centralized control systems, energy efficient lamps/ballasts shall be used where practical to maximize energy efficiency.

4.2 EXTERIOR LIGHTING

Exterior lighting shall use campus standard LED lighting fixtures and poles for walkways, parking and roadways, compatible with the campus surroundings. All exterior lighting fixtures shall be full cut-off to avoid sky glow and light trespass conditions. Control exterior lighting utilizing combination photocell and time schedule control.

4.3 INTERIOR LIGHTING

In performing spaces, house lighting and stage lighting shall be dimmable linearly from 0% to 100%, and be controllable separately from any other zone. Lighting shall be controlled by dimmers located near the performers, in the back of the room, and from the room A/V control system. Lighting control protocol shall be DMX or sACN only

Interior lighting shall use LED lamps to the greatest extent possible, but fluorescent lamps may be appropriate for some areas and shall use the 4' T8 lamp. HID sources should not be required. Incandescent sources should be avoided altogether, except where required for performance lighting which is exempt from the energy codes.

For offices, classrooms and meeting rooms, pendant indirect lighting or recessed direct/indirect fixtures should be strongly considered, and must be carefully coordinated in rooms with projectors so that the fixtures do not interfere with the projected image. Select luminaires for areas where VDTs and monitors are planned which are designed to minimize veiling reflections, and provide multilevel lighting control and task lighting to reduce the illuminance on the VDT. In addition, in rooms with audio visual, design lighting with variable or switched levels as indicated with a separate controlled zone to reduce glare and illuminance on the audio visual display. In rooms with projectors or monitors, provide a separate bank of lighting control switches or station near the instructor position for ease of controlling lighting during presentations.

For spaces where glare control is not required, lay-in fixtures may be used. This includes corridors, workrooms, restrooms, common areas, equipment rooms and storage rooms. Recessed LED downlights shall be used in areas where aesthetics call for an upgraded appearance, such as in main lobbies. Decorative fixtures shall be selected in coordination with the Architect to match the overall visual theme of the space.

All interior lighting shall be controlled by some automatic means. This shall include occupancy/vacancy sensors for smaller enclosed areas and relay control with clock and/or timer supervision for larger areas. Uniformity must be maintained when in reduced lighting modes. The corridors and common areas shall be controlled through the building management system with local wall switch override. Wherever natural daylight is provided, incorporate daylighting controls to promote energy savings by using artificial lighting only as needed. This can be accomplished with automatic dimming, stepped switching

or simple on/off control depending on the functional needs of the space. All lighting shall be "instant on" to facilitate quick response to demand and power interruptions.

Exit and emergency lighting shall comply with the IBC. Emergency lighting for means of egress to 1 fc average, 0.3 fc minimum, shall be provided. Emergency lighting shall be included in restrooms, electrical rooms, and communication rooms.

Lighting levels and methods of control for individual spaces are indicated in the program space data sheets.

Performance lighting is described in a separate section of this program.

5. FIRE AND LIFE SAFETY

5.1 FIRE ALARM

Comply with Utah State Fire Marshal's "Rules and Regulations" and UVU requirements. A variety of manufacturers have installed systems on campus. Coordinate with campus facilities during design to ensure that any new system is acceptable to the campus. Design an addressable system capable of reporting back to central campus security office (Gunther Trades Building). Design strobes visible from all locations except private offices and coordinate with furniture plans. Based on preliminary code evaluation, a voice evacuation system is required. Verify this requirement during the design. Design speakers to comply with NFPA including for higher ambient noise requirements. Where smoke control systems are required, coordinate the integration of the fire alarm with the smoke control systems. For performance spaces, interconnect the performance sound and lighting systems with the fire alarm system so that the performance sound will be interrupted and the lighting energized. Provide duct detectors and fan shutdown where required by NFPA and the IMC, including detection of smoke at all return air shafts serving multiple floors. Coordinate location of the building annunciator with the Campus fire marshal. All other detectors and functions shall comply with the referenced codes and standards. All fire alarm wiring shall be in conduit. Final programming of system shall be coordinated with the Campus Fire Marshal to ensure that the program shall be compatible with existing campus fire alarm programming.

5.2 DISTRIBUTED ANTENNA SYSTEM

A distributed antenna system shall be provided throughout the facility to boost signals for both emergency radios. The option of adding capability for cellular phone coverage as well shall be explored and presented during the design process.

6. TELECOMMUNICATIONS RACEWAYS AND CABLING

6.1 GENERAL

Comply with UVU Infrastructure and Telecommunications Specifications and coordinate all design and installation with the UVU campus Office of Information Technology Staff.

6.2 TELECOMMUNICATIONS SPACES AND RACEWAYS

Stacked telecommunications closets are required to serve each floor of the building. Equipment layout and wall space shall be coordinated with the Campus. Closets shall be located such that when cabling is routed through the raceway system provided, no cable length shall exceed 290' regardless of the path. Two IDF closets per floor may be required depending on floor size and closet location. Give consideration to the ease and accessibility of running new and future raceways and cables out of each room. Four 4" conduits from the MDF to the stacked IDF locations shall be provided and four 4" sleeves between floors. MDF minimum size shall be 10' x 20' and IDF minimum 10' x 15'. Both normal and emergency circuits

are provided to each IDF, 3 each, with one fourplex per circuit. The air conditioning for these rooms shall be dedicated to the rooms and on the generator.

A cable tray distribution network is to be provided throughout each floor and into the MDF/IDF closets. Cable tray shall be routed above corridors, common and similar areas. In all ceiling areas where accessible, provide ladder-type tray to match existing campus standard. Where ceilings are inaccessible, provide an equivalent conduit system bridging cable trays in accessible ceilings. It shall be the designer's responsibility to size the cable tray and raceway system for the intended cabling installation. Specify that cable runs take routes that shall limit the total cable distance, between termination end points, to 290' or less.

Each voice/data outlet location shall consist of a 5" square box with two gang mud ring and one 1.25" conduit stubbed to the nearest cable tray. Refer to program space plans for quantities and coordinate exact locations with the users during design. As a minimum, provide one voice/data drop for each workstation, fax machine, copy machine, vending machine, desk, computer terminal and teaching station. Allow one voice/data box per 80 square feet for areas that are not specifically defined. A wireless network shall be provided throughout all areas of the building. Coordinate wireless access point locations with UVU IT group during the design.

6.3 TELECOMMUNICATIONS CABLING

Voice-data cabling (structured cabling systems) shall include copper station cabling, copper and fiber backbones, all terminations, wall plates, patch panels, copper patch cables, fiber patch cords, cross connects, racks and wire management. All copper cable shall be terminated in compliance with the EIA/TIA 568B and C standards. In addition comply with all the UVU Master Infrastructure and Master Cabling Specifications. The installer of the voice and data cabling system shall be Siemens CI certified and shall provide a warranty for the complete installation through the Siemens warranty program. Every strand of fiber and every conductor of copper shall be tested in full compliance with the above identified EIA/TIA standards. All fiber shall be tested at both 1310 and 1550 nM. All test results shall be documented on 8 ½" x 11" paper and electronically in a Microsoft Excel format for every conductor of copper and fiber cable.

From the MDF, a backbone of 100 pair category 3 copper riser rated, plenum rated cable for voice, and 48 strand single mode fiber cabling for data shall be provided to each subsequent wiring closet, or intermediate data frame (IDF) on each of the floors for voice and data signal distribution. Additional 24-strand fiber cables shall be provided to performance spaces. All fiber shall be terminated into separate RIC/LIU's at each end with SC connectors. Install all fiber cable inside of plenum rated innerduct. Rack mount all cable termination equipment inside enclosed, three section, minimum 24", steel, 19" equipment racks with locking, smoked plexi-glass front doors.

Horizontal cabling shall be provided from each voice-data outlet to the nearest IDF on the same building level. With the exception of cable for wireless access point data outlets, all horizontal cable specified for data jacks shall be 10 G, augmented category 6A UTP plenum rated cable with a white jacket. All horizontal cable specified for wireless access point data outlets shall be 10 G, augmented category 6A UTP plenum rated cable with a white jacket. All horizontal cable specified for voice jacks shall be category 5e UTP plenum rated cable with a blue jacket. All horizontal voice cable shall be terminated in 110 punch down blocks at the equipment room (IDF) end, and on workstation outlets at the station end. A typical drop will consist of (2) CAT 6A cables and one CAT 5E cable, however, more or less will be required based on specific location and application. All room shall have voice/data drops, except storage rooms. In offices, split the pairs from the single voice cable to each specified RJ-14 jack. All horizontal data cable shall be terminated in patch panels loaded with augmented category 6, RJ-45 connectors in the equipment room (IDF) end, and on workstation outlets at the station end. The patch panel at

the equipment end shall be located in an enclosed, 3-section, minimum 24", steel, 19" equipment rack with locking, smoked plexi-glass front doors.

UVU desires that the building, and all immediately adjacent outdoor areas, be provided with reliable wireless local area network coverage. Provide data outlets at owner designated locations for wireless access points to cover all interior areas as well as to spill-out into all immediately adjacent outdoor areas. Design wireless access point data outlets with two augmented category 6, RJ45 data jacks mounted on a double gang wall plate. Two augmented category 6 cables shall be provided for termination to the two RJ-45 jacks for data. Locate all data outlets for wireless access points above the ceiling. At a minimum, without implying limitation, design 6 wireless access point outlets per floor.

7. SECURITY SYSTEMS

7.1 CARD ACCESS, CCTV AND INTRUSION DETECTION

All security systems shall comply with established campus standards, shall be IP based, and shall be simple network management protocol (SNMP) compatible. Systems shall be integrated with existing headend equipment and annunciate alarm conditions to, and be completely monitored by, UVU.

A complete access control system shall be specified to control entry to all perimeter entry/exit points, MDF rooms, IDF rooms, and at select sensitive interior spaces. Card readers shall be the proximity type, and shall comply with established campus standards. Card readers shall report to distributed door controllers. Coordinate door hardware to minimize the aesthetic impact to the appearance of the building. System manufacturer shall be Lenel and integrated into the existing UVU card access system.

A complete video surveillance system shall be specified to provide for visual monitoring at all building entry/exit points, at select main building thoroughfares, elevator lobbies, all MDF's and IDF's, and at other select sensitive interior areas. Camera manufacturer shall be Axis and shall be specified for viewing of owner designated subject areas, and installed in appropriately rated enclosures. Signals from cameras shall be connected to a central switching/multiplexing system with minimum 20" video monitors for viewing. All camera images shall be digitally recorded by DVR's that are local area network accessible. The video surveillance system shall integrate with the campus Milestone video surveillance system and software.

A complete intrusion detection system shall be specified for electronic monitoring and status reporting of all building entry/exit points, select building thoroughfares, all MDF's and IDF's, and at other select sensitive interior areas. Sensing devices shall include door position switches, motion sensors, and where/if appropriate, glass break sensors. All sensing devices shall report to a zoned monitoring panel for specific location identification of an alarm condition. The intrusion detection system shall be integrated with the video surveillance system for priority viewing of security breach areas.

8. AUDIO AND VIDEO SYSTEMS

8.1 GENERAL

The basis of design for all audio/video (AV) systems shall be the latest edition of the UVU Audio/Visual Design Guide (AVDG), which is incorporated into this program by reference. The architectural/engineering design team shall strictly follow all requirements of the AVDG for each type of space. Space types are defined in the AVDG as to equipment, wiring, rough-in and installation requirements for the various spaces. All instructional, performance, practice, and meeting spaces

shall be provided with an AV system as defined in the AVDG and this program. In additional, the UVU AV staff shall be fully involved with the design team throughout design to provide direction, input and review of the AV systems design.

8.2 FACILITY-WIDE DIGITAL SIGNAGE SYSTEM

A digital signage system shall be specified.

Video panels shall be sized for the application. Each panel shall be 46 to 55 inches (diagonally measured), or larger for special applications.

Video panels for digital signage applications shall be professional-grade and rated for a minimum of 16 hours per day operation.

Video panels used for digital signage shall be wall-mounted using a secure wall or ceiling mount. Security devices shall be installed to protect against theft.

Each digital signage application requires a double-gang electrical power outlet, concealed behind the video panel. This power outlet will support at least 2 devices that require 120VAC power.

Each application shall have the following low voltage jacks terminated in an outlet concealed behind the video panel:

- Two Category 6A cables are required for each Digital Signage video panel, terminated in the nearest telecommunications room.
- See the TDDG for more information.

The design shall require the A/V Contractor to provide a media player, software and license for each application and connect the media player to the existing campus system (SCALA). The Designer shall work with the AVPM to select the appropriate solution on a case-by-case basis, probably deploying one or more of the following options:

- Provide an Open Pluggable Specification (OPS) media player. UVU's preferred video panel from NEC has integrated OPS card slots.
- A second option is to use thin-client computers. Products from Lenovo and Intel are currently being used.

The Designer shall inquire with the UVU AVPM on a case-by-case basis about the requirements for a project.

8.3 TV DISTRIBUTION SYSTEM

The campus currently uses an IP-based TV system. For each TV location, provide a power outlet and a standard data drop with CAT 6A cabling run to the nearest data closet. The coax TV distribution system on campus is still used in existing buildings, but not being implemented in new buildings.

There is a possibility that performance spaces may require a high-definition, automated video recording and storage system to allow students to access and use their performances from digitally stored archives. If the budget does not allow these systems to be installed initially, then provide empty raceway rough-in so that they could be added later.

THEATRICAL

THEATRE EQUIPMENT NARRATIVE
STRUCTURAL LOADING
ELECTRICAL LOADING
HEAT LOADING
PERFORMANCE SOUND, VIDEO, AND COMMUNICATIONS REPORT
ACOUSTICAL DESIGN GUIDANCE FOR MECHANICAL SYSTEMS
THEATRE EQUIPMENT BUDGET

Method Studio

Utah Valley University Performing Arts Complex

Theatre Equipment Narrative

TE/R01

Issue 1 | April 20, 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 245160-00

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ARUP

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Appendices

Appendix A

Typical Details

1 Introduction

This narrative describes the performance equipment for the new Utah Valley University Performing Arts Complex.

1.1 Theatre Equipment

Performance equipment includes production systems and devices intended to support the programming in the Concert Hall, Proscenium Theatre, Dance Venue, Instrument Ensemble Room, and Choral Ensemble Room as well as related support facilities. Performance Sound, Video and Communications (PSVC) equipment intended to support the same performance and support spaces is described in a companion narrative. For all of these spaces and equipment significant coordination is required by the architect, engineers, and design team.

Equipment is listed by CSI specification:

Division 11: Equipment

- 11 61 11 Adjustable Acoustics
- 11 61 13 Adjustable Acoustics Drapery and Track
- 11 61 14 Operable Performance Partitions
- 11 61 23 Theatrical Platforms
- 11 61 33 Theatrical Rigging
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- 11 61 61 Theatrical Lifts
- 11 61 63 Theatrical Seating Wagons
- 11 61 71 Performance Dance Floor Surface
- 11 61 93 Performance Lighting Instruments and Accessories

Division 12: Furnishings

- 12 66 23 Telescopic Seating Risers

Division 26: Electrical

- 26 09 61 Performance Dimming and Controls

Division 27: Integrated Audio-Video Systems and Equipment

Refer to companion document.

1.2 Architectural and Technical Elements

This narrative also provides specific recommendations and advice on architectural elements that are not performance equipment but do have significant impact on all performance equipment and require careful coordination. These elements include:

Fixed, Loose, and Bench Seating

Stage floors

Stage galleries and catwalks

Performance lighting positions

Grids (forestage and overstage)

Orchestra pit and seating wagon railing fascia

Adjustable proscenium panels

Forestage reflector

Balconies and boxes

Acoustical doors

Company switches

Conduit, Wiring and Back boxes

2 Concert Hall

2.1 Theatre Equipment

2.1.1 11 61 13 Adjustable Acoustic Drapery and Track

The adjustable acoustic drapery and track consists of electro-mechanically driven fabric drapes that operate horizontally on curtain tracks. These drapes deploy out from storage pockets and into the room along the walls of the concert hall auditorium. Each drape or pairs of drapes will be motor driven from a central control station. The system will utilize a programmable logic controller and encoders/limit switches to locate the position of each drape. The system will allow for a number of presets to be reliably recalled as needed for different performance types or room settings.

Accommodation required - Coordination of finishes, fabric color, storage pockets and access, electrical conduit and wiring, and structural framing systems with Architect, Electrical and Structural Engineer.

2.1.2 11 61 23 Theatrical Platforms:

Orchestra Risers – Orchestra risers will be provided to elevate sections of the orchestra above the performance platform. Riser layout will be developed with orchestra layouts in DD.

Conductor Podium – A portable conductor's podium with steps and railings will be provided.

Accommodation Required – Storage for risers and podium when not in use located under platform in basement level.

Sound Control Position – The in-house sound control location is planned to be located at the cross aisle in front of the parterre wall. A depressed slab in this area will form a pit that scissor

type variable height platforms can be collapsed into. Demountable partitions that drop into flush sockets will be provided to enclose the area and mask the technical equipment.

Accommodation required - Coordination of finishes, electrical conduit and wiring, and structural slab elevations with Architect, Electrical and Structural Engineer.

2.1.3 11 61 33 Theatrical Rigging:

Concert Canopy Reflector Rigging – Motorized hoists will be provided to allow acoustic adjustment of the canopy reflectors. The center 3 reflectors will be independently adjustable and the outer reflectors will be adjustable in pairs (DS- L/R, MS-L/R, and US-L/R). The system will utilize a programmable logic controller and encoders/limit switches to locate the position of each reflector. The system will also allow for a number of presets to be reliably recalled as needed for different performance types or acoustic settings.

Speaker Cluster Rigging – Motorized hoists will be provided for the Left / Center / Right Speaker Clusters. Clusters will be flown to performance height when in use and lowered onto trolleys to be taken away when not in use.

Controls – Controls for motorized rigging elements will be provided in a master control panels and remote pendant controllers.

Chain Motor Control – An 8-way chain motor control system is envisioned for the concert hall. Chain motor power and control receptacles and structural strong points will be located Front of House and above the performance platform - adjacent to the catwalks. This will allow for the suspension of trusses or other temporary production equipment. Only installed infrastructure for the chain motor system will be provided, no loose equipment (chain motors, stands, extensions, truss, etc.) will be provided.

Accommodation required - Coordination of the structural design of attic or grid and strong point locations to support rigging equipment. Coordination of all MEP systems allow clear area for rigging operation. Coordination of electrical services and connections as required for electric motors.

2.1.4 11 61 61 Theatrical Lifts

Lift - The motorized lift system is a steel framed lift table consisting of a proprietary lift system anchored to lift pit foundation slab. The lift is provided with all controls, safeties and post and chain railing. Lift controls shall be from a hand held pendant with receptacles backstage and on the lift. Preset positions will include “Stage Extension” with lift at performance platform elevation, “Seating” with lift at auditorium front row elevation, and “Storage” with lift at basement level.

Accommodation required - Structural slabs as required for lift machinery to be provided by other trades. Finish flooring and fascia to be provided by other trades. Coordination of electrical services and connections as required for electric motors and motor control cabinets. Coordination of devices in lift table and cable management to lift pit floor (demountable aisle lights, convenience power, and loudspeaker wiring access).

2.1.5 11 61 63 Theatrical Seating Wagon

Seating Wagon – The first two rows of seats will be located on a seating wagon that sits atop the Stage Extension Lift. When in use, the wagon's finished floor elevation is at the same elevation as the fixed seating in the next adjacent row. When not in use the wagon will store in the basement and allow the lift to form a stage extension allowing for approximately 8'-6" of extra platform depth.

Accommodation required –Finish flooring and fascia to be provided and installed by other trades. Fixed seating to be provided by other trades.

2.1.6 11 61 93 Theatrical Lighting Instruments and Accessories

An inventory of approximately one hundred twenty (120) concert lighting fixtures with mounting and distribution hardware will be provided. Fixture accessories (barndoors, tophats, irises) as well as an inventory of stage extension cables will be provided. The concert lighting should be designed to give an even wash of light over the extent of the concert platform allowing musicians to be seen and to read their scores. No followspots for the concert hall will be provided, however a followspot booth and accommodations for future followspots in planned.

Accommodation required - Electrical services and connections as required with Electrical Engineer.

2.1.7 26 09 61 Theatrical Dimming and Control

This system shall consist of approximately ninety six (96) remote controlled dimmers for performance lighting. Additional dimmers for house lighting will be required per electrical engineer. The dimmers are wired to individual performance lighting outlets distributed throughout the concert hall (primarily at the tech level). Performance lighting control will be DMX distributed throughout the concert hall by way of sACN (ENET). Portable DMX nodes will convert sACN to DMX at facility panel locations. A portable lighting control console for the performance lighting will be included. Console operation shall be possible from the control room, and rehearsal position in the audience chamber. Architectural lighting control will be provided and pushbutton stations will be located adjacent to entry doors. Master control will be by way of touchscreen control stations located backstage and in the control booth.

Accommodation Required – Electrical contractor to provide electrical services to dimmer racks and two-wire plus ground branch circuits to fixed lighting and performance lighting outlets - including all labor, wire, raceways, standard back boxes and fittings. All labor, wire, raceways, and standard back boxes for control systems provided by others per contractor. Coordination with house lighting designed by Electrical Engineer. Accommodation of electrical power and control conduit and wiring with Electrical Engineer.

2.1.8 Other (Items required but not specified)

Musician Chairs & Stands – Professional orchestra chairs, music stands, and stand lights. Chairs and stands to be portable and stackable. Include rolling racks for stands and chairs.

Miscellaneous Stage Equipment - Complement of ladders, tools, first aid, safety equipment and other miscellaneous items as required.

Accommodation - Storage required when not in use.

2.2 Architectural Elements

2.2.1 12 61 00 Fixed Auditorium Seating

Fixed seating of approximately 695 quality chairs with self-rising seat bottoms, seat arms, letter and number plates, and end standards will be provided. Demountable chairs will be located to provide locations for wheelchair positions and for temporary technical areas. Seats to include provisions for aisle fixed seats with transfer arms for disabled access to ADA and local code requirements. All demountable chairs to be removable in singles or gangs of 2 and 3.

Accommodation Required - Coordination of seating layout, riser layout, sightlines, finishes, fixing details and underfloor supply (if any) with Architect, Structural, and Mechanical, engineers. Coordination of removable seating needs and aisle light requirements with Electrical Engineers.

2.2.2 12 62 03 Loose Auditorium Seating

Loose seating of approximately 60 quality chairs to match finishes of fixed seating will be provided. Seating to be used in box levels as shown on architect's and theatre consultant's drawings.

Accommodation Required - Coordination of railings, sightlines, and finishes with Architect.

2.2.3 12 67 23 Bench Choral Seating

Choral seating in continuous benches at the choral balcony. Finish and Fabric to match fixed auditorium seating.

Accommodation Required - Coordination of seating layout, riser layout, sightlines, finishes, fixing details and underfloor supply (if any) with Architect, Structural, and Mechanical, engineers. Coordination of removable seating needs and aisle light requirements with Electrical Engineers.

Note: Fixed, Loose, and Bench seating in Construction Budget not in Theatre Equipment Budget

2.2.4 Stage Floor

Performance Platform floor. Refer to attached details in appendix.

Accommodation required – Slap depression and loading requirements coordinated with structural engineer. Coordination of finishes and details with Architect.

2.2.5 Lighting Bridges & Lighting Positions

Refer to attached details in appendix.
The catwalks or lighting bridges will carry a considerable amount of performance lighting equipment. All railings in these areas must be sized to accommodate standard lighting equipment clamps, and in many positions, must be adjustable. Provision for lighting positions on the balcony front and under upper level side boxes will be developed.

Accommodation Required - Coordination of finishes and structural support system with Architect and Structural Engineer. MEP zones to be coordinated and clear of lighting positions. Adequate work light and performance running lights to be provided in the technical level and attic area. Electrical services for equipment to be coordinated with electrical engineer.

2.2.6 Company Switches & Cable Passes

Electrical disconnects (company switches) as required for temporary production power (lighting, rigging, automation and machinery). Locations, quantities, and sizes are provided will be identified in DD.

A system of temporary cable passes as required to allow temporary production cabling to be run between the loading dock, house mix positions, control booth, and performance venues will be developed in DD.

Accommodation Required - Coordination of finishes, fire protection strategy, and structural penetrations/slab depressions with Architect and Engineers.

2.2.7 Conduit, Wiring and Back boxes

Provision of electrical wiring services and materials for the performance equipment systems described in this document

Accommodation Required - Coordination of finishes, locations, access, and structural support system with Architect and Engineers.

3 Proscenium Theatre

3.1 Theatre Equipment

3.1.1 11 61 11 Adjustable Acoustics

The adjustable acoustics in the Proscenium Theatre consists of electro-mechanically driven fabric banners that operate vertically. These banners deploy out from banner boxes located at the catwalk level along the side walls. The banners will be operated from a central control station located in the stagehouse. The system will utilize a programmable logic controller and encoders/limit switches to locate the position of each banner. The system will allow for a number of presets to be reliably recalled as needed for different performance types or room settings.

Accommodation required - Coordination of finishes, fabric color, and access, electrical conduit and wiring, and structural framing systems with Architect, Electrical and Structural Engineer.

3.1.2 11 61 14 Operable Performance Partitions

Operable performance partitions will be provided at the back wall of the orchestra pit. One side of the partition will be acoustically reflective and the other side acoustically absorptive. The track layout will allow partitions to be deployed with either side facing out or a combination of both. This adjustment will provide some control of loudness in the pit. The partitions will also allow access to the seat wagon storage area on the other side of the partitions from the orchestra pit.

3.1.3 11 61 23 Theatrical Platforms

The in-house sound mix position will be located directly in front of the parterre wall. A depressed slab in this area will form a pit that scissor type variable height platforms can be collapsed into. Demountable partitions that drop into flush sockets will be provided to enclose the area and mask the technical equipment.

Accommodation required - Coordination of finishes, electrical conduit and wiring, and structural slab elevations with Architect, Electrical and Structural Engineer.

3.1.4 11 61 33 Theatrical Rigging:

Counterweight Rigging - The single purchase counterweight rigging system will have accommodation for 60 linesets on 8” centers to suspend and move scenery, lighting, and drapery within the stagehouse. Approximately 50 linesets will be provided (10 deferred/future). The 60’ long ladder battens are constructed of 1.9” OD schedule 40 pipe with approximately 1800 pound load capacity above pipe weight and will require 6 lift lines. Batten extensions will be provided for 10 linesets to allow for additional batten length when required. A locking rail will be provided at stage level. The system also includes outriggers and an index strip light at stage and gallery levels. A capstan winch will be provided to assist with lifting heavy loads.

Fire Safety Curtain – Required by code to allow for smoke separation between stage and audience.

House Curtain Rigging – A manually operated house curtain traveler track will be provided to allow for a traveling and paging of the main drape.

Stage Traveler Tracks - Portable manual traveler tracks attached to overhead battens for bi-parting of a two panel curtains to be used for mid-stage and upstage travelers.

Side Tab Masking – Fixed tracks located under the stage galleries on the onstage side will be provided to allow for side tab masking panels.

Chain Motor Control – A 12-way chain motor control system will be provided for the proscenium. Chain motor power and control receptacles will be located at the grid and forestage grid. This will allow for the suspension of trusses or other temporary production equipment from

these locations. Additionally, a grid hatch is planned with a rigging beam located above to for hoisting loads up to the grid. Four 1 ton chain motors, four chain motor stands, and chain motor extension cables will be provided.

Speaker Cluster Rigging – No hoists for loudspeakers will be provided in the proscenium. Fixed locations for the house system is envisioned. Chain motors can be used to hoist touring equipment.

Other - Miscellaneous loose rigging equipment is provided for use which includes a compliment of belay pins, cable support cradles, bottom weight pipe for draperies, purchase line snubbers and heat shield borders.

Accommodation required - Coordination of structural design of stage house to support rigging equipment. Coordination of all MEP systems in stagehouse to allow clear area for rigging operation. Electrical services and connections as required for connections to theatre equipment with Electrical Engineer. Coordination of structural columns and support with Architect and Structural Engineer.

3.1.5 11 61 43 Stage Draperies

Velour drapery shall be an opaque inherently flame retardant polyester fabric providing long service life with little maintenance. The main curtain is to be sewn with 100% fullness and with lining. A matching valance will be provided. An inventory of black velour masking draperies (legs, borders, side tab masking panels, and mid-stage and upstage travelers) sewn flat is included. A filled leno cyc, a white scrim, and a black scrim are supplied. Muslin drawstring bags and storage hampers with lids and heavy-duty casters are also provided.

Accommodation required - Main Curtain and valance to be selected by Architect. Masking color selection is to be from standard manufacturer's colors.

3.1.6 11 61 61 Theatrical Lifts

The motorized orchestra pit lift system is a steel framed lift table consisting of a proprietary lift system anchored to the lift pit foundation slab. Orchestra lift is provided with all controls and safeties Lift controls shall be from a hand held pendant with receptacles backstage and on lift. Orchestra lift will accommodate a seat wagon to allow for an increased seat count when the orchestra pit is not in use. Preset positions will include "Stage" with lift at stage elevation, "Seating" with lift at auditorium front row elevation, and "Orchestra Pit" with lift at Orchestra pit and wagon storage level. Removable and permanent railings at vertical openings at and below lifts may be integral to the lifts, or may be provided by other trades. Lift will incorporate loudspeakers.

Accommodation required - Structural slabs as required for lift machinery to be provided by other trades. Finish flooring and fascia to be provided by other trades. Coordination of electrical services and connections as required for electric motors and motor control cabinets. Coordination of devices in lift table and cable management to lift pit floor (demountable aisle lights, convenience power, and loudspeaker wiring access).

3.1.7 11 61 63 Theatrical Seating Wagon

Seating Wagons – The first two rows of seats will be located on a seating wagon that sits atop the Orchestra Pit Lift. When in use for seating, the wagon's finished floor elevation will play at auditorium level. When not in use the wagon will store in the basement and allow the lift to form a stage extension or an orchestra pit. The next two rows of seats will be located on 5 separate seating wagons that sit atop a concrete slab adjacent to the orchestra pit lift on the audience side. The wagons will be designed to break apart between fixed seating with double arms to allow for a near continuous layout of seats in a row. The wagons will be removed by unlocking each wagon from its adjacent wagon and moving them onto the lift. The wagons can then be raised onto the stage with the lift and stored in wings, the scene shop, the loading dock or offsite. System to include removable railing inserts as required.

Accommodation required – Finish flooring and fascia to be provided and installed by other trades. Fixed seating to be provided by other trades Coordination of adjacent surfaces, storage locations, column placements, and slab accommodation with Architect and Structural Engineer.

3.1.8 11 61 71 Performance Dance Floor Surface

Although not provided, it is recommended that a modular and portable dance floor for the proscenium be acquired for setting over the permanent stage floor. The purpose of the temporary floor is to provide an injury-reducing, resilient floor for dance use. The protection and "feel" in dance performances provided by the portable floor cannot be achieved by the permanent stage floor due to construction requirements. Provided for the proscenium will be a demountable vinyl dance floor covering of approximately 2400 square feet. The floor will be provided in approx. 6'-0" wide by 60' long rolls. Floor will be laid flat with taped seams. The floor will store on specially designed dance floor cart(s) to allow for easy rolling and unrolling of the floor.

Accommodation required - Storage for cart when not in use.

3.1.9 11 61 93 Theatrical Lighting Instruments and Accessories

An inventory of approximately one hundred seventy five (175) demountable stage lighting fixtures with mounting and distribution hardware will be provided. The fixture are primarily tungsten fixtures but does include a modest compliment of LED wash lights and cyc lights. Two (2) followspots are provided. Accessories including components for 10 side lighting booms, 10 light ladders, side arms, c-clamps, safety cables, barndoors, tophats and an inventory of extension cable, two-fers, and multi cable will be provided.

Accommodation required - Electrical services and connections as required with Electrical Engineer.

3.1.10 26 09 61 Theatrical Dimming and Control

This system shall consist of approximately three hundred thirty six (336) remote controlled dimmers for performance lighting. Additional dimmers for house lighting will be required per electrical engineer. The dimmers are wired to individual performance lighting outlets distributed throughout the proscenium. Performance lighting control will be DMX distributed by way of

sACN (ENET). Portable DMX nodes will convert sACN to DMX at facility panel locations. A portable lighting control console for the performance lighting will be included. Console operation shall be possible from the control room, and rehearsal positions in the audience chamber. Architectural lighting control will be provided and pushbutton stations will be located adjacent to entry doors. Master control will be by way of touchscreen control stations located backstage, in the control booth, and from a portable touchscreen.

Accommodation Required – Electrical contractor to provide electrical services to dimmer racks and two-wire plus ground branch circuits to fixed lighting and performance lighting outlets - including all labor, wire, raceways, standard back boxes and fittings. All labor, wire, raceways, and standard back boxes for control systems provided by others per contractor. Coordination with house lighting designed by Electrical Engineer. Accommodation of electrical power and control conduit and wiring with Electrical Engineer.

3.1.11 Other (Items required but not specified)

Personnel Lift - A portable motorized unit for elevating a worker to service lighting and scenery above the stage floor.
Miscellaneous Stage Equipment - Complement of ladders, tools, first aid, safety equipment and other miscellaneous items as required.
Accommodation: Storage required when not in use.

3.2 Architectural Elements

3.2.1 12 61 00 Fixed Auditorium Seating

Fixed seating of approximately 485 quality chairs with self-rising seat bottoms, seat arms, letter and number plates, and end standards will be provided. Demountable chairs will be located to provide locations for wheelchair positions and for temporary technical areas. Seats to include provisions for aisle fixed seats with transfer arms for disabled access to ADA and local code requirements. All demountable chairs to be removable in singles or gangs of 2 and 3.

Accommodation Required - Coordination of seating layout, riser layout, sightlines, finishes, fixing details and underfloor supply (if any) with Architect, Structural, and Mechanical, engineers. Coordination of removable seating needs and aisle light requirements with Electrical Engineers.

3.2.2 12 62 03 Loose Auditorium Seating

Loose seating of approximately 16 quality chairs to match finishes of fixed seating will be provided. Seating to be used in box levels as shown on architect’s and theatre consultant’s drawings.

Accommodation Required - Coordination of railings, sightlines, and finishes with Architect.

3.2.3 Stage Floor

Refer to attached details in appendix.

Accommodation required – Slap depression and loading requirements coordinated with structural engineer. Coordination of finishes and details with Architect.

3.2.4 Adjustable Proscenium

The adjustable proscenium is used to change the width of the proscenium opening. Made of steel or aluminum framed masking panels on the face of the proscenium opening. Panels are plywood-clad and covered with a finish per the Architect. Panels are supported by "barndoor" type tracks overhead and guided by knife tracks embedded in the stage floor.

Accommodation required - Coordinate finishes, fabric color, soffits, and structural supports with the Acoustician and Structural Engineer.

3.2.5 Forestage reflectors

Acoustic reflectors located above the forestage area (but below the forestage grid) will be required for acoustic reflections. These reflectors require carefully coordinated openings through them to allow for the rigging of theatrical lighting, scenery, loudspeakers and temporary production equipment from the forestage grid above.

Accommodation required - Coordinate finishes, acoustic and theatrical criteria, and structural supports with the Structural Engineer.

3.2.6 Lighting Bridges & Lighting Positions

Refer to attached details in appendix. The lighting bridges and lighting positions will carry a considerable amount of performance lighting equipment. All railings in these areas must be sized to accommodate standard lighting equipment clamps, and in many positions, must be adjustable. Provision for lighting positions FOH will be on the balcony front, under the side boxes, in the tech boxes, and vertically between the proscenium wall and the side seating/tech boxes will be developed.

Accommodation Required - Coordination of finishes and structural support system with Architect and Structural Engineer. MEP zones to be coordinated and clear of lighting positions. Adequate work light and performance running lights to be provided in the technical level and attic area. Electrical services for equipment to be coordinated with electrical engineer.

3.2.7 Company Switches & Cable Passes

Electrical disconnects (company switches) as required for temporary production power (lighting, rigging, automation and machinery). Locations, quantities, and sizes are provided will be identified in DD.

A system of temporary cable passes as required to allow temporary production cabling to be run between the loading dock, house mix positions, control booth, and performance venues will be developed in DD.

Accommodation Required - Coordination of finishes, fire protection strategy, and structural penetrations/slab depressions with Architect and Engineers.

3.2.8 Conduit, Wiring and Back boxes

Provision of electrical wiring services and materials for the performance equipment systems described in this document

Accommodation Required - Coordination of finishes, locations, access, and structural support system with Architect and Engineers.

3.2.9 Acoustical Doors

Large acoustical door(s) to close off the proscenium stagehouse area from the scene shop area are required. Door to be double set of manually operating with oversized leaves. Fire codes typically require a roll down fire shutter (or doors to be fire rated) on the scene shop side.

Accommodation Required - Coordination of finishes and structural supports system with Architect and Structural Engineer. Coordination with fire protection requirements.

4 Dance Venue

4.1 Theatrical Equipment

4.1.1 11 61 11 Adjustable Acoustics

The adjustable acoustic system in the dance venue consists of manually drawn horizontal fabric drapes on curtain tracks along the side and rear walls of the audience space.
Accommodation required - Coordination of finishes, fabric color, storage pockets and structural framing systems with Architect and Structural Engineer.

4.1.2 11 61 33 Theatrical Rigging:

Stage Traveler Tracks - Portable manual traveler tracks attached to catwalks or battens for bi-parting of a two panel curtains to be used for the main curtain and an up-stage traveler.

Roto-Drape - A set of roto-drape hardware is included so that 5 sets legs can easily be rotated flat to increase floor space for dance class.

Manual Pile Wind Winches – Eight linesets will be provided that are operated by manual winches. The winches will be mounted on structural supports along the side walls of the stage at the catwalk/gallery level. Rigging beams above will provide support for blocks and associated rigging. The linesets will be located in the spaces between fixed catwalks and are repositionable to allow flexibility.

Other - Miscellaneous rigging is provided for FOH and stage uses.

Accommodation required – Coordination of structural design to support rigging equipment. Coordination of all MEP systems in stagehouse to allow clear area for rigging operation. Electrical services and connections as required for connections to theatre equipment with Electrical Engineer. Coordination of structural columns and support with Architect and Structural Engineer.

4.1.3 11 61 43 Stage Draperies

Velour drapery shall be an opaque inherently flame retardant polyester fabric providing long service life with little maintenance. The main curtain is to be sewn with 100% fullness and with lining. An inventory of black velour masking draperies (legs, borders, and upstage traveler) sewn flat is included. A filled leno cyc, a bounce, and a black scrim, supplied. Muslin drawstring bags and storage hampers with lids and heavy-duty casters are also provided.

Accommodation required - Main Curtain to be selected by Architect. Masking color selection is to be from standard manufacturer's colors.

4.1.4 11 61 71 Performance Dance Floor Surface

Although not provided, it is recommended that a modular and portable dance floor for the audience side of the dance venue be acquired for setting over the permanent floor. The purpose of the temporary floor is to provide an injury-reducing, resilient floor for dance use. The protection and "feel" in dance performances provided by the portable floor cannot be achieved by the permanent floor due to construction requirements and heavy loads imposed by the telescopic seating units. Provided for the dance venue will be a demountable vinyl dance floor covering of approximately 2400 square feet. The floor will be provided in approx. 6'-0" wide by 60' long rolls. Floor will be laid flat with taped seams. The floor will store on specially designed dance floor cart(s) to allow for easy rolling and unrolling of the floor.

Accommodation required - Storage for cart when not in use.

4.1.5 11 61 93 Theatrical Lighting Instruments and Accessories

An inventory of approximately one hundred sixty (160) demountable stage lighting fixtures with mounting and distribution hardware will be provided. The fixture are primarily tungsten fixtures but does include a modest compliment of LED wash lights and cyc lights. Two (2) followspots are provided. Accessories including components for 10 side lighting booms, side arms, c-clamps, safety cables, barndoors, tophats and an inventory of extension cable, two-fers, and multi-cable will be provided.

Accommodation required - Electrical services and connections as required with Electrical Engineer.

4.1.6 12 66 23 Telescopic Seating Risers w/seats

A telescopic riser with 132 attached fold down seats will be provided. Integrated motor will electrically deploy the risers. Seats will be manual lift up with assisted folding mechanism. The first row of seats (approx. 18) will sit on the floor in front of riser system.

Accommodation required - Architectural niche for storage of risers when not in use. Electric power provided for power deployment. Structural support and floor build up to support telescopic system.

4.1.7 26 09 61 Theatrical Dimming and Control

This system shall consist of approximately two hundred forty (240) remote controlled dimmers for performance lighting. Additional dimmers for house lighting will be required per electrical engineer. The dimmers are wired to individual performance lighting outlets distributed throughout the venue. Performance lighting control will be DMX distributed by way of sACN (ENET). Portable DMX nodes will convert sACN to DMX at facility panel locations. A portable lighting control console for the performance lighting will be included. Console operation shall be possible from the control room, and rehearsal positions in the audience chamber. Architectural lighting control will be provided and pushbutton stations will be located adjacent to entry doors. Master control will be by way of master stations located backstage, and in the control booth.

Accommodation Required – Electrical contractor to provide electrical services to dimmer racks and two-wire plus ground branch circuits to fixed lighting and performance lighting outlets - including all labor, wire, raceways, standard back boxes and fittings. All labor, wire, raceways, and standard back boxes for control systems provided by others per contractor. Coordination with house lighting designed by Electrical Engineer. Accommodation of electrical power and control conduit and wiring with Electrical Engineer.

4.1.8 Other (Items required but not specified)

Personnel Lift - A portable motorized unit for elevating a worker to service lighting and scenery above the stage floor.
Miscellaneous Stage Equipment - Complement of ladders, tools, first aid, safety equipment and other miscellaneous items as required.

Accommodation required - Storage required when not in use.

4.2 Architectural Elements

4.2.1 Stage Floor

Refer to attached details in appendix.

Accommodation required – Slap depression and loading requirements coordinated with structural engineer. Coordination of finishes and details with Architect.

4.2.2 Lighting Bridges & Lighting Positions

Refer to attached details in appendix. The lighting bridges and lighting positions will carry a considerable amount of performance lighting equipment. All railings in these areas must be sized to accommodate standard lighting equipment clamps, and in many positions, must be adjustable. Provision for lighting positions FOH will one lighting bridge and two boom positions on the side walls. Overstage will be 2 side galleries and 3 over head lighting bridges.

Accommodation Required - Coordination of finishes and structural support system with Architect and Structural Engineer. MEP zones to be coordinated and clear of lighting positions. Adequate work light and performance running lights to be provided in the technical level and attic area. Electrical services for equipment to be coordinated with electrical engineer.

4.2.3 Company Switches & Cable Passes

Electrical disconnects (company switches) as required for temporary production power (lighting, rigging, automation and machinery). Locations, quantities, and sizes are provided will be identified in DD.

A system of temporary cable passes as required to allow temporary production cabling to be run between the loading dock, house mix positions, control booth, and performance venues will be developed in DD.

Accommodation Required - Coordination of finishes, fire protection strategy, and structural penetrations/slab depressions with Architect and Engineers.

4.2.4 Conduit, Wiring and Back boxes

Provision of electrical wiring services and materials for the performance equipment systems described in this document

Accommodation Required - Coordination of finishes, locations, access, and structural support system with Architect and Engineers.

5 Instrument Ensemble

5.1 Theatre Equipment

5.1.1 11 61 11 Adjustable Acoustics

The adjustable acoustic system in the instrument ensemble room consists of walk-along horizontal fabric drapes on curtain tracks along all 4 sides of the room. Drapery track will be mounted to the pipe grid.

Accommodation required - Coordination of finishes, fabric color, storage pockets and structural support with Architect and Structural Engineer.

5.1.2 11 61 51 Theatrical Pipe Grids

Pipe Grid – The pipe grid will be constructed of 1.9” O.D. schedule 40 (or 80) black pipe. The grid consists of a 5’ matrix of perpendicular; intersecting steel pipes suspended from overhead structure. The grid shall provide serviceable hanging locations for performance lighting, A/V equipment, and drapery.

Accommodation required - Structural support capable of handling loads.

5.1.3 Other (Items required but not specified)

Personnel Lift - A portable motorized unit for elevating a worker to service lighting and scenery above the floor.
Miscellaneous Stage Equipment - Complement of ladders, tools, first aid, safety equipment and other miscellaneous items as required.

Accommodation required - Storage required when not in use.

5.2 Architectural Elements

5.2.1 Floor

Refer to attached details in appendix.

Accommodation required – Slap depression and loading requirements coordinated with structural engineer. Coordination of finishes and details with Architect.

5.2.2 Company Switches & Cable Passes

Electrical disconnects (company switches) as required for temporary production power (lighting, rigging, automation and machinery). Locations, quantities, and sizes are provided will be identified in DD.

A system of temporary cable passes as required to allow temporary production cabling to be run between the loading dock, house mix positions, control booth, and performance venues will be developed in DD.

Accommodation Required - Coordination of finishes, fire protection strategy, and structural penetrations/slab depressions with Architect and Engineers.

6 Choral Ensemble

6.1 Theatre Equipment

6.1.1 11 61 11 Adjustable Acoustics

The adjustable acoustic system in the choral ensemble room consists of walk-along horizontal fabric drapes on curtain tracks along the sides of the room. Drapery track will be mounted to the pipe grid.

Accommodation required - Coordination of finishes, fabric color, storage pockets and structural support with Architect and Structural Engineer.

6.2 Architectural Elements

6.2.1 Floor

Refer to attached details in appendix.

Accommodation required – Slap depression and loading requirements coordinated with structural engineer. Coordination of finishes and details with Architect.

6.2.2 Company Switches & Cable Passes

Electrical disconnects (company switches) as required for temporary production power (lighting, rigging, automation and machinery). Locations, quantities, and sizes are provided will be identified in DD.

A system of temporary cable passes as required to allow temporary production cabling to be run between the loading dock, house mix positions, control booth, and performance venues will be developed in DD.

Accommodation Required - Coordination of finishes, fire protection strategy, and structural penetrations/slab depressions with Architect and Engineers.

Appendix A

Typical Details

ARUP

77 Water Street
New York NY 10005
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Job Title

UVU Concert Hall

Drawing Title

TYPICAL CONCERT HALL CONCERT PLATFORM CONSTRUCTION

Scale: NTS

Print at Sheet Size 8.5x11

File Name: 00X STAGE FLOOR DETAILS.DWG

Drawing Status

FOR INFORMATION ONLY

Job No	Drawing No	Issue
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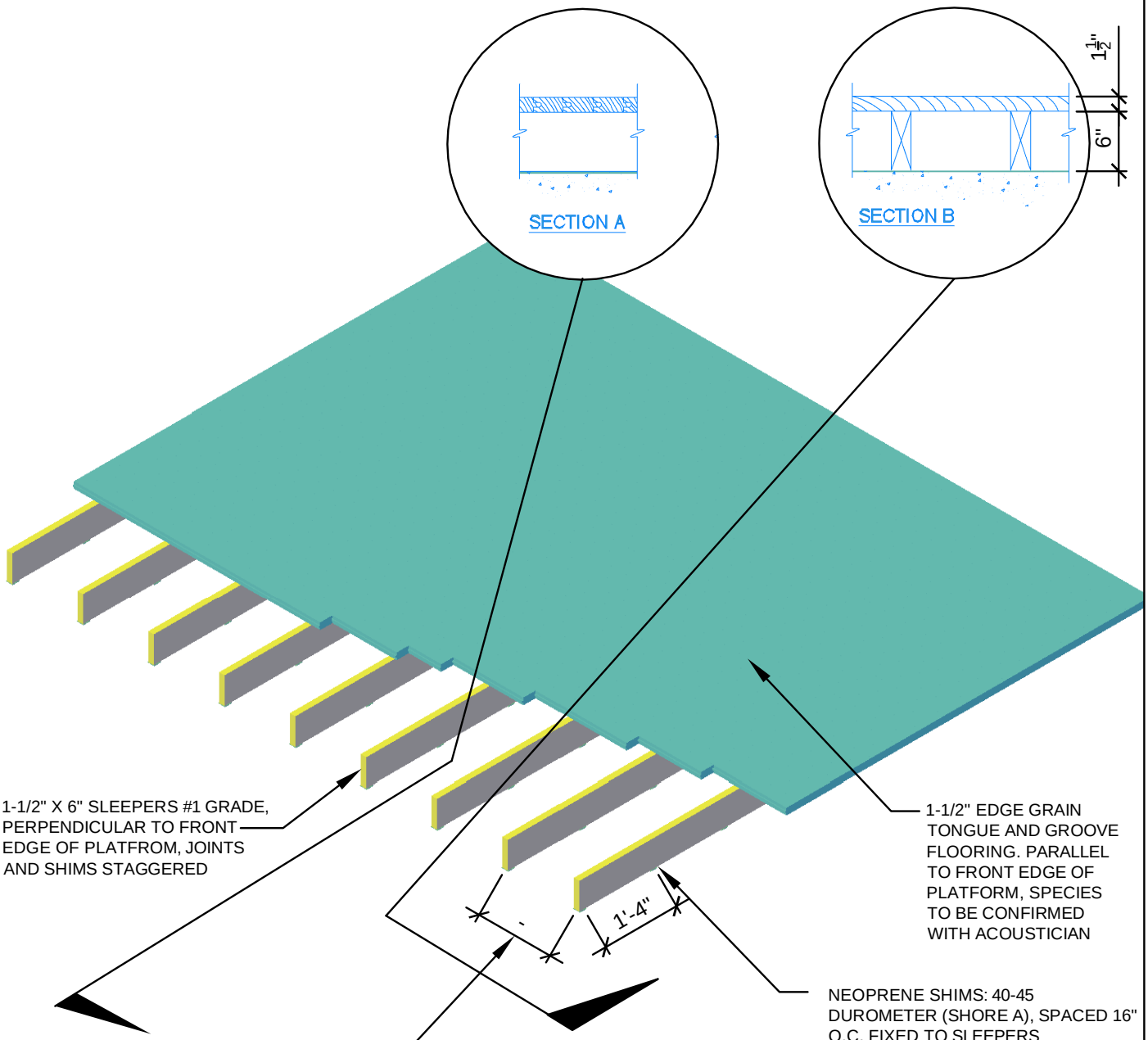

PLOT BY: Michael Parrella PLOT TIME: 5/19/2015 1:18 PM

ARUP

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New York NY 10005
Tel +1 212 896 3000
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Job Title
UVU Proscenium Theatre

Drawing Title
TYPICAL THEATRE
STAGE FLOOR CONSTRUCTION
RESILIENT FLOOR

Scale: NTS
Print at: Sheet Size 8.5x11
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Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
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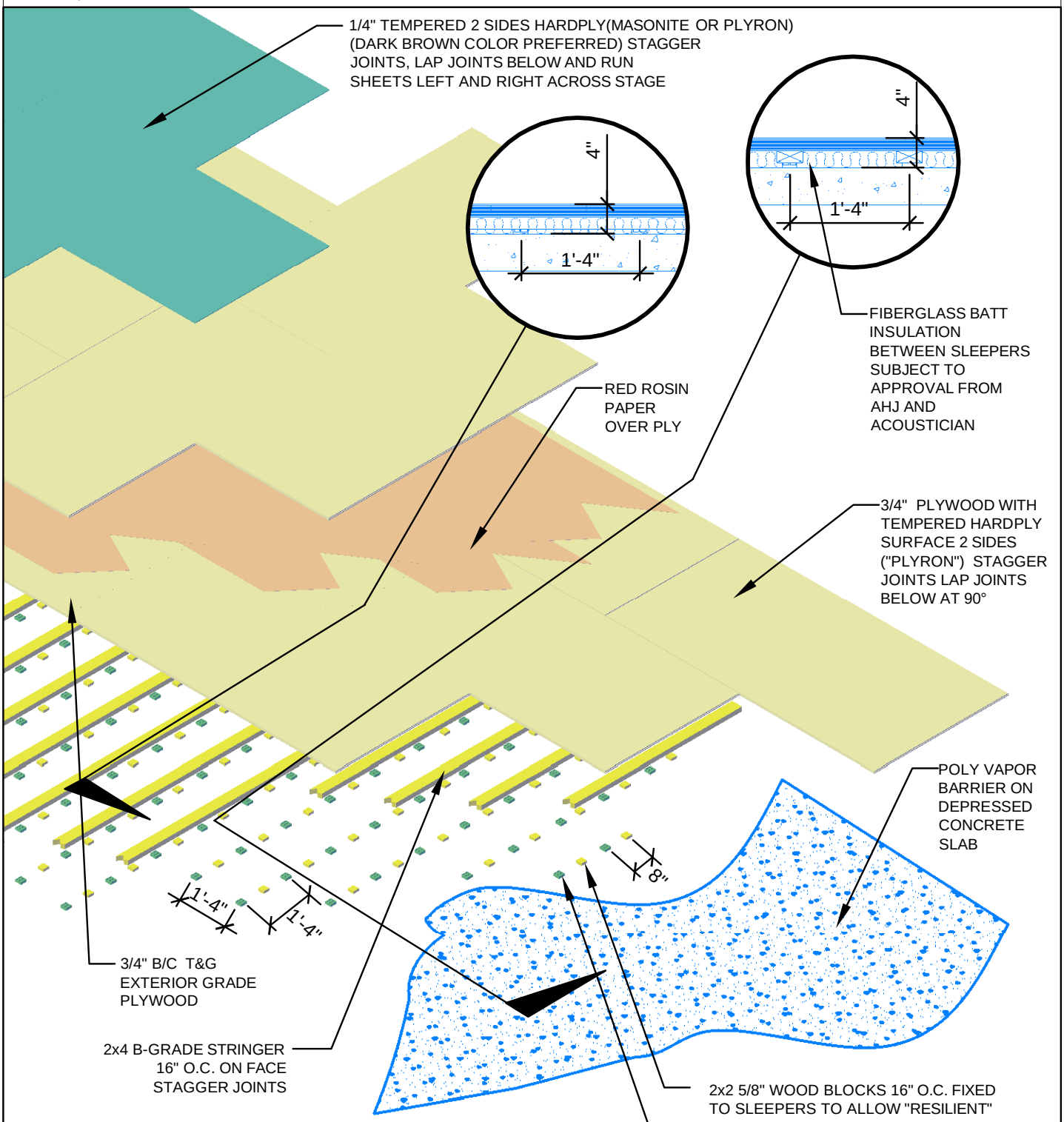

- LOWER PLYWOOD LAYERS ARE SCREWED ON 12" ALONG PAR BATTENS - NO ADHESIVE
- UPPER PLYWOOD LAYERS ARE SCREWED 18" ON CENTER PLUS PERIMETER
- OIL TEMPERED HARBOARD IS COUNTERSUNK AND SCREWED 12" ON CENTER PLUS PERIMETER
- FLOOR LOAD IS 150 lbs/sq. ft.

PLOT BY: Michael Parrella PLOT TIME: 5/19/2015 1:13 PM

ARUP

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Job Title
UVU Instrument Ensemble

Drawing Title
TYPICAL STAGE FLOOR CONSTRUCTION
HARDWOOD RESILIENT FLOOR

Scale
NTS

Print at
Sheet Size 8.5x11

File Name
00X STAGE FLOOR DETAILS.DWG

Drawing Status
FOR INFORMATION ONLY

Job No	Drawing No	Issue
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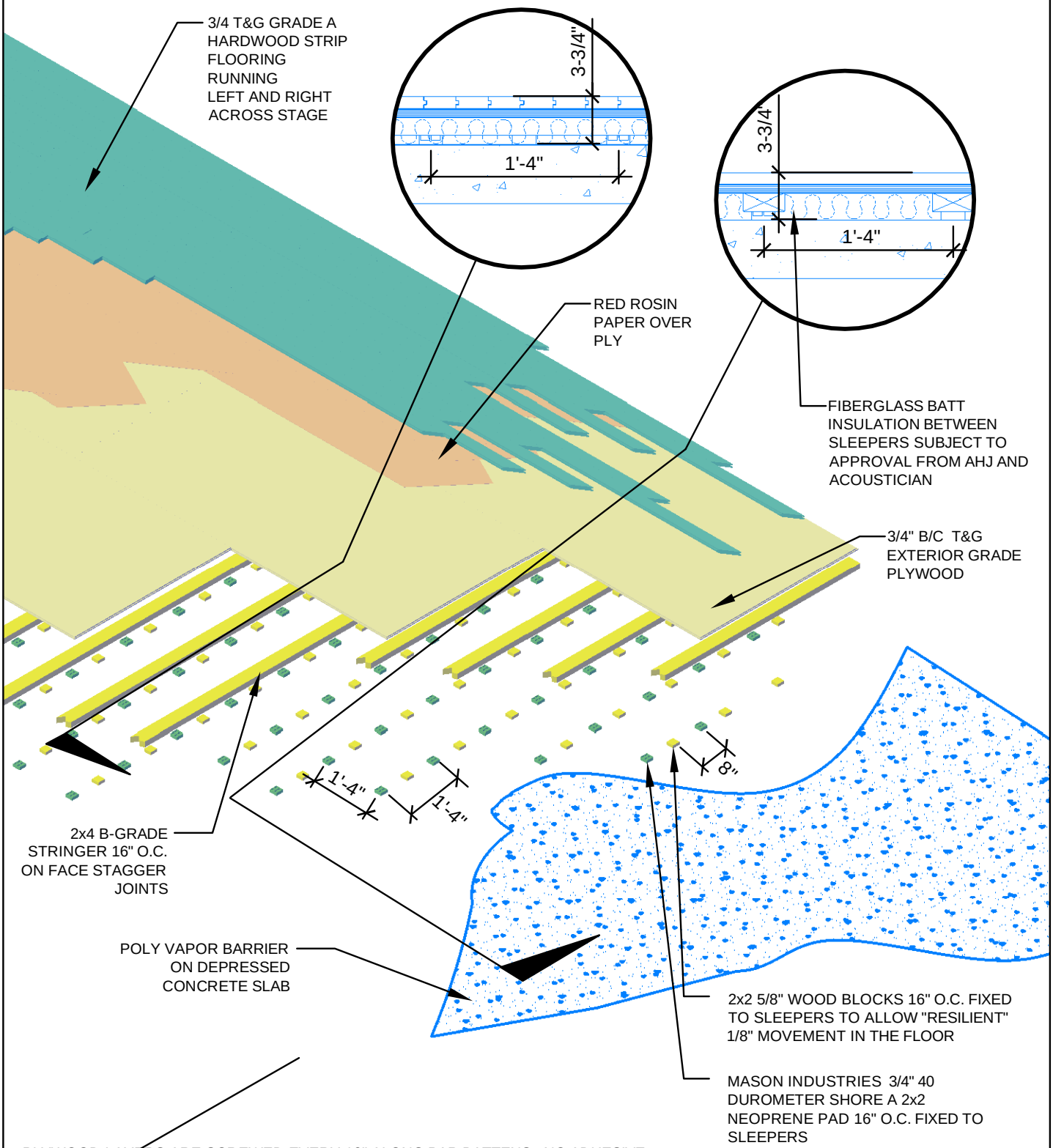

- PLYWOOD LAYERS ARE SCREWED EVERY 12" ALONG PAR BATTENS - NO ADHESIVE
- TONGUE AND GROOVE IS NAILED THROUGH GROOVE EVERY 12'
- FLOOR LOAD IS 150lbs/sq. ft.

PLOT BY: Michael Parrella PLOT TIME: 5/19/2015 1:12 PM

ARUP

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Job Title
UVU Dance Venue

Drawing Title
TYPICAL THEATRE
STAGE FLOOR CONSTRUCTION
BASKET WEAVE FLOOR (12")

Scale: NTS
Print at: Sheet Size 8.5x11
File Name: 00X STAGE FLOOR DETAILS.DWG
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
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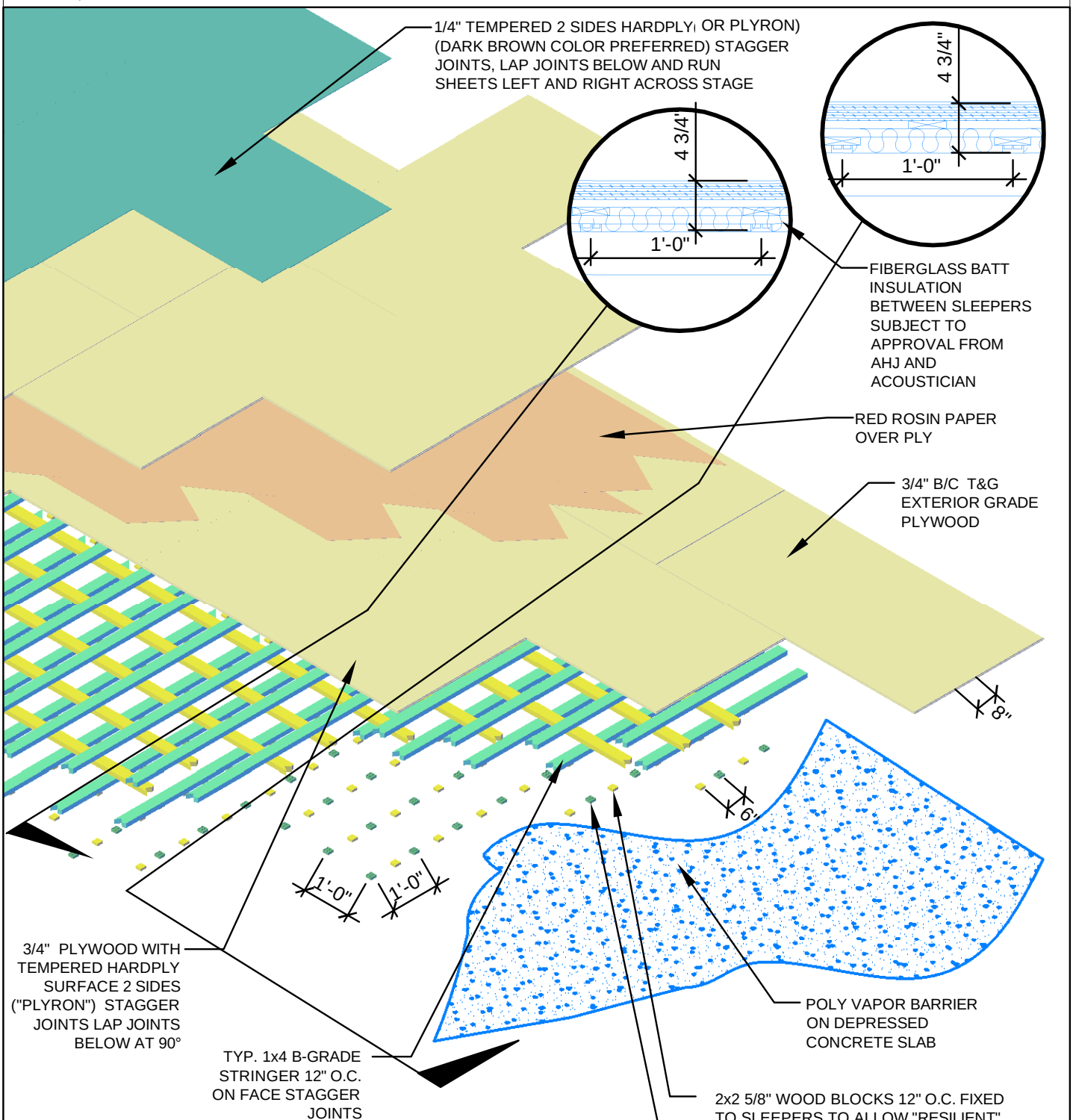

- LOWER PLYWOOD LAYERS ARE SCREWED ON 12" ALONG PAR BATTENS - NO ADHESIVE
- UPPER PLYWOOD LAYERS ARE SCREWED 18" ON CENTER PLUS PERIMETER
- OIL TEMPERED HARBOARD IS COUNTERSUNK AND SCREWED 12" ON CENTER PLUS PERIMETER
- FLOOR LOAD IS 150 lbs/sq. ft.

PLOT BY: Michael Parrella PLOT TIME: 5/19/2015 1:14 PM

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Job Title
UVU Choral Ensemble, Rehearsal

Drawing Title
TYPICAL THEATRE
STAGE FLOOR CONSTRUCTION
HARDWOOD RESILIENT FLOOR

Scale: NTS
Print at Sheet Size 8.5x11
File Name: 00X STAGE FLOOR DETAILS.DWG
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
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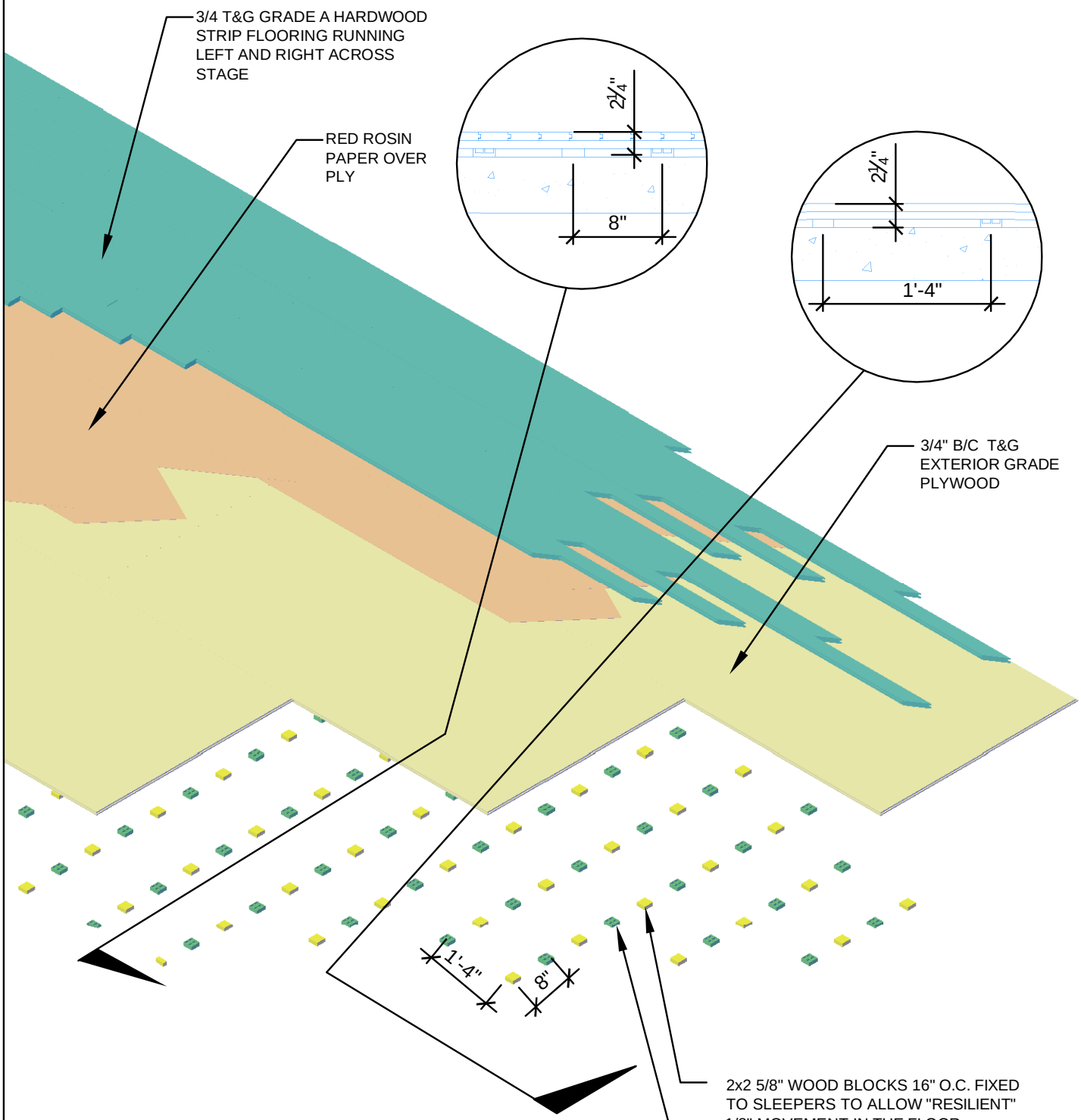

- TONGUE AND GROOVE IS NAILED THROUGH GROOVE EVERY 12'
- FLOOR LOAD IS 150lbs/sq. ft.

PLOT BY: Michael Parrella PLOT TIME: 5/19/2015 1:16 PM

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Job Title

Drawing Title

TYPICAL THEATRE STAGE FLOOR CONSTRUCTION WALL BASE OPTIONS

Scale: NTS

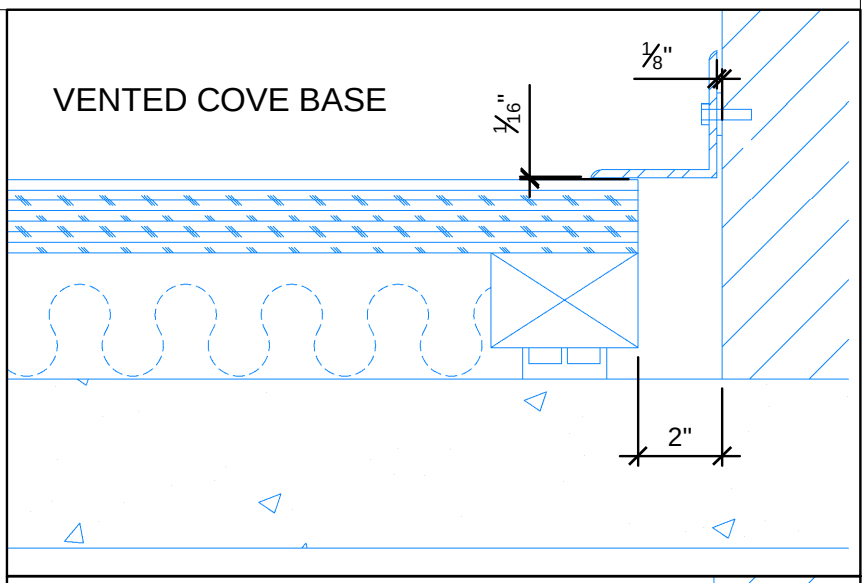
Print at Sheet Size 8.5x11

File Name: 00X STAGE FLOOR DETAILS.DWG

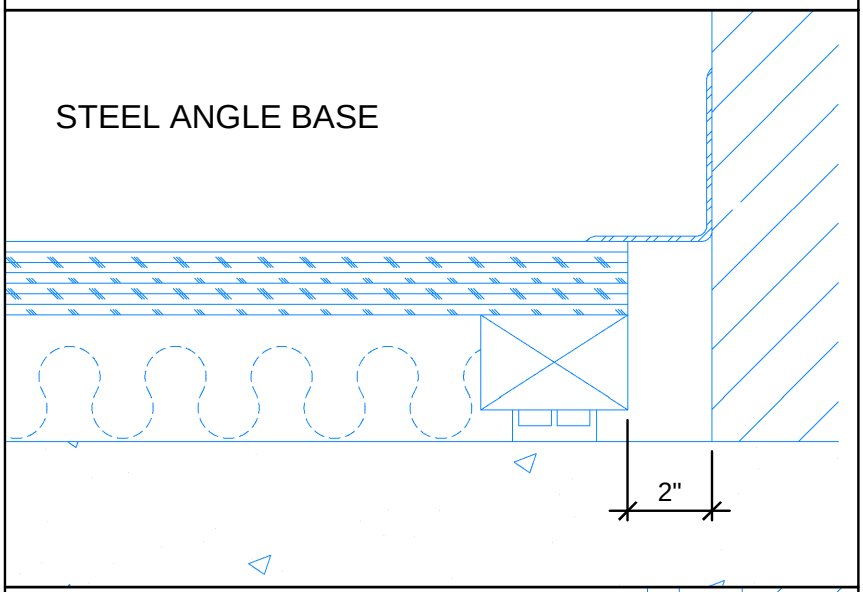
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
	SK-009	A

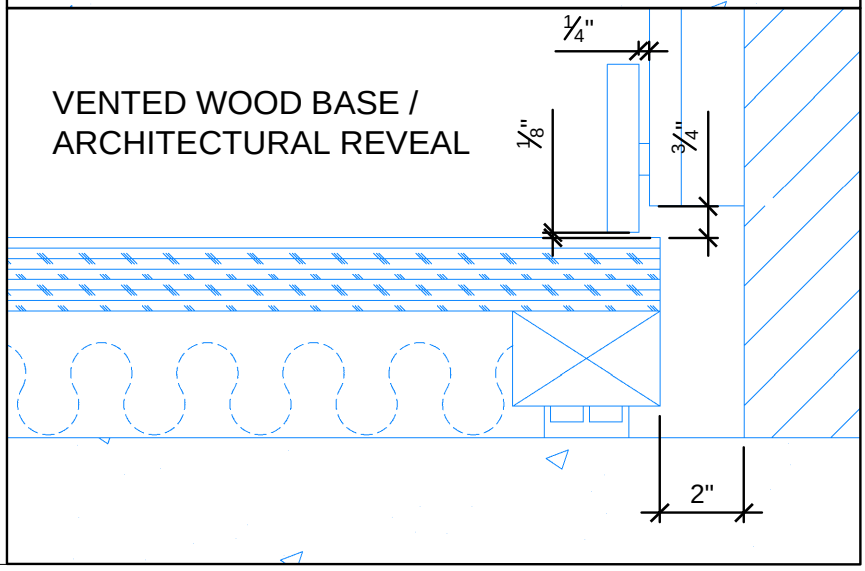
FOR USE ON STAGE/WORKING DECKS WHERE DURABILITY IS CRITICAL. 3"X3"X 3/16" STEEL BASE ANGLE HELD ABOVE FIN FLOOR SURFACE. MOUNT AWAY FROM FACE OF PERIMETER WALLS FOR CONTINUOUS VENTING WITH RUBBER SPACER AT EACH MECHANICAL FASTENER.



FOR USE WHERE APPEARANCE AND DURABILITY ARE EQUALLY IMPORTANT. PRE-MANUFACTURED 4" HIGH RUBBER BASE WITH INTERMITTENT VERTICAL GROOVES ON BACK FACE FOR VENTING.



FOR USE IN PUBLIC VIEW WHERE APPEARANCE IS CRITICAL. ARCHITECTURAL FINISH FURRED OUT FROM WALL, HELD MIN OF 3/4" ABOVE FIN FLOOR SURFACE FOR VENTING. EXPOSED REVEAL OR OPTIONAL WOOD BASE MOUNTED TO FACE OF ARCHITECTURAL FINISH, MIN 1/8" CLEAR OF FIN FLOOR AND 1/4" FROM FACE OF WALL WITH INTERMITTENT RUBBER SPACERS.



PLOT BY: Michael Parrella PLOT TIME: 5/19/2015 1:18 PM

ARUP

77 Water Street
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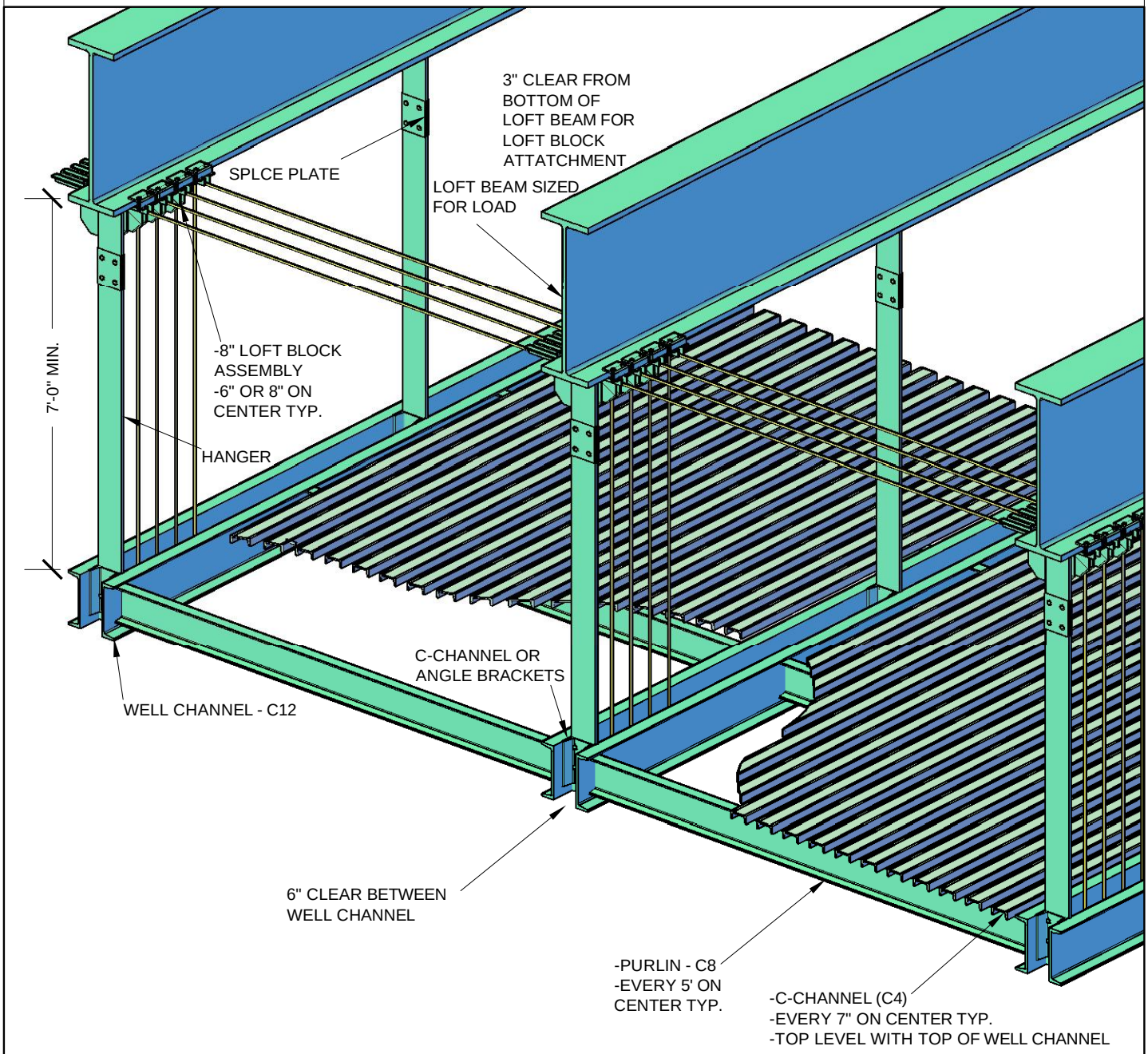
Job Title
UVU Proscenium Theatre

Drawing Title
TYPICAL THEATRE DETAIL
C-CHANNEL GRID
UNDER-HUNG CONFIGURATION

Scale: NTS
Print at Sheet Size 8.5x11
File Name: 401 GRID C-CHANNEL.DWG
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
	SK-401	**A**



TYPICAL GRID SURFACE LOADING:
2000 PSF CONCENTRATED IN 4 SQ FT
WITHIN 40% OF A BAY WHICH IS DEFINED
AS THE AREA BETWEEN 4 GRID HANGERS

PLOT BY: Joe Chapman PLOT TIME: 4/27/2012 2:55 PM

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Job Title
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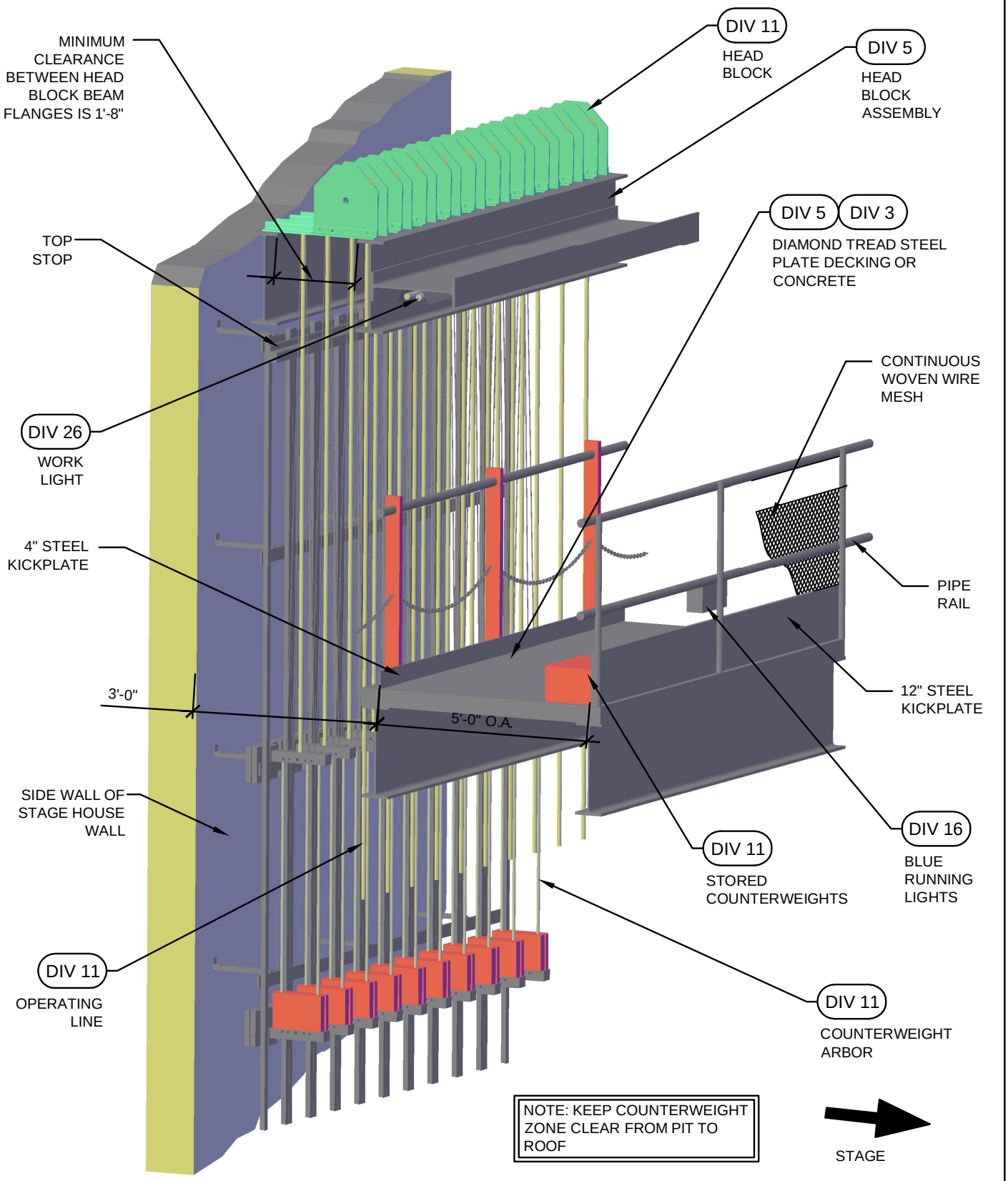
Drawing Title
TYPICAL THEATRE DETAIL
LOADING GALLERY DETAIL

Scale: NTS
Print at Sheet Size 8.5x11
File Name: 503 LOADING GALLERY.DWG
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
	SK-503	**A**



PLOT BY: Joe Chapman PLOT TIME: 4/27/2012 3:05 PM

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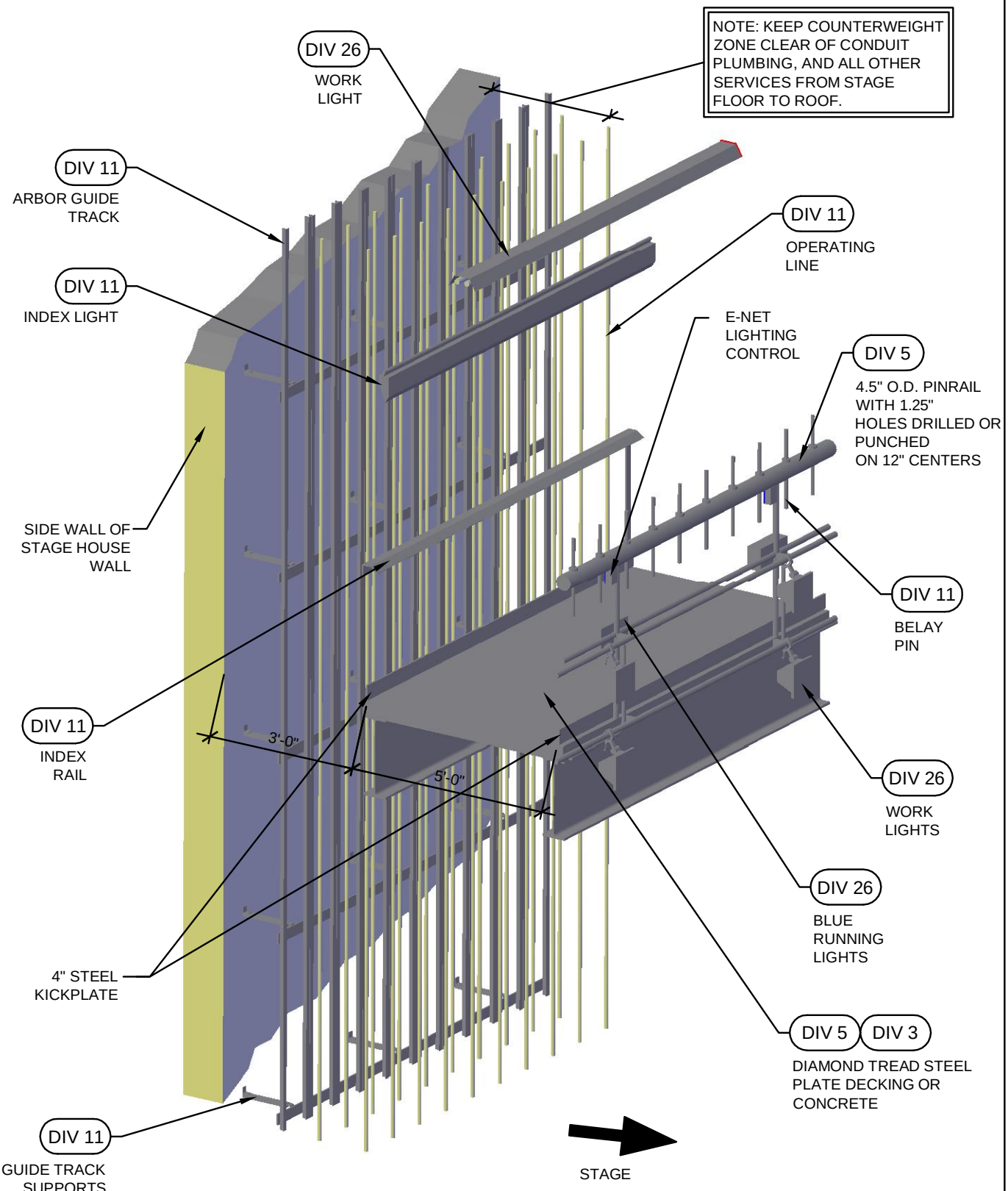
Job Title
UVU Proscenium Theatre

Drawing Title
TYPICAL THEATRE DETAIL
MID GALLERY

Scale: NTS
Print at Sheet Size 8.5x11
File Name: 504 MID GALLERY 2.DWG
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
	SK-504	**A**



PLOT BY: Joe Chapman PLOT TIME: 4/27/2012 3:07 PM

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Job Title
UVU Proscenium Theatre

Drawing Title
TYPICAL THEATRE DETAIL
GALLERY DETAIL

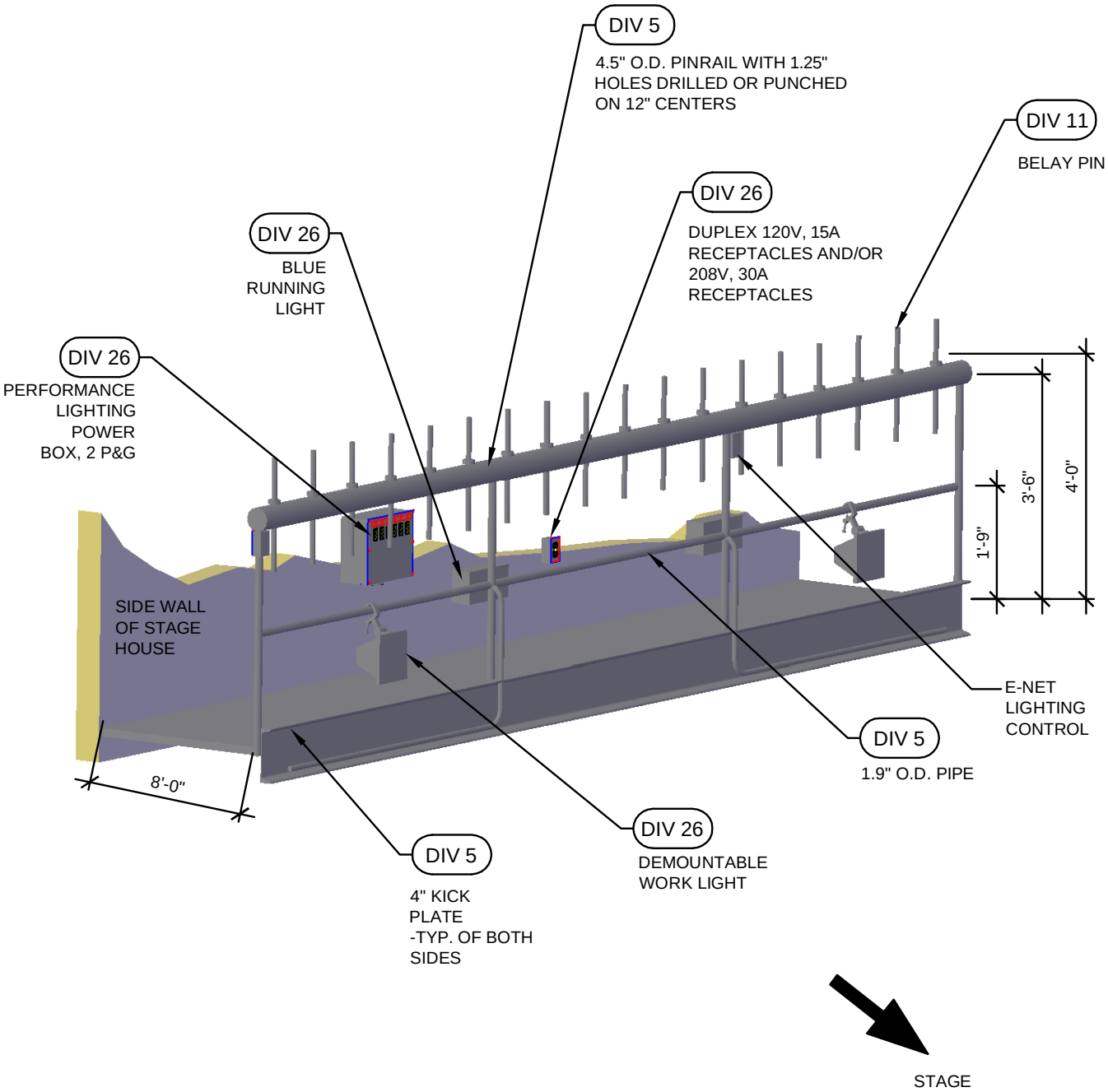
Scale NTS

Print at Sheet Size 8.5x11

File Name 502 MID RAIL.DWG

Drawing Status
FOR INFORMATION ONLY

Job No	Drawing No	Issue
	SK-502	**A**



PLOT BY: Joe Chapman PLOT TIME: 4/27/2012 3:04 PM

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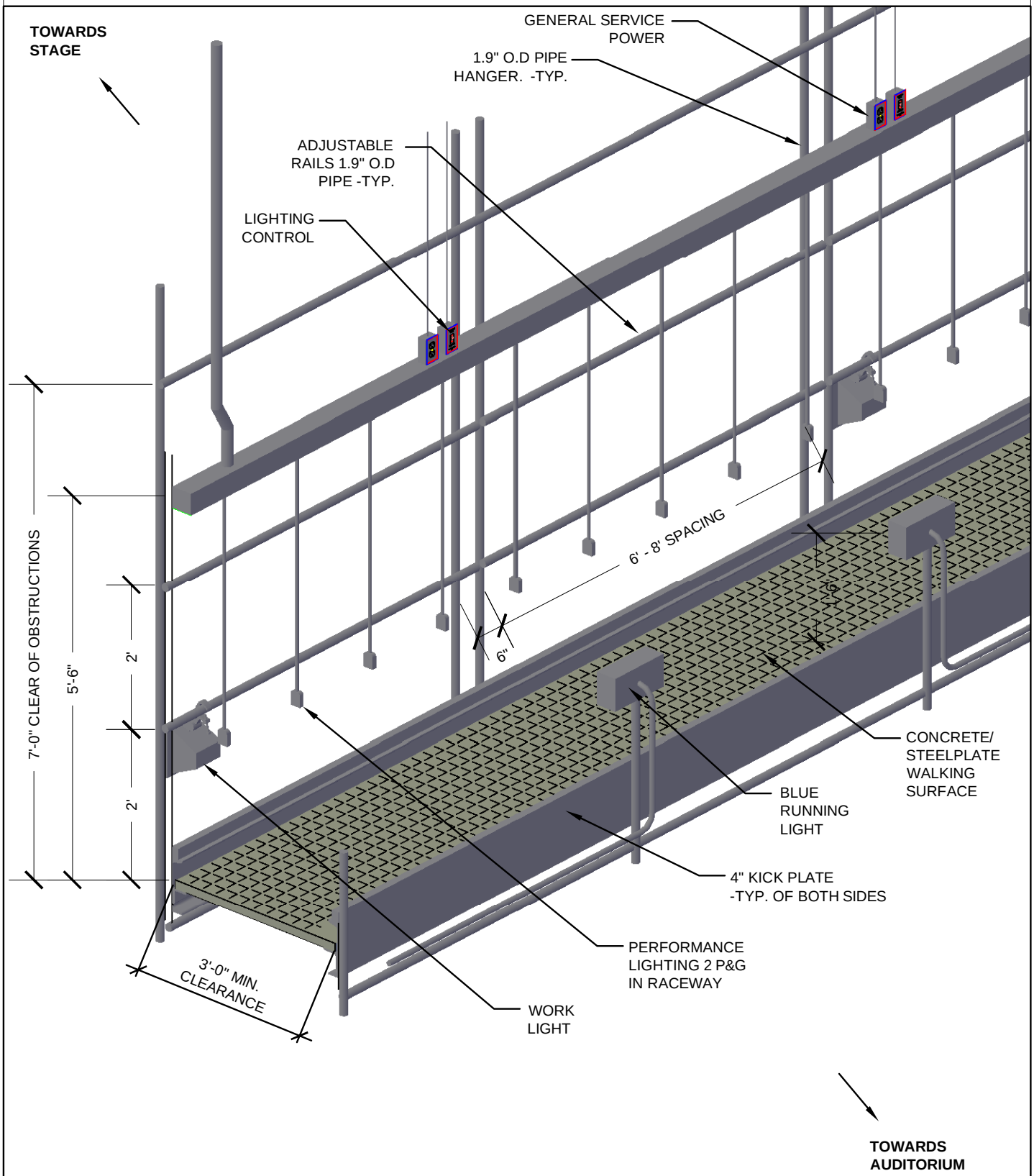
Job Title
UVU Concert Hall
Proscenium Theatre

Drawing Title
TYPICAL THEATRE DETAIL
LIGHTING CATWALK
RACEWAY MOUNTING DETAIL

Scale: NTS
Print at Sheet Size 8.5x11
File Name: 207 CATWALK - ADJ PIPE & RACEWAY ISO.DWG
Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
	SK-207	**A**



PLOT BY: Joe Chapman PLOT TIME: 4/27/2012 2:47 PM

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Job Title

UVU Dance Theatre

Drawing Title

TYPICAL THEATRE DETAIL
LIGHTING CATWALK DETAIL
ISOMETRIC VIEW

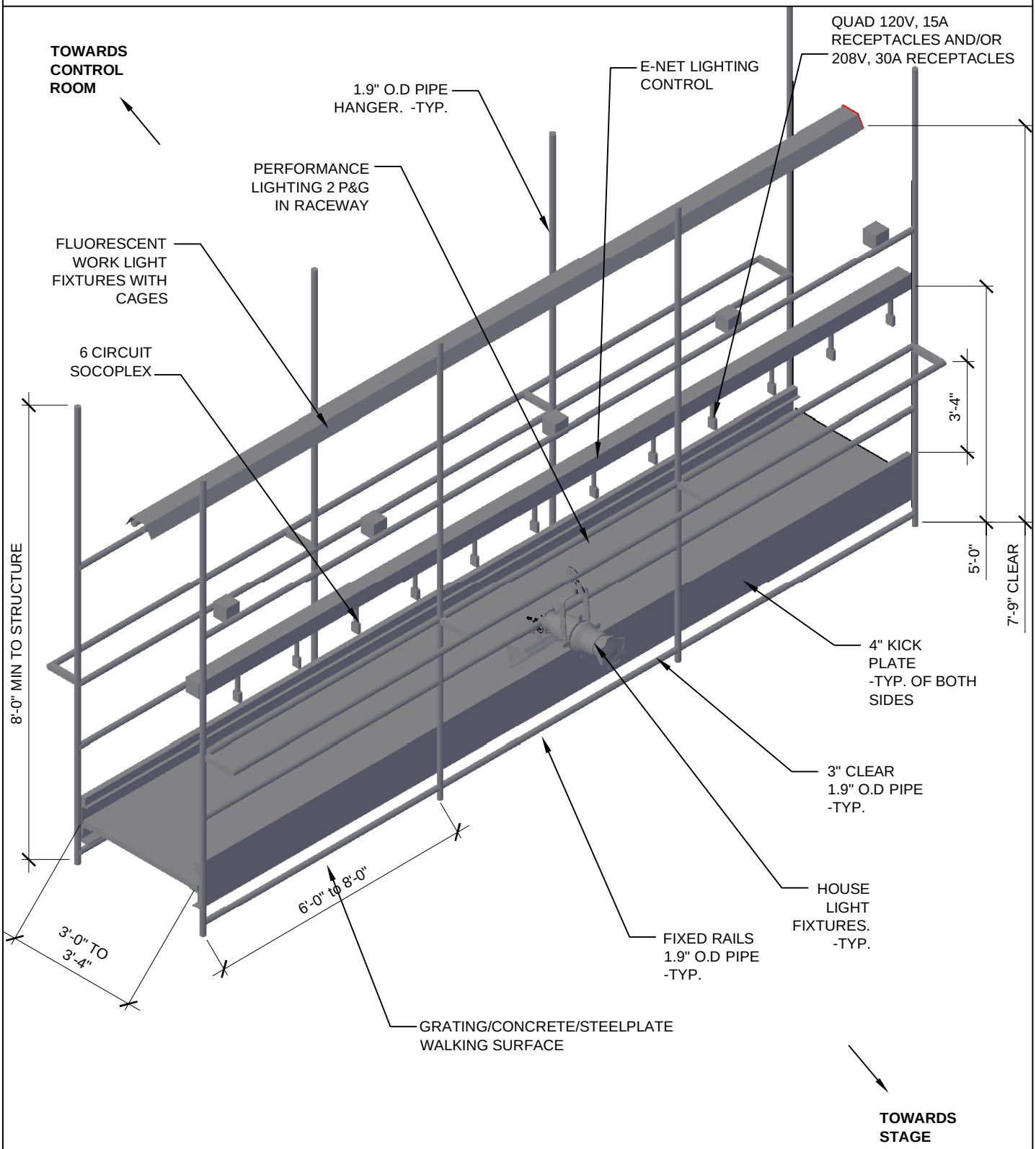
Scale: NTS

Print at Sheet Size 8.5x11

File Name: 201 CATWALK ISOMETRIC.DWG

Drawing Status: **FOR INFORMATION ONLY**

Job No	Drawing No	Issue
	SK-201	**A**



PLOT BY: Joe Chapman PLOT TIME: 4/25/2012 11:37 AM

Method Studio

Utah Valley University Performing Arts Complex

Performance Equipment Structural Loading Report

245160/R01

Issue 1 | April 15, 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 245160-00

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ARUP

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Tables

Table 1 Performance Equipment Structural Load Table

1 General

This report is intended to provide information that will be of use in the design of structural systems for performance or presentation spaces. It describes performance equipment and systems that are unique to performance buildings and the typical loads imposed upon the structure by this equipment. This document seeks to inform the Project Structural Engineer, who has the responsibility of the structural design, of the intended use of the space and its equipment.

The structural requirements of Performance or Presentation Spaces are unique. The structural systems will provide attachment points and support of stage rigging equipment and stage machinery, as well as temporary, production-specific elements.

Items of structural concern from the Theatre Consultant's perspective are listed below. Additional items may be added as they become apparent.

- Grid Iron
- Forestage Grid
- Head Block Beam Assembly – primary support for counterweight rigging systems
- Loft Beam/Roof Steel – support for individual suspension lines
- Loading Gallery
- Fly and Operating Galleries
- Locking rails and Pin Rails
- Stage Floor Framing and Support System
- Auditorium Floor Framing and Support System
- Stage Apron Support
- Loading Dock areas
- Orchestra and Platform Extension Lifts Support and Guide System
- Auditorium Lighting Catwalks
- Fixed and Demountable Lighting Pipes in the Stage and Auditorium
- Rigging Beams
- Rigging Points

The loading values given in the following drawings and tables are typical. Conditions resulting in loads in excess of the table values will be addressed

separately. Local building codes, requirements, and legislation will always have priority over information presented here.

Loads in the report are expressed in pounds per linear foot – PLF or pounds per square foot – PSF.

Performance machinery and rigging system loads given in this report do not reflect shock or impact loads. An additional 25% should be added to the values shown for shock or impact loads. Motorized rigging may generate impact loads greater than 25% and should be evaluated based on speed and load.

2 Auditorium

It is critical that the auditoriums be designed without intermediate support columns. The auditorium roof structure will be required to support a variety of elements and equipment, as shown in the drawings and presented in this report, in addition to the weight of the roof itself.

2.1 Auditorium Roof Structure

2.1.1 Acoustic Devices and Treatments

The roof may require additional material, or material of a higher mass than typical to prevent the transmission of outside noise into the auditorium. This may result in higher than typical loads on the roof structure.

2.1.2 Suspended Ceiling

The roof structure will also support an acoustic suspended ceiling or canopy that is of suitable mass and construction to reduce the transmission of noise and act as an acoustic reflector surface. Portions of the suspended ceiling or canopy may be motorized to be adjustable.

2.2 Auditorium Floor

2.2.1 Concrete Accommodations

Concrete auditorium floors have special requirements to accommodate chair installation, depending on the type of chair. Floor mounted chairs require a 3” minimum thickness concrete with the top 1 ½” free of any obstructions, including reinforcing. Riser mounted chairs require a 4” (100mm) minimum thickness concrete with the front face 2 ¾” (69.9mm) free of any obstructions, including reinforcing.

2.2.2 Flatness and Levelness Requirements

Finish surfaces to the following tolerances, according to ASTM E 1155:

Specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 21

2.2.3 Concrete Strength

Normal weight concrete must have a minimum compressive strength of 3000 P.S.I. Structural light weight concrete must have minimum requirements of 2500 P.S.I. and a dry weight of 90 to 115 pounds per cubic foot.

2.2.4 Wood Floor Accommodations

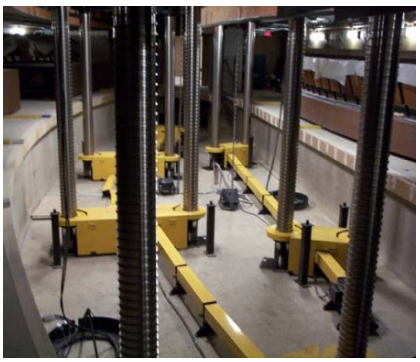
If a wooden floor is employed and placed on a concrete subfloor, the seating anchors will be assumed to pass through the wooden floor and into the concrete below with the same conditions as described above. If no concrete is present, threaded inserts may be epoxied into the wooden floor with a pull out strength as recommended by the manufacturer. Screwing or lag bolting the seating units into a wooden floor is unacceptable.

2.3 Orchestra Pits

Performance spaces containing an orchestra pit place unique structural requirements on the stage edge. In order to accommodate the musicians while keeping the first row of audience seating as close as possible to the performers on stage, the orchestra pit is partially recessed beneath the stage edge (the "underhang"). This recessed orchestra pit area must not be obstructed by column supports that would interfere with instruments and musicians. Combining the need for a column free area, an area not too far below stage level and the code required headroom, results in a thin, or tapered stage edge that is cantilevered and still achieves the stage live load requirement of 150 PSF.

2.4 Orchestra Lifts

In front of the stage there may be a lift moved by screwjacks, electro-mechanical devices, scissor mechanisms, or other devices. These lifts will be capable of achieving multiple elevations, typically as high as the stage edge and as low as the trap room or orchestra pit. Common lift elevations include: stage level - where they can serve as a stage extension, auditorium level - where they serve as a place for additional seating, orchestra pit, seat storage,



and trap room - where they allow access for storage.

2.4.1 Machinery Pit

Under the lift table there will be a machinery pit to accommodate the lifting mechanism. The depth and loading of the pit will depend on several factors, including the type of mechanism and the square footage of the lift table, but is typically 5’0” below the lowest required elevation of the lift table surface.

2.4.2 Other Considerations

The lower elevations of the lift table and the machinery pit may be impacted by the water table or flood plain conditions. Due to the difficulties in coordination, servicing, and life expectancy, we do not recommend screwjack or other lifting mechanisms requiring caissons. Because of this, the loads imposed by the lift will be transferred to the floor slab of the machinery pit. The floor slab of the machinery pit must be structurally linked to the auditorium.

2.4.3 Loading Diagram

The loads shown on the appropriate loading diagrams are estimates. The lift manufacturer will provide more detailed loading at the time of bid award that will address the specific lift table construction and support mechanism arrangement they intend to employ.

2.5 Performance Lighting Positions

2.5.1 Lighting Pipes, Balcony Rails, Gallery Rails, and Box Booms

Performance lighting fixtures are attached to permanent horizontal and vertical pipes throughout the stagehouse and auditorium. The pipes are often part of railing systems at the onstage side of the galleries or located on the underside of galleries and balconies. Details of the lighting positions will be developed during the design phases.

Provision for the suspension of lighting, sound, and camera equipment shall be provided on balcony fronts and on or under audience seating boxes. The design of the balcony rails will need to be coordinated with the architectural finishes, architectural lighting, and lighting and sound receptacles. In addition, the rails will need to support a range of performance lighting fixtures without impacting the audience sightlines. The front balcony rail must be rigid enough to

support cameras and projectors without vibration.

2.5.2 Loading Requirements

Lighting rail positions need to support 35PLF with a deflection criteria of L/360. The lighting support pipes are typically 1.5” nominal Schedule 40 steel pipe with an outside diameter of 1.9” and are located as shown on general arrangement drawings. Side lighting positions having the same loading criteria are located vertically on the side walls – these are known as boom or box boom lighting positions.

2.6 Catwalks / Lighting Bridges

Catwalks / Lighting Bridges provide access and support for production equipment, typically portable lighting fixtures and loudspeakers mounted overhead with the auditorium. A catwalk system may also be utilized to provide access and support for additional building equipment and systems.

2.6.1 Hangers

Catwalks are to be suspended from the roof structure by hangers at a typical spacing of 6’-0” to 8’-0” centers, but not exceeding 10’-0” centers (dependant on load and deflection). In addition to supporting the required loads, the catwalks must be rigid and not shake or wobble when personnel are on them.

2.6.2 Decking

Catwalk decking is typically steel plate, concrete, or in special cases grating. Decking should be securely fastened to framing in order to prevent noise from vibration.

2.6.3 Rails

The sides of catwalk systems facing the performance area require pipes on which lighting instruments may be mounted. In certain instances these pipes may be required on the opposite side of the catwalk as well. These pipes are required to be 1.5” Schedule 40 or Schedule 80 steel pipe with an outside diameter of 1.9”. These pipes shall be mounted on movable brackets to permit flexibility, located as shown in the detail drawings provided by the Theatre Consultant.

These pipes must often meet code requirements as guard rails as well as serve as lighting fixture positions. Due to this, their design and arrangement must be coordinated with the Architect, Code Consultant and Theatre Consultant.

2.7 Forestage Grid

Some performance spaces require a rigging zone in front of the proscenium. This working area is functionally similar to the stage grid and used for the suspension of scenery and other technical equipment. Temporary and permanent rigging equipment, powered or manual may be located here. Tension wire grids – typically constructed from 1/8" woven aircraft cable – or steel bar grating are often used. This type of grid surface provides an open transparent work surface beneath a system of support hangers. The loads imposed are shown on the provided schedule and diagrams.

2.7.1 Aesthetics and Coordination

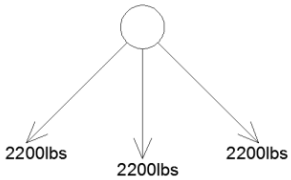
Due to its location, the underside and audience facing edge of the forestage grid is often visible to the audience below which can lead to architectural and aesthetic concerns over its appearance. Coordination with architectural elements and forestage reflectors is likely.

2.8 Speaker Clusters

2.8.1 General

Some Performance or Presentation Spaces will utilize loudspeakers over the Auditorium. These speakers can be freely suspended or attached to a hoist that allows them to be raised or lowered. The loads from these speakers and their hoisting equipment are supported by the forestage grid, catwalks, or the roof structure. These loads are shown on the appropriate loading diagram.

2.9 Rigging Points



Some performance spaces require Rigging Points (also known as Strong Points). A Rigging Point is an attachment location for temporary loads. The Rigging Point will typically support 2200lbs in the vertical direction as well as lateral loads up to the 45° direction.

2.9.1 Location

The location, capacity, and arrangement of the Rigging Points are shown on the appropriate loading diagram.

3 Stage

The stage or performance platform incorporates any area where a performance may take place. In a typical Proscenium style theatre, Rigging Systems are employed to suspend and hoist loads over the stage. These systems include counterweight flying systems, electric hoists and manually operated rope systems. In other types of theatres, pipe grids may be used to suspend loads over the stage.

Loads associated with the loading gallery, fly gallery, and operating galleries, together with their self-weight, are transferred to the roof structure or grid and can be transferred to the front and rear stage walls.

Loads due to the following equipment may transfer to the grid or roof structure:

- Counterweight Rigging
- Motorized Rigging
- Rope Rigging
- Dead Hung Loads
- Tied off Lateral Loads
- Proscenium Fire Safety Curtain

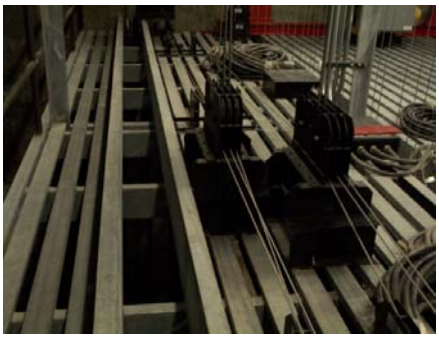
Lateral loads may be also transferred to the stage house roof structure.

In spite of the large load carried on the proscenium and stage house side walls, it is preferred that no columns or pilasters project into the stagehouse (from the wall on the stage side).

3.1 Grid Iron

Below the roof beams, a steel floor known as a grid (or grid iron) is required. The grid is a work surface that allows blocks and drop lines to be mounted over any point on the stage for suspending scenery or equipment. The grid surface is typically constructed from 3” channel steel laid leg down and running parallel to centerline. This surface can also be formed using structural grating. Assembly of the surface, whether channel or grate, may be completed in such a way that sections can be removed for replacement if damaged. In this instance, any fasteners must not loosen through use.

3.2 Grid Wells



The support for the grid is typically from a pair of channels running parallel to the centerline on the same centers as the roof beams above the grid. The channels are spaced 6” apart providing a nearly unobstructed slot for passage of lift lines. These slots are referred to as grid wells. Channels making up the grid wells are typically suspended from the roof beams by steel plate hangers on centers appropriate for the span and load of the grid. The pairs of channels running between the front and back walls of the stagehouse typically transfer the loads from the grid to the respective walls.

3.2.1 Details

Details of typical grid iron support arrangements will be provided by the Theatre Equipment Designer.

3.3 Head Block Beams

The hoisting lines from one arrangement of individual loft blocks pass over a single multi-grooved sheave known as a head block at one side of the stagehouse. These sheaves are mounted to a beam assembly known as the head block beam.

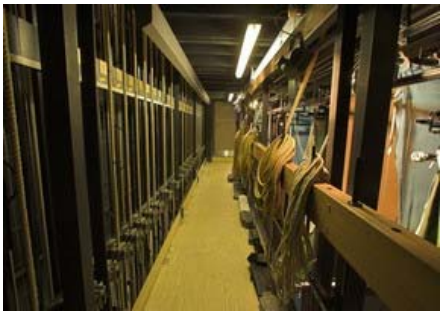
3.3.1 Location

This assembly runs in a direction parallel to centerline at one side of the stagehouse and is positioned over an open and unobstructed slot running all the way down to the stage floor below. Head blocks are usually mounted above the head block beam, but underhung designs are also possible. The head block beam’s vertical placement will vary with upright and underhung designs.

3.3.2 Load Reactions

Due to the nature of counterweight rigging forces, the head block beam assembly will experience reactions in both the vertical and horizontal planes as well as substantial torsion.

3.4 Galleries

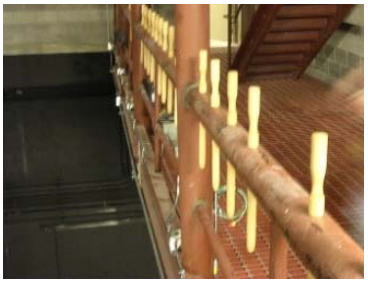


Galleries are working surfaces typically located in the stagehouse below the grid and above the stage floor. They can be referred to as loading galleries, operating galleries, or fly galleries depending on location. These elements provide circulation and access for technical personnel while serving as tie-off points for overhead rigging lines, storage space for counterweight bricks. Typically on-stage railing is utilized as mounting positions for stage lighting equipment. Additional portable performance equipment or machinery can be installed on them when necessary.

3.4.1 Location

Generally, fly and operating galleries are located on both sides of the stage and slightly above proscenium height. Where stage depth permits, these galleries may be connected with a narrow crossover gallery on the back wall of the stagehouse. The offstage (furthest from centerline) edges of the loading gallery and operating gallery must align in plan. Their location in relation to the rigging wall and the counterweight arbors is a critical issue and should be monitored throughout design and construction. This will ensure that the rigging system is in the correct relationship for safe operation and that no incursion into the counterweight travel occurs. Clear dimensions from the wall to the face of all galleries will be provided by the Theatre Consultant.

3.4.2 Pin Rails



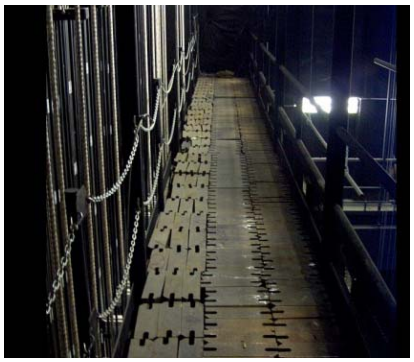
The ropes of a spot line system are tied off to belaying pins inserted in a pin rail on the stage side of the fly gallery and the operating gallery. The pin rails experience reactions in the vertical plane referred to as uplift. Loads are shown in the schedule and drawings.

3.4.3 Locking Rail

A locking rail for the counterweight system may also be located on the offstage side of the operating gallery. The locking rail experiences reactions in the vertical plane referred to as uplift. Loads are shown in the schedule and drawings.

3.4.4 Loading Galleries

When a counterweight rigging system is provided, a loading gallery is located below the grid and the head block beam assembly along the wall of the stagehouse adjacent to the counterweight arbors. This is used for loading the counterweights and storage of weights not in use. In operation, the weight is transferred from loading gallery to the head block assembly and back again. For this reason it is typical to hang the off-stage (furthest from centerline) edge of the loading gallery from the head block beam assembly.



Hangers supporting the loading gallery and fly galleries below must be located in alignment with the grid hangers. This ensures that all potential rigging obstructions are kept within the same plane.

3.4.5 Counterweight Brick Considerations

Since unused, loose counterweight bricks are stacked on the loading gallery, it requires 12” high kick plates and expanded metal screens up to the intermediate horizontal railing on the stage (closest to centerline) side to prevent accidental dropping of weights. Safety rails on the offstage (furthest from centerline) side of the loading gallery require specific construction to ensure they do not impede the operation of the loading gallery. Details for these railings will be provided.

3.4.6 Gallery Floors

The construction of gallery floors will typically be steel diamond plate or concrete.

3.5 Stage Floor

The Proscenium stage floor finish will typically be hardboard, Plyron or finished plywood on a wooden sub-frame laid onto a depressed concrete slab set 4” to 6” below the finished floor level. The Concert Hall floor, Dance Venue sprung dance floor, Instrument Ensemble and Choral Ensemble room floors will typically be T&G hardwood on a wooden sub-frame laid onto a depressed concrete slab set 4” to 12” below the finished floor level. Details will be developed and provided.

3.5.1 Flatness and Levelness Requirements

The concrete slab should be finished to the following tolerances, according to ASTM E 1155:

> Specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; with minimum local values of flatness, F(F) 30; and of levelness, F(L) 21

3.5.2 Floor Types

Most performance space floors are “floating”, “sprung”, or “resilient”. Resiliency of the floor is determined by the arrangement of the sub-floor framing and the use of resilient pads in the transition from the stage floor to the building structure. Allow 4” to 12” depression for resilient stage and performance platform floor construction.

3.5.3 Loading

In addition to the weight of the stage buildup, the stage will carry a considerable quantity of heavy performance equipment and must be designed to support the loads expressed herein. Concentrated loads on stage floors are normally in the form of casters that generally have hard plastic, rubber, or pneumatic tires. The most extreme loads for the stage are imposed by small forklifts carrying a maximum load or a movie camera crane. These elements may exert as much as 2200lbs on each wheel with wheels being 4’-0” to 7’-0” apart.

3.6 Manual Rigging System

Scenery, draperies, and lighting equipment may be suspended over the stage by means of a single-purchase counterweight flying system, motorized system, or a combination of any of these.

3.6.1 Operation

In general, the scenery or lighting equipment is attached to a pipe batten and sufficient weights are placed in the arbor to counter-balance the weight of the load. The operator raises and lowers the load by pulling the purchase line rope fixed to the counterweight arbor. When stationary, the rope is held in a “rope lock” located on a “lock rail” typically at stage level or at an operating gallery. The rope locks are designed to sustain a significant imbalance in a counterweight set resulting in uplift imposed on the lock rail. In addition, the lock rail can be used as a tie-off point for one end of a block-and-fall or as a point of securing a capstan winch for dead hoisting equipment overhead.

3.6.2 Single-Purchase Rigging

In a single-purchase system, the counterweight arbor travels the same distance as the load. The load is counterbalanced by an equivalent weight. The full clear height of one wall of the stage is required for the counterweight vertical guide tracks.

3.6.3 Pipe Batten

The counterweight pipe batten is suspended on steel wire ropes that pass over loft blocks on the grid. The other ends of the cables are fixed to the counterweight arbor that is able to move along vertical guide tracks fixed to one side wall of the stagehouse.

3.6.4 Loft Blocks

Below the roof structure or mounted on the grid are fixed rows of pulleys, known as loft blocks. The rows are arranged parallel to the proscenium opening on loft beams that run perpendicularly to the proscenium.

3.6.5 Lift Line Loading

Since the load due to the counterweights is distributed between the head block beam assembly and the loading gallery, the total load does not change. Only approximately 70% of the weights that the system can accommodate will be supplied. Accordingly, a diversity factor of 0.70 may be applied to the loads due to the counterweight flying system.

3.6.6 Loading Diagram

A schematic loading diagram of the stagehouse will be provided following selection of a preference grid type.

3.7 Vertical Guide Tracks

Vertical guide tracks are arranged in continuous lengths spaced at 6” or 8” centers from the stage floor to the underside of the head block assembly. These steel “T” shapes or extruded aluminum channels are attached back to the wall with horizontal steel angles called wall battens. Wall battens must be affixed to the stagehouse bearing wall, or in some cases, to an

acoustic partition wall. The method of attachment is typically masonry anchors spaced 5'-0" on vertical and horizontal centers. The wall framing at the rigging side of the stagehouse should be designed for a minimum horizontal load of 10 PSF or to withstand the predicted seismic loads caused by the counterweight arbors.

3.8 Motorized Rigging System

The type of Motorized Rigging System will be dependent on the scope of the project and may consist of loads moved directly by electric hoists. The exact requirements are shown in the provided drawings.

3.8.1 Dynamic Loads

Motorized Rigging Systems can impact significant dynamic loads to the building, depending on speed and load. These should be taken into account by the Project Structural Engineer and are NOT reflected in this document.

3.8.2 Direct Drive

Direct Drive systems for sets moved directly by electric power may require a different positional arrangement of sheaves.
Additional uplift loads are created in the area of this equipment.

3.9 Proscenium Fire Safety Curtain

In performance spaces with stages located at one end of the auditorium, code typically requires a Fire Safety Curtain at the proscenium. This is intended to provide fire and smoke separation between the stage and the auditorium. Such a curtain is, in effect, a fire resistant door rated for an amount of time determined by local codes that covers the proscenium opening.

3.9.1 Operation

The Fire Safety Curtain will be suspended and raised on wire rope cables via an electro-hydraulic winch which also acts as a damper. It will be counterbalanced by a counterweight arbor located on one of the stagehouse walls or by a direct drive unit. The curtain is released in an emergency condition with its descent velocity checked by a damper device. Its edges are guided and captured in steel

pockets ('smoke pockets') left and right of the proscenium opening. These ensure an overlap of the proscenium opening under the potential pressure differential of a fire.

3.9.2 Code Requirements

Local legislation (building codes) includes figures for air pressure loads on this curtain from the pressure differential. Such lateral loads are transferred through the rigging system and the smoke pockets at the proscenium wall. These should be reflected in the design of the wall.

3.9.3 Loads

The loads imposed by the Fire Safety Curtain System are shown in the loading diagrams.

3.10 Smoke Hatches

At the top of the stagehouse, a smoke hatch system is required to clear smoke from the stagehouse in the event of a fire. The total opening area of the smoke hatches must comply with applicable fire codes.

3.10.1 Location

The smoke hatch system is required to be entirely above the level of the loft beams. It may be formed in the stagehouse walls or as a structure raised above the roof line.

3.10.2 Alternatives

An alternative solution is to use a standard High-Transmission Smoke vent. In this case the vent will be mounted on the stagehouse roof slab. In conditions where snow is likely to be experienced, allowance must be made for the snow load. In certain circumstances a mechanical smoke extraction system may be acceptable by code.

3.10.3 Acoustic Qualities

The smoke hatch system must provide acoustical isolation equal to the isolation provided by the balance of the roof area.

3.11 Pipe Grid

Pipe grids are formed from Schedule 40 or Schedule 80 steel pipe with a 1.5” nominal dimension (1.9” o.d.) and assembled in a matrix consisting of 4’-0” or 5’-0” squares. Threaded rod is utilized to hang the pipe grid assembly from structural steel above.

3.11.1 Hangers

Hangers are located along the primary – or load bearing – pipe 6’-0” to 8’-0” on center. Structural steel beams or joists shall run perpendicular to the primary pipe. The grid assembly is braced to the wall every 8’-0” to 10’-0” utilizing a wall clip.

3.11.2 Loading

The pipe grid loading is 30PLF per pipe with a deflection criterion of L/200. The wall clips experience a lateral load of 250lbs.

3.11.3 Details

Details of pipe grid connections will be provided. Arrangements of pipe grids will be shown on the appropriate loading diagram.

3.12 Additional Loads

3.12.1 Scenery

Scenery may be stacked against walls of the side stage and scenery storage areas. Types, construction methods, and finishes should anticipate this.

3.12.2 Winches & Chain Motors

Winches and chain motor hoists may be installed in the wings or side stages and other storage areas for the temporary suspension of equipment from the ceiling. Unless called out differently, loads here are considered to be 2200lbs per point. Where a hoist is suspended from a trolley on a beam, allowance should be made for one trolley to have the full 2200lb load at any point along the beam.

3.12.3 Industrial Washers

Industrial washers (extractors) in the costume and wardrobe areas require appropriate mounting and floor construction to not only withstand the load of the machine but the vibration as well.

3.12.4 Projection Room Floor

Stability and isolation of projection room floors are critical. A satisfactory floor construction is a reinforced concrete slab not less than 4” thick. If conduit is required to be embedded, a tamped cinder fill not less than 4” thick and a trowel cement finish not less than 2” think shall be provided. The booth should be free from vibration. Low pile carpet or vinyl are preferred finishes.

3.12.5 Followspot Booth Floor

Minimum live load capacity for followspot positions should be at least 100 pounds per square foot, distributed over the entire floor area of the position. The live load deflection of beam elements supporting the working surface of a followspot position should not be greater than L/600. The total load deflection of those beam elements should not be greater than L/480.

All loads expressed in this document are indicative loads. Theatre Equipment Designer to provide loads based on equipment design and selection.

Tables

GENERAL LOADING REQUIREMENTS

plf	= Pounds per linear foot
psf	= Pounds per square foot
p	= Pounds

Control Rooms:

Floor Load	psf	**100**
Conc.	p	**500**

Dimmer Rooms:

Floor Load	psf	**100**
Conc.	p	**1000**

Projection Rooms:

Floor Load	psf	**200**
Conc.	p	**1200**

Followspot Rooms:

Floor Load	psf	**100**
Conc.	p	**500**

Fixed Seating Areas:

Floor Loads - Low	psf	**60**
Floor Loads - High	psf	**100**

Aisles:

Floor Load	psf	**100**

Loading Dock & Storage Areas:

Floor Load	psf	**200**
Conc.	p	**2000**

Stage:

Floor Load	psf	**150**
Conc.	p	**1200**

Performance Platform:

Floor Load	psf	**100**
Conc.	p	**1000**

Lighting Positions:

Linear for each Railing	plf	**35**
Conc.	p	**100**

Lighting Catwalks:

Area	psf	**40**
Conc.	p	**500**
Linear for each Railing	plf	**35**

Gridiron:

Area	psf	**150**
Conc. (in 4 sq/ft)	p	**2000**
Lateral		**250**

Forestage Grid:

Area	psf	**150**
Conc. (in 4 sq/ft)	p	**2000**
Lateral		**250**

Stagehouse Galleries:

Area	psf	**75**
Conc.	p	**500**

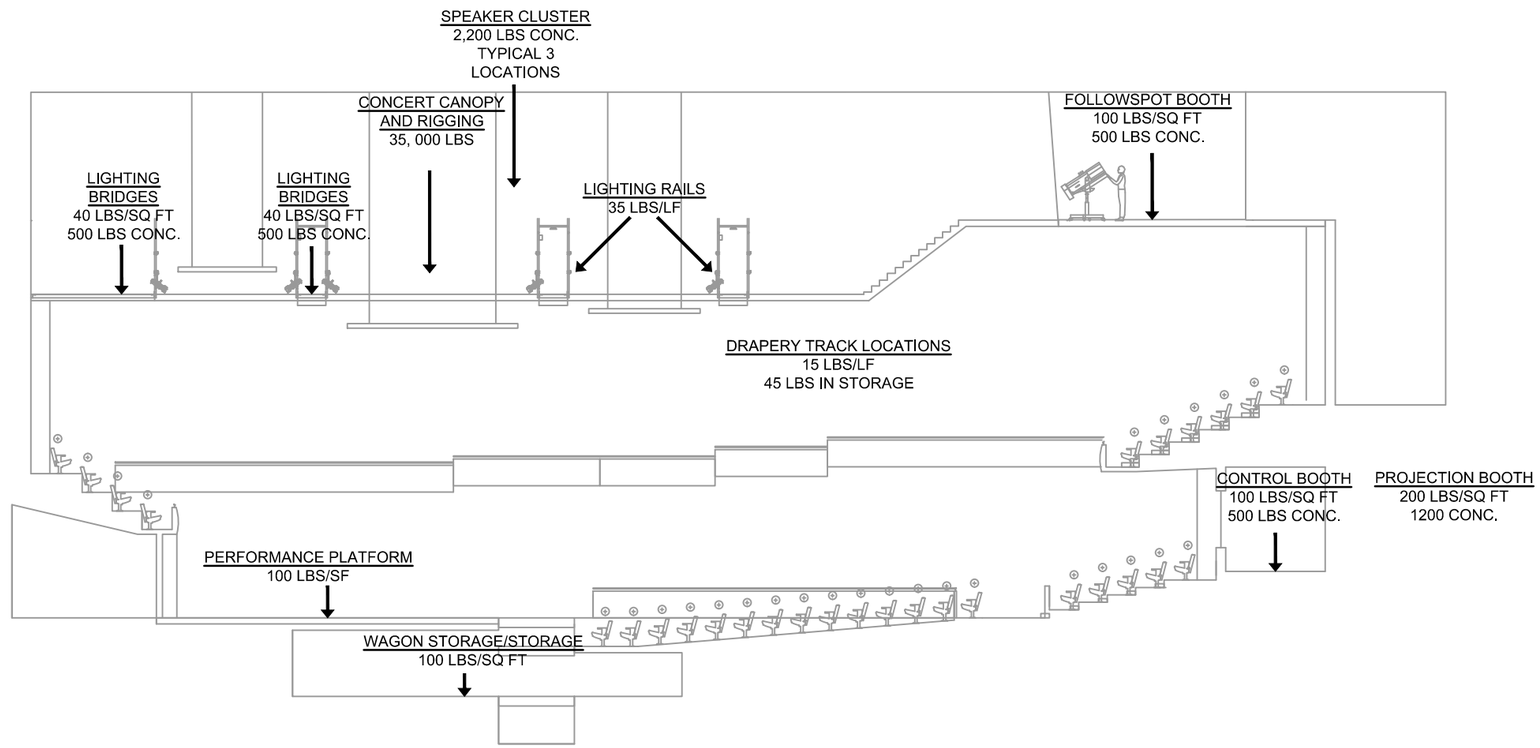
Loading Gallery:

Area	psf	**600**

Pinrail Loading:

Pinrail Uplift	plf	250
Pinrail Uplift Conc.	p	500

11x17



1 CENTERLINE SECTION - CONCERT HALL

1/16"=1'-0"

PLOT BY: Robert Young PLOT TIME: 4/19/2016 1:13 PM

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Issue	Date	By	Chkd	Appd
SD	04/19/2016	LG	RY	RY

NOT FOR CONSTRUCTION

Client: METHOD STUDIO

Job Title: UTAH VALLEY UNIVERSITY PERFORMING ARTS COMPLEX

Drawing Title: THEATRE PLANNING STRUCTURAL LOADING SERIES

Scale: AS NOTED

Printed at Sheet size 11x17

File Name: 2016-04-19_STRUCTURALLOADINGSKETCHES.DWG

Drawing Status: **SCHEMATIC DESIGN**

Job No: **245160-00**

Drawing No: **SK-001**

Issue

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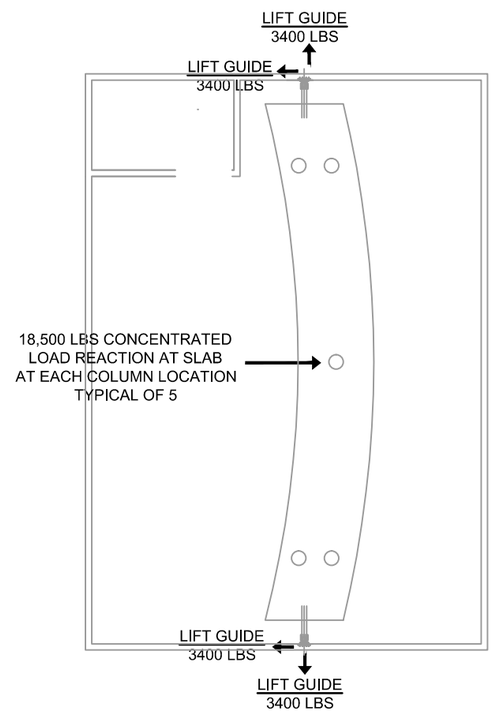

STAGE EXTENSION LIFT: 440 SQ. FT.
150 LBS/ SQ FT STATIC LOAD
50 LBS/SQ FT DYNAMIC LOAD
40 LBS/ SQ FT SELF LOAD

92,200 LBS TOTAL STATIC PAYLOAD
43,700 LBS TOTAL DYNAMIC LOAD
17,700 LBS TOTAL SELF LOAD

1 BASEMENT PLAN - CONCERT HALL
1/16"=1'-0"

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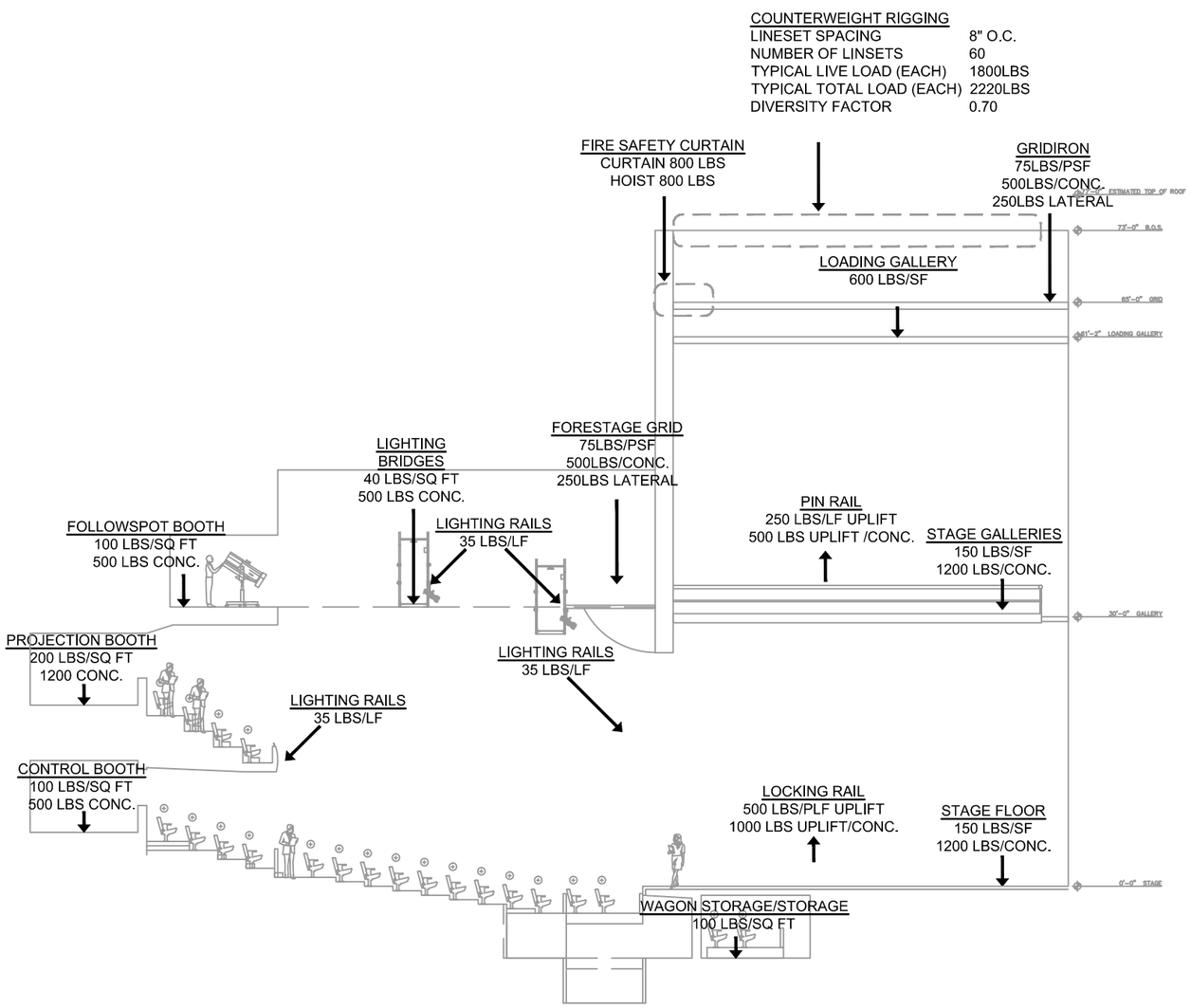

1 CENTERLINE SECTION - PROSCENIUM

1/16"=1'-0"

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File Name: 2016-04-19_STRUCTURALLOADINGSKETCHES.DWG

Drawing Status: **SCHEMATIC DESIGN**

Job No: **245160-00**

Drawing No: **SK-003**

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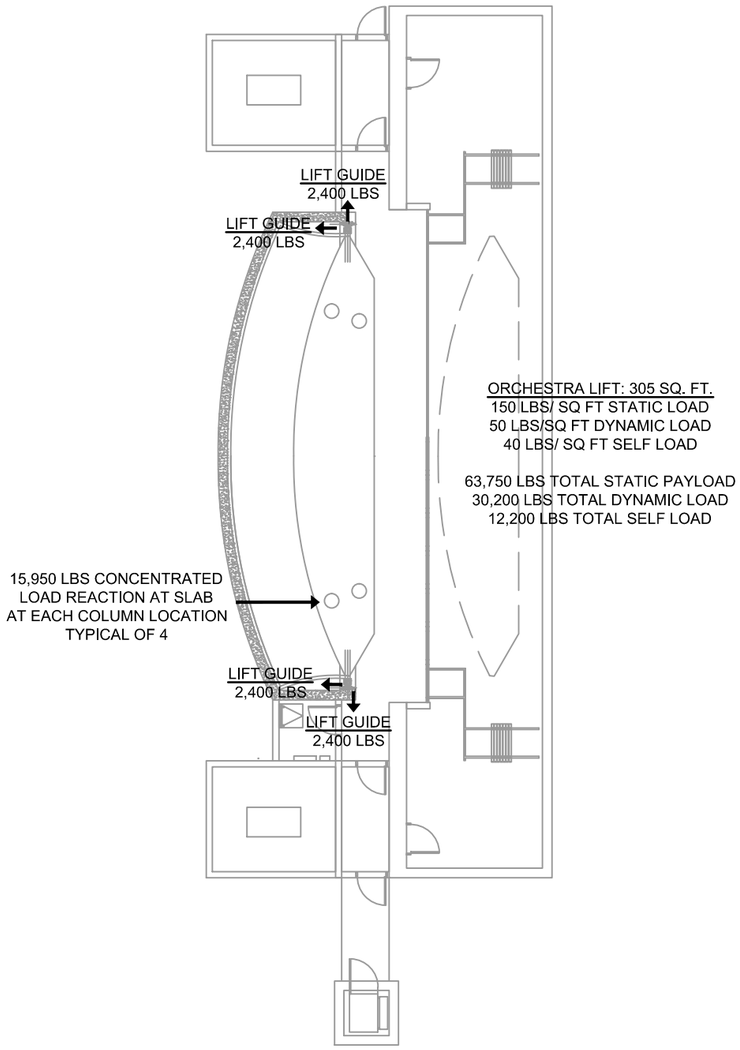

1 BASEMENT PLAN - PROSCENIUM

1/16"=1'-0"

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Drawing Status: **SCHEMATIC DESIGN**

Job No: **245160-00**

Drawing No: **SK-004**

Issue

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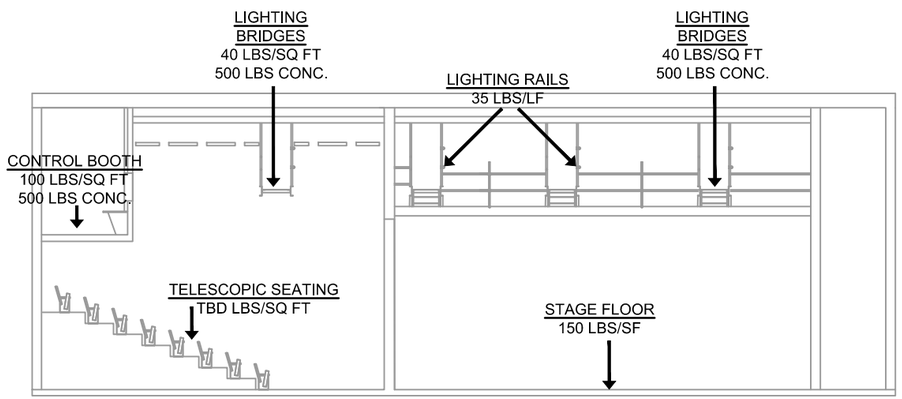

1 CENTERLINE SECTION - DANCE STUDIO

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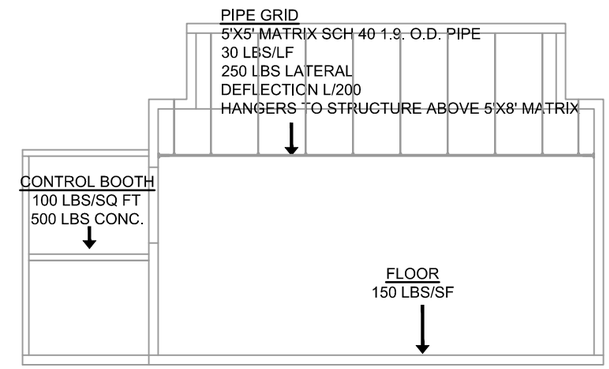

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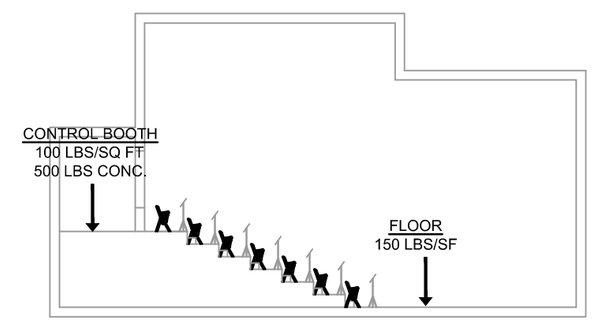

3 CENTERLINE SECTION - CHOIR REHEARSAL

1/16"=1'-0"

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Job No: **245160-00**

Drawing No: **SK-005**

Issue:

Method Studio

Utah Valley University Performing Arts Complex

Performance Equipment Electrical Loading Report

Elec-R01

Issue 1 | 15 April 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 245160-00

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ARUP

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Appendices

Appendix A

Acoustical Design Guidance for Electrical Systems

A1 Scope

A2 Acoustically Sensitive Spaces and Noise Criteria

A3 Electrical Systems Design Guidance

A3.1 Power Distribution, Transformer Location, Choice and Mounting
A3.2 Lighting System Dimmer Room Location
A3.3 Small Transformers and Motors, Relays
A3.4 Building Systems Serving Stage Machinery
A3.5 Ballasts
A3.6 Low Noise Dimmers
A3.7 House-light Fixtures
A3.8 Aisle Lights
A3.9 Circuit Layout
A3.10 Cable Routing and Sound Isolation

A4 Emergency Power

A5 Acoustic Testing

1 Electrical Power Estimates

Buildings for assembly, performance, presentation and broadcast are among the most complex of building types with regard to the design, accommodation, and installation of electrical and mechanical systems.

Performance facilities include extensive and interdependent systems for performance lighting, rigging, motorized production equipment, audio-visual equipment, and electronic data distribution which require electrical power and connection to electronic control devices. Because of the highly specialized nature of the technical equipment and performance areas, locations of control devices, conduits and conduit separations are important.

Various devices located on the plans and specified by the theatre equipment designer will be incorporated into the electrical engineer's work and documents. The electrical requirements of all the various performance systems should be integrated into the work of the Project Electrical Contractor, so that the responsibility for wire ways and power supplies are under one contract.

Some systems may be supplied and installed by the electrical contractor, other systems may be supplied and installed by specialty contractors utilizing empty conduit and power feeds installed by the electrical contractor. In order to achieve this integration, all of the device information, and wire ways and wire size information provided by the project's electrical engineers, should be included in Contract Documents.

The design and realization of these systems requires the particular engineering expertise of the Project Electrical Engineers who will design the electrical installation of these systems, including code compliance, size of wire and conduit for feeds, branch circuits, and controls utilizing the vocabulary provided in this document that fully describes and defines the performance requirements of the various performance power and control system.

1.1 Estimated Electrical Loads from Theatre Performance Equipment

Below are estimated requirements for electrical supplies for each area imposed by performance equipment.

- Loadings and supply sizes shown are typical only, and will need to be checked, confirmed and incorporated into the overall scheme by the project's electrical engineers for each specific equipment component.
- This information does not necessarily reflect applicable Codes, Rules and Regulations as interpreted by the state and local authorities having jurisdiction. Code compliance remains the responsibility of the Architect and engineers.

- The Theatre Equipment Designer will provide General Arrangement drawings indicating the locations of the anticipated loads and devices during Design Development.
- Loads are given in kW. Motor sizes are given in HP.
- The supply requirements given below include a diversity allowance typical of the nature and use of the intended loads.
- Power is indicated as either general or clean. Clean power systems shall be per the performance A/V equipment designer and typically utilize an isolated ground (clean earth) to ensure minimal electrical interference (especially for Performance Audio systems).

Information is based on the design information available at time of preparation of this report and is provided to inform the planning of general power and distribution requirements.

The loading information in this report should be adopted into the overall power loads, transformer needs and distribution strategies developed by the project engineers.

2 Performance Electrical Systems

2.1 Performance Lighting

Performance Lighting is accomplished through a system of dimmers, non-dims, control and data devices, with receptacles located throughout the theatre for the connection of portable theatre lighting fixtures.

Typical performance lighting fixtures include 750w Ellipsoidal Spotlights, 1kw and 2kw Fresnels, and 750w PAR fixtures, as well as broadcast fixtures, moving light fixtures, and LED fixtures.

Specification of the dimming and control equipment by the theatre equipment designer will take place in the Design Development and Construction Document phase. This will include selecting and specifying equipment, locating equipment on General Arrangements drawings, preparing detail drawings, schedules, and risers for equipment.

2.2 House Lighting and Work Lighting

House Lighting (dimmed general illumination and architectural lighting in the auditorium) will be designed by the Architectural Lighting Designer. This system will be circuited and scheduled by the Project Electrical Engineer with input from the theatre consultant and acoustician.

It is anticipated that the house lighting in the auditorium areas will be connected to the performance dimming and/or controls to accommodate integrated systems use.

Work Lighting includes fixtures used to illuminate the theatre seating, floor, stage, grid and its support areas during maintenance and non-production periods. Some Work Lighting fixtures may be portable, plug-in units included in the Performance Fixture package. Other Work Lighting fixtures will be permanent, architectural lighting fixtures. The theatre consultant will provide design criteria and recommendations for fixed or portable work lighting fixtures. These will be designed, circuited, scheduled, and specified by the Electrical Engineer.

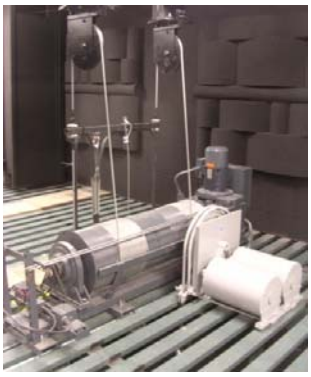
Dimmers, relays, and controls for Work Lighting will be specified by the theatre equipment designer. The Project Electrical Engineer will supply a schedule of permanent, work light circuits for accommodation in the dimming and control systems.

2.3 Emergency Power/Lighting

Feeding dimming systems and relay control systems with emergency (or alternative) power is not recommended. Transfer of lighting loads to emergency power is best accomplished downstream of the production lighting dimming and relay control systems. Commercially available Branch Circuit Automatic Transfer Switches may be appropriate for this project, if required. Control signal emergency bypass devices are also available.

The Electrical Engineer has full responsibility for the design of emergency lighting systems to meet code requirements.

Uninterruptible Power supplies (UPS's) should be supplied for processors and computers on all performance sensitive computer systems, i.e. lighting control, sound control, lift and rigging controls etc.



2.4 Performance Machinery

The theatre may include elements of performance machinery specified by the theatre consultant that require electrical accommodation designed and specified by the Electrical Engineer. Such machinery might include motorized rigging, motorized systems for adjusting room acoustics, and orchestra lifts.

Project Electrical Engineer's responsibilities include:

- Junction boxes and empty conduit for power and control systems.
- Electrical power distribution with disconnect switches at equipment locations.

2.5 Performance Sound, Video and Communications

Performance Sound, Video, and Communication (PSVC) systems include a variety of special power and distribution requirements described in subsequent sections.

The PSVC systems wiring will be supplied and installed by the PSVC contractor using empty conduit provided by the Electrical Contractor.

The Project Electrical Engineer's responsibilities include:

- Junction boxes, terminal cabinets, floorboxes, loudspeaker backcans, cable tray, and empty conduit for signal and control distribution.
- Transformer-isolated electrical power supply and isolated ground distribution to equipment locations

3 Performance Lighting Overview

In the Concert Hall, Proscenium, and Dance Venue the production lighting will be controlled by remote dimmers and relay controlled non-dim circuits distributed strategically throughout the stage and auditorium.

Branch circuit protection devices for all performance locations must be easily accessible to performance personnel. Panel boards for receptacles and equipment in the theatre should be located in the theatre near the area of devices served, or immediately adjacent to the theatre.

3.1 Dimming Systems

The performance dimming and control equipment will consist of dimmer racks and relay cabinets, control wiring and devices, branch circuit wiring and distribution. The electrical supply and distribution system must be designed to meet the following criteria:

- Dimming System Supply: 208Y/120V
- Branch dimmed circuits: All 2-wire + Ground (no shared neutrals). Receptacle rating as per schedule.
- Voltage at Performance Lighting Receptacles under full load conditions: 115-120V.
- Reference NEC Article 520 in the engineering of the performance dimming system

Most dimming systems produce distorted waveforms due to extremely non-linear currents drawn by the dimmers. This electrical interference can affect electronic control devices, computers, etc. Because of the harmonics generated by high speed SCR power switching, supply neutral conductors must be oversized due to excess current in the neutral

Branch circuit runs can be extremely long in performance buildings. Voltage drop at the receptacle must not exceed 5%. Because of the restrictive voltage drop allowance, long branch-circuit runs, and the insertion loss of the dimmers the dimming system power may often be supplied at an elevated voltage. The Dimmer Racks should be located as close as possible to the branch circuits supplied. In a large installation it may be cost-effective to locate the dimmer racks in multiple locations (multiple dimmer rooms) within the facility in order to minimize the lengths of branch circuit runs.

A Harmonic Mitigating Transformer (HMT) or K-13 rated transformer dedicated to the dimming system and production supply panels is recommended and will help to isolate the dimming system's distorted wave forms.

Most dimmers control power by dividing the AC wave form. An economical level of filtering is included in every dimmer but considerable harmonic distortion is still present. This may cause audible noise from buss-bar systems, the dimmers themselves, and distribution wire ways if live and neutral wires are separated. Branch circuit live and neutral conductors must share the same path and containment.

Electrical noise affecting audio amplification equipment is also generated, therefore rigorous ferrous screening and separation of these services is essential.

In addition to a physical and wiring separation of audio power and conduit from performance lighting circuits, it is advisable to separate other noise susceptible wiring from this system, such as computer and telecommunications equipment.

At some stage of dimming, neutral current can exceed phase current on three phase systems, although these currents are normally less than the full-on current.

Over-current protection of dimmed circuits will be provided as part of the Performance Dimmer equipment.

Although there is a diversity of total load, each branch circuit must accommodate its full specified load.

Production lighting load may go from nil to full listed load in less than one second.

3.2 Company Switch or Broadcast Supply Panels

A Company Switch or Broadcast Supply Panel is a power supply for temporary performance equipment. A project may include several Company Switches in various locations for specific requirements. The theatre equipment designer will provide the location, system voltage, and ampacity of each Company Switch.

All company switches require a suitable cable connection chamber with Buss-Bars to enable termination of bare cable ends to lugs. Some disconnects will require single-pole separable connectors, such as the cam-lock J Series (or compatible as approved), in addition to the cable connection chamber. The Cam-lock connector is the industry standard power connector.

This equipment should include pilot lamps indicating presence of power on each phase and may include a voltmeter for monitoring phase voltage on any phase.

Reference Article 520-51 of the NEC.

3.3 Fault Current Protection

3.3.1 Dimming System

Commercially produced performance dimming systems typically have an AIC short circuit rating of 100,000 RMS symmetrical amperes. Either the short circuit let through must be reduced below the 100,000 amperes withstand rating of the equipment or the dimming systems must be specified and supplied with custom modification to increase the system withstand rating.

3.3.2 Company Switch or Broadcast Supply Panels

As above, the temporary equipment connected to these disconnects will typically have an AIC short circuit rating of 100,000 RMS symmetrical amperes. Since the withstand rating of the temporary equipment is out of the control of the specifier, the Company Switch must have adequate fault current withstand ratings.

4 Performance Sound, Video and Communications System Overview

The Performance Sound, Video, and Communications (PSVC) system enables the playback of effects, music, live sound reinforcement and video. It supports the recording of events and performances. It supports communications between technicians and staff through headsets and video feeds. It provides assistive listening support to the hard of hearing.

Loadings, sizes, or other terms are typical only, and must be checked, confirmed and incorporated into the overall scheme by the Project Electrical Engineer for each specific equipment component.

This information does not necessarily reflect applicable Codes, Rules and Regulations as interpreted by the state and local authorities having jurisdiction. Code compliance remains the responsibility of the Architect and Engineers.

The PSVC designer will provide General Arrangement drawings indicating the locations of the anticipated loads and devices for the PSVC systems during Design Development.

Loads are given in KW.

Equipment locations requiring Isolated Ground or Isolated Power electrical supplies are designated in the chart below and will be indicated in the PSVC drawings (as information for work by others).

The supply sizes given include a diversity allowance typical of the nature and use of the intended loads.

Information is based on the design information available at time of preparation of this report and is provided to allow general power and distribution requirements to be planned.

4.1 Isolated Ground (Clean Earth) – Production Audio Systems

The performance spaces will require an Isolated Ground power distribution system for all PSVC equipment. In an isolated ground distribution system, all equipment grounds are isolated from building conduit, rebar, back boxes, etc., and dedicated insulated ground conductors connect to the building ground at a central point. H/N/G conductors should be individual home runs and oversized.

Conduit, junction boxes, and panels are bonded to the safety ground in the normal fashion.

All receptacles connected to the Isolated Ground system must use Isolated Ground receptacle devices colored orange to clearly identify the Isolated Ground characteristic.

Panel boards servicing the Isolated Ground receptacles must be labelled with orange lamacoid labels to clearly identify the Isolated Ground characteristics of the panel.

Since rack-mounted audio component chassis are common with the isolated ground system, conduits and wire ways to sound, video, and communications system racks must be isolated from the racks via insulated couplings, or other method ensuring that there is no electrical connection. Racks must be electrically insulated from the floor surface and situated such that they will not come in contact with alternate paths to building ground during operation.

The audio system will require a Faraday shielded transformer-isolated power supply and distribution system for all audio equipment electrical supplies. Such a supply is referred to as “clean” or “technical” power. The need for a “clean” power supply can sometimes be avoided by providing a 100% dedicated audio equipment power supply and distribution system from the service equipment; i.e. a direct connection back to building transformer secondary with no other devices (dimmers, lighting, motors, etc.) on the circuit.

4.2 Sound, Video, and Communications System Conduit Separation

Production Sound and Communications wiring is divided into four (4) wiring categories each of which require a separate conduit system. The four categories consider (L) Low level signals, (M) Medium level signals, (H) High level signals, and (O) Other signals. Do not intermix wiring categories in a given raceway or conduit.

Sound, Video and Communications wiring, raceways, and conduit shall remain physically separate from any other system which may cause interference.

Where Alternating Current power must be parallel to Sound, Video and Communications wiring, raceways and conduit maintain a separation of at least 3’-0” in runs under 75’-0”, or 6’-0” in runs over 75’-0”.

Sound, Video and Communications wiring, raceways, and conduit must not run parallel to power mains of potential in excess of 600 Volts.

Sound, Video and Communications wiring, raceways and conduit must not run near power transformers, thyristor dimmers, power control equipment, heavy current switchgear, breaker panels, fluorescent ballasts, motors, or any other equipment which radiates interference.

In order to reduce magnetic interference in the theatre, do not route major power supplies through the area of the theatre.

4.3 Wire Category Guide

Wiring Category	Contents
L – Low Level	Microphone signals and other sensitive wiring (0-100 millivolts)
M – Medium Level	Audio line level signals, Amplifier Inputs, Paging, Microphone Control, Technical Intercom, and Control Signal Wiring (100 millivolts-10 volts)
H – High Level	Loudspeaker circuits, infrared emitters, and other low voltage control wiring (10-70 volts)
O - Other	Video, Telephone, Digital, and Control circuits

4.4 Schedule of Minimum Conduit Separation by Category:

Minimum separation between conduits carrying wiring of different groups (90 degree crossing in close proximity is acceptable except where noted).

Category	L	M	H	O
L	Adjacent	6”	12”	12”
M	-	Adjacent	12”	12”
H	-	-	Adjacent	6”
O	-	-	-	Adjacent
Thyristor 120V	36”	12”	6”	12”
220/240V	6”	.6”	Adjacent	Adjacent
Other less than 600v not Thyristor controlled	6”	6”	Adjacent	Adjacent
Other less than 600v Thyristor controlled	24”	12”	6”	12”
600V+		May not be parallel or crossing.		
Plumbing Pipe	6”	6”	6”	6”
Heat Sources	12”	12”	12”	12”

Unusually heavy current demands in adjacent conduit or long parallel runs may dictate greater separation to avoid interference in the Sound and Communications System conduit.

Install conduits per the table above. Where it is absolutely necessary to cross a conduit with a conduit where separation is called for, the intersection must be at 90 degrees.

Install Sound, Video and Communications wiring within continuously grounded ferrous metal conduit or raceway.

PVC conduit will not provide shielding such as that gained from EMT, and so is unacceptable.

Signal conduits shall be mechanically and electrically connected to receptacle boxes and electrically isolated from sound system equipment racks.

5 Cable Passes

The installation of temporary production equipment often requires the installation of temporary cabling. Cable passes include a system of capped and sleeved openings through walls and floors, empty cable trays, and cable hooks for the routing of temporary cabling throughout the theatre, backstage and to the street.

The theatre equipment designer can provide the locations of penetrations and routing of cable tray and hooks by the Project Engineers and Architect for inclusion in Contract Drawings.

All loads expressed in this document are indicative loads. Theatre Equipment Designer to provide loads based on equipment design and selection.

6 Electrical Load Schedules

Schedule - Concert Hall				
Category	**Demand kW**	**Group Diversity %**	**Total Space Group Demand KW**	**Notes**
Group Total - General	31	81%	25	
Group Total - Lighting	231	78%	180	
Group Total - Rigging / Machinery	129	78%	100	
Group Total - Projection	25	88%	22	
Group Total - Adjustable Acoustics	56	80%	45	
Group Total - Sound	64	78%	50	ISO
Diversified Space Total	**537**		**422**	

Schedule - Proscenium Theatre

Category	Demand kW	Group Diversity %	Total Space Group Demand KW	Notes
Group Total - General	46	76%	35	
Group Total - Lighting	567	78%	440	
Group Total - Adjustable Acoustics	35	101%	35	
Group Total - Machinery / Rigging	147	82%	120	
Group Total - Projection	21	84%	18	
Group Total - Sound	95	79%	75	ISO
Diversified Space Total	**911**		**723**	

Schedule - Dance Theatre

Category	Demand kW	Group Diversity %	Total Space Group Demand KW	Notes
Group Total - General	14	69%	10	
Group Total - Lighting	302	79%	240	
Group Total - Rigging / Machinery	12	104%	12	
Group Total - Sound	33	81%	27	ISO
Diversified Space Total	**361**		**289**	

Schedule - Instrument Ensemble

Category	Demand kW	Group Diversity %	Total Space Group Demand KW	Notes
Group Total - General	12	83%	10	
Group Total - Lighting	50	89%	45	
Group Total - Projection	22	97%	21	
Group Total - Sound	20	79%	16	ISO
Diversified Space Total	**104**		**92**	

Schedule - Choral Ensemble

Category	Demand kW	Group Diversity %	Total Space Group Demand KW	Notes
Group Total - General	47	0%	0	
Group Total - Lighting	22	97%	21	
Group Total - Sound	3	0%	0	
Diversified Space Total	**71**		**35**	

Schedule - Other Parts of the Facility

Category	Demand kW	Group Diversity %	Total Space Group Demand KW	Notes
Group Total - General	4	69%	3	
Group Total - Lighting	14	100%	14	
Group Total - Sound	19	63%	12	
Group Total - Shop	131	77%	100	
Group Total - Dressing Rooms	30	60%	18	
Group Total - Costume / Laundry	60	84%	50	
Group Total - Trucks / Loading	70	85%	60	
Group Total - Ticketing	17	71%	12	
Group Total - Lobby	58	86%	50	
Group Total - Exterior	29	87%	25	
Diversified Space Total	**432**		**344**	

Schedule - Facility Totals

Production Equipment		**1905**	kW
Diversified Total	**75%**	**1429**	kW

ISO = Isolated Ground Power (Clean Earth)

Appendix A

Acoustical Design Guidance for Electrical Systems

A1 Scope

Noise generated by electrical equipment often contains pure tones to which human hearing is very sensitive. Even the smallest transformers, relays and ballasts can generate noise which may be considered annoying. The perception of these pure tones can be more pronounced in acoustically critical areas with low background noise levels.

Quiet parts of a performance could be impacted by noise from these electrical components, so there is a need for diligence in design and construction.

The intent of this document is to:

- Present guidelines to assist the design team with controlling noise and vibration from building electrical systems.
- Establish costs.

A2 Acoustically Sensitive Spaces and Noise Criteria

In order to achieve acoustical excellence in the UVU Performing Arts Complex, low noise and vibration levels are essential, especially in acoustically critical spaces. Where the term “acoustically critical spaces" is used in this document, it generally includes performance halls, rehearsal and practice spaces, and certain other support spaces. These are rooms where special precautions must be taken in the design of the building mechanical and electrical systems, and in the structural and architectural design to achieve low background noise targets.

- Spaces with background noise criteria of NC 30 or more stringent, as defined in the UVU PAC Program Document, are considered “acoustically critical spaces”.

A3 Electrical Systems Design Guidance

A3.1 Power Distribution, Transformer Location, Choice and Mounting

Transformer rooms should be located at-grade level, and remote from acoustically critical spaces. They must not be located directly adjacent to any noise critical space, either vertically or horizontally. High voltage distribution to multiple step-down transformers with structure connected to the Proscenium Theatre and Concert Hall is not acoustically acceptable.

If practical, all power should be distributed at final voltage from a room at one location.

The noise and vibration generated by oil-cooled transformers can be significantly lower than that from equivalent air-cooled units, and in this application, may be worth the extra cost.

Vibration isolation mountings for transformers will be considered individually when the transformer type, size and location are known. The transformer coils should be mounted on spring or neoprene isolators.

A3.2 Lighting System Dimmer Room Location

Dimmer racks produce considerable airborne and structure borne noise because they contain transformers and cooling fans. In order to achieve adequate noise isolation, dimmer rooms should not be located directly adjacent (vertically or horizontally) to the Concert Hall, Proscenium Theatre, or other acoustically critical space.

At minimum, dimmer room locations should be separated from acoustically critical spaces by heavy masonry walls, intervening corridors, and/or storage rooms. All cable penetrations through the dimmer room partitions and floor slabs must be carefully detailed to limit the impact on the acoustic separation provided by the construction.

No trunking or conduit may pass directly from the dimmer room to an acoustically critical space. The cable route should be through at least two penetrations in series.

Dimmer racks may need to be mounted on neoprene-steel sandwich pads to ensure discontinuity from supporting structures. Trunking and conduit that serve the dimmer racks should be equipped with flexible connections, that separate flexible ground wires, so that vibration is not carried into the structure by the conduits. The transformers serving dimmers should not be located in the dimmer rooms.

A3.3 Small Transformers and Motors, Relays

Equipment containing small transformers should not be installed within acoustically critical spaces. If this type of equipment must be located in spaces directly adjacent to acoustically critical spaces, it may require vibration isolation.

Equipment such as electrical or magnetic door closers and relays should not be used within acoustically critically spaces.

A3.4 Building Systems Serving Stage Machinery

Relays and fans in performance equipment, control panels, and racks must be located outside of the performance space and any acoustically connected spaces.

Control systems should be designed such that power to motor contactors in the auditorium/stage is cut off when the control system is off.

A3.5 Ballasts

Fluorescent fixtures must not be used in performance spaces for house lighting or performance lighting; they may be used for work-lights only. Silent electronic ballasts should be used for the work-lights, although it should be noted that not all ballasts termed "electronic" are actually silent. Ballasts for fluorescent and HID work-lights should be resiliently mounted.

High frequency fluorescent fixtures may be used in the other acoustically critical spaces, usually in conjunction with incandescent, but ballasts for them must be the silent, electronic type.

A3.6 Low Noise Dimmers

Specify dimmers used with performance lighting and houselights to minimize noise generated by the filaments.

A long rise-time dimmer should be specified to minimize noise at reasonable cost, or intrinsically low noise dimmer circuitry (e.g. sine wave) specified. Certain low-noise dimmers are relatively inefficient, so the cooling systems for the dimmer rooms should account for their heat dissipation.

A3.7 House-light Fixtures

Fluorescent, cold cathode, plasma and neon fixtures are normally too noisy for house-light applications in performance spaces. Incandescent fixtures on dimmers also radiate noise, but by properly choosing fixtures and specification of dimmers, this noise can be minimized.

Low voltage fixtures often cause noise problems associated with the high temperature of the fitting. These produce noise as a result of thermal movement; when they cool, or after dimming out.

As a preliminary guideline, quartz, "T4" sources, EVR or smaller, are usually acceptable, and under balconies, sources of ≤ 100W may be used, but only with special, low-noise dimmers to be specified with advice from Arup.

LED fixtures are ideal, acoustically, with appropriate type and placement of LED drivers.

A3.8 Aisle Lights

Incandescent mains voltage or LED fixture are recommended. Low voltage fixtures may be acceptable if they are fed by a few transformers located outside of the acoustically critical spaces. Be aware of different metal types in one luminaire resulting in heat expansion at different rates.

Fluorescent fixtures are unacceptable for aisle lighting.

A3.9 Circuit Layout

Load house-lighting dimmers as fully as possible to minimize noise.

A3.10 Cable Routing and Sound Isolation

Sound isolation can be severely reduced by chases or penetrations in walls for electrical trunking or conduit. Cable routes should not pass directly between acoustically critical spaces, or from noisy spaces to acoustically critical spaces. In some areas, surface mounted fittings will be required to avoid penetration of sound isolating walls or ceilings.

A4 Emergency Power

Testing of emergency generators should be scheduled so that it does not coincide with performances, critical rehearsals, or presentations. Emergency generator(s) should be located and silenced so that noise emission during normal testing meets the noise limits at the site boundary and to avoid unnecessary disturbance to users enjoying the nearby campus surroundings.

Contactors for emergency lighting fixtures should not be located in acoustically critical spaces. Such relays are normally on, and can generate disturbing hum in a quiet space.

Exit signs in acoustically critical spaces should not contain relays, transformers, or contactors and must not be fluorescent. Incandescent mains voltage or LED fixtures are acceptable. Low voltage fixtures are acceptable if fed by a transformer or batteries located outside of the space.

A5 Acoustic Testing

Lighting specifications should ensure that any contractor proposed changes to any of these lights, ballasts, transformers and dimmer combinations will require them to first submit the new device, with associated light, ballast, transformer and/or dimmer to Arup for review and approval.

Some lighting system components that are determined by Arup to be a noise risk may require laboratory noise testing to evaluate compliance with noise criteria.

Method Studio

Utah Valley University Performing Arts Complex

Performance Equipment Heat Loading Report

4/15/R01

Issue 1 | 15 April 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 245160-00

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1 Heat Load Estimates

1.1 Estimated Heat Loads from Theatre Equipment

This report provides general estimates of heat loading imposed by production equipment in the performance spaces. The equipment used for performance is quite efficient but does contribute some heat to the occupied envelope that can increase the overall ambient temperature and thus lead to discomfort for audience and performers.

It should be remembered that attire for various events can range from formal including multiple layers of clothing to groups wearing a minimal amount of clothing. Theatrical performer costumes can range from large scale heavy-duty character outfits that might be multiple layers of heat-trapping material, to practically nothing at all.

Estimates for heat loading from performance electrical equipment are based on predictions of performance equipment use during the course of a performance or presentation. The figures offered are based on the average use over the period of a typical performance – nominally 2 to 3 hours. Additionally a 15 minute peak average figure provided which is less than the maximum available load and reflects an estimate a particularly large or bright scene. The project's HVAC engineers shall ensure that comfortable conditions are maintained for the 2 to 3 hour average loads, understanding that the temperature will be allowed to rise slightly above normal limits during a fifteen (15) minute peak average.

Where loadings, sizes, dissipations, or other terms are given, these are typical only and will be checked and confirmed by the project's mechanical engineers for incorporation of each specific equipment contribution.

The information presented here is offered solely as general guidelines and does not necessarily reflect applicable Codes, Rules, and Regulations as interpreted by the state and local authorities having jurisdiction. The actual design and configuration is the responsibility of the MEP Engineer performing this portion of the work.

1.2 Heat Loading Schedules

The following schedule gives Arup's estimate of the technical equipment heat output in various parts of each theatre facility. Heat loads due to audience, actors, non-performance equipment and operating staff are not included. (Note: Figures given in this document for technical equipment supplement occupancy information is given by the architect and code consultant).

Schedule Notes:

- Heat loads given are for specialist equipment only.
- Allowance for people and general lighting has not been included.
- All environments are to be non-condensing.

1.2.1 Concert Hall

Room Name	Height	Heat (kW)		Temperature (F)		Humidity		Notes
		Peak	3 hour	Min	Max	Min	Max	
Auditorium	(+35ft AFF)	46	39	70	74	40%	60%	Lighting loads above platform
Performance Platform	(+3ft AFF)	6	5	70	74	40%	60%	Radiated energy from lights
FOH Catwalk	(+35ft AFF)	13	6	65	85	0%	85%	Lighting loads at FOH catwalks
Control Booth		4	4	65	75	0%	85%	Control equipment
Projection Booth*		10	10	68	75	0%	60%	Projection Equipment
Followspot Booth*		4	4	65	75	0%	60%	Followspots
Dimmer Room		4	4	68	75	0%	60%	Dimmers and data distribution
Amp Rack Room		7	7	68	75	0%	60%	A/V Rack Loads

1.2.2 Proscenium Theatre

Room Name	Height	Heat (kW)		Temperature (F)		Humidity		Notes
		Peak	3 hour	Min	Max	Min	Max	
Auditorium	(+30ft AFF)	27	13	70	74	40%	60%	Lighting load from lighting fixtures in auditorium area
Stage	(+6ft AFF)	26	14	70	74	40%	60%	Radiated energy from lights
Grid	(+30ft AFF)	78	41	65	85	0%	85%	Lighting load from lighting fixtures above stage
Control Booth		4	4	65	85	0%	85%	Control equipment
Projection Booth		7	7	68	75	0%	60%	Projection Equipment
Followspot Booth*		3	3	65	74	0%	60%	Followspots
Dimmer Room		8	8	68	75	0%	60%	Dimmers and data distribution
Amp Rack Room		8	8	68	75	0%	60%	A/V Rack Loads

1.2.3 Dance Venue

Room Name	Height	Heat (kW)		Temperature (F)		Humidity		Notes
		Peak	3 hour	Min	Max	Min	Max	
Auditorium	(+20ft AFF)	12	6	70	74	40%	60%	Lighting load from lighting fixtures in auditorium area
Stage	(+6ft AFF)	23	9	70	74	40%	60%	Radiated energy from lights
Catwalks above stage	(+25ft AFF)	85	34	65	85	0%	85%	Lighting load from lighting fixtures above stage
Control Booth		4	4	65	85	0%	85%	Control equipment
Dimmer Room		6	6	68	75	0%	60%	Dimmers and data distribution
Amp Rack Room		8	8	68	75	0%	60%	A/V Rack Loads

1.2.4 Instrument Ensemble

Room Name	Height	Heat (kW)		Temperature (F)		Humidity		Notes
		Peak	3 hour	Min	Max	Min	Max	
Auditorium	(+21ft AFF)	16	12	70	74	40%	60%	Lighting load from lighting fixtures in the room
Stage	(+6ft AFF)	5	3	70	74	40%	60%	Radiated energy from lights
Control Booth		4	4	65	85	0%	85%	Control equipment
Dimmer Room		1	1	68	75	0%	60%	Dimmers and data distribution
Amp Rack Room		8	8	68	75	0%	60%	A/V Rack Loads

1.2.5 Choral Ensemble

Room Name	Height	Heat (kW)		Temperature (F)		Humidity		Notes
		Peak	3 hour	Min	Max	Min	Max	
Control Booth		2	2	65	85	0%	85%	Control equipment

*Exhaust system may be required to connect with flex duct to projector.

2 Notes on Heat Dissipation Requirements

Increasingly, microprocessor based equipment susceptible to heat is being utilized in areas where historically heat gain has been acceptable. Moving lights and automation equipment deployed at high level in the theatre is a good example of this. Equipment failure can occur if temperatures exceed 100 degrees F. To avoid serious damage to electronic control equipment and dimmers, the maximum ambient temperature in the dimmer room, sound rack room, and theatre technical areas may not exceed 90 degrees F. It is recommended that an independent system with local thermostat control be provided to these areas to ensure the required environment.

2.1 Control Rooms

Control rooms sometimes have sustained use outside of main occupied use of the auditorium and stage. This use can be 24/7 and thus a separate air system should be provided. Control rooms should be conditioned at all times.

2.2 Dimmer and Amplifier Rack Room

Remote dimmer rooms and amp rack rooms can be powered under varying loads over 24/7 schedules and thus a separate air system should be provided. Occupancy of room is normally under maintenance conditions only. Dimmer rooms should be conditioned at all times.

2.3 Performance Machinery/Rigging

This equipment is rarely used for long periods of time. Consequently, figures are only given if sustained use is expected.

2.4 General

The loading information in this report should be adopted into the overall heat loads, equipment and distribution sizing and systems control strategies in the project building services engineer's report.

Recommendations are based on design information available at time of preparation of this document and are provided to allow design parameters and control principles for the ventilation system to be calculated.

3 Fire and Smoke Alarms

There are many different types of effects used in performances and shows. Many of these produce smoke, haze or other gaseous products. Separate control zones for the theatres and ancillary areas from the rest of the building are needed for

both artistic control of these effects as well as general air quality and artist and audience protection.

A secondary smoke removal system should have no duct detectors. If required, duct detectors in the theatre systems should be at the AHU not close to the theatre/auditorium source and be capable of override.

4 Fire Protection

The design of sprinkler systems needs to be carefully coordinated with the performance functions and performance systems. Sprinkler systems in the theatres, the backstage areas, control rooms, dimmer rooms and audio rack rooms should be pre-action or dry-pipe systems where possible.

Refer to the *Theatre Consultant Guide for Fire Protection Strategies* for additional information.

All loads expressed in this document are indicative loads. Theatre Equipment Designer to provide loads based on equipment design and selection.

Method Studio

Utah Valley University Performing Arts Complex

Performance Sound, Video, and Communications Report

PSVC/KG01

Issue 1 | April 20, 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number Job number

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1 Overview

The Performance Sound, Video, and Communication systems (PSVC) intended to support performances in the various project venues encompass five main areas of function and capability. Depending upon the performance requirements of the individual performance spaces, some or all of these capabilities will be provided as part of the scope of their technical systems. These five main functional areas are:

- **Recording, Signal Distribution & Routing Systems**
- **Reinforcement/Playback Systems**
- **Paging and Monitoring Systems**
- **Technical Communications (Intercom) Systems**
- **Portable Speaker/Effects Systems**

Although the primary loci for these systems are the Concert Hall, Proscenium Theater, Dance Venue, Instrumental Ensemble Rehearsal Room/Scoring Stage, and Choral Rehearsal Room, there will be certain aspects of these systems that may be part of lobbies, select performer support spaces and/or rehearsal rooms as well.

The requirements for the first three systems apply to all of the performance facilities in this project. Consequently the following descriptions of these systems are generic in nature, and references to system usage in "theater" should be understood to refer to performance facilities in general, not specifically to theaters. However, as the implementation of the last two system types is more specific to the facility in which they will operate, the details for these systems will be discussed venue by venue.

1.1 Recording/Signal Distribution & Routing Systems

Implementation of these systems will be comprised of three levels of connectivity:

- Local Connectivity
- Intra-building Connectivity
- Inter-Building Connectivity

These systems will provide the "future-proofing" of the technical systems by providing a flexible infrastructure that can adapt to the changing specifics of the technology.

- **Local Connectivity**

Accommodations are made to support the interconnectivity of technology both within each of the performance spaces as well as between these spaces and other locations within their buildings.

This interconnectivity will primarily consist of audio, video, single-mode fiber, and CAT-6a tieline panels within each of the performance areas that terminate in patching panels within the venues associated equipment/control rooms. This variety of signal types will support routing of audio and video for performance needs, for recording, and allow for future networked video/audio or digital control requirements.

- **Intra-Building Connectivity**

Cabling from venue specific equipment/control rooms will provide connectivity to/from other spaces within PAC, including the:

- Concert Hall,
- Proscenium Theater,
- Dance Venue,
- Instrumental Ensemble Rehearsal Room/Scoring Stage, and
- Choral Rehearsal

It still needs to be decided which of the Control Rooms will be designated as a "hub" with the capability to link all of these spaces in creative and flexible ways. Signal types will include audio, video, single-mode fiber, and CAT-6a.

- **Inter-Building Connectivity**

Single-mode fiber optic tielines will link the PAC venues with other locations in the UVU campus. These tielines will be routed to the appropriate MDF and associated pathways.

1.2 Reinforcement/Playback Systems

The audio reinforcement/playback systems will supply high-quality sound reinforcement to the audiences. The configuration of the reinforcement systems can range from the simple to the more complex depending upon the nature of reinforcement required:

- **Speech Reinforcement**
- **Music Playback**
- **Concert Sound Reinforcement**

As the nature of these systems varies greatly from space to space, these descriptions will be specifically defined for each performance space.

1.3 Paging and Monitoring Systems

Front of House

A front-of-house paging and monitoring system will allow the provision of background music as well as public pages/announcements and performance monitoring to all public theater spaces, including the lobby and circulation areas of the theater. Public pages will originate from either the stage/house manager, or from specific locations within the pre-show/lobby areas.

The system will also allow the stage/house manager to ring a chime in the public and production spaces for typical “10 minute warnings” at intermissions. A distributed loudspeaker system, typically ceiling-mounted, will be connected to power amplifiers and signal processors located in the main theater equipment racks will provide audio signal.

There will be no volume controls within the public areas. Background music and page levels will be preset for each area from controls at the audio equipment racks. Page-enable controls will also be provided to "lock-out" or "enable" zones or areas for paging. Any public page or announcement will override the background music or performance monitoring.

Back of House

A similar paging and monitoring system designated as a "back-of-house" or technical paging and monitoring system will allow the stage manage/house manager to page into dressing, makeup, and green room areas. Provision will also be made for audio monitoring of the performance in these backstage spaces via ceiling mounted loudspeakers with wall-mounted volume controls.

1.4 Technical Communications Systems

A multi-channel digital technical intercom system will allow wired communications between technical locations, technical offices, and front of house locations during pre-show, show, and intermission activities. The technical intercom system will be comprised of both portable "belt-pack" units as well as in-wall units for use by front-of-house staff. The in-wall units will be single channel stations typically located within each of the front of house usher areas such as the entry vestibules. Each station will utilize a handset for private communications with the Stage Manager or other appropriate house staff. This talk loop will be designated as a front-of-house loop and will not contain actor's calls, technical calls, or other conversations

Typical locations for intercom receptacles in backstage or technical performance spaces include:

- Audio Control
- Lighting Control
- Orchestra Pit
- Stage Walls

- Rigging Lock Rail
- Floor Level Locations
- Catwalk Level
- Loading Gallery
- Technical Grid Level
- Backstage wings
- Audio Rack Room
- Dimmer Rack Room
- Stage Manager's Position
- Technical Offices
- Scene Shop
- Mid-house Technical/Director's station

Typical locations for intercom stations in House Staff areas include:

- Box Office
- House Manager's Position
- Usher Stations
- Lobby

1.5 Portable Speaker/Effects Systems

Capabilities for foldback, special effects playback for drama, and playback of pre-recorded program material will be provided by a flexible system of loudspeaker signal-level receptacles located throughout the Theater combined with a four or eight-channel loudspeaker matrix patching panel in the equipment room.

The targeted locations for these receptacles will allow utilization of small, portable loudspeakers over a wide range of the room positions with a minimal amount of portable cabling required for use. Specific locations will be discussed for each performance space.

2 Concert Hall System

2.1 Overview

The Concert Hall is a variable performance space with an emphasis on support for acoustic music productions. The Concert Hall also functions as a variable classroom environment. To support these two functions the main audio system will be comprised of a Playback System, and a Reinforcement System. Infrastructure support for video projection will also be provided as an integral part of the facility.

The Playback System will be a permanently installed stereo loudspeaker system and will be controllable from a location in the hall to avoid having to go to the Control Booth to operate the system.

The Reinforcement System will also be permanently installed, and for simple, speech reinforcement requirements, it also will be capable of being operated from a hall location other than the audio control position.

These electroacoustic systems will provide audio reinforcement, reproduction of pre-recorded material and musical effects for speech, drama and music. Elements of these systems will be primarily concentrated at the platform end of the room, and at an audio control position at the "rear" of the upper level seating. Other technical locations include the audio equipment racks, which will also be in the control area. Locations for temporary use of portable equipment may also be included.

Receptacles for microphones, production communications and portable loudspeakers will be distributed throughout the house and technical areas at each of the levels (Orchestra, Platform, Choral Balcony, and Technical Level). High quality components will be specified for excellent performance, reliability and durability.

An infrared hearing assistance system with rechargeable wireless headsets will be provided for all seating areas. The emitters will be permanently located in the upper levels of the room, potentially at the technical level railings.

The functional capabilities of the systems, as well as the specific equipment provided, will enable productions, whether technically advanced or technically simple, to utilize state of the art production and control facilities in presenting their performances.

2.2 Recording/Signal Distribution & Routing Systems

The Concert Hall will be provided with audio, video, single-mode fiber, and CAT-6a tieline panels as described in the Overview. These panels will be located as follows:

- Performance Platform
- Choral Balcony
- Seating area side walls
- Rear of Hall, at the exterior of the Control Room
- Rear of the Hall at the interior of the Control Room.

2.3 Reinforcement/Playback System

2.3.1 Electroacoustic Control Position

Primary control and audio mixing of the electroacoustic systems will occur at an audio control position located in the control booth at the rear of the house. A large,

operable window, centered upon the audio console position, will allow the audio operator to hear the sound in the room rather than the control room monitors if appropriate. Additionally a second "in-house" mixing position will be provided at the parterre wall.

Control equipment will include:

- A 24 to 32-input digital multi-bus mixing console with 8 group mixes to provide flexibility and control in live mixing situations, additionally, six to eight pre/post effects busses will provide sufficient capabilities for the use of effects or loudspeaker sends for electronic music presentations.
- Foldback mixing for the musicians and performers will take place at the main control console utilizing one or more of the auxiliary busses or groups.
- A four-channel wireless microphone system will be available for the performers, using diversity antenna systems. The wireless receivers will be located within the platform area to maximize the signal reception and minimize dropouts.
- In additional to the wireless microphones, hard-wired microphone positions will be provided for the platform and choral areas via wall mounted (or floor pocket) receptacle plates.
- Three panels located at the Stage Left, Upstage, and Stage Right areas of the platform will allow connection of multi-conductor snake cables and associated stage boxes. These panels will support the micing and reinforcement/recording of live performers within the Concert Hall area.
- The microphone inputs (fixed and wireless) will terminate at a patch panel in the Control Position, where they may be assigned to any of the console inputs via patching into the rack-mounted digital stage-box.
- A 24 to 36 input, two-way, transformer isolated splitter will allow for simultaneous connection of the selected microphone inputs to the house mixing console as well as to a (NIC) second console (for broadcast, recording, or foldback) via a multi-pin receptacle panel located in an adjacent location within the control position.
- Four microphone inputs, independent of those controlled from the house control position, will be connected to an automatic microphone mixer. When the hall is used for simple, non-musical events (talks, lectures, etc.), these microphones can be used without requiring the presence of an audio operator at the console. Under these conditions the appropriate speech reinforcement audio equipment will be capable of being remote turned-on from specified locations other than the audio control position.
- A system of security covers will be utilized to provide control of unauthorized access to the audio system electronics and controls when an audio operator is not present.

2.3.2 Sound Equipment Room

The audio equipment room will house the audio racks for signal processing, signal patching, amplification, and other necessary support equipment. This area will most likely be within the footprint of the control booth at the rear of the hall.

- To maintain compatibility with various program formats a variety of program source devices will be provided for the reproduction of prerecorded musical and vocal tracks.
- CD/DVD/MP3 players will be provided, and will need to be able to be operated from the control booth.
- When in the system is being operated from the sound control position these machines will be operated with wired remote controls from the sound control position.
- Recording capabilities will consist of OFE digital recording software and DAW devices.

2.3.3 Permanent Loudspeaker Systems

Speech reinforcement will be produced by full-range, compact loudspeaker cabinets located on the centerline of the hall, directly in front of and above the platform. This central array will provide uniformly distributed audio coverage for the main floor audience seating area, as well as to the seating in the choral balcony.

Similar full-range loudspeaker systems will be located to the left and right of the central array. These loudspeakers are to be used for reproduction of stereo and two-channel directional effects. Used in conjunction with the central array, these units would allow "Left/Center/Right" three-channel mixing, especially when utilized with consoles that provide "L/C/R" panning as an option. As on option, subwoofers will supplement the stereo system for the very low frequency requirements of special effects and music.

2.4 Technical Communications System

The Concert Hall will be provided with a Technical Communications system as described in the Overview. Elements of this system will be located as follows:

- Choral Balcony
- Seating Area Side Walls
- Rear of Hall, face of Control Room
- Control Room
- Dimmer Room
- In-Wall Stations at the Usher Station/Vestibules
- Box Office

2.5 Paging and Monitoring System

The Concert Hall will be provided with a Paging and Monitoring system as described in the Overview. Elements of this system will be located as follows:

- PAC Lobby
- Large Practice Rooms

- Medium Rehearsal Room
- Large Rehearsal Room
- Backstage Corridor

2.5.1 Video Show Relay System

In conjunction with the audio monitoring/paging system video monitoring will also be provided for both Front-of-House and Back-of-House locations. Six to eight channels of local video will be available in specific areas such as backstage corridors, dressing and rehearsal rooms, lobby late-arrivals viewing, control booths, etc. Lobby and public video monitors, when used, will only be capable of providing images from the performance spaces.

The video monitoring system will utilize video cameras permanently located in the performance spaces and large rehearsal spaces. Video distribution will be via a combination of coaxial MATV cabling and IPTV network streaming. Local tuners/convertors will be provided at each display panel, allowing the users to select which video source is to be displayed. Head-end components for these systems will be located within the equipment racks.

A fixed camera will be located in the control room area and focused on the platform so that this signal can be distributed to lobby areas when there is no late seating. This signal will also be distributed to various waiting areas such as the green room and other waiting areas.

2.6 Portable Speaker/Effects System

Routing and control systems of the portable loudspeakers will provide capabilities for foldback, effects playback, and playback of pre-recorded program material at a variety of locations within the recital hall.

- A patchable eight-channel loudspeaker matrix panel, connected to receptacles located throughout the hall and eight channels of power amplifier will drive the portable loudspeakers.
- These receptacles will be located as follows:
  - At the platform apron, to provide foldback for the performers downstage.
  - On-stage, at mid and rear stage left and stage right locations for effects/foldback requirements.

2.7 Miscellaneous Systems/Requirements

<u>Hearing Systems</u>

In order to accommodate individuals with hearing impairments and to comply with the Americans with Disabilities Act (ADA), an assistive listening system (ALS) is provided. The ALS distributes sound from the audio system through an infrared

transmitter to wireless compact personal receivers with individual headsets and local volume controls. The receiver headsets may be used anywhere in the Concert Hall. These receivers are also compatible with the receiver headsets utilized for the Theater systems.

Power and Heat Requirements

The estimated power and heating requirements for the Audio Equipment Room are noted in the Electrical Loading Report. Other considerations are as follows:

- Electrical power for the audio and audiovisual equipment will be via a separate Technical Power service, with Isolated Ground. This Technical Power will feed the equipment racks, the AV Control Booth, House Mix position, and various technical power receptacles on the platform for use by performers, and the Stage Manager's panel.
- The sound equipment room should be separately zoned for cooling, so that it will be adequately cooled even when other building systems are turned off. (The audio equipment may be used for 8 to 15 hours per day for several days at a time. During other periods, system equipment may be used only 4 hours per day.)

3 Proscenium Theater System

3.1 Overview

The Proscenium Theatre is a variable performance space with an emphasis on support for drama, musical theatre, dance, film, amplified music and amplified speech. The Proscenium Theater also functions as a variable classroom environment. To support these two functions the main audio system will be comprised of a Playback System, and a Reinforcement System. Infrastructure support for video projection will also be provided as an integral part of the facility.

The Playback System will be a permanently installed stereo loudspeaker system and motorized center cluster, and will be controllable from a location in the hall to avoid having to go to the Control Booth to operate the system.

The Reinforcement System will also be permanently installed, and for simple, speech reinforcement requirements, it also will be capable of being operated from a hall location other than the audio control position.
These theater electroacoustic systems will provide audio reinforcement, reproduction of pre-recorded material and musical effects for speech, drama and music. Elements of these systems will be primarily concentrated at the stage end of the room, and at an "in-house" audio control position at the parterre level seating. Other technical locations include the audio equipment racks, which will include racks housing control or patching equipment in the control area, and other racks in a dedicated equipment room.. Locations for temporary use of portable equipment may also be included.

Receptacles for microphones, production communications and portable loudspeakers will be distributed throughout the house and technical areas at each of the levels (Backstage, Orchestra Pit, Stage, Main Seating Area, Technical Level, Catwalks). High quality components will be specified for excellent performance, reliability and durability.

An infrared hearing assistance system with rechargeable wireless headsets will be provided for all seating areas. The emitters will be permanently located in the upper levels of the room, potentially at the technical level railings.

The functional capabilities of the systems, as well as the specific equipment provided, will enable productions, whether technically advanced or technically simple, to utilize state of the art production and control facilities in presenting their performances.

3.2 Signal Distribution & Routing Systems

The Proscenium Theatre will be provided with audio, video, single-mode fiber and CAT-6a tieline panels as described in the Overview. These panels will be located as follows:

- Stage Platform
- Orchestra Pit
- Mid-house Director's Technical Position
- Seating area side walls
- In-house Mix Position
- Rear of Hall, at the exterior of the Control Room
- Control Room
- Catwalk Level
- Gridiron Level

3.3 Technical Communications System

The Proscenium Theatre will be provided with a Technical Communications system as described in the Overview. Elements of this system will be located as follows:

- Stage Platform
- Orchestra Pit
- Seating area side walls
- Mid-house Director's Technical Position
- Rear of Hall, at the exterior of the Control Room
- Catwalk Level
- Gridiron Level
- Control Room
- Dimmer Room
- In-Wall Stations at the Usher Station/Vestibules

- Box Office
- Scene Shop
- Technical Director's Office

3.4 Paging and Monitoring System

The Proscenium Theatre will be provided with a Paging and Monitoring system as described in the Overview. Elements of this system will be located as follows:

- PAC Lobby
- Orchestra Pit (via receptacle)
- Dressing Rooms
- Make-up Room
- Large Rehearsal Room
- Backstage Corridor
- Green Room

3.4.1 Video Show Relay System

In conjunction with the audio monitoring/paging system video monitoring will also be provided for both Front-of-House and Back-of-House locations. Six to eight channels of local video will be available in specific areas such as backstage corridors, dressing and rehearsal rooms, lobby late-arrivals viewing, control booths, etc. Lobby and public video monitors, when used, will only be capable of providing images from the performance spaces.

The video monitoring system will utilize video cameras permanently located in the performance spaces and large rehearsal spaces. Video distribution will be via a combination of coaxial MATV cabling and IPTV network streaming. Local tuners/convertors will be provided at each display panel, allowing the users to select which video source is to be displayed. Head-end components for these systems will be located within the equipment racks.

A fixed camera will be located in the control room area and focused on the stage so that this signal can be distributed to lobby areas when there is no late seating. This signal will also be distributed to various waiting areas such as the green room and other waiting areas.

3.5 Reinforcement/Playback System

3.5.1 Electroacoustic Control Position

Primary control and audio mixing of the electroacoustic systems will occur at an audio control "in-house" position located out in front of the control booth location at the rear of the house.

Control equipment will include:

- A multi-input (48 to 96) multi-bus digital mixing console with a minimum of 8 group mixes to provide flexibility and control in live mixing situations. Additionally, twelve to sixteen pre/post effects busses will provide sufficient capabilities for the use of effects or loudspeaker sends for electronic music presentations
- When required, stage foldback (monitor) mixing for the stage performers will take place at the main control console utilizing one or more of the auxiliary busses or groups. Alternately a network node will be located off-stage left and stage right for the provision of local console for foldback control of effects or offstage choruses, etc.
- An eight-channel wireless microphone system will be available for the performers, using diversity antenna systems. The wireless receivers will be located within the stage area to maximize the signal reception and minimize dropouts and will utilize portable rack-mounted receivers which could be located in the control rooms or within the stage area.
- In additional to the wireless microphones, hard-wired microphone positions will be provided for the stage and orchestra pit areas via wall mounted (or floor pocket) receptacle plates.
- Three 16-input panels located at the Stage Left, Up-Center, and Stage Right sides of the stage area and two 16-input panels located within the Orchestra Pit will allow connection of multi-conductor snake cables and associated stage boxes. These panels will support the micing and reinforcement of live performers within the Theatre area.
- The microphone inputs (fixed and wireless) will terminate at a patch panel in the Control Position, where they may be assigned to any of the console inputs via rack-mounted digital stage rack units. The analog patching also allows connectivity to the fiber network I/O panels which are located in the PSVC equipment rack room. Area. Once the signals are on the fiber network they may be assigned to any of the console inputs or other locations within the building
- A 36 to 40 input, three-way transformer isolated splitter will allow for simultaneous connection of the selected microphone inputs to the house mixing console, to a (NIC) second console (for broadcast or foldback) via a multi-pin receptacle panel located at stage right on-stage, as well as to a (NIC) third console (for broadcast via a multi-pin receptacle panel located in an adjacent location within the enclosed control booth.
- Four microphone inputs, independent of those controlled from the house control position, will be connected to an automatic microphone mixer. When the theatre is used for simple, non-musical events (talks, lectures, etc.), these microphones can be used without requiring the presence of an audio operator at the console. Under these conditions the appropriate speech reinforcement audio equipment will be capable of being remote turned-on from specified locations other than the audio control position.

- A system of security covers will be utilized to provide control of unauthorized access to the audio system electronics and controls when an audio operator is not present.

3.5.2 Sound Equipment Room

The audio equipment room(s) will house the racks for analog signal processing, signal patching, amplification, networked A/V, and other necessary support equipment. These rooms are typically located adjacent to the IT TR rooms as well as having some components located within the footprint of the control booth at the rear of the hall.

- To maintain compatibility with various program formats, source devices such as digital cart playback devices, CD/DVD players, and DAW hard-drive recording/playback devices will be provided for the reproduction of prerecorded musical and vocal tracks.
- These machines will be capable of being operated remotely from the sound control position.

3.5.3 Permanent Loudspeaker Systems

Speech reinforcement will be produced by full-range, compact modular line array loudspeaker cabinets located on the centerline of the hall, directly in front of and above the stage. This central array will provide uniformly distributed audio coverage for the main floor audience seating area, as well as to the seating in the choral balcony.

Similar full-range line array loudspeaker systems will be located to the left and right of the central array. These loudspeakers are to be used for reproduction of stereo and two-channel directional effects. Used in conjunction with the central array, these units will allow true "Left/Center/Right" three-channel mixing, especially when utilized with consoles that provide "L/C/R" panning as an option. Subwoofers will supplement the stereo system for the very low frequency requirements of special effects and music.

For areas in the under balcony seating and upper balconies where sightlines may be occluded to the central array, ceiling-recessed and ceiling mounted loudspeakers will be utilized to fill in sound where necessary.

3.5.4 Portable Speaker/Effects System

Routing and control systems of the portable loudspeakers will provide capabilities for foldback, effects playback, and playback of pre-recorded program material at a variety of locations within the Proscenium Theatre.

- A patchable eight-channel loudspeaker matrix panel, connected to receptacles located throughout the theatre and eight channels of power amplifier will drive the portable loudspeakers.
- These receptacles will be located as follows:

- At the stage apron, to provide foldback for the performers downstage.
- On-stage, at mid and rear stage left and stage right locations for effects/foldback requirements.
- At selected locations backstage, to enable effects playback and foldback loudspeakers to be positioned as needed and "flown" using the theatrical rigging system.
- In the orchestra pit and pit lift to provide effects playback and foldback
- At selected locations within the house, to enable effects playback and foldback loudspeakers to be positioned as needed.
- At selected locations within the catwalk systems, for effects playback

3.6 Miscellaneous Systems/Requirements

3.6.1 Hearing Systems

In order to accommodate individuals with hearing impairments and to comply with the Americans with Disabilities Act (ADA), an assistive listening system (ALS) is provided. The ALS distributes sound from the audio system through an infrared transmitter to wireless compact personal receivers with individual headsets and local volume controls. The receiver headsets may be used anywhere in the seating area of the Proscenium Theater. These receivers are also compatible with the receiver headsets utilized for the Recital Hall systems.

3.6.2 Power and Heat Requirements

The estimated power and heating requirements for the Audio Equipment Room are noted in the Electrical Loading Report. Other considerations are as follows:

- Electrical power for the audio and audiovisual equipment will be via a separate Technical Power service, with Isolated Ground. This Technical Power will feed the equipment racks, the audio portions of the Control Booth, various technical power receptacles on the stage and orchestra pit for use by performers, the Stage Manager's panel, and the touring audio company switch.
- The sound equipment room should be separately zoned for cooling, so that it will be adequately cooled even when other building systems are turned off. (The audio equipment may be used for 8 to 15 hours per day for several days at a time. During other periods, system equipment may be used only 4 hours per day.)
- On stage, during road shows, heat and power loads equivalent to those in the Audio Equipment Room may be generated.
- A 200A 120/208-volt 3-phase audio system company switch with cam-lock connectors for road show equipment will be provided at the rear of the stage for temporary shows.

4 Dance Venue System

4.1 Overview

The Dance Venue is a variable performance space with an emphasis on support for dance performances with amplified sound. The Dance Venue also functions as a variable classroom environment. To support these functions the main audio system will be comprised of a system to be used for both Playback and Reinforcement. Infrastructure support for video projection will also be provided as an integral part of the facility.

These Systems will be a permanently installed stereo loudspeaker system and will be controllable from the audio control location at the Control Booth.

These electroacoustic systems will provide audio reinforcement, reproduction of pre-recorded material and musical effects. Elements of these systems will be primarily concentrated at the stage end of the room, and at an audio control position at the "rear" of the upper level seating. Other technical locations include the audio equipment racks. Locations for temporary use of portable equipment may also be included.

Receptacles for microphones, production communications and portable loudspeakers will be at locations throughout the house and stage areas. High quality components will be specified for excellent performance, reliability and durability.

An infrared hearing assistance system with rechargeable wireless headsets will be provided for the seating area. The emitters will be permanently located in the upper levels of the room.

The functional capabilities of the systems, as well as the specific equipment provided, will enable productions, whether technically advanced or technically simple, to utilize state of the art production and control facilities in presenting their performances.

4.2 Signal Distribution & Routing Systems

The Dance Venue will be provided with audio, video, single-mode fiber, and CAT-6a tieline panels as described in the Overview. These panels will be located as follows:

- Stage Platform
- Rear of Hall, in the Control Room

4.3 Technical Communications System

The Dance Venue will be provided with a Technical Communications system as described in the Overview. Elements of this system will be located as follows:

- Stage Platform

- Control Room

4.4 Paging and Monitoring System

The Dance Venue will be provided with a Paging and Monitoring system as described in the Overview. Elements of this system will be located as follows:

- Lobby
- Dressing Rooms
- Green Room
- Backstage Corridor

4.4.1 Video Show Relay System

In conjunction with the audio monitoring/paging system video monitoring will also be provided for both Front-of-House and Back-of-House locations. Six to eight channels of local video will be available in specific areas such as backstage corridors, dressing and rehearsal rooms, lobby late-arrivals viewing, control booths, etc. Lobby and public video monitors, when used, will only be capable of providing images from the performance spaces.

The video monitoring system will utilize a fixed camera located in the control booth area and focused on the stage so that this signal can be distributed to lobby areas when there is no late seating. This signal will also be distributed to various waiting areas such as the green room and other waiting areas.

4.5 Reinforcement/Playback System

4.5.1 Electroacoustic Control Position

Primary control and audio mixing of the electroacoustic systems will occur at an audio control position located in the control booth at the rear of the house. A large, operable window, centered upon the audio console position, will allow the audio operator to hear the sound in the room rather than the control room monitors if appropriate.

Control equipment will include:

- A 16 to 24-input multi-bus digital mixing console with 4 group mixes to provide flexibility and control in live mixing situations, additionally, four to eight pre/post effects busses will provide sufficient capabilities for the use of effects or loudspeaker sends for electronic music presentations.
- Foldback mixing for the stage performers will take place at the main control console utilizing one or more of the auxiliary busses or groups.
- A four-channel wireless microphone system will be available for the performers, using diversity antenna systems. The wireless receivers will be located within the stage area to maximize the signal reception and minimize dropouts.

- In additional to the wireless microphones, hard-wired microphone positions will be provided for the stage areas via wall mounted receptacle plates.
- Three panels located at the Stage Left, Up Center, and Stage Right sides of the stage area will allow connection of digital stage boxes. These panels will support the micing and reinforcement of live performers within the Concert Hall area.
- The inputs to the digital stage box will microphone inputs (fixed and wireless) will terminate at a panel in the Control Booth where they can connect to the console.
- A system of security covers will be utilized to provide control of unauthorized access to the audio system electronics and controls when an audio operator is not present in the Control Booth.

4.5.2 Sound Equipment Room

The audio equipment room will house the audio racks for signal processing, signal patching, amplification, and other necessary support equipment. This area will be within the footprint of the control booth at the rear of the hall.

- To maintain compatibility with various program formats a variety of program source devices will be provided for the reproduction of prerecorded musical and vocal tracks.
- CD/DVD/MP3 players will be provided.

4.5.3 Permanent Loudspeaker Systems

Playback/Speech reinforcement will be produced via flown full-range loudspeaker systems located to the left and right of the stage area. These loudspeakers will be used for reproduction of stereo and two-channel directional effects as well as sound reinforcement. As on option, subwoofers will supplement the stereo system for the very low frequency requirements of special effects and music.

4.5.4 Portable Speaker/Effects System

Routing and control systems of the portable loudspeakers will provide capabilities for foldback, effects playback, and playback of pre-recorded program material at a variety of locations within the recital hall.

- A patchable four-channel loudspeaker matrix panel, connected to receptacles located throughout the hall and four channels of power amplifier will drive the portable loudspeakers.
  - These receptacles will be located as follows:
    - On-stage, at mid and rear stage left and stage right locations for effects/foldback requirements.

4.6 Miscellaneous Systems/Requirements

<u>Hearing Systems</u>

In order to accommodate individuals with hearing impairments and to comply with the Americans with Disabilities Act (ADA), an assistive listening system (ALS) is provided. The ALS distributes sound from the audio system through an infrared transmitter to wireless compact personal receivers with individual headsets and local volume controls. The receiver headsets may be used anywhere in the Concert Hall. These receivers are also compatible with the receiver headsets utilized for the Theater systems.

Power and Heat Requirements

The estimated power and heating requirements for the Audio Equipment Room are noted in the Electrical Loading Report. Other considerations are as follows:

- Electrical power for the audio and audiovisual equipment will be via a separate Technical Power service, with Isolated Ground. This Technical Power will feed the equipment racks, the audio portions of the Control Booth, various technical power receptacles on the stage for use by performers, and the Stage Manager's panel.
- The sound equipment room should be separately zoned for cooling, so that it will be adequately cooled even when other building systems are turned off. (The audio equipment may be used for 8 to 15 hours per day for several days at a time. During other periods, system equipment may be used only 4 hours per day.)
- On stage, during road shows, heat and power loads equivalent to those in the Audio Equipment Room may be generated.

5 Instrumental Ensemble Rehearsal Room/Scoring Stage

5.1 Overview

The instrumental ensemble rehearsal room is a variable rehearsal space that will also serve as a commercial scoring stage, and will occasionally serve for recitals and concerts. To support these functions the main audio system will be comprised of a Playback System. Infrastructure support for video projection will also be provided as an integral part of the facility.

The Playback System will be a permanently installed stereo loudspeaker system and will be controllable from a location in the venue.

The functional capabilities of the systems, as well as the specific equipment provided, will enable productions, whether technically advanced or technically simple, to utilize state of the art production and control facilities in presenting their performances.

5.2 Recording/Signal Distribution & Routing Systems

The instrumental ensemble rehearsal room will be provided with audio, video, single-mode fiber, and CAT-6a tieline panels as described in the Overview. These panels will be located as follows:

- Wall panels at four sides of the room.

5.3 Technical Communications System

The instrumental ensemble rehearsal room will be provided with a Technical Communications system as described in the Overview. Elements of this system will be located as follows:

- In-Wall Stations at the "Rear of room"

5.4 Reinforcement/Playback System

5.4.1 Electroacoustic Control Position

The instrumental ensemble rehearsal room will be provided with a location to control the playback system, via a portable equipment rack with the necessary playback devices and components to drive the playback loudspeakers.

- CD/DVD/MP3 players will be provided.

5.4.2 Permanent Loudspeaker Systems

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Playback will be produced via flown full-range loudspeaker systems located to the left and right of the stage area. These loudspeakers will be used for reproduction of stereo and two-channel directional effects.

5.5 Miscellaneous Systems/Requirements

<u>Power and Heat Requirements</u>

The estimated power and heating requirements are as follows:

- Electrical power for the audio and audiovisual equipment will be via a separate Technical Power service, with Isolated Ground. This Technical Power will feed the equipment racks, various technical power receptacles on the stage for use by performers. .

6 Choral Rehearsal Room

6.1 Overview

The Choral Rehearsal Room is a variable performance space with an emphasis on rehearsal and recitals. The Choral Rehearsal Room also functions as a variable classroom environment. To support these two functions the main audio system will be capable of playback as well as speech reinforcement. Infrastructure support for video projection will also be provided as an integral part of the facility.

The Playback/Reinforcement System will be a permanently installed stereo (Left/Right) loudspeaker system and will be controllable from a location in the venue

The electroacoustic systems will provide audio reinforcement, reproduction of pre-recorded material and musical effects. Elements of these systems will be primarily concentrated at the stage end of the room, and at an audio control position at the "rear" of the upper level seating. Other technical locations include the audio equipment racks, which will also be in the control area. Locations for temporary use of portable equipment may also be included.

Receptacles for microphones, production communications and portable loudspeakers will be distributed throughout the house and technical. High quality components will be specified for excellent performance, reliability and durability.

An infrared hearing assistance system with rechargeable wireless headsets will be provided for the seating area. The emitters will be permanently located in the upper levels of the room, potentially at the technical level railings.

The functional capabilities of the systems, as well as the specific equipment provided, will enable productions, whether technically advanced or technically simple, to utilize state of the art production and control facilities in presenting their performances.

6.2 Signal Distribution & Routing Systems

The Choral Rehearsal Room will be provided with audio, video, single-mode fiber, and CAT-6a tieline panels as described in the Overview. These panels will be located as follows:

- Performance area
- Seating area side walls
- Rear of Hall, at the exterior of the Control Room
- Control Room

6.3 Technical Communications System

The Choral Rehearsal Room will be provided with a Technical Communications system as described in the Overview. Elements of this system will be located as follows:

- Performance area
- Control Room
- In-Wall Stations at the Usher Station/Vestibules
- Box Office

6.4 Paging and Monitoring System

The Choral Rehearsal Room will be provided with a Paging and Monitoring system as described in the Overview. Elements of this system will be located as follows:

- PAC Lobby

6.4.1 Video Show Relay System

In conjunction with the audio monitoring/paging system video monitoring will also be provided for both Front-of-House and Back-of-House locations. Six to eight channels of local video will be available in specific areas such as backstage corridors, dressing and rehearsal rooms, lobby late-arrivals viewing, control booths, etc. Lobby and public video monitors, when used, will only be capable of providing images from the performance spaces.

The video monitoring system will utilize a fixed camera located in the control booth area and focused on the performance area so that this signal can be distributed to lobby areas when there is no late seating. This signal will also be distributed to various waiting areas such as the green room and other waiting areas.

6.5 Reinforcement/Playback System

6.5.1 Electroacoustic Control Position

Primary control and audio mixing of the electroacoustic systems will occur at an audio control position located in the control booth at the rear of the house. A large, operable window, centered upon the audio console position, will allow the audio operator to hear the sound in the room rather than the control room monitors if appropriate.

Control equipment will include:

- A 16 to 24-input multi-bus digital mixing console with 4 group mixes to provide flexibility and control in live mixing situations, additionally, four to eight pre/post effects busses will provide sufficient capabilities for the use of effects or loudspeaker sends for electronic music presentations.

- Foldback mixing for the musicians and performers will take place at the main control console utilizing one or more of the auxiliary busses or groups.
- A four-channel wireless microphone system will be available for the performers, using diversity antenna systems. The wireless receivers will be located within the performance area to maximize the signal reception and minimize dropouts.
- In additional to the wireless microphones, hard-wired microphone positions will be provided for the performance area via wall mounted receptacle plates.
- Three panels located at the Stage Left, Up Center, and Stage Right sides of the performance area will allow connection of digital stage boxes. These panels will support the micing and reinforcement of live performers within the Choral Ensemble area.
- The inputs to the digital stage box will microphone inputs (fixed and wireless) will terminate at a panel in the Control Booth where they can connect to the console.
- A system of security covers will be utilized to provide control of unauthorized access to the audio system electronics and controls when an audio operator is not present in the Control Booth.

6.5.2 Sound Equipment Room

The audio equipment room will house the audio racks for signal processing, signal patching, amplification, and other necessary support equipment. This area will most likely be within the footprint of the control booth at the rear of the hall.

- To maintain compatibility with various program formats a variety of program source devices will be provided for the reproduction of prerecorded musical and vocal tracks.
- CD/DVD/MP3 players will be provided.

6.5.3 Permanent Loudspeaker Systems

Playback/Speech reinforcement will be produced via full-range loudspeaker systems located to the left and right of the performance area. These loudspeakers will be used for reproduction of stereo and two-channel directional effects as well as sound reinforcement. As on option, subwoofers will supplement the stereo system for the very low frequency requirements of special effects and music.

6.5.4 Portable Speaker/Effects System

Routing and control systems of the portable loudspeakers will provide capabilities for foldback, effects playback, and playback of pre-recorded program material at a variety of locations within the recital hall.

- A patchable four-channel loudspeaker matrix panel, connected to receptacles located throughout the hall and four channels of power amplifier will drive the portable loudspeakers.
    - These receptacles will be located as follows:
    - On-stage, at mid and rear stage left and stage right locations for

effects/foldback requirements.

6.6 Miscellaneous Systems/Requirements

Hearing Systems

In order to accommodate individuals with hearing impairments and to comply with the Americans with Disabilities Act (ADA), an assistive listening system (ALS) is provided. The ALS distributes sound from the audio system through an infrared transmitter to wireless compact personal receivers with individual headsets and local volume controls. The receiver headsets may be used anywhere in the Concert Hall. These receivers are also compatible with the receiver headsets utilized for the Theater systems.

Power and Heat Requirements

The estimated power and heating requirements for the Audio Equipment Room are noted in the Electrical Loading Report. Other considerations are as follows:

- Electrical power for the audio and audiovisual equipment will be via a separate Technical Power service, with Isolated Ground. This Technical Power will feed the equipment racks, the audio/recording portions of the Control Booth, various technical power receptacles on the performance area for use by performers, and the Stage Manager's panel.
- The sound equipment room should be separately zoned for cooling, so that it will be adequately cooled even when other building systems are turned off. (The audio equipment may be used for 8 to 15 hours per day for several days at a time. During other periods, system equipment may be used only 4 hours per day.)

7 Other Rehearsal Rooms

7.1 Overview

The electroacoustic system serving other rehearsal rooms' will consist of infrastructure only, at this time. The infrastructure will provide conduit, power, and wiring for audio, video, single-mode fiber and CAT-6A.. Elements of these systems will be distributed throughout the space. These tie lines will be routed to the control position and audio equipment room designated as the "hub".

Method Studio

Utah Valley University Performing Arts Complex

Acoustical Design Guidance for Mechanical Systems

245160/R01

Issue | April 4, 2016

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 245160

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ARUP

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Appendices

Appendix A

Technical Design Guidance

1 Scope

The intent of this document is to:

- Provide the project mechanical engineers with acoustic design information for early planning decisions regarding mechanical systems space and cost requirements,
- Establish project acoustic design criteria.

The technical design appendix is for the project engineer's reference as the design develops.

2 Introduction

For Performing Arts Centers, mechanical systems sizing and cost tend to be greater than those for conventional building projects. The additional space requirements are driven by needs for larger ducts, larger fans, and larger noise control devices to meet the low background noise criteria.

However, the cost of achieving low noise levels can be reduced if early planning is undertaken to evaluate the system's needs for noise control, and if alternate design options are given proper attention. A cost-effective solution necessitates a collaborative process involving the architect, engineer, and acoustic consultant. This effort will ideally result in a robust solution that can adjust and respond to changes as the design progresses, without significant design revisions. Without careful early planning, integration of noise control can become more costly and less effective.

Once a high-level design approach is agreed, a periodic acoustic review of the mechanical system design progress is recommended over the course of the project. As appropriate, Arup will also provide detailed recommendations for specific systems and specifications relating to noise and vibration control, and help develop solutions where other important requirements may conflict with the acoustic intent.

However, it will be the responsibility of the project architect and engineers to ensure that these recommendations are incorporated in the appropriate contract documents, and to identify where other design issues may conflict with the acoustic requirements.

3 Definitions and Criteria

- The term "acoustically critical spaces" is used in this document. These include performance halls, rehearsal and practice spaces, and certain other support spaces requiring low noise levels. Spaces with background noise criteria of NC 30 or more stringent, as defined in the UVU PAC Program Document, are considered "acoustically critical spaces".

- The noise criteria apply to all systems operating normally and together, including both house and production lighting.
- Recommended noise targets for spaces where the NC criterion is greater than 30 are also listed in the UVU PAC Program Document.
- These criteria, and the guidelines for achieving them will impact all disciplines and influence fundamentals of space planning, structural, mechanical and electrical systems design approach.

4 Space Planning and Program Development

4.1 Main Equipment Room Planning

- Avoid locating mechanical equipment directly adjacent to, or directly above or below, acoustically critical spaces. There should be at least one non-critical 'buffer' space (corridor, storage closet, etc) between the equipment rooms and the critical spaces. In general, mechanical and electrical rooms housing the major equipment should be located as far as possible from acoustically critical spaces.
- Fresh-air intake and air exhaust louvers should not overlook the main front-of-house external public areas of the building, but should either be located at roof level, or overlooking non-public areas such as back-of-house loading docks. In addition, noise will need to be attenuated to achieve applicable local code required noise levels at the property line.
- When it is necessary to install major equipment on upper floors (i.e., not on-grade), the structural floor and ceiling slabs of these rooms will need to be sufficiently stiff and massive for airborne noise control, as well as to provide a stable base for effective functioning of vibration isolators. Typically internal slabs and roof slabs below mechanical equipment shall have a minimum weight of 100psf, however structural requirements, such as minimum slab thickness, will be based on the type and size of equipment planned for each space.
- A general rule-of-thumb for "quiet" operation is to select a larger fan which provides the same performance at a lower speed (rpm) and higher efficiency. This approach may lead to slightly larger air handling unit (AHU) sizes to accommodate the larger fans, and larger equipment rooms. However, it is typically more cost effective to select quieter fans than to buy and install additional noise control devices to reduce fan noise.

4.2 Air Handling Systems

- Air handling systems serving acoustically critical spaces should deliver constant volume during high-occupancy usage. This will help keep background noise levels consistent during performances and rehearsals. Variable air volume systems are acceptable if they can be designed to include a constant volume mode of operation.
- The Concert Hall and Proscenium Theatre should have dedicated constant volume air handling systems.

- In the following areas, air handling systems must be operated, not just controlled, independently of the systems serving the audience and stage areas because of operating schedules and load variations. It is recommended that independent self-contained air handling units with air ducted to the rooms be used. This will allow the technicians to work in the control rooms out of hours without running the main systems.
    - Control rooms
    - Followspot rooms
    - Dimmer rooms
    - Sound/communications systems rack rooms
    - Instrument storage rooms
    - Recording and broadcast rooms

4.3 Main Noise Control Efforts

- Larger-scale noise control devices should be included in initial planning of space allocation and cost. This may include a bank of sound attenuators within the fan casing, a lined plenum box downstream of the fan discharge, or longer runs of lined ductwork within the fan room.
- At an early stage, it should be determined if in-duct acoustic lining will be acceptable for use on the project, or if noise control will be handled entirely with sound attenuators. If lining is acceptable, then it may be used in a variety of areas instead of attenuators.
- For initial space planning of mechanical rooms allowance should be made for primary sound attenuator sizes, as listed in Figure 1 for supply and return air systems.
- Where there are concerns for noise transmission to the outdoor environment through the AHU intake and exhaust, sound attenuators may be recommended on the outside air intake and exhaust side of the AHU as well.
- Technical considerations are given in the Appendix for each type of noise control approach.

4.4 Duct and Pipe Size and Routing Pathways

- When planning the size of the required duct and shaft spaces, allow for the maximum allowable duct velocities listed in Figure 2.
- Do not route ducts and pipes through acoustically critical spaces.
- Do not route ducts servicing acoustically critical spaces through noisy spaces.
- All ducts and pipes serving acoustically critical spaces should follow the velocity guidance in Figure 2.
- Ductwork serving acoustically critical spaces should be designed for lowest possible friction losses, so to minimize fan power consumption and noise generation.
- When large volumes of air are being delivered in main supply or other larger ducts, it is recommended that radiused elbows be used to reduce turbulence regenerated noise. At main two-way splits, (“T”-connections), it is recommended that two short-radius elbows be joined per SMACNA standard

construction. Use of a radiused elbow will typically require more space than a square elbow. Square elbows with turning vanes are acceptable only when velocities and static pressures are low enough to ensure a low-noise flow.

- Ducts should be routed such that they do not cross demising partitions between acoustically critical spaces. Ideally, all duct pathways only cross the corridor wall. Where this is not possible, cross-talk attenuators, limp mass vinyl duct wrap and/or drywall soffits are often required.
- Geometrically self-balancing systems without terminal dampers are preferred for systems serving acoustically critical spaces. These systems will use dampers only on the major duct branches before entering the space. Dampers need not be avoided altogether, but the system should be designed with as much symmetry as is practical, locating dampers far from terminals and using them to divide the airflow rather than closing it off.
- Rainwater pipes should not run through the roof void above the acoustically critical spaces, as rain noise can be audible during a storm.

5 Project Design Criteria

Background noise criteria for each space are defined in the UVU PAC Programming Document in terms of NC and PNC criteria.

PNC / NC	Primary Attenuator lengths, ft.			
	Supply Air	**Return Air**	**Fresh Air Intake**	**Exhaust Air**
20	10-ft	10-ft	3-ft	3-ft
25	10-ft	10-ft	3-ft	3-ft
30	7-ft	7-ft	3-ft	3-ft
35	7-ft	7-ft	3-ft	3-ft
40	5-ft	5-ft	3-ft	3-ft
45	5-ft	5-ft	3-ft	3-ft

Figure 1: Primary Attenuator Lengths – Recommendation for Initial Space Allocation.

PNC / NC	Maximum Velocity	
20 (underfloor system)	entry to plenum branch duct feeding plenum riser duct mechanical room	300 fpm (1.5 m/s) 500 fpm (2.5 m/s) 1000 fpm (5.0 m/s) 1200 fpm (6 m/s)
20 (Conventional approach – with terminal devices)	at terminal last 4 diameters next 10 diameters next 10 diameters riser duct mechanical room	300 fpm (1.5 m/s) 400 fpm (2.0 m/s) 600 fpm (3.0 m/s) 700 fpm (3.5 m/s) 1000 fpm (5.0 m/s) 1400 fpm (7 m/s)
20 (Alternative approach - no terminal devices)	at terminal to 7 diameters riser duct mechanical room	450 fpm (2.3 m/s) 700 fpm (3.5 m/s) 1000 fpm (5.0 m/s) 1400 fpm (7 m/s)
25 (with terminal devices)	at terminal last 4 diameters next 10 diameters next 10 diameters riser duct mechanical room	400 fpm (2.0m/s) 500 fpm (2.5m/s) 600 fpm (3.0m/s) 700 fpm (3.5m/s) 1200 fpm (6.0 m/s) 1600 fpm (8 m/s)
30	at terminal branch duct to room riser duct mechanical room	600 fpm (3.0 m/s) 900 fpm (4.5 m/s) 1200 fpm (6.0 m/s) 1800 fpm (9 m/s)
35	at terminal branch duct to room riser duct mechanical room	700 fpm (3.5 m/s) 1000 fpm (5.0 m/s) 1400 fpm (7.0 m/s) 1800 fpm (9.0 m/s)

Figure 2: Duct Velocities

Notes:

- *Velocities are for general planning.*
- *Some diffusers require even lower velocities to achieve noise criteria.*
- *Return ducts can typically be 10% smaller than supply ducts.*
- *Velocities assume clear cross-sectional area in duct (i.e. acoustic lining does not reduce cross-sectional area)*

Appendix A

Technical Design Guidance

A1 Technical Design Guidance

A1.1 Fan Selection

- Fan selections should minimize noise at the source. This is typically accomplished by selection of larger fans to operate at low rpm (800-1200 fpm) and high efficiency. Less efficient fans will produce higher noise levels, as the mechanical energy is converted to acoustic energy rather than air movement.
- Centrifugal fans with backward-inclined aerofoil blades are generally acceptable. Axial, vane-axial, and forward-curved centrifugal fans are sometimes acceptable if selected properly.
- Design of air handling systems for maximum efficiency (minimum external static pressure) is critical, since a fan operating at 80% efficiency will usually be 10 – 12dB quieter than when operating at 40% efficiency. 10dB of extra noise control is often very difficult and expensive to achieve.

A1.2 Fan Coil Units

- Fan coil units *must not be used* in spaces with a systems noise limit ≤ NC30.
- Use oversized units running at low speeds in spaces with a limit of NC35.

A1.3 Duct Attenuators and Acoustical Plena

- Sound attenuators are most effective when placed in the AHU casing, and therefore are preferred in lieu of attenuators which reside in the ductwork. High performance attenuators 3 or 5-ft in length placed in the casing can provide the same effectiveness (and lower pressure drop) as 7 or 10-ft attenuators which need more open area to account for the higher ductwork velocities. Pressure losses through attenuators are typically limited by design to ~ 0.25 in H_2O (60 Pa).
- Secondary duct attenuators are required on most supply and return air systems serving acoustically critical spaces. These are usually located after branch duct VAV or volume dampers, prior to entering the room.
- Attenuators should be located with care, ideally in long runs of straight duct, in order to achieve their rated performance. Poorly placed attenuators can generate more noise than they mitigate. The airflow should approach and leave the attenuator smoothly, with transition angles ≤ 15°, and should be evenly distributed across the face of the unit. Custom attenuators are available if unusual geometries are necessary.
- Control of low-frequency fan noise can also be achieved using a large acoustically lined plenum box downstream of the fan outlet. This is common for rooftop units. Such plenum boxes are more efficient at the attenuation of fan noise below 100 Hz than conventional attenuators.

A1.4 Acoustical Lining

- If permissible, internal acoustical lining can often replace sound attenuators, thus lowering pressure drop and HP requirements for fan motors.
- Closed cell foam lining can be used, but provides about 50% less acoustic performance than traditional lining. Cotton-based duct lining is available, and can be used in lieu of fiberglass lining.
- Acoustical duct lining will generally be 2-inch thick for ducts within mechanical rooms, and 1-inch thick when used in spaces outside of mechanical rooms. Final lining requirements can be determined after the duct layout and equipment selections have been made. Additional thermal insulation is not usually required for acoustically lined ducts.

A1.5 Duct Materials and Geometry

- All duct designs should consider minimizing frictional losses, to reduce noise generation within the duct and noise output from the fan.
- Rectangular sheet metal duct should be used for most applications; as it provides the most cost effective attenuation of low frequency fan noise along the duct. Ducts with an aspect-ratio > 3:1 should be avoided.
- If exposed ductwork is required inside an acoustically critical space or inside a noisy space, internally lined circular duct should be considered, since this shape allows less noise to break into or out of the duct. Circular ducts should not be used for general purposes in acoustically critical systems, since they do not adequately allow for the attenuation of low frequency noise.
- Transitions in duct geometry should be ≤ 15º.

A1.6 Mechanical Systems Vibration Isolation

- At absolute minimum, all operating equipment shall be vibration isolated per ASHRAE standards. In some cases, isolation methods may be employed which exceed ASHRAE guidance in order to achieve lower noise or vibration levels.
- All large equipment must be founded on stiff and massive slabs, or rooftop dunnage steel. No equipment should be mounted to lightweight structures.
- Pipework should be supported on isolation hangers throughout the equipment room, and for at least 50-ft from the connected equipment. In some cases additional isolation may be warranted.
- Large diameter chilled water pipes should not be supported from structure common to the acoustically critical areas. These large, noisy pipes should run only in spaces that are inherently noisy (major equipment rooms, loading dock, etc.) Isolators alone do not provide adequate protection against the high vibration energy in these pipes.

A2 Air Distribution Methods

A2.1 Under-floor Air Supply from Plenum

- It is important to distribute air evenly throughout the under-floor plenum. This may be achieved by distributed ductwork in the plenum.
- For comfort reasons, some engineers propose terminal devices for induction (mixing) of incoming (cool) air and ambient (warm) air at the terminal device. These devices can generate unacceptably high noise levels, and consequently are not recommended for acoustically critical spaces.
- When using individual air supply through a large under-floor plenum, refer to Figure 2 for guidelines for the maximum air velocities in the supply ducts feeding the plenum.

A2.2 Conventional 'Overhead' System

There are two approaches to the design of very low noise overhead systems:

- Remove terminal grilles/diffusers (noise-generating obstructions) and provide simple openings at duct terminations, or
- Keep the air velocity very low throughout the system (refer to Figure 2).

The acoustical performance and cost of the two approaches are discussed below.

A2.3 Conventional Approach – very low velocities, with terminal device

- Use only well-tested terminal devices (grilles, diffusers, etc.) in any acoustically critical space. Air velocities must be so low that air 'drifts' into the terminal.
- The vertical duct drops to supply diffusers should be at least 4 times the duct diameter in length, in order to develop a well-distributed flow profile.
- For the initial design of systems with terminal devices, refer to the guidelines in Figure 2 for the maximum allowable air velocities.

A2.4 Preferred Approach – medium to low velocities, no terminal devices

- Significant savings are possible when terminal devices can be eliminated. If the terminal design and ductwork layout conform to the acoustical requirements discussed below, the air velocities can be higher (and duct sizes smaller) than in the very low velocity systems described above.
- For this type of system, the duct termination must be unobstructed. Proprietary metal diffusers should not be used. A plain open termination or a scoop nozzle is acceptable. If the approach is understood early, it is possible to design the terminal openings into the ceiling or upper walls so they are not visually obtrusive. Where some spreading of the air is necessary, a smooth 'diffuser plate' can be suspended in front of the terminal. It should be placed

far enough away from the terminal so that the effective cross-sectional area is larger than the duct cross-sectional area.

- For the initial design of systems without terminal devices, refer to the guidelines in Figure 2 for the maximum allowable air velocities.

A2.5 Volume Dampers

- Airfoil splitter dampers generate the least noise of any damper type, and are recommended. They should be placed as far from the duct termination as possible and ≥ 10 duct diameters from the nearest terminal (assuming internal acoustic duct lining is used).
- Do not use face or neck dampers at any diffusers in acoustically critical spaces.

A2.6 Local Reheat Coils

- Local reheat coils generate noise, and should be located outside of acoustically critical spaces.

A2.7 Fire Dampers

- Use only ‘out of the air stream’ type fire/smoke dampers.

A2.8 Terminal Devices

- Terminal diffusers should only be considered for acoustically critical spaces when detailed acoustic test data is available. Mass produced diffusers and grilles are often unsuitable when low noise levels are required as they are not designed to be silent. Specialist manufacturers are recommended if such a solution is desired.
- If the team elects to explore/develop a terminal for which appropriate test data are not available, noise (and probably air flow) tests will be required, and provision must be made in both program and budget.
- In noise-critical spaces with low ceilings, such as the control rooms, or other situations where some diffusing of air will be required, use a flat plate or “plaque” suspended just beneath the terminal to diffuse supply air.

A3 Water-Side Design Considerations

A3.1 Pumps

Select and balance centrifugal pumps for maximum efficiency. The diameter of a pump impeller should not exceed 80% of the pump's inside case diameter, as measured on a line through the cutwater and centre of rotation. Low pump efficiency and small impeller-cutwater clearance tend to cause high pump noise and energy transmission to the fluid and piping.

A3.2 Chillers and Cooling Towers

To minimize noise, hermetically sealed centrifugal chillers are required. Cooling towers must not be mounted on structure that is common to noise-critical spaces. Mounting cooling towers on a grade slab, structurally separate from the rest of the facility is preferred. If the cooling tower is mounted on building structure, large spring isolators must be used. Noise emission to surrounding neighbors will need to be considered, and mitigating measures (enclosures) may be required.

As noted above, the pipe circuit connecting the chilled water pumps, the cooling tower, and the chiller must be fully isolated over their entire lengths with combination steel spring/neoprene isolators.

A3.3 Drinking Fountains

Do not mount drinking fountains on walls common to noise-critical spaces or inside the Acoustics Isolation Joint. Vibration isolation of the cooler is essential.

A4 Acoustic –Design Coordination List

The following list outlines a generic schedule for coordination efforts between the mechanical systems engineer (ME) and acoustic consultant (AC).

A4.1 Schematic Design

AC provides guidelines for velocity, NC criteria and main noise control strategies.

AC identifies local noise code / criterion for environmental noise emissions.

ME provides single-line diagrams for review of main routing and pathways, and distribution within the acoustically critical spaces.

AC recommends main sound attenuator locations based on main duct distribution layout.

ME provides main MER equipment room layouts for AC review.

ME sends plans for main outdoor equipment locations for AC review.

AC identifies main design challenges and studies for next phase.

A4.2 Design Development

ME provides equipment basis-of-design sound levels for all major equipment.

AC conducts noise calculations for areas NC30 or lower to predict if noise criteria can be met with given design.

ME and AC workshop together to remediate conditions in the design where acoustic criteria are exceeded.

ME provides duct velocities and duct geometries within acoustically critical spaces for AC review.

ME sends outline specs to AC for review and comment.

A4.3 Construction Documents

ME sends progress plans showing all equipment, duct, terminal devices and dampers for AC review.

AC reviews final basis of design selections for equipment serving spaces NC30 and lower

AC prepares sound attenuator and vibration isolation schedule, or coordinates with ME specifications.

AC reviews 90% documents for final QC/QA review.

A4.4 Construction Administration

ME sends AC relevant shop drawings and submittals for review and comment.

ME and AC conduct joint site visits to review pipe and duct penetration detailing and installation of noise and vibration control devices.

AC assists ME with final commissioning and punch-lists.

APPENDICES

SPECIFICATIONS INDEX

AREA SUMMARY

GROSS AREA		
Level 1	76,593	GSF
Level 2	48,112	GSF
Tech & Pit Levels	6,000	GSF
Total	130,705	GSF

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Owner Project Requirements (OPR)

Utah Valley University Performing Arts Complex
SCHEMATIC DESIGN

5/2/16

Utah Valley University

DFCM

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OWNERS PROJECT STANDARDS

1.0 OVERVIEW

1.1. INTRODUCTION

The purpose of this OPR standard is to establish a common standard for creating an OPR and a description of what a Basis of Design response should be to each applicable OPR requirement. This guide is intended to be used by building owners, designers, commissioners and green building providers in producing OPR and BOD documents. Each probable component of the OPR is identified by the appropriate paragraph number while the required BOD response is shown below the OPR requirement in *italicized* font.

1.2. SCOPE OF OPR

The OPR should cover the entire scope of the project including site requirements, architectural requirements, sustainable requirements, mechanical-plumbing-electrical (MEP) requirements and operations and measurement and verification requirements.

The OPR should be used as a guidepost throughout the project to make sure the owners requirements are achieved through the design and construction delivery of the project.

1.3. PROCESS

The owner is responsible for production of the OPR and the designers are responsible for the production of the BOD. The commissioner is responsible to verify the project achieves the owner's requirements and that the design and construction do not deviate from the OPR without approval.

The OPR is a living document and is updated as required throughout the design and construction process when it is deemed appropriate by the owner.

In some cases the owner will seek assistance from the designers or commissioners is developing the OPR. This guide can be used as a starting point for what information the owner should include in a typical OPR.

2.0 STANDARD OPR

2.1. OPR EXECUTIVE SUMMARY

2.1.1. OBJECTIVES

The Owner's objective is to develop a high quality building by applying quality design and construction practices in accordance with the sustainable principles listed within the OPR.
This document is intended to systematically and clearly communicate the expectations of the owner. The objective of this OPR is to provide the base information required for the design and construction teams to deliver a well-planned and cost effective facility that meets the following goals:

a. A building that provides the occupants needs to fulfill their daily mission
b. A building that delivers a secure facility that is easily operated and maintained
c. A building that has low utility and maintenance costs
d. A building that provides excellent environmental quality and a healthy work and living environment

e. A building that achieves the sustainable goals listed in this OPR

2.1.2. DEVELOPING THE OPR

It is the owner's responsibility to develop an accurate OPR to provide the designers and constructors with the correct information to deliver the facility that meets the owner's desires. The OPR forms the basis from which all design, construction, acceptance and operational performance evaluations are made.

The project commissioner will review the owners OPR and will assist the owner in defining and clarifying their objectives and goals. These objectives and goals may include:

a. Owners expectation of how the facility will be used and operated
b. Functional requirements
c. Sustainability goals
d. Measurable performance
e. Success Criteria

2.1.3. OPR CONTENT

The OPR will contain general and detailed information for the owner's requirements. These requirements may include:

a. Specific project requirements to supplement the programming documents
b. Owners standards for systems, equipment and products
c. Owners goals for the use, sustainability and performance of the facility
d. The OPR is considered a living document and will be updated during the design, construction, acceptance and operation phase if items are discovered that need to be changed to keep the OPR document current with the owners ultimate goals.

2.1.4. BOD RESPONSE

The Basis of Design is a narrative document created by the designers that records the concepts, calculations, decisions and product selections used in the design to meet the goals of the OPR and to satisfy the applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and specific assumptions made by the designers.
The BOD documents the designers work and includes but is not limited to:

a. Ambient and space conditions used in the design
b. Input and output data utilized for the load calculations
c. Assumptions and safety factors utilized in the design
d. Specific codes, standards and guidelines considered and utilized for the design
e. Reasons for system selections made and reasons for systems selections that were rejected
f. Specific engineering studies that were done in determining selected systems, components or assemblies
g. Specific design elements that were used to meet sustainable goals

2.1.5. PROJECT TEAM INFORMATION:

Role	Name	Company	Address	Phone	Email
Owners Representatives					
Owners Representative	Clint Bunnell	DFCM		435-840-4192	cbunnell@utah.gov
Owner Energy Manager	John Burningham	DFCM		801-641-7270	johnburningham@utah.gov
Code Officials					
Authority Having Jurisdiction	Pat Tomansino	State of Utah		801-608-4833	ptomasino@utah.gov
Code Inspector		TBD		-	-
Fire Marshall	Richard Gee	State of Utah		801-284-6350	rgee@utah.gov
Special Inspections		TBD		-	-
User and Maintenance Representatives					
Project Manager	Kurt Baxter	UVU Facilities		(801) 863-8322	KBaxter@uvu.edu
User Representative	Linda Moore	UVU SOA		(801) 863-6827	Linda.Moore@uvu.edu
Facilities Manager	Frank Young	UVU Facilities		(801) 863-8322	frank.young@uvu.edu
Plumbing Shops Rep	Scott Draper	UVU Facilities		(801) 863-8322	JDraper@uvu.edu
Electrical Shops Rep.	Denny Rucker	UVU Facilities		(801) 863-8322	RUCKERDE@uvu.edu
Mechanical Shops Rep	Keith Sabin	UVU Facilities		(801) 863-8322	SABINKE@uvu.edu
Controls Shops Rep	Scott Draper	UVU Facilities		(801) 863-8322	JDraper@uvu.edu
Energy Manager	Scott Draper	UVU Facilities		(801) 863-8322	JDraper@uvu.edu
Owners Consultants					
Energy Modeler	Cordell Post	Colvin Engineering		801-322-2400	cpost@cea-ut.com
Commissioning Provider	TBD	-		-	-
Envelope Commissioning	Don Rasmussen	ATI		(385) 229-4980	drasmussen@archtest.com
Programming Design/Engineering Team					
Architect of Record	Joe Smith	Method Studio		801-532-4422	joe@method-studio.com
Design Architect	Todd Kelsey	Method Studio		801-532-4422	todd@method-studio.com
Cost Estimator	Kris Larsen	CCC		801-578-1201	klarson@cccutah.com
Kitchen Designer	n/a	n/a		-	-
Structural Engineer	Mark Harris	Reaveley Engineering		801-505-4028	MHarris@reaveley.com
Civil Engineer	Koby Morgan	Ensign Engineering		801-255-0529	kmorgan@ensignutah.com
Landscape Architect	Brandon Reed	Loft Six Four		(801) 580-3325	brandon@loftsixfour.com
Mechanical Engineer	Roger Hamlet	Colvin Engineering		(801) 505-5392	rhamlet@cea-ut.com
Plumbing Engineer	Roger Hamlet	Colvin Engineering		(801) 505-5392	rhamlet@cea-ut.com
Electrical Engineer	Dave Wesemann	Spectrum Engineering		(801) 401-8468	Dew@spectrum-engineers.com
Construction Team-TBD					
Project Executive	TBD				

Project Manager	TBD				
Superintendent	TBD				
Project Engineer	TBD				
Cost Estimator	TBD				

2.2. PROJECT DESCRIPTION

2.2.1. PROJECT DESCRIPTION

- The Art Complex will become a regional gathering space and visual landmark for the arts. It will provide a new campus "gateway" to the public. It will provide versatile learning and performance spaces to display the excellent quality of student and faculty expertise
- The location of the Art Complex is planned to be on the east side of campus connecting to the existing Noorda Theatre and Gunther Trades Building. Exact connection points and new building orientation will be determined during the design process
- The Art Complex will provide a gateway to the east side of the campus and will connect to existing parking and pedestrian pathways, while considering future campus developments
- The structure will be approximately 130,000 G.S.F.
- The Art Complex will house theatre, dance and music instruction and performance spaces. The majority of spaces in the new facility are multi-purposed with a focus of creating collaborative learning environments, which will be shared by departments within the School of Arts.
- The program will include a 900-seat Concert Hall, 501-seat Proscenium Theatre and 150-seat Dance Hall
- The project will also include studio offices, faculty offices, classrooms, music rehearsal rooms, productions shops and support spaces.
- It is anticipated that the project will be 3 levels for the main building with increased heights at the Concert Hall and Theatre
- The project will include remodeling a scene shop into the existing Noorda Theater basement with an adjacent scene shop extension.

2.2.2. PROJECT DELIVERY METHOD

The project is to be delivered by the design/bid/build method.

2.2.3. PROJECT BUDGET

The projects allowable budget is:

a.	Design	$ 0,000
b.	Consultants	$ 0,000
c.	Overhead	$ 0,000
d.	Site Work	$ 0,000
e.	Construction	$ 0,000
f.	Abatement	$ 0,000
g.	Contingency Fees	$ 0,000
h.	Total Project	$ 54,000,000

The project budget will be reviewed and updated by the owner at each milestone of the design to verify the design is meeting the project scope and budget.

2.2.4. UTILITY RATE SCHEDULES/METER

2.2.4.1. NATURAL GAS RATE SCHEDULE:

Decatherm: $8 per decatherm

2.2.4.2. ELECTRICAL RATE SCHEDULE

KWH Peak (Summer): $ .07.
Kohl Off-Peak (Summer): $.05
Kohl Peak (Winter): $.05
Kohl Off-Peak (Winter): $.04
KW Demand Peak (Summer): $12
KW Demand Peak (Winter): $10

2.2.4.3. METER

Natural Gas Meter Number: 1254887
Electrical Meter: 54789654

2.2.4.4. UTILITY INCENTIVES/REBATES

Rocky Mountain Incentives: Prescriptive
Questar gas Incentives: Custom
Responsibility for Documentation Control: CxA

2.2.5. ABATEMENT

Abatement is not anticipated at this time, to be fully analyzed during schematic design, include assessment of remodel spaces.

2.2.6. GREENHOUSE GAS EMISSIONS

CO2: DAQ Guideline
Methane: DAQ Guideline
Nitrous Oxide: DAQ Guideline

Direct Emissions Contributors: Generator, Boilers
Who is Responsible for filing the proper DAQ filings: A/E Team, Contractor, Owner

2.2.7. PROJECT SCHEDULE

Project Schedule		
Item	**Description**	**Target Date**
1.	Completion of the OPR	Schematic Design
2.	Schematic Design Phase Begin	1/20/2016
3.	Design Cx Kick Off Meeting	Schematic Design
4.	Draft Cx Plan Created	Schematic Design
5.	Schematic Design Phase End	5/9/2016
6.	Completion of the BOD	DD
7.	Design Development Phase End (Construction Documents Complete)	TBD
8.	Pre Bid Meeting	TBD
9.	Complete Construction Contracts	TBD
10.	Construction Begin	TBD
11.	Submittals complete and approved	TBD
12.	Construction Cx Kick Off Meeting	TBD
13.	Construction Inspections	TBD
14.	Commissioning check sheets and forms completed	TBD
15.	Static and Electrical Tests Executed	TBD
16.	Envelope Tests Executed	TBD
17.	Start Up and Check Out Executed	TBD
18.	Test and Balance Executed	TBD
19.	Functional Performance Testes Executed	TBD
20.	O&M Documentation Completed and Reviewed	TBD
21.	Training Completed	TBD
22.	Final Project Completion	TBD
23	Expected Occupancy	TBD
24.	Final Cx Report	TBD
25.	Deferred testing	TBD
26.	Warranty follow up and report	TBD
27.	Utility Baseline Finalized	TBD
28.	Measurement & Verification Performance Evaluation	TBD

2.2.8. SPACE PLANNING

Space plan matrix is provided to indicate required spaces, their occupant load.

Space Plan Matrix						
Space Name	Size (sqft)	Shift	Number of Occupants (FTE)	Occupied From	Occupied To	Notes
TBD-				7:00 AM	10:00 PM	This will be updated in schematic design based on client direction

2.2.9. ADAPTABILITY FOR FUTURE EXPANSION

It is anticipated the building will be added to in the future, the campus main is expected to continue throughout the entire facility, future building size and type are not know at this time but reasonable infrastructure should be provided. Full analysis of future needs will occur during schematic design

2.2.10. APPLICABLE CODES AND STANDARDS AND LEED VERSION

The designers shall use applicable required local, regional or national codes and standards in design development of the project. Any special codes or standards to be utilized are listed below:

Incorporate DFCM and UVU standards, see online documents. LEED is not required, in lieu design and construction teams are required to meet DFCM High Performance Building Standards.

2.2.11. USER REQUIREMENTS

The facility users will require system training and instruction on the general and specific operation, maintenance, repair and troubleshooting of the systems and equipment supplied. To facilitate these requirements the project shall include:

2.2.11.1. FACILITY OPERATIONS AND MAINTENANCE

The owner will employ operating engineers and maintenance staff to provide for all operation and maintenance of the facility. These staff members must be trained by the design and construction teams to adequately operate and maintain the facility

2.2.11.2. OPERATOR TRAINING

The construction documents shall require operation and maintenance instruction on all systems equipment utilized on the project

i. If the systems are the same systems utilized on other facilities operated and maintained by the same staff as the new facility the training may be limited to only specific project details

    1. 4 hours Training required for all equipment and components
    2. 4 hours Training required for control systems operations

ii. If the systems are new to the owners staff sufficient training will be provided on site or off site to allow an average operator or maintenance technician to adequately operate and maintain the system or equipment

    1. 1 hour required for each type of equipment or component
    2. Two 4 hour training events for basic control system operation
    3. Two, one week offsite training classes provided by the control manufacture at a professional training facility for control programming and functional operations of the system provided

All operator training classroom and field training shall be Video tapped and produced on DVD format media; by a professional videographer proving that they have video tapped and edited video for this exact video training purpose at least for 20 previous projects.

All videotaped presentations will be evaluated by the personnel being trained. The personnel shall fill out evaluation forms in accordance with ASHRAE 0-2013 Appendix P. If the evaluations do not achieve at least a 2 average then the training shall recommence.

2.2.11.3. O&M MANUALS

All Operating and Maintenance manuals shall provide the information needed to understand startup, operate, maintain, shut down and repair equipment and assemblies used on the project. At a minimum O&M manuals shall include but not limited to:

i. Basic Description
ii. Name, address and contact information for the manufacture and local representative
iii. Startup, shutdown and operating instructions
iv. Parts list
v. Specific Maintenance information as to actions taken, material used and required frequency
vi. Troubleshooting guide and instructions
vii. Name, address and contact information for the authorized service and repair providers

2.2.11.4. SYSTEM MANUAL

The system manual shall be the repository of information and operating documents to provide systems based organizational information for system managers and operators. The systems manual may include but is not limited to:

ii. Recommended Standard Operating Procedures
iii. Pertinent Submittals and Shop Drawings
iv. Pertinent O&M Manuals
v. Final OPR
vi. Final BOD
vii. Pertinent Record drawings
viii. TAB and Testing Reports
ix. Pertinent training materials
x. Commissioning Report
xi. Re-Commissioning / Ongoing-Commissioning Requirements

2.2.11.5. UTILITY BASELINES

The owner assisted by the designers, energy modelers and the commissioner shall define and establish the projects utility baselines to be used by operators to evaluate future performance of the facility. A monthly utility baseline shall be developed for electrical usage, gas usage and water usage based upon the system design and its parameters.

2.2.11.6. MEASUREMENT AND VERIFICATION REQUIREMENTS

The owner plans to utilize a measurement and verification program to verify ongoing operations and commissioning of the facility. The facility will use the following M&V system and procedures:

i. Project shall utilize Level II M&V, which will include sub meters to separate loads to more accurately determine operator performance of electric, gas and water usage over time. At a minimum the building shall be provided with the following meters:

1. Main electric meter, lighting load sub-meter, and HVAC load sub-meter
2. Main water meter, landscape sub-meter, cooling tower sub-meter.
3. Natural gas meters: main building service gas meter.
4. BTU meters for heating water and chilled water services to the building.

The operators shall be provided with simple work tools to normalize the meter readings for weather and occupancy variations on a monthly basis.

2.2.11.7. OWNERS DIRECTIVES

None noted during program to be re-discussed at schematic design

2.2.11.8. LIFE CYCLE EXPECTATIONS

General Building: 50 years
Building Envelope Systems: 50 years
HVAC Systems: 50 years
Plumbing Systems: 50 years
Electrical Systems: 50 years

2.2.11.9. WARRANTY REQUIREMENTS

General warranty periods provided by manufacturers for building materials and systems equipment are for a period of one year after substantial completion as defined in the contract documents. Some specific materials, systems or equipment may have a longer warranty period. Typical extended warranties are:

a. Roofing – 20 year warranty for leakage and material failure
b. Windows – 10 year warranty for trim and glass
c. Sealants – 2 year warranty
d. HVAC Compressors – 5 year warranty parts and replacement labor
e. Water Heaters – 5 year warranty parts replacement
f. Elevator – 5 year warranty
g. DDC Control System – 2 years parts and labor
h. UPS Battery warranty – 2 years parts and labor
i. Generator Warranty - 2 years parts and labor
j. Lighting Ballast Warranty - 2 years parts and labor
k. Lighting Bulb Warranty - 2 years parts and labor
l. Access Control Warranty - 2 years parts and labor
m. Boiler Warranty - 2 years parts and labor
n. Chiller Warranty - 2 years parts and labor
o. Pump warranty - 2 years parts and labor
p. VFD Warranty - 2 years parts and labor
q. Air Handling Devise Warranty (including EF, MAU, RTU, Relief Fans, Smoke Fans, Transfer Fans) - 2 years parts and labor

2.3. OWNERS PROJECT REQUIREMENTS (OPR)

2.3.1. DESIGN DOCUMENT REQUIREMENTS

The following list of drawing requirements refers to content and not to required number of drawing sheets. Local code requirements may change the drawing requirements listed below and code requirements take precedence over the OPR.

2.3.1.1. DESIGN DOCUMENTS

In general all construction documents shall adhere to the following standards, any deviations must be approved by the owner's representative. The below requirements must be submitted by the design team.

a. Ownership:

   All drawings, specifications, addenda and special reports shall become the property of the owner at the completion of the project as PDF record documents.

b. Drawing standards. All drawings shall be produced in the latest version of AutoCAD and Revit.

c. All drawings shall be provided in "D" size drawings and in "IP" dimensions, weights and measures

d. Project Web Site: The designers shall maintain a Web based project site that maintains the latest design and construction documents in PDF format. This site shall be maintained from schematic design through the warranty period of the project and all document located on this site shall be the latest version of the document.

e. Distribution requirements: The Architect shall distribute drawings, specifications and addenda as required in the design contract

2.3.1.2. SPECIFIC DESIGN DOCUMENT REQUIREMENTS

a. Cover sheet for each section will have all legally required code calculations, certifications and reference materials and notes

a. Mechanical drawings shall include:
   i. Double line drawings for all duct and large bore pipe
   ii. Equipment shown on drawings shall be drawn to actual scale dimensions
   iii. All equipment and devices shall have a unique number identifier, including all equipment, terminal units and air distribution devices
   iv. Drawings or specifications shall include a complete sequence of control for all controlled components.

b. Electrical drawings shall include:
   i. All panels shall utilize the owners panel naming standards
   ii. Fire alarm schematic & wiring details
   iii. Security system schematic & wiring details
   iv. Communication systems schematics & details
   v. Grounding system riser diagram

2.3.2. DRAWINGS DELIVERALES

Drawings shall follow the below requirements:

2.3.2.1. SD DRAWINGS

SD Drawings shall include the following:

i. Owners Project Requirements (OPR)
ii. Schematics of all elevations of the exterior in a 3D format.
iii. Schematics in a 3D format shall be submitted for the following:
    a. Entrance
    b. Architectural Feature Spaced
    c. Other areas deemed necessary by the owner
iv. Specifications are not required to be included in the SD phase
v. Energy Modeler shall submit a preliminary energy model and potential Energy Efficient Measures for the project. (This shall be submitted in conjunction with the SD drawings by the Owner Hired Energy Modeler, Architect and Engineers shall assist the Energy Modeler in their model)

2.3.2.2. DD DRAWINGS

DD Drawings shall include the following:

i. A narrative of the following:
    a. Architectural
    b. Mechanical
        i. Including zoning areas (individual or by zones)
    c. Plumbing
        i. Include circulating temperatures
        ii. Include storage temperatures
    d. Electrical
    e. Lighting
    f. Landscaping
    g. Conformance to the OPR
ii. Basis of Design (including models, manufacturers THIS DOES NOT INCLUDE SIZING)
    a. Architectural (include samples of finishes)
        i. Exterior Cladding
        ii. Window Types
        iii. Interior Wall Finish
        iv. Woodworking
        v. Conveying Systems
        vi. Carpet
        vii. Tile
        viii. Wood flooring
        ix. Specialty Finishes
    b. Kitchen
        i. Kitchen equipment
        ii. Kitchen finishes
        iii. Kitchen requirements
    c. Mechanical (including models, manufacturers THIS DOES NOT INCLUDE SIZING)

i. System Type
ii. System Design Temperatures:
    1. Design OA Winter/Summer
    2. Hot Water Temperatures
    3. Chilled Water Temperatures
    4. Condenser Water Temperatures
    5. Direct Evaporative Temperatures
iii. AHU Model
iv. VAV Model
v. Built Up AHU
vi. RTU Model
vii. Sizing of Duct (FPM)
viii. Boiler Model
ix. Chiller Model
x. Evap Model
xi. Cooling Tower Model
xii. Chilled Beam Model
xiii. Heat pump Model
xiv. Split System Model
xv. VRF Model
xvi. FCU Model
xvii. Pump Model
xviii. Heat Exchanger Model
xix. Chemical Treatment Provider
xx. Pipe Material
xxi. Main Piping on Plans
xxii. Main Duct on Plans
xxiii. Controls Installers
xxiv. BTU/Energy Meters Manufacturer
xxv. Other Systems Model (this includes any equipment costing above 5,000 including installation)

d. Plumbing Systems (including models, manufacturers THIS DOES NOT INCLUDE SIZING)
    i. Domestic Water Piping
    ii. DWV Piping
    iii. W (Laboratory Water and Vent) Piping
    iv. RO Model
    v. DI Model
    vi. Master Mixing Valves Model
    vii. Local Mixing Valve Model
    viii. Plumbing Fixture Model (include manufacturer and models)
        1. Water Closet
        2. Urinal
        3. Lavatories
        4. Sinks
        5. Flush Valves
        6. Faucets
        7. Floor Drains
        8. Floor Sinks
        9. Emergency Showers
        10. Eye Wash Stations
        11. Grease Interceptors
        12. Sand/Oil Interceptors

13. Compressed Air Piping
14. Compressed Air model
15. Service Sinks

ix. Water Softener Model
x. Storage Tanks Model
xi. Solar Hot Water Heating Systems
xii. Roof Drains
xiii. Irrigation Systems
xiv. Reduce Pressure Backflow Prevention Models
xv. Valve Models
xvi. Circulating Pumps

e. Electrical
   i. Lighting Controls Manufacturer
   ii. Daylighting Controls Manufacturer
   iii. Generator Manufacturer
   iv. ATS Manufacturer
   v. UPS Manufacturer
   vi. Occupancy Sensor Manufacturer
   vii. Switchgear Manufacturer
   viii. Panel board Manufacturer
   ix. Switch board Manufacture
   x. Main Distribution Manufacturer

2.3.2.3. CD DRAWINGS/BID SET

CD Drawings/Bid Set shall have all information needed to build the building with limited ASI, PR, Addenda, and RFIs. Any drawing set that needs more than two (2) addendum (not including alternates) will not be considered ready for use and the Architect shall bear all cost for delay to pull the drawings due to their delay. In addition addendum shall not delay the bid process while allowing at least 14 (calendar) days for contractors to price addendums.

2.3.2.4. CONFORM SETS

The architect shall issue a full new set of drawings and specifications to the contractor every time one of the following occurs (the Architect/Engineer Team shall NOT be compensated for new issues of drawings as if one of the below is true then the Architect has failed to complete their drawings to the Owners requirements in a timely manner):

i. RFIs exceeds more than One (1) per 1,000 sq.(i.e. is RFIs exceed 100 on a 99,000 sq. ft. building a new conformed set will be issued, this will occur in this instance every time RFIs exceed this limit for instance if RFIs exceed 200 on a 99,000 sq. building a new conformed set will be issued at 100 RFIs and a new conformed set will be issued at 198 RFIs)
ii. ASI exceed more than 15 or the resulting ASI result in more than an increase of contract value of 1%., documents shall be reissued at interval levels on all drawings and specifications at each ASI level (i.e. new conformed set at ASI 15 and new conformed set at ASI 30, etc.) and if the cost increases by 1% at each level (i.e. new conformed set at 1% increase in contract value and a new conformed set issued at 2% increase in contract value etc.)
iii. PR that increase the contract in total of more than 1% even if the Owner request more as this is still a failure on the Architectural team to find out what the owner/user wants. (i.e.

new conformed set at 1% increase in contract value and a new conformed set issued at 2% increase in contract value etc.)

2.3.2.5. AS BUILT DRAWINGS

As built drawings shall be provided that record all revisions and changes to construction documents. The contractor is to maintain one set of as built record drawing that accurately reflects actual changes made to the project. Include a cross reference on the contract drawings that change has been made and where the change document is located. Identify and date each change, or revised drawing made.

The following shall be submitted by the individual identified below at the end of the project OR within 60 days of substantial completion:

i. The contractor shall mark-up the record set and scan approved marked up drawings in PDF format.
ii. The Architect shall submit one set of approved contract drawings in DXF format to be used by the owner for future renovations.
iii. A BIM model shall be produced by the contractor as well submitted in .rvt file format.
iv. A hard copy of all actual written or computer generator field markups shall also be submitted by the contractor.
v. The architect shall take all submitted redlines and incorporate on their DXF formatted files and PDF and shall submit to the owner the drawings with all below incorporations:
    a. All RFI, ASI, approved PRs, and Addenda
    b. All underground redlines including: underground plumbing with dimensions and elevation, underground electrical (comprising of 2" or more meaning that if three ¾" conduit are ran from within 2 feet of each other we expect to see a redline for it), other underground items that are larger than 2".
    c. All above ground installation changes and all electrical distribution piping including pipe racks (comprising of 2" or more meaning that if three ¾" conduit are ran from within 2 feet of each other we expect to see a redline for it). Dimensions are not needed unless the piping of electrical, plumbing or mechanical is either not shown on the original drawings or has shifted to another space.

2.3.3. DESIGN DATA

The following data is to be utilized in the design of the facility. See space plan matrix for size, occupants and operating schedules, section 2.2.8 of this OPR.

Design Data Matrix										
Space Name	Summer Temp	Summer Humidity	Winter Temp	Winter Humidity	Pressure Relationship	CO_2 Above Ambient	Air Quality	Sound Level	Light Level	Notes
See programming document room data sheets	-	-	-	-	-	-	-	-	-	

2.3.4. SUSTAINABILITY REQUIREMENTS

The project goal is to achieve sustainability goals outlined in the DFCM High Performance Building requirements, see http://dfcm.utah.gov/high-performance-building-standard.html for full criteria.

2.4. COMMISSIONING REQUIREMENTS

The commissioner has been hired by the owner to assist in the delivery of a high performance fully functional building. To achieve these goals the owner has charged the commissioner with the following responsibilities in delivering technical commissioning for the project:

2.4.1. COMMISSIONING SCOPE OF WORK

Discipline	Commissioning Scope
Building Envelope	• Air Leakage Pressure Test • Thermal Barrier Inspection • Roof Inspection • Window & Door Inspection
Mechanical	• Installation Inspection • HVAC System PFT & FPT • HVAC Control System PFT & FPT
Plumbing	• Installation Inspection • Hot Water System PFT & FPT • Plumbing Fixtures PFT • Pressure Booster PFT & FPT • Water Softener PFT & FPT
Fire Protection	• Installation Inspection • Fire Protection PFT
Electrical	• Installation Inspection • Power PFT & FPT • Lighting PFT & FPT
Fire Alarm	• Installation Inspections • Fire Alarm PFT & FPT
Security	• Installation Inspections • System PFT & FPT
Communications	• Installation Inspections • System PFT & FPT

a. Commissioning responsibilities during phases of commissioning

Phase	Commissioning Responsibility
Pre Design Phase	• Review OPR • Review BOD
Design Phase	• Create Design Commissioning Plan • Create and Manage Design Issue Log • Review Design Documents

	• Supply Cx Specifications • Attend Pre Bid Meeting
Construction Phase	• Create Construction Commissioning Plan • Review Submittals • Create and Manage Construction Issue Log • Hold Commissioning Kick Off Meeting • Create PFT & FPT Check Sheets and Forms • Perform Site Inspections • Observe / Verify / Perform site PFT tests
Acceptance Phase	• Observe / Verify FPT • Review O&M Manuals and As Built Drawings • Verify Operator Training • Create Commissioning Report • Create Systems Manual
Warranty Phase	• Observe / Verify deferred testing • Perform a Warranty site visit and review report • Verify documentation of utility baselines
On Going Cx Phase	• Assist operators with maintaining baselines

2.5. PROJECT SPECIFIC REQUIREMENTS

2.5.1. ENERGY PERFORMANCE

The project will be designed using the latest adopted version of IECC. The project will follow the DFCM HPBS using a prescriptive approach working with the design team, energy modeler and DFCM.

2.5.2. RENEWABLE AND SITE BASED RESOURCES

a. Not included

2.5.3. TRANSPORTATION REQUIREMENTS

a. Number of Parking Spaces: Code Minimum
b. Alternative Parking: 10 spaces for low emission vehicles or HPBS minimum requirement
c. Alternative Transportation Provisions: Bicycles

2.5.4. BUILDING ENVELOPE

a. Air Leakage at 75 Pa: Less than .1 cfm/sq. ft.
b. Roof: Cool Roof
c. Insulation: R-20 walls, R-30 roof
d. Roof Warranty: 30 year

2.5.5. ACCESSIBILITY REQUIREMENTS

The facility shall meet all current ADA requirements and enhanced Utah state requirements. Systems requiring routine operation and maintenance, such as HVAC components and electrical panels shall be designed to provide adequate access and clearances for all operation and maintenance tasks. The facility shall also be designed to meet any additional requirements listed below:

2.5.6. AESTHETICS REQUIREMENTS

Private and open offices shall maintain the same interior design attributes as other office spaces. Exterior façade of the building shall maintain a uniform look and shall aesthetically fit in with the surrounding buildings as approved by the Owner. Comply with UVU campus standards.

2.5.7. MECHANICAL SYSTEM REQUIREMENTS

The HVAC system shall be designed to contribute to the overall energy goals and space controllability and to meet the design data matrix of this OPR. The system shall be constructed to industry best practices and shall be constructed of standard industry components that the operation and controllability of such are well understood by typical operators. All systems must be accessible and the design should take into consideration ease of operation and maintenance. To meet the energy, indoor comfort and quality levels the design should adequate levels of capacity and redundancy to fulfill these goals.

Specific system and equipment requirements of the Owner are as follows:

a. System Type:
b. Air Distribution System Type: Medium Pressure VAV with hot water reheat. Reheat coils shall be installed in the ductwork, and are not to be part of the VAV box.

Specific equipment and system manufactures allowed are as follows:

a. Chillers: Project will use existing chillers in existing central plants
b. Boilers: Project will use existing boilers in existing central plants
c. Pumps: Any Manufacture
d. VFD: ABB, Danfoss, Yaskawa
e. AHU: Alliance, ClimateCraft, Energy Labs, Haakon, Huntair, Unitech
f. FCU: Any Manufacture
g. Terminal Units: Any Manufacture
h. Exhaust Fans: Any Manufacture
i. Humidifiers: Any Manufacturer
j. DDC Control System: TAC StruxureWare BACnet system, installed by Utah Yamas Controls
k. DDC Valves and Actuators Manufacturer: Belimo or TAC

Specific functional and installation requirements shall be as follows:

a. General
    a. Room Comfort Control: Rooms with common exposure may share an adjustable T-stat. No more than three identical rooms on a common thermostat.
    b. Central plant heating water design supply temperature = 100°F. Design for 15°F temperature differential.
    c. Central plant chilled water design supply temperature = 48°F. Design for minimum 12°F temperature differential.
b. Building Recovery (from unoccupied temperatures and design outside air requirements)
    a. Heating: 1 hour
    b. Cooling: 1 Hour
c. Motors
    a. Efficiency: Premium
d. AHU
    a. Fan Redundancy (including VFDs): 100%~~83%~~ ability with single fan/vfd failure
    b. Filtration Requirements: 4" MERV 13 FF,
    c. Filtration Rack FPM: Do not exceed 450 FPM

d. FPM Max across coils: 500 FPM
e. Windows in Doors: Provide them in all access doors
f. Max FPI in coils: 10
g. Direct Evap:
    i. Pan Slope: ½" per foot
    ii. Sump Capacity: Enough to handle complete drain of pad without overflowing with full tank
    iii. Evap Piping Material: Copper
    iv. Evap Drain Time: Drain entire sump in 10 minutes
    v. Overflow Drain Size: 4"
    vi. Moisture Sensors: One on the floor of AHU and one in the overflow
h. AHU Walls Pressure Class Rating Minimum: 6"
i. AHU Set point: Pressures shall be rest based on VAV damper position

e. Pumps
    a. Pump Redundancy (including VFDs): n+1
    b. Impeller Size: Max Impellors on Pumps with VFDs, Trim for all others
    c. Pump Type: vertical inline, floor mounted.
    d. Accessories: Gauges piped to inlet outlet and before strainer on Pumps
    e. Suction Straighteners Pressure Drop: 1 psi

f. Controls
    a. Wiring Identification: Cabling that is part of the TAC BACnet bus shall have a yellow jacket
    b. Number of NAE/JACE/AS: One per floor
    c. Number of Spare Points: 20%of all spare points spread across the floor
    d. Graphics: Graphics to reflect campus standard
    e. Strategies: Duct Static Reset, Room Temp Reset based on OA, Pump Set point Reset based on Valve position,
    f. System Integration (other equipment): Generator, ATS, Lighting Controls,

g. FCU
    a. Filtration: Provide MERV 13 filter in filter door
    b. Access: Provide ability to remove entire unit out of the space without any removal of permanent construction, including the T-Grid Mains; provide code NEC required 30 x30 access in front of electrical panels; provide access to both sides of the FCU to access motor.
    c. .

h. VAV
    a. Access: Provide 30 x30 access to the controls and free and clear access of no less than 24 x24 to the valves and control valves.
    b. VAV minimums: Occupied mode - Provide lowest as code allowed for minimum. Unoccupied and standby modes – no minimum, allow box to close.
    c. Occupancy Sensors: Tie all offices, conference rooms, private spaces, work rooms, to occupancy sensors
        i. Standby Temperatures: Standby temperatures in the room shall be 67\78.

d. VAV boxes shall not be provided with factory mounted reheat coils. Use duct-mounted reheat coils selected for campus standard heating water supply temperature and temperature differential.

i. Humidifiers: Size humidifiers to serve a single room, electric type with replaceable steam cylinder. Must be capable of operating with normal tap water used on campus.

j. Labeling
    a. Equipment: Plastic Engraved Labels with Equipment tag, CFM, GPM, at rated SP or Head
    b. Concealed Equipment: Ceiling Grid Labels for Valves, Equipment, Drains, Vents

k. Test and Balance
    a. Procedural Standards: NEBB T&B Procedural Standard
    b. Contract Association: T&B Contractor shall be hired under the General Contractor Contract

2.5.8. PLUMBING SYSTEM REQUIREMENTS

The plumbing system shall be designed to provide excellent service to the occupants and to meet the sustainable water use goals of this OPR. The plumbing system shall utilize fixtures and components that are easily replaceable and that have ready local access to replacement parts and components.

Specific system and equipment requirements of the Owner are as follows:

a. Sanitary System Type: Service weight cast iron pipe and fittings with heavy-duty no-hub couplings rated to 30 psig pressure.
b. Cold & HW System Type: Copper Pipe system, soldered joints, min. type L copper tube

Specific equipment and system manufactures allowed are as follows:

a. Water Closets: Low flow, wall hung - Any Manufacture
b. Urinals: Ultra Low flow – Any Manufacture
c. Lavatories: Moen Model 8413F03 pivot action single-lever faucet with lifetime cartridge replacement – No exceptions
d. Sinks: Any Manufacture
e. Mop Sinks: Any Manufacture
f. Water Heaters: Gas-fired, tank-type, condensing – Any Manufacture
g. HW Return Pumps: Any Manufacture
h. Electric Water Coolers : Electric wall hung – Any Manufacture
i. Mixing Valve: Any Manufacturer
j. Bottle Fill Stations: Any Manufacturer; No filter installed

Specific functional and installation requirements shall be as follows:

a. Time to Lavatories for Hot Water: 15 seconds
b. Time to Showers for Hot Water: 15 seconds
c. Circulating Water Temperature: 120 F
d. Design Temperature Max and Min of Hot Water:
    a. At Lavatories: 110 F
    b. At Private Lavatories: 110 F
    c. At Showers: 120 F
    d. At Janitor Sinks: 120 F
    e. At Kitchen Sinks: 140 F
e. Capacity of the Hot Water System: Continuous Hot Water at Temperature for 10 gpm. Ability to have up to 100 gpm for 10 minutes of capacity.
f. Controls of Plumbing Fixtures:
    a. At Lavatories: Single lever
    b. At Private Lavatories: Single Lever
    c. At Toilets: Flushvalve, lever handle
    d. At Urinal: Sensor, battery powered
g. Isolation Requirements:
    a. Building Isolation: Yes
    b. Floor Isolation: Yes
    c. Room Isolation: Yes
    d. Fixture Isolation: Yes
h. Bottle Fill Stations: Shall be located: At each required pair of drinking fountains.
i. Labeling
    a. Equipment: Plastic Engraved Labels with Equipment tag, CFM, GPM, at rated SP or Head

        b. Concealed Equipment: Ceiling Grid Labels for Valves, Equipment, Drains, Vents
    j. Specialty Waters
        a. Industrial Hot Water/Cold Water: Yes for industrial cold, no for industrial hot
        b. RO System: No
        c. DI System: No
        d. Softwater System: Provide softwater to below x requirements.

2.5.9. FIRE PROTECTION SYSTEM REQUIREMENTS

The facility shall be fully sprinkled with a system that meets code requirements for the facility type, use and occupancy. The system shall be constructed of pipe no thinner than schedule 10 iron pipe. The fire sprinkler system shall be interconnected with the fire alarm system for alarm and notification.

"Insert any special fire sprinkler requirements of the owner"
Wet sprinkler system that complies with NFPA 13
Standpipe system that complies with NFPA 14

2.5.10. ELECTRICAL SYSTEM REQUIREMENTS

The electrical system shall be designed to provide all building power requirements for occupant transportation, HVAC, plug load, emergency load, lighting load and other special loads of the building as required by local or regional codes and the design of the other building components. The electrical system shall be designed with adequate capacity for future changes and renovations of the building and utilize high quality materials and components. The system shall be constructed to industry best practices and shall be constructed of standard industry components that the operation and controllability of such are well understood by typical operators. All systems must be accessible and the design should take into consideration ease of operation and maintenance.

Specific system and equipment requirements of the Owner are as follows:
    a. Emergency System: Diesel Generator for emergency standby load only
    b. Redundancy Power: No redundancy power is required
    c. Power Quality: Power Quality adequate for operation of computer systems

Specific equipment and system manufactures allowed are as follows:
    a. Switchgear: Any Manufacture
    b. Transformers: Any Manufacture
    c. Panels: Any Manufacture
    d. Emergency Generators: CAT or equals as approved by UVU
    e. UPS Systems: Schnieder or equals as approved by UVU
    f. Occupancy Sensors: WattStopper or equals as approved by UVU
    g. Network Lighting Controls: GE or equals as approved by UVU

Electrical Systems Functional Requirements
    a. Outlets
        a. Voltage Drop: 5% at 20 amp load
        b. Labeling: Outlets Labeled by panel board and circuit number
    b. Lighting strategy- Daylighting & outdoor views –
            1. Interface with the lighting controls system specified in specification section 260943 by means of a BACnet compliant connection. Perform all programming and setpoint adjustment of the lighting control system as described in specification section 260943 and by the relay schedules and tables on the drawings. Provide

graphics on the 230900 system to show all lighting systems controlled through this interface. All lighting control system inputs/outputs are to be present on the same remote user interface as used for the HVAC controls, and all remote programming and adjustments shall be possible by using the same remote user interface.

c. Lights
    a. Lamp Type: LED
d. Occupancy Sensors
    a. Vacancy/Occupancy: Vacancy type
    b. Time Out: 20 minutes
e. Daylight Sensors
    a. Can occupant override: Yes
    b. Override Time: Until unoccupied
f. Network Lighting Controls
    a. Dark Building: Yes
    b. Switches for Override: 1 per floor
    c. Global Override: 1 per building
    d. Override Time: 2 hours
    e. Location of Switches: In janitors closet
    f. Lockout override switches during occupancy?: Yes
g. UPS System
    a. Loads to Backup: IDF/MDF Rooms
    b. Length of UPS Backup: 10 minute backup
    c. UPS systems may be either central, or Owner-furnished, rack-mounted. Coordinate with Owner and users during design.
h. Generator
    a. Loads to Backup: Life Safety, Emergency Lighting,
    b. Length of Generator Backup: 48 hours at full load
    c. Interface with the generator controls specified in specification section 263213 by means of a BACnet compliant connection. Monitor generator controls for status (on/off), summary alarm, fuel level, and 12 additional points that will be selected from the generator manufacturer's list of available points by UVU. Provide a graphical display of all generator systems on the 230900 controls system.
    d. Interface with each transfer switch specified in specification section 263600 by means of a BACnet compliant connection. There are two transfer switches on the project. Monitor each switch for normal power available, emergency power available, transfer switch position = normal power, and transfer switch position = emergency power. Provide a graphical display of all transfer switch data on the230900 system.
i. Transformers
    a. K Value
        i. Non-Linear Loads on Load Side: K-Rated as required by the specific loads.
        ii. Linear Loads on Load Size: K-1
j. Labeling
    a. Outlets/Light Switches: plastic P-Touch Type Labels; Clear with Black Lettering; Panel board and Circuit Number
    b. Panel board/Transformers/Relay Panels: Engraved Plastic Labels; Black with White Lettering: Red with White Lettering for emergency; Panel Designation; Feed From, Voltage, Safety labels with PPE designation, and kCAL designation; Label wiring inside panel; breakers; and typed schedule

2.5.11. FIRE ALARM REQUIREMENT

The building shall have a fire alarm and notification system throughout the facility. The system shall provide primary notification of any smoke or fire event directly to the building occupants and to a UL station.

Specific system and equipment requirements of the Owner are as follows:

a. Fire Alarm System: Addressable
b. System Integration: Integrated with the intrusion alarm system

Specific equipment and system manufactures allowed are as follows:

a. Fire Alarm: Select from one of the manufacturers that exist on campus.

2.5.12. SECURITY REQUIREMENTS

The building shall have a security system throughout the facility. The system shall provide access control, CCTV monitoring and intrusion alarm notification. All access doors will be monitored by CCTV and will have card access. All public spaces and parking lots shall have CCTV monitors. CCTV and card access systems shall be and extension of, and integrated into the existing security systems on UVU campus.

Specific system and equipment requirements of the Owner are as follows:

a. Card Access System: Proximity card type
b. CCTV: Color cameras system with network video recording archive capability

Specific equipment and system manufactures allowed are as follows:

a. Access Control: and Intrusion Alarm: Lenel
b. CCTV: Milestone platform with Axis cameras

2.5.13. COMMUNICATION REQUIREMENTS

The building shall be served by a modern phone system and Ethernet computer network for a high speed network. All offices, workstations, and conference rooms shall have the one network connection and one phone system connection. Conference rooms, corridors and public spaces shall be configured to accommodate the installation of future wireless access points. All communication cable within concealed spaces or walls shall be run in oversized conduit.

A distributed antenna system shall be provided for emergency responder radio systems in compliance with the IBC/IFC.

2.5.14. ACOUSTICAL REQUIREMENTS

The design shall prevent ambient noise from intruding into the building and causing noise levels above those indicated in the Design Data Matrix, 2.4.2 of this OPR. The design shall also prevent internal generated noise from rotating and vibrating equipment from infringing on adjacent spaces not to exceed those levels indicated in the Design Data Matrix. See programming document narrative and room data sheets for specific acoustical requirements

2.5.15. VIBRATION REQUIREMENTS

The design shall prevent occupants adjacent to rotating or vibrating equipment from sensing vibrations from equipment through the structure. The design will also prevent occupants from sensing vibrations caused by

structural deflection as results of foot traffic in hallways or floors. Performance and music instruction spaces to have a high degree of vibration isolation, see programming narrative for additional information.

2.5.16. SEISMIC REQUIREMENTS

The facility design shall comply with all local, regional and national code requirements.

2.5.17. BENCHMARKING REQUIREMENTS

The design shall provide predicted utility usage benchmarks for each utility system to the building. These benchmarks shall be based upon the engineers design calculations or design modeling. The designer shall also include predicted possible uncertainty predictions for the baselines provided. These baselines will be utilized to evaluate future building performance and operator evaluation.

2.5.18. MEASUREMENT & VERIFICATION REQUIREMENTS

The design will provide the following infrastructure for Measurement and Verification of utility performance of the building:

a. Electric meters: Provide (1) Master utility meter, (1) HVAC Load Sub-Meter, (1) Plug Load Sub-Meter, (1) Lighting Load sub-Meter.
b. Water meters: Provide (1) Master utility meter, (1) Landscape water Sub-Meter, (1) Cooling tower water Sub-Meter, (1) Kitchen water Sub-Meter
c. Gas meters: Provide (1) Master utility meter, (1) Kitchen gas Sub-Meter, (1) Boiler gas Sub-Meter

The design shall provide a modeling tool that can be utilized to normalize the measurement data taken from the meters listed above; for ambient weather, occupant load and utility costs for monthly intervals.

END