KELLER AUDITORIUM

SEISMIC ANALYSIS SUMMARY

March 2020

OMF OFFICE OF MANAGEMENT AND FINANCE

INTRODUCTION

For over 100 years, the Keller Auditorium has remained one of Portland's largest and most popular performing arts venues, hosting nearly 400,000 guests each year for musical performances, Broadway shows, and civic events. Along with four other venues, the Keller Auditorium is owned by the City and operated by the Portland'5 Centers for the Arts.

Like thousands of older civic buildings up and down the West Coast, the Keller Auditorium was not built with the structural features needed to withstand major earthquakes. Although more than 80 percent of the original brick and terra cotta building was removed when the auditorium was renovated in 1968, the exterior walls were left intact behind a new façade, doing little to improve the building's structural resilience.

Like thousands of older civic buildings up and down the West Coast, the Keller Auditorium was not built with the structural features needed to withstand major earthquakes.

Building codes and knowledge about structural engineering have changed significantly over the past 50 years, raising questions about the ability of older civic buildings like the Keller Auditorium to withstand a major earthquake. After the Keller Auditorium was placed on the City's master list of unreinforced masonry buildings, the City, Portland'5 Centers for the Arts, and a consultant team began a structural assessment of the Keller Auditorium in 2017.

The structural assessment revealed that the building requires significant structural enhancements to withstand a major seismic event. Beyond the building's structural and seismic issues, the operators report that the facility has serious shortcomings that detract from guest comfort, limit accessibility, pose complications for productions, limit revenue-generating opportunities, increase operating costs, and make maintenance difficult.

INTRODUCTION

For performers, the theater has inadequate dressing room space, poor on-stage air conditioning, and no access from the backstage area to the lobby, compared to venues of similar size around the country. For event attendees, the current slope of the aisles is too steep, the number and location of accessible seating areas do not meet ADA standards, and restrooms are inadequate, creating long waits. Materials containing asbestos are common throughout the building and older equipment, such as house lights, lack back-up systems that are needed to improve safety and operational predictability. Overall, the facility is severely outdated when compared to similar venues in peer cities.

Portland'5 is actively addressing maintenance safety issues through operations policy and targeted maintenance investments, but the facility is poorly suited to continue as Portland's premier performing arts venue.

To better understand the scope, scale, and cost of the needed enhancements, the City worked with Portland'5 and consultants to develop a preliminary series of options for the Keller's future:

Option	Desription	Estimated Construction Closure	Estimated Construction Cost
1(b)[2]	Building renovation intended primarily to address structural deficiencies, but not other desirable functional and operational enhancements. This option generally preserves current configuration, amenities, and the internal and external appearance of the building.	1-2 years	$119 million
2	Building renovation intended to address structural deficiencies as well as strategic improvements to improve the patron and performer experience, meet current accessibility requirements, and meet audience amenity expectations. This option includes modest expansions of the building area at the front (west) and rear (east) and significantly updates the internal configuration and functionality as well as the external appearance. Accessibility, comfort, sightlines, and acoustics for patrons would be improved.	2 years	$215 million
3	Full replacement of the auditorium with a new state-of-the-art facility. This option includes a conceptual "ideal" space plan meeting current industry standards and patron expectations. This replacement facility could be built at an alternate location, ideally with a larger footprint than the current site, which would allow continued operation of the existing facility during construction; it could also be located on the current site, though the small footprint presents challenges.	2.5 years	$245 million

[1] All cost estimates assume construction begins in 2024.

[2] Option 1(a) was an early conceptual approach to seismic strengthening that would reinforce all structurally questionable walls with additional concrete. This option was quickly deemed infeasible because of the numerous impacts on the building's interior that would render many hallways and existing spaces unusable. This option is also more expensive than the Option 1(b) that was subsequently developed and modeled. Option 1(a) was not further developed and is not considered viable.

The following project summary report includes:

- The building's history
- Construction information
- The Keller's role in the regional performing arts scene
- Details regarding the three options for renovation or replacement

Additional technical information on the structural analysis and renovation or replacement options is available upon request from the Office of Management & Finance's Spectator Venues Program.

No funding is currently identified to support major construction at the Keller, including any of the options described above. The focus of the City's effort to date has been to fully understand the current condition of the building and the options for renovations or replacement.

Next steps will include discussions with elected officials, community leaders, and arts organizations, including major tenants and users of the Keller to develop a strategy for action. The Keller will remain in use for the foreseeable future.

BUILDING HISTORY & CONSTRUCTION

Located between SW Clay and SW Market Streets, and SW 2nd and SW 3rd Avenues, the Keller Auditorium was constructed by the City of Portland in 1916-1917 as the Public (or Municipal) Auditorium.

Later renamed the Civic Auditorium, the building underwent a major renovation and modernizing remodel in 1967-1968 during the implementation of the South Auditorium Urban Renewal Plan, which demolished and redeveloped the neighborhood immediately to the south. The renovation transformed the auditorium from a utilitarian multi-purpose facility with a gently sloping orchestra floor and large wrap-around balcony to the steeply sloped orchestra with two balconies that are present today.

The late-1960s renovation was extensive and completely removed and rebuilt the interior, the front (west) façade, and the stage end (east) part of the building. However, the primary structural system holding up the roof, the masonry brick walls running east-to west along the north and south sides of the building, and the roof structure itself were not replaced and remain intact today.

Unaltered since 1968, the auditorium structure consists of concrete floors that are supported by either concrete or steel beams with a mixture of concrete, brick, and concrete masonry unit (CMU) walls. The layout of the existing structure consists of a basement under the building at two different final grades. The remainder of the existing building is defined by the main orchestra floor which slopes to connect the two basement grades. There are two existing balcony levels. All existing floor levels have access to the main elevators and stairwell.

The portion of the existing building that is around the stage end is laid out differently than the public access areas. There are two levels of rehearsal rooms with high ceilings on the south side and seven levels of dressing rooms with low ceilings on the north side. The roof structure is supported by large, open web steel trusses that support steel beams encased with concrete which support the 4-inch concrete roof slab.

The overall dimensions of the Keller Auditorium are 249 feet in the east-west direction by 192 feet in the north-south direction. During the 1960s renovations, the stage was enlarged and extended partially into the right-of-way of SW 2nd Avenue.

KELLER TODAY

The Keller Auditorium is owned by the City of Portland and operated by Portland'5, which is part of Metro. It is overseen by the Metropolitan Exposition and Recreation Commission.

At 102 years old, the Keller continues to play a key role in the region's performing arts landscape, hosting nearly 400,000 guests annually. Seating approximately 3,000, the Keller is the largest theatrical auditorium in the state and the only one in the metropolitan area capable of hosting travelling Broadway performances, large opera shows, and ballet productions.

Within the portfolio of venues operated by Portland'5, the Keller plays an especially important role, as commercial productions and concerts are among the more profitable shows: they represent approximately half of the organization's total annual revenue. The financial success of large commercial shows at the Keller helps Portland'5 support the Keller's resident companies and the operation of the smaller theaters, making local productions more feasible and affordable.

Very limited changes have been made to the Keller since the 1968 major renovation and modernization. However, building codes have changed significantly over the past 50 years and awareness of the region's seismic vulnerability has increased. As a result, we now have questions regarding the Keller's structural resiliency and ability to withstand a major earthquake.

Because the building is a mix of structural systems built in 1917 and 1968, it can be partially considered an unreinforced masonry (URM) building. Amid renewed interest in regulatory approaches to address the City's unreinforced masonry buildings, the City, Portland'5 Centers for the Arts, and a consultant team began a comprehensive structural assessment of the Keller Auditorium in 2017.

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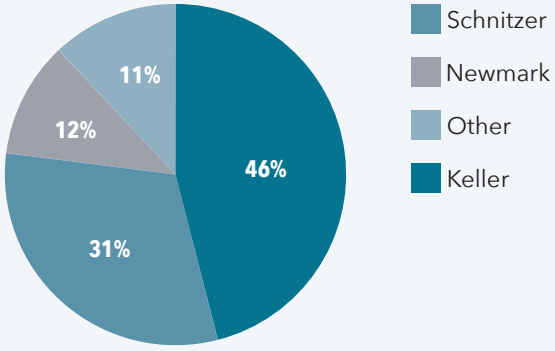
TOP TEN PORTAND'5 PERFORMANCES BY REVENUE (FY 2018-19)

1	Aladdin	$895,527	Keller	Broadway
2	Phantom of the Opera	$646,032	Keller	Broadway
3	The Nutcracker	$454,515	Keller	Oregon Ballet Theatre
4	The King & I	$361,937	Keller	Broadway
5	Wicked	$355,753	Keller	Broadway
6	Come From Away	$341,746	Keller	Broadway
7	My Favorite Murder	$339,379	Schnitzer	Commerical Show
8	Waitress	$333,427	Keller	Broadway
9	School of Rock	$314,043	Keller	Broadway
10	The Lightning Thief	$297,773	Keller	Commerical Show
		$4,340,132		

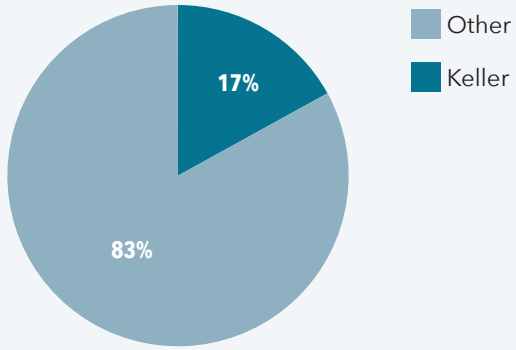
In FY 2018-19, the top ten highest-grossing events for Portland'5 brought in over $4.3 million. Of those ten shows, the Keller hosted nine and generated $4 million, or 92%.

PORTLAND'5 EVENT REVENUE BY VENUE (FY 2018-19)



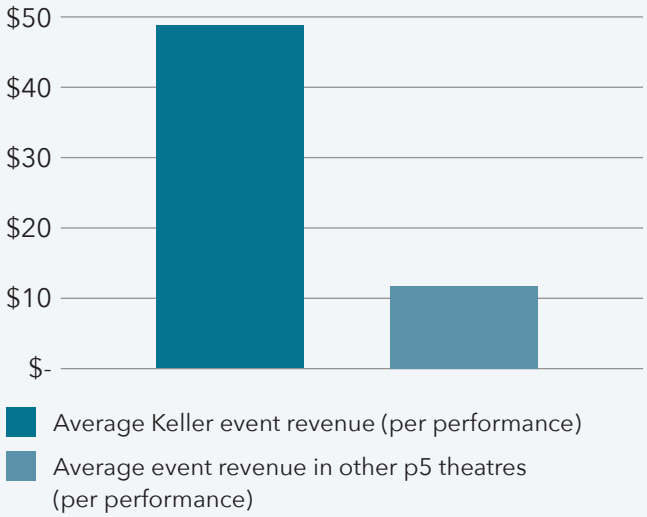
In FY 2018-19, events held at the Keller generated over $8 million, accounting for 46% of all revenue from Portland'5 venues.

PORTLAND'5 PERFORMANCES BY VENUE (FY 2018-19)



In FY 2018-19, the Keller hosted 17% of the 983 performances held across all Portland'5 venues.

PORTLAND'5 EVENT REVENUE BY PERFORMANCE



In FY 2018-19, the Keller generated average revenue of $48,000 per performance. During the same period, the other Portland'5 theaters generated average revenue of $12,000 per performance.

STRUCTURAL ASSESSMENT & MODELING

The City retained Miller Consulting Engineers (MCE) to develop a partial Tier 3 ASCE 41-13 structural analysis of the building[3].

Miller's initial scope of work consisted of relying on partially legible drawings from 1917, 1966, and exploratory site visits to develop a digital structural model. The scope of the analysis was limited to the main structural systems in the building, particularly shear walls and diaphragms.

The model was used to test the building's structural capacity in close to 600 different mode scenarios to develop an understanding of its behavior. The model produced loads in all the walls that were used as lateral resistance elements and, even though the walls added in 1966 are more rigid, a significant portion of the lateral load is transferred to the 1917 brick masonry exterior walls. The modeling demonstrated that the structure of the building, in its current configuration is vulnerable to failure in a number of different seismic scenarios.

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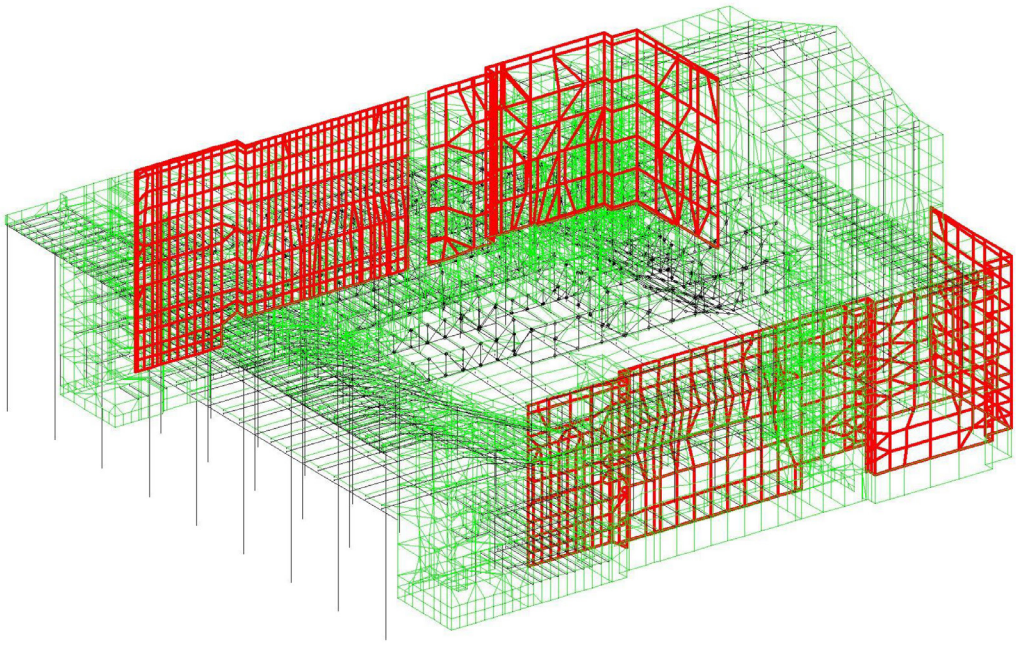
[3] The building was analyzed by MCE according to building code standards for the seismic rehabilitation of existing buildings created by the American Society of Civil Engineers (ASCE 41). In their analysis, MCE followed the recommendations of ASCE 41 for both force levels and acceptance criteria. The force levels that were used for this analysis are BSE-2E and BSE-1E with their acceptance criteria being "Limited Safety" and "Damage Control" respectively.

Brick Shear Wall Location



To help understand a rough order of magnitude of the necessary upgrades, Miller developed an engineering cost estimate. This estimate was based on repairs to strengthen the concrete and masonry walls adding reinforced pneumatically placed concrete to the inside face of the wall to resist the missing shear capacity, as well as provide additional out-of-plane capacity. Masonry partition walls were expected to either be braced or removed and replaced with metal stud walls.

The costs of this approach were estimated to be over $50M and did not include any of the associated architectural or mechanical work that would be required. In addition, this approach to the repairs would render the building unusable because of the added thickness to many walls in areas where there is not adequate space. This approach to the seismic enhancements is not a viable option and was not pursued further.

RETROFIT REFINEMENT & DEVELOPMENT OF OPTIONS

Whatever the future holds for the Keller, seismic improvements must be made to ensure safety for building occupants. However, seismic improvements alone will not improve the building's aging infrastructure, outdated design, lack of amenities for patrons and performers, and lack of accessibility.

In this phase of study, the City and Portland'5 expanded the consultant team to include architects, theater experts, cost consultants, and mechanical engineers to develop a better understanding of what a Keller renovation and retrofit project would include.

After the initial seismic modeling, Miller conducted additional analysis to find more efficient seismic solutions. These options included programmatic and architectural revisions along with more efficient solutions to address the building's structural deficiencies.

FIGURE 1, KELLER AUDITORIUM: RENOVATION AND REPLACEMENT OPTIONS COMPARISON.

	Option 1B*	Option 2	Option 3	Option 3
	Renovation of existing building to address seismic deficiencies only	Renovation of existing building to address seismic deficiencies and improve operations, accessibility, and theater experience	Replacement of existing building with state-of-the art facility on current site	Replacement of existing building with state-of-the art facility on alternative site
Estimated cost (construction only, assumes construction begins in 2024)	**$119 million**	**$215 million**	**Not estimated**	**$245 million** *does not include demolition*
Estimated cost per square foot	**$896**	**$1,318**	**Not estimated**	**$1,137**
Number of seats	**3,000**	**2,500**	**2,800-2,900**	**2,800-2,900**
Improves seismic safety and resiliency	2 **Better**	2 **Better**	1 **Best**	1 **Best**
Meets modern safety and accessibility requirements	✗	✓	✓	✓
Improves functionality for guests and performers	✗	✓	✓	✓
Improves aesthetics and amenities	✗	✓	✓	✓
Allows for Broadway and local performances during construction	✗	✗	✗	✓
Allows facility to serve the community for 50+ years	✗	✓	✓	✓

KEY

1 2

Rating for relative Seismic Safety after renovation; 1, 2, or 3 (1 being best)

✓

Identifies options that DO meet the criteria of the category

✗

Identifies options that DO NOT meet the criteria of the category

* Option 1A is not included in this evaluation because it was a preliminary engineering exercise only and did not result in a project that was operationally or financially feasible.

Option 1(b) – Seismic Upgrade with Required Sustaining Projects (estimated $119 million)

The model for Option 1(a)[4] was used as the starting point for the modelling for Option 1(b). This option presents a solution to the seismic issues present at the Keller that limits the work areas and reduces costs as much as possible.

The goal of this option is to strategically select the lateral elements of the building that were going to be upgraded, repaired, or replaced due to deterioration, in order to produce the greatest structural and cost benefits. This process of analysis was structurally driven and only those areas of the building impacted by necessary structural work receive architectural enhancement. One of the early decisions that provided a significant benefit to this analysis was the removal of the existing concrete facade panels and replacement of the building's unreinforced masonry exterior walls with new walls and lightweight cladding.

One of the advantages to this option was that most of the primary structural systems were based on modern materials. Design and analysis based on these modern materials allows for better structural capacities to be used for comparison.

In addition to the structural work, this option includes costs to rebuild areas of the building affected by the structural modifications. It also includes costs associated with building system upgrades that will need to be done to keep the building operational for another 20 to 30 years. The project would require closing the building for up to two years during construction.

In summary, the cost for this option is substantial and although less expensive than the other two options, the disruption to everyday business operations is profound. There are no significant improvements to the theatrical, functional, and programmatic elements that are generally considered necessary for a venue of this type to continue to be competitive for the next 20-plus years.

[4] As described in the summary, Option 1(a) was an early conceptual approach to seismic strengthening that would reinforce all structurally questionable walls with additional concrete. This option was quickly deemed infeasible and was not further developed, but it did result in the model that was used in Option 1(b).

Option 2 – Major Renovation Including New Additions (estimated $215 million)

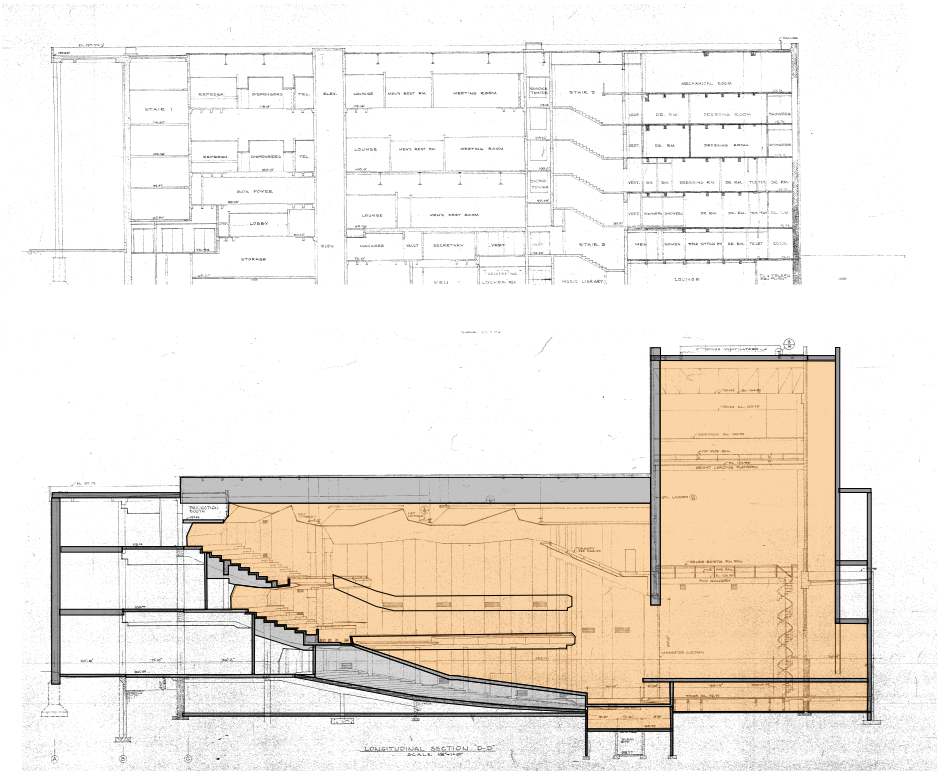
Option 2 was developed to not only strengthen the building to prevent collapse (while recognizing that the building may need major repairs or replacement after a major seismic event), but also to upgrade the facility to 21st century standards to the maximum extent possible. The purpose of developing this option was to test the concept of reinventing the Keller into a state-of-the-art Broadway-capable theater able to serve the Portland region for another 50 years.

The structural model for Option 2 used the model that had been developed through Options 1(a) and 1(b). However, because this option was directed primarily by the attempts to address the programmatic needs of the building, the structural changes to the building were extensive.

As with Option 1(b), Option 2 proposes demolishing unreinforced masonry walls and replacing them with new steel and concrete structures, bracing the auditorium ceiling, bracing structural walls, expanding the building's footprint at the NE and SE corners and over the current arcade on the west, extending the second balcony and adding additional box seating, improving acoustics, rebuilding the orchestra, changing the stage height, completely rebuilding the dressing room tower, adding a full kitchen and other guest experience amenities, fully addressing ADA accessibility issues, and adding a three-truck loading dock at the stage level on the north-east corner of the building. Mechanical and electrical modifications are extensive and intended to bring the building fully up to modern standards for efficiency and comfort. Theatrical technical equipment improvements include total replacement of the production rigging system, new orchestra pit lifts, new seating, and other enhancements.

Due to the space constraints within the building, the seating count of the auditorium is reduced from 3,000 seats to around 2,500 in this option. Because of the extensive changes to the auditorium and changes in almost every part of the building, the project would require closing the building for approximately two years during construction.

In summary, as with Option 1(b), the cost for this option is high and the disruption to everyday business operations is profound. However, unlike Option 1(b), this option makes significant improvements to the theatrical and functional elements that are needed for a modern venue to continue to be viable for the next 50 years.



OPTION 2 SECTION

Option 3 – New Theater Building on Alternate Site (estimated $245 million)

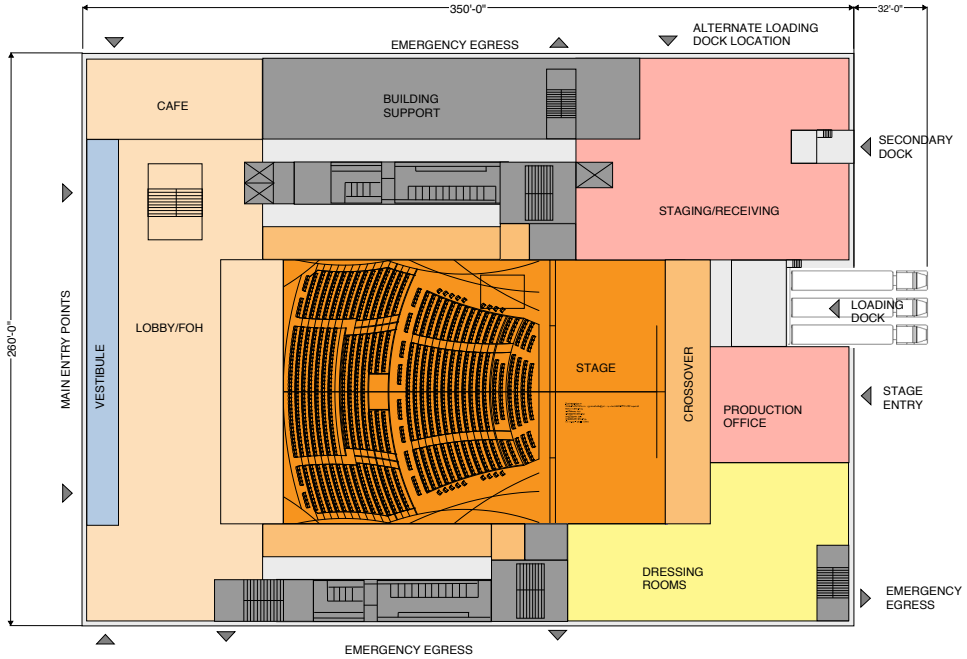
This option would replace the Keller Auditorium with a new facility that serves the needs of Portland'5 and the community, creating a new a state-of-the-art home for opera, ballet, and traveling Broadway productions. The option assumes a 2,800-seat auditorium built on an undetermined site located somewhere in central Portland.

This option was developed by LMN Architects with input from The Shalleck Collaborative, who are theater consultants. Because it is entirely new construction, the building would be expected to conform to whatever version of the Oregon Structural Specialty Code (OSSC) is in effect when the project is permitted. This option is the most likely to survive a major seismic event with little or no damage and can be expected to be usable sooner after an earthquake than either of the other options.

A preliminary room list was developed which details the ideal location, square footage, and amenities required for each element of a new auditorium (e.g., public space such as the lobby, lobby support, reception areas, staff support areas, performance space such as the auditorium, stage, stage support spaces, performer support, workshops, services, administrative areas, etc.). The room list and square footage calculations were used to develop the cost estimate for this project. Note that the estimate does not include costs for land/land acquisition; however, building in a different location would free up the current site for sale and redevelopment.

A major new facility could be an anchor and catalyst for neighborhood growth and encourage additional public/private investment. It would also allow the existing Keller to remain in operation during the construction of the new building. Construction of a new building is estimated to take 2.5 years to complete.

In summary, the cost is the highest of the options studied. However, because the building is larger, the cost per square foot is less than a major renovation and upgrade of the existing Keller Auditorium (Option 2). An entirely new facility would also be the safest option and can be designed and built to modern theatrical standards ensuring a long lifespan.



OPTION 3 GROUND FLOOR FOOTPRINT

August 30, 2018

MOVING FORWARD

The structural studies and conceptual options developed by the City and Portland'5 over the last two years are the first steps of a more comprehensive community conversation about the best path forward for the Keller Auditorium and Portland'5 Centers for the Arts.

The scale of the need at the Keller is still being assessed and stakeholders will need time to digest information and consider options for either renovating or replacing the building.

In the meantime, it is important that the Keller continue to operate successfully while the City and Portland'5 work with the community to determine of the best path forward. The Keller meets all current fire, life, safety code requirements and, apart from questions about its performance in a major seismic event, can be considered safe, even if lacking in modern amenities.

Given the Keller Auditorium's seismic issues and the building's unique ability among the region's venues to accommodate large shows and Broadway productions, the need for renovation or replacement is clear.

However, there are no current funding sources identified for a project of this magnitude and scale. As shown by the options described in this report, there are multiple ways the City and Portland'5 could proceed that would ensure the region has a large performing arts venue that can accommodate educational programs, cultural events, and world-class performances for years to come. However, renovation options that would put Broadway, opera, ballet, and independent performance productions out of commission for two years or more would harm Portland'5's operational sustainability as well as severely stress the resident companies.

Given the Keller Auditorium's seismic issues and the building's unique ability among the region's venues to accommodate large shows and Broadway productions, the need for renovation or replacement is clear.

COMMUNITY INTEREST IN IMPROVEMENTS

Over the past several years, a group of interested property owners in the surrounding neighborhood hosted an international design competition to envision what an updated Keller Auditorium would entail.

The proposals focused exclusively on the exterior of the Keller and were not intended to address the many existing seismic, structural and guest/performer experience deficiencies of the building, but to reimagine its image from the outside and improve its relationship to the surrounding area. Operational and financial parameters were not placed on the respondents.

Stufish Entertainment Architects was selected as the winner of the design competition for their captivating proposal to transform the face of the Keller Auditorium with a large, multi-level glass addition to the west, into and over SW 3rd Avenue toward the Ira Keller Fountain. While the project as proposed would not address all structural or operational deficiencies of the existing building, it demonstrates the community's recognition of the Keller's importance and shows a desire from neighboring property owners and businesses to participate in conversations about the future of the facility.

Next Steps

Over the coming months, the City and Portland'5 will engage in discussions about this information with decisionmakers, potential donors, tenants, and users of the Keller Auditorium. Determining a process for how to move forward and developing a funding strategy will be the focus of these conversations.

Additional Information

More detailed project information is available upon request from the Spectator Venues Program.