Snell Hall
Feasibility Study

OREGON STATE UNIVERSITY
Corvallis, Oregon

January, 2010
REPORT

Snell Hall Feasibility Study

Prepared by

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Prepared for

Oregon State University
Corvallis, Oregon

Project Number 09011

January, 2010
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I. EXECUTIVE SUMMARY

Snell Hall/MU East includes a group of buildings and additions located near the center of the Oregon State University campus on Jefferson Way. One of those buildings, Snell Hall Tower, is the focus of this report. Snell Hall Tower, referred to as Snell Hall in this Report, is a five story building with a partial basement. Snell Hall was originally designed in 1958 and built in 1959 as a residence hall. It is now being used as an office building housing various student services and activities operated by Memorial Union. Snell Hall was designed in the modern style of architecture. It is not considered to be a historic or significant building.
Snell Hall is located in the Campus Master Plan Sector C, OSU's campus core and academic center. New buildings and major remodeling projects are expected to be compatible with existing uses and building character. Major changes would be required and Snell Hall is specifically earmarked for redevelopment.

Snell Hall was originally designed as a residence hall resulting in closely spaced columns, the narrow building footprint with remote or without core facilities and the low nine foot floor to floor heights. Ventilation depends on the windows. Much of the building does not function well as an office, B occupancy, building. The nine foot floor to floor heights are severely limiting relative to flexibility, distribution of services especially ventilation air, and space planning.

Building data:
- Use 1959: R-1: Congregate Residence
- Use 2009: B: Office, Professional, Service
- Height: 60 feet, 5 stories with basement
- Floor Area: 67,215 SF gross floor area

The building envelope consisting of brick bearing walls, curtain wall/windows systems and roofs does not come close to meeting any standard from comfort to energy and in some cases structurally. The roof is nearing the end of its expected life. Building entrances and exits are protected from spalling brick by temporary wood framed canopy structures. The curtain wall systems are failing in many respects. The architectural character of the building is not compatible with surrounding older buildings such as Waldo Hall, Memorial Union, and the Bennes designed buildings or with recently renovated buildings like Valley Library fronting Jefferson Way. Brick is the only unifying element on Snell Hall.

KPFF Consulting Engineers conducted a general structural evaluation of Snell Hall in accordance with ASCE 31-03, *Handbook of the Seismic Evaluation of Buildings*, Tier 1 and 2.

The structural system consists of built-up steel columns, conventionally reinforced concrete lift slabs, and reinforced brick shear walls. The columns are founded on concrete combined strip footings. The reinforced
brick walls have spread footings, but the perimeter non-bearing walls are supported on 8-inch grade beams. The reinforced brick walls, located at stairs and elevators and along one long side, provide resistance to earthquake and wind forces.

KPFF believes the Snell Hall structural system to be inadequate to resist seismic loads prescribed by the Life Safety Performance Level of ASCE 31. The reinforced brick shear walls and their footings are not adequate to resist the anticipated shear and overturning forces respectively. Given the deteriorating condition of the brick, new shear walls, approximately eight, supported on pin piles, should replace the existing brick shear walls.

In addition to the shear walls, various other structural improvements are necessary, including replacement of deficient curtain wall systems and seismic restraint of equipment.

The steam piping infrastructure and heating terminal devices that serve most of the building are currently over 50 years old normally considered beyond normal economic service life. The system is most likely very maintenance intensive to keep in operation.

No mechanical ventilation exists in most of the building. Where ventilation is provided by operable windows, the current Building Code requires that the operable section of the window be at least 4% of the floor area in each space.

The current HVAC system does not meet current mechanical and energy code requirements.

Water service would need to be increased to provide the volume required for a full coverage fire protection system.

Electrical systems include:
- Power Service
- Power Distribution
- Grounding
- Lighting
- Life Safety
• Tel/Data
• Fire Alarm

Power service and distribution is 50 years old and is due for replacement or upgrading. Grounding and bonding systems are likely inadequate. Lighting is inadequate at elevator stops and lighting in general should be upgraded to current lighting and technology standards. POE lighting is inadequate and a new emergency power source is needed. Improvements to the Tel/Data system need to be made. A new addressable fire alarm system is needed.

The elevator is in need of a major upgrade.

LEED and SEED programs will impact any redevelopment option.

Two redevelopment options have been considered. Redevelopment Option 1 involves system upgrades, remodeling, renovation and building envelope additions to Snell Hall Tower. Redevelopment Option 2 involves replacing the existing Snell Hall Tower with a new office building of similar gross floor area.

REDEVELOPMENT OPTION 1

INFRASTRUCTURE IMPROVEMENTS

SITE IMPROVEMENTS...........................................35,960 SF

EXISTING BUILDING RENOVATION & REMODELING

Existing Gross Building Area:.......................67,215 SF
Additions:......................................................10,000 SF

Construction work required to renovate, remodel and add to the existing building would be extensive. The building would need to be vacated and Snell Hall services would be provided at temporary facilities or at another location.

Redevelopment of Snell Hall would involve implementing the recommendations outlined in this report summarized as follows:

Figure 6  Existing Electrical Distribution
• Provide selective demolition as required to replace curtain wall systems, add shear walls, replace mechanical and electrical systems, reroof, and remodel the building.
• Provide eight new shear walls integrated with the architecture, locations to be determined, with brick cladding where exposed.
• Add approximately three feet to the exterior of the building designed to accommodate new windows/curtain wall systems, solar control, and mechanical systems.
• Replace the roof and consider mechanical systems.
• Renovate or replace the elevator.
• Completely remodel the building to accommodate its program and to address the deficiencies outlined in this report.

The 2010 order of magnitude total project cost estimate for the Option 1 programmed site improvements, renovation, remodeling and additions is:

DIRECT CONSTRUCTION COST (DC)........$ 12,600,000

INDIRECT CONSTRUCTION COST (IDC)
50% (DC) .............................................$ 6,300,000

SUBTOTAL.................................................$ 18,900,000

15% PROJECT CONTINGENCY ............$ 2,900,000

TOTAL PROJECT COST.........................$21,800,000

COST PER SQUARE FOOT.....................$282/SF

REDEVELOPMENT OPTION 2

INFRASTRUCTURE IMPROVEMENTS

SITE IMPROVEMENTS.............................35,960 SF

REPLACE THE EXISTING SNELL HALL TOWER AND WALDO PLACE ENTRANCE BUILDINGS WITH A NEW B OCCUPANCY OFFICE BUILDING

Gross Building Area:.............................80,000 SF
Demolition of the 3,258 square foot Waldo Place Entrance is included in this option. Removal of this building would create a useable and functional site for a new office building. This addition is relatively minor and was designed to specifically integrate with existing Snell Hall.

Construction work required to demolish the existing building and replace it with a new building would be extensive. Snell Hall services would be provided at temporary facilities or at another location.

A new building would be designed and constructed in accordance with OSU design standards and the Campus Master Plan. It would be of non combustible concrete and steel construction and incorporate brick, window/curtain wall elements and details consistent with other buildings on campus.

The 2010 order of magnitude total project cost estimate for the Option 2 programmed Snell Hall demolition and new building is:

DIRECT CONSTRUCTION COST (DC)......$15,070,000

INDIRECT CONSTRUCTION COST (IDC)  
50% (DC)                                                      $  7,535,000

SUBTOTAL..................................................$22,605,000

10% PROJECT CONTINGENCY                  $ 2,260,000

TOTAL PROJECT COST.............................$24,865,000

COST PER SQUARE FOOT.........................$311/SF

CONCLUSION

Option 1, remodel and renovation, results in an improved, safer, code compliant and more functional building. It does not address Snell Hall’s core deficiencies which are its inadequate floor to floor heights, lack of core facilities, narrow footprint and columns. These elements affect flexibility and space
planning needed for an office building. Campus master plan building design guidelines relating to scale, proportion may not be fully addressable.

Option 2, new building, offers an opportunity to address all of Snell Hall's issues at a relatively small increase in cost.

McBride Architecture recommends replacing existing Snell Hall with a new building.
II. INTRODUCTION

Snell Hall, also referred to as MU East, includes a group of buildings and additions located on Jefferson Way on the main campus of Oregon State University in Corvallis, Oregon. One of those buildings is the Snell Hall Tower, a five story building with partial basement. In this Report, Snell Hall Tower is primarily referred to as Snell Hall; the other buildings/additions are not included except as they directly affect conditions around Snell Hall Tower. It was originally designed in 1958 and built in 1959 as a residence hall, but currently the main use is as an office building.

This report outlines two potential alternative building redevelopment options that could be further considered by OSU. The alternatives include:

- Existing building renovations, remodeling, additions, an extensive and integrated approach.
- Replace the existing building with a new building.

McBride Architecture was retained to provide a condition assessment of Snell Hall. The purpose of this investigation was to develop an understanding of the condition and effectiveness of the architectural, structural, mechanical and electrical systems and to provide budgetary cost information to correct deficiencies.
The general consensus of opinion about Snell Hall seems to be one of dissatisfaction. It has never provided a comfortable environment even when new. The building has always had problems with leakage. It is hot in the summer and cold in the winter.

STUDY TEAM

The process involved a Study Team that included the University User Group, Facilities Services and the Design Team.

University User Group:
- Sid Cooper, Assistant Director, Building Services, Memorial Union
- Fred Wood, Site Operations Senior Maintenance Manager, Facilities Services
- Mike Blair, University Civil Engineer, Facilities Services

Facilities Services:
- Lori Fulton, University Architect, Facilities Services

Design Team:
- Richard McBride, AIA, Architect, McBride Architecture, PC
- Ron Kernan, PE Structural, KPFF Consulting Engineers
- Jonathan L. Ricket, PE Mechanical, PAE Consulting Engineers
- Stephen Turina, PE Electrical, PAE Consulting Engineers
- Harvey Childers, Cost Consultant, DMC Cost Consulting

PROCESS

The investigation, and evaluation process included the following tasks:
- The Oregon State University Campus Master Plan was reviewed for its affect on the Snell Hall building and site.
- A review of web site posted and drawing file archive
information was conducted.

- Record documents were reviewed, including Architectural drawings 1-25 and Structural drawings 101-107 dated, March 2, 1958. The Architect of Record is Burns, Bear, McNeil & Schneider Architects, Portland, Oregon.
- Available reports and documents about the building were reviewed.
- A tour of the building included the design team, members of the User Group and other OSU personnel.
- Curtain Wall Shop Drawing numbers 1 thru 11, Fentron Industries, Inc., Seattle, February 20, 1959, were reviewed. Drawing 3 is titled “Recaulk Snell Hall”, April 18, 1966.
- The Snell Hall Curtain Wall Assessment, McBride Architects, September, 1999, was revisited.
- A basic Oregon Structural Specialty Code (IBC) review was performed.
- An analysis of HVAC, plumbing, electrical, data, alarm, lighting and other systems was conducted by PAE to determine the adequacy and general condition of the existing systems.
- An ASCE 31 Tier 1 and 2 seismic evaluation was performed.
- Issues relating to accessibility have been considered.
- Various sketches and other drawings have been prepared to compliment the text.
- A draft report was prepared and presented to the University for review and comment on November 6, 2009, at a Study Team meeting at OSU.
- An outline of a repair and replacement architectural program was developed for budgetary cost estimating purposes.
- Budgetary cost estimates were prepared for two options.
- Comments were addressed and this final report was prepared and presented to the University on January 12, 2009.
III. BACKGROUND INFORMATION

ARCHITECTURAL HISTORY

Snell Hall Tower and Cafeteria were constructed as a single residence hall project in 1958. An addition was constructed on the west side of the building in 1976. The building use changed from residential to office, professional at this time. The addition is functionally fully involved with the First Floor of Snell Hall Tower. To the south the tower is connected to a one story building housing Memorial Union arts and crafts programs. The interior has undergone various tenant improvements as tenants come and go. A large portion of the Fifth Floor remains undeveloped; it seems largely because of the condition of building on this floor. The roof was replaced in 1986 and restored in 2005.

Snell Hall was designed in the modern international style of architecture. It is not considered to be a historic or significant building.

CAMPUS MASTER PLAN

The Oregon State University Campus Master Plan (CMP) guides all design and construction projects on campus. That includes site, new building and major remodeling projects.

The CMP organizes the campus into 9 Sectors, each with its own set of guidelines guiding development. Snell Hall is in Sector C, OSU's campus core and academic center. About 750,000 SF of new building area compatible with existing uses and character is planned for this Sector. Development will occur through in-filling and redevelopment of existing buildings. Snell Hall is specifically earmarked for redevelopment.

The following Plate taken from the Campus Master Plan indicates Sector C and Snell Hall.
Figure 4.7: Map of Sector C
Individual building projects are expected to contribute toward campus infrastructure improvements, such as:
- Frontage improvements
- Utility improvements
- Bike paths and shelters
- Bus and shuttle shelters and stops
- Sidewalk & pedestrian upgrades
- Pavement upgrades
- ADA compliant pedestrian ways
- Street lighting
- Street markings
- Accessible parking

Other design and planning features that are encouraged in Sector C include:
- Site buildings with ten foot setbacks, consistently.
- Create main entrances off Jefferson Way, centered in the façade.
- Continue OSU tradition of landscaping and horticulture.
- Continue campus planning in the tradition of the original Olmstead plan.
- Use traditional materials and design patterns, brick and stone.
- Practice sustainability.

RECOMMENDATION
Make the required site and building design improvements.

SITE

Snell Hall is located on the corner of Jefferson Way and Benton Place near the center of campus. The south boundary borders Goss Field and the west elevation faces historic Waldo Hall. Site areas include:

<table>
<thead>
<tr>
<th>Description</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL BUILDINGS FOOTPRINT</td>
<td>32,803 SF</td>
</tr>
<tr>
<td>OUTDOOR COVERED AREA</td>
<td>4,061 SF</td>
</tr>
<tr>
<td>LANDSCAPE &amp; WALKS</td>
<td>13,679 SF</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>50,543 SF</strong></td>
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</table>
The site slopes down at least one floor to the southeast. Catch basins connected to a separated storm sewer system are located in areas where this natural surface drainage is interrupted by buildings. Storm sewers are located on both the west and east sides of Snell Hall.

Fire hydrants are located along Jefferson Way and Benton Place; actual locations and capacity remain to be determined.

Other utilities serving the site include the sanitary sewer located on the west side of Snell, domestic water, natural gas, telephone and electric power. Campus steam and limited chilled water also serve the building. Chilled water is provided from Valley Library.

The public entrance to the Snell Hall Tower is from Jefferson Way. Public entrance is also provided from the Waldo Place. Accessible and service entrances are from Benton Place. Other points of entry and egress are through the 1976 addition and the crafts center building, formerly the Snell Cafeteria.

Landscaped lawn and shrub areas exist between the building elements and covered walkways. Mature trees line the streets and sidewalks. Surfaces under canopies are concrete paved; concrete paving is in good condition. Street sidewalks are in poor condition.

The following figure is a Site Plan indicating the major existing physical elements within the Snell Hall site.
RECOMMENDATION
Make the required site and utility improvements. Increase chilled water service.

ARCHITECTURE

Building Data

Constructed: 1959
Use 1959: R-1: Congregate Residence
Use 2009: B: Office, Professional, Service

Contractor: Emerick Construction
Portland, OR

Curtain Wall Contractor: Fentron Industries
Seattle, WA

Architect: Burns, Bear, McNeil & Schneider
Portland, OR

Structural Engr.: Stanley V. Carlson, P.E.

Height: 5 stories (60’) w/ partial basement and penthouse.

Type Of Construction

Basement: Reinforced concrete with daylight on the Benton Place side.

Structural Frame: Reinforced concrete lift slab supported by steel columns, laterally braced with reinforced brick shear walls at central core and stairwells.

Roof: Rock and lightweight ballasted EPDM over rigid insulation.

Stairs: Metal w/ 1 ½ inch concrete wearing surface. Stair tower roofs are metal deck.

Skin: Aluminum Curtain Wall consisting of an Aluminum Frame, Aluminum Windows and Porcelain Enameled Steel Panels. Structural brick bearing walls.

Wall Insulation: Nominal 1 ½ inch thick porcelain enamel panels had fiberglass insulation with aluminum foil backing.

HVAC: Two pipe low pressure steam.
Chilled water from Library chillers at basement and first floor only. Ventilation through operable windows.

Sprinkler: Dry stand pipe in stairs only.

Sound Insulation: None.

**Floor Area, Height, and Volume**

<table>
<thead>
<tr>
<th>Floor</th>
<th>Area</th>
<th>Ht</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Roof (PH)</td>
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<td>9 ft</td>
<td>1,116 cf</td>
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<td>292 sf</td>
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<td></td>
<td>416 sf</td>
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<td>3,452 cf</td>
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<tr>
<td>5th Floor</td>
<td>11,874 sf</td>
<td>9 ft</td>
<td>106,866 cf</td>
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<td>4th Floor</td>
<td>11,874 sf</td>
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<tr>
<td>Total Area</td>
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<td>628,393 cf</td>
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Figure 11  Ground Floor and Basement Floor Plan

Figure 12  First Floor Plan
Figure 15  Fourth Floor Plan

Figure 16  Fifth Floor Plan
Figure 17  Building Sections of Each Wing

General

Snell Hall was built as a residence hall and was intended to provide inexpensive housing for students. Most of the building is now used as an office building with some specialized uses on the lower floors such as the radio station and craft studios. This was a significant change in use as it affects the ability to provide ventilation and other services.

The structural system utilizes 8" thick precast reinforced concrete slabs lifted into place on steel column supports. The wings are 36 feet wide, with the columns placed 23'-6" on center, 7'-8" in from the exterior.

Because it is a concrete structure, the cantilevered edges can be expected to have experienced some level of creep over time. Floor slabs are also subject to forces causing deflection and thermal expansion and contraction. These conditions have a direct affect on the anchorage details for the curtain wall system.

Typically, the floor-to-floor height in the building is only 9 feet. The original design called for the corridors to receive a layer of acoustic tile in the center. At the
ceilings of the perimeter rooms, the bottom of the concrete slabs were left exposed, providing a ceiling height of 8'-4". The heads of the windows are located about 2" below the concrete ceiling.

Most of the building now has a furred or suspended ceilings installed to accommodate lighting and extensive telcom wiring. This required hanging the ceiling below the heads of the windows and is less than adequate. There is very little opportunity to provide interstitial space for ventilation and other systems. Ceiling heights are below 8 feet in these areas with 7'-6" being code minimum. For large open plan areas a 7'-6" ceiling height is completely inadequate.

Snell Hall is a lift slab building with a reentrant corner. Reinforced brick stair and core walls were intended to provide for lateral resistance to wind and earthquake loads. Sections regarding brick and structure present detailed discussions about issues relating to the shear walls.

New buildings planned as office space usually provide environmental, communication and other systems as close to the center of the building as possible. The restricted ceiling height does not allow for interstitial space to deliver those systems to where they are needed. The only possible opportunity is at the exterior wall. There is steam heat piped to most of the building, but chilled water at the lower floors only. Fresh air is provided by means of operable windows and there is no centralized air conditioning. Wiring is distributed at the ceiling, but space is limited.

RECOMMENDATION
Implement recommendations of other sections of this report. The inadequate floor-to-floor height limits the flexibility of this building. Possible considerations would be to return the building to its original function as a residence hall or to replace the building with one that is designed to accommodate its program.

**Interior Elements**

Interior partitioning, finishes, doors, hardware, casework and specialties were not evaluated as part of this study.
RECOMMENDATION
Remodel as needed.

Accessibility

The original main entrance to Snell Hall is approximately centered in the Jefferson Way elevation. The Campus Master Plan calls for building entrances to be located on Jefferson Way. The sidewalk along Jefferson Way is too steep to provide wheel chair access to the building, therefore, access is provided from Benton Place and from Waldo Place. The Benton Place entrance door is not compliant.

The existing elevator provides access from the Basement through the Fifth Floor, however, the elevator itself is not fully compliant. The change in the floor elevation at the First Floor makes about half of the First Floor inaccessible to wheelchairs.

There is a presumably accessible restroom on first floor only; the other restrooms are not.

Much needs to be done to make this building ADA compliant.

RECOMMENDATION
Conduct a detailed ADA survey to Identify all accessibility issues and implement projects to correct deficiencies. Implement the elevator project.

Hazardous Materials

Lead paint is likely to exist, given the age of the building.

An asbestos survey and report dated October 31, 2008, conducted by Forensic Analytical Consulting Services indicated that asbestos remains in the building as follows:
- Floor tile, various locations.
- Exterior window glazing putty.
- Roof patching compound, second floor.
- Sink undercoating.
- Sheet vinyl.
Pipe and fitting insulation.  
Cement asbestos board at kiln.  
Fire doors suspect.  
Fire brick suspect.

Reports relating to testing for mold indicated that, despite all the water intrusion, there is not a mold problem in Snell Hall. The building materials that have become wet from roof and wall leaks generally do not support mold growth.

**RECOMMENDATION**  
Monitor carpet, gypsum board and other materials for dampness and clean as recommended. Replace curtain wall and roof systems to eliminate source of water intrusion. Develop a plan to manage lead paint and asbestos; remove where possible.

**Elevator**

Snell Hall contains one six stop passenger elevator installed as part of the original construction in 1959. The equipment is overhead traction geared, manufactured by the Westinghouse Elevator Company. The doors are single speed center opening to 3’-6” wide. The 50 year old equipment is worn, outdated, difficult to maintain and in need of modernization to meet current electrical, mechanical, life-safety, accessibility and energy performance standards and requirements.

A major repair, and modernization and code upgrade has been identified by Elevator Consulting Services. Balzhiser and Hubbard Engineers have prepared plans and specifications to implement an elevator modernization project including interrelated building systems such as the fire alarm system.

**RECOMMENDATION**  
Implement the consultant recommended upgrade package as soon as possible.
Roofs

Many of the problems plaguing the building with water damage over the years are directly attributable to the roof.

The original 1959 building is shaped in an "L" plan configuration. The main roof is designated Area A on Jefferson Way and Area B on Benton Place. The roofs over the stair towers at the ends of the wings are Area D and the roof over the stair/elevator penthouse Area C.

The 1959 original built up roofs were a flooded roof designed without slope to hold water as a way to keep the Fifth Floor cooler in sunny weather. The EPDM roofing systems were applied as a reroofing project in 1986. In 1999 the EPDM roofs were failing at terminations and seams and leaks were prevalent throughout the building. It is recommended that major maintenance and repair of seams and details be undertaken at 10 years into the life of ballasted EPDM roofs. Much of the interior damage and brick spalling is a result of roof leaks during this period. In 2005, a major repair project was undertaken which appears to be performing as of this writing.

Areas A and B are Loosely laid E.P.D.M., ballasted with rounded river rock, on expanded polystyrene insulation on a lift slab concrete deck.
Areas C and D are Loosely laid E.P.D.M., ballasted with rounded river rock or mortar faced extruded polystyrene insulation board, on gypsum board on metal deck.

Drainage and overflow drains are provided by internally plumbed cast iron roof drains. The roof surface is not sloped to drains and therefore ponds water throughout.

Coping metal is standing seam stainless steel in good condition. Other flashing and counter flashing materials are also stainless steel. A building joint separates Area A from Area B.

Water damage is apparent to the walls and ceilings from the 5th to the third floors between rooms x09 and x10. This location corresponds to an area of previously...
damaged base flashing on the roof.

Extensive water damage is present all the way to the ground in the brick wall on the south side of rooms x02, both on the exterior and interior faces. This water damage corresponds to previously damaged base flashings at the roof.

There has been extensive damage to the ceilings and ceramic tile walls in Toilet 553 and to ceilings in other fifth floor ceilings.

All three stairways show extensive water damage from the roof above. Ceilings below metal deck are falling down. Structural metal is rusting. The steel structural members at Stair No. 1 exhibit corrosion. Brick walls are showing efflorescence and spalling. The brick walls of and adjacent to Stair No. 1 are spalling and mortar is deteriorating. Many of the existing ceiling stains match photographs taken in 1999.

RECOMMENDATION
Monitor, maintain and repair the roofs in the short term to maintain habitable building conditions. This roof is nearing the end of its expected life and should be replaced with a well draining new roofing system within the next few years as the details begin to fail.

Brick

Brick walls are used as towers and base elements to define the building architecture and to provide shear walls. The vertical circulation elements, stairs and elevator, ends of the building wings, expansion joint near the building re-entrant corner, and at the bathrooms, are all treated as brick elements. There are brick treatments as well, at the main building entrance, on the first floor.

The brick walls are solid construction, consisting of 4" brick, 2" solid grout, 4" brick for a total thickness of 10". The structural section of this report discusses the effectiveness of these walls as shear walls.

Brick veneer or brick masonry cavity walls are probably the most effective in resisting moisture penetration.
Even though brick is a porous material and the outer wythe may be susceptible to wind driven rain penetration, the cavity is designed to collect and direct moisture down through the cavity to the bottom, where it is collected and diverted back to the exterior, through use of weep holes and through the wall flashings.

Solid walls like those at Snell Hall are more resistive to moisture than single wythe walls, but they depend on complete filling of all voids and cavities. Any cavities or air spaces allow the presence of moisture, resulting in leaking walls, reduction in the strength of the masonry, and contribute to efflorescence and spalling due to freezing and thawing. Water can enter a wall as rain driven by the wind, as condensation, or at joints with other materials. The roof and flashing has leaked over the years, failing at the top of the brick walls, allowing water to enter. When water gets into these walls it travels down the wall through voids in the grout and through porous masonry and mortar joints.

The brick walls display evidence of efflorescence on both the interior and exterior sides. In places the brick is spalling and experiencing structural failure. Wood framed canopies have been constructed at building entrance/exit points to protect people from falling pieces of spalled masonry.

An abandoned chimney has structural cracks near the chimney top.

**RECOMMENDATION**

Remove and cap the chimney at the roof level.

Research, test and develop repair solution for the damaged portions of the brick walls. Replace their shear wall function with new shear walls as described in the structural section. Match existing brick, mortar and blend, a difficult task.

**Curtain Wall**

McBride Architecture evaluated the curtain wall system in 1999. Much of the information gathered during that evaluation remains valid today except that deterioration and defects are more pronounced. Especially concerning are reports of structural failure where the
A curtain wall is a non load bearing independently supported outer wall that carries its own weight and is freely removable. Metal and glass react differently to environmental conditions but must be made to work together as an enclosure system to satisfy multiple functions including the control of forces such as gravity, wind, rain, snow, light, heat, cold, view, air, sound, security, privacy.

The curtain wall used on Snell Hall is by Fentron Industries, Inc., Seattle. Fentron has been out of business for approximately twenty years, and the stockpile of available replacement parts has been completely depleted in that time. They will be very difficult to acquire, unless custom made. In 1999, McBride Architecture conducted interviews with Curt Anderson, former Manager for Engineering Services, and Patrick Boucher, former engineer, for Fentron to obtain information about and to pursue possible solutions utilizing the existing system.

System Type 310, the system used at Snell Hall, was the most common system used by Fentron at the time. It is not a true curtain wall system but a modified window system adapted for use as a wall system. The system is based on an industrial steel window section transposed to aluminum.

Natural forces which can cause failure include water, wind, sunlight, temperature, gravity, lateral loads and building related forces.

**WATER**
The most common cause of problems with any enclosure is incursion of rain, snow, vapor or condensate. Wind driven moisture can gain entry through small openings, then travel inside the wall to appear far from the point of entry. Water vapor can penetrate microscopic holes and will condense on cool surfaces. Actual leaks are usually confined to joints and openings when they are not weather tight.

**WIND**
Wind loads are greater at corners and edges and
increase in effect depending on height. Wind contributes
to movement of the wall, affecting joint seals and wall
anchorage. Positive and negative wind pressures can
cause stress reversal on surfaces and cause water to
travel in any direction, including up. Wind is a major
factor in potential water leakage.

SUNLIGHT
Organic material such as pigments, gaskets, plastics
and sealants will break down when exposed to
ultraviolet radiation and ozone. Fading and failure of
these materials will affect both the appearance and
weather tightness of the wall. Shading devices and the
use of glare-reducing or high performance types of
glass should be considered in the development of any
curtain wall.

TEMPERATURE
Temperature changes are responsible for the thermal
movement of materials. It causes joints to open and
close and causes infiltration and exfiltration of air and
water infiltration. Heat passage through the wall results
in heat gain in hot weather and heat loss in cold
weather. Thermal insulation of opaque portions of wall
areas is important because these areas constitute a
large portion of the total Snell Hall curtain wall area.

GRAVITY
Gravity or the weight of the wall system is fixed and
static rather than variable and dynamic. Gravity can
cause deflections in horizontal members particularly
those carrying heavy loads such as glass. The weight
of the wall, however, is transferred to the building frame
at regular intervals and is not as critical as wind forces.
Larger gravity forces such as roof and floor loads act on
the building frame. As those forces can cause
deflection in the building frame, connections of the wall
to this frame must provide for enough movement to
insure that additional vertical loads are not imposed on
the wall.

LATERAL LOADS
Seismic forces can impose additional static and
dynamic loads on the building frame and the wall
producing both vertical and horizontal deflections in the
wall. Exterior cladding panels are required to be
anchored out-of-plane with a minimum of four connections for each wall panel. Glazing in curtain walls and individual panes over 16 square feet in area, located up to a height of 10 feet above an exterior walking surface, are required to have safety glazing. Such glazing located over 10 feet above an exterior walking surface shall be laminated annealed or laminated heat strengthened safety glass that will remain in the frame when the glass is cracked.

Design integrity considerations that affect curtain wall performance are structural integrity, weather tightness, provisions for movement, moisture control, thermal insulation, fire and smoke stops.

STRUCTURAL INTEGRITY
The industrial steel window section the system is based on is only 1-1/2 inches deep. This is insufficient to carry the loads imposed on the surface or to span from floor to floor. Fentron provided for the additional loads by adding 2 inch wide by 4-1/2 inch deep vertical mullions to carry the loads between the floors.

WEATHER TIGHTNESS
There are three basic approaches in curtain wall design to achieve weather tightness, including barrier design, internal drainage and pressure equalization. Pressure equalization is the most difficult and the most effective, but cannot be accomplished after the fact. Internal drainage systems are the most commonly used. They rely on mechanisms within the wall system that collect infiltration moisture and direct it harmlessly to the exterior. There is no system of weep holes or any other system to remove moisture once it has entered the system. A barrier design relies on exterior seals such as caulk and sealants to create 100% barrier against moisture. The sealants originally used at Snell Hall no longer perform at all. They have hardened, become brittle and failed. Attempts to repair this deficiency using a Belzona MR7 tape system have been made. Water has penetrated into the wall, either through failure in the tape, or at the top. It has been reported that the frame sections fill with and hold water during winter months. Rust is showing and working through the tape. In 1999, pin holes were observed in the tape. Attempts were made to test this repair by applying a Rilem tube to the
tape surface, but those tests were inconclusive.

PROVISION FOR MOVEMENT
The infusion of moisture either through infiltration or condensation depends on adequate provision for movement and is closely associated with proper joint design. To be successful, the wall must accommodate movement between the wall components and differential movements between the wall and building structure. Relative movements of the wall components are affected primarily by thermal movement of the wall elements and erection tolerances for them. Movement between wall components and the building structure are a direct function of the dead and live load deflections, the creep, elastic frame shortening, shrinkage, thermal, wind and seismic deformations of the structure.

Normally, a curtain wall system would be attached to the building at alternate floors with dead load or gravity anchors with attachment at intermediate floors by wind load anchors allowing for thermal movement. Because the building is only 60 feet tall and the floors are so close together, the designers elected instead to treat the wall as one piece and dead loaded it all to the structure at the base of the wall with dead load anchors. Wind load anchors with slotted connections to allow movement attach the wall to the building structure at each floor above the gravity anchor. Thermal expansion for aluminum is at the rate of 1/4 inch per 20 feet, so 3/4 inch movement would be required at the top of the wall. The shop drawings call for slotted holes in the wind anchors, but the holes were cut as slots on the edge of the anchor rather than inside. This has allowed some of the bolts to work their way to the edges, and, in some cases, out of the clips. Where the bolts have worked free or failed, the wall system is still tight to the building, because the attachment to either side appears to be holding, apparently with exceptions. There have been reports of anchor failures allowing the curtain wall system to become laterally detached from the building and deflect outward by inches. It has also allowed undesirable differential movement between the mullions causing the wall to appear uneven.

MOISTURE CONTROL
Condensation control is important because metal and
glass have low heat retention capabilities. There should have been a vapor barrier at the room side wall face and impervious surfaces within the wall should be insulated to keep them warmer than the dew point of the air contacting them.

THERMAL INSULATION
The porcelain enamel steel wall panels were originally supplied with 1-1/2 inch of fiberglass insulation with an R value of 6. There is no vapor barrier. There is little evidence that any of that material still exists. Gravity and moisture have compressed and dissipated most, if not all, of the insulation leaving an R value for the wall approaching 0.

The aluminum windows are single pane clear glass and have no thermal break. The window area is confined to about 9% of the building area, however, they do not meet the requirements of the current Energy Code.

The wall has little, if any, insulating value, and is susceptible to condensation and other forms of moisture intrusion. One former student reports that, “in the winter months, students would spray water on the walls to create a sheet of ice on the inside of the wall.” They used freezing water as a bulletin board system.

FIRE AND SMOKE STOPS
Prevention of the spread of fire and smoke by continuous fire stopping between the curtain wall and the edge of each floor slab is required. The only continuous stop provided is a 12 gauge metal plate at the floor used to bridge the 1" gap to the curtain wall. Safing material not subject to breakdown by fire was not installed.

RECOMMENDATION
Replace the entire curtain wall system with a new system meeting current design, code, SEED and other performance standards and requirements. Consider an integrated system that could provide for mechanical and electrical solutions and help solve other building problems.
STRUCTURAL SYSTEM

KPFF Consulting Engineers was retained to conduct a general structural evaluation of Snell Hall. ASCE 31-03, *Handbook of the Seismic Evaluation of Buildings*, issued in 2003, was used as the basis for the assessment of the building as it relates to seismic hazards. An ASCE 31 Tier 1 and 2 Seismic Evaluation was conducted.

The evaluation included limited field reconnaissance to observe the general physical status of the building and the site, and an assessment of significant structural deficiencies observed. No testing or demolition of finishes to expose the existing structural elements was conducted to determine their material properties.

Observations, analyses, and conclusions contained in this report reflect KPFF's best engineering judgment. Conclusions about the structural system are drawn from review of the existing building drawings, site observations of the structure made during a site visit on September 11, 2009, and experience with structures of similar construction. Concealed problems with the construction of the building may exist that cannot be revealed by this level of review.

Building Description

Snell Hall was constructed circa 1958 from structural drawings prepared by Stanley V. Carlson, P.E., for the architectural firm Burns, Bear, McNeil & Schneider. The structure consists of two seismically isolated five story segments oriented in an “L” shape with overall plan dimensions of 168 feet by 202 feet with approximately 11,900 square feet on each floor.

The building construction documents, dated March 12, 1958, give a comprehensive view of the building construction. Documents examined included Architectural drawings 1-25 and Structural drawings 101-107. According to the drawings, the building is constructed of 8 inch thick reinforced concrete lift slab floors, 8 inch x8 inch built-up steel support columns, and 10-inch thick reinforced brick walls. Concrete compressive strength is listed at 3,000 psi and the yield
reinforcing steel strength is listed at 60,000 psi. Brick compressive strength is assumed to be 1,500 psi. The drawings indicate poured concrete strip footings supporting the columns only and none for the perimeter walls. A 3-inch joint at the north end of the south wing separates the two portions of the building.

Figure 25 Typical L Shape Building Footprint

Site Reconnaissance

On September 11, 2009, a representative of KPFF made a site visit to review the condition of the existing structure. The primary objective of the visit was to become familiar with the building, determine the as-built conditions and observe the existing structural system where possible.

The following observations were made:

- In general, the building appears to be constructed as indicated on the structural drawings.
- The brick shear walls at the south and west stair towers of the building showed signs of spalling at isolated locations. The cause of the spalling appears to be related to moisture intrusion and not seismically created damage.
- There is significant efflorescence on the interior stair tower wall, which reduces in severity at lower levels.
There were no apparent diagonal cracks in the exposed portions of the existing brick walls.

**ASCE 31 Structural Evaluation**

The structural system consists of built-up steel columns, conventionally reinforced concrete lift slabs, and reinforced brick shear walls. The columns are founded on concrete combined strip footings. The reinforced brick walls have spread footings, but the perimeter non-bearing walls are supported on 8-inch grade beams. The reinforced brick walls, located at stairs and elevators and along one long side or rack wing, provide resistance to earthquake and wind forces.

For the purpose of American Society of Civil Engineers (ASCE) 31 evaluation, the construction is classified as building type RM2: Reinforced Masonry Bearing Walls With Stiff Diaphragms. The wall material is clay brick, not concrete masonry, but the existing system can be most accurately represented by using this building classification type.

The building structure’s lateral load resisting components were evaluated to determine their capacity to resist earthquake ground motion. The general structural seismic evaluation was performed using the criteria of ASCE 31, *Handbook for the Seismic Evaluation of Buildings*.

ASCE 31 uses a three-tiered method to evaluate an existing building (for this project, only Tiers 1 and 2 were used) as defined in the original scope of work:

**Tier 1 - Screening Phase** includes completing checklists for the structure, geologic site hazards and foundations, and nonstructural items. During this phase, a review is performed of any available construction documents. A site visit is made to observe the building for any indications of deterioration of the structure and finishes, and to compare the as-built information with the construction documents.

**Tier 2 - Evaluation Phase** includes analysis of the non-compliant elements from Tier 1, utilizing a simplified static analysis approach.
Tier 3 - Detailed Evaluation Phase consists of a non-linear analysis of non-compliant Tier 2 items and is not appropriate for this report.

KPFF evaluated the building using both the Tier 1 Life Safety Performance Level screening phase and Tier 2 Evaluation phase outlined by ASCE 31. A Tier 3 evaluation was beyond the scope of this project. For a building complying with the Life Safety Performance Level, its expected performance will include damage to both structural and nonstructural components during a design earthquake, such that, (a) at least some margin against either partial or total structural collapse remains, and (b) injuries may occur, but the overall risk of life-threatening injury as a result of structural damage is expected to be low.

In this document, the base shear, or the total seismic force on the building, is calculated by a prescribed formula accounting for geographic seismicity, the type of building structure, its stiffness, and its overall mass. The base shear is distributed to each story based on a weighted proportion of the floor’s mass and height above the ground. For the purpose of this report, the structural elements are analyzed by distributing the shear equally over the shear wall area at each floor neglecting the relative stiffness of individual walls.

The demand on each structural component is compared to the capacity of that element. For a given structural element, a demand-capacity ratio (DCR) is the demand (D) divided by the capacity (C) of the existing element, and is a relative measure of how much is required of the structure in its current condition. A DCR of 1.0 means the demand is equal to the capacity of that element. A DCR of more than one means the structure is required to resist more than its capacity. For example, a DCR of 2.0 means the element is required to resist a force twice its existing strength. A DCR of less than one means the structure has reserve capacity. DCR's for the existing brick walls range from $1.36$ to $4.21$ at the base.

The level of seismicity is determined per ASCE 31, Section 2.5, as follows:
From the USGS Seismic Hazard Curves and Uniform Response Spectra, the short period spectral response acceleration ($S_s$) and 1-second period spectral response acceleration ($S_1$) parameters are:

$$S_s = 0.815g$$
$$S_1 = 0.401g$$

Because there is limited information about the in situ geological conditions, the site class was assumed to be “D” per the 2007 Oregon Structural Specialty Code (OSSC). Based on a Class D site classification, Site Coefficients $F_a$ and $F_v$ were found to be:

$$F_a = 1.174g$$
$$F_v = 1.599g$$

Spectral response acceleration parameters define the level of seismicity of a site as low, moderate, or high. The acceleration parameters are determined as below and the resulting product classifies the level of seismicity:

$$SDS = 0.67F_a S_s = 0.638g > 0.500g = \text{High Seismicity}$$
$$SD1 = 0.67F_v S_1 = 0.427g > 0.200g = \text{High Seismicity}$$

Both SDS and SD1 indicate that this building is located in a high seismicity region.

**Required Checklists**

The following evaluation is based on checklists selected considering the building is located in a region of high seismicity and utilizing the Life Safety Performance Level. A Tier 1 evaluation is a screening phase used to identify a building’s possible structural deficiencies. As such, the Tier 1 checklists are compliant/non-compliant. An item fails if it does not meet an ASCE 31 criterion and is rated as noncompliant, even if it is just slightly nonconforming. The Tier 1 evaluation also serves to focus the attentions of a Tier 2 review. A Tier 2 evaluation determines the degree of deficiency, or may reverse a finding of a Tier 1 study.

For this building, six checklists were used for the Tier 1 evaluation as required by ASCE 31:
Basic Structural (Sec. 3.7)  
Supplemental Structural (Sec. 3.7)  
Geologic Site Hazard and Foundation (Sec. 3.8)  
Basic Nonstructural (Sec. 3.9.1)  
Intermediate Nonstructural (Sec. 3.9.2)  
Supplemental Nonstructural (Sec. 3.9.2)

The six required checklists completed for this building may be found on pages 8 through 26 in the ASCE 31 Evaluation located in the Appendix.

Life-Safety Deficiencies and Recommendations

The deficiencies noted below are based on the Life Safety Performance Level and are organized by the appropriate checklist. Those items noted with the (NC) designation indicate deficiencies that can be considered as potential life safety risks. Those items noted with the (U) designation indicate areas where not enough information was available to determine whether that item was acceptable or deficient.

BASIC STRUCTURAL CHECKLIST:

- **Torsion (NC):** The estimated distance between the story center of mass and the story center of rigidity is more than 20 percent of the building width.  
  **Recommendation:** The addition of new concrete walls located symmetrically throughout the structure would ensure that this torsional effect does not occur.

- **Masonry Units (NC):** There shall be no visible deterioration of masonry units.  
  **Recommendation:** Following rehabilitation, which includes new concrete walls, existing brick walls will not be relied on to provide any earthquake or wind resistance.

- **Shear Stress Check (NC):** The shear stress in the reinforced brick shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. DCR’s range from 1.36 to 4.21 at the base.  
  **Recommendation:** Following rehabilitation, which includes new concrete walls, existing brick walls will
not be relied on to provide any earthquake or wind resistance.

GEOLOGIC SITE HAZARDS AND FOUNDATIONS:

- Liquefaction (U): Geotechnical documents were not made available to determine if the site soils are susceptible to liquefaction. 
  Recommendation: Availability/review of existing geotechnical documentation would verify the risk of liquefaction. Based on experience with other campus projects, we do not anticipate this is an issue.

BASIC NONSTRUCTURAL COMPONENT CHECKLIST:

- Panel Connections (U): Exterior cladding panels shall be anchored out-of-plane with a minimum of four connections for each wall panel. 
  Recommendation: Verify existing conditions and provide additional cladding panel anchors to meet this connection criteria as required.

- Attached Equipment (U): Equipment weighing over 20 pounds that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be braced. 
  Recommendation: Verify existing conditions and provide bracing to meet this connection criteria as required.

- Fire Suppression Piping (NC): Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996). 
  Recommendation: Verify existing conditions and provide bracing to meet this connection criteria as required.

- Flexible Couplings (U): Fluid, gas and fire suppression piping shall have flexible couplings. 
  Recommendation: Verify existing conditions and replace rigid couplings as required.

SUPPLEMENTAL NONSTRUCTURAL COMPONENT CHECKLIST:

- Glazing (NC): All exterior glazing shall be laminated, annealed or laminated heat-strengthened safety
glass or other glazing system that will remain in frame when glass is cracked.  
**Recommendation:** Verify existing conditions and replace glass or cladding system as required.

- **Partition Tops:** The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet.  
  **Recommendation:** Verify existing conditions and provide lateral bracing as required.

- **Lens Covers:** Lens covers on light fixtures shall be attached or supplied with safety devices.  
  **Recommendation:** Verify existing conditions and provide safety devices as required.

- **File Cabinets (NC):** File cabinets arranged in groups shall be attached to one another.  
  **Recommendation:** Verify existing conditions and provide positive attachment between cabinets as required.

- **Cabinet Doors and Drawers (NC):** Cabinet doors and drawers shall have latches to keep them closed during an earthquake.  
  **Recommendation:** Verify existing conditions and provide latches as required.

- **Heavy Equipment (NC):** Equipment weighing over 100 pounds shall be anchored to the structure or foundation.  
  **Recommendation:** Verify existing conditions and provide anchorage as required.

- **Electrical Equipment (NC):** Electrical equipment and associated wiring shall be laterally braced to the structural system.  
  **Recommendation:** Verify existing conditions and provide lateral bracing as required.

- **Doors (U):** Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01.  
  **Recommendation:** Additional analysis required to determine likely drift demands and adequacy of existing mechanically operated doors.
• Fluid and Gas Piping (NC): Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping.  
  Recommendation: Verify existing conditions and provide bracing as required.

• Shut-off Valves (U): Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure.  
  Recommendation: Verify existing conditions and provide automatic shut-off valves as required.

• C-Clamps (NC): One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained.  
  Recommendation: Verify existing conditions and provide C-clamp restraints as required.

INTERMEDIATE NONSTRUCTURAL COMPONENT CHECKLIST:

• Glazing (NC): Glazing in curtain walls and individual panes over 16 square feet in area, located up to a height of 10 feet above an exterior walking surface, shall have safety glazing. Such glazing located over 10 feet above an exterior walking surface shall be laminated annealed or laminated heat strengthened safety glass that will remain in the frame when glass is cracked.  
  Recommendation: Verify existing conditions and replace glass or cladding system as required.

• Vibration Isolators (U): Equipment mounted on vibration isolators shall be equipped with restraints or snubbers.  
  Recommendation: Verify existing conditions and provide restraints as required.

Seismic Rehabilitation Scheme

KPFF believes the Snell Hall structural system to be inadequate to resist seismic loads prescribed by the Life Safety Performance Level of ASCE 31. The reinforced brick shear walls and their footings are not adequate to resist the anticipated shear and overturning forces.
respectively. This will affect the approach the owner and architect takes in remodeling and occupying the building. Following is a preliminary scheme by which the structure could be rehabilitated to meet Life Safety Performance Level criteria. Reference layout sheet 101 (page 29) in the ASCE 31 Evaluation located in the Appendix for additional information.

In the locations where reinforced brick walls currently exist, new 12” reinforced shotcrete shear walls could be provided on the interior face of these walls, with positive attachment to the concrete lifts slabs being made throughout. In several other locations, new 12” reinforced concrete shear walls must be provided, which will impact the existing room layouts and window areas. At the ends of the new shear walls 9” diameter drilled and grouted pin piles will be required to resist overturning loads carried by these shear walls. Depth and actual quantity of the piles is to be determined by a geotechnical engineer. For the purpose of the report, we recommend assuming four (4) pin piles at each end of each new wall. Piles are to be topped with monolithically poured pile caps that will need to occur below existing footings and positive attachment to the existing foundation required. Demolition work required to install these elements would be extensive.

In addition, numerous nonstructural elements such as piping, mechanical and electrical equipment will require seismic restraint and bracing, and existing glazing and cladding panels will likely have to be replaced in most locations.

This scheme will require a thorough analysis beyond this ASCE 31 evaluation, including concrete testing and steel reinforcement locating, to determine the final details for strengthening. The solutions offered in this report are intended for estimating purposes only and are subject to change following actual design calculations.

Conclusions

The reinforced brick shear walls are the primary lateral force resisting structural elements used to resist wind and earthquake forces. The shear walls are continuous from the basement to the roof, with reinforcing steel
clearly indicated on the drawings. The brick compressive strength in the walls was assumed to be 1500 psi, which will need to be confirmed with testing. The brick shear wall thickness is 10 inches in all locations. Because the dead and lateral loading of this building are quite large and the lateral capacity of the walls is low, none of the walls come close to meeting the “Quick Check” of average shearing stress prescribed in ASCE 31.

Due to potential building drift, some localized damage may occur at the junction between the east/west interface of the two Snell Hall segments during a major earthquake, as well as between the dining area building and office building found adjacent to Snell Hall that were built following its construction.

The proposed rehabilitation scheme will require a total of eight (8) new reinforced concrete walls, approximately four (4) new pin piles per wall end, seismic restraint of MEP equipment, and replacement of glazing or cladding systems that do not meet required safety criteria.

**BUILDING CODE**

The 2007 Oregon Structural Specialty Code (The International Building Code) was used to evaluate the building for code compliance. Building area is within allowable limits. The building as it exists exceeds the allowable number of stories by one floor. The addition of fire sprinklers would allow for a one story increase. The following is a summary of the code evaluation:

The existing building is classified as a Business Group B Occupancy. The construction type appears to be Type IIB or upgradable to IIA. Allowable building heights and areas based on occupancy and construction type are:

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<tr>
<th>OCC</th>
<th>TYPE</th>
<th>STORY</th>
<th>AREA</th>
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<tr>
<td>B</td>
<td>IIA</td>
<td>5</td>
<td>187,500 SF</td>
</tr>
<tr>
<td>B</td>
<td>IIB</td>
<td>4</td>
<td>92,000 SF</td>
</tr>
</tbody>
</table>
The existing building areas are:  
Group B Occupancy, Business: 67,215 SF  
TOTAL: 67,215 SF

Snell Hall is open to the 1976 addition which would substantially increase its floor area but not exceed allowable limits.

A number of code deficiencies exist in this building. Many are mentioned in other sections of this report.

LEED

The Design Team recommends pursuing LEED for New Construction since the option for a renovation project encompasses so much new construction. The project would consist of following the LEED NC process and commissioning. The LEED process affects all building systems and processes of planning, design, construction and building operation.

SEED

New and significantly remodeled State of Oregon buildings are required to exceed Energy Code minimum requirements by 20%. Architectural, Mechanical and Electrical systems are all impacted by this set of requirements.

MECHANICAL SYSTEMS

HVAC Systems

DESCRIPTION:
In most of the Snell Hall Tower building, the original steam convector heating and operable window ventilation system is in use. A partial ground floor, on the east side of the building, has a ducted forced air heating and ventilation system. No air conditioning was originally provided, however most of the offices are now provided with small individual window packaged type...
(window shaker) air conditioners. In a few areas, small fan coil air conditioning systems were provided as part of the 1976 addition. Additionally, after the 1976 addition, heating ventilation and air conditioning is provided to a portion of the first floor of the tower using a medium pressure dual duct system.

The heating source is medium pressure (60 psi) steam from the Central Plant. Medium pressure steam is piped to the Dining facility building, reduced in pressure, and then piped to the tower mechanical room for distribution throughout the building. All the convactor units and heating coils in the building use low pressure steam directly.

Ventilation for most of the building is via operable windows. No direct ventilation is provided to interior hallways or corridors. Two central fan systems exhaust air from the restroom cores in each wing.

With construction of the Addition in 1976, 205 gallons per minute (GPM) of chilled water from the Valley Library chiller plant was piped to the Addition, the Dining facility, and the Tower building. Of the total flow rate, only 26 GPM is allocated to the Tower building. The chilled water plant in the Valley Library has had recent upgrades, however, the piping system from the Library to the building is the original from 1976.
General Condition
The steam piping infrastructure and heating terminal devices that serve most of the building are currently over 50 years old. From the drawings it appears that no major upgrades or replacement has been performed. A system of this age is normally considered beyond normal economic service life. The system is most likely very maintenance intensive to keep in operation. Steam systems of this age are notoriously difficult to operate efficiently due to the intensive maintenance required for hundreds of steam traps and the erosion of the condensate return system.

The fan coil air conditioners, and central system installed with the 1976 addition are now approximately 33 years old which is normally considered beyond the economic service life.

The campus steam supply to the building is reportedly in good condition and has ample capacity.

The condition of the chilled water piping for the Dining Facility, Addition and the Tower building is fair but the current pipe size (4-inches diameter) severely restricts adding air conditioning (via chilled water) to other areas of the Tower building.
CODE ISSUES:
The current air conditioning system (Individual window units) is not compliant with the current State Energy Code requirements for new construction or major system upgrades.

Corridors are not ventilated in accordance with the current Oregon Mechanical Code for an office building.

Chilled water fan coils units do not comply with the State Energy Code requirements for economizer cooling for equipment with mechanical cooling.

No mechanical ventilation exists in most of the building. Where ventilation is provided by operable windows, the current Building Code requires that the operable section of the window be at least 4% of the floor area in each space. Individual spaces were not verified during the site visit. Modifications to windows or interior partitions need to maintain the 4% requirement.

The elevator shaft does not have a building code required 3 square foot smoke vent to the outside at the top of the shaft.

RECOMMENDATIONS:
Recommendations assume that this building is to be upgraded to current comfort and energy efficiency standards.

The current heating and ventilation system does not meet the normal standard of comfort and control expected for a modern office or academic building. Replacement of the existing system with "like", is not recommended. Additionally, replacement with a similar system will have difficulty complying with the State Energy Efficiency Design (SEED) Program requirement of using 20% less energy than a "Code" building.

A replacement system should include mechanical ventilation and mechanical cooling.

A replacement system should use a hydronic heating for building distribution instead of steam. Campus steam will be used to heat the water.
Provide additional chilled water plant capacity (Approximately 200 tons). This could be either a new plant at the or close to the building or an expansion of the Valley Library plant and replacement of the existing 4-inch diameter distribution piping with 6-inch diameter piping.

Plumbing Systems

DESCRIPTION:
A 3" domestic cold water service is provided to the building through the ground floor mechanical room. Reduced Pressure Backflow prevention is provided to protect the campus supply. The cold water is then piped to the hot water generator or distributed throughout the building to the plumbing fixtures.

Hot water is generated in a steam to hot water generator located in the ground floor mechanical room. Hot water is then distributed throughout the building the plumbing fixtures.

Gas service to the building has been added in approximately 1976 to serve the craft center and a fire place in the dining facility.

GENERAL CONDITION:
Piping: The majority of the original hot and cold water piping infrastructure was replaced in 1988 and appears to be in good condition.

Hot Water Heater: The original storage tank/steam heat exchanger was replaced with a steam hot water generator in 1988 and appears to be in good condition.

Plumbing fixtures appear to be in fair condition but are visually dated.

CODE ISSUES:
None noted.

RECOMMENDATIONS:
Recommendations assume that this building is to be upgraded to current comfort and energy efficiency standards.
Replace existing plumbing fixtures with new low flow dual flush fixtures to improve water use efficiency.

Fire Protection Systems

DESCRIPTION:
None installed.

GENERAL CONDITION:
N/A

CODE ISSUES:
New construction would require that a building of this type be fire protected with a full coverage sprinkler system.

RECOMMENDATIONS:
Recommendations assume that this building is to be upgraded to current comfort and energy efficiency standards.

Install a full coverage sprinkler system.

ELECTRICAL SYSTEMS

SEED and LEED programs will impact electrical systems.

Service

DESCRIPTION:
Snell Hall service voltage is 208Y/120V. It has its original service panel from 1958. The 1958 500kVA transformer was replaced with a 1000kVA transformer in 1976 to accommodate the Television Studio and related air conditioning. The equipment (Snell Hall panel enclosures and circuit breakers) appear original with no modifications except for the change in service capacity.

GENERAL CONDITIONS:
The equipment has been kept clean with exception to dust build up. OSU Facilities Staff did indicate the room had flooded on one occasion, but the equipment checked out and no issues of failure or pending failure were noted.
CODE ISSUES: None noted.

RECOMMENDATIONS:
Electrical distribution equipment of this age is normally recommended to be replaced. An alternate to full replacement is replace the circuit breakers and have the equipment structure (bus work and enclosure) inspected and tested for secure bus terminations, adequate bracing for the current available fault and check the bus insulators.

Distribution

DESCRIPTION:
The distribution equipment in Snell Hall is original from 1958; manufacturer is FEMCO. The original building (1958) sub distribution panel is located on ground floor. Each floor has three branch panels, one in each wing and one in the Northeast corner. In 1976 a new sub distribution panel was provided adjacent to the original sub distribution panel. Feeders from the new sub distribution panel were added to re feed two risers serving floors 3, 4 & 5, providing additional capacity for new office loads.

GENERAL CONDITIONS:
The equipment has been kept clean with exception to dust build up.

CODE ISSUES:
The building has some panels located within stairwells and feeders within stairs that are not to support the stair system.

RECOMMENDATIONS: (same status as service)
Electrical distribution equipment of this age (1958) is normally recommended to be replaced. An alternate to full replacement is replace the circuit breakers and have the equipment structure (bus work and enclosure) inspected and tested for secure bus terminations, adequate bracing for the current available fault and check the bus insulators. The 1976 equipment is relatively newer, but should be inspected and tested as well.
Feeders should be tested (megger) to confirm insulation is in good condition. Feeder terminations should be IR scanned to confirm terminations not under thermal stress.

Remove the panels and feeders from the stairs.

Provide additional branch panels to support the office loads.

Grounding

DESCRIPTION:
Existing 1958 documents do not indicate any ground conductors provided in the feeders or branch circuits. In 1976 grounding conductors were added to feeders and branch circuits feeding Broadcast Areas. System grounding electrodes were not observed.

GENERAL CONDITIONS:
Grounding electrodes, bonding of the water, gas and structure were not observed.

CODE ISSUES:
Grounding provisions should be checked. Grounding electrode conductor sizes need to be verified.

RECOMMENDATIONS:
Verify grounding electrodes and their ground to earth resistance. Verify grounding electrode and grounding electrode conductors as noted. Provide grounding conductors in existing feeders and branch circuits.

Lighting

DESCRIPTION:
Building Exterior: Site lighting consists of Campus standard post top luminaire. Building exterior mounted luminaries consist of original wall mounted incandescent luminaires, HID flood sources in wall packs and under canopy surface mounted styles with yellowing polycarbonate lenses.
Control: Not verified Typical campus control is PE cell with Time Clock, located within nearest building or by building mounted photo cells.
Building Interior: Building interior lighting systems vary. The original residence hall incandescent luminaires have been replaced with fluorescent. The building has linear fluorescent luminaires (mountings: recessed, surface, suspended), and track lighting with MR 16 lamps. Fluorescent lamps are a mix of T12 and T8. Control is provided by manual switches with no auto-control.

CODE ISSUES:
Not sufficient illumination at the elevator stops.

RECOMMENDATIONS:
Replace all T12 luminaires with luminaires with T8 technology.
Provide occupancy sensors for the offices areas and restrooms.
Provide additional lighting at the elevator stops.
Replace all existing 1958 luminaires still in use.

Life Safety

DESCRIPTION:
Snell Hall does not have an emergency power system. The building does have a panel (Panel “E”) that is dedicated to serve Path-of-Egress (POE) and exit lights. The emergency branch wiring is kept separate from the normal lighting circuits in the building. In addition to the 1958 emergency lighting system, some of the exit signs have battery packs with sealed beam lights attached.

GENERAL CONDITIONS/CODE ISSUES:
The spacing of POE lighting will not provide sufficient illumination to meet POE requirements. POE lighting is required to be on emergency power source for areas requiring two or more exits. Spacing of existing POE luminaires will not provide required 1FC of illumination.

RECOMMENDATIONS:
Provide a new emergency power source (emergency generator or central battery inverter) to feed Panel “E”. Connect additional luminaires and add new luminaires in the POE areas (corridors, stairs, exit discharge).
**Tel/Data**

**DESCRIPTION:**
The main telcom room is a closet in a ceramics (pottery) class room. The space is especially dusty with the clay use. Telcom cabling is routed within raceway and open cabling attached to conduits.

**GENERAL CONDITIONS:**
The telcom pathway system appears stretched in serving the work stations. A proper MDF or TR rooms do not exist. A lot of abandoned cabling exists.

**RECOMMENDATIONS:**
Provide EIA/TIA approved TR rooms. Remove all unused cabling and termination blocks. Provide raceways for exposed cabling, or proper training method.

**Fire Alarm**

**DESCRIPTION:**
The Fire Alarm system consists of an old Simplex Zoned system. Dialer is a Silent Knight unit.

**GENERAL CONDITIONS:**
System is outdated. No visible notification (strobes) were observed. No fire alarm devices were observed for the elevator system.

**CODE ISSUES:**
Building is missing proper Alarm Notification. Elevator needs fire alarm devices and inner-tie.

**RECOMMENDATIONS:**
Provide new addressable Fire Alarm system with detection at elevator, shut down intertie, and notification device throughout the facility.
IV. REDEVELOPMENT OPTIONS

Two redevelopment options have been considered. Redevelopment Option 1 involves system upgrades, remodeling, renovation and building envelope additions to Snell Hall Tower. Redevelopment Option 2 involves replacing the existing Snell Hall Tower with a new office building of similar gross floor area.

REDEVELOPMENT OPTION 1

Program

INFRASTRUCTURE IMPROVEMENTS
- Street and curb improvements
- Frontage improvements
- Utility improvements
- Bike paths and shelters
- Bus and shuttle shelters and stops
- Sidewalk & pedestrian upgrades
- Pavement upgrades
- ADA compliant pedestrian ways
- Street lighting
- Street markings
- Accessible parking

SITE IMPROVEMENTS...........................................35,960 SF
- Landscaping
- Irrigation
- Excavation & backfill, new footings
- Two new accessible public entrances
- Storm drainage system
- Site lighting

EXISTING BUILDING RENOVATION & REMODELING
Design

Existing Gross Building Area: .........................67,215 SF
Additions: .....................................................10,000 SF

Construction work required to renovate, remodel and add to the existing building would be extensive. The building would need to be vacated and Snell Hall services would be provided at temporary facilities or at another location.
Redevelopment of Snell Hall would involve implementing the recommendations outlined in this report summarized as follows:

- Provide selective demolition as required to replace curtain wall systems, add shear walls, replace mechanical and electrical systems, reroof, and remodel the building.
- Provide eight new shear walls integrated with the architecture, locations to be determined, with brick cladding where exposed.
- Add approximately three feet to the exterior of the building designed to accommodate new windows/curtain wall systems, solar control, and mechanical systems.
- Replace the roof and consider mechanical systems.
- Renovate or replace the elevator.
- Completely remodel the building to accommodate its program and to address the deficiencies outlined in this report.

**Budget**

The 2010 order of magnitude total project cost estimate for the Option 1 programmed site improvements, renovation, remodeling and additions is:

- DIRECT CONSTRUCTION COST (DC)...........$ 12,600,000
- INDIRECT CONSTRUCTION COST (IDC) 50% (DC).....................................................$ 6,300,000

- Furnishings and Equipment
- Site Environmental Clean-up
- Hazardous Material Abatement
- Infrastructure Development (in DC)
- A & E Fees
- Building Commissioning
- Permits & Systems Development Charges
- 1% of DC for Art
- Temporary Facilities and Moving
- University Project Management, Inspection, Printing
- Survey and Geotechnical Report
- Special Inspection and Construction Testing
SUBTOTAL.................................................$ 18,900,000

15% PROJECT CONTINGENCY                 $  2,900,000

TOTAL PROJECT COST............................$21,800,000

COST PER SQUARE FOOT..............................$282/SF

REDEVELOPMENT OPTION 2

Program

INFRASTRUCTURE IMPROVEMENTS
- Street and curb improvements
- Frontage improvements
- Utility improvements
- Bike paths and shelters
- Bus and shuttle shelters and stops
- Sidewalk & pedestrian upgrades
- Pavement upgrades
- ADA compliant pedestrian ways
- Street lighting
- Street markings
- Accessible parking

SITE IMPROVEMENTS
- Landscaping and tree replacement
- Irrigation
- Three new accessible public entrances
- Storm drainage system
- Environmental clean up
- Demolition of existing structures
- Excavation, site preparation, grading
- Site lighting
- Site security system
- Covered public access to rented vehicles

REPLACE THE EXISTING SNELL HALL TOWER AND WALDO PLACE ENTRANCE BUILDINGS WITH A NEW OCCUPANCY OFFICE TYPE BUILDING
Design

Gross Building Area: ........................................ 80,000 SF

Demolition of the 3,258 square foot Waldo Place Entrance is included in this option. Removal of this building would create a useable and functional site for a new office building. This addition is relatively minor and
was designed to specifically integrate with existing Snell Hall.

Construction work required to demolish the existing building and replace it with a new building would be extensive. Snell Hall services would be provided at temporary facilities or at another location.

A new building would be designed and constructed in accordance with OSU design standards and the Campus Master Plan. It would be of non combustible concrete and steel construction and incorporate brick, window/curtain wall elements and details consistent with other buildings on campus.

Budget

The 2010 order of magnitude total project cost estimate for the Option 2 programmed Snell Hall demolition and new building is:

DIRECT CONSTRUCTION COST (DC)......$15,070,000

INDIRECT CONSTRUCTION COST (IDC)
50% (DC)......................................................$  7,535,000

- Furnishings and Equipment
- Site Environmental Clean-up
- Hazardous Material Abatement
- Infrastructure Development (in DC)
- Programming
- A & E Fees
- Building Commissioning
- Permits & Systems Development Charges
- 1% of DC for Art
- Temporary Facilities and Moving
- University Project Management, Inspection, Printing
- Survey and Geotechnical Report
- Special Inspection and Construction Testing

SUBTOTAL..................................................$22,605,000

10% PROJECT CONTINGENCY               $   2,260,000

TOTAL PROJECT COST............................$24,865,000

COST PER SQUARE FOOT..............................$311/SF
V. APPENDIX

- Structural Report - KPFF
- Mechanical Report - PAE
- Electrical Report - PAE
- Cost Estimates - DMC
OSU SNELL HALL TOWER

MECHANICAL AND ELECTRICAL FEASIBILITY STUDY

October 27, 2009

PAE CONSULTING ENGINEERS, INC.
808 SW Third Avenue, Suite 300
Portland, Oregon 97204
(503) 226-2921
I. MECHANICAL

1. HVAC Systems

Description:
The Snell Hall Tower is a five story building (with partial ground floor) located on Jefferson Way on the main campus of Oregon State University. It was originally designed and built in 1958 as a dormitory building but currently the main use is as an office building. The tower is connected to a Dining facility on the south, built at the same time, and a one story Addition on the west side built in 1976.

In most of the Tower building, the original steam convector heating and operable window ventilation system is in use. A partial ground floor, on the east side of the building, has a ducted forced air heating and ventilation system. No air conditioning was originally provided, however most of the offices are now provided with small individual window packaged type (window shaker) air conditioner. In a few areas, small fan coil air conditioning systems has been provided during the 1976 addition. Additionally, after the 1976 Addition, heating ventilation and air conditioning is provided to a portion of the first floor of the tower using a medium pressure dual duct system.

The heating source is medium pressure (60 psi) steam from the Central Plant. Medium pressure steam is piped to the Dining facility building, reduced in pressure, and then piped to the tower mechanical room for distribution throughout the building. All the convector units and heating coils in the building use low pressure steam directly.

Ventilation for most of the building is via operable windows. No direct ventilation is provided to interior hallways or corridors. Two central fan systems exhaust air from the restroom cores in each wing.

With construction of the Addition in 1976, 205 gallons per minute (GPM) of chilled water from the Valley Library chiller plant was piped to the Addition, the Dining facility, and the Tower building. Of the total flow rate, only 26 GPM allocated to the Tower building. The chilled water plant in the Valley Library has had recent upgrades, however, the piping system from the Library to the building is the original from 1976.

General Condition:
The steam piping infrastructure and heating terminal devices that serve most of the building are currently over 50 years old. From the drawings it appears that no major upgrades or replacement has been performed. A system of this age is normally considered beyond normal economic service life. The system is most likely very maintenance intensive to keep in operation. Steam systems of this age are notoriously difficult to operate efficiently due to the intensive maintenance required for hundreds of steam traps and the erosion of the condensate return system.

The fan coil air conditioners, and central system installed with the 1976 addition are now approximately 33 years old which is normally considered beyond the economic service life.
The campus steam supply to the building is reportedly in good condition and has ample capacity.

The condition of the chilled water piping for the Dining Facility, Addition and the Tower building is fair but the current pipe size (4-inches diameter) severely restricts adding air conditioning (via chilled water) to other areas of the Tower building.

West Wing – Typical Window Air Conditioners and Operable Window Ventilation
Typical Office - Steam Convector Heating

Mechanical Room – Steam Supply Header

Mechanical Room – Condensate Return Header
Code Issues:

1. Current air conditioning system (Individual window units) is not compliant with the current State Energy Code requirements for new construction or major system upgrades.

2. Corridors are not ventilated in accordance with the current Oregon Mechanical Code for an office building.

3. Chilled water fan coils units do not comply with the State Energy Code requirements for economizer cooling for equipment with mechanical cooling.

4. No mechanical ventilation in most of the building. The current Building Code, ventilation by operable windows requires that the operable section of the window be at least 4% of the floor area in each space. Individual spaces were not verified during the site visit. Modifications to windows or interior partitions need maintain the 4% requirement.

5. Building Code: Elevator shaft does not have a (3 square foot) smoke vent to the outside at the top of the shaft.

Recommendations:

Recommendations assume that this building is to be upgraded to current comfort and energy efficiency standards.

1. The current heating and ventilation system does not meet the normal standard of comfort and control expected for a modern office or academic building. Replacement of the existing system with “like”, is not recommended. Additionally, replacement with a similar system will have difficulty complying with the State Energy Efficiency Design (SEED) Program requirement of using 20% less energy than a “Code” building.

2. A replacement system should include mechanical ventilation and mechanical cooling.

3. A replacement system should use a hydronic heating for building distribution instead of steam. Campus steam will be used to heat the water.

4. Provide additional chilled water plant capacity (Approximately 200 tons). This could be either a new plant at the or close to the building or an expansion of the Valley Library plant and replacement of the existing 4-inch diameter distribution piping with 6-inch diameter piping.

2. Plumbing Systems

Description:
A 3” domestic cold water service is provided to the building through the ground floor mechanical room. Reduced Pressure Backflow prevention is provided to protect the campus supply. The cold water is then piped to the hot water generator or distributed throughout the building to the plumbing fixtures.
Hot water is generated in a steam to hot water generator located in the ground floor mechanical room. Hot water is then distributed throughout the building the plumbing fixtures.

Gas service to the building has been added in approximately 1976 to serve the craft center and a fire place in the dining facility.

**General Condition:**

Piping: The majority of the original hot and cold water piping infrastructure was replaced in 1988 and appears to be in good condition.

Hot Water Heater: The original storage tank/steam heat exchanger was replaced with a steam hot water generator in 1988 and appears to be in good condition.

Plumbing fixtures appear to be in fair condition but are visually dated.
Typical Restroom – Fixtures
Code Issues:
1. None noted.

Recommendations:
Recommendations assume that this building is to be upgraded to current comfort and energy efficiency standards.
1. Replace existing plumbing fixtures with modern, low flow, dual flush to improve water use efficiency.

3. Fire Protection Systems

Description:
None installed

General Condition:
N/A

Code Issues:
1. New construction would require that a building of this type be fire protected with a full coverage sprinkler system.

Recommendations:
1. Recommendations assume that this building is to be upgraded to current comfort and energy efficiency standards.
2. Install a full coverage sprinkler system.
II. ELECTRICAL

1. Service
   a. Description: Snell Hall service voltage is 208Y/120V. It has its original service panel from 1958. The 1958 500kVA transformer was replaced with a 1000kVA transformer in 1976 to accommodate the Television Studio and related airconditioning. The equipment (Snell Hall panel enclosures and circuit breakers) appear original. No modifications except for the change in service capacity.

   b. General Conditions: The equipment has been kept clean with exception to dust build up. OSU Facilities Staff did indicate the room had flooded on one occasion, but the equipment checked out and no issues of failure or pending failure were noted.

   c. Code Issues: None noted.

   d. Recommendations: Electrical distribution equipment of this age is normally recommended to be replaced. An alternate to full replacement is replace the circuit breakers and have the equipment structure (bus work and enclosure) inspected and tested for secure bus terminations, adequate bracing for the current available fault and check the bus insulators.
2. **Distribution**

   a. **Description:**
      The distribution equipment in Snell Hall is original from 1958, manufacture is FEMCO. The original building (1958) sub distribution panel is located on ground floor. Each floor has three branch panels, one in each wing and one in the Northeast corner. In 1976 a new sub distribution panel was provided adjacent to the original sub distribution panel. Feeders from the new sub distribution panel were added to re feed two risers serving floors 3, 4 & 5, providing additional capacity for new office loads.

   b. **General Conditions:**
      The equipment has been kept clean with exception to dust build up.

   ![DISTRIBUTION PANEL](image)

   c. **Code Issues:** The building has some panels located within stairwells and feeders within stairs that are not to support the stair system.
d. **Recommendations:** (same status as service)

Electrical distribution equipment of this age (1958) is normally recommended to be replaced. An alternate to full replacement is replace the circuit breakers and have the equipment structure (bus work and enclosure) inspected and tested for secure bus terminations, adequate bracing for the current available fault and check the bus insulators. The 1976 equipment relatively newer, but should be inspected and tested as well.

Feeders should be tested (megger) to confirm insulation is in good condition. Feeder terminations should be IR scanned to confirm terminations not under thermal stress.

Remove the panels and feeders from the stairs.

Provide additional branch panels to support the office loads.

3. **Grounding**
   a. **Description:**

   Existing 1958 documents do not indicate any ground conductors provided in the feeders or branch circuits. In 1976 grounding conductors were added to feeders and branch circuits feeding Broadcast Areas. System grounding electrodes were not observed.

   b. **General Conditions:** Grounding electrodes, bonding of the water, gas and structure were not observed.

   c. **Code Issues:** Grounding provisions should be checked. Grounding electrode conductor sizes need to be verified.

   d. **Recommendations:** Verify grounding electrodes and their ground to earth resistance. Verify grounding electrode and grounding electrode conductors as noted. Provide grounding conductors in existing feeders and branch circuits.

4. **Lighting**
   a. **Description:**

   Site

   1. Site lighting consists of Campus standard post top luminaire.
   2. Control: Not verified (typical campus control is PE cell with Time Clock, located within nearest building.

   i. Building Exterior

   1. Building exterior mounted luminaries consist of original wall mounted incandescent luminaires, HID floods sources in wall packs and under canopy surface mounted styles with yellowing polycarbonate lenses.
   2. Control if provided by building mounted photo cell.

   ii. Building Interior

   1. Building interior lighting systems very. The original dormitory incandescent luminaires have been replaced with fluorescent. The building has linear fluorescent luminaires (mountings: recessed, surface, suspended), and track lighting with MR 16 lamps. Fluorescent lamps are a mix of T12 and T8.
   2. Control is provided by manual switches, no auto-control.
b. **Code Issues:** Not sufficient illumination at the elevator stops.

c. **Recommendations:**
   i. Replace all T12 luminaires with luminaires with T8 technology.
   ii. Provide occupancy sensors for the offices areas and restrooms.
   iii. Provide additional lighting at the elevator stops.
   iv. Replace all existing 1958 luminaires still in use.

5. **Life Safety**

   a. **Description:**
   Snell Hall does not have an emergency power system. The building does have a panel (Panel “E”) that is dedicated to serve Path-of-Egress (POE) and exit lights. The emergency branch wiring is kept separate from the normal lighting circuits in the building. In addition to the 1958 emergency lighting system, some of the exit signs have battery packs with sealed beam lights attached.

   b. **General Conditions:**
   The spacing of POE lighting will not provide sufficient illumination to meet POE requirements.

   c. **Code Issues:**
   POE lighting is required to be on emergency power source for areas requiring two or more exits. Spacing of POE luminaires will not provide required 1FC of illumination.

   d. **Recommendations:**
   Provide a new emergency power source (emergency generator or central battery inverter) to feed Panel “E”. Connect additional luminaires and add new luminaires in the POE areas (corridors, stairs, exit discharge).
6. **Tel/Data**

   a. **Description:**
      The main telcom room is a closet in a ceramics (pottery) class room. The space is especially dusty with the clay use. Telcom cabling is routed within raceway and open cabling attached to conduits.

   b. **General Conditions:** The telcom pathway system appears stretched in serving the work stations. A proper MDF or TR rooms do not exist. A lot of abandoned cabling exists.

   ![TELCOM CLOSET (in ceramics area)](image)

   **Code Issues:** Abandoned cabling needs to be removed.

   **Recommendations:** Provide EIA/TIA approved TR rooms. Remove all unused cabling and termination blocks. Provide raceways for exposed cabling, or proper training method.
7. **Fire Alarm**

   a. **Description:** The Fire Alarm system consists of an old Simplex Zoned system. Dialer is a Silent Knight unit.

   **General Conditions:** System is outdated. No visible notification (strobes) were observed. No fire alarm devices were observed for the elevator system.

   ![FIRE ALARM PANEL](image)

   b. **Code Issues:** Building is missing proper Alarm Notification, elevator needs fire alarm devices and inner-tie.

   c. **Recommendations:** Provide new addressable Fire Alarm system with detection at elevator, shut down innertie, and notification device thru out the facility.
### Oregon State University
### Snell Hall

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Introduction and Scope

Mac McBride of McBride Architecture, P.C. retained KPFF Consulting Engineers to conduct a general structural evaluation of the Snell Hall Building located on the Oregon State University campus at 2150 SW Jefferson Way in Corvallis, Oregon. The building was originally student housing, but is currently being used as office space. ASCE 31-03, *Handbook of the Seismic Evaluation of Buildings*, issued in 2003, was used as the basis of our assessment of the building as it relates to seismic hazards. An ASCE 31 Tier 1 and 2 Seismic Evaluation was conducted.

Our evaluation included limited field reconnaissance to observe the general physical status of the building and the site, and an assessment of significant structural deficiencies observed. No testing or demolition of finishes to expose the existing structural elements was conducted to determine their material properties.

Observations, analyses, and conclusions contained in this report reflect our best engineering judgment. Conclusions about the structural system are drawn from review of the existing building drawings, site observations of the structure made during a site visit on September 11, 2009, and our experience with structures of similar construction. Concealed problems with the construction of the building may exist that cannot be revealed through our review. KPFF, therefore, can in no way warrant or guarantee the condition of the existing construction of the building and the building site and future performance of the building.

Building Description

Snell Hall was constructed circa 1958 from structural drawings prepared by Stanley V. Carlson, P.E., for the architectural firm Burns, Bear, McNeil & Schneider. The structure consists of two seismically isolated five story segments oriented in an “L” shape with overall plan dimensions of 168 feet by 202 feet with approximately 11,900 square feet on each floor.
The building construction documents, dated March 12, 1958, give a comprehensive view of the building construction. Documents examined included Architectural drawings 1-25 and Structural drawings 101-107. According to the drawings, the building is constructed of 8 inch thick reinforced concrete lift slab floors, 8"x8" built-up steel support columns, and 10-inch thick reinforced brick walls. Concrete compressive strength is listed at 3,000 psi and the yield reinforcing steel strength is listed at 60,000 psi. Brick compressive strength is assumed to be 1,500 psi. The drawings indicate poured concrete strip footings supporting the columns only and none for the perimeter walls. A 3-inch joint at the north end of the south wing separates the two portions of the building.

**Site Reconnaissance**

On September 11, 2009, a representative of KPFF made a site visit to review the condition of the existing structure. The primary objective of the visit was to become familiar with the building, determine the as-built conditions and observe the existing structural system where possible.

The following observations were made:

- In general, the building appears to be constructed as indicated on the structural drawings.
- The brick shear walls at the south and west stair towers of the building showed signs of spalling at isolated locations. The cause of the spalling appears to be related to moisture intrusion and not seismically created damage.
- There is significant efflorescence on the interior stair tower wall, which reduces in severity at lower levels.
- There were no apparent diagonal cracks in the exposed portions of the existing brick walls.

**ASCE 31 Structural Evaluation**

The structural system consists of built-up steel columns, conventionally reinforced concrete lift slabs, and reinforced brick shear walls. The columns are founded on concrete combined strip footings. The reinforced brick walls have spread footings, but the perimeter have non-bearing walls are supported on 8-inch grade beams. The reinforced brick walls, located at stairs and elevators and along one long side or rack wing, provide resistance to earthquake and wind forces.

For the purpose of American Society of Civil Engineers (ASCE) 31 evaluation, the construction will be classified as building type RM2: Reinforced Masonry Bearing Walls With Stiff Diaphragms. The wall material is clay brick, not concrete masonry, but we believe that the existing system can be most accurately represented by using this building classification type.

The building structure's lateral load resisting components were evaluated to determine their capacity to resist earthquake ground motion. The general structural seismic evaluation was performed using the criteria of ASCE 31, *Handbook for the Seismic Evaluation of Buildings*.

ASCE 31 uses a three-tiered method to evaluate an existing building (for this project, only Tiers 1 and 2 were used) as defined in the original scope of work:

Tier 1 - Screening Phase. Includes completing checklists for the structure, geologic site hazards and foundations, and nonstructural items. During this phase, a review is performed of any available construction documents. A site visit is made to observe the building for any indications of deterioration of the structure and finishes, and to compare the as-built information with the construction documents.
Tier 2 - Evaluation Phase. Includes analysis of the non-compliant elements from Tier 1, utilizing a simplified static analysis approach.

Tier 3 - Detailed Evaluation Phase. This phase consists of a non-linear analysis of non-compliant Tier 2 items and is not appropriate for this report.

We evaluated the building using both the Tier 1 Life Safety Performance Level screening phase and Tier 2 Evaluation phase outlined by ASCE 31. A Tier 3 evaluation was beyond the scope of this project. For a building complying with the Life Safety Performance Level, its expected performance will include damage to both structural and nonstructural components during a design earthquake, such that, (a) at least some margin against either partial or total structural collapse remains, and (b) injuries may occur, but the overall risk of life-threatening injury as a result of structural damage is expected to be low.

In this document, the base shear, or the total seismic force on the building, is calculated by a prescribed formula accounting for geographic seismicity, the type of building structure, its stiffness, and its overall mass. The base shear is distributed to each story based on a weighted proportion of the floor's mass and height above the ground. For the purpose of this report, the structural elements are analyzed by distributing the shear equally over the shear wall area at each floor neglecting the relative stiffness of individual walls.

The demand on each structural component is compared to the capacity of that element. For a given structural element, a demand-capacity ratio (DCR) is the demand (D) divided by the capacity (C) of the existing element, and is a relative measure of how much is required of the structure in its current condition. A DCR of 1.0 means the demand is equal to the capacity of that element. A DCR of more than one means the structure is required to resist more than its capacity. For example, a DCR of 2.0 means the element is required to resist a force twice its existing strength. A DCR of less than one means the structure has reserve capacity. DCR's for the existing brick walls range from $1.36$ to $4.21$ at the base.

The level of seismicity is determined per ASCE 31, Section 2.5, as follows:

From the USGS Seismic Hazard Curves and Uniform Response Spectra, the short period spectral response acceleration ($S_s$) and 1-second period spectral response acceleration ($S_1$) parameters are:

\[ S_s = 0.815g \]
\[ S_1 = 0.401g \]

Because there is limited information about the in situ geological conditions, the site class was assumed to be “D” per the 2007 Oregon Structural Specialty Code (OSSC). Based on a Class D site classification, Site Coefficients $F_a$ and $F_v$ were found to be:

\[ F_a = 1.174g \]
\[ F_v = 1.599g \]

Spectral response acceleration parameters define the level of seismicity of a site as low, moderate, or high. The acceleration parameters are determined as below and the resulting product classifies the level of seismicity:

\[ S_{DS} = 0.67F_aS_s = 0.638g > 0.500g = \text{High Seismicity} \]
\[ S_{D1} = 0.67F_vS_1 = 0.427g > 0.200g = \text{High Seismicity} \]

Both $S_{DS}$ and $S_{D1}$ indicate that this building is located in a high seismicity region.
Required Checklists

The following evaluation is based on checklists selected considering the building is located in a region of high of seismicity and utilizing the Life Safety Performance Level. A Tier 1 evaluation is a screening phase used to identify a building's possible structural deficiencies. As such, the Tier 1 checklists are compliant/non-compliant. An item fails if it does not meet an ASCE 31 criterion and is rated as noncompliant, even if it is just slightly nonconforming. The Tier 1 evaluation also serves to focus the attentions of a Tier 2 review. A Tier 2 evaluation determines the degree of deficiency, or may reverse a finding of a Tier 1 study.

For this building, six checklists were used for the Tier 1 evaluation as required by ASCE 31:
- Basic Structural (Sec. 3.7)
- Supplemental Structural (Sec. 3.7)
- Geologic Site Hazard and Foundation (Sec. 3.8)
- Basic Nonstructural (Sec. 3.9.1)
- Intermediate Nonstructural (Sec. 3.9.2)
- Supplemental Nonstructural (Sec. 3.9.2)

The six required checklists completed for this building may be found on pages 8 through 26.

Life-Safety Deficiencies and Recommendations

The deficiencies noted below are based on the Life Safety Performance Level and are organized by the appropriate checklist. Those items noted with the (NC) designation indicate deficiencies that can be considered as potential life safety risks. Those items notes with the (U) designation indicate areas where not enough information was available to determine whether that item was acceptable or deficient.

Basic Structural Checklist:
- Torsion (NC): The estimated distance between the story center of mass and the story center of rigidity is more than 20 percent of the building width.
  **Recommendation:** The addition of new concrete walls located symmetrically throughout the structure would ensure that this torsional effect does not occur.

- Masonry Units (NC): There shall be no visible deterioration of masonry units.
  **Recommendation:** Following rehabilitation, which includes new concrete walls, existing brick walls will not be relied on to provide any earthquake or wind resistance.

- Shear Stress Check (NC): The shear stress in the reinforced brick shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy. DCR's range from \(1.36\) to \(4.21\) at the base.
  **Recommendation:** Following rehabilitation, which includes new concrete walls, existing brick walls will not be relied on to provide any earthquake or wind resistance.

Geologic Site Hazards and Foundations:
- Liquefaction (U): Geotechnical documents were not made available to determine if the site soils are susceptible to liquefaction.
  **Recommendation:** Availability/review of existing geotechnical documentation would verify the risk of liquefaction. Based on experience with other campus projects, we do not anticipate this is an issue.
Basic Nonstructural Component Checklist:

Panel Connections (U): Exterior cladding panels shall be anchored out-of-plane with a minimum of four connections for each wall panel.
Recommendation: Verify existing conditions and provide additional cladding panel anchors to meet this connection criteria as required.

Attached Equipment (U): Equipment weighing over 20 pounds that is attached to ceilings, walls, or other supports 4 feet above the floor level shall be braced.
Recommendation: Verify existing conditions and provide bracing to meet this connection criteria as required.

Fire Suppression Piping (NC): Fire suppression piping shall be anchored and braced in accordance with NFPA-13 (NFPA, 1996).
Recommendation: Verify existing conditions and provide bracing to meet this connection criteria as required.

Flexible Couplings (U): Fluid, gas and fire suppression piping shall have flexible couplings.
Recommendation: Verify existing conditions and replace rigid couplings as required.

Supplemental Nonstructural Component Checklist:

Glazing (NC): All exterior glazing shall be laminated, annealed or laminated heat-strengthened safety glass or other glazing system that will remain in frame when glass is cracked.
Recommendation: Verify existing conditions and replace glass or cladding system as required.

Partition Tops: The tops of framed or panelized partitions that only extend to the ceiling line shall have lateral bracing to the building structure at a spacing equal to or less than 6 feet.
Recommendation: Verify existing conditions and provide lateral bracing as required.

Lens Covers: Lens covers on light fixtures shall be attached or supplied with safety devices.
Recommendation: Verify existing conditions and provide safety devices as required.

File Cabinets (NC): File cabinets arranged in groups shall be attached to one another.
Recommendation: Verify existing conditions and provide positive attachment between cabinets as required.

Cabinet Doors and Drawers (NC): Cabinet doors and drawers shall have latches to keep them closed during an earthquake.
Recommendation: Verify existing conditions and provide latches as required.

Heavy Equipment (NC): Equipment weighing over 100 pounds shall be anchored to the structure or foundation.
Recommendation: Verify existing conditions and provide anchorage as required.

Electrical Equipment (NC): Electrical equipment and associated wiring shall be laterally braced to the structural system.
Recommendation: Verify existing conditions and provide lateral bracing as required.

Doors (U): Mechanically operated doors shall be detailed to operate at a story drift ratio of 0.01.
Recommendation: Additional analysis required to determine likely drift demands and adequacy of existing mechanically operated doors.

Fluid and Gas Piping (NC): Fluid and gas piping shall be anchored and braced to the structure to prevent breakage in piping.
Recommendation: Verify existing conditions and provide bracing as required.

Shut-off Valves (U): Shut-off devices shall be present at building utility interfaces to shut off the flow of gas and high-temperature energy in the event of earthquake-induced failure.
Recommendation: Verify existing conditions and provide automatic shut-off valves as required.

C-Clamps (NC): One-sided C-clamps that support piping greater than 2.5 inches in diameter shall be restrained.
Recommendation: Verify existing conditions and provide C-clamp restraints as required.

Intermediate Nonstructural Component Checklist:
Glazing (NC): Glazing in curtain walls and individual panes over 16 square feet in area, located up to a height of 10 feet above an exterior walking surface, shall have safety glazing. Such glazing located over 10 feet above an exterior walking surface shall be laminated annealed or laminated heat strengthened safety glass that will remain in the frame when glass is cracked.
Recommendation: Verify existing conditions and replace glass or cladding system as required.

Vibration Isolators (U): Equipment mounted on vibration isolators shall be equipped with restraints or snubbers.
Recommendation: Verify existing conditions and provide restraints as required.

Seismic Rehabilitation Scheme

Based on our evaluation and review, we believe the Snell Hall structural system to be inadequate to resist seismic loads prescribed by the Life Safety Performance Level of ASCE 31. The reinforced brick shear walls and their footings are not adequate to resist the anticipated shear and overturning forces respectively. This will affect the approach the owner and architect takes in remodeling and occupying the building. Following is a preliminary scheme by which the structure could be rehabilitated to meet Life Safety Performance Level criteria. Reference layout sheet 101 (page 29) for additional information.

In the locations where reinforced brick walls currently exist, new 12” reinforced shotcrete shear walls could be provided on the interior face of these walls, with positive attachment to the concrete lifts slabs being made throughout. In several other locations, new 12” reinforced concrete shear walls must be provided, which will impact the existing room layouts and window areas. At the ends of the new shear walls 9” diameter drilled and grouted pin piles will be required to resist overturning loads carried by these shear walls. Depth and actual quantity of the piles is to be determined by a geotechnical engineer. For the purpose of the report, we recommend assuming four (4) pin piles at each end of each new wall. Piles are to be topped with monolithically poured pile caps that will need to occur below existing footings and positive attachment to the existing foundation required. Demolition work required to install these elements would be extensive.

In addition, numerous nonstructural elements such a piping, mechanical and electrical equipment will require seismic restraint and bracing, and existing glazing and cladding panels will likely have to be replaced in most locations.
This scheme will require a thorough analysis beyond this ASCE 31 evaluation, including concrete testing and steel reinforcement locating, to determine the final details for strengthening. The solutions offered in this report are intended for estimating purposes only and are subject to change following actual design calculations.

**Conclusions**

The reinforced brick shear walls are the primary lateral force resisting structural elements used to resist wind and earthquake forces. The shear walls are continuous from the basement to the roof, with reinforcing steel clearly indicated on the drawings. The brick compressive strength in the walls was assumed to be 1500 psi, which will need to be confirmed with testing. The brick shear wall thickness is 10 inches in all locations. Because the dead and lateral loading of this building are quite large and the lateral capacity of the walls is low, none of the walls come close to meeting the “Quick Check” of average shearing stress prescribed in ASCE 31.

Due to potential building drift, some localized damage may occur at the junction between the east/west interface of the two Snell Hall segments during a major earthquake, as well as between the dining area building and office building found adjacent to Snell Hall that were built following its construction.

The proposed rehabilitation scheme will require a total of eight (8) new reinforced concrete walls, approximately four (4) new pin piles per wall end, seismic restraint of MEP equipment, and replacement of glazing or cladding systems that do not meet required safety criteria.
## Summary of Division Totals

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<th>Item Description</th>
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<tr>
<td>Div 2 Existing Conditions</td>
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<tr>
<td>Div 3 Concrete</td>
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<tr>
<td>Div 4 Masonry</td>
<td>335,520.00</td>
</tr>
<tr>
<td>Div 5 Metals</td>
<td>442,350.00</td>
</tr>
<tr>
<td>Div 7 Thermal &amp; Moisture Protection</td>
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</tr>
<tr>
<td>Div 8 Door &amp; Windows</td>
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<td>Div 9 Finishes</td>
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<td>Div 14 Conveying Systems</td>
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**Total**  

|                                     |          |      |           | 165,000.00 |
## Div 2 Existing Conditions

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# Div 3 Concrete

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
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**Total** 938,130.00
Div 4 Masonry

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<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
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Total 335,520.00
## Div 5 Metals

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<th>Quantity</th>
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<th>Unit Cost</th>
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</thead>
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<tr>
<td>Steel studs</td>
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<td><strong>Total</strong></td>
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### Div 7 Thermal & Moisture Protection

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Total 167,189.85
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</thead>
<tbody>
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**Total**  2,287,600.00
## Div 9 Finishes

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**Total**
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<td>35,000.00</td>
<td>35,000.00</td>
</tr>
</tbody>
</table>

**Total** 129,500.00
### Div 21 Fire Suppression

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire sprinklers (retrofit)</td>
<td>77,215.00</td>
<td>sf</td>
<td>4.00</td>
<td>308,860.00</td>
</tr>
</tbody>
</table>

**Total**  
308,860.00
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>New fixture allowance</td>
<td>1.00</td>
<td>ls</td>
<td>70,000.00</td>
<td>70,000.00</td>
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</tbody>
</table>

Total: 70,000.00
<table>
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<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>New retrofit HVAC system</td>
<td>77,215.00</td>
<td>sf</td>
<td>20.00</td>
<td>1,544,300.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>1,544,300.00</td>
</tr>
</tbody>
</table>
### Div 26 Electrical

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service &amp; Distribution</td>
<td>77,215.00</td>
<td>sf</td>
<td>1.70</td>
<td>131,265.50</td>
</tr>
<tr>
<td>Lighting &amp; Branch Wiring</td>
<td>77,215.00</td>
<td>sf</td>
<td>7.50</td>
<td>579,112.50</td>
</tr>
<tr>
<td>Emergency systems</td>
<td>1.00</td>
<td>ls</td>
<td>62,500.00</td>
<td>62,500.00</td>
</tr>
</tbody>
</table>

**Total** 772,878.00
Div 27 Communications

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comm, Fire, Secuity alarms etc</td>
<td>77,215.00</td>
<td>sf</td>
<td>4.34</td>
<td>335,113.10</td>
</tr>
</tbody>
</table>

Total 335,113.10
## Div 31 Earthwork

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrape sod</td>
<td>962.00</td>
<td>cy</td>
<td>12.60</td>
<td>12,121.20</td>
</tr>
<tr>
<td>Rock for constr staging &amp; bldg pad</td>
<td>1,924.00</td>
<td>cy</td>
<td>55.00</td>
<td>105,820.00</td>
</tr>
<tr>
<td>Excavate for footing etc</td>
<td>1.00</td>
<td>ls</td>
<td>25,000.00</td>
<td>25,000.00</td>
</tr>
</tbody>
</table>

| Total                                   |          |      |           | 142,941.20  |
## Div 32 Exterior Improvements

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street Improvements (street, gutter, walks)</td>
<td>1.00</td>
<td>ls</td>
<td>95,325.00</td>
<td>95,325.00</td>
</tr>
<tr>
<td>Bike paths &amp; shelters</td>
<td>1.00</td>
<td>ls</td>
<td>21,750.00</td>
<td>21,750.00</td>
</tr>
<tr>
<td>Bus shelters (3 each)</td>
<td>1.00</td>
<td>ls</td>
<td>30,000.00</td>
<td>30,000.00</td>
</tr>
<tr>
<td>Street lighting (4 each)</td>
<td>1.00</td>
<td>ls</td>
<td>12,000.00</td>
<td>12,000.00</td>
</tr>
<tr>
<td>Courtyard pavers</td>
<td>2,000.00</td>
<td>sf</td>
<td>10.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td>Accessibility ramps etc</td>
<td>1.00</td>
<td>ls</td>
<td>15,000.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td>Landscaping &amp; Irrigation</td>
<td>36,000.00</td>
<td>sf</td>
<td>3.00</td>
<td>108,000.00</td>
</tr>
</tbody>
</table>

**Total** 302,075.00
**Div 33 Utilities**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility upgrades (street)</td>
<td>1.00</td>
<td>ls</td>
<td>50,000.00</td>
<td>50,000.00</td>
</tr>
<tr>
<td>Utility upgrades (site)</td>
<td>1.00</td>
<td>ls</td>
<td>25,000.00</td>
<td>25,000.00</td>
</tr>
<tr>
<td>New fire vault &amp; valves</td>
<td>1.00</td>
<td>ls</td>
<td>20,000.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td>New service from power company</td>
<td>1.00</td>
<td>ls</td>
<td>6,000.00</td>
<td>6,000.00</td>
</tr>
</tbody>
</table>

**Total** 101,000.00
# Summary of Division Totals

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Div Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Div 1 General Conditions</td>
<td>165,000.00</td>
</tr>
<tr>
<td>Div 2 Existing Conditions</td>
<td>513,857.20</td>
</tr>
<tr>
<td>Div 3 Concrete</td>
<td>1,125,300.00</td>
</tr>
<tr>
<td>Div 4 Masonry</td>
<td>640,368.00</td>
</tr>
<tr>
<td>Div 5 Metals</td>
<td>1,577,272.50</td>
</tr>
<tr>
<td>Div 7 Thermal &amp; Moisture Protection</td>
<td>253,363.62</td>
</tr>
<tr>
<td>Div 8 Door &amp; Windows</td>
<td>2,338,600.00</td>
</tr>
<tr>
<td>Div 9 Finishes</td>
<td>1,201,405.00</td>
</tr>
<tr>
<td>Div 10 Specialties</td>
<td>42,000.00</td>
</tr>
<tr>
<td>Div 14 Conveying Systems</td>
<td>189,000.00</td>
</tr>
<tr>
<td>Div 21 Fire Supression</td>
<td>212,341.25</td>
</tr>
<tr>
<td>Div 22 Plumbing</td>
<td>270,252.50</td>
</tr>
<tr>
<td>Div 23 HVAC</td>
<td>1,389,870.00</td>
</tr>
<tr>
<td>Div 26 Electrical</td>
<td>925,763.70</td>
</tr>
<tr>
<td>Div 27 Communications</td>
<td>335,113.10</td>
</tr>
<tr>
<td>Div 31 Earthwork</td>
<td>329,396.20</td>
</tr>
<tr>
<td>Div 32 Exterior Improvements</td>
<td>302,075.00</td>
</tr>
<tr>
<td>Div 33 Utilities</td>
<td>101,000.00</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>11,911,978.07</td>
</tr>
<tr>
<td><strong>Profit &amp; Overhead Factor @ 10%</strong></td>
<td>1,191,197.81</td>
</tr>
<tr>
<td><strong>Contingency @ 15%</strong></td>
<td>1,965,476.38</td>
</tr>
<tr>
<td><strong>Total Direct Construction Cost</strong></td>
<td>15,068,652.26</td>
</tr>
<tr>
<td><strong>Indirect Construction Cost @ 50%</strong></td>
<td>7,534,326.13</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>22,602,978.39</td>
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</tbody>
</table>
## Div 1 General Requirements

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Services:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Job Shack</td>
<td>12.00</td>
<td>mo</td>
<td>400.00</td>
<td>4,800.00</td>
</tr>
<tr>
<td>Phones</td>
<td>12.00</td>
<td>mo</td>
<td>150.00</td>
<td>1,800.00</td>
</tr>
<tr>
<td>Sanitary Facilities</td>
<td>12.00</td>
<td>mo</td>
<td>150.00</td>
<td>1,800.00</td>
</tr>
<tr>
<td>Temp Power</td>
<td>12.00</td>
<td>mo</td>
<td>300.00</td>
<td>3,600.00</td>
</tr>
<tr>
<td>Security &amp; Safety Fencing</td>
<td>12.00</td>
<td>mo</td>
<td>500.00</td>
<td>6,000.00</td>
</tr>
<tr>
<td>Daily Clean-up</td>
<td>12.00</td>
<td>mo</td>
<td>1,000.00</td>
<td>12,000.00</td>
</tr>
<tr>
<td>Supervision</td>
<td>12.00</td>
<td>mo</td>
<td>10,000.00</td>
<td>120,000.00</td>
</tr>
<tr>
<td>Final Clean-up</td>
<td>1.00</td>
<td>ls</td>
<td>15,000.00</td>
<td>15,000.00</td>
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</table>

**Total** 165,000.00
## Div 2 Existing Conditions

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structure Demolition:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building</td>
<td>628,393.00</td>
<td>cf</td>
<td>0.40</td>
<td>251,357.20</td>
</tr>
<tr>
<td>Foundations</td>
<td>750.00</td>
<td>ls</td>
<td>22.00</td>
<td>16,500.00</td>
</tr>
<tr>
<td><strong>Site Demolition:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove concrete and/or pavers</td>
<td>1.00</td>
<td>ls</td>
<td>23,000.00</td>
<td>23,000.00</td>
</tr>
<tr>
<td>Remove or relocate landscaping</td>
<td>1.00</td>
<td>ls</td>
<td>58,000.00</td>
<td>58,000.00</td>
</tr>
<tr>
<td>Remove or relocate site furnishings</td>
<td>1.00</td>
<td>ls</td>
<td>10,000.00</td>
<td>10,000.00</td>
</tr>
<tr>
<td>Waste removal</td>
<td>1.00</td>
<td>ls</td>
<td>155,000.00</td>
<td>155,000.00</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td></td>
<td>513,857.20</td>
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</tbody>
</table>
### Div 3 Concrete

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin piles 40' long 5&quot; diameter</td>
<td>5,120.00</td>
<td>vlf</td>
<td>73.00</td>
<td>373,760.00</td>
</tr>
<tr>
<td>Footings</td>
<td>644.00</td>
<td>cy</td>
<td>260.00</td>
<td>167,440.00</td>
</tr>
<tr>
<td>Concrete stem walls</td>
<td>170.00</td>
<td>cy</td>
<td>450.00</td>
<td>76,500.00</td>
</tr>
<tr>
<td>Elevated slabs</td>
<td>765.00</td>
<td>cy</td>
<td>500.00</td>
<td>382,500.00</td>
</tr>
<tr>
<td>Slab on grade</td>
<td>190.00</td>
<td>cy</td>
<td>240.00</td>
<td>45,600.00</td>
</tr>
<tr>
<td>Reinforcing</td>
<td>53.00</td>
<td>ton</td>
<td>1,500.00</td>
<td>79,500.00</td>
</tr>
</tbody>
</table>

**Total** 1,125,300.00
## Div 4 Masonry

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>New brick veneer</td>
<td>26,682.00</td>
<td>sf</td>
<td>24.00</td>
<td>640,368.00</td>
</tr>
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</table>

Total 640,368.00
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural steel</td>
<td>368.00</td>
<td>ton</td>
<td>2,950.00</td>
<td>1,085,600.00</td>
</tr>
<tr>
<td>Steel decking</td>
<td>77,215.00</td>
<td>sf</td>
<td>4.00</td>
<td>308,860.00</td>
</tr>
<tr>
<td>Steel studs</td>
<td>56,250.00</td>
<td>sf</td>
<td>3.25</td>
<td>182,812.50</td>
</tr>
</tbody>
</table>

Total: 1,577,272.50
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>New exterior door allowance</td>
<td>1.00</td>
<td>ls</td>
<td>25,000.00</td>
<td>25,000.00</td>
</tr>
<tr>
<td>New interior door allowance</td>
<td>1.00</td>
<td>ls</td>
<td>96,000.00</td>
<td>96,000.00</td>
</tr>
<tr>
<td>New glazed curtain wall (average cost)</td>
<td>29,568.00</td>
<td>sf</td>
<td>75.00</td>
<td>2,217,600.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>2,338,600.00</td>
</tr>
</tbody>
</table>
### Div 9 Finishes

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior mtl framing</td>
<td>86,400.00</td>
<td>sf</td>
<td>2.50</td>
<td>216,000.00</td>
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<tr>
<td>Drywall</td>
<td>172,800.00</td>
<td>sf</td>
<td>1.75</td>
<td>302,400.00</td>
</tr>
<tr>
<td>Acoustic ceilings</td>
<td>77,215.00</td>
<td>sf</td>
<td>3.00</td>
<td>231,645.00</td>
</tr>
<tr>
<td>New flooring allowance</td>
<td>77,215.00</td>
<td>sf</td>
<td>4.00</td>
<td>308,860.00</td>
</tr>
<tr>
<td>New rubber base</td>
<td>7,000.00</td>
<td>lf</td>
<td>3.50</td>
<td>24,500.00</td>
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<tr>
<td>Painting</td>
<td>1.00</td>
<td>ls</td>
<td>118,000.00</td>
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</tbody>
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**Total** 1,201,405.00
## Div 10 Specialties

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEC</td>
<td>15.00</td>
<td>ea</td>
<td>400.00</td>
<td>6,000.00</td>
</tr>
<tr>
<td>Toilet Accessories</td>
<td>1.00</td>
<td>lt</td>
<td>36,000.00</td>
<td>36,000.00</td>
</tr>
</tbody>
</table>

**Total**                                      **42,000.00**
### Div 14 Conveying Systems

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>New elevator 6 stop 2500 lb 200 fpm</td>
<td>2.00</td>
<td>ea</td>
<td>94,500.00</td>
<td>189,000.00</td>
</tr>
</tbody>
</table>

| Total                             |          |      |           | 189,000.00 |
Div 21 Fire Supression

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire sprinklers</td>
<td>77,215.00</td>
<td>sf</td>
<td>2.75</td>
<td>212,341.25</td>
</tr>
</tbody>
</table>

Total 212,341.25
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumbing Allowance</td>
<td>77,215.00</td>
<td>sf</td>
<td>3.50</td>
<td>270,252.50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>270,252.50</td>
</tr>
<tr>
<td>Item Description</td>
<td>Quantity</td>
<td>Unit</td>
<td>Unit Cost</td>
<td>Extension</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>New HVAC system</td>
<td>77,215.00</td>
<td>sf</td>
<td>18.00</td>
<td>1,389,870.00</td>
</tr>
</tbody>
</table>

**Total** 1,389,870.00
<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service &amp; Distribution</td>
<td>77,215.00</td>
<td>sf</td>
<td>1.94</td>
<td>149,797.10</td>
</tr>
<tr>
<td>Lighting &amp; Branch Wiring</td>
<td>77,215.00</td>
<td>sf</td>
<td>9.24</td>
<td>713,466.60</td>
</tr>
<tr>
<td>Emergency systems</td>
<td>1.00</td>
<td>ls</td>
<td>62,500.00</td>
<td>62,500.00</td>
</tr>
</tbody>
</table>

**Total** 925,763.70
### Div 27 Communications

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comm, Fire, Security alarms etc</td>
<td>77,215.00</td>
<td>sf</td>
<td>4.34</td>
<td>335,113.10</td>
</tr>
</tbody>
</table>

Total: 335,113.10
### Div 31 Earthwork

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrape sod</td>
<td>962.00</td>
<td>cy</td>
<td>12.60</td>
<td>12,121.20</td>
</tr>
<tr>
<td>Rock for constr staging &amp; bldg pad</td>
<td>4,405.00</td>
<td>cy</td>
<td>55.00</td>
<td>242,275.00</td>
</tr>
<tr>
<td>Grade &amp; Compact site</td>
<td>1.00</td>
<td>ls</td>
<td>40,000.00</td>
<td>40,000.00</td>
</tr>
<tr>
<td>Excavate for footings</td>
<td>1.00</td>
<td>ls</td>
<td>35,000.00</td>
<td>35,000.00</td>
</tr>
</tbody>
</table>

| Total                             |          |      |           | 329,396.20 |
### Div 32 Exterior Improvements

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street improvements (street, gutter, walks)</td>
<td>1.00</td>
<td>ls</td>
<td>95,325.00</td>
<td>95,325.00</td>
</tr>
<tr>
<td>Bike paths &amp; shelters</td>
<td>1.00</td>
<td>ls</td>
<td>21,750.00</td>
<td>21,750.00</td>
</tr>
<tr>
<td>Bus shelters (3 each)</td>
<td>1.00</td>
<td>ls</td>
<td>30,000.00</td>
<td>30,000.00</td>
</tr>
<tr>
<td>Street lighting (4 each)</td>
<td>1.00</td>
<td>ls</td>
<td>12,000.00</td>
<td>12,000.00</td>
</tr>
<tr>
<td>Courtyard pavers</td>
<td>2,000.00</td>
<td>sf</td>
<td>10.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td>Accessibility ramps etc</td>
<td>1.00</td>
<td>ls</td>
<td>15,000.00</td>
<td>15,000.00</td>
</tr>
<tr>
<td>Landscaping &amp; Irrigation</td>
<td>36,000.00</td>
<td>sf</td>
<td>3.00</td>
<td>108,000.00</td>
</tr>
</tbody>
</table>

**Total** | | | | **302,075.00**
Div 33 Utilities

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility upgrades (street)</td>
<td>1.00</td>
<td>ls</td>
<td>50,000.00</td>
<td>50,000.00</td>
</tr>
<tr>
<td>Utility upgrades (site)</td>
<td>1.00</td>
<td>ls</td>
<td>25,000.00</td>
<td>25,000.00</td>
</tr>
<tr>
<td>New fire vault &amp; valves</td>
<td>1.00</td>
<td>ls</td>
<td>20,000.00</td>
<td>20,000.00</td>
</tr>
<tr>
<td>New service from power company</td>
<td>1.00</td>
<td>ls</td>
<td>6,000.00</td>
<td>6,000.00</td>
</tr>
</tbody>
</table>

| Total                           |          |      |           | 101,000.00 |