8.0 PROJECT DESIGN CRITERIA

8.1 APPLICABLE CODES

The project will be designed and constructed in accordance with the current applicable laws, codes, and requirements of regulatory agencies having jurisdiction including the following:

- 1997 UBC and 1998 California Amendments (92 California Building Code Parts 2-9, Title 24, CCR).
- 1996 NEC and 1998 California Amendments (91 California Electrical Code - Part 3, Title 24, CCR).
- 1997 UMC and 1998 California Amendments (92 California Mechanical Code - Part 4, Title 24, CCR).
- 1997 UPC and 1998 California Amendments (92 California Plumbing Code - Part 5, Title 24, CCR).
- 1994 Uniform Fire Code with State Amendments (California Fire Code - Part 9, Title 24, CCR).
- 1998 Building Standards Code (92 State Referenced Standards Code - Part 12, Title 24, CCR).
- Safety Orders of State Industrial Accident Commission.
- CAL/OSHA, current regulations.
- OSHA, current regulations.
- Requirements of the State Fire Marshal (SFM).
- Titles 8, 19, and 24, California Code of Regulations (CCR), 1991 edition.
- ADA Act Title III, 1991.
- NFPA 101 Life Safety Code.
- ANSI A117.1 Providing Accessibility and Usability for Physically Handicapped people, 1986.
- ADA P.L. 101-336

In addition, the project will be designed in accordance with the current UC Riverside Campus Standard Design Guide.

8.2 ANALYSIS OF THE PROJECT BASED ON UNIFORM BUILDING CODE

Occupancy

This project will have a mix of occupancies as classified by Table 3-A of the Uniform Building Code. The theater will seat 300 and have a stage and will be classified as an A-2 occupancy. The ballroom, and the dining facilities will have an occupant load of more than 300 and will be classified as an A-2.1 occupancy. The meeting rooms, and the retail spaces, including those in the existing bookstore that is to remain will each have an occupant load of less than 300 and will be classified as A-3 occupancies. The remainder of the spaces in the project will all have occupant loads of less than 50 and will be classified as B occupancies.

Fire Separation

There is a one-hour fire-rated occupancy separation required between the A-2 and the B occupancies, and the A-2.1 and the B occupancies. There is no fire-rated occupancy separation required between the A-3 and the B occupancies.

Construction Type and Allowable Floor Area

The Uniform Building Code sections 504 and 505, along with Table 5-B, sets allowable floor areas based on Occupancy and Type of Construction. Buildings with multiple stories, sprinkler systems, and building separations can increase the allowable floor areas. Due to the large size of the project program for new construction, and the existing buildings that are to remain, it is best to assume that the new construction will be of Type I fire resistive construction.

Type I fire resistive construction allows for unlimited building area no matter what the occupancy type is for the building. For the A and B occupancies that the spaces in this project will be classified as, the Type I construction requires a four-hour rated exterior walls if there is less than 5 feet between the project and other buildings, two-hour rated walls if there is less than 20 feet, and one-hour rated walls if there is less than 40 feet. Interior walls should be non-combustible and generally one-hour rated. Stair and elevator shafts are required to be of two-hour rated construction. Floors, floors/ceilings, and the roof structure are required to be of two-hour rated construction. The project will be required by UCR to be fully fire sprinklered and have smoke detectors, even though these are not required to increase the allowable building area. The sprinklers may be used to allow for unprotected openings in interior walls between activity spaces and lobbies and hallways.

Occupant Load

The occupant load factors are set forth in the Uniform Building Code in Table 10-A. The occupant load for the movie/performance auditorium will be based on the actual seating capacity of 300 seats. The Mutipurpose Event Space, meeting rooms, and dining facilities will be based on a 15 square feet per person occupant load factor. The retail areas will be based on a 30 square feet per person occupant load factor if the retail space is in the basement or on the ground floor, and be based on a 60 square feet per person occupant load factor if the retail space is on the upper floors of the building. All other spaces in the project are generally office type spaces and they will be based on a 100 square feet per person occupant load factor.

Once the occupant load is calculated, a minimum of two exits will be required for the Multipurpose Event Space, meeting rooms, dining facilities, and the retail spaces when the occupant load for these spaces exceed 50 persons. Two exits will be required when the occupant load of the office spaces exceed 30 persons.

Exiting

Stories above or below the first floor require at least two exits for up to 500 occupants, three exits for 501 to 1,000 occupants. Where two or more exits are required, at least two must be separated by a distance equal to not less than one half the diagonal of the area served, measured in a straight line or along the exit path when within a fire-resistive corridor. Travel distance to an exit is limited to 250 feet in a fully sprinklered building. At that point, the occupant must enter a horizontal exit, exit passageway, exit enclosure (stair), or reach an exterior exit door.

All exit doors are to swing in the direction of travel and have panic hardware. Once the need for panic hardware is established, it must be maintained throughout the exit path to a public way.

Corridors and Hallways

Rooms, aisles, hallways, doors, and corridors are all components of the exit access. Corridors may be required to be fire-rated, depending upon the number of occupants served, the type of occupancy, the building construction type, and whether the building is fire sprinklered.

The minimum width of a corridor is 44 inches. However, since out-swinging doors cannot reduce the required exit width by more than one-half, corridors are usually designed as not less than 5 feet in width, which will also satisfy disabled requirements for allowing two wheelchairs to pass through the corridor, side by side.

Plumbing Fixture Count

The calculation for the minimum number of plumbing fixtures that are required for this project is outlined in Table A-29-A of the Uniform Building Code. The fixture count is based on the occupancy types of the spaces in the project. The theater, ballroom, meeting rooms, and dining facilities fall under the requirements for Group A occupancies on Table A-29-A.

The office areas of the project fall under the requirements for Group B on the Table. The retail areas of the project fall under the requirements for Group M on the Table. All other areas in the project will fall under the requirements for Educational Facilities other than Group E on the Table.

Each restroom facility will require fixtures that are accessible to the disabled as outlined in the California Disabled Accessibility Guidebook and Chapters 11 and 11B of the Uniform Building Code.

8.3 ACCESSIBILITY FOR THE DISABLED

The California Disabled Accessibility Handbook, and Chapters 11 (Accessibility) and 11B (Accessibility to Public Buildings) of the Uniform Building Code establish the disabled access requirements that will be applicable to this project.

The American with Disability Act (ADA) is civil legislation enforced by the Federal Department of Justice to prohibit discrimination on the basis of disability. At such time that the project is designed, the design architect will need to meet with the UCR Coordinator of Disabled Services, and others, to review both accessibility and user needs.

All of the ADA accessibility requirements are too numerous to list in their entirety. However, the primary accessibility issues affecting the design of the project:

Site Development:

1. Site development and grading must be designed to provide access to all entrances and exterior ground floor exits, and access to normal paths of travel, and where necessary, shall incorporate pedestrian ramps, curb ramps, etc.

2. When more than one building is located on a site, accessible routes of travel must be provided between the buildings. The accessible route of travel must be the most practical direct rout between accessible building entrances and the accessible entrance to the site.

3. All entrances and all exterior ground-level exits are required to be accessible.

Buildings:

1. All portions of buildings are required to be accessible, except for portions not customarily occupied, such as employee spaces accessed only by ladders, catwalks or crawl spaces, or spaces frequented only by service personnel for repair or maintenance purposes.

2. Floors of a given story are required to be a common level throughout, or must be connected by pedestrian ramps, passenger elevators, or wheelchair lifts.

3. Ground and floor surfaces along accessible routes are required to be level up to ¼” vertical; and additional ¼” change may be accomplished by means of a 1 vertical to 2 horizontal slope.

4. Carpet is required to have a firm pad or no pad, ½" maximum pile height, and exposed edges must be attached to the floor and have trim that meets the requirements of changes in floor level noted above.

5. Circulation aisles are required to be 44 inches in minimum clear width.

6. Elevators are required to be accessible.

7. Wheelchair lifts may be provided in lieu of elevators when the vertical distance between landings, as well as the structural design and safeguards, are as allowed by the State of California, Division of the State Architect, Access Compliance, and the Department of Industrial Relations, Division of Occupational Safety and Health.

Fixture/Appliances:

1. Toilet facilities are required to be accessible.

2. Drinking fountains are required to be accessible both for individuals in wheelchairs, and for individuals who have difficulty bending or stooping. This can be accommodated by the use of "high-low" fountains.

3. Public telephones, if provided, are required to be accessible, and at least one in each bank and a total of 25 percent are required to be equipped with hearing aid compatible volume controls.

4. If a total of four or more public pay telephones are provided, and if at least one of the total is in an interior location, then at least one interior public pay telephone is required to be a text telephone in compliance with Code Section 1117B.2.9.2.

5. Vending machines are required to be installed in compliance with Code Section 1117B.6, Controls and Operating Mechanisms.

6. Objects protruding from walls, such as public telephones, must meet the requirements of Code Section 1121B, Protruding Objects.

Assembly/Seating/Work Areas:

1. Fixed or built-in seating, tables, or counters are required to be accessible in terms of clearances, knee space, and height of work surfaces.

2. Employee workstations are required to be accessible in terms of width, aisle width, and floor level accessibility.

3. Fixed storage facilities such as cabinets, shelves, closets, or drawers, located in accessible areas, must have at least one of each type which complies with the clear floor space, height, and hardware requirements of Code Section 1125B, Storage.

4. Occupancies are required to provide assistive-listening systems in assembly areas.

5. Wheelchair spaces are required in assembly seating areas.

One primary impact on recent projects has been the requirement for raised and Braille character signs to designate permanent rooms and spaces, and to provide direction to, or information about, functional spaces of the building. The Uniform Building Code, Chapter 11B, Section 1117B sets these requirements. Since the determination of exact text and sign placement requires a solid understanding of how the building may be utilized by a disabled individual, and is not explicitly prescribed by Code, a separate signage consultant with experience in ADA signage is usually retained for this portion of the project.

Maintenance Considerations

Materials and systems should be considered and used based upon good professional judgment, as well as life cycle costs and UCR maintenance requirements. The building should be planned for a 50-75 year life cycle. This means that major systems should be chosen based upon long term durability, ease of maintenance, and ability to accommodate change and evolution of the buildings.

Circulation & Parking

The Commons Expansion circulation system comprises two major systems: vehicle and pedestrian. The university has a long-term goal of removing or restricting automobile access at the center of the campus. Planning for the Commons Expansion should meet the following goals:

Service

- Improve service access and loading to the Commons Expansion.
- Create a service and loading area of sufficient size to accommodate the proposed program as well as future growth on the Commons Expansion site.

Parking

- Provide sufficient accessible parking for ADA needs, within University guidelines.

8.4 NOISE

The diversity of uses in and around the Commons Expansion will require careful acoustic separation and zoning. Particular attention needs to be given to assembly spaces and acoustical separation, performance requirements of the theater, and the overall acoustic ambiance of the public spaces—balancing the needs of activity and study.

Exterior noise generation and control should be considered. The exterior spaces will be used for a variety of scheduled and ad-hoc events. Consideration should be given to using outdoor space, buildings and locations for events to limit the acoustical impact on the surrounding buildings.

8.5 SECURITY

The Commons Expansion should be planned as a facility that can be open and accessible 24hrs/day, 365 days/year. It must also be planned so that individual areas, such as the Food venues, Performance spaces, and student organization spaces can have individual security and access independent of the hours of operation of other portions of the center.

Security is also a function of the design: the Commons Expansion should be visible, open and accessible in a way that "see and be seen" creates a natural sense of safety and security for the users of this facility.

8.6 ENGINEERING SYSTEMS

The following reports have been prepared by our engineering consultants and are based upon program needs, existing conditions, codes and good practice, review of existing buildings and conditions, and knowledge of the general planning and organizational approach for the Commons Expansion.

A. Structural Engineering

The structural design for the University of California Riverside Commons Expansion project will provide a structural system integrated with the program requirements for space layout and the architectural and building service needs. The existing site includes four existing buildings including the Bookstore, Lounge, Costo West, and Cafeteria/Costo East as well as the arcades between the buildings. Portions of the arcades, the entire Lounge, and portions of Costo West and Cafeteria/Costo East are proposed to be removed. The plan is to remove the eastern portion of the Costo West and the western portion of the Cafeteria/Costo East. The project will consist of new buildings in conjunction with the existing buildings noted above and the existing Bookstore located to the north. New buildings will replace the removed buildings. User needs in terms of possible future adaptability of the spaces and current flexibility of use will be carefully considered and the level of user comfort, as determined by the acoustic and vibration sensitivity of the structure, will be addressed.

Structural design will be in accordance with current code standards, including the 1998 California Building Code, for resisting vertical, seismic and wind loading. However, the 2001 California Building Code may become the code standard, depending on the timing of the design for the project.

The administrative and office areas will be designed for a minimum live load of 50 psf and the remaining public space floor areas for a live load 100 psf. The roof will be designed for a live load of 20 psf except in areas where mechanical equipment occurs, which will be designed accordingly. Consideration will be given to locating areas with heavy loads at the slab-on-grade level to avoid the need for heavy structural framing.

Since the building is located in seismic zone 4, earthquake resistance will be an important objective of the structural design. The building will be designed with a lateral force resisting system that provides ductility for dissipation of energy generated during an earthquake. Structural systems will be detailed to limit the effects of earthquake damage to both structural and nonstructural components of the building. Seismic restraints are to be provided for all equipment. The portions of the existing buildings that are to remain will be analyzed for seismic design requirements based on the applicable code.

Structural Framing and Foundation

The project, including the existing and new structures, is planned to have an area of approximately 105,000 gross square feet of new structure and the re-use 45,000 gross square feet of existing structure. The new structural framing will relate to the architectural layout of the space. The column spacing will be evaluated to provide the most efficient structural framing that accommodates the usage of the space. A concrete frame with concrete shear walls or concrete ductile frame or a structural steel frame with concrete and metal deck slabs with steel braced frames or steel moment frames are being considered for the new portions of the building. The column free requirements for the new Multi Purpose Room will require steel trusses to provide a long span roof structure. The structural steel frame is considered to be a more efficient and cost effective structural system not only for the long span roof but also for throughout the new building.

Structural modifications will be required to the existing structures where portions of the existing structure are being removed. The modifications may be in the form of additional vertical supports and foundations, however due to the location of the demolition line, the modifications are not anticipated to be extensive for vertical loading requirements.

The geotechnical and foundation investigation has not been performed as of this date. Based on the foundations utilized for the existing structures on the campus, the new building foundations are anticipated to be reinforced spread and continuous footings and drilled caissons/piers. The new foundations adjacent to existing structures with below grade floor areas will require drilled caissons/piers to prevent surcharge loading of the existing foundation walls. The drilled caissons/piers will be required along the west side of the new structure adjacent to Costo/West and the east side of the new structure along the northern portion of the Cafeteria/Costo East. The existing structures to remain will require the addition of new foundation walls where the existing below grade portions of the structure are being removed. The new foundation walls will be required along the northern portion of the east wall of the Costo West and the northern portion of the west wall of the Cafeteria/Costo East.

Structural/Service Coordination

Layout of the structural grid will be coordinated with the planning module established for the various building functions. During schematic design, distribution of services will be carefully coordinated with the structural elements, particularly at framing intersections and major crossover points, in order to avoid conflicts, limit penetrations of major structural members, and to optimize the use of available height within the building.

The layout of the lateral load resisting elements, which are anticipated to be steel moment or steel braced frames, will be carefully planned to maintain flexibility of the interior spaces and to provide an efficient structural system.

Structural Issues

The following structurally related issues are to be addressed:

1. The existing buildings were designed in accordance with older building codes that had less stringent requirements than the present building code, especially for the seismic design of structures. Therefore, the seismic design and performance level of the existing buildings probably do not meet the design and performance level of buildings designed in accordance with the present day building code. If the use of the buildings is to be changed from the existing use or the building structures are modified, these buildings may be required to be upgraded to the present building code. Due to portions of the existing buildings being removed, seismic upgrade of the remaining portions may be required.

2. As noted above, modifications to the existing structures to remain, in the form of additional vertical supports and foundations, will be required along the demolition lines.

3. Based on a general and limited review of the structural drawings for the portions of the existing buildings to remain, the following structural issues have been observed and should be addressed:

   a. In general, due to the date the buildings were designed and the building code requirement changes that have occurred since the time the buildings were designed, a review of the seismic design and performance of the structures should be performed.

   b. The Costo Hall building was originally designed for a future floor above the roof. The proposed expansion scheme does not call for this addition therefore the existing building should require minimal effort to bring it into compliance with current codes. However a floor has been added between the original existing first floor and roof to provide a second floor. The structural drawings for the added floor were not provided.

      An addition at the second floor would increase the seismic design loads for the structure and this could be an issue with respect to the present day building code requirements. Review of the structural drawings for the second floor addition should occur as part of the process of the renovation of Costo.

   c. The seismic design of the arcades is based upon the cantilever action of the brick encased concrete columns, concrete encased steel columns, and reinforced brick columns supported by footings and caissons. The seismic performance of the arcade structures should be reviewed where the arcades are to remain.

   d. The seismic demand (force level) has increased since the existing buildings were designed due to changes in the building code requirements. The seismic force demand and the design capacities of the buildings should be reviewed.

   e. The confinement requirements for shear walls have increased since the time the existing buildings were constructed to limit damage and increase performance of shear walls. The design of the shear walls for the buildings should be reviewed.

   f. The detailing of the various seismic load resisting elements and connections of the existing buildings should be reviewed.

3. The elevations of the existing building foundations and the new building foundations should be reviewed to attempt to reduce construction costs. As noted above, new foundation walls will be required where the below grade portions of the existing buildings are being removed and drilled caissons/piers will be required for the new building where it is adjacent to existing below grade structures.

4. The seismic design and performance level of the existing Bookstore should be evaluated to verify the adequacy of the design. This building is not expected to be an issue because it was recently constructed.

5. Seismic/expansion joints will be required between the existing and new structures if the new building is to be directly adjacent to the existing buildings in order to prevent having to seismically analyze and more than likely upgrade the existing structures to meet the present day building code requirements.

6. The site has existing underground utility tunnels, one that traverses the existing Costo Hall building. The location of the tunnels should be considered in the design of the new project.

7. Except for portions of Costo Hall and the Terrace Rooms, it is expected that all new MEP systems will be provided. The anchorage of the existing M/E/P equipment and systems should be reviewed within Costco Hall and the Terrace Rooms as part of the design process.

B. Mechanical, Plumbing, And Electrical Systems

The evaluations, performance criteria, system and infrastructure requirements that follow are based upon preliminary meetings with UCR staff and site or document investigations.
All of this information should be confirmed during the program verification process.
Of particular importance is the project's impact on the various aspects of the campus infrastructure. Specific availability of utility infrastructure, both planned and existing should be reviewed in the context of other campus capital projects.

The mechanical, plumbing, and electrical systems supporting the Commons Expansion will be designed to provide a proper environment for the various activities in the facilities, to assure the safety and comfort of the occupants. Full consideration of the University's Design Criteria and Master Plan for the campus utility infrastructure will be given, to assure the flexibility of the facilities into the future, and their conformance anticipated campus growth objectives.

Primary Utilities Distribution Strategy

The Commons site is located at the historic core and geographic center of the UCR built Campus. The University's long term utility distribution (chilled water and steam) strategy employs a new satellite utility plant and expansion of the Utility Tunnel network. The location of the new building will be closely coordinated with the existing tunnel network to assure efficient utility supply and to avoid physical conflicts.

The existing Central Chilled Water Plant - Chilled Water Generation and Thermal Energy Storage, as well as the distribution system have marginal capacity for this project. The new project will require careful coordination with the Campus Infrastructure Planning on the East Campus, and will consider the following:

- Optimize the ratio of chilled water generation capacity to thermal storage capacity.
- Installing additional chiller capacity.
- Increasing the ton-hours capacity of thermal energy storage by increasing differential temperatures and/or storage capacity volume.
- Increasing the pump capacity to improve the residual pressure and efficiency of the distribution system.

For the purpose of this programming study, the Commons has been considered as a connected load to the existing campus distribution system. The project's impact on all available systems and their distribution network have been identified/quantified accordingly.

Energy and Water Conservation and Environmental Protection

An effort will be made in the design of the mechanical, plumbing, and electrical systems, to maximize the energy conservation and environmental protections beyond the standards provided by the regulatory agencies. Sound judgement must be exercised in the implementation of such measures in order to achieve a balance between initial costs and consequential benefits.

Specific measures and consequential considerations are identified in the mechanical, plumbing, and electrical systems sections that follow.

MECHANICAL SYSTEMS

The mechanical systems are designed to maintain comfort conditions in the spaces, and will be designed to deal with diversity in load in an economic and energy efficient manner.

Location

- Location: City of Riverside
- Latitude: 34°N
- Elevation: 940 feet

Outside Design Conditions

- Summer: 110°F DB/69°F WB (coincident ASHRAE 0.1%)
- Wet Bulb: 75°F WB (non-coincident ASHRAE 0.1%)
- Outdoor Daily Range: 36°F
- Winter: 34°F DB (ASHRAE 0.2%)
- Heating Degree Days: 1,818

Interior Design Conditions

Space Type	Temperature (°F) Summer	Winter
• Administrative zone	78	68
• Retail/enterprise zone	78	70
• Dining/Food service	78	68
• Student service zone	78	68
• Student activities zone	78	68

Minimum Supply and Exhaust Air

- Administrative zone: .... 6 Air Changes per hour.
- Retail / enterprise zone: .... 8 Air Changes per hour.
- Dining / Food service: .... 8 Air Changes per hour.
- Student services zone: .... 6 Air Changes per hour.
- Student activities zone: .... 6 Air Changes per hour.
- Mechanical Rooms: .... 6 Air Changes per hour.
- Toilets: .... 10 Air Changes per hour.

Filtration

All areas: 65% minimum ASHRAE 52.1

Internal Gains

- Initial design occupancy loads (to be confirmed by the design team).
- 1 person per 100 square feet over net usable office and support area.
- Equipment gains will be determined with the users during Schematic Design.

Lighting gains will be determined with the users during Schematic Design. Initial estimates are based on a heat gain of 1.5 W/SF.

Cooling Systems

The initial estimate for the Commons peak cooling load is 600 Tons. The chilled water temperatures shall be $42^o/67^o$F. Variable flow air handling units with cooling coils of low face velocity and pressure drop will provide the cooling.

Heating Systems

The primary source of heating for the Commons is the existing central high pressure steam distribution system. Steam to water heat exchangers at 15 psi steam pressure shall serve the heating coils and food preparation areas.

Air Supply

The offices and administrative areas will have separate air handling systems from all other areas. This will allow the office areas to operate on their own schedule and to be shut down when not in use.

The food preparation and service areas will require specific technical criteria in order to function properly, safely, and within the health code requirements. Where cooking equipment is installed, proper exhaust and ventilation will be required to extract the odors and grease from the cooking and food process areas and discharge that air to the outside of the building.

This ventilation system will also include self-cleaning devices which will be used for the removal of the deposited grease within the ductwork. Proper plumbing will also be required for both hand and pot sinks within the space, as well as floor drains. Proper fire suppression equipment will also be included in this space.

Energy Conservation and Environmental Protection

The key to energy conservation for this type of building is controlling the systems' operation to accommodate diversity in use. This will be achieved by zoning of the air systems and implementing a building automation system.

There is usually significant hard surface area in food service and living room areas, which provides high admittance surfaces for absorbing temperature swings. Running the fans in free cooling mode from midnight through to 6:00 AM in summer will precool the building reducing demand for chilled water the next day. Typical savings for a nighttime cooling strategy are approximately 25% of chilled water demand.

Other measures to improve the Commons energy efficiency/performance are the following:

- High efficiency pumps.
- Variable frequency drives on pumps and fans.

Air and water distribution systems designed with low static pressure drops and significantly reduced fan and pump power requirements.

PLUMBING AND FIRE PROTECTION

The Commons will be provided with all required plumbing and fire protection systems to assure user safety, proper facility functions, and energy efficiency. In general, the Commons will be supported by the following plumbing and fire protection systems.

Domestic Cold Water

Domestic cold water distribution system will supply all plumbing fixtures, and all plumbing and HVAC equipment requiring water. The maximum water supply pressure will be limited to 80 psi by using pressure reducing assemblies. Backflow preventers will be provided where required by the Code. Any new direct buried mains shall be Class 900 PVC per University Standards. Piping above grade shall be Type "L" copper tubing with soldered fittings.

A Civil Engineering evaluation will be required to determine if additional water storage will be required because of this project in order to augment the existing campus water storage system. The maximum anticipated water demand for this project is expected to have be a peak flow of 200 gpm, with an average daily consumption of 2,400 gallons.

Domestic Hot Water

The domestic hot water supply will be provided by high efficiency instantaneous steam water heaters, generating water at a 140°F temperature. Water for general use purposes (hand washing, etc.) will be blended to 120°F and circulated throughout the building. Kitchen facilities will be provided with 140°F water. Any equipment requiring greater than 140°F water will be provided with local booster heaters. Piping shall be Type "L" copper tubing with soldered fittings. All distribution piping will be provided with thermal insulation.

Sanitary Waste and Vent

A complete sanitary waste and vent system will be provided throughout each building in accordance with the Uniform Plumbing Code. A gravity system will be provided for fixtures above grade and where it is possible to meet the invert elevations of the Campus sewer system. Sewage ejectors will be provided for fixtures below the Campus sewer invert elevations.

The maximum anticipated additional sewer load from this project is 0.44 CFS.

Piping material will be no-hub cast iron above grade, and service weight hub-and-spigot below grade. Direct buried pipe shall be either RCP or Class 900 PVC per University Standards.

Estimated Plumbing Fixture Requirements

The number of plumbing fixtures provided should comply with current UPC requirements and, more importantly, be sufficient in number and locations to meet the actual population of the Commons and associated outdoor gathering spaces. The following usage table assumes that there will be some overlap of uses and that the population is 50% male, 50% female.

Program Element		Planned Population	Men's			Women's		D.F.
			W.C.	URN	LAV	W.C.	LAV	
Admin. / Student Use (3 levels)		300	6	3	3	6	3	2
Food/Assembly- (Ground)		800 + 400= 1200	4	4	3	13	3	4
Assembly- (Upper Level)		800	3	3	2	11	2	3
Food Service Staff		50-60	2	1	1	3	1	-
Totals			15	11	9	33	9	9

Kitchen Grease Interception

The kitchen will be provided with a Code required grease interceptor to separate grease from the kitchen drainage prior to entering the sanitary system. These grease interceptors tend to be quite large, depending on the size of the kitchen, and will be located outdoors in an accessible utility area.

Storm Drainage

The storm drainage system will be sized for 2 inches per hour rainfall in accordance with County of Riverside requirements. The system will provide a gravity drain of all roof areas, overflow, and plaza areas. The storm drain piping will be connected to the Campus storm drain system. Areas below the storm drain system elevation will be provided with sumps, sized to retain a minimum of one-half hour rainfall at a rate of 4 inches per hour. Pumps and discharge piping will provide the drainage of these sumps into the Campus storm drain system.

Piping material will be no-hub cast iron above grade, and service weight hub-and-spigot below grade.

Foundation Drainage

A "French Drain" porous wall piping system will be provided to protect the building foundations from ground water. This system will be connected to the building's sump pit via a sand interceptor.

Natural Gas Distribution

Natural gas supply will be provided to the kitchen facilities, and any other gas fuel burning equipment. The gas service will be provided with gas meter, pressure regulator, and earthquake valve, as required. Piping shall be threaded black steel for low pressure systems and welded steel for high pressure systems. Piping shall run in the Utility Tunnel and shall not be direct buried.

Fire Protection

The project will be provided with a fire service connected to the nearest practical water main (please refer to "Site Utilities"). A post indicating valve, double check valve assembly, and fire department connection will be provided outside the building.

The building will be protected by a hydraulically calculated, automatic wet sprinkler system, based on light or ordinary hazard standards, as occupancy dictates. The maximum sprinkler zone shall be 52,000 square feet with a dedicated sprinkler control valve, flow switch, and drain valve. Light hazard areas will be designed to 0.1 gpm per square foot for any area over 1,500 square feet, while ordinary hazard spaces will be designed to 0.15 gpm per square foot for the same area requirement, unless otherwise required by the Campus Fire Marshal.

Pre-action sprinkler systems will be considered to accommodate sensitive areas as required. The panels in the electrical rooms are to be protected with water shields.

Fire standpipe systems and associated fire pumps will be provided where dictated by occupancy or Campus requirements.

The actual fire sprinkler systems provided are subject to the approvals of the Campus Fire Marshal.

Energy Conservation and Environmental Protection

The following systems will be considered for implementation wherever it is practical to do so.

Maximum Water Conservation

Water conserving plumbing fixtures with high efficiency control technologies. These include water closets, lavatory faucets, low flow showerheads, etc.

Electrical and Telecommunication Raceway Systems

The electrical systems will provide support for all the facilities within the Student Center and will include the following:

- Lighting (interior and exterior)
- Power (normal and emergency, 277/480V, 120/208V, 3-phase, 4-wire)
- Signal systems: Fire alarm, telecommunication raceway systems, and security

Design Loads

The preliminary estimated loads for the entire Commons Expansion are obtained by assigning unit loads per square foot (VA/SQ. FT.) based on today's usage and with considerations for future growth. The basis for the connected loads is as follows:

- Lighting: 2 VA/SQ. FT.
- Receptacle & Office Power: 4 VA/SQ. FT.
- Chillers: 0 VA/SQ. FT. (Chillers in Central Plant)
- HVAC Fans & Pumps: 4.5 VA/SQ. FT.
- Plumbing: .5 VA/SQ. FT.
- Misc. (Fire Alarm, Communication, Security) 1 VA/SQ. FT.

Total 12 VA/SQ. FT.

The following is a summary of the preliminary load estimation for the Commons Expansion. This will be updated as additional information is received.

Items	Sq. Ft.	VA/Sq. Ft.	KVA	15% Margin Allowable	Total KVA
Existing to remain	50,000	12	600	90	690
New Construction	100,000	12	1200	180	1380
Sub Total					**2070**

The total estimated load for the Commons Expansion is 2070 KVA. This load will be distributed to each building by using pad-mounted transformers or secondary unit substations. The transformer size for each building will be determined based on occupancy, usage, and building size. The following are the recommend transformer sizes for planning and budgeting based on estimated loads:

Existing Building: 1000 KVA
New Building: 2000 KVA

All transformers will have 480/277V, 3-phase, 4-wire secondary. With better defined loads and building configurations, it may be possible to reduce the size of transformers.

Power System

The existing Campus power distribution systems are a combination of 5KV and 12KV feeders through Utility Tunnels and underground ductbanks. The existing 5KV system will be ultimately converted to a 12KV system. New 12KV feeders via underground ductbanks and manholes will be provided for future expansions.

The electric services to the existing Buildings and the Costo Hall are from the existing 5KV systems via tunnels. These 5KV services are obsolete and will be removed. The new electric service for the Commons (both existing and new construction) will be obtained from the 12KV campus distribution via underground ductbank. This system will be accessed by the planned feeder ductbank running south toward the existing north side of the Commons (See site utility dwgs. for location). It is assumed for this study the electric service manhole with 12KV feeders will be available for this project.

Main Power Distribution

Each building will have a main electrical room. This electrical room will contain both main switchboards and distribution boards. Dry-type step-down transformers will be provided to obtain 208/120V power. Electrical closets will be provided on each floor for lighting and power panels and step-down transformers as required.

The building power distribution will be at 277/480V and 120/208V via cable feeders in conduits and will be distributed as follows:

- 480V, 3-phase, 3-wire for all motor loads 1/2-horsepower and larger.
- 277V, 1-phase for fluorescent lighting and HID fixtures.
- 208V, single phase or 3-phase for special equipment.
- 120V, single phase for receptacle outlets and motors smaller than 1/2-horsepower.

The main switchboard will be 277/480V, 3-phase, 4-wire and will be located in the main electrical room. The main switchboard will be rated 3000A for the 2000 KVA transformer, and 1600A for the 1000 KVA transformer.

277/480V distribution boards and feeders will be provided for service to the elevators, pump rooms, lighting panel boards, and motor control centers.

Motor control centers and/or distribution boards for mechanical equipment will be provided for each mechanical area.

Emergency Power

Emergency power will be provided for exit and egress lighting, fire alarm systems, fire pumps, security systems, communication systems, elevators, building management systems, and other equipment required by the University of California at Riverside.

The current UCR approach for emergency power is to provide a diesel generator set for each building. The size and quantity of generator sets will be determined when loads and building configurations are defined. Outdoor generator sets with sound-attenuated weatherproof enclosure and diesel tank are recommended.

Grounding System

Main grounding electrode systems will be provided for all the switchboards and transformers. All grounded busses in the power system and in the communications rooms will be connected at a main grounding bus in the electrical room.

Lighting

The lighting levels will be designed in accordance with Illuminating Engineering Society (IES) recommendations. The lighting power density will be less than that mandated by the California Code of Regulations (CCR), Title 24 - Energy Conservation Regulations. The following lighting levels will be used as the basis of design, with some variation depending on ambient factors:

Room	Maintained Lighting Levels At The Work Plane (Foot Candles)
• Retail enterprise zone	80 - 100
• Conference/meeting space	40 - 50
• Offices/student workplaces	40 - 50
• Dining/food service	30 - 50
• Corridors/lobby	20 - 30
• Toilets	30 - 40
• Electrical/Mechanical spaces	20 - 30
• Student activities zone	40 - 50

Light fixtures in conference rooms, offices and electrical/mechanical spaces will be fluorescent type with T8 lamps and electronic ballasts. Compact fluorescent light fixtures will be used where applicable.

Light fixtures in offices and public toilets will be controlled by occupancy sensing devices. Multi-purpose rooms will have dimming systems.

Lobbies and dining areas will make use of decorative fixtures, but care will be taken to minimize energy usage. Public space and corridors will be controlled by low voltage lighting control systems.

Special lighting fixtures will be provided for the entertainment areas.

Exit signs will be LED type.

Exterior lighting will be high intensity discharge and will be controlled by photo cells and time switch.

Fire Alarm System

An addressable fire alarm system matching UCR campus standards and ADA requirements will be provided and consist of the following:

- A main fire alarm control panel located in each building.
- Ceiling mounted smoke and heat detectors in all the electrical and mechanical rooms, electrical closets, elevator lobbies and in return air ducts in accordance with code and as required by UCR.
- Audio-visual alarm stations will be provided along all egress routes, toilet areas, lobbies and other areas of assembly.
- Pull stations will be provided along egress routes.

The fire alarm system will be linked with elevators for return to a predetermined floor, and the mechanical air supply system for shut-down, in the event of fire alarm signal.

The fire alarm system will also be linked to the sprinkler flow switches and valve monitors.

The fire alarm system will be connected to the campus main fire alarm system through a telephone interface. All devices shall be addressable.

The fire alarm system is subject to the approval of the Campus Fire Marshall.

Security System

Door contacts, card key access, and alarm in a central panel will be provided for the Security System.

All wiring will be in a separate Security Conduit system.

The security alarm will be connected to the UCR campus security department by telephone.

The security system equipment will match the existing UCR campus security system.

Telecommunications Raceway Systems

Empty conduits will be provided from site telecommunication manholes to each building for incoming cables. Empty conduits will also be provided between buildings for inter-connecting cables as required.

All empty conduits will be provided with pull cord.

Telecommunication closets will be provided per UCR telecommunication service requirements. Backboards, ground bars, and receptacles will be provided. Riser conduits and/or sleeves will be provided for vertical distribution cabling. Cable trays will be provided for horizontal distribution cabling.

Outlet box with empty conduit and pull cord up into accessible ceiling will be provided for each communication outlet.

Energy Conservation and Environmental Protection

The electrical systems will be designed with high efficiency fixtures and equipment in order to maximize energy conservation.

- Use high-efficiency fluorescent light fixtures with electronic ballasts and T-8 lamps.
- Use Metal Halide fixtures for outdoor and high-bay lighting.
- Use dimmers, timers, and occupancy sensors to reduce lighting energy consumption.
- Use high-efficiency motors.

C. Site Utilities

The Student Center will be supported by the existing site utilities (please refer to attached diagrams).

Electrical

The existing Campus power distribution is a combination of 5KV and 12KV systems via Utility Tunnel and underground ductbanks. UCR will ultimately convert the entire campus distributions to 12KV system. New 12KV feeders via underground ductbanks and manhole will be added to accommodate load requirements for future expansion.

The electrical services to the existing Buildings and Costo Hall are from existing 5KV service via tunnels. These services are obsolete and will be removed. New 12KV services will be provided via underground ductbanks to the Commons Expansion, for both the existing portion and the new construction.

This system will be accessed by the planned feeder ductbank running south toward the existing north side of the Commons (See site utility dwgs. for location). It is assumed for this study the electric service manhole with 12KV feeders will be available for this project.

Chilled Water

The estimated cooling load for Commons is 600 tons of refrigeration. Currently the central Campus distribution system has a 6" connection to the mechanical room in the cafeteria that provides service to the existing Commons and Bookstore, for a total of 170 tons of refrigeration. A possible connection to the Campus distribution system is represented by the main 10" chilled water line in the Utility Tunnel south of the project site. This requires a future extension of the chilled water network, as a part the Campus Master Plan.

Steam

The central UCR Campus distribution system is the source of high pressure steam to the site. The existing Central Plant has adequate capacity to provide service for this project. The steam distribution system provides 100 psi steam to the buildings via a piping network in the Utility Tunnel. Estimated total steam demand for the Commons is 5,000 lbs per hour. Current demand from the existing buildings is approximately 1,700 lbs per hour and is provided by a 3" HPS and 2" condensate line return through the Utility Tunnel from the Physical Science Building.

Sanitary Sewer

The sanitary sewer nearest the site is a 15" sewer line in North Campus Drive, which flows east to west. There is an additional 8" sewer line in Eucalyptus Drive which also flows east to west. The apparent potential bottle-neck in the system is represented by the 15" city sewer line in University Drive. The maximum anticipated sewer load identified in the Sanitary Waste and Vent discussion above of 0.44 CFS may exceed the existing City sewer system capacity at this point.

A Civil Engineering evaluation is required to determine if this added flow will create a problem in the existing sewer lines.

Storm Drain

The site appears to be well served by a very substantial storm drain system. North Campus Drive has two parallel storm lines, one 72" and one 39" in diameter. There is an 18" drain that increases to 24" in Eucalyptus Drive. There are numerous catch basins and storm connections within the vicinity of the site.

Natural Gas

There is existing high pressure natural gas piping in the Utility Tunnel on the south side of the project site. The service is 4" in size. A 1-1/2" lateral branch feeds the Physical Education Building from valve station 6. A 2-1/2" lateral branch feeds Pierce Hall from valve station 5. A 1-1/2" lateral branch feeds the existing building from Pierce Hall via a Utility Tunnel.

Telecommunications

UCR is planning to install a new fiber optic backbone for the telecommunication system concurrent with the new 12KV electrical distribution system. The new telecommunication service for the Student Center will be obtained from the ductbanks and manholes of the new telecommunication backbone installations.

D. Food Service Program

A major component of the Commons expansion project will be related to the food service program. The other food service venues on campus consist of “The Barn” and the residence halls. The commons represents the largest percentage of transactions on campus. It is envisioned that part of the existing food service facility will remain in operation during phase one of construction. Three of the most popular venues will be closed at the beginning of construction. Therefore, additional alternative food service venues will need to be provided for students and staff during this time. The University will continue to operate the food service facilities, as is current practice.

The current student population is approximately 13,500 with a projected growth to 21,000 students in 2010. This translates into a 64% growth factor. Currently the student commons handles 4,000 to 5,000 transactions per day with approximately 40% of them occurring between 12:00 and 1:00 p.m. Using the growth factor as a guide the future transactions will total 6,500 to 8,200 per day. Similarly, 2,600 to 3280 of these transactions will occur between 12:00 and 1:30 p.m. The student survey indicated that use of the food service facilities would increase after completion of the renovation. The survey also indicated that 42% or more of the transactions would occur between 12:00 and 1:00 p.m. The seating capacity to support this level of usage should total 1,300 to 1,800 seats. As many of these seats as practical should be indoors. There is also a need for queuing, circulation and waiting areas at the serving platforms. This area can be calculated by various means, such as a percentage (50%) of the platform area or increased square footage allowance (18 to 20 sq. ft. per seat) in the dining area. However, it must be included in the area calculations.

Conceptually the food service program will be comprised of several “themed” service platforms in the primary food service area. Each platform will provide a unique menu. The following “themes” have been identified as the anticipated platforms: hamburger & fries, Latin, Asian, Italian, delicatessen, coffee house and convenience store. There is also a desire to satisfy the “lighter” menu requirements, i.e. soup and salad bar, vegan, etc. This may require the addition of another platform. The platforms will be presented in a “Marché” concept. Each platform will incorporate the most current styles of exhibition cooking, open kitchen, product merchandising and “just in time” food preparation. Some platforms will include space for preparation work in addition to finish cooking and display space. The Italian platform will have exhibition cooking with a wood-fired pizza oven and a pasta and sauté station. The Asian platform would also have a display cooking station with a wok range. Flexibility will be designed into each platform through the use of moveable equipment with quick disconnects and utility distribution systems. At least part of the facility will be designed for the potential of 24 hour operation. The most likely platforms for 24 hour operation are the coffee house and convenience store. The convenience store will utilize “market” type merchandising, and incorporate vegetarian and deli fare.

There will be other food service venues in the student commons. A grille will be included in the “games area”. The facility will have its own preparation and cooking area with seating for 100 people. A “cyber café” will be operated as a separate entity. Limited food and beverage service will be available. There will be 50 seats in the space.

The main kitchen of the new facility will function quite differently than the current main kitchen. Since the platforms will perform the majority of the finish cooking, the main kitchen will be limited in its scope. The basic receiving, dry storage, refrigerated storage, vegetable preparation, prep cooking, baking and utensil washing areas will be located in the kitchen. There will be a very limited catering function supported by the main kitchen. The space allocated for the main kitchen will also provide the staff dressing rooms and restrooms. Office space for the cash room, catering office, food service managers and the chef will be required. The cash room, catering office and managers’ office will need to provide adequate space for 3 people. The chef’s office will be a single person office. Additionally, a dedicated meeting room approximately the size of a small office is required for food service personnel.

Space requirement summary:		ASF
1.	Seating (indoor), 700 at 16 sq. ft. per seat	11,200
2.	Main Food Court	
	"Food Area"	
	2.1 Italian	500
	2.2 Latin	400
	2.3 Burger & Fries	400
	2.4 Asian Platform	700
	2.5 Food Queuing, waiting and circulation @ 50% of @. 2.1-2.4	1,000
	"Retail Area"	
	2.6 Delicatessen	300
	2.7 Vegan/Salad	400
	2.9 Convenience store (market)	700
	2.10 Retail Queuing, waiting and circulation @ 50% of @. 2.6-2.7	350
3.	Grille, at games area	
	4.1 Seating, 100 at 16 sq. ft. per seat	1,600
	4.2 Food prep/finish cooking	1,000
4.	Cyber café	
	5.1 Seating, 50 at 18 sq. ft per seat	900
	5.2 Service Platform	700
5.	Main Kitchen	5,400
6.	Banquet holding/service pantry (adj. to multi-purpose)	1,200
7.	Office/support, 3 spaces at 120 sq. ft. each	360
8.	Cash Room	120
9.	Conference Room	120
10.	Storage Area	1,000
11.	Shipping and Receiving (indoor space inc. recycling)	750
12.	Staff Lockers 2 @ 200	400
Food Service total		28,600

In addition to functional requirements, all food service facilities will be designed to comply with current plumbing, mechanical, fire suppression and health codes. This includes requirements for wet and dry sprinkler systems, hoods over cooking areas and associated exhausts, staff support (lockers, handwashing, etc.). Food preparation areas will require washable and high-reflectance wall and ceiling surfaces, and quarry tile (or equivalent) floors and base.

The selected equipment will be capable of supporting HAACP (Hazard Analysis and Critical Point) certification. Proper utility services, i.e. electrical, gas, water and waste lines must be provided to the proper locations. A major consideration for food service operations is the installation of a grease interceptor.

The equipment specified will be of the most current manufacturing standard and exemplify the “state of the art” for food service equipment. Considerations in specifying the equipment will be production capacity, efficiency, versatility, cleanability and durability. There will be a high percentage of custom fabricated equipment specified in the various food service venues. The exhaust ventilators will have “wash down” cycles to remove grease on a regular basis. Several equipment items, typically pot washing and ware washing equipment, will be specified to reduce labor costs. Most refrigeration equipment will be connected to a remote refrigeration rack. This will reduce the “heat gain” in the food service spaces.

Typical Equipment associated with basic food preparation tasks is as follows:

Dry storage shelving
Walk-in coolers and freezers
Storage shelving for walk-ins
Blast chillers
Mixers
Exhaust ventilators
Janitors sinks
Hand sinks
Rethermalizing ovens
Work tables
Preparation tables with sinks
Plicers
Vegetable cutters
Pot and pan washing equipment
Cart wash area

The equipment required for the pantry includes the following:

Hot food cabinets
Reach-in refrigerators
Work counters
Coffee maker
Ice and water station
Hand sink

A partial list of food service equipment associated with the food court is listed below.

Storage shelves
Work tables
Reach-in refrigerators
Exhaust ventilators
Fryers
Broilers
Refrigerated assembly counters
Wood burning pizza oven
Steamers
Blenders
Wok range
Pasta cooker
Refrigerated prep tables
Coffee makers
Iced tea brewing/dispensing equipment
Customer service counters
Refrigerated display cases
Ice cream dipping cabinets
Sandwich prep tables

Ice machines
Walk-in refrigerators
Reach-in freezers
Pot & pan wash sinks
Griddles
Fry dump stations
Convection ovens
Tortilla warmers
Panini grill
Juicers
Mongolian Grill
Fire and ice station
Food warmers
Soda dispensing equipment
Cash registers/point of sale stations
Work counters
Dry display cases
Self serve salad bar
Condiment stations

A partial list of equipment required for the banquet follows:

Banquet serving carts
Roll-in refrigerators
Dish-up counters
Beverage service counters
Ice and water stations
Rack dollies
Clean dishtable
Dishwasher, conveyor
Booster heater

Queen Marie carts
Roll-in freezers
Heated holding cabinets
Coffee makers
Dish carts
Soiled dishtable
Disposer
Rack sort shelf
Storage shelving

Typical equipment required for the Coffee House/Café is as follows:

Service counter
Dry display case
Coffee maker
Work counter

Refrigerated display case
Espresso machine
Condiment counter
Display shelving

E. Communications Systems

The Communications systems outlined in this section of the report will be considered for both new construction and the renovation of the Commons. The Communications Systems for UCR's Commons will support the following systems:

Data network, including academic and administrative computing
Telephone services

The systems will be fully integrated with the campus' existing telephone and data network systems and will be based on the University's standards. They will be designed to be flexible, accessible, resilient and easy to manage. The systems will be supported by a cabling infrastructure that will include high performance copper and optical fiber cabling.

Additionally, consideration should be given to emerging wireless data systems, particularly for local area networks such as the cyber café.

Since communications technology is a rapidly evolving field, it is important that the planning and infrastructure:

Provide for evolution and change throughout the life of the facility
Be coordinated with the UCR computing and communications staff to reflect specific performance and technical requirements.

Communications Rooms and Associated Infrastructure

The following rooms will be required to support Communications Systems throughout the Commons:

- **Communications Distribution Rooms (Telecommunications Closets - TCs)**

Communications Distribution Rooms housing patch panels and termination frames will be required on each floor, with each set of rooms vertically stacked if possible. Standards dictate that the maximum cable run from these rooms be no more than 300 feet, therefore, multiple rooms may be required within a building with a large floor-plate. TC's will be necessary in both the new construction and possible in the renovated areas of the Commons. These rooms will also house active network electronics and will act as the transition point between the horizontal and backbone communications cabling.

Equipment racks will be provided in each room to house patch panels and network equipment. In addition, backboard (8'H x 3/4"D fire retardant finished grade plywood) will be provided lining the walls of each room to support wall-mounted equipment.

Each room will be environmentally controlled (temperature and humidity) and will be locked to prevent unauthorized access. A signal ground bar will be provided in each room. Both isolated ground and normal power receptacles will be provided around the perimeter of each room. Individual 20A circuits will also be provided for each equipment cabinet.

The Telecommunications closets will be sized at a minimum of 60 square feet. However 80 square feet is recommended.

- **Main Communications Distribution Rooms (MDF)**

An MDF will be required in each building, which will house main patch panels and Main Termination Frames and support building-wide network servers and other resources. This room is typically located on the first floor of the building and will support the cabling connection point to the main Campus-wide voice and data networks.

Equipment cabinets will be provided in the room to house patch panels, network equipment, servers and associated equipment. In addition, backboard (8'H x 3/4"D fire retardant finished grade plywood) will be provided to support wall-mounted equipment and termination frames.

The room will be environmentally controlled (temperature and humidity) and will be locked to prevent unauthorized access. A signal ground bar will be provided in the room. Both isolated ground and normal power receptacles will be provided around the perimeter of each room. Individual 20A circuits will also be provided for each equipment cabinet. Should Emergency Power be required to support these systems in this room, it can be provided by installing standalone dedicated Uninterruptible Power Supply (UPS) or utilize a building wide UPS system.

The MDF will be sized at 80 square feet of usable floor space for the 1st 20,000 square feet of usable building floor space. An additional 5 square feet will be added for each additional 10,000 square feet of usable building floor space.

- **Communications Infrastructure**

The communications rooms (MDF and Telecom Closets) will be connected by a series of risers and horizontal connections, which will be sized to support both Day One needs and future requirements. This distribution system will be supported throughout the Commons with a series of dedicated cable trays and conduits.

At each Communications Outlet location, a 4-11/16" x 4-11/16" x 2-1/8" electrical backbox will be provided. A double-gang mud-ring will be provided on each backbox. A 1" conduit will be provided from each outlet backbox, complete with a pull wire. No outlets will be daisy-chained. Each conduit will run to a 12"W x 6"H cable tray that will run along the major corridors in the ceiling space. These trays will route cabling from each outlet to the nearest communications room and will also support cabling running between communications rooms on the same floor. The overall strategy for routing communications cabling throughout the facility will be based on a distribution system in the ceiling voids.

In some locations requiring the extensive distribution of power and data services, consideration may be given to providing a raised flooring system to support a wide range of furniture configurations and layouts. Outlets would be provided in floor boxes mounted in the raised floor, allowing users to connect as required. In these areas, a chase would be provided in an appropriate wall to allow cables to transition from the ceiling void to the raised floor void.

- **Communications Cabling Infrastructure**

The communications cabling infrastructure will be based on the following design guidelines:

1. The cabling system will be standards compliant (EIA/TIA 568A and UCR Campus standards).

The system will provide universal access throughout the facility. Communications outlets will be provided throughout.

2. The cabling system will provide a high level of flexibility and resilience.

3. The cabling system shall include high performance copper and optical fiber cabling, as well as wireless systems where appropriate.

Communications Outlets will be provided throughout the facility. Each outlet will support voice, data and digital media connectivity.

4. Backbone connectivity will be supported by multipair copper cabling for voice applications and optical fiber cables for data. These cables will run from each Telecom Closet to the MDF. Typical configuration will be:

   - Multipair telephone riser cables, with two pairs provided in the riser cable for each telephone outlet supported.

   - Singlemode and Multimode optical fiber cables to support backbone network connectivity, with connections to the other Telecom Closets on that floor as well as to the MDF Room.

F. Audiovisual Requirements

This report addresses the audiovisual requirements anticipated in the Commons Expansion and it describes the impact of those technologies on the architectural planning and design of the buildings. Additionally, this report identifies critical acoustical considerations, with emphasis toward the acoustical impact of multimedia technologies on the buildings' design and construction. Information is presented with the principal aim of informing the budgeting, planning and architectural design efforts of the project.

Scope of Technical Considerations

It is important to identify the specific scope of technologies and issues to be addressed within the considerations of this report.

As electronic media and computing technologies continue to converge and become increasingly critical aspects of the academic environment, it can be difficult to draw a clear line distinguishing audiovisual technologies from other information and communication technologies. For the purpose of this report, audiovisual (AV) technology is considered to include all architecturally integrated, individual room-based media systems. This includes audio and video media presentation, large screen computer display, voice reinforcement, film projection, teleconferencing, and distance learning sound/image origination and associated control systems. Areas which are addressed within this report include the Movie Theater, Performance Auditorium, Multipurpose Event Room, Meeting / Conference Rooms, and Breakout Rooms.

This report does not address the integration of broadband media distribution (e.g., off-air, cable or university broadcast television), telecommunications systems (e.g., satellite, microwave, voice communications and data networking), electronic computing (e.g., client/server systems, peripherals) and structured cabling systems.

This report also outlines critical acoustical issues with consideration for the general use spaces, Auditorium, as well as building shell improvements (e.g., new windows), building interior improvements, new building services (e.g., electrical, HVAC, plumbing, etc.). Particular emphasis is placed on the impact of media technologies on the design and acoustic performance of the buildings. Information provided is of a general nature and is not based on any specific technical analysis of proposed building designs or site conditions.

Basis of Analysis and Recommendations

This analysis of AV and acoustic requirements for the UCR Commons Expansion project is based on information provided in the Program Summary – First Draft, dated February 1, 2001.

Architectural Integration

The integration of sophisticated media and information technologies into any architectural environment presents a wide range of technical and architectural issues to be addressed during the building planning and design processes. These issues are particularly complicated in the context of college and university buildings due to the long occupancy cycles and the limited availability of resources for future building and infrastructure improvements. It is critically important to recognize that the successful implementation of audiovisual capabilities is as much a function of the architectural environment and the building infrastructure as it is a function of the AV systems themselves. Based on this premise, the information presented in this section will identify the specific elements of the architectural design that will be key to the University's ability to ultimately realize the highest level of value from their investment in AV technology for the Commons Expansion.

Space Planning

Consideration of AV issues during the space planning process will be essential to the successful architectural integration of the AV systems and capabilities. Critical adjacencies of technical areas and support spaces must be addressed, as well as consideration for the adjacency of incompatible activities and systems. For example, care must be taken to ensure that audiovisual equipment rooms and sensitive audio/video electronics are not located in proximity to electromagnetic fields, as might be generated by electrical transformers, motors, elevators and some lighting equipment. These concerns are relevant both horizontally and vertically within the building. Within individual audiovisual areas, analysis of audience sightlines to image displays, evaluation of image sizes and proper positioning/configuration of audience/student seating arrangements will all play an important role in maximizing the effectiveness and efficiency of the AV systems. In addition, it will be necessary to explore alternative image display systems for each application to ascertain the most appropriate arrangement (e.g., front v. rear projection, monitor v. projection, CRT v. flat panel). The need for equipment rooms, closets, cabinets and other forms of technical equipment containment must be assessed.

Electrical

Audiovisual electrical considerations fall into two general categories: line voltage and low voltage. Line voltage electrical, or "Technical Power," addresses the requirements for 110 - 277 VAC, 60 Hz power and electrical grounding service to technical equipment such as audiovisual systems. Specific requirements for power service to communications, data networking electronics and other technical equipment not addressed within this report will be provided by others. Low voltage electrical considerations refer to media and equipment control signaling.

a. Technical Power

Normal line voltage power service for AV equipment is 110 volts alternating current (VAC). Some equipment, such as high-intensity video/data projectors, may require higher voltage power service (e.g., 220 VAC). Fluctuations in Technical Power voltages shall not exceed +/- 10%. Power conditioning, surge suppression or other protective measures should be employed where necessary to maintain the quality of Technical Power service. All branch circuits and individual Technical Power receptacles within each individual classroom and associated technical support area must be wired to a common phase leg from the electrical transformer. Any audiovisual systems within the building that require uninterrupted power service will be equipped with integrated UPS units to enable orderly shut-down of the systems. No building UPS service or emergency generator power is anticipated to support the audiovisual systems.

b. Grounding

Technical Power service shall provide a dedicated ground with a separate insulated copper ground wire from each receptacle to the Technical Power ground busbar at the electrical panel board. Technical Power receptacles must not be grounded to the building structure.

The general audiovisual presentation systems in the UCR Commons Expansion will not require true isolated grounding with service distribution from an isolation transformer. However, it should be noted that other technologies and special systems within the Auditorium may require more stringent grounding and power service (e.g., theatre systems, broadcast systems). Electrical power service, including grounding, to all technical systems and equipment within the building should be considered comprehensively. In doing so, it may be prudent to upgrade the standard of power service to the audiovisual equipment in order to maintain a consistent quality of service to technical systems throughout the facility. In no case, however, should the Technical Power service to the audiovisual systems provide a lower standard of performance than identified herein.

c. Low Voltage Cable Containment

All low voltage cabling for AV systems will be routed through conduit, wireways or other containment. No plenum cabling will be used. The project electrical contractor will be expected to install the conduit required for all AV cabling. Pull wires are to be installed in the AV conduit by the electrical contractor to facilitate later installation of the low voltage cable by the AV contractor. All conduits specified to support the audiovisual systems shall be EMT type above grade and galvanized rigid steel with PVC coating below grade. Flexible metal conduit may be used above grade in runs of less than ten feet (10').

The depth of AV connection boxes and conduit diameters may require non-standard wall depths in some locations. Such conditions will be identified at a future date.

Flush floor power distribution outlets and signal connection boxes will be required at locations where connections cannot reasonably be made at wall outlets. The size and density of cabling and connections will preclude the use of standard "poke-thru" type fittings. Every effort must be made in the planning and design process to minimize the need for large floor electrical boxes. Where oversized flush floor electrical connections are specified for AV applications, consideration must also be given to the structural and other building design implications.

d. Low Voltage Remote Control Interfaces

Some line voltage electrical devices (e.g., projection screens, window coverings, lighting control systems) may need to be operated by low voltage AV control systems. This transition between line and low voltage systems will require specification of suitable interface electronics and may be accomplished by the use of relays, or serial control interface devices. Specific conditions will be identified as they become known.

e. Miscellaneous AV Electrical

AV systems will frequently interface with other systems such as telephone and computer networks. Coordination between the AV Consultant, the AV Contractor and other consulting disciplines and construction trades will be essential in achieving a smooth integration of the various systems.

Lighting

Lighting is an extremely important consideration in developing an effective audiovisual environment. Such issues as light levels, color temperature, angles of incidence, control circuiting and switching all impact the quality of an AV production or presentation. The following specific factors should be taken into consideration:

a. Visual Displays

Where visual image display systems (e.g., monitors, projection screens) are utilized it is imperative that consideration be given to the impact of room lighting conditions on the quality of the image display. Where window glazing allows exterior daylight or lighting from adjacent interior spaces into an AV space, blackout window coverings should be provided.

Lights in AV rooms should be circuited to allow fixtures adjacent to projected images to be turned off during projection.

The potential for glare from architectural lighting and windows onto video/data monitors should be considered during fixture specification and placement.

Light fixtures should provide maximum directivity of illumination and minimal surface brightness to reduce the opportunity for glare and distribution of unwanted light onto image display screens.

Special precautions must be taken to control lighting where video camera systems are used in association with image displays (e.g., video teleconferencing, distance learning). See Video Camera Lighting for additional information.

b. Video Camera Lighting

- Lighting for video camera systems is critical at locations using video teleconferencing, distance learning, videotape recording and other video camera applications. The following shall be considered:
- Lamp color temperature for video camera lighting shall be in the range of 3000 - 3400 degrees Kelvin. All lamps used for video camera lighting within a given room shall be of the same color temperature specification.
- Illumination levels for video camera lighting should provide a minimum of 50 footcandles illumination at the vertical facial plan of the subject.
- Provide illumination of background surfaces located behind camera subjects to enhance the separation of the subjects from the background in the camera's view.
- Provide preset lighting controls with low voltage control interfacing to AV system controls in all rooms with video camera systems. This will allow preset configuration of the lighting system to proper levels for video camera applications. Ties to the AV control system will facilitate automatic switching to the video lighting configuration when the camera system is activated from the AV control system.
- Special caution must be taken in distance learning and video teleconference facilities to avoid conflicts between image displays and camera subject illumination. This issue is particularly difficult in distance learning where instructors like to move around the classroom while they lecture; often taking them in proximity to a projected image display which must be located in a darkened area.

c. Presenter Illumination

In formal AV presentation rooms or instructional areas where a presenter will be speaking while lights are dimmed for image projection, it is advisable to provide spotlight illumination of the presenter. Placement and orientation of the lighting must be carefully considered to avoid conflicts with AV image displays.

d. Lighting Controls

It should be the objective of lighting control systems installed in AV presentation facilities to make operation of the lighting systems as simple as possible so that adjustment of the light levels does not become a distraction from the presentation. The challenge to achieving simplified lighting control in AV spaces is compounded by the fact that lighting systems in these facilities are generally more complex than those with which most people are familiar. To make operation of the lighting controls in AV spaces as simple as possible, it is recommended that preset control systems be installed where more than three control circuits are required and in all formal presentation and instructional spaces.

e. Task Lighting

Lighting in instructional areas and meeting rooms generally must provide illumination of work surfaces for note taking and interaction among the room occupants during media presentations. Such task lighting should be designed to provide appropriate levels of illumination at the work surface with minimal diffusion onto adjacent surfaces in order to prevent deterioration of image display quality. This is particularly critical in facilities utilizing front projection display systems.

f. Daylight Control

Where windows are provided in instructional areas, meeting rooms and other AV presentation environments, blackout window coverings must be provided. Standard window blinds and sun shading devices are typically insufficient for controlling daylight intrusion in visual display environments. In facilities with direct sun exposure, edge and bottom channels are recommended on blackout window coverings to prevent light leakage at shade perimeters. Where a large number of individual blackout window coverings are provided or in more formal environments, it is recommended that the window coverings be motorized with remote control capability tied to the AV system controls. This will help avoid distraction of the presenter/instructor and delays in the presentation when it becomes necessary to darken the room.

Furniture and Millwork

The current and future technology associated with audiovisual systems of the nature of those proposed for the UCR Commons Expansion are typically associated with a substantial amount of specialized millwork and furniture systems. During design, consideration should be given to allow the present or future integration of the following types millwork and furnishings described below.

a. Tables

Where appropriate, accommodations should be made for AV and computing equipment within meeting room or conference room tables. The following issues should be considered:

- The shape of conference and meeting room tables should take into consideration the necessity of viewing image displays as well as the instructor/presenter and other meeting/class participants at the table(s). Traditional racetrack conference table shapes and linear seating arrangements do not address this requirement very well.
- For any facilities that may be deemed suitable/appropriate for teleconferencing capabilities, tables used in video teleconferencing rooms must be shaped to position the meeting participants directly facing the primary camera position. This generally limits the number of primary conference participants to less than eight (8) people. In applications requiring more than eight (8) participants, it is advisable to distinguish between primary participants, secondary participants and observers. This allows a hierarchy for positioning of videoconference participants relative to the camera with minimal compromise in capacity.
- Tables must anticipate the need to distribute power and low voltage electrical between equipment used on the tabletop and the cable connectivity through the floor to remote equipment and systems. At a minimum, this condition will require cable passage through the tabletop to electrical connections in the floor. This can be typically accomplished using standard tables with grommets in the top. It is the least costly approach but involves the most inconvenience. In more high-end facilities (e.g., boardrooms) it may be appropriate to extend the electrical connections from the floor up to the tabletop. Generally this requires custom table construction and is relatively costly. However, it affords the highest level of usability. With especially complex AV systems, this type of accommodation goes a long way in simplifying use of the systems.

b. Lecterns

Facilities appropriate for formal presentations may require a lectern to be provided. Lecterns are available as standard furniture product or may be built custom for high-end facilities. Some lecterns may require AV equipment to be installed in them that would necessitate modifications to standard product. Cable management and access for electrical connections must be considered when AV equipment is installed in lecterns. It is not practical to utilize portable lecterns where integrated AV equipment is required in the lectern.

c. AV Equipment Cabinets

To simplify use of AV systems it is often desirable to separate the equipment that the system users (i.e. instructors, presenters) will need to access from the system control and processing electronics. In instructional areas, this can be achieved by locating the user-accessed equipment in the instructor's console. In conference rooms it may be more appropriate to provide a millwork cabinet to house the media equipment. AV equipment cabinets will require adjustable shelving and considerations for ventilation, security and cable distribution. A high level of design detailing and coordination will be required in the development of such complex cabinetry.

d. Mobile AV Furniture

Mobile AV furniture and equipment carts will likely be utilized throughout the Commons Expansion. While the majority of the units are expected to be standard utility carts, there may be a desire to provide custom or high-end manufactured carts in the "executive" meeting areas.

e. Media Equipment Consoles

Media equipment consoles to support the control and execution of events within the Movie Theatre/Performance Auditorium will require control consoles to house a variety of electronic equipment. Although it is anticipated that there will most likely be some need for customized millwork in such areas of the Theatre as the main control room and "back of house" systems, the majority of media equipment consoles should be supplied by existing design, "off-the-shelf" furniture.

Interior Finishes

Strongly saturated colors and complicated patterns should be avoided when video cameras are introduced into the system complement. All finishes in rear projection rooms are to be matte black, including ceiling, floors and walls. Dark table surfaces should be avoided in videoconferencing and distance learning facilities. Light colored table surfaces will help reflect light up onto faces and improve lighting quality for camera imaging. The Acoustics section of this report identifies additional information on interior finish requirements in AV areas.

Acoustics

Acoustical issues are being addressed in detail within the Acoustics section of this report. However, it should be noted here that the acoustical performance of an AV facility has a direct and very significant relationship to the performance of the AV systems. Architectural acoustics must be considered in all AV areas with the aim of maximizing the intelligibility of speech, optimizing the quality of recorded and electronically reproduced sound, preventing the introduction of unwanted sound into AV rooms and preventing sound originating in AV rooms from disturbing activities in adjacent rooms.

Structural

The integration of AV equipment into the building may have some implications to the building structural design and associated costs. The following points are noted for consideration:

a. Floor Electrical Penetrations

As discussed previously, it will be necessary to provide flush, over-sized electrical service boxes and voice/data connections at selected locations throughout the instructional areas and in some meeting rooms. Due to the nature and required number of connections, standard "poke-thru" fittings may not be acceptable. As a result, it may be necessary to make special accommodations in the building structural design to allow for the penetrations through the floor construction.

b. Floor Loading

Although there are a number of locations throughout the buildings where there will be AV equipment cabinets and consoles, it is not anticipated that this equipment will impose any extraordinary floor loading conditions.

c. Equipment Support Structures

Some anticipated audiovisual equipment will be physically affixed to the building. In some of those situations it may be necessary to provide special structural accommodations. The following conditions are noted:

Blocking should be provided at all locations where equipment is mounted at wall brackets (e.g., cameras, loudspeakers).

Video projectors will require structural support frames to be installed between the overhead structure and the finished ceiling as appropriate to the detailed architectural conditions. Such structural mounts should consider the variety of equipment mounting conditions and locations possible among the various equipment options.

Recessed projection screens installed in the ceiling will require structural support. Depending on the screen type and materials used, it may be necessary to build a fire-rated enclosure around the screen assembly.

d. Accessible Flooring Systems

- Accessible floor systems provide a plenum space below the floor for distribution of power and cabling for telephone, data and AV. Such flooring systems are also occasionally used for HVAC distribution. The following comments are offered with regard to accessible flooring systems and their relationship to audiovisual:
- Traditional access flooring systems providing a plenum depth of 12" or greater can effectively accommodate large volumes of cabling and power distribution without penetration of the structural floor. As a result, such floor systems may be cost effective in locations with a high density of connection points and/or high volumes of cabling.
- Low profile (2"-3" depth) cable flooring systems typically does not provide sufficient depth to accommodate AV flush connection boxes and restricts the number of connections allowed in any given floor box. Low profile access flooring should be avoided when considering AV cabling and connection access via the floor.

- Floor duct and trench systems are also commonly used for distribution of large amounts of power and signal cabling through floors. Such systems are not recommended where frequent access or cabling changes are anticipated.

e. Slab Isolation

35mm film, 70mm film and Digital Cinema spaces may require a structurally isolated concrete slab in order to provide vibration isolation for the film projection units. Isolation of such film imaging equipment is necessary to protect projection units from structural vibrations, which may result from building systems (e.g., HVAC) or low frequency audio signals found on the audio tracks accompanying most contemporary film productions.

Architectural Accessibility

While ADA and other accessibility codes will provide the mandate for architectural accessibility throughout the campus, special consideration should be given to the implications of accessibility on the subject of audiovisual.

Thoughtful design solutions can go a long way beyond the mandates of code-required accessibility toward making AV environments and systems accessible to disabled persons. Most codes do not go so far as to specify equipment accessibility requirements. For example, in the days before strict accessibility standards, raised floors in AV projection rooms were a common solution to the problem of aligning projectors with screens and making the equipment accessible. Any able-bodied person could climb the short flight of stairs to easily access the projection equipment. When codes were enacted requiring wheelchair access to raised floor spaces, the cost of floor area for ramps, or alternatively lifts, typically led to the preferred solution being the elimination of the raised floor and the provision of a portable step for accessing the equipment. This solution meets the code requirements but makes access for everyone inconvenient, or worse, unsafe. Access for the disabled becomes virtually impossible.

Audiovisual technical support is a job that could be well suited to a disabled person provided that the architectural environment and AV systems are conceived and implemented with reasonable consideration for accessibility. While there will undoubtedly be some incremental costs to achieve the required accessibility, it stands to benefit the able-bodied as well as the disabled. Arup strongly urges the design team to approach the design of technical AV areas and systems in a manner that strives for elimination of accessibility barriers.

Audiovisual Systems

The intent of this section is to briefly describe the AV systems that may be developed in the UCR Campus Center Ballroom, Performing Arts Theatre, Meeting / Conference Rooms, Breakout Rooms and General Classrooms. In the context of this report, it is impossible and inappropriate to detail the full extent of individual AV system issues. Rather, this discussion is intended to establish a common understanding of the general nature and extent of AV capabilities available and appropriate to the uses of the different facilities. Those capabilities are described in functional terms and by technical sub-system. Additional information regarding possible AV capabilities to be provided in other areas of the Center may be provided upon further discussion and discovery with the design team.

AV Control Systems

Audiovisual control systems offer the ability to remotely operate AV equipment and selected room environmental functions (e.g., lighting, window coverings, projection screens). AV control systems vary in type and sophistication from simple hand-held infrared remotes to elaborate computer-based systems with custom graphical user interfaces. The principal objective of an AV control system is not to make system operation convenient - as a TV remote allows one to change channels without getting off the sofa. Rather, the aim is to transform the operation of a complex electronic system into something simple and intuitive enough for the operator to have access to the full range of system features (including environmental functions) with a minimal amount of training. This makes the selection of the type of control system, as well as the configuration and character of the interface, a function of many different factors. Considerations that should be addressed include the nature of the AV system, the intended applications, the backgrounds of the users and the character of the organization.

Audio Systems

Audio systems can be further divided into a number of sub-categories based on function. Audio sub-systems are described as follows:

a. Voice Reinforcement

The intent of a voice reinforcement system is to supplement a presenter's natural speech where size of the audience area and other conditions necessitate. Wherever possible, passive architectural methods will be utilized to reinforce the levels and intelligibility of speech. Where necessary, electronic reinforcement systems will be introduced.

Electronic voice reinforcement systems utilize microphones to originate the audio and speakers to provide the sound reproduction and distribution. A variety of microphone and speaker systems are available and will be selected based on specific applications and environmental conditions. Voice reinforcement systems may also be tied to other systems such as assistive listening systems and simultaneous translation systems.

b. Assistive Listening Systems

Assistive listening systems (ALS) are intended provide sound reinforcement for people with hearing impairments. Sound is transmitted to individual headsets via wired or wireless distribution electronics. Audio signal origination may be provided by dedicated microphones or the ALS system may be tied to room voice reinforcement electronics where they occur. Multi-channel systems may be provided where other functions such as simultaneous translation are required.

The American's with Disabilities Act (ADA) mandates the provision of ALS systems. Permanently installed ALS equipment is required in all facilities with a capacity of fifty (50) or more people, in facilities with built-in sound reinforcement systems and in facilities with fixed seating. Receivers must be provided for four (4) percent of the total number of seats in the equipped room, but not less than two (2) units.

c. Simultaneous Interpretation (Translation)

Conferencing facilities occasionally require system electronics to support simultaneous foreign language translation. Simultaneous translation electronics may be tied to other systems, creating economies within the electronics. Care must be taken to configure simultaneous translation systems and related building infrastructure in compliance with international standards as established by the International Electromechanical Commission (IEC). No facilities have been identified within the UCR Commons Expansion program that will require simultaneous interpretation.

d. Background Music Systems

Background music systems provide low level (volume) music distribution and may be desirable in areas such as dining rooms, multipurpose assembly areas, lobbies and other public spaces. A variety of local and broadcast sources are available for music origination. Background music systems may be integrated with paging systems.

e. Media Audio Reproduction

Media audio systems reproduce sound from pre-recorded media such as videotape, audiotape and film. Typically, media audio systems provide stereo reproduction of recorded material. Media sound reproduction usually has a direct relationship to an image display system, which leads to positioning of the primary stereo pair of speakers adjacent to the image display in order to maintain the orientation of sound and image to a single point.

High-end entertainment and some marketing/sales applications may require enhanced stereo, or Surround Sound reproduction.

f. Audio Acquisition (Recording & Distribution)

Audio signals may be acquired for recording and distribution using microphones located in selected instructional and entertainment areas. The appropriate type of microphones, quantity, location, etc. is a function of what the acquired audio is being used for and the nature of the environment in which the sound is originated. No “broadcast quality” audio recording requirements are identified within the UCR Commons at this time.

g. Audio Playback

Audio source inputs to individual AV systems will vary by application. Some of the applicable alternatives include the following:

- Audiotape (Multiple Formats)
- Compact Disc
- DVD
- Audio From Video Sources
- Computer Audio

Video (Electronic Imaging) Systems

The discussion of video or electronic imaging systems in this section does not make a distinction between analog and digital image sources. Also, the term "video" may be used to indicate computer-generated images as well as traditional video image media sources.

Visual Display

Visual display systems facilitate reproduction of images from recorded media, cameras, computers and other sources. Many different systems and technologies are available, with each being suited to a particular range of applications and viewing environments. The specific image display system most appropriate to a particular application will be a function of the size of the viewing area, ambient light levels in the viewing environment, source input requirements and budget. Among the more common currently available visual display options are the following:

Small - Medium Image Size

- CRT Monitors (including televisions)
- LCD Flat Panel Displays
- Plasma Flat Panel Displays

Large Image Size

- Rear Projection Units
- CRT Projectors
- LCD Projectors
- DLP Projectors
- Monitor Walls

Very Large Image Size

- Projection Cube Systems
- Light Valve Projectors
- Dot Matrix Displays
- HID Tube Displays
- Video (Imaging) Sources

Historically, film-based imaging has been the dominant instructional support medium. Today, electronic image reproduction (e.g., video and computers) has largely replaced film in the educational environment. With the increasing popularity (and affordability) of computer-based digital imaging, electronic technologies will continue to be an increasingly important element of the instructional process and educational environments. This fact must be recognized in the development of the instructional resources of the UCR Commons.

Video source inputs to individual AV systems will vary by application. Some of the applicable alternatives include the following:

- Videotape (Multiple Formats)
- Digital Video Disc (DVD)
- Laser Disc
- Video Camera
- Film-to-Video Transfer
- Broadcast Television (Analog, Digital, HDTV)
- Campus Instructional Television
- Document Camera/Graphics Stand
- Videoconference/Distance Learning Feed
- Computer Graphics
- Internet

Video Acquisition (Recording & Distribution)

Video cameras may be used in the Theatre, Ballroom, Meeting/Conference Rooms and General Classrooms for recording, monitoring and/or distribution of meetings and events. While video cameras could technically be considered simply another video source device, they are discussed separately here because of the impact that their application has on the architectural and operational environments.

Cameras may be installed on wall brackets and operated remotely via robotic pan/tilt mechanisms and motorized zoom lenses. While AV control electronics can greatly simplify the operation of sophisticated camera systems, care must be taken to match the level of technical/operator support available with camera system complexity. Additionally, when video cameras are to be used in a facility, care must be given to selection of colors and finish patterns, configuration of lighting and arrangement of people and furnishings and image display systems, as discussed elsewhere in this report.

Film Projection

Existing educational organizations often hold collections of archival films, thereby necessitating film projection capabilities. It is anticipated that the use of high-end film media (E.G., 35mm, 70mm and Digital Cinema) in the UCR Commons will be limited to the Theatre (see Theatre Audiovisual Systems below). The display of other film medias (e.g., overhead transparencies and 35mm slides) is also anticipated within the Theatre, along with the Ballroom and Meeting / Conference Rooms and Breakout Rooms. These requirements will be addressed primarily through the use of portable equipment that can be brought into the classroom or meeting room as needed. Therefore, in most areas of the project, film imaging is expected to be secondary to Electronic Imaging.

Teleconferencing

Teleconferencing is one of the most misunderstood technologies addressed within the scope of these audiovisual considerations. Since teleconferencing is fundamentally a telecommunications technology, the point where teleconferencing transitions into the realm of “audiovisual” should be defined.

Within the context of this discussion, the connection of standard "plug-and-play" teleconferencing products into the telecommunications infrastructure, as well as the development of that infrastructure, is considered to be the domain of the Telecommunications discipline. When room-based audiovisual systems integrate teleconferencing capabilities, they are considered a part of the audiovisual effort. This typically occurs in high-end conference facilities and in distance learning facilities. Close collaboration between the telecommunications and audiovisual disciplines is key to the effective integration of the various teleconferencing and related technologies.

Identification of the most appropriate teleconferencing technology for any specific application should involve discussion with the users to define who the expected conference participants are, the nature of the discussions and the expectations/objectives of the participants in their desire to use teleconferencing. The various forms of teleconferencing are distinguished as follows:

a. Audio Teleconferencing

Audio teleconferencing utilizes standard telephone (voice) connection(s) between two (2) or more locations with one or more individuals at each location. Simple speaker-phone capability (as available with most PABX telephone systems) is the simplest form of audio teleconferencing. More sophisticated audio teleconferencing systems utilize built-in microphones, speakers and other AV equipment to streamline system use. This level of system is usually provides "full-duplex" audio, which means it allows parties at each end of the conversation to be heard simultaneously. (Unlike typical speakerphone systems which cut off one side or the other when both speak at once.) Only very sophisticated and costly audio teleconferencing systems allow more than two (2) party conferences without the assistance of the phone company. Audio teleconferencing is anticipated to take place in Meeting / Conference Rooms and Breakout Rooms. The appropriate level of development in each area has not yet been specifically determined.

b. Video Teleconferencing

Broadly defined, video teleconferencing is the use of a real-time motion video connection between one or more sites to support communication between individuals or groups. This technology may potentially be used in the Meeting / Conference Rooms and General Classrooms.

Video teleconferencing can be implemented and conducted quite simply on an individual basis using computer-based desktop systems and IP communication networks. (Utilizing utilize a data network as the video teleconferencing transmission medium will have tremendous implications on the design and performance of the network and must be coordinated with the campus IT group.) Small groups of four to eight people can also easily be set up for videoconferencing using standard hardware packages. However, larger groups and more specialized applications may require the use of multiple cameras and increasingly complex switching and control systems. Development of video teleconferencing capabilities at this level can be a complicated process involving custom system integration and careful architectural planning and design. It is anticipated that the UCR Commons Expansion will have call for video teleconferencing at each of these levels and that accommodations should be made accordingly.

Transmission of video teleconference signals is an important consideration in planning for the technology. The higher the image quality requirements, the greater the transmission capacity required. Industry standards are in place to support video teleconference transmission over switched public digital networks (e.g., ISDN) and over IP based data networks (e.g., LAN, WAN). At the present time, most private data networks do not have the capacity to adequately support motion video transmission for video teleconferencing. However, this technology is evolving quickly and rapid improvements will be seen within the timeframe of the UCR Commons Expansion project. Therefore ISDN is currently the most common transmission medium for group video teleconferencing. In this medium, transmission costs are reoccurring and can be quite expensive for high quality image transmission. The most cost-effective and appropriate solution for any individual application (or set of applications) can only be determined on a case-by-case basis. Specific alternatives and costs should be discussed with the University and the project's Audio Visual Consultants to ensure that appropriate performance is achieved at the lowest possible cost.

c. Multimedia Teleconferencing

Multimedia teleconferencing refers to the use of computers and other electronic media to support communication between remote locations. An audio connection between the remote sights is typically the primary communication medium. (Video is also often used.) Beyond this primary connection, the various parties share information by some additional medium such as a shared computer application, still images or other presentation graphics.

The use of multimedia and shared computing to support teleconferencing is a powerful and frequently under-utilized tool. In applications where video teleconferencing is cost prohibitive, an audio teleconference connection can be greatly enhanced by shared data and/or graphics. This form of teleconferencing can be quite effective in terms of content and relative cost. Often, existing wide area computer network connections can provide the communication pathways at little or no significant incremental cost.

Potential Interfaces Between Audiovisual and Other Services / Systems

The audiovisual systems of the UCR Commons will rely on a number of critical interfaces to other systems and services of the University at large. Those services and systems are not included within the scope of the consultant's work on the project. However, they are mentioned here in order to alert the project team of the critical link between the various related systems and the audiovisual systems. Following provides a brief listing of the possible current or future technical l interface points:

- Distance Learning Distribution
- Audio/Video Recording & Distribution
- Data Networking
- Local Area Network (LAN)
- Wide Area Network (WAN)
- Internet
- Electronic Mail
- Off-air Broadcast Television (TV)
- Cable Television (CATV)
- Direct Broadcast Satellite (DBS)
- Voice / Telephone
- Voice Mail
- High-speed Public Data Networks (e.g., ISDN)

THEATRE SYSTEMS

The intent of this section is to briefly describe the functionality and design considerations specifically related to technical theatre systems associated with the Theatre. As with the general audiovisual systems, it is impossible and inappropriate at this time to attempt to comprehensively detail the full extent of these systems in the context of this report. Rather, this discussion is intended to establish a common understanding of the general functionality of these theatre systems and identify some of their critical design considerations. The discussion also seeks to clarify the delineation between components of these systems which typically fall under the design scope of the Audio Visual and Sound Systems Consultant, and those which traditionally remain the responsibility of the Theatre Consultant.

Performance Sound System

a. Audio Reinforcement/Reproduction System

The permanently installed ‘in-house’ performance sound system will comprise a ‘front-line’ of loudspeakers around the stage or proscenium, and a system of ‘fill-in’ loudspeakers distributed through the auditorium. The ‘front-line’ of devices will typically comprise three main loudspeaker clusters flown across the forestage in an “LCR” (Left-Center-Right) configuration to provide audio coverage across the majority of the audience areas, and “image shift” or “pull-down” devices distributed across or possibly integrated into the stage front, to localize the audio image away from the overhead clusters and towards the stage for the near-stage seating rows. Additional ‘front-line’ devices may be added as necessary in the form of “stage stacks” – loudspeaker arrays stacked up on either side of the stage or proscenium in a left-right configuration.

‘Fill-in’ loudspeakers are then distributed as necessary throughout the auditorium to complement the front-line clusters in spaces such as side boxes, upper balcony seating and seating areas under deep balcony overhangs. These loudspeakers are set up to complement the front-line clusters without being acoustically obtrusive, such that sound does not ‘appear’ to originate from them, by careful positioning, time alignment and output level setting.

In addition to a permanently installed performance sound system, most music venues will provide the infrastructure to support temporary ‘touring’ sound systems which may be brought in with a touring band or theatre company performing at that venue. This infrastructure includes high-level technical grids or structural rigging points from which touring loudspeaker clusters may be hoisted and flown, provision of technical power service at those positions and connectivity for routing audio signal to and from such positions.

b. Live Audio Origination & Production

Origination of live audio is facilitated by a network of audio facility panels distributed around the stage and other strategic location within the auditorium, into which individual microphones or multi-way microphone 'break-out boxes' can be connected. Audio signals fed into these panels are then typically routed to the Audio Equipment Room, where they can be patched to an 'in-house mix position' or the Audio Control Room, and thence amplified and reproduced through the audio reinforcement/reproduction system described above.

An 'in-house mix position' is necessary to facilitate live audio control from a position within the main auditorium volume, usually within the rear third of the stalls seating area. This location allows sound engineers to monitor and adjust the sound quality and balance within the auditorium as heard by the audience. An in-house mix position may either be a provided on a permanent basis, through allocation of a dedicated and fixed location for the equipment, or a temporary position may be planned through allocation of removable seating and provision of appropriate 'stage blocks' to create a flat surface over a raked floor profile.

In addition to audio origination via hard-wired microphones, break-out boxes and connection panels, a variety of wireless microphones will be provided to facilitate on-stage maneuverability during live productions and performances, and to support 'roaming' voice reinforcement from any location within the auditorium. The complement of wireless microphones provided will likely include both hand-held and lavalier ('lapel') types.

c. On-stage Monitoring

In addition to delivering clear, well balanced sound to the audience, the performance sound system must also feed back an appropriate audio 'mix' back to the performers themselves in order for them to hear each other and monitor their own performance. This is either achieved using on-stage monitor loudspeakers or, increasingly commonly, wireless 'in-ear monitoring' devices. In order to support monitoring using on-stage loudspeakers, audio facility panels will be provided in or around the stage into which the loudspeakers can be connected as necessary. These facility panels will likely also be used as downstage microphone connection points. Wireless in-ear monitoring capability, on the other hand, will be supported as necessary through provision of mobile transmitters and in-ear monitoring receivers on a temporary basis.

d. Assitive Listening Systems

As described previously in this document, the American's with Disabilities Act will mandate the provision of an ALS system in the Theatre auditorium. This system will comprise wireless transmitters (radio-frequency antenna or infra-red emitters) distributed as necessary throughout the auditorium, and a contingent of compatible wireless receiver systems (belt-pack receivers and discrete ear-pieces, integrated receiver-headsets, or other) available for distribution to individuals with a hearing impairment.

Video Origination and Visual Projection Systems

Visual systems that typically fall under the scope of the Audio Visual Consultant include in-house video origination and video and film projection. Other theatrical projection systems such as performance lighting, spot lighting, 'house blues' and high intensity film projection (such as "PANI" and "PIGI" projection systems) will remain under the design influence of the Theatre Consultant.

a. Video Origination

Facility panels will be provided at strategic location in the auditorium to support connectivity of video cameras (portable or 'dolley' mounted) and 'live' distribution of video signals either to an in-house production facility or Outside Broadcast (OB) vehicles. Permanently installed and remotely controlled cameras mounted on 'pan-tilt-zoom' mechanisms may also be provided to facilitate video origination for relay into FOH and BOH areas, and potentially local image capture for video teleconferencing.

b. Film Projection

Film projection requirements for the Theatre may include 35 mm still slide projection and 16 mm or 35 mm motion film projection. Whilst 35 mm slide projection can generally be accommodated in any well planned and positioned projection room (see sub-section entitled 'Control Rooms'), a requirement for motion film projection, particularly 35 mm film projection, will significantly influence the design of the projection room. Issues to consider include space planning, both for the relatively large floor-standing projectors themselves and for any support equipment (such as vertical film platters, spool rewind benches, etc.), structural support and vibration isolation, and special ventilation requirements (often dedicated exhaust runs are required). Additionally, 35 mm film projectors will possibly require provision of non-standard, high voltage power service.

c. Video Projection

Video projection will likely be required in the Theatre to support large-scale display of computer presentations and video footage during conferences and seminars, and to support applications such as video teleconferencing and digital cinema screening.

Effective video projection in a venue the size of the Theatre may be facilitated using a high resolution, high intensity video projector, also located in the projection room. This projector may be permanently installed (typically suspended overhead on a support structure fixed to the ceiling slab) or provided on a temporary basis and simply placed on an appropriate counter-top (if sightlines permit). Video projectors may also require provision of non-standard, high voltage power service.

Theatre Communications

a. Technical Intercom

An in-house intercom system is required to facilitate communications between technical theatre personnel, both during set construction and rehearsals, and during live performances. This system will likely comprise a combination of dedicated technical intercom connection panels provided at fixed strategic positions throughout the auditorium, complemented by a wireless intercom system to facilitate roaming communications.

Control Rooms

Of critical importance in the early schematic design phase of the design process is the effective space planning of the audio and lighting control rooms, and the projection room. These may be individual spaces dedicated to each functional purpose, or they may be integrated into a single control room. Either way, the size, geometry and orientation of these rooms must consider specific issues such as operational requirements, internal room acoustics and room-to-room noise isolation, sightlines to stage, special ventilation requirements, and so on. The design of these rooms must therefore be closely coordinated with the Audio Visual Consultant, specifically for the audio control and visual projection rooms, and the Theatre Consultant, for the lighting control room (including spot light rooms).

Equipment Rooms

Equally critical to the control rooms is the appropriate space planning and design of the equipment rooms, specifically the audio 'rack room' and the performance lighting dimmer room. Important design issues to be considered here include the general location of the rooms (for example, they should be distanced relative to each other to avoid the detrimental effects of electromagnetic interference), appropriate room design in terms of size and geometry to promote efficient equipment storage and access, and informed decision making with regard to the implementation of access flooring, drop ceilings, etc., with consideration for operational requirements and cable management.

Cable Containment and Pathways

The requirements and considerations associated with low voltage cable containment for the above technical theatre systems will be as described in Section II Part A of this document, ie. conduits shall generally be EMT type above grade and galvanized rigid steel with PVC coating below grade. Additionally, large cable pathways will need to be identified to support temporary cable routing for touring sound systems and Outside Broadcast (OB) applications. These pathways will likely comprise a combination of large diameter conduit, in-floor trenches, cable hooks (for example along backstage passage ways) and in-wall cable 'pass-throughs'.

F. Acoustics

Basis Of Acoustic Considerations

This report establishes appropriate acoustic design limits, outlines the acoustic design concepts, and provides an overview of the project. The report is based in part on the general information provided to our office, and in part on our experience with projects of this type.

In terms of architectural acoustics issues, this report provides a preliminary guideline regarding sound insulation and room finishes. With regard to the building services, it outlines basic HVAC Systems, Plumbing and Electrical Services noise and vibration control requirements.

It is the intention of this review to highlight the main acoustical issues that will need to be concentrated upon in greater detail during subsequent design stages. It is also our intention to highlight key acoustical issues in this report, in order that they be taken into account by the Design Team and the Quantity Surveyor early on in the design process.

Acoustics And Technology

The UCR Commons Expansion project will contain various facilities and activities that will rely on the use of integrated media and information technology, including the Theatre component, offices, conference and meeting rooms, dining areas and medical services rooms. With respect to architectural acoustics, the historical model of instructional building construction is no longer valid in the age of electronic media and information technology. Inadequate room acoustics (e.g., excessive reverberation, noisy mechanical services) and insufficient sound isolation between instructional areas can make an organization's extensive investment in instructional technologies completely ineffective. As a result, there is a new economic basis for investment in appropriate acoustic constructions in instructional buildings.

Following are some of the acoustic issues that may result from the integration of media and information technologies into instructional areas and other spaces in the building:

Technology equipment such as personal computers and video projectors will require a higher ventilation capacity due to increased heat produced by this equipment. The noise generated by the increased air movement and potentially larger air handling units may require additional noise control.

Noise generated by internal cooling fans in computers, video projectors, and other equipment will result in higher noise levels, interfering with speech intelligibility in spaces such as instructional areas where speech intelligibility is important to the learning process.

Facilities with microphones for sound recording and distribution to remote locations (i.e. distance learning, the Theatre, etc.) will require reduced room background noise levels in order to provide intelligible sound pickup. This will have implications on design of HVAC systems, lighting and other building services that contribute to background noise levels.

Electronically reproduced sound from multimedia systems in instructional areas and other facilities (i.e. conference rooms, the Theatre, etc.) will result in higher noise levels within individual spaces than have been found historically in instructional and meeting facilities. As a result, increased sound insulation is required between adjacent spaces in order to prevent disturbances between rooms.

The use of laptop computers by students for note taking in lectures has become quite common at many universities. Noise produced by the strike of key keyboards can interfere with speech intelligibility and the learning process.

Raised computer floors are often required where there is extensive use of technology. Raised floors that have a hard surface can result in loud noise in the space due to footballs and the rolling of chairs. The use of such floors impacts on noise isolation between adjacent spaces where normal design would require that acoustic partitions extend from slab to slab.

The use of sound reinforcement systems in instructional areas, conference/meeting rooms, the Theatre, the Ballrooms, etc. will result in the need for better sound insulation constructions between adjacent instructional areas.

Architectural Planning

The need for special acoustic construction including walls, doors, and floor/ceiling assemblies can be reduced by considering noise insulation during the Schematic Design stage. Space planning that locates noise producing areas such as restrooms, mechanical/electrical rooms, elevators, loading docks, and classrooms/laboratories with machinery, and any rooms with loudspeakers away from noise sensitive spaces such as instructional areas, conference rooms, offices and especially the Theatre, will reduce the number of locations where special sound insulation construction is required. The location of loud mechanical and electrical services machinery directly above or below noise sensitive spaces should be avoided. Also, the location of corridors with hard floor finishes above noise sensitive spaces, such as conference rooms and large instructional areas, should be avoided as disturbing footfall noise can be transmitted to spaces below.

Building Envelope

The roof and façade construction of all buildings, but especially the Theatre, should be such that they provide adequate insulation from exterior noise sources. Typically, glazing is the limiting factor in the sound insulation provided by the building façade. It is not known at this time if there is any intent to have a naturally ventilated building. It is worth noting though, that the use of natural ventilation is generally not compatible with sound insulation of instructional areas, especially when the instructional areas are located near roadways, loading docks, courtyards, and main footpaths. The facade recommendations will be further refined after consideration of site noise conditions.

Interior Partition Wall And Floor/Ceiling Assemblies

Interior partition design determines the level of sound insulation between adjacent spaces. With the introduction of multimedia technologies into the instructional areas of the project, it will be necessary to upgrade the acoustic performance of many of the building interior partitions and floor/ceiling assemblies.

Instructional areas and study areas will need to be acoustically insulated from adjacent spaces to limit disruptive noise. Offices and conference rooms require varying degrees of insulation, depending on the needs of the faculty and staff that will use them. Similarly, the layout and design of the Theatre is a key to optimizing and achieving adequate noise isolation.

Party Wall Construction

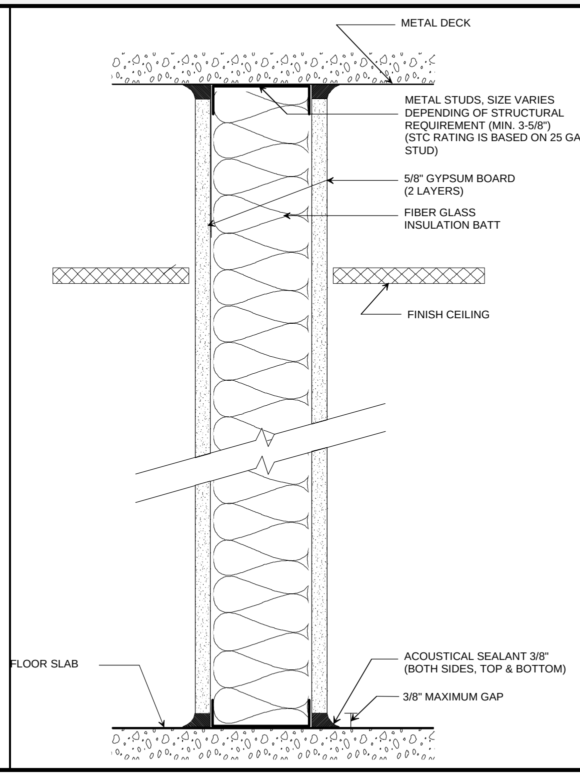
The sound reduction performance of conventional walls, doors, and floor/ceiling assemblies is described in terms of a criterion commonly referred to as Sound Transmission Class (STC). In addition to the acoustical privacy requirement, higher STC rated walls, doors, and floor/ceiling assemblies are used to contain the building mechanical/electrical systems and provide acoustical insulation between adjoining spaces. Doors and glazing are usually the limiting factor in the sound insulation provided by interior partitions. The use of operable walls is generally not recommended for the division of instructional areas, conference rooms, the ballrooms, and other noise sensitive spaces. If operable partitions are used, as they likely will be in the Ballroom area at least, they will need to meet strict acoustic design criteria.

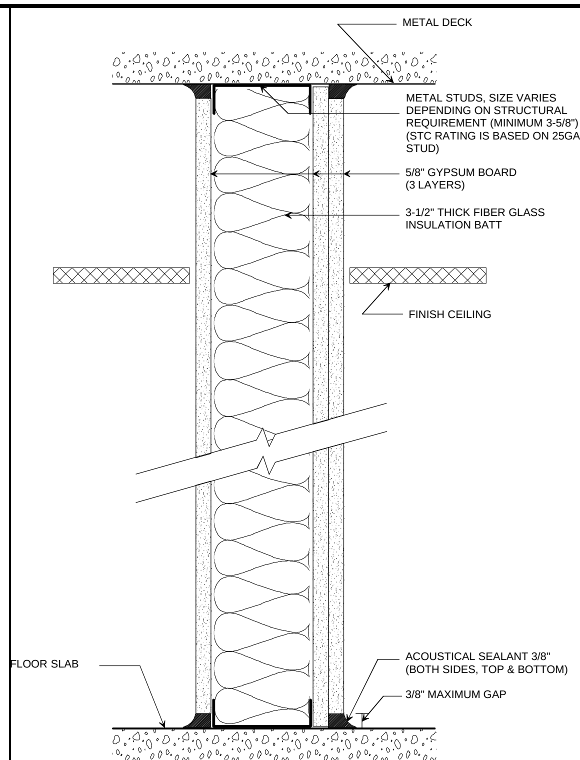
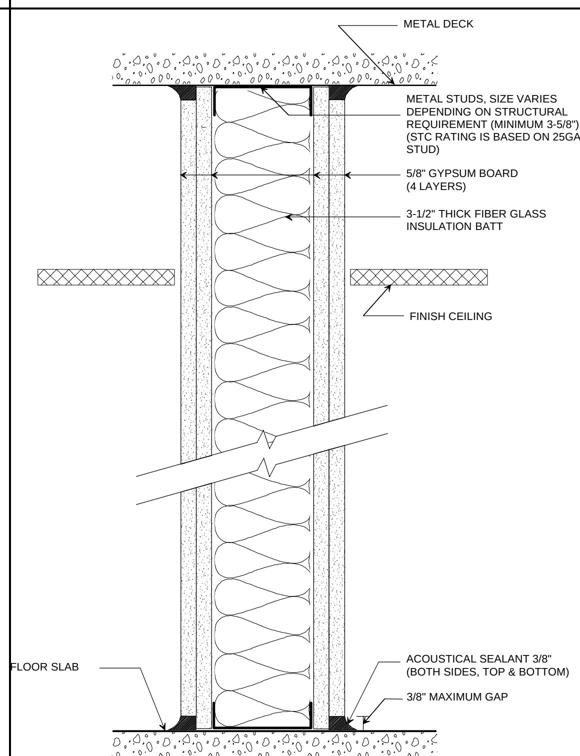
Table 1 provides suggested STC ratings for some partitions as might be expected in the Campus Center project. These STC ratings may be utilized for construction cost estimating and in the design and selection of room envelope elements. Specific acoustic wall construction recommendations should be developed during the initial design stage based on detailed program requirements and performance expectations.

Partition Wall Separating[1,2]	STC Ratings	Type	Doors
Mechanical Rooms and Open Plan Office Areas	55[3]	4	Acoustic doors or vestibules may be required
Mechanical Rooms and Corridors	50[3]	3	Solid core wood or equivalent metal construction with seals around head and jambs
Mechanical Rooms and Cellular Offices	60[3]	5	Acoustic doors or vestibules required
Mechanical Rooms and Classrooms	60[3]	5	Acoustic doors or vestibules required
Restrooms	40	1	Solid core wood or equivalent metal construction
Conference Room/Meeting Rooms and Adjacent Spaces	50	3	Solid core wood or equivalent metal construction with seals around head and jambs and the door bottom close cut to the carpet.
Between Exam/Observation Rooms and Adjacent Spaces	50	2	Solid core wood or equivalent metal construction
Between Private Offices	45	2	Solid core wood or equivalent metal construction
Between Classrooms	45	2	Solid core wood or equivalent metal construction
Between Classrooms with Speech Reinforcement Systems	50	3	Solid core wood or equivalent metal construction with seals around head and jambs and the door bottom close cut to the carpet.

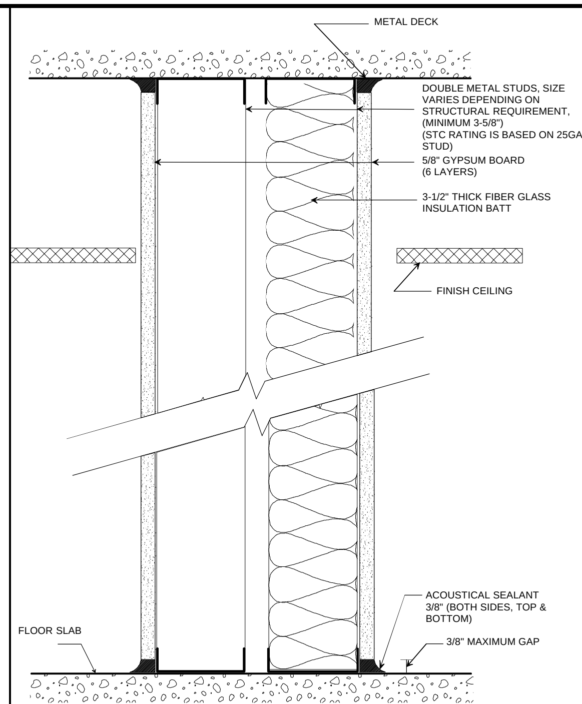
Note:
1. Mechanical rooms should not be located adjacent to Conference Rooms, the Theatre and other low NC areas.
2. Full height relative to the floor structure above.
3. Walls may require masonry construction

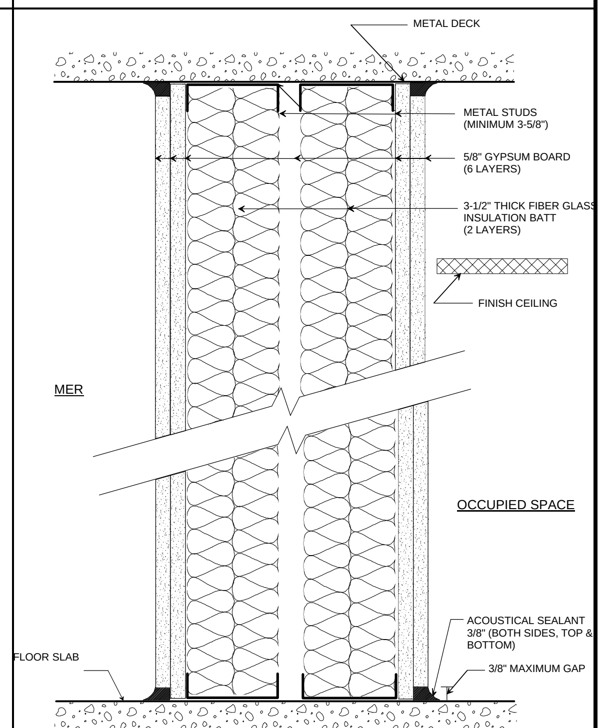
Table 1: Recommended Interior Partition Walls

Type/ STC Rating*	Example Constructions	
Type1 STC40	Metal studs with a single layer of 5/8-inch thick gypsum board on each side of the studs and fiberglass sound insulation blanket in the wall cavity. The gypsum board should extend from slab to slab and the decking flute should employ foam seal where decking runs perpendicular to the wall top track.	

Type 2 STC45	Metal studs with three layers of 5/8-inch thick gypsum board (two on one side and one on other the stud) and 3-1/2-inch thick fiberglass sound insulation blanket in the wall cavity. The gypsum board panels should be constructed from slab to slab with the gypsum board terminated about 3/8-inch from the slab on the top and bottom, the gap between the gypsum board and slab should be filled with non-hardening acoustical sealant. If the wall top track is perpendicular to the direction of the decking flute, employ polyurethane foam seal to blank-off the flute cavities.	
Type 3 STC50	Metal studs with four layers of 5/8-inch thick gypsum board (two on each side of the stud) and 3-1/2-inch thick fiberglass sound insulation blanket in the wall cavity. The gypsum board panels should be constructed from slab to slab with the gypsum board terminated about 3/8-inch from the slab on the top and bottom, and the gap filled with non-hardening acoustical sealant. If the wall top track is perpendicular to the direction of the decking flute, cut gypsum board to match flutes and seal between gypsum board and decking with acoustical sealant. Wall electrical outlet boxes on the common partition wall should be placed minimum one stud space apart.	

<table>
<tr>
<td>Type 4
STC55</td>
<td>Double rows of metal studs with two layers of 5/8-inch thick gypsum board (one layer on each side). The wall cavity should be filled with 3-1/2-inch thick fiberglass insulation blankets. The gypsum board panels should be constructed from slab to slab with the gypsum board terminated about 3/8-inch from the slab on the top and bottom, and the gap filled with non-hardening acoustical sealant.

If the wall top track is perpendicular to the direction of the decking flute, cut gypsum board to match flutes and seal between gypsum board and decking with acoustical sealant. Wall electrical outlet boxes on the common partition wall should be placed minimum one stud space apart.</td>
<td>
</td>
</tr>
<tr>
<td>Type 5
STC 60</td>
<td>Double rows of 3-5/8-inch metal studs with four layers of 5/8-inch thick gypsum board (two layers on the interior side and two layers on the exterior side. The wall cavity should be filled with two 3-1/2-inch thick fiberglass insulation blankets. The gypsum board panels should be constructed from slab to slab with the gypsum board terminated about 3/8-inch from the slab on the top and bottom, and the gap filled with non-hardening acoustical sealant.

If the wall top track is perpendicular to the direction of the decking flute, cut gypsum board to match flutes and seal between gypsum board and decking with acoustical sealant. Wall electrical outlet boxes on the common partition wall should be placed minimum one stud space apart.</td>
<td>
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Note: *STC ratings depend on the use of maximum 25 ga. stud, spaced at minimum 24” o.c.

Table 2: Wall Construction Details

Floor/Ceiling Slab

Sound insulation provided by floor/ceiling constructions is determined primarily by the thickness of concrete and the type of ceiling below it. Where it is necessary to increase sound insulation, the slab thickness may be increased, floated slabs may be required, or secondary gypsum board or plaster ceilings may need to be constructed. This could be necessary if instructional areas, large conference rooms, distance learning facilities, the Theatre or other noise sensitive spaces are located directly above or below mechanical rooms or other spaces producing high noise levels.

Raised computer floors that have a hard surface can result in loud noise in the space due to footfalls and rolling chairs. Such floors may also need to be cut where acoustic partitions extend from slab to slab. The extent of raised computer floors to be installed in the project is not known at this time.

Theatre and Multi Use Assembly Spaces

As stated elsewhere, there will need to be a review of the noise isolation details to all adjacent spaces in key areas, but especially in the presentation spaces. At the earliest possible time, it is recommended that an acoustics consultant should review the proposed plans to ensure that optimum noise isolation can be achieved with minimum effort. This will involve consideration of adjacent spaces as well as those areas above and below these areas.

Room Geometry And Finishes

Room geometry and finishes determine what will happen to sound that is generated within a room. The noise level in any room is made up of both a direct component and a reverberant component. The direct component is the sound that comes directly from its source to the listener. The reverberant component is the sound that comes from the source and then bounces around the room before reaching the listener. A high reverberant noise level can interfere with speech intelligibility. Floor, ceiling, and wall finishes will need to be chosen for each room to provide the sound absorption performance required for the intended room functions. In small instructional areas or large instructional areas with speech reinforcement systems, this may include sound absorptive ceilings (i.e., typical lay-in ceilings). In instructional areas, and the Theatre, without speech reinforcement this may include hard sound reflective ceilings, sound absorbing wall panels and carpeted floors. Specific room finish recommendations should be based on detailed program requirements developed as the design progresses.

Theatre

At the present time, we suggest you make allowance for use of carpet at the front of the room and down the aisles, plush theatre style seating (i.e. cloth covered and foam padded seats and backs), and some acoustic treatment of the rear wall. Should this room be used for teleconferencing as well, acoustic material would also need to be incorporated into the final ceiling design as well as the upper sidewall areas. However, the final program use will help to dictate the final room finish schedule.

Of equal importance is establishment of the floor area and volume. Setting both parameters to match the "best use fit" for the Theatre, as it will undoubtedly be a multi-purpose room, at the onset would go a long way to producing a very good facility. In addition, establishing the basic room shape at the onset would be very important to ensuring that basic acoustic problems such as echos, etc. can be eliminated without the need for costly acoustic treatment.

Building Mechanical Services

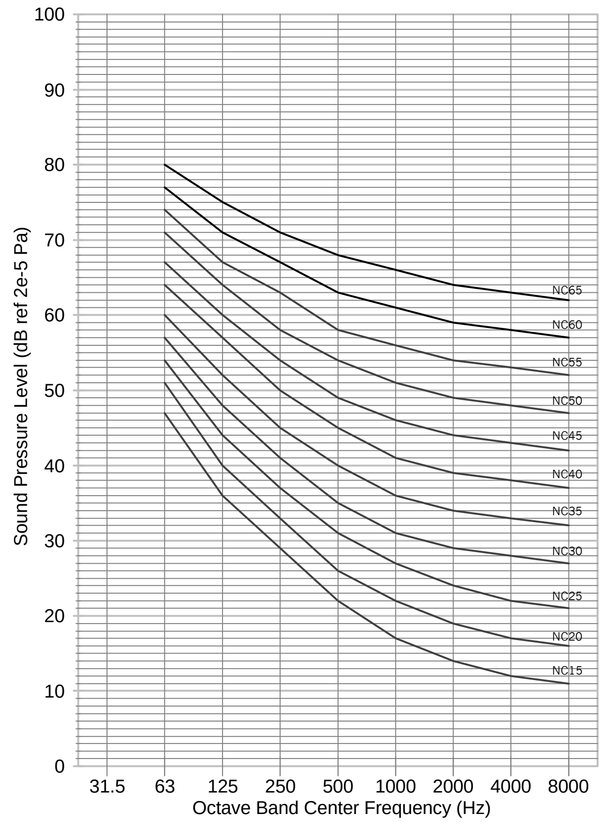
Uncontrolled levels of continuous noise, such as that generated by the operating of mechanical services, can interfere with speech communication and can cause annoyance inside the buildings and exterior to the buildings. Further, mechanical systems and other background noise sources can greatly impact the effectiveness of electronic sound recording, distribution and communication systems. Controlling noise can add to the project cost. On the other hand, high noise levels can significantly impair the viability of costly media and communications systems and make a facility ineffective for the very purpose it is being built. A realistic and balanced approach must be used in specifying services noise criteria. Design noise criteria for continuous background noise are established to act as design constraints for noise control in mechanical services systems.

Design Noise Criteria

Criteria for continuous noise are well established, and a widely accepted schedule of values is published by ASHRAE[1]. The project design noise criteria for mechanical services noise are based on the ASHRAE recommended standards and the consultant's experience with other university and similar projects. The criteria are presented in terms of Noise Criterion (NC) curves. Suggested project design NC levels are recommended for each type of area and are presented in Table 3.

[1] American Society of Heating Refrigeration and Air Conditioning Engineers, *HVAC System and Equipment*, 1996.

Occupied Space	**Design Noise Criteria (NC)**
Theatre	25-30
Distance Learning	25-30
Conference/Meetings Room	25-35
Classrooms	30-35
Director's/Dean's Offices	30-35
Study Areas	30-35
Private Offices	30-35
Observation Rooms	30-35
Examination Rooms	30-35
Green Rooms	30-40
Projection Room	30-40
Ballrooms	35-40
Open Plan Office Areas	35-40
Pre-function Areas	35-40
Lounge/Study	35-40
Dining Rooms	35-40
Retail	35-45
Student Dining	40-45
Therapy Rooms	40-45
Foyer/Lobby	40-45
Café	40-45
Food Court	40-45
Bookstore	40-45
Cafeteria Kitchen	45-55
Mechanical/Electrical	N/A*



NC Curves

*** N/A means Not Applicable**

Table 3: Mechanical Services Design Noise Criteria

Noise Control Approach

The recommended mechanical services noise criteria for the majority of the spaces are not considered to be particularly difficult to achieve. A well-designed mechanical system that adheres to the following noise and vibration control guidelines and that incorporates standard noise control measures (such as lined ductwork and in-duct sound attenuators) should achieve the required Noise Criteria and should avoid the need for potentially costly and difficult remedial measures at a later stage in the project. Of particular concern are the Theatre, the main conference and meeting rooms, distant learning spaces and other low NC rooms.

The following provides preliminary guidelines on limiting noise and vibration in HVAC/electrical systems:

Mechanical/Electrical Equipment Room

The location of mechanical and electrical rooms can have a major impact on the background noise environment within each of the buildings. The shorter the distance between noisy equipment and noise sensitive spaces, the greater the requirement for sound insulation and vibration isolation. Careful space planning and layout of the major items of mechanical equipment could represent significant cost savings in terms of necessary noise control at a later date.

Fan/Air Handling Unit

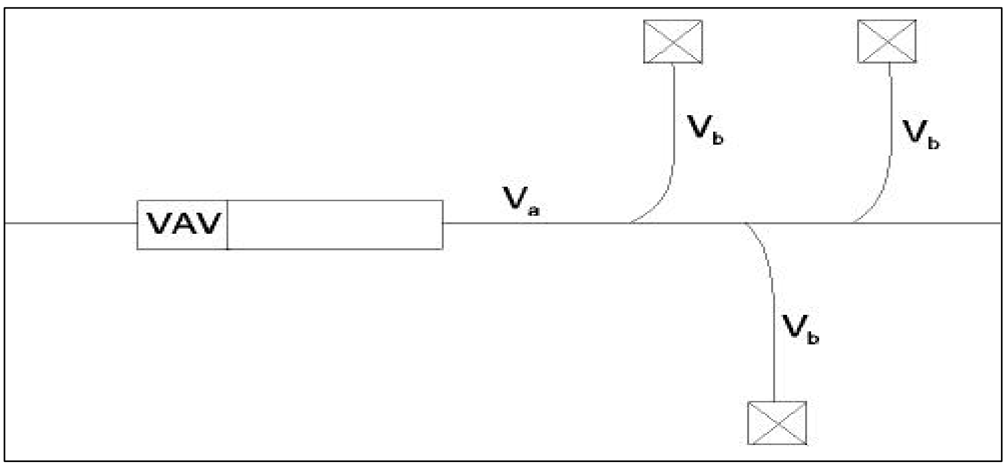
Selecting the quietest equipment available will reduce the necessary treatment. Octave band sound power levels, or sound pressure levels at a specified distance, should be obtained for the major items of the mechanical system and substantiated by reliable test data. Fans should be selected at optimum operating points. Backward inclined centrifugal or plug fans are preferred over forward curved fans and axial flow fans. Duct connections at the inlet and outlet of an air handling unit should be designed for uniform and good airflow.

Air Movement

Table 4 presents the recommended air velocity for ductwork. Air velocity is not the only determinant of the level of regenerated noise in ductwork. Prevention of regenerated noise due to air movement in ductwork generally depends upon maintaining an aerodynamically efficient ductwork design as well as limiting the velocity of the airflow. The geometry of duct branches, duct tees, transitions, etc. should be as good as, or better than, those recommended by the HVAC industry as good practice. Reference is made to such documents as SMACNA[2]. It is essential to minimize air turbulence by separating different duct fittings by a minimum of three to four major duct dimensions.

[2] Sheet Metal and Air-Conditioning Contractor's National Association, Inc.

Primary Ductwork	Maximum Air Velocity (fpm)[1]	
Main Supply	1,800	
Main Return	2,000	
Secondary Ductwork	**Maximum Air Velocity (fpm)**	
NC	**Va**	**Vb**
30	1000	600
35	1200	750
40	1300	900
45	1400	1000
50	1600	1200



Note: 1. If main supply/return duct passes over/adjacent noise sensitive spaces (NC35 or lower), then the air velocity needs to be reduced.

Table 4: Recommended Air Velocity for Ductwork

Duct Noise Breakout

Wherever possible ductwork leaving mechanical equipment rooms should be routed through non-noise-sensitive spaces. Where ducts must be routed through noise sensitive areas, breakout noise may need to be controlled by wrapping the ducts with a noise attenuation blanket or by placing ducts above hard ceiling systems (i.e. plaster or gypsum board). Ducts penetrating floors and/or walls near air handling units and passing immediately through or over noise sensitive spaces often cause excessive noise and should be acoustically treated, even if the ducts contain no outlets.

Sound Attenuators

Allow for primary prefabricated sound attenuators (also known as sound traps or silencers) in all supply and return air systems serving occupied areas. Sound attenuators should be located a minimum of one duct diameter from the fan inlet/outlet in locations where good air flow conditions exist in order to minimize the pressure drop imposed on the fan, and through the sound traps as well. The sound traps also need to be strategically placed to minimize both noise breakout and break-in effects.

Diffusers and Grilles

Air diffusers and grilles must be selected and specified for the appropriate NC criteria. In order to meet the NC requirements in any particular area, the diffusers and grilles should be selected with the manufacturer's NC rating equal to 10 NC points below the project design NC values. The NC ratings required for final selection of diffusers and grilles should be listed in the mechanical schedules. The devices must be served from nearby ductwork that produces uniform airflow. Poor airflow conditions, such as what can be imposed by poorly installed flex duct, can easily increase the noise levels by 10 to 20 dB above manufacturers' ratings.

Mechanical Approach

- Major utilities will be provided from UCR central plant, including chilled water.
- All mechanical equipment is to be located in mechanical rooms. There should be no rooftop or exposed HVAC units.

Small Air-handling Units (within building envelope)

Small air-handling units considered in this section include fan coil units, fan powered VAV boxes, and unit air conditioners. Each of these can generate excessive noise within the conditioned space if untreated. There are three main sources of noise to consider in small packaged units. These sources are: unit air discharge, unit air inlet, and casing radiated noise. Discharge noise is usually controlled by acoustically lining the unit discharge or by adding sound attenuators at the outlet. Similar methods are employed for controlling noise from the inlet side. The unit casing offers limited sound insulation. Some improvement can be achieved by increasing the thickness and the stiffness of the casing material. Small packaged units are often a significant source of vibration induced noise levels. Vibration isolation should be installed between the units and the ductwork, and between the units and the building structure, suspended ceilings and lightweight partitions. The location of these units in the ceiling void of instructional areas, conference rooms, offices, classrooms and the Theatre should be avoided.

Chillers & Cooling Towers

This facility is planned to rely on the existing and expanded university chilled water distribution system for cooling needs. However, should timing or capacity issues require the consideration of chillers or cooling towers on site, the noise data, and location, of any such equipment should be provided to an acoustical consultant as soon as possible for assessment.

Noise Radiated to the Exterior

At some point, it may be necessary to address the noise radiated to nearby buildings, and the community from the rooftop mounted equipment (i.e. rooftop fans, etc.) and from inlet/outlet noise from Mechanical Equipment Rooms, as well as electrical rooms.

Vibration Isolation

Rigidly mounted HVAC equipment often transmit the full vibrational force to the building structure. Structure-borne vibration (i.e. vibration that is transmitted through building structural elements) can travel considerable distances through buildings and may be perceivable as either vibration or re-radiated noise in areas remote from the equipment. This can result in disturbing physical vibration felt by the occupants and/or annoying rumble noise when the vibration excites the structure at frequencies within the normal hearing range. Vibration isolation should be provided for all rotating and reciprocating mechanical equipment. Isolator types should be based on the equipment weight, rotational speed (i.e. rpm), motor horsepower, and location (i.e. on-grade or on suspended slabs, etc.) of the equipment.

Building Electrical Services

Typical sources of building electrical services noise include transformers and lighting ballasts. Even small power transformers can generated loud “buzzing” noise. Transformers should be located in rooms that are not adjacent to noise sensitive spaces and the transformer mounts should incorporate properly selected and appropriate vibration isolation systems.

In highly noise sensitive spaces, such as distance learning rooms, the Theatre, classrooms, etc., lighting ballasts can produce unacceptable levels of noise. If lighting ballasts are used in these spaces, they should be specified to have sufficiently low noise levels.

Proper and sufficient noise and vibration control of emergency gen-sets is essential. Such equipment must be located distant from occupied spaces.

Building Plumbing

Building plumbing can generate unacceptable fluid flow noise in walls and ceiling plenums. It may be necessary to resiliently mount piping within noise sensitive spaces. It may also be necessary to externally lag the piping with noise insulating jackets. Restroom plumbing is often of particular concern. It is best to locate restrooms, especially public restrooms, away from other noise sensitive spaces.

All floor mounted pumps will need to be installed on vibration isolators. In addition, all pipes attached to vibration isolated pumps must be attached via flexible connectors (within 50 ft. of the pumps).

Care must also be exercised in the location of steam pressure reducing valves should any be used on this project. Proper vibration isolation and noise control is critical.

G. Civil Engineering

Required services for the Student Commons Expansion will include natural gas, potable water, sanitary sewer and storm drain, fire protection, electric power, telephone; data/communication, chilled water, steam, and steam condensate. To the extend possible, all utilities shall come from existing campus supply sources.

Criteria used on the design of the sanitary sewer, storm drain and water facilities should correspond to the Uniform Plumbing Code, Riverside County Fire Department Standards, State Marshal Standards, Campus Fire Marshal, and any state and federal requirements and be coordinated with the University Design and Construction. The costs for connecting any and all site utilities to existing facilities are to be borne by the project.

All existing buildings such as the Old Book Store, New Book Store, Physical Education, Pierce Hall and all other buildings in the vicinity shall remain operational during demolition, removal, relocation and installation of all proposed site utilities. The construction of utility relocations and connections to existing shall be closely coordinated with UCR Planning, Design and Construction.

Site Sewer System

There is an existing 8-inch line flowing North at the Northwest corner of the proposed construction area that extends North, East of the existing Physical Education building. There is also an existing 6-inch line flowing North at the Northeast corner of the proposed construction that currently services this area. Any proposed sewer lines should feed to both of these existing lines. Piping material for the new sewer laterals shall be PVC SDR 35, consistent with Campus Design and Construction practice.

Site Storm Drainage

The Student Commons Expansion site is located in the center of the campus, which is within the FEMA Zone C (areas of minimal flooding). There is an existing 21-inch storm drain line flowing North from the Northwest corner of the proposed construction area that extends North, East of the existing Physical Education building. There is also an existing 8-inch storm drain line flowing North from the East side of the proposed construction area that extends North, East of the new Book Store building. Runoff from the proposed building and associated site development shall be conveyed to these systems. Storm drain piping material shall be PVC SDR 35 consistent with Campus Design and Construction practice.

Domestic and Fire Water

There is an existing combined domestic and firewater loop on campus that includes a 6" main from the Northwest corner of the proposed construction area, continuing to the South, East and then North to the Northwest corner of the proposed construction area. This existing line has existing site fire hydrants attached to it. Domestic water supply for the Student Commons Expansion will come from this line. Site water piping shall be C900, PVC, consistent with Campus Design and Construction practice. All required domestic and fire water laterals extending off of this looped line will require backflow prevention and detector checks in accordance with the UCR list of approved backflow devices. Also the fire line shall require post indicator valves and fire department connections as specified.

Utility Tunnel

Most existing buildings on campus are supplied chilled water supply and return, steam, steam condensate, and natural gas via a tunnel, which runs from the campus central plant. To supply the proposed Student Commons Expansion, there are two existing tunnels. One tunnel accesses the East side and the other the West side of the proposed site. The existing tunnel located coming Southeast out of the Physical Education building can be connected to the expansion as it currently does to the existing building. The other existing tunnel coming West out of Pierce Hall can be connected to the expansion as it currently does to the exiting University Commons.

H. Landscape and Site Issues

Landscape investigation was limited to campus and urban design study by the architect. It is anticipated that specific landscapes concepts, including plant materials, streetscape materials, lighting, etc will be developed as part of the design process, and will be consistent with overall campus standards and specific guidelines and recommendations that come from the ongoing LRDP update.

The existing Commons sits on the north side of the main east-west oriented campus mall. To the east this open space is linear and formal, immediately south of the commons it is large and open, but without formal definition beyond the carillon tower. As the mall continues to the west it becomes much less formal and more park-like.

To the immediate east of the Commons is one of the major north-south pedestrian walks on the campus. This walk, though well used, lacks definition as a pedestrian street and gathering place.

The Commons site is one of the most active spaces on campus. Potentially, the various activities may spill into the surrounding plazas and courtyards. Gathering areas, dining terraces, etc., are energized by pedestrian circulation and visibility. Exterior areas designated for high usage (dining, performances, etc.) should be visible and accessible to the fullest extent possible.

The existing Commons service area is currently large enough to meet the service needs of the Commons as well as provide a number of parking spaces that are used by service vehicles and staff. This area also provides a turning area for the bookstore dock to the north, and is adjacent to the east-west service access to the science facilities to the east. The service area can be somewhat reduced, but should provide a minimum of 3 12'x48' loading areas plus a 12'x36' space for a trash compactor.

- Service cart accessibility should be located the farthest away from student activity areas and closets to existing service access.
- Service area sights, sounds and odors should be screened and/or mitigated as much as possible.
- Bicycle parking is scarce throughout the campus. Additional racks will be required for the student center; preferably placed as close to the front door as possible in a safe, visible manner.
- Maximum sun exposure is desired for plazas and dining terraces, relying on local devices to create shade as required. The use of deciduous trees in plaza areas can provide shade in warmest months and sunlight in cooler months.
- Light levels should increase in this area due to later hour use and intensity of uses. Fixture types can relate to social function of facility as well as to the campus vernacular in general.
- Because the Commons is different in form and function than most other “academic”: buildings on campus, it would seem appropriate that construction materials reflect this character difference.
- Surface materials needs to be extra durable because of wide variety of possible functions and intense usage.