B. GREEN BASIS OF DESIGN

Sustainable Design Concept

The history of Alaska is a history of resource utilization enjoyed by the people who live there. In a similar vein, the missions of the National Park Service and the U.S. Forest Service both are inexorably linked to natural resources. The Project Interpretive Message captures this relationship:

> *"The harsh realities of this dynamic environment first defined the plants and animals that could live here, then forcibly shaped human culture through adaptation; and now, the culture in its own turn affects the resource."*

The design of the Mary Lowell Center must be able to adapt to this dynamic environment, which is a function of the climate extremes of Seward. These extremes are either an abundance or scarcity of resources. A third season or swing season occurs in-between abundance or scarcity resources or in which resources are either increasing or decreasing:

Abundance: During the summer months, the environment is one of abundance; sunlight hours, temperature and visitor occupancy are at their peak.

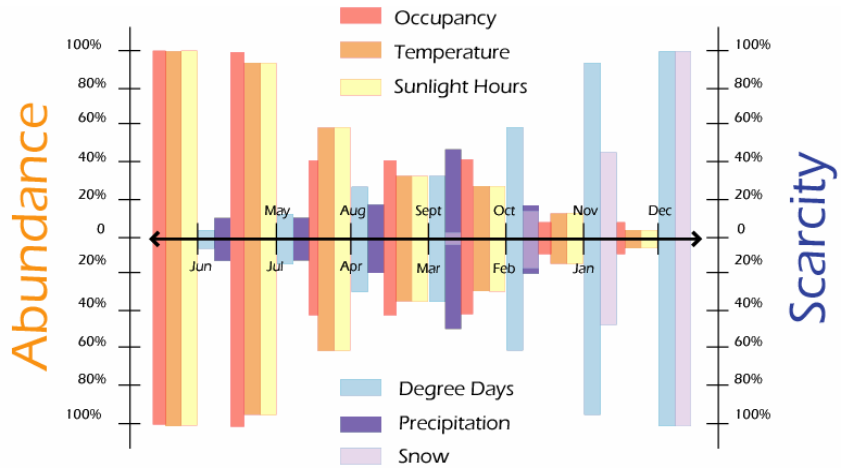
Scarcity: During the winter months, the environment is one of scarcity: sunlight, temperature and visitor occupancy are at their low point.

Swing: The times between the extremes of scarcity and abundance in which change occurs quickly and rapidly.

Therefore the climate is much like a pendulum, which slows during the upward swings as it approaches either summer (abundance) or winter (scarcity) and speeds through the low point in the swing during spring and fall seasons.

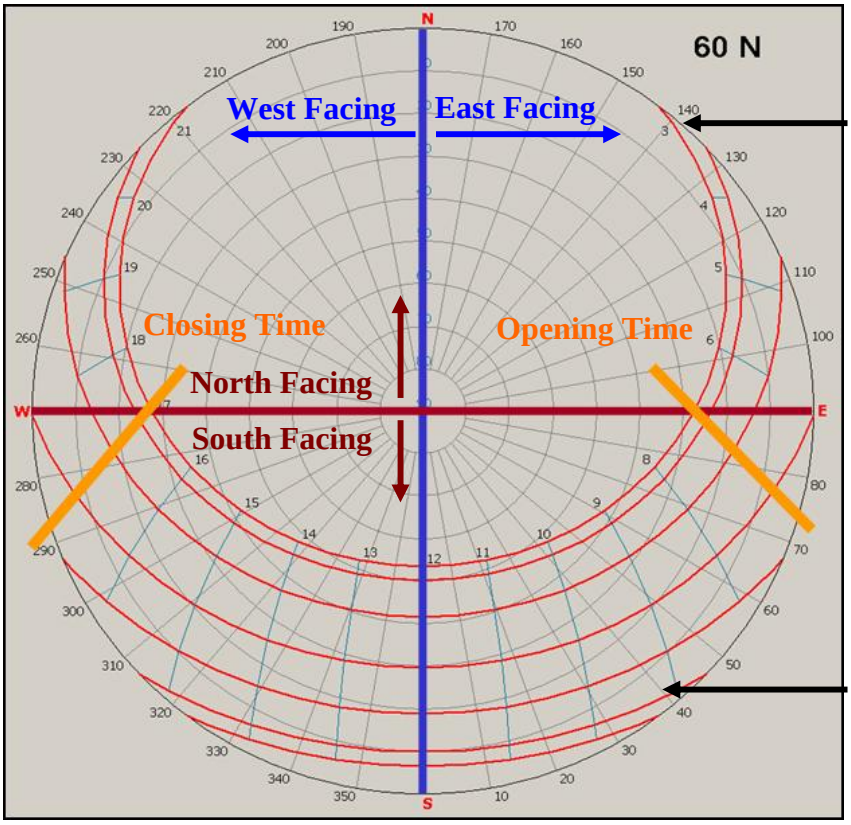
Taken separately, the seasonal extremes would each require separate design responses that would result in two drastically different buildings. Simply by selecting winter conditions as the driver of the design would result in a building that would perform poorly during the summer and swing seasons. The same would be true if the summer season were used as the driver. The most sustainable response is to investigate how the building can respond to both extremes through adaptations that could occur during the swing seasons. By understanding the extremes of daylight, temperature and occupancy during abundance and scarcity, a sustainable design response can be understood.

Figure B-1 Abundance and Scarcity



1. Daylight Swing Analysis

The 60 degree North latitude of Seward creates a dynamic seasonal change with regards to available daylight. **Figure B-2** below captures how the swing affects both summer and winter design conditions.



June: 18 hrs of sunlight

May & September: 12 hrs of sunlight

December: 5 hrs of sunlight

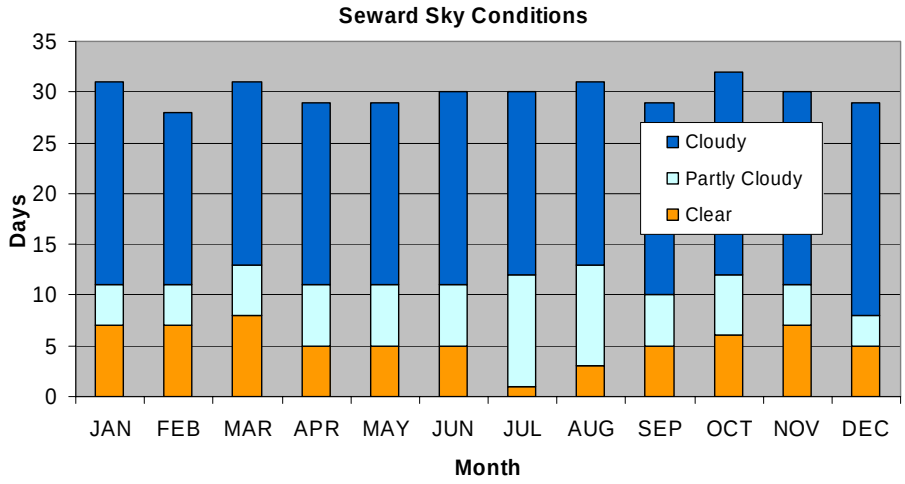
Figure B-3 depicts the exact design conditions that must be considered for the building to be able to respond to both extremes:

Figure B-3: Design Conditions

	Summer	Fall/Spring	Winter
Total Daylight Hours	18 hrs	12 hrs	5 hrs
North Solar Exposure	8 hrs	0 hrs	0 hrs
South Solar Exposure	10 hrs	12 hrs	5 hrs
East/West Solar Exposure	10 hrs	6 hrs	2.5 hrs
Sun Altitude Angles (during operational times)	30-55 degrees	10-30 degrees	0-10 degrees

The sky conditions must also be considered during the design of the building. As can be seen in **Figure B-4** below, the majority of days in the Seward area are cloudy and partly cloudy. Partly cloudy and cloudy skies are the average for 75% of the year. Most sunlight hours per day occur between 9:30 AM and 2:30 PM. While sky conditions indicate that passive solar gains are not possible, overcast sky conditions can present a good opportunity for daylighting as the brightest spot of the sky always occurs at the zenith. Thus, skylit atriums offer the opportunity to let daylight penetrate deep into a building providing good daylight to core areas of the building.

Figure B-4: Seward Sky Conditions

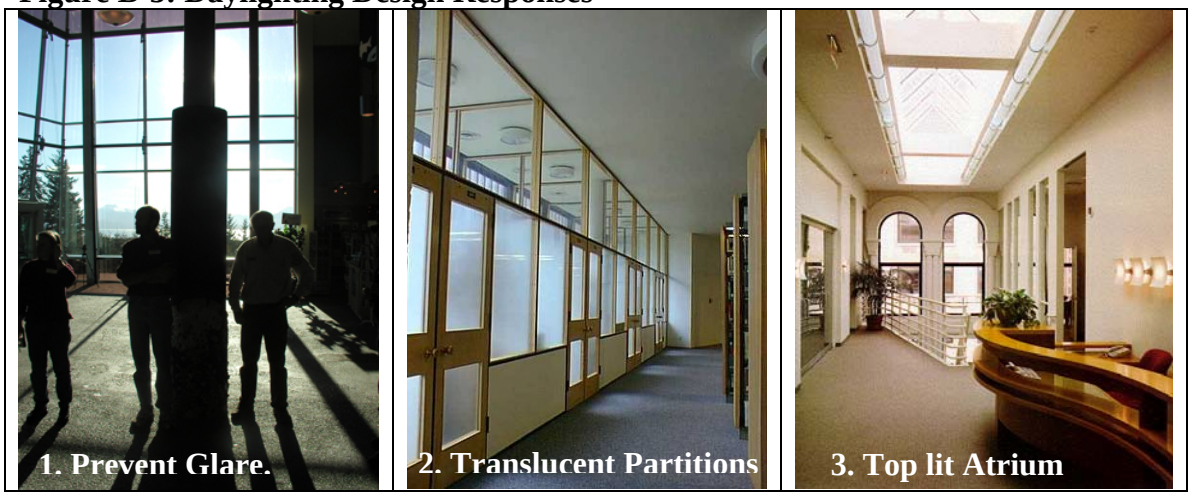


Daylighting Design Responses:

1. **The low sun angles of Seward must be controlled via interior blinds or fixed louvers to prevent glare**
2. **Interior walls should be perpendicular to glazing or feature translucent or transparent panels to allow for daylight penetration**

3. **Cloudy sky conditions are ideal for top lighting through skylights or atria to distribute daylight to all levels of the building.**

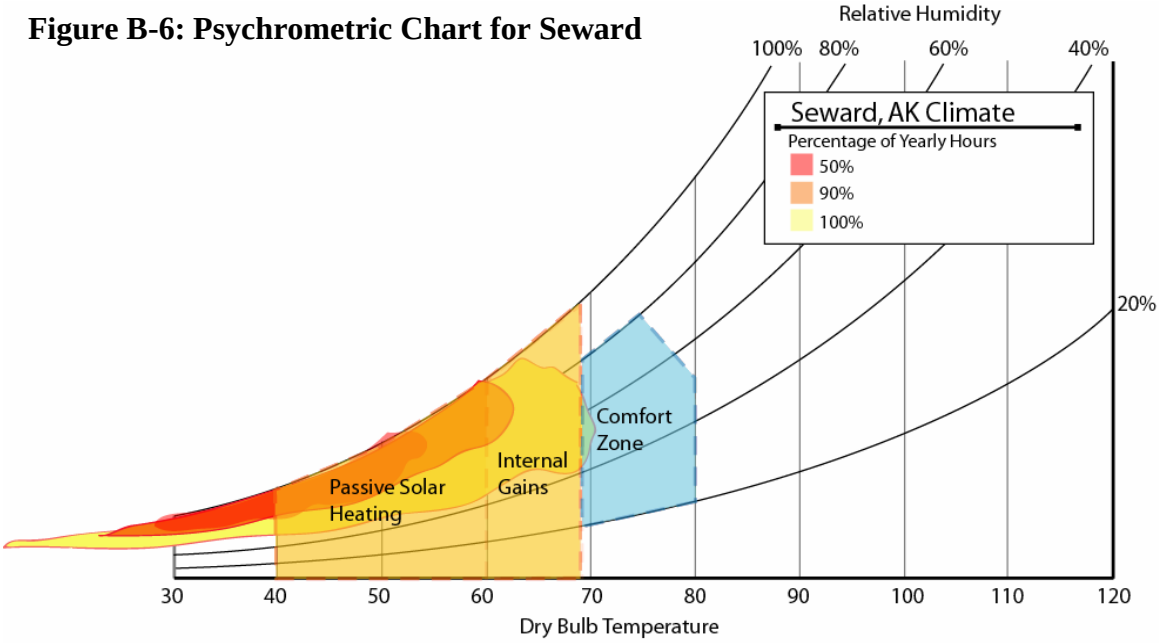
Figure B-5: Daylighting Design Responses



2. Temperature Swing Analysis

Both the average relative humidity and the normal daily temperature are combined on the psychrometric chart to determine a more precise comfort zone, **Figure B-6**. The psychrometric chart also reflects how the normal thermal comfort zone may be extended through the use of selected building strategies.

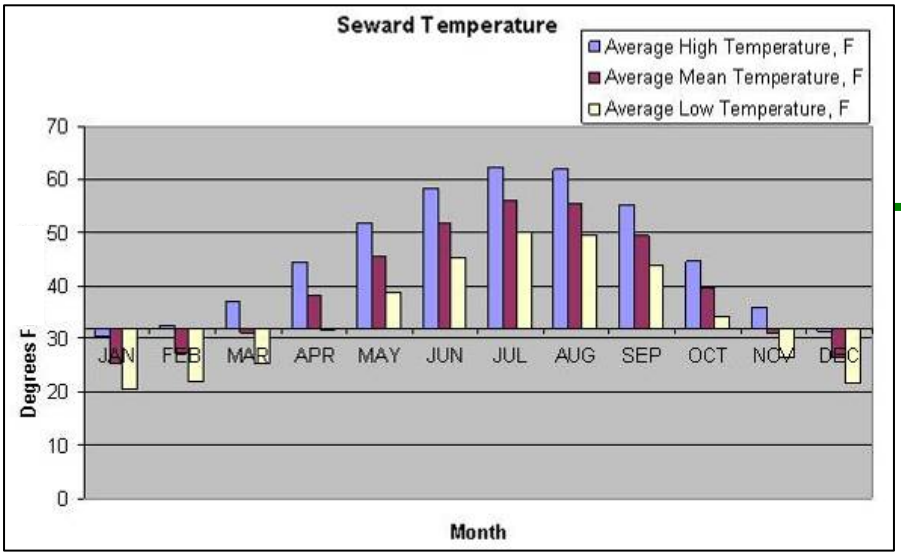
Figure B-6: Psychrometric Chart for Seward



In Seward, the temperature and relative humidity average in the low range, evidenced by most of the data falling to the left of the thermal comfort zone. For most of the year, heating is necessary to warm indoor spaces. An ideal design response for winter conditions is to design a highly insulated enclosure to retain solar gains and to limit glazing to prevent heat loss. As there are limited daylight hours available during the winter, designing for direct solar gains to heat the building is not a realistic design response.

During the summer conditions internal building gains move the temperature and relative humidity into the thermal comfort conditions. An ideal response would be an open, naturally ventilated building. This could be accomplished with large operable windows to provide good ventilation deep into the building and exposed thermal mass to moderate high temperatures. For Seward, a well-ventilated building would not require a chiller. **Figure B-7** below depicts the average temperatures of Seward and reflects these two different seasonal design responses (abundance/scarcity).

Figure B-7: Temperature and Design Considerations



Ventilation Mode:

- **Operable Windows**
- **Cooling not needed**
- **Economizer**

80% Heating Mode

- **High Insulation**
- **Interior Mass**
- **Little Infiltration**
- **Retain Int. Loads**

Temperature Design Responses

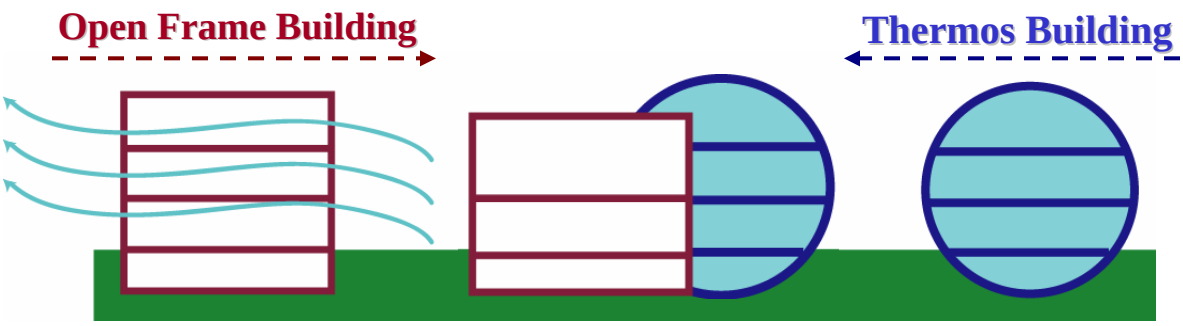
1. **Utilize operable windows to allow ventilation during the summer**
2. **Utilize exposed thermal mass to moderate daily temperature swings**
3. **Use interior insulated shutters to vary apertures thereby reducing thermal loss during the winter and increasing daylight during the summer**

3. Occupancy Swing Analysis

The Partner Agencies all feature occupants that will use the building during the entire year. Staff levels will remain relatively constant during the year, with the exception of a small percentage of seasonal staff. However, The Visitor Facilities have large occupancy swings from the summer to the winter. Almost all of the visitors will be arriving during the summer months and will dwindle down to small numbers during the fall, winter and spring seasons. Per the neighboring Sealife Center, 95% of visitors arrive from May-August. The Conference Center is anticipating roughly 20 events that will occur during the swing seasons of the year: September-November and February-March.

As the building has two different types of occupancy patterns, steady and variable, the design of the building needs to respond to both conditions shown in **Figure B-8** below. By separating the two occupancy types, the area of the building with variable occupancy could reduce operating times without affecting the other steady state office component of the building.

Figure B-8: Occupancy Patterns and Building Conditions



Visitor's/Meeting Center

- **Variable Occupancy**
- **Expandable**
- **Quick Systems Response**

Office Center

- **Steady Occupancy**
- **Contraction**
- **Steady Systems Response**

Another efficiency that is inherent in the occupancy separation is that the heating and ventilation systems can be different and optimized for the occupancy type (**Figure B-9**). For steady occupancy areas, a radiant floor heating system is a highly efficient method to

provide a thermally comfortable environment. During the summer, operable windows could supply ventilation to cool spaces and prevent heat buildup.

These systems, however, are not ideal for highly variable occupancy such as the Visitor's Center and Conference Facility. The systems for these spaces should have quick response times such that as the number of occupants increases (such as at the start of a meeting) the heating and ventilation systems can maintain thermal comfort. An Under Floor Air Distribution system is ideal for these spaces as it responds quickly to changes in occupancy and is the most efficient method for the supply of conditioned air.

A final consideration can be made for spaces that may be used during off-peak hours. The meeting room has the potential to be operating after closing hours for community meetings and events. If this space is designed as a room within the building, then the community room, lobby, restrooms, and all other spaces that are connected with the entry would have to be conditioned during evening in which an event is held. However, if the community room is separated from the building and contains restrooms and an exterior entrance, then it could operate independently of other spaces in the building. This could reduce security concerns, heating and staffing required to operate the community room after hours (**Figure B-9**).

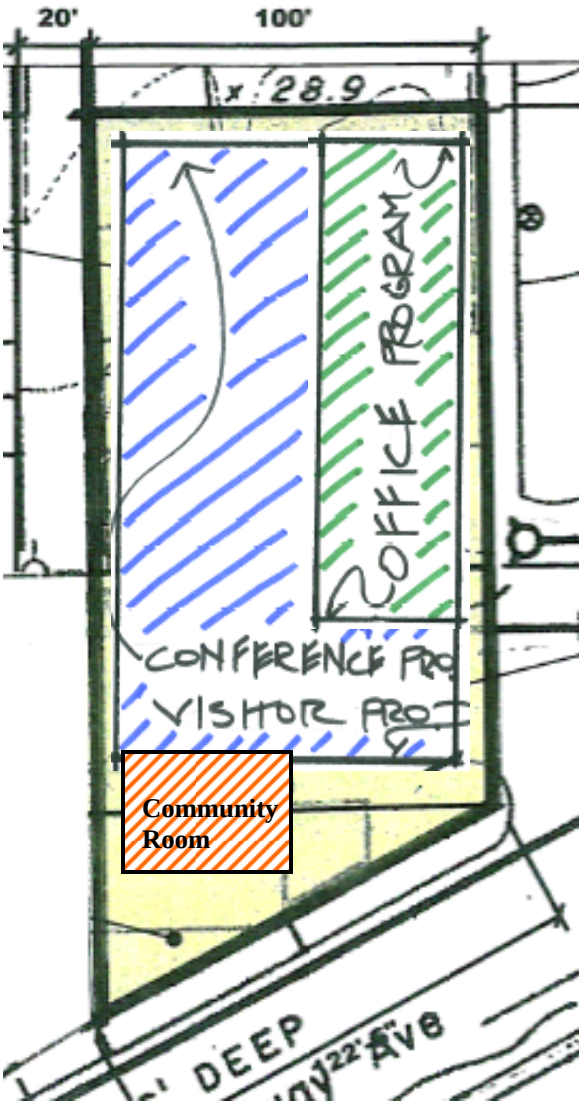


Figure B-9 separating the uses of the building

Occupancy Design Responses

1. **Physically separate the building into two occupancies: variable (Visitor's Center and Conference Facility) and steady (Office Spaces)**
2. **Design separate heating and ventilating systems that can efficiently respond to the two occupancy conditions**
3. **Provide a separate entry and restrooms for the community room to allow for after hours operation**

4. Bridging Abundance and Scarcity

In order for the building to optimize the design for daylighting, temperature and occupancy swings, the building must be able to adapt to the conditions of their abundance and scarcity. There are two key spaces that can be designed to effectively bridge abundance and scarcity swings: the Atrium (designed for the Office Spaces) and the Washington St. Promenade (designed for the Visitor's Center and Conference Facility), **Figure B-10**.

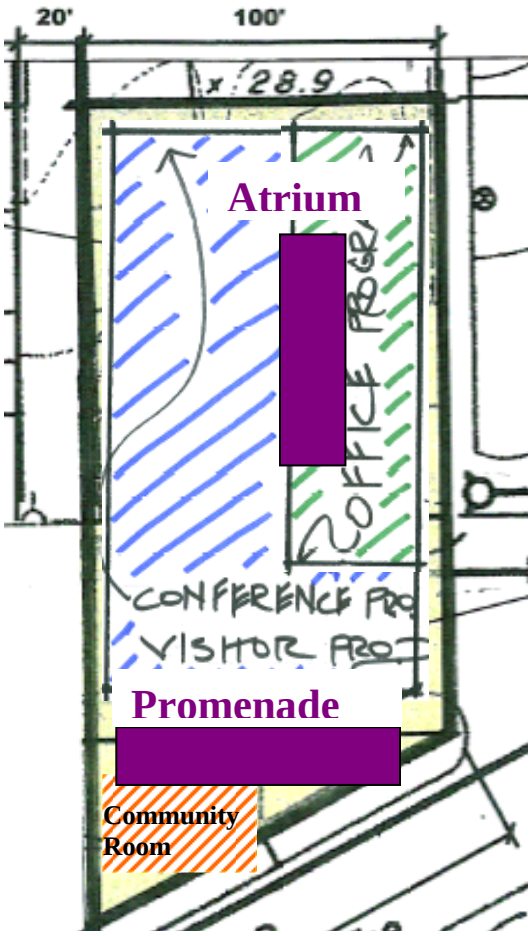


Figure B-10: Spaces that bridge Abundance and Scarcity

Atrium Design

A central atrium can be designed to accommodate both the abundance (summer) and scarcity (winter) conditions. Located at the center of the building, it is ideally situated to provide building core occupants with an amenity that provides thermal and visual delight.

During the summer, an effective daylight strategy can be employed due to the abundance of sunlight hours. A glazed atrium can supply multiple floors with access to daylight. In addition, moderate temperatures are abundant resulting in ideal conditions to naturally ventilate the building through operable venting located at the top of the atrium. To further aid thermal comfort, one side of the atrium can feature exposed thermal mass that can absorb heat during peak conditions and radiate it back out during off-peak conditions.

During the winter, daylighting is not an ideal condition as daylight hours are extremely limited. In addition, spaces that encourage heat to escape should be eliminated. The atrium space can be designed to shut off the unoccupied space (that is used for summer ventilation) in order for spaces to retain heat during the winter. Thermal screens or wall systems can shut off the volume of the atrium from occupied spaces, thereby cutting off thermal plumes and preventing drafts. **Figure B-11** shows how the atrium can transform and mitigate the seasonal swing.

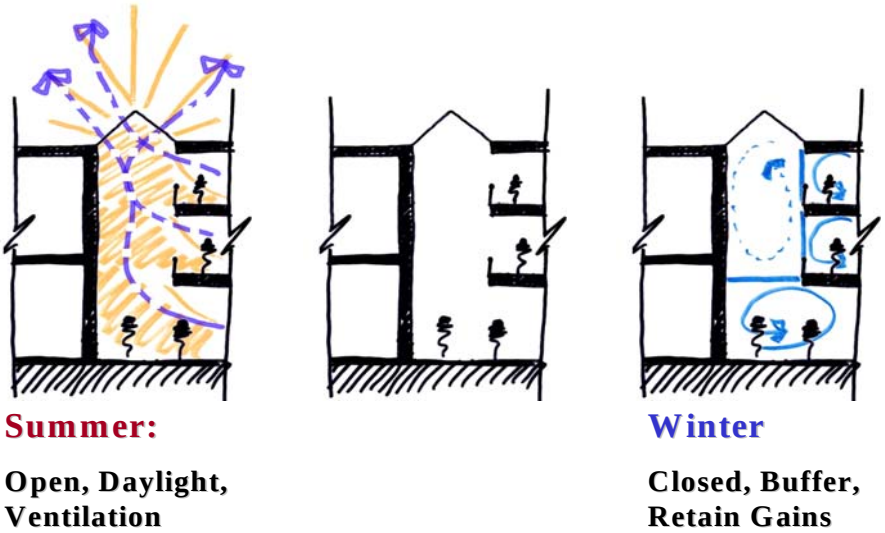
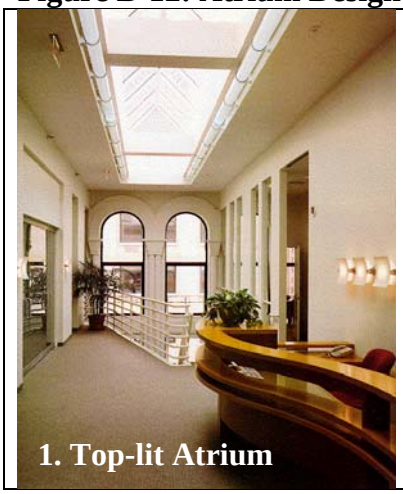


Figure B-11: Atrium Summer and Winter Operation

Atrium Design Responses (Figure B-12)

1. **Glaze the atrium to allow daylight to penetrate multiple floors**
2. **Design thermal screens or wall systems that shutoff convective cycles and reduce the heated volume**
3. **Expose thermal mass to collect sunlight in swing seasons and moderate summer peak conditions**

Figure B-12: Atrium Design Responses



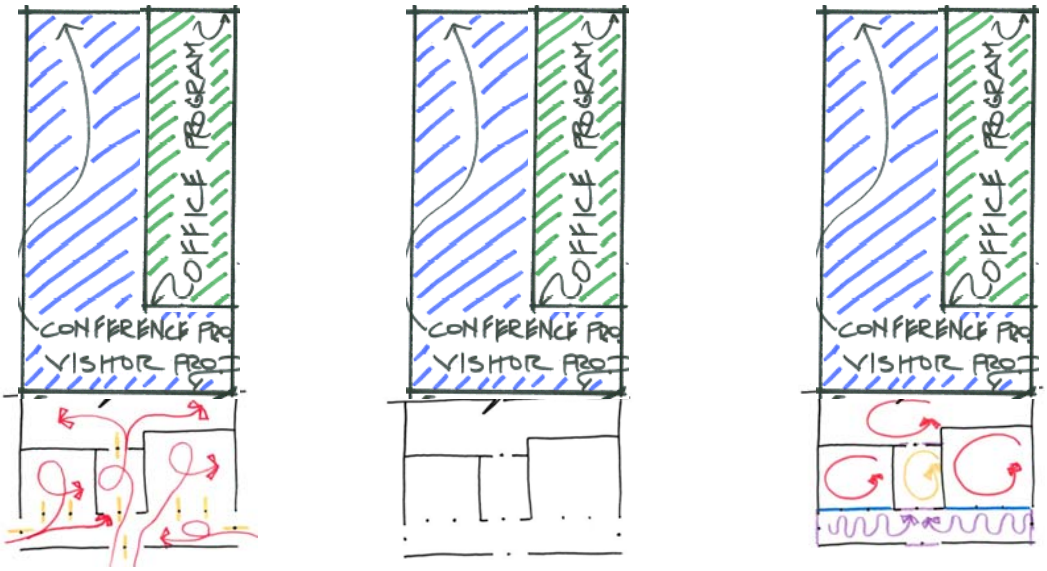
3. Exposed Mass

<u>Washington St. Promenade Design</u>

The main entrance to the facility is located at the south edge of the site. This area is subject to large swings in occupancy and thermal conditions. To help moderate these swings, the design of the entrance can be similar to the design of a transitional street promenade. During the summer, in which occupancy, thermal comfort and activity are at their peaks, the promenade should be open and inviting. Wall and glazing systems that can open up to allow functions to spill out to the public spaces are ways in which the promenade can be activated with use and take advantage of favorable climate conditions (**Figure B-13**).

During the winter, the promenade can be closed off to act as a thermal buffer between harsh outside conditions and heated indoor spaces. It is also an area that can act as a large mudroom for occupants to shed layers of clothing and wipe off their boots prior to entering the building. As the building does not need additional space during winter conditions when occupancy is low, this space does not need to be conditioned to indoor temperatures. A radiant slab is an ideal technology to moderate the promenade space, as it does not heat the air that typically escapes when doors are opened.

Figure B-13: Promenade Summer and Winter Operations



Summer:

Open, Expandable, Ventilation

Winter

Closed, Buffer, Mud Room

Washington St. Promenade Design Responses (Figure B-14)

1. **Provide large operable wall systems that allow the space to expand during the summer and contract during the winter**
2. **Proivde walk-off mats within the porch to allow occupants to remove snow and ice from boots prior to entering**
3. **Use a radiant slab to moderate front porch temperature during the winter**

Figure B-14: Front Porch Design Responses

1. Operable Wall Systems	**2. Recessed Floor Mats**	**3. Radiant Floor**

<u>Green Basis of Design Overview</u>

Each of the building features that respond to the swing from abundance to scarcity, have design implications that span the traditional roles of design team and consultants. For example, the atrium design must be described in architectural, mechanical, electrical and interior design narrative and design documents. It is therefore critical that all members of the design team are aware of how their design decisions impact others and, consequently, the overall performance of the building.

A Green Basis of Design (GBOD) document was created to communicate integrated design decisions to all on the design team and to the owner. Components, systems and design features are described in the GBOD that serves to capture owner requirements, design standards and sustainable design goals. It also serves as a preliminary commissioning document that can be used to evaluate the design at the end of each design phase thereby ensuring that the owner's needs and the sustainable design goals of the project are being met by the design team.

(This page left blank.)