Energy Program:
Proposed High-Speed Rail Station
Portland, Oregon

Christiaan Bovard

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Jean von Bargen

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Thesis Statement:

Rail stations in the United States were once prominent public buildings representing technological achievement in the modern world. These active landmarks formed valuable urban centers within the city. With the advent of the automobile, private transportation became the preferred form of transportation leading to the decline of rail travel and stations. Total dependence on the automobile coupled with increasing population levels has resulted in both the overcrowding of our current highway system and skyrocketing pollution levels. Regional commuters currently experience longer travel times due to recurrent congestion on major freeways. As the demand for travel increases so does the necessity for a rapid and energy efficient transportation solution. The City of Portland should invest in a high-speed rail station that services an environmentally responsible form of public transit along the Pacific Northwest Corridor. By focusing efforts toward building a high-speed station downtown, the aim of this project is to restore the urban richness associated with the historic train station as a place of activity and culture while promoting public transportation.

Locating the new high-speed rail terminal at Portland's historic Union Station provides a desired rapid connection from downtown to the greater Pacific Northwest. Studies have shown that rail ridership along Amtrak's Cascades line has steadily risen in recent years (National Railroad Passenger Corporation, "Annual Amtrak Ridership of 25.4 Million Marks Third Straight Year of Record Increases"). The proposed transportation hub will offer passengers a state-of-the-art rail station with a range of on-site amenities including restaurants, a business center, and a hotel. The arrival of a high-speed transit hub in the heart of the city will undoubtedly bring an increased value to adjacent properties and the northern part of downtown as a whole.

Energy Consumption:

High-speed rail stations by nature are grand structures. They must house a spectrum of services under a single roof. As a result, stations require large amounts of energy to sustain daily rail operations while providing riders a safe and comfortable travel experience. Rail stations anticipate higher energy demands compared to other types of buildings because they are utilized day and night with little or no downtime throughout the year. Although energy usage is higher for these types of buildings, the energy saved and pollution avoided by using a fuel efficient means of transportation far exceeds other forms of transportation and therefore can be justified.

The future only holds one certainty**:** the unpredictability of increasing energy costs. Energy reducing strategies must be implemented into the station design to avoid uncontrollable operating costs in the future. As a premier gateway and symbol of Portland, the station should echo the environmental values of conservation this community holds strong.

Energy Conservation Strategies:

The design and proper orientation of the station can reduce the overall energy footprint of the building. Certain strategies outlined below take advantage of natural patterns found on the site such as natural light and wind while the others strategies are based on innovative building technologies.

Passive Strategies

Natural Daylighting

Using natural daylighting techniques is advantageous to light office spaces to minimize the need for supplementary lighting and further reduce energy usage. When high task lighting is required, energy efficient fixtures and elements such as compact fluorescent bulbs should be specified.

Top Lighting

Areas of high traffic such as waiting rooms, concourses, and train platforms should take advantage of top lighting when allowed. Top lighting is an effective means of lighting because it produces an even distribution of light across surfaces (Lechner 384). These areas generally require high ambient lighting with no glare to clearly navigate passengers through the station and to their respected trains. When employing top lighting as a lighting strategy careful attention must be given as not to overheat a space being served.

Interior Finish Materials

White or light colored interior finish materials should be used as they have a high reflectance factors and reflect up to 80 percent of incident light (Lechner 367).

Cross Ventilation

Local winds on the site routinely move East-South-East and North-West-North at a speed of 7-10 knots**;** enough to provide a breeze but not sufficient to entirely rely on cross ventilation as a means of cooling. To ensure proper cross ventilation, the integration of operable windows in strategic areas of the station could help alleviate the need for a robust cooling system and therefore reducing facilities costs. Offices should also be equipped with operable windows giving workers more control over their working environment and the potential for increased productivity.

<u>Active Strategies</u>

Ground Source Heat Pump

The station will create a significant amount of internal heat gains generated by trains, office equipment, lights and travelers inside the station requiring an active cooling system. A ground source heat pump in conjunction with an all-water cooling system can assist in pre-cooling air for conditioning needs.

Automatic Lighting Dimming Controls

Lighting sensors can be incorporated into the lighting design to detect when interior lighting levels are acceptable without the need of supplementary lighting. These lighting controls can also turn of lights in empty parts of the station at night.

Photovoltaics

Photovoltaics should be incorporated into the large roof structure of the train shed to collect energy during sunny days. This is energy can be stored on-site and used to operate digital train timetables, information kiosks, and public announcement systems.

	FUTURE NO. OF ROOMS	ROOM TYPE	ROOM DIMS FEET	TYPICAL AREA SF	TOTAL FUTURE SF	NOTES
Amtrak-Ticketing						
Ticketing w/ Baggage Check-in	8	Ticketing Windows	9 x 10	90	720	
Ticket Queue Area	8		10 x 1	10	80	10 Linear feet per ticketing window
Automated Vending Ticketing	6		3 x 2	6	36	
Employee Lounge	1	Lounge	15 x 12	24	180	Minimum 100 sf/ Add 10 sf per employee
Cash Accounting	1	Office	8 x 10	80	80	
Supervisor	1	Office	10 x 9	90	90	
Station Manager	1	Office	12 x 10	120	120	
Data Equipment Room	1	Data	10 x 8	80	80	
Secure Storage	1	Storage	10 x 12	120	120	
Employee Restroom	2	Restroom	10 x 18	180	360	
Copy / Print Room	1		10 x 8	80	80	
Office Supply	1	Storage	10 x 8	80	80	
				Total	2,026	
				Circulation Percent 40%	810	Circulation Space = Total SF x 40%
				Total SF Including Circulation	2,836	

	FUTURE NO. OF ROOMS	ROOM TYPE	ROOM DIMS FEET	TYPICAL AREA SF	TOTAL FUTURE SF	NOTES
Amtrak-Baggage						
Baggage Room-Checked	1	Baggage	90 x 40	3610	3,610	10 sf/passenger x (361 Peak Hour)
Baggage - Self Claim	1		25 x 1	25	25	25 Linear feet
				Total	3,635	
				Circulation Percent 40%	1,454	Circulation Space = Total SF x 40%
				Total SF Including Circulation	5,089	

	FUTURE	ROOM TYPE	ROOM DIMS	TYPICAL AREA	TOTAL FUTURE	NOTES
	NO. OF ROOMS		FEET	SF	SF	
Amtrak-Waiting Room						
Waiting Area w/ seating	1	Waiting Hall	90.25 x 60	5,400	5,400	20 sf/ per seated, 10 sf/per standing
Public Lockers	1			500	500	
				Total	5,900	
				Circulation Percent 50%	2,950	Circulation Space = Total SF x 50%
				Total SF Including Circulation	8,850	

	FUTURE	ROOM TYPE	ROOM DIMS	TYPICAL AREA	TOTAL FUTURE	NOTES
	NO. OF ROOMS		FEET	SF	SF	
Amtrak-Security						
Security Storefront	1		6 x 8	48	48	
Office	1	Office	10 x10	100	100	
Holding Room	1		7 x 5	35	35	
Captain's Office	1	Office	10 x 8	80	80	
Restroom	1	Restroom	6 x 6	36	36	
				Total	299	
				Circulation Percent 30%	90	Circulation Space = Total SF x 30%
				Total Including Circulation	389	

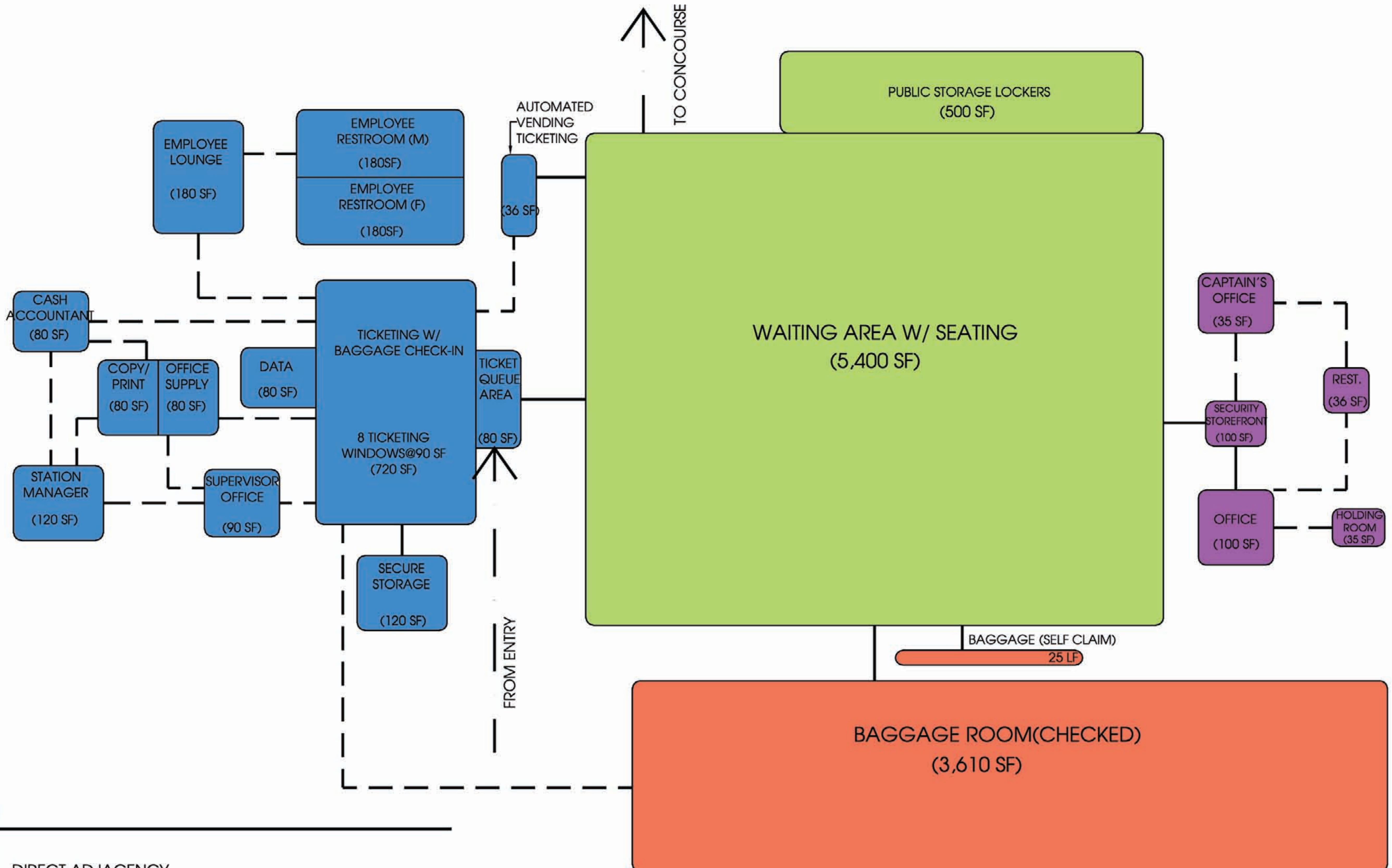
Total of all spaces	17,164	
Req'd Mechanical Space	2,541	Req'd Mechanical Space = Total of all spaces x
Total of all spaces w/ Mechanical Space	19,738	

***All figures based on 1 Million Passengers Annually**
Daily Ridership=1,000,000 / 270= 3,703
Peak Hour(2-Way)= 3703 x (.15) = 555
Peak Hour(1-Way)= 555 x (.65) = 360
Waiting Area= (.5)(360)(20sf/seated person) + (.5)(360)(10sf/standing person) = 3,600 + 1,800=5,400 sf

Daily Ridership = Annual Ridership / 270
Peak hour 2-way traffic = (.15) Daily Ridership
Peak hour 1-way traffic = (.65 hour 2-way traffic)
Waiting Area = (.5)(Peak Hour 1-way)(20 sf/seated person) + (.5)(Peak Hour 1-way)(10sf/ standing person)

Formulas adopted from <u>Amtrak Design Guidelines 2001</u>

SCALED PROGRAM DIAGRAM



LEGEND

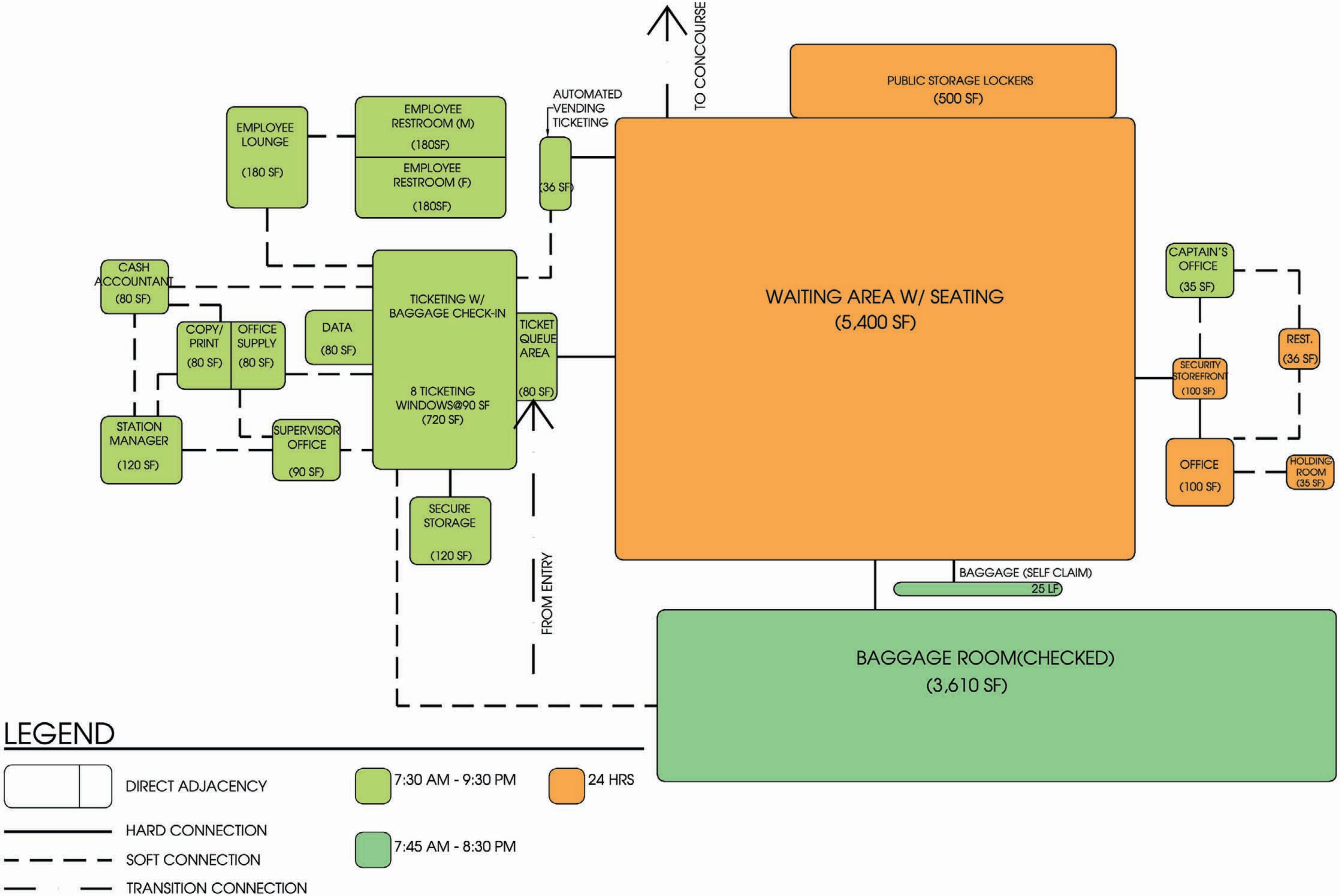
DIRECT ADJACENCY

HARD CONNECTION

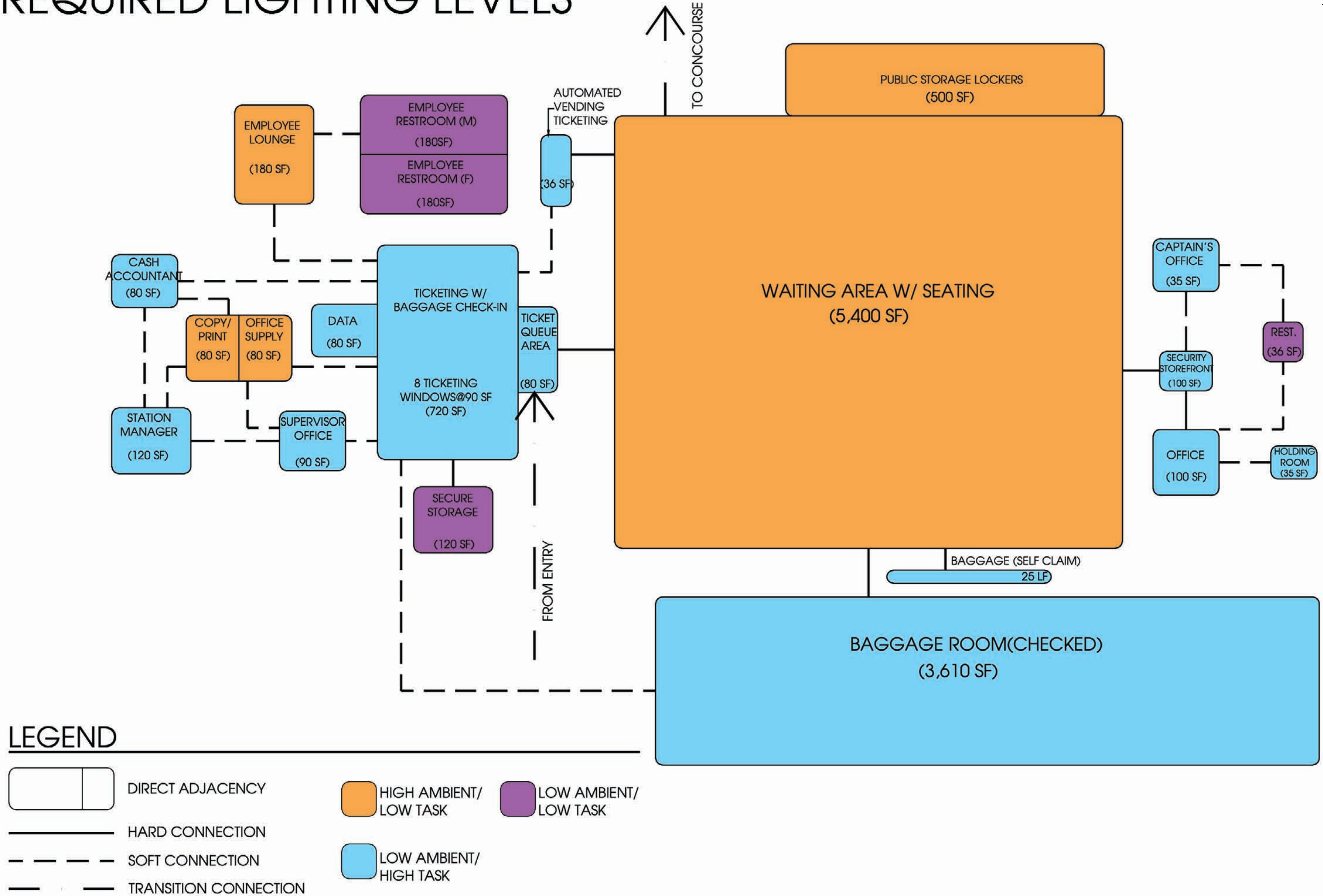
SOFT CONNECTION

TRANSITION CONNECTION

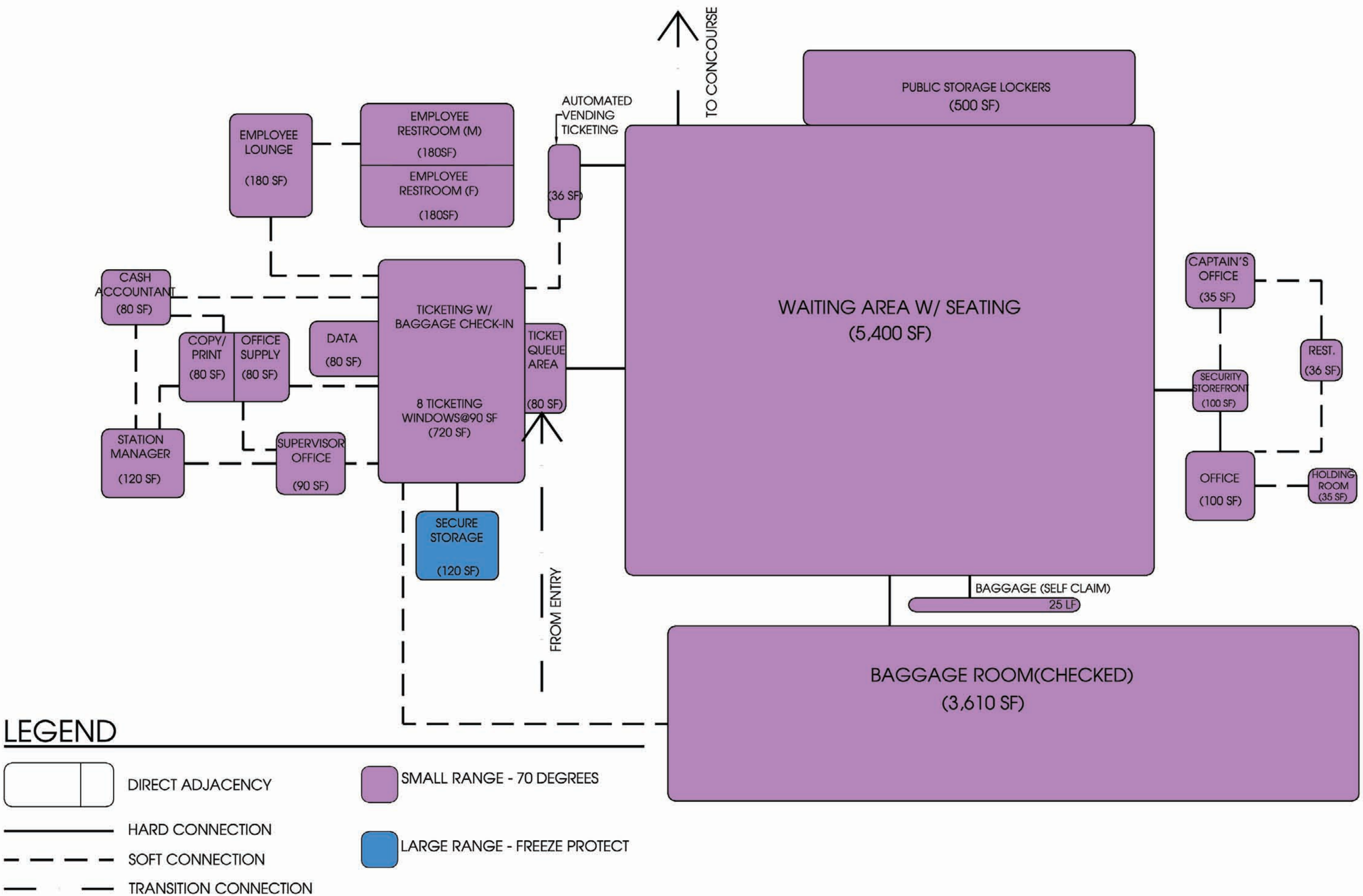
SCHEDULING DIAGRAM



REQUIRED LIGHTING LEVELS



REQUIRED TEMPERATURE RANGE



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