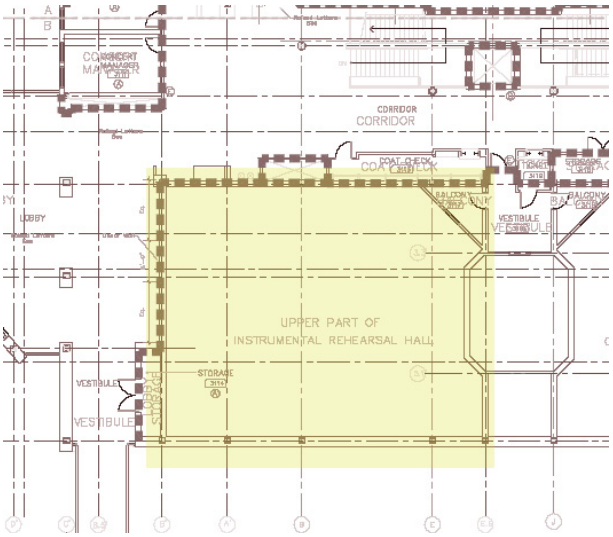
DESIGN GOALS

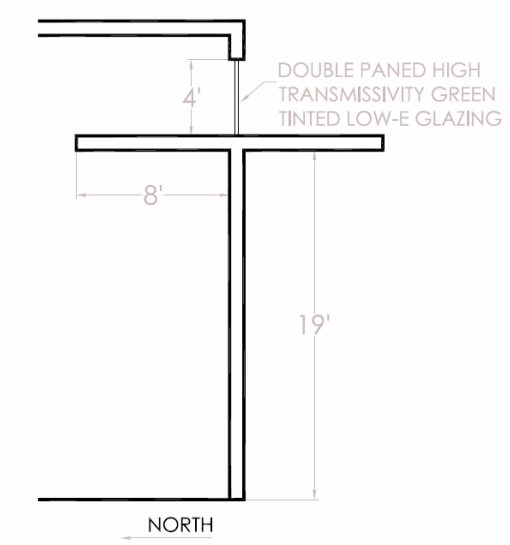


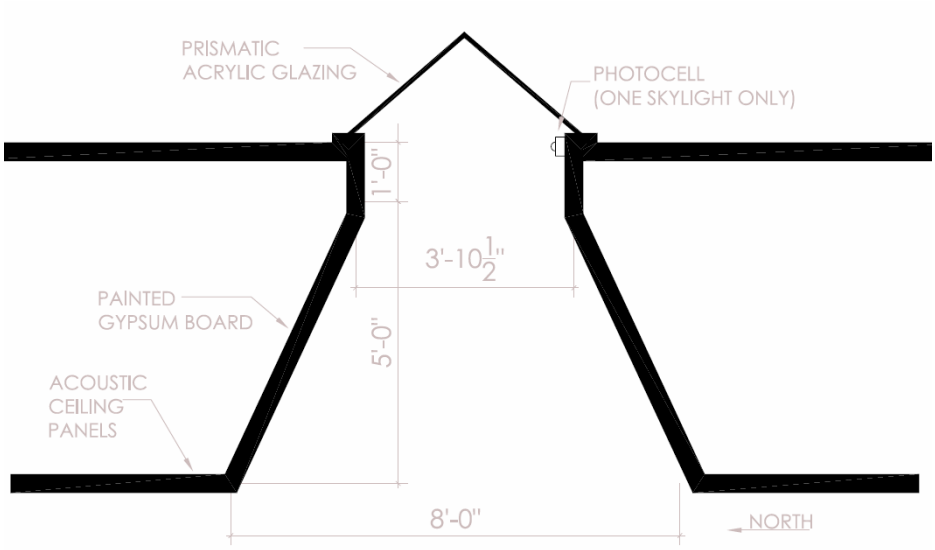
light wood floor ρ=.5
painted gypsum walls ρ=.7
acoustic ceiling tiles ρ=.8

The large instrumental rehearsal room in the Whalen Center is a primarily functional space. During large ensemble rehearsals in this space it is important for the musicians to be able to read their music, and to see and clearly understand the visual direction provided by the conductor. The lighting system in this space must provide adequate levels of functional illuminance while preserving facial detail and color quality. A horizontal task plane illuminance of 30fc is sufficient considering the visual tasks and the average age and visual ability of the college students using this space. Since this space has an unobstructed south facing wall and a ceiling with no floor above it, the lighting design should attempt take advantage of the electric lighting energy savings and productivity enhancing potential of daylight. Yet direct sunlight is visually distracting and should be avoided. Automatic lighting controls that are both simple and flexible should be incorporated to take advantage of the daylighting system and to comply with ASHRAE automatic shutoff guidelines. There is an observation balcony in the northeast corner of the room and a audio recording studio on the east wall which has windows for observing the space. The lighting design for this room must preserve the views from both of these vantage points. Aesthetically, the lighting system needs to find a balance between sterile function and dramatic emotion. Like most spaces in the Whalen Center the appearance of this rehearsal space should not be overpowering. The mood of the room should be determined by the music being created, rather than by the lighting system.

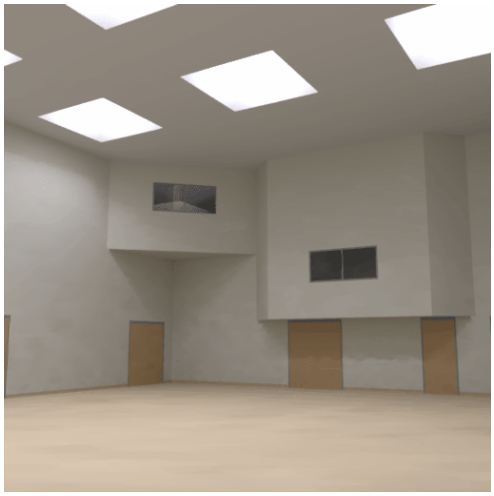
DESIGN COMPARISON

To develop a lighting design appropriate for this space, two distinct systems will be compared, and one of these designs will be selected and fully developed. One system to be compared will incorporate a continuous lightshelf along the south wall of the space, coupled with dimmable semi-direct linear fluorescent pendants (type FF) from Litecontrol. (www.litecontrol.com) The lightshelf is solid, and the top surface is a specular material. The interior overhang of the lightshelf is designed to eliminate any penetration of direct sunlight to the task plane. Three continuous rows of FF luminaires will be suspended at 12' AFF in the east/west direction. The second system for comparison includes nine splayed skylights arranged symmetrically in the ceiling of the rehearsal room. Each skylight will have a diffuse glazing area of 4'x4' and will splay out to 8'x8' as it travels through the 6' plenum. These skylights will be paired with electric lighting by compact fluorescent downlight pendants (type FA) by ERCO (www.erco.com) placed in a symmetrical 8' OC array, 12' AFF.





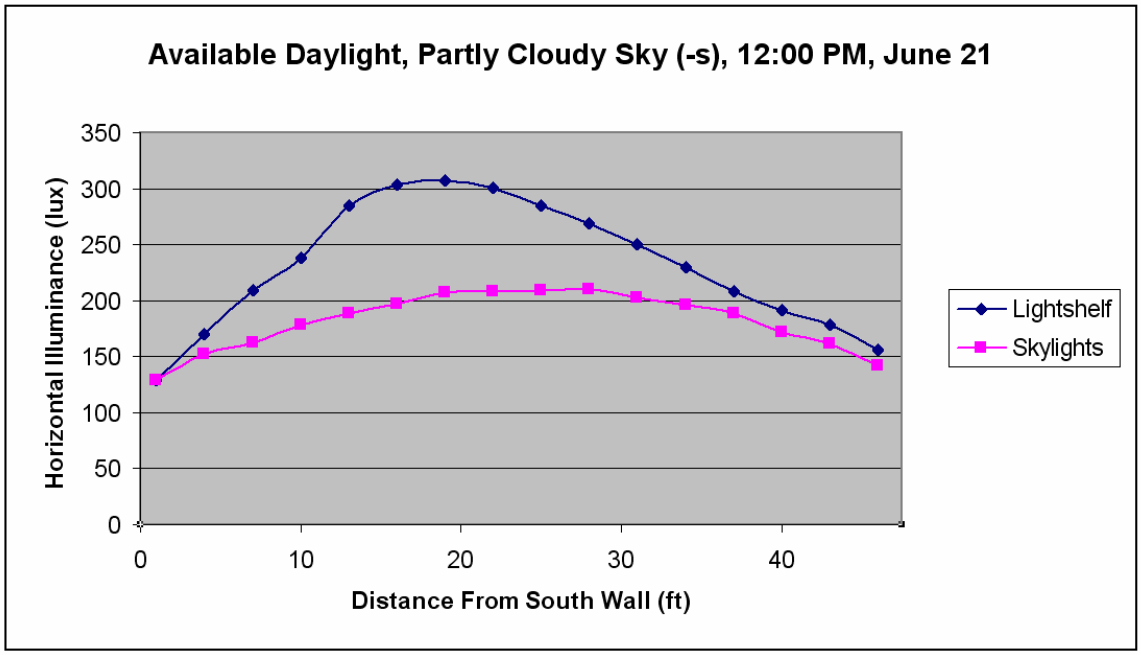
COMPARISON DATA



SKYLIGHT

LIGHTSHELF

144 sf	glazing area	244 sf
208 lux	available daylight	270 lux
359 lux	available electric light	508 lux
0.72 W/sf	power density	0.82 W/sf
65%	daylight well efficiency	47%



COMPARISON ANALYSIS

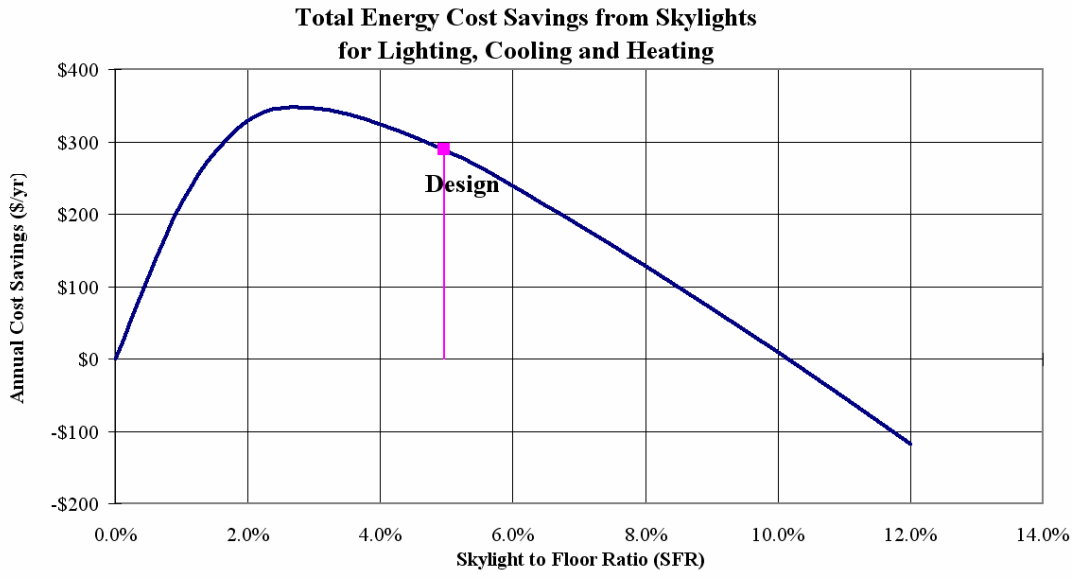
The analysis of the two lighting systems reveals that the splayed skylight system is the best system for this application. This is due to the relatively low daylight well efficiency of the lightshelf when compared to the splayed skylights. The diffuse skylights bring in more illuminance per square foot of glazing area than the lightshelf. More glazing results in more negative impact on building HVAC loads. Also, the illuminance provided by the skylights is much more uniform across the task plane, whereas the lightshelf provides fairly uneven illuminance. This discontinuity will be even more pronounced under clear sky conditions when direct sunlight hits the lightshelf. The uneven daylight illuminance can be accounted for by 'zoning' the electric lighting system, but this would require multiple photocells connected to a complex control system. The lightshelf system luminaires provide more horizontal illuminance than is necessary in an instrumental rehearsal room occupied primarily by 18-24 year old college students. Also, the continuous rows of type FF luminaires may create awkward and distracting banding on the specular finishes of instruments. The skylight system luminaires will provide appropriate levels of crisp, direct light with a 40° cutoff. This distribution will enhance facial rendering and reduce glare from distant fixtures.

SELECTED DESIGN SCHEMATIC

Daylight will be brought into the space through splayed skylights. The skylights are laid out in a symmetrical pattern which fits within a 2'x2' acoustic ceiling tile grid. The skylight glazing is a 4'x4' pyramid-shaped triple glazed prismatic acrylic unit manufactured by Sunoptics. (www.sunoptics.com) The inside of the splayed well will be gypsum board with high reflectance non-specular paint. The electric lighting system in this space will consist of pendant mounted compact fluorescent downlights (type FA) from ERCO (www.erco.com) symmetrically spaced at 8' on center and mounted at 12' above the floor. This mounting height virtually eliminates the considerable reflectance losses that would be experienced if the luminaires were mounted at or near the 25' ceiling height. This room cavity loss is amplified when the low reflectance acoustic

velour curtains are drawn. Also, bringing the luminaires closer to floor level makes maintenance of the luminaires much easier. The electric lighting will be controlled by an occupancy sensor and an open loop photocell dimming control. The electric lighting must be triggered on by an automatic wall switch at the room entrance and then a dimming level will be determined by the photocell signal and setpoints. The electric lighting will stay on as long as the occupancy sensor detects activity. This 'manual on, automatic off' control scheme allows for occupancy with no electric light if that is what is desired by the occupant. Open loop photocell control results in a nearly linear signal to output relationship. The photocell setpoint should ensure there is always a horizontal task illuminance of 30fc. All of the electric lighting in this space will be controlled by the photocell and occupancy sensor combination.

According to SkyCalc, a daylighting analysis spreadsheet provided for free by HMG (www.h-m-g.com) shows that although this integrated daylighting system loses roughly 6,400 kWh/year of energy, there is an energy cost savings of around $290/year. Although this energy cost savings is virtually negligible when compared to the energy costs of the entire building, it is important to recognize that there would be no energy cost savings at all if the skylights were not paired with a photocell based control system.



LIGHTING ANALYSIS

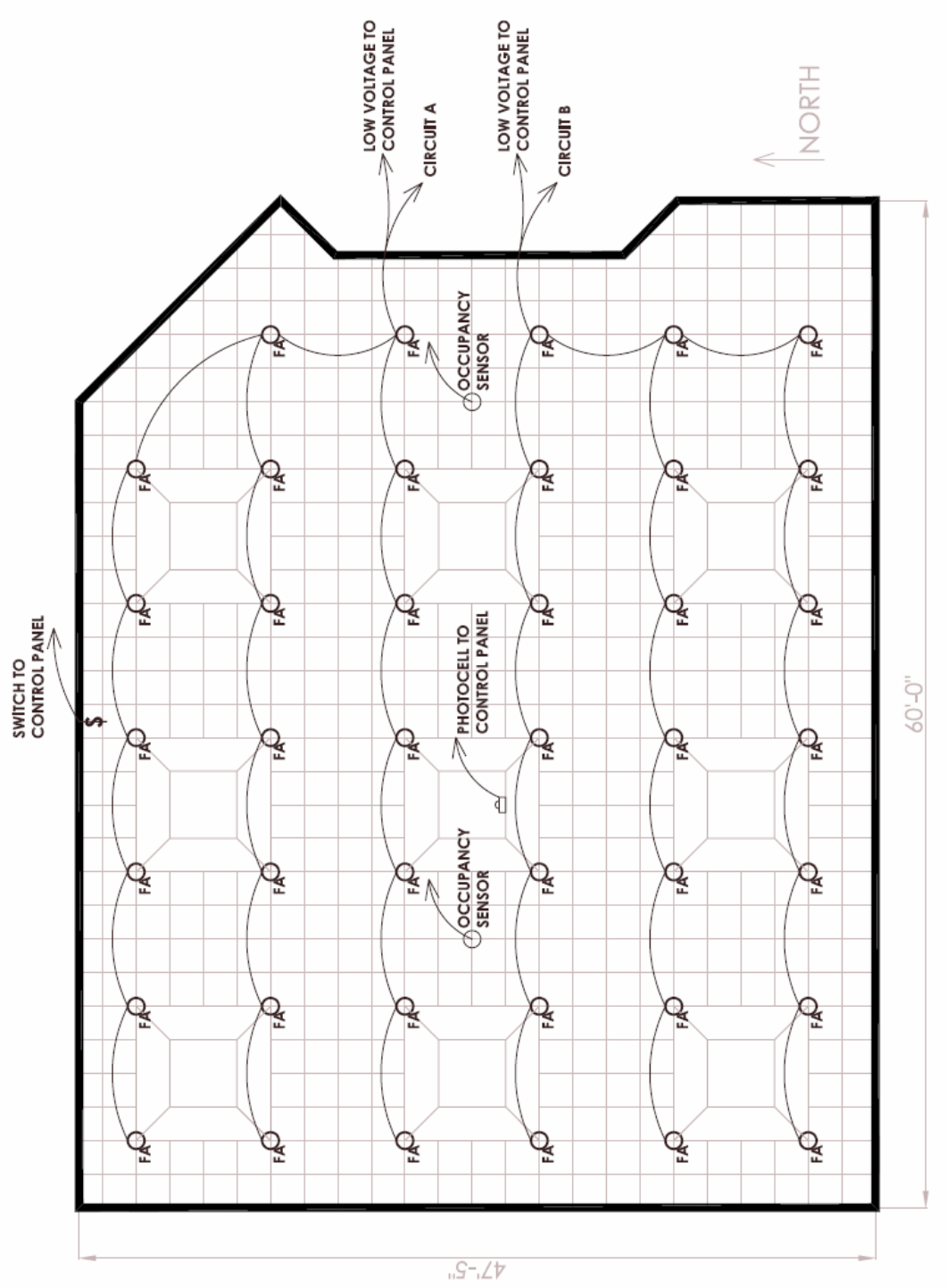
The considerable height of the space and the use of prismatic skylight glazing results in uniform daylight illumination. The splayed skylights provide visual detail to the ceiling while also remaining fairly anonymous, not necessarily drawing attention to themselves. Although the designed 'skylight to floor ratio' is larger than the ratio of peak efficiency, the location and scale of the skylights fuse well with the physical constraints of the room. The chromatic quality and uniformity of the daylight will make this a very appealing and productive rehearsal space during daylight hours. The 8' spacing and intentionally clean profile of the pendants succeed in preserving the view of the rehearsal space from the observation room and sound room. The electric lighting system provides sufficient illuminance for the primary tasks while also serving as an architectural element of the space. The complete lighting system achieves the design goals of functional, efficient lighting while also adding an element of detail and interest to this potentially bland space.

ASHRAE/IESNA 90.1-1999 Compliance

University Classroom (9.3.1.2)

Room Area	2850	sf
Allowed Density	1.6	W/sf
Allowed Wattage	4560	W
Luminaire Count	41	ea
Ballast Input Watts	50	W
Actual Wattage	2050	W
Actual Density	0.72	W/sf
% Difference	55.04	% Below 90.1

LIGHTING PLAN



DAYLIGHT ONLY

ELECTRIC LIGHT ONLY