

# Clare Hall daylight in window design

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**ABSTRACT:** This paper expands on a case study of a Ralph Erskine University building located in Cambridge, UK. It explores the relationship between daylight, visual perception and window design. The scope of this paper is to serve as a reminder that window design has an important influence in the quality and use of architectural space. The paper suggests that through an articulated use of window types the designer has the opportunity to extend the control on the function and perception of a space. The conclusion shows examples of this articulation and proposes an integration of the effects of window design at the onset of the design process.

Conference theme: education/construction

Keywords: daylight, window design

## INTRODUCTION

Clare Hall's university complex was designed in 1969 by Swedish architect Ralph Erskine. It is conceived as a village space surrounded by green areas, free from cars and open to pedestrian movement. Upon visiting Clare Hall, one becomes aware at the particular way the building opens to the outside through windows. The site is composed of three long blocks running from north to south between Herschel road and the university football ground (Fig.1). At the East of the site, adjoining the garden of Elmsite, is the main building (Fig.2). This is divided into two areas: to the south the administrative spaces and seminar room, to the north the dining spaces. The two areas are connected by the common room, functioning as rest area and passageway.

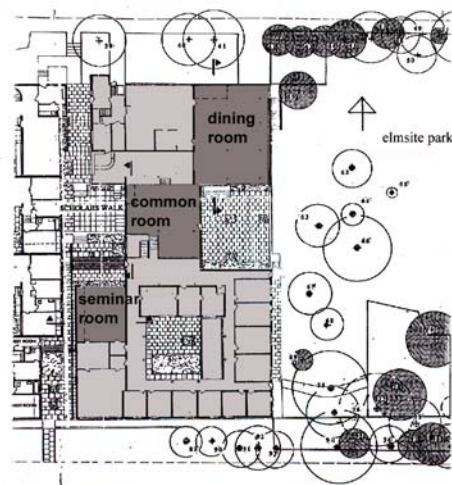
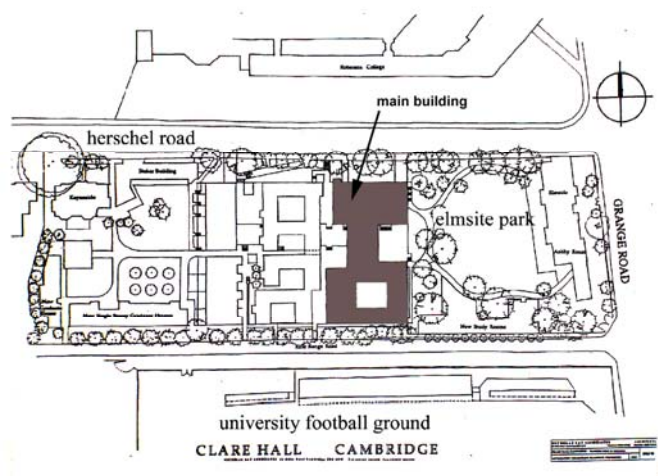
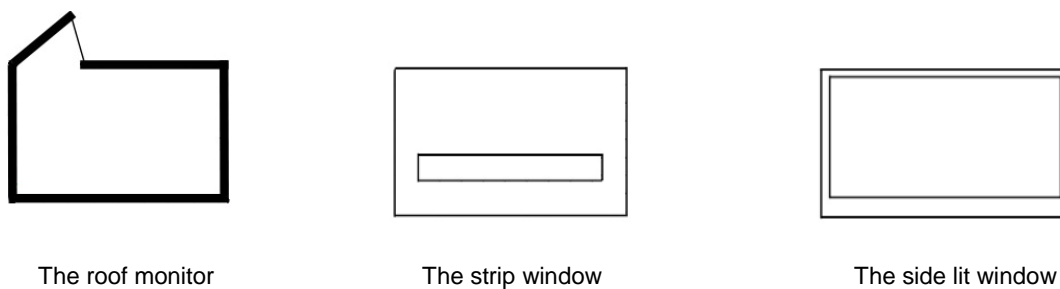


Figure 2: The main building.

Within the main building we find three recurrent window types: *the roof monitor*, *the strip window* and *the side lit window* (Fig.3). It is important to further specify these types. All are in fact windows that open to one side of the building. The roof monitor, however, draws and reflects light from above, the strip window is a an insert placed low within a prevailing opaque wall surface, and the side lit window occupies most or all of the wall façade. Erskine develops and combines these window types to modulate the quantity and quality of daylight in the space. The study explores how this process takes place and the implications on the perception and use of a space. Three rooms are particularly suitable for the scope. They are: *the seminar room*, *the common room*, and *the dining room*.

This study considers each room individually and in separate sections. Each section begins by comparing the visual perception with the daylight factors readings and the CIBSE (Chartered Institution of Building Service Engineers) recommended minimum and average daylight factors (where CIBSE recommended lux values are given, daylight factors are derived considering 10,000 lux standard overcast sky). The section then proceeds to analyse each window type in the room in relation to its overall contribution to visual perception and daylight values of that room and concludes with observations and comments. The study's final conclusion is a synthesis of the observations and comments made in each section.



**Figure 3:** Clare Hall's three recurrent window types.

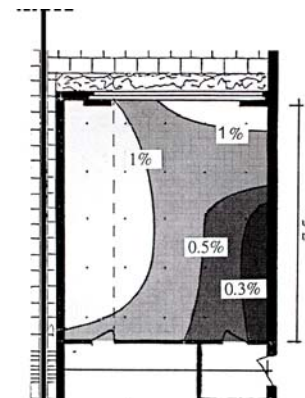
The study uses the support of photography, daylight factor readings (%) and luminance readings ( $\text{cd/m}^2$ ). All daylight measurements are taken under overcast conditions with a mesh of points taken at a working plane height of 900mm with the alternate use of existing textile screens

### 1.0 SEMINAR ROOM

The seminar room serves as a multipurpose space that includes reading and writing activities. It has two windows: the roof monitor and the strip window. Upon entering the room from an unlit antechamber, light is perceived asymmetric, with the bright illuminated wall contrasting with the adjacent walls (Fig.3).



**Figure 3:** The seminar room looking north.



**Figure 4:** Daylight distribution in the seminar room.

With the two windows unscreened, daylight readings show an average daylight factor of 1.1 and a minimum daylight factor of 0.3. Both values are below the CIBSE recommendations for seminar/classroom spaces, as shown in Table 1 (CIBSE, 1987) and Table 2 (CIBSE, 1994). The daylight contours show a considerably uneven distribution of light within a space measuring only approx.  $50\text{m}^2$  (Fig.4).

**Table 1:** CIBSE recommended daylight factor values (%) for selected areas.

	Average daylight factor (%)	Minimum daylight factor (%)
<b>Schools and colleges</b>		
Assembly halls	1	0.3
Classrooms	5	2
Staffrooms, common rooms	5	1.5
<b>Domestic</b>		
Lounges and multipurpose rooms	1.5	0.5
<b>General building areas</b>		
Entrance halls and reception areas	2	0.6

Source: CIBSE 1987

**Table 2:** CIBSE recommended standard maintained illuminance values (lux) for selected areas.

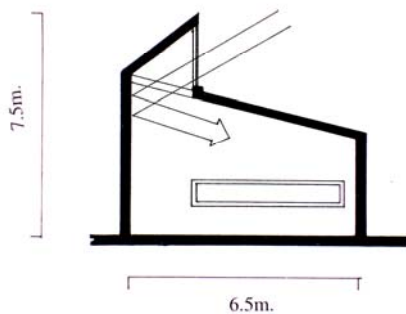
	Standard maintained illuminance (lux)
<b>Education</b>	
Seminar rooms	500
<b>Institutional accommodation</b>	
Main entrances	200
Corridors	20 - 100
Lounges	100-300
Dining rooms	150

Source: CIBSE 1994

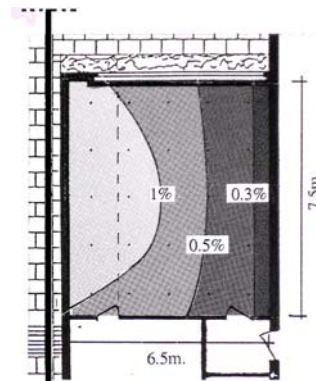
The below standard average daylight factor indicates that the room is generally under lit. Daylight distribution, however, is treated with diversity showing how a variety of day lit spaces can be achieved even within a relatively small space.

### 1.1 The roof monitor.

Relative to the size of the room, the roof monitor is a large opening using approx. 20% of the ceiling surface and fully extending on one side of the room. It is perceived as the main source of illumination but does not provide with any view to the outside (Fig.5). Light enters the room by reflecting off from the west wall.



**Figure 5:** The roof monitor's geometry.

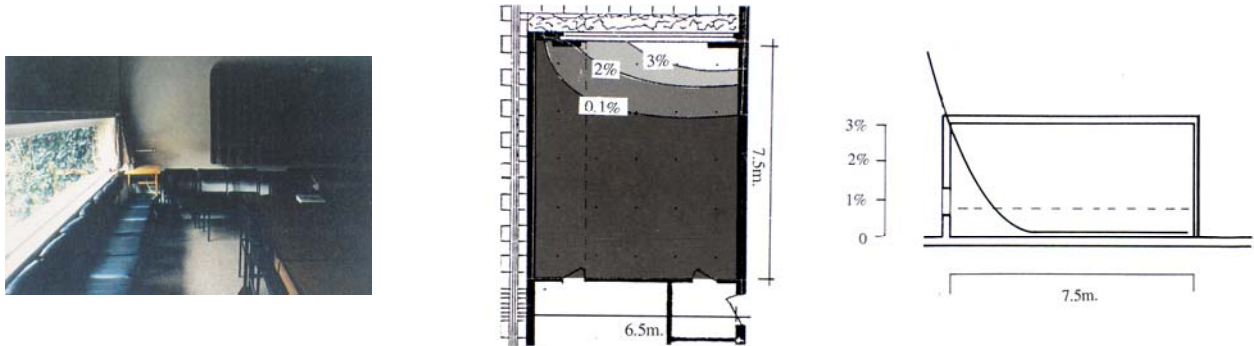


**Figure 6:** Contribution of the roof monitor to daylight.

In order to quantify the roof monitor's contribution to daylight, a test was performed with the strip window fully screened. In respect to an unscreened situation, results show a virtually unchanged average daylight factor (1.0%) and a uniform daylight distribution in the room, confirming the roof monitor's perceived functional property (Fig.6).

## 1.2 The Strip window

Positioned perpendicularly to the roof monitor, the strip window is a horizontal opening measuring 6m x 0.5m and elevated only 1.5 m from the ground. View to the outside is possible from a seated position. There is a strong desire to kneel down and use the window for outside viewing. This perception was tested with daylight readings of the room with the roof monitor fully screened (Fig.7). Results show that adequate daylight values are reached only for specific task activities in direct proximity of the window plane, as the arrangement of the freestanding chairs might suggest.



**Figure 7:** Daylight distribution and penetration from the strip window.

## OBSERVATIONS AND COMMENTS

The presence of two different window types (i.e. the roof monitor and the strip window) is responsible for the strong contrasts perceived in the room and for the uneven daylight values recorded at the working plane level. This unevenness, however, also creates the opportunity for light diversity and zones of interest even within a small space.

By conferring a single role to each window – in this case, view only for the strip window and daylight only for the roof monitor, the user is able to *read* its specific function. It could be argued that the importance of reading the function of a window in a building is comparable to that of reading the function of its structure.

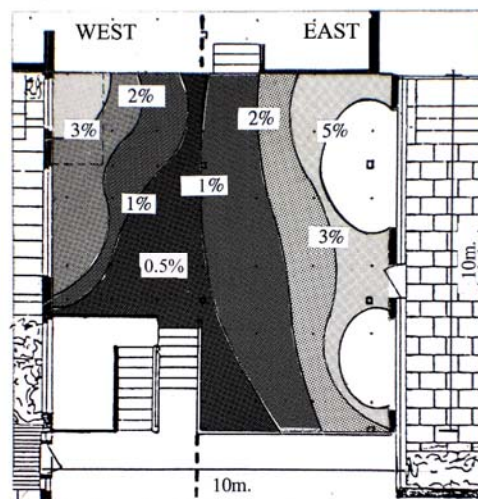
The strip window's low daylight penetration and the strong drive to look through it to the outside suggests a link between windows transmitting low amounts of daylight and the desirability to look through them to the outside.

## 2.0 COMMON ROOM

Located at the centre of the main building, the common room opens to the west to the college's main pedestrian routes and to the east to a terrace with open views of the Scholars' Garden. The west wall is characterised by strip windows and a south facing clearstory, the east wall by a fully glazed side lit window façade (Fig.8).



**Figure 8:** The west wall (top) and the east wall (bottom) of the common room.



**Figure 9:** Daylight distribution in the common room.

The different characteristics of the west and east wall windows contribute to the perception of the common room as two separate environments: the soft intimacy of the west wall and the high brightness of the fully glazed east façade. The perception was tested considering the west and the east zone of the room, with the separation axis of the two zones corresponding approximately to the passage way through the room (Fig.9).

West wall zone: average daylight factor of 2.1 and minimum daylight factor of 0.5%.  
 East wall zone: average daylight factor of 2.9 and minimum daylight factor 0.5%.

Based on the CIBSE recommendations for this specific type of space, the common room is generally under lit (Table 1). Minimum daylight factors, however, are met in most areas of the room. The room is perceived and used in two distinct ways: quiet and intimate discourse on the west zone, active working activities in the east zone, suggesting how an articulated window design extends the design possibilities, use and classification of a space.

### 2.1 The roof monitor

The roof monitor illuminates the west zone of the common room directly and through a reflection off the west wall (Fig.10). The result is a diffused soft light within that portion of the room. The contribution of the west wall (clerestory and strip window) to the common room's daylight factor was tested with the east wall glazing fully screened. Results show how the combination of roof monitor and strip window brings daylight deep within the room, creating a soft light that also offers opportunities of view to the outside (Fig.11).

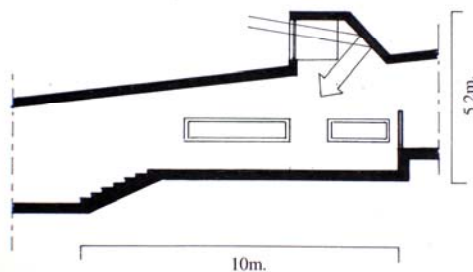


Figure 10: The roof monitor geometry.



Figure 11: Light from the west wall.

### 2.2 The strip window.

As shown in figure 12 the west wall is comprised of two strip windows. The strip window on the left generates a high contrast light on the wall and follows the considerations of section 1.2. On the other hand, the light generated by the strip window on the right is perceived as a comfortable visual transition between the inside and the outside of the room. The relationship between the visual comfort experienced and analytical data was tested with luminance values taken at and around the strip window opening. Results showed that by comparing the reflected light of the wall to the transmitted light of the strip window, lux values remained almost unvaried, giving an example of the link between similar luminance values and visual comfort (Baker, N., Steemers, K., 1996).

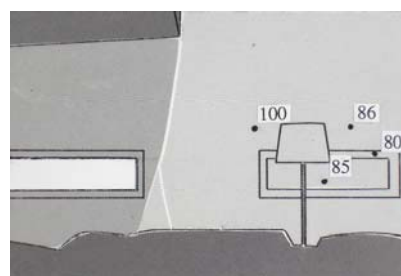


Figure 12: Visual comfort and luminance (cd/m2) values in the west wall area.

### 2.3 The side lit window.

Whilst the west wall generates a diffused light environment, the almost fully glazed east wall offers no intermediate passages between the inside and the outside and creates a strong contrast in the room, contributing in visually separating the room in the two zones mentioned in section 2.0. The area of interest decisively shifts from the inside of the room to the outside garden spaces. As show in figure 13, the range of luminance values between the window and the internal part of the room varies considerably, an effect that is further enhanced by the choice of dark furniture and fittings.

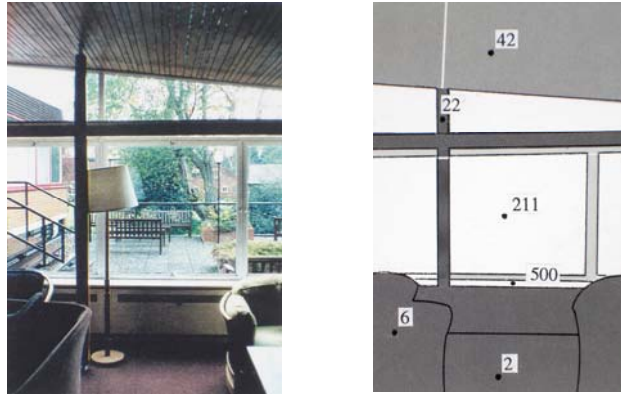


Figure 13: The side lit window and luminance values

#### OBSERVATIONS AND COMMENTS

Different window types can be coordinated to visually unify space, as in the case of west wall's roof monitor and strip window, or divide it, as in the case of the side lit window in respect to the rest of the common room.

Assigning a function and complying with the recommended daylight standards of a room does not by itself qualify the use of that room. Results show how the coordination of window types can extend the design possibilities of that room, transforming how the space is used.

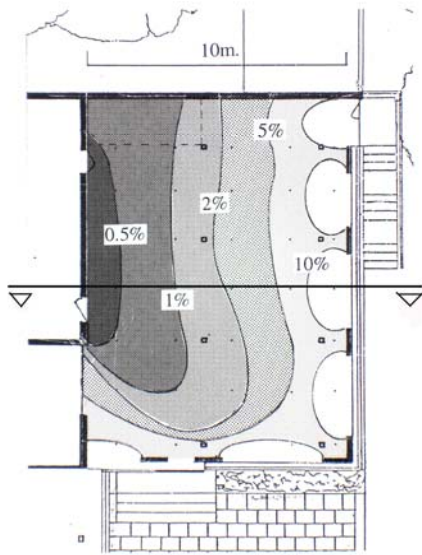
### 3.0 THE DINING ROOM

With respect to the more contained areas of the college complex – the dining room is almost fully exposed to the open garden spaces (Fig.14). It features two side lit windows: facing east towards the Scholar's Garden and facing south towards a recessed terrace. The dining room is dominated by the sidelight, the characteristic view of the Scholar's Garden and, beyond, the Cambridge University library skyline. Accessed through an unlit corridor, a strong and sudden change in brightness occurs when entering the room. Once in the room, one perceives the contrast between the bright side lit window and the dark floor and ceiling fittings.

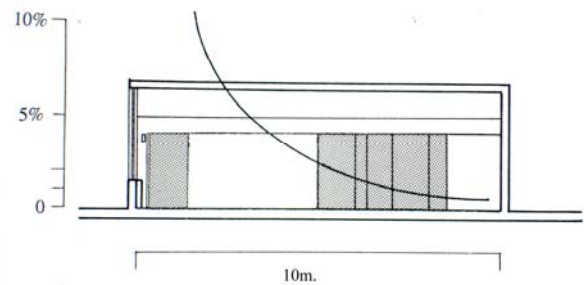


Figure 14: The dining room looking east.

The dining room's average daylight factor is of 4.8%, well above the recommendations set for this typology of space (Table 2). The daylight contours show an abruptly decreasing distribution of light throughout the space (Fig.15).

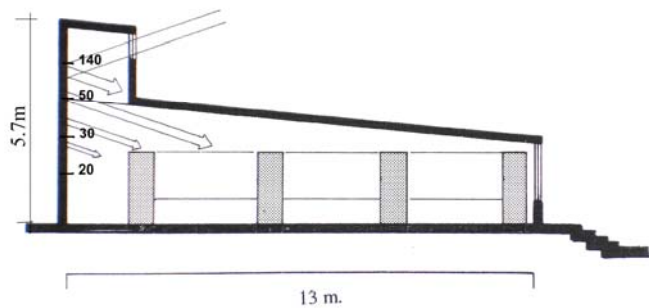


**Figure 15:** Daylight distribution and penetration in the dining room space.



### 3.1 The roof monitor

The roof monitor is aligned to the north wall and reaches 5.7m above ground (Fig.16 and Fig.17). It is positioned in the area of the room least exposed to daylight, and perceived as an attempt to contribute to daylight in this area. This perception, however, is contradicted by daylight testing taken with the roof monitor screened. In this instance, results show no significant decrease in daylight values anywhere in the working plane level. This indicates that the particular design of the roof monitor contributes more in illuminating the upper level of the north wall rather than significantly contributing to daylight in the horizontal plane.



**Figure 16:** The roof monitor's geometry and luminance readings of the north wall (cd/m<sup>2</sup>).



**Figure 17:** Light from the roof monitor.

### 3.2 The side lit window.

The most relevant characteristic of the large east side lit window is the potential subdivision in height through textile screens, enabling change in window configuration (Fig.18). The subdivision has implications for daylight and view.



Configuration A

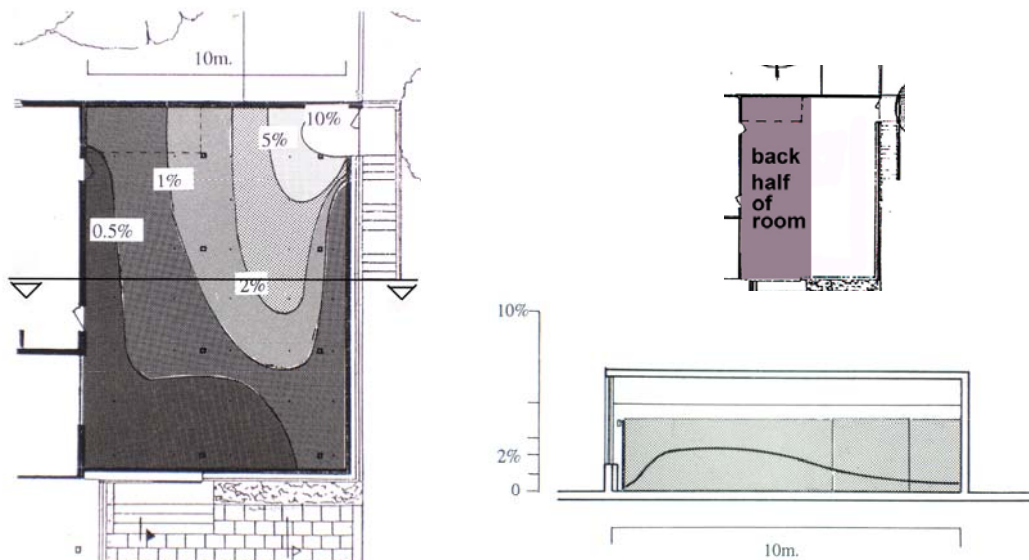


Configuration B

**Fig 18:** The two configurations of the dining room.

#### DAYLIGHT

As shown in figure 18, with screens fully closed (Configuration B) the side lit window allows a large 'L' shaped opening. For an observer located at the back half of the room, the height of the textile screen approximately coincides to the visual field determined by the external obstructions and the corresponding *sky component*.



**Figure 19:** Daylight distribution and penetration in configuration B.

With this configuration the average daylight factor for the room is of 2.2%, thus within the recommendations for this type of space. Furthermore, the distribution of daylight (Fig. 19) highlights the contribution of the north wall to reflecting light deep within the room. Results show that a flexible variation in the side lit window's configuration allows for a diverse room arrangement to be achieved while satisfying the daylight requirements of that room.

#### VIEW

By changing configuration we allow for two levels of external view:

Configuration A: the foreground (Elside Park), the adjacent buildings, the sky. A bright, open view to the outside.

Configuration B: the foreground trees trunks and the distant tall buildings in the background. Allows for privacy.

#### OBSERVATIONS AND COMMENTS

Windows whose expected role is to provide for daylight can assume a different function when set in a specific context. In this case, the roof monitor's specific design and location illuminates the north wall rather than significantly contributing to daylight in the room.



By allowing for change in window configuration we are able to transform the quantity and quality of daylight in the room. As shown, this can be achieved simply using textile screens to create tailored silhouettes.

A flexible window system can create diversity in the type of light entering the room. It also offers opportunities on creating selective views to the outside. By drawing the screens we can pass from a brightly lit space to a moderately lit one, and from a fully open view to a distant, framed view.

## CONCLUSION

The three window types presented in the case study show the following characteristics:

The roof monitor. Mainly provides daylight in a room. When used in conjunction with walls, it bathes the wall with light and, depending on the height from the floor, generates a suffused light deep within the room.

The strip window. Provides view but does not significantly contribute to daylight in the room. When there is a strong contrast between the strip window and the hosting wall, the strip window creates the desirability to look through it to the outside.

The sidelit window. Provides daylight and view but also a strong contrast in the room and visually expands the area of interest from the inside of the room to the outside.

A classification of these types, however, is put into question when the windows are articulated and placed in coordination with one another. The study shows how an articulated vocabulary of window types can transform the perception, functional properties and use of a room. Specifically:

- Through a greater control over window *roles* we have the opportunity to state their specific function and render that function readable to the user.
- The combination of different window types in the same space generates different light environments and areas of interest. The coordination of window types offers the designer a greater design palette that extends the design potential and properties of a space.
- Variable configurations of a window types offer the opportunity to modulate the quantity and quality of daylight in the room. They also create the opportunity for a selective view to and from the outside. This can be achieved simply by using screens.

The study finally suggests a specific direction in window design for professionals and students: the opportunity to show and incorporate the effects of window design at an early phase of the design development. What Ralph Erskine has achieved through talent and experience can evolve into a controlled craft *at the drawing board* through the assistance of tools that visualise and modulate the effects of window design in space.

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