A STUDY OF VARIATIONS AMONG MIES'S COURTYARD HOUSES BY A COMBINED SET OF VISUAL AND ENVIRONMENTAL PROPERTIES

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Abstract

Descriptions of space are invariably concerned with their geometrical properties, such as proportions, volumetric relationships, topological structures etc. However, description of space cannot be separated from the perception of space and hence the concern among space syntax researchers to introduce perceptual descriptors of space such as isovist to their list of topological descriptors. Visual descriptors of space such as isovist, as this paper argues, do not exhaust the perceptual qualities of space. Space is perceived in a context which is a combination of its visual and environmental properties. Moreover, perception is not only spatial but also temporal.

That the perception of space is inadvertently tied to both geometry and its environment has never been challenged as a theoretical argument by design scholars and practitioners alike. Still, analytic studies in design have continously separated the two, where environmental studies are foregrounded upon understanding behavioural aspects in the context of technolgical requirements of the design, and geometric interpretations are tied to perceptual identifiers of spaces and forms. This paper investigates how visual and environmental properties of space can be juxtaposed over a dynamic time-scale in order to develop a rich perceptual description of space through the analysis of experimental court houses designed by Mies and his students in the 1930's.

The Court Houses

Mies's court houses are extremely innovative in their planning and are exemplary of an architect trying to create functional differentiation in the plans not through the traditional mode of discrete rooms, but through subtle changes in the proportions and configuration of the enclosing walls. Although unbuilt, Schulze (1985) describes the court house as Mies's most compelling architectural accomplishment of the 1930s.

The houses are T-shaped in plan, with the stem of the T flanked by two other, smaller courts [i]. The courts are walled exterior spaces and are tied to the interior spaces by large uninterrupted glass walls. In addition to the large glass walls facing the courts, a main difference in

these houses from Mies's earlier houses is the virtual insulation from site specific views. Views and available sunlight, the two factors that determine the orientation of rooms, can thereby be treated independently, whereas before they were mutually related (Tegethoff, 1985). Moreover, both Tegethoff (1985) and Schulze (1985) stress on the interesting interplay between the inner and outer spaces of these houses – because of the bounding court walls on both sides of the living spaces, the open spaces can be visually integrated into the interior layout (see Figure 1).

Figure 1:

House with Three Courts [ii] *(1931-40)*

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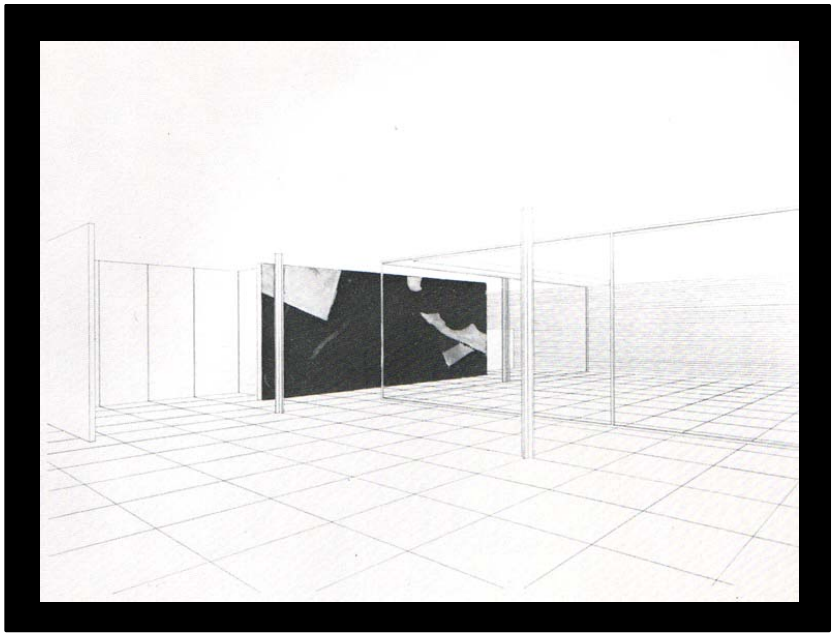
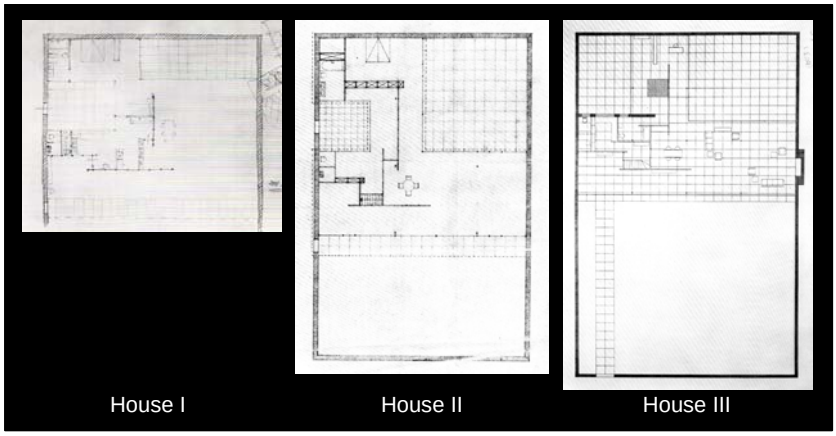


Figure 2 shows three variations of the court house developed by Mies with his architecture students. The geometric variations in the three houses are: (i) the depth of the living area, (ii) the directionality, or the orientation of the bedroom, and (iii) proportions of the two smaller courts of the house. The topological relationship between spaces and their connectivity remains the same in all the three cases. Because they seem to be arbitrary explorations of various spatial conditions, scholars have really not found explicit differences that can describe the variations of these houses by geometric properties alone. Through a series of layered visual and environmental analysis of properties such as isovists, shadow maps, illuminance levels, and contrast over diurnal and seasonal time-scales, this paper shows that it is the rich perceptual differences of the space that reveal the variations among the different court houses.

Figure 2:

Plans of Three Variations of House with Three Courts [iii]



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Although, in Schulze (1985) there is a reference to Mies's awareness of the site for the Hubbe House project from 1935, it is speculative that Mies himself was senstive to the variations of shadows and light in these houses. The following experiment conducted on three variations of Mies's court houses, does not aim to explore this as a historical argument, but rather, it attempts to investigate the kind of variations such a study reveals.

Geometric Interpretations

This section reports the analyses from the distribution of some isovists characteristics of the three plans. The computation was performed using UCL DepthMap (authored by Alasdair Turner at the University College London [University College London, 2000-2006]; the analysis reported here used version 6.052r). Before describing the results we need to report an issue in setting up the analysis; working with fully glazed partitions, we need to distinguish between the set of points at which isovist values are computed from the sets of point which constitute the positions actually seen. In the case of the court houses here, the points that fall within the two smaller courts will belong the latter set, but not to the former. None of the current software helping compute isovist values gives us an option for doing this, thus restricting our analysis a little. In order to compensate for this, we have computed two ranges of distribution, one with the walls facing the courts treated as opaque objects (as if curtains were fully drawn within – shown in figure 3), and other with these glass walls treated as being completely transparent, but also allowing a complete access through them (figure 4).

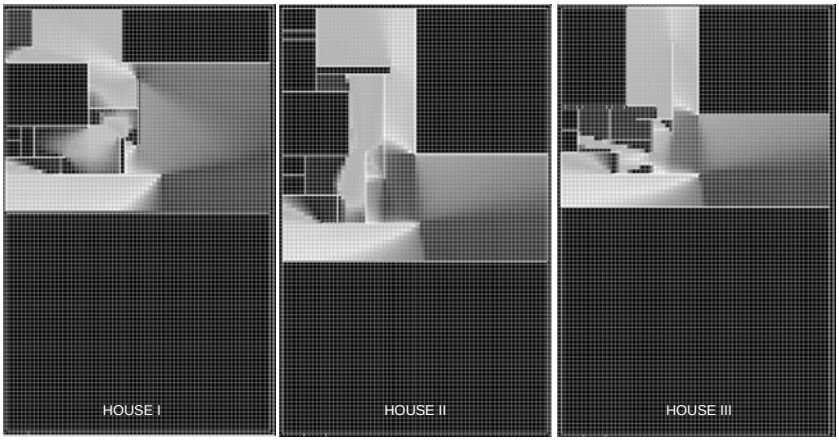

Figure 3:

Isovists Showing Distribution of Visible Area (walls facing the courts are opaque)

If the walls are treated as opaque, the results are not surprising. In all cases, the maximum area visible is in the living room, followed by the bedroom; the sizes of isovists are consistent within the rooms, and in other words, correspond with the actual sizes of the rooms. The only

difference is that in the latter two plans, there is a single zone of points with the maximum area isovists concentrated in the middle of the plan. The point to note here is that the distribution pattern here is remarkably like one produced by a cellular plan, rather than a free-flowing open one, which it is actually supposed to be. Clearly, however, this is an artifact of treating the courtyard walls as if opaque. If we make these walls permeable to vision (and by default, also to access), more interesting differences emerge between the plans. In house III, there is almost no difference in the distribution patterns of the living room or of the bed room; whereas the first two designs show a clear distinction between these two spaces (including their courtyards). The other point is that the free endpoints of partitions act not only as areas of sharp transitions, which is entirely expected, but as areas of transitions between zones which offer differently sized isovists. Moving around in this house, therefore, users would expect to find a strong sense of internal spatial differentiation that matches the basic programmatic use in the house, subtly counteracting the fudging of boundaries induced by the free-plan. It is important to see that the transparent walls contribute to this sense, allowing a degree of choice to the inhabitant; when they are opaque, the transitions are before the internal passage that leads to the bedroom, and when they are not, the transitions are after the passage, thus making it a more public area within the house.

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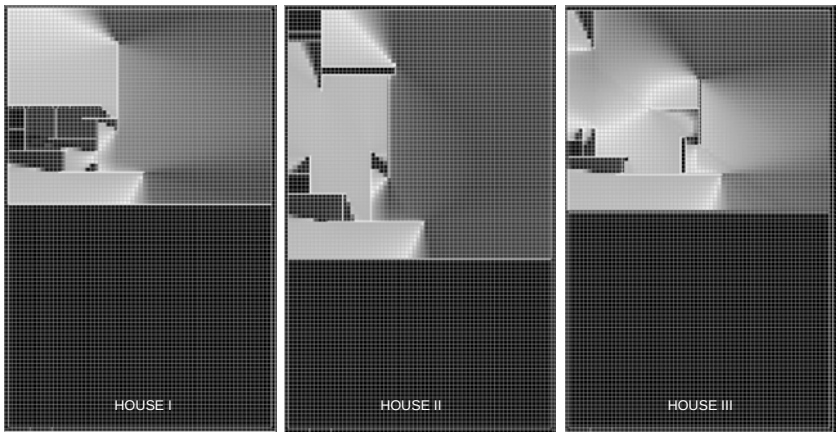
Figure 4:

Isovists Showing Distribution of Visible Area (walls facing the courts are transparent)



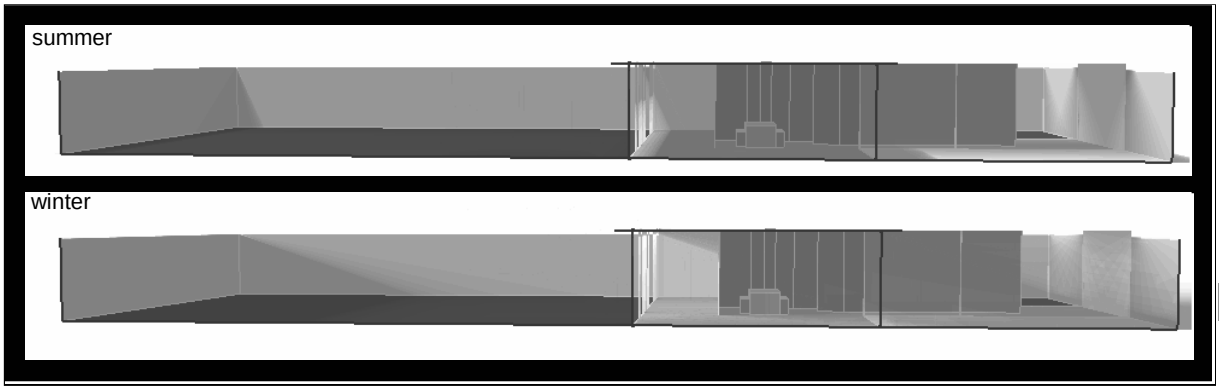
Seeing them in the Sun

The enclosed courts make the house plan relatively independent of its orientation on site in terms of the exterior views. What then makes a difference is how sunlight renders the house towards its perception as a cellular or open plan. The set of analyses shown in this section investigate how light or its absence differentiates the three different plans, and whether this pattern follows the visual differences shown by the isovist maps in the earlier section.

Because of the low height to width ratio across the cross-section of spaces, direct sunlight enters the spaces primarily during the months when the sun altitude is low, regardless of the orientation of the house (see figure 5). So we evaluate the winter months with respect to orientation before further investigations on light.

Figure 6 shows how the sun-lit portions of the house vary with orientation for house III. These patterns will ofcourse vary during the course of the day from sunrise to sunset, but within the range shown here. The plan shows a distinct difference in the north-south house, in such that a part of the living room receives direct sun during the winter months. The implication here is that for the north-south orientation during the winter months, there are periods, albeit just a portion of the

year, when shadows would play an important part in how objects and surfaces are rendered within the space.



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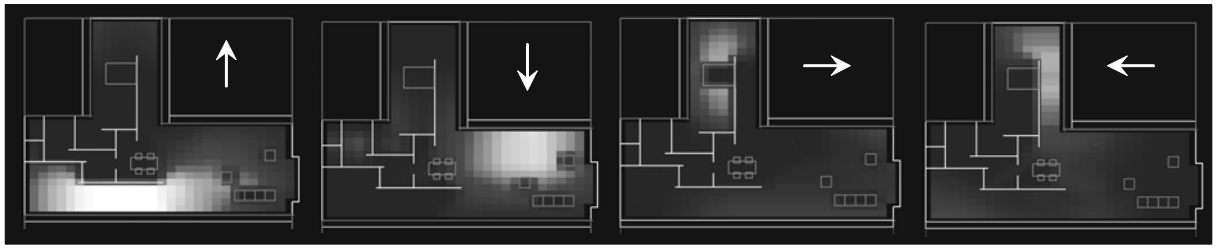

Figure 5:

Shadow Range During Summer and Winter Months for House III (for south orientation)

Observing the effect of the variation of depth from house I to house III for the north-south orientations only (figure 7), we find that house III shows the least variation (by having the smallest depth) in light across the cross-section of the plan. Note that the variation is dampened in the main living area across the east-west cross section of the living room by the trees annotated on the large court. This is consistent with the isovist maps that show that the living space, as perceived, is really the side that has bi-directional light from the front and the back courts.

Figure 6:

Area of the House that Receives Direct Sunlight during Winter Months for Different Orientations of House III

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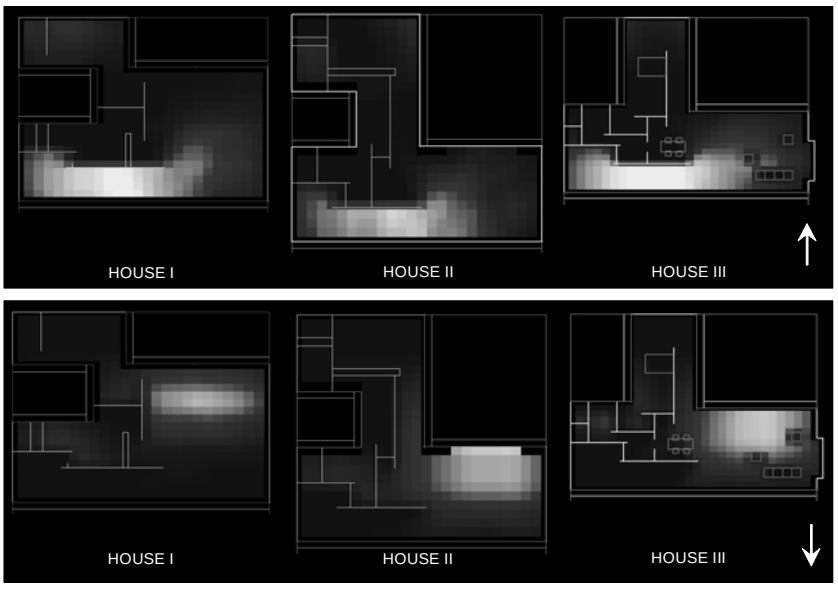


Figure 7:

Sun-lit zones of the three houses during winter Months (for south and north orientation)

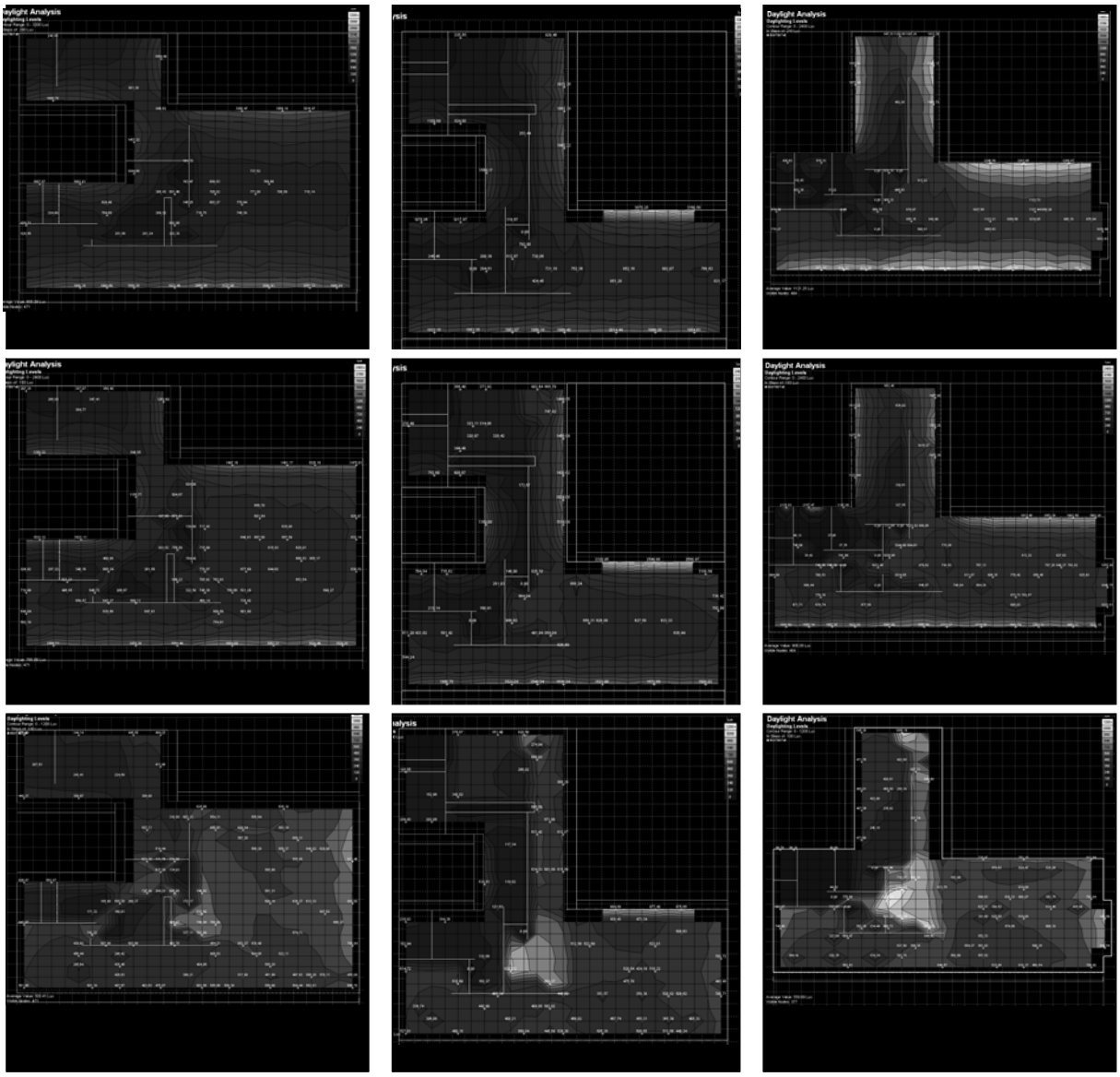
If what the variations seek is a free plan, and if we also seek for the clean, shadowless perspectives (such as figure 1), then it is house III that demonstrates them by having the least variability both within the living room and bedroom, and also across the cross section of the living room itself. This becomes more clear as we explore daylight levels within the house when observed under diffused light conditions.

Under the Clear Sky

The masonary walls of the courts cast long shadows at low altitude sun. The trees and the lanscaped texture of the large court soften the light reflected on the ceiling. This does not prevent the living area from abundant light and views to the outdoors, but instead, allows the main living space to be dominated by diffused, indirect light for most part of the year. The two smaller courts are paved, which increases the amount of reflected light coming in from the surfaces outside.

Figure 8:

096-06 *Illuminance Levels for the three house types at floor, mid-level, and ceiling level*



HOUSE I HOUSE II HOUSE III

Figure 8 shows the illuminance levels in the house when computed under diffused sky conditions. These show interesting differences among the three plans. For one, the variability of illuminance levels within the space decreases with the depth of the living room, almost giving it the perception of an "outdoor" room. This integration with the

outdoor spaces is further enhanced in house III by the larger proportion of the smaller court that allows the bedroom to be duplicated as an extension of the living room in the perpendicular direction. Infact, the light quality of the bedroom and the living room is indistinguisable in house III (consistent with the isovist maps). This is because the stem of the T in the plan is extended to allow enough light from both directions.

On the other hand, what is interesting to note is that house type I demonstrates these exact same qualities in terms of variability, but with decreased amounts of light levels. In this house, while the indoor spaces (including the service core in this case) are still integrated by light, there is a heightened sense of separation between the outdoor courts and the inside, with the perimeter as the threshold between the two. Another interesting point is that the presence of the threshold (via the variation between the perimeter to core illuminance) is clear at the eye level, but becomes absent in the white, uniformly-lit ceiling (see figure 9). Also, while the intensity of light levels in house I is the most, it is house III that has the largest uniform indoor area. It is this uniformity of light that translates into shadowless interior spaces, thus bringing the material and surface properties at the forefront in the registration of the space, where otherwise, the perception of a surface or an object is rendered by the shadow that falls on it.

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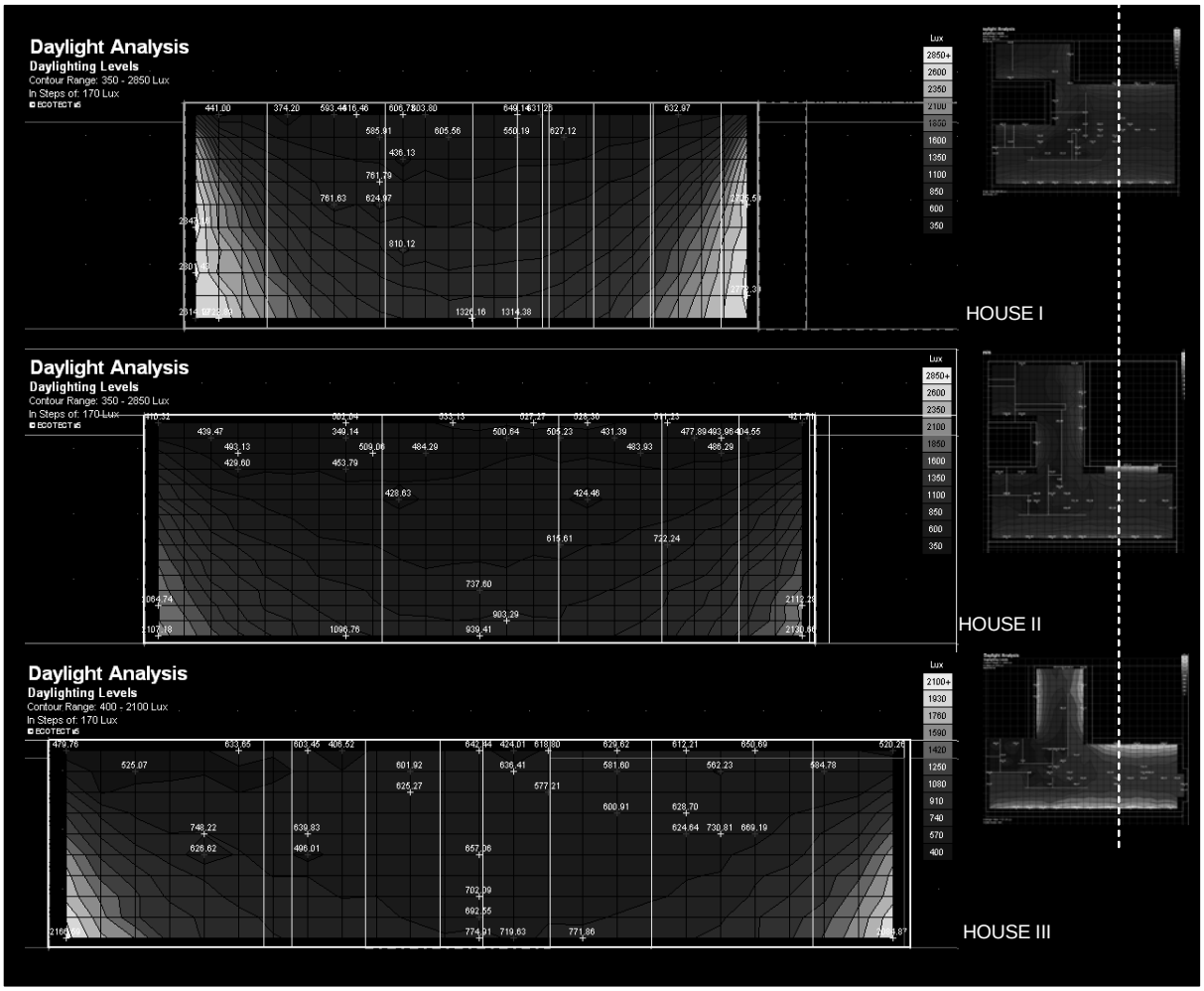
Figure 9:

Illuminance Levels across the cross-section of the three houses



These variations are infact similar in spirit to the proposition that the retina responds to luminance discontinuties, not in what comes between them (Baxandall, 1995). Increased variation in the illuminance intensities between the outside and inside allows a range that separates the indoor living space from the oudoor courts, while

the even distribution of light within the space (also enabled by the uniformly bright white ceiling) reduces the affect of shadows in the preception of object and form.

Concluding Remarks

On a broader level, the main contribution of this study is to initiate a methodological basis for choosing and aggregating a diverse range of formal properties into a set of integrated perceptual descriptors of the space. Visual and environmental properties of a space are not uniformly sensitive to design variations. In addition, the time-scale may affect less or more significant changes in properties depending on the inherent nature of the design. Therefore, development of space descriptors requires a mapping of formal dependencies between properties of the space and design variations, and a definition of the context operating on the design variations. This paper has used the study of Mies's court houses to highlight the process and thereby initiate a systemic framework for analyzing perceptual differences in space as a function of design variations that are not explicitly geometric.

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i. Schulze (1985)

ii. Images of the house taken from Tegethoff (1985)

iii. Tegethoff (1985)