EXCESSIVE RELIEF

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Within architectural representation lies a paradox. Representations are of course not reality; they pull out and abstract specific aspects of it in order to focus attention on others. They are always partial. Yet, it is through representations that architects claim an ability to understand, predict, and transform reality. Most optical media work through the flat plane, sheet, screen, or retina, meaning that they fundamentally lack the very real aspect of depth. How architecture manages depth through different technologies of mediation and with different aesthetic propositions is a task woven deeply into the discipline's conceptual arguments. For architectural representation, depth is always virtual.

Adolf Hildebrand's 1893 text, *The Problem of Form in the Fine Arts* contains a set of unique observations regarding perception, distance, and the aesthetic qualities of depth.[1] Hildebrand posited that art creates a clear unified idea of form and space that distinguishes it from the dissolution into fleeting appearances as occur in nature. In his arguments, he identified two categories of visual perception. One he termed "visual projection" (German: Fernbild), which also translates as "distance picture." These perceptions were coherent and clear, essentially two-dimensional silhouettes. The other type of perception was near, consisting of 'a succession of disconnecting shifting views.'[2] The close view was "kinaesthetic," related to movements of the head, the eyes, and the lens. Hildebrand privileged the clarity of the far view and feared the confusion of the near, yet also claimed that our sense of depth was necessarily based on the kinaesthetic movements of the near view. The goal of an artwork was to integrate the depth sensations of the near with the coherent visual projection of the distant view. 'This unity which the artist makes of visual impression and kinaesthetic idea, is the most fundamental source of our aesthetic enjoyment in a work of art.'[3]

Although Hildebrand discusses painting, sculpture, and architecture, it was in bas-relief that he found the crux of his argument. There are several developments within the history of aesthetics that could be unfolded from Hildebrand's text, the following essay is interested in two speculations on the strangeness of depth.

Ludovisi Sarcophagus – CE 250-260, National Roman Museum, Palazzo Altemps, Rome.

1) See: Adolf Hildebrand, "The Problem of Form in the Fine Arts" (1893), in Empathy, Form, and Space: Problems in German Aesthetics, 1873-1893, Harry Mallgrave (ed.) (Los Angeles: The Getty Center 1994).
2) Ibid., 31.
3) Ibid., 32.

Ludovisi Sarcophagus – CE 250-260,
National Roman Museum, Palazzo Altemps, Rome.

The first aspect concerns how the space between objects becomes present in perception. 'Now, since the volume of a single object is suggested by the outlines of its form, so a certain volume of air may be indicated by several objects put together, for the boundaries of the objects also limit the volumes of air which lie between them. The problem is: to arrange these objects that our kinaesthetic ideas aroused by them shall not remain separate, but co-operate and lead from one to another...'[4] In relation to relief sculpture, Hildebrand imagined parallel planes of glass capturing coherent volumes of space between the figure's foremost points and the backplane of the relief.[5] Depth was the receding sequence of clearly defined spatial figures. This was the way through which the artwork attempts an integration between near and far, kinaesthetic and visual perceptions, in the creation of a coherent idea of form and space.

Hildebrand's arguments are part of a much larger conversation in the late 19th century around the relations between psychology, aesthetics, and empathy theory.[6] As Adrian Forty has pointed out, in addition to Hildebrand's text, 1893 also saw the publication of August Schmarsow's essay *The Essence of Architectural Creation* and Theodor Lipps' *Raumästhetik und geometrisch-optische Täuschungen*.[7] For these and other theorists at the time, empathy theory proposed, 'that in perceiving things the mind projects into them its knowledge of bodily sensations.'[8] Much of the discourse around these questions concerned how empathetic projection underlied aesthetic responses to form and space without the traditional conventions of signification and mimetic resemblance. For Hildebrand, the sensation of movement coalesced around the eyeball; in its muscular tension of shifting focus between the near and far, saccadic jumps and starts exaggerated by close proximity and stereoscopic doubling which implied the movement of one eye into two positions.

Bas-relief was crucial for Hildebrand, for the spectator views these sculptures frontally as an elevational surface. His description of a planar layering of shallow depth foreshadows several important developments within the aesthetic theory over the first half of the 20th century. The idea of overlapping, occluding elements fluctuating between figure and ground became part of the narrative of Cubism, Clement Greenberg's "medium specificity" and Colin Rowe and Robert Slutzky's essay on *Transparency: Literal and Phenomenal*.[9] Detlef Mertins remarks that Hildebrand's

4) Ibid., 49.
5) See: Ibid., 80-81.
6)See: Adolf Hildebrand, Adolf Göller and August Schmarsow, *Empathy, Form and Space: Problems in German Aesthetics, 1873-1893*, Harry Mallgrave (ed.), (Los Angeles: Getty Center, 1994).
7) See: Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture* (London: Thames & Hudson, 2004).
8) Ibid., 260.
9) See: Detlef Mertins, "Transparency: Autonomy & Relationality", in: *AA Files*, No. 32, Autumn 1996 (London: Architectural Association School of Architecture, 1996).

Photogrammetry scan of the Ludovisi Sarcophagus, Palazzo Altemps, Rome (2019). Distant view.

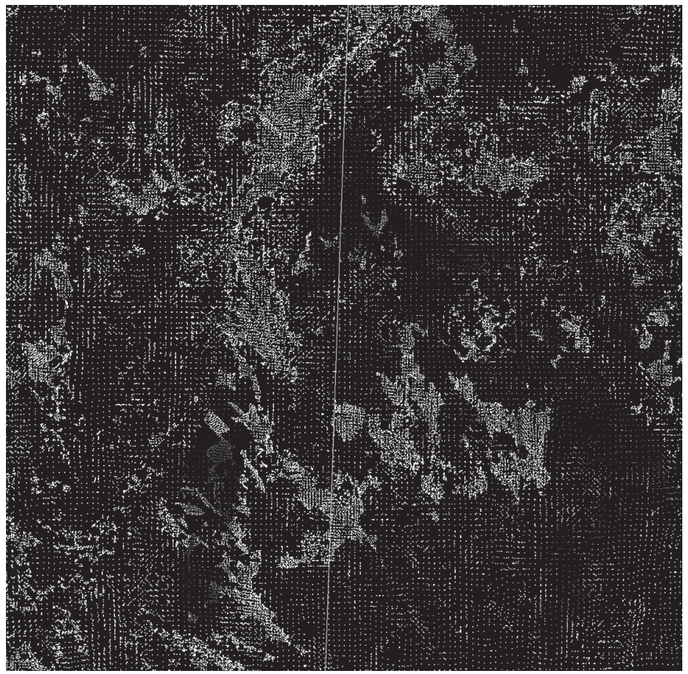
Author's note on the photogrammetry scans of a 3rd century Roman Sarcophagus: This model purposefully explored the lowering of resolution by limiting the images, thus reducing the amount of overlap used in the depth construction. The realism of the stone surfaces becomes high in specific locations, and more abstract as dispersed points in other, and in combination at specific resolutions produces a strange weathering of materiality.

"effective form" and "inherent form" show strong similarities to Rowe and Slutzky's "phenomenal" and "literal transparency."[10] This is the aesthetic lineage of flatness and the delimitation of flatness, of space as an abstract concept activated in the mind of the observer, and aesthetic pleasure in the ambiguity of perceptual depth. It is a legacy revisited often throughout the 20th century.

The second aesthetic quality is a bit trickier to tease out. It could be described as a sensation of depth in *excess* of what is physically present. Hildebrand noticed in relief sculpture that when bodies, limbs, or architectural elements obscured, overlapped, occluded, and intersected, a discrepancy was produced between the tactile and the visual, a rupture between what sensation presented and what the observer knew to be reality: 'Form relations which give the desired effects in the visual projection do not correspond exactly with the actual measurements of the object. Differences of depth may combine, producing the effect of a single plane, and this through contrast may cause others to show their difference more forcibly. Actual and visual form are not the same, and the conception of relief is attached to the visual, not the actual form. For it is with visual effects that we are concerned. Accordingly, the relief is independent of all actual depth measurements.'[11]

This is a strange statement. It suggests that the aesthetic quality of depth is in contradiction with the actual quantity of three-dimensional reality. And furthermore, for spatial coherence, the "effective perception" of form and space is more important than the true geometric measurement. This is ultimately Hildebrand's argument, "The Problem of Form in the Fine Arts," is not the representation of the natural world as a source or model of beauty but is instead the unity of human perception created through the artwork. 'The parallel between nature and the work of art, therefore, is not to be sought in the equality of their actual appearances but rather in the fact that they have the same capacity for evoking an idea of space. It is not because of an illusion that we believe the picture to be a piece of reality - as in a panorama - but because of the power of the stimulus contained in the image.'[12] Lurking within this statement is a push towards the autonomy of art, a fear of art blurring into life, and a desire for clear demarcated separation, but there is also an acknowledgement of the tricky questions that follow attempts to simulate the perception of depth.

10) Ibid., 8.
11) Adolf Hildebrand (1893), in Harry Mallgrave (1994), 88.
12) Ibid., 242.



Photogrammetry scans of the Ludovisi Sarcophagus, Palazzo Altemps, Rome (2019) Near view.

The *Ludovisi Sarcophagus*, a Roman work from the third century of the common era, is a great example for several of these aspects. The bas-relief carving occupies a thickened surface of shallow depth that corresponds to Hildebrand's planar analysis. The intensity of the interlocking figures in the bas-relief removes the visibility of a background plane, but the viewer senses its presence. In other words, no one who looks at this artwork perceives an infinitely receding space; it is clearly bounded in depth with both a frontal and a background plane (both are virtual). However, what is also abundantly clear is the strangeness of depth in this particular bas-relief. The entanglement of limbs, heads, horses, and torsos presents a sensation of depth in excess of what is actually there in the reality of the carved stone.

This perceived excess emerges from a mismatch between the empathetic projection of bodily sensation and the objective facts as they exist in the object. The affect is not one of space as a clearly defined negative area in figure versus ground, nor is it the layered planarity of spatial interpenetration, nor is this an ambiguous fluctuation between contradictory readings as discussed in perceptual psychology. And, as opposed to Hildebrand's desire to neutralise the discrepancies between near and far perceptions, the *Ludovisi Sarcophagus* seems to intensify them. Viewing the work consists of multiple moments of disconnected events, much closer to the kinaesthetic near view than the clarity of the distant silhouette. Yet, the surface is approached and engaged frontally, there is a compact boundedness that the depth sensations constantly push against. This artwork produces an argument in favour of the friction between tactile and optical sensation, for stretching the relations between reality and its representation. These qualities are what the philosopher Graham Harman would classify as the tension between a real object and its sensuous qualities, a tension at the basis of many aesthetic experiences.[13] The aesthetic response could also be categorised as an "ostranenie" effect, translated as "estrangement" or "defamiliarisation," as theorised by Viktor Shklovsky.[14] This is the uncanny sensation of not being able to quite reconcile the visual with the haptic, which intensifies and elongates attention, requiring a reconsideration of assumptions.

Several of these attributes can also be found in the aesthetics of Realism emerging in the 19th century. Exemplified by painters such as Gustave Courbet and writers like Émile Zola, there is a close attention to descriptive detail and a detached almost objective stance; an interest in the discrete mark of representation and an almost formless aggregation of episodic situations, sometimes related, sometimes just sitting adjacent to each other avoiding all acknowledgement. Realism is not the clear coherent visual projection of a distant view; it consists of an aggregation of discrete, fragmented, and meaningless close views; its attitude is in a way similar to scanning.

THE MARK AND THE PULSE

The alignment between the fragmented kinaesthetic near views of Adolf Hildebrand and the discrete sampling sequences of scanning is a hinge point in Zeynep Çelik Alexander's essay *Scanning: A Technical History of Form*.[15] In the late 19th century, the conversations between the emerging fields of the psychology and physiology of perception laid the groundwork not only for Gestalt formalism that would influence so many early Modernist aesthetic stances (Bauhaus pedagogy), but also developments in the scientific understanding of connections between stimulus and sensation (Johannes Müller, Hermann von Helmholtz).[16] The problem is that movement creates discrete fragments of sensation, yet perception is whole and continuous. This is where the analogy to scanning offered by Alexander becomes interesting. The modern eye is not a human eye, and maybe the human eye was never as "human" as we believed. The eye is like a scanner, sampling data remotely, unconsciously, while integration happens elsewhere.

13) See: Graham Harman, *The Quadruple Object* (London: Zero Books, 2011).
14) See: Viktor Shklovsky, "Art as Device" (1917), in: *Theory of Prose*, (Kalkay Archive, 1991).

15) See: Zeynep Çelik Alexander, "Scanning: A Technical History of Form", in: *Design Technics: Archaeologies of Architectural Practice*, Zeynep Çelik Alexander and John May (ed.), (Minneapolis: University of Minnesota Press, 2019), 71-102.
16) Ibid., 121.

Friedrich Kittler states: 'The computer ... is the only medium that combines these three functions – storage, transmission, and processing – fully automatically.'[17] It is helpful to remember that the "storage" of visual images includes how an image is "captured," and for a digital image this is done through the scanning of reflected energy. John May describes the digital image as '... a process of detecting energy emitted by an environment and chopping it into discrete, measurable electrical charges called signals, which are stored, calculated, managed, and manipulated through various statistical methods.'[18] There is a substantial amount of anxiety regarding the technology of the digital image and its ability to manipulate the appearance of reality in ways outside human control. However, it is a misplaced fear for images have always "manipulated the appearance of reality." What is different, as Kittler says, is that the exchanges between states are now fully automatic. Images are information, exchanged between machines in manners that human vision has no access to. Given this situation, the aesthetics of depth would seem to be of little value for computational exchanges concerned with issues such as economics, security, trade, bureaucracy, and war.

17) Friedrich Kittler, *Optical Media: The Berlin Lectures* (1999), (Cambridge: Polity Press, 2010), 26.
18) John May, *Signal. Image. Architecture* (New York: Columbia Books on Architecture and the City, 2019).

And yet, depth matters. The first reason is that machine image analysis requires the correct identification of the content of a digital image. A dog must be identified as different than a missile. The problem is that the form of an object alters as it is seen from different angles, distances, and lighting conditions. These variations are especially diverse if the object is near. The computational analysis must "learn" how shape changes in depth for the same entity. The second issue is that machine vision must navigate environments with a complex assortment of obstacles and affordances. The environment, scanned and stored as an array of reflected energy, does not always match the reality of objects as distributed in physical space, discrepancies that could prove extremely problematic for autonomous vehicles for example. Both issues are concerned with depth, specifically the differences between spatial reality and its representation as digital images. There are several technologies that address the problem of depth in machine vision and image analysis: AI neural networks - Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs), LiDAR scanners, and Multi-spectral Tomography to name a few. The remainder of this essay will focus on one class, Photogrammetry.

DEPTH CALCULATED THROUGH ENERGY

Since a digital image is simply an array of scanned electromagnetic energy, any point in the environment scanned twice, from slightly different positions, can be assigned a three-dimensional location in space. Photogrammetry is as old as photography. In the 19th century, the surveying of distance in military and engineering operations, as well as the popular entertainment of the Stereoscope, used double photographs from two slightly different origins to compute depth. Prior to photography, measurements of depth through imagery was done through perspective drawings. Ultimately, these operations are tied to the origin of geometry, the measure of the earth through triangulation. The difference between contemporary computational methods and these earlier technologies is not that significant conceptually, it is simply the accelerated speed of processing and increased ease of use. Armed with a digital camera (smartphone) and photogrammetry software (app), almost any set of "photos" can be processed to build a digital model of the environment. The interesting difference is in the aesthetics.

A photogrammetry model is built from fragmented discrete points, extracted from pixel data in a set of digital images, captured as energetic information by a moving digital camera. In this situation, a "photographer" is one who collects images of the environment in a constrained sequence: first, surfaces are captured frontally; second, height-frame-focus are systematically maintained; lastly, the overlap between pairs of images is regulated in relation to the desired detail of the final model. This conditions a camera into a scanner and its operator as a component in the process. The integration of this scanned information into a spatial geometry happens later through software that aligns associated frames and computationally assigns a location and colour in this virtual space. What is processed may be information, however, what is visualised is a luminous dot of a specific hue, saturation, brightness - distributed into a certain density, and it is here that a host of aesthetic problems arrive. Andrew Saunders, writing on *Baroque Topologies*, states:

> 'The point cloud as a three-dimensional model composed of millions of light points is in itself a painterly form of describing space. The heterogeneous field of points produce gradients, quite opposite of a linear representation of space that is reliant on enforcing clear profiles and crisp contours. Through non-uniform distribution of points and relative spacing based on proximity to point of view, the point cloud adds to the modes of architectural representation by generating an advanced type of transparency with varying depth and resolution.'[19]

19) Andrew Saunders, *Baroque Topologies* (Modena: Palombi Editori, 2018), 65.

Resolution density relates to the fidelity of the scan, to the memory of the camera, the processing power of the machine, and the desired use of the information. However, within a point-cloud model, resolution is also an aesthetic factor tied to how far the viewpoint is from a modelled surface. From a distance, surfaces look solid. This is because the viewing point in the digital model is far enough away not to perceive the gaps between the scanned points. As the viewpoint comes closer to the surfaces, resolution becomes apparent as the points pull apart, transforming solidity into veils of the visually diaphanous, then ultimately into nothing. Photogrammetry models are not extruded heightfield maps; they turn corners; yet the models are less than fully three-dimensional in the round; they are more akin to bas-relief. Furthermore, the relationship between resolution and distance also inverts the aesthetics of realism and abstraction as the closer the viewer gets to the surface the more abstract it appears. Since the source information are images, a point-cloud model is in every way a photoreal model. Realism is no longer added on top of geometry designed as abstract form. It no longer makes sense to understand "rendering" as a separate activity *after* drawing or *after* modelling. It is imaging, all the way back to the moment of capture.

There are numerous relations between these aesthetic questions of the photogrammetry model and Hildebrand's observations on depth in the bas-relief. His desire to neutralise the apparent contradictions is still a prominent position. This is achieved either through making the model appear more continuous, more "real," or by clearly showing its discrete artifice of hovering abstract points. What these two directions mean technically is as follows: To make the model appear continuous in the close view is done by sorting the points through triangulation to create surface meshes. To make the model more abstract means lowering the resolution or filtering the points in colours that emphasise the artificiality of discrete objects. Both responses have long traditions as attitudes towards the aesthetics of architectural representation. Both are also ultimately pragmatic, for how does one work with millions of individual *points*?

Most architectural representations store and manipulate *lines* in order to control the edges of surfaces. The abstract substitution of the line for the control of form can be discussed in a myriad of manners, but bluntly it is an efficient mode of mediation for the control of form. Move a few lines and one can transform and regulate incredibly complex formal compositions. Lines also lie in the medium of drawing, very different from the photogrammetry models of coloured point-clouds. One medium that does work with large aggregations of coloured marks, as Saunders identifies in the quote above, is painting. Saunder's use of painting contains a specific reference to Heinrich Wölfflin's categories of the "linear" and the "painterly," which Wölfflin used to theorise the difference between Renaissance and Baroque art and architecture.[20] Linear qualities are those that emphasise the bounding contour of a form, clarifying figure from ground.

20) See: Heinrich Wölfflin, *Renaissance & Baroque* (1888), trans. Kathrin Simon, (Ithaca : Cornell University Press, 1966).

Painterly qualities multiply the mark, loosening the edge, and blurring distinctions between figures and background. The categories Wölfflin established are helpful in that point-cloud models consist of gradient colour densities, in many ways closer to painting than the sharp edges of linear drawing. Edges and corners in a photogrammetry model scumble and fray, holding no special importance in the field of scanned information. This equivalency between all point information is part of what is so difficult in working with these models. Conventions of architectural representation are built around a hierarchy that treats breaks in surfaces, the outlines, corners, and edges, as more important that the information internal to a surface. A point-cloud model is a collection of discrete independent entities, each instance equally accessible and apparently meaningless.

If all points are equivalent, then the points that register a moving or movable object - creature, plant, cloud, or car - are just as valid as the points registering building and ground. These more ephemeral things sometimes appear to float away from the scanned surface as "noise." The first process of working with point-clouds is often the filtering out of these statistically errant irregularities, and it is decisions such as these that speak to how working with points is different than working with lines, and also why so much effort is placed on converting points to meshes. Once the digital environment is meshed, the model can be smoothed and relaxed, then cut to produce plans and sections, renderings and animations. Leaving the model as a collection of points feels unwieldy and chaotic. However, maintaining the representation as discrete points presents a multitude of important aesthetic questions, especially given the relations to models of information in digital mediation. Walter Benjamin addressed the relation between the line and the surface as follows:

> 'The graphic line is determined in opposition to the surface. This opposition has not only a visual but a metaphysical dimension. The ground situates itself in relation to the line. The graphic line designates the surface, and in so doing determines it by attaching itself to it as a ground.'[21]
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> 'A picture has no ground. Nor does one colour ever lie on top of another, but instead at most appears in the medium of another colour ... There is no ground in painting, nor is there any graphic line ... The medium of painting is designated as the mark in the narrower sense; for painting is a medium, a mark, since it has neither ground nor graphic line.'[22]

Jumping from late 19th century German aesthetic theory into the early 20th century media theory it influenced, the distinction between drawing and painting made by Walter Benjamin may prove helpful for this discussion.

Painting, photography, and energetic pulse are very different technologies, however there is an important similarity raised by Benjamin's distinction. All three of these mediums have no ground. If "ground" exists, it is built out of differences in colour and value between discrete marks as a perceptual event, not as a material fact. Digital images are visually similar to painting as they consist of a "marked medium" not "lines on a ground," only now the marks are electromagnetic pulses. In order to design within this realm, architecture will have to develop techniques for working with electrical signals as collections, techniques best described with concepts such as filtering and sorting. This is work with thresholds, with algorithms that compute local variations in pixel information. At certain limits human eyes perceive a jump, a discretisation; at other limits, we see smooth gradients of seamless deformations. It is odd to associate one of these with abstraction and the other with realism as these two aesthetic attitudes are no longer different in kind, they are separated simply by degree.

The techniques of statistical filtering are the primary ways one operates with large data sets. Filtering thresholds *is* image processing. This describes the primary operations of a graphic design software such as Adobe Photoshop, and the higher-level control available in platforms such as Processing. Energetic data is stored numerically as information defining the hue, saturation, and luminosity of each point. These numeric abstractions can be filtered based on thresholds of local variations in their immediate pixel neighbourhood, allowing differences to be increased or lowered. These sharp differences in adjacent pixels are what allow human and machine vision to "see" edges, figures, and grounds in a digital image. At the level of the energetic array, it is simply an organised pattern within a range of values; filtering data through thresholds becomes a way of working within these mediums to produce sensations of depth. In this manner, depth is always an augmentation of the real with the virtual.

For architecture, developing a method of working through filtering is only part of the question. The larger issues are aesthetic. The perceptual depth of a digital image and the actual depth of a point-cloud model built from digital images present problems initially identified by Aldolf Hildebrand in 1893. For Hildebrand the distant was clear while the near was confused. For digital depth, the distant looks real, while the near looks abstract. In very similar ways, we are still negotiating the tensions between near and far, tactile and optical, abstraction and realism. The difference between the end of the 19th century and the start of the 21st might simply be that we no longer believe that the successful integration of these is a strictly human capacity, nor that this reconciliation should be the desired goal of an artwork. Once this is acknowledged, our attention can shift towards the provocations that arise when depth cannot be fully integrated, and instead produces an aesthetic estrangement of reality through the augmentation of the virtual.

21) Walter Benjamin, "On Painting, or Sign and Mark" (1917), in: *The Work of Art in the Age of Its Technological Reproducibility, and Other Writings on Media*, Michael Jennings, Brigid Doherty, and Thomas Levin (ed.), (Cambridge: Belknap Press of Harvard University Press, 2008), 221.
22) Ibid., 223.

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