The Architecture of Spacetime: Memory as a Project

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Abstract

In the past decades, memory became one of the most popular thematics in architecture. Frequently associated with building resto-ration and historical design interventions, nowadays memory is acquiring new meanings which embrace its complexity by accepting the theoretical contributions coming from different fields and thus lending architecture an interdisciplinary aspect. This is particularly due to the breakthroughs achieved in both relative and quantum physics in the 20th century. With time, these discoveries introduced a new ontologic domain that questioned the scientific, artistic, and philosophical paradigms that are based on an outdated reading of reality. In the process of moving from discussing space to understanding spacetime, a designer discovers new dimensions, reconsiders his methodologies, and develops a unique vocabulary. In this scenario, to the intricate mechanisms that regulate the memory construction processes, Edmund Husserl and others added new representational techniques and computational workflows to suggest innovative alternatives to obsolete design methods.

Keywords: Memory, Architecture, Spacetime, Computational Design, Animation.

Space and Time

Space in architecture has, for a long time, been one of the most prominent subjects of debate and study, often standing as an *a priori* condition, a blank canvas open to any type of manipulation, either physical or concep-tual. Every discipline that lived through centuries of his-torical and cultural layering needs solid foundations to serve as a basis for the evaluation of a period or a style. Space in architecture represents the empty pages wait-ing to be written on to be used by readers from vari-ous backgrounds and education to absorb the shared knowledge. What would happen if these blank pages started to blend with the written chapters, the index etc.? Space, as we know it, or even better as we cus-tomarily think about it, can be associated with a static object, an infinite yet measurable entity. The designer assigns qualitative aspects to space to overcome this notion and, thus, associates the contained qualities with those of the container. This way of thinking space is ex-tremely functional to the human brain both thanks to its elementary mechanisms and its scalability. However, it might be time to reconsider some of these assumptions because of new scientific evidence discovered, particu-larly in the 20th century.

Architecture, and by extension the artistic and human-istic disciplines, respond to a spatial conception that dates back to the 17th century. The same spatial and temporal understanding has been the main reference until the early 1900s and relates to a true, absolute,

mathematical, and unidirectional model which will be the foundation of western thinking. Sir Isaac Newton published his most complete work *Philosophiae Naturalis Principia Mathematica* in 1687. In this treatise, he outlined the primary laws of physics of which many are still valid. Those empty pages, dissociated from any content as entities that justify their own existence, represent the 'way of thinking space, way of thinking time' that Newton postulates in the *Principia*: "Absolute space, in its own nature, without relation to anything external, remains always similar and immovable [...] Relative space is some movable dimension or measure of the absolute spaces, which our senses determine by its position to bodies; and which is commonly taken for immovable space" but also "Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external [...] Relative, apparent and common time, is some sensible and external (whether accurate or unequable) measure of duration by the mean of motion, which is commonly used instead of true time" [Newton 1934]. Newton precisely distinguishes between relative and absolute time, the first being a deceptive measure of the second, which is the only 'true' absolute and mathematical time which we will refer to as Newtonian time from now on. Movement and transformation pertain to relative time. Every object is placed 'in space and in time' within a precise order. If any of these objects were to be altered, it would be subject to an ontological shift, establishing a new identity that would fully replace its precedent without the possibility for any observation and correlation between the two (according to Newtonian space and time models).

The abstract tone of Newton's intuition so presents the time dimension as resistant to any external interference that it might be mistaken with Bergson's notion of 'duration'. Or it could be linked to a priori dimension which should not be confused with 'the a priori condition for each general appearance' described by Kant while associating it to the 'pure form of sensible intuition' [Kant 1987]. The Newtonian time or spatialized time (given the similar qualities shared by the two dimensions according to the English physicist) is a quasi-divine dimension, way far from Kant's time, which, along with space, cannot be a self-sufficient being. According to Kant, there would not be any blank pages as part of a greater, celestial universe, waiting to be filled by the events.

Conversely, it would be the events themselves, as sensible relations developed by the intricate mechanisms of the human mind to generate the pages on which they would be recorded.

Nevertheless, Newton's models and postulates persisted for more than three centuries before being shaken by a scientific revolution that challenged the firmly established authority on physics.

Spacetime

In the early decades of the 20th century, this model of reality was wiped out thanks to the work of some of the greatest minds working on modern physics. Hermann Minkowski and Albert Einstein began to think that the two dimensions might relate to each other and theorized time as the so-called fourth dimension of space [Minkowski 2004]. The two dimensions blend into each other and become a *unicum*: the spacetime. The absolute, linear Newtonian time does not exist anymore. In the Special Theory of Relativity (1905), Einstein described: a) how time dilates relative to such qualities of space as mass and acceleration; and b) that a multiplicity of times not only exists but implies that all of them are equally real and can only be defined and measured relative to each other. The observer plays a key role in this. The observer is the 'external' entity that observes and measures properties in relation to its reference system. Physics seems to no longer describe how things evolve in time, but "how things evolve in their own times, and how 'times' evolve relative to each other" [Rovelli 2018, p. 16]. This Scientific revolution was rapidly followed by General Relativity and lit a vibrant debate between the most prominent scientists and philosophers such as Proust, Quine, e.g., the series of conferences and lectures by Albert Einstein and Henri Bergson, and inspired several movements and avantgardes such as futurism and cubism in art and such others in the literature.

The observer, who is capable of identifying himself with a reference system and measuring extraneous spaces and times, is the human being. However, as humans, we suffer the coexistence of a plurality of times that are often in conflict with each other. We are pushed to look for the meaning of this conflict by introspectively investigating our nature. Therefore,

it was thanks to modern breakthroughs in physics and the contemplation of the complex mechanisms of the human mind that we began to learn that "to understand ourselves means to reflect on time. But to understand time we need to reflect on ourselves" [Rovelli 2018, p. 155]. This form of research increased the tension between the scientific approach and the ideological introspection which characterized the past century and allowed hybrid figures such as Edmund Husserl to emerge.

Internal time-consciousness

According to Husserl, the key element for reading through the complexity of temporal phenomenon is perception. This is notably evident when he insists on the perception of temporal persistence in his famous treatise *The Phenomenology of Internal Time-Consciousness* where he also discusses the relationship between the observer and the immanent temporal objects (all the objects or entities that are subject to the mechanisms of temporal perception) in their 'modes of appearance'. Husserl uses 'sound' to describe the phenomenon of persistence. Sound manifests through its duration, which coincides with the experience of its perception. However, this also includes a second phase which involves the sinking of the unity of duration into the past. Husserl argues that, as long as memory recalls the sound, its unity of duration is not yet fully exhausted. By using sound to describe his spacetime unicum, Husserl openly engages the observer in one of his most peculiar abilities: memory: "To my consciousness, points of temporal duration recede, as a point of a stationary object in space recede when I 'go away from the object'. The object retains its place; even so, does the sound retain its time, its temporal points are unmoved, but the sound vanishes into the remoteness of consciousness; the distance from the generative now becomes ever greater. The sound itself is the same, but 'in the way that' it appears, the sound is continually different" [Husserl 2019, p. 45]. The temporal immanent object is defined by some of its inherent attributes including the 'lasting now', the existence of a portion of its duration that is already elapsed, and the recurring exchange of the 'now-points' across its duration. Yet simultaneously,
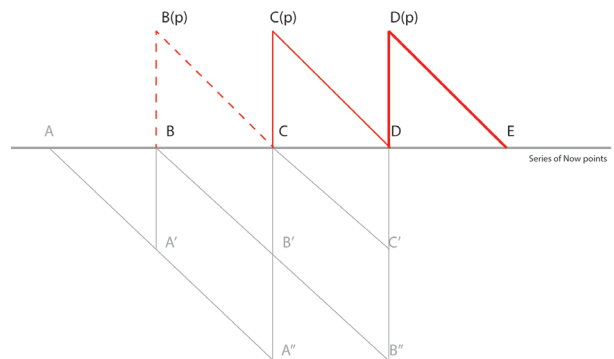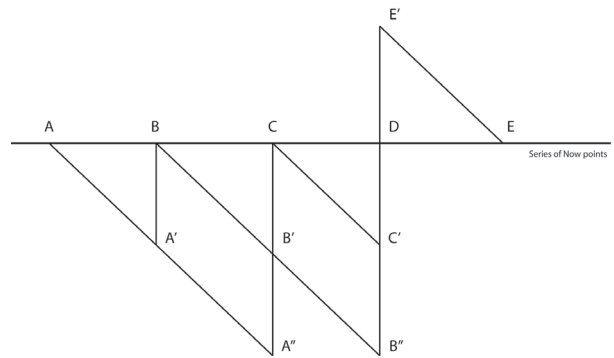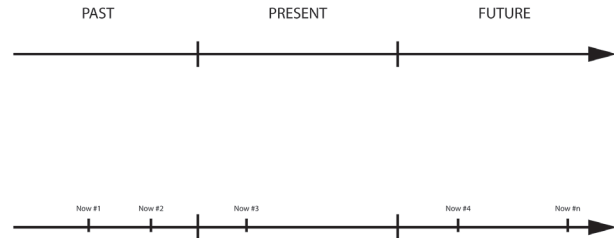

Fig. 1. Newtonian timeline diagram (elaboration by Nicolas Turchi).

Fig. 2. E. Husserl temporal diagram, 'D' as 'Now' momement (elaboration by Nicolas Turchi).

Fig. 3. E. Husserl temporal diagram, Running-off phenomena (elaboration by Nicolas Turchi).

being immediately correlated to the appearance (thus to any perception related phenomenon), the immanent temporal objects are additionally described by their reflections on the observer and specifically by how he draws distinctions between those and their original appearance: "We speak here with reference to the perception of the duration of the sound which extends into the actual now, and say that the sound, which endures, is perceived, and that of the interval of duration of the sound only the point of duration characterized as now is veritably perceived. Of the interval that has expired we say that we are conscious of it in retentions, specifically, that we are conscious of those parts or phases of the duration, not sharply to be differentiated, which lie closest to the actual now-point with diminishing clarity, while those parts lying further back in the past are wholly unclear; we are conscious of them only as empty. The same thing is true with regard to the running-off of the entire duration. Depending on its distance from the actual now, that part of the duration which lies closest still has perhaps a little clarity; the whole disappears in obscurity, in a void retentional consciousness, and finally disappears completely (if one may say so) as soon as retention ceases" [Husserl 2019, p. 46].

On Newton's timeline, it was possible to locate a series of points linked to events, no matter whether or not they were mutually related, that are temporal abstractions that run on an infinite plane without causing or being subject to modification (fig. 1). A mathematical matrix or a simple set of coordinates would suffice to describe the essence of time itself. On the contrary, Husserl's diagram of internal time-consciousness, where the observer is the real protagonist, is oriented according to every fleetingly perceived 'now' moment that is built on the flow of experience (*Erlebnisstrom*). Each of these 'now' moments is not static and generates a series of sub-entities, namely the 'no more' and 'not yet' (fig. 2) on which will later speculate, among the others, McTaggart. This is precisely where a new level of complexity gets introduced into Husserl's diagram: every 'now' point produces an echo of its own unity of duration which will thereupon bounce back on the banks of the perpetual 'now' that is perceived and thus cause a ripple projected towards the future. The series of 'echoes and ripples', which defines the dilation of a temporal object unity of duration, coin-
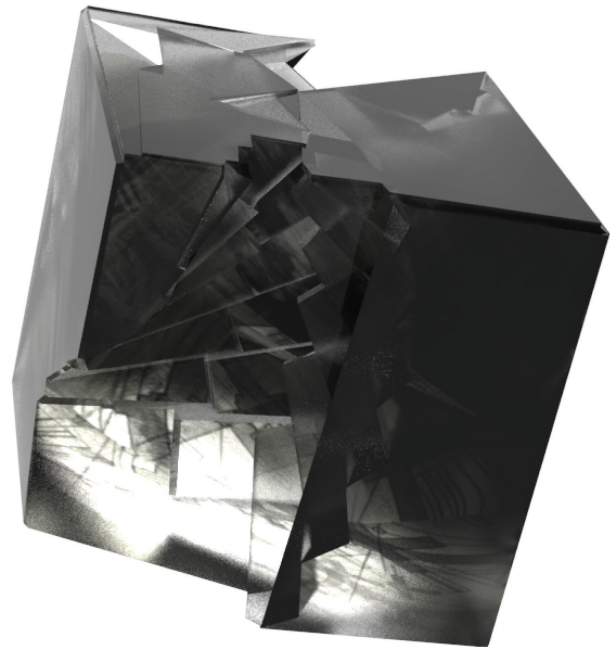

Fig. 4. Internal consciousness of time speculation on platonic object (elaboration by Nicolas Turchi).

cides with the retention and protention phenomena. Retention and protention are the main mechanisms deployed by humans to internally organize the phases of temporal perception and the major tools used by Husserl to recast the idea of temporality.

Retention

Retention is described by the extension of the unity of endurance of an object perceived through the running-off phenomenon: "the further we withdraw from the now, however, the greater the blending and drawing together" [Husserl 2019, p. 47]. What is 'no more' tends to sink down into the obscurity of memory and resurface from time to time to varying degrees by the accumulation of the protention's ripples, defining: "a kind of temporal perspective (within the originary tem-

poral appearance) analogous to spatial perspective. As the temporal object moves into the past, it is drawn together on itself and thereby also becomes obscure" [Husserl 2019, p. 47]. The sinking down of the perception of a temporal object is the basis of the running-off phenomenon. Despite a quasi-antithetic position between this phenomenon and Bergson's use of the avalanche to disclose the idea of the time of consciousness and accumulation of experience, the two share certain similarities including the impossibility to be discretized without undermining their nature: "With regard to the running-off phenomenon, we know that it is a continuity of constant transformations which form an inseparable unit, not severable into parts which could be by themselves nor divisible into phases, point of the continuity, which could be by themselves" [Husserl 2019, p. 48].

Protention

Protention is the act of producing one or a series of anticipations based on the idea of possibility. It is not a simple forecast because these predictions are highly influenced by the involvement of stratification of running-off phenomena which results in a conditioned projection. The majority of neural signals does not travel from the eyes to the brain: it travels in the opposite direction, from the brain to the eyes. The brain builds an expectation of what is yet to be seen based on what has already happened or drawing from experience. It creates the image of what it anticipates the eyes will see. This information is sent by the brain to the eyes through intermediate stages. Only if any discrepancy is detected between the brain's prediction and the light that reaches the eyes will the neural networks send signals back to the brain. In other words, it is not the image of what is observed that is sent from the eyes to the brain, but only the information relative to the discrepancies from the brain's expectation. [Rovelli 2020, p. 190]. Retention and protention are surprisingly linked together within the cerebral activity. A series of studies on patients affected by amnesia demonstrates how difficulties in recalling certain events from the past would also deeply affect the capacity of imagining future events. This was confirmed by further investigations deploying tomographic images which high-
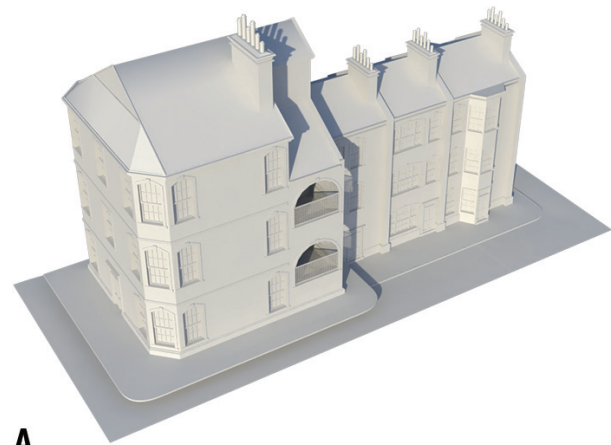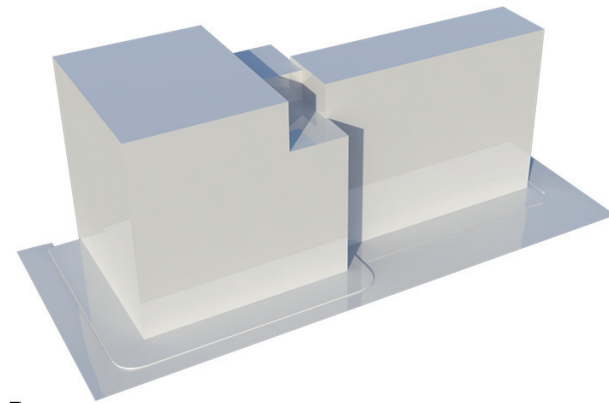
A

B

Fig. 5. Phase I, Recognition (elaboration by Nicolas Turchi).

lighted how the brain areas that are activated during the act of remembering and those lighting up during the formulation of possible futures showed extremely relevant matches [Schacter et al. 2013]. This also demonstrates that the act of recalling a memory involves the subject's creativity, thus making remembering a constructive process. In modern psychology 'reconstruction' and 'construction' are the terms used to describe respectively the act of recalling old memories and the act of creating new ones.

Retention and protention, both mechanisms that define human perception, are particularly embraced by one figure over the others: the designer. The designer is the one in charge of bringing to life shared memories and at the same time drawing from personal experience, but also the one who is responding to concrete matters such as bureaucratic issues and building site development. The designer also needs to have a peculiar inclination towards a synthesis that starts with the filtering of a multitude of information and is ultimately directed towards the final scope of a project. Furthermore, the designer is that profile who can better read the 'leap' that occurs when the sunk down information re-emerges as protention. Building on this idea, the analogy shows even more potential when a new entity –the project– is considered as a temporal existence built on a collection of immanent objects that exist in a series of 'now' points, generating a multitude of retentional and protentional connections across the same project. We can begin to read the 'project' through Husserl's diagram of internal consciousness of time, along with its constituents temporal objects, and the role of the 'observer' interpreted by the designer (in the involvement that arises from this position). Yet temporal objects build relationships via retentions, protentions and mutations from which is possible, by forcing the system in favour of a better reading, to extract temporal units from which to trace further connections. The architect becomes more and more subject to time, or the spatialized version of time, by experiencing the nonlinearity of events. With the rise of digitalization, the new representation techniques and computational methodologies shorten the distance between the temporal events of a project. New virtual dimensions are beginning to offer dynamic and interactive playgrounds that cannot be described by the Newtonian model anymore.
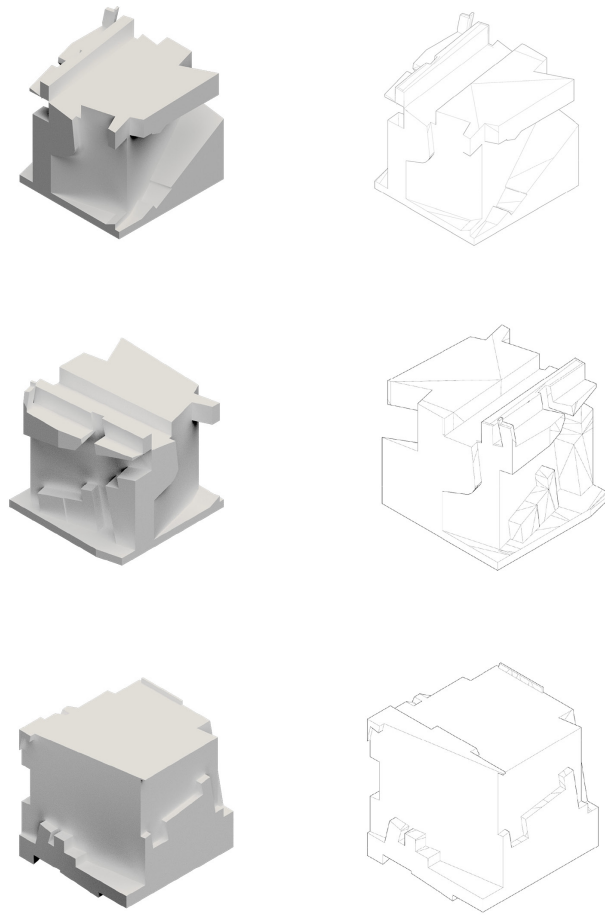

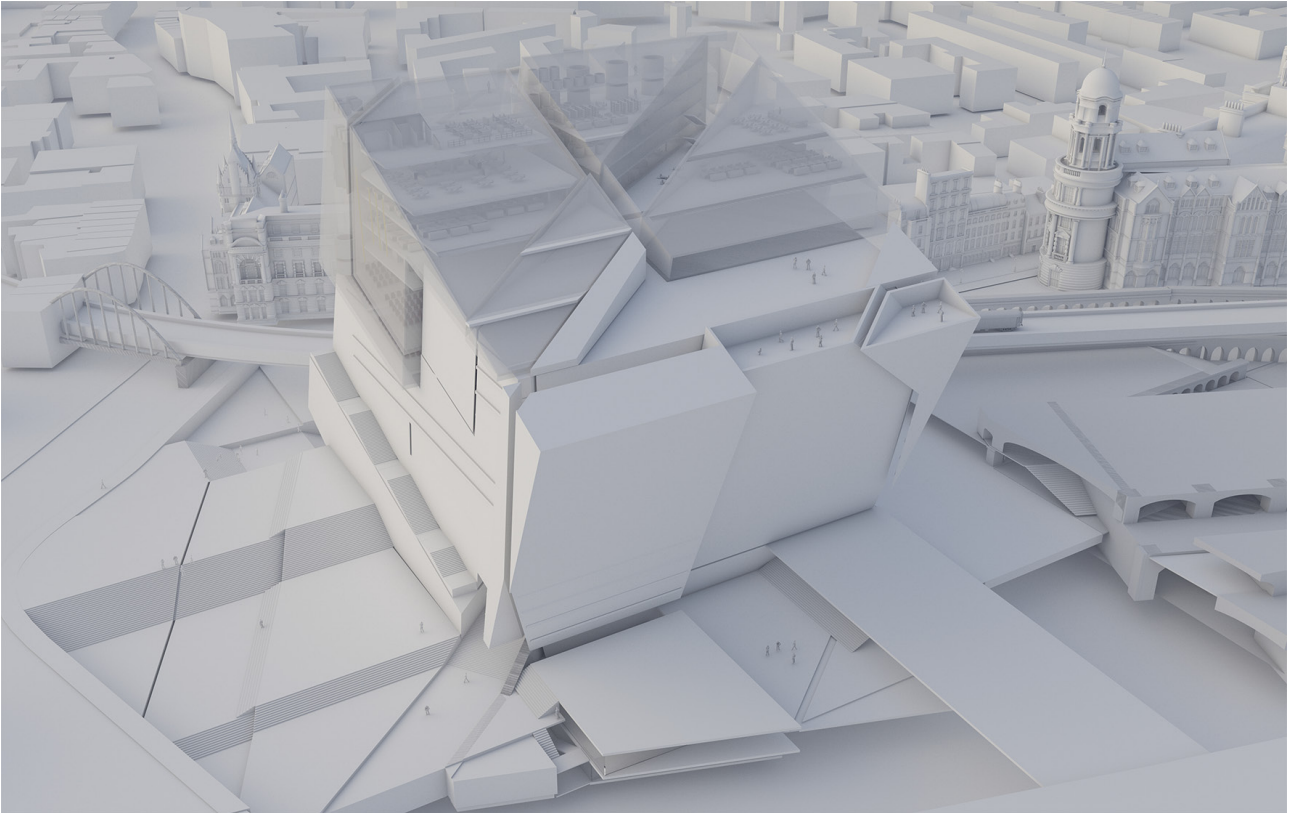*Fig. 6. Phase II, Fragmentation / Clustering (elaboration by Nicolas Turchi).*

Fig. 7. Phase III, Projection / Manipulation (elaboration by Nicolas Turchi).

Case-Study

In this concluding part of this article, we will examine a case-study extracted from a more articulated research project which is part of a 2018 thesis in Architecture at the Harvard Graduate School of Design. One of the main goals of the thesis is an attempt to transpose the internal consciousness of time theorized by Husserl onto the generative design and representational workflow of an architectural project. It is the project for the new overground station of Bishopsgate Goodsyard in the heart of London. The project, described in a single volume, will also include a research centre and the department of physics of the New University of London. Bishopsgate area is the central node of London, the capital city, and has recently seen an urban restyling that attracted an impressive number of investors which contributed to the general upgrade of Shoreditch. However, the site is very heterogeneous, rich in leftover spaces that have seen several attempts at reuse and reclamation over time. A relatively young portion of the city that has been transformed several times already, starting with the conversion of the old railway station, which was destroyed by a fire on the 5th December 1964. Since 2000, the commuting and circulating trajectories are governed by the new overground station as part of the Circle Line that connects the major interest points across Central London. Thanks to its typological variety, the cultural mix, the urban decay, and the high density of infrastructures present on the site, Bishopsgate Goodsyard was the perfect case-study for this type of thesis. The case-study consists of three macro-operations that reflect the immanent temporal objects investigation. The first cognitive operation involves 'recognition', the perceptive moment when the first information is gathered, verified, and stored. The second stage involves both 'clustering' and 'fragmentation' and includes intrinsic retention and protention, both about the single existence of the project (its unity of duration). The third operation is the 'projection' which necessarily includes a certain degree of 'manipulation'. While in the first two stages the subconscious elaboration of any temporal object is crucial, in the third step the observer finally realizes his perceptive potential and thus becomes responsible for the existence of the project itself and becomes fully exposed to any third-party verdict.

Recognition

All the activities involving inquiry into immanent temporal objects can be listed as part of the recognition process. To give a few examples, analysis of the urban, historical, environment, and also the investigations of adjacent buildings and their residents, market analysis, and finally any competition brief and the reading of regulations. All these information sources constitute themselves as temporal identities that which play walk-on parts hierarchically subordinated to the superior temporal existence of the project (although they can still play a protagonist role by being considered as the centre of their own temporal existence, once again it is the observer who has the authority for reformulating this relationship). The most interesting aspect, which adds complexity to the first stage, is the implication of the presence of the observer, who is, the designer. The analysed information is subject to the first form of manipulation by the designer who, based on his previous experience with architectural interventions or his accumulated deep knowledge of old competition briefs or even his scholarly work on particular typologies that populate the area, etc., inexorably filters, and counterfeits the results of the first stage of the investigation. It is pertinent to recall how the brain elaborates a first image creating a prediction of what will be observed, operating a pre-selection of the information based on the temporal consciousness of the past [Rovelli 2020, p. 190]. This is another side effect of the impossibility of discretizing the temporal flow which remains a complete abstract manoeuvre that cannot be fully operated in reality, therefore we cannot section a portion of the same flow without avoiding maintaining all the passive retention that insists on it.

In the case-study, the designer, passionate about the history of architecture and particularly fascinated by the Victorian style and its declination across the British capital, filtered a good portion of the contextual information, synthesizing it (as it happens in the case of a synecdoche) in a typical Victorian style residential building in London (fig. 5A). However, even at this stage, there are multiple reductions already happening which tend to combine and affect each other rather than running in parallel. Following this first step, the Victorian building read as a more generic contextual unit is further abstracted to ease the possible translation into the next level of information (e.g., the masterplan reading, a physical model setup, a visualization that highlights the project vs the surrounding context etc.) (fig. 5B).

Fig. 8. Project bird view, new overground station, external agents' influence (elaboration by Nicolas Turchi).

Fig. 9. Retentional and Protentional echoes affecting the temporal entities beyond the project boundaries (elaboration by Nicolas Turchi).
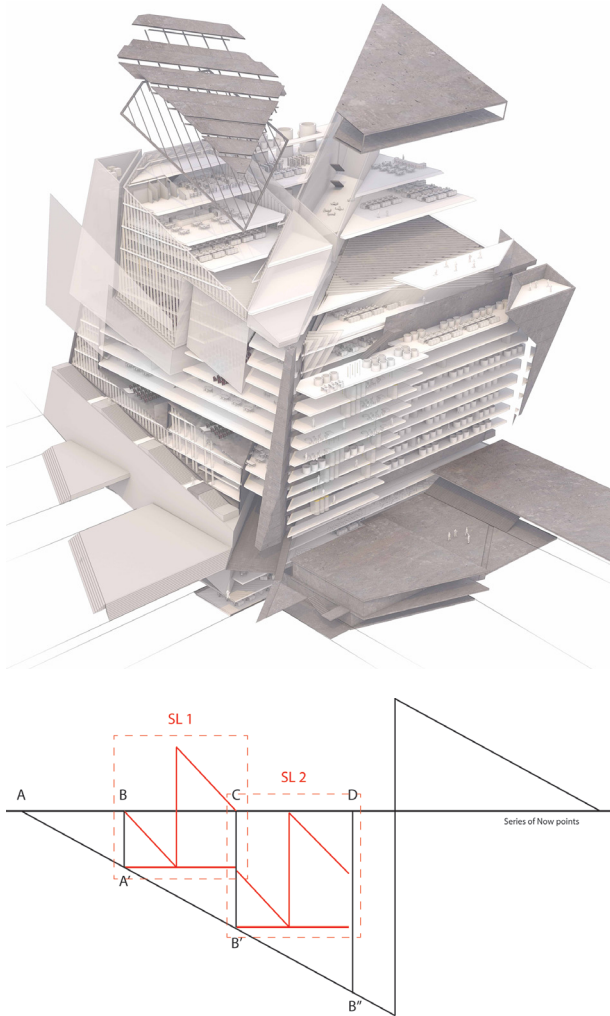
Fig. 10. *Fragments of fragments, structural and programmatic investigations affect the internal retentional processes (elaboration by Nicolas Turchi).*

Fig. 11. *Fractal system of temporal influence, scaling (elaboration by Nicolas Turchi).*

Fragmentation / Clustering

Once a certain reality recognition is filtered and stored, it becomes part of the individual's memory. Yet, the gathered information is still responding to the running-off phenomenon as it sinks from the chosen 'now' point of the temporal perspective. We cannot speak of static entities as if with no relations. Every set of information that has been filtered during the recognition process keeps transforming as it begins to interact with other fragments of sedimented memory which are indeed actively conditioning the newly stored information.

After the recognition phase, it is time to deal with the accumulated information. The study-case shows portions of the city that previously went through abstraction beginning to be altered by the fragmentation and clustering processes (fig. 6). Similar activities operate on the sedimented memory. As recollections fade out, they also tend to blend and hybridize with those events that are either close in time or qualitatively relevant to them (clustering process). The information is further optimized by the human mind by reduction and smaller fragments of memories are being lost down the temporal perspective (fragmentation process). Clustering and fragmentation, apparently antithetic processes, are forged by the same running-off phenomenon. The portions of the city are subjected to projection and solid Boolean operations (difference, intersection) until they organize in a multi-layered unit of information on which the observer can still read some temporal object traces. (Fragmentation + Clustering) (fig. 6).

Projection / Manipulation

lThe third stage of the investigation is perhaps the most complex one. The capacity of overcoming the 'leap' between retention and protention has been acknowledged as one of the human peculiarities and it is not limited only to serve the purpose of time perception, but it also constitutes one of the most crucial surviving tools humans possess. The ability to create and always refine future predictions is what feeds the species' evolution algorithm and drives our progress. The designer finally has the opportunity of materializing the processes of clustering and

Fig. 12. Programmatic vivi-sectioning of the building, example of scaling property applied to the project (elaboration by Nicolas Turchi).

cognitive synthesis of information into a projection, into a project (from 'pro'-forth + 'jacere'-to throw). At this stage, a multitude of instances and contingencies may affect the protention outcome starting with, for instance, the design team's final goals, which may be environmental, aesthetic, communicative, economic etc. Thus, the projection results in an altered version which is subject to manipulation to respond to external entities.

In the case-study, the multi-layered unit begins to compromise in response to the environmental and site strategies. The volume is tilted to maximize solar exposure and the environmental comfort (fig. 7) inside the main building as well as to avoid casting an undesired shadow on the nearby residences.

But it also responds to functional necessities such as those of a pre-existing railway that pierces through the volume causing the loss of a fragment of the building (contingencies, shocking events could also erase some portions of memories). A further rotation of the volume facilitates the connection between different levels of the site (fig. 8).

Another potential aspect of the internal time-consciousness research, yet only partially developed, is the fractal capacity of this procedure (fig. 11); the possibility of taking advantage of its scalability (by both enlarging or reducing its spectrum) (figs. 10, 12) which permits the propagation of the generated retentional echoes and the protentional ripples within and outside the project boundaries (fig. 9). The 'leap' does not merely reflect the moment, the 'now' that is being manipulated by the designer, it further identifies and acknowledges the observer in his new role. From absolute and quasi-divine Newtonian space and time to a great responsibility that the designer, or the architect, must be ready to take on to fully become the observer-thus-the-creator of his own space and time, spacetime, and finally of his memory. A memory that becomes a project.

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