Architecture, Heritage, and the Metaverse: New Approaches and Methods for the Digital Built Environment

ANDREA MONETA

This article reviews the author's professional work and academic research as an architect and scenographer in the collective virtual space of Second Life. With the aim of establishing a more sophisticated, convincing presence for architecture and heritage in the metaverse, it explores the application of the design methodology of "architecture by elements" (ABE). ABE works by facilitating interaction between individual elements of archetypal historical architectures, as in a language, to generate new, contemporary designs. Case studies discussed here illustrate how this approach enables buildings and urban spaces imbued with cultural memory to be built in digital space from a critical interpretation of the past.

We live in an *extended* world that includes the coexistence of real and virtual places, which determine our real and virtual lives. At the same time, the world of communication, dominated by the culture of image, is shifting into the world of interaction within a digitally driven society.

As a feature of this new communicative paradigm, the term "metaverse" (i.e., beyond universe) has been used to describe a future iteration of the Internet made up of persistent, shared, 3D virtual spaces linked into a perceived virtual universe. Generically referred to as "collective virtual shared space," the metaverse is considered to be the basis for the next version of the Internet, which will include all virtual worlds.[1]

This study is focused on virtual-world environments and, specifically, those of Second Life, a multiuser virtual environment, where users create 3D environments and objects and move through them with their own avatars, engaging with other users in real time. The study's aim is to introduce the role of memory and heritage into discussions of the digital built environment by emphasizing the importance there of architectural composition and history. More specifically, it imagines this occurring through an application

***Andrea Moneta** is a Senior Lecturer in the School of Art & Design at Nottingham Trent University, U.K.*

of the principles of "architecture by elements," a theoretical methodology developed by Gianfranco Moneta.[2]

Broadly speaking, the article is aimed at answering the following research questions. Can the expertise of the architect and of architectural knowledge improve the physical quality and experience of virtual worlds? And can the principles and methods of "architecture by elements" (ABE) be applied in a digital built environment, and in doing so, produce new architectures as a critical interpretation of heritage architecture?

The article will review the existing body of knowledge about architectural design in virtual worlds and describe the author's professional work and research, as a digital architect and academic, on the metaverse of Second Life. Case studies from Second Life will be used to illustrate the varied outcomes of the research, while considering the opportunity presented by the metaverse to transform the design and experience of architecture both in the real and virtual worlds.

ARCHITECTURAL DESIGN THEORY AND VIRTUAL WORLDS

Research on architectural design must now include its development in cyberspace since the 1990s.[3] In the early years, as the boundaries of architecture were first being expanded into cyberspace, this process was facilitated by a number of inspired designers (from Archigram to Asymptote) and by theoretical contributions. Later on, however, digital incursions into the realm of architecture have mainly been developed through the activities of parametric architecture, form-based design, and computer gaming.

In the meanwhile, architecture in the real world has been influenced by late-capitalist processes of branding and globalization, the decline of older values, and the loss of stable references.[4] Major advances in automation, information technology, and the advent of the fourth industrial revolution have all furthered the globalization of architecture, eradicating existing qualities of place and cultural identity.[5]

At the same time, urban designers and architects like Rem Koolhaas, Daniel Libeskind, Saha Hadid, and Frank Gehry have rejected formal design orthodoxies and principles, experimenting with new designs that have fueled bold, dramatic statements within the urban environment.[6] Their post-urbanist works have been sensational, designed to impress the public and celebrate their clients' magnificence. But they have also often come at the expense of human scale and relationships with context and history. In particular, Koolhaas's concept of "bigness" has had a great impact on the last generation of architects and architecture schools. Many who came of age under the influence of this work now consider such architectural principles as composition, scale, proportion and hierarchy, as well as the lessons of history, to be the "chains" of an old-fashioned approach to the discipline.[7] As a result, a new generalized globalization of means and methods has generated atopia: an indifference to place, local identity, *genius loci*, and social purpose.

Architectural design in the virtual world is currently mirroring this tendency. Yet the nature of space in the virtual world is fundamentally different from its manifestation in the real world. Consequently, the architecture of the virtual world needs its own theory and practice.[8] This is why digital, virtual environments have become a locus of research and experimentation to (re)establish the founding role of architecture through the application of principles of functional organization.[9] Not surprisingly, these design principles are being inspired not by the latest, "icastic" generation of architects, but by the theories of past architects and urbanists. The application of Le Corbusier's utopian and visionary urban planning, for example, with its highly centralized structure, has been particularly helpful to the design of virtual environments that may be easily navigated. And Frank Lloyd Wright's opposite approach, aimed at the dissolution of the city in favor of more widespread, decentralized communities, has likewise helped virtual cities grow organically.[10]

Kevin Lynch's work on the perceptual form of urban environments has also been key to solving the important tasks of navigation and orientation in virtual environments.[11] In particular, his observation that users understand their surroundings in consistent and predictable ways by forming mental maps has been used to enhance spatial awareness among users of virtual spaces.[12] It was Lynch who introduced the term "way-finding" to define "a consistent use and organization of definite sensory cues from the external environment." He also described five main elements that people use to orient themselves using a mental map: paths, edges, districts, nodes and landmarks. These elements, and their mutual interactions, have been extensively used to define principles of architectural design of virtual environments in academic research on the subject.[13]

Another important contribution to the design of virtual worlds has been the work of Christopher Alexander. Long before his famous 1977 *A Pattern Language*, Alexander employed computation and structure to develop tools to improve urban layouts and the design of houses. This work came in opposition to traditional urban planning approaches, which relied on imposing preconceived grids, zones, roads and buildings on human activity.[14] Alexander's methodology has since been used in the development of object-oriented programming, interaction design, and new software technology called "design patterns" in Macs, iPhones, other computer systems, and video games.[15] *A Pattern Language* also inspired *The Sims* (2000), one of the best-selling video game series of all time.[16]

It may be strange to say it, but despite the impact of the fourth industrial revolution, most architectural design theory deployed in cyberspace today is almost thirty years old. Yet it was also nearly three decades ago, in 1993, that Marcos Novak introduced his "liquid architecture" and "transarchitectures,"

a mode of design thinking that explored the integration of physical and virtual space in navigable digital environments.[17]

In recent years, pattern design has been developed into generative design, another method of using computational processes to design the virtual world, but one supported by the application of grammar to formally define design languages.[18] Generative design grammar may thus be seen as based on a set of rules that describe an architectural "style." Unfortunately, the overall formal result of generative design to date is more phantasmagoria than architecture: a plurality of combinations of fantastic, bizarre, complex imagery. However, interesting work in the field continues to emerge from two teams of architects, engineers, academics and scientists collectively grouped under the names "digital architectonics" and "discrete architecture." Both have sought to reappraise the digital in architecture as a step toward reappraising architecture as a driving cultural force in the twenty-first century.

Of these two teams, that dedicated to "digital architectonics" was founded by Prof. Ludger Hovestadt of ETH Zurich (the Swiss Federal Institute of Technology). Active since 2009, his group's work on computer-aided architectural design has aimed to master strategies and theoretical approaches to methodology and abstraction in computational design and digital modeling.[19] Their use of the term "architectonics" derives from Immanuel Kant's *architektonik*, a concept that acknowledges architecture as something unstable (as in the virtual world of video games) as opposed to the traditional, solid and concrete architecture of the real world.[20] One of the projects Hovestadt's team has worked on is the systematic arrangement of elements derived from Vitruvius's *De Architectura* to produce construction instructions that can be used in generative design.

The field of "discrete architecture," meanwhile, utilizes mereology (the study of a whole through the relationship between its parts) to employ the techniques of bonding, joining, interlocking, entangling and overlapping to develop an architecture of constituent parts.[21] Both approaches demonstrate a desire to experiment with the basic building blocks and rules of architecture using computation.

This article constitutes a further exploration of such innovative directions developed through generative design. Its particular focus is the application of the theory of architecture by elements (ABE) to the virtual world of Second Life.

GAMING AND VIRTUAL WORLDS

A virtual world can be considered a brand-new digital built environment, an extension of the real world that includes not just a physical appearance, but also cultural and social interaction, aesthetic appreciation, and philosophical engagement. Awareness of the importance of these concerns in the built environment is part of design training in architecture, but it is generally not included in the education of those who design and build virtual worlds — i.e., game designers, programmers, and (sometimes) users. As a consequence, the design of a typical virtual world, such as that produced as the background for computer games, may be broadly described as similar to a film set, characterized by a fairy-tale naivety, yet generally aimed at reproducing a real-world environment.[22]

Thirty years since they first exploded into the entertainment industry, one result of this limited development is that these games are starting to look and play the same. Despite the recent massive increase in Internet speed and the improvement of IT devices, the novelty factor of games developed in the last fifteen years has thus reached a low point.[23] In response, developers nowadays are spending a great amount of resources trying to turn games into movies, to improve their look and "appeal." One could argue this condition is the direct consequence of the lack of architects in the virtual world. Without architects, the virtual world has come to be filled only with scenography that seeks to imitate real architecture. Absurdly, in the virtual world, where everything is unlimited, architecture is limited.

Virtual environments need to go beyond the limitations of such purely mimetic realism. A bold new attitude is needed to create a basis for the full development of the virtual world's creative and artistic potential. Put simply, to realize a digital spatial revolution, games and other virtual worlds need to abandon the depiction of reality. Instead, they need to develop an understanding of architectural concepts and theories to give life to truly utopian designs — to make the impossible possible.

To realize such a future, however, it is fundamentally important to consider the main difference between buildings in the real and virtual worlds. In the first realm, buildings are fixed and not generally transformable. But in the digital realm, they can change and quickly reconfigure themselves as "performances" in a dynamic interactive process with the user.[24] The virtual world is also a place for action and functionality, where gamers may use architecture with specific purpose, as might a *parkour* athlete.

Applying architectural principles to the virtual world should also involve understanding history and context. Bringing history into a virtual world may seem to be nonsense because virtual worlds are commonly considered to be timeless, without a tie to chronology. In fact, however, they typically "borrow" themes and characteristics from a specific real past — as games may be set, for example, in the Middle Ages or during World War II. But the use of the past as a process by which historical architectural archetypes form the "elements" of a language can also open up new territories for architecture, at the same time as it may enhance the quality of the digital built environment in game design and other reaches of the metaverse.

Since the 1980s, when virtual worlds first started to appear in gaming, digital built environments have typically been created from scratch by software developers, conceptual artists,

3D modelers, and game designers. On specific platforms and in certain conditions, users (game players), may also be given the chance to modify and/or create content in a virtual world. Game designers are currently trained to be proficient with IT skills, but also to create 2D and 3D art. Depending on their role and skill level (junior, senior) they are then authorized to design and realize characters, objects and environments; to create textures; and to visualize other virtual elements through digital and nondigital sketches and animations.

A game designer's skill set, however, does not include specialized training in architectural, landscape, or urban design. As a consequence, virtual worlds are currently being created by a legion of nonarchitects (I will call them designers of architectures), who assume the role played in the real world by architects, landscape designers, urban planners, and interior designers. But designing architecture in the metaverse is a challenging task even for experienced architects, let alone for those without their cultural background and technical training. Freed from spatial, economic and technical limitations, without a natural environment to fit into or an anthropic history to respect, designers of architectures may easily become lost in a digital magic domain, where everything is possible and potentially huge.

A further complication is that virtual worlds are never isolated from the real world; indeed, the two realms extend into and influence each other.[25] *Minecraft* (2009), the most popular computer game in history, which offers a form of "digital LEGO" to its users, has thus been successfully utilized to facilitate engagement and participation in real architectural and urban-planning processes. The real world can also influence the virtual world on an imaginary level, for example, through the influence of the imaginary worlds of books, movies, television, role-playing games, and religion. Such "real world" imaginaries may provide a powerful background for the design of characters, narratives and spaces in the virtual world. It is why so many computer games are related to old myths, famous novels, and fantasy books, and why their architectures reflect a sort of fairy-tale expressionism.

However, the real world can also influence the virtual world on a more factual, *objective* level. Thus it is that past events and recent history often lie behind many of the landscapes users experience in virtual worlds and games. History is not tangible, but it does live within individual memories, which reproduce over time to produce cultural memory. This is why individuals can maintain a sense of personal identity by linking to a shared culture, based on collective memory of the past.

The virtual world can also record and display shared cultural memory through physical appearances, with the aim of linking the past to the present, enhancing the user's connection with a specific environment and architecture.[26] But this will require that designers of virtual architectures evolve the skills and knowledge to include a more solid array of competences that only architectural training can offer. At the same time, the role of the architect needs to be extended into the virtual world to understand the functional aspects of gaming and storytelling. What is really needed is a constructive dialogue between the disciplines of architecture and gaming.

Such a dialogue can be seen to be even more necessary when the design of a virtual world involves the reproduction of historical environments and their architectures. Most of the time, this reproduction follows controversial philological approaches and methods. Take, for example, the development of the video game *Assassin's Creed II*, where, as a background for the actions of players, industry giant Ubisoft created a detailed virtual replica of Florence during the Renaissance. To help ensure historical accuracy, the company even employed a young professor of architectural history and theory, Maria Elisa Navarro, as a consultant. The result was a movie-like, impressively detailed reproduction of period costumes and architectures — but with major "adjustments." Among these were the increased total height of buildings to improve climbing movements, and the introduction of curved streets to a totally reinvented map of Florence to enhance the potential for surprise encounters among players.[27]

Context is another important aspect to consider in the design of real-world architectures. Thus, architects are trained to analyze and understand the environments in which they design, including both tangible and intangible elements inherited from the past. These elements include the anthropic history, the landscape and natural environment, the past use of the place, and the memory of inhabitants. Good architects thus usually start their design efforts by recognizing the value of preexisting elements, which they then reinterpret through their own cultural background and cognitive and professional experiences.

None of these processes exist in the virtual world. Direct emotional exchanges are mediated through a user interface and/or an avatar. Gamers are alone, but at the same time share the experience of a virtual space with other people. They likewise occupy a meta-space in which there is no sense of gravity, there are no smells, nothing may be physically touched, and there is no evidence of history other than that which has been (re)created specifically to provide a sense of time in the metaverse.[28]

SECOND LIFE AS A DESIGNER'S SANDBOX

The virtual-world gaming site Second Life is still active after more than fifteen years, a long period for a creation of its type. But Second Life's continued existence is in part a result of it being more than just a game; it is a place for creativity bridging between Internet and real-world cultures. Second Life is a user-dominated platform, which regularly produces engaging content: from art performances to political campaigns, from land auctions to adult entertainment. Unlike games created in fixed environments, Second Life was built

as an empty space, designed to be filled with content generated by users, a feature that naturally attracted architects and urban planners.

Born in 2003, Second Life now looks terribly dated compared to other platforms. Among these later arrivals is *Fortnite*, by Epic Games, which some have speculated embodies the future of a new Internet metaverse.[29] Nevertheless, during the last seventeen years, Second Life has constantly changed because its users are proprietors, not guests. As residents of this virtual world, they build their own homes, cars, and any other items they choose, no matter how weird, using basic 3D modeling software embedded in the platform.

Second Life is still relevant for the many possibilities of interaction and creative experimentation it offers. It thus appeals to users from such disciplines as theater, performing arts, architecture, urban planning, fashion design, social science, and psychology. Furthermore, it provides an ideal platform for distance learning and an ideal shared space for research on the intersection between architecture and gaming.

With regard to architectural production on Second Life, as is the case with any virtual world, the initial aspect of a structure to consider is its functionality. In the virtual world, avatars must be able to move around and truly experience the spaces that exist there. Functionality in this regard is the key to enabling users to enjoy the aesthetics of virtual architecture. In this regard, Second Life allows users to engage in a virtual reality experience without a headset. Such a mode of virtual interaction creates places that are *real* to the extent that they may be built, modified and experienced. Place is not just defined as space with static visual *character,* but space that is *happening*.

A NEW METHODOLOGY FOR THE METAVERSE: ARCHITECTURE BY ELEMENTS

> *Language can be considered as a set of language games: it is comparable to a city, built at different times, made of buildings with different purposes and functions.*
>
> — L. Wittgenstein, 1953[30]

The research effort documented here involves an application of the theory of "architecture by elements" (ABE) to the metaverse of Second Life. ABE is an architectural theory described by Gianfranco Moneta in his 2002 book *Logica e Complessità dell'Architettura*, and successfully applied in real-world contexts during his long career as an architect and academic in Italy. The research leading to ABE involved investigating the inner processes of architecture and its mechanisms of configuration — a research effort that the author participated in between 1997 and 2005 at the Faculty of Architecture of University of Rome La Sapienza. In brief, the ABE methodology aims to restore the identity of architecture as an intertwining not just of art and technique, but of thought and ideology. As such, it is inspired by the works of philosophers Edmund Husserl and Enzo Paci (phenomenology), Martin Heidegger (existentialism), and Ludwig Wittgenstein (philosophy of language).

This article explores the possibility of extending ABE research to and testing it in the virtual world. Specifically, it will explore the potential of ABE to improve the design possibilities inherent to the empty space of Second Life, using the language of architecture.

History plays a fundamental role in the operation of ABE: it guides the architectural design process through the selection of a reference language from the past and the historical/morphological reading of phenomena related to it. ABE, in fact, considers "design" to involve any historical development that may be critically read as a process. But history as a *process* here is intended to encompass not just past activities that interact to produce a further result, but any form of evolutionary realization. Considering "the past as a friend," designers may thus choose freely from an endless source of forms and compositional principles.

One of the key elements of ABE is also an analogy to the principles of linguistics and, specifically, Wittgenstein's theory of "language-games."[31] This term is used here to describe a compositional activity that encompasses both a language and the processes of communication it affords. Wittgenstein also used the term "language-game" when comparing language to a city, an entity built over time and made of structures with different purposes and functions.

Applying this philosophical concept to the built environment, it is possible to see how the language of architecture as a whole is composed by different language-games, each containing its own language parts and rules. The process of ABE may thus be considered a language-game, in which an architectural lexicon provides a set of parts which may be associated or contrasted with one another to produce language-game units. As a result, each architecture unit is organized and defined as a simple or complex sentence, whose meaning identifies it as a work of architecture.

This methodological approach first and foremost needs to be understood through a definition of its components: lexicon, syntax, and semantics. It is useful here to consider the work and theory of the architect Louis Isadore Kahn, who was known for his efforts to combine modernism with the weight and dignity of ancient monuments. Moreover, ABE methodology was inspired by Kahn's monumental architecture, which utilizes complex organizations of single independent units (elements), an approach that derived from the architect's understanding and application of Classical Greek and Roman architecture as language-games.

As noted above, the compositional activity of architectural design in virtual worlds has so far mainly been limited to the imitation of structures in the real world. Despite the essentially mimetic character of this process, however, designers cannot eliminate their cultural backgrounds, and

thus bring their personal interpretations of history and architecture into the virtual realm. Doing so involves an act of knowledge that starts with an initial synthesis. In systematic terms, this includes 1) a choice of reference lexicon (a list of forms); and 2) the selection of criteria for the interrelation of these elements (a syntax); which leads to 3) the creation of meaning using the selected material to establish a form to host a function (semantics).

This approach follows Kahn's own shift of design paradigm during the course of his career. This evolved from a modernist architectural ideology in which "form follows function," toward the revolutionary idea of "form that generates the function."

Such an *act of knowledge* immediately implies the question: What is the reference lexicon that a designer can use? For Kahn, lexicon and syntax could be freely chosen from both the present and the past, offering an endless source of forms and compositional principles. The past thus represented a shared cultural heritage, a collective and universal memory without specificity of time and place.

ABE theory further develops this approach, considering the coexistence of both "known" forms taken from the history of architecture, and "new" forms produced through the coexistence of different lexicons and syntaxes in a single, organic process of creation. Thus the use of the past does not necessarily imply a mere stylistic resumption, but can also lead to the reinterpretation of archetypal symbols. This may in turn enable an important process of reappraisal within architecture.

Furthermore, ABE considers archetypes as internal to an ongoing historical process, subject to constant transformation based on reuse. The overlap of historical buildings over time may thus give rise to extraordinary figures, from which it is possible to identify fundamental architectural principles (FIG. 1). In this process, architecture, through its ability to create symbols, can access the domain of the unconscious, giving shape to archetypes that produce — through form — deep structures derived from history or nature.

In some cases, the forms coincide with the archetypes. But, more importantly, archetypes embody principles of form that can be reutilized through new acts of architectural design. Hence, form may take on a profound meaning that goes beyond aesthetic value, to become a *form-principle*.[32]

This interpretation of form follows Aristotelian ideas, which emphasize the arrangement or organization of elements, as the result of which they become the thing they are. As matter, a series of elements are potentially anything they can become; it is only the act of design that determines what they *actually* become.[33] Kahn used this definition in his work when he introduced the concept of elements and their organization. This notion also underlies ABE theory, which imagines individually characterized *elements* of architecture interacting with each other as a language. Architectural elements, therefore, acquire semantic value when they are constituted in a syntactic system.

ABE theory thus reestablishes the importance of *form as a principle* derived from the archetypes of past architecture. And it aims to reuse this strong compositional principle, which allows a practitioner to design a work of architecture by putting elements in relation to each other after establishing them as part of a defined lexicon.

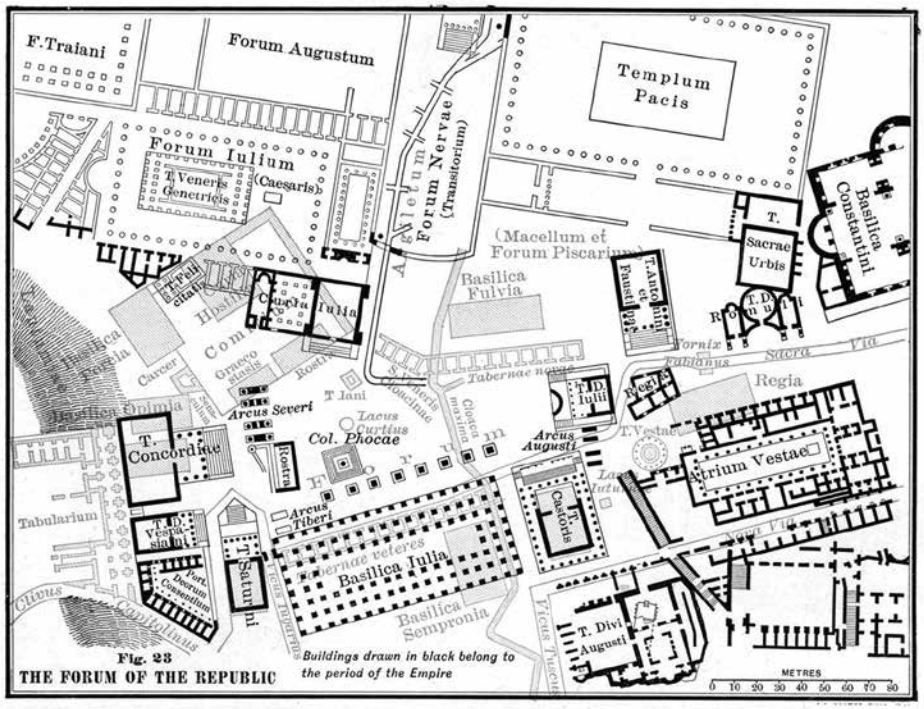

FIGURE 1. *The Roman Forum during the Republican and Imperial eras. The overlap of historical buildings over time gives rise to the extraordinary architectural figures of the Forum, from which it is possible to identify fundamental architectural principles and archetypes. Such archetypes are not immutable, however; as elements derived from a historical process, they are subject to a constant transformation derived from their reuse. Source: S.B. Platner,* The Topography and Monuments of Ancient Rome *(Boston: Allyn and Bacon, 1904). Public domain.*

The result of this compositional process are new combinations and associations of elements, which allow the construction of figures with greater complexity — linguistic sentences that possess innovative characteristics. At the same time, the reuse of elements derived from history guarantees the continuity of new architectural design, incorporating a sense of time into the process. Innovation is likewise guaranteed by the reuse of elements in a different context, decontextualizing their former figurative qualities. Representing time and context are, in fact, key concerns for architectural design in the virtual world — and, specifically, in the blank space of Second Life.

In ABE, elements may be organized using three principal methods: 1) juxtaposition; 2) interpenetration; and 3) translation, rotation and subtraction.[34] In the case of juxtaposition, when one element approaches others it will typically establish an interdependence, a bond, and therefore a relationship in the form of a linguistic principle. This organizational method may additionally employ strong structuring axes to achieve formal stability (in the case, for example, of terrace housing). In the case of interpenetration, elements may be organized in infinite combinations following nonparallel axes. In such a composition, elements may intersect and overlap each other, realizing complex organizational form. In the resulting new unit, however, each element will retain its identity while also contributing to a higher-rank unit: the language *sentence*. In the third method, involving translation, rotation and subtraction, individual elements may yield up aspects of their own discrete character to the advantage of other elements, thus building stronger combinations. Indeed, the subtraction process may even generate a controlled break-up of elements — their deconstruction.

To explore design in the virtual world using these principles, the author co-created the architectural design company Weretomato, together with three other Italian architects — Maurizio Crocco, Mario Leante, and Luigi Nappi — who were members of Archabout, a transdisciplinary lab dedicated to cultural production, research, and education in architecture, theater, and visual arts. Weretomato designers have in particular used Second Life as a research platform to apply ABE's methodology, developing innovative architectural environments, interactive content, and immersive experiences for Second Life users and private institutions.

CASE STUDY 1: HADRIAN'S VILLA ISLAND ON SECOND LIFE

As a necessary premise, it is important here to underline the difficulty of representing virtual designs using two-dimensional, grayscale images and text through the centuries-old technology of the printed page. Academic research on the virtual world would greatly benefit from alternative media for dissemination.

The Weretomato team realized, as a collective design on Second Life, Hadrian's Villa, in a private region (an island) measuring 65,536 square meters (256 x 256 meters). As a manifesto of architecture on Second Life, the project was based on the Ancient Roman architectural landmark, using the theoretical principles of ABE. The aim was not just to reproduce the famous building designed by the Roman Emperor Hadrian in Tivoli, but to develop a critical interpretation of it by seeking to understand its founding spatial principles. Hadrian's Villa is a perfect historical example of ABE's principles, the same ones that guided the design process on Second Life. Choosing this complex was the first step of ABE's act of knowledge, setting an example of Ancient Roman architecture as the reference lexicon with its forms, syntax and semantics.

As a work of architecture, Hadrian's Villa was also chosen in order to explore the role of reuse as a process, where new designs become part of the temporal development of architecture, allowing a sense of time to be present in each new project. Hadrian's Villa was thus "re-created" on a blank island within Second Life as a linguistic sentence, reusing the complexity of its single elements in a different context, decontextualizing its former figurative qualities to produce an entirely different architectural entity in the virtual world. In fact, such a process accords with the historical process by which the original Hadrian's Villa was built through different phases and reusing an existing, older, Republican-era villa.[35] The planometric design composition of the Hadrian's Villa on Second Life accomplished its original syntax, using a disposition centered on several vanishing points, within which both old and new elements were altered using rotations, changes of position, fracturing, and dissonance. This approach developed a formal coherence of the whole using two of ABE's organizational compositional principles: 1) juxtaposition; and 3) translation, rotation and subtraction.

The design included the scaling of the floor plan of Hadrian's Villa so it might fit within the physical constraints of a standard Second Life island. The deletion of selected building elements was also required, to maintain the overall proportions of all elements and their organizing axes. A scaled 3D model of Hadrian's Villa was also built to help the team discuss in real-time all design choices during the realization of the complex. Using avatars, these design meetings were held "in the air," flying over the island to obtain an aerial view of the building site **(FIG. 2)**. In its final realization, several of the eastern peripheral buildings that were part of the historical Hadrian's Villa (the Academy and Canopo) were omitted from the Second Life design, so that the complex could fit on the island. The choice also allowed creation of a more compact floor plan, leaving space for additional buildings and further functions **(FIG. 3)**.

In reference to the image in Figure 3, spaces in the Second Life complex focused on a number of cultural and educational programs:

FIGURE 2. *Weretomato designers' meeting, flying over the building site on Second Life with Hadrian's Villa scale 3D model. This digital meeting allowed the designers to work together, building and testing architectural design options and results in real time. Source: personal archive.*

F) *LumesArch — Telematic University,* a space designed to deliver e-learning educational activities, including architectural design, theater design, and generative architectural design.

E) *Scenography Sandbox*, a place to experiment and create set design and live performances for students and instructors in BA Architecture and Scenography courses at the University of Rome La Sapienza.

The *Maritime Theater,* a place for temporary exhibitions, performances, and cultural events.

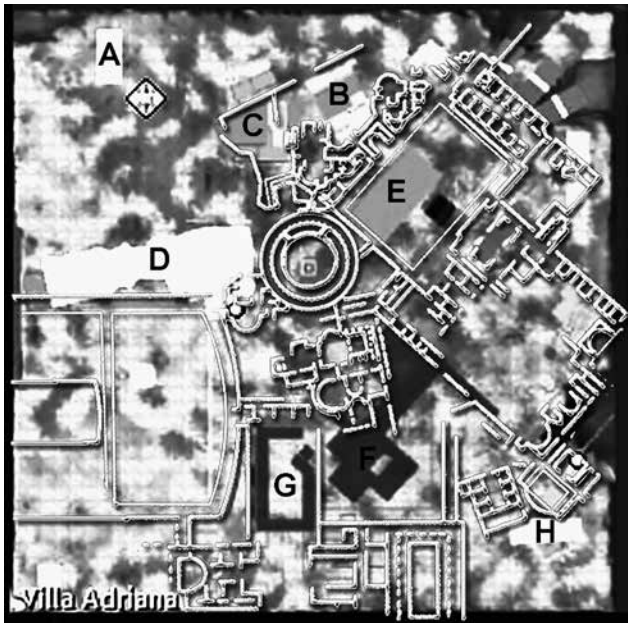

FIGURE 3. *Hadrian's Villa floor plan on its Second Life island. The original building's walls had to be scaled down and selected to fit the square size of the island and to accommodate further new buildings (represented with letters). Source: personal archive.*

D) *WAM — Web Art Mouseum*, a museum-laboratory dedicated to Web art.

G) *Contemporary Art Gallery* curated by Footprint.

B and C) *15 studio spaces* of different sizes to be rented for representative and commercial functions.

A and H) *20 apartments* to be rented with the possibility for personalized interior design.

ABE created the process by which these "new" buildings with their different functions could be designed into the "old" architecture of Hadrian's Villa. By incorporating new elements into this original structure, they generated new *sentences*, thus realizing an innovative dialogue between past and present. The disposition of peculiar elements of Classical Roman architecture (columns, arches, septum, etc.) facilitated this development. Specifically, it allowed contemporary architectural spaces to become part of the Hadrian's Villa complex, respecting the form and syntax of Roman architecture. The dichotomy between old and new was here transformed into nonduality, making *oneness* a fundamental outcome of the ABE methodology, enabling the workings of time to become part of the design process.

The result of the design process for Hadrian's Villa island was a multifaceted kaleidoscope of dynamic architectures. These transformed themselves within the historical framework of the "ruins" of the Roman villa, following the demand for new uses in the virtual world of Second Life. It is also anticipated that the architectural elements of Hadrian's Villa, based on the establishment of a specific lexicon, will allow further development of new architectures on the island, as new *sentences* compatible with its historical preexistence. In other words, new elements may continue to evolve as integral parts of it, in an open conversation with the past.

The relationship with history, in fact, is intended here not as a simple copying of forms, but as a process. Memory thus provides the forms and the principles, but it is history that shows how to operate within a limitless process of mutation and transformation. Meanwhile, the impact of Hadrian's

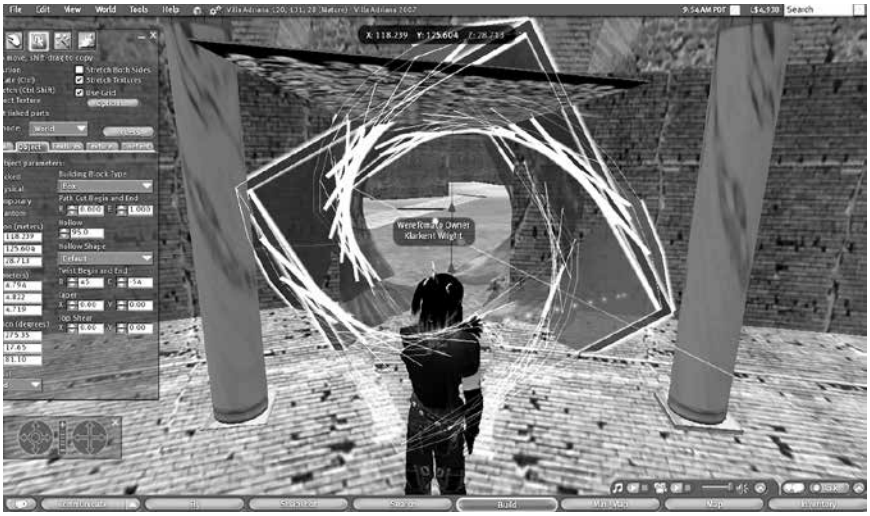

FIGURE 4. *Distant Learning on Second Life with Hadrian's Villa Island. The scenography student's avatar introduces and modifies her set design during an online tutorial using the object creation tool of Second Life. Source: personal archive.*

Villa island has already been successfully validated through several different applications: as a distance learning platform, as a performative space, and as an exhibition space.

In the first case, the island has been used as an online platform for the teaching of a scenography module at the University of Rome La Sapienza, a site where the author's students could experiment with their set-design projects. Using avatars that could move and talk, Second Life, in fact, gave the instructors of the module the chance to interact in real time with students, and directly intervene in the process of design development. Feedback from students included that this provided "an engaging tutorial experience," and that it "it enhance[d] design interactivity." The coexistence of instructors and students in the same virtual space facilitated the development of a pedagogic connection that transformed the design process into a live, engaging, interactive experience. Moreover, tutorials were not limited to review of 2D or 3D images, but could also involve direct experience of a 3D design model — from inside, outside, and even flying over it **(FIG. 4)**.

Another use of Hadrian's Villa island has been for live theater performances allowing the participation of scenography students, professional designers, and an audience in the form of avatars. One of these, "@nts," was a multidimensional performance freely adapted from the novel *The Electric Ant* by Philip K. Dick. This was staged simultaneously in the Maritime Theater of Hadrian's Villa Island on Second Life and in the real world of the studio theater of the Faculty of Architecture at the University of Rome La Sapienza.

The scene for "@nts" was conceived as a mutating organism, whose main character, a cyborg, is represented as a physically abstract entity within the real world that is able to experience the virtual and real universes in parallel. The performance allowed perception in both worlds, a reality beyond time and space. The two set designs were also extended to the whole of the theater space, eliminating any separation between actor and spectator. Audiences in both the virtual and real worlds were surrounded by this sensorial and changing organism, which communicated through sound, light, music, and video projections on a large cube. Video projections on the cube acted as CCTV views into the other world, realizing a real-time visual connection between the performances within Second Life and the real world **(FIGS. 5, 6)**.

Such a digital connection served as an interface between the two worlds, realizing a space-time short circuit and establishing a new, multidimensional performance space. Post-show audience feedback highlighted the quality of the performance and the overall experience. But it also elicited descriptions such as that the events were "a new way to engage with digital technology"; that "both performances had an emotional impact on me"; and that "the performance linked real and virtual worlds."[36]

A third use Hadrian's Villa has been as an exhibition space for WAM — Web Art Mouseum, a museum dedicated to promoting and disseminating digital art. A series of events in this space has so far highlighted the work of artists from around the world and facilitated aesthetic innovations related to digital technology as an tool for artistic creation and communication. Positive feedback was collected from the audience at an exhibition and WAM launch event in the real world (in Rome's San Lorenzo district), an event that included multimedia installations and performances.

CASE STUDY 2: TEMPLE UNIVERSITY CAMPUS ON SECOND LIFE

The project to build a virtual campus on Second Life for Temple University provides a further verification of ABE's effectiveness as a method for designing virtual architectures. The initial client request was for the faithful reproduction in virtual space of the university's real-world campus in Philadelphia. The design brief, in fact, requested a series of

FIGURE 5. *Multidimensional performance of "@nts." Real-world performance at the Studio Theater of the Faculty of Architecture Vallegiulia, University of Rome La Sapienza. The physical "cube" is used to create a visual connection in real time to the virtual-world performance on Second Life. Source: personal archive.*

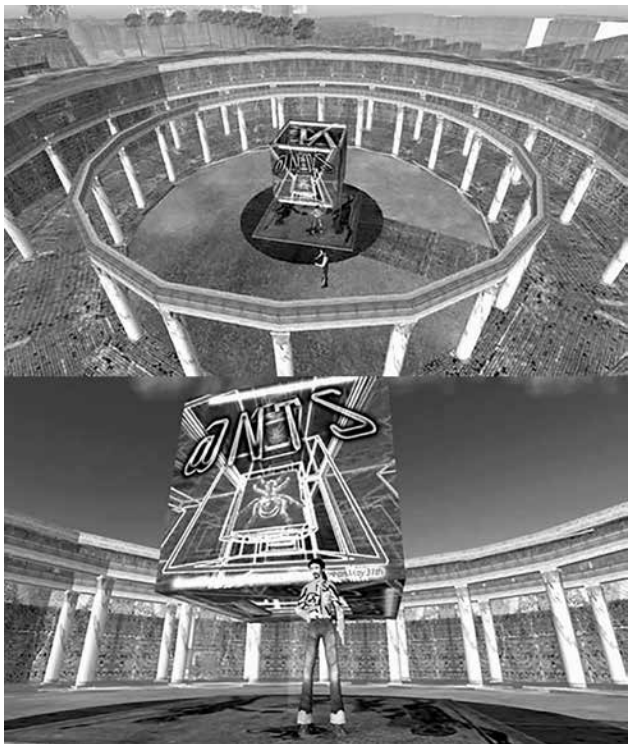

FIGURE 6. *Multidimensional performance "@nts." The virtual-world version in the Maritime Theater of Second Life. The digital "cube" here is creates a visual connection in real time with the real-world performance in the Studio Theater of the Faculty of Architecture Vallegiulia, University of Rome La Sapienza. Source: personal archive.*

specific environments for e-learning, in which instructors could simulate scientific experiments and potentially risky activities without exposing students to actual danger, while at the same time training them in risk assessment. The size an island on Second Life proved inadequate to enclose the area to be reproduced. Weretomato designers, therefore, had to make a choice: either scale and adapt the buildings to fit the smaller space of a Second Life island, or create a totally different space. The design team opted for the second alternative, which meant exploring new configurations and characteristics for the virtual version of the campus.

Without direct reference to the real-world campus buildings, designers applied ABE methodology to realize a completely new environment, yet one that would retain a design connection to the city of Philadelphia, where Temple University is situated. It was thus able to explore specific new characteristics of what such a new built environment should and could be.

According to the principles of ABE, the initial step in the design of this new virtual Temple campus had to be an *act of knowledge*, choosing a *reference lexicon* which would establish a basis for the design of the campus in the absence of the real world. The strategy adopted was to base the design on Philadelphia's gridded street plan, but to create a *linguistic game* that would realize an architectural dialogue between it and an iconic architectural complex.

The design, then, focused on two reference elements. One was Philadelphia's grid plan, which could be adapted to the modular frame of space on Second Life, composed of square islands 256 by 256 meters in size. The grid would thus establish an urban network to connect the different parts of the campus, which could then be superimposed on it to create an organic composition. The other element selected was the National Parliament House in Dhaka, Bangladesh, designed by one of most famous recent residents of Philadelphia, Louis Kahn, whose work was introduced earlier as a relevant *trait d'union* with ABE methodology.

Kahn's approach to design, with its characteristic formal coherence and articulation, is almost entirely absent in digital environments. One reason is that it does not reflect the trend within contemporary architecture (widespread in the real world), to create structures as single episodes, made up of conceptual and icastic forms. As mentioned earlier, ABE methodology declines to pursue this contemporary self-referential principle, which principally results in radical new identities disconnected from their context.

By contrast, Kahn's masterwork represents one of the best examples of his peculiar *architecture of totality*, designed to incorporate and deliver a strongly unitary sense of space. His Dhaka Parliament House can thus be considered an architecture of articulation, of autonomous elements that are accosted, interpenetrated, rotated, and then integrated. Within ABE this same unitary focus may be derived by incorporating elements derived from a Classical Roman architectural complex, such as the Baths of Caracalla or Trajan's Market.

Thus choosing Kahn's architecture was not intended to result in a copy of it, but to interpret it so as to give new building a form of preexistence, imbuing it with the dignity of memory.

To fit the given space on a Second Life island, the floor plan of Dhaka complex first had to be scaled down, following the same approach taken to the design of Hadrian's Villa. During this process, Kahn's architecture also underwent a sort of aging process (FIGS.7,8). Using brickwork textures, lowering walls to different heights, removing the roofs of buildings, Weretomato designers were thus able to create a sort of "modern ruin" of a past glorious architecture. From this they then sought to extract the structuring force from Kahn's Dhaka project, and to articulate it according to the grid chosen as a structuring element of the new campus. Again, the objective here was to create the sense of a past within the virtual world of Second Life, to inhabit virtual space as an expression of a previous civilization.

The new virtual campus for Temple University is now located within Second Life on what is known as Diamond Island. Its impact can today be measured not just by the sustained avatar "traffic" to it, but the enthusiastic response to it by the university as a client and by the university's students and instructors. The design provides users with playful and articulated spaces, allowing them to simulate their scientific experiments and potentially risky activities in a safe environment in a way that delivers a variety of learning activities. Comments given as feedback from students and instructors have included descriptions of it as "an engaging virtual campus's spaces" and "an easy to use virtual environment."

Interestingly, the overall impact of this architectural design has also been partially achieved though of its incompleteness. In some parts of the island, Kahn's "ruin" prevailed over everything else because those areas were not "inhabited" by the new campus. Indeed, in some areas of the island the campus consists only of a few broken walls detached from the whole.

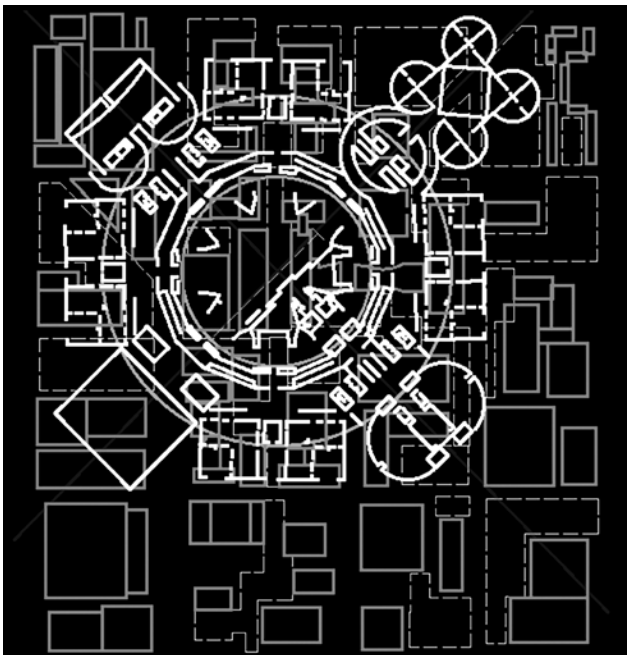

FIGURE 7. *Diamond Island masterplan. The ABE design methodology informed both the selection of a language and the use of elements. Louis Kahn's National Parliament House plan (white) created a dialogue with the city of Philadelphia's grid (grey). Source: personal archive.*

The validity of the idea and the structuring capacity of the architectural system created on Diamond Island, however, remains as a solid framework for further experimentation and research on Second Life and the potential for sophisticated new architectures in the virtual world.

FIGURE 8. *Aerial view of Diamond Island's completed design. Kahn's architecture (brickwork elements) was almost reduced to ruin, to create the dignity of memory. Interpreted as a sort of preexistence, it created a dialogue with the new architectures of the campus. Source: personal archive.*

TOWARD A POSTDIGITAL SPATIAL REVOLUTION

After decades of experimentation, as Nicholas Negroponte declared in his 1998 book *Beyond Digital*, it is now evident that the digital revolution is over. We currently live in the postdigital era, where it is difficult to draw a line between the digital and the nondigital. As an acknowledgement of the hegemony of computational processes, life in the postdigital era is thus focused on enhancing the application of the computer age to life and society.[37] While the digital revolution enhanced architecture with CAD and virtual reality, the postdigital paradigm will allow architects and designers of architectures to better understand the oneness of the digital and the nondigital. Paraphrasing Mel Alexenberg, we need to consider postdigital architecture as works that

> *. . . address the humanization of digital technologies through interplay between digital, biological, cultural, and spiritual systems, between cyberspace and real space, between embodied media and mixed reality in social and physical communication, between visual, haptic, auditory, and kinaesthetic media experiences, between virtual and augmented reality.*[38]

As predicted by Guy Debord in his 1967 *The Society of the Spectacle*, contemporary cultures are replacing authentic social life with its representation. As an aspect of social life, the built environment is constantly shaped by social interactions, and, at the same time, it shapes them.[39] Consequently, we need to acknowledge that the virtual world is becoming a wider expression of our personal and collective space, an interactive spatial dimension where at the very same moment we shape it, it shapes us.

This revolutionary ongoing process has had major consequences on architecture, specifically with regard to the loss of permanence, one of its principal former characteristics. No longer an expression of immortality, for the first time the millennial discipline is shifting its essence from the creation of tangible artifacts to the realization of ephemeral places. Architecture of the virtual world, in fact, evades permanency as a function of time, by integrating space and time. This new architecture is thus an expression of the fluid, instable, ever-changing digital environment that is the virtual world.[40]

Generative design, the latest field of architecture research, which works with artificial intelligence, has thus inspired a new generation of architects, educators and theorists though such movements as discrete architecture and digital architectonics. As discussed already, these have started to question the anachronistic formal continuity presently evident between design in the real and virtual worlds. New approaches are thus focused on exploring a truly computational architecture based on parts and rules that may either be driven by, or totally free from, human-imposed parameters. In this revolutionary approach, architects don't design forms anymore; they design the processes that generate the forms. This may be seen as provoking an analogy with nature, which generates the form of a tree, a fish, or a flower through a specific algorithm. In this new role, architects become "orchestrators" of these processes.[41]

Applying ABE to the virtual world, the article has tried to shed some light on how a correct application of architecture theory to generative design can increase the physical quality and complexity of design in the virtual world. ABE, in fact, demonstrates how it is vital to incorporate memory and heritage into the development of virtual architecture — as long as history is seen as a process, an evolutionary realization leading to environments that are not just different from the real world, but potentially better than them.

Applying the principles and methods of ABE on Second Life, it has been possible to produce architectures through a combinatory process that realizes a meaningful spatial awareness for the users, through the semantic values derived by a critical interpretation of heritage architecture. Using ABE methodology, designers can freely choose from an endless source of forms and compositional principles from the past, in order to create architecture in the virtual world that possesses aesthetic value that is not simply a copy of previous architectures. These architectures are *different* from what we normally see in contemporary real world and virtual world, because they are embedded with the lexicon and syntax of a language derived from memories of the past. These architectures, as *language-games*, guarantee a continuity across new designs, incorporating time into the design process.

Last but not least, case studies on Second Life confirm the validity of the virtual world as a distance-learning tool, not just to teach and research single disciplines, but also to contribute to the hybridization of architecture, theater and gaming.

The COVID-19 pandemic accelerated the development of a more tangible, actualized Internet, in response to the need for safer places to interact and live.[42] The metaverse — as a persistent, shared, 3D virtual space, linked into a perceived virtual universe — is now seen as a possible futuristic evolution of the "new normal," where the virtual world will fulfill our real world needs and activities with engaging online experiences.

Considering the scale and impact that this revolutionary virtualization process will have on our lives in the next two decades, architects should embrace this challenge. They should offer their competencies to support this postdigital spatial revolution, provided that their contribution does not disregard the role of memory, history, and architectural heritage.

REFERENCE NOTES

1. J.C. Smart et al., "Metaverse Roadmap Overview" (2007), retrieved 5/12/2020 from http://metaverseroadmap.org/inputs4.html#glossary.
2. G. Moneta, *Logica e Complessità dell'Architettura* (Rome: Edizioni Kappa, 2002).
3. V. Bourdakis and D. Charitos, "Virtual Environment Design: Defining a New Direction for Architectural Education," in *eCAADe99 Proceedings* (1999), pp.400–10, retrieved August, 28, 2020 from http://fos.prd.uth.gr/vas/articles/ecaade99/.
4. G. Bocchi and M. Ceruti, *La sfida della complessità* (Milan: Bruno Mondadori, 2007), p.16.
5. H. Ibelings, *Supermodernism: Architecture in the Age of Globalization* (Rotterdam: NAi Publishers, 1998).
6. D. Saitta, "Three Urbanisms Revisited," *Intercultural Urbanism*, August 31, 2011, retrieved August 29, 2020, from http://www.interculturalurbanism.com/?p=523.
7. R. Koolhaas, *S,M,L,XL* (New York: The Monacelli Press, 1995).
8. Bourdakis and Charitos, "Virtual Environment Design."
9. M.L. Maher, S. Simoff, N. Gu, and H.K. Lau, "Designing Virtual Architecture," *CAADRIA 2000: Proceedings of the Fifth Conference on Computer Aided Architectural Design Research in Asia*, May 19, 2020, retrieved from http://articles.cumincad.org/cgi-bin/works/Show?e501.
10. R. Ingram, "Building Virtual Worlds: A City Planning Perspective," in *Proceedings of the Fourth UK VR-SIG Conference*, Brunel University, 199, retrieved September 2, 2020, from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.23.1534&rep=rep1&type=pdf.
11. K. Lynch, *The Image of the City* (Cambridge, MA: MIT Press, 1960).
12. D. Campbell, "Design in Virtual Environments Using Architectural Metaphor," M.Arch. thesis, University of Washington, 1996.
13. H.A. Bridges and D. Charitos, "The Architectural Design in Virtual Environments," in *Kluwer Proc. International Conference* "CAAD Futures" '97 (Munich:, Kluwer Academic Publishers, 1997).
14. C. Alexander, S. Ishikawa, M. Silverstein, M. Jakobson, I. Fiksdahl-King, and S. Angel, *A Pattern Language: Towns, Buildings, Construction* (New York: Oxford Univ. Press, 1977).
15. M. Mehaffy and N.A. Salingaros, "The Pattern Technology of Christopher Alexander," *Metropolis*, October 7, 2011, retrieved February 9, 2020 from https://www.metropolismag.com/technology/the-pattern-technology-of-christopher-alexander/.
16. E. Adams, "Designer's Notebook: The Role of Architecture in Videogames" (October 9, 2002), retrieved June 29, 2020, from https://www.gamasutra.com/view/feature/131352/designers_notebook_the_role_of_.php.
17. J. Brouchoud, "Architects in Cyberspace, or Not," July 14, 2010, retrieved September 10, 2020, from https://arcHadrian's Villairtual.com/2010/07/14/architects-in-cyberspace-or-not/.
18. N. Gu, "Dynamic Designs of Virtual Worlds: Using Generative Design Agents," (2006), retrieved September 12, 2020, from https://core.ac.uk/reader/41229973.
19. L. Hovestatd, "Digital Architectonics," retrieved September 1, 2020, from https://www.caad.arch.ethz.ch/.
20. A. Gerber and U. Götz, eds., *Architectonics of Game Spaces* (Bielefeld: Transcript, 2019), p.138.
21. G. Retsin, ed., "Discrete: Reappraising the Digital in Architecture," *Architectural Design*, No.258 (March/April 2019).
22. M. Gerosa, *Second Life* (Rome: Meltemi Editore, 2007), p.223.
23. This topic is discussed on gamestop.com, retrieved July 4, 2020, from https://www.gamespot.com/forums/games-discussion-1000000/do-a-lot-of-modern-games-look-the-same-32846070/.
24. S. Boyd Davis, *The Design of Virtual Environments with Particular Reference to VRML* (Centre for Electronic Arts, Middlesex University. 1996).
25. R.A. Bartle, *Designing Virtual Worlds* (Indianapolis: New Riders Pub., 2004), p.65.
26. M. Veltman, "Remembering the Old World: An Analysis of the Interaction between Virtual Heritage and Cultural Memory," *Junctions, Graduate Journal of the Humanities*, Vol.2 (2017), p.42, retrieved January 12, 2020, from http://junctionsjournal.org/.
27. M. Saga, "What It's Like to Be an Architectural Consultant for Assassin's Creed II," *ArchDaily*, May 7, 2015, retrieved March 28, 2020, from https://www.archdaily.com/774210/maria-elisa-navarro-the-architectural-consultant-for-assassins-creed-ii/.
28. M. Crocco, L. Nappi, and A. Moneta, *Progettare su Second Life: l'Architettura del Metaverso* (Rome: Weretomato, 2008), retrieved February 5, 2020, from https://www.andreamoneta.it/Architecture/portfolio.html.
29. P. Gene, "Silicon Valley Is Racing to Build the Next Version of the Internet: Fortnite Might Get There First," *Washington Post* online, April 17, 2020, retrieved June 20, 2020, from https://www.washingtonpost.com/video-games/2020/04/17/fortnite-metaverse-new-internet/.
30. L. Wittgenstein, "Philosophical Investigations," in G. Moneta, *Logica e Complessità dell'Architettura* (Rome: Edizioni Kappa, 2002), p.89.
31. Ibid., p.114.
32. Ibid., p.89.
33. Definition of "Form," *Encyclopædia Britannica*, retrieved June 14, 2020, from https://www.britannica.com/topic/form-philosophy.
34. Moneta, *Logica e Complessità dell'Architettura*, pp.109–12.
35. G. Froio, "Fragment and Composition: Hadrian's Disposition in the Modern Architecture," *FA Magazine*, No.32 (April-May-June 2015), p.54, retrieved February 3, 2020, from http://dspace-unipr.cineca.it/bitstream/1889/2886/1/FAmagazine%2032%202015.pdf.
36. Audience verbal feedback was collected after the show in the real world; audience feedback in the virtual world was collected through Second Life live chat with avatars.
37. D.M. Berry, "Post-Digital Humanities: Computation and Cultural Critique in the Arts and Humanities," *Educause Review*, May 19, 2014, retrieved September 20, 2020, from https://er.educause.edu/articles/2014/5/postdigital-humanities-computation-and-cultural-critique-in-the-arts-and-humanities.
38. M. Alexenberg, *The Future of Art in a Post-Digital Age* (Bristol: Intellect Books Ltd., 2011).
39. J. White, *Virtual Reality and the Built Environment* (Oxford: Architectural Press, 2002) p.73.
40. *Designing Digital Space: An Architect's Guide to Virtual Reality*, pp.289,312.
41. Michael Hansmeyer, TED Talk, 2012.
42. Gene, "Silicon Valley Is Racing to Build the Next Version of the Internet."