Digital Ornaments

The Crossover of Digital Technology & Contemporary Ornamentation

Research Report 2022- 2023 | Paulina Panus

Figure 01: Studies for a dome by Benjamin Dillenburger.
(https://www.architectural-review.com/essays/radical-openness-at-ted-global)

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Research Report
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Introduction

Abstract

The use of digital design and fabrication technologies in architecture has followed a paradigm shift, enhancing the design and construction processes and performances of architecture. While it has enhanced the performability and efficiency aspects of architecture, it has removed the aesthetics and symbolism of ornamentation and individuality of buildings. This research questions what the new relationships and arrangements for architecture and ornament are, specifically focusing on the use of AI, and digital tools, to understand how these instruments can be used to bring craft, functionality, symbolism, and context back to contemporary architecture.

Keywords

Ornamentation; detail; classical ornament; contemporary ornament; Artificial Intelligence (AI); digital technology; structure; function; symbol.

Background

Ornamentation has long been a topic for debate. Historically, it was integral in creating a sense of craft in the design. In classical architecture, ornamentation was the key component to constructing buildings that symbolized a sense of beauty as well as expressing social values, hierarchy, and order[1]. Throughout time, the meaning and use of ornament has transformed, with each movement in architecture adding influence on its definition. From historical, cultural, to social and technological circumstances, these factors have significantly impacted ornamentation over the years, where the second industrial revolution was the defining moment. During this period, mass-production and an effort to reduce cost and increase efficiency became a primary focus for construction[2]. Although these technological evolutions were vital in the development of the construction industry, the push for mass-production meant the focus was steered away from ornament and craft, and therefore was no longer seen as a necessity to design. In present architecture, there is an immense amount of new fabrication technology, and thus it is "increasingly challenging the historic relationship between architecture and its means [and process] of production"[3]. The availability of it allows architecture to no longer be bound by the limitations of standardization and mass-production, bringing forth new opportunities for modern day architecture to be redefined, and in turn to redefine ornament.

1 Picon, A. (2013). Ornament: The politics of architecture and subjectivity. Wiley. p. 11

2 Retsin et al., (2019). Robotic Building: Architecture in the Age of Automation. Detail Business Information GmbH, The. p. 8

3 Kolarevic, B. (2005). Architecture in the digital age: Design and Manufacturing. Taylor & Francis. p. 4

Problem Statement

Digital tools and fabrication technology can change the way architecture is being designed and thought about. A variety of digital tools is powering contemporary architectural design, some of which include AI, parametric modeling, digital fabrication, and robotics[4]. Such tools enable architects to produce complex designs, creating advanced forms, new textures, optimizing functions and generating new processes of construction. These tools, however, are being under-utilized. Their focus mainly lies on the methods of mass production, standardization, and efficiency, as from the second industrial revolution, generating an architecture that has become un-ornamental. Contemporary ornamentation used is restricted to façade design, where the designs contain ideas like patterns and repetition. Although these sorts of designs can be successful, they lack the craft and "the sense of depth that classical ornamentation once had"[5]. Current social, cultural, and technological design mindsets and influences means that present ornamentation no longer encapsulates the significance it once had. This research questions this reality and investigates the use of contemporary computational design and fabrication techniques to understand how such tools can revitalize ornamentation and re-imagine it in today's architecture.

4 Turner, K. (2021). Architecture as Ornament. Open Access Te Herenga Waka-Victoria University of Wellington. Thesis. https://doi.org/10.26686/wgtn.15177483.v1. p. IV

5 Turner, K. (2021). Architecture as Ornament. Open Access Te Herenga Waka-Victoria University of Wellington. Thesis. https://doi.org/10.26686/wgtn.15177483.v1. IV.

Research Questions

Considering the following problematique, the thesis will explore ***how AI and digital technology change the way we design and think about ornaments and details?*** To answer the main research question, the thesis requires investigating subsequent questions, which include:

1. What could contemporary ornament aim to contribute/communicate to modern architecture and audiences?
2. What are the potentials of digital technology/ tools and how will they change the fabrication process of ornaments?
3. Why should ornaments be reintroduced into architecture, if they are deemed as time-consuming, non-functional, and purely decorative?

Aim

Contemporary ornament lacks a clear definition. The thesis aims to question what is traditionally known to be an ornament, which was suppressed by the modernism era. The goal is not to resurrect the ornament from the past and look back on it as it was, but instead to find a deeper abstraction of the lost craft situated in the digital era. In The Politics of Architecture and Subjectivity, Picon discusses how buildings do not have the ability to speak, but part of their appeal lies in the notion that they could if suitable conditions were met[6], and one of the ways they speak is through ornamentation. Contemporary ornament serves as a tool for a "current image-driven culture within a spectacle-laden public sphere"[7]. In contemporary architecture, "the structural, digital, sensual, representational, and symbolic facets stratify ornament metaphorically and literally, making it a powerful instrument of impression and expression"[8].

6 Picon, A. (2013). Ornament: The politics of architecture and subjectivity. Wiley.

7 Allmer, A., Balik, D. (2016). A Critical review of ornament in contemporary architectural theory and practice. ITU Journal of Faculty of Architecture, 13(1). p. 158

8 Allmer, A. Balik, D. (2016). A critical review of ornament in contemporary architectural theory and practice. Dokuz Eylul University. doi: 10.5505/ituj-fa.2016.73745. p. 157

Figure 4: Integrated Ornament; Source: https://unsplash.com/photos/er00p3S4us4

Figure 5: Sagrada Familia; Source: https://unsplash.com/photos/cbpUu4Eomrs

Theoretical Framework

The following concepts will be introduced and studied to strengthen and frame the research.

Ornament & Detail

The term 'Ornament' is defined as "a useful accessory that lends grace or beauty"[9]. It is "a thing used or serving to make something look more attractive but usually having no practical purpose"[10]. Details on the other hand, can be defined as "a part considered or requiring to be considered separately from the whole"[11], which contains "information about something"[12]. The above-mentioned definitions for both concepts refer to both terms as being additional elements whose main roles are to serve their carriers. Although they are defined to be serving their carriers, they do so in different ways. Ornaments mainly provide an aesthetic purpose, occasionally mixing in with practical characteristics, whereas details entirely fulfill practical purposes. Ultimately, a detail can be an ornament, however, an ornament cannot be a detail. This thesis will thus focus on the term ornament, as it will encompass the idea of 'detail' when studied.

9 Ornament [Def. 2]. (n.d.). In Merriam-Webster online. Retrieved from http:// Merriam-Webster.com.
10 Ornament [Def. 1]. (n.d.). In Oxford English Dictionary online. Retrieved from http:// www.oed.com.
11 Detail [Def. 2b]. (n.d.). In Merriam-Webster online. Retrieved from http:// Merriam-Webster.com.
12 Detail [Def. A2]. (n.d.). In Cambridge Dictionary online. Retrieved from https://dictionary.cambridge.org

Historical Ornament

Throughout history, ornament was predominantly used as an expression of culture or supremacy[13], until the second industrial revolution, where modernist conceptions of ornament were acquired from the manufacturing processes. Ornament has been either integrated into the design of the building or applied as a decoration. The first type of use demonstrates how ornament is integrated into the framework of the building, either in the façade, ceiling, roof, or the entirety of the building[14]. These types of ornaments stem from the structure or materiality of the building and are most appropriate when trying to stay true and not mask the building. The applied ornament is seen as decor. In comparison to the scale of the building they often seem very small, and are depicted as paintings, sculptures, carvings, etc. However, through the applicative form of ornamentation, it could also aid to provide a more human scale building that is able to communicate to the public. Its function would allow it to speak and seek connection to its viewer.

Contemporary Ornament

Ornaments in contemporary architecture are open to interpretation. There is a variety of ornaments from architectural details to art to urban texture. It can be applied from a "graphic composition to a flat image, from a relief to a three-dimensional structure"[15]. One of the results of contemporary ornament has been that it "now lacks a simple definition, it cannot be understood as it was in classical terms"[16]. The development of digital tools often creates ornamentation that lacks a deeper meaning and can only be described as an effect. The contemporary ornament should seek to be designed with functionality as the driver but should "never be reduced to [only] a question of function" or "an artifact of construction or craftsmanship"[17]. It emerged as a concept to explicitly express the symbolic dimension of form it holds. "Form is interpreted symbolically and ornament is a primary device of its expression"[18]. Thus, structure and functionality should be implemented as the performing notion, however such ornament should also always express something other than its material existence—a dimension that people understand symbolically. It should also be able to create a bond between people and their surroundings, where it seeks to captivate the viewer to something else, an abstraction that will create an appreciation for the space. The qualities of the contemporary ornament sought, will not be distinct and blunt, instead they will be illusory and illogical; form, structure and material reinterpreted by the observer. The definition of the contemporary ornament will be iterated throughout the research and design process as more research and explorations are conducted.

13 Loos, A., Opel, A. (1998). *Ornament and crime: selected essays.* Riverside, Calif: Ariadne Press

14 Elrayies, G.M. (2018). *Architectural ornaments in the twenty-first century: An analytical study.* Taylor & Francis Group doi: 10.1201_9781315166551-2. p. 12.

15 Dal, M. (2021). *Architectural Sciences and Technology.* Livre de Lyon. p 101

16 Picon, A. (2013). *Ornament: The politics of architecture and subjectivity.* Wiley.

17 Levit, R. (2008). Contemporary Ornament: Return of the Symbolic Repressed. Harvard Design Magazine. Number 28. p.3

18 Levit, R. (2008). Contemporary Ornament: Return of the Symbolic Repressed. Harvard Design Magazine. Number 28. p.3

Digital Technology & Ornament

Digital technology has progressed significantly over the years, ultimately affecting the way buildings are designed and constructed. Through such advancements, the construction and craft of ornaments has also evolved with it, linking the contemporary ornament to the digital design and manufacturing process. "Architecture needs mechanisms that allow it to become connected to culture"[19]. The use of digital technology becomes a mechanism of cultural expression, thus reflecting an ornamentation that combines the technical, culture, and experience. "The digital surface is not just the technical expression of the production tool, and the tool path, it is also the cultural expression as a tool for restoring traditions of craftwork"[20]. The process of making is integral to the role of the contemporary ornament.

Aesthetics & Beauty

An important characteristic of ornamentation is its beauty. Beauty can exist in two forms "free beauty and merely adherent beauty. Free beauty does not presuppose a concept of what the object is (meant) to be. Adherent beauty does presuppose such a concept as well as the object's perfection in terms of that concept"[21]. Ornaments historically and presently, have taken on one of these types of beauty. They either demonstrated the notion of "the power of the presentation on the subject rather than the object's purposefulness"[22] or by being adherent in which "part and whole connection are considered simultaneously", where it unites "taste with reason"[23]. A form of beauty takes shape in every design. However, beauty is subjective, and its inherent form is subject to the perception of the observer. The visual aesthetics are the initial connection between architecture and the observer, regardless of the observer's perception of its beauty. Architecture should engage people's thoughts and emotions, as it becomes "central to this concept of infinite fulfillment because, [...] criticism both consummates the finite and particular work by raising it to a higher level"[24]. The perception and critique of ornament is the continuation of its completion through its infinite connection with other architecture examples and critiqued work.

19 Moussavi, F., Kubo, M. (2007). *The Function of Ornament.* Cambridge: Actar, Harvard School of Design.p.5.

20 Pell, B., Hild, A., Jacob, S., & Zaera-Polo, A. (2012). *The articulate surface: Ornament and technology in Contemporary Architecture.* Birkhäuser.

21 Kant, I. (1987). *Critique of Judgment.* (W. S. Pluhar, Trans.). Hackett Publishing Co. (Original Work Published 1790). p.229-230

22 Kant, I. (1987). *Critique of Judgment.* (W. S. Pluhar, Trans.). Hackett Publishing Co. (Original Work Published 1790). p.229

23 Kant, I. (1987). *Critique of Judgment.* (W. S. Pluhar, Trans.). Hackett Publishing Co. (Original Work Published 1790). p.231

24 Osborne, P., Matthew C. (2021) *Walter Benjamin.* The Stanford Encyclopedia of Philosophy. Edward N. Zalta (ed.). https://plato.stanford.edu/entries/benjamin/.

Figure 6: AI Generated Ornamentation; Source: https://mymodern-met.com/midjourney-architecture-qasim-iqbal/

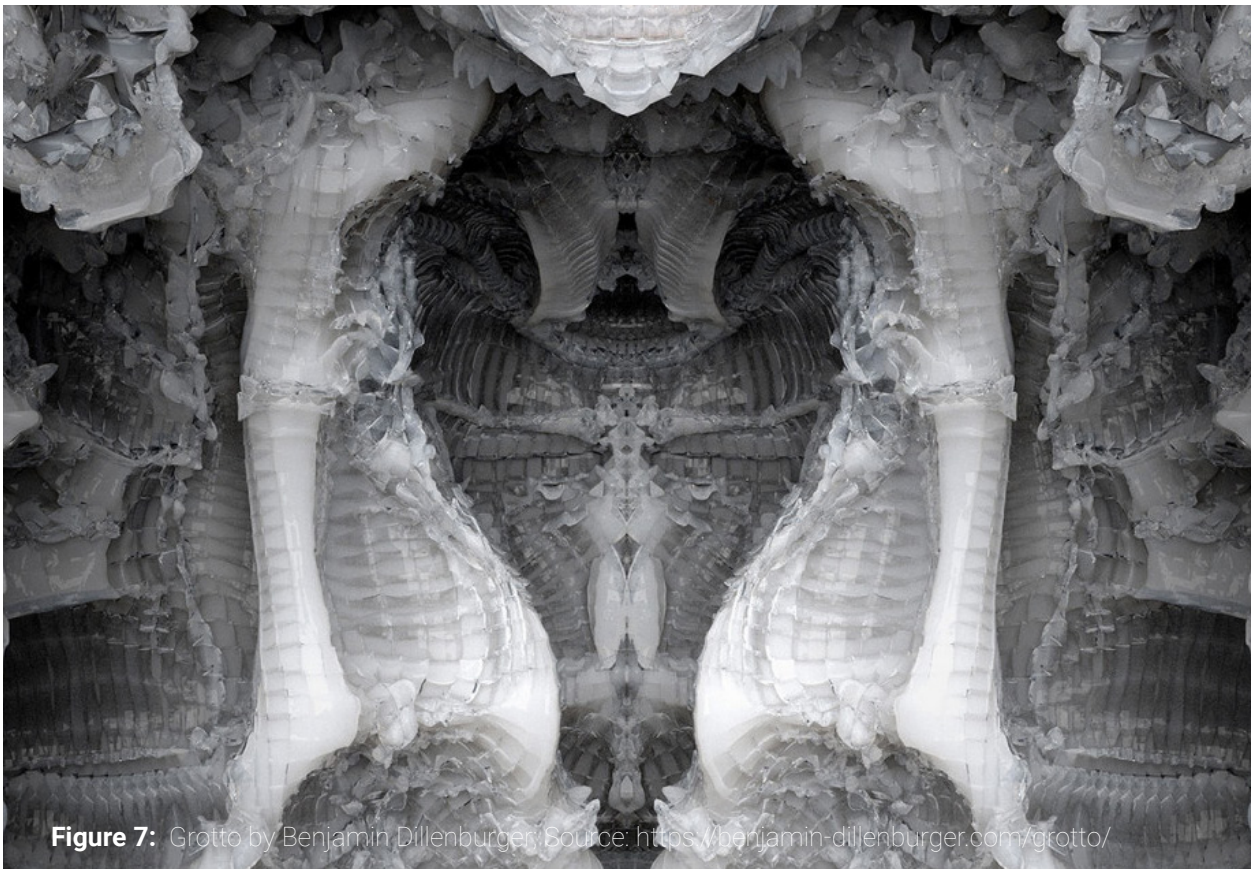

Figure 7: Grotto by Benjamin Dillenburger. Source: https://benjamin-dillenburger.com/grotto/

Methodology & Methods

The method of this thesis is subdivided into four parts, beginning with a theoretical background obtaining historical and contemporary definitions and perspectives on ornament, AI, and digital technology. The second part includes conducting case study analysis on projects from various time periods and locations, to study their significance, craft, and type of technology used for design and fabrication. In the third section, ornamentation will be studied through the digital realm and AI looking at the capabilities of current innovations, software, materials as well as the progression of the digital and its effects on architecture design and production. The fourth part is the testing and realization of these design proposals where the fabrication method and theory are tested and demonstrated in different architectural situations.

1. Historical & Interpretive Research: Archives, collecting data, narratives, literature review.
2. Case studies & Combined Strategies: Studying architectural drawings, journal articles, studying existing projects, re-drawing, re-modeling.
3. Qualitative research: Visual/narrative devices, AI, 3d scan, scripting.
4. Simulation & Modeling Research: Building (digital) models, prototyping, AI simulated environments, robotics, fabrication.

Literature

Primary sources of literature will be used to gain knowledge about the varying perspectives on ornamentation, artificial intelligence, and digital technology, as well as their definition throughout different architectural time periods. The literary research methodology provides the base for a holistic understanding of the topic due to its roots in architecture, history, and theory. The sources will give insight into the design and construction process, social and political influence, the position of the ornament and artificial intelligence in the different contexts, and the connection between architecture, technology, people, and culture. Next to the academic literature, more current and modern literature on architecture and ornament as well as digital technologies, AI, software, scripting, design, and manufacturing texts will provide contemporary approaches for understanding the connection between architecture, ornamentation, and digital technology.

Case Studies

As the architectural ornament has been introduced in numerous buildings and locations in the world, case studies will be used to show how various cultures have adapted such elements. A contemporary example that will be explored is the Digital Grotesque II by Michael Hansmeyer and Benjamin Dillenburger. Studying such project will explore the evolution of ornamentation and its relationship with digital technology. It is the first 3D printed wall which contains unseen levels of resolution and topological complexity in architecture design, using compositional strategies based on purely geometric processes. The tools used to examine such projects will consist of studying architectural drawings, sketches, re-drawing, and re-modeling, to better understand the relationship and reasoning of ornament within the studied projects, and how the information can be extracted and adapted to redefine ornament.

Computational Design & Artificial Intelligence

Computational design will be used to understand how such tools can revitalize ornamentation and re-imagine it in contemporary architecture. Digital design has created a new way of designing in architecture. Its evolution approaches AI, parametric and generative techniques, which provide a more flexible design process, where it no longer has a definitive form, but rather a form based on mathematical function and rule-based reasoning. The architect no longer generates the form using traditional methods of pen and paper or a mouse. Instead forms are created with a complexity that would be impossible to create otherwise or requiring hours of work. Every component of the images produced are generated through these customized algorithms with minimal human intervention. The influence of such technique unveils captivating opportunities to pursue an exploration of ornament through such mediums.

Qualitative Research & Simulation

This following method begins by taking the knowledge learned from previous steps and applying it to software to create small-scale digital explorations and tests which then translate into small-scale prototypes using manufacturing. After an evaluation and critical reflection of these algorithms and prototypes, they will be refined and iterated to create designs that reflect the information learned and concluded.

Figure 8: Library of iterations of columns generated by using mathematical algorithms. (Source: https://www.archdaily.com/138323/subdivision-michael-hansmeyer/columns1)

Relevance & Preliminary Conclusions

This research will explore the potential in revitalizing ornament, within the realm of artificial intelligence and digital technology. It will highlight how such technologies can be beneficial and are unforeseeably interwoven in their creation, having the potential to generate a multitude of outcomes. By using a process of digital software and modeling, visual scripting, algorithms, fabrication tools and robotics, these techniques will find ways to explore and optimize its new forms. The design assignment will focus on implementing the researched and newly defined 'Contemporary Ornament' into a design brief and a building scale, with its new definition and set of rules for the current time period.

Figure 9: Researh Plan Diagram
(Source: Created by author)

Annotated Bibliography

Historical & Theoretical Texts

Loos, Adolf. & Opel, Adolf. (1998). *Ornament and crime: selected essays*. Riverside, Calif: Ariadne Press

The book criticizes ornamentation in useful objects. It became important in the history of art when the Art Nouveau movement was forming, and it made other artists see a more personal way forward with designing. The essay set up some big ideas for designers and art institutes, and thus, became fundamental to the Bauhaus design studio, and the ideology of modernism in architecture.

Sullivan, L. H., & Weingarden, L. S. (1990). *A system of architectural ornament*. Rizzoli.

In this book, Louis Sullivan claims that "form should be decorated to enhance its expression". The book was divided into manuscripts and drawings, exploring the theory of architectural ornament, primarily through botanical forms.

Vitruvius. (1960). *The ten books on architecture*. (M.H. Morgan, tr.) New York: Dover Publications (Original publishing date 1914.)

The publications are a guide to various traditions of building projects, including Greek and Roman architecture as well as military camps, cities, and buildings, both large and small. There is also information on the planning and designing of harbors, aqueducts, cities, machines, and many different measuring devices.

Modern Texts on Ornamentation

Moussavi, F., Kubo, M. (2007). *The Function of Ornament*. Cambridge: Actar, Harvard School of Design.

The book collects work produced in a studio at the Harvard University Graduate School of Design, where ornament contrasts the traditional, historic view as being purely a symbolic decoration. Farshid Moussavi points out in the text the increasingly cosmopolitan society has made it difficult for buildings to communicate symbolically. The book describes ornament as "a material expression that is intrinsically tied to a building's construction, program, and setting".

Pell, B., Hild, A., Jacob, S., & Zaera-Polo, A. (2012). *The articulate surface: Ornament and technology in Contemporary Architecture*. Birkhäuser.

This book gives an international account of technologies used in the manufacture of contemporary ornaments as well as strategies of application, examining a range of contemporary built examples. Ornament has now re-emerged as a category of design in architecture, where contemporary technologies of design and fabrication introduce unprecedented opportunities to intertwine the constructive logics and expressive articulations of buildings. Ornament now explores the interactions between structure, envelope, and space, instead of aestheticizing them. The purpose is rather to engage in crafting networks of identity.

Picon, A. (2013). *Ornament: The politics of architecture and subjectivity*. Wiley.

Ornament is notably connected to digital tools and culture. Indeed, some have accused many modern buildings of being technologically regressive. However, the author stresses that some significant traits of past ornamental tradition persist. As such, they provide insights into past discourses of feeling and order. Contrary to what was said in the early nineteenth century of modern buildings, existing ornament was not only for pleasure. As such it took part in, and contributed to and expressed social values, hierarchies, and order in society during the periods these buildings were produced. In this publication, Picon brings attention to these shifts in power that took place in ornament through various historical periods and question the political issues at stake in the modern and contemporary revival of ornament.

Pimlott, M. (2004). *Ornament and Picture-Making. Ornament. Decorative Traditions in Architecture*. OASE, (65), 6–25. Retrieved from https://www.oasejournal.nl/en/Issues/65/OrnamentAndPicture-Making

This issue of OASE examines how figurative architectural traditions can provide modern Europeans with more insight into the influence of history on our daily lives. In addition, the question is raised whether references to tradition incorporated in architecture yield more than the lifestyles and fashions with which we now shape our environment. This question is particularly relevant in the Netherlands, which has made an exceptional contribution to modernism in all its forms, and which is currently embroiled in an uneasy and moralistic debate about its own traditions.

AI, Digital Technologies, Software & Architectural Texts

Dal, M. (2021). *Architectural Sciences and Technology*. Livre de Lyon.

The following book discusses a variety of subjects related to architecture. Some of the topics include, examining architectural ornaments using historical precedents, using pavilion design as an example of the re-ornamentation, studying the concept of "aesthetic value" lost in modern day design, the digital fabrication shift in architecture, as well as integrating the algorithmic tectonics to the design process.

Grünberger Christoph, & Heys, P. (2022). *The age of data: Embracing algorithms in Art & Design*. Niggli, imprint of Braun Publishing AG.

This book focuses on a new breed of designers who are pioneering the exploration of innovative graphics, 3D animation, kinetic objects, real-time visuals, robotics and conceptual design through the use of algorithm-supported tools. The book will provide an insightful look at the diversity of artists and designers with a emphasis on "robotics and the 'hybrid' approach between digital and analog".

Kolarevic, B. (2005). *Architecture in the digital age: Design and Manufacturing*. Taylor & Francis.

Digital technologies will dramatically alter building practices. This book explores how these changes started, and what they are shaping in the twenty- first century. It examines how contemporary approaches

evolve, albeit on a much faster scale due to digital technologies. It explores how these new notions affect the production of physical architecture, and how these notions unfold in the future in terms of habitat, social systemic beliefs and technology.

Pearson, M., & Watz, M. (2011). *Generative art: A practical guide using processing.* Manning Publications Co.

Generative Art encourages artistic methods that use computational techniques to generate illustrations and art efficiently and improperly. The book describes both the technique and beauty of these and other algorithms, and featured examples through creative expression. Beyond algorithm and art, the book outlines the technical steps and programmatic ideas necessary for making these graphics. Through tutorial plans, it also encourages designers and artists to combine and reuse these steps and tools to generate illustrations of their own.

Reas, C., & McWilliams, C. (2010). *Form+code: In design, art, and architecture.* Princeton Architecturel Press.

The book is an introductory to the history, theory, and techniques used in the art of software. The essays, code samples, and illustrations in the book link the different topics together to help the reader understand the software that goes into the arts. The book is organized into themes such as parameters, visualization, transformation, and code-repetition.

Retsin, G., Jimenez, M., Claypool, M., & Soler, V. (2019). *Robotic Building: Architecture in the Age of Au-tomation.* Detail Business Information GmbH, The.

This book answers questions relating to the use of robots affecting the results of structures and the ways it affects the thinking of architects who work with robots. It provides several examples and explores the idea of the architect as robot, in which the robot unites with its environment and becomes part of our experience.

Other Texts & Sources

Allmer, A. Balik, D. (2016). *A Critical Review of Ornament in Contemporary Architectural Theory and Prac-tice.* ITU Journal of Faculty of Architecture, 13(1), 157–159.

This critical review discusses the controversial issue of ornament throughout the past century. The main purpose of this paper is to examine the reemergence of the topic of ornament in architectural theory in the middle of contemporary architectural theory and practice to redefine or investigate its limits. This is an intricate wave in contemporary architecture; an in-depth study of architecture and ornament explores its overlapping with cultural, social, and economical status quo. Through a close reading of specific contemporary case studies, this paper makes a layered reading of architecture and ornament as a powerful instrument of image-driven, contemporary culture within themes.

Cache, B. (n.d.). *Objectile.* Frac Centre-Val de Loire. https://www.frac-centre.fr/_en/art-and-architecture-collection/rub/rubauthors-316.html?authID=134

Detail [Def. A2]. (n.d.). In Cambridge Dictionary online. Retrieved from https://dictionary.cambridge.org

Detail [Def. 2b]. (n.d.). In Merriam-Webster online. Retrieved from http:// Merriam-Webster.com.

Elrayies, G.M. (2018). *Architectural ornaments in the twenty-first century: An analytical study*. Taylor & Francis Group doi: 10.1201_9781315166551-2. p. 12.

Ornamentations are valued differently in architecture. Against the general view of ornamentations as "useless", the discipline is looking at the aesthetical importance of the decoration whether is a crime or a functional element, between rejection or reinvention. This paper aims to investigate about the pros and cons of that topic by studying the qualities of several contemporary ornamented buildings. Ornamentation seems to me to be a translator and a bridge, which connects the building to the environment and connects people with history and culture.

Kant, I. (1987). *Critique of Judgment*. (W. S. Pluhar, Trans.). Hackett Publishing Co. (Original Work Published 1790).

The book discusses aesthetics. Kant calls aesthetic judgments "judgments of taste". Here Kant claims that, though they are inevitable in every person, their universality exists only in relative terms. Our individual wants and needs do not affect our appreciation of beauty. Throughout the piece, Kant claims that aesthetic judgments of taste—our beauty-related subjective sentimental strivings—are personal and influenced from the social environment. "Aesthetic pleasure comes from the free play between the imagination and the understanding when perceiving an object".

Levit, R. (2008). *Contemporary Ornament: Return of the Symbolic Repressed*. Harvard Design Magazine. Num-ber 28.

Levit's article "Contemporary Ornament: The Return of the Symbolic Repressed" deals with what the role of ornament is in contemporary architecture. Under which conditions has it returned to an extent that marks the current forms. Increasingly, the symbolic significance of ornament is on the rise, and occupies a prominent place in both.

Ornament [Def. 2]. (n.d.). In Merriam-Webster online. Retrieved from http:// Merriam-Webster.com.

Ornament [Def. 1]. (n.d.). In Oxford English Dictionary online. Retrieved from http:// www.oed.com.

Osborne, P., Matthew C. (2021) *Walter Benjamin*. The Stanford Encyclopedia of Philosophy. Edward N. Zalta (ed.). https:// plato.stanford.edu/entries/benjamin/.

Turner, K. (2021). *Architecture as Ornament*. Open Access Te Herenga Waka-Victoria University of Wellington. Thesis. https://doi.org/10.26686/wgtn.15177483.v1.

Turner explores the use of digital technology to recapture methods of ornamentation traditionally used in architecture. In so doing, this research uses the architectural column as a design mechanism, and parametric modelling conventions to redefine the place that ornamentation has in contemporary architecture. By using a process of visual scripting and digital modelling, these techniques are used to explore how digital tools and history can reimagine ornamentation. This research focuses on small-scale digital tests and

small-scale prototypes using additive manufacturing. To further refine and finalize the designs, the research is then applied to an architectural design context, and a final large column prototype is robotically fabricated.

Appendix A

Figure 01
Armstrong, R. (2012) [Studies for a dome by Benjamin Dillenburger] [Image]. The Architectural Review. https://www.architectural-review.com/essays/radical-openness-at-ted-global

Figure 02
Highlike. (n.d.). *MICHAEL HANSMEYER AND BENJAMIN DILLENBURGER* [Digital Grotesque by Benjamin Dillenburger] [Image]. Highlike. https://highlike.org/michael-hansmeyer-and-benjamin-dillenburger-2/

Figure 03
Banks, C. (2019). [Applied Ornament] [Image]. Unsplash. https://unsplash.com/photos/mgLX9vQhxc8

Figure 04
Artmane, L. (2020). [Integrated Ornament] [Image]. Unsplash. https://unsplash.com/photos/erO0p3S4us4

Figure 05
Kidd, D. (2019). [Sagrada Familia] [Image]. Unsplash. https://unsplash.com/photos/cbpUu4Epmrs

Figure 06
Stewart, J. (2022). *Dreamlike AI Renderings Celebrate the Intricacy of Renaissance Architecture*. [AI Generated Ornamentation] [Image]. MyModernMet. https://mymodernmet.com/midjourney-architecture-qasim-iqbal/

Figure 07
Dillenburger, B. (2013). *Digital Grotesque with Michael Hansmeyer*. [Grotto] [Image]. Benjamin Dillenburger. https://benjamin-dillenburger.com/grotto/

Figure 08
Cilento, K. (2011). *Subdivision / Michael Hansmeyer*. [Library of iterations of columns generated by using mathematical algorithms] [Image]. ArchDaily. https://www.archdaily.com/138323/subdivision-michael-hansmeyer/columns1)

Figure 09
Panus, P. (2022). [Research Plan Diagram] [Image].

Fig. 07 Studies for a dome by Benjamin Dillenburger.
(https://www.architectural-review.com/essays/radical-openness-at-ted-global)