

Form Follows Function:
An Analysis of *De Architectura* and its Influence

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Abstract:

Over 2000 years ago, the Roman architect and engineer, Marcus Vitruvius Pollio, scribed *De Architectura*, a multi-volume work unearthed in the 15th century, in St. Gallen, Switzerland. As the only surviving architectural source from antiquity, the book has been indispensable in the study of Greco-Roman architecture, positioning Vitruvian and Greco-Roman architectural concepts in many ways as one in the same. Additionally, Vitruvian ideas, as expressed in *De Architectura*, regarding architectural form, materials, location, and process have been foundational to the evolution of Western architecture. This paper explores *De Architectura's* impact on Western architectural theory and practice spanning the Early Middle Ages to present day. In particular, the ensuing pages detail the influence of *De Architectura* on the distinct architectural styles of the Renaissance; Industrial Revolution, Bauhaus Movement; and Post World War II Modernism. This paper concludes by highlighting the ways in which Vitruvian ideas have inspired modern, sustainable architectural practices, better positioning humanity to address some of the most pressing environmental challenges of our time.

In 1417, Poggio Bracciolini, a secretary at the Abbey of Saint Gall in St. Gallen, Switzerland, unearthed a book dating back over a millenia. The book, *Ten Books on Architecture* or *De Architectura* by Marcus Vitruvius Pollio, went largely unnoticed until its release to the public in 1486. Its influence on architectural thought was immediate.¹ Very little is known about Vitruvius, other than his approximate dates of birth and death, and the few anecdotes present in his writing. He likely only lived to see one of his buildings constructed, a basilica in Umbria.² However, Vitruvian ideas about everything from form, to building materials and location would prove indispensable to the study of architecture from the time of *De Architectura* to the present day. Since the Renaissance, Vitruvian ideas, as captured in *De Architectura*, have been extrapolated endlessly and have proven essential in the development of western architecture. In addition to its impact on the trajectory of architectural study, the importance of *De Architectura* also stems from its place as the only surviving architectural source from antiquity. For centuries, the book has been essential in the study of Greco-Roman architecture, serving as the basis for all classical architectural thought in the post-classical era, and positioning Vitruvian and Greco-Roman architectural concepts largely as one in the same.

De Architectura's influence began roughly 2000 years ago, soon after Augustus' decisive defeat of Mark Antony in the War of Actium, which positioned Augustus as princeps and leader of Rome.³ Shortly after, Vitruvius presented Augustus an architectural treatise called *De Architectura*. The treatises' ten books included rough outlines of traditional approaches to all areas of architectural thought which likely derived from the work of several older architects combined with Vitruvius' own theories and vision.⁴

¹ Lino Bianco.. "Architecture, Engineering and Building Science: The Contemporary Relevance of Vitruvius's De Architectura." *Sustainability* 15, no. 5 (2023): 2. <https://doi.org/10.3390/su15054150>.

² Marcus Vitruvius Pollio. *The Ten Books on Architecture*, trans. Morris H. Morgan. (Cambridge, MA: Harvard University Press, 2006), 135.

³ William C. McDermott. "Augustus." *The Classical Weekly* 32, no. 4 (1938): 42.

⁴ Gretchen E. Meyers. "Vitruvius and the Origins of Roman Spatial Rhetoric." *Memoirs of the American Academy in Rome* 50 (2006): 83.



Figure 1. 1521 Italian translation of *De Architectura Libri Decem* (The Ten Books on Architecture) by Marcus Vitruvius Pollio. Photographed by Mark Pellegrini, 2008.

De Architectura has stood the test of time and today remains as the oldest surviving piece of writing on architecture. This makes comparative analysis much more difficult for the simple fact that there is nothing to compare it to. This position makes influences of the ideas especially difficult as, beside the clear influence of classical Greek architecture, all must be deciphered through analysis of structures - most of which are crumbling and faded.

One of the most distinct non-architectural aspects of the text is Vitruvius' notable lack of literary skill. My research has brought me to two separate conclusions on the reason for this. The first, found in the text's own preface where Albert A. Howard, who wrote the preface to the 1914 Harvard translation of *De Architectura*, simply declares that Vitruvius lacked the forte of many of his peers, going as far as to berate his general lack of skill in the area, "He ends each book with a brief summary, almost a formula, somewhat like a sigh of relief, in which the reader unconsciously shares."⁵ On the other hand, a review of the book asserted that Vitruvius's writing, while undoubtedly shoddy, was not a result of Vitruvius' literary shortcomings but rather his significant alterations to the Latin language. "Most of the technical architectural treatises of Vitruvius's days were in Greek, and, to express himself adequately in Latin, Vitruvius had to

⁵ Vitruvius, *The Ten Books on Architecture*, Preface.

devise-sometimes unsuccessfully-an entirely new rhetorical style.”⁶ Packer’s explanation seems far more likely, especially when it is reflected in other sources “his very text is evident he wrote neither latin nor greek”.⁷ Despite Alberti’s own slander of Vitruvius’ lack of writing skill, this points, again to Vitruvius’ need to alter an entire script in order to effectively communicate his ideas as it would be much harder to decipher to a typical latin reader. If the latter option is correct, it would certainly have proved incredibly influential in the development of architectural writings, at least in the time of Rome, though we have no way to know whether that's true due to the aforementioned lack of other sources on architecture from the time.

Due to the complexity of the script, it is likely that Vitruvius scribed the work himself. This is made more probable as literacy in Rome was quite high, and while largely contained to the elite, was not uncommon for average citizens.⁸ In addition, there are numerous personal sentiments towards Augustus written in the books, especially in the introductions. Likewise, Vitruvius addressed Augustus directly multiple times (though it is through reference as “Caesar”), mentioning a number of individuals he had worked with previously, including a claim of military service under Julius Caesar which comes with the only surviving story of the Battle of Larignum in 56 BCE.⁹ In effect, any possible debate about the validity, date or detail of *De Architectura* has been put to rest. We know for certain that this treatise was written soon after Augustus’ rise to power in direct address to him.¹⁰

The Early Middle Ages

After Rome's fall in the West, many newly independent territories fell into a state of near apocalyptic chaos. The technologies and ideas which Rome had taken centuries to build slowly disappeared as centuries of violence and struggle wreaked the continent.¹¹ Among these were the Vitruvian ideations of architecture. With these ideas forgotten, new architectural stylings gradually took hold, as did new techniques. Unlike many modern depictions of the Dark Ages as

⁶ James E. Packer. “Review: Ten Books on Architecture by Vitruvius, Ingrid D. Rowland, Thomas Noble Howe, Michael J. Dewar.” *Journal of the Society of Architectural Historians* 60, no. 4 (2001): 505. <https://doi.org/10.2307/991738>.

⁷ Leon Battista Alberti. *On the Art of Building in Ten Books*, trans. Joseph Rykwert, Neil Leach, and Robert Tavernor. (Cambridge, MA: MIT Press, 1988), 154.

⁸ Jasvinder Dhesi. "An Investigation Concerning Ancient Roman Education: The Dispelling of Widespread Illiteracy and the Significance of the Classical Model of Education Grounded in the Lives of Scholars and Emperors." (Undergraduate honors thesis, University of Colorado Boulder, 2015), 5.

⁹ Vitruvius, *Ten Books on Architecture*, 63

¹⁰ Vitruvius, *Ten Books on Architecture*, Preface.

¹¹ Arrush Choudhary.. “From the Light and into the Dark: The Transformation to the Early Middle Ages.” *Vanderbilt Undergraduate Research Journal* 10 (2015): 3. <https://vurj.vanderbilt.edu/index.php/vurj/article/view/4074>.

a time wholly consumed by mysticism and devoid of science, the new architectural systems emphasized a rational approach to space with a focus on geometric forms, particularly the square. While distinct from many Vitruvian ideas, there were many similarities, both architectural systems, Vitruvian and those developed in the Dark Ages, emphasize an importance of ἀναλογία, the Hellenic, and more specifically, platonic idea of proportion.¹²

The thick pillars and heavy stonework of Dark Age style were emblematic of Classical architecture, even deriving theory and practice from it. Yet, they lacked the concrete theory which allowed Renaissance architecture to thrive in this context. Even the blatantly Roman movement of the middle ages, *Romanesque*, paled in overall classicality to the architecture of the Renaissance period. This was in large part due to the rediscovery of *De Architectura*. The all-inclusive nature of the text allowed architects to stop meandering through the unknowns of Roman architecture; now, they had access to more tangible theory which allowed for more complex and accurate extensions of Classical architecture.

The Renaissance

The inception of the Renaissance marked a significant change in European culture. The emergence of texts and ideas from the classical world from 1500 years prior would prove massively influential in every facet of life, changing the way people viewed the world. Ideas like Humanism, which were in large part derived from Classical philosophers like Cicero and Aristotle, would shape the culture of the Renaissance and Europe at large for years to come.¹³ The Renaissance would be defined by its infatuation with Classical ideas and their intermingling with not just philosophy, but art, engineering and architecture. This rediscovery of Classical text and obsession with everything classical naturally led to the re-emergence of Vitruvian texts. Architecture would see a quick yet massive change.

In *De Architectura*, Vitruvius states: “They are due to proportion, in Greek ἀναλογία. Proportion is a correspondence among the measures of the members of an entire work, and of the whole to a certain part selected as standard. From this result the principles of symmetry. Without symmetry and proportion there... is no precise relation between its members, as in the case of those of a well shaped man.”¹⁴

¹² François Bucher. “Medieval Architectural Design Methods, 800-1560.” *Gesta* 11, no. 2 (1972): 40. <https://doi.org/10.2307/766593>.

¹³ Paul Oskar Kristeller. “Humanism.” *Minerva* 16, no. 4 (1978): 587.. <http://www.jstor.org/stable/41820353>.

¹⁴ Vitruvius, *Ten Books on Architecture*, 72.

The fascination with this harmony is what truly separates the Renaissance from the prior architectural styles of the Dark Ages, and most prominently displays the importance of Greco-Roman thinking in architecture during this period. Of note is an emphasis on the human body as the basis of design with designers viewing the human form as a masterclass in symmetry and harmony. One of the most well known examples of this idea is Leonardo da Vinci's *Vitruvian Man* which, to da Vinci at least, was the perfect male form. This perfection was due to both the figure's symmetry and aforementioned ἀναλογία (proportion). The idea of the figure is described directly by Vitruvius himself (hence the "Vitruvian Man"). In his description, Vitruvius theorizes the proportions of the human body, likening each section of the body to other parts and the whole; from the forehead to the lengths of the feet every part of the person is a fraction of another. Vitruvius believed that the building should replicate the portions of the body, the Vitruvian man is therefore an abstract guide to this approach. It proved massively influential which could be seen in architectural thought through the newfound emphasis on proportion and symmetry present in not only constructions, but drawings of the time and later.¹⁵



Figure 2.¹⁶ *Study of a Man According to Vitruvius (Vitruvian Man)*.
Leonardo da Vinci, ca. 1485-1490.

¹⁵ Ralf Weber and Sharon Lerner. "The Concept Of Proportion In Architecture: An Introductory Bibliographic Essay." *Art Documentation: Journal of the Art Libraries Society of North America* 12, no. 4 (1993): 151. <http://www.jstor.org/stable/27948585>.

¹⁶ Small lines on the joints define the most basic proportions of the human figure

Vitruvius then compares the form specifically to the optimal design of the temple.¹⁷ However, it is important to note that Vitruvius' primary intention in *De Architectura* was first and foremost to aid Augustus and his reign, entrenching it in only the ideas of the time. Therefore, these ideas must be viewed in the abstract; we no longer build temples, yet the same principles are still applicable today.¹⁸ Even 500 years ago, this was understood. These concepts were applied in tandem with Dark Age architectural developments and an empirical analysis of Roman ruins to forge a distinctive style of architecture which was both new and old. Existing ideas on form and structure were paired with those of Vitruvius - the geometric forms which had gained popularity over the millenia saw their harsh gothic facades stripped away and replaced with softer frescoes and columns of Roman heritage. Yet it retained the form of earlier works, applying newfound Vitruvian thinking to them, placing a revolutionary emphasis on the form's proportion.¹⁹

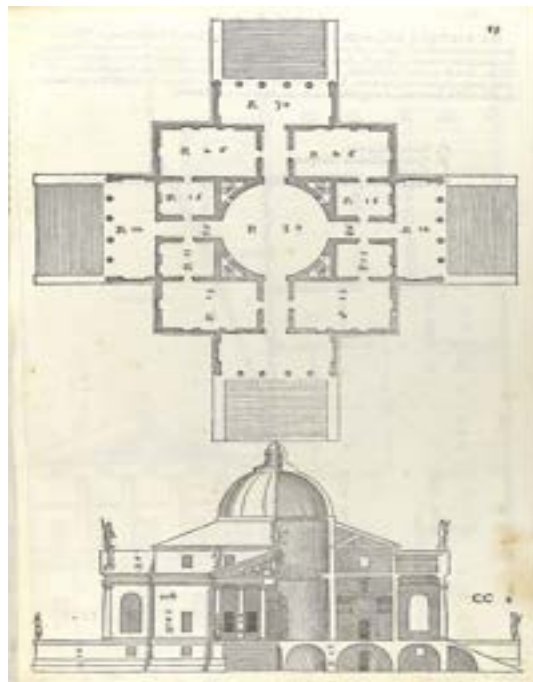


Figure 3.²⁰ *Villa Almerico (Villa Rotunda)*,
from *I quattro libri dell'architettura* di
Andrea Palladio, Andrea Palladio, 1570.

¹⁷ Vitruvius, *Ten Books on Architecture*, 73.

¹⁸ Polina Stepanova. "Vitruvian Concepts in the Modern Age" (Master of Architecture, Columbia University, 2021) 3.

¹⁹ Richard J. Betts. "Structural Innovation and Structural Design in Renaissance Architecture." *Journal of the Society of Architectural Historians* 52, no. 1 (March 1, 1993): 6. <https://doi.org/10.2307/990755>.

²⁰ One of the Renaissance's most esteemed buildings, the Villa Rotunda exemplifies a number of important Vitruvian ideas; Symmetry, most clearly seen in the 4 identical sides of the structures facade, while also drawing from the form of the Greek temple. These temples were discussed in great detail by Vitruvius himself, especially in its symmetry, which is, again, displayed to great effect here.

The Rise of Industry

Architecture, while shifting to new styles, over the next few hundred years saw little real change in its theory. The onset of the Industrial Revolution would see an abrupt end to this stagnation. The most important change during this period came in the mid 19th century with the introduction of steel support on a grand scale. The mid 19th to early 20th centuries saw the erection of many engineering marvels: The Crystal Palace in London, The Eiffel Tower in Paris, and The Hamburg Hauptbahnhof (Hamburg Central Station) in Germany among many others.²¹



Figure 4. Hamburg Hauptbahnhof Station in Hamburg, Germany, Photographer unknown, 1910.

More importantly however, the introduction of steel removed the limits of height placed on buildings for all of human history as the higher a building, the larger the load on the lower portion became. To Vitruvius, this problem was referred to as “firmitas” or firmness. Steel circumvented this, taking away the concern of the structural integrity of stone, effectively ending the ‘Vitruvian Triad’ of “firmitas”, “venustas” and “utilitas” (Firmness, beauty, and utility).

In *Tall Office Buildings Artistically Considered*, Louis Sullivan responds to this phenomenon. In the essay, Sullivan likens the office building to the classical column, describing its base, the bottom two floors, typically reserved for commercial enterprise, while the

²¹ Gul Rahman Abdulrahimzai, Alaa Salah Mosa Abushreita, and Ahmad Sayeed Dildar. “The Age of Steel: The Transformation of the Nineteenth-Century Construction Industry.” *Kardan Journal of Engineering and Technology* 5, no. 1 (December 2023): 48. <https://dx.doi.org/10.31841/KJET.2023.34>

midsection, typically around five floors, is used for office space with the last 1-2 stories defining an attic. Corresponding to a column, like elements are uniform. This is specifically stated by Sullivan in the piece. Furthermore, in regards to a column, its form is determined by its function. Hence, Sullivan's coining of the term "Form ever follows function". Besides a reference to columnar structures most popular in the Classical era and Sullivan's clear classical influence in his own work, the idea of form follows function draws directly from the ideas of *venustas* and *utilitas* in the Vitruvian triad (beauty and utility - form and function). In effect, this means that form is deterministic of the building's purpose. The same idea and one which Sullivan draws from is emphasized by Vitruvius. To Vitruvius, this idea was not just seen through *venustas* and *utilitas*, but through the natural world as well. In the natural world, form is shaped by the function it provides; Tree bases are thicker to provide support to the rest of the tree, the eyes of prey animals are positioned to best look for predators. To Vitruvius and Sullivan alike, the same should be applied to the building.²²

The Bauhaus

The Interwar period saw an explosion of modern art with a focus on utopianism after the damages industrial warfare wreaked on the European world. The Bauhaus School of Design in Weimar, Germany was one of the pioneers of modern design in the early 20th century. There was, like Sullivan's writing, a heavy emphasis on 'form follows function'. At a glance, the designs of the Bauhaus were in stark contrast to anything in the classical period. In ancient Greece and Rome, buildings featured more intricate facades and commonly featured the use of columns and ornate motifs among other elements. In contrast, the buildings of the Bauhaus were simplistic, making heavy use of glass and steel with forms and motifs sticking out in unpredictable ways.²³ Yet while the facade itself was largely separate from that of a Vitruvian outline, many of the concepts of buildings constructed by 'Bauhauslers' followed an array of Vitruvian principles.

One of the most distinctive examples of this is the ADGB Trade Union School designed by Hannes Meyer & Hans Wittwer. During the design process, architects and students created plans which focused on the facility's intake of natural light. Similarly, there was an emphasis

²² Stepanova, *Vitruvian Concepts in the Modern Age*, 2.

²³ Wenwen Chen and Zhouzhou He.. "The Analysis of the Influence and Inspiration of the Bauhaus on Contemporary Design and Education." *Engineering* 5, no. 4 (April 2023): 324.
<https://doi.org/10.4236/eng.2013.54044>.

placed on the lay of the land itself, with the construction conforming to the low slope of the site. Both of these are concepts which Vitruvius emphasized.²⁴ However, the most important Vitruvian element was, again, that form follows function. At a glance, this is obvious: a set of what were effectively concrete and glass boxes naturally follows function. Yet, at this location we see a significantly more abstract interpretation of the idea: Democracy. At first this seems antithetical – How can a building be democratic? It's a building. Yet upon closer inspection, the answer is much clearer.

“The individual buildings constitute functional units in themselves, with their arrangement resulting not from subjective formal rules of composition, but from their relationship to one another... Neither hierarchy nor authority were apparent: this was a democratic building both in form and function.”²⁵



Figure 5.²⁶ Federal School of the ADGB, Photographed by Junkers Luftbild, 1930.

In effect, the balance of forms on the site created a place which lacked the traditional hierarchy of a school, instead emphasizing a more balanced, level society. This site represents a larger shift in culture at the time which saw a gradual abstraction of traditional, in this case, Vitruvian ideas. The same can be seen in Bauhaus art, with color and shape defining works of art rather than the more distinct uses of form in earlier styles. However, while this idea did exist in

²⁴ Vitruvius, *Ten Books on Architecture*, 171-172.

²⁵“The “School in the Woods” as a Socio-pedagogical Ideal,” Bauhaus Kooperation, 2025, <https://bauhauskooperation.com/kooperation/project-archive/magazine/discover-the-bauhaus/the-school-in-the-woods-as-a-socio-pedagogical-ideal>.

²⁶ Notice the uniformity of the structures, representative of an equal community, also, notice how the buildings conform to the slopes of the site.

architecture previously, it essentially boiled down to making buildings larger to display strength or wealth. The abstraction of Vitruvius' doctrine in this way, while emblematic of a larger shift in society, would also prove to bring on a new wave of architectural theory and practice helping modern construction form into what it is today. A prolific example of this is Frank Lloyd Wright's Fallingwater, designed in 1933 which uses the waterfall to represent nature as "an image of nature perceived in the process of growth and change".²⁷



Figure 6. "Fallingwater" home of Edgar J. Kaufmann designed By Frank Lloyd Wright. Photographed by Ezra Stoller, 2008.

Architecture after the Second World War

While the introduction of wide-scale, industrial warfare and its total realization during the First World War paired with the devastation which followed, such a realization altered the ethos of the European continent. The Second World War posed a distinct, and much more concrete challenge to these designers who were reeling not 30 years earlier. One of these designers, French-Swiss Architect Charles-Édouard Jeanneret or Le Corbusier, would prove incredibly important in the development of architectural thought and practice in the mid-late 20th and 21st centuries. Corbusier's likely most important - or at least most Vitruvian addition to the world of design was that of *Le Modulor* or simply *Modulor*. In spirit, it was the successor to the Vitruvian

²⁷ Neil Levine. "Abstraction and Representation in Modern Architecture: The International Style and Frank Lloyd Wright." *AA Files*, no. 11 (1986): 14. <http://www.jstor.org/stable/29543489>.

man of da Vinci, drawing from classical ideas like the Golden Number devised by Euclid.²⁸ Unlike the Vitruvian man's more abstract relation to building design, Corbusier intended *Le Modulor* itself to be a tool employed by architects.²⁹ More specifically, Corbusier viewed Modulor as the optimal human scale in architectural practice, something on which to base spatial design.

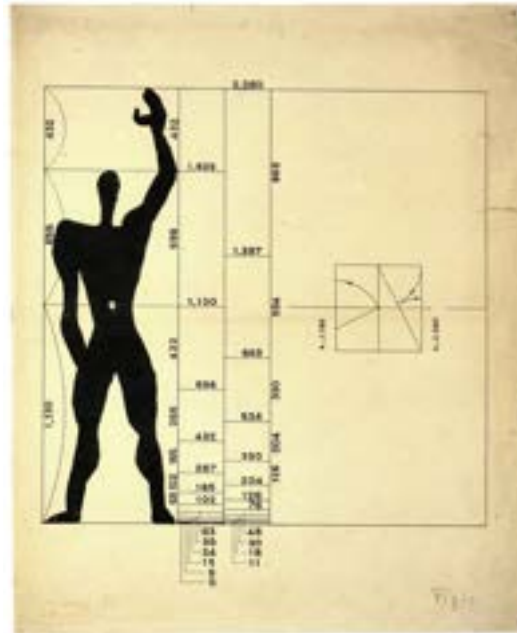


Figure 7.³⁰ *Modulor*. Le Corbusier, 1950.

This is related to *De Architectura* in two ways: the first being the aforementioned Vitruvian man and Vitruvian outline of the human figure with all three attempting to create the mathematically optimal form. However, the second is the larger human scale.³¹ Vitruvius, like Le Corbusier emphasized the importance of design in relation to humans, “The size of a forum should be proportionate to the number of inhabitants, so that it may not be too small a space to be useful, nor look like a desert waste for lack of population.”³² This idea is reflected in Modulor

²⁸Maddalena Mameli. “Le Corbusier and the American Modulor.” New York City: *LC2015 - Le Corbusier, 50 years later*, (2015): 1.

²⁹ Mameli, “*Le Corbusier and the American Modulor*”, 9.

³⁰ The almost alien-like appearance of the figure is likely intended for ease of drawing rather than accuracy while the numbered bars on the diagram's side represent a universal system of measurement based on the human form devised by Le Corbusier.

³¹ Donald Tomkinson. “The Marseilles Experiment.” *The Town Planning Review* 24, no. 3 (October 1953): 206. <http://www.jstor.org/stable/40101528>.

³² Vitruvius, *Ten Books on Architecture*, 132.

and its emphasis as a direct tool in the Architects arsenal, allowing one to understand a space relative to its inhabitants. The influence of this idea, while somewhat subtle, has nestled itself into design ethos. The human figure has become a mainstay in contemporary architectural drawing and modeling, allowing for deeper thought into the scale of buildings and their relationship to their inhabitants.

Sustainability in Architecture

Not dissimilar from the rise of the human in architecture is the rise of the non-human in recent decades. The blights of a globalized, industrial world have caused much damage to our planet. In response, many have begun to emphasize the importance of leading a more sustainable life. This is true for architecture, and despite living 2000 years before the effects of climate change and global ecological dam, the ideas of Vitruvius have been important in the formation of sustainable architectural practice and theory. An early example in Portland itself is that of the Aubrey Watzek House designed by John Yeon. The house uses local wood (specifically noble fir) for the construction while also surrounding the house with a number of native plants. The use of domestic resources was an idea heavily emphasized by Vitruvius and sees a unique interpretation here which displays an emphasis on the importance of the preservation of local species and an attempt to integrate architecture into the site to create a more cohesive environment.³³

More broadly however, *A Green Vitruvius: Principles and Practice of Sustainable Architectural Design* by Vivienne Brophy and Lewis J. Owen translates Vitruvian concepts into the modern age with a focus on sustainability. The text's depth and detail make it a very important book in and of itself; however, its relationship to Vitruvius makes it equally relevant. Brophy and Lewis highlight a number of distinctly Vitruvian concepts, emphasizing an awareness of the site and its conditions. To minimize energy usage, awareness of the area's climate and relation to the sun supersede all other elements. Vitruvius states that the sun's exposure creates natural light but also a fiery heat in the summer months. In the modern day, this means higher energy use from cooling, and lower energy use from the surplus of light from the sun. Likewise, a subpar site will change the need for air conditioning and light, even interfering with construction in some cases and, as stated by Vitruvius, can have a negative effect on the

³³ Vitruvius, *Ten Books on Architecture*, 17

health of its inhabitants.³⁴ Lewis, Brophy, and Vitruvius all demand that we put deep thought into all elements of the construction and site alike, the latter for the sake of the building and its inhabitants, and the two former for the sake of our world.



Figure 8. Aubrey R. Watzek House in Portland, Oregon.
Photographed by Visitor7, 2011.

Conclusion

Vitruvius' *De Architectura* has profoundly shaped architectural theory and design worldwide since its inception roughly 2000 years ago. *De Architectura* has guided many of history's greatest architects, engineers and artists, helping to develop the unique architectural styles of various periods, including the present day. From da Vinci to Le Corbusier, the principles outlined in *De Architectura* have resonated deeply; concepts like the Vitruvian Triad (firmness, beauty, and utility), balance, the human scale, and the idea of 'Form Follows Function' have been instrumental in the evolution of architectural theory and practice since the Renaissance. Vitruvius' insights have not only survived, but thrived, adapted and been reinterpreted, ensuring his legacy endures in the built environment as well as the ongoing discourse of architectural theory and practice.

³⁴ Vivienne Brophy and J. O. Lewis. *A Green Vitruvius: Principles and Practice of Sustainable Architectural Design*. (Washington, DC: Earthscan, 2011), 3. <https://doi.org/10.4324/9781849776929>

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