

BERLAGE'S TECTONICS: A REFLECTIVE STUDY ON THE ORIGIN OF DR. H.P. BERLAGE'S DESIGN PRINCIPLES, SYSTEMS OF MEASUREMENT AND THOUGHTS ON MASS PRODUCTION

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written by: Laura Wiedenhöver

with the support of Sabina Tanović

Abstract

This study aims to reflect on the origin of Dr. H.P Berlage's architectonic principles and systems of measurement to uncover *how* he designed and *why* he voiced certain thoughts on mass production. This is done by analyzing his architectural background and writings, namely *Normalisatie in Woningbouw* and *Thoughts on Style*. One chapter is devoted to analyzing Berlage's proportional and modular brick systems in the *Gemeentemuseum* and *Beurs van Berlage*. Two modern case-studies by Guerst & Schultz Architecten which were inspired by the study of Berlage's brick systems are also analyzed followed by a short personal exploration. These case-studies help reveal how the smallest module in a building can be used as a system of measurement to create sophisticated "unity in variety" – the main design principle Berlage strived for. By examining the origins of Berlage's tectonic theories in practice one sees the impact they had on his designs and the merit they still provide to the next generations of architects. Based on this work, it can be concluded that Berlage's design process results in an overly complex methodology that may provide limitations or be too difficult for practical use; however, if chosen, it could result in an enriched and fulfilling architectural vision.

Keywords: standardization, modularity, system of measurement, bricks, proportions

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1 Introduction

Throughout history, architects have traditionally relied on systems of measurement derived from geometric forms for construction (Wingender, Jan Peter 2016, 150). Although Dr. Hendrik Petrus Berlage was not the first to adopt this methodology, he could be considered the most influential Dutch architect in the 20th century who developed the idea of material standardization to a high degree and who relied on the ancient building technique of proportion and measurement (De Jong, T.M., & van der Voordt, D.J.M., ed. 2002, 118). Berlage argued for the return of what he called “truthful architecture,” a type of architecture that was “naked,” without a false layer of coating or unnecessary ornamentation (Berglage, H.P. 1996). His argument for using materials systematically and truthfully reveals how he desired for buildings to show their structural systems and rhythm on both the inside and outside—buildings as readable artifacts that reflected their makeup and composition.

1.1 Historical Context

Berglage lived and worked during pivotal moments of innovation in Dutch construction history. During the mid to late 19th century, cities in the Netherlands had poor living conditions—accommodations for working families were often humid, dark and vermin-infested (Moraes Zarzar 2010, 2). With residents of big cities basically living in slums, there was an urgent need for improvements and with that a high demand for new housing (p. 2). Along with housing, a great deal of replacement and refurbishment of monumental buildings was needed, and the name *Berglage* was not unheard of among the architects that were tasked with reshaping the Dutch cities (p. 2). Berglage is well known for his *Plan Zuid* (South Plan), an urban development concept for Amsterdam South, along with municipal works such as the *Beurs van Berglage* (Beurs of Berglage) in Amsterdam and the *Gemeentemuseum* (Municipal Museum) in The Hague.

The housing crisis in the mid to late 19th century accelerated an architectural housing movement which became a fundamental principle of the early Modern Movement that Berglage associated himself with (Berglage, H.P. 1996, 48). This was in part due to the generation before which had put precedence on constructing individual homes, allowing them to resurrect ornate brick constructions inspired by historic styles (Wingender, Jan Peter 2016, 25). Berglage and others heavily criticized this generation for their lack of attention to more pressing social matters (Berglage, H.P. 1996, 48).). In this reflective study, one will see that Berglage’s architectonic principles for design were deeply rooted in his personal social and political views— something he attributed to the theoretical writings of Gottfried Semper (Frampton, Kenneth, & Cava, John 1995, 337).

1.2 Objects of study

Berglage often relied on two systems of measurement when designing throughout his career: the relative Egyptian triangle (also known as the 8:5 triangle) and the proportion of a standardized

Waal brick *Beurs* (de Jong, et. al, 2002, 119) (Rossi, Corinna 2003, 23). This paper examines the origin of Berlage's proportional and modular devices and uses the *Gemeentemuseum* in The Hague and *Beurs van Berlage* in Amsterdam as case-studies (Chapter 5) which are built according to both the relative Egyptian triangle and *Waal* brick method. This study also briefly reflects on one other construction built according to the same measuring devices— a housing *bouwblok* (block construction) on Hobbemastraat in Amsterdam *Zuid* (Chapter 3). Analyzing the *Gemeentemuseum* and *Beurs* helps to uncover Berlage's architectonic principles and reveals *how* he designed and *why* he voiced certain thoughts on systems of measurement and mass production. Addressing the design principles and systems of construction used, followed by a study of Berlage's choice of material—the *Waal* brick—is supported by a critical analysis of Berlage's two texts, *Normalisatie in Woningbouw* and *Thoughts on Style*. The modern case-studies of Geurst & Schultz Architecten and personal exploration are discussed after the analysis of the *Gemeentemuseum* and *Beurs* to reveal how Berlage's construction logic has impacted the methodology of modern works.

1.3 Interpretive ideas

By analyzing the *Gemeentemuseum* and *Beurs van Berlage* as historic case-studies that exhibit Dr. H.P. Berlage's major design principles and by reviewing literature he wrote at different time periods in his career, this text critically examines Berlage's architectonic principles and systems of measurement that impacted his thoughts on mass production. In this way, this paper aims to contribute to the modern-day architectural approaches of mass housing production. Hence, the main research questions for this thesis are:

RQ: *To which extent have the origins of Berlage's design principles and measuring systems impacted the tectonic construction in the Gemeentemuseum and Beurs van Berlage and how has this influenced the work of Geurst & Schulze Architecten?*

Additionally, several sub-questions have been created to help support the analysis. First:

SRQ1: *Did Berlage's brick construction logic impact the design and production of houses in The Netherlands in the early 20th century?*

By evaluating Berlage's utilization of brick as a unit of measurement, the impact of his construction logic can be identified among proceeding housing designs by the generation of architects following Berlage. The second sub-question can be defined as:

SRQ2: *How is mass production perceived by Berlage, and what impact did these views have on the perception of mass housing construction within the context of early 20th century Dutch housing development?*

Mass-production and standardization remain important aspects for evaluation and considered within the domain of architecture. By examining these topics in Berlage's writings, identifying what impact this had on the acceptance of mass housing production, if any, can help to measure the impact of his thoughts and subsequently place them into the required context. To tackle the issue, the third sub-question is:

SRQ3: *How useful are proportional and modular measuring devices within the context of urban development and architectural design? How effective are these techniques within the context of mass housing production?*

Although thoughts and analysis of the techniques of modularity and standardization are useful, the effectivity of these techniques needs to be considered as well.

1.4 Literature review

When considering the origin of Berlage's architectural design principles and construction logic, few papers investigate in depth the impact of the progressive proportional and modular measuring devices Berlage applied. While some studies only briefly touch upon the subject, many do not conduct a thorough impact analysis.

The book *Ways to Study and Research Urban, Architectural and Technical Design* is one of few examples where the implementation of Berlage's proportional systems in the *Beurs van Berlage* is reviewed (De Jong, T.M., & van der Voordt, D.J.M., ed. 2002). A detailed analysis of the Egyptian triangle and *Waal* brick methods is provided, in Chapter 14 "Analysis of Buildings", through text and drawings made by Dutch architect Jan Molema. Dutch architect Jan Peter Wingender is the editor of *Brick An Exacting Material* in which he exhibits a chapter, entitled, "Brick: On Size, Scale and Order" written by Dutch architect Jeroen Guerst (Wingender, Jan Peter 2016). This chapter also provides some information on Berlage's modular brick devices; in addition to exhibiting modern works designed by Geurst & Schulze Architecten inspired by Berlage's systems of measurement. Jeroen Guerst states that, architectural design goes beyond the choosing between modernist and traditionalist styles and instead aims to convey the essence of architecture by starting with the material of choice and the ordering principles that derive from that material, hence, supporting Berlage's main design principle— "unity in diversity" (p. 157).

Studies on Berlage's thoughts on mass production are also limited. The paper, 'Innovation, Identity and Sustainability in H.P. Berlage' Stock Exchange,' written by Brazilian architect and urbanist Dr. Karina Moraes Zarzar, also mentions the building systems of Berlage but places more attention to the history of Berlage's style and his influence of Romanesque architecture (Moraes Zarzar, Karina 2010). While examining the *Beurs van Berlage* (previously known as the Amsterdam Stock Exchange), Moraes Zarzar states,

Berlage argued that if the architects did not compromise with the capitalists, the engineers and industry would take over by producing buildings quickly and cheaply. His compromise with the capitalists brought him to the necessity of creating buildings under concepts such as simplicity and order, which implies that the design would be based on essential elements focusing on durability, flexibility, functionality and construction

(Moraes Zarzar, Karina 2010,11).

Moraes Zarzar briefly refers to Berlage's thoughts on mass production but does not go into further detail. Although the work provides useful contribution, it does not provide the depth required for this analysis. The paper, "Berlage and Housing, 'the most significant housing type,'" published in the *Netherlands Yearbook for History of Art* and written by Dr. Helen Searing, served as a valuable source which contains a great deal of investigative work on Berlage's perception on housing and mass construction (Searing, Helen 1974).

The notion is to examine the origin and impact of Berlage's tectonic principles and systems of measurement in combination with his thoughts on mass production. Few studies (Chapter 14 "Analysis of Buildings" in *Ways to Study and Research Urban, Architectural and Technical Design*, "Brick: On Size, Scale and Order" and "Berlage and Housing, 'the most significant housing type'") analyze these topics in conjunction and depth which I aim to pursue (De Jong, T.M., & van der Voordt, D.J.M., ed. 2002) (Wingender, Jan Peter 2016) (Searing, Helen 1974). Critically analyzing this matter could contribute to existing literature.

1.5 Methodology

To identify Dr. H.P. Berlage's views on the relevant topics of architectonics, systems of measurement and mass production, I cite relevant primary sourced materials and publications, including *Thoughts on Style* and *Normalisatie in Woningbouw* (Berlage, H.P. 19996) (Berlage, H.P. 1918). These readings provide the necessary context to derive the findings required for analysis. Once this context is obtained and the relevant thoughts are compiled, a collection of research questions relating to the impact of Berlage's thoughts on standardization and mass production are addressed and evaluated. Furthermore, these findings are supported by a reflection on modern day case studies inspired by Berlage's design principles and construction logic.

1.6 Structure

This thesis is a reflective analysis of Berlage's thoughts on architectonics, systems of measurement and mass production. Attention is placed on the study of his thinking process, which includes Berlage's architectural background (his formal education and personal learning excursions) and the theoretical works by Gottfried Semper and Eugène Emmanuel Viollet-le-Duc—

this is done to understand the pedagogies and architectural theories that influenced Berlage's designing process. After chapter 1, "Introduction," chapter 2, "A Short Inquiry on Mass Production and Dutch Brick," is provided, where the topics: "Mass production vs. Standardization," "Dutch brick" and "Introduction of the cavity-wall" are briefly analyzed. Sources from American architects Michael Czap and David Walsh and Dutch author Orsel Ewin are introduced in this chapter (Czap, Michael 2018) (Walsh, David 2009) (Orsel, Edwin 2006). Chapter 3, "Berlage's Tectonics," follows with sub-topics, "Shaped by French and German traditions" and "Berlage's conceptualized unity of the *bouwblok*." German architect and theorist Gottfried Semper, French architect and theorist Eugène Emmanuel Viollet-le-Duc and Dutch architect P. J. H. Cuypers are heavily analyzed in this chapter. Sources from American architects Paul H. Rovinelli and Edgar Kaufman Jr. and Dutch art historian Pieter Singelenberg are also introduced in this chapter (Rovinelli, H. 1984) (Kaufmann Jr., Edgar 1974) (Singelenberg, Pieter 1995). Chapter 4, "Berlage's Thoughts on Standardization," covers "Berlage's *Normalisatie in Woningbouw*, 1918" and "Egoistic architecture vs. Ecocentric Architecture" (Berlage, H.P. 1918). Chapter 5, "Gemeentemuseum & Beurs van Berlage," includes topics titled, "Berlage's use of brick as a module for construction," "History and system of measurement in the *Gemeentemuseum*," "Analysis of the *Beurs*" and "Reflection and conclusion." Chapter 6, "Modern Implementations of Berlage's Modular Brick Systems," reveals modern case-studies titled, "Case study 1, Andreas Ensemble Lelylaan, Amsterdam, Geurst & Schulze Architecten," "Case study 2, Nieuw-Crooswijk, Rotterdam, Geurst & Schulze Architecten," "Reflection" and "Personal Exploration." These case-studies reflect on Berlage's systems of measurement, brick work and construction logic. Finally, chapter 7, "Conclusion," reflects on the impact of Berlage's architectonics, systems of measurement and mass production concepts and provides answers to the research questions addressed in chapter 1.

2 An Inquiry on Mass Production and Dutch Brick

2.1 Mass production vs. Standardization

The term mass production describes a large-scale production of standardized parts and products. It was at the turn of the 20th century when this process flourished, starting in automotive industries before gradually making its way into the world of construction (Czap, Michael 2018). Construction, however, is not mass production. According to American architect David Walsh, construction industries today are beginning to experience the same turning point automobile industries had in 1908 (Walsh, David 2009). They are only just starting to take advantage of Henry Ford's path to automated assembly lines, interchangeable parts and increased affordability (Walsh 2009). The ways in which construction firms think and operate involve a multitude of factors, thus making it difficult to associate with other industries of mass production (Czap, Michael 2018).

Unlike mass production, the use of standardized elements and sizes in building has been done since ancient times (Wingender, Jan Peter 2016, 150). According to Dutch architect Jeroen Geurst, standardized sizes have been greatly accepted and implemented in the Dutch construction industry, much more than in neighboring countries (p. 150). In the Netherlands, the standardized system of measurement is based on the basic measurement of 0,3 meters. It is this system of measurement that typically determines the structural grid of most residential and office buildings today (p. 150).

2.2 Dutch brick

Brick as a construction material is typically associated with contemporary Dutch architecture today, it was the Romans that introduced this technique when the Netherlands became a part of the Roman empire in 19 BC, but it was quickly forgotten in the centuries after. The reintroduction of brick in the Netherlands did not occur until around 1200, probably to the credit of monastic orders who encouraged the manufacturing of brick from local clay deposits (Orsel, Edwin 2006, 2380).

The standardization process of Dutch brick did not occur until the end of the 17th century (p. 2385). Until the 19th century, however, various brick sizes were used simultaneously in different regions of the Netherlands. The number of bricks with different sizes and proportions started to decrease when machine-produced bricks emerged later in the same century—the *Waal* brick as the most popular (p. 2380).

Today, the *Waal* brick is the most common brick used in the Netherlands, its traditional size unchanged from 21,5 cm x 10,5 cm x 5,25 cm. Its popularity originates from the mid-19th century, due to the development of brick factories along the major rivers near the clay sources. Although the *Waal* brick is produced at an industrial level now, and is no longer made by hand, it is favored among masons because of its weight and ease of handling. While the *Waal* brick is convenient to use its proportions are not ideal (Wingender, Jan Peter 2016, 151).

Since the *Waal* brick's length is not a multiple of its height, problems occur with rowlock courses. To solve this issue, bricks need to be shortened in the rowlock course or need to be shifted— often resulting in brick waste. However, the thickness of the *Waal* brick has been taken into consideration since 16 courses of brick fit precisely in a meter (Wingender, Jan Peter 2016, 151). The *Gemeentemuseum* is an informative example of how Berlage approached the problem of building with the *Waal* brick—chapter 5 reveals this in closer detail.

2.3 Introducing the cavity-wall

Until the end of the 19th century walls were made of solid brickwork and various masonry bonds (Wingender, Jan Peter 2016, 135). The introduction of the cavity-wall resulted in a distinction between what was at the time termed as the “load bearing interior wall” and the “rainproof exterior wall.” Although it took about a century to perfect, for example, problems of cracks in the insulated external wall, it was the moment when the cavity-wall gained traction in the construction industry that the architectural application of brick changed in purpose from being structural to cladding. This resulted in a significant architectural discourse about the proper application of brick (p. 7).

The inclination to separate the exterior wall from the loadbearing wall resulted in differing approaches which can be seen when architects associated with the Amsterdam School movement during the start of the 20th century, (1910's-1930's), applied dresses of brick on buildings that disregarded the logic of the loadbearing structure and program (p. 28). The housing project *Het Schip*, designed by Michel de Klerk in Amsterdam and completed in 1919 is a well-known example of the Amsterdam School style— Michel de Klerk who was one of the founding members of the Amsterdam School shared similar socialist ideals like the other early Modern Movements and built *Het Schip* in response to the urgent need for better living conditions for the working-classes in the Netherlands (Berlage, H.P. 1996, 48) (Hidden Architecture 2015). The way in which de Klerk developed the organic brick exterior of the building, however, led to scrutiny and critique. Dr. H.P. Berlage and others would go on to criticize this expressive brick work by labeling it as “false architecture” (Wingender, Jan Peter 2016, 28). Berlage strongly believed form should follow function, unlike the architects of the Amsterdam School; he favored principles of structural rationalism and clear, truthful construction (Frampton et. al, 1995, 185).

Figure 1 and Figure 2 show how the brick exterior of *Het Schip* is rather ornate and expressive, without necessarily following a clear logical connection with the structure or inside-spaces (Wingender, Jan Peter 2016, 28). To understand how Berlage's design methodology developed and why it differed from the next generation of architects, his tectonics are examined in the following chapter.

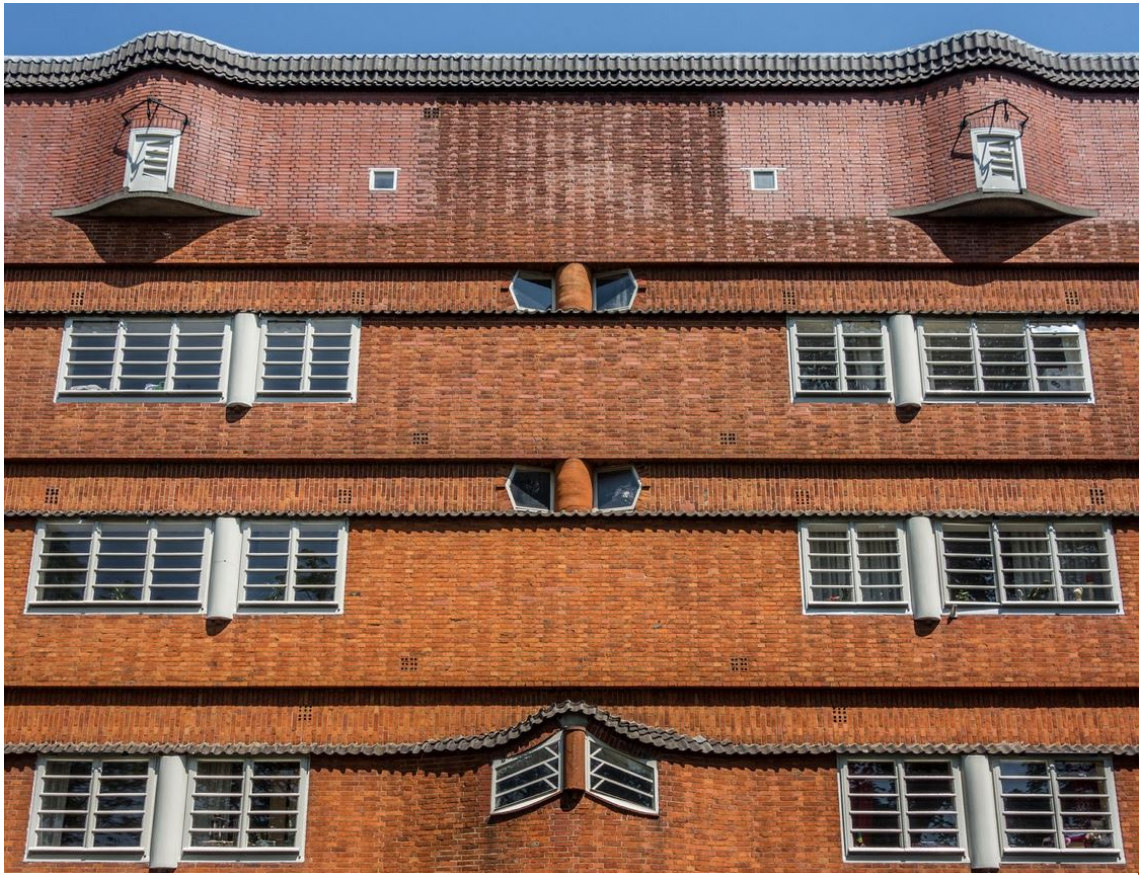


Figure 1 - Organic exterior facade of Het Schip (Hidden Architecture 2015)



Figure 2 - Detail of brick overhang in Het Schip (Hidden Architecture 2015)

3 Berlage's Tectonics

The early Modernists strived to separate themselves from the generation before, which sought innovation from historic references, such as the Middle Ages or the Renaissance (Wingender, Jan Peter 2016, 26). Rather than creating architecture that expressed itself through history and ornament, architects of the early Modern Movement created brick structures that were unarticulated or undecorated (p. 26). Emphasis was put on the unity of individual components to form a whole (Rovinelli, H. 1984, 257). Hence, the collective rational brickwork served to create new space and not replicate historical forms (Wingender, Jan Peter 2016, 26). To further understand how Berlage became associated with the early Modern Movement and how his theories of architecture evolved, an analysis of his early architectural education is conducted in this chapter.

3.1 Shaped by French and German traditions

Berlage was influenced by both French and German traditions throughout his architectural career, both of which played a role in shaping his architectonic principles. It was German architect and theorist Gottfried Semper who passed along German traditions to Berlage while he attended the Polytechnikum (now the ETH) in Zurich in the 1870s. Although Semper had already left the Polytechnikum to pursue other work in Europe while Berlage attended the school, his pedagogy taught by his assistants certainly played a role in the architectural development of Berlage (Kaufmann Jr., Edgar 1974). Dutch architect P. J. H. Cuypers influenced Berlage with French traditions, since Cuypers was heavily influenced by French architect and theorist Eugène Emmanuel Viollet-le-Duc (Frampton et. al, 1995, 337). Unlike Viollet-le-Duc and Cuypers, however, who promoted Gothic architecture, Berlage preferred Romanesque architecture (Moraes Zarzar 2010, 7).

A lecture Berlage held in 1904 was the moment where he defined architecture as the “art of spatial enclosure” (Frampton et. al, 1995, 18). He argued that the purpose of a wall is to achieve “surface flatness” and its assemblage of parts should be stripped of any unnecessary dressing or ornament which does not convey its structure truthfully. This remark was a clear response to Gottfried Semper, who suggested the peeling away of historical dressing to reveal a wall’s pure spatial possibilities (Frampton et. al, 1995, 16). This appears in Semper’s book, *Der Stil* (Style), published in 1860, where he mentions his *Bekleidungstheorie* (Theory of Dressing) (Sorensen, Lee n.d.).

Semper’s writings on the art of construction greatly influenced Berlage. It was Semper that divided the art of constructing into two aspects: the *tectonics* of the frame and the *stereotomics* of the earthwork (Frampton et. al, 1995, 5). Frampton writes that the Caribbean hut Semper saw in the Great Exhibition of 1851 led to his theoretical writings in his book, *Die vier Elemente der Baukunst* (Four Elements of Architecture), which set the premise of his two construction

procedures: *tectonics* and *stereotomics* (p. 5). These two associations of the wall resulted from the vocabulary of the German language: *die Wand*, referring to a screenlike partition and *die Mauer*, signifying a massive fortification (Frampton et. al, 1995, 5). The influence of Semper becomes even more apparent when analyzing the structure and facade of Berlage's Gemeentemuseum, which is done in chapter 4.

Berlage became familiar with the architectural principles of Viollet-le-Duc through the work of P. J. H. Cuypers. Although Cuypers belonged to the generation preceding the Traditionalist movement that sought to bring back historic stylistic references from the Middle Ages and the Renaissance, Berlage was influenced by the Gothic structural rationalism that Cuypers displayed in his works (Gothic Revival n.d.). Viollet-le-Duc's theoretical writings attributing to the Gothic logic and rationality of construction in his works *Dictionnaire* and *Entretien*, inspired Berlage to use proportional grids such as the Egyptian triangle (also known as the isosceles triangle) and modular systems as a device to create structures of unity (Frampton et. al, 1995, 337). This would then evolve into Berlage's main architectonic principle of *eenheid in veelheid* or "unity in diversity" (Rovinelli, H. 1984, 257).

After his studies at the Polytechnikum, Berlage traveled throughout Italy and was drawn to Romanesque architecture. Berlage perceived these buildings as simple and proportional, such as the tower of the Palazzo Pubblico in Siena, which to him, evoked a sense of "dignity, majesty and power" (Moraes Zarzar 2010, 7). It was the simplicity of Romanesque architecture that intrigued Berlage. According to Brazilian architect Karina Moraes Zarzar, some of the simple Romanesque characteristics that may have stood out to Berlage were the use of solid masonry walls and vaults, round arches, narrow slit-windows, large towers, decorative arcades and naked facades. By studying how Romanesque buildings function and how their structure works, rather than replicating or imitating their aesthetics, Berlage developed his own principles or methodology of architectural construction—resulting in a new architectural style and modern take on Semperian tectonics (Moraes Zarzar 2010, 8-9).

Berlage's conception of space is demonstrated in his simple forms that are externally masked with ornamentation, materials and components which are truthful to their internal structural systems—his forms follow function (Frampton et. al, 1995, 18). Order and simplicity were the two major principles Berlage followed when designing. It was his fascination with Romanesque architecture while traveling in Italy that resulted in such a conceptualization in his work (Moraes Zarzar 2010, 2) He aspired to create pure constructions with minor decorative support by building like the Greeks, Romans and medieval man (Singelenberg, Pieter 1995, 25). Berlage criticized architects of Functionalism who aimed to erase all forms of ornamentation in order to create "modern architecture." He argued that there is strength in creating a new type of ornamentation which is discreet since excessive amounts of ornament leads to a sign of inadequacy in architecture. (p. 25).

It was due to the wide-spread resurging interest of building with brick in the Netherlands in the middle of the 19th century that brought about a new national architectural culture—leading to the revival of many buildings replicating Gothic and Renaissance styles. This was seen mainly in the first large expansion of Dutch cities like Amsterdam and The Hague in the last quarter of the 19th century (Wingender, Jan Peter 2016, 24). P. J. H. Cuypers and other architects created individual houses with ornamented brick facades, which juxtaposed the predominantly “white” plastered housing districts that previously existed. First regarded as being too unusual, the brick homes eventually became a nationwide Dutch favorite. The pressing matter of the housing crisis in the late 19th century, however, resulted in architects to quickly shift their attention from individual houses to mass housing production (p. 25). Berlage’s preference to build more housing blocks in the Netherlands is analyzed in the following section.

3.2. Berlage’s conceptualized unity of the *bouwblok*

The generation after Cuypers, which included Berlage, expressed strong criticism towards the fragmented streetscape. This was partially due to the significance architects of the previous generation placed on individual homes, rather than on the collective housing block. Berlage and others seized this opportunity to fight for *einheitliche blockfronts* (unified block facades), which already existed in Germany at the time— **Figure 3** is an example of what these bouwbloks looked like (Wingender, Jan Peter 2016, 25). Berlage’s generation used brick to express the embodiment of the streetscape, rather than to imitate historical styles and started an architectural housing movement which became a fundamental principle of the early Modern Movement (Wingender, Jan Peter 2016, 26) (Berlage, H.P. 1996, 61).

Berlage’s design for a *bouwblok* (block construction) on Hobbemastraat in the Amsterdam *Zuid Plan* (South Plan) in 1905, reveals how he used his architectonic principles of order and simplicity and his proportional and modular devices to create “unity in diversity”. The Hobbemastraat had a plan module of 1,21 x 1,21 m and an elevation module of 1,21 x 1,00 m—both of which derived from the dimensions of the *Waal* brick. Berlage created a unified streetscape through the repetition and division of these modules—the grouping of the masses (dwellings) forms a monumental housing block. The Hobbemastraat in Amsterdam was part of a series of designs that Berlage composed around proportional grids and modular systems (**Fig. 4**). Two other projects included in the series are the *Beurs van Berlage* and the *Gemeentemuseum*—which are addressed further in chapter **5** (Berlage, H.P. 1996, 47). Berlage’s thoughts on standardization in reference to housing is addressed further in the next chapter.



Figure 3 - Bouwblok houses in Karlsruhe, Germany, circa. 1850 (Berlage, H.P. 1996, 33)

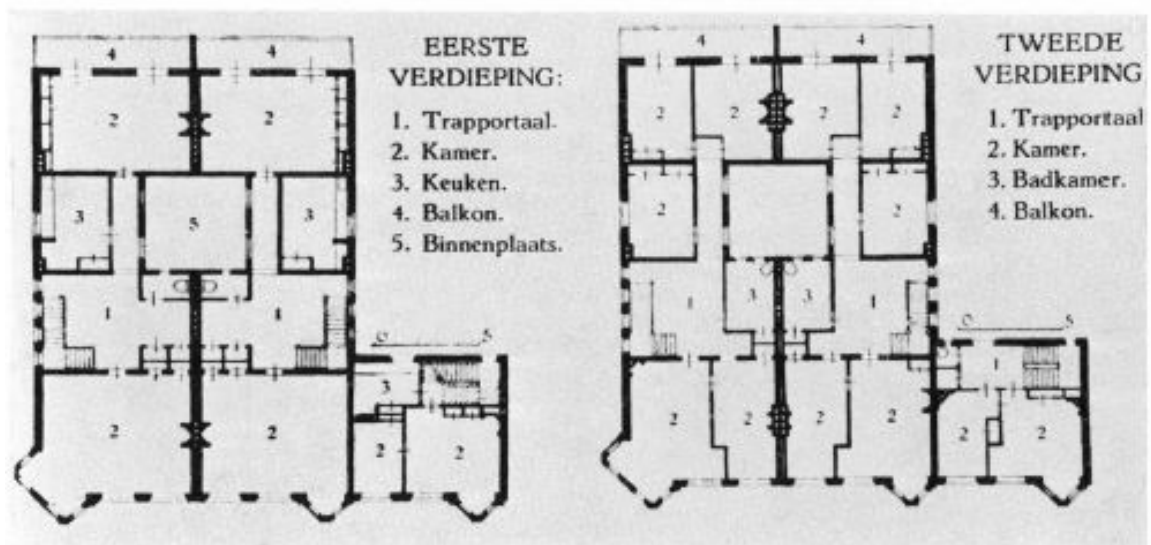


Figure 4 - Hobbemastraat bouwblok plans (Searing, Helen 1974, 136)

4 Berlage's Thoughts on Standardization in Housing Construction

The poor living conditions and housing crisis that the Netherlands continued to face at the end of the 19th century became such an urgent issue in the early Modern Movement that Dr. H.P. Berlage saw it as a professional imperative. Berlage's remarks on housing construction in the Netherlands evoked his architectonic theories and brought forth his socio-anthropological and political views, much of which he indebted to Gottfried Semper's writings (Searing, Helen 1974, 155, 157) (Frampton et. al, 1995, 337). Berlage's thoughts on standardized housing construction are revealed in his book, *Normalisatie in Woningbouw* (Berlage, H.P. 1918).

4.1 Berlage's *Normalisatie in Woningbouw*, 1918

Normalisatie in Woningbouw, published in 1918, was a lecture that Berlage held at the *Architectura et Amicitia*; the topics addressed, however, were remarks that he had previously shared at the newly established *Instituut voor de Volkshuisvesting* (Congress for Public Housing) in Amsterdam (Berlage, H.P. 1918). Berlage responded to a report on standardization written by J. van der Waerden, the Director of the *Bouw- en Woningtoezicht* (Building and Housing Supervision) of Amsterdam at that time (Searing, Helen 1974, 156). According to Helen Searing, Berlage used Van der Waerden's report on standardization as an opportunity to apply his general design theories to the problems of housing rather than directly respond to the problems raised by Van der Waerden (p. 156).

Searing writes that the proposals of Van de Waerden seem obvious today; that in order to meet the demands during a housing crisis, there must be standardization— both of the plan and the structural elements. Standardized and prefabricated parts save time in the process of constructing. In his lecture, Berlage noted that Van de Waerden's "idea" of standardization was not revolutionary for the time; however, it was the "degree" of standardization that Van de Waerden suggested which made it so unappealing to those in the congress (p. 156-157). Van de Waerden believed that the government should control the manufacture and distribution of all building materials and that little choice among details be allowed— he suggested that only one style of door be used along with one basic floor plan, except for corner dwellings. The fear of having infinite, identical housing units produced by the government which restricted all individual freedom of expression angered housing reformers, architects and workers present at the congress (p. 157-158).

To the surprise of many attending the lecture at the *Architectura et Amicitia*, Berlage supported the ideas of Van de Waerden. Berlage stated that there is great promise if standardized housing elements be put together with talent than with *doodambtelijk[heid]* (lifelessness) (p. 160). He also mentioned that when the most talented young architects consider the call to create standardized housing, extraordinary things could be achieved; since, the control and conception of

units grouped together into great masses required much greater ability and talent versus building a single house (Berlage, H.P. 1918, 45-46). Berlage's design principles of order and repose are heavily conveyed in the lecture and are supported by the examples of historical buildings and cities he used in his lecture—which reveal that order and regularity is itself a very human activity (Fig. 5). Searing argues that what Berlage wanted was not the extreme standardization Van de Waerden advocated for, which is like what one sees in industries of mass production, but he supported the repetition of the same dwelling type with “quiet” variety, the creation of united *bouwbloks* (Searing, Helen 1974, 161-162).

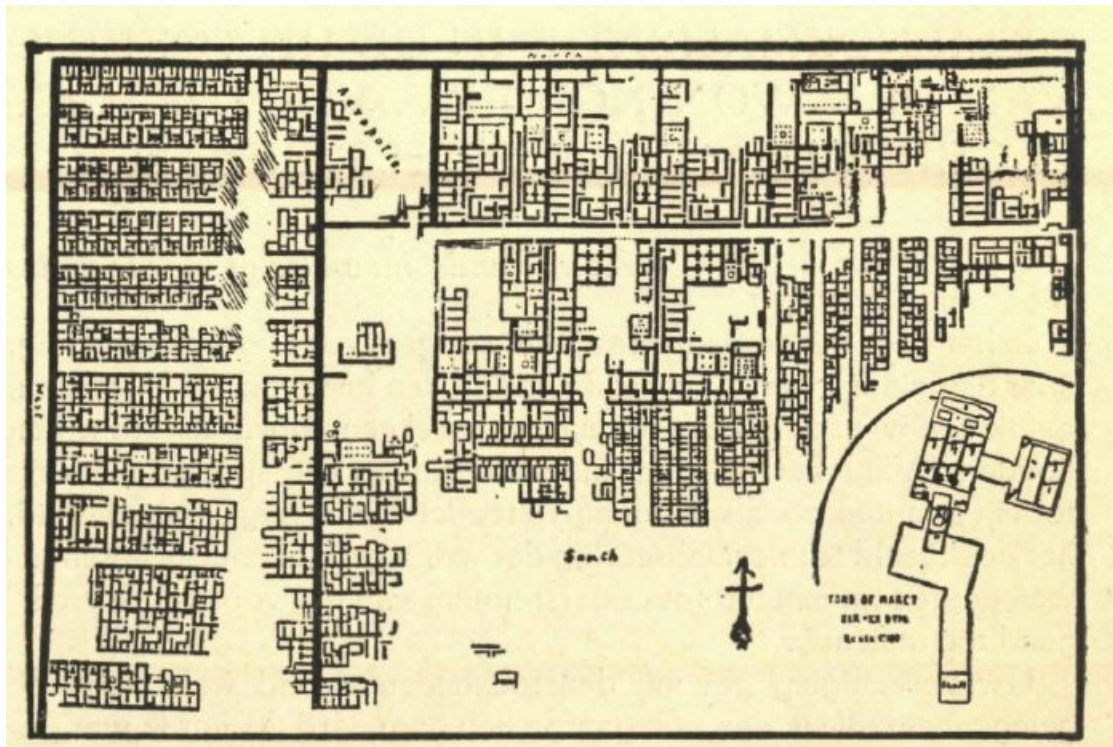


Figure 5 - Plan of Illahun, an Egyptian worker city in 3000BC (Berlage, H.P. 1918, 22)

4.1.a Egoistic architecture vs. Ecocentric architecture

According to Berlage, the 19th century had lost the sense of the collective due to the “hyper-individualism” which had developed in the Netherlands (Berlage, H.P. 1918, 37). He believed that standardized *bouwbloks* have a social and aesthetic necessity, that the grouping of identical dwellings can become an expression of collective culture and can form a new architectural order (Berlage, H.P. 1918, 37) (Searing, Helen 1974, 161-162).

Viollet-le-Duc's *familiemagazine* (family magazine), a type of communal family house, is mentioned in *Normalisatie in Woningbouw* to highlight Berlage's disapproval of Van de Waerden's comment which suggested that the bourgeoisie would not approve of living in the same dwelling type as the lower working classes (Berlage, H.P. 1918). Berlage used this example to reiterate that collective housing, which existed in the past and was in fact first associated with the working classes, is now taking on a more necessary character; hence, referring to the architectural and

tectonic nature of the modern housing *bouwblok*. Although housing blocks have collectively housed various levels of society in history before, it is just the way in which they are conceived now that differs— standardized and mass produced.

Berlage advocated for standardized housing construction which followed his architectonic principles of order and repose. He acknowledged that even though housing reformers, architects and workers were strongly against the idea of building identical rowhouses, they must consider standardization, along with simplicity and order, to bring back “morality” and “social equality” to the art of construction (Berlage, H.P. 1918, 38, 41, 44) (Kaufmann Jr., Edgar. 1974). This also prevents architecture from being taken over by industries that produce buildings quickly, cheaply and with *doodambtelijk* (Moraes Zarzar, Karina 2010,11) (Searing, Helen 1974, 160). Berlage’s design for the *bouwblok* on Hobbemastraat in Amsterdam *Zuid*, as mentioned in Chapter 3, is one such example. The following chapter will further analyze Berlage’s principle of “unity and diversity” along with his systems of proportion and measurement.

5 Gemeentemuseum & Beurs van Berlage

Dutch architects in the early 19th century, Berlage included, were fascinated with building with brick (Wingender, Jan Peter 2016, 24). However, unlike other architects, Berlage often used two systems of measurement to refine the layouts of his buildings: an approximation of the Egyptian triangle (the 8:5 isosceles triangle) and the proportions of the standardized *Waal* brick. This chapter analyzes the *Gemeentemuseum* and *Beurs van Berlage* as case studies, to reveal the way in which Berlage implemented his systems of measurement and how his architectonics principles, inspired by Gottfried Semper's and Viollet-le-Duc were implemented in the designs. Focus is placed on the *Waal* brick system because of its systematic modular application, in that one module of brick is used to define the entire structure of the building.

5.2 History and system of measurement in the *Gemeentemuseum*

The *Gemeentemuseum*, which had two design iterations (1919-1924, 1927-1935) was first criticized for having too many forms—it was envisioned as a symmetrical 'U' shaped building with domes along both ends (Singelenberg, Pieter 1995, 33). Art historian Pieter Singelenberg writes that critic A. Boeken, expressed disappointment with the muddle of separate roof surfaces and chimney-like corner constructions and claimed that the exterior of the building had too many visual leaps that resulted in “the tragic ideal of our great realistic architect” (p. 33). The conservative periodical *Onze Zelfstandigheid* also criticized Berlage for designing a “complex of mosques” and stated that Berlage's brick formations deserved no praise especially since “the laudation of the Dutch Renaissance” (p. 34). Due to much critique, Berlage had to rethink the way in which he approached the design for the museum. Berlage's second version of the complex followed a newly envisioned structure, created by a 1,1m² grid, unlike the 3,5m² grid used in his first design (p. 35). It was the idea to rely on the proportions of a standardized sized brick, specifically the *Waal* brick, which made this design possible.

Aware of the problem that occurred with rowlock courses since the *Waal* brick's length is not a multiple of its height, Berlage adjusted the proportion of the Brick to work with the 1.1m² grid— derived by a multiple of the *Waal* brick (10 x headers + mortar joints) (Wingender, Jan Peter 2016, 152). He changed the height of the brick from 5,25 cm to 4,50 cm, resulting in a *Waal* brick whose size was now 21,5 cm x 10,5 cm x 4,50 cm (p. 153). This allowed Berlage to work with a brick module that reflected the interior grid-like structure of the building— two headers of brick plus two mortar joints fit in 11 cm (p.153) (Fig. 6). With the adjusted dimensions of the *Waal* brick, Berlage established a window glazing dimension of 440 mm, which helped to establish harmony among the different window dimensions in the façade— this technique would go on to inspire the work of Geurst & Schulze Architecten which is analyzed in chapter 6 (p. 153). Along with using the modified *Waal* module, Berlage also incorporated an approximated Egyptian triangle into the design—something he learned from studying the work and theoretical writings of Viollet-le-Duc

(Frampton et. al, 1995, 337) (Kaufmann Jr., Edgar. 1974). Berlage argued that designing with an isosceles triangle helps maintain the proportions of the building, an aspect to the historic art of construction — it helps bring rhythm and order into the design (Singelenberg, Pieter 1995, 43).

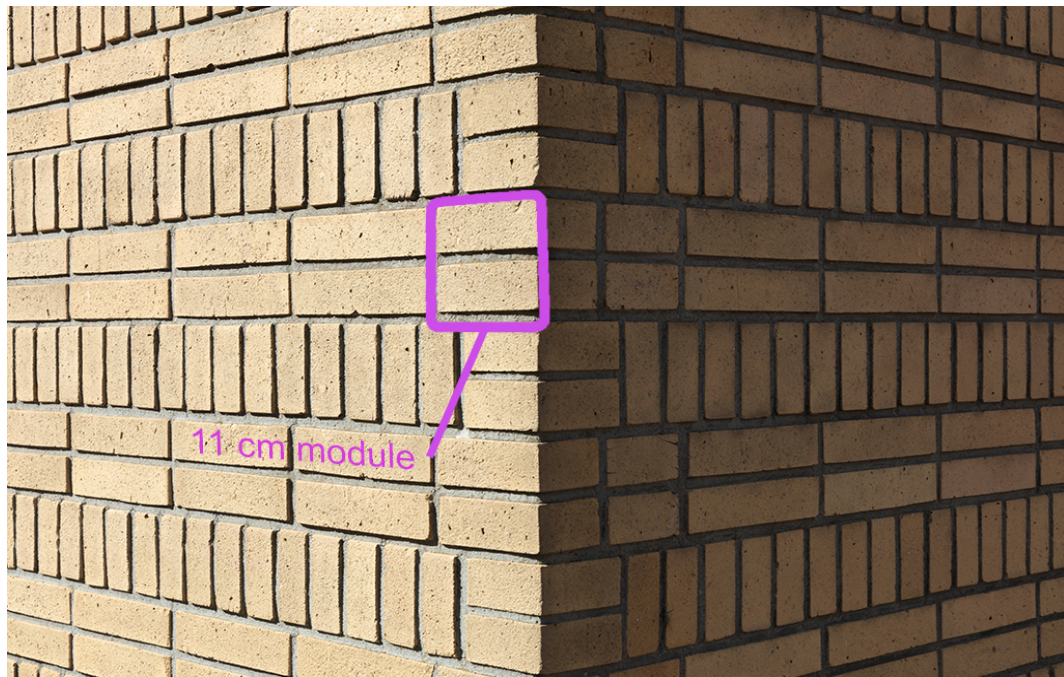


Figure 6 - Closeup of Gemeentemuseum brickwork with edit from author (Schreurs, Gerrit, 2021)

Berlage's choice to implement an approximation of Violet-le-Duc's Egyptian triangle (8:5 triangle) method was not unique, in that it was reminiscent of the way harmonious proportions were derived in Romanesque architecture (Singelenberg, Pieter 1995, 43) (Kaufmann Jr., Edgar. 1974).

5.2a Analysis of the *Beurs van Berlage*

To understand how Berlage used the relative Egyptian triangle to design, I will briefly analyze the *Beurs van Berlage* in Amsterdam. As mentioned earlier, Dr. H.P. Berlage revered the simplicity of form and saw value in studying proportionality and measure to establish a coherent building design that suited a site and its functions— this was a historic practice amongst builders; however, it is often forgotten by many in daily practice today (de Jong, et. al, 2002, 118). Berlage was one of several Dutch architects in the late 19th century to recognize the beauty of this historic approach and applied it to the *Beurs van Berlage*. According to Dutch architect Jan Molema, the *Beurs* was the Dutch hallmark for progressive architecture during the 20th Century and it is its “purification of form” that continues to impress later generations (p. 119). Berlage arrived at the “purified” design of the *Beurs* by using a proportional system that approximated the Egyptian Triangle— a significant tool invented at the end of the 19th century to study the proportions of ancient Egyptian architecture (Rossi, Corinna 2003, 23).

Berlage used an approximation of the Egyptian Triangle (8:5 isosceles triangle) with oblique side $\sqrt{41}$, base 8 and height 5 to design the *Beurs* (de Jong, et. al, 2002, 119) (Rossi, Corinna 2003, 23). This proportional system has a ratio of 1:1,6 which is very similar to the Golden Section ratio (1:1,618...); however, the advantage is that Berlage's system works with whole numbers (de Jong, et. al, 2002, 119). As stated previously, Berlage's choice to use a relative Egyptian Triangle comes from the theoretical writings of Viollet-le-Duc in his book, *Entretiens*, which reveals proportional studies he conducted on various monuments from different time periods—Figure 7 is a study Viollet-le-Duc conducted on the Parthenon in Rome (Rossi, Corinna 2003, 11,15). Figure 8, drawn by Dutch Architect Jan Molema, reveals the 8:5 triangle Berlage implemented in the construction of the *Beurs*.

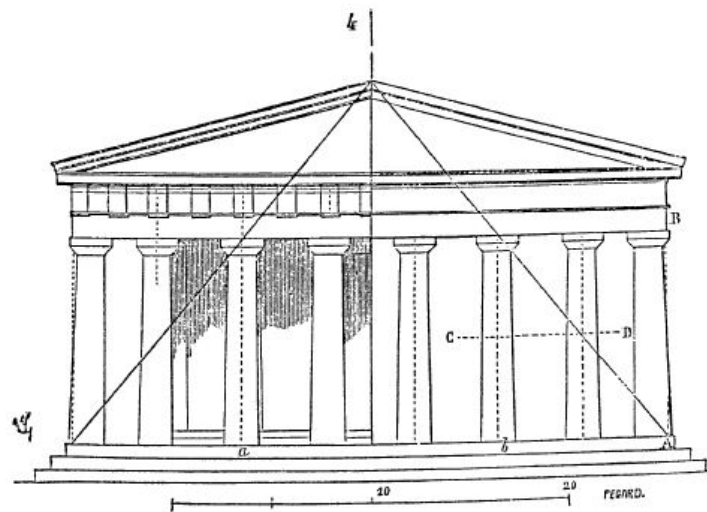


Figure 7 - Viollet-le-Duc's study of the Egyptian Triangle on the facade of the Parthenon (Rossi, Corinna 2003, 15)

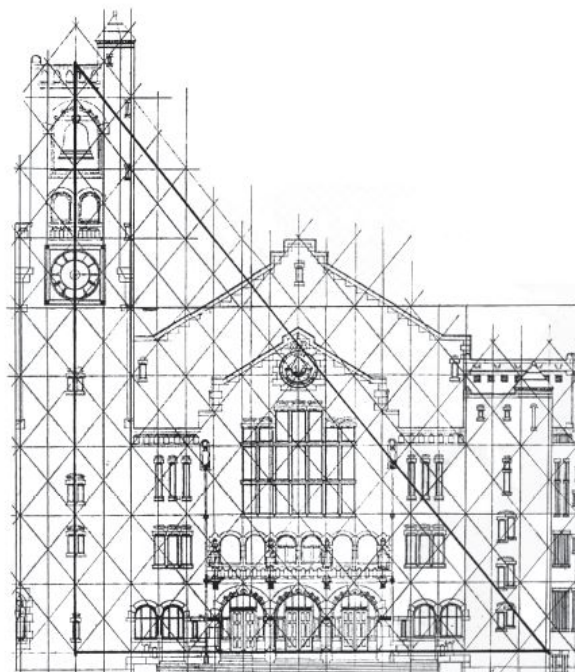


Figure 8 - Berlage's proportional system used on the Beurs (de Jong, et. al, 2002, 124)

Along with a proportional system, Berlage also implemented the *Waal* brick in the *Beurs* construction as a second measuring device. The *Waal* had the popular Dutch industry format, 21,5 cm x 10,5 cm x 5,25 cm, with a proportion of 1:2 (Berlage only altered the brick size to 21,5 cm x 10,5 cm x 4,50 cm for the construction of the Gemeentemuseum) (de Jong, et. al, 2002, 120). According to Dutch architect Jan Molema, however, Berlage's choice to use the standardized *Waal* brick with his proportional system for the design of the *Beurs* made it "appear awkward" at some intersections. (p. 123). This is due to Berlage's applied *Waal* brick format of 11,2 cm (two headers of 5,25 cm plus a mortar joint) and 6,25 cm (one header plus a mortar joint)— has proportion 1:1,8, which only partially correlates with the proportions of his 8:5 Triangle (1:1,6) (p. 119). Molema writes that the standardized *Waal* brick Berlage used in the construction of the *Beurs* would have been more suited for a construction that relied on a different triangle that Viollet-le-Duc saw as "proportionally correct"— an equilateral or right-angled one as shown in Figure 9. Yet, this also would have been difficult with the standardized *Waal* brick, since space needs to be kept between the bricks for mortar and tolerance of size deviation (p. 120).

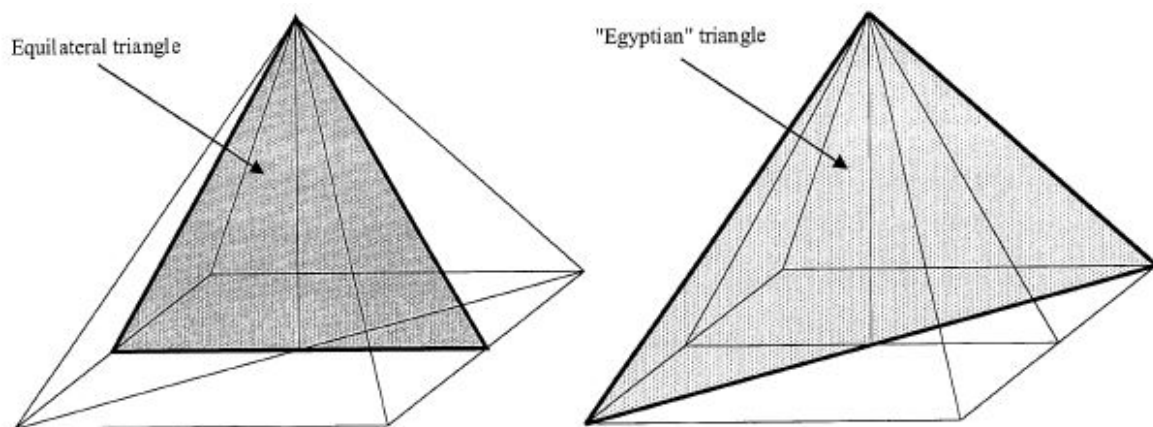


Figure 9 - Viollet-le-Duc's Equilateral and Egyptian triangles (Rossi, Corinna 2003, 12)

To help improve the issue of wall cohesion especially at terminations such as corners, and between windows, Berlage implemented a cross bond he termed, "*drieklezoor*" (three-quarters of a brick stretcher) (p. 120). According to Molema, this strategy, however, also had its limitations and resulted in different brick termination patterns, some a-symmetrical; therefore, not entirely satisfying the architectural principles of "quietness" and "repose" that Berlage himself envisioned (p. 120). To achieve more "quietness" and wall cohesion, Molema suggests that we would expect Berlage to have designed the surfaces between windows with an odd number of brick headers (resulting in symmetrical brick course terminations). Although Molema states that Berlage did not do so and used an even number of headers, we see in Figure 10 and Figure 11 that Berlage uses 21 brick heads for window openings and 13 heads between windows on the ground floor— together they make 34 headers for two modules of 17 headers (p. 120).



Figure 10 – 21 brick heads above a window opening in the Beurs façade, edit from author (van Hoek, Bart n.d.)

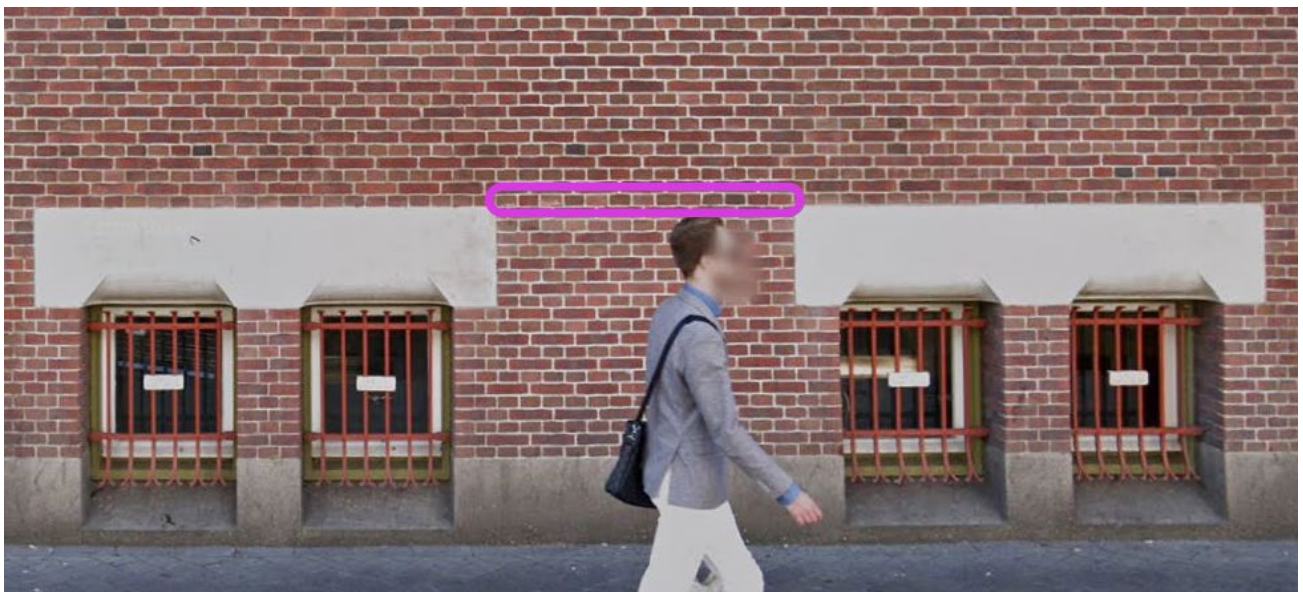


Figure 11 – Beurs façade on Damrak street revealing 13 brick headers on ground floor, edit from author (Google n.d.)

The *Beurs van Berlage* was the first in a series of buildings that Berlage designed using the relative Egyptian Triangle (8:5 Triangle) and the *Waal* brick module (Berlage, H.P. 1996, 47). The way he designed the *Beurs* would encourage him to experiment further in search of refinement with other constructions such as the *bouwblok* on Hobbemastraat in Amsterdam (Chapter 3), built in 1905, and the *Gemeentemuseum* (second version), eventually constructed in 1927.

5.3 Reflection and conclusion

According to Pieter Singelenberg, Dr. H.P. Berlage was in pursuit of monumental design through material directness (Singelenberg, Pieter 1995, 25). His search for calmness or repose was synonymous with style and it was to be always present both inside and outside of the building (p. 31). Today, the *Gemeentemuseum* stands as a historic monument and is itself acknowledged to be an artwork along with the other art pieces inside (Omroep West, 2020, Timestamp 1:49-2:03). Berlage's choice to use a concrete framework for its structure and clad the building with a latticework of standardized bricks— inspired by Semper's *Bekleidungstheorie* (Theory of Dressing)— made the *Gemeentemuseum* one of the earliest concrete framed structures in the Netherlands (Sorensen, Lee n.d.) (Omroep West, 2020, Timestamp 1:30-1:42). Although completed in 1935, it remains as a “wondrous” icon of early Modernist architecture (2:21-2:29). The influence Berlage's systematic construction process has on modern works is analyzed in the following chapter.

6 Modern Implementations of Berlage's Modular Brick Systems

To see how Berlage's architectural principles of "quietness" and "repose" and his implementation of proportion and measure have inspired modern works today, this chapter analyzes two works of Geurst & Schulze Architecten and a personal exploration. Captivated by the way Dr. H.P. Berlage used brick to design the *Beurs* and the *Gemeentemuseum*, Geurst & Schulze Architecten has developed its own method of construction by using the size of a step riser to develop harmonious brick façades that showcase "unity in diversity" – the main design principle Berlage strived for (Rovinelli, H. 1984, 257).

6.1 Modern case study, Andreas Ensemble Lelylaan, Amsterdam, Geurst & Schulze Architecten

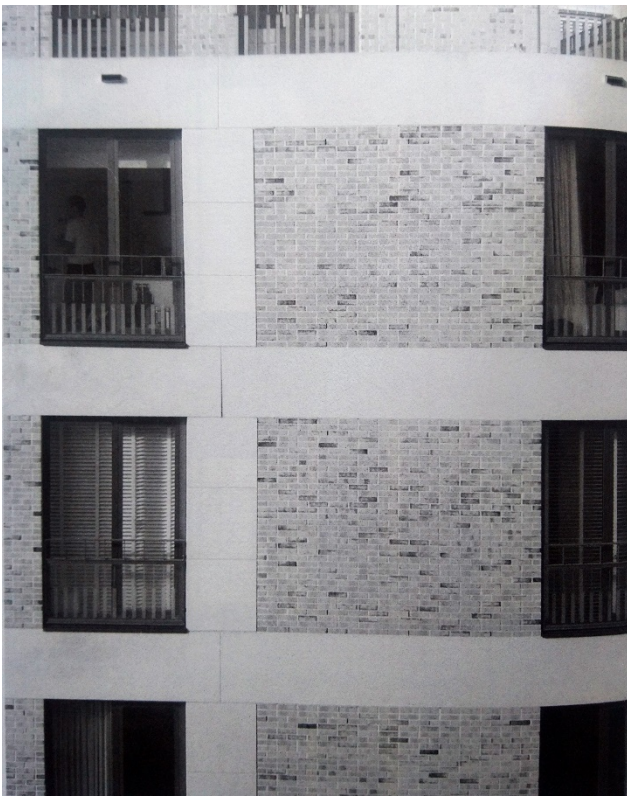


Figure 12 - Facade of Andreas Ensemble Lelylaan (Wingender, Jan Peter 2016, 160)

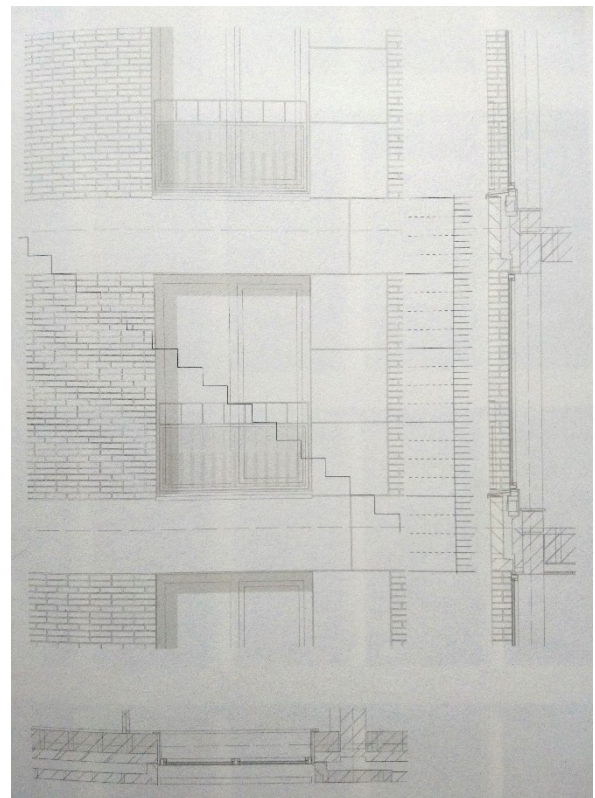


Figure 13 – Proportional brick system of Andreas Ensemble Lelylaan (Wingender, Jan Peter 2016, 161)

The Andreas Ensemble Lelylaan located in Amsterdam was built using "the most elaborate system of measurement" by Geurst & Schulze Architecten (Wingender, Jan Peter 2016, 156). It is composed as a super-block, containing more than 500 dwellings and a hotel. Reflecting on Berlage's concept of a *bouwblok*, this structure is created as an ensemble of parts, with units grouped together to form a long urban façade. To achieve "unity in diversity", the architects have composed each varied façade with its own façade variant (**Fig. 12**) (p. 156).

Each façade composition consists of four zones per story— the size of four steps ($4 \times 185 = 740 \text{ mm}$) (Fig. 13) (p.156). Each zone has 12 rows of brick and they alternate between masonry and concrete every 740 mm. The size of a step, in this case, 185 mm, is the proportional system that Geurst & Schulze Architecten integrated into their design process (Wingender, Jan Peter 2016, 156). The architects believe that integrating the size of a step with the size of a brick allows for designs with good technical solutions (p. 153). This especially helps with the proportioning of the façade since the dimensions of the façade material are “inextricably linked” with the section of the building (p. 153).

The grid module of the Andreas Ensemble Lelylaan is 5,40 m, resulting in a division of 7 zones of 7 brick headers. These zones also form the rhythmic breaks in the windows and the width of the concrete piers, each 770 mm wide (p. 156). This measurement system is clear to see in the composition of brick headers and courses as well as in the height of the interior furnishings such as the railings on the staircases (p. 156).

6.2 Case study 2, Nieuw-Crooswijk, Rotterdam, Geurst & Schulze Architecten

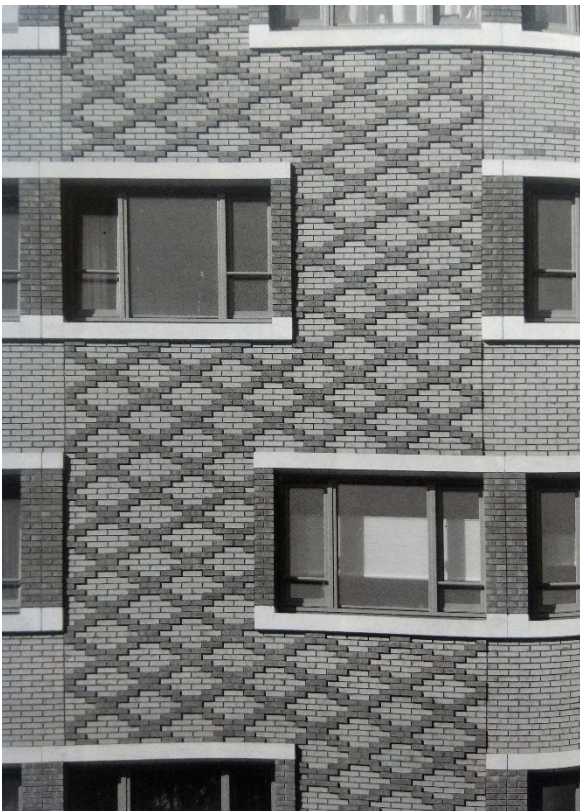


Figure 14 - Facade of Nieuw-Crooswijk (Wingender, Jan Peter 2016, 164)

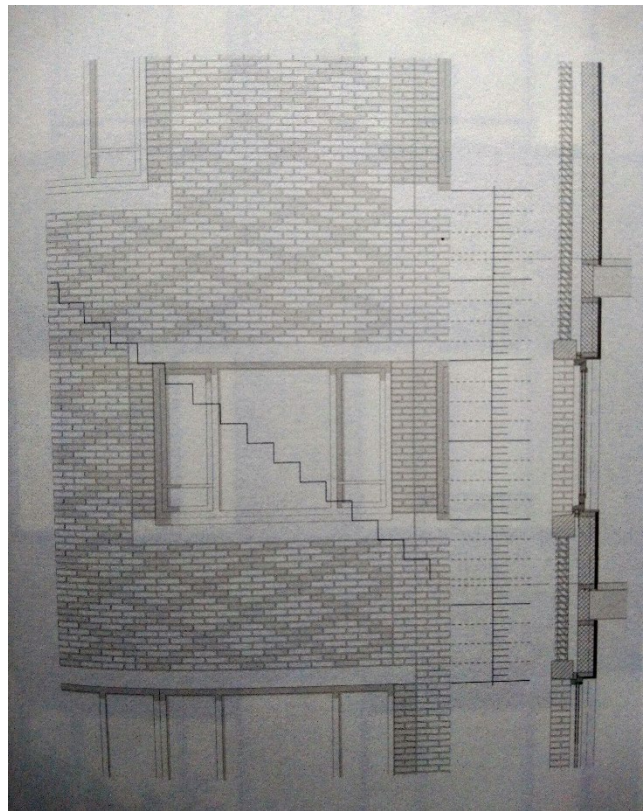


Figure 15 – Proportional brick system of Nieuw-Crooswijk (Wingender, Jan Peter 2016, 165)

The Nieuw-Crooswijk building located in Rotterdam (Fig. 14) was also constructed using the size of a step and the size of a brick (p. 155). To create a harmonious façade that integrated lintels and sills around the window openings, Geurst & Schulze Architecten proposed to make the lintels and

sills the size of a 185 mm rise –the size of the step riser (p. 155). The window openings in the building have both a height and width of 1.48 m, while the spandrel also has a height of 1,48 m (half the height of a story)— it is composed of eight steps ($8 \times 185 = 1480 \text{ mm}$) (Fig. 15). This allowed for a façade zone of 3 layers of 6 step risers (8 step risers of brick, minus 2 step risers for the lintel and sill); hence, 18 rows of brick (p. 155). Due to expected problems with the insulation problems of the roof garden, however, the parapet of this building needed an additional layer of masonry, thus making the topmost zone of the building unproportioned to the rest (p. 155).

6.3 Reflection

These works of Geurst & Schulze Architekten reveal how Dr. H.P. Berlage's proportional systems and brick measuring devices have influenced their work. Although they do not use the 8:5 triangle, such as Berlage, they use another ancient proportional technique— the dimensions of the human body, specifically, the size of a human footstep (p. 153).

6.4 Personal Exploration

Inspired by the design process of Geurst & Schulze Architekten, I conducted a personal study that incorporated the size of a step riser and the dimensions of a terracotta block. Instead of relying on traditional stacking techniques, I chose to create a structure with a façade that could be prefabricated off-site and quickly assembled on-site. The topics of mountability and dry stacking were considered and thus inspired me to develop a terracotta block as seen in Figure 16 with a dimension of 420 mm x 360 mm x 50 mm (L x W x H). The height of each terracotta façade element is the equivalent of two step risers ($180 \text{ mm} \times 2 = 360 \text{ mm}$), while the width is equal to the

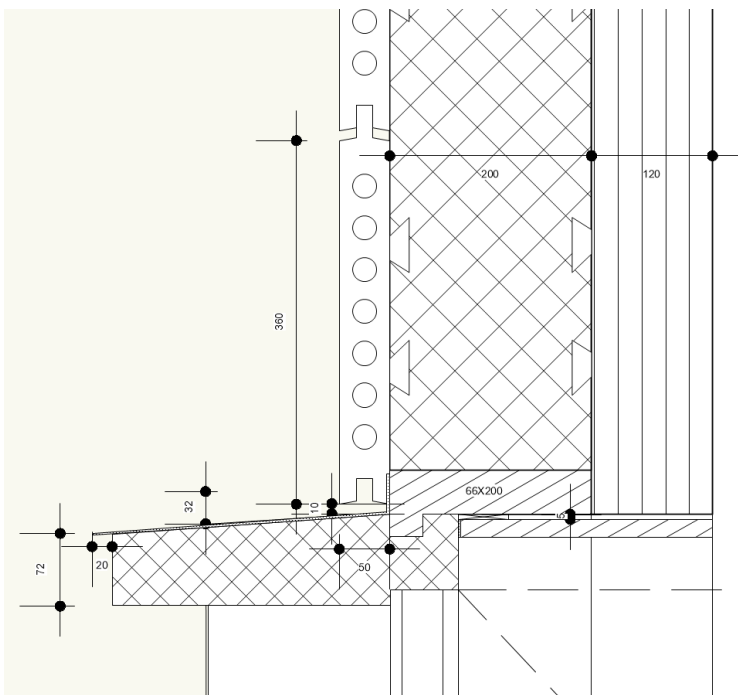


Figure 16 - Detail of dry-stacked terracotta block

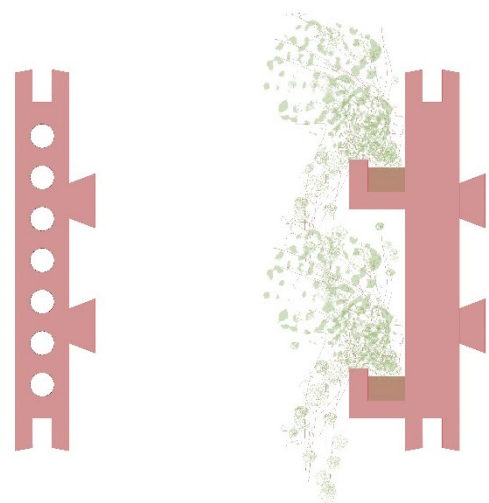


Figure 17 – adapted form of façade element, North vs. South

same length of two *Waal* bricks placed back-to-back (210 mm x 2 = 420 mm).

Interested in testing to see how future architecture projects could implement the idea of proportion and measurement while also trying to mitigate issues the building industry faces today such as construction waste, high costs, lengthy construction phases, the Urban Heat Island Effect and more, this exploration can act as an example for future development.

The terracotta elements as seen in [Figure 17](#) are adapted to meet the needs of different oriented facades, a “pure” energy-efficient element for the South with an integrated water-pipe system used for collecting solar energy is proposed as well as a “layered” planter façade element for the North to provide greenery and shading. In [Figure 18](#) a fragment of a Northern façade is shown including a cross-section of the interior—the purple lines highlight the 22 steps that are aligned and revealed in the interior structure.



Figure 18 - Northern façade with cross-section revealing indications of interior step risers on exterior terracotta elements

7 Conclusion

By analyzing the works of both Berlage and numerous individuals that were relevant and acted as a form of inspiration for his work, this paper finds that Berlage's design process was overly rigid and over-engineered which therefore had its limitations. These limitations were already voiced during his lifetime by the generations of architecture following him— particularly by the architects of the Amsterdam School Movement. When considered within the scope of Geurst & Schulze Architecten, it can be stated that Berlage's architectonic principles and techniques for proportional and dimensional designing result in an overly complex methodology that, despite being rigid, is too defined to be generally practical but could result in an enriched and fulfilling design that can be applied en masse.

When considering the concept of mass construction and mass-applied construction, the principles outlined by Berlage are put into practice today by Geurst & Schulze through means of not only considering Berlage's proportional measuring devices but by also considering Berlage's architectonic principles, such as “unity in diversity”— as can be seen in their building facades. Future work could, as a result, be more “daring” against the principles. This can be seen in The Netherlands today in which many buildings are too alike, often due to the engineers and building corporations building quickly and cheaply and not interested in exploring designs that push the limits of façade variety— just as Berlage warned by stating that standardized mass housing has potential but needs to be pursued without *doodambtelijk[heid]* (lifelessness). With the Netherlands facing another housing crisis in the 21st century, young architects interested in designing new housing developments should consider Berlage's principle of “unity in diversity” and elevate it to a higher level, as many buildings today are too standardized and therefore do not meet the demands or wishes of the population, yielding in housing which lacks the liveliness that every individual wishes for.

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Figure 15	27	(Wingender, Jan Peter 2016, 165)
Figure 16	28	(Wiedenhöver, Laura 2021)
Figure 17	28	(Wiedenhöver, Laura 2021)
Figure 18	29	(Wiedenhöver, Laura 2021)