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Picture on the front cover: «Paris Lacaton & Vasal». Photo: Ulrik Stylsvig Madsen

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TOWARDS A TECTONIC APPROACH – ENERGY RENOVATION IN A DANISH CONTEXT

MARIE FRIER HVEJSEL, POUL HENNING KIRKEGAARD AND SOPHIE BONDGAARD MORTENSEN

Abstract

Given the increasing environmental and legislative demands to reduce energy consumption, not only new constructions but also the existing urban fabric is about to change radically in the coming decades. Existing buildings cannot simply be restored but must undergo a transformation to comply with these demands. As the largest potential for energy savings lies in re-insulation of the building envelope, specifically by adding an additional insulation layer, this transformation will dramatically affect the everyday experience of the built environment. Articulating the architectural consequences and potentials of this transformation is an urgent matter if it is not to be realized solely as a monotonous technical cladding. In this matter, that of conceiving such extra insulation layer simultaneously as a technical 'principle' and as a spatial 'gesture' revealing an aesthetic architectural potential through this transformation is inevitably a tectonic question. By analyzing three historical examples, Adolf Loos' Villa Moller, Le Corbusier's Unité d'Habitation, and Frank Lloyd Wright's Johnson Wax Administration Building, chosen for their tectonic ability to exploit the technical 'principle' defining the building envelope as an aesthetic 'gesture', this paper discusses the architectural challenges related to energy renovation in a Danish context and tectonic design method as an approach to these challenges in everyday practice.

Keywords:
energy renovation, everyday architecture, tectonic method

Introduction

During the coming decades the existing urban fabric is about to change radically in order to meet the necessary and increasing environmental and legislative demands to reduce energy consumption. In Denmark the demands for 2050 aims for a CO_2 neutral society, which asks for an energy saving of 73% of the existing consumption for buildings (Kragh and Wittchen, 2010). As estimated by the European Commission, construction and operations of buildings in Europe are responsible for 40–50% of the total energy consumption today and it has been found that the greatest energy saving potential lies in renovation of existing building mass (European Commission, 2014; Jensen, 2009). Recent research estimates that 75% of the buildings that exist today will subsist and still be here in 2040, hence, a considerable amount of the existing building mass must be energy renovated to comply with the aims for 2050 (Jørgensen, 2010; Kongebro, et al., 2012). As the largest potential for energy savings lies in the re-insulation of the building envelope, specifically by adding an additional insulation layer, this transformation will dramatically affect our spatial experience of the built environment (Jensen, 2009; Havelund, 2011; Marsh, Fauerbjerg and Kongebro, 2013). Hence, the question of articulating the architectural consequences and potentials of this transformation is an urgent matter if it is not to be realized solely as a uniform technical cladding. It is our hypothesis that this calls not only for technical development and innovation, but is to a great extent a matter of developing a tectonic approach, which is capable of articulating and realizing the aesthetic potential within such technical transformation process. As architects we have a great responsibility to involve ourselves in the hasty development and practice of the building industry in this matter. This is where this paper takes its point of departure.

Within the midst of the hasty multidisciplinary economical and technical context of the current and future building industry the quality of the general architectural practice – of everyday practice – is increasingly challenged. Within this midst, the fundamental and in our understanding finest potential of architecture to invite us to be together or to contemplate in solitude by addressing the human scale, what we have chosen to describe as the ability of architecture to 'gesture' us, is easily oppressed. When considering the particular context of energy renovation, this challenge seems only to increase its extend. Since energy consumption is measureable, it stresses the technical and objective 'principles' of architecture, whereas the more aesthetic immeasurable, but in our understanding essential, dimension of architecture as a spatial 'gesture' is hard to position within this context. Consequently, the technical potential and advantages of energy renovation have already been studied in great detail and outlined through innumerable research and practical pilot projects (Geier, 2013; Hrabovszky-Horváth, Szalay and Csoknyai, 2013; Kaufmann.Lichtblau.Architekten, 2013). However, as stated also by Terri Peters reduced energy consumption does not neces-

sarily induce better architecture (Peters, 2011). Hence, there is an urgent need to link and develop these results further through a particular focus on the aesthetic immeasurable dimension of architecture and the challenge of positioning it in everyday renovation practice. In the Danish context, the research effort addressing this particular question of architectural quality related to energy renovation is currently increasing, forming the foundation for overcoming this challenge. In this matter Søren Smidt-Jensen and Signe Cecilie Nørgaard use the architectural preservation scale as a starting point, whereas Marsh is focusing on different typologies and building periods as specific case studies (Smidt-Jensen and Nørgaard, 2011; Marsh, Fauerbjerg and Kongebro, 2013). Signe Kongebro on the contrary is suggesting a specific focus on daylight, which appears as an approach embracing the question of architectural transformation and hereby positioning a necessary consideration of the relation between preservation and transformation as a key issue when concerned with the question of architectural quality in energy renovation (Kongebro, et al., 2012). Hence, a significant issue and common point of interest of several researchers is the importance of preservation of the architectural expression, which is contained in the existing building envelope, which is naturally a key issue if dealing with existing buildings worthy of preservation. However, if inverted, there is a simultaneous need to develop a strategy for how to radically add architectural value to buildings of no particular existing spatial quality through transformation; to develop an architectural strategy for energy renovation that critically addresses the increasing spatial monotony of everyday practice, of ordinary single family houses, multistory dwellings, and office complexes etc. It is this particular challenge that we address with this paper. In this matter the recently published design guide Arkitektur Energi Renovering that is the result of cooperation between Danish Building Research Institute, Henning Larsen Architects, The Energy Foundation, and Realdania form a significant foundation (Marsh, Fauerbjerg and Kongebro, 2013). Herein the authors endeavour a 'holistic' approach to energy renovation focused at 'increased value'. In this matter they define three kinds of increased value that should all be present in forming a holistic energy renovation project: 'user value', 'architectural value' and 'economical value' (Marsh, Fauerbjerg and Kongebro, 2013). In the design guide the authors have described three basic building typologies: the single-family house, the multistory dwelling, and the office complex that they have chosen to apply since they define the majority of the building mass in relation to the number of square meters and the energy consumption. In total the design guide form a basic outline for how to approach an energy renovation project moving from an understanding of the given building typology, over analysis of its specific profile and potential to the design of the actual renovation project. When describing architectural value the authors refer to that of 'taking advantage of the geometry', 'including unused spaces', 'extending the existing building', 'adding new functions', and 'improving the spatial quality', however, without offering an elabo-

rate account of the latter (Marsh, Fauerbjerg and Kongebro, 2013, p. 5). In this paper we take this work, and the three basic typologies described herein, as a basis from which to zoom in further on the question of 'improving the spatial quality' through the energy renovation process. How can the building envelope provide 'improved spatial quality' by means of the energy renovation process we ask ourselves? The choice to use the three typologies described in the design guide as a basis here is done as a means to enable a relation of the potential findings of the paper to the current discourse and practice of energy renovation in a Danish context of which the mentioned design guide is a currently dominant exponent. Hence, the aim here is not to discuss the appropriateness of this choice of typologies as such, but to attain a tectonic perspective on the topic of energy renovation. As stated above, the most significant measurable potential for energy saving is to be found in the building envelope by an added exterior layer of insulation (Kragh and Wittchen, 2010; Wittchen, 2004; Wittchen 2009). Hence, the task of developing the architectural potential of this additional layer is central, forming our focus here. It is our hypothesis that a recalling of the etymological meaning of the tectonic as an account for the dual aesthetic and technical task of the tekton, can become a decisive means in addressing this question of 'improving the spatial quality' as it links the technical need for an additional insulation layer with its experienced aesthetic value. Consequently, it is the objective of the paper to discuss the architectural challenges related to energy renovation in a Danish context and tectonic design method as a potential approach to these challenges in everyday practice.

Method

Methodologically this is done through a rereading of tectonic theory focused at the spatial and methodological conceptions of the term that is specific to, and link, the works of Gottfried Semper, Eduard Sekler, and Marco Frascari (Semper, 2004 [1861]; Sekler, 1964; Frascari, 1984). Hence, this rereading is intended to relate the notion of tectonics with the present challenges of energy renovation in everyday practice as a critical developer. In this matter Semper's positioning of the creation of an inviting spatial experience, what we denote here as a 'gesture', as the primary responsibility of the architect, forms a critical point of departure. In Sekler's work this critical point of departure can be said to be developed methodologically in Sekler's account for the tectonic as a critical shaping of spatial 'gestures' by means of structural 'principles' (Sekler, 1964). Finally, Frascari's linking of the general spatial quality of architecture, its narrative, to the active constructive solution of the detail as the breeding ground of architecture allows us to form a tectonic analysis method enabling us to critically study the relation between spatial 'gestures' and 'structural' principles in specific building details and the role of the architect in this matter, a method that is described at length in the literature (Hvejsel, 2011; Hvejsel and Kirkegaard, 2015; Hvejsel, 2014). Applying this

analysis method we analyze three details in three acknowledged existing historical examples of architecture: A single-family house, Adolf Loos' Villa Moller, a multistory dwelling, Le Corbusier's Unité d'Habitation, and an office block, Frank Lloyd Wright's Johnson Wax Administration Building. The examples are selected because of their unique ability to unfold a spatial 'gesture' at the human scale by means of a spatial transformation and exploitation of the building envelope, see figure 1–3 below.

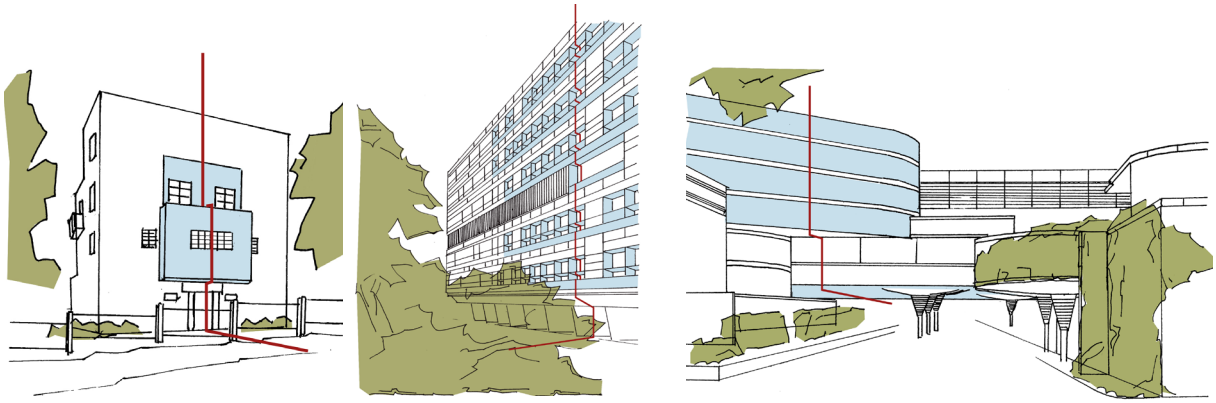


Figure 1–3
Villa Moller by Adolf Loos 1930, Unité d'Habitation by Le Corbusier 1952 and Johnson Wax Administration Building by Frank Lloyd Wright 1936.
Exterior views exemplifying the ability of the building envelope to unfold a spatial 'gesture' at the human scale.

The motivation to choose these historical examples, that are not energy renovation projects, is to focus our attention on the above stated research question of 'how the building envelope can provide improved spatial quality'. As an example the bay window of Loos' Villa Moller unfold and embracing 'gesture' that is visible and sensed in both interior and exterior. By analyzing these 'gestures' tectonically it is the intention to uncover their relation to the structural 'principles' applied in their realization, hence, to learn from them at a critical methodological level applicable in future energy renovation practice. This means that these works are studied here as illustrative examples addressing the need to develop our ability to learn from our heritage, which is (still) a major challenge to the architectural discipline, especially as new technical demands are raised such as those related to energy renovation. Recently, Journal of Architectural Education devoted an entire issue to the question of precedence and the linkage between history, criticism, theory and design in architecture (Dodds, 2011). Of particular interest to us here, Edourd Sekler has addressed this challenge continuously in his teaching and research introducing tectonics as a possible means in this matter, showing an example that we follow here (Sekler, 1957; Moholy-Nagy, et al., 1967). In a further development the proposed analysis of the three illustrative examples could be elaborated into full-bodied case studies by combining them with for example anthropological and societal studies of contemporary single-family houses, multistory dwellings, and office blocks throughout an actual energy renovation process, but it is outside the scope of this paper. Researchers like Robert Yin and Donald Schön offer valuable directions to engage with the complexity of this work at a

later stage (Yin, 2009; Schön, 1983). Thus, whereas the three examples are historical, diverse with regards to geographical context, and picked out because of their architectural value, not as examples of energy renovation as such, it is our hypothesis that they are applicable in developing and critically positioning the question of 'improving the spatial quality' within the energy renovation process: We need to develop both a critical eye to and vocabulary to describe the difference between inhabitable spaces and mere structural frameworks and in exploiting the potential of the necessary additional insulation layer that characterize the energy renovation process in the creation of future spatial 'gestures'. It is our hypothesis that a tectonic analysis of these three historical examples is applicable in this matter.

Tectonic method and energy renovation in architecture

In works such as the single family house Villa Moller by Loos, the multistory dwelling Unité d'Habitation by Corbusier and the office block Johnson Wax Administration Building by Wright architecture's finest potential to unfold spatial 'gestures' addressing the human scale seems clearly exemplified in the detailing of these works. In Villa Moller a bay window projects out demarcating a covered entrance that characterize the face of the villa as it addresses its inhabitants while simultaneously providing an embracing seat and view of the life of the villa in the interior. In Unité d'Habitation the interior walls as well as the entire façade have been made inhabitable and the transition between interior and exterior marked by Corbusier's brise soleil detailing has been developed as a furnishing three-dimensional spatial element that join the materiality of wood and concrete. Finally in the Johnson Wax Administration Building the vault resulting from the columns create a sense of interiority both in the exterior approaching of the building where they define a change of scale demarcating the entrance at a human scale, and in the interior where the columns divide, cover and define the furnishing of the working spaces. Hence, each one in its own way, a sense of interiority is achieved in these examples by means of a deliberate tectonic detailing of the building envelope marking and addressing the human scale. It is our observation, that in these specific experiences of interiority, the delicate notion of architectural quality seems to materialize both as a spatial 'gesture' addressing the human body and mind, and as a constructive junction manifest in the application of a structural 'principle': In such 'gestures', stemming from an active shaping of structural elements, we are reassured of architecture's potential to move its inhabitants over time providing a sustaining value - without them, it is our observation that it is reduced to a structural framework. Articulating and revealing this quality in the multidisciplinary practice of architecture is, however, a recurring challenge. Especially, in the ordinary architectural practice and in the coming massive energy related transformation of or-

dinary single-family-houses, multi-story dwellings and office block complexes that will dramatically effect the built environment, the question of articulating the architectural consequences and potentials of this transformation is an urgent matter if it is not to be realized solely as a monotonous technical cladding as stated above. If we are to succeed in this matter it is our observation that we need to develop both a detailed critical eye and a vocabulary that can describe such 'gestures' of interiority as well as the 'principles' needed to reveal them within the hasty and economically challenged context of the ordinary architectural practice. In its capacity as a description of the task of the fundamental architectural task of the tekton to unite aesthetics and technique the notion of the tectonic provides a methodological means in the development of such critical eye and vocabulary. As exemplified in Sekler's research and teaching on the topic, the notion tectonics refers both to the designed result, representing a form of knowledge that can be pointed out in actual design works but simultaneously calls for a critical awareness at a methodological level, representing a form of knowledge that can be expressed verbally (Sekler, 1964; 1957). In continuation hereof it is our hypothesis that analysis of the mentioned details in the three examples by Loos, Corbusier, and Wright can help provide such detailed critical view at the building envelope if attaining a tectonic method of analysis.

Since its emergence in German architectural theory around 1850 and continuing through its reintroduction in, especially, Kenneth Frampton's seminal work in the 1990's, tectonic theory has found application as a means of architectural analysis and criticism (Frampton, 1990; Frampton, 1995; Hartoonian, 1994; Beim, 2004). Recently, the notion has also become associated specifically with the development of digital fabrication and certain experimental material technologies and fractal geometries (Leach, Turnbull and Williams, 2004; Reiser and Umemoto, 2006; Hensel, 2013). However, when facing the conditions of contemporary architectural practice where single-family houses, schools, offices, and hospitals are increasingly experienced as raw structural frameworks rather than inviting dwelling spaces that 'gesture' the human scale, a repositioning of the term seems still to be pressing. Specifically, there is a need to spur an understanding of the tectonic that is present also to this ordinary everyday practice: What is, for example, the possible tectonic quality of a simple pillar and plate system in a prefabricated dwelling or of a layer of insulation added to the building envelope as it is the case in the everyday practice of energy renovation? Emerging research efforts that bridge traditional critical analytical and new practice-oriented and technology driven tectonic research is currently growing, forming the foundation to overcome this challenge, such as Research Centre for Architecture and Tectonics, RCAT at AHO and the project 'Architecture in The Making' resulting from a cooperation between Chalmers, KTH, LTH and UMA. In the Danish context the research center CINARK at KADK has paved the way through the last decade with their effort to position tectonic theory in

relation to the ordinary architectural practice through a specific focus on industrialized construction. With the recent research project 'Towards a Tectonic Sustainable Building Practice' which is performed across the three major Danish research institutions – The Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation, Aarhus School of Architecture and Danish Building Research Institute, Aalborg University – this work has been developed further positioning tectonic theory as a sustainable strategy. With this paper we pursue a continuation hereof into the specific field of energy renovation. As described above this entails a zooming in on the building envelope in order to develop a detailed critical eye and vocabulary that can describe and position the architectural potential of this renovation process within the hasty and economically challenged context of everyday architectural practice. Hence, we zoom in on the specific challenge of energy renovation and on positioning tectonic theory in relation to the specific task of adding an extra layer to the existing building envelope as described also in the introduction. In this matter a re-reading of the work of Gottfried Semper and his spatial conception of the tectonic marks a critical potential. In drawing a parallel between the notion of the German 'wand' signifying wall and the notion of 'gewand' signifying dressing, Semper stated architecture's immediate emergence as a dressing of the human body as its primary purpose, unfolding a soft contrast in relation to the often solid walls behind them «necessary for reasons that had nothing to do with the creation of space; they were needed for security, for supporting a load, for their performance, and so on» (Semper, 1989 [1851], p. 104). Hence, with Semper's introduction of this dual purpose and layering of the wall, the notion of 'honesty of construction', commonly attributed to the tectonic, is literally reversed: The architectural expression of the space is not destined to technically reveal its underlying structure, rather the structure should carry the spatial intent of the work in an aesthetic addressing of the human body and mind, defining the primary responsibility of the architect (Hvejsel and Kirkegaard, 2013). Thus, as a point of departure a rereading of Semper's theory equips us with a critical eye forcing us to consider the technical task of cladding an extra insulation layer as a spatial matter. In continuation hereof Edouard Sekler's distinction between 'structure', 'construction', and 'tectonics' allows us to take this critical perspective on the building envelope and the additional insulation layer needed in energy renovation further, as it marks a direction for associating the spatial language of architecture with that of human body language and hereby our experience of architectural quality at the human scale (Sekler, 1964). As stated above Sekler applied this tectonic association between the language of space and form and that of the human body also in this teaching and research as a means to critically link analysis of existing and even historical works with the development of future design strategies, paralleling our objective here. See for example (Sekler, 1957; Giedion and Sekler, 1959; Sekler, 1965; Moholy-Nagy, et al., 1967). In Sekler's terminology, the tectonic

describe the way we implement specific structural 'principles' through construction in order to transmit a particular architectural 'gesture', as he stated that: «through tectonics the architect may make visible, in a strong statement, that intensified kind of experience of reality which is the artist's domain – in our case the experiences of forces related to forms in a building» (Sekler, 1964, p. 92). According to Sekler, what matters «is the tectonic statement: the noble gesture which makes visible a play of forces, of load and support in column and entablature, calling forth our empathetic participation in the experience», and he, hereby, stressed the spatial linkage between the architects' idea and the inhabitants' eventual experience of a piece of architecture on behalf of the inhabitant (Sekler, 1964, p. 92). If returning to the question of energy renovation, Sekler hereby equips us with a vocabulary as it forces us to explicitly describe the 'gesture' in relation to the cladding 'principles' applied. Through his essay Tell the tale detail, Marco Frascari allows us to apply this vocabulary in analysis of existing works as well as in design processes through his particular account for the detail as the breeding ground of architecture in general (Frascari, 1984). In the essay, Frascari exemplified his thesis on the signifying role of the detail to the experienced quality of architecture and tectonic method as the means to solve the detail by analyzing the work of Carlo Scarpa, stressing how Scarpa's interior ziggurat architectural language unite space and technique. If juxtaposing Semper's spatial account for the tectonic with Sekler's linguistic account for the notion with Frascari's account for the physical detail as the origin of experienced architectural quality as such, the question of the tectonic is positioned as a critical method in architecture linking analysis and design by stressing the question of our role as architects in the building process (Hvejsel, 2014; Hvejsel and Kirkegaard, 2015). If referring back to the projecting bay-window that characterise Loos' Villa Moller for example, we can begin to decipher how a methodological conception of tectonic theory allows us to stress and articulate the fact that the experienced architectural quality of this work manifests itself as a sense of interiority on behalf of both architect and inhabitant, emanating in a deliberate shaping of the building envelope in detail on behalf of the architect. Hence, because of the critical linkage of the experienced aesthetic quality and technical realization of architecture that they imply, these notions of 'gesture' and 'principle' can become means in describing the spatial potential of the building envelope in detail and hereby for analyzing and learning from the examples of Loos, Corbusier and Wright described earlier. Herein, we identify the notion of:

'Gesture'
as describing the experienced spatial quality of the detail at the human scale, explaining what it does
and
'Principle'
as describing the structural build up of the detail, explaining how it does it.

As stated in the introduction, the three chosen examples refer to the three basic typologies defined in the newly published energy renovation design guide *Arkitektur Energi Renovering* by Danish Building Research Institute, Henning Larsen Architects, Energifonden, and Realdania. However, by taking Semper's spatial conception of the tectonic and using Sekler's terminology and Frascari's explicit account for the tectonic significance of the detail related to the architectural whole we zoom in further in order to elaborate upon the spatial potential of the building envelope as stated above. Below we are tectonically analyzing a specific detail in each of the three examples in order to extract knowledge from them at a methodological level applicable in critically positioning the spatial potential of the building envelope in the energy renovation process. Before progressing into the proposed analyses it should be stated that these are focusing solely at exemplifying and grasping the spatial potential of the building envelope from a tectonic point of view as described above. Hence, even though dealing with highly recognized examples that have been the subject of numerous and extensive studies, the analyses presented here are limited in scope as well as in extend, the object here being to stress this spatial potential of the building envelope rather than to present a thorough study. For extensive studies of the respective examples see Risselada (2008), Sbriglio (2004) and McCarter, Steele and Carter (1999).

Three tectonic analyses

Villa Moller – Bay window

In the example of Villa Moller a three-dimensional puzzle of spaces shape the interior, which is immediately opposed in the symmetrical façade expression visualized on figure 1 above. Both in the interior and the exterior the bay window detail, which is the object of our analysis here, defines a focal point. Applying the notions of 'gesture' and 'principle' as a means of analysis allows us to describe the role of this detail tectonically by relating its spatial effect in experiencing the villa with its means of realization from a structural point of view. As the window is pushed out of the façade the inhabitant is met by a covering 'gesture' upon entering the villa. The cantilevering 'principle' of the Bay Window simultaneously disclose an idea of the dynamic built up of the interior that is intriguing and underlined in the subtle, but nevertheless present suggestion of a reference to the human face on the front facade. As one moves under the bay window to enter the villa, through its mouth so to speak, the experience of the weight of the bay window compress the entrance space hereby strengthening the contrasting experience of the dynamic system of stairs and spaces of varying ceiling heights that opens up to the inhabitant from here, see figure 4 and 5 below. Hence, in the exterior the bay window stands out as a decisive detail defining a 'gesture' in an otherwise regular and rather monotonous building envelope, marking an example for how to conceive of an energy renovation strategy that goes

beyond a mere technical cladding. If turning to the interior on the other hand it marks a key point in the experience of Loos' dynamic Raumplan 'principle' allowing for an embraced overview of the interior life of the villa as exemplified on figure 6 below. The views from the bay window seat, which form a small interior library, are diagonal adding to the experience of spatial depth and volume in the villa. If summarizing the study of the bay window, it witnesses a deliberate spatial transformation of the building envelope on behalf of Loos, stemming from the envisioning of an embracing spatial 'gesture' addressing the human body and mind in both interior and exterior. Simultaneously, this transformation entails the development of a cantilevering structural 'principle' enabling its practical realization. Loos' introduction of the bay-window define a subtle, but decisive transformation of the building envelope that evidently define the overall character and sustainable quality of the villa from a spatial point of view, as the breeding ground of the life of the villa. With regards to the current architectural challenges of energy renovation it exemplifies how such single transforming detail that unite 'gesture' and 'principle' can change and define the overall spatial quality of a single family house both in its interior and exterior as a sustainable spatial value over time.

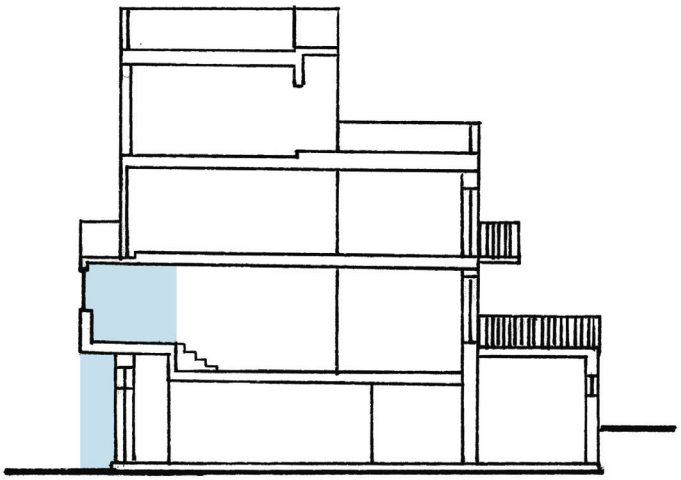
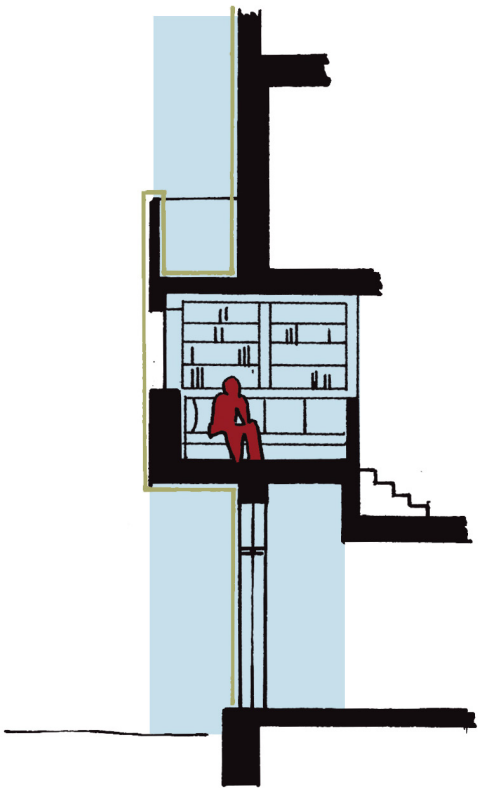
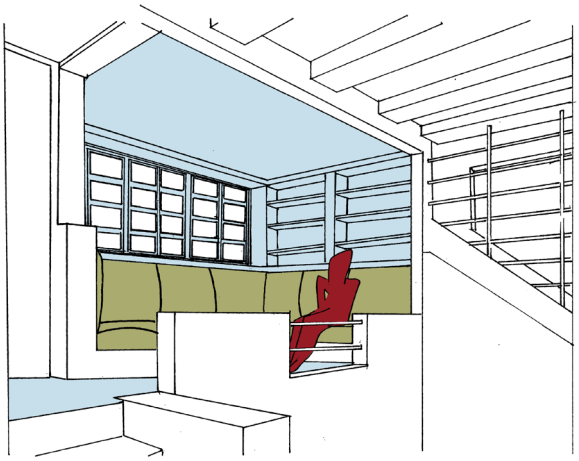


Figure 4
Villa Moller by Adolf Loos 1930.
Drawing showing the analysed detail within the overall section of the single-family house.





Unité d'Habitation – Brise Soleil

In the example of Unité d'Habitation the building envelope itself forms an inviting space stemming from the application and development of Corbusier's Brise Soleil 'principle' as a three-dimensional spatial detailing that furnish the transition between interior and exterior as visualized on figure 2 above. Applying the notions of 'gesture' and 'principle' as a means of analysis allows us to describe the role of this detail tectonically by relating its spatial effect in experiencing the unité with its means of realization from a structural point of view. As the façade is expanded in order to incorporate the brise soleil 'principle' a space of encounter for the family members inhabiting the individual apartment to gather is created, see figure 7 and 8 below. In the transition from interior to exterior wood and concrete merge forming places to store things and memories of importance as well as to conduct daily life activities such as laundry, homework etc. In the junction of interior wall, exterior terrace, façade and window pane formed by the Brise Soleil 'principle' the structural elements employed attain a furnishing character offering places of physical interaction and emotional quality as exemplified on figure 9 below. By unfolding a staging 'gesture' that frames and gives life to everyday activities, even urging time together which is otherwise spare, marks an example for how to conceive of an energy renovation strategy that goes beyond a mere technical cladding. In the exterior the same detail 'gestures' the approaching inhabitants and visitors as a three di-

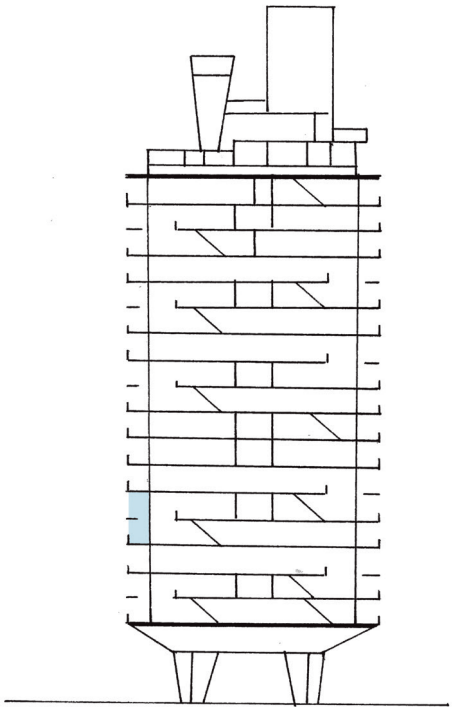
Figure 5 (left)
Bay-window in Villa Moller by Adolf Loos 1930.
As it is visible in the section drawing, the creation of the bay window stems from a tectonic transformation of the building envelope by means of a cantilevering 'principle'.

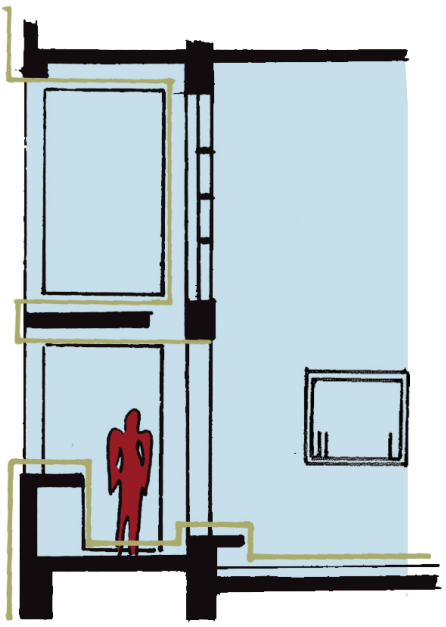
Figure 6 (right)
Bay-window interior in Villa Moller by Adolf Loos 1930.
From the interior perspective it is evident how the bay window forms an embracing 'gesture' stemming from the tectonic cantilevering 'principle' of Loos' Raumplan.

mensional ornate patterning of the façade that is expressive of individual affiliation as well as the sense of community that define the unité. If summarizing the study of the Brise Soleil detail, it witnesses a deliberate spatial transformation of the building envelope on behalf of Corbusier, stemming from the envisioning of a staging spatial 'gesture' addressing the human body and mind in both interior and exterior. Simultaneously, this transformation entails the development of a double structural build up of the façade as a 'principle' enabling its practical realization by means of a depth in the building envelope. Corbusier's introduction of the Brise Soleil detail define a subtle, but decisive transformation of the building envelope that has come to evidently define the overall character and sustainable quality of the multi-story dwelling from an spatial point of view, as the breeding ground of the diverse life of the unité. With regards to the current architectural challenges of energy renovation it exemplifies how such single transforming detail that unite 'gesture' and 'principle' can change and define the overall spatial quality of an entire building block as well as of the individual apartment interior.

Figure 7 (left)
Unité d'Habitation by Le Corbusier 1952. Drawing showing the analysed detail within the overall section of the multi-story dwelling.

Figure 8 (right)
Brise Soleil in Unité d'Habitation by Le Corbusier 1952.
As visible in the section drawing, the creation of the Brise Soleil stems from the tectonic double structural build up of the façade defining the constructive of Corbusiers' Unité.





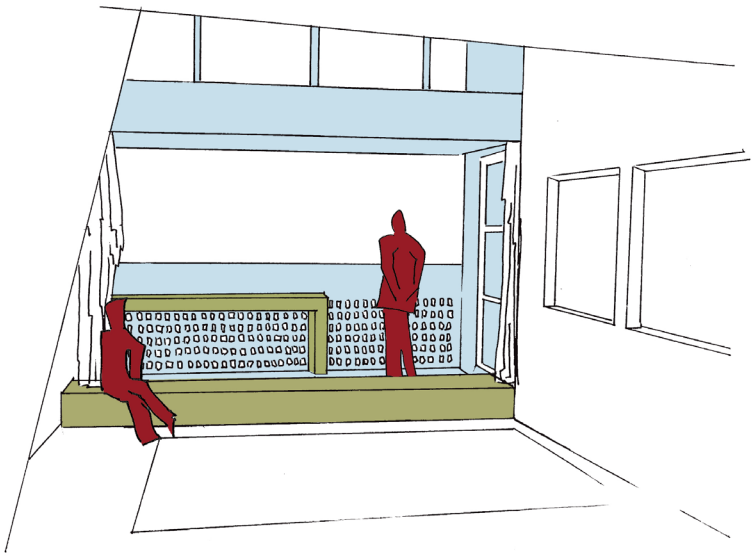


Figure 9
Brise Soleil interior in Unité d'Habitation by Le Corbusier 1952.
From the interior perspective it is evident how the Brise Soleil poses a staging 'gesture' stemming from the tectonic double structural build up of the façade that define the constructive 'principle' of Corbusiers' Unité.

Johnson Wax Administration Building – Vault

In the example of Johnson Wax Administration Building the building envelope itself forms an inviting spatial relation as seen on figure 3 above. This spatial relation stems from the application and development of Wright's vaulting columns defining the decisive structural 'principle' of the complex as a three-dimensional spatial detailing that furnish the transition between interior and exterior. Applying the notions of 'gesture' and 'principle' as a means of analysis allows us to describe the role of this detail tectonically by relating its spatial effect in experiencing the unite with its means of realization from a structural point of view. As the columns stretches towards the sky and spread out in vaults comparable to trees in a forest or the upward strive of a church space, the workers at Johnson Wax Administration Building experience a covering 'gesture' caused as they conduct their work, see figure 10 and 11 below. Both in the interior and the exterior the columns and their covering vaults are reproduced at different scales marking the arrival and parking of cars, an inviting entrance at the human scale, a modular built up of the interior office plan as well as the detailed furnishing of the interior, herein individual working stations as well as the reception etc. Hence, the structural column itself becomes an ornate means and motif that define the quality of the interior as well as the exterior also at an emotional level as a common strive and joy amongst the workers that is evidently an example for how to conceive of an energy renovation strategy that goes beyond a mere technical cladding as visualized on figure 12 below. If summarizing the study of the vault detail, it witnesses a deliberate spatial transformation of the building envelope on behalf of Wright, stemming from the envisioning of a covering spatial 'gesture' addressing the human body and mind in both interior and exterior. Simultaneously, this transformation entails the development of a system of columns that make up the construct of the building envelope as a 'principle'. Wright's introduction of

the vault detail define a subtle, but decisive transformation of the building envelope that has come to evidently define the overall character and sustainable quality of the office complex from an spatial point of view; as the breeding ground of the work life unfolded here. With regards to the current architectural challenges of energy renovation it exemplifies how such single transforming detail that unite 'gesture' and 'principle' can change and define the overall sustainable spatial quality of an entire office complex here by reapplying it at different scales defining a common identity and idea for the workers.

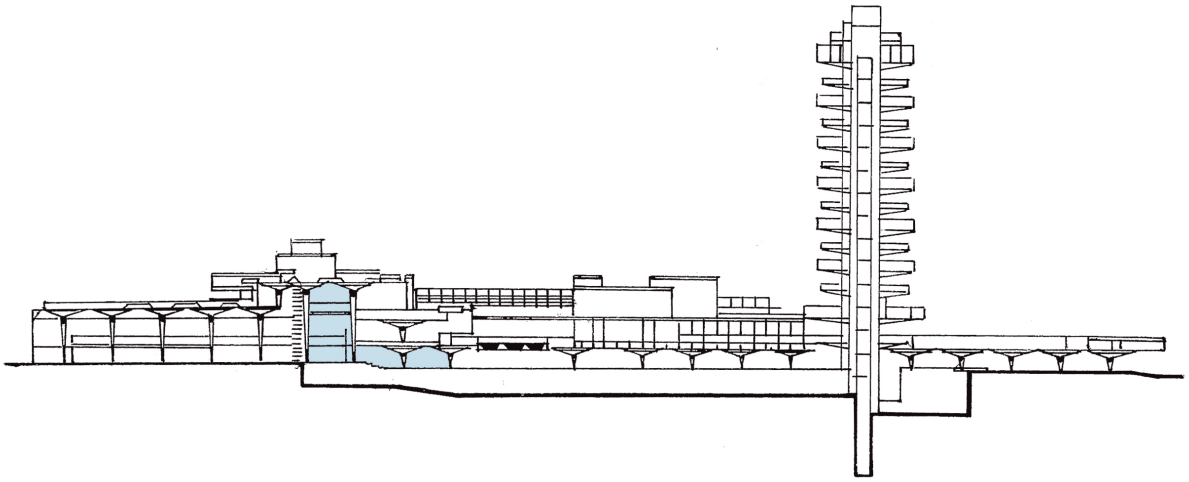


Figure 10
Johnson Wax Administration Building by Frank Lloyd Wright 1936.
Drawing showing the analysed detail within the overall section of the office complex.

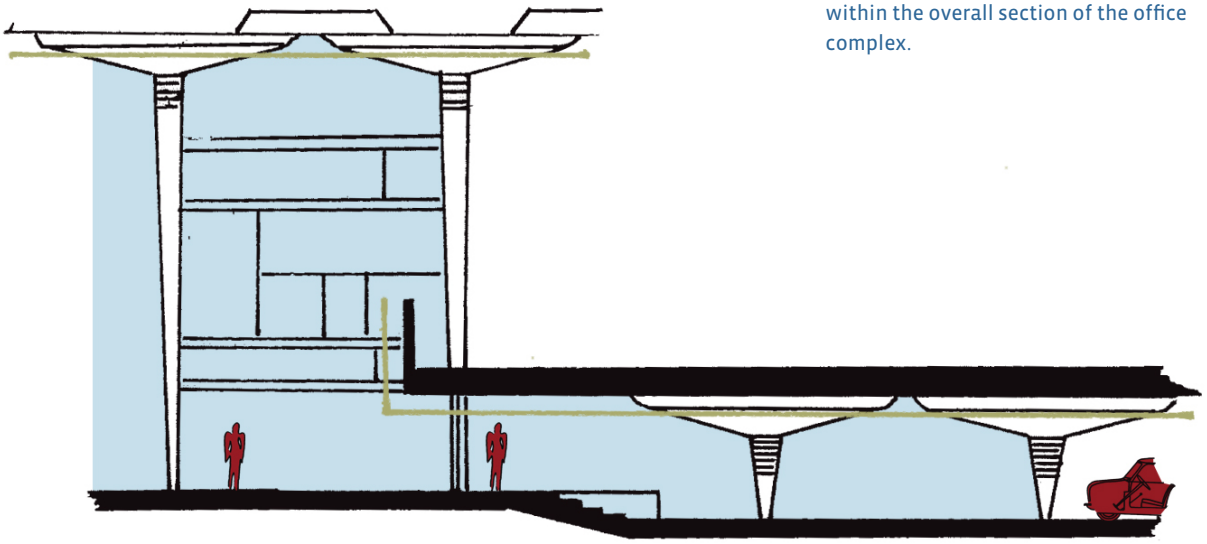


Figure 11
Vault in Johnson Wax Administration Building by Frank Lloyd Wright 1936.
As visible in the section drawing, the creation of the vault stems from the system of columns that define the structural build up of the building envelope as a 'principle' constructing the office complex.

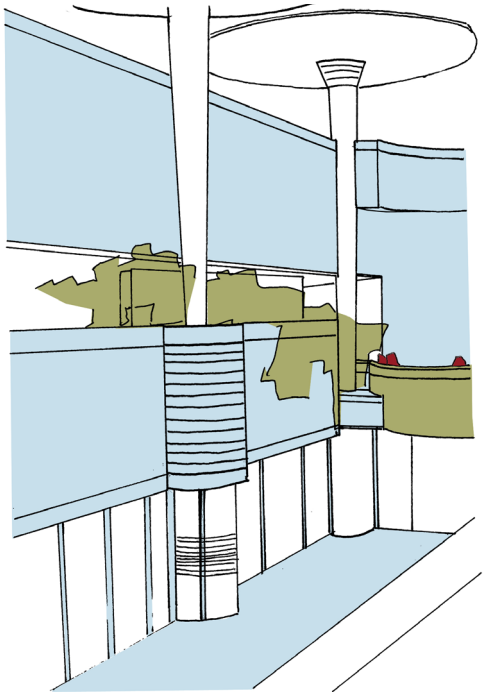


Figure 12
Vault interior in Johnson Wax Administration Building by Frank Lloyd Wright 1936.
From the interior perspective it is evident how the vault pose a covering 'gesture' stemming from the system of columns that define the structural build up of the building envelope as a tectonic 'principle' constructing the office complex.

If juxtaposing the results of the above analysis of three specific façade details, one in each of the chosen examples, it becomes clear how the experienced quality of each work seem to result from a deliberate transformation of the building envelope on behalf of the respective architects that is manifest in these details. Hence, the knowledge that can be extracted from them with regards to energy renovation is not formal; it is of no future interest to evaluate the assets of for example Loos' Raumplan versus Corbusier's *Plan Libre* as such. Rather the knowledge that can be extracted from them is methodological and critical, representing a common tectonic attention to the significance of such furnishing details as spatial 'gestures' and structural 'principles'. Each one in their own way witness a subtle attention to scale in architecture emanating in a detailed view at the building envelope, almost considering it as if it was furniture. In each example, here the bay window, the Brise Soleil, and the cover, a furnishing of both interior and exterior is provided suggesting use, dialogue, action, and encounter by means of an addressing of the human scale unfolding an inviting sense of interiority. If returning to the issue of energy renovation and the pressing architectural challenges that it pose to our future practice and our everyday experience of the built environment, the study of these details first of all equip us with a critical eye and vocabulary regarding this process. It allows us to discuss the outcome and the topic of the sustainability of the necessary additional insulation layer also from a spatial point of view; hereby questioning how it can 'improve the spatial quality' of architecture in general as called for in the introduction.

Discussion

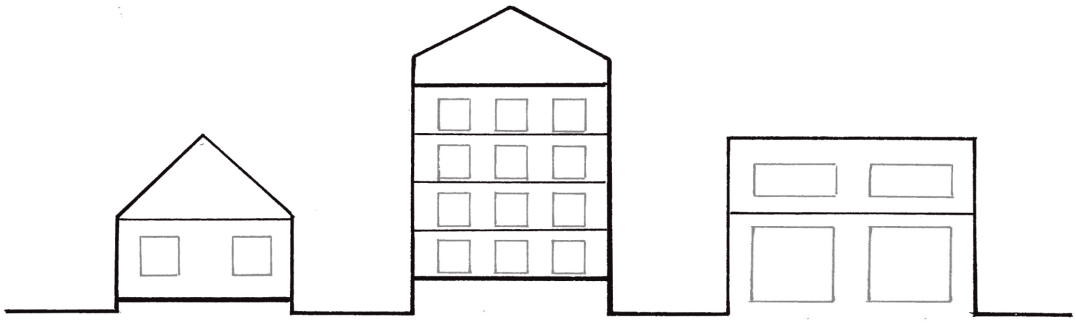
As argued in the introduction there is an urgent need to articulate the architectural consequences and potentials of the transformation resulting from the energy renovation process, especially that of adding an insulating layer to existing building envelopes, if it is not to be realized solely as a monotonous technical cladding. In this matter the above analyses exemplify sustainable architectural values emanating in a spatial transformation and utilization of the building envelope to address the human scale. If concerned with the topic of preservation related to energy renovation, one could say that these details, the bay window, the Brise Soleil, and the vault represent exactly the kind of details that should be preserved in this process. With regards to the simultaneous need to develop a strategy for how to radically add architectural value to buildings of no particular existing spatial quality on the other hand, they represent a potential to develop an architectural strategy for energy renovation that critically addresses the increasing spatial monotony of everyday practice, which is our objective with this paper: It entails a detailed conception of the building envelope as a mediator of use, dialogue, action, and encounter that equips us to challenge this monotony by stressing the question of how to add sustainable architectural value in the renovation process from a spatial point of view? The analysed examples, being historical, diverse in geographical context and in principle unrelated to energy renovation as such, state a parallel tectonic point of departure in a declared attention to detail and scale. As it appeared in the analyses above their sustainable experienced architectural quality seems to spring from exactly these details. With reference to the spatially motivated tectonic theories by Semper, Sekler and Frascari, they stress the primary need and responsibility of the future architect to envision such spatial 'gestures' and following to exploit, challenge and develop the structural 'principles' needed to facilitate their realization. Hence, as stated by Frascari, the ultimate responsibility rests upon the individual architect and studio, requiring of us to critically develop and sharpen our individual interior mindset. One could therefore rightly ask how a future design guide addressing energy renovation practice can possibly describe and position architectural value beyond that of stressing the need to; take advantage of the geometry, include unused spaces, extend the existing building, add new functions, and improve the spatial quality, as already done in *Arkitektur Energi Renovering* by Danish Building Research Institute, Henning Larsen Architects, Energifonden, and Realdania (Marsh, Fauerbjerg and Kongebro, 2013). Nevertheless the above analyses have proven that by zooming in and attaining a tectonic analysis of chosen spatial details has equipped us with a vocabulary that allows us to elaborate the components so to speak, affecting the experienced quality of the built environment. In this matter, the notions of 'gesture' and 'principle' allow us to describe the experienced quality of such details with reference to the human scale, as they refer to the question of how the building envelopes that make up the built environment address

us, what activities they invite, what encounters they foster, and allow us to evaluate and to develop these in direct critical dialogue with the development of the structural 'principles' enabling their realization. Hence, the above analyses have opened up a potential to continue the work in *Arkitektur Energi Renovering* by means of an elaboration of the notion of spatial quality as such springing from a stressing of a significance of the detail understood as a furnishing addressing of the human scale. If envisioned applied within the particular challenges of energy renovation and that of adding an extra insulation layer we could understand the notions of:

'Gesture'
as describing the experienced spatial quality of the additional insulation layer at the human scale, explaining what it does
and
'Principle'
as describing the structural build up of the additional insulation layer, explaining how it does it.

As summarized from the three analyses, this vocabulary provides us with a critical eye focused at fostering a spatial exploitation of the building envelope as 'gestures' addressing the human body and mind. Simultaneously it allows us to express verbally and evaluate if, how, and to what extend these 'gestures' relate tectonically to the 'principles' applied in constructing the envelope. Hence, if returning to the three basic typologies defined in the design guide *Arkitektur Energi Renovering* a potential to zoom in and continue the work of Danish Building Research Institute, Henning Larsen Architects, Energifonden, and Realdania opens up. This, with an account for how to understand the additional insulation layer that define the 'principle' of energy renovation as a 'gesture' that furnish interior and exterior as suggested in figure 13 and 14 below.

Figure 13
Existing urban fabrics represented by a single-family house, a multistory dwelling and an office complex.



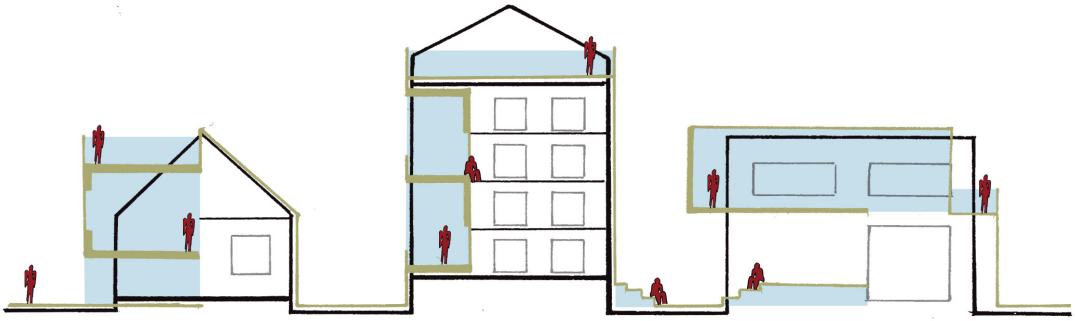


Figure 14
Energy renovation envisioned as a tectonic transformation of the building envelope shaped to form spatial 'gestures' that cover, caress, embrace, frame etc., hereby embodying individual contemplation and community encounter in interior and exterior realized by means of a cladding 'principle'.

The notion of a spatial 'gesture' related to architecture is at once word and action as it refers to the human body language, a nuanced spatial language that allows us to express everything from attraction to surprise by means of subtle changes in our body language. When relating it to the notion of 'principle' a critical concern for and development of the means of this expression is entailed that is crucial in the context of everyday construction practice; here such critical eye and vocabulary enable us to consider the structure of the additional insulation that defines the 'principle' of energy renovation as a furnishing spatial 'gesture'. In the case of an everyday single-family house the additional insulation layer that define the technical 'principle' of the energy renovation process may be seen simultaneously as for example an intimate bay window expressing a 'gesture' at the human scale as visualized on figure 14. Likewise this critical eye and vocabulary can help us envision this additional insulation layer as a means to furnish both interior and exterior by means of 'gesturing' terraces, stairs, cornices, colonnades, cantilevers etc. if applied in the everyday practice of energy renovation in multi story dwellings and office complexes. Within the complex multidisciplinary and tight economical conditions of everyday architectural practice, and specifically that of energy renovation, in which the technical measurable aspects of the construction are stressed further and easily biased, the development of such critical tectonic method enabling a linkage or even fusion of 'gesture' and 'principle' is urgently needed if we are to succeed in positioning the soft value aesthetic value of architecture herein. At a general level Frank Lloyd Wright, who shared a great interest in addressing the economical and construction technical conditions of the general architectural practice, described this ability on behalf of the architect to tectonically unite 'gesture' and 'principle' clearly when examining the model of the Larkin Building in his studio: «*Suddenly, the model was standing on the studio table in the center. I came in and saw what was the matter. I took those four corners and pulled them away from the building, made them individual features, planted them. And there began the thing I was trying to do... I got features instead of walls ... I knew I had the beginning of a great truth in architecture*» (Pfeiffer, 2007, p. 24). Looking at the necessary additional insulation layer as a spatial feature as proposed by Wright and applying the notions of 'gesture' and 'principle'

in this matter positions the need to improve the spatial quality through the energy renovation process in which a direct addressing of the human scale is implied beyond a mere practical utilization of unused attic spaces or extension of the building volume as such.

Conclusion

In the above we have addressed the pressing architectural challenges related to energy renovation, focusing on the particular question of how to add sustainable architectural values by means of the necessary additional insulation layer beyond a mere technical cladding. We have addressed this issue by means of a rereading of tectonic theory focused at the spatial conceptions of the term in the works of Eduard Sekler, Gottfried Semper, and Marco Frascari intended to link the notion of tectonics with the present challenges of energy renovation in everyday practice as a critical developer stressing the spatial potential of structural elements in architecture. In continuation hereof we have analysed three details in three acknowledged existing historical examples of architecture: the bay-window in Loos' Villa Moller, the Brise Soleil in Corbusier's Unité d'Habitation, and the vaults of Wright's Johnson Wax Administration Building, examples that have been picked out because of their unique ability to unfold a spatial 'gesture' at the human scale through a spatial transformation and exploitation of the building envelope by means of structural 'principles'. By applying the notions of 'gesture' and 'principle', derived from Sekler's etymological account for the tectonic as a means of analysis a potential to extract knowledge from these examples at a methodological level has open up. By referring to the human body language the notion of 'gesture' and 'principle' entail an elaboration upon the need to improve the spatial quality through the energy renovation process in which a direct addressing of the human scale is implied beyond a mere practical utilization of unused attic spaces or extension of the building volume as such. Hence, the above attempt to introduce tectonic method as a critical means related to the everyday practice of energy renovation has led to the development of a critical eye and vocabulary applicable in the transformation of the necessary additional insulation layer that define the energy renovation process as a 'principle' into a series of spatial 'gestures' of interiority flavoring our every day life. In concluding it is herein our observation that tectonic method holds the potential to equip us with a detailed spatial view and in depth structural understanding of the building envelope that is evidently needed and which marks a promising area of further research.

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