Crown Hall on Structure and Proportions / Jorge Serra

This paper is an attempt at discussing Mies van der Rohe's Crown Hall under the perspective of its structure, proportions, construction and overall architecture. The relationship between these elements is often cited when Mies' masterpiece is brought up, although it is rarely examined further than the commentary on the apparent outside structure of the building. For the purpose of this argumentation, Crown Hall is compared in terms of execution to the nearby Galvin Library – a seemingly similar building, as well as Mies van der Rohe's own proposal for the library that was never carried out. By doing so, I will try to better understand the relationship between structure, proportions, construction and architecture in a more fundamental way, not only to get a better perception of the building, but also Mies' work in general and his philosophy regarding the discipline. Peter Carter defines three distinct typologies in Mies' This paper is an attempt at discussing Mies van der Rohe's Crown Hall under the perspective of its structure, proportions, construction and overall architecture. The relationship between these elements is often cited when Mies' masterpiece is brought up, although it is rarely examined further than the commentary on the apparent outside structure of the building.

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Peter Carter defines three distinct typologies in Mies' later body of work; the low-rise steel frame, high-rise steel frame, and clear span building.[1] Belonging to the latter, Crown Hall is often regarded as one of the best accomplishments of the German architect. It appeals to the general public through its striking beauty and elegance; and architects – for the most part, appreciate it for its clarity and exceptional spatial execution. The building is simple – almost too simple. And it's precisely that simplicity - or at least apparent simplicity, that is remarkable at first glance. The building is clear, and even an untrained eye can easily understand how it works.

The clear span solution for Crown Hall derives from the architect's desire for a completely open space inside. The school of architecture is a space for learning, exchanging and communicating ideas, and what better way to allow

for this exchange than by having a completely open space that the students occupy. Crown Hall is essentially one very large room.

Construction of Crown Hall; the supporting girder forming the frame are clearly visible, as well as the roof purlins suspended to them.

We can also notice the connection between the columns and the girders clearly showing where they were connected together resulting in an unavoidable horizontal seam.

For this space to be truly completely open, structure had to be relegated to the outside. In essence, the ceiling of the building is suspended to the girders, which in turn are supported by columns – and fixed to them, forming moment frames on the north - south axis of the building.
This set up allows for the structure to be on the outside of the building; allowing for an open space inside devoid of any obstacles, and expressing this very scheme from the outside of the building. Mies' philosophy of having the building express itself and its construction are here fully fulfilled.

The slenderness of the columns was achieved through construction methods. Indeed, when the girders and columns form a moment frame, the columns should be supporting the bending moment of both the dead load of the building – its self-weight, and the live load during its occupation – rain, snow, wind and other variable loads. Although with their actual slenderness, this is not possible. If the eight columns of the building were designed for both the live loads and dead loads, they would have been much thicker. This in turn would have resulted in a less gracious structure, and the striking lightness of the building would have been lost. To be able to have slender columns, the structural engineer - Frank J. Kornacker, came up with an ingenious solution. When the building was being erected, the girders were not immediately welded to the columns, but simply pinned during construction. The roof and ceiling were then suspended, resulting in the girders taking all the resulting bending moment. Only once all the self-weight of the structure was already suspended did they weld the frames together.

By doing so, the columns are effectively only receiving axial loads from the roof structure and only have to be designed for the bending moment created by the live loads and not the bending moment from the dead loads; the building being a steel structure construction the dead loads account for a majority of the stresses, allowing the columns to circumvent this makes a remarkable difference.
By considering the construction method, Frank Kornacker was able to optimize the structure in a remarkable way, resulting in an elegant structure that isn't unnecessarily oversized as would have been the case, had he not chosen this particular method of erection.

Another fact that isn't noticeably apparent in Crown Hall is how the roof works, especially when dealing with wind loads and lateral forces. The ceiling being suspended, when the façade of the building has to deal with wind loads, part of it – approximately half, go through the ceiling back to the moment frame created by the girders and columns.
From the actual glass panes the wind then transfers to the mullions, and in turn to the chords in the roof structure, and back to the portal frame. In the

north - south axis this isn't so much a problem because it is in line with the axis of the frames themselves, so they are able to resist the loads. On the east - west axis on the other hand, the roof has to be framed in order to act as a diaphragm and be able to transfer the loads correctly. Cross bracing isn't apparent in the building itself, but it is nevertheless present and a necessity in order for the roof act as a truss and resist the lateral loads.
Again, by doing so they are able to give the building a lighter feel and while they are not openly showing some of these elements, in turn they give a batter clarity to the building as a whole.

The articulation of the façade is very clear from the outside, and reflects what the occupants experience once inside the architecture.

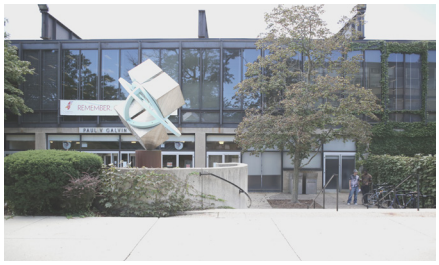
When we shift to the inside of the building, a lot of attention has also been to some key elements, particularly the window frames. While from the outside they answer to the overall aspect of the building and create a coherent and elegant framing, they also respond to the conditions inside. Indeed, not only are their sizes appropriate for the occupants - at eight feet tall by five feet wide they respect a human scale, but their treatment also has a very clear intention towards the occupants.

With Crown Hall, Mies van der Rohe created a truly universal space. Completely open and adaptable to the occupants, the time, and the needs.

The 2005 restoration of Crown Hall redid the frosted panels Mies had intended in the original project, and with them a very particular experience to the building. The eight foot strip around the building conveys a sense of intimacy and closeness that is very specific to Crown, and particularly efficient when talking about studies and concentration. They allow for a maximum of light to still come through to the insides, but give a serene glow that reflects the conditions outsides of the building. The top panels of glass are completely transparent and give a direct relation to the outside that follows the seasons outside. Crown hall is a very different building in the autumn and in the summer.
These elements create a very suitable environment for an academic building, and encompass the philosophy of a completely open space, adaptable and changing with time.

Neighbouring Crown Hall by just a few feet is the S.O.M built Galvin Library. The master plan for IIT – designed by Mies van der Rohe, had planned for a library for the campus. And Mies himself had his own proposal with plans worked out to the detail.[2]
Unfortunately in 1958 the commission for the remaining buildings was stripped away from the architect and given to Skidmore, Owings & Merrill. Mies van der Rohe was not able to build his intended project for the library, and S.O.M was given the commission - with Walter Netsch as chief architect. At first glance, the Galvin Library follows a similar language to Crown hall; we can see girders supporting the ceiling, and a uniform curtain wall encloses the building.
But the similarities end here.

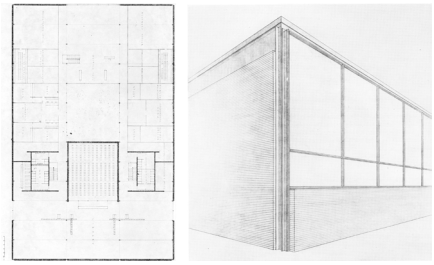
The first important distinction to be made here is the nature of the building.



Entrance to the Galvin Library at the Illinois Institute of Technology. Built by Skidmore, Owings & Merrill

When considering Carter's classification for Mies' body of work, the library is a low-rise steel frame structure – to the contrary of Crown Hall as a clear span. This is true for both projects for the library – S.O.M's but also Mies' own project. Yet the architects here try to echo Crown Hall's expression in a move that makes very little sense. In Crown Hall, the girders were a necessary move to span such a length without interruptions on the inside. The library on the other hand was planned as a steel framed building from the beginning, articulated through bays and a regular grid of supports on the inside of the building. Having to accommodate several offices as well as enclosed spaces, a clear span was not a necessity for the library building, yet the architects insisted on such an expression.

This is fundamental in the understanding of the Galvin Library building, but also in terms of Mies' clarity when dealing with structure and construction. In his own project for the library and administration building – also a steel framed building and not a clear span, Mies understood the elemental differences in typologies and their different expressions. In turn, his own project has a very different expression that does indeed reflect the structure of the building. What Skidmore, Owings & Merrill did with the Galvin Library – and conversely with Hermann Hall as well, was to go against the very nature of the buildings, and express them in terms of aesthetics and appearances - ironically an almost post-modern attitude regarding architecture. On the façade then, the clarity of Crown Hall is completely lost. The girders aren't supported by columns and cantilever from the roof a few inches, giving an unclear characteristic to the clarity of the construction. The structure is not expressed by the building; on the contrary, we are in the realm of deception. The façade also loses some hierarchy with such a system, and become almost monolithic, with an inappropriate amount of repetition of modules. It results in an unbalanced and little articulated expression of the façade. And while it makes sense for Crown Hall to have one continuous façade, as it reflects the uniformity of the space inside, it doesn't for the library.



Mies van der Rohe's project for the Library and Administration Building, unbuilt. The corner articulation embodies the philosophy behind the building, with a curtain wall in front of a steel structure, and the articulation of two different façades.

In Mies' own scheme for the library and administration building, the façades are indeed beautifully articulated. The oblong bays create an asymmetry in the structural elements, something Mies acknowledges and even values in his project, as it expresses inherently the buildings construction.
The articulation of the S.O.M façade has another drawback, but this time on the occupants of the building. For his library, Mies understood that floor to ceiling glass wasn't the most adequate solution for that specific program – as it could potentially be distracting. And even when he did it - such as in Crown Hall, he articulated it in a way that wouldn't be detrimental to the occupants and created an interior space of great quality.

The Galvin Library - in its attempt to mimic Crown Hall's qualities - ends up with a completely transparent curtain wall, devoid of any articulation. This is turn creates a space that feels completely open. This is not only at odds

with the actual program, but also the building itself – as again, it is not a clear span building. The building being elevated creates an uncomfortable situation from inside where the occupants tend not to sit too close to the windows as it can be disorienting due to the complete transparency and relative height of the floor to the outside.
Another interesting point to note when speaking about Crown Hall and the Galvin Library is the way they are anchored to the ground.
Both buildings have the first floor raised above ground level approximately five feet. While Crown Hall elevates itself by providing windows to the basement level – not only bringing quality to the interior spaces but also integrity to the façade, the Galvin Library rests on a concrete plinth. This unfortunately weighs down the building, and is in direct contradiction with the first level and its transparency.



The articulation to the ground of both buildings differs and is a big part in their perceived lightness.

It seems that in the S.O.M building the contradictions are many. It is not surprising when we understand the echo they were trying to create with the pre-existing Crown Hall building. But the result is a building that makes very little sense. But trying to replicate an exterior condition – namely the similar appearance to Crown Hall, creates a situation where the building is at odds with itself structurally, but also architecturally.
Crown Hall is the way it is because it's the way the building was thought, conceived. Its appearance is only the result of what the architect wanted to achieve on the inside. The result is a technically remarkable building that ends up being a beautifully balanced composition. Unfortunately the Galvin Library seems like it is trying to be something other than itself.

By trying to be seemingly similar to its neighbour, the building loses in clarity and quality. Something as futile as wanting - from the start, a specific appearance out of context is detrimental to the overall architecture.
As soon as Walter Netsch imposed a specific condition that was completely unrelated to the rest of the building, it stopped making sense.

Notes

[1] Carter, Peter. *Mies van der Rohe at Work*. 1974

[2] Hilberseimer, Ludwig. *Mies van der Rohe.* 1956