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Walk Over a Bridge, Under a Stream

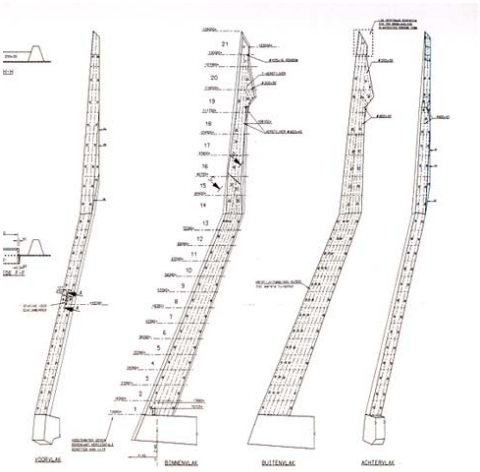
Bridge over Urban Stream, Guelph

During my research it quickly became apparent that whenever an architect designs a bridge the aesthetic is always derived from the very industrial appearance of nuts, bolts, cables, turnbuckles, etc. And why not, it makes perfect sense. Designing a bridge by utilizing an already existent aesthetic in the connections themselves, advocates a perfect harmonious junction of form and function. One no longer has to follow the other. However, due to the enormous amount of precedent in this method of bridge design, I decided to try something else. In fact, I decided to do the complete opposite and experimented with how steel construction can adhere to minimalism in order to step back and give more attention and praise to the thing itself which is being crossed, in my case, the stream. No more visible nuts and bolts, no more visible connections, only nature.

One unique precedent, which more or less strives for this same goal, exists in Rotterdam, Holland. The Erasmus Tension Bridge is nicknamed “The Swan” due to its elegant stature and form. The fact that this towering structure holds an unimaginable amount of weight underneath it goes unnoticed due to its ability to disguise strain. The bridge was designed in a way which allowed all the governing forces, acting on the tower, to be absorbed on the inside of structure.

Erasmus Bridge, Rotterdam, Holland

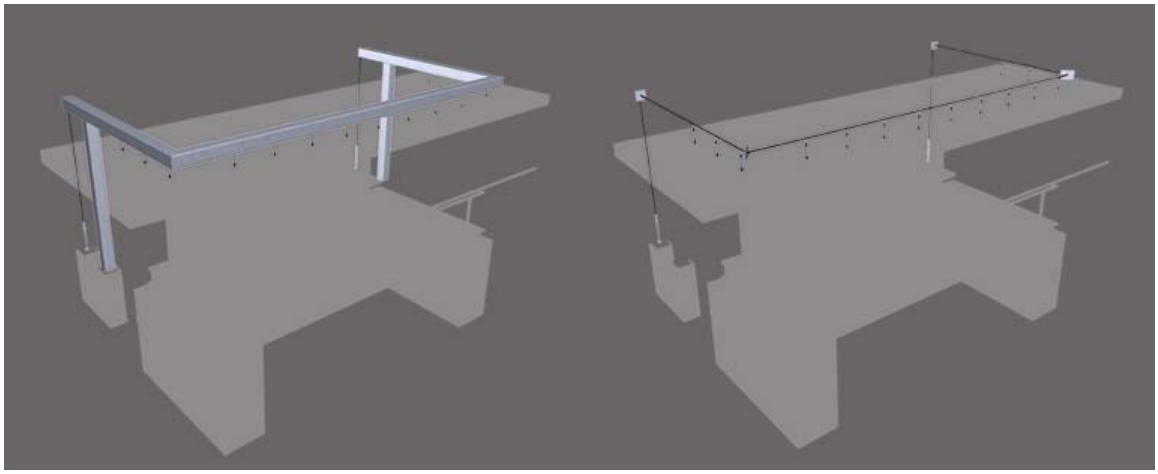
“What made this special for us was not the quantity of steel or the scale of the project. It was more what you don’t see: the complexity of the structure. With the Erasmus Bridge, we were constructing a form that had to be fine and elegant; the forces were all absorbed by an invisible structure inside the pylon.”(P. Heerema, Managing Director)[1]



Although the connections themselves are not celebrated in such an explicit manner as most

architects would like to see it, the pylon itself, which resolves all the tensile forces involved in holding up the bridge, also acts as an advocate of uniting form and function by carrying out an intrinsic structural function while at the same time resonating an elegant, uninterrupted presence in the Rotterdam skyline.

This was the main intention in the design of my bridge as well. A suspension system with lateral support was introduced into the project with the means of eliminating any necessary columns or compressive supports on the south side of the bridge. The structure of this system is composed of HSS sections which house the suspension cable and turnbuckles internally while the middle connecting HSS section also acts as a compressive lateral support. As a result, the HSS sections provide a pure form for the bridge, opening up the entire south, east, and west side, allowing the attention of the passer-by to be guided towards the stream.



HSS sections hide inner structure

In experimenting with how these types of pure forms can be achieved using steel, I gained an insight into how these pure forms can do something more for the idea of the bridge. In turn, I based my entire thesis on how this design method can be more effective in heightening the awareness of the passer-by, by reiterating and amplifying the natural context around him, including that which he is walking over. Again, a parallel exists when reading the testimony of a very popular passer-by of the Erasmus Bridge, the mayor of Rotterdam.

“The long and short of it is that we have discovered the river. Until then we had always seen the river as the artery over which goods flowed but which was not actually part of the city. Now we’ve discovered that instead of being a dividing line, the river could act as a link that would draw the two shores together. Only when you have discovered the binding effect can you start to think about extending the city to the other shore.” (Bram Peper, Mayor of Rotterdam)[1]

By eliminating any necessary load-bearing elements on the majority of my bridge, I was able to amplify its natural context by bringing the stream literally over the head of the passer-by, allowing him/her to walk across, directly under it. As a result, the only

element that gives any sort of an architectonic enclosure on the south side of the bridge is falling water, pumped up from below the north side of the bridge. The north side also has the only load-bearing wall, which again not only acts as a structural element, but as an aesthetic one by blocking the view of the unpleasant urban stream filtration system located on the north side of the bridge.

With all this carefully consideration, it is easy to see how the presence of heavy-duty bolted connections might take away from what the design is trying to achieve. If dominating connection details where apparent throughout the visible structure, the eye of the passer-by would surely focus on these in admiration of engineering rather than on the river, stream, or ravine, in admiration of the natural environment.

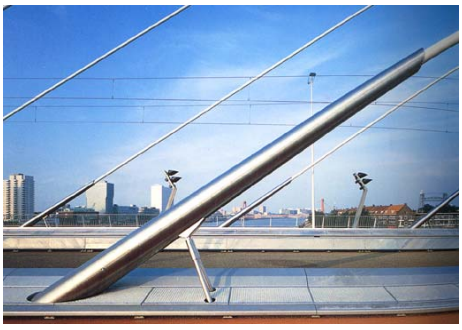
Millennium Bridge Detail

Pedestrian bridges such as the Millennium Bridge by Norman Foster are beautifully sculpted pieces of engineering and art. However it is for this very reason why they fail to heighten human awareness of the surroundings. Fancy details and architectonic elements capture the eye of the passer-by, leaving him/her in awe and amazement. The only thing he/she really fails to truly observe and analyze is the thing they just walked over. Therefore the question really becomes, "how can a bridge be both beautifully crafted and still leave room for the observer to look beyond the bridge itself?" Of course, my best attempt to answer this question lies within my design.

Waterfall View; Landscape is unobstructed

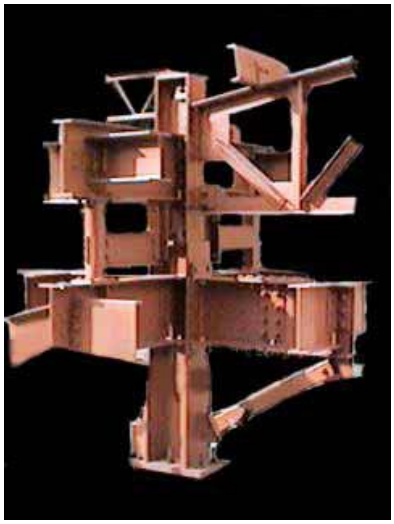
Although there is still one single architectural element (falling water) on the south side in order to define an architectonic space on the bridge, it is itself a part of the natural context that I'm trying to amplify; therefore it does not act as any fancy distraction.

Besides the hidden disguised tension system, the integrity of the structure is held together mainly by fillet welds using coped steel beams. By cutting off a portion of the flange of one channel section and fitting it perpendicularly into another, the webs of the two beams can be welded together, creating an invisible connection on the outside of the structure.[3] This technique is used heavily in my design. Other types of connections such as turnbuckles are often simply hidden from view by a steel sleeve or cover. This is also used in the Erasmus Bridge.



The idea of bringing the stream up and over the passer-by lent a lot of opportunities in using steel in a truly creative way. Although the pump itself is a regular water pump, the method of dispersion of the pumped water was in fact achieved with the use of structural steel. More specifically, a round hollow section was used with holes punched into the side in order to spread the water evenly on the sloped roof surface to be able to generate the waterfall on the south side. Prior to the dispersion of the water, it is carried up vertically in a thick Plexiglas case, which is fitted between two channel sections. By integrating standardized steel sizes into the machine itself that fuels the poetics of the bridge, I believe that the design successfully reveals the creative potential of structural steel.

Steel Sculpture



The creative use of steel has been somewhat of a playground for engineers, architects, and even artists. What I found is that this creative use can be broken down into three main categories. Obviously finding new creative methods in structural assembly is the most dominant and most relevant to engineers. Other than that, it can be used artistically, and finally, functionally, where the steel is utilized to bring about the poetics of the structure. Although all three have to be addressed by the architect, the latter, I believe, is one that has been explored the least and yet has the greatest ability to serve the intentions of the architect. Santiago Calatrava is famous for his bridges due to his ability to combine engineering with artistic forms. It is more than enough to be a successful bridge. However, I believe that in order for any bridge to fully qualify as architecture, the material itself has to be used in this third way, where the architect utilizes the structural property of the material itself in such a manner that it will have an intrinsic role in defining the poetics of the structure. In other words, give the material a function that will ultimately be responsible for carrying out the big idea of the bridge. On a very minor scale, this is what I attempted to accomplish by incorporating the steel into the pumping mechanical system.

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