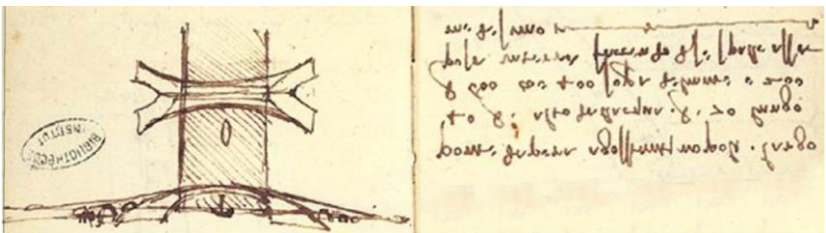


Gazing At Da Vinci's Enigmatic *Dame-Sketch To The Ottomans: Galata Bridge*
 Mohammad Bolhassani (assistant professor of architecture at the city college of New York)
 Ahmed Helal (undergraduate students at Spitzer school of architecture, CCNY)



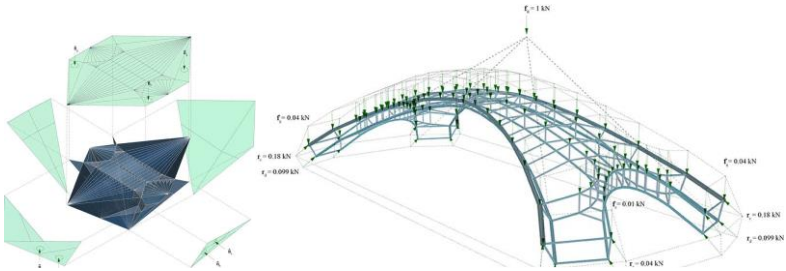
Undergraduate architecture student Ahmed Helal at City College of NY examining the prototype

Leonardo Da Vinci's list of accomplishments put him among the world's greatest artists and inventors. However, over 500 years ago, one controversial sketch wasn't as much appreciated and has been the topic of many contemporary investigations. Da Vinci's design for what would have been the longest bridge in the world was panned in the 1500s. The bridge would have connected Istanbul to the neighboring city of Galata as commissioned by an Ottoman Sultan. In Da Vinci's ambitious design, builders would have for the first time erected a bridge using a double-curvature arch. Back then, conventional bridge designs were made in the form of semicircular arches, however, Da Vinci's design was nothing like his fellows. The Ottoman Emperor rejected Da Vinci's design, and called it a 'risky endeavor,' as the polymath spelled out his pitch for the contract in a letter sent to the Ottomans, describing the bridge as being as tall as a building so that it would have allowed ships to cross underneath it without obstruction.

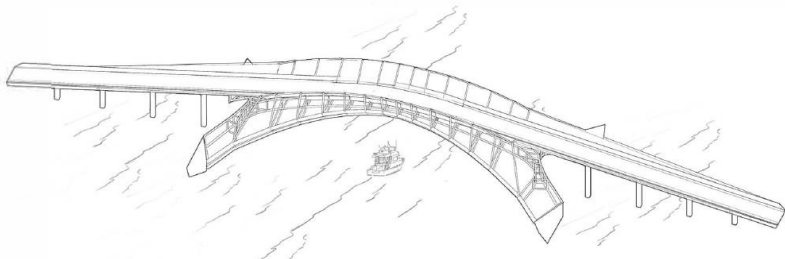
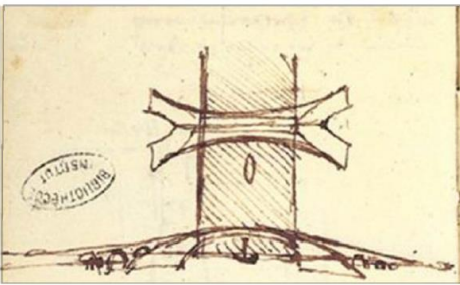


The Galata bridge sketch appears in one of Leonardo's notebooks in a royal library in France. (Institut de France)

Today, more than five centuries later, we are reexamining Da Vinci's ambitious proposal but not only to look into the structural feasibility of whether or not his design would have been safely constructed, as the latter has been recently proven in an MIT research using small scale experimentation. But to delve into the inner workings of Da Vinci's mind to see if the polymath had prior knowledge of creating stable and efficient forms which has only recently been developed using a computational framework based on the principle of geometrical equilibrium in 3D. Was his sketch just freehanded, something he had done in seconds? Or the renaissance painter and inventor had an intuition that was more than five centuries ahead of its time? Although most historians believe he had no mathematical or geometrical calculation in his design, our study proves otherwise! Through rigorous analysis of Da Vinci's design, we have found that the polymath had intuitively drawn his sketch according to the principles of geometric design that was developed in 2D almost 400 years after his time and just recently in a 3-dimensional manner with the help of computational frameworks.



To design structures more efficiently, German structural engineer, Carl Culmann, invented a geometrical design method to generate the form of structures called graphic statics based on the work of the French mathematician Pierre Varignon. Architects borrow this idea to manifest designs with magnificent structures. One of the most famous structures designed using this technique is the Eiffel Tower in Paris. The theory of three-dimensional graphic statics was proposed by William John Macquorn Rankine in the 19th Century. The idea was way ahead of its time that the method was not able to be delivered by the tools they had. Rankin proposed the idea of the reciprocal relationship between the form and force in three dimensions and it was not manifested by people at the time due to its complexity. The method has been recently reestablished by Prof. Akbarzadeh at Upenn using a computational framework. Authors have been working on designing bridges using this method and most of the time their work ended up very similar to Da Vinci's bridge which initiated comprehensive research on his design. The results of our work, using the dimensions given in his drawing, accurately matched his concept, which raised the question of how did he actually design it? Was he aware of mathematical and geometrical aspects of his design? If not, how did he come up with such a complex geometry? We may not know the answer, but altogether our study once again proved how intricate and complex Da Vinci's mind was.



This research further continues to explore the potential of Da Vinci's design with the use of modern materials and methods of construction to see how the design would have been built in our modern time. Furthermore, to pay homage to the genius mind of Da Vinci in realizing such an advanced design centuries ago, and to speculate on what he would have done using the means of our digital age.

