

Structural Art, the 4th Dimension, and Metaphors for Teaching Design

John A. MATTEO*

*1200 Architectural Engineers, PLLC
210 N. Lee Street, Suite 210, Alexandria, VA 22314
jmatteo@1200ae.com

Abstract

The potential for a work of structural engineering to extend beyond the literal and inspire our aesthetic sensibility – to be structural art – is to see in a physical work signs of the creative human spirit that are fundamental to design. We understand that structural art is possible from the great achievements of the past, upon which we build both technically and artistically, to design for the present and the future. This indeed was part of the spirit of David Billington's teaching at Princeton University – to abstract principles from the great works and artists of the past to fuel our design creativity. This paper elaborates upon this dual perspective as fundamental to teaching design. Also presented as laudable figures in the lineage of design education, Eugene Emanuel Viollet-le-Duc and Hardy Cross have offered an enriched perspective on time and change in structural engineering.

We live in the built environment and envision its growth or change for the future. Part of our mission as designers and teachers is to preserve the values and lessons of the past, most poignantly demonstrated in the works themselves. Standing before a work of structural art, what we witness in our time and place is inevitably somewhat different from what was conceived during its design and seen immediately following its construction. We witness the effects of time, which may be seen in the gradual signs of environmental exposure, or from responses to loads imposed by nature, or from changes imposed by human use or intervention, all through the lens of current thinking. If we value the work, we then may ask how to best perpetuate its physical longevity and/or lessons for the future. A conservatorial perspective of the effects of time on the built environment, with the versatility to apply these ideas to new work, will help cultivate creative and enduring structures.

Metaphor in language is akin to design thinking itself. From the literal or prosaic, we extend our thinking beyond what is, and envision what could be. We design and communicate about the envisioned or built environment within the framework of three main languages – Speech, Graphics and Mathematics. This idea helps students develop the breadth of communication skills needed in the profession, but also acknowledge that each language offers strengths and weaknesses in representing the physical world. Viollet-le-Duc climbed and surveyed Mont Blanc and witnessed nature's effects on the earth's surface as analogous to the effects of time and environment on architecture. Hardy Cross, perhaps known best to structural engineers for the moment distribution method which converges toward equilibrium through a series of approximations, also applied his methods to the flow of water in a network of conduits or conductors. As one might visualize the flow of water following a path of least resistance down a mountain, the flow of force in a complex structure will follow the path of greatest resistance, which may change over time.

Each found common ground, from a broadened perspective in nature, to explain and evaluate the physical world. Likewise, David Billington saw art in the best examples of structural engineering, offering a newly articulated perspective that has inspired a new generation of teachers and designers.

References

- [1] D. Billington, *The Tower and the Bridge – The New Art of Structural Engineering*, Princeton University Press, 1985.
- [2] E. Viollet-le-Duc, *Mont Blanc*, Sampson Low, Marston, Searle, & Rivington, 1877.
- [3] H. Cross, "Analysis of Flow in Networks of Conduits or Conductors", *Arches, Continuous Frames, Columns and Conduits*, University of Illinois Press, 1963. P. 242.