Animate the Assembly

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Abstract

Architects rely on drawings. We learn, teach, and communicate through drawing. We use them to tell the story that they are trying to tell. Over the history of architectural drawings, their definition encompasses a wide variety of approaches. As architects and educators, it is essential to draw from this variety of approaches to develop drawings that communicate as we want them to.

My research of technical drawings is shared with students in both building technology and studio classes to show them that their drawing explorations are rooted in a long history of creating drawings that illustrate technical and tactile information.

Teaching a lecture course is a design exercise. I teach Materials and Methods of Construction. I approach each class as if I am telling the students a story. I select two buildings that can be part of a story because of their similarities or differences, and I describe the projects in a wholistic way. Part of the story is the construction of the building, the construction assemblies and details.

There is a way to make the construction drawings even more engaging and accessible and that is through the use of animation. I use a combination of standard animation and stop-frame animation to describe building assemblies and details.

The other way that I use animation to teach the students about building assemblies is to have them create animations, the assignment is called Animate the Assembly. Rather than draw detailed plans and sections the students use detailed plans and sections to build a model that they use to create the animation.

Keywords: Pedagogy, Low-tech, Post-digital Animation, Technical Drawings

Architects Drawings

Architects rely on drawings. We learn, teach, and communicate through drawing. We use them to tell the story that they are trying to tell. Over the history of architectural drawings, their definition encompasses a wide variety of approaches. As architects and educators, it is essential to draw from this variety of approaches to develop drawings that communicate as we want them to.

In the book *Envisioning Architecture*, Frasier and Hemni make the following distinction: “There is a distance, however slight, between a drawing as representation and what it endeavors to represent. Drawings are more than passive recipients of their authors’ actions; they do more than reflect a way of seeing. They abstract vision and thought, imposing a material presence on the act of representation and thereby on imagination.” [1] The

authors make the point that drawings can abstract vision and thought. This abstraction leaves space for the recipient.

The drawing is an abstraction. The author decides what to include and what not to. The more layers of information are left out the more weight and space are available to those which are included. The abstraction allows complex ideas to be communicated through clear intentions of which marks are drawn.

Precedents of Drawing Types

My research of technical drawings is shared with students in both building technology and studio classes demonstrating that their drawing explorations are rooted in a long history of creating drawings that illustrate technical and tactile information. The art and science can be inextricably intertwined in one carefully crafted drawing. Perhaps this furthers the desire to have building technology and design inextricably intertwined as well.

Helen Thomas in the book *Drawing Architecture* said of the drawing by Choisy (*Fig. 1*),

"This axonometric, represented as an etching by J Bury in Choisy's book *L'art de batir chez la romaine (The Art of Roman Building)* demonstrates what he called the determining structural concept of a late Roman building. Much of his research attempted to prove that the economics of construction were influential in regards to the monumentality of Roman structural systems – requiring an interest in both the material and formal qualities of these structures. In order to explain the relationship between the quantities and surface qualities of construction materials, and their interface with structural systems. Choisy developed a technique of parallel projection called the worm's eye view – an isometric drawing extrapolated upwards from a rotated plan. At the bottom of the drawing a scale with three axes indicates how effectively this technique could communicate three-dimensional information, and also reveals the angle of the plans' rotation. The rotational space of this approach meant that internal material surfaces could be understood as essential components – here of a vault's spatio-tectonic form. The white, exposed plan forms, cut at different heights, show the variety of different compositions of the pillars of stone, and possibly concrete, which support the vaults – from these spring the arches of the vaults. The wall surfaces and curved planes of the vaults are clothed in a variety of brick patterns. Although technical in intent, the drawing is rendered with shadow that enhances its three-dimensional quality, and the underside of the structure contrasts with the brightly lit external wall and the blustery spring sky above." [2]

From the Endnotes of *Envisioning Architecture* the authors say of Choisy's drawings in his *History of Architecture*, "His drawings depict buildings with detail and ornamentation suppressed, presenting a diagrammatic and abstracted view of the examples. Reyner Banham talked about the influence of Choisy's drawings as showing a "logical construct rather than the accidents of appearance" and as "elegant and immediately comprehensible diagrams". [3]

Eliminating or suppressing detail and ornament to afford immediate comprehension is the technique that is articulated in the quotes. One must find the best vantage point. Use of fine linework to allow for the clarity of the material surfaces. Choisy's techniques are the same that I am exploring in the line animations I am developing for use in educating architects and students (of architecture).

In *Details for Modern Architecture*, Edward Ford uses the axonometric drawing of details to supplement the text description. In the preface for *Details of Modern Architecture Volume 2* he states that " . . . there are problems resulting from the redrawing of construction drawings in axonometric or other form . . . the best way to communicate an architectural thought is an architectural drawing, not a paragraph, and that this

process has corrected a far greater number of misconceptions than it is likely to have created. Most of the original drawings in question would be only partially legible to the professional in published form and incomprehensible to the novice in any form." [4] Choosing one way to represent is always a trade-off but I agree with Ford that the axonometric form is more accessible. I would stipulate that by creating a consistent language for the details they become even more accessible.

Tectonica Journal [5] has peel away axonometric drawings (*Fig. 2*) that achieve a clarity that is exceptional. They execute an appropriate view, high level of abstraction, fine linework to describe material relationships, and peel away to reveal hidden layers. The techniques allow complex assemblies that are in Banham's words about Choisy's drawings to be "elegant and immediately comprehensible". In the inserted drawing of Antonio Bonet's La Casa Ricarda these techniques are exhibited.

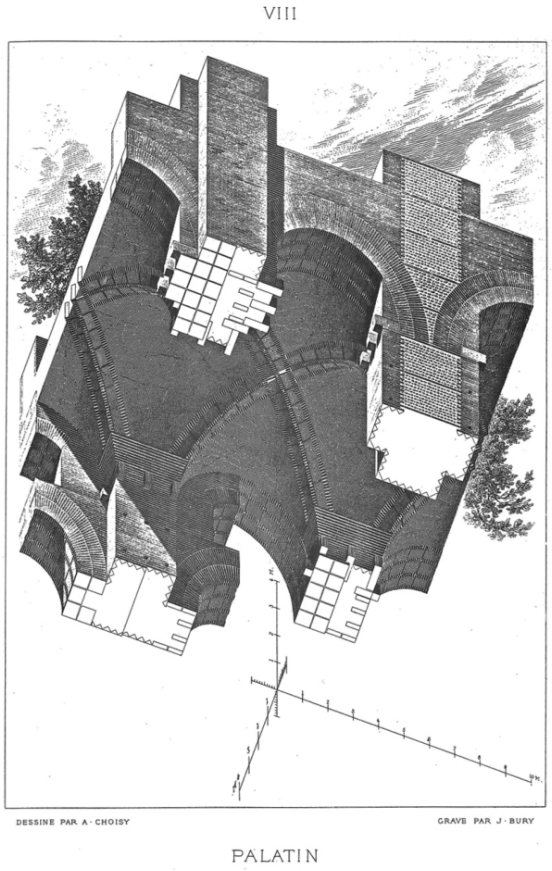

Fig. 1. Auguste Choisy, Palatin, 1873, Etching

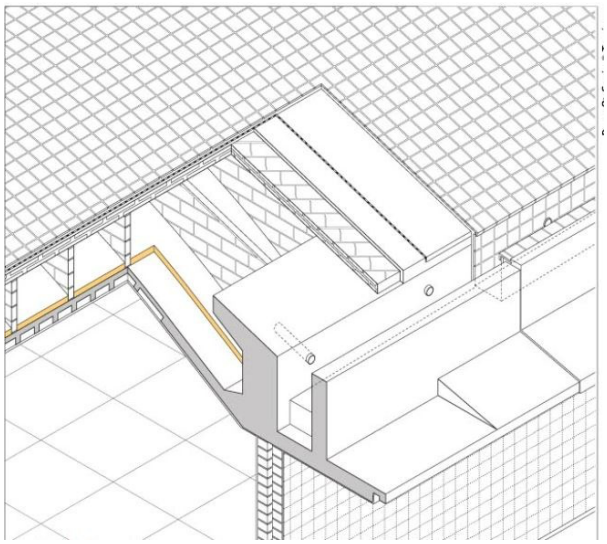

Fig. 2. Tectonica, Antonio Bonet House

At the introduction of the Chapter of Envisioning Information where the topic of gaining legibility through Layering and Separation is addressed, Tufte describes, “Confusion and clutter are failures of design, not attributes of information. And so the point is to find design strategies that reveal detail and complexity – rather than to fault the data for an excess of complication. Or, worse, to fault viewers for a lack of understanding. Among the most powerful devices for reducing noise and enriching the content of displays is the technique of layering and separation, visually stratifying various aspects of the data.” [6] p.53

The data that is stratified still needs to be understood as a part of the whole. As Tufte states, “What matters-inevitably, unrelentingly-is the proper relationship among information layers. These visual relationships must be in relevant proportion and in harmony to the substance of the ideas, evidence, and data conveyed.” [7] p.54

In this drawing dashed lines represent movement and allow the viewer to understand the relationships between the elements. Exploded axonometrics are a useful approach to a complex assembly, however, they can become complicated as they are endeavoring to show many things in a single drawing. I believe that the relationships can be demonstrated using a sequence of frames in which the individual elements are added to the assembly one at a time or are highlighted as a part of the whole, one at a time to understand the relationships. This approach benefits from not having to show all in one frame or drawing. The frames can zoom in and out so the more intricate details are legible. The two drawing approaches can augment one another to tell the full story.

Animate the Lecture

Teaching a lecture course is a design exercise. I teach Materials and Methods of Construction and approach each class as if I am telling the students a story. I select two buildings that can be part of a story either through their similarities or differences, and describe the projects in a wholistic way. Part of the story is the construction of the building, the construction assemblies, and the details. I curate the drawings carefully during lectures to emphasize abstraction techniques that showcase clear intentions. I have been experimenting with what drawing approaches are accessible to the students that are in their second year of architectural studies.

The architecture and the drawings need to attract and hold the attention of students of architecture. The best drawings that I have found come from the journal Tectonica which is published in Spain. The buildings they describe and the drawings they use to describe them appeal to my sense of aesthetics. Each building has a series of peel away axonometrics to describe their construction. The line weights are delicate, and the language of the drawings is so consistent that they become more and more legible with each drawing that you read.

But there is a way to make that same axonometric even more engaging and accessible and that is through the use of animation. I use a combination of standard animation and stop-frame animation to describe building assemblies and details.

Digital animations in architecture come with certain expectations. Photo-realistic flythroughs of a building is far from what I am interested in for this purpose. What I am working with is much closer to drawings than to more typical architectural animations. As in the example above by Choisy, the animation I am hoping to create is “elegant and immediately comprehensible.” Looking to notable examples of technical drawings is helpful. If the aforementioned technical drawings have been analyzed for a more in-depth understanding of how they achieve their effectiveness, this is even more useful. I have found few examples of animations for describing technical aspects of architecture from which to learn.

For the buildings that I present in class, I create, with a research assistant, a series of simple line animations (*Fig. 3*) to describe the assemblies and details. We use 3dsmax to create the model and the animations, and aftereffects to compose the video. We are experimenting with various views and techniques to describe the construction. In the same way that drawing has encompassed a wide variety of approaches, we endeavor to define different ways to use the inherent potential that comes with animation.

There are many approaches to teaching technical ideas to students. Difficulty arises in clearly communicating technical details of a building, such as building assemblies and building performance to beginning architecture students. One reason that it is difficult to describe an assembly in a static drawing is that construction is a process, each subsequent layer builds on the previous layer. A static drawing provides a superficial reading of the relationships whereas an animation provokes a more precise answer to the assembly and details of assemblies coming together. This is evidenced by the questions that the students ask while creating the frames for the assembly animation. I have been asked: What is the spacing for the battens? Why is there blocking within the insulation layer? How thick is the vapor barrier? A more precise, in-depth understanding of the assembly is required to make the frames of the animation.

Architects are taught to find relevant precedents rather than reinventing the wheel. Finding precedent animations for use in architecture has proven difficult. While there are few animations for educating architects, other fields have leveraged the use of animation. Science documentaries often use moving diagrams to communicate complex information to the audience. From studying science documentaries, I have learned that the simplest animations can make information more intuitive. In our visually saturated culture simple line animations are superior to hyper-realistic images for communicating complex ideas. As with drawings, clarity and aesthetics of an animation are important to make them engaging and useful. While animation is not new, it has not had the depth of experimentation that drawing has had. The use of color to highlight and sound to punctuate provide further tools. My primary exploration is their use in building assemblies but there are many examples of information that benefit from communication through animation, such as: design ideas, massing of a building on a site, the relationship of the building enclosure to the structure, the analysis of the structure and passive heating and cooling.

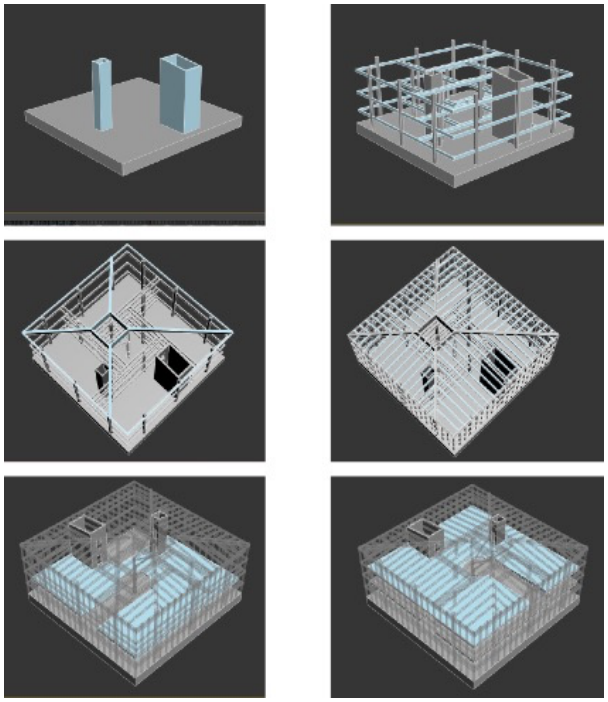

Fig. 3. Frames by Author and Student Helper of ted'A School

Animate the Assembly

Students are not only shown building assembly animations in Materials and Methods of Construction

course that I teach, they create their own through an assignment that I call “Animate the Assembly”. (*Fig. 4*).

This past semester, I gave the students detailed plans and wall sections. It is a small and simple house project from Detail Journal called the Weekend House in Vallemaggia by Roberto Briccola Architekten. The students used the plans and sections (which depicted each wood member) to build a rhino model of the house. Through a series of frames, the students demonstrated the assembly of the building in the order of construction. I have inserted some frames from the student animations which include the label and short description of the function of the layer.

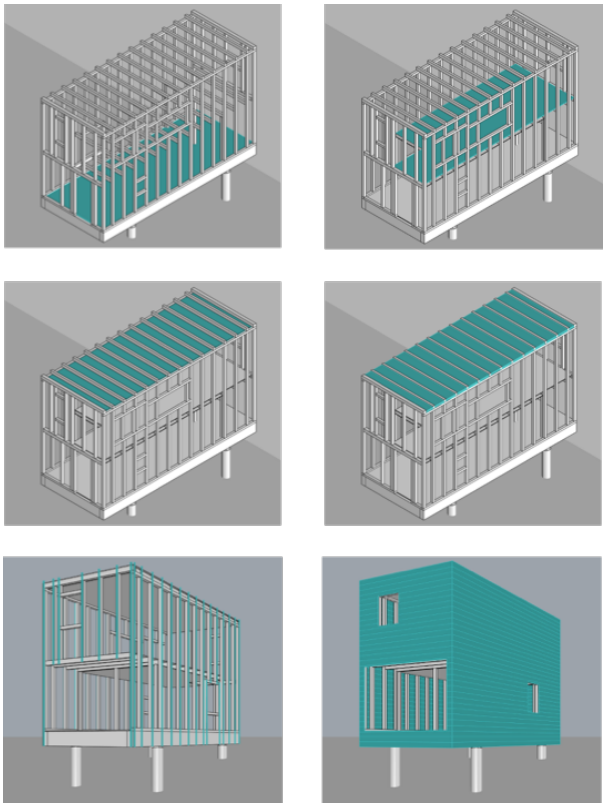

Fig. 4. Frames by Student for Animate the Assembly project

This was both a design project and a building technology project. The students were asked to experiment with finding the best view to show each part of the assembly. They were also asked to experiment with transparency, color to highlight and cut-away views to best show the assembly. This was the design component of the project.

The project required the students to look at the plans and sections and model in three dimensions what they understood. Typically we would have them draw a wall section from scratch but this worked in reverse and asked them to read and understand the plan and section drawings to create a model and then an animation of the construction. By the end of the project they knew the relationships between all the elements in the assembly and what their role was for one simple building.

Last year, before teaching was remote due to the pandemic, students worked in teams to “Animate the Assembly” but using physical models instead of digital models. Each team had a different building, and the buildings were not as simple as the Weekend House. The physical models were great for showing structure, wall and floor assemblies but were nearly impossible for showing construction details. I have inserted some frames from this version of Animate the Assembly with the physical model (*Fig. 5*).

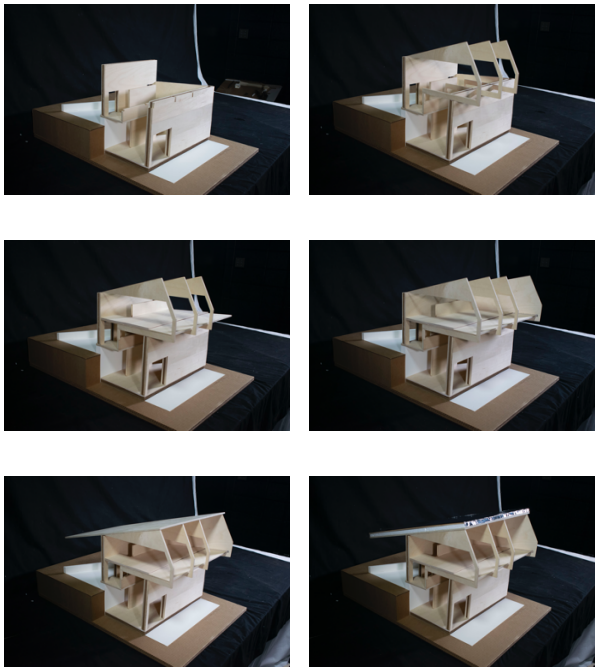

Fig. 5. Frames by Student for Animate the Assembly project

Animate the Assembly

Conclusion

Over the history of architectural drawings, their definition encompasses a wide variety of approaches. As architects and educators, it is essential to draw from this variety of approaches to develop drawings that communicate as we want them to. My research of technical drawings is shared with students in both building technology and studio classes demonstrating that their drawing explorations are rooted in a long history of creating drawings that illustrate technical and tactile information.

The research is a journey to find design strategies that reveal detail and complexity. Stratification of information is one way, pulling apart information and then tying it back together. The relationship among the layers is what matters. The goal as taken from Choisy's worms eye view is to create elegant and immediately comprehensible diagrams.

Animations are useful in describing complex information, here I have demonstrated their use to teach students building assemblies. They are used as a tool in lectures and in the project Animate the Assembly where the students are required to demonstrate an ability to read a 2d drawing to create an animation of the building assembly.

What Tufte shows in *Envisioning Information* is that putting the right mark in the right place can be the act that gives the information clarity. It may be the act that makes the information available to someone, a beginning student of architecture or someone with a different exposure to complex information, that enables them to come to a new comprehension of the material.

Notes or References:

1 Iain Fraser, Rod Hemni, "Envisioning Architecture", (New York: Van Nostrand Reinhold, 1994), 172, viii

2 Helen Thomas, "Drawing Architecture" (New York: Phaidon Press Inc, 2018), 151.

3 Reyner Banham, "The Architecture of the Well-Tempered Environment (Chicago: University of Chicago Press, 1969), 264-265

4 Edward R. Ford, "The Details of Modern Architecture, Volume 2: 1928 to 1988", (Cambridge, Massachusetts: The MIT Press), Preface xi.

5 Fernando Alvarez y Jordi Roig, Rehabilitacion de La Ricarda de Antonio Bonet, Tectonica 18 rehabilitacion, Tectonica Monografias de Arquitectura, Tecnologia y Construccion, (Madrid: ATC Ediciones), 72-73.

6 Tufte, E. R., & Graphics Press,. (1990). Envisioning information, 53

7 Tufte, E. R., & Graphics Press,. (1990). Envisioning information, 54