Interdisciplinary Studio Pavilion [ISP] 2019

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The Interdisciplinary Studio Pavilion 2019 was designed for students the in the majors of architecture, architectural engineering, and construction management to be split into teams to design a pavilion for the Wine History Project. The 8 teams were tasked with designing a pavilion that was able to be easily transported, assembled, and disassembled for the purpose of being moved around to various locations within San Luis Obispo County. This was done by combining each team members individual skillset and knowledge to design the pavilion with these factors in mind

Key Words: Interdisciplinary, IPD, architecture, construction management,

Background

The narrative of the WHP is a broad narrative of the viticulture environment: agriculture, land use, crop selection, the economic vitality of the county, and the relationships among the people who form the history of San Luis Obispo County. The purpose of the ISP 2019 project is to design a pavilion that will enable the public to experience a connection to that narrative. This studio will be an immersion in tectonic architecture. Tectonic architecture is defined as “the science or art of construction, both in relation to use and artistic design.”

Process

The Interdisciplinary Studio Pavilion 2019 was structured as a competition between interdisciplinary teams of students to design a suitable pavilion for the Wine History Project of San Luis Obispo (the “WHP”). Its curricula emphasized aesthetics; fabrication methods and techniques; ease of assembly, reassembly and transportability; and function.

Students were organized into eight interdisciplinary teams of architecture, architectural engineering and construction management students. Teams were tasked to produce conceptual designs, schematic designs, digital models, physical mock-ups, detailed drawings, structural calculations, detailed cost estimates and materials lists, description of fabrication techniques and methodologies, fabrication labor estimates, interconnection details, and assembly and disassembly manuals. At completion of the course, students presented their work, including scaled mockup models. WHP representatives selected

the design (or designs) of one or more teams. This design (or designs) will survive to the build phase of the project. The build phase is outside of the scope of this senior project.

The ISP goals and objectives are listed in Table 1.

Table 1

ISP Goals and Objectives

Goal	Description of Goal	Description of Objectives
1	Incorporate WHP values into the design, demonstrated by achieving the listed objectives.	a) establish a set of 3 to 5 value propositions through interviews with the WHP; b) gain WHP approval of these proposed value propositions; and c) demonstrate how the design addresses each value proposition.
2	Achieve an integrated design through interdisciplinary teaming, demonstrated by achieving the listed objectives.	a) establish team protocols for interdisciplinary participation; b) measure the team's adherence to those protocols; c) establish a list of design elements that required interdisciplinary participation in their design; and d) explain the interdisciplinary characteristics of each of those design elements.
3	Connect the user to the design and the design to the site, demonstrated by achieving the listed objectives.	a) establish a suitable scale that enables users to connect with the pavilion through the exhibits mounted therein; b) express the defining narrative that connects the pavilion to the site; and c) explain the specific features of the pavilion that advance that narrative
4	Facilitate the user experience, demonstrated by achieving the listed objectives.	a) identify one or more elements of the user experience, and b) demonstrate how the pavilion facilitates those experiences.
5	Incorporate tectonic portability into the design, demonstrated by achieving the listed objectives:	a) establish joinery of elements that enable easy knockdown and reassembly of the pavilion; b) specify durable connections that with withstand numerous knockdown/reassembly cycles; c) assure that all hardware is weather-resistant, (the use of non-corrosive metals and/or compatible metals is encouraged); and d) amalgamate all connections into the architectural aesthetic.

Deliverables

My team's project was based on the biomimicry of a butterfly. At first it was a butterfly's wings and how they moved, then how they refracted light, and finally how they emerged out of a cocoon. We had an aluminum truss system that was covered with panels that acted as our cocoon, and then aluminum round with clear acrylic panels that connected to the structure and acted as the wings.

There were many deliverables that were due throughout the quarter. It could be broken down nicely into the three different "reviews" that we had. The first review was during week 6 and we just had to have a very basic understanding of what we were building, how we were going to build this, and why the WHP should consider us for the pavilion. This was difficult because I didn't really understand yet what my team wanted the pavilion to look like, so I mostly had to be very vague when discussing things. The next review was during week 8 and was supposed to be a dress rehearsal for the final showcase. This is when the design was supposed to be finished and now all the focus on building it and making positive it was structurally sound. After this review my team wanted to make design changes, the architectural engineer and me had to sit down our architects and tell them that they had 8 weeks to design it so what we have is final. Our review was during week 10 and we had to have everything for the pavilion finished.

My personal deliverables could be broken down into three categories; full scale detail model, fabrication plan, and operating manual. The full scale detail model was due for our final project showcase. It included procuring materials with a budget of $400, and then building the model in the CAED support shop. The fabrication plan was due by the end of finals week. It included a step by step process of how students in Spring 2020 will build our pavilion. The operating manual was also due by the end of finals week. It was intended to be given to the WHP and would be all they need to then bring the pavilion around SLO county and keep it in peak condition.

Full Scale Detail Model

The full scale detail model was needed for our final showcase where it would be displayed to show what the pavilion would look like in real life. The model had a $400 budget so we had to change our structure from aluminum to steel. This made it about three times as heavy as the structure would actually be. Also, we had to just get the refractive film and not the acrylic sheet it goes on. The only benefit of having to switch from aluminum to steel was that to weld aluminum TIG welding is required and it is a very difficult process.

There were many challenges that were presented during the full scale detail model. The first was the fact that I had never welded before this, so I had to learn how to do so on the fly. This was made easier because the head of the CAED support shop, Dave, enjoys welding very much so he would constantly be checking in on me and giving me pointers. Another challenge was getting quotes from companies to make the $400 budget. Some companies were very helpful, so it was simply a phone call and asking about pricing. Other companies were very difficult to get a hold of and I'd have to request a quote over email, or call multiple times throughout the day hoping to get a hold of an employee who would provide pricing.

Choosing what portion of the pavilion to model also became a difficult decision to make. Our instructor, Maggie, encouraged choosing a portion with difficult connections to showcase how these would actually be made. We wanted to choose a portion of the pavilion that would look very good at the showcase. We felt that the purpose of the full scale model was to impress the WHP with the beauty of the pavilion. We ended up doing somewhat of a middle ground between the two. The connection between the truss and modular skin was shown, and also between the wing and modular skin. However, this made us unable to get excess acrylic, so when a cutting error of a piece of the acrylic happened there was nothing we could do to fix it.

Figure 1: This is out finished full scale detail model at the final showcase.

Fabrication Plan

The Fabrication plan required a binder that gave step by step instructions on how to build the pavilion. This binder is intended to be given to the class in Spring 2020 that will be building the pavilion. Within the fabrication plan binder it was required to have, material lists, processing activities, activity sequences, required connectors, material handling and storage plan, safety and security plan, material costs and fabrication hours, & other important details.

During the making of the fabrication plan the end user had to be in mind. This will be designed for students who will be making the pavilion within the CAED support shop. This meant that I could not tell them to use a piece of equipment that was not within the shop already. I also had to include many Autocad plans that I developed so that they could more easily understand what was being built. Students will have a much easier time seeing the Autocad plan (shown in picture below) then just having step by step directions of how big to cut pieces and where to weld them.

The biggest challenge of the fabrication plan was the “wings” within our pavilion. This was because I never received any set directive of how they were supposed to look. There were many different models that were created and every time the wing would be designed differently. I had to take the multiple different models and see what they had in common then design the wing to look like that. This was made easier with Autocad, which allowed me to determine what angles were needed to make the wing provide the adequate place required while also touching the ground at the appropriate spots.

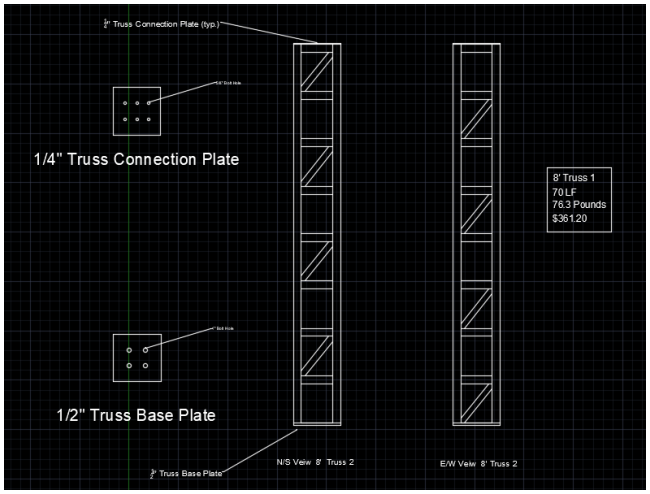


Figure 2: This is a sheet from Autocad that shows a portion of the truss to be fabricated in the shop.

Operating Manual

The Operating Manual required a binder be produced that included step by step instructions on how to operate the pavilion to keep it in the best shape. This binder was intended to be given to the WHP so they could have everything needed to operate, move, build, and maintain the pavilion throughout its life span. Withing the binder there were many deliverables, that included assembly drawings and connection details, transportation guidelines, assembly and disassembly instructions, maintenance and operating instructions, spare parts list, and other necessary items.

Assembly drawings were basically able to be taken from the fabrication plan sheets. These just show how to take all the different modules that were fabricated and put them together properly. The connection details were a little bit more difficult to create. The plan is for people to be building this who aren’t necessarily construction workers. This means the details needed to be very easy to understand for an average person. This was done again through Autocad. I decided that everything shown in the detail needed to be called out. Along with the details there was the description of how to put the pavilion together onsite which was very thorough to hopefully take away any confusion that there might have been.

The transportation guidelines were important because one of the main things that influenced design was the fact that this structure had to be able to be moved in a Uhaul truck. This meant finding the largest Uhaul and determining how to place all the materials so they could easily be transported. Throughout the quarter this changed greatly. With our final pavilion design, however, it lended

itself very nicely to transportation. The maintenance instructions were easy to come by as the material spec sheets more often than not will have a maintenance section within them. The main materials that maintenance would really effect was the panels. We chose very durable panels for this very reason but it still is recommended that if they are to be cleaned there are certain substances to use.

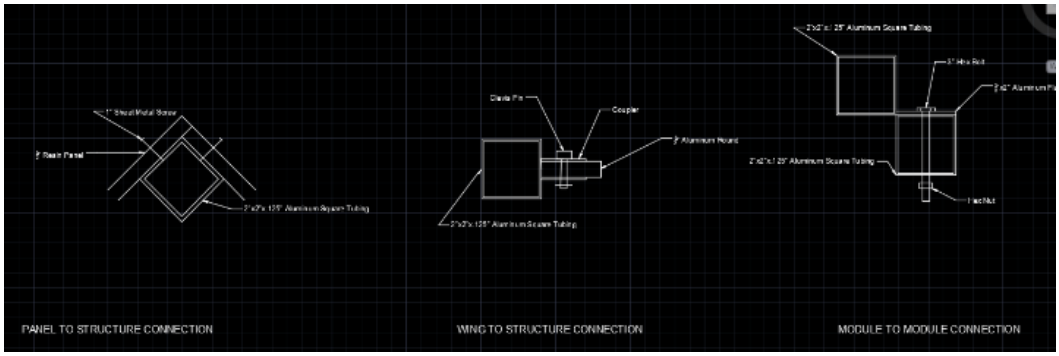


Figure 3: This is a sheet from Autocad that shows a few of the connection details required in the pavilion

Lessons Learned

Through this course there was a great deal of lessons to be learned. I originally thought the class was going to be an easy way to get my senior project done, but this was completely false. This class made it so that if you forgot to see something at one point it would come back to bite you greatly. One example of this is the idea that if you are going to build modular you need to have this figured out through the whole design process. Instead of this, my group designed a pavilion that I then had to figure out how to modularize.

I did not enjoy my time in this class. I spent most of the time not knowing what was expected of me and then I'd get told the day before something was due that I have all this stuff I had to figure out. This is mainly due because my group did not work well together. The goal of this class is to work throughout design and figure out all the details why we are designing. Instead it seemed that I was handed a design and told to figure out how to make it work.

The instructions of deliverables in this class were also always very vague. It may be because I am used to Construction Management classes where it is a very set in stone submittal style, but I never knew how to present the material I needed to turn in. I believe that in this type of class where we have reviews with clients the students should have more freedom of how they want to express their project. I would end up giving all my material to turn in to the architects of my group and they would format it how they liked. The upsetting part about this is some of the stuff I was really proud of would get shown to the client differently then I wished and/or left off of the poster board completely.

I believe that the class did help me in my future as a Construction Manager because now I know what a bad group looks like and what steps not to take if I ever get placed in the design portion of a project. I do wish I had taken IPD before I had taken this class because there were lessons in the class that would have directly benefited me in this class. Also, I wish this class was not during my final quarter here at Cal Poly. This is more selfish, but I was planning on having a fun last quarter and not putting in the required hours that this class demanded.

Figure 4: A scale model of our pavilion

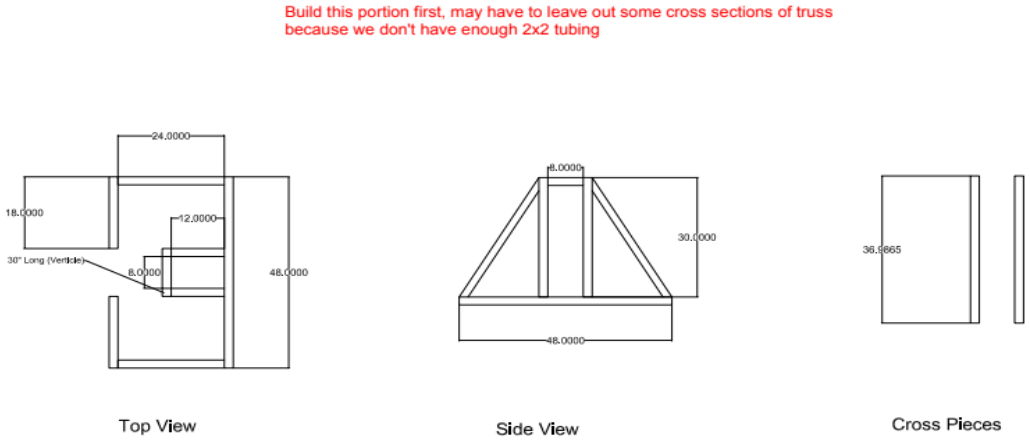


Figure 5: An Autocad design of our full scale detail model.

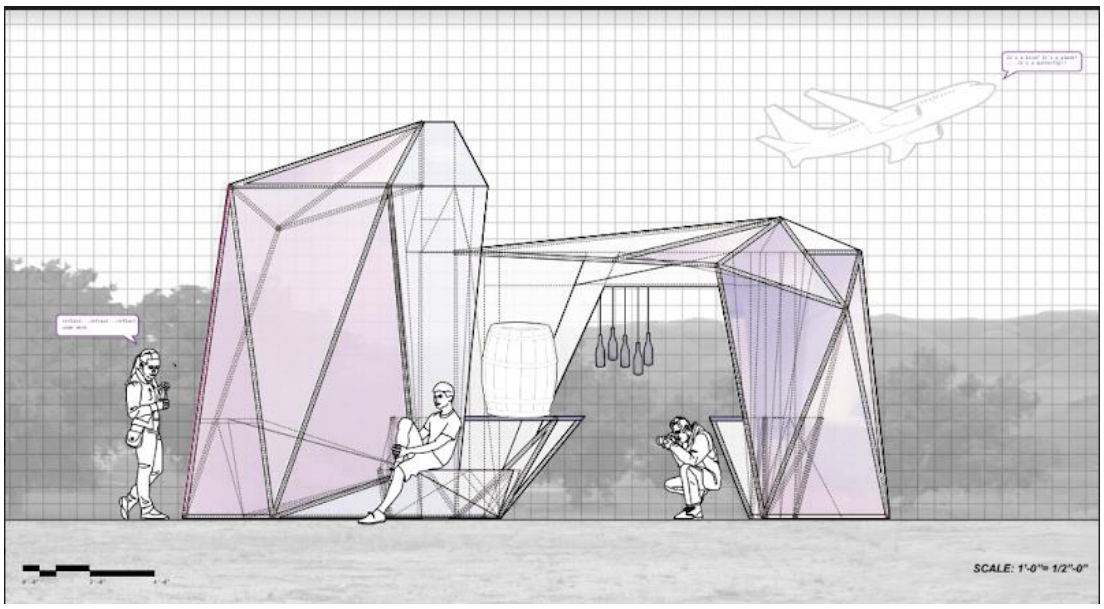
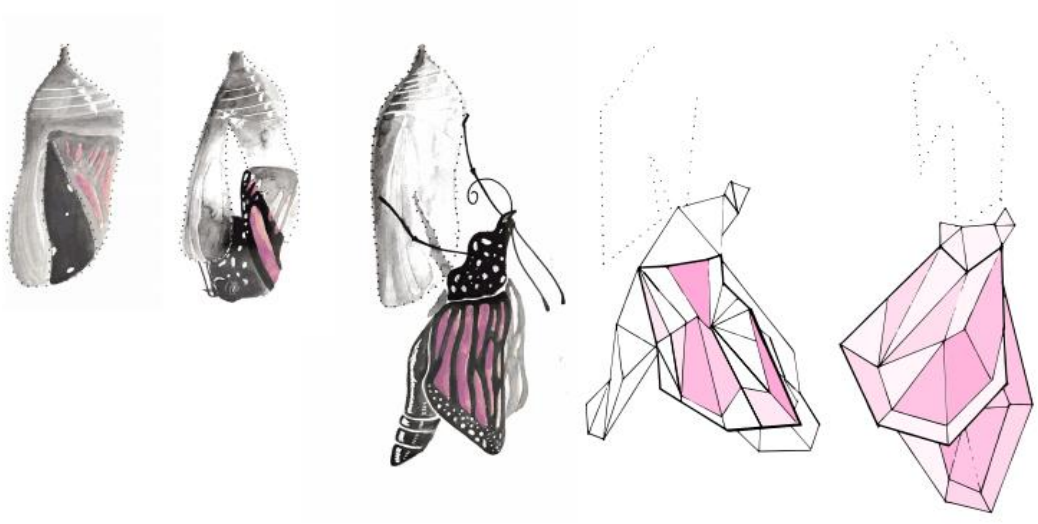


Figure 6: A rendering of what our pavilion was intended to look like at Saucelito Canyon.



BUTTERFLY & LIGHT DIFFRACTION

The caterpillar experiences a metamorphosis from a chrysalis [cocoon] to a butterfly. From a condensed space of a chrysalis, the butterfly experiences a contrasting environment of freedom, flight, and lightness when emerging from the chrysalis.

These juxtapositions leave room for an in between when the butterfly is partially emerged from the chrysalis. Light, free moving wings temporarily meet a rigid, enclosed cocoon where visual tension is created, suggesting the potential emergence and movement of the wing. This in between phase is formally represented in the pavilion "ichoate iridescence."

Figure 7: An explanation of our biomimicry.

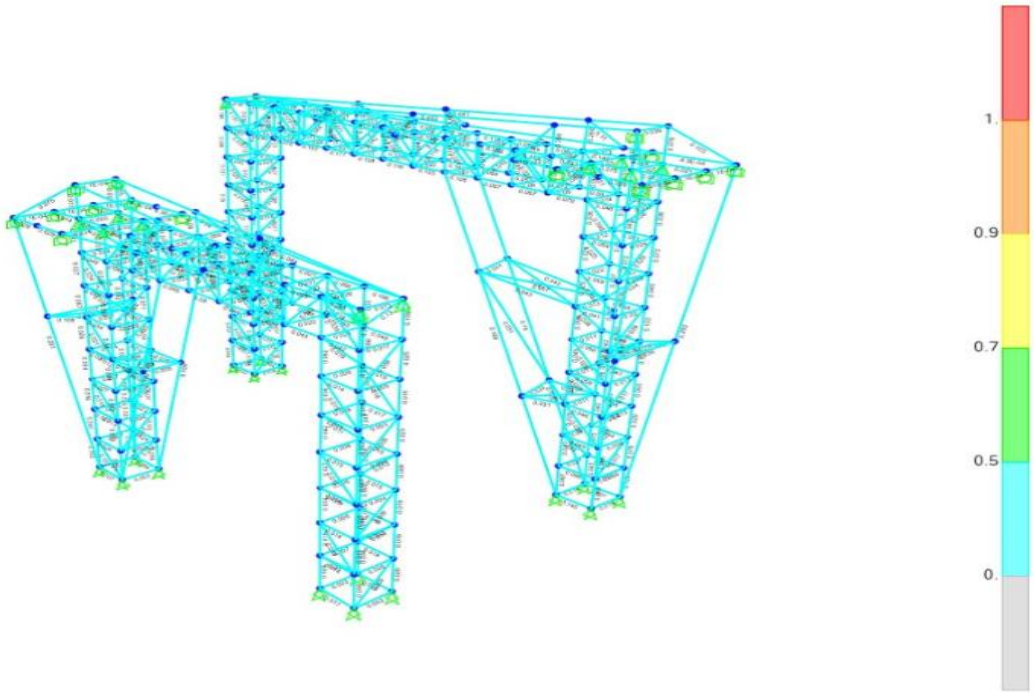
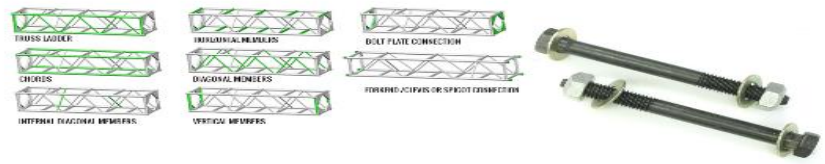


Figure 8: A SAP model that shows are pavilion is structurally sound.

ASSEMBLY



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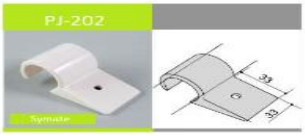
-The square steel trusses will be connected to each other with through bolts

-Steel tube and nylon 6 tubing will be connected by t joint/y joint/ ect. Based on the geometry of each connection



-Foam board paneling will be assembled by placing the PJ-202 on the tube and screwing on panel every

Figure 9: An early material list of the pavilion.