ACES LIBRARY REVIT MODEL

GROUP 4

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SPRING 2022

Introduction

Our project group was tasked with reconstructing a Revit model of the ACES library, also known as the Funk Library. The ACES Library is located on the south quad at the University of Illinois at Urbana Champaign at 101 South Goodwin Avenue, Urbana, IL. Construction finished on this institutional building on October 4, 2001. It was built for the purpose of holding the several thousands of architectural texts that were previously held at Mumford Hall. This steel framed building, with primarily brick exterior, contains five floors including a basement and has approximately 83,000 gross square feet. The original architects of the building are Jeffrey D. Anthena, Woolen, Molzan and Partners, Phillips Swager Associates while the original contractors are Clark Engineers MW, Inc and Henneman Raufeisen and Associates Inc. There have been no renovations since its original construction in 2001 (Funk Library, 2020).

In addition to housing the Agricultural Communications Documentation Center (ACDC), the Funk ACES Library has many other functions and facilities. The library "supports research and provides extensive print and online collections for numerous campus units" (Funk Library, 2020) , including the College of ACES, the School of Integrative Biology and the School of Molecular and Cellular Biology. In the basement there are computer labs and several conference rooms. The Funk Library also provides offices for alumni connection and is used to host corporate interviews and scholarships for the College of ACES.

Not only does the library have a wide variety of practical purposes, the design of the library also reflects the philosophy of the project. The unique octagonal shape of the building draws viewers' eyes and serves as a focal point on the south campus. In the article "ACES

Library" it states that the project "aims to create distinguished architecture which can increase the visual unity of the scenery of the south campus" which can be seen in our SketchUp drawing in Figure 1.

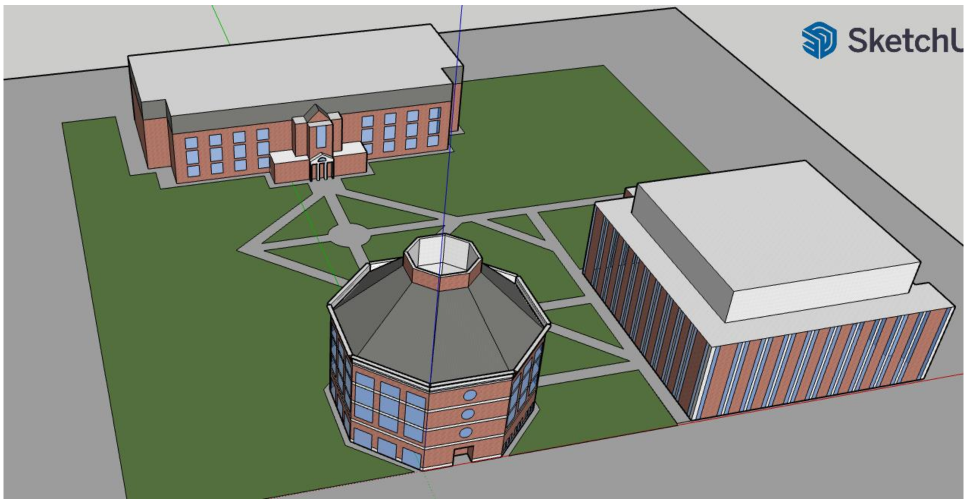

Figure 1. Model of the Animal Science Laboratory, Turner Hall, and the ACES Library on South Quad (Made in SketchUp)

Field Work

All the members of our group visited the ACES library on Sunday February 20th at 2 pm. From our site visit, we were able to confirm that there were no major discrepancies between the drawings and the building itself. This is due to the fact that ACES has not been renovated since its construction in 2001 (Dillon-Duque, 2022). The only problem we ran into was with the top (5th) floor. All the doors were locked so we could not gain access to those rooms, as it was a Sunday, and they were only open Monday through Friday. From the plans and from talking with TAs, we discovered those rooms were just meeting rooms, so we determined another site visit during open hours was not necessary.

During the cite visit, we had the chance to explore some of the beautiful features that the library had to offer. We took note of a breathtaking lightwell and skylight (Figure 2) and the unique layout of study areas next to the curtain walls (Figure 3). The lightwell would prove to be a great challenge in our project. We also noticed the library's octagonal shape resulted in many aspects of the building being symmetrical. This information saved us a great deal of time during the modelling process, as we could reflect many elements over different axes.

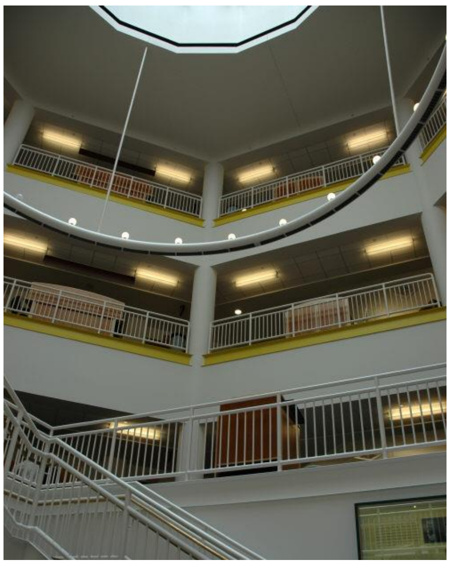

Figure 2 (left). Center shaft with ring chandelier and skylight

Figure 3 (Right). second floor study space

Although we originally planned to use PlanGrid more to verify and cross check information with the sheets, we found we did not need to do so. The geometry and layout of the building was simple enough that we were able to just use our eyes to confirm the sheets were correct. While we performed our site visit, each of us examined and took pictures of a level and then uploaded these photos to a designated box folder for each floor. Then after our site visit, we compared the photos and floor plans for each floor to make sure all elements were accounted for.

These photos also became especially useful towards the end of the project when we were working on the finishes and furnishings.

Through our project a recurring issue was locating specific information and dimensions of the small details on our plans. Often, we could see certain details from the pictures we took (for example, the small wall feature surrounding the base of the building) but exact measurements on the plans were virtually impossible to find. The PDF of the plans did not include a table of contents and was nearly 230 pages long. We ran into a similar problem with finding the roof thickness. We even spent 30 minutes at office hours with a TA looking for the thickness of the roof and were not able to find a definite measurement. We solved problems like these with (TA-approved) estimates based on surrounding features. For example, we noticed on the plans that the small wall feature that went around the base of the building went up to the same height as the first mullein in our curtain walls, a feature we were able to directly measure.

Modeling

To model our building, we started with the structural components (beam system, foundation etc.) before moving on to the architectural elements. First, we did our grids and levels and then began with our columns and beam system. We completed the beams for every floor and the roof although we had to go back and change the beams in the roof a few steps later. Next, we tackled exterior walls, curtain walls, and foundation and floor slabs. One of the most difficult parts of the project was the roof, which we spent a great deal of time on because this is when we realized we made an error with the roof's superstructure that had to be fixed before moving on to the roof. We then completed our interior walls, ceilings, rooms, doors and other finishes and small details. To wrap up the modeling we created a site plan and added in the column footings that were missing from our foundation.

Many challenges were faced during this project, the most notable of which being the roof. The ACES Library roof is an octagonal shape with a lightwell in the center which goes down to the fifth level. From the fifth floor, you can see an intricately designed octagonal pyramid skylight at the bottom of the well. We had been told by other groups that this was a very difficult component to add and that most groups just ignored it! Luckily for us, we were able to find a similarly shaped skylight design on BIMObject, that we were able to change the dimensions of to fit our space. The skylight would not allow us to place it over the shaft opening we had cut on the floor of the fifth level. At first, we adjusted the shaft opening so it would not extend through the floor and then changed the material of that area to glass. This allowed the skylight to be placed. It looked good, but we then discovered that we could change the material to air!

Unfortunately, the roof had more problems than the lightwell. For one, everything had to be placed in the 3D view (shown in figure 4) and none of the beams or the roof showed up in any of our plans. This made it exceedingly difficult to model. Additionally, it had to be modeled twice! We realized we had originally built our beam structure to the wrong level of our roof, meaning we had to go back and redo the whole super structure of the roof. As stated in the Field Work section, we also were unable to find the thickness of the roof. We worked with a TA for 30 minutes after office hours ended in an attempt to find it but eventually, we all declared defeat. Looking at the section and elevation views, we (our team and two TAs) estimated that the roof was approximately 6 inches thick. Using this thickness and our newly refinished beam system, we were able to construct our roof. In the 3D view, it looked fine, if the view was zoomed in, but when the view was more zoomed out, it appeared you could see the beams underneath the roof, almost as if they were poking through (even though the beams were placed correctly). After consulting with our TA, Ryan, we slightly adjusted the slope of our roof to hide this appearance.

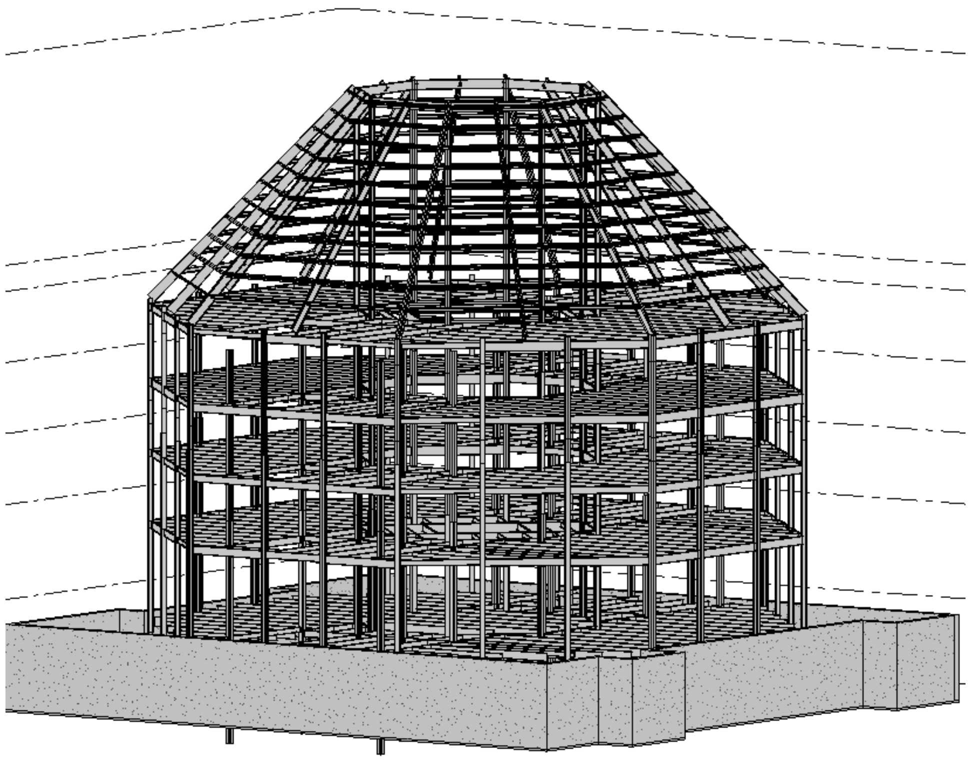

Figure 4. Foundation and Super Structure of ACES

Another collection of problems we had was caused by the thickness of the exterior walls. Like the roof, we had a difficult time finding the thickness of them as it appeared different in several views. Eventually we found a note saying the wall was 10 inches and used that as our measurement. However, after creating all of the interior walls on the lower and ground level it became clear that the exterior walls were not 10” but were actually 1’ 2” thick. At that point too many things had been placed using offsets from the interior side of the exterior wall to fix the walls. However, moving forward all offsets and dimensions were done from the outside of the exterior wall because this was not affected by the wall thickness error.

In other parts of our building, we made simplifications to the lower level of the ACES library. The plans describe an intricate system of slanted floor slabs, each room having several different sections of slanted floors. After discussing with a TA during office hours, we decided to simplify the system to two different elevations. The main lower level floor elevation is –18 ft. One area, the auditorium, is –20 ft, which we decided was a significant enough difference to permit a different level of slab. The slabs are connected by walls made of the same material.

One major component of the building we were unfortunately unable to add was the 28’ diameter circular chandelier that hung from the fifth floor all the way down to the ceiling of the second (as seen in figure 2). We looked on BIMObject and Revit City for a chandelier that had the same shape. We were able to find a few, but none of their radii were able to be scaled or changed. Since none of them were even close to 28’ in diameter, we omitted this light fixture.

We also decided to ignore the air ducts coming out of the top of the building. In real life, these pipe structures come out of the HVAC system and protrude just higher than the top edge of the roof. Although it is a moderately significant feature when looking at the building, it is part of the HVAC system (which we did not have to incorporate for this project) so it was left out.

We made some assumptions and simplifications to the fifth level as well. This level is unique since the ceiling is slanted (since it is inside the roof). These were especially difficult to model since the roof was only able to be seen in 3D and section views. Revit would not allow us to make ceilings because they protruded through the roof. As a result, ceilings were omitted on the fifth floor. Additionally, each wall we drew on the fifth floor went through the roof as well. To fix this, we had to go to the 3D view and use the profile tool to trim the edge of the wall, so it was in line with the roof. This was a painstaking process, so we were unable to do it for every wall. Every wall that was not edited with the profile tool was simply raised as high as it could be raised without poking through the top of the roof as seen in figure 5.

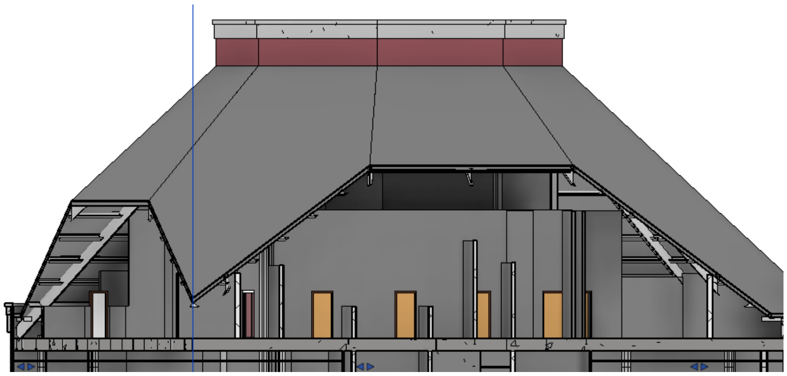

Figure 5. Cut 3D view of fifth floor walls

Work distribution was relatively uniform. We all worked about the same amount and came into the lab in groups of 2 or 3 a few times a week (until the final week). We quickly developed "specialties", or areas of the project we knew we were especially good at. For example, Mackenzie and Yami became experts at interior walls while Nora learned how to do stairs in a quick manner. Previous experience came into play too. Jocelyn had previously used SketchUp in a modeling class, so she took on most of the work for that portion. These "specialties" allowed us to work quicker and more efficiently, especially towards the end of the project, where time was of the essence.

Solar Study

We set the location at Urbana, IL and the date to April 30th, 2020, which is the date we did the solar study. The time of the sun path is set to from sunrise to sunset which is 4:59a.m. to 6:42p.m with the 15-minute time interval. Through this solar study we noticed that the majority of the curtain walls are placed on the east and west sides of the building. This is the same side of the building that receives the most amount of sunlight. We concluded that the architect did this on purpose to maximize the amount of natural light that enters the building.

Energy Analysis

Unfortunately, after running three unsuccessful energy analyses on two different accounts with three different analysis settings and with the help of two TAs, we had to give up hope of producing a successful energy analysis. After setting the location to Urbana IL for our first attempt we chose settings based on what we thought matched the ACES library best. For example, for building type we chose University Building and for energy usage we chose a year-round school. However, the analysis failed and gave us a strange error that the system had to be updated. We tried again and this time we used the exact settings that were used in the BIM assignment, which can be seen in figures 6 and 7. When this analysis also failed, we switched accounts and asked a TA for help, but the third analysis also failed and gave us the same error as the first two times. We then asked a second TA who after reviewing what we had done explained to us that sometimes these things happen, and you just cannot have an energy analysis. Our group came up with a few possible explanations for why this could have been the case. One of the most common reasons that this happens to people is “unusual material thermal properties”. Thinking back to how we were able to input the skylight, we remembered that since we needed to place the window on a surface, we changed the material of the floor slab under the skylight to “air”. This could have confused the energy analyzer resulting in a failed analysis. Another possible reason could be the lights we imported from BIMObject. It’s possible that the tool didn’t know what to do with our interior lights (since they were not in the English Imperial folder) and so the software crashed.

Energy Settings

Parameter	Value
Ground Plane	Ground Level
Project Phase	New Construction
Analytical Space Resolution	1' 6"
Analytical Surface Resolution	1' 0"
Perimeter Zone Depth	15' 0"
Perimeter Zone Division	✓
Average Vertical Void Height Threshold	6' 0"
Horizontal Void/Chase Area Threshold	1.00 SF
Advanced	
Other Options	Edit...

Advanced Energy Settings

Parameter	Value
Target Percentage Skylights	0%
Skylight Width & Depth	3' 0"
Building Data	
Building Type	Office
Building Operating Schedule	12/6 Facility
HVAC System	Central VAV, HW Heat, Chiller 5.96 COP, Boilers 84.5
Outdoor Air Information	Edit...
Room/Space Data	
Export Category	Rooms
Material Thermal Properties	
Conceptual Types	Edit

Figure 6 (top) and Figure 7 (bottom). Revit Energy Settings for second and third energy analysis attempts

Conclusions and Recommendations

This project was tough but rewarding for all of us. We ran into problems described in the Modeling section of this paper: thickness of walls, the roof, slated floor slabs, and an overall difficulty of finding certain measurements. One of the biggest ways we solved these was simplification. In the beginning of the project, we really wanted to do everything exactly right and we would overreact to some tiny detail being off. And for a long time, we were able to make everything exact. We took the time to make every single beam, column, and interior wall the corrected size, thickness, type, offset exciter. However, as the project progressed, we learned that some assumptions just had to be made or the project would never get finished. This was done with the floors in the basement, the fifth floor and the thickness of the exterior walls. We also completely omitted some details too, like the fifth-floor ceilings and the air ducks coming out of the top of the building. When we couldn't find a measurement of a component, we relied heavily on the measurements of neighboring components to calculate or estimate it. For the estimated measurements, we were always sure to double check with a TA. Overall, this project has taught us many things. With respect to time management, it's important to distribute tasks early so that procrastination does not happen. We were a step or two behind the entire project because we did not seriously start working on it until after spring break and then we suffered a major setback when we had to remake the entire roof super structure due to making it incorrectly the first time. We also learned valuable tricks to reading construction plans. Probably the most notable take away was how detailed construction drawings are and how it takes time to completely understand what is being depicted. As future professional engineers, we realize that some of the assumptions we made would not be acceptable in real life, but as we progress through the civil engineering curriculum here, we know that reading plans will get easier.

Some advice our group would have for future students would be to get started early! Familiarize yourself with the sheets and if you do not have a table of contents, consider making one for your own to use. Split up the files into architectural plans and structural, as well as furnishing plans if you have one. Work in groups of 2-3 a few times a week. If a whole group works on it at once, some people end up doing nothing. Lastly, do not stress excessively over the small things. If it looks right (for the purposes of this project) it is likely fine.

References

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