Fresno Music Concert Hall

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The Central Valley is home to a growing generation of performance arts. Much of its success is with the help of Fresno's Philharmonic Orchestra. The Fresno Philharmonic currently has 73 musicians, who are all members of the American Federation of Musicals and who are proudly raised in the Central Valley. Fresno professional symphony orchestra presents unique live musical experiences to thousands of people of the Central Valley with their exceptional styles of music genres, they provide high-quality educational music programs to students throughout the regions. Genres ranging from the classical symphony, pop series, jazz, and Broadway entertainment. Fresno Philharmonic and Carnegie Hall's Link Up education program hosted 11,500 students over the past year. A musical educational program that benefits students from the Fresno, Sanger, Central, and Clovis Unified school districts. Fresno Philharmonic Orchestra currently performs in the Williams Saroyan Theatre in Downtown Fresno. With the growth in musical education expected to increase over the next years, the Fresno Philharmonic faces challenges with their current venue. With the Saroyan venues increase in accommodating artists from around the globe, the Fresno Philharmonic has seen a decrease and difficulty in scheduling their concerts. A decrease that effects the community and young aspiring artists. The Fresno Philharmonic Orchestra needed to expand outside of the Saroyan Theatre and present a new hall that defines what the Central Valley is all about, bringing the community together through the performing arts. Fresno Philharmonic Orchestra commissioned a new Music Hall Auditorium.

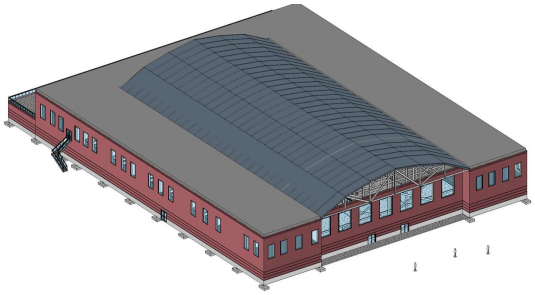

Figure 1

Above & Beyond Engineering, a consulting group located in Fresno, California, is contracted to provide the design of the auditorium. The Music Hall Auditorium comprises of 90,000 square feet building. Two story building, offers 2,600 seating, main stage, four conference rooms, practice rooms, two dressing rooms, mechanical and electrical rooms, outdoor balcony, and first and second story bars. The four conference rooms will serve as a large gathering in hosting musical education to students as well as business conferences. Practice rooms will help musicians and students better their skills. Practice rooms will offer individual personal rooms for fine-tuning, as well as larger practice rooms to accommodate larger groups of similar musical instruments for improving harmonic sounds.

Approximately 22,000 square feet will be reserved for accommodating 2,600 ticket holders. The stage makes up of 2,400 square feet, elevated 5 feet above the finished floor. Stairs and wheelchair ramps are available, sections with disability are reserved. Dressing rooms for both genders are provided behind the stage to allow changes

between sets. Mechanical and electrical rooms are built in to control sound and lighting. Last but not least, the auditorium has an outdoor balcony with an outdoor bar, which overlooks the San Joaquin River.

The Music Hall Auditorium is composed of steel frames to fully support gravity loads and is designed per publications and standards of ASCE, ACI, AISC, and CBC. Steel trusses are designed to act as long spans to accommodate the public. This ensures that the ticket holders get the best experience without a single bad seat. The open space and acoustical dampers found underneath the truss roof help bounce back the sound so that musicians, as well as fans, can enjoy even the most sensitive sound, all while blocking the outside noise.

The large open space of the site makes the construction of onsite concrete walls a cost-effective way to pour and tilt up, ready to connect to the steel frames. Reducing the headache of shipping the concrete walls by means of transportation. Tilt up concrete walls will be connected from the exterior and interior of the building. This will ensure that the exterior is protected from any weather conditions and possible automobile accidents.

Tilt up concrete walls are also great in reducing energy. Concretes reflective surface help reduce temperatures by five degrees, cutting cost from air conditioning. In return, allows less power to light up the building at night. Insulation of the concrete walls can also be taken into consideration, improving the R-value, and taking advantage of the thermal mass, absorbing or reflecting solar energy all of which can help lead to a sustainable design.

A series of concentrically braced frames (CBF) will be used as the lateral force resisting system in the front and rear of the building. For architectural purposes, glass will be used for the front and rear walls of the building to expose the CBF's. Moment resisting frames will be used along the sides of the building as the lateral force resisting elements. Precast concrete cladding will be used to enclose the sides of the structure.

The roof and second-floor diaphragms will transfer the lateral forces through the building into the lateral force resisting elements. Corrugated galvanized steel Verco panels will be used along with insulation and a Duro-Last exterior membrane. The second-floor diaphragm will also be composed of Verco corrugated decking which will be covered by lightweight concrete.

A strong building starts with an equally strong foundation. The main purpose of a foundation is to support the building and to transfer the load from the columns to the soil. There is a variety of soil types and every soil has unique properties which should be discovered to help when designing the foundation. The first step in designing the foundation is to estimate the soil properties by visiting the site and run soil tests. The soil where the music hall is to be built on silty sand. The soil has a dry density of 128 pounds per cubic foot (pcf), an internal angle of friction of 37 degrees, and a cohesion of zero pounds per square foot (psf). The soil properties can be determined as the analysis of columns goes on. After the initial analysis of the columns, the different types of columns will be evaluated depending on the type of load they are to carry. As a result of this assessment, different types of footings will be designed to support specific columns.

The footings are designed to resist the bearing capacity and to limit the settlement after 30 years. The footings were placed at a depth of 4 ft from the ground surface. In addition to this, there will be three different types of spread footings size. After the analysis, the three types were chosen to be square footings. The measurements of the footings are 10 ft x 10 ft, 7 ft x 7 ft, and 4 ft x 4ft. Every type of footing is designed to ensure the safety of the building by meeting the settlement limit of the building as well as the bearing capacity. The process of designing the footing is to satisfy the bearing capacity requirement and the settlement limit. A factor of safety of 3 is used to calculate the bearing capacity in a bid to ensure the safety of the music hall. Each type of the footings will be reinforced with steel reinforcement per ACI standards. Also, rebars will be included at the base of the footings. The clear cover to protect the rebars is 3 inches. There are going to be 12 #8 reinforcement bars, and 8 #6 rebar dowels.

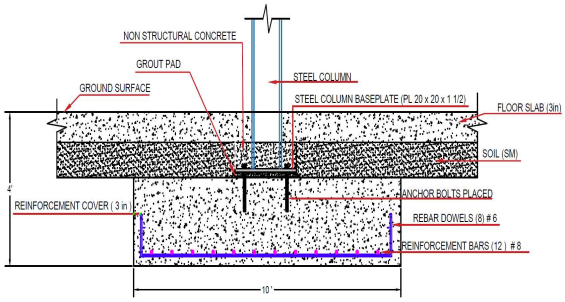

Figure 2

The Fresno Philharmonic Orchestra (FPO) new concert's hall will bring hundreds of people all around the Central Valley for their concerts. Typically, the concerts are performed on Saturday evenings at 7:30 PM and Sunday afternoon at 3:00 PM and are only for once a month. For this reason, the traffic will not be impacted drastically since the concerts are not during either the AM or PM peak hours. The concert hall will be located in Northern West of Fresno by the intersection of Alluvial and Palm as shown in Figure 3.

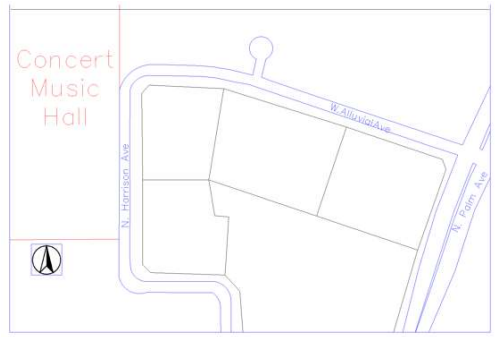

Figure 3

After studying the intersection of Palm and Alluvial, the future volumes of approaching cars are found. As shown in Figure 4, the current and future volumes of cars approaching the intersection can be seen. Because of the attraction of people, the volumes of cars increase for all the different directions.

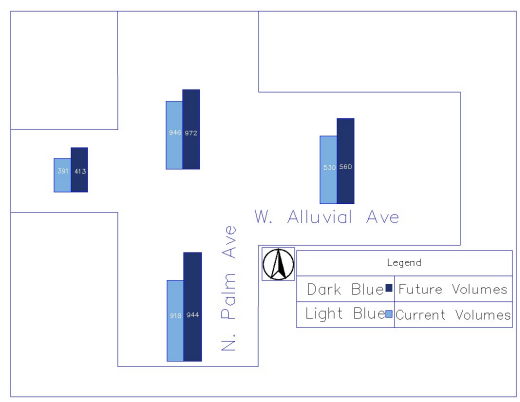

Figure 4

In order to know how the intersection is running smoothly or if improvements are needed, the level of service (LOS) must be checked for the current and future volumes of cars. The current level of service for each direction for each turn is shown in Figure 5.

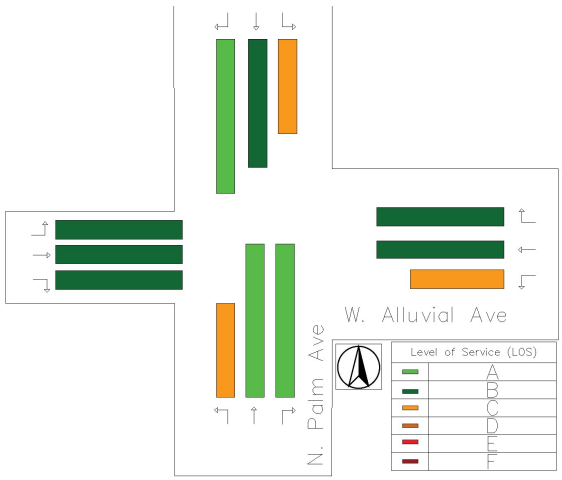

Figure 5

The transportation team is required to design the parking lot to accommodate the number of guests who will be attending the new Fresno Music Concert Hall. The parking lot area is approximately 450,000 square feet. The parking lot has a capacity of 1144 parking stalls, 20 ADA parking stalls, and 20 stalls for electric vehicles. The number of parking stalls was obtained based on the number of attendance, the number of ADA stalls was found using the Fresno of City requirements, and the electric vehicles stalls were added to encourage the use of environmentally friendly cars, which is expandable if needed. Also, there will be 10 bicycle parking stalls that can be expandable and was design as a part of improving active transportation in the valley. As part of the interior circulation inside the parking lot to ensure that the transportation system is smooth and organized. Sidewalks, loading zones, yield signs, and concrete curbs were designed to ensure a safe environment for people. There will be two access entries to the building from Harrison Ave and one emergency access for access located on the opposite side on Alluvial Ave. The access can handle the traffic capacity and have a width of 35 feet per access, and the emergency access exit/entry was designed for adequate capacity during the peak hour. The parking lot structure and access entries can be seen in Figure 6.

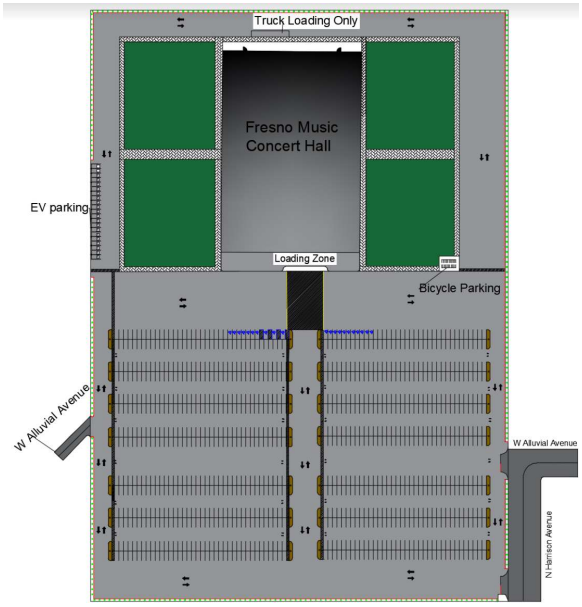

Figure 6

At the beginning of the year in 2018 the Fresno Philharmonic orchestra was fed up with scheduling issues and determined to find a proper home to perform. Over the lifetime of the Orchestra, they were forced to split their time between the Saroyan and the Shaghoian Theaters. The Fresno Philharmonic receives roughly $2 million annually and has finally received enough to create a home for themselves. This led to the formation of A&B Engineering whose sole purpose was to design a new home for the Orchestra. This new home would be a state of the art theater that contained a bar, kitchen, restrooms, conference rooms, practice rooms, and seating for over 2500 people. A project of this scale required immense care in developing a sustainable sewer and potable water system. The first step in this process is

calculating the sewer and water demand for the site as accurately as possible.

Figure 7

The first step in this process was using the plumbing code to determine the Gallon per minute use and a number of fixtures within the music hall. It was determined that there would need to be 4 bathrooms, a kitchen, and a bar. Next, the Fire demand was added to the calculations so that in case of a fire there would be adequate water in order to extinguish the fire. Following this, the sewer demand for the building was calculated. Due to it being a music hall it was decided that the Sewer demand would be 100% of the potable water demand, excluding fire flow demand. Following this, the next step was to determine the locations and specifications of the pipes used in constructing the music hall. It was determined that for the potable water demand of the theater that Schedule 80 PVC pipe would be used. For the Fire Flow Pipe Diameter, it was determined that C900 PVC would be necessary as this pipe was larger than 4 inches in diameter. The sewer line for the Music hall is C900 pipe as well. For each of the potable water and sewer lines, there were two connections used for redundancy purposes. In case something goes wrong and one is out of service the other would be able to fulfill the needs of both.

Following this process, it was important to determine whether the current systems were able to adequately provide for the addition of a property as large as a music hall. This would account for factors such as headloss, pressure, flow rate, and pipe velocity.

Overall the design was based on a series of very important topics, the first one of these being sustainability. It is important that these systems outlast the music hall and that there will not be a fear of pipes bursting or breaking. This being said the pipes were designed according to the standards of The City of Fresno.

Economics was another very important idea that was kept in mind during the design process. The most important place that this was accounted for was the layout of the facility. Each linear foot of pipe added costs a very large sum of money so pipes were specifically placed in locations to reduce the total linear footage of pipe used. An example of this is the pipe connecting to the middle of the building. It was connected at the middle in order to provide the restrooms, located on the adjacent wall, with adequate water and sewer systems.

The final topic that was an important factor was efficiency. The system must be designed in a way to be easily constructed and added to the facility. This was done by working on designing components that were easily obtainable and easy to install for the contractor. Overall this led to a well-rounded design that will lead to a Music Hall that can be enjoyed by the people of Fresno and beyond for many years to come.

Fresno Music Concert Hall includes two identical parking lots in it in front of the building of the project. One is on the north side and the other one is on the south side. The drainage system that will be serving this project will be located on both sides of the parking lots. Since both parking lots are identical, the drainage system designer will complete the design of the north parking lot and the south parking lot will have the same design.

The drainage system, as a whole, will include 36 inlets to collect the storm water, 36 pipes to transport the storm water, and two basins that will store it. For the convenience of the people visiting the music hall, the drainage system was designed to prevent the parking lots from flooding since the people's most concern is finding a parking whenever they visit a place for entertainment to not miss the show. Therefore, all stalls of the parking lots should be available and not flooded. Starting from the inlet on the far right the discharge will start at a particular rate then it will increase as it moves to the left running through the pipes. Nevertheless, the volumes that the inlets carry increase as the storm water moves to the left.

In addition, the pipes sizes change as well, as long as the flowrate keeps increasing. The transportation team and the drainage designer will collaborate to make sure the slopes are good enough to make sure the inlets collect the storm water; it is very important to ensure the slopes are correct, so the cars do not face any floods. On the other hand, the volume of the cars coming to visit the music hall won't affect the efficiency of the drainage system.

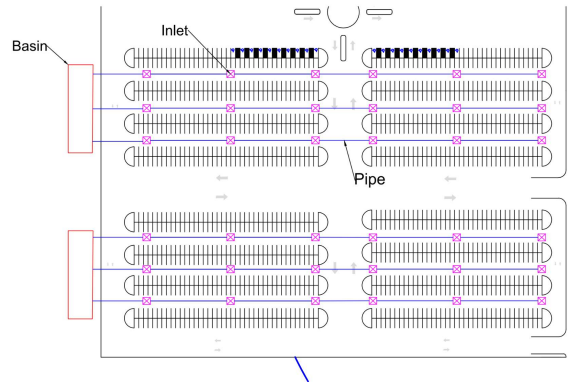

Figure 8

A&B Engineering

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