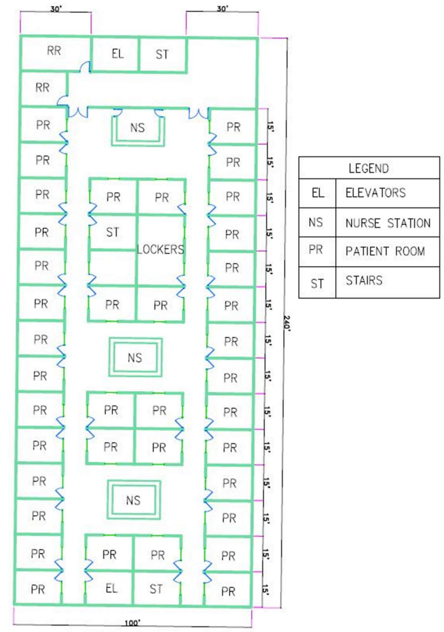
Do It for The Kids!!

New Children's Hospital Project

By:

The current Valley Children's Hospital in Madera, CA is reaching the capacity of the number of children they are able to service. In addition, children in cities closer to Bakersfield have an extensive drive to receive medical care. This is especially problematic given an emergency situation. In order to alleviate this issue, this project proposes a new children's hospital be built just south of the city of Tulare. The location of the new children's hospital was strategically selected to meet the community needs of the Central Valley. The location has easy access to State Route 99 and is centrally located between Fresno, CA and Bakersfield, CA.

The hospital is divided in to three wings and three stories, the middle being the main wing and a wing on each side. This children's hospital will serve up to 210 children. It will contain an emergency room, surgery room, food services, laboratory, and pharmacy. The side wing is designed to accommodate patient's beds on each floor. Each floor includes 38 patient beds, 3 nurse's stations, 2 elevators, 3 stairs access, guest restrooms and a waiting area. Each of the patient's room is approximately 300 square feet and includes



private bathroom.

Each of the rooms are strategically arranged such that the patient shall be visible in their bed from the nurse's station. The framing for the building will be comprised of steel beams, columns and studs. The roof will have a parapet and walking area for maintenance to be done for mechanical units on the roof.

Hospital wing dimensions are 240 ft x 100 ft. The wing is three stories, with each story height of 15 ft. The hospital wing is designed to accommodate patient's beds. The size of the room is 300 SQ., which includes the patient's bathroom. The size of the patient's rooms was designed in accordance with California Building Code (CBC). The rooms were design to keep patient's comfortable and provide most efficient access. The wing includes 3 nurse's stations, which are placed so assigned patients are easily visible. The wing also included three staircase access in case of a fire, and 2 elevators, one for faculty and other for visitors. The waiting area on each floor includes visitor's restrooms.

The material for the hospital framing design was chosen to be steel for its high strength and ductility, compared to concrete and timber. For the flooring and roofing a 6-inch concrete slab is used. Instead of common Portland Cement, Fly Ash concrete was used to reduce the CO_2 emissions.

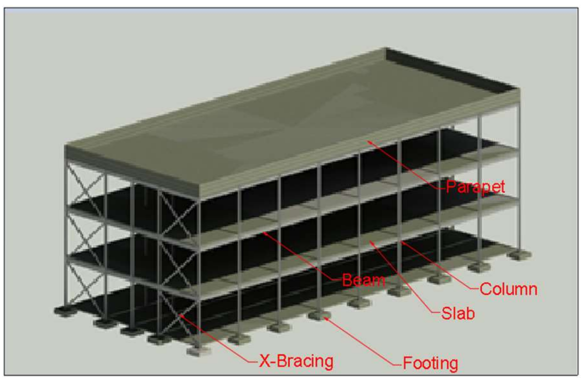


Figure 2: Hospital Wing Framing

Structural design for hospital has to be to the highest standard. In a natural disaster, hospitals should be the last building's standing. The hospital wing was design for gravity and lateral loading starting from the roof down to the foundation. For the lateral loading moment frames were used in the longer direction, and X-bracing system was used in the shorter direction.

The parking structure was designed to include 210 parking stalls. The typical stall is nine feet wide and twenty feet long, in accordance with the Tulare County standards. Twelve of these

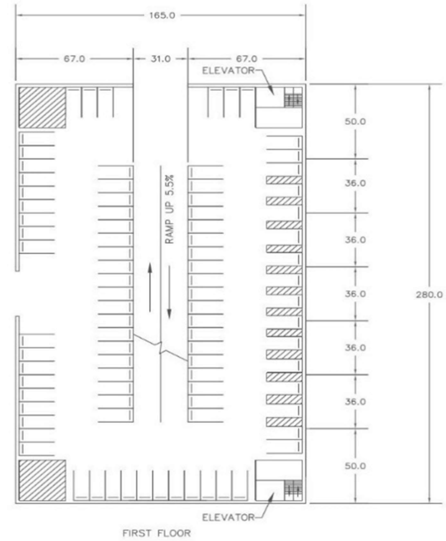


Figure 3: Plan View of Parking Structure

stalls meet ADA requirements by being marked as such and incorporating five foot wide access aisles next to the stall. Additionally, two of these eleven stalls meet ADA van requirement, as they are eleven feet wide instead of nine. There are two sets of stairs and elevators on the sides of the structure closest to the hospital so that pedestrian transport to and from is most convenient.

The vertical load resisting system was divided into various types of beams, girders, and columns. Pretopped double tee beams were selected for the beams. A pretopped beam includes a driving wearing surface, eliminating the need for a cast-in-place surface after erection of the structure, while the double tee is an efficient choice in that it serves to act as both a beam and a slab. A combination of L-beams and inverted tee beams were selected for the girders, depending on whether they were supporting a single bay or two bays. The columns were chosen to have a rectangular cross section.

In total, the structure was designed for five different beams, four different girders, and five different columns.

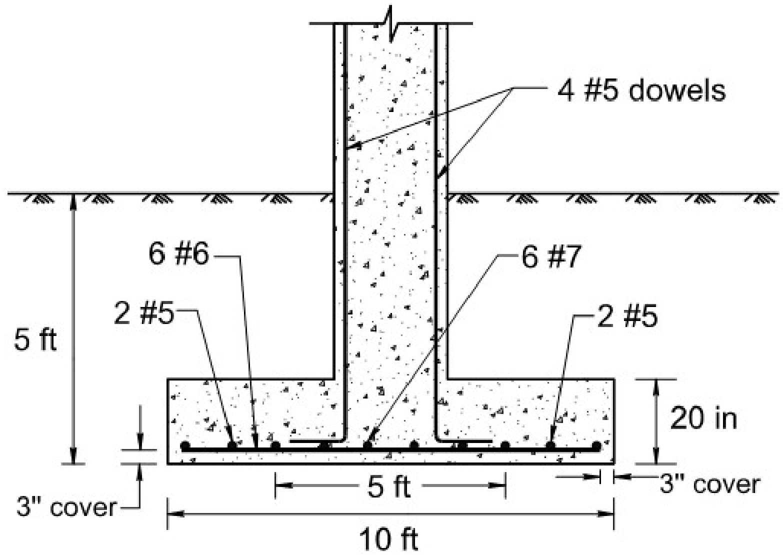


Figure 4: Spread footing cross-sectional plan

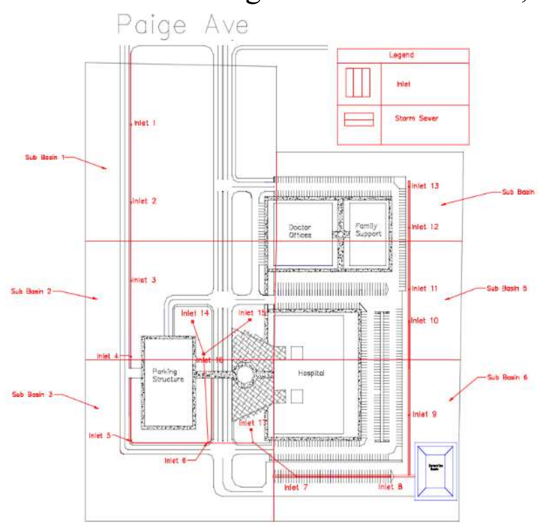
Shallow spread footings were designed to support the columns of the parking structure. Soil properties used in the design include a dry density of 105 pounds per cubic foot (pcf), a cohesion of 30 pounds per square foot (psf), and an angle of friction of 33 degrees. After analyzing the column loads, it was decided that three different sizes of rectangular spread footings will be used to support the appropriate columns. The footing sizes are 6 ft x 10 ft, 8 ft x 12 ft, and 12 ft x 24 ft. All footings will be placed at a depth of 5 ft below the ground. The footings were designed to have sufficient bearing capacity and to minimize the settlement that will occur after 20 years. The footing sizes were first determined by limiting the total settlement of the structure, since settlement typically controls the design. Once the sizes were obtained, the allowable bearing capacity of the footings were found using a factor of safety of 3. From the results, it was found that the footings have sufficient bearing capacity and therefore can safely support the column loads. All footings will consist of steel reinforcement, including rebars in both directions for the base of the footing and dowel bars for the stem. The standards of the California Building Code (CBC) and the American Concrete Institute (ACI) were applied in the design of the foundations.

The grading plan is also an essential component of the overall design of this project, as the design of the storm water drainage system is based on the grading plan. The main design consideration for the grading plan was to provide the most suitable slopes and elevations for the finished ground surface that will allow water to flow properly to the drainage inlets. Tulare County and other typical design standards were consulted in providing the proper slopes for the ground. Finished ground elevations were calculated based on these slopes and the existing topographic data. Once the grading design was complete, the cut and fill volumes of soil were calculated from the elevations. The cut and fill volumes determined the quantity of soil that needs to be imported to the site to complete the grading work. The design of a sanitary sewer system is another significant element of civil engineering. Where there is water consumption there is typically sewage. A sanitary sewer line is an underground carriage system specifically for transporting sewage from houses or commercial buildings through pipes into treatment facilities or to an area of disposal. The main function of the hydraulic design of the sanitary sewer system is to safely carry the design peak discharge while at the same time transporting suspended materials to the main sewer line. A design that is not adequate will require more maintenance, or even worse, will result into sewage backup. Having a proper design for the sanitary sewer system should accommodate for maximum occupancy of the building.

Design of stormwater drainage system is an important civil engineering element that general public most of the time overlooks. Proper stormwater drainage design is needed to get rid of excess rainfall overland runoff created by the development project. Before development of the site, the rainfall will usually infiltrate to the ground. The impervious spaces created by development will leave little or no space for the water to infiltrate. This will lead to flooding. Stormwater drainage design will solve this problem by adequately designing inlet structure and storm sewer that will convey the excess flow safely to a detention basin designed to store the adequate amount of excess stormwater runoff so the hospital structure can carry on working without the fear of flooding.

Stormwater design usually consist of four main design components. They are hydrologic analysis, design of collection system, design of the conveyance system and finally design of the detention pond. The locations of designed inlets, storm sewer pipes and detention pond location is provided in the figure below. A brief rundown of the design methodology is provided in the next paragraph.

After analyzing rainfall data, an Intensity-Duration-Frequency (IDF) curve was developed for the site location. With the help of the grading plan the locations of the inlets were determined. Using the rational method,



the flow for the inlets through on land flow and gutter flow was calculated. Using the rational method, the pipe size and pipe flow was determined. Using the volumetric method, the dimensions of the detention pond will be determined.

Figure 3: Stormwater Pipes and Inlets

Design of water distribution is a key element of the hospital as potable water is required for drinking, cleaning etc. and to fight fires. Without a supply of clean water, the hospital will not be able to serve the community. Multiple methods were used to calculate water demand and distribution system is designed based on most conservative demand so that the distribution system can operate as the demand increases in the future.

Water will be delivered from the city of Tulare by installing new water main which will connect to existing main lines on east and west side of the project. The new booster pump will be installed on site to deliver water to the on-site elevated storage tank and to regulate pressure as city water pressure fluctuates throughout the day. On-site storage tank will be used to store water for fire flow requirements. The distribution system is designed with redundancy as the hospital will need to operate in case of an emergency. If the city fails to deliver water or pump stops functioning, elevated storage tank will provide water which will keep the hospital functioning.

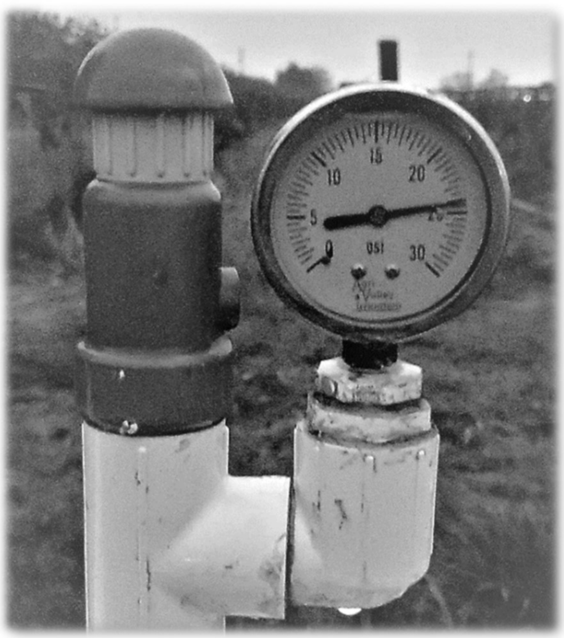
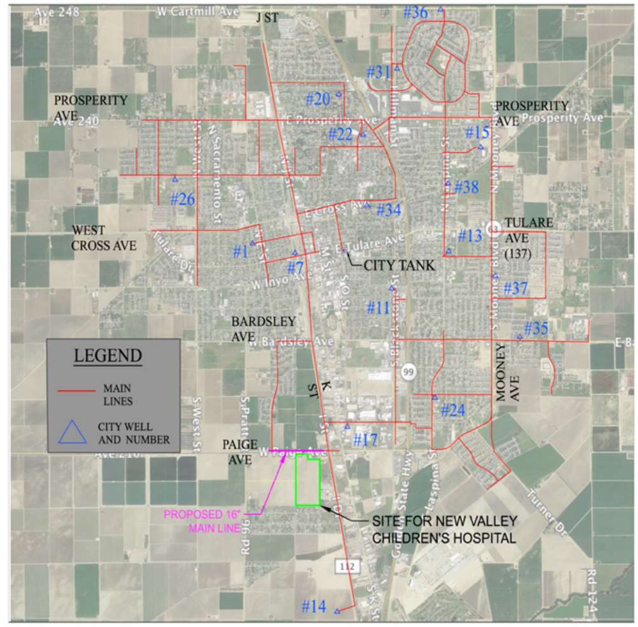


Figure 4: Water Pressure Gauge

To optimize the system, the designed pump will also use variable frequency drive system. The drive will regulate the pump speed as the demand or city main line pressure fluctuates. This drive will result in constant water pressure delivered to the hospital building. This will greatly reduce energy cost as the pump will not be running at max rpm all the time.

The water distribution system of the City has to bring water to the New Valley Children's Hospital. The



EXISTING TULARE WATER SYSTEM: MAIN SERVICE LINES ≥ 10"

Figure 5: Main Service Lines in Tulare

water demand used by the hospital may cause some pressure drops in other areas of the City. To observe any changes in pressure, the system was modeled in EPANET, a software used to analyze water distribution systems. The water distribution system for Tulare, which included the proposed hospital, was analyzed using EPANET to confirm that the system met all the standards and regulations.

The City of Tulare currently runs on 22 active wells, shown in the figure to the right, that maintain peak hour demand of 19,000 gallons per minute. The capacity of the wells can achieve about 22,000 gallons per minute. With the New Valley Children's Hospital receiving about 700 gallons per minute during peak hour, the current capacity will not have to be increased. Although when there is a fire in the City or the hospital, this number increase by 2500 gallons per minute. This can cause significant pressure drops across Tulare. One of the criteria recommends that the pressure anywhere during a fire will not drop below 20 psi.

The design of the pipe connection from the city to the hospital will be based on the flowrate needed during peak hour and needed fire flow. The connection from the New Valley Children's Hospital to the City of Tulare will be a 12" C900 PVC pipe with a length of about one-half mile, connecting to the 12" main lines on the east and west side of the project site.

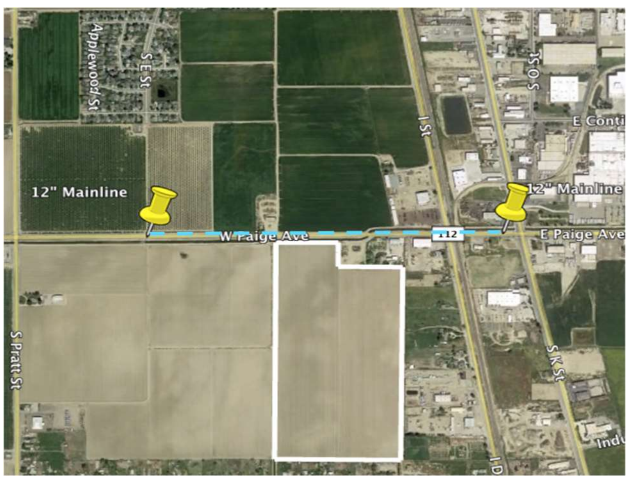


Figure 6: Service Connection

The decided design of the children's hospital's parking structure is customer-centric and aims high for medical care, sustainability, and enhanced facilities coupled with modern design. The design of the parking lot will be based on the city of Tulare specification or standards for hospitals and the parking capacity of the garage will be calculated based on the number of beds for the patients.

The designs of the parking lot would allow safe movements of pedestrians, along with continuous flow of traffic. Circulation patterns for pedestrians would be designed to minimize the use of "short cuts" that often damage landscape. Similarly, circulation systems will be designed for vehicles to reduce conflicts on the main entries and exits.

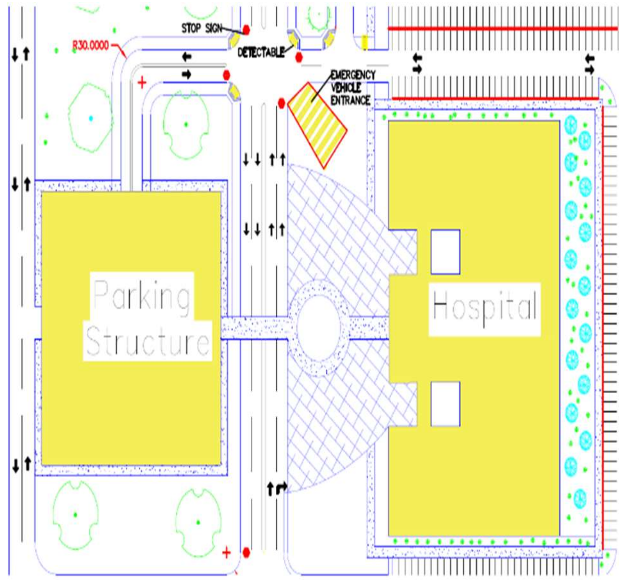


Figure 7: Intersection Within the Site

Safe, quick, and direct access to the main hospital campus should be enabled through a pavement and the parking structure would be having convenient pedestrian bridges and well-thought-out elevators and stairways. There will be paved parking around the buildings of hospitals. The pavement will be preferably designed by using Rubberized Hot Mixed Asphalt (RHMA) and HMA as they have long lasting life and produce minimum traffic noise. The design includes 600 parking stalls among which more than 216 are made of concrete and are based on the 90-degree design of parking garage.

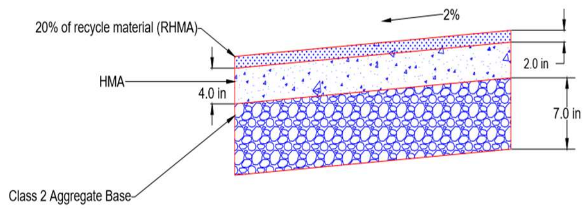


Figure 8: Typical Cross-section of the Pavement Plan

The parking design of the parking lot will also include a solar-powered electric vehicle charging station with backup battery providing both 120-volt and a 240-volt outlets and charging 4 electric vehicles at a time. The alternative energy parking stalls will help to avoid long queues and waiting intervals for charging. The services might be used like shuttle services will facilitate the patients and staff.

Traffic control has to be installed at an intersection which will be on Paige Avenue and on the entrance and exit of the site. Moreover, the design allows maximum speed of 25 miles/hour inside the location of hospital to avoid any accidents.

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