

## BACKGROUND:

The Robert M. Arnold Public Health Sciences Building is an interesting collage of structural systems. Different portions of this building employ different methods of supporting the necessary loads. The building itself consists of five floors above grade plus a mechanical “penthouse” on the roof. It also extends 3 stories below grade.

The main framing system in the Public Health Sciences Building is a cast in place concrete framing system. Almost all of the remaining portions of the structure are made of concrete. The columns are continuous cast in place reinforced concrete columns. The typical columns are 24 inches square and are on an average grid of 30 feet by 30 feet. The columns do not taper towards the top, however, the amount of reinforcement can vary. The shape of some columns changes from rectangular to circular on certain floors. For these situations the columns have a diameter of 24 inches. Supporting Campus Drive, the turnaround, and the entrance plaza, under which the building extends, is an area of the building which uses cast in place reinforced concrete. The average beam size is 24 inches wide by 30 inches deep.

Although the framing of Arnold building is mainly composed of concrete structural elements there are some portions of the building where steel has been used. Steel framing was used for the stairs and skylight in the atrium. A special stipulation was made by the structural engineers that the structure of the atrium be designed so that only no torsion resulted on the rest of the building. The columns on the fifth story are made of tube steel with the typical size being TS 12x12x<sup>5</sup>/<sub>8</sub>. Steel was also employed in the design of the roof structure that houses the building’s mechanical equipment. The typical steel column in this area is a TS 4x4x4<sup>1</sup>/<sub>4</sub>. The irregularity of the steel roof structure lends itself to atypical beam and girder sizes ranging from W 10x12 to W 30x132. There also are a few steel columns scattered throughout in the main structure.

The floor system of Arnold Building is mainly composed of two way post-tensioned concrete floor slabs. The slab in the basement is not post-tensioned but instead is made of fiber reinforced concrete. The portion of the building located under the entrance plaza uses reinforced concrete slabs. The roof slab is also composed of reinforced concrete. With the noted exceptions the typical floor system is a flat post-tensioned concrete slab with drop panels.

The foundation of the Public Health Sciences Building consists mainly of spread footings and wall footings. Where the foundation is required to resist lateral loads carried down by shear walls, the Building uses deeper drilled piers. The average footing is about 12 feet square, however, sizes ranging from eight feet square to 28 feet by 24 feet. The depth ranges from 30 inches to 48 inches deep, but is typically around 40 inches deep.

The lateral forces exerted on the building are resisted by a combination of shear walls and braced frames. The braced frames are isolated to the fifth floor, the mechanical penthouse, and the roof structure. Shear walls are used on all other levels. They extend down through the parking structure where openings for vehicular traffic reduce the efficiency of the design.

## PROPOSED ALTERNATIVE

Arnold Building will be divided into 4 main structures. The portion of the building below grade will be a monolithic flat plate concrete slab construction as was originally designed. The section of the building that is above ground will be divided into three sections. These sec-

tions will be determined by the vertices of the triangular atrium. These structures will have independent lateral systems. The above grade portions of the building will be redesigned to employ steel for both gravity and lateral elements of the structure. Stringent drift tolerances will be required to prevent collisions between the separate structures. The roof levels and the mechanical levels will remain unchanged except for where new joints in the building exist. These areas are currently designed using steel.

Following the modification of the above grade structure the below grade elements will be analyzed and changed accordingly. The intention is to reduce the self weight of the structure ultimately reducing foundation size; additionally by a reducing the weight of the structure, the participating mass in a seismic event will be minimized.

## **METHODS**

The majority of the structural design for the proposed changes will be carried out through the development of a RAM Model. This main computer model in RAM Structural System will be supplemented by the use of RISA, Spreadsheets, and hand calculations; as is required by the project. The design of footings in the ram model will be compared with CRSI manuals and adjustments will be made. These adjustments will be made because sometimes RAM Footing design produce an overly conservative result. The final design will be based upon the structural requirements of the building as well as constructability.