1.0 Executive Summary

This report provides an analysis on the design of the above-grade structural components of a six-story, 48,000 square foot apartment building. In addition to the design a construction estimate, schedule, and return on investment analysis were completed. The building was designed as a terrace-shaped structure that will be composed entirely of reinforced concrete.

The building was designed to resist a multitude of forces, all of which were analyzed in during the loading analysis process. The foundation of the building in addition to each of the structural elements (columns, beams, slabs, shear walls), were designed to withstand all of the forces exerted on the structure.

The different elements that composed the building were calculated by following ACI 318-11 code. The slabs were designed as one/two-way slabs, this was done because the slab where the corridor runs fits the constraints of a one-way slab, so it was designed as such. The slabs in the rooms that spanning 15-25ft were designed as two-way slabs. The shear walls for the elevator and the stairwells were designed as load-bearing shear walls. They were added to resist the torsion caused by the wind and the axial loading when of the floors when treated as columns. The beams were designed to transfer the load of the slabs onto the columns, and to ensure the floor slabs would not deflect past their limit. The columns were designed to resist axial load and a small moment due to the eccentricity of the axial load. The column self-weight from the floors above is also accounted for in the axial load. The estimate was compiled by taking off the quantities used to construct the building and applying a unit price to each of them. The budget of construction was determined through a return on investment analysis of the apartment’s units.

After designing the different members in the building, the shear walls were designed to have two rows of #8 bar at 18” on center spacing. The elevator shear walls had additional reinforcement on the corners because the minimal reinforcement did not withstand the axial load, so two extra #8 rebar at 4” on center spacing were added. The slabs were designed to be 7.5” thick, their reinforcement was five #5 bars on both column strips and 10 #10 bars in the middle strip of the slab. The typical cross-section that was used throughout the building was a
18x22” beam with 4 #11 bars and #3 stirrups. The typical column cross-section was 12”x12” with 8 #5 bars at 8.375in spacing on center with #4 ties at 10” on center. The total estimate of the above grade structure was $6,656,439. The estimate came in under the project budget of $7,170,000 and generated a return on investment of 7.4%.

In conclusion, the design of the building was over-conservative and the analysis of a concrete structure would have been more precise if the structure was analyzed as an entire moment frame rather than individual structural components. The reinforcement in the beam was overdesigned and the spacing was of the reinforcement was designed incorrectly. The over conservative design led to a higher estimate than needed.