# EXECUTIVE SUMMARY

## STRUCTURAL DEPTH

The existing post-tension system offers numerous advantages. However, there is the issue of low punching shear capacity, and pre-stress losses due to cracking caused by concrete shortening and restraining boundaries. To mitigate these problems, the existing system includes the usage of expensive expansion joints and expensive formwork for drop panels for certain areas of the building.

The proposed structural breadth will include a refinement of the existing post tension system. Proposed changes include the study of alternative tendon layouts to achieve an optimum load balance and the increase of deflection control, re-alignment of offset columns, the utilization of Welded Reinforcement Grids in shear walls and columns, establishing a concrete shear wall core only system, the relocation of expansion joints to a more rational distance along the building, and to utilize restraint-free slab and non-load bearing wall connections to reduce concrete shortening issues.

By reducing the amount of restraining boundaries such as walls, further pre-stress losses can be reduced. This can be made possible by establishing a concrete shear wall core only system, and do away with unfavorable arrangement of independent shear walls. Additional coupling beams connecting the shear walls of the core will be designed to yield, while the wall portion of the core will remain elastic. There are two expansion joints can be relocated to a more rational adjacent distance from each other. Another solution is to utilize restraint-free slab and non-load bearing wall connections.

The pre-stressing tendons can be rearranged to provide a more optimized load-balance resulting in better deflection control. An additional change will be to relocate offset columns so that the column grid will be more aligned. This column realignment will result in the reduction of curved tendon paths and a more efficient tendon layout. In addition it may be possible to eliminate the drop panels carrying the loads from the $7^{th}$ floor due to the offset steel columns on the $7^{th}$ floor. The shifting of the $7^{th}$ floor steel columns may lead to the redesign of the roof framing system, mainly the spans of the truss members.

The reduction of reinforcements without reducing the effectiveness of the shear cores and ductile performance can be made possible with Welded Reinforcements Grids (WRG). The WRG will also reduce rebar congestion, improve constructability, construction time, and labor cost up to 75%. Tests had shown that a safe structure can be designed with 50% less vertical reinforcements required by present code used in boundary elements. The modified concrete core will be designed in accordance with ASCE 7-05 and UCSD test data. The reduction of building weight will result in a less base shear.

**BREADTH STUDY I (Architectural)**

### *Facade Study*

The existing facade contains a large portion of brick veneer. An alternative solution is to use precast architectural panels (manufacture not decided yet), which can be customized to resemble the existing veneer appearance. The exterior wall will then be stiffer. The use of precast panels can reduce labor cost and construction time of the exterior facade. A study on the thermal performance of the exterior wall system will also be studied and compared with the existing one for energy cost and savings.

### *Retirement Home Case Study*

An investigation will be conduction on elderly housing, typically on the arrangement of spaces and its practical locations. Since the building is also a multi use building with plenty of public or social spaces, privacy is a considerable issue. The existing first floor plan consists of 50% housing units and 50% public spaces. There is also a need to study whether the transportation system (elevators) is adequately provided. All of the assisting living, nursing units, and dementia areas are located on the $7^{th}$ floor. This could pose an issue if an emergency arises where an ambulance is required to transport a patient as elevators may be inadequately provided.

### *Floor Plan Arrangement*

Due to the rearrangement of columns and the increase of the shear core, the architectural plans will require modification; mainly due to floor area. Depending on the case study of retirement home communities, public and health service areas may need to be relocated to the ground floor for convenience.

**BREADTH STUDY II (Construction)**

### *LEEDs Certification and Value Engineering*

Value engineering was never considered in the construction of Ingleside at King Farm as design documents were not completed before the construction began. The bid documents were not even completed then. Turner-Konover stepped in to act as the designer of record to complete the design of the building systems. Due to this reason, LEEDs certification was not an idea developed during the design process, but was pursued during the construction process. If it was implemented in the early design stages, more money could have been saved.

Through the usage of Welded Reinforcements Grids (WRG), a reduction of steel reinforcements is possible. Results include improved constructability, reduced construction time, and labor cost of up to 75%. The realignment of the columns on the 7$^{th}$ floor and the reduction of drop panels will also produce savings.

The utilization of the artificial pond besides the building into the mechanical system can aid in the LEEDs certification, and become a cost effective cooling system for the building similar to how the cooling of solar panels work. The movement of cool water through duct work in the building will help with mitigating unwanted latent heat from the building during the summer months. Other green/sustainable usage and methods will be researched as well.

In addition, a cost analysis and schedule acceleration scenarios will also be studied, integrating both the structural depth and architectural breadth study.