Mathew Nirenberg
Structural Option
Metropolis at Dadeland
Adviser: Schneider
Proposal – Executive Summary
12/12/05

Thesis Proposal – Executive Summary

Depth and Breadth Analysis

The Metropolis at Dadeland is a 28 story, 313 foot tall primarily residential structure in suburban Miami-Dade County, Florida. It encompasses over 477,000 sq-ft. The tower was designed as the center of a “new downtown” away from downtown Miami.

The proposed thesis will be an investigation of replacing and existing cast-in-place concrete and post-tensioned slab structure with a steel frame. A comparison of replacement structures will be made between a conventional steel frame and composite floor system. The steel system will may cause a difficulty with height limitations, but the use of a composite floor and limiting ceiling heights should be able to mitigate this issue.

In addition to the redesign of the gravity system will be a redesign of the lateral resisting system. Not only was it not completely adequate according to the findings of technical report 3, but braced or moment frames should be more compatible with the steel framework than the existing shear walls.

As breadth analysis relating to the structural redesign construction issues and electrical layouts will be addressed. Changing the structural system of the building has very obvious effects of schedule and cost of a project. Any manipulation of system or method in the construction of this building could have a substantial impact on the management of this project.

The need for a lighting redesign in the residential spaces is simple. With the post-tensioned slabs the ceilings of the lower units were just a plastered finish on the floor above. No lights were installed in the ceilings of the individual living units due to this system. Since when using a steel structure a dropped ceiling is preferable to hide the less finished structural system there is now space in the ceiling plenum to install lights. The investigation of this lighting will focus more on the actual electrical wiring of the spaces than on the aesthetics of the moods set by increased lighting flexibility.

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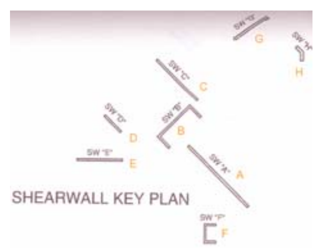
General Information

The Metropolis at Dadeland is a 28 story, 433,221 sq-ft tower that consists primarily of condominiums. There is also retail space on the ground floor and a parking deck within the interiors of the second through seventh floors. The developers had a plan of this structure being a new landmark as part of an attempt to create a new "downtown" in suburban Miami-Dade County just 10 miles from downtown Miami, Fl. Upon completion it will be the tallest structure south of downtown Miami in Florida. There are many other buildings being constructed on adjacent properties currently that are noticeably shorter that Metropolis.

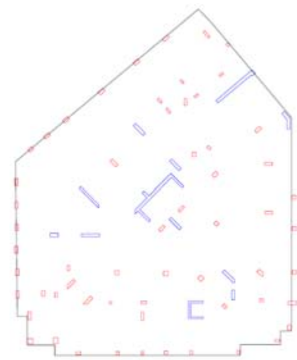
The building is an entirely concrete structure with concrete strengths that range from 4-10 ksi. There are a variety of columns throughout the structure that range in strength, size, and geometric orientation. There is also an array of 8 different shear walls that run to varying heights within the building and some have many openings within them in order to permit traffic flow through the space. All of the slabs are post-tensioned concrete and mainly vary from 8.5" to 9" thick. The exceptions are a thicker post-tensioned 8th floor to account for the increased loads in the fitness spaces and an 18" thick, normally reinforced 22nd floor. The foundation consists of a 5' thick mat slab that sits under the majority of the building. The mat slab sits on an array of 16" mini-piles. The perimeter columns, the only columns not to be supported by the mat, all sit on pile caps which are connecting either three or four 18" mini-piles.



The MEP systems are both delineated into two different parts. The first part of these systems is the equipment that services the public spaces. That includes the first floor, parking deck, and all hallways. The rest of the systems, which is largely independent from the first part, are the equipment present to service each individual residential unit.

Proposed Depth Redesign

In South Florida today almost all of the new mid- to high-rise construction is being done with cast-in-place concrete and post-tensioned concrete slabs. This is primarily because developers are looking to get the most building within a limited amount of space an in many cases, including my structure, get as many floors as possible in within a height limitation.



In order for most systems, aside from post-tensioned slabs, to be effective and efficient in their application a regular column pattern is preferable. The existing column layout in this structure is very irregular with bays ranging from 10’ to 27’. To begin the redesign of the Metropolis of Dadeland condominium I plan to show that a regular column pattern can be achieved with only minimal adjustments to the floor plans. This will provide an opportunity to redesign the structure of the building without a major hindrance on the use of other materials. I anticipate that this will lead to a column grid that has bays somewhere between 20’ and 25’ in either direction.

Once this has been achieved, a steel structure will be investigated as the redesign of this building. Attention will be paid to whether or not including composite design will be a reasonable addition to a standard steel structure. This should be useful since this will be able to decrease the depth of the beams and girders which will help save of the vertical limitations that being created by using a steel structure. Another method to help mitigate this problem that may be created is to compare the differences between having a flat concrete slab placed on the steel frame and casting the concrete on metal form deck.

Means and Methods

The proposed thesis will begin with rearranging the column layout to make a grid. To do this I plan to just use AutoCAD. I plan to be able to overlay the floor plans on one another. This will enable me to find the locations that cause the least impact on floor plans. With the impacts of each decision immediately evident I am eliminating a number of possible complications when one design that works on one floor later on does not work for the last floor I inevitably check it for.

With this “improved” column grid I will be able to proceed with designing the steel framework within the building. Sizing members for gravity loads will be based on AISC *Manual of Steel Construction* and loading from ASCE 7-02. This will be preformed with the aid of RAM Structural System. This investigation will include live loading patterns. This will include sizing the slab thickness in conjunction with the form deck from tables provided by deck manufacturers.

The members will need to be resized as the lateral loads are applied in addition to the accompanying bracing to resist these loads. These loads will be from the detailed lateral load analysis that was performed in Technical Report 3 based on ASCE 7-02. This will be a continuation of the RAM model that has already been introduced for earlier parts of this redesign. As more refined values result careful attention will be paid to floor-to-floor heights in order to try and mitigate overall height issues and to be sure that resulting column lengths are accurate and as efficient as possible. Efficiencies can be checked by comparing costs in Means *Building Construction Cost Data*.

The results will be presented as floor plans that will be shown each time the plans vary. The presentation of results will also show stresses and displacements at critical locations to prove that this is as efficient a design as could be achieved.

Tasks and Tools

Task 1: Column Layout
- scan and overlay floor plans
- establish reasonable spacing
- make any required floor plan adjustments to allow grid to work

Task 2: Trial Member Sizes
- determine reasonable beam layout from grid size
- determine slab thickness from continuous slab spans
- beam size based on factored gravity loads
- size columns for gravity loads

Task 3: Refine Sizes
- apply lateral loads to model
- create braced/moment frames to resist loads
- resize members that are no longer adequate

Task 4: Check Serviceability
- determine story and building deflections
- increase sizes as needed based on most effective use of material

Task 5: Complete Report of Findings
- output of design results
- interpret sizes and values

Proposed Schedule

Week	Activity
1/9 - 1/14	Layout Column Grid
1/15 - 1/21	First Iteration of Steel Floor Member Sizes
1/22 - 1/28	Build Model for Gravity Loads
1/29 - 2/4	Check Building for various Load Patterns
2/5 - 2/11	Apply Lateral Loads to the Model
2/12 - 2/18	Design Lateral System
2/19 - 2/25	Refine Lateral and Gravity Members (including servicability)
2/26 - 3/4	Catch-Up
3/5 - 3/11	Spring Break
3/12 - 3/18	Analyze / Design Lighting Layout
3/19 - 3/25	Compare Costs and Efficiencies as Related to Breadth 2
3/26 - 4/1	Write Report and Design Presentation
4/2 - 4/8	Tie-Up Loose Ends
4/10 - 4/14	Presentation Week
4/17 - 4/21	Reflections

Breadth Topic 1

Lighting / Electrical

Currently the ceilings within the living units are just a finish on the bottom of the slab above. Since this will no longer be practical with a steel framework I plan on introducing suspended ceilings into the space. This will enable lights to be placed in the ceiling throughout the space instead of primarily on the walls as many of the installed lights currently are located. By including the news loads on the electrical system, wiring and circuitry within each unit will need to be redesigned. I will include in my analysis wiring and switching that will be needed to operate the new lights, circuit layout in the breaker panels in an individual living space, and check to see if this has an increased overall load on the entire buildings system.

Breadth Topic 2

Construction Management

There are two things that I am looking at in my main proposal that have a direct impact on the constructability of the building. First the beam spacing will be reviewed to see what impact it may have on the required depth of the form-deck and overall depth of the structure. This becomes a CM issue when it comes to added labor for more structural members versus having to maneuver lighter members.

Secondly, there is the challenge of installing shear studs to enable the composite design of the floors. The standard rule-of-thumb presented to us by Dr. Geschwindner in AE 403 is that each stud is the equivalent of an extra 7 pounds of steel in the beams. I would like to look at how accurate this estimate is and from this analysis be able to determine if the composite system is a good decision. Even if shear studs become for expensive or labor intensive than a conventional steel system, there is still trade off between cost and ability to limit the height of the building.