PROPOSAL

CITY VISTA.

BUILDING 2. 5TH AND K STREET . WASHINGTON D. C.

JULIE DAVIS
STRUCTURAL
DR. MEMARI
JANUARY 14, 2007

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EXECUTIVE SUMMARY

City Vista is a three building mixed used complex in downtown Washington D.C. Building 2 is strictly residential and contains 149 condos along with a community room, library, steel frame pedestrian bridge, and outdoor patio. This 11 story 324,298 square feet building reaches a height of 114'-0". City Vista was designed by world renounced architects Torti Gallas and Partners. The design uses strong vertical and horizontal elements. Building 2 skyline is a powerful horizontal statement though the use of a roof overhangs. This horizontal element is counteracted with protruding glass and crème colored brick vertical components throughout the building's façade. During design *The District of Columbia Building Code* was used in conjunction with the IBC, ASCE 7-05 and ACI.

The building is a flat plate post tension system with (4) shear walls for lateral support. A grid of (52) cast in place piles support the 7 1/2" PT slabs. The deep foundation system consist of over 250 16" Diam. augured cast in place piles drilled to a depth of 60-65'. The ground floor is a 4" slab on grade. Post Tension tendons are unbounded in one direction and uniform in the other.

City Vista's is heavily dictated by the 130'-0" height restriction in downtown Washington D.C., Including the pent house Building 2 is 128'-6" tall a little shy of the governing 130'.

In this report I will proposal a resign of the current structural system. Instead of the current cast in place system, I suggest a precast system of hollow core planks, inverted t-beams, columns, and shear walls. This system will meet height requirements without losing any rentable space. A precast system also presents the possibility of a LEEDS certification, faster construction, and a reduction in cost.

Changing the current structural system will present architectural challenges regarding the current floor plan. Corridors may need relocation, and apartment layouts may need alterations. An architectural study will be done with the new column grid to verify all codes are met for egress and flow is sufficient. An in-depth life cycle assessment will also be conducted for each system to highlight the benefits of a precast system.

The following report outlines my plan of action and timeline to accomplish the redesign and analysis of City Vista Building 2.

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EXISTING CONDITIONS

City Vista is a three building mixed used complex in downtown Washington D.C. Building 2, is strictly residential and contains 149 condos along with a community room, library, steel frame pedestrian bridge, and outdoor patio. This 11 story 324,298 square feet concrete building reaches a height of 114'-0". Construction of Building 2 began in 2005 and was completed in 2007. City Vista was designed by world renouned architects Torti Gallas and Partners. The design uses strong vertical and horizontal. Building 2 skyline is a powerful horizontal statement though the use of a roof overhangs. This horizontal element is counteracted with protruding glass and crème colored brick vertical components throughout the building's façade. At ground level the building narrows for a more intimate appearance.

Foundation System:

Building 2's foundation system is a 4" slab on grade with a deep foundation system. Drilled at a depth of 60-65' below grade there are over 250 16" diam. augured cast in place piles. This foundation system was chosen due to the median to stiff clay located up to 22' below grade. Piles have an assumed service capacity of 125 tons and typically are reinforced with 1 #8 x 15'-0" LG. Piles under shear walls are reinforced at 25' with 4-#8 vert. and #4 ties. The slab is thicken at interior CMU walls and location of increased service loads. Grade beams at a width of 1'- 0" are placed around the buildings perimeter at varying depths.

Floor System:

A two way post-tension slab is used for all floors. The tendons are unbounded and span in both directions with a minimum of (2) tendons above columns . Banded tendons are used north to south and uniformed tendons east to west. Bundles size varies but are restricted to a minimum of 4 tendons per bundle. The 7 ½" slab is reinforced two-ways with #4@24" bottom mesh reinforcement and #5 top bars at various locations. Rebar is also provided around the perimeter. Where tendons and rebar intersect chairs should be placed with #4 ties for lateral stability. Tendons stressing will be done with a hydraulic jack, anchorage blockouts are grouted and tendons cut 1" from slab edge, stressing sequence is as followed;

1.Stress 50% banded tendons
2.Stress 50% of uniform tendons
3.Stress remaining 50% banded tendons
4.Stress remaining 50% uniform tendons

Balconies are conventionally reinforced with #4 @ 12" O.C and 2-#5 top & bottom.

Lateral System

Building two is a joint less structure with a central core. The flat plate post tension slab is supported by a grid of (52) cast in place gravity concrete columns. (4) Concrete shear walls are used for lateral stability, three of which surround the elevator shaft (i.e. the central core). Cold form metal studs are

used for most wall construction with the exception of stairwells, mechanical rooms and storage areas which are masonry construction.

Shear Walls: Shear walls footings are to be reinforced at a depth of 25'-0" with vertical bars and ties. Typical shear wall reinforcing are #4@12" vertical and horizontal, 8#8 in the middle, and #3 ties in various arrangements. An F'_c of 5000 and F_y of 60,000 is used in each shear wall.

Columns:

(52) Cast in place columns are used with an f'c=5000psi. Columns take some lateral forces but predominantly support gravity loads.

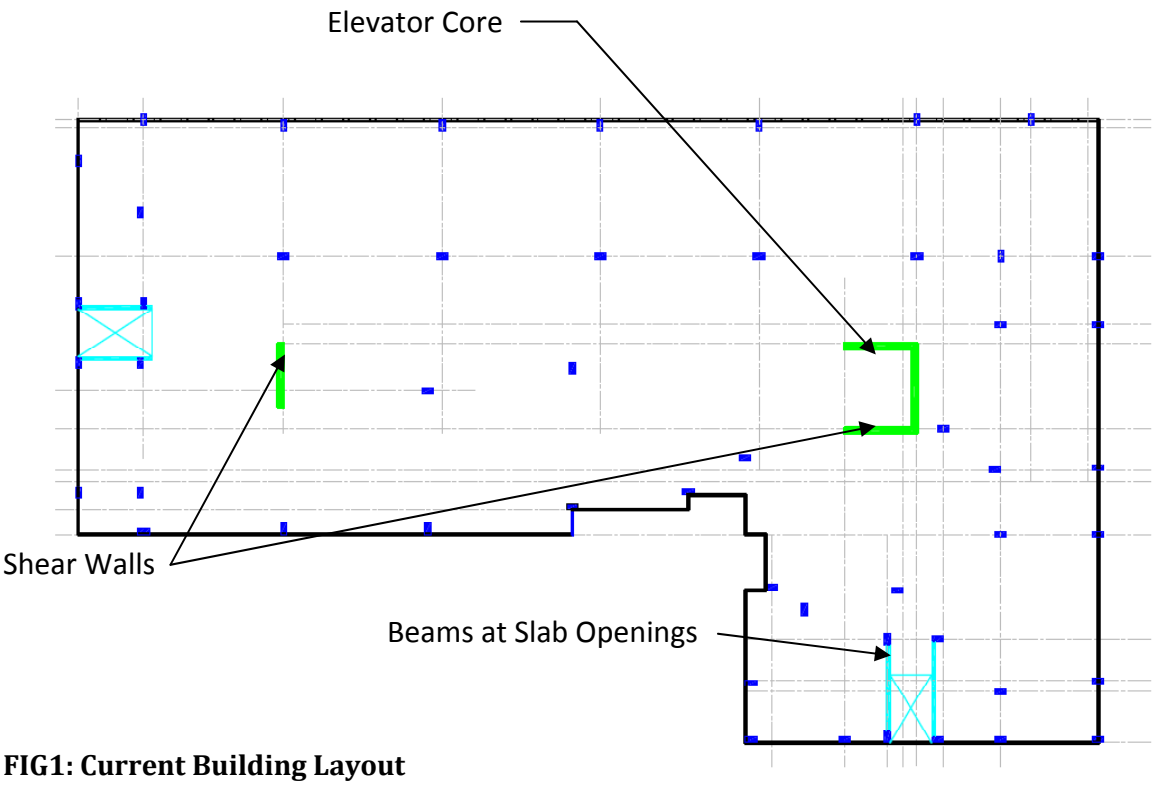

FIG1: Current Building Layout

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PROBLEM

City Vista's presents designers with several challenges due to its design and location as a result many structural systems are not feasible for use al City Vista.

1. City Vista is located in Washington D.C where there is a height limit of 130 ft. Currently Building 2 is 114'-0" not including the penthouse. At sections that include the penthouse the building height is 128'-6". It will be a challenge to stay within the 130' limit.
2. Because a flat plate system is used the underside of the floor slab is already a finished ceiling. When choosing alternate floor systems this is taken into consideration.

When considering alternative structural solutions for City Vista cost and construction time were as much a concern as floor to ceiling height. Washington DC construction business is very demanding and the faster and cheaper the construction the better.

PROPOSED SOLUTION

Taking into consideration the height restriction and competitive market I propose a precast system for City Vista. This system would consist of hollow precast floor planks with a slab thickness between 8-10 inches which keeps City Vista well within the height requirement. The lateral system will include precast shear walls and precast inverted T-beams and precast column. This system could potentially present faster erection time, a cheaper bottom line, possible LEED certification, and the same floor to ceiling height.

BREATH

LEED Certification:

Changing City Vista from a cast in place system to a precast system allows the possibility of LEED certification. When approached correctly a precast system is able to acquire 23 of the 26 points required for LEED certification. Since all structural elements are cast in a factory waste, production pollution and concrete content can be closely monitored. A life cycle assessment will be performed for the proposed precast system and cast in place system. This will be accomplished though the use of MC2 and primavera software, research, and input from precast companies and concrete contractors. A comparison of cost, reuse, recyclability, reduction of materials, schedule, and LEED points will be formulated.

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Architectural Alterations:

City Vista's current layout is conducive for a post tension system. The columns grid does is not a square grid, which is needed for the precast system. Column alterations will be made resulting in the creation of architectural issues. After the precast system is designed an architectural study will be done to verify that all code are met and that flow though the building is sufficient. The mechanical ductwork will also be examined because new column locations could interfere with current vertical and horizontal duct work locations.

TASK AND TOOLS

The following schedule will give a brief overview of the steps and resources I will take to redesign City Vista's structural system. A schedule has also been included to chart the approximate timeline for completion of each task.

Precast Alternative

Task #1: Obtain material from outside sources

- Contact structural engineer for cad drawings
- Contact CM for cost and scheduling information

Task #2: Determine Loading

- *ASCE7-05* will be used to determine wind, snow drift and seismic loading.
- *International Building Code* will be used to determine dead and live loading conditions
- *District of Columbia Building Code* for load provision specific to Washington D.C
- Loading diagrams will be created so during design conditions will be clear

Task #3: Experiment with potential column grids layouts

- Create new column grid using guidelines specified in PCI
- Create grid around current architectural and mechanical set up

Task #4: Preliminary Sizing for Typical Bay

- Using bay sizes determined in task 3, floor planks and columns will be designed using the PCI handbook.
- Dead load will be determined from floor plank literature and used to design inverted t-beams

Task #5: Reconfiguration of Column grid

- The preliminary design will be examined and altered for optimization

Task #6: Re-size members

- Members will be redesigned if needed
- The small atrium and balconies will also be tackled at this time

Task #7: Lateral Members

- Lateral analysis will done on the building
- New shear walls will be designed in existing locations

Task #8: Connections

- Using the PCI and other sources connections will be examined
  1. Between façade and floor planks
  2. Floor plank to floor plank
  3. Column to floor plank
  4. Column to column
  5. Shear wall to floor plank

Task #9: Design Check

- Spot checks and computer analysis will be done to verify new design
- The current foundation system will be examined to verify ability to support new structure

Task #10: Recreate mechanical and/or architectural plan

- Corridors will be altered in response to the new column grid
- Using the International Building Code and the District of Columbia Building Code a study will be done to verify all codes are met.
- An architectural study will also be done to examine the new corridors flow throughout the building.
- The mechanical system layout will also be examined

Task #11: Consider cost and Schedule

- A schedule and cost analysis will be done for the new precast system using primavera and MC2

Task #12: LEEDS

- A life cycle assessment will be done for each system. This assessment will consider reuse, recyclability, reduction of materials, and the possibility of LEED certification.
- A comparison will be made between the two systems regarding the finding of the life cycle assessment.

Task #13: Write Final Report
Task #14: Prepare Presentation

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SCHEDULE