Use of High-Strength Concrete in Tall Buildings

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PREMIERE ON PINE

- 440 foot structure
- 490,000 square feet
- 42-story residential tower with 386 units
- Four levels of parking above grade, with five levels below
- Opened in November 2014
- Targeting LEED Silver certification
PREMIERE ON PINE

• 7 1/2” POST-TENSIONED FLAT PLATES

• HIGHLY EFFICIENT CORE-WALL SEISMIC SYSTEM

• COLUMN SIZES ARE CONSTANT FROM GROUND TO TOP

• FORMWORK PRODUCTIVITY WAS MAXIMIZED
**Buildings Above 240' in High Seismic Regions**

- **Seismic restrictions triggered at 240'**

- **Ductile frames or dual systems (ductile frames/shear walls) are mandated by code above 240'**

- **Alternatively, shear walls can be used if ductile behavior is proven through performance based analysis**
  – Peer review required
15,000 PSI Column Concrete

- Believed to be the strongest concrete ever specified in Seattle
- Allows shear walls and columns to be smaller than typical towers this size
- Smaller shear walls and columns mean larger floor plates and more real estate inside the building
**Tested Concrete Compressive Strength**

- **8 ksi Specified**
  - Min = 8,210 psi
  - Max = 13,080 psi
  - Mean = 10,877 psi
  - Std Dev = 881 psi

- **12 ksi Specified**
  - Min = 14,490 psi
  - Max = 16,770 psi
  - Mean = 15,384 psi
  - Std Dev = 599 psi

- **15 ksi Specified**
  - Min = 15,540 psi
  - Max = 18,550 psi
  - Mean = 17,108 psi
  - Std Dev = 651 psi

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**Bar Chart**

- **f'c = 8 ksi**
- **f'c = 12 ksi**
- **f'c = 15 ksi**

- **X-axis:** Tested Concrete Compressive Strength, f'c (ksi)
- **Y-axis:** % of Samples
Mix Design Characteristics

- Cement Type I-II: 775 lb
- Fly Ash: 110 lb
- Silica Fume: 50 lb
- Slag: 140 lb
- Water: 305 lb
15 ksi Concrete Column Test Data

The graph illustrates the concrete compressive strength (fc) over maturity (days). The x-axis represents the maturity in days, ranging from 0 to 90, while the y-axis shows the compressive strength in psi (pounds per square inch). The graph includes multiple lines and data points for different levels, each indicated by a specific marker. The target strength is represented by a black line on the graph.
15 ksi Concrete Column Test Data
COLUMN CONCRETE PLACEMENT AT SLAB

PT SLAB

CONCRETE COLUMN

“STAYFORM” TIED TO COLUMN TIES
**Post-Tensioning Advantages**

- Thinner slabs & Shallower beams
- Longer spans & Fewer columns
- Reduced floor to floor height
- Better control of deflection & cracking
- Smaller columns & foundations
- Reduced seismic loads
TOWER SLABS - SERVICE DEFLECTION
FOUNDATION PLAN