

## High Fly Ash Concrete A Contractors Perspective

### A Case Study Review of:

- The Liu Centre
- The WaterFall Building
- A Private Residence

## Liu Centre

- Original Tender based on Standard Type 25Mpa Concrete Mixes
- Post Award discussions held to see if High Fly Ash mix could be used
- Intent was to produce a mix with 50% of cementitious material being FlyAsh. Original intent to use for substructure only
- HCL concerns lack of cement affect quality
- Agreed to a test pour at elevator pit

## Liu Centre Mix Design ( H1)

- Spec'd Strength 25 Mpa @ 28 days
- 195 kg FlyAsh 8%
- 195 kg Cement 8%
- 760 kg sand 32%
- 1080 kg stone 46%
- 130 L water 6%
- Slump 110 +/- 20 mm
- Air Content 3 +/- 1%

## Results of Initial Tests

- No problems encountered agreed to continue
- First pours were to footings, walls, columns
- All Pumped - No flatwork
- Lot of attention to formwork, placing techniques
- Material was different from conventional mixes
- Results achieved were very positive
- Crew had no hesitation to use this mix
- Used for all exposed concrete except exterior SOG and Topping mixes



- ### Conclusions From Liu Centre
- More Expensive to use than normal 25 or 30 Mpa concrete (+/- 15% extra)
  - Mix produced better esthetic results than originally specified or normal 25Mpa concrete
  - Mix used for walls, beams and columns only, not used for topping or exterior SOG
  - Mix was easy to work with and flowed well, good consolidation and workability
  - 30.5 to 37.5 Mpa 28 day strengths achieved
  - Consistent 40 Mpa 56 day strengths achieved

## The WaterFall Building

- High End Arthur Erickson Designed Artist Live/Work Studios
- Lots of Exposed Sandblasted Concrete
  - Interior / Exterior walls, columns, slabs
- Cost Savings required
- Originally specified coloured concrete agreed to be deleted from scope if suitable alternative found

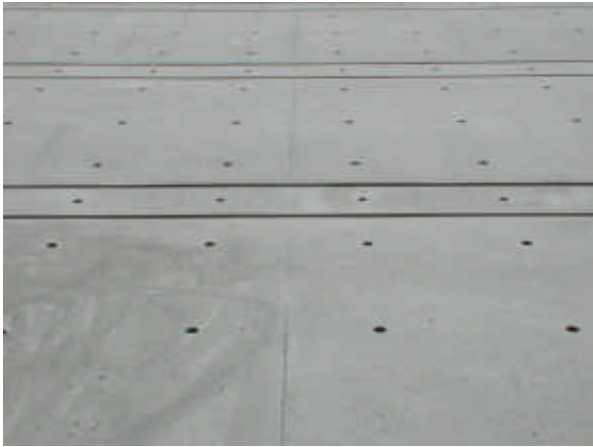
## Design Criteria

- 30Mpa @ 28days with F2 rating required
- Ocean designated H1 25 Mpa @ 28 days, but would only guarantee 28 Mpa @ 56 days
- Liu Centre achieved 30.5 to 37.5Mpa @ 28 days
- Ocean agreed to designate H1 30Mpa @ 56 days if 0.5 L / m3 Superplasticizer added
- 56 day spec accepted by Fast and Epp
- New Mix called "HC1"

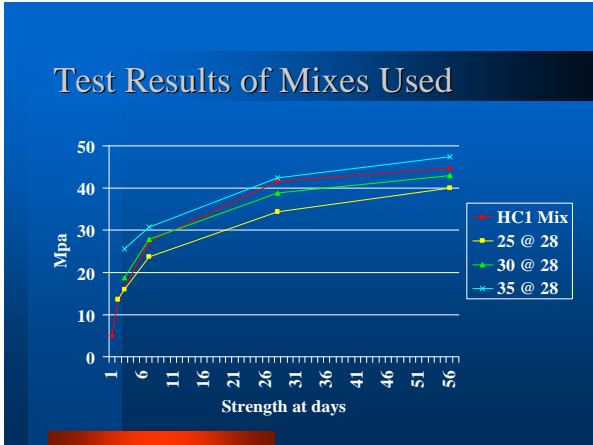
## Initial Tests

- Test pours made on site
  - 570 Granville mix
  - Architect Specified A1 mix
  - High Fly Ash mixes (H1, HC1, and others)
- 11 test samples made in total
- Mix with superplasticizer lightened colour
- Mix with 14mm aggregate produced finer finish









- ### Problems/Concerns Discovered
- Darkens during cold weather
  - More susceptible to bleeding
  - Extended time needed to finish slabs, even in warm weather conditions
  - Forms need to be stronger due to slower set time
  - More difficult to patch, blend than conventional concrete (lighter colour)

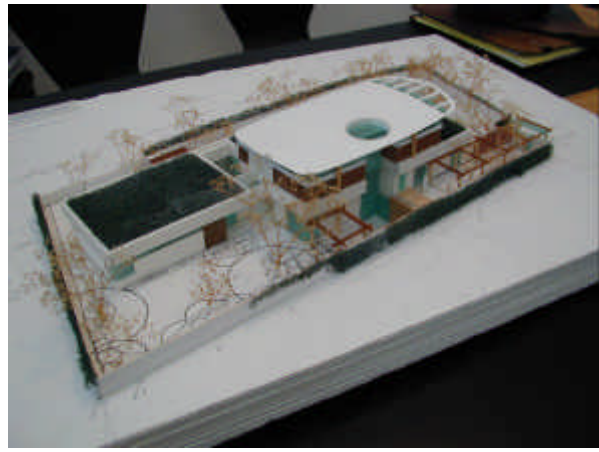
### Positive Results

- Easy to pump, or place with bucket
- Flows well within forms, around Rebar
- Dense and uniform surface finish
- Lighter colour
- Site crew liked working with the product
- Excellent compressive strength results
- Aesthetically pleasing finish

### Private Residence

#### Bing Thom Architect Designed House Exposed Concrete Throughout

- Originally wanted white cement
- Budget constraints looked at options
- Many different samples/options looked at
- High Fly Ash mix selected due to aesthetics
- Using for slabs, as well as walls









### Problems and Concerns

- Darkens during cold weather
- 7 day slab stripping strength (18 – 20 Mpa)
- Extended time needed to finish slabs
- More difficult to patch, blend than conventional concrete (lighter colour)
- Possible issue with paste at sharp corners
- Can produce a blotchy surface finish if special precaution not taken with formwork

## Benefits and Conclusions

- Can Produce excellent results for Architectural Concrete
- Very workable mix, easy to place
- More expensive than conventional mixes when compared strictly on a strength basis ( +/- \$8.00 to \$10.00/m<sup>3</sup>)
- Less expensive than comparable Grey Cement Architectural Concrete mixes ( range of \$2.00 to \$10.00/m<sup>3</sup>)