Practical Experiences with EcoSmart™ Concrete

AN ARCHITECT'S EXPERIENCE: OVERCOMING TECHNICAL ISSUES

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OVERVIEW

- WHY USE FLY ASH CONCRETE?
- CASE STUDIES
- CHALLENGES
- OPPORTUNITIES

WHY USE FLY ASH CONCRETE?

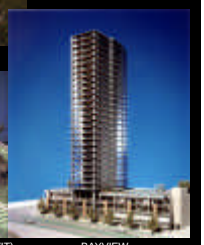
- GREEN MANDATE / AGENDA
  - •REUSE OF WASTE MATERIAL
  - •LOWER CO2 EMISSIONS
- ECONOMICAL
- QUALITY PRODUCT
- EASY TO USE

CASE STUDIES

- *•Type of Fly Ash Used*
- *• Chronology of Pours*
- *• Previous FA Experience*
- *• Strength Development*
- *• Workability*
- *• Finishing*
- *• Appearance*
- *•Economics*
- *• Post construction perspective*

YORK UNIVERSITY COMPUTER SCIENCE BUILDING

NICOLA VALLEY INSTITUTE OF TECHNOLOGY (NVIT)



BAYVIEW

TYPE OF FLY ASH

YORK UNIVERSITY:

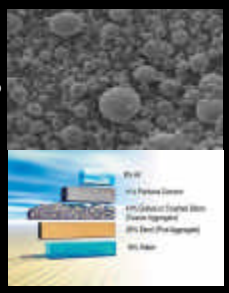
- TYPE C
- LAFARGE, STONEY CREEK, ONTARIO
- FLY ASH APPLICATION: 50% (High Volume Fly Ash - HVFA)

NVIT:

- TYPE F
- LAFARGE, ALBERTA
- FLY ASH APPLICATION: (50%) 40%

BAYVIEW:

- TYPE C1
- CENTRALIA, WASHINGTON
- FLY ASH APPLICATION: 15 / 33/ 45%



CHRONOLOGY OF POURS

YORK UNIVERSITY:

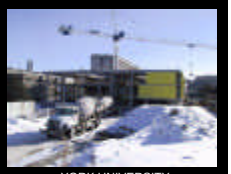
- MAY TO DECEMBER
- NO CHANGES IN SCHEDULE
- CURED & FINISHED AT -10°C

NVIT:

- LATE OCTOBER TO FEBRUARY
- WORKED THROUGH WINTER
- DIFFICULT CONDITIONS TO SET TYPE F FLY ASH

BAYVIEW:

- MID-DECEMBER TO MID-SUMMER
- WINTER OUTDOOR TEMPERATURE (-1°C)
- NO ISSUES FOR POURING AND SETTING CONCRETE
- USED WHERE APPLICABLE (RELATED TO SETTING TIME)



YORK UNIVERSITY

PREVIOUS FLY ASH EXPERIENCE

YORK UNIVERSITY:

- ELLIS DON CONSTRUCTION, TORONTO, ONTARIO
- 15 YEARS EXPERIENCE
- ACTIVELY EXPERIMENTING WITH FLY ASH

NVIT:

- SWAGGER CONSTRUCTION, ABBOTSFORD, BC
- FIRST TIME WORKING WITH FLY ASH

BAYVIEW:

- LEDCOR
- COMPANY'S STANDARD USE OF FLY ASH (15% IN SLAB & 40% IN FOOTINGS) 13% INCREASE OVERALL

STRENGTH DEVELOPMENT

YORK UNIVERSITY:

- CURED FASTER THAN NORMAL PORTLAND CEMENT DURING THE SUMMER

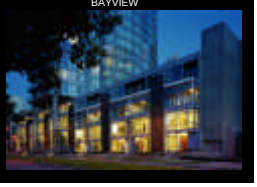
NVIT:

- SLOWER CURING TIME FOR THINNER ELEMENTS (I.E. SLAB) DUE TO TYPE F AND WINTER CONDITIONS

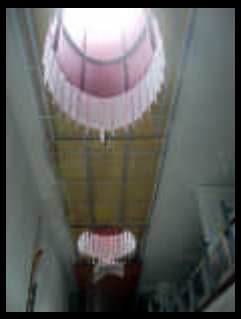
BAYVIEW:

- NO EFFECT ON SCHEDULE
- CONTRACTOR DID NOT SIGNIFICANTLY CHANGE USE OF FLY ASH IN SLABS

BAYVIEW



YORK UNIVERSITY



NICOLA VALLEY INSTITUTE OF TECHNOLOGY

WORKABILITY

YORK UNIVERSITY:

- EASIER TO PUMP AND PLACE
- COMPACTED BETTER THAN CONVENTIONAL CONCRETE MIXES REDUCING THE NECESSITY TO UTILIZE A SLUMP ENHANCING ADMIXTURE

NVIT:

- WORKERS HAD TROUBLE CURING AND SETTING THINNER ELEMENTS (I.E. SLABS)
- TYPE F FLY ASH REQUIRES LONGER PERIOD TO SET

BAYVIEW:

- FOUND IT EASIER TO WORK WITH 40% FLY ASH
- "HOT-SPOTS" WERE NON-EXISTENT
- EVEN SET AND FINISH

NVIT

FINISHING

YORK UNIVERSITY:

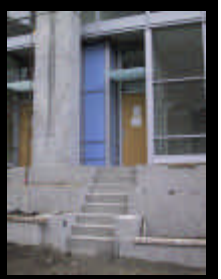
- LOW WATER CONTENT IN HFVA
- USED FOG MISTER TO KEEP THE SHEEN ON THE SURFACE

NVIT:

- DELAYED WORKING ACCESS TO SLAB
- ADDITIONAL FINISHING COSTS (FUEL & LABOUR)
- PROJECT DELAYS

BAYVIEW:

- NO CHANGE IN FINISHING TECHNIQUE
- SLABS WERE PREHEATED A DAY BEFORE, DURING AND IMMEDIATELY AFTER FINISHING



BAYVIEW

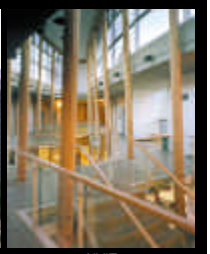
APPEARANCE

YORK UNIVERSITY, NVIT, AND BAYVIEW

- SAME EXPERIENCE FOR THREE PROJECTS
- LIGHT IN COLOUR
- DENSER & SMOOTHER FINISH

YORK UNIVERSITY

BAYVIEW



NVIT

ECONOMICS

YORK UNIVERSITY:

- NO INCREASE IN COSTS
- LESS COST FROM MATERIAL (FA VS CEMENT) & LESS LABOUR FOR PLACING

NVIT:

- INCREASE IN COST (FUEL & LABOUR)
- FINISHING DELAYS

BAYVIEW:

- DID NOT CHANGE HIGH-RISE CONSTRUCTION TECHNIQUE
- LOW INITIAL COST OF FLY ASH WOULD NOT OFFSET COSTS RESULTING FROM CHANGES IN CONSTRUCTION SCHEDULE

POST CONSTRUCTION PERSPECTIVE

YORK UNIVERSITY:

- BIG SUCCESS
- CONTRACTORS CONFIDENT IN USING HIGHER QUANTITIES OF FLY ASH
- AESTHETICALLY: LOOK BETTER & BETTER QUALITY

NVIT:

- CONTRACTOR UNDERSTOOD AESTHETIC & STRUCTURAL ADVANTAGES BUT SAW NO ECONOMIC ADVANTAGE IN WINTER CONSTRUCTION, DESPITE LOWER MATERIAL COST FOR FLY ASH

BAYVIEW:

- PLEASED WITH HIGHER FLY ASH REPLACEMENT
- REQUIRE CHANGES TO CONSTRUCTION PROCEDURE & SCHEDULE TO INCREASE FLY ASH IN TOWER SLABS

SUMMARY

	YORK	NVIT	BAYVIEW
• Type of Fly Ash Used	Type C	Type F	Type C1
• Chronology of Pours	May to December	Late October to February	December to mid-summer
• Previous FA Experience	15 Years	None	Used for some applications
• Strength Development	Cured faster than regular	Very slow	No effect on schedule
• Workability	Easier to pump & place	Workers had trouble	Easy to work with
• Finishing	Used fog mister	Delays experienced	Standard finish procedures
• Appearance	Denser & smoother surface	Satisfactory	Denser & smoother surface
•Economics	Less cost from material (FA vs cement) & less labour for placing	Increased costs for fuel, labor & accelerators	Cost savings (lower material cost & no change in schedule)
•Post construction perspective	Successful & confident to use HVFA again	Understood aesthetic qualities. No economic value in cold climate applications, despite material costs.	Pleased with Fly Ash application. Require changes in project schedule for FA application in high-rise slabs.

CONSIDERATIONS

- DETAILED SPECIFICATION
  - TYPE OF FLY ASH (TYPE C VS. TYPE F)
  - TYPE C HAS HIGHER CALCIUM CONTENT = HIGHER PRIMARY CEMENTING ACTION
  - APPLICATION OF FLY ASH
- CHRONOLOGY OF POUR
  - CLIMATE CONSIDERATIONS
  - THINNER ELEMENT (SLABS) HARDER TO CURE DURING WINTER

CONSIDERATIONS

- PREPARE ENTIRE DESIGN TEAM
- DISCUSS USE OF FLY ASH EARLY ON DURING DESIGN PROCESS
- MANAGE PERCEPTIONS
  - *YORK*: CREW ORIENTATION
  - *NVIT:* UNFAMILIAR WITH HVFA
  - *BAYVIEW*: UNFAMILIAR WITH HVFA

CHALLENGES

HIGH-RISE APPLICATION

- INABILITY TO TURN FORMS AROUND QUICKLY DUE TO SLOWER EARLY-STRENGTH DEVELOPMENT
- IMPACT ON CONSTRUCTION SCHEDULE
- FLY ASH BETTER SUITED FOR THE PODIUMS AND PARKADES

FUTURE OPPORTUNITIES

- HIGH-RISE APPLICATION
  - •LARGEST ENVIRONMENTAL IMPACT BY USING 50% FLY ASH IN HIGH-RISE SLABS
  - •NEED TO OVERCOME SCHEDULE CONSTRAINTS
- WIDESPREAD EDUCATION OF THE CONSTRUCTION INDUSTRY
- MORE SUCCESSFUL DEMONSTRATION PROJECTS.
- INCENTIVES FOR OWNERS, CONTRACTORS AND ENGINEERS TO "EXPERIMENT" WITH HVFA.