Standing Committee on Concrete Technology
Annual Concrete Seminar 2007

High Workability Concrete for Bored Pile Construction

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Sequence of Work in Bored Pile Construction

- **Week 1**: Excavation
- **Week 2**: Excavation, Rock Drilling
- **Week 3**: Rock Drilling, Airlifting, Cage, Concrete

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Presentation Scope

• Method of Concreting Bored Pile
• Problems and Defects
• Deficiencies in Current Practice
• Proactive Approach
• The Way Forward
Concreting of Bored Pile
General Setup

Concrete Truck

Ramp

Skip

Concreting Platform

Tremie Pipe

Concrete Truck
Stages in Bored Pile Concreting

1. Extract Tremie Pipe
2. Extract Temporary Casing
3. Drop in Concrete Head
4. Concrete Overbreak
QA / QC

- Slump tests / Flow table
- Check temperature ($\leq 32^\circ$)
- Cube samples to determine concrete strength
Concreting Takes Many Hours
Concreting Time Varies With Pile Length
Slump Varies With Time

![Graph showing the relationship between slump and time. The graph indicates that slump decreases with time.]
Common Problems Encountered

• Temporary casing cannot be withdrawn

• Tremie pipe cannot be withdrawn

• Blocked tremie pipe

• Reinforcement cage rides up with temporary casing
Defects
Honeycomb

- Reduced workability affects self compaction
Air Voids
Entrapped Air Inside Concrete During Pouring

(1)

(2)

Air Voids

(3)
Segregated Concrete

- Additive quantity needs fine-tuning
Remedial Actions

• Grouting

• High pressure water jet to remove “weak” concrete, followed by pressure grouting

• Stitched pile

• Additional pile
Deficiencies in Current Practice
First In .... Last Out

First few truckloads need to remain workable throughout concreting

* Indicate order of truckload
Deficiencies in Current Practice

• Large piles / deep piles mean large concrete volume

• Specification / Contract Document
  – Single slump value specified on drawing
  – Workability vs time not considered
  – Lack of flexibility in interpretation

• Quality control
  – Need to control consistency in material properties
The Proactive Approach

• Need to Consider …..
  – Specification
  – Concrete volume (related to pile size and depth)
  – Site constraints (physical or environmental restrictions)
  – Site location (travel time to site from batching plant)
Route to Pile Acceptance

- Pile Acceptance
  - Concrete Performance
    - Time
      - Concrete Volume
      - Site Constraints
      - Construction Procedure
    - Material Consistency

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SUCCESS STORY

Hong Kong – Shenzhen Western Corridor

Delivery ~ 3 hours

Grade 45/20
• Designed slump 200mm
• Workability 5 hours
SUCCESS STORY
Hong Kong – Shenzhen Western Corridor

- **Supplier** formulated a special concrete mix with enhanced workability

- **Engineer** relaxed concreting time to 5 hours

- **Contractor** checked workability prior to pouring

- **Side-effect**: minor segregation, need to pour additional concrete to avoid undercasting
Way Forward
Concrete Triangle

- Designer
- Concrete Supplier
- Contractor

Constructability

Concrete Quality / Performance

Consistency

Slump Retention
The End