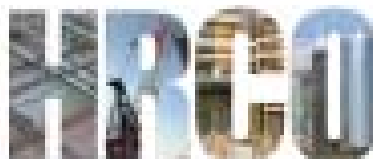


Formwork Industry Meeting I



New York City Department of Buildings

February 25, 2010

Outline For Today

HRCO Background

Presentation of Proposals

Open Discussion

High-rise Concrete Formwork

NYC
Buildings

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A Review of High-Risk Construction

- High-rise Concrete
- Cranes and hoisting
- Excavations

Motivated by:

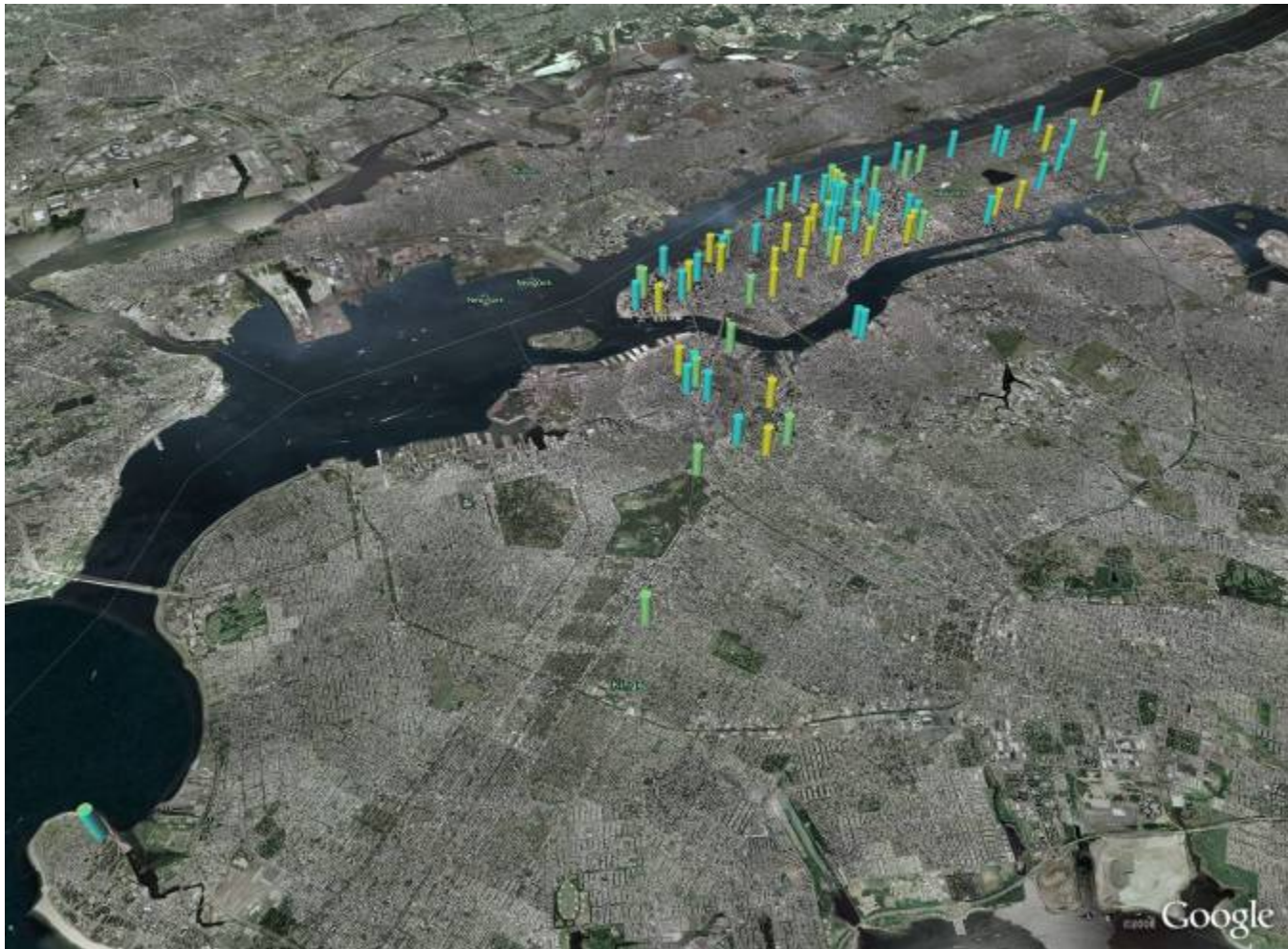
- March 15, 2008 crane collapse
- May 30, 2008 crane collapse
- 9 total fatalities

CTLPC is the Program Director




- 5 participating firms
- Over 30 experts
 - Field assessments
 - Industry outreach
 - Design review
 - Regulatory review



High-rise Concrete Formwork



Site Visits

-  Union
-  Non-Union
-  Unknown

Short-term Implementation Milestones- Formwork

- Issue minimum design requirement technical bulletin
 - Issue special design requirement bulletin for adjacent structures used as formwork
 - Develop requirements for formwork inspection
-

Critical Formwork Construction Defects

- Lateral bracing
 - Post spacing
 - Stripping and reshore sequences
 - Number of reshored floors
 - Stamped formwork design (when required)
-

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Critical Formwork Defect Origin

Number of Fully Inspected Site Observations	98
Number of Critical Formwork Defects	56 (57%)
Number of Critical Formwork Defects Attributable to Construction and Inspection Failures	44 of 56 (79%)

Critical Formwork Design Defects

- Sequencing of form removal
 - Knowledge of adequate concrete strength
 - Connection detail
 - Layout detail
 - Knowledge of allowable construction loads
-

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Critical Formwork Defect Origin

Number of Fully Inspected Site Observations	98
Number of Critical Formwork Defects	56 (57%)
Number of Critical Formwork Defects Attributable to Design Defects	25 of 56 (45%)

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“Formwork failures, and failures caused by improper shoring or premature removal of supports and inadequate lateral bracing, have periodically occurred throughout the history of concrete construction.”

–Guide for Shoring/Reshoring of Concrete Multistory Buildings, ACI 347.2R-05

High-rise Concrete Formwork



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1. Minimum Design Information

Current Industry References:

“An overall plan for scheduling of shoring and reshoring...should be prepared by a qualified and experienced formwork designer.”

-Guide to Formwork for Concrete, ACI 347-04

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Municipalities with historic instances of formwork collapse have requirements for engineered formwork design

- **Fairfax County, Va.**
 - **Philadelphia**
-

Minimum Design Information Proposal

Formwork Design Drawings to Contain CLEAR...

1. Reshoring sequence notes
 2. Minimum concrete compressive strengths prior to stripping
 3. Numbers of reshored floors
 4. Post spacings
 5. Vertical formwork design
 6. Lateral bracing design
 7. Bracing sequence notes
 8. Connection details (e.g. nailing schedules)
 9. Construction load assumptions
-

High-rise Concrete Formwork



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2. Special Design Requirements

High-rise Concrete Formwork



Current Industry References:

“When any construction or demolition operation exposes or breaches an adjoining wall...the person causing the construction shall, at his own expense perform the following:

1. Maintain the structural integrity of such walls, have a registered design professional investigate the stability and condition of the wall, and take all necessary steps to protect such wall. “

-Building Code of the City of New York, 3309.8

Current Industry References:

“...Existing structures shall be evaluated by a registered design professional...to determine (concrete) loads that may be safely supported by the structure...”

-Buildings Bulletin 2009-011

Special Design Requirements Proposal

A qualified professional engineer shall prepare, sign, and seal a set of formwork drawings when adjacent structures are used directly or indirectly (as lateral bracing) to support formwork

-Proposal builds on established code requirements for protection of adjoining walls (BCNYC 3309.8 and Bulletin 2009-011)

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3. Inspection Requirements

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Current Industry References:

“Inspection is recommended and is required in some jurisdictions before concrete placement.”

-Guide for Shoring/Reshoring of Concrete Multistory Buildings, ACI 347.2R-05

“...formwork shall be inspected...to verify that the sizes... conform to the formwork drawings.”

-Building Code of the City of New York, §1906.2

Inspection Requirement Proposal

Formwork inspection to be performed...

1. By the formwork designer or his qualified designate
 2. At established intervals
 3. On each non-standard configuration
 4. When adjacent structures are used directly or indirectly as formwork
-

High-rise Concrete Overview

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