Mitigating and Remediating Damage to Properties Adjacent to Construction in Congested Urban Environments

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Adjacent Construction

• What is it?
  – Construction in close-proximity to adjacent structures
  – Lot-Line construction
  – Additions/Extensions

• What is an adjacent structure?
  – Building
  – Utilities (above or below ground)
  – Roads/Sidewalks
  – Buried Structures (tunnels, mass transit)
3307.1 Protection required. Adjoining public and private property shall be protected from damage during construction, remodeling and demolition work. Protection must be provided for footings, foundations, party walls, chimneys, skylights and roofs. Provisions shall be made to control water runoff and erosion during construction or demolition activities. The person making or causing an excavation to be made shall provide written notice to the owners of adjoining buildings advising them that the excavation is to be made and that the adjoining buildings should be protected. Said notification shall be delivered not less than 10 days prior to the scheduled starting date of the excavation.
Code Requirements – Nothing New

Whenever an excavation of either earth or rock for building or other purposes shall be intended to be, or shall be carried to the depth of more than ten feet below the curb, the person or persons causing such excavation to be made shall at all times, from the commencement until the completion thereof, if afforded the necessary license to enter upon the adjoining land, and not otherwise, at his or their own expense, preserve any adjoining or contiguous wall or walls, structure or structures from injury, and support the same by proper foundations, so that the said wall or walls, structure or structures, shall be and remain practically as safe as before such excavation was commenced, whether the said adjoining or contiguous wall or walls, structure or structures, are down more or less than ten feet below the curb. If the necessary license is not accorded to the person or persons causing such excavation, the owner of the adjoining land shall not be liable for any injury sustained by the said walls, structures, or foundations, unless the owner, for a valuable consideration, shall have asked for such license and refused it, with intent to defraud or injure the owner of the said adjoining land.
Design Considerations: Pre-Construction

• Adjacent Structure Concerns
  – Separate buildings or adjoining (party) walls
  – Structure construction type (unreinforced masonry, concrete, steel)
  – Stability (orientation of framing, mechanical connections)
  – Weatherproof integrity
  – Contractor Means & Methods (Vibration, Noise, Dust)
  – General Condition of Structure

• Need to understand the existing building in order to manage risk
Design Considerations - Unreinforced Masonry

• Typically Empirically Designed (1700’s to early 1900’s)
• Party wall construction often encountered
  – Wall supports floor framing of adjacent buildings
  – Typically rely on framing on both sides of wall to provide lateral support.
• General lack of mechanical connection between framing and walls
• Need to consider how interruptions in framing affect stability
  – Stairwells, chimneys, etc.
• Soft Stories
Typical Floor Plans – Masonry Walk-Ups
Unreinforced Masonry
Typical Floor Joist Mechanical Connection
Unreinforced Masonry: Façades

- Minimal joining of masonry
- Facades tend to peel away from return wall
- May require reinforcing prior to construction
Stabilization & Weatherproofing
Typical Wall Exposure During Demolition
Design Considerations

• New Development or Renovations
  – Excavation Depth
    • Support of excavation
    • Underpinning
    • Dewatering
  – New Building Height
    • Roof Protections
    • Weatherproofing between buildings (seismic gap)
    • Chimney Extensions
    • Roof Protections
  – Means & Methods
    • Vibrations
    • Noise and Dust
    • Other…
Common Sources of Damage

- Excavation
  - SOE Installation
  - Underpinning
- Dewatering
- Vibration
  - Demolition
  - Blasting
  - Pile Driving
  - Drilling
Risks from Excavation – Depth of New Construction…

New Above Existing

New Below Existing

Increased Lateral Load on Existing Building

Earth Support

Underpinning
Excavation Effects: Settlement

a) Settlement and Differential Settlement

b) Relative Deflection and Deflection Ratio
d) Horizontal Displacement and Horizontal Strain

c) Tilt and Angular Distortion (Relative Rotation)

Boscardin and Cording, 1989
Underpinning – Things to Consider…

• Underpinning is never required – Need vs. Want
  – There is always an alternate solution!
• Permission needed to underpin neighbor’s wall
  – Trespass
• Anything deeper than 4’ typically needs lateral support
• Settlement will occur
Support of Excavation - Considerations

- Depth of excavation relative to depth of adjacent structure
- Type of adjacent foundation
- Groundwater elevation
- Contractor means and methods
Support of Excavation: Considerations

• Types of SOE
  – Soldier pile & lagging
  – Steel sheet pile
  – Secant or tangent pile wall
  – Slurry Wall
  – Jet-grout or soil-mix wall
  – Soil nail wall

• The proper system depends on a number of factors

• A combination of systems may be required
Support of Excavation

STAGE 1 - INSTALL FIRST TIER TIEBACKS

STEPS:
1. Locally excavate at tieback locations to EL 18± at top of berm.
2. Install first tier tieback through existing foundation wall at EL 19+
3. After installation of all first tier tiebacks, excavate remaining demolition berm at existing foundation wall.
4. De-water as necessary to maintain dry working conditions during underpinning and foundation installation.
Support of Excavation – Means & Methods

- Performed in proper sequence
- Equipment used
- Effects of Drilling
- Vibrations
Groundwater

- Need to consider effects of dewatering on adjacent structures
- Dewatering can lead to significant changes in soil stress
- Leakage through SOE can be catastrophic to adjacent structures
  - Near instantaneous settlement
Vibration Effects

- Contractor Means & Methods
  - Equipment Used
  - Materials Encountered

- Limit Vibration Intensity
  - Establish appropriate limits

- Adjacent structure type will affect response
  - May need to evaluate response

Figure 12-3  Damage data: probability analysis. (From Siskind et al., 1980b.)
Vibration Response

• Response from rock removal activities; drilling, blasting, hammering

• Consider building and appurtenance responses
Pre-Construction Surveys

- Document existing condition of adjacent properties prior to construction
- A useful tool to help resolve claims for minor damages

Before Construction

During Construction
Preemptive Stabilization

- Condition warrants stabilization before construction can continue
- Temporary or permanent
- Who pays for it?
Façade Stabilization
Preemptive Stabilization

1. POCKET SHALL EITHER BE MADE BY SAWCUTTING WITH DEMOLITION SAW OR CHOPPING WITH CHIPPING GUN.
2. POCKET SHALL BE MADE AS SMALL AS POSSIBLE TO MAINTAIN THE INTEGRITY OF THE WALL.
3. IF A SOUND EXISTING TIE IS FOUND WITHIN THE PORTION OF MAIN BUILDING (TEMPORARILY EXPOSED) THE NEW TIE CAN BE OMITTED AT THAT LOCATION, UPON ACCEPTANCE BY THE ENGINEER.
4. LAG BOLTS SHALL BE PRE-DRILLED WITH 5/16" DIAMETER X 2" PILOT HOLE.
5. AFTER ROD INSTALLATION, INFILL POCKET WITH BRICK MASONRY.

WALL TIE DETAIL
Scale: 1" = 1'-0"
Monitoring during Construction

• Typically monitor for:
  – Vibration
  – Movement
  – Groundwater Levels

• Establish Monitoring Plan
  – Indicate type and locations of monitoring equipment
  – Frequency of readings
  – Threshold criteria
  – Action plan if criteria exceeded

• Monitoring helps to manage risk
Damage
When damage does occur:

- **Assessment**
  - Level of damage
  - Elements affected
  - Cause

- **Major structural damage**
  is often the result of building settlement
  - Large cracks in masonry
  - Slippage of floor joists
Stabilization

- Temporary bracing and shoring often required
Repairs

- Permanent stabilization
- Masonry repairs
- Partial rebuilding
Permanent Stabilization

- Tie floor framing into exterior walls
Masonry Repairs
Masonry Repairs/Strengthening

- Liner Walls
  - CMU, CIP, Shotcrete
- Fiber-Reinforcing
Façade Pinning

- Pin façade elements back to structure
- Numerous methods
  - Mechanical Anchors
  - Epoxy Anchors
Concrete Repairs

- Crack injection
- Patch repairs
Summary

• Proper Prior Planning…
  – Assess damage potential prior to construction
  – Develop appropriate protections
  – Implement Protections
  – Monitor

• Stabilize & repair if damage does occur

• Communication is key to successful project
QUESTIONS?

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