SOLUTIONS FOR THE BUILT WORLD

Fall 2015 Iowa DOT Vibration Seminar

Pre-Construction Surveying: Techniques and Examples

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WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS
Wiss, Janney, Elstner Associates, Inc.

IOWA DOT

Iowa DOT Specifications

Iowa DOT Specifications

- Special Provisions for Pre-Blast Crack and Damage Survey
  - Visually inspect and recording all existing defects in the identified structures
- Special Provisions for Vibration Monitoring (to Protect Historic Structures)
  - Develop a plan which minimizes the potential for vibration damage due to construction and demolition activities
  - Monitor vibrations and crack behavior at the identified structures to protect them from vibration induced damage

Special Provisions

- Identified Structures

B. The following properties shall be protected per the requirements in this special provision.

Address	Property Owner	National Register Status
108 N 2nd Street	Deborah Dunn	Listed – in Historic District
100 E Main Street	Kurt & Joyce Rasmus	Listed – in Historic District
101-103 E Main Street	Lyn Knight	Listed – in Historic District
105 E Main Street	Carey Inc.	Listed – in Historic District
200 W Main Street	Mandy Feltner	Listed – in Historic District
201 W Main Street	Alecia & Stanley Maurer	Listed – in Historic District
203 W Main Street	Russell Harvey	Listed – in Historic District
108 S 2nd Street	Richard Angell	Listed – in Historic District
114 S 2nd Street	Randall Smith & Tori May	Listed – in Historic District
115 S 2nd Street	Carey Hetrick	Listed – in Historic District
117 S 2nd Street	Strub Properties	Listed – in Historic District

All structures are located within 100 feet from U.S. 59 in Cherokee.

Special Provisions

- Pre-Construction Condition Survey
  - Professional Engineer (State of Iowa) experienced in evaluating structural vulnerabilities and vibration monitoring
  - List of prequalified firms
    - Exponent (Wood Dale, IL)
    - Klienfelder East (Omaha, NE)
    - WJE (Northbrook, IL)
    - Terracon Consultants (Des Moines, IA)
  - The Contractor is responsible for arranging with the property owner the rights-of-entry to their property in order to engage in condition surveys, vibration monitoring, and crack monitoring

Special Provisions

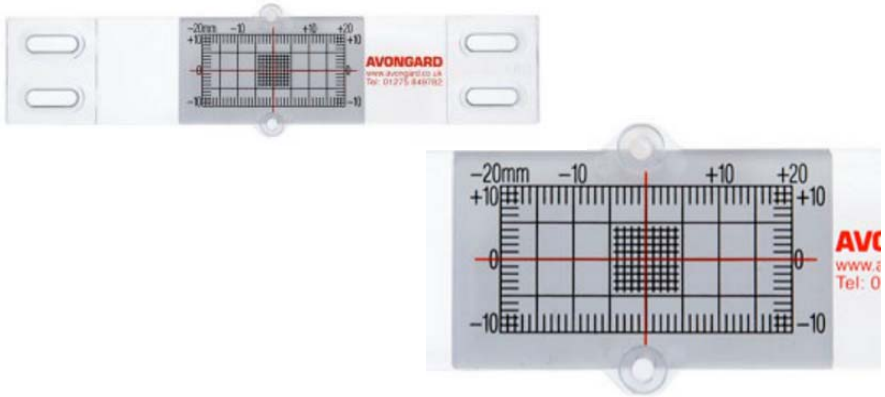
- Pre-construction condition survey
  - Document all aspects of the structural condition through observations, actual measurements, plan sketches, photographs, and any other data the preparer may deem appropriate.
  - Evaluation of the risk from construction vibrations
  - Photos and plan sketches indicating existing vulnerabilities

Special Provisions

- Monitoring Plan
  - Description of monitoring/communications equipment, alarm notification system
  - Description of post-alarm survey in the event of a PPV threshold exceedence
  - Requires daily activity log of vibration activity and crack monitors
  - Daily testing and logging of entire seismograph/communications network
  - Construction methods and equipment chosen to achieve low project vibration levels *Contractor*

Special Provisions

- Equipment Installation and Monitoring Program
  - Crack monitoring
  - Vibration monitoring
  - Elevation or positional surveying
  - Building tilt monitoring
  - Subsurface inclinometer



Special Provisions

- Vibration Limits
  - PPV level shall be determined by a qualified expert in the field of vibration monitoring
  - In no case shall the PPV level exceed 0.2 inches/second [ips] as measured at or in very close proximity to the monitored structure
  - Alarmed monitoring system shall signal any vibration event that equals or exceeds a *threshold* of 80% of the *PPV Limit*
  - Immediately cease work if the alarm at the structure indicates the *threshold* is exceeded
  - Alternative construction methods will be used if the *PPV Limit* is exceeded

Special Provisions

- Post-Construction Survey and Report
  - Determine if any structural changes are the result of the construction activity
- Basis For Payment
  - Lump sum cost

Condition Surveying

General Procedures

- Notify building owners/occupants
  - Contractor or Iowa DOT representative
  - Iowa DOT letter of explanation

    "In order to make this successful, we ask for your participation by allowing the specialized firm access to your building to complete the necessary condition surveys and vibration monitoring. As an owner, you do have the right to deny access to the Contractor, but we do not feel denial would benefit any party."
- Schedule inspection
  - Time needed varies widely

General Procedures

- Perform Preconstruction Survey
  - Assess vulnerabilities of subject property
    - Building system and materials
    - Distance to construction work
  - Assess and document condition
    - Visual inspection
    - Document observed distress (vibration sensitive)
      - High resolution photographs, video
      - Measure select conditions (crack widths, offset, existing settlement)
  - Secondary Purposes
    - Answering homeowner questions
    - Correcting sensitive conditions prior to start of construction

General Procedures

- Develop survey report and monitoring plan
  - Submitted to Contractor
- Solicit review by Contractor and IowaDOT

Data Presentation Methods

Photograph/Video Logs

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CONDITION SURVEY PHOTOGRAPH LOG

Project:	Iowa Route 26 (IA-26) Reconstruction Pre-Blast Crack and Damage Survey (SP-120197)
Iowa DOT Project:	STPN-026-1(21)--2J-03 Allamakee County, Iowa
WJE Project No.:	2015.2484
Subject Property:	601 N. Front Street, Lansing, Iowa
Date of Survey:	July 9, 2015
Survey Performed By:	Nathaniel S. Rende, P.E.
General Description:	The residence at 601 N. Front Street is a one-story, 3 bedroom single-family home originally built in 1919. An addition was constructed on the east end of the residence in 2005. The plan dimensions of the residence measure approximately 30 feet north-south by 60 feet east-west. The original portion of the residence is wood-framed structure supported on stone masonry foundation walls. The addition is wood-framed supported on concrete foundation walls. The exterior façade of the residence contains vinyl siding and painted concrete walls. The roof of the residence is aluminum panels. A separate wood-framed shed structure is present on the west side of the property.

Photo No.	Photo Location	Description/Observed Condition
001-008	Interior, 1st floor, East addition	Overall photographs
009	Interior, 1st floor, East addition	Separation of molding
010-016	Interior, 1st floor, E dining room	Overall photographs
017-018	Interior, 1st floor, E dining room	Previous drywall cracking (painted over) above south window
019-022	Interior, 1st floor, NE bedroom	Overall photographs
023	Interior, 1st floor, NE bedroom	Crack: drywall, east wall at window corner, 0.015-inch wide
024	Interior, 1st floor, E dining room	Crack: drywall, HL, adjacent to doorway
025-028	Interior, 1st floor, central N bedroom	Overall photographs
029-030	Interior, 1st floor, hallway	Crack: drywall, painted over, north wall
031-032	Interior, 1st floor, hallway	Crack: drywall, above doorway at west end of hallway, 0.015-inch
033-043	Interior, 1st floor, SW kitchen	Overall photographs
033	Interior, 1st floor, SW kitchen	Crack: drywall, base of window at south wall, HL
040-041	Interior, 1st floor, SW kitchen	Crack: drywall, above door opening, west wall, HL
043	Interior, 1st floor, SW kitchen	Separation of crown molding
044-049	Interior, 1st floor, hallway west end	Crack: drywall, corners of wall, above doorway
050-054	Interior, 1st floor, NW bedroom	Overall photographs
055-057	Interior, 1st floor, W bathroom	Overall photographs
058	Interior, 1st floor, W bathroom	Crack: drywall, HL north of doorway
059-063	Interior, Stairwell to basement	Overall photographs
064-072	Interior, Basement, E room (addition)	Overall photographs
073-074	Interior, Basement, E room (addition)	Crack: concrete, walls leading to central room
075-079	Interior, Basement, center room	Overall photographs
080-087	Interior, Basement, west end	Overall photographs
088-091	Interior, Basement, bathroom	Overall photographs
092-101	Exterior, East elevation	Overall photographs
102-104	Exterior, East elevation	Crack: concrete, front porch, east elevation, marked/measured 0.005-inch wide
105-115	Exterior, South elevation	Overall photographs
116	Exterior, South elevation	Crack: concrete, at new addition joint
117-119	Exterior, South elevation	Crack: concrete, adjacent to east window to basement, 0.010-inch max
120	Exterior, South elevation	Crack: concrete, adjacent to west window to basement, 0.015-inch max

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Photograph/Video Logs

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Photograph/Video Logs

Appendix A3: Preconstruction Survey Photographs (Per SP-120197)
IA 26, Allamakee County STP-026-1(021)--2J-03
641 N. Front Street, Lansing, Iowa

PRE__001

PRE__002

PRE__003

PRE__004

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PRE__006

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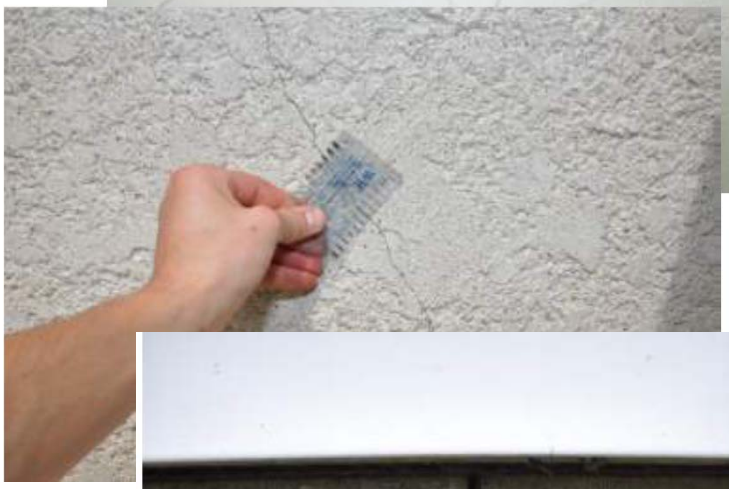
PRE__015



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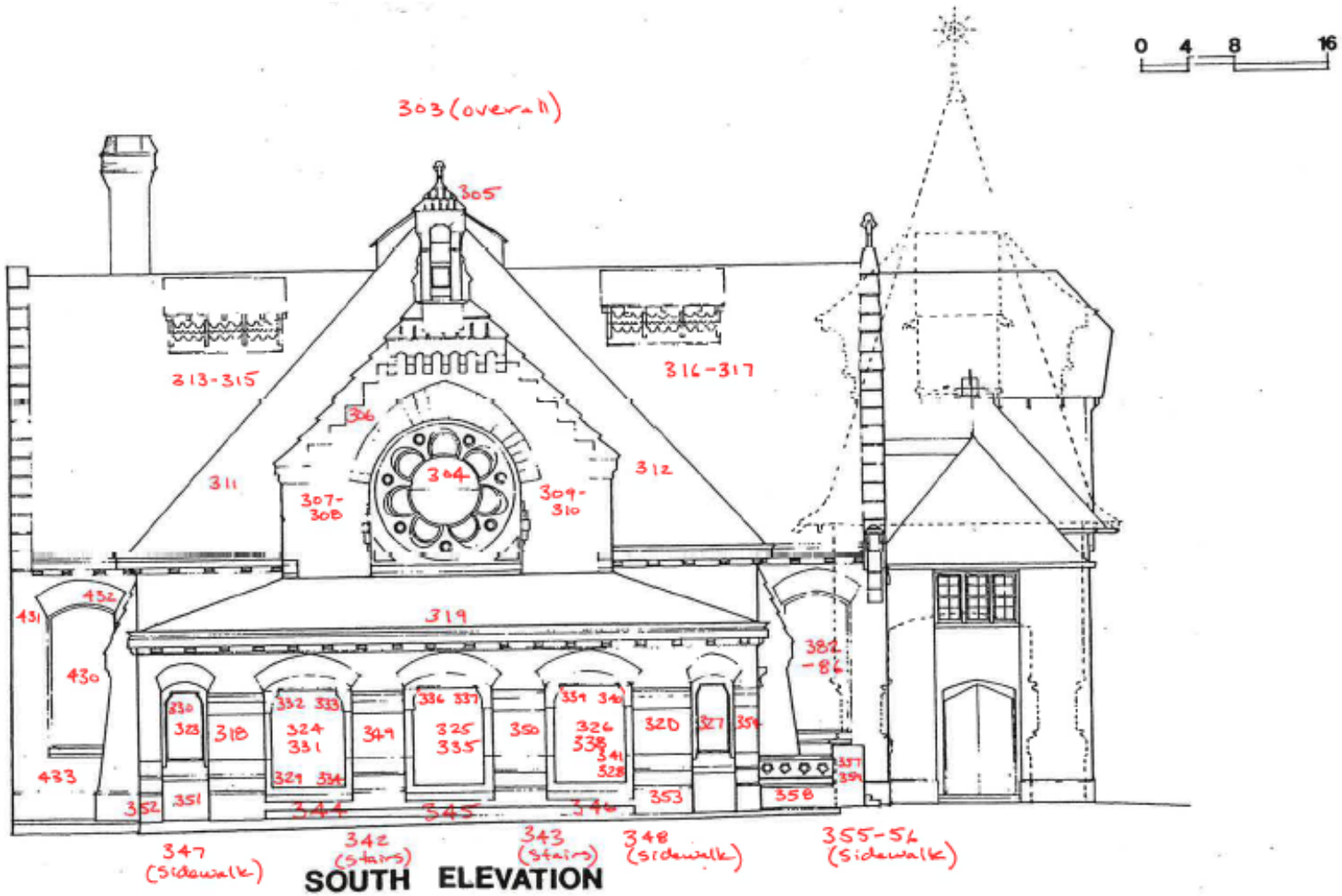
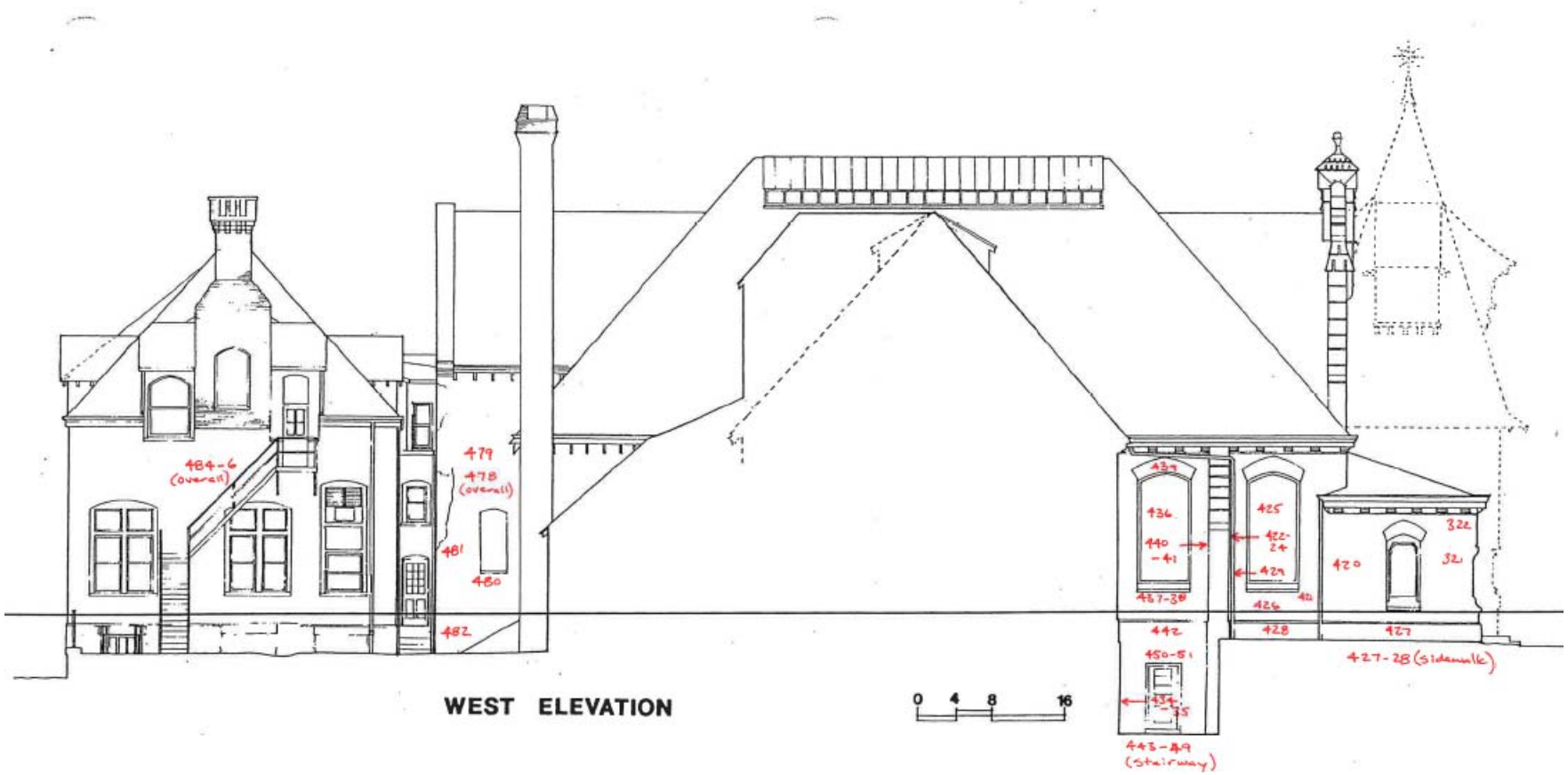
Condition Documentation - Drawings



Condition Documentation - Drawings



Condition Documentation - Sketches

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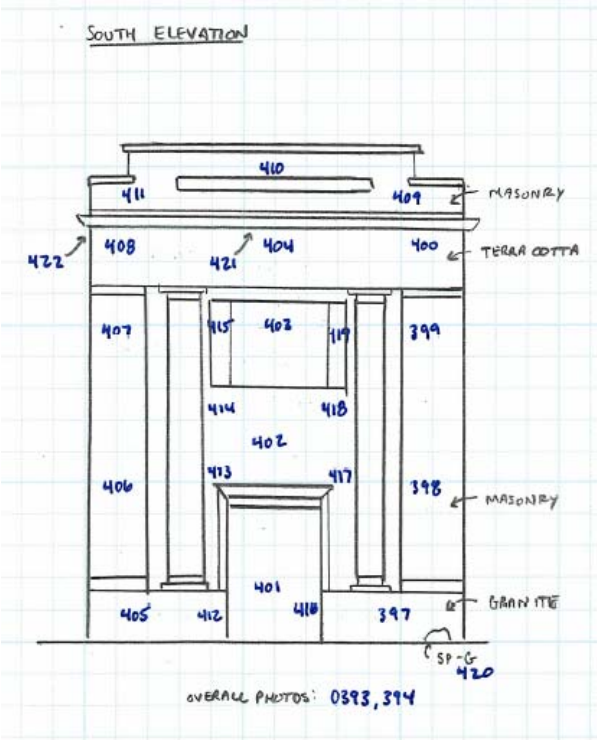

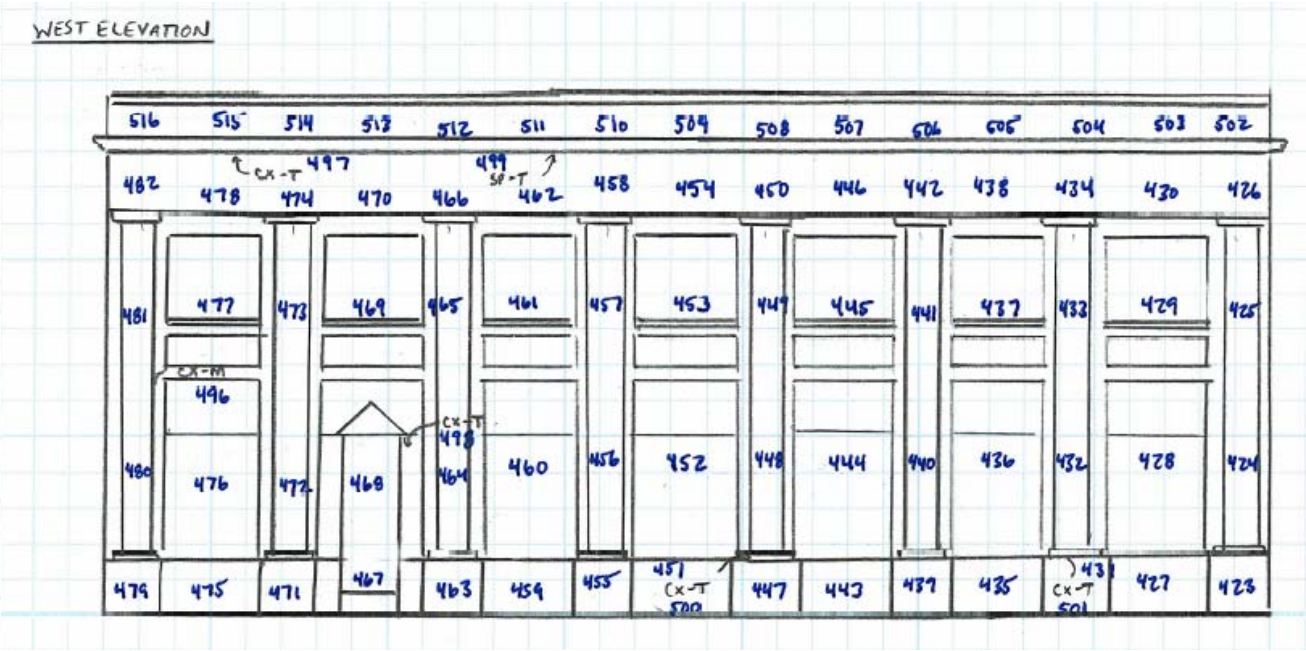

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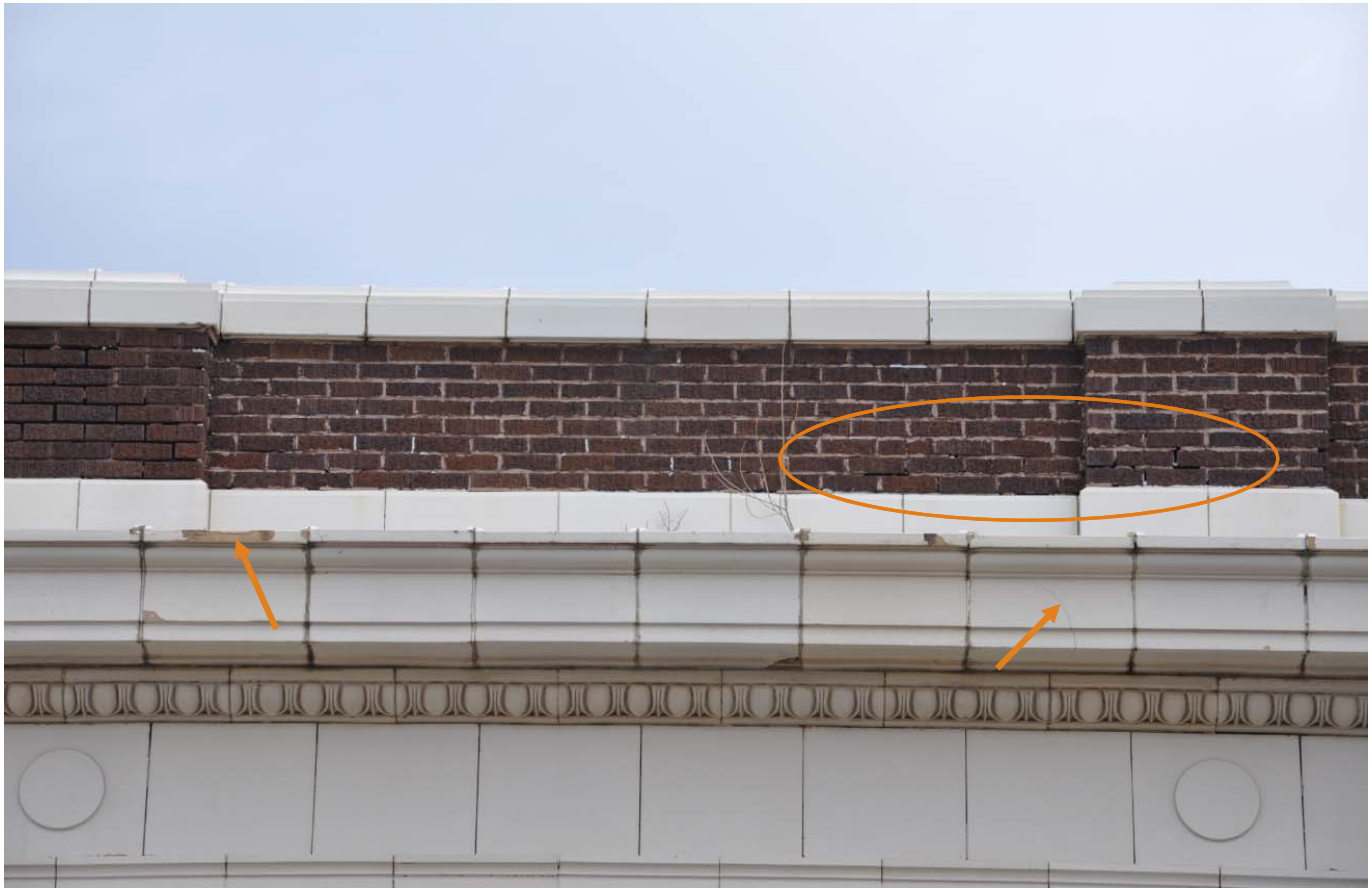

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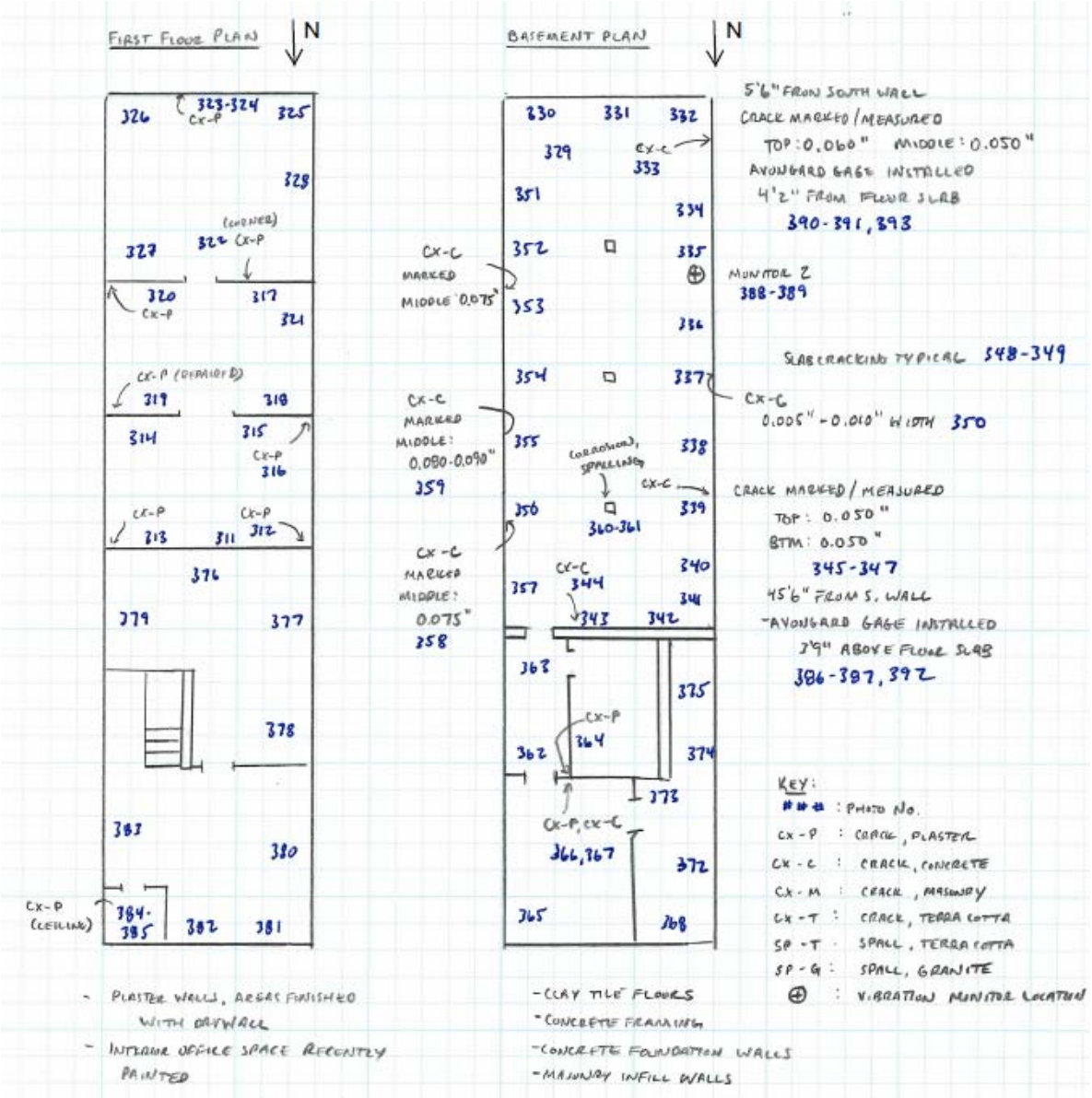

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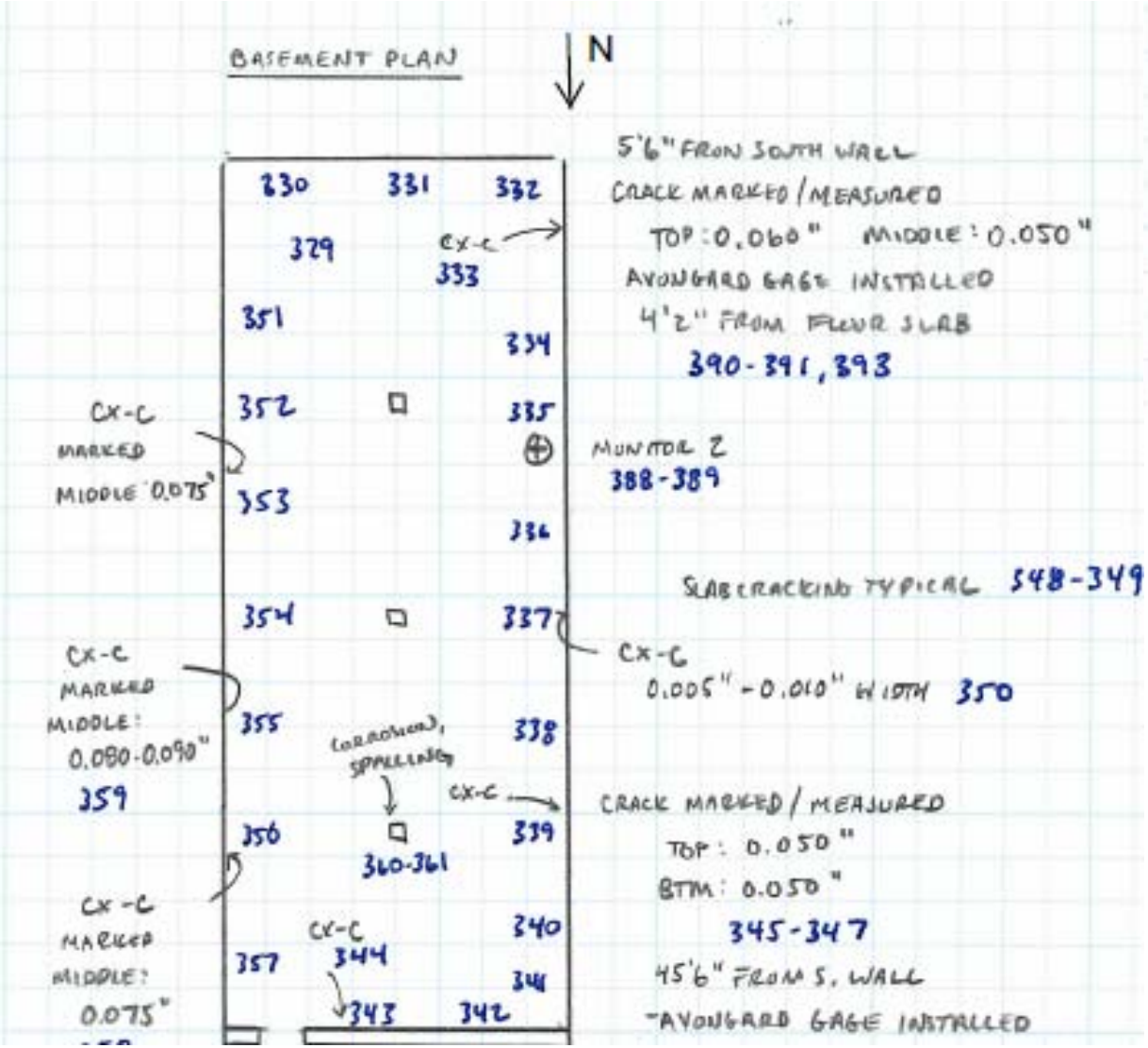
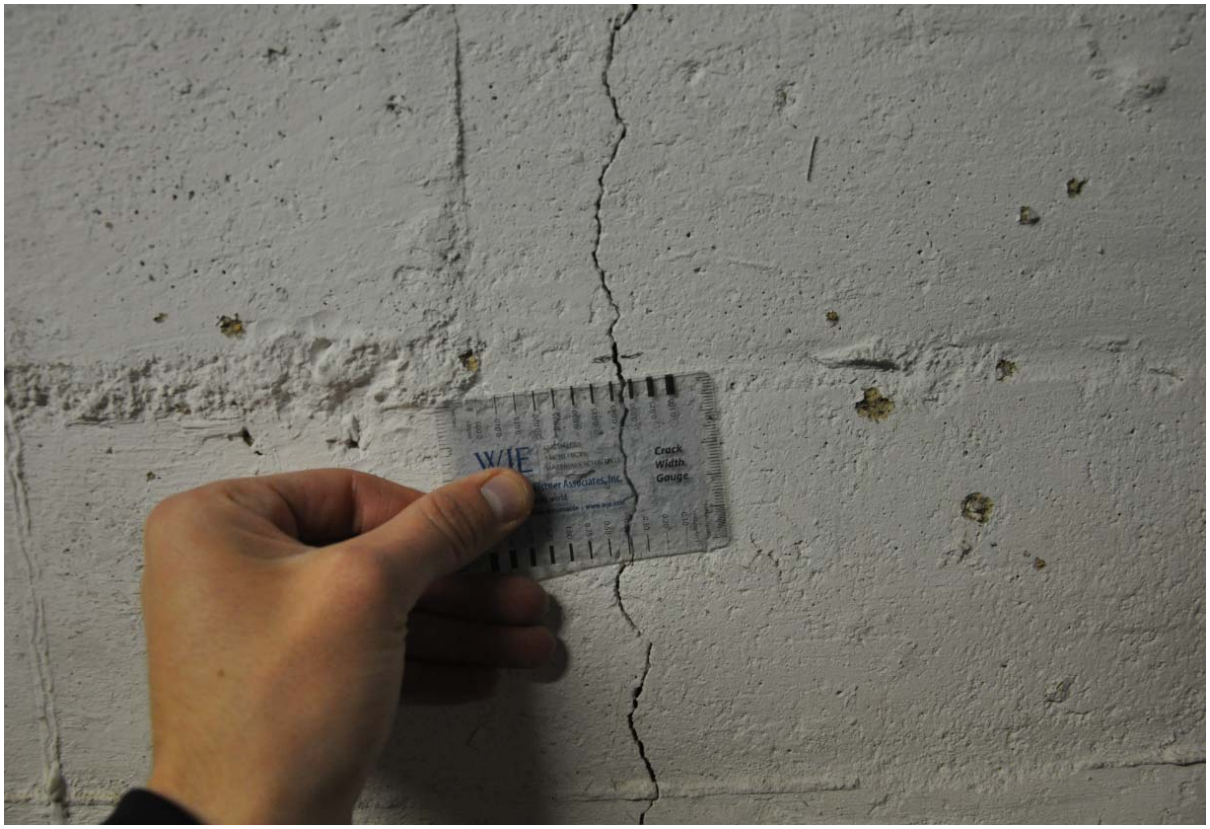


KEY:

###	: PHOTO NO.
CX-P	: CRACK, PLASTER
CX-C	: CRACK, CONCRETE
CX-M	: CRACK, MASONRY
CX-T	: CRACK, TERRA COTTA
SP-T	: SPALL, TERRA COTTA
SP-G	: SPALL, GRANITE
⊕	: VIBRATION MONITOR LOCATION

Condition Documentation - Sketches



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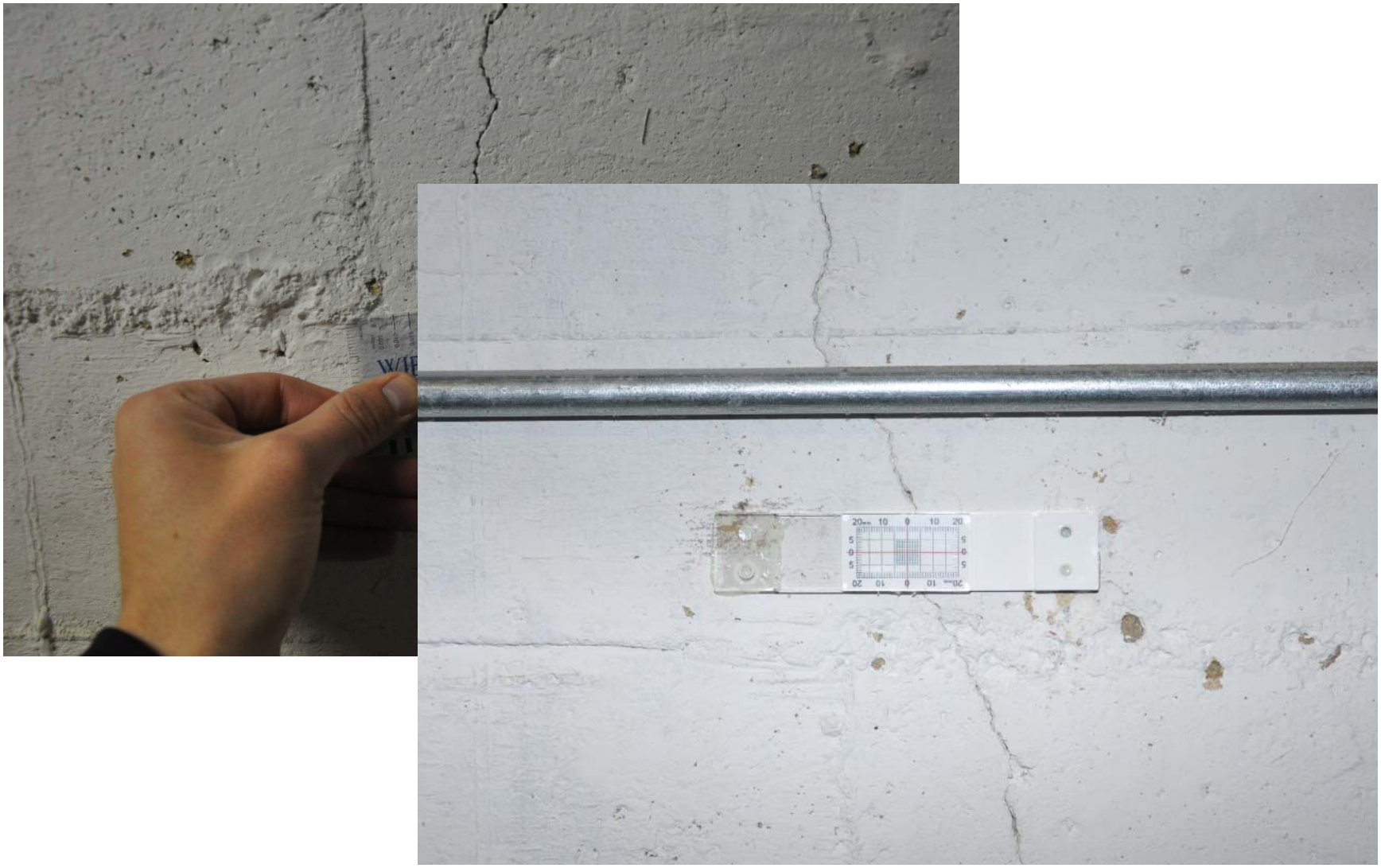

Condition Documentation - Sketches

IA-3 Resurfacing - Pocahontas County, Iowa

- Basilica-style cathedral, constructed in 1901
- Stone masonry foundation
- Multi-wythe exterior walls/pilasters

Condition Documentation - Sketches

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Pocahontas County, Iowa

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Condition Documentation - Sketches

IA-3 Resurfacing - Pocahontas County, Iowa

- Basilica-style cathedral, constructed in 1901
- Stone masonry foundation
- Multi-wythe exterior walls/pilasters
- Wood-framed primary floor
- Plaster interior finishes

Condition Documentation - Sketches

IA-3 Resurfacing - Pocahontas County, Iowa

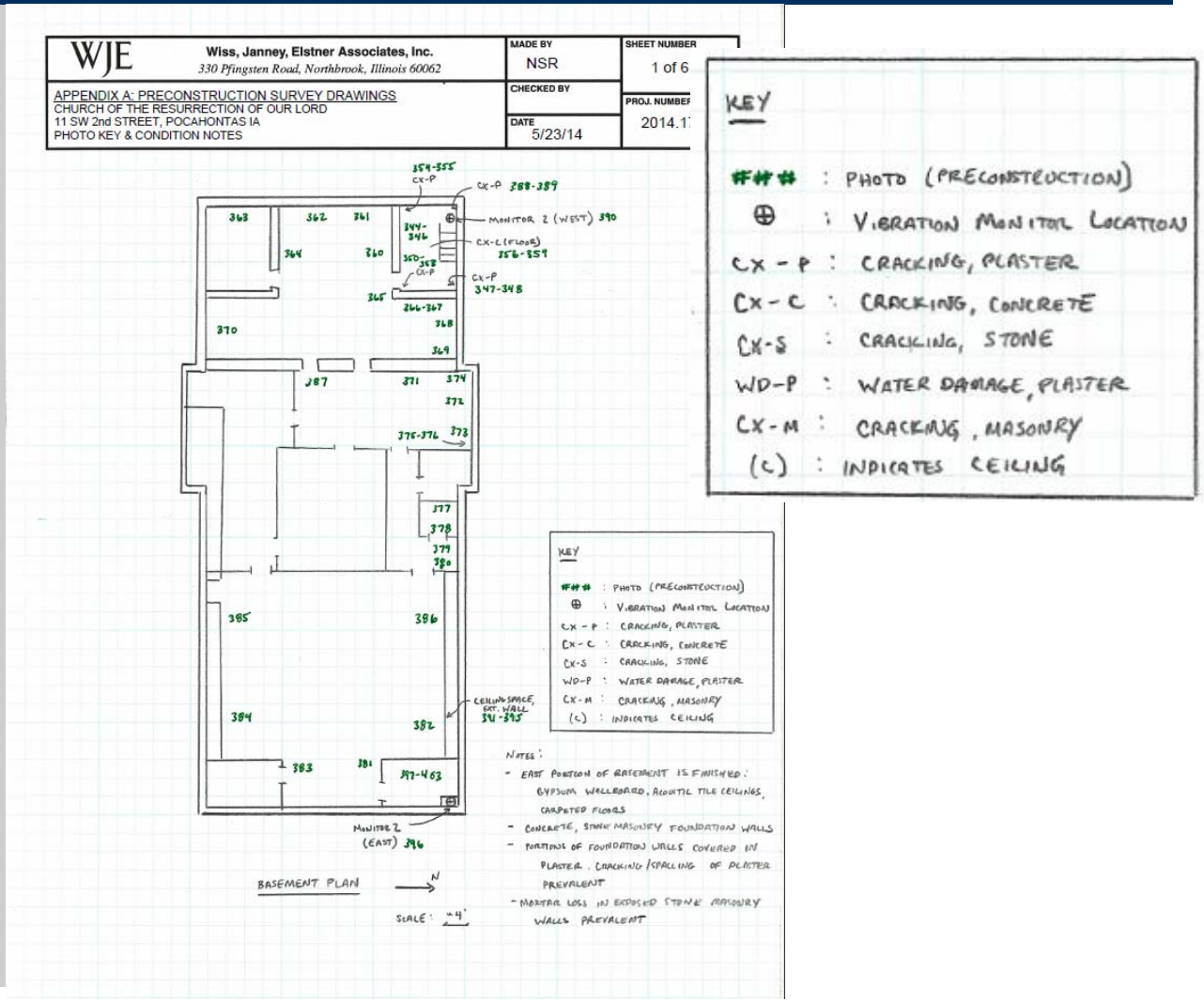
- Basilica-style cathedral, constructed in 1901
- Stone masonry foundation
- Multi-wythe exterior walls/pilasters
- Wood-framed primary floor
- Plaster interior finishes
- Masonry bell tower

Condition Documentation - Sketches

IA-3 Resurfacing -

Pocahontas County, Iowa

- Interior plan view sketches



Condition Documentation

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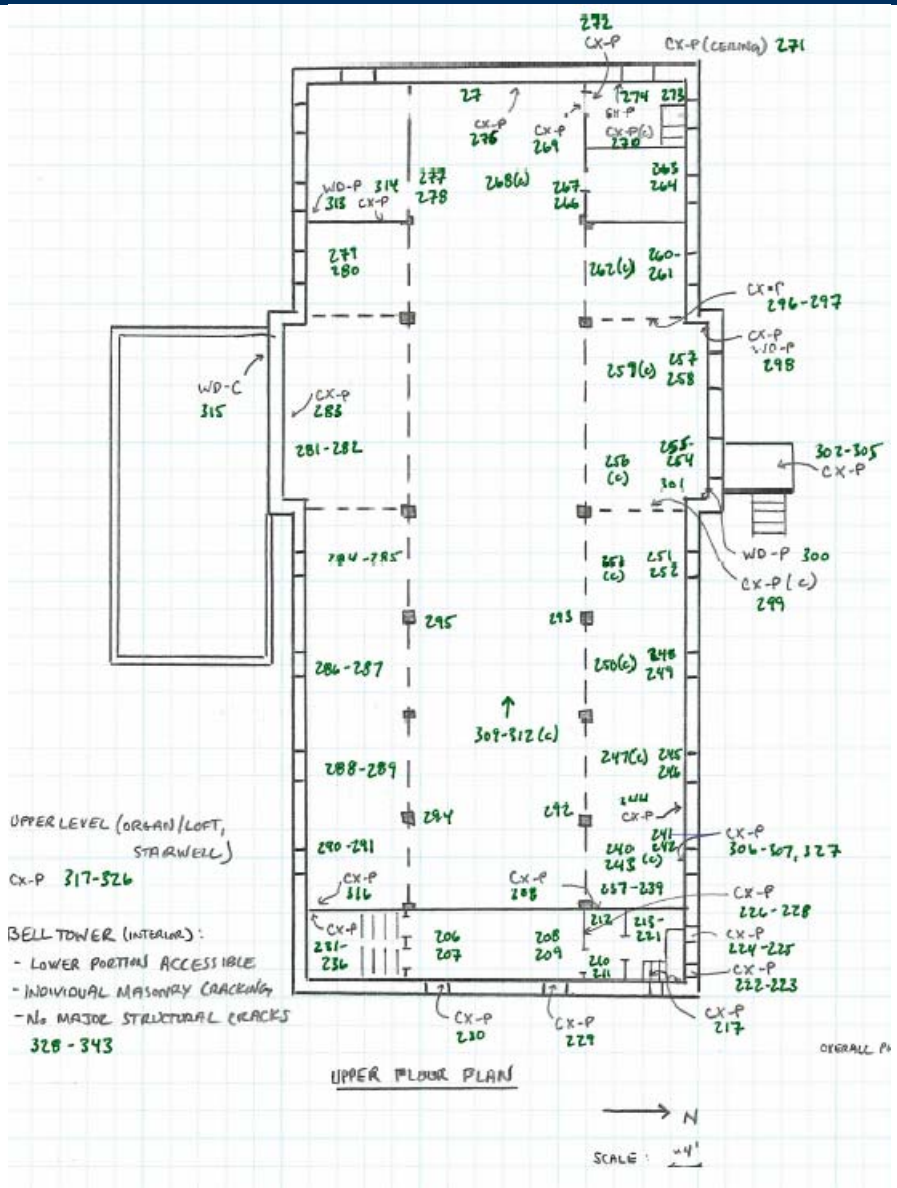

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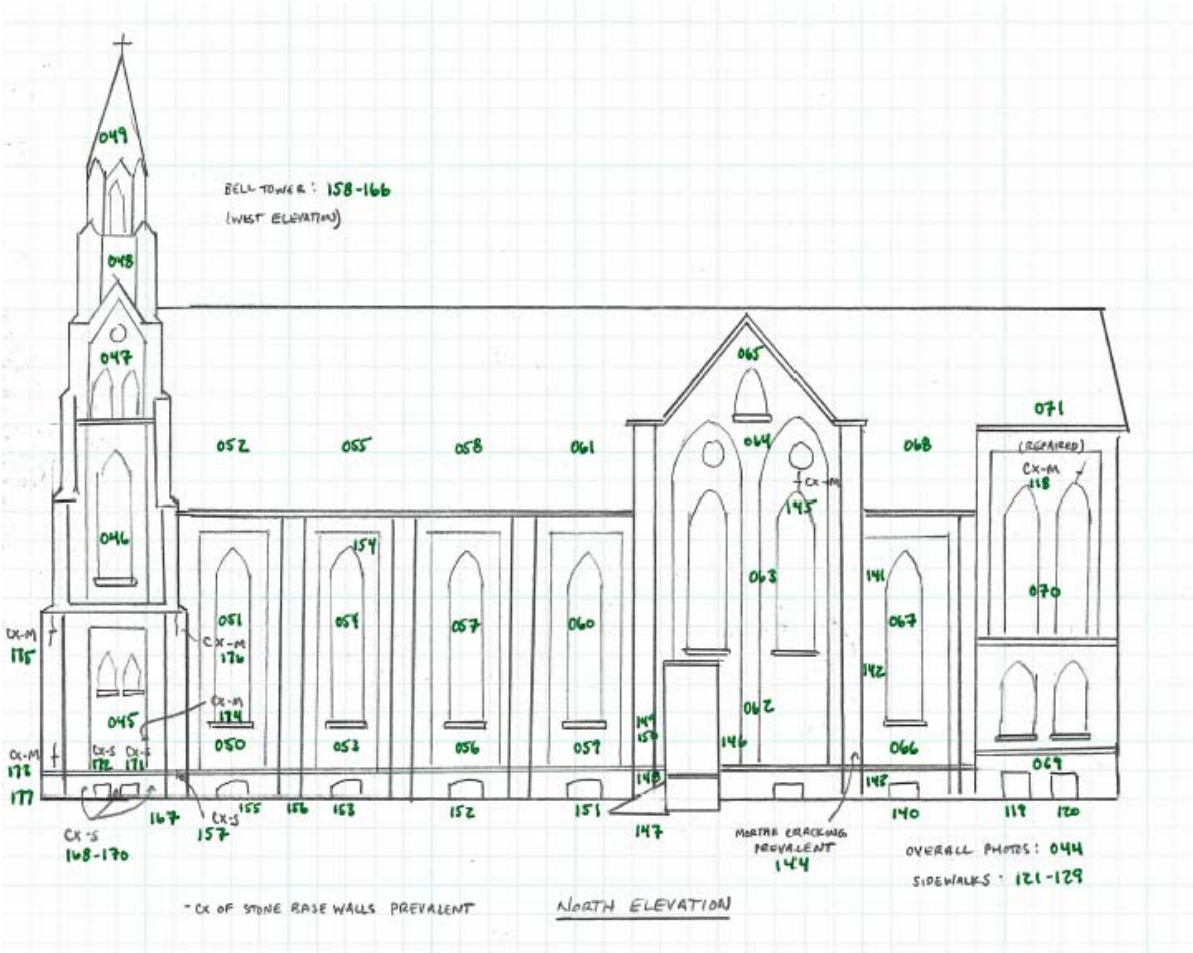
Condition Documentation

IA-3 Resurfacing -

Pocahontas County, Iowa

- Interior plan view sketches
- Exterior elevation view sketches



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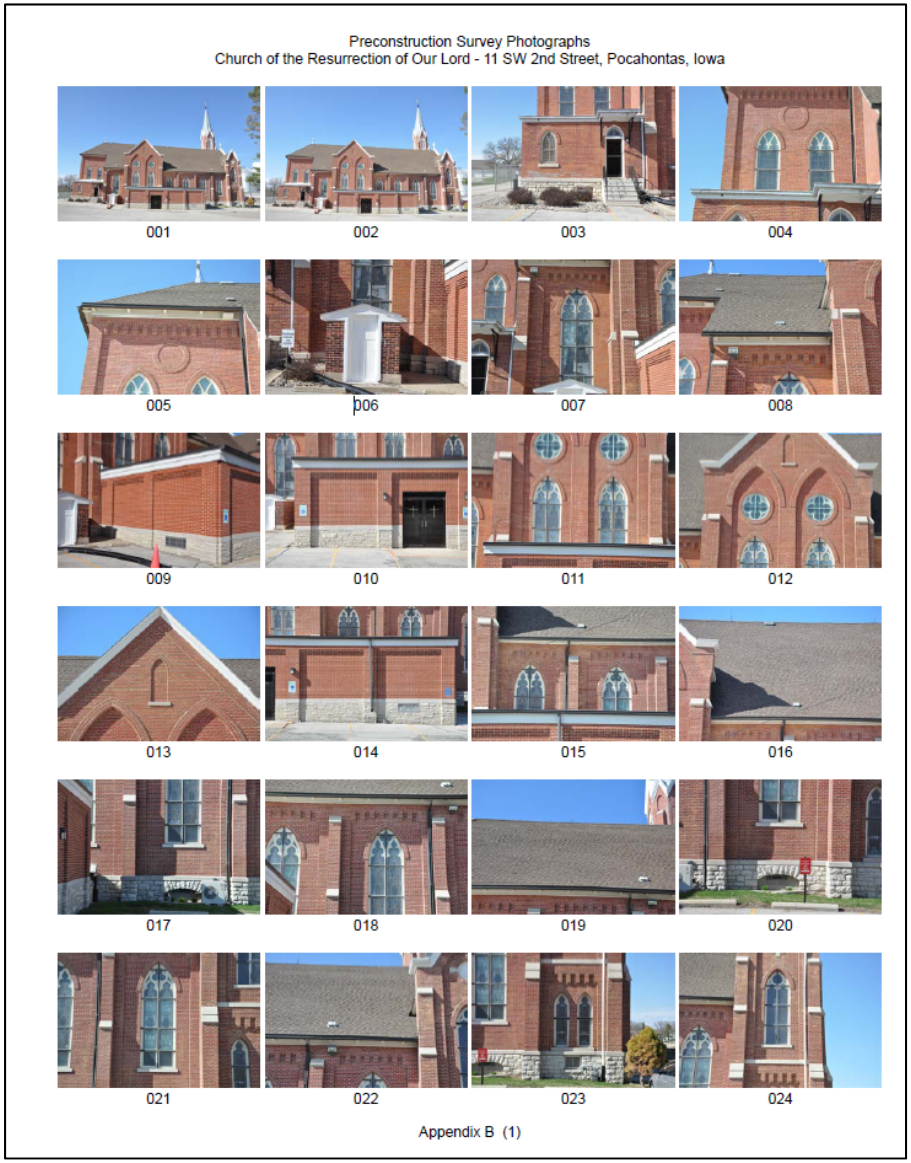
Condition Documentation

IA-3 Resurfacing - Pocahontas County, Iowa

- Interior plan view sketches
- Exterior elevation view sketches
- Survey Photographs



Preconstruction Survey Photographs
Church of the Resurrection of Our Lord - 11 SW 2nd Street, Pocahontas, Iowa

001 002 003 004
005 006 007 008
009 010 011 012
013 014 015 016
017 018 019 020
021 022 023 024

Appendix B (1)

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Condition Documentation

IA-3 Resurfacing -

Pocahontas County, Iowa

- Interior plan view sketches
- Exterior elevation view sketches
- Survey Photographs
- Drone Video Inspection

DRONE VIDEO

Detailed Vibration Analysis

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Need for Detailed Analysis

- Sensitive Structures
  - Structures of historic significance
  - Structures with sensitive finishes
  - Structures with sensitive instruments
    - Hospitals
    - Research Facilities
    - Manufacturing
- Large number of affected buildings
  - Dense Residential/Commercial Areas

Vibration Receivers

- People
  - Primary perceptible/disturbing
  - Secondary effects
- Structures
  - Structural Damage
  - Architectural Damage (Finishes)
- Equipment
  - Vibration-sensitive research, advanced technology

Detailed Analysis Procedures

- Survey Existing Background Vibrations
- Analyze Anticipated Vibration Levels
  - Analyze vibration propagation characteristics
  - Assess specific construction methods
  - Analyze response of subject building
- Assess impact of vibrations
- Assess proposed construction methods
- Develop mitigation measures

Questions?