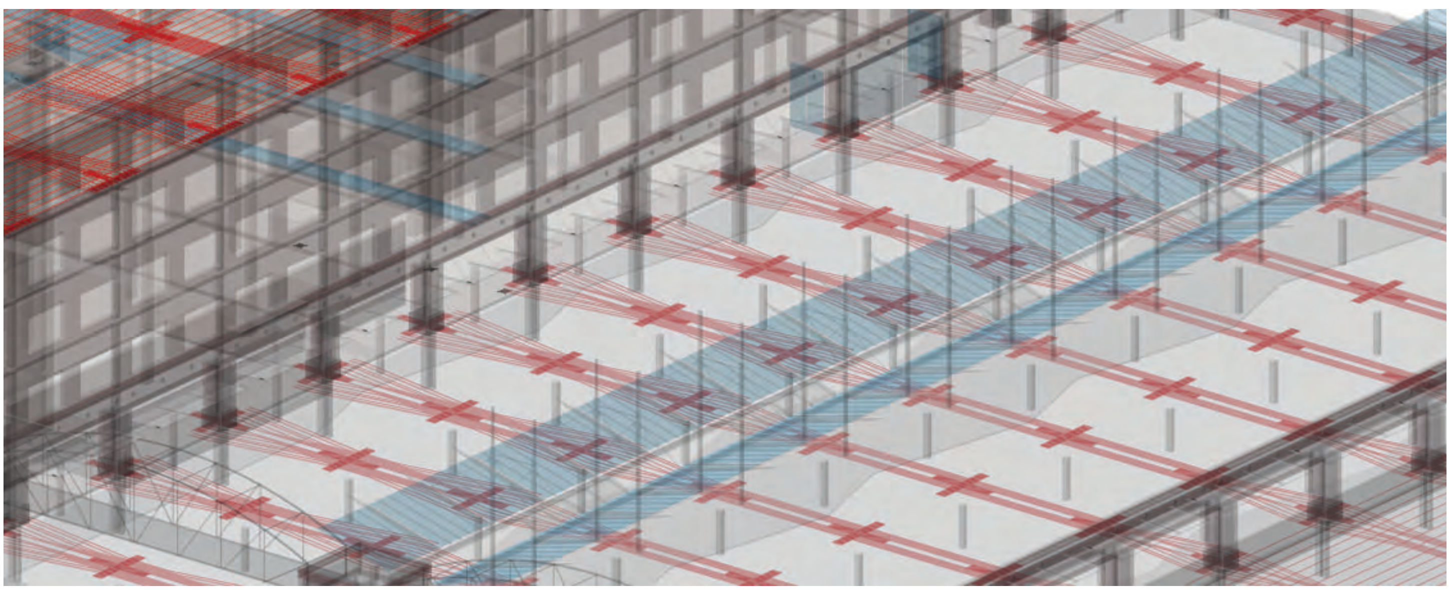


Marion County Courthouse Square
555 Court Street NE, Salem Oregon
Remediation Study Final Report
February 07, 2011

Volume Four of Six

VOLUME IV

I. PRESENTATION GRAPHICS

A. June 09, 2010

B. July 26, 2010

C. October 26, 2010

D. January 20, 2010

Marion County

Courthouse Square Structural Remediation

Project Summary

June 09, 2010

SERA

Team Members and Expertise

Marion County • Building Owner, Client	• Dave Henderson- Director, Business Services • Tom Hogstad, Facilities Manager • Gary Hales, Loss Control Manager • Steve Frank, Maintenance Supervisor
Salem Keizer Transit District • Building Owner, Client	• Andrew Cooper, Safety and Loss Control Specialist • Trent McCoy, Facilities Maintenance Supervisor
SERA Architect • Project manager and team coordinator • Building assessment • Sustainability Resources • Interior Design	•Joe Pinzone- Principal-in-charge • Russ Pitkin- Project Manager • George Hager- Project Architect, Project coordinator • Brian Cobb- Project Architect • Carissa Mylin- Interior Designer • Russell Holzinger- BIM, graphics, support
Miller Consulting Engineers • Structural engineering	• Ray Miller- Structural Engineer • Eric Watson- Structural Engineer • Andrew Leichty- Structural Engineer
RDH Building Sciences • Building envelope and waterproofing	• Ariel Levy, PE- Building Science Specialist • Eric Lawrence

Team Members and Expertise

PAE Consulting Engineers • Mechanical, Electrical, Plumbing engineering	• Nick Collins, PE • Jon Ricket, PE- Mechanical Engineer • Dennis Bohn, PE- Electrical Engineer
H&A Construction • Cost Modeling, Constructability Review	• Bob Able, Cost Estimator
Fortis Construction • Construction Manager, General Contractor • Cost Modeling, Constructability Review	• Pete Smith • Andy Franklin • Tom Sowa
GeoDesign •Geotechnical engineering	•George Saunders, PE, GE •Scott McDevitt, PE
David Evans & Associates • Building Survey	• Jon Broadwater, PLS
Carlson Testing, Inc. • Material Testing	• Mark Powlison, Special Project Department Manager

Team Members and Expertise

The flow of this presentation. . . .

- Symptoms: The damage we mainly see is caused by some other issue.
  - We observed almost all of the spaces and surfaces to document defects.

- Testing: We investigated key areas to determine the fundamental cause.
  - We opened and revealed specific areas to learn more.

- Diagnosis: Information we've gathered is beginning to be analyzed. They're still more to go.
  - What is the evidence telling us?

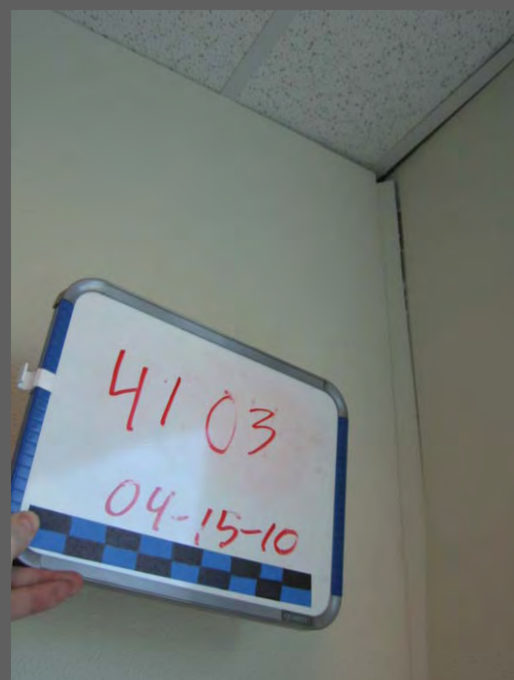
Milestones and Key Events

• Project kickoff meeting	March 10, 2010
• Process definition and development	March 11 through April 09
• Onsite observation	April 14 through 21
• Geotechnical soil borings	April 12 through May 15
• Full building survey	April 15 through May 02
• Exterior brick and window survey	May 06 through 08
• Sidewalk excavation	May 01
• Material testing	May 05 through June 11
• Window water infiltration testing	May 10 through 29
• Remaining exterior brick and window survey	June 26

Interior finishes- Walls

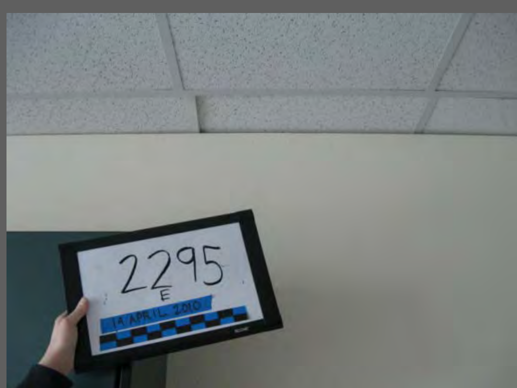
- Wall cracking is prevalent throughout the building
  - Progressively more frequent
  - Progressively more numerous

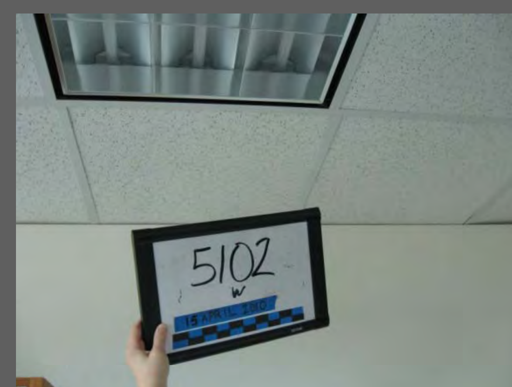
Interior finishes- Walls



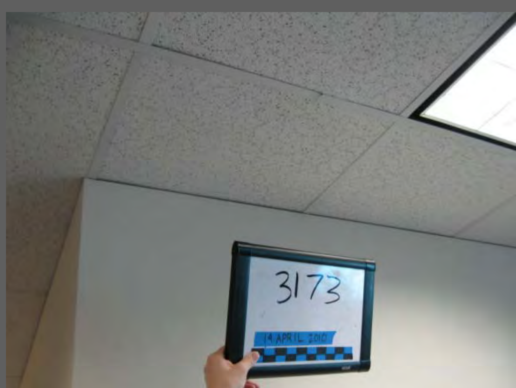
Interior finishes- Ceilings

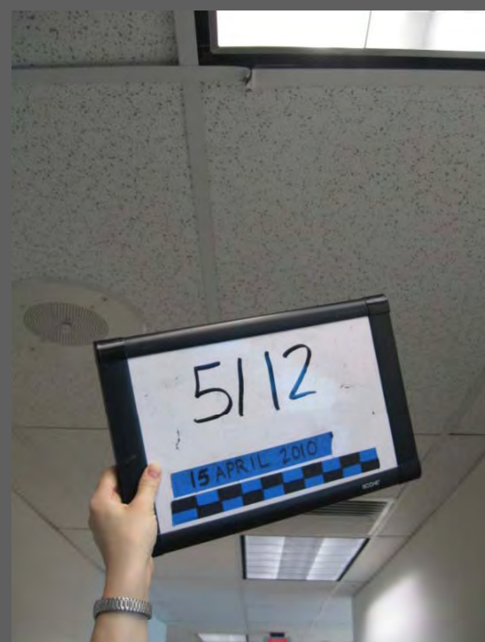
- Ceiling misalignment is prevalent through the building
    - Misalignment is extremely pervasive with a few buckled ceiling grids
    - Acoustic tiles have sustained damage
    - Nearly all perimeter grids have been damaged





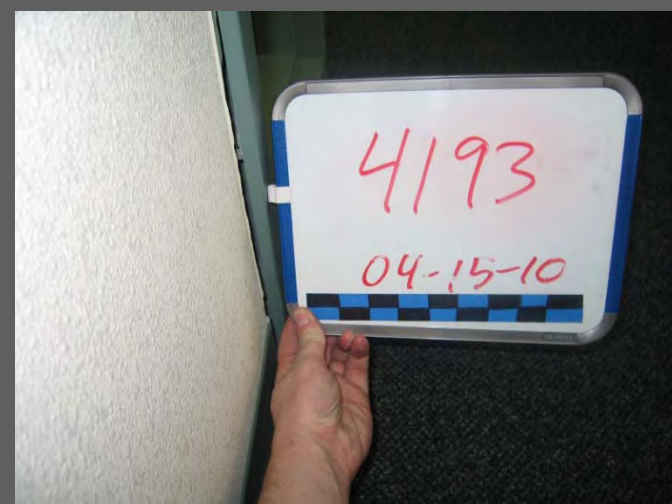
Interior finishes- Ceilings



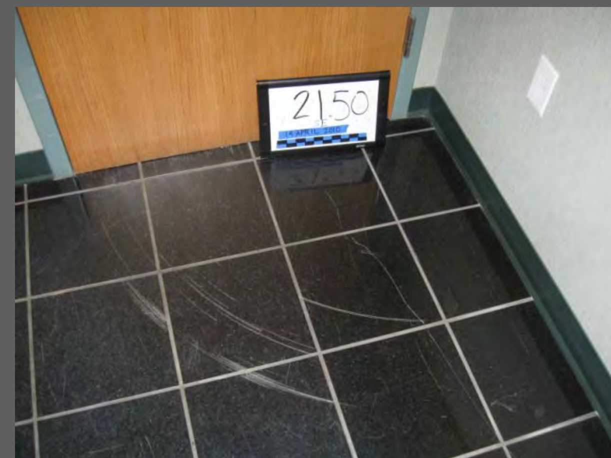


Interior finishes- Doors

- Building movement has caused door issues
  - Fire Life Safety doors have been impacted
  - Doors have been modified to fit conditions
  - Many doors are not square within the frame or are warped

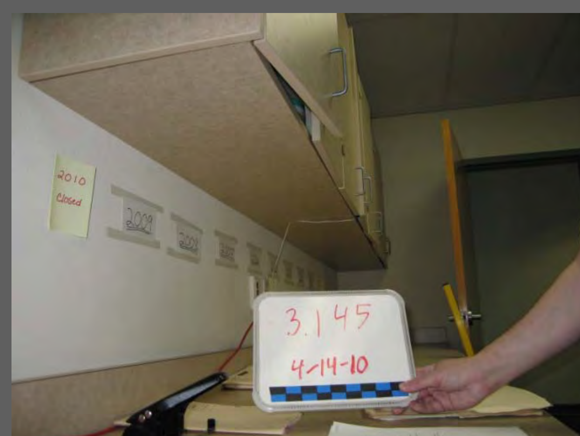


Interior finishes- Doors

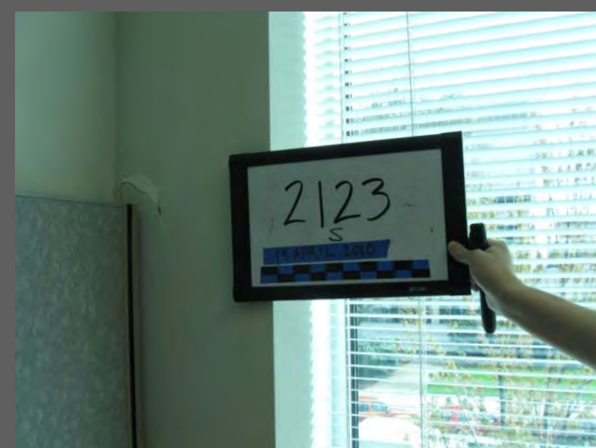


Interior finishes- Cabinetry, Casework and Furniture

- Deflection in the floor slabs have caused other damage throughout the building
  - Anchored systems furniture are damaging walls
  - Cabinetry and casework are not level causing function issues
  - Counter top backsplashes are detaching from the walls
  - Employee desks are not level



Interior finishes- Cabinetry, Casework and Furniture



Building equipment

- Areas visually observed include:
  - Main duct risers (east and west shafts)
  - Ductwork, sprinkler piping, electrical equipment above ceiling at worst deflection
  - Basement fan rooms and duct connections
  - Gas pipe riser at the street meter and at the 5th Floor
  - Roof top equipment

Building equipment

- Equipment damaged related to building movement include:
  - Intake louver at parking garage ramp
  - Fan room wall cracks in the Basement
  - Fan housekeeping pad cracked

Building equipment

- A note of special concern
  - Fire/ smoke damper access panels should be installed at west shaft
  - Equipment wear and tear


Building Envelope and Waterproofing

- Interior damage from water infiltration includes:
  - Ceiling and soffit staining
  - Window frame staining
  - Water infiltration at the foundation walls

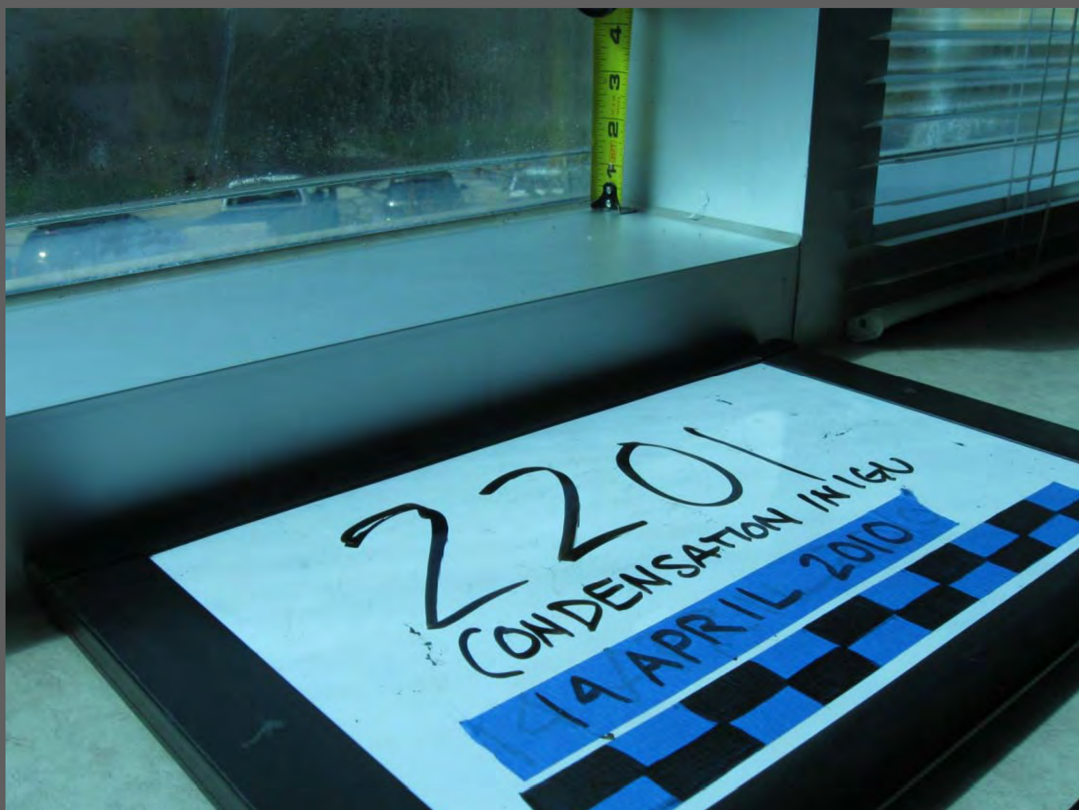
Building Envelope and Waterproofing

Building Envelope and Waterproofing

- Exterior Observation found:
  - Water infiltration issues at the curtain walls including failed window units
  - Window frames out of alignment
  - Brick control and expansion joints not uniform
  - Window sealant at the end of it’s useful life
  - Cracks in the brick facade


Building Envelope and Waterproofing

Building Envelope and Waterproofing



Building Envelope and Waterproofing

- Further investigation at the foundation revealed:
  - Installation of the foundation wall damp proofing system
  - Water issues exacerbating an already delicate structural condition
  - Construction defects during installation
  - Missing design detailing and then failed field solutions

Building Envelope and Waterproofing

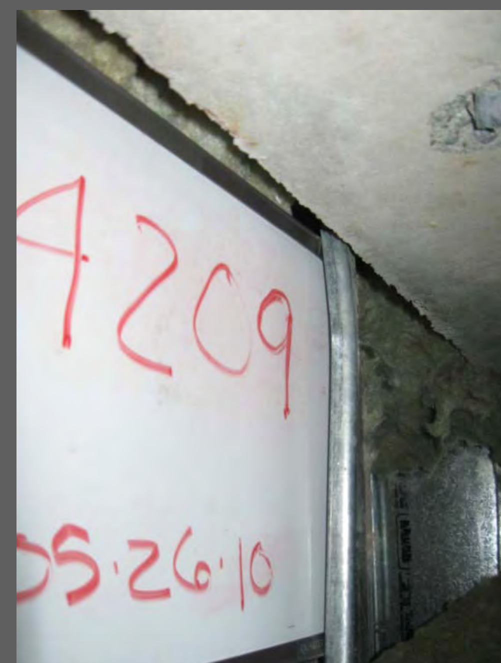
Building Envelope and Waterproofing

Building Structure

- Exterior brick and window survey and structural observations let to further discoveries:
  - Installed tendons different than design drawings
  - Construction methods have directly contributed to interior damage; slab deflections didn't help

Building Structure

- Exterior brick and window survey and structural observations let to further discoveries:
  - Quality control issues at the time of construction
  - Observed brick movement revealed deformed structural stud walls

Building Structure

SE Corner

SW Corner

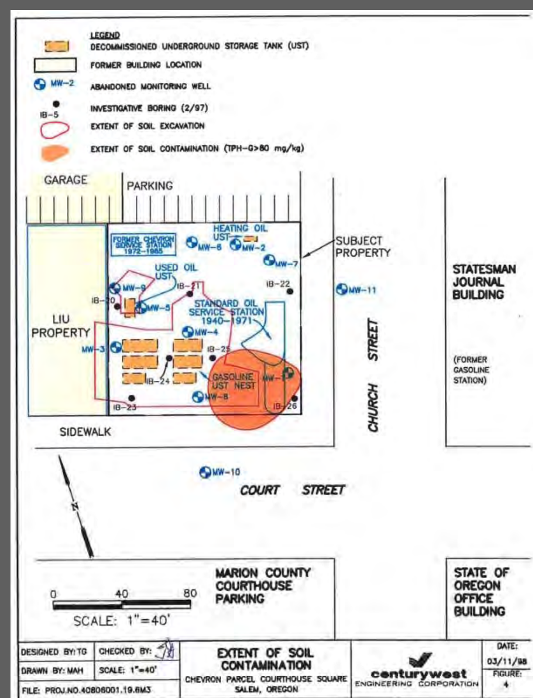
Building Structure

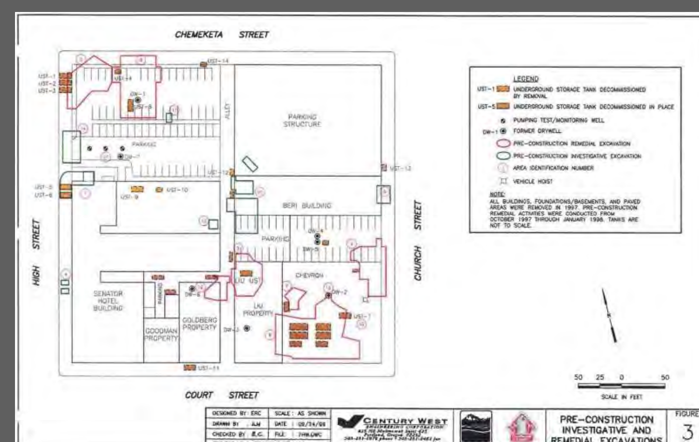
NW Corner

NE Corner

Geotechnical and Foundations

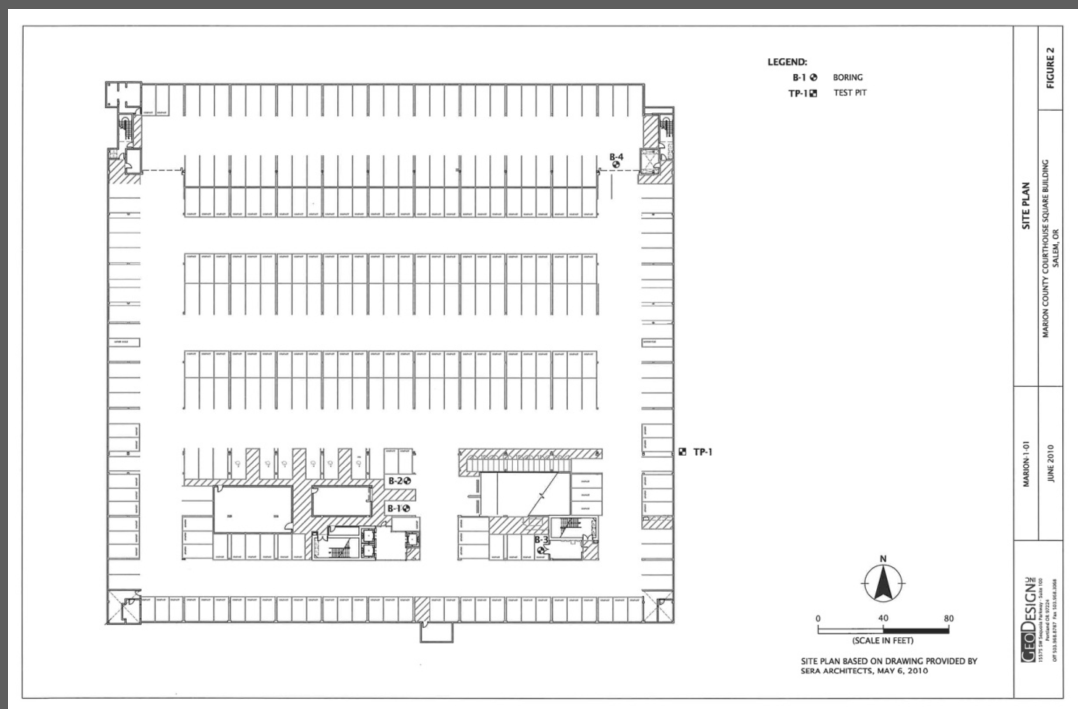
- Remediation excavations up to 20 feet prior to site development
- Century West reports indicated placement of temporary loose soils but didn't document removal
- Excavations were backfilled and compacted according to specifications.





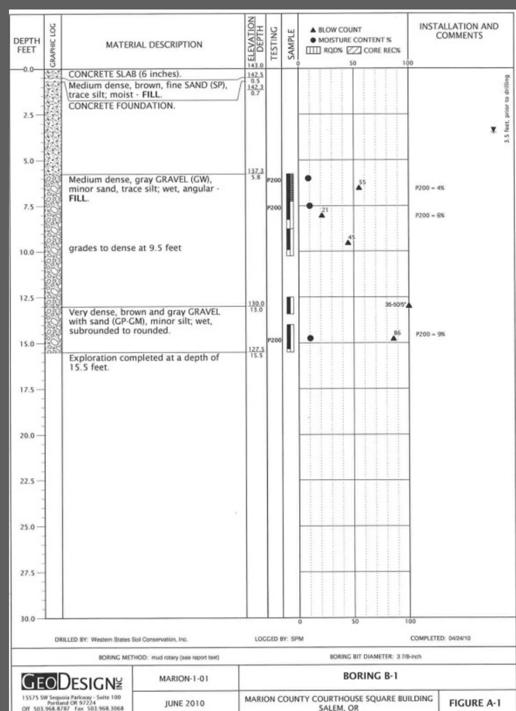
Geotechnical and Foundations

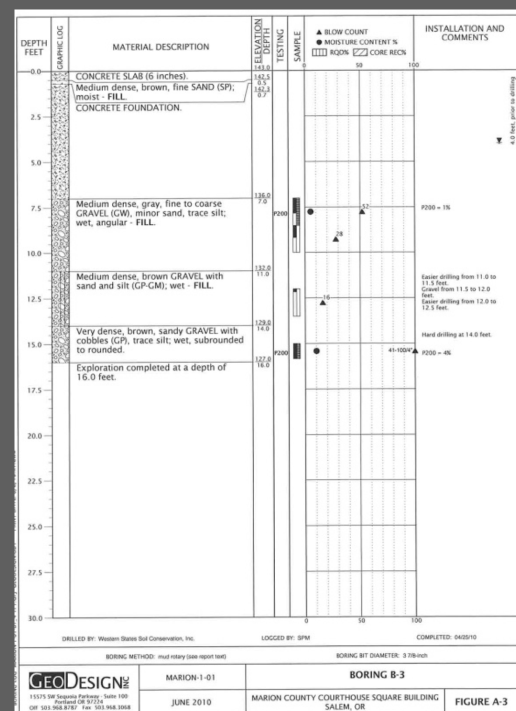
- Four soil borings at critical foundation areas where building distress was observed.
- Gravel fill and native soils are generally medium dense to very dense.
- Gravel fill not adequately compacted could lead to isolated settlement areas.



Geotechnical and Foundations

- Original design recommended bearing pressure of 2500lbs for gravel fill and 6000lbs for native soil.
- An exploratory excavation at observed confluence of building damage.
- Any settlement would have occurred quickly.

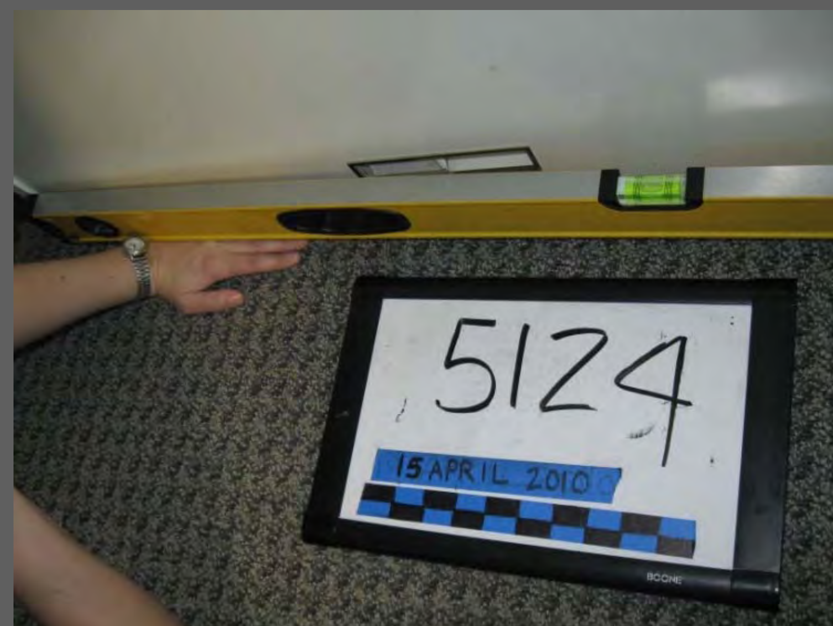




Full Building Survey

- Existing slabs exhibited significant perceptible deflections:
  - Previous survey showed the deflections grew progressively worse
  - Needed a defensible and repeatable methodology
  - Survey portions of the building not previously surveyed

Full Building Survey



Foundation/Soil

a. Appears all footings designed for 6,000 psf

b. Per discussions w/GeoDesign, likely to have structural fill present below all footings

c. Original geotech report notes to use 2,500 psf for footings on fill. However, GeoDesign still would expect only 1-2” of immediate settlement of footings on fill. Would not continue long term

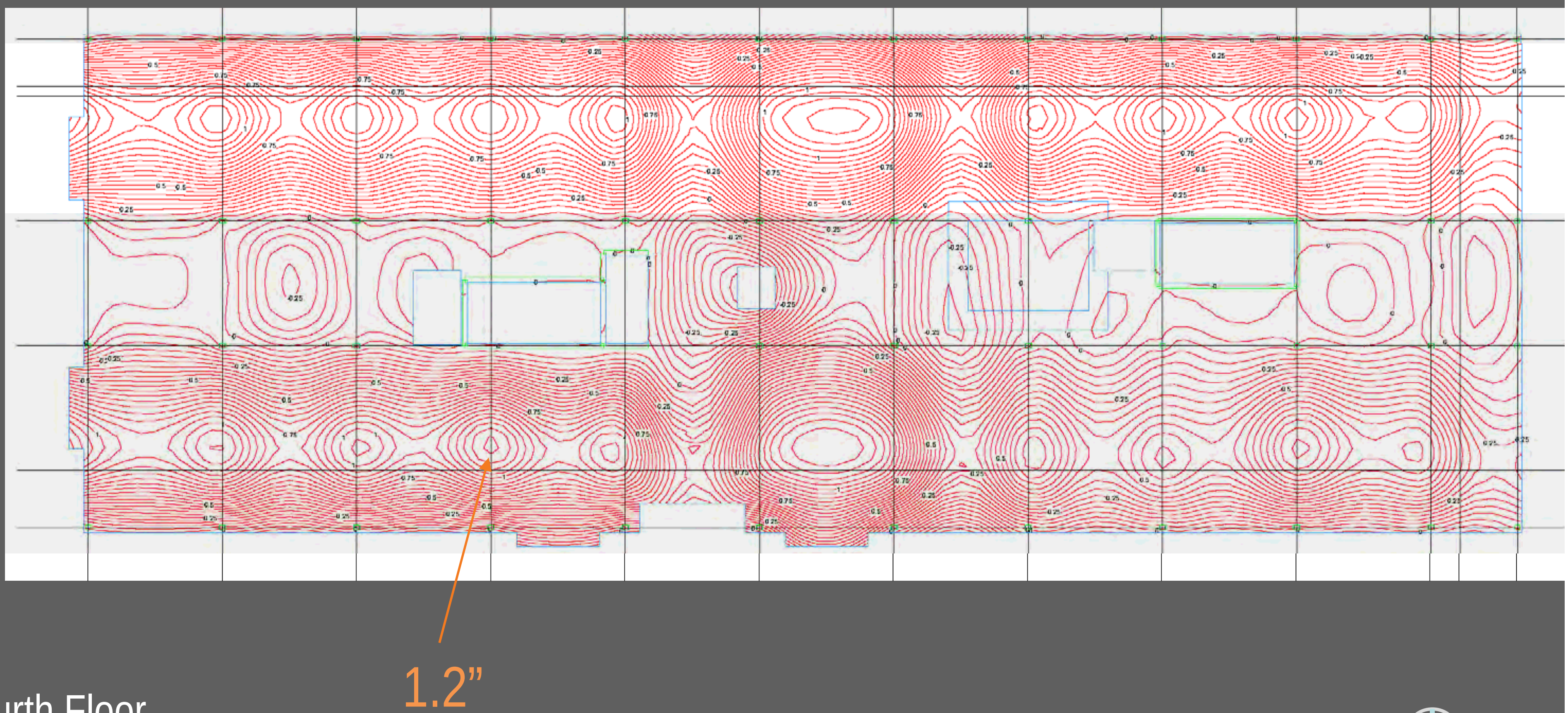
d. Foundation soil bearing not likely to be contributing factor to condition of structure

e. May be other issues with punching shear and reinforcing in mat foundations. Final analysis still needs to be performed.

Analysis of As-designed structure is 95% complete

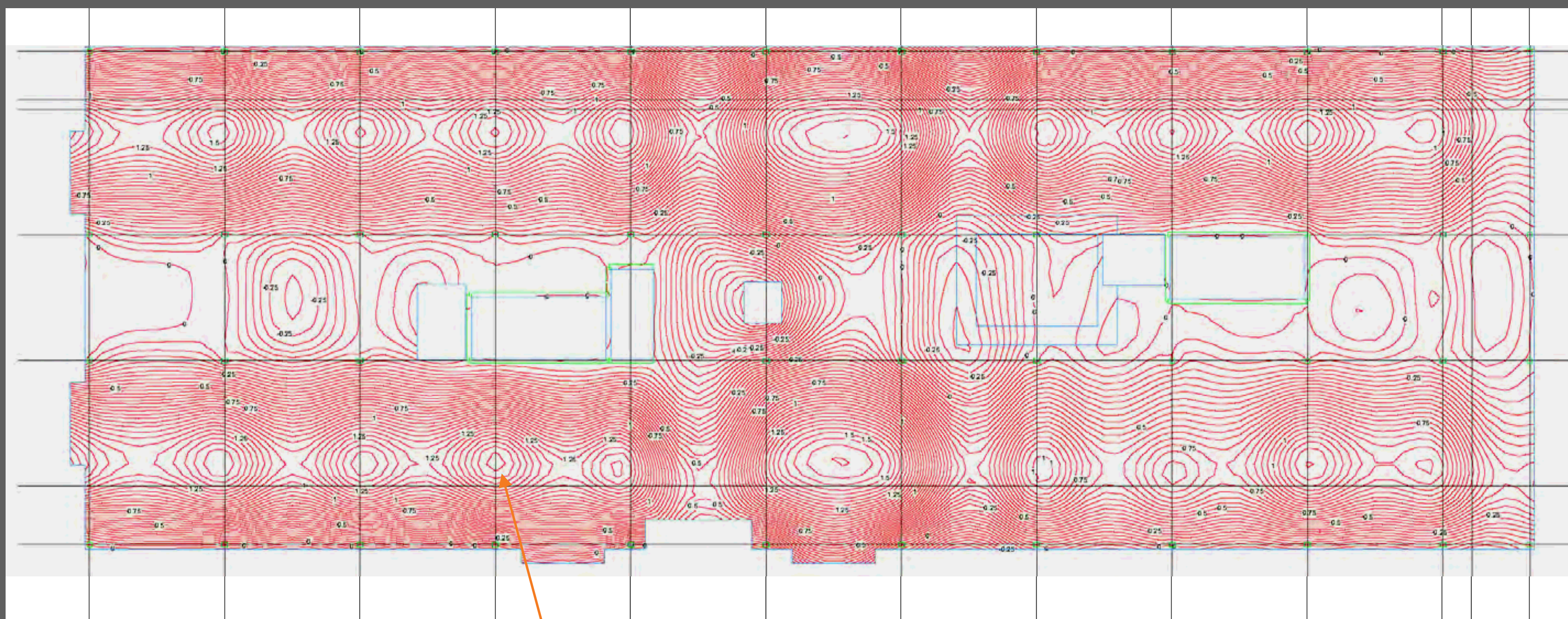
- High amount of precompression stress
  - Many areas over the industrial standard recommend 300 PSI
  - Some areas around 450 PSI
- High amount of load balancing in east-west spans
  - Up to 200% DL – Typically stay within 80% range
- Calculated deflections at ≈ 50% of the field survey deflections

CONSTRUCTION LOADING: STD DEFLECTION PLAN (INITIAL 30 DAYS)



ourth Floor

SUSTAINED LOAD: STD DEFLECTION PLAN
D = 0.5L (AFTER 5,000 DAYS)

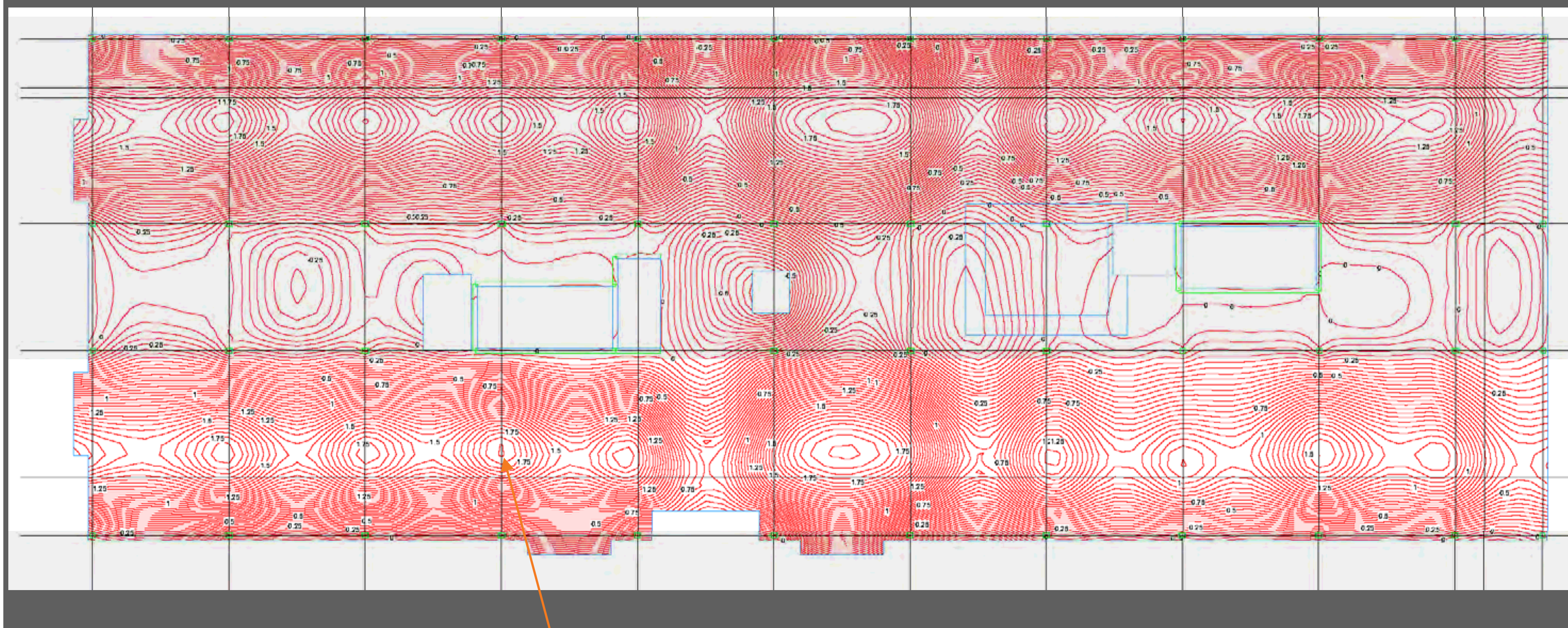


1.6”

3.5” Field Survey

ourth Floor

FINAL INSTANTANEOUS LOAD: STD DEFLECTION PLAN (D+L)



ourth Floor

Analysis of As-designed structure is 95% complete

d. A few areas where additional top reinforcement should have been added in original plans for service loading considerations

e. A few areas where additional reinforcing for strength may be needed

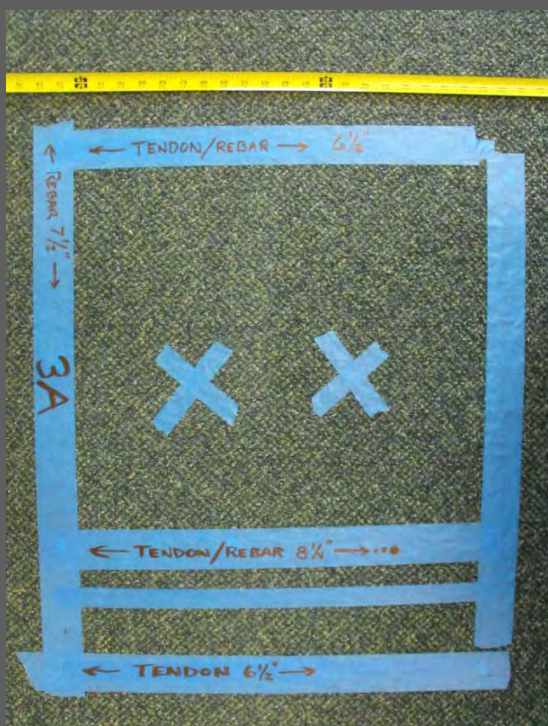
f. Still need to locate tendon loss calcs from DSI and slab calcs from Century West

Core Shear Walls

- Preliminary seismic analysis indicates shear walls in north-south direction may be around 50% below seismic demand
- West mat foundation may be under strength in north-south direction also
- Need to locate original structural calculations to review design procedure
- Cracking in core shear walls likely due to restraint forces from P.T. slab

Material Testing

- Full building survey informed where material samples were to be taken:
    - Gather data from perceived ‘good’ and ‘bad’ locations at each floor
    - Each side of slab’s pour strip
    - Used a combination of GPR and x-ray to locate cores



Material Testing

- Concrete core testing results showed less than designed strengths of 5000psi:
  - Ground Floor = 4360psi, 4600psi, 4424psi
  - Second Floor = 3460psi, 4210psi , 3710psi, 4080psi
  - Third Floor = 3960psi, 3490psi, 3800psi, 3500psi
  - Fourth Floor = 4310psi, 3730psi, 4860psi, 4520psi
  - Fifth Floor = 5150psi, 4240psi, 4520psi, 4510psi

Petrographic Results

a. Some variation in thickness
   i. ACI 117 permits up to 1/4” variation

b. PH low on top surface likely due to curing compound used
   i. Not a structural issue

c. PH is high (12-13) for remainder of slab which is desirable for corrosion protection

d. % unhydrated cement
   i. If concrete wasn’t cured properly, water could evaporate from the mix which would not allow all particles to by hydrated

Core Sample Results

- 5th Floor – Average f'_c = 4605 PSI
- 4th Floor – Average f'_c = 4355 PSI
- 3rd Floor – Average f'_c = 3688 PSI
- 2nd Floor – Average f'_c = 3865 PSI
- 1st Floor – Average f'_c = 4460 PSI

Core sample results (continued)

Per ASTM C42, historically, core strengths have been taken as 85% of standard cured molded cylinders

5000 PSI X 0.85 = 4,250 PSI

However, concrete continues to gain strength with age (i.e., 5,000 PSI @ 28 days ≈ 5,800 PSI @ 3,650 days. So, 5,800 x 0.85 = 4,930 PSI).

Average cores should be above 4,930 PSI and none are.

Variation in core length similar to petrographic. Most areas within 1/4” tolerance

Have not seen GPR results yet; need to review tendon drape

North Block Site Observation

a. Cracked concrete, water penetration in walls and slab, bearing problems

b. Areas injected have failed – 3 methods used

   i. Epoxy Injected

   ii. Cleaned out & Applied Sealant

   iii. Top Coat

c. Procedure for destructive testing of slab and inspection of steel strand

d. Have not been able to locate calculations or testing in records

e. Analysis has not yet been performed

Bus Mall Site Observation

a. Concrete slab shortened 3” in north/south direction
b. Crack gauges installed
c. Water penetration through basement walls
d. Analysis has not yet been performed

Bus Mall Site Observation

Bus Mall Observation

- Observations include:
  - Cracking of the foundation wall
  - Cracking of non-structural members
  - Cracks at columns with significant damage due to water infiltration

TYPICAL MOVEMENT OF THE INTERIOR PARTITION

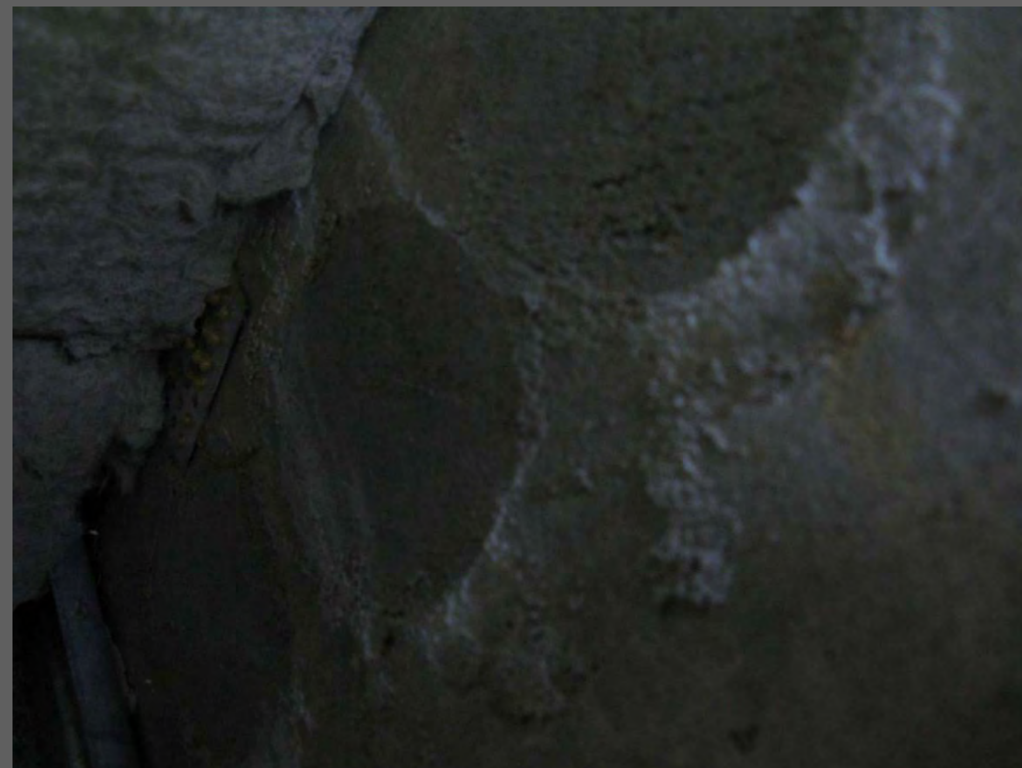
Typical movement of the interior partition walls in the east-west direction throughout the building indicating the settlement of the PT slab. Typically, the movement was measured to be around 5/8", but some measured greater than 1".

FASCIA CONNECTION AND GROUT POCKET

Surface corrosion of the fascia connection as discussed during the meeting. It appears to be an insignificant issue, but does call out the lack of a rust-inhibiting primer coat being applied to the structural connection. In addition, there is a grout pocket to the lower left that appears to be in very good condition with no visual signs of moisture penetration or corrosion of the PT connection.

THREE GROUT POCKETS ALONG THE NORTH SLAB EDGE

Slab edge along the north building edge and these are part of the banded PT group along Gridline L, which appears to be in very good condition with no visual signs of moisture penetration or corrosion of the PT connection.



WOOD CHIPS CAST INTO CONCRETE COLUMN

Poor construction methods were used during the construction of the slab; as a full layer of debris was allowed to be cast into the concrete column at Grid D-13 effectively placing a bond breaker approximately 2’ below the fifth floor slab. The screw driver was easily driven approximately 2” into the concrete column.

WOOD CHIPS CAST INTO CONCRETE SLAB

Another indication that poor construction methods were used during the construction of the slab; another pocket of wood debris was cast into the concrete slab approximately at Grid L-10 near the slab edge. The wood debris pocket appears to be approximately 3” in diameter and 1” deep.

SIGNIFICANT CRACKING IN CONCRETE COLUMN AT GRID A-10

Crack w/spall removed at Grid O-10

Cracking that has occurred at each of the concrete columns at the joint between the building and the bus mall (Grids A-10 and O-10). The spall at Grid O-10 was easily removed exposing the reinforcing steel and corrosion on the reinforcing steel due to water penetration.

GROUT POCKETS ALONG THE BUS MALL SLAB EDGE NEAR GRID F-3

Along the north edge of the bus mall at the expansion joint between the Bus Mall and North Block.

Shows that moisture is flowing through the expansion joint, around the gutter fix and wetting the slab edge, which is causing damage to several of the grout pockets. The grout pocket at the center has spalled and signs of corrosion are visible on the slab edge.

SIGNIFICANT CRACKING IN CONCRETE COLUMN AT GRID M-1

Cracking has occurred at the concrete column at Grid M-1, as well as moisture penetrating through the basement concrete walls and causing damage to the concrete structure.

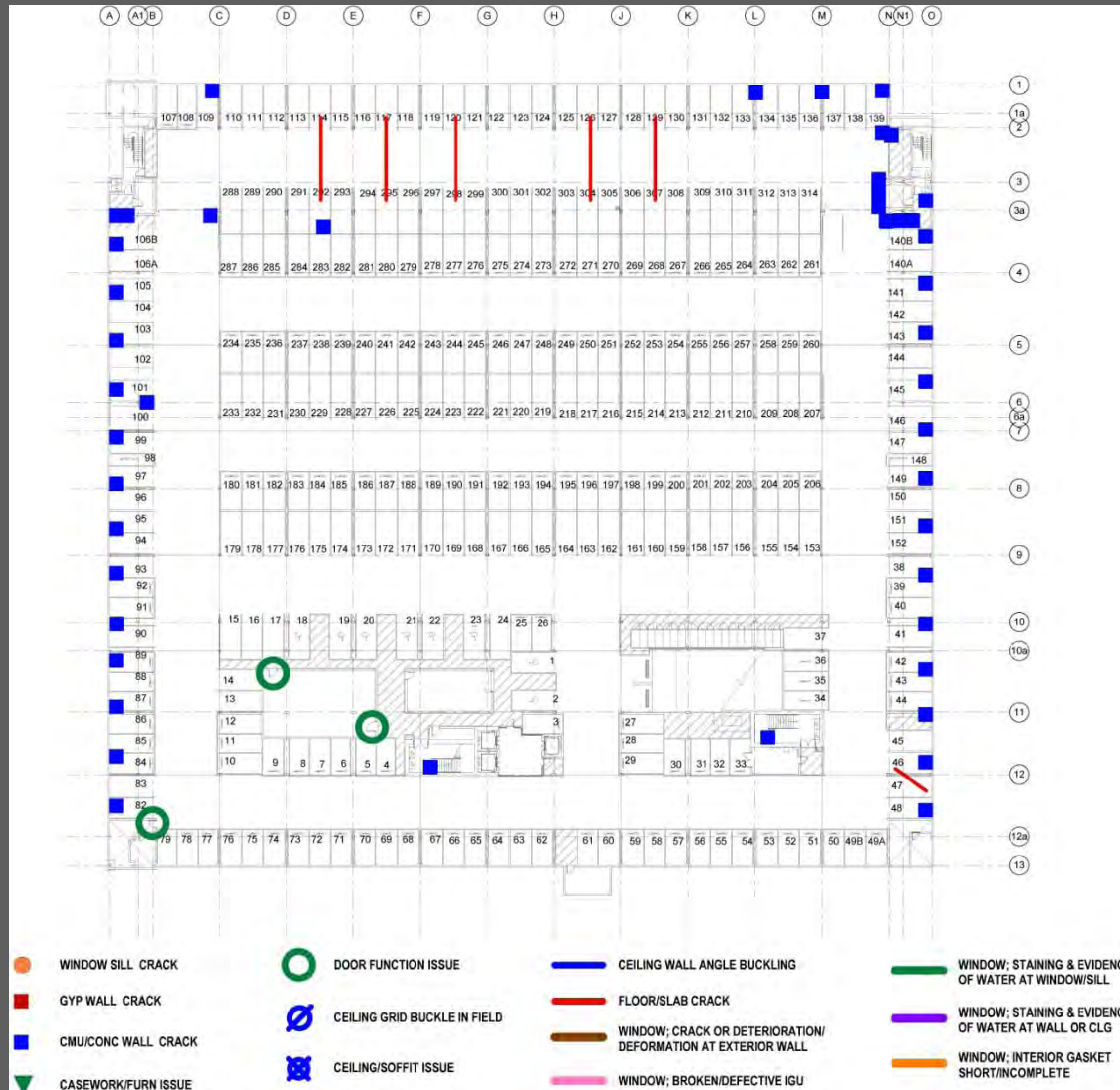
Next Steps . . . . Prognosis

- The Design Team will be analyzing all of the information:
  - Some residual work for the exterior brick and window survey
  - Computer modeling of the testing report results
  - Development and testing of options
  - Cost modeling


Marion County
Courthouse Square Structural Remediation
Project Summary
June 09, 2010
SERA

Mapping of Building Damage

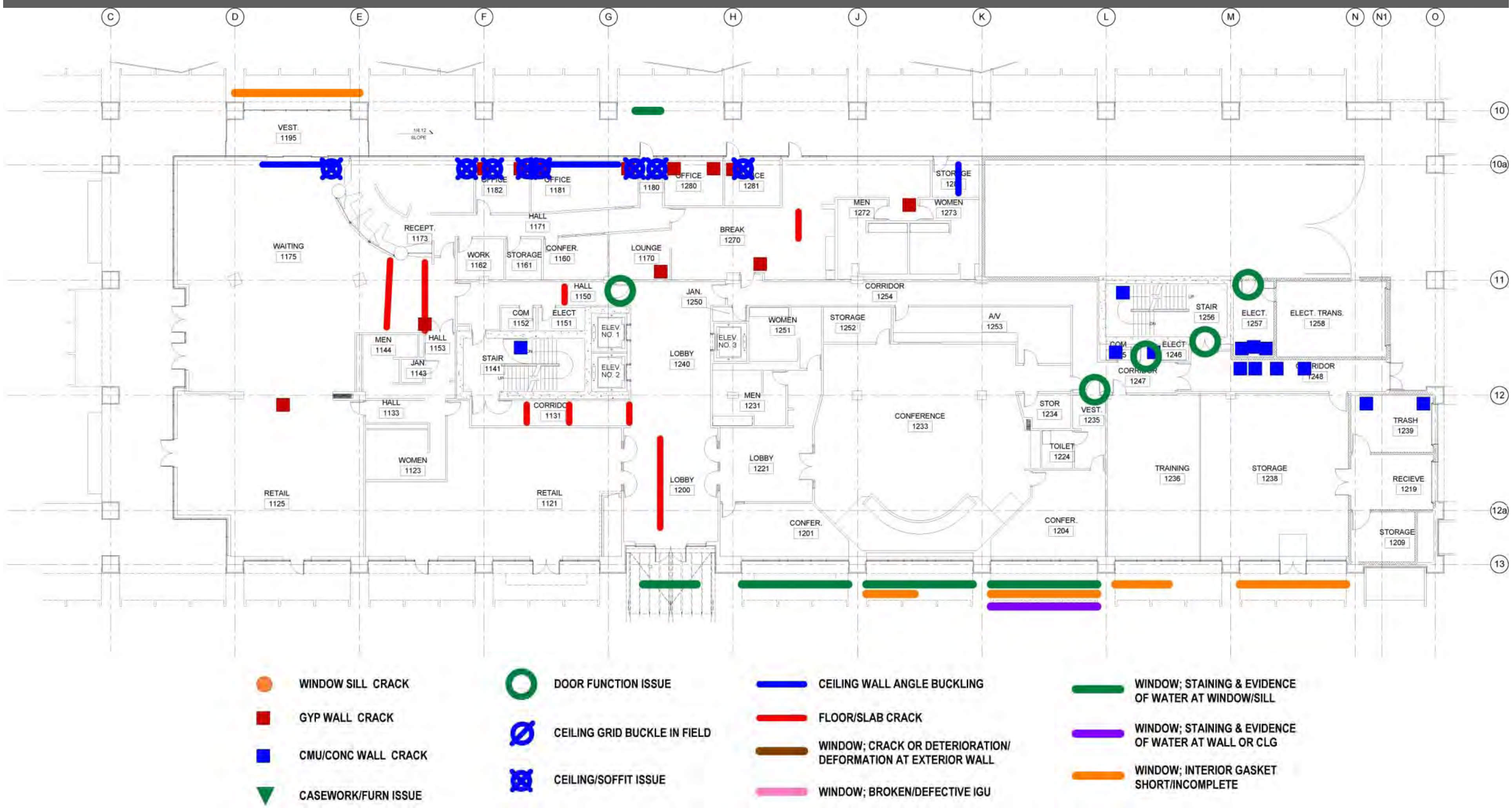
SYMPTOMS



Garage Level

Mapping of Building Damage

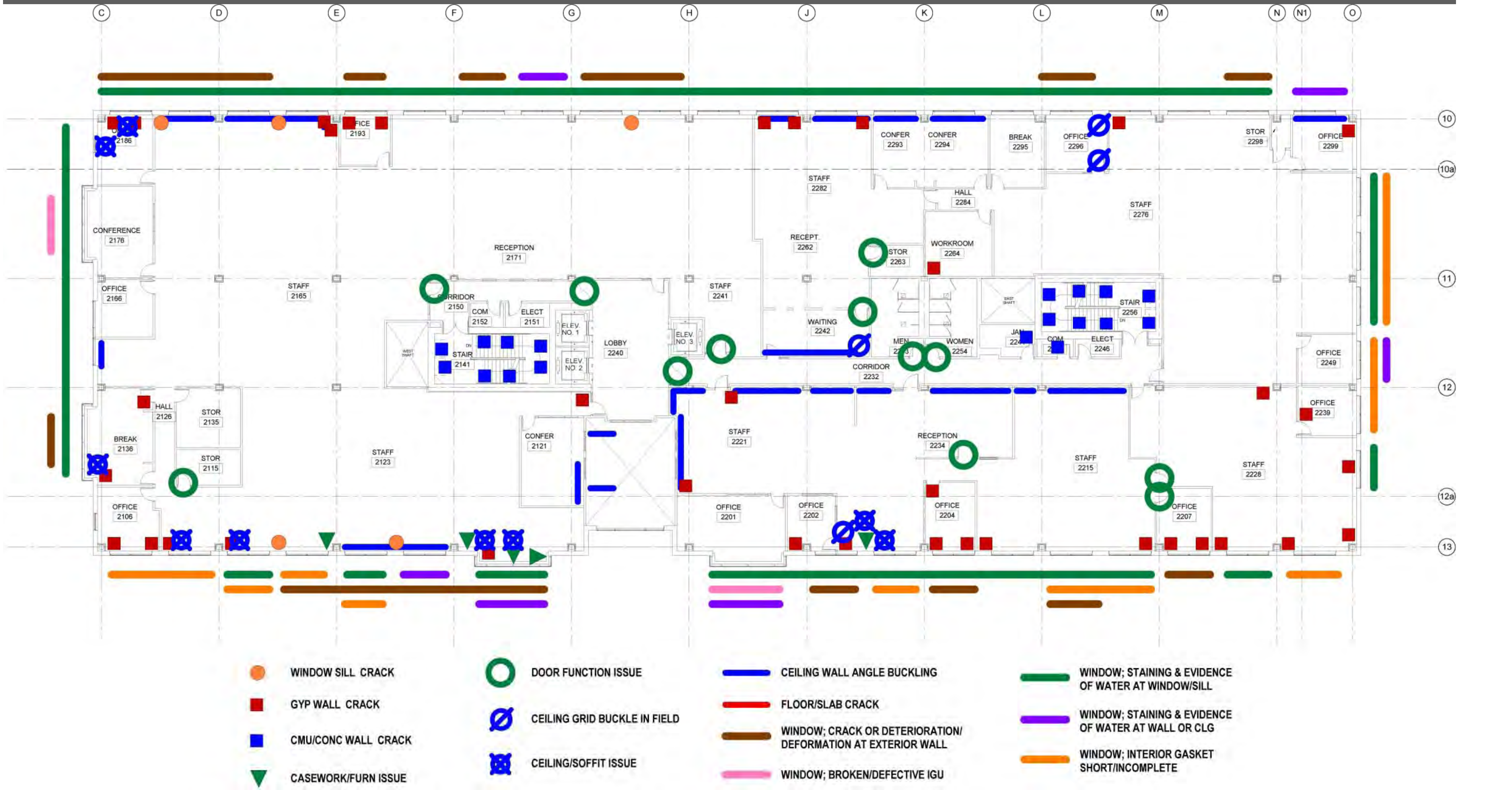
SYMPTOMS



Ground Floor

Mapping of Building Damage

SYMPTOMS

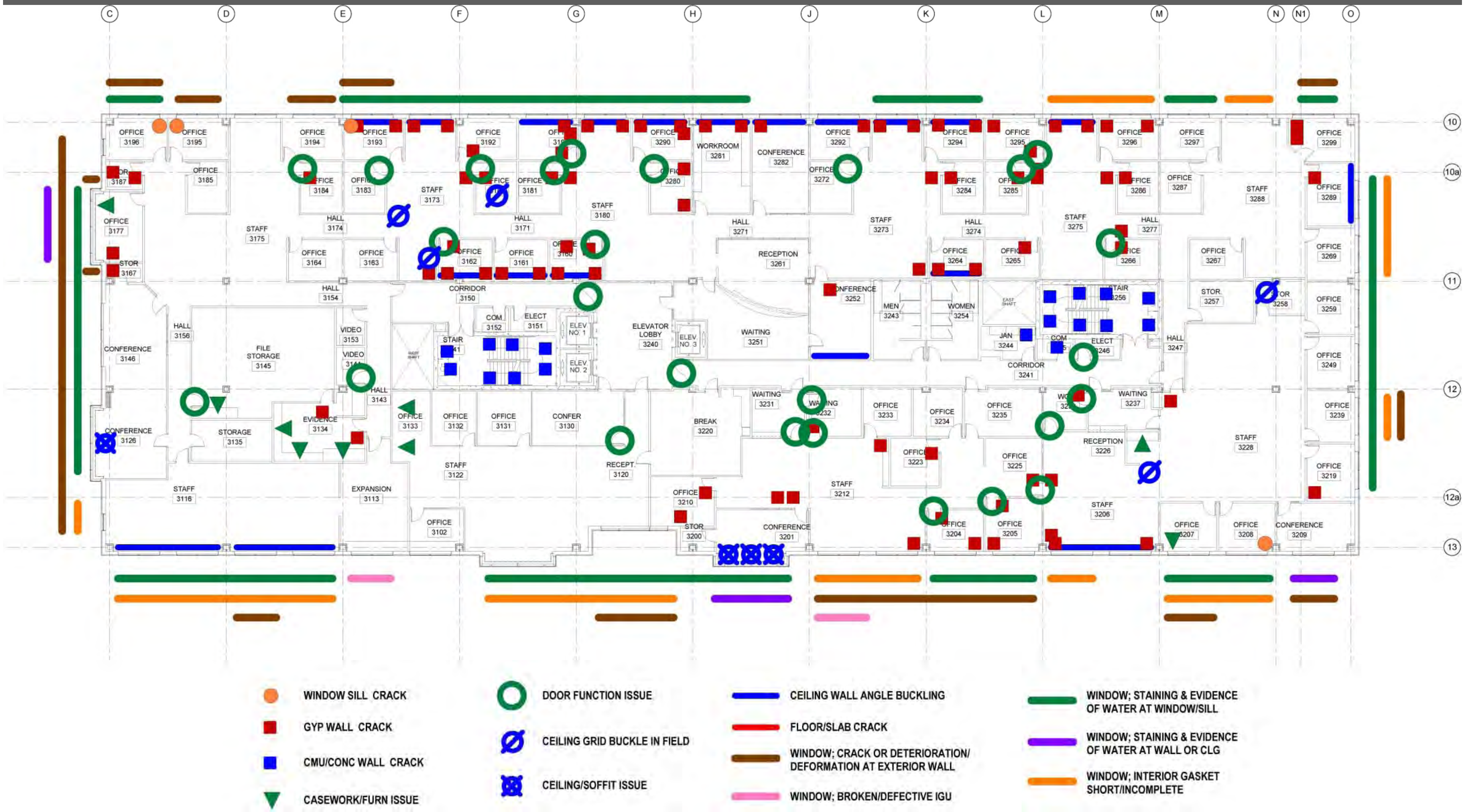


Second Floor

SERA

Mapping of Building Damage

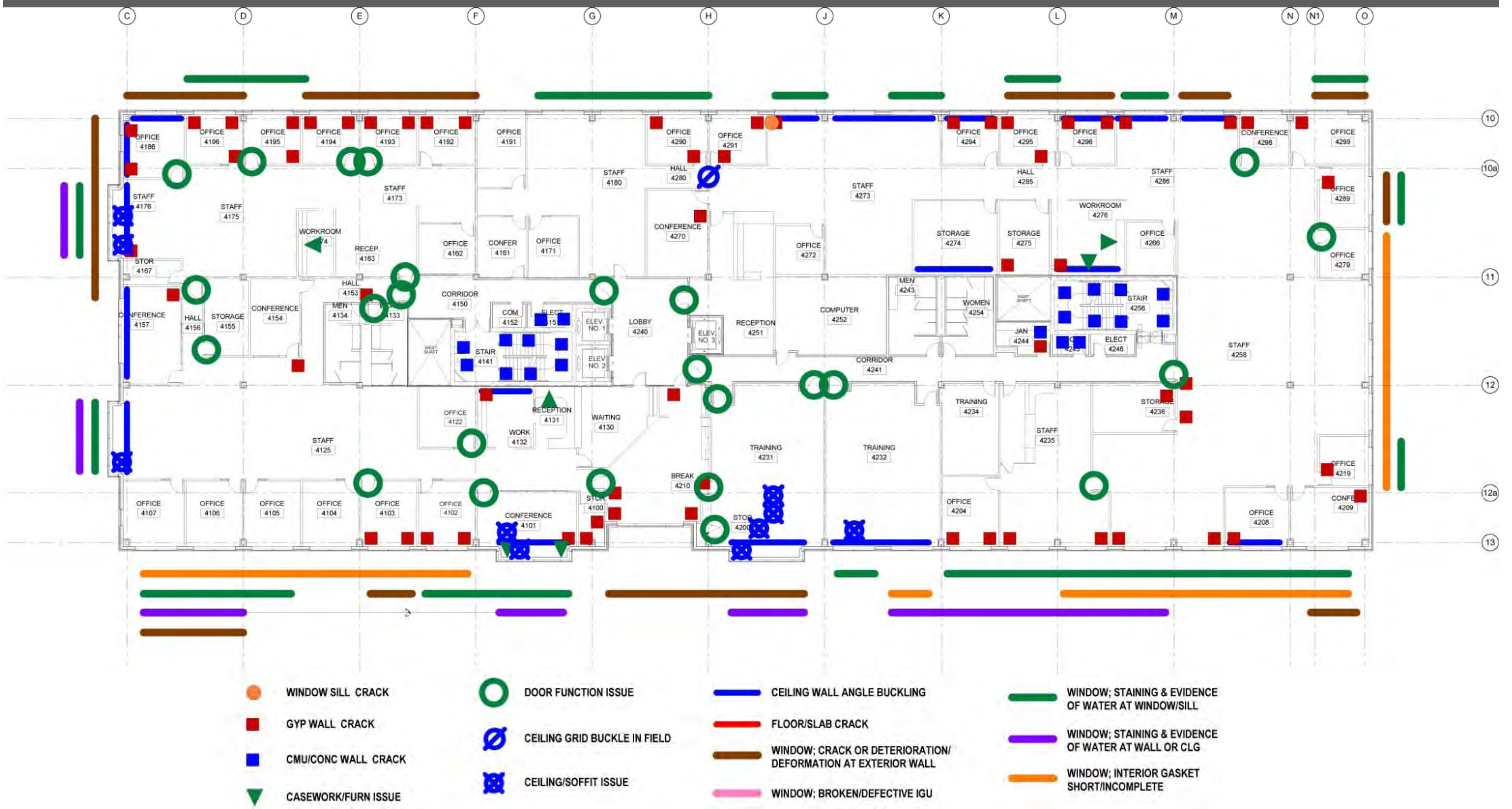
SYMPTOMS



Third Floor

Mapping of Building Damage

SYMPTOMS

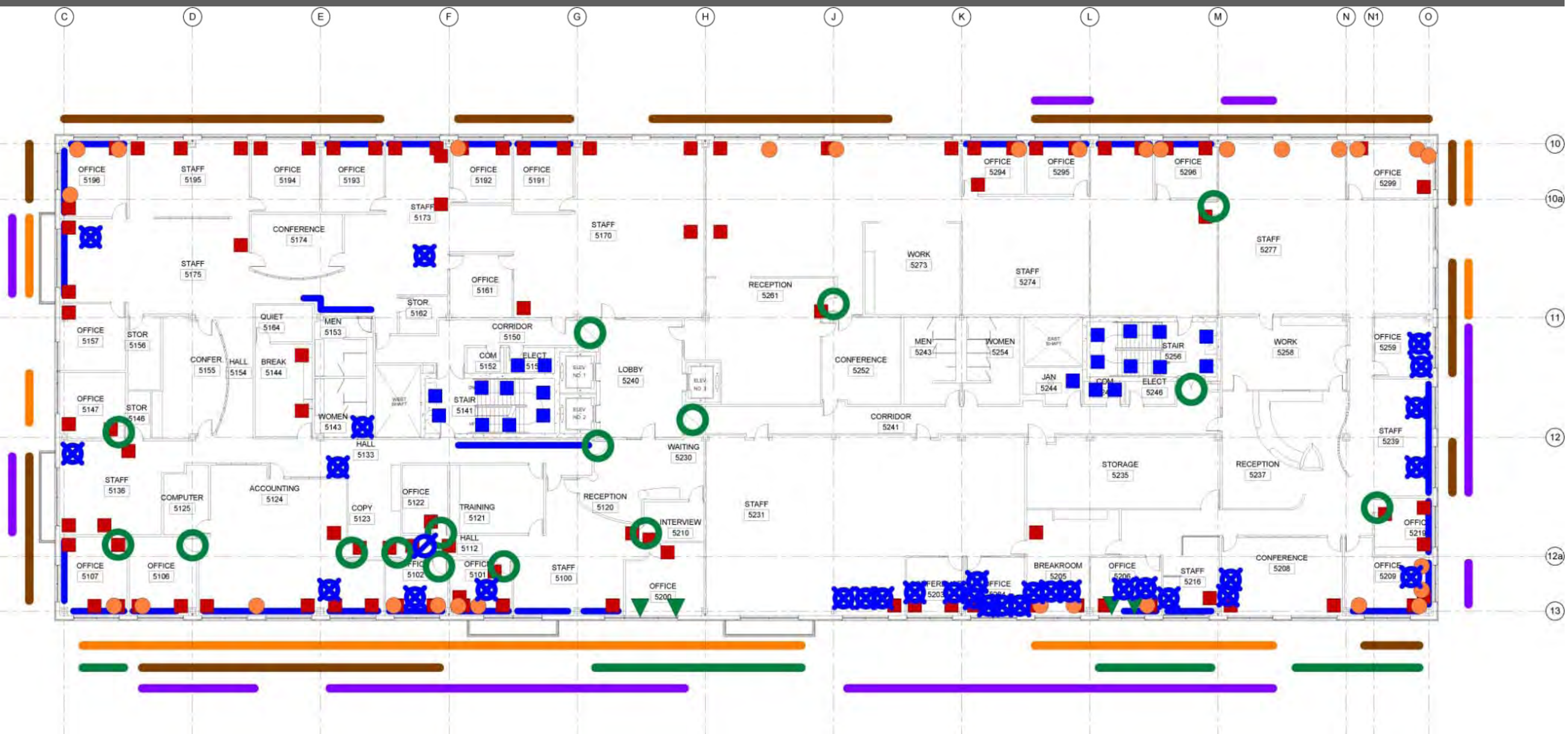


Fourth Floor

SERA

Mapping of Building Damage

SYMPTOMS



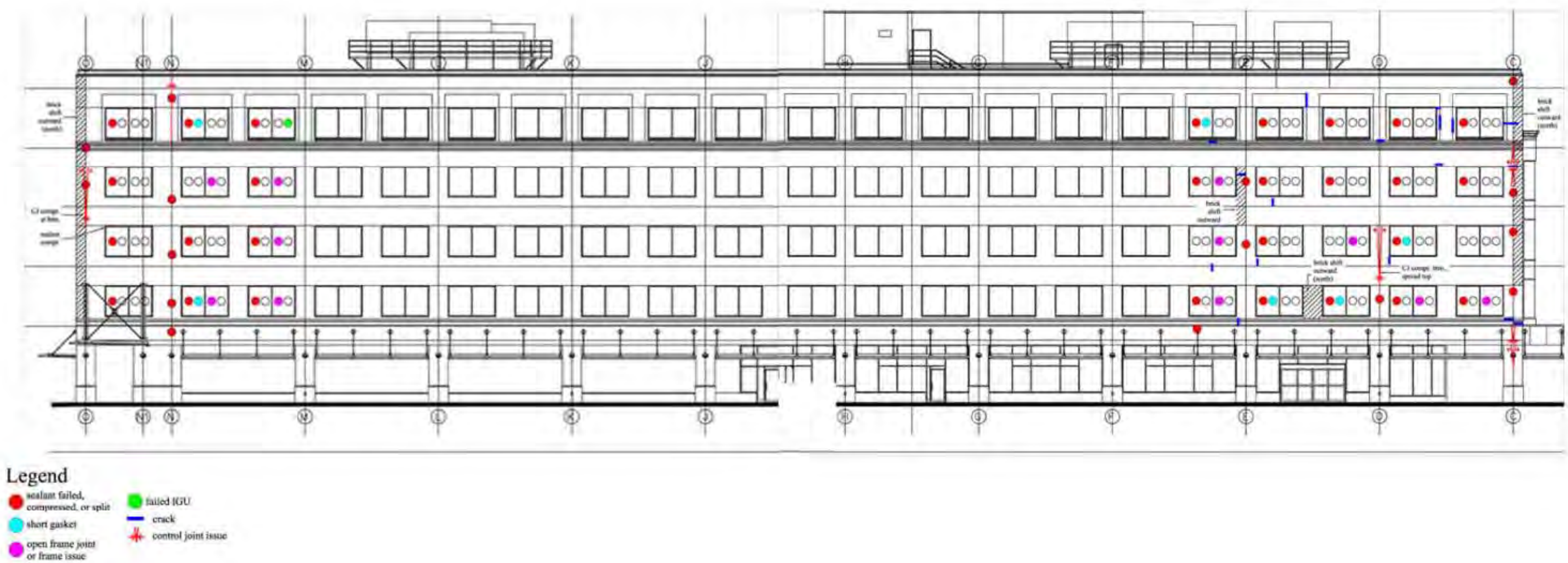
- WINDOW SILL CRACK
- GYP WALL CRACK
- CMU/CONC WALL CRACK
- CASEWORK/FURN ISSUE
- DOOR FUNCTION ISSUE
- CEILING GRID BUCKLE IN FIELD
- CEILING/SOFFIT ISSUE
- CEILING WALL ANGLE BUCKLING
- FLOOR/SLAB CRACK
- WINDOW; CRACK OR DETERIORATION/ DEFORMATION AT EXTERIOR WALL
- WINDOW; BROKEN/DEFECTIVE IGU
- WINDOW; STAINING & EVIDENCE OF WATER AT WINDOW/SILL
- WINDOW; STAINING & EVIDENCE OF WATER AT WALL OR CLG
- WINDOW; INTERIOR GASKET SHORT/INCOMPLETE

Fifth Floor

Mapping of Building Damage

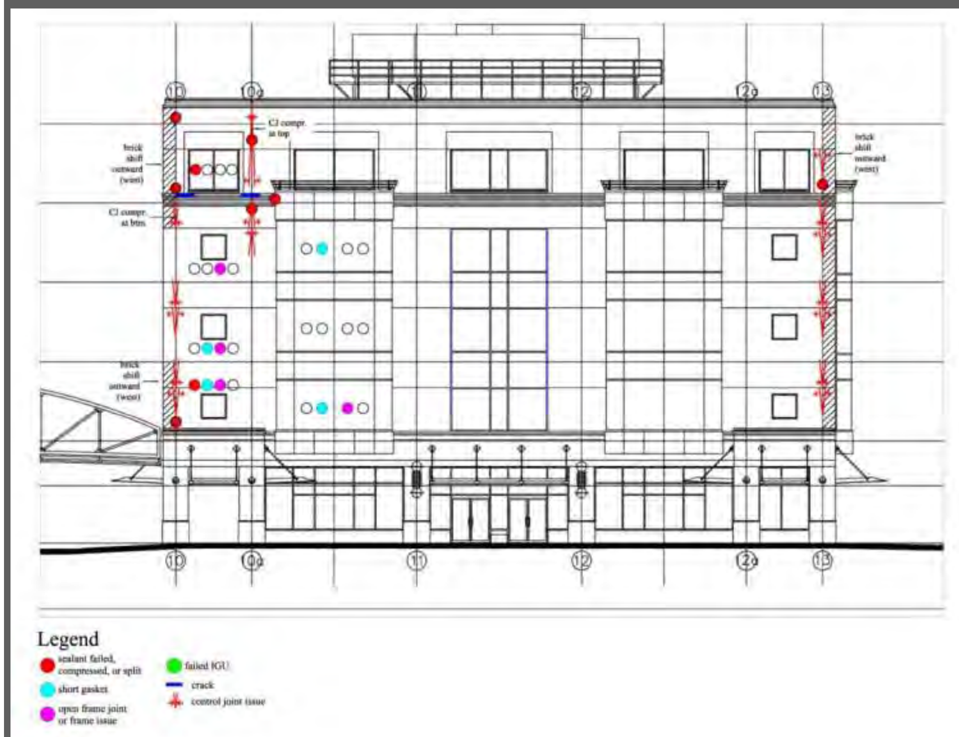
South Elevation

Mapping of Building Damage



North Elevation

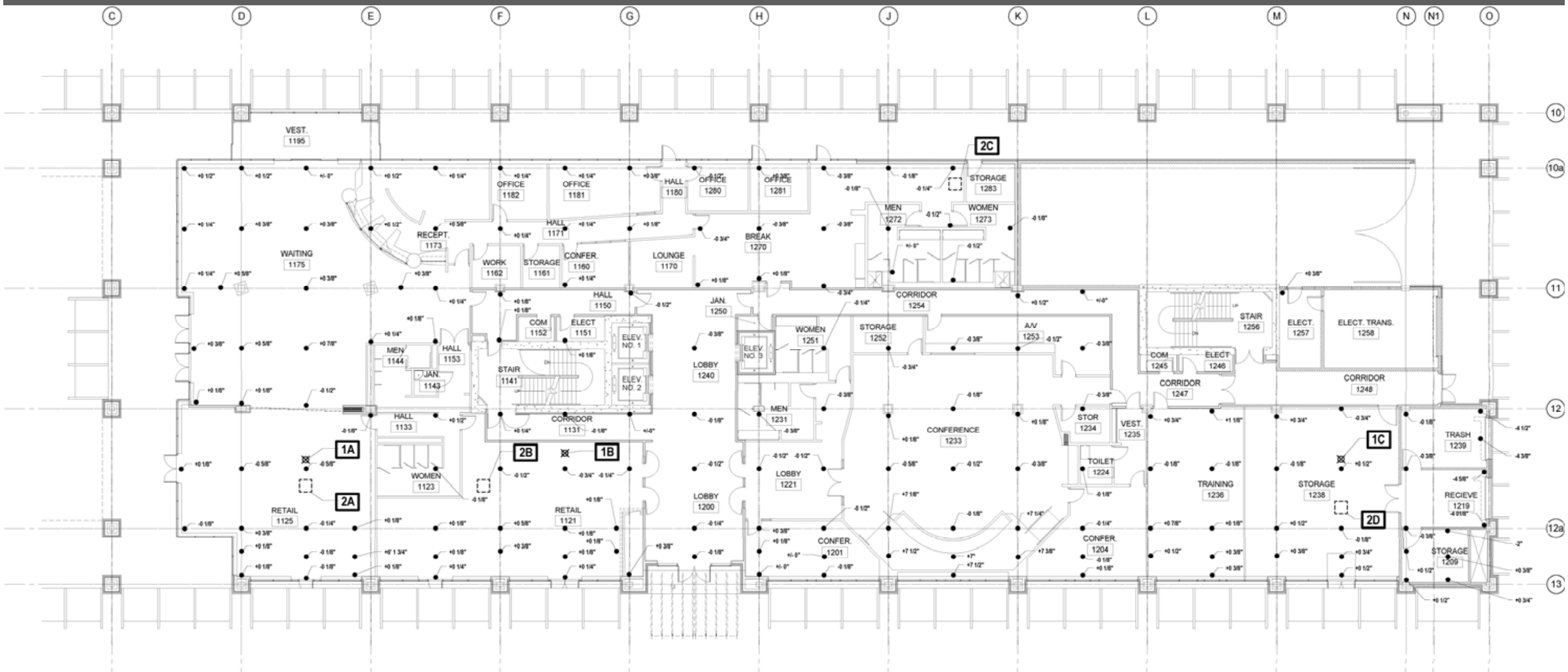
Mapping of Building Damage



West Elevation

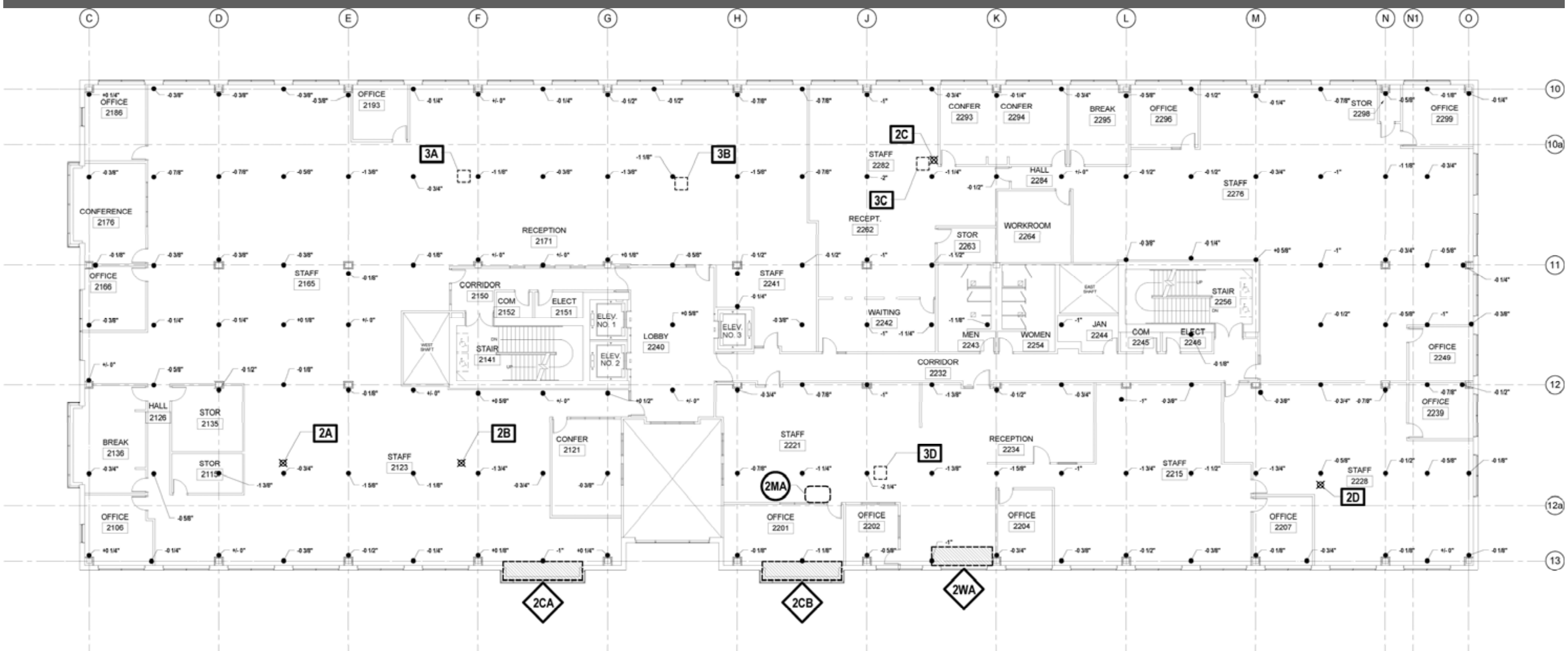
East Elevation

Slab Deflections



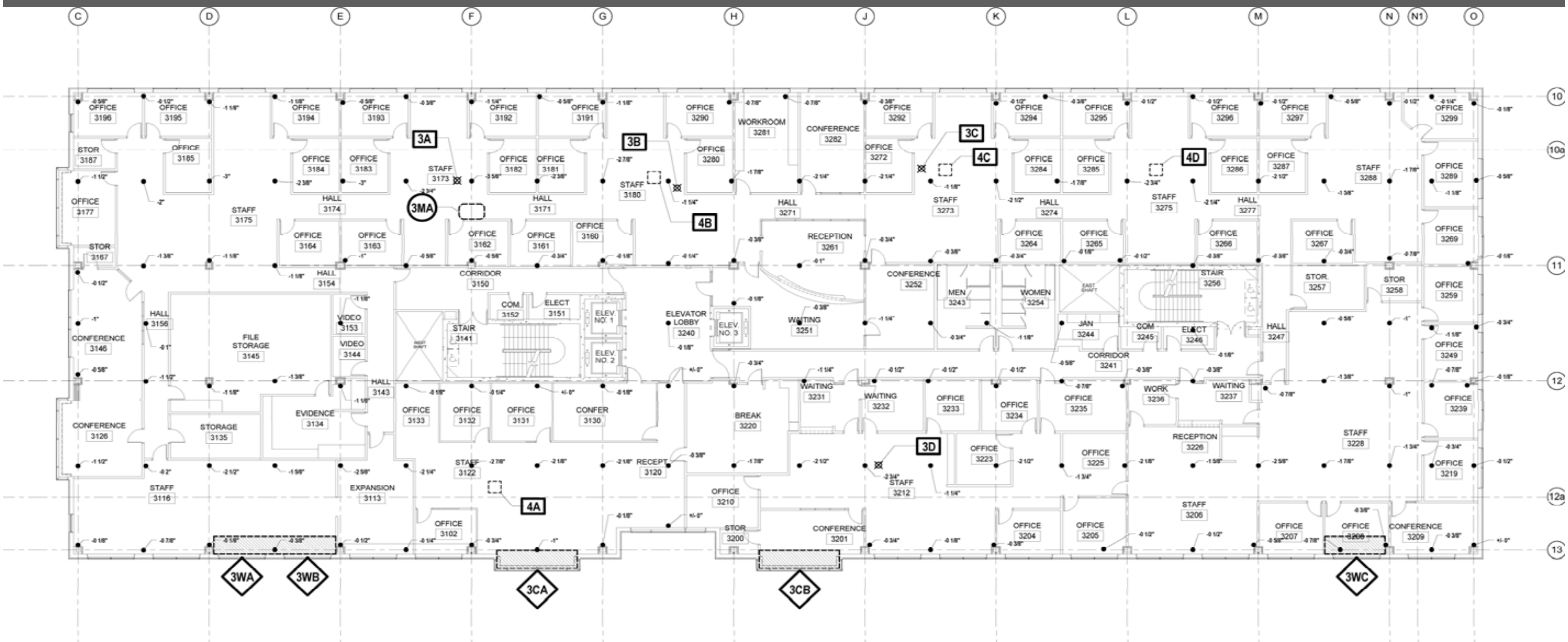
Ground Floor

Slab Deflections



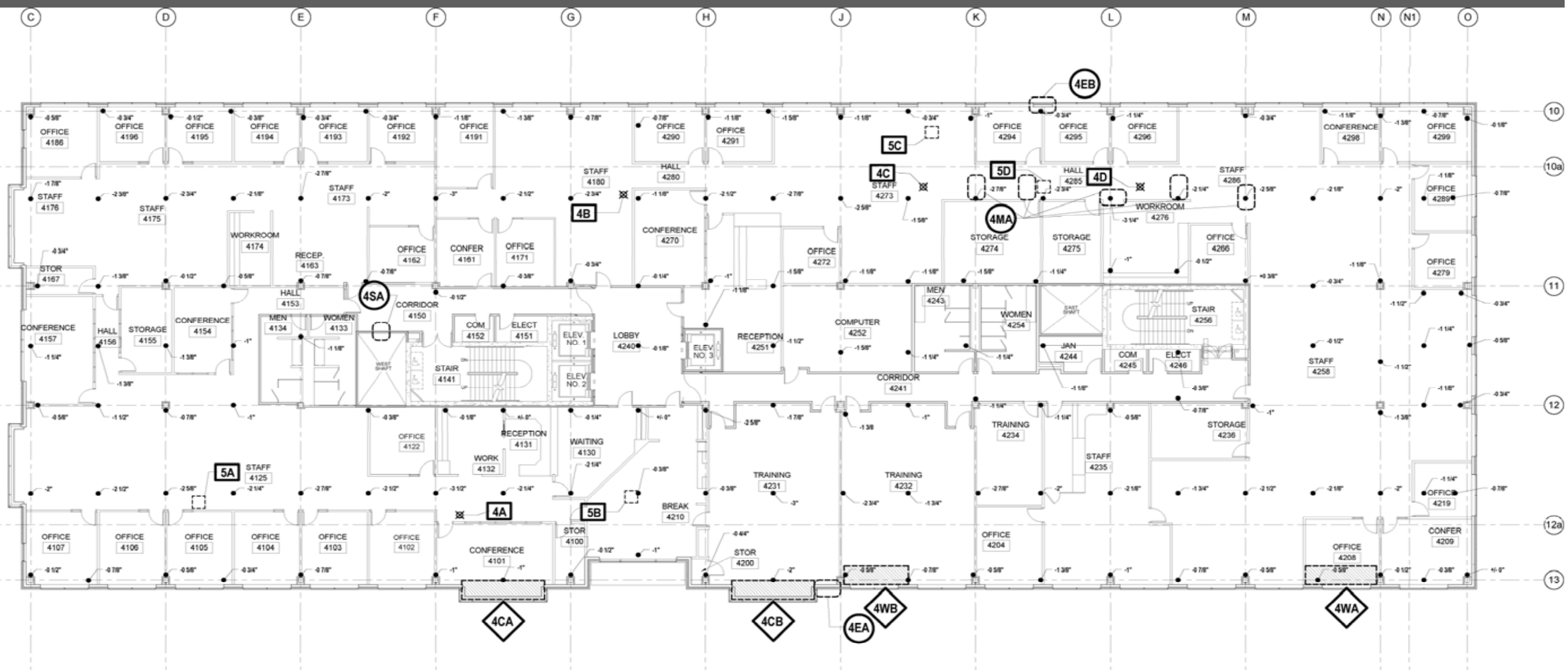
Second Floor

Slab Deflections



Third Floor

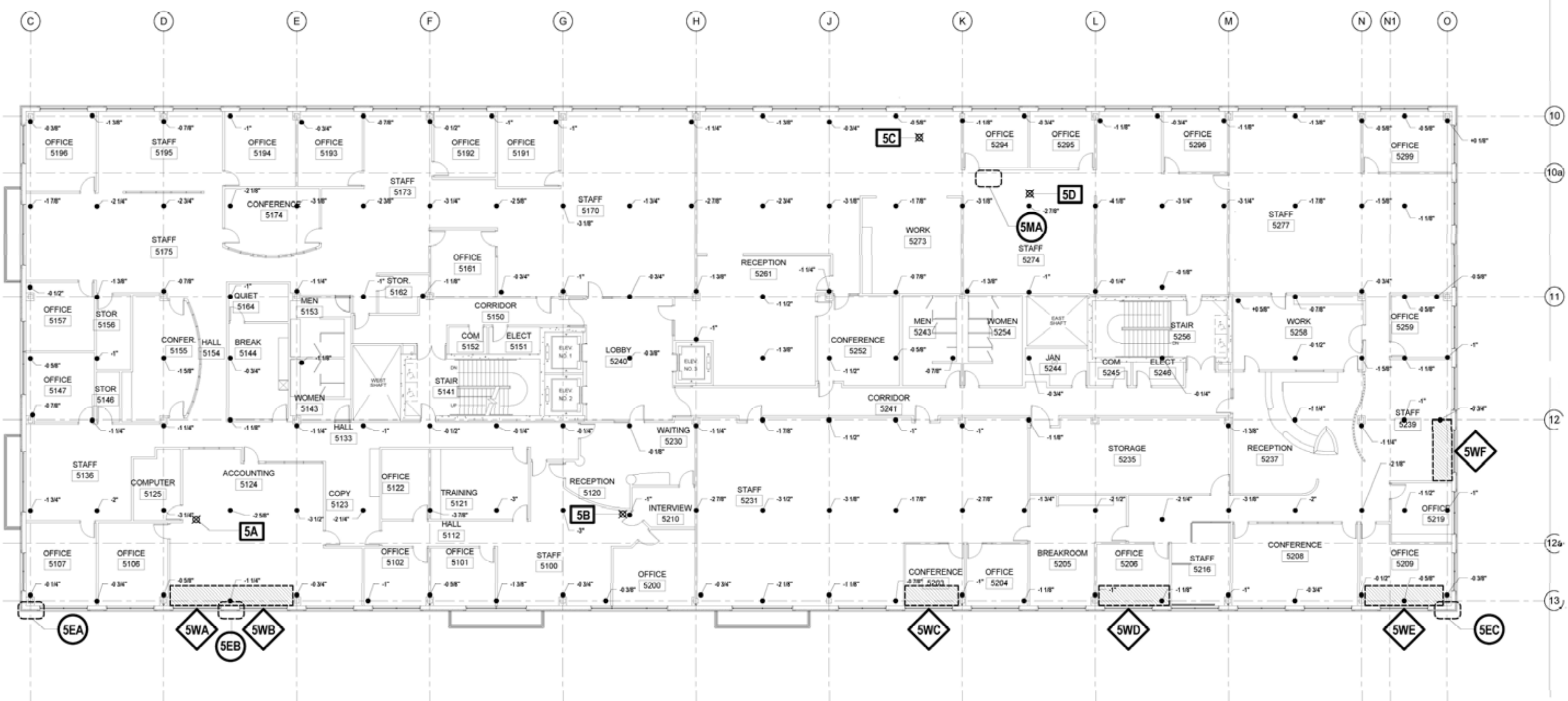
Slab Deflections



Fourth Floor

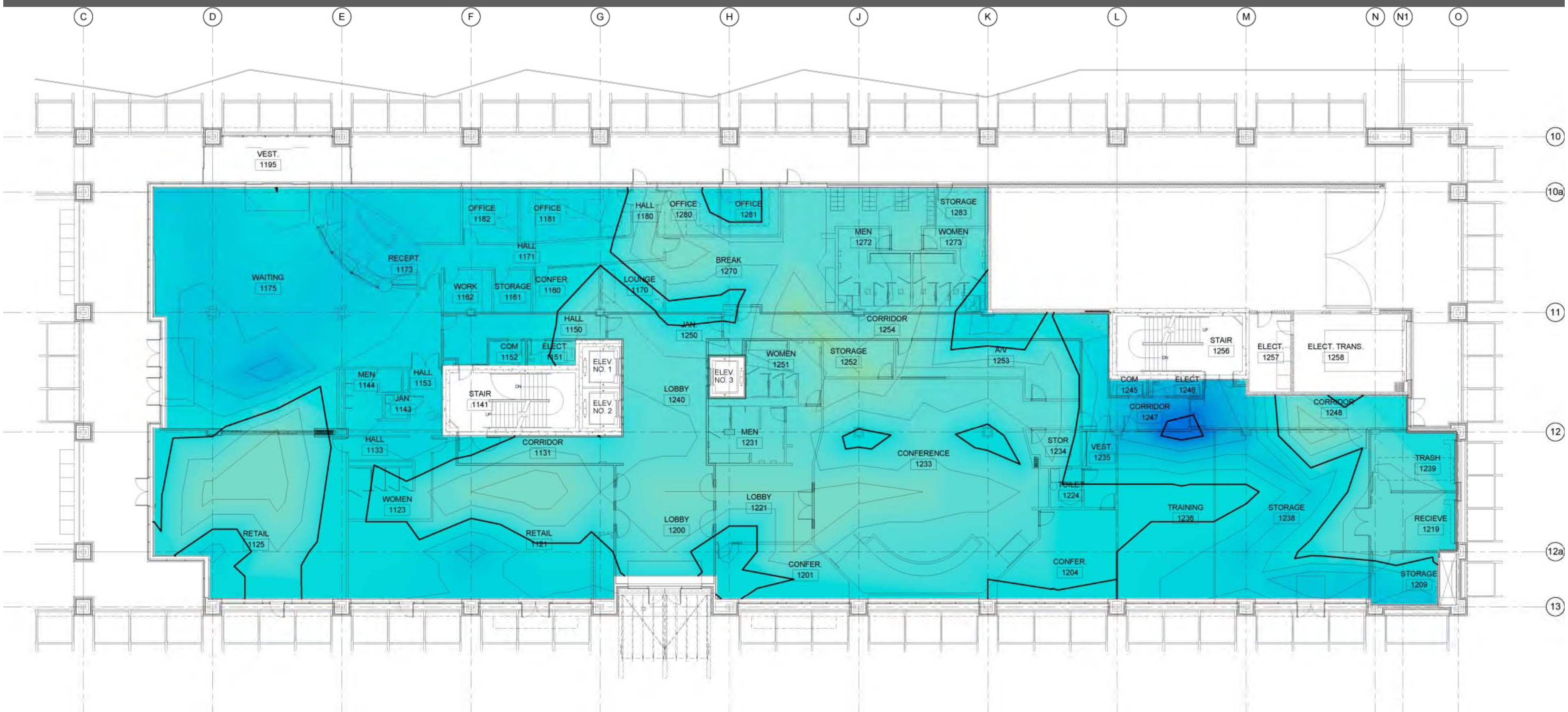
SERA

Slab Deflections



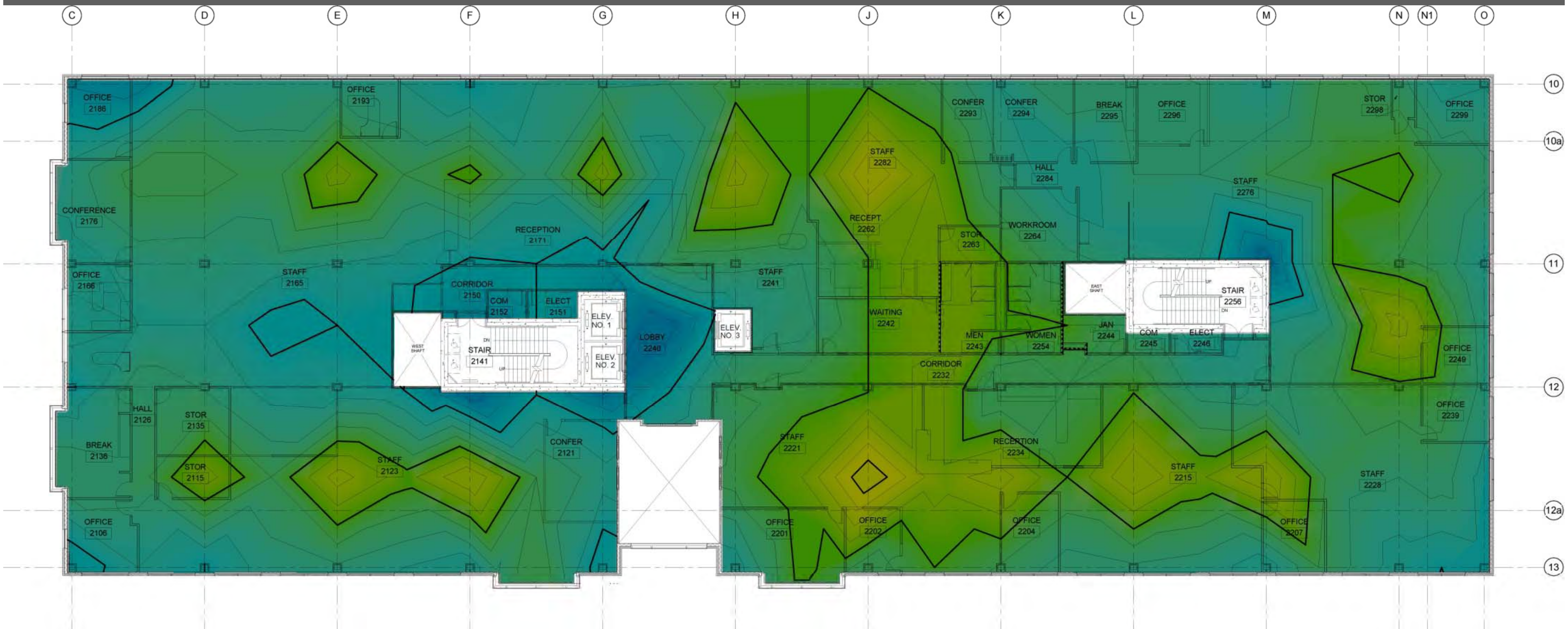
Fifth Floor

Slab Deflections



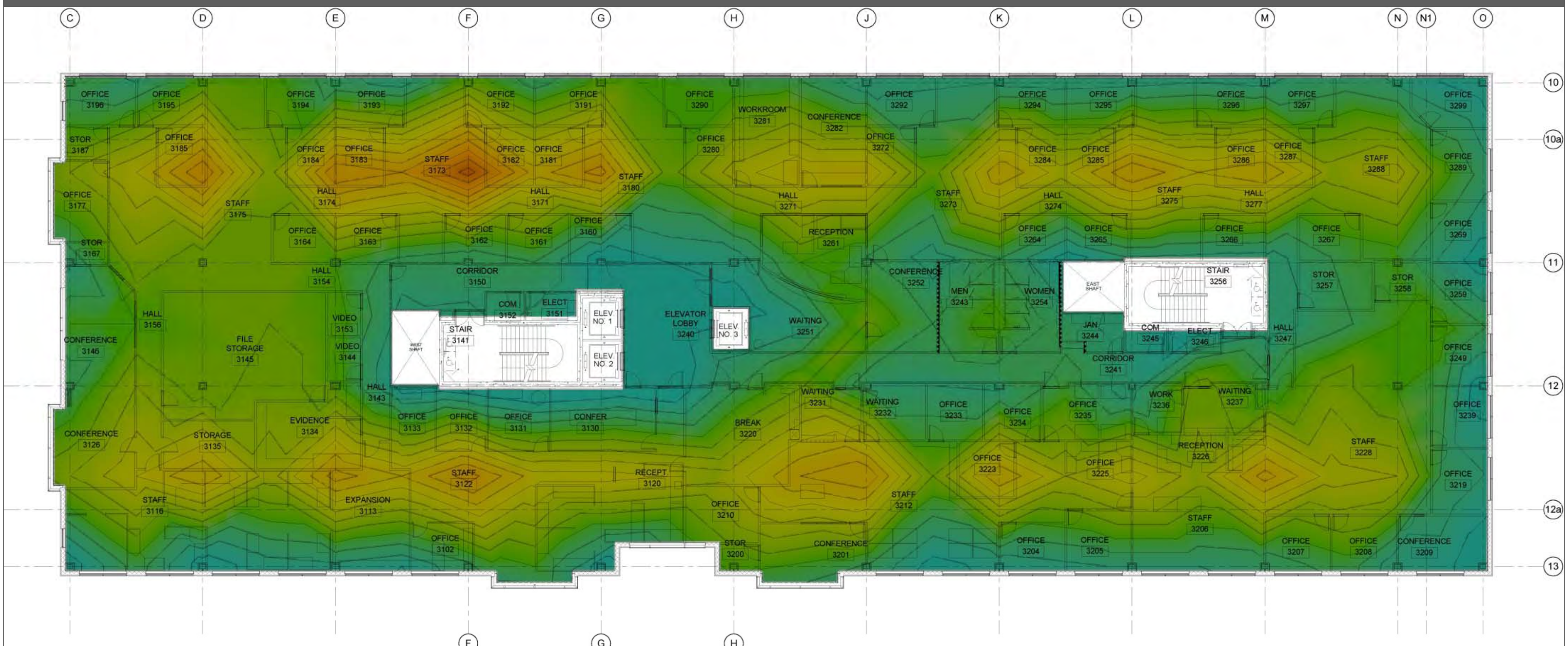
Ground Floor

Slab Deflections



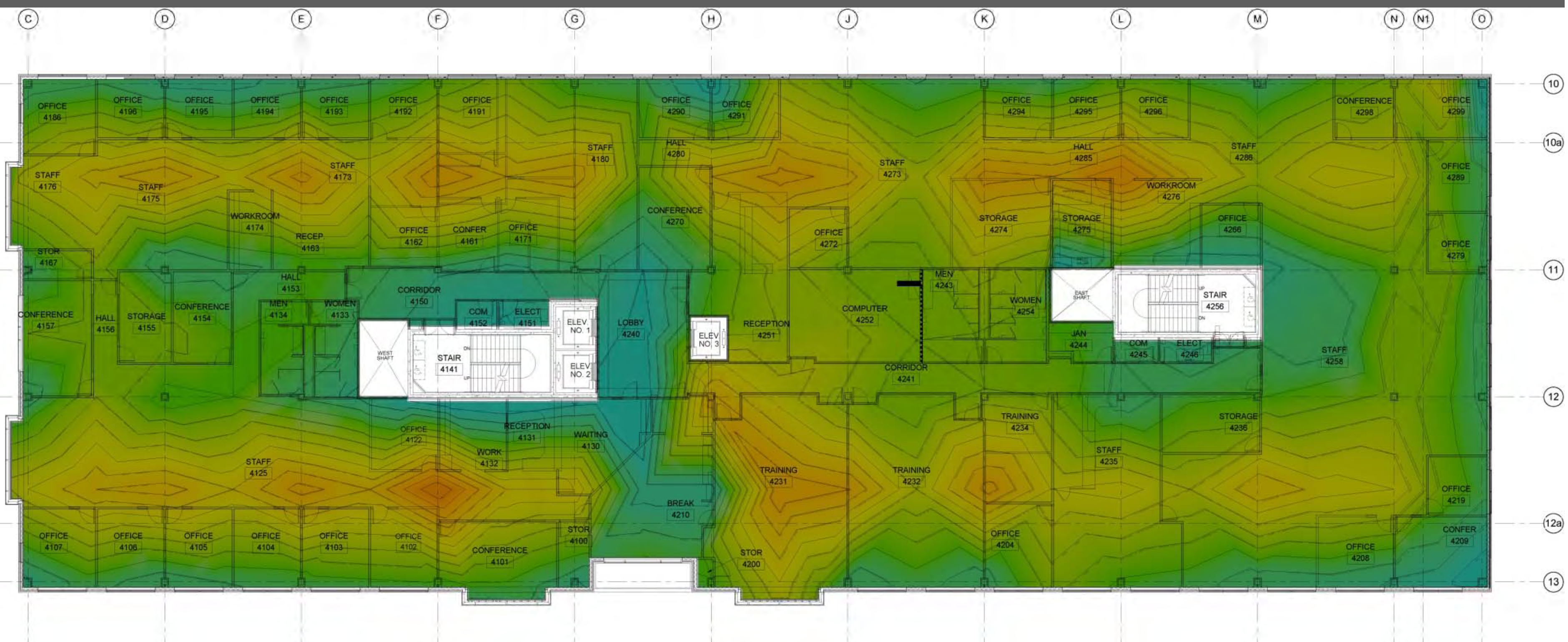
Second Floor

Slab Deflections



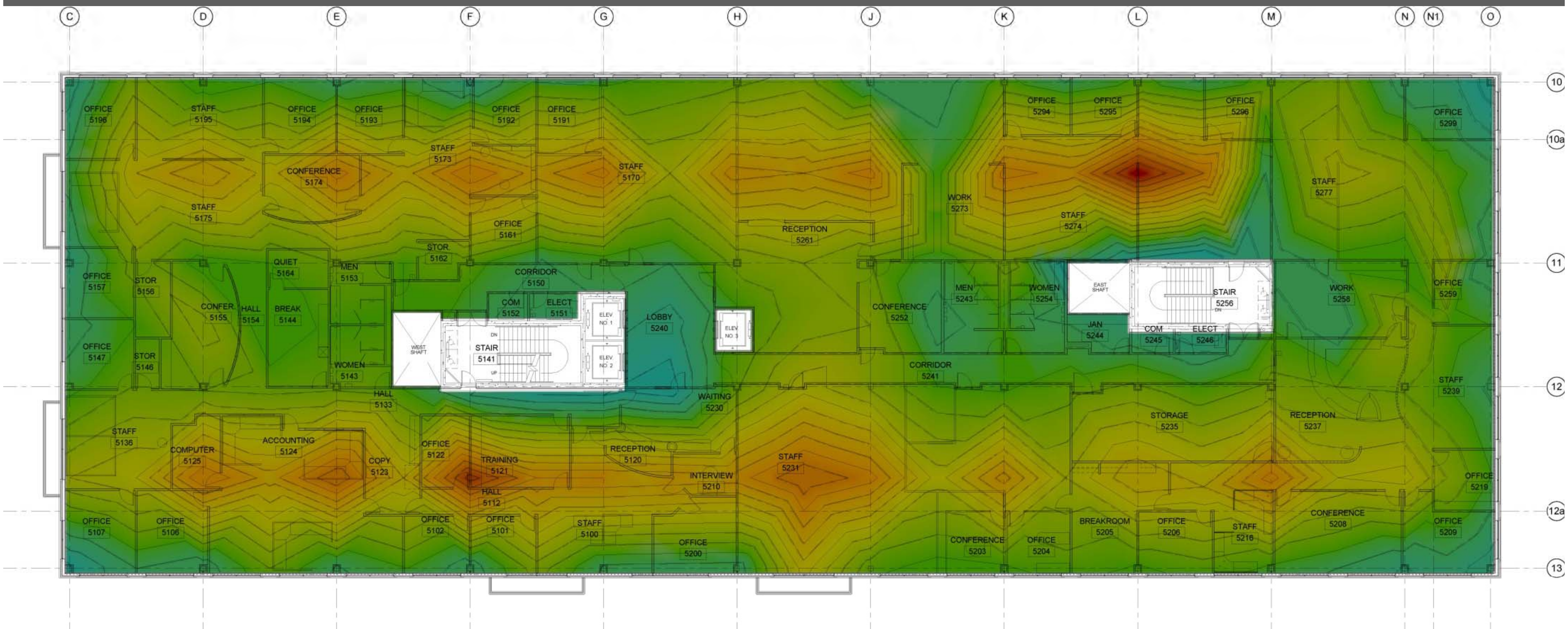
Third Floor

Slab Deflections



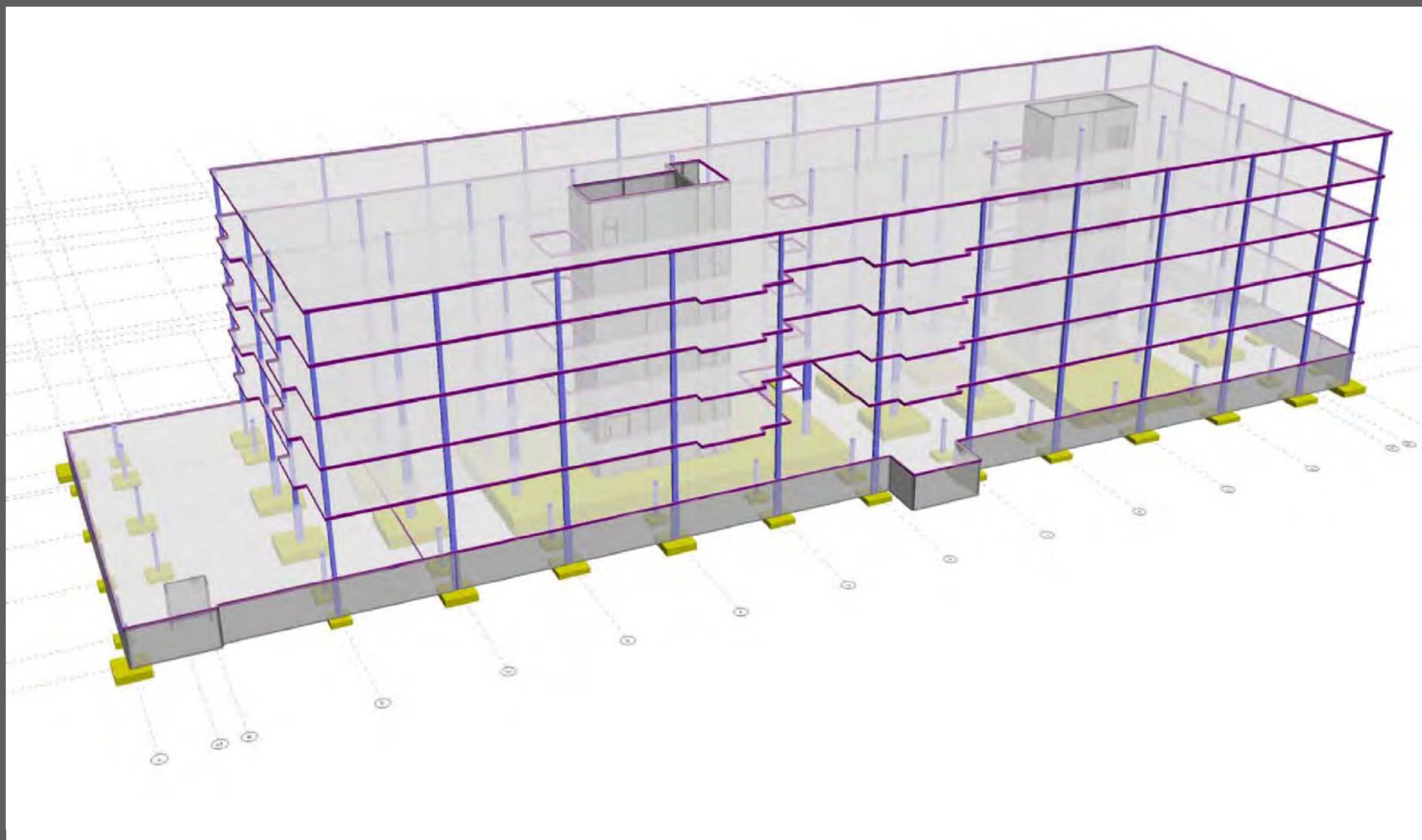
Fourth Floor

Slab Deflections

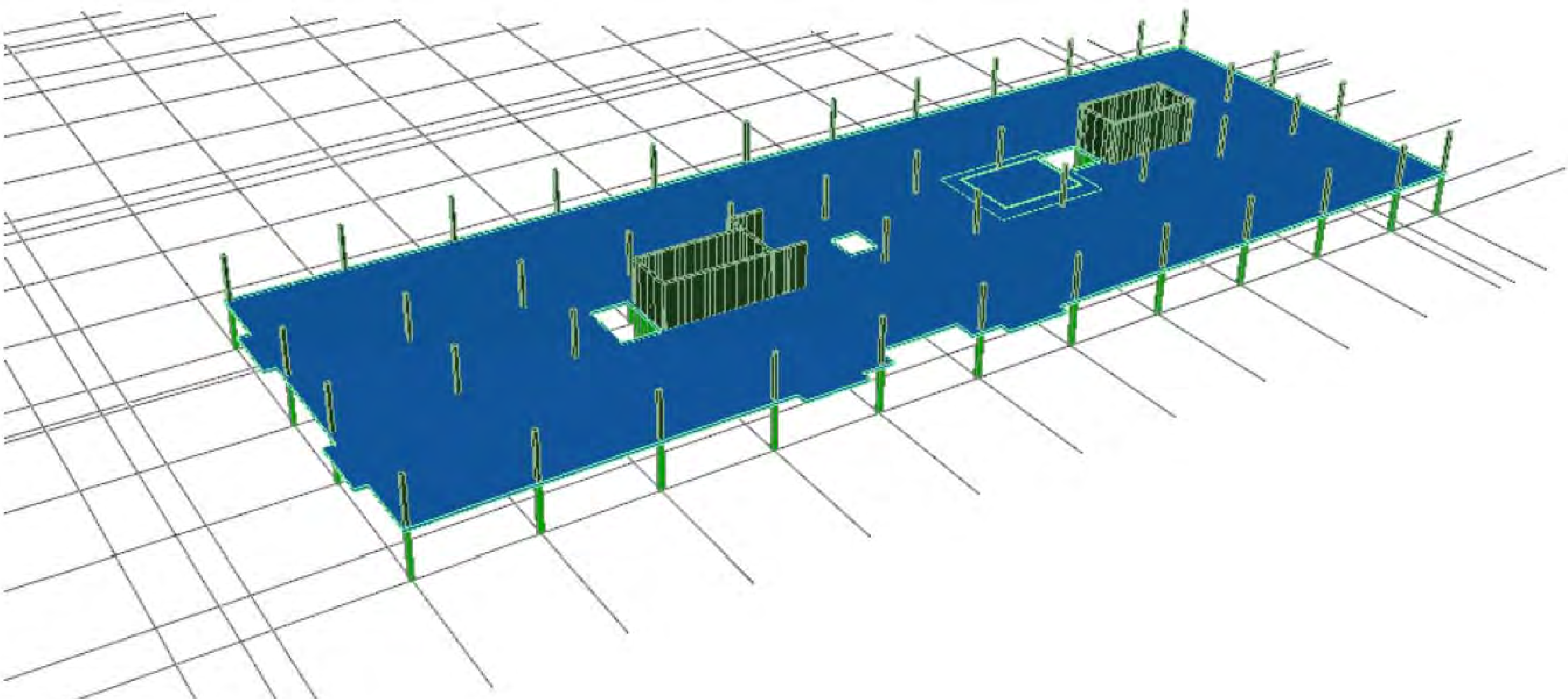


Fifth Floor

Structural Model



Slab Summary



Next Steps . . . . Prognosis

- The Design Team will be analyzing all of the information:
    - Some residual work for the exterior brick and window survey
    - Computer modeling of the testing report results
    - Development and testing of options
    - Cost modeling

Marion County Courthouse Square
Structural Remediation Project Summary

July 26, 2010

Marion County OREGON

Cherriots SALEM-KEIZER TRANSIT

SERA

TEAM MEMBERS

MARION COUNTY
Building Owner, Client

- Dave Henderson- Director, Business Services
- Tom Hogstad, Facilities Manager
- Gary Hales, Loss Control Manager
- Steve Frank, Maintenance Supervisor

SALEM KEIZER TRANSIT DISTRICT
Building Owner, Client

- Andrew Cooper, Safety and Loss Control Specialist
- Trent McCoy, Facilities Maintenance Supervisor

SERA ARCHITECT
Project manager and team coordinator
Building assessment
Sustainability Resources
Interior Design

- Joe Pinzone- Principal-in-charge
- George Hager- Project Architect
- Gregg Sanders-Senior Project Manager
- Russ Pitkin- Senior Project Manager
- Brian Cobb- Senior Project Architect
- Carissa Mylin- Interior Designer
- Russell Holzinger- BIM, graphics, support

MILLER CONSULTING ENGINEERS
Structural engineering

- Ray Miller- P.E., S.E. Structural Engineer
- Eric Watson- P.E., S.E. Structural Engineer
- Andrew Leichty- P.E. Structural Engineer

RDH BUILDING SCIENCES
Building envelope and waterproofing

- Ariel Levy, PE- Building Science Specialist
- Eric Lawrence

TEAM MEMBERS

PAE CONSULTING ENGINEERS
Mechanical, Electrical, Plumbing Engineering

- Nick Collins, PE- Mechanical Engineer
- Dennis Bohn, PE- Electrical Engineer

H&A CONSTRUCTION
Cost Modeling, Constructability Review

- Bob Able, Cost Estimator

FORTIS CONSTRUCTION
Construction Manager, General Contractor
Cost Modeling, Constructability Review

- Pete Smith
- Andy Franklin
- Tom Sowa

GEODESIGN
Geotechnical engineering

- George Saunders, PE, GE
- Scott McDevitt, PE

DAVID EVANS & ASSOCIATES
Building Survey

- Jon Broadwater, PLS

CARLSON TESTING, Inc.
Material Testing

- Mark Powlison, Special Project Department Manager

PRESENTATION OUTLINE

WHAT HAVE WE DISCOVERED TO DATE?

- Building Overview
- Basic Concepts
- Observations

WHAT HAS CHANGED?

- Bus Mall Structure
  - Action Plan and immediate Action
- Building Structure
  - Action Plan and Immediate Action
- Bus Mall Pavers

WHAT ARE THE NEXT STEPS?

- Impact to Agencies
- Current Work
- Next Steps

HOW INFORMATION IS PRESENTED

The flow of this presentation. . . .

Concepts: The underlying principles of basic structural systems used and deficiencies observed

Observations: The damage we mainly see is caused by some other issue.
We observed almost all of the spaces and surfaces to document defects.

Testing: We investigated key areas to determine the fundamental cause.
We opened and revealed specific areas to learn more.

Summary: Results, recommendations, and next steps.

MILESTONES & KEY EVENTS

Project kickoff meeting	March 10, 2010
Process definition and development	March 11 through April 09
On-site observation	April 14 through 21
Geotechnical soil borings	April 12 through May 15
Full building survey	April 15 through May 02
Exterior brick and window survey	May 06 through 08
Sidewalk excavation	May 01, 2010
Material testing	May 05 through June 11
Window water infiltration testing	May 10 through 29

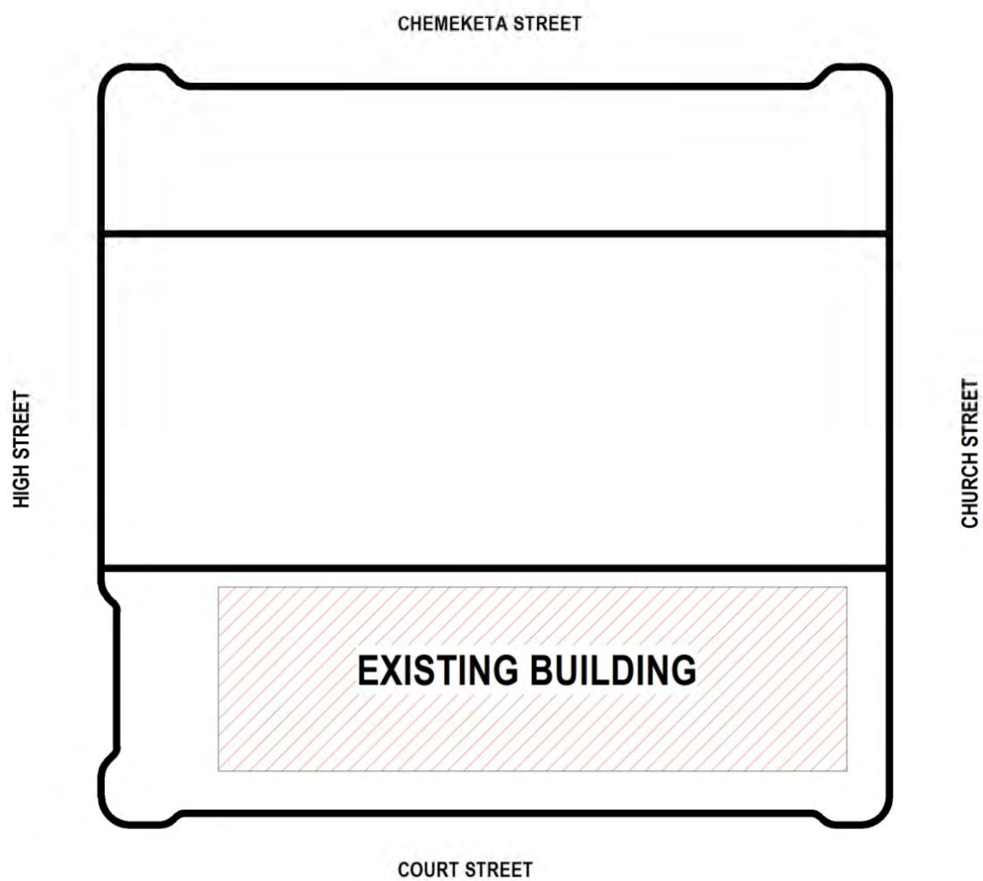
MILESTONES & KEY EVENTS

Project Summary Presentation	June 09, 2010
Analysis of Bus Mall Structure	June 14 through June 28
Remaining exterior brick and window survey	June 26, 2010
On-site observation of Bus Mall	June 30, 2010
Closure and Relocation of Bus Mall	July 02, 2010
Analysis of Building structural system	July 01 through July 16
Implementation of 90-Day Relocation Plan	July 19, 2010
On-site observation of Building columns	July 24, 2010
Remediation Options for entire site	Mid-August through Mid-September 2010
All Building occupants relocated	End of October 2010

WHAT HAVE WE DISCOVERED TO DATE?

- Building overview
- Basic Concepts
- Observations

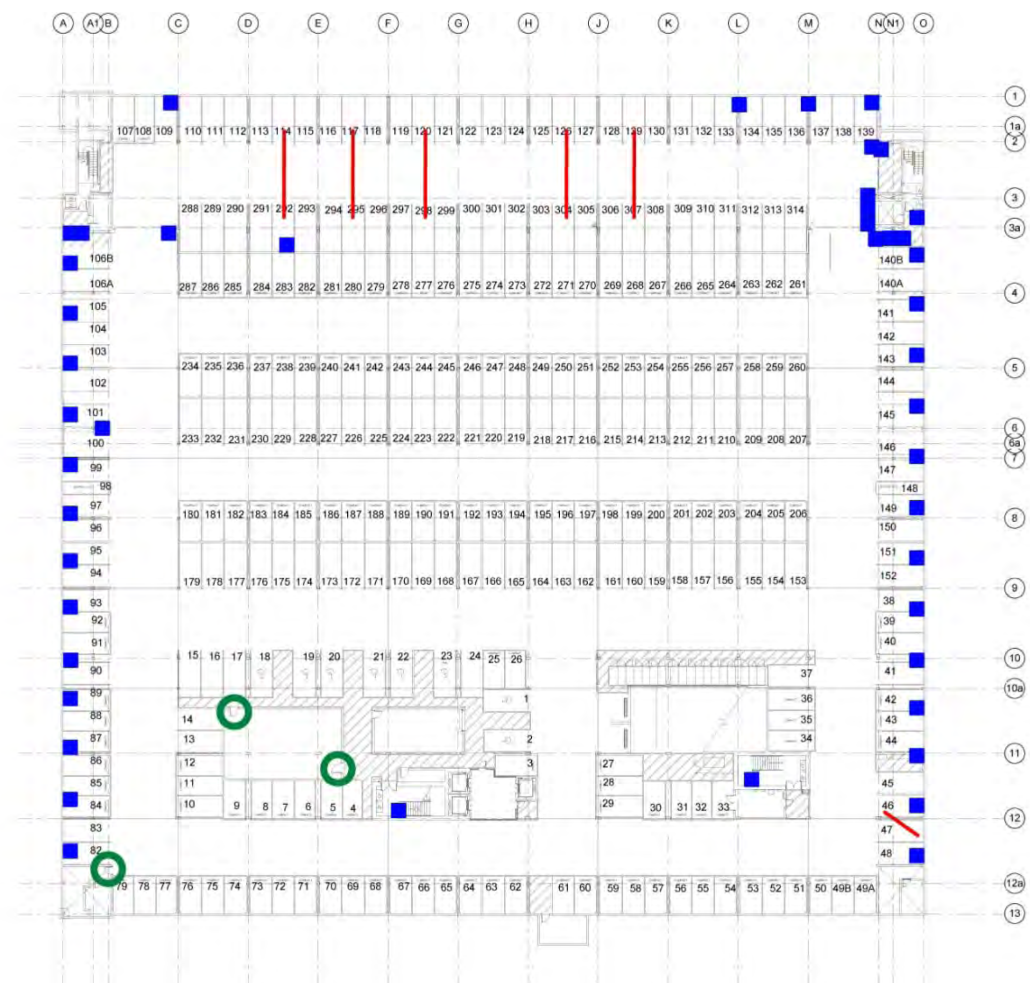
COURTHOUSE SQUARE



- Observe Problems
- Test for Specific Concerns
- Develop Remediation Options

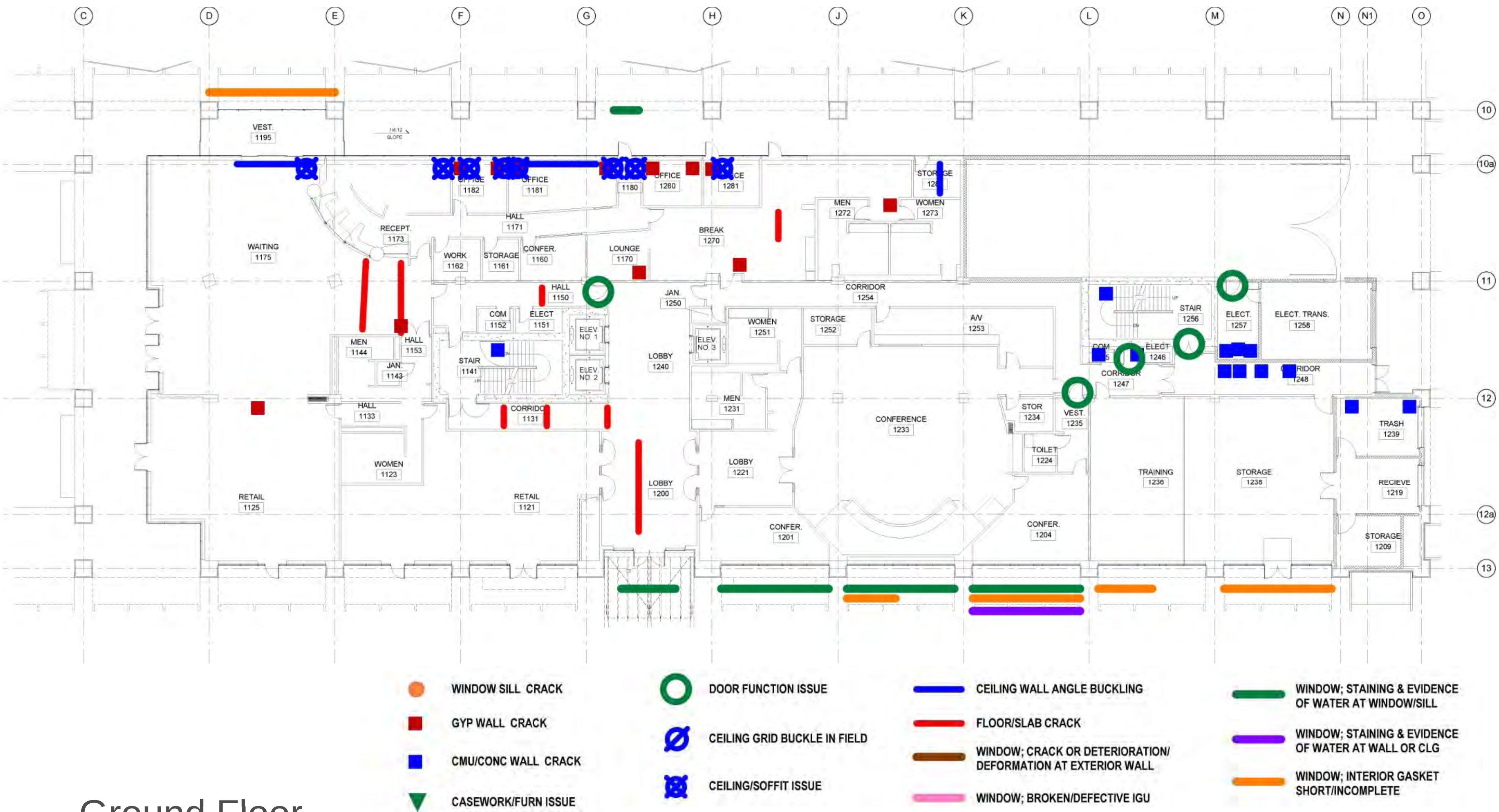
BUILDING OVERVIEW

- WINDOW SILL CRACK
- GYP WALL CRACK
- CMU/CONC WALL CRACK
- CASEWORK/FURN ISSUE
- DOOR FUNCTION ISSUE
- CEILING GRID BUCKLE IN FIELD
- CEILING/SOFFIT ISSUE
- CEILING WALL ANGLE BUCKLING
- FLOOR/SLAB CRACK
- WINDOW; CRACK OR DETERIORATION/ DEFORMATION AT EXTERIOR WALL
- WINDOW; BROKEN/DEFECTIVE IGU
- WINDOW; STAINING & EVIDENCE OF WATER AT WINDOW/SILL
- WINDOW; STAINING & EVIDENCE OF WATER AT WALL OR CLG
- WINDOW; INTERIOR GASKET SHORT/INCOMPLETE



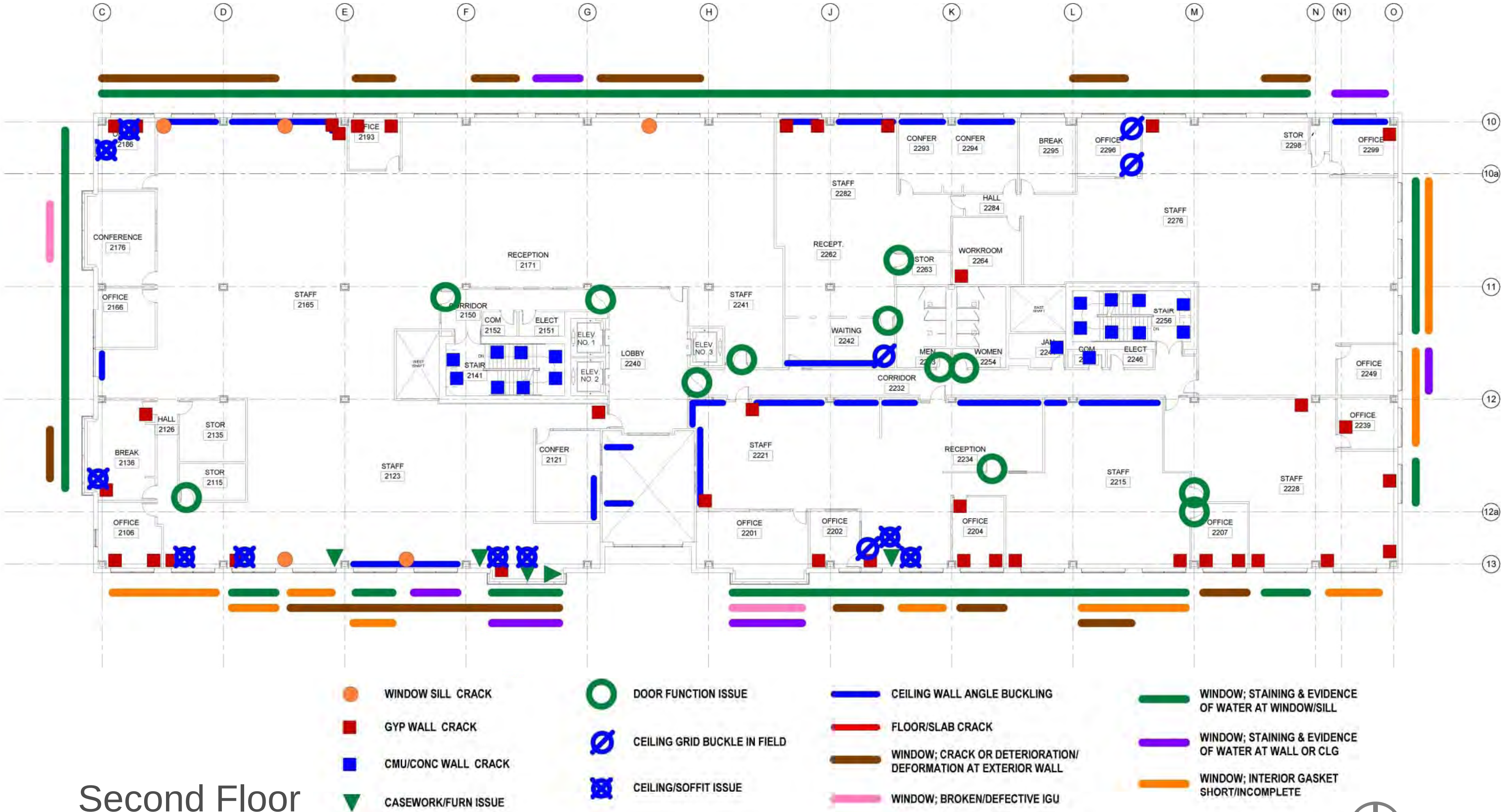
Garage Levels

BUILDING OVERVIEW



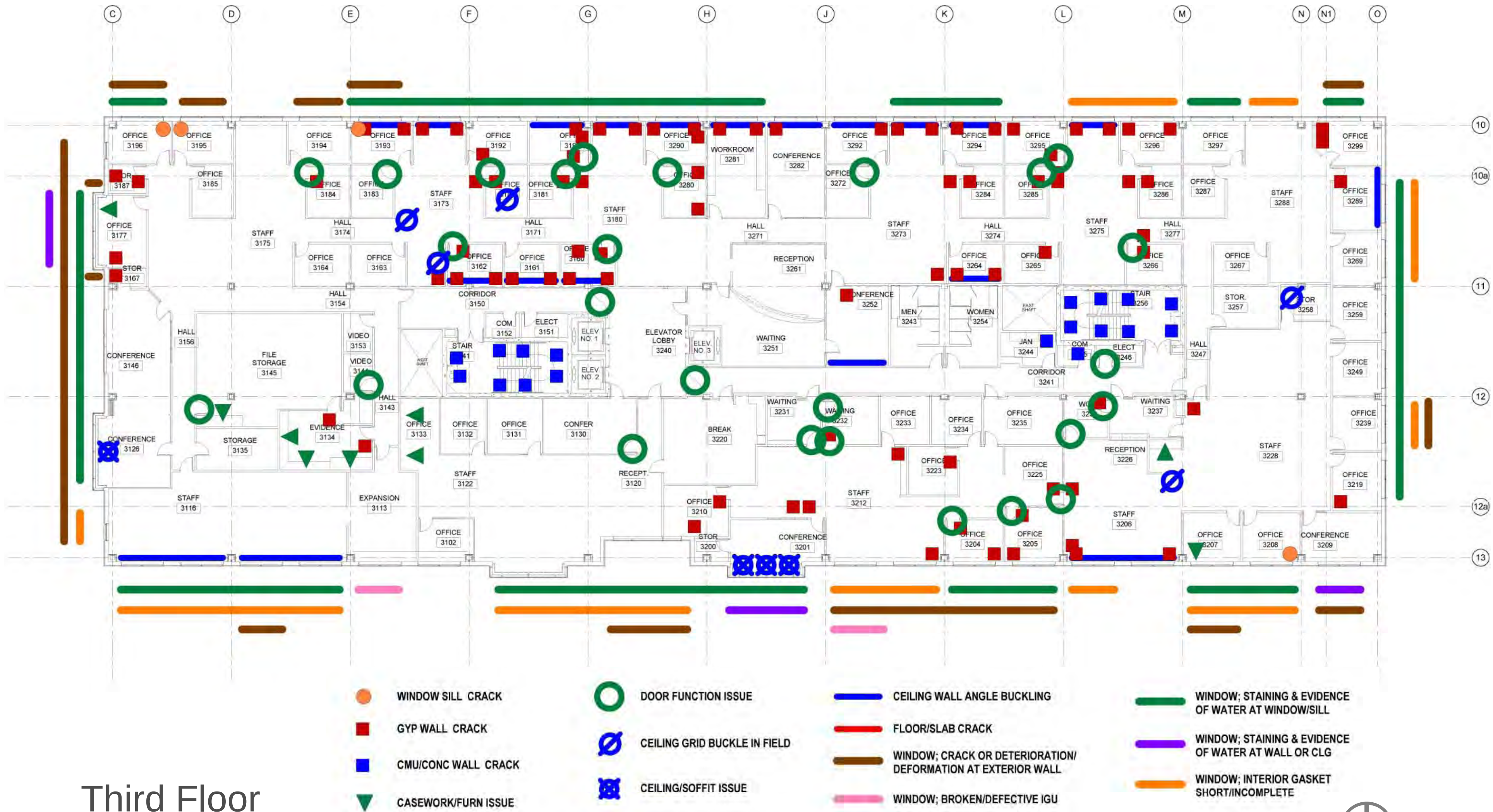
Ground Floor

BUILDING OVERVIEW



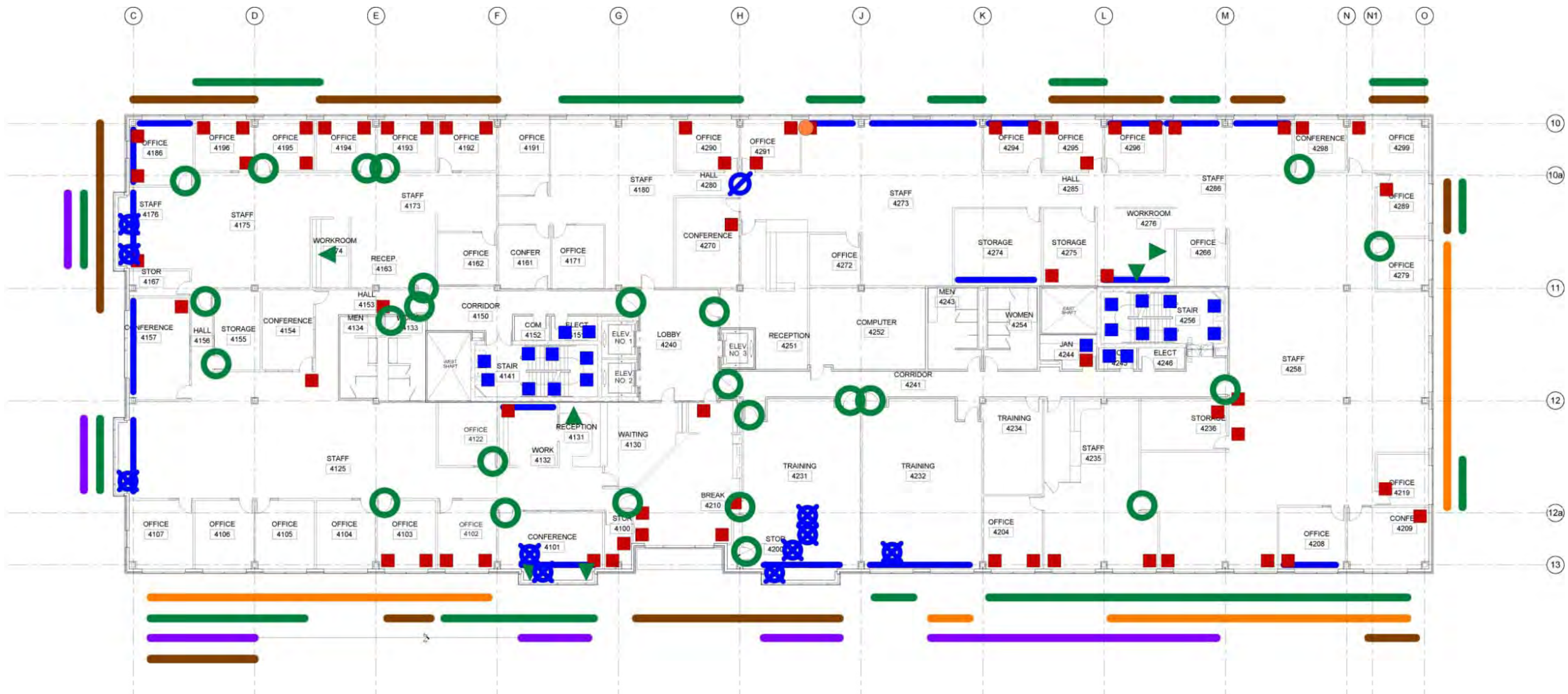
Second Floor

BUILDING OVERVIEW



Third Floor

BUILDING OVERVIEW



- WINDOW SILL CRACK
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- WINDOW; STAINING & EVIDENCE OF WATER AT WALL OR CLG
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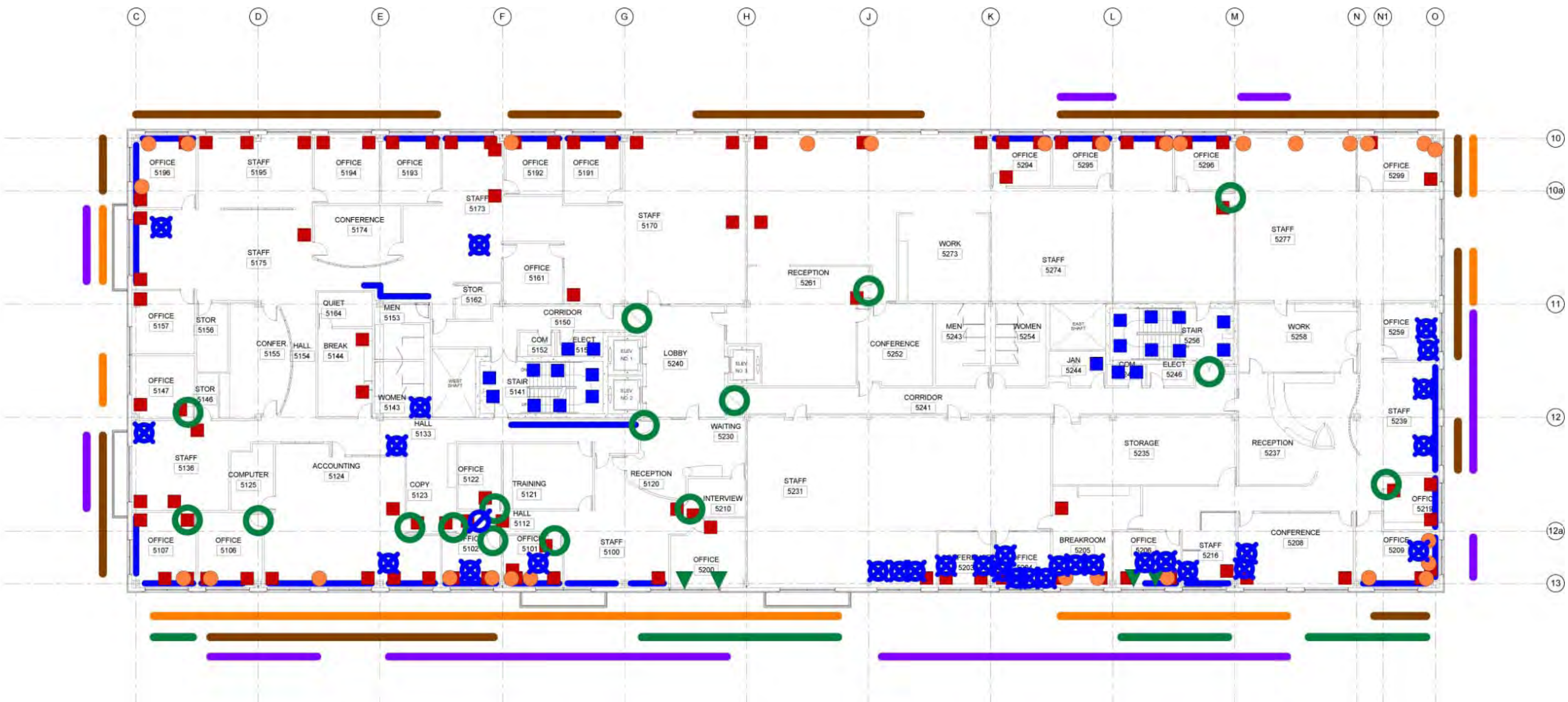
Fourth Floor

Marion County OREGON

Cherriots SALEM-KEIZER TRANSIT

SERA

BUILDING OVERVIEW



- WINDOW SILL CRACK
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- WINDOW; INTERIOR GASKET SHORT/INCOMPLETE

Fifth Floor

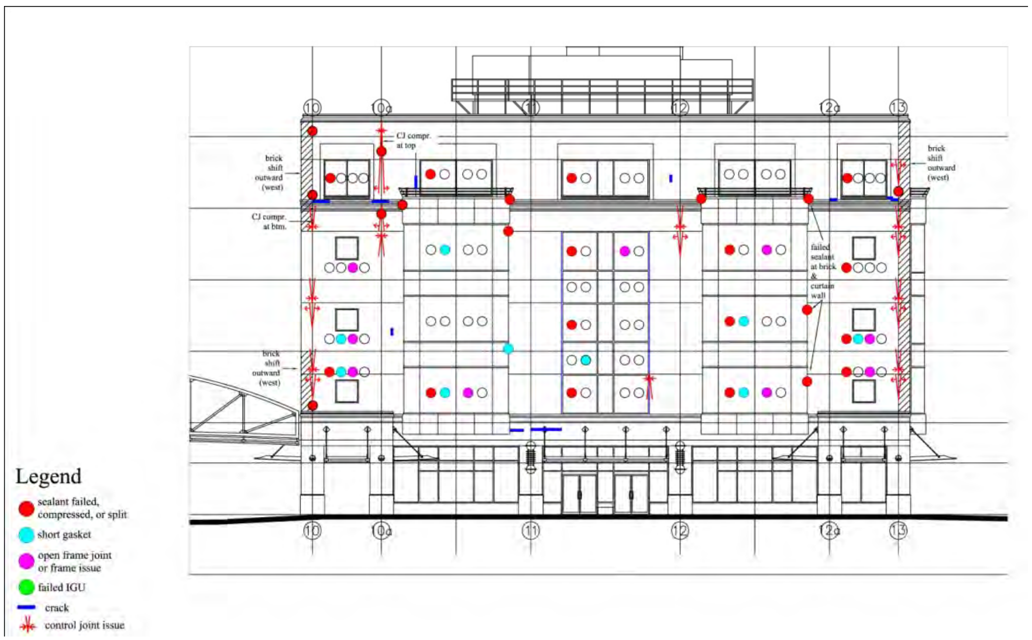
BUILDING OVERVIEW

South Elevation

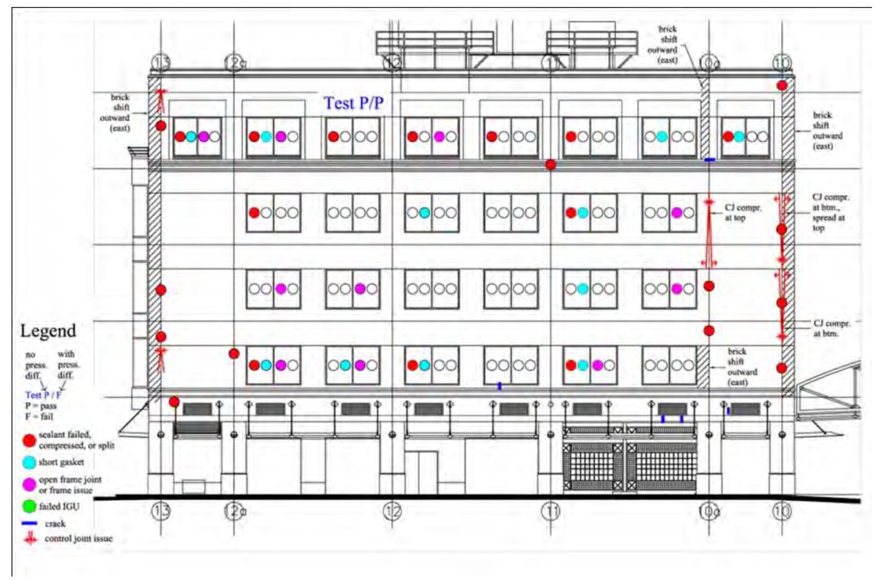
BUILDING OVERVIEW

North Elevation

BUILDING OVERVIEW



West Elevation



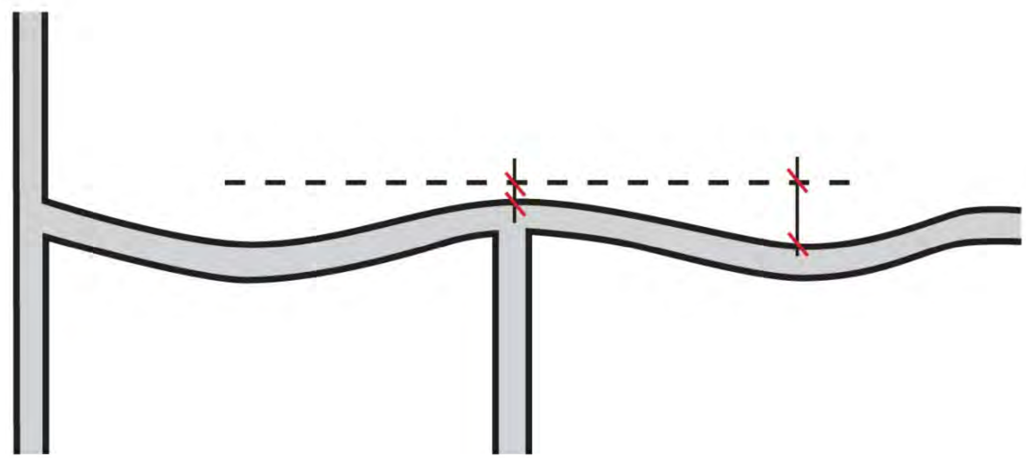
East Elevation

BASIC CONCEPTS

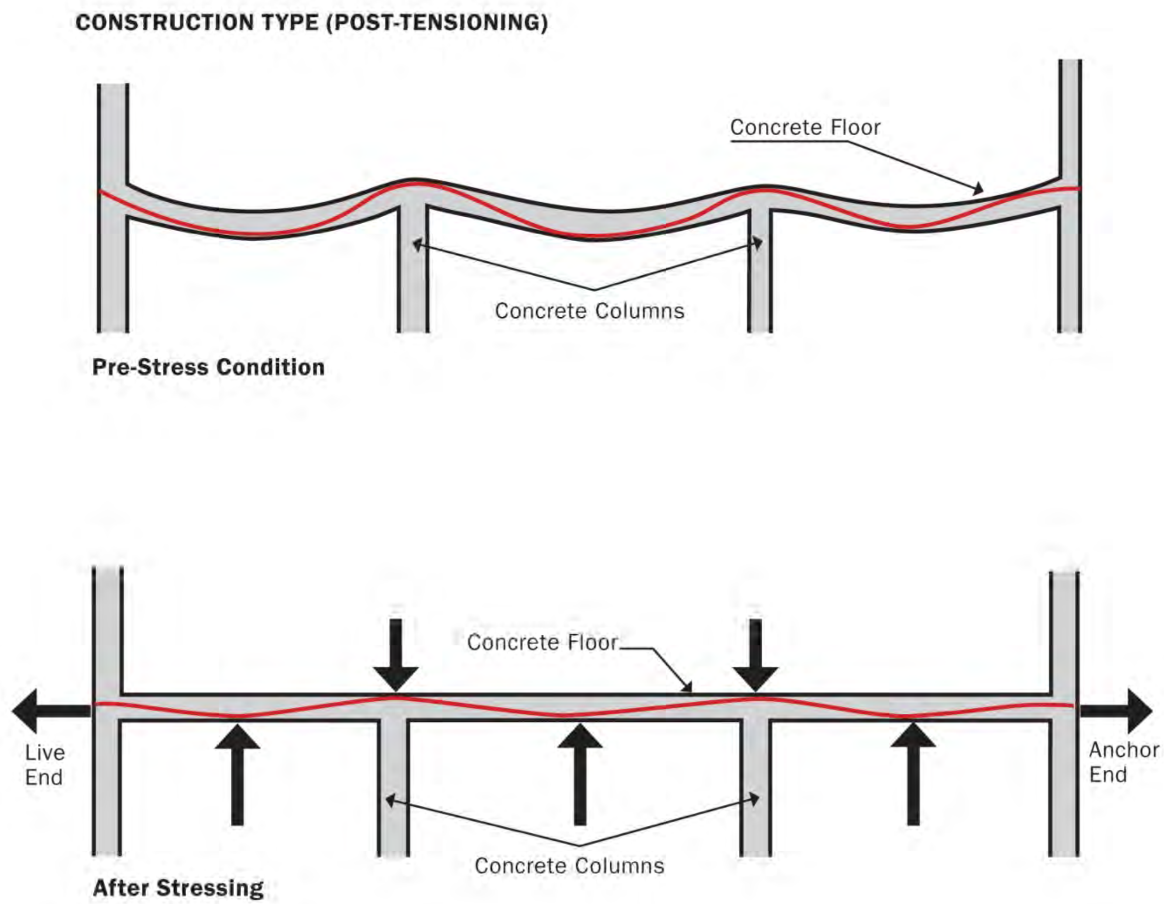
- Fundamentals of concrete slabs
- Fundamentals of seismic design
- Fundamentals of column design

BASIC CONCEPTS

DEFLECTIONS/STRENGTHS



HOW POST TENSIONED CONCRETE WORKS



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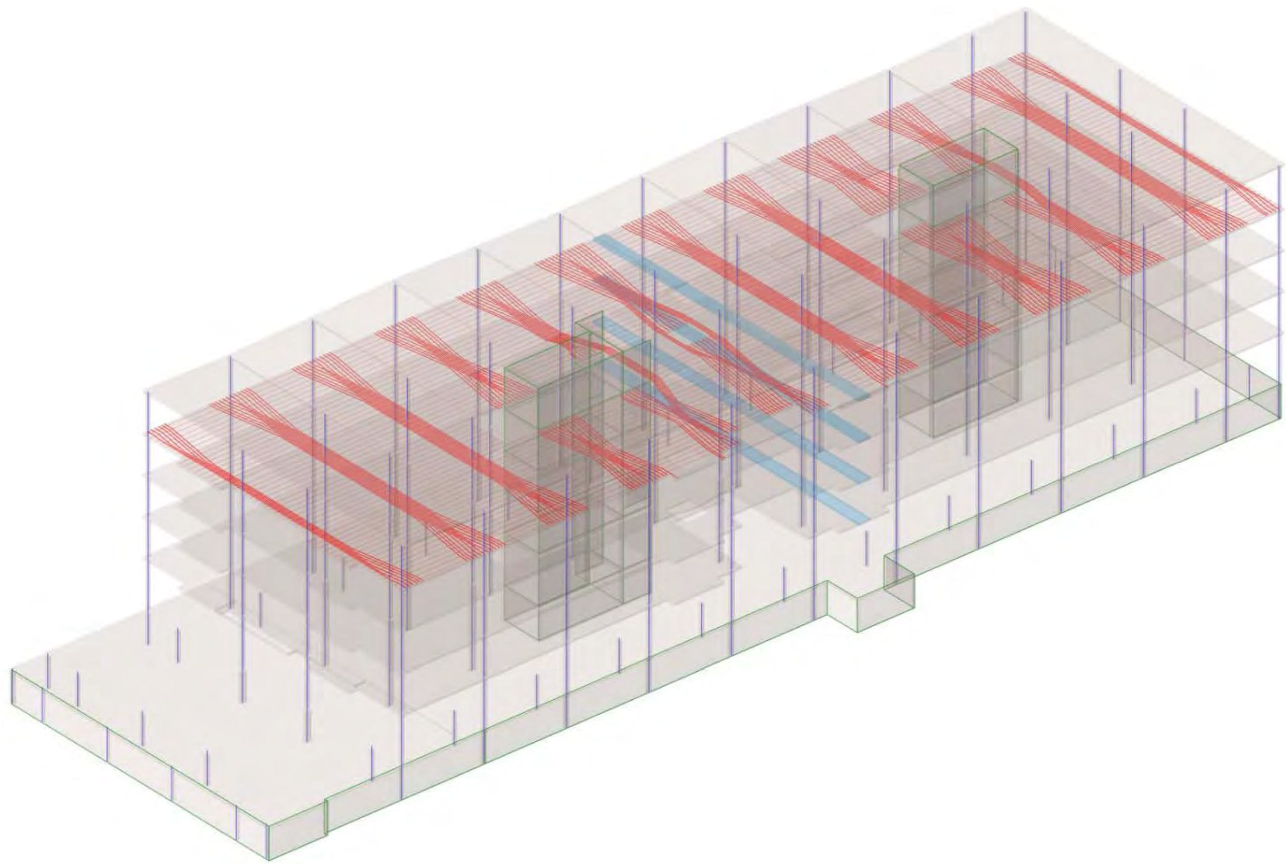
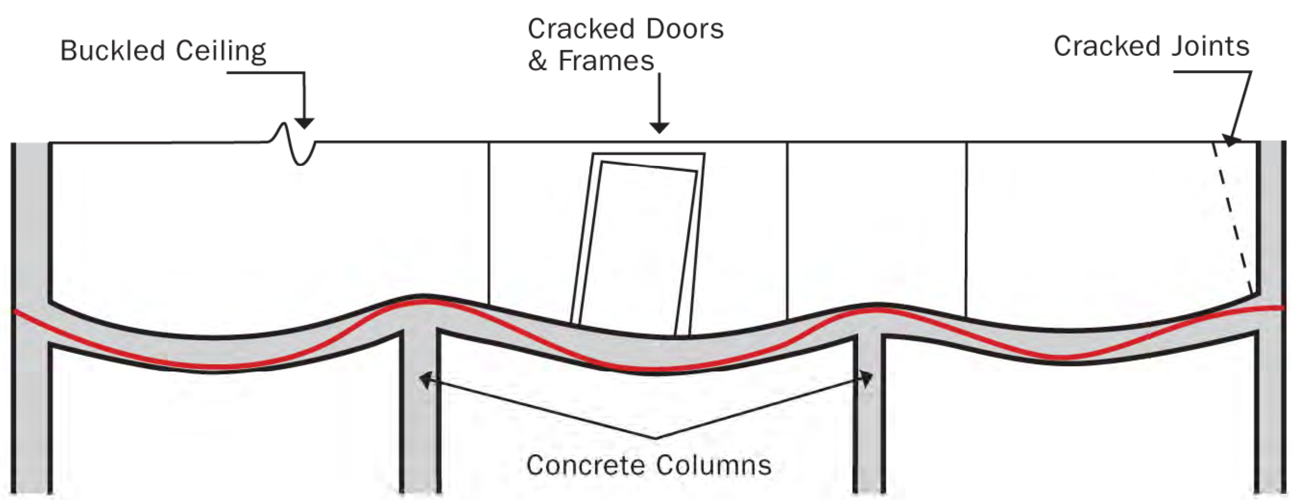
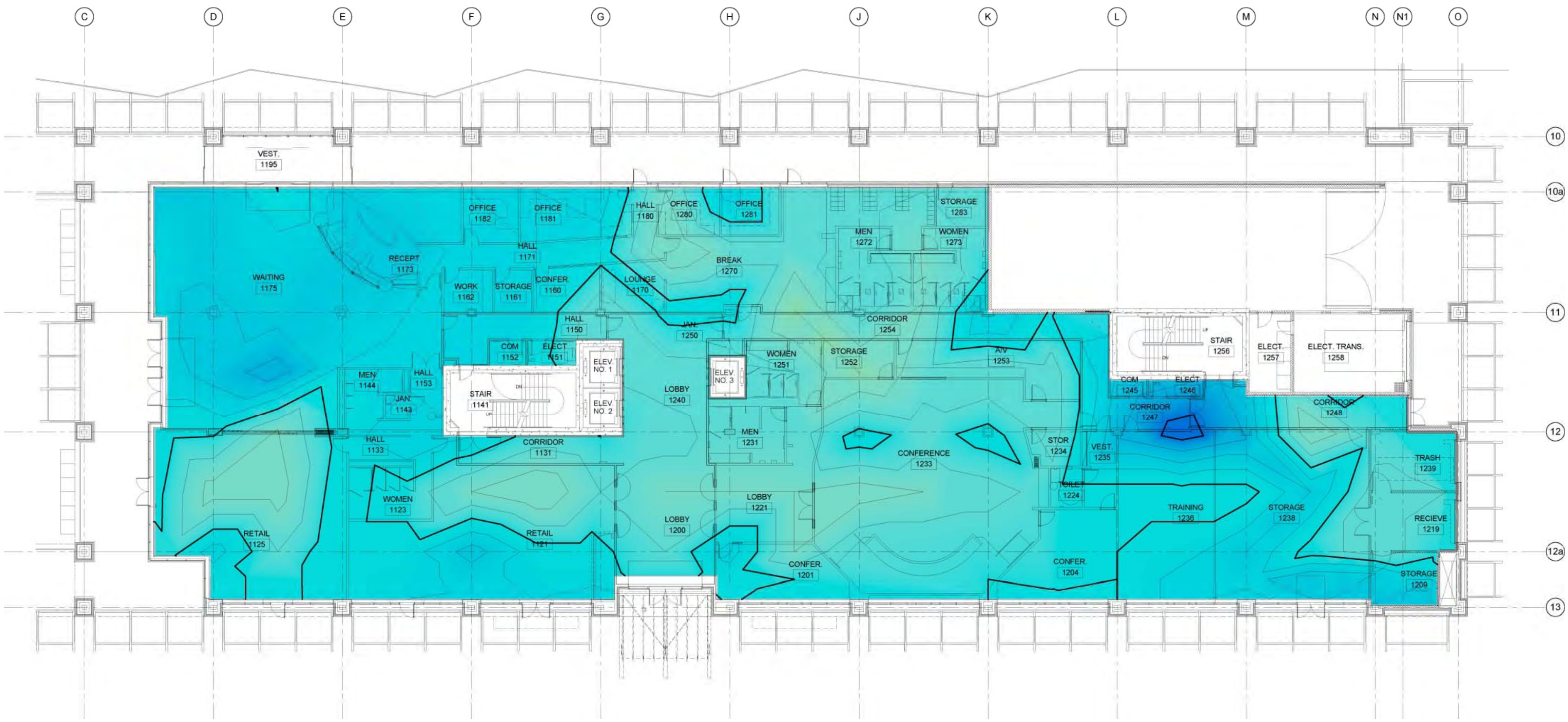


WHAT HAPPENS WHEN IT FAILS

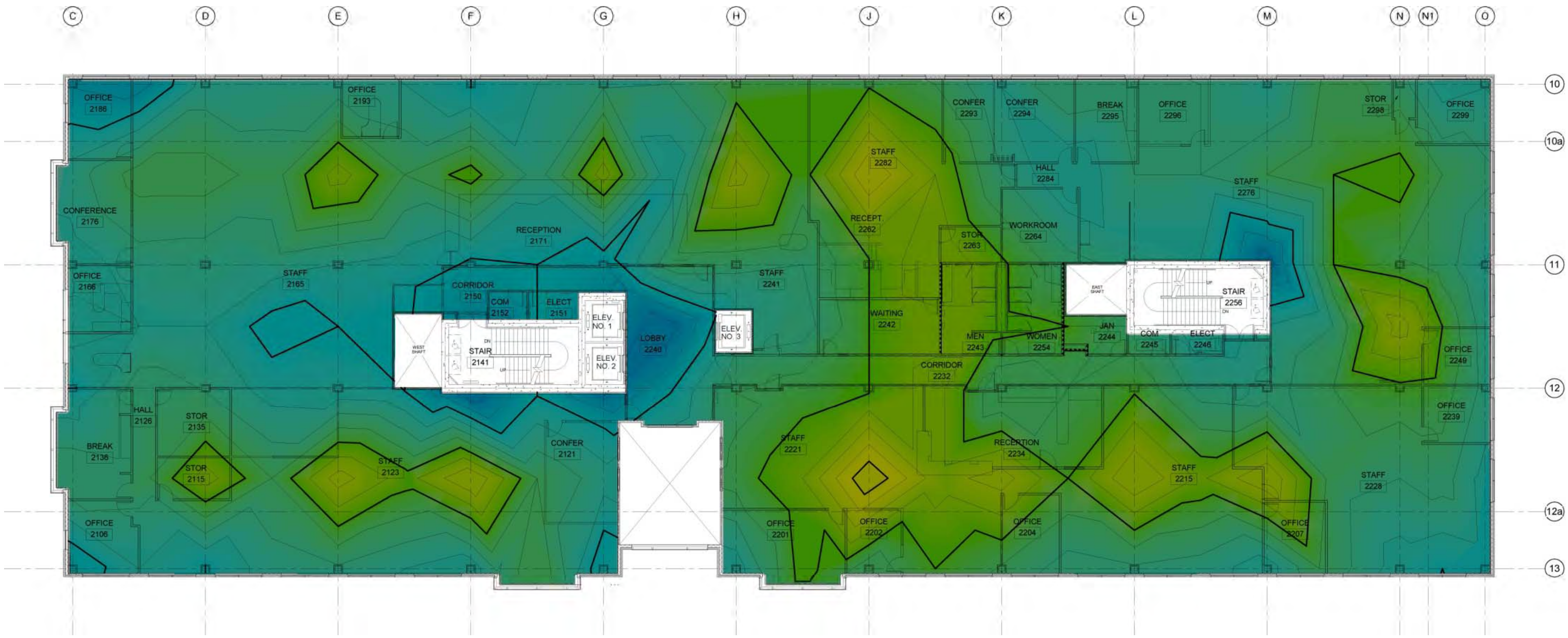


OBSERVED SLAB DEFLECTION



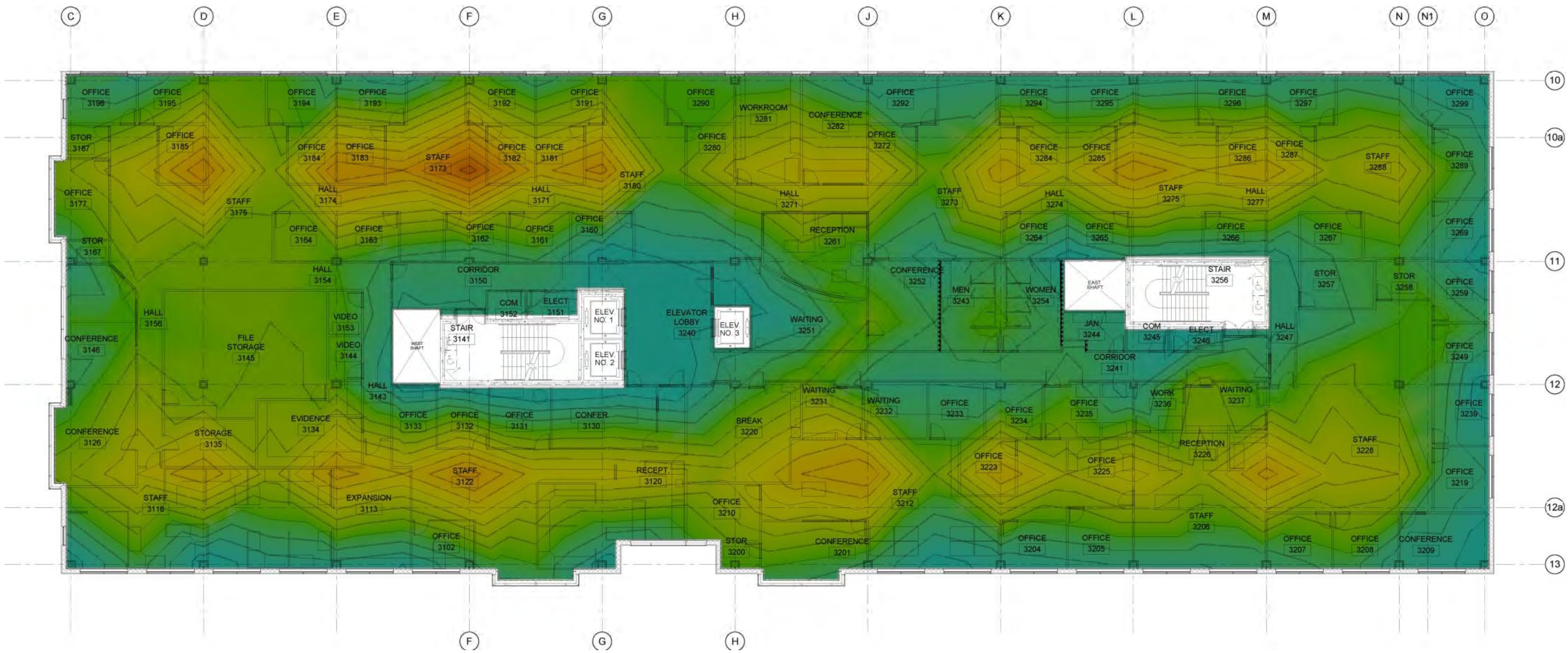
Ground Floor

OBSERVED SLAB DEFLECTION



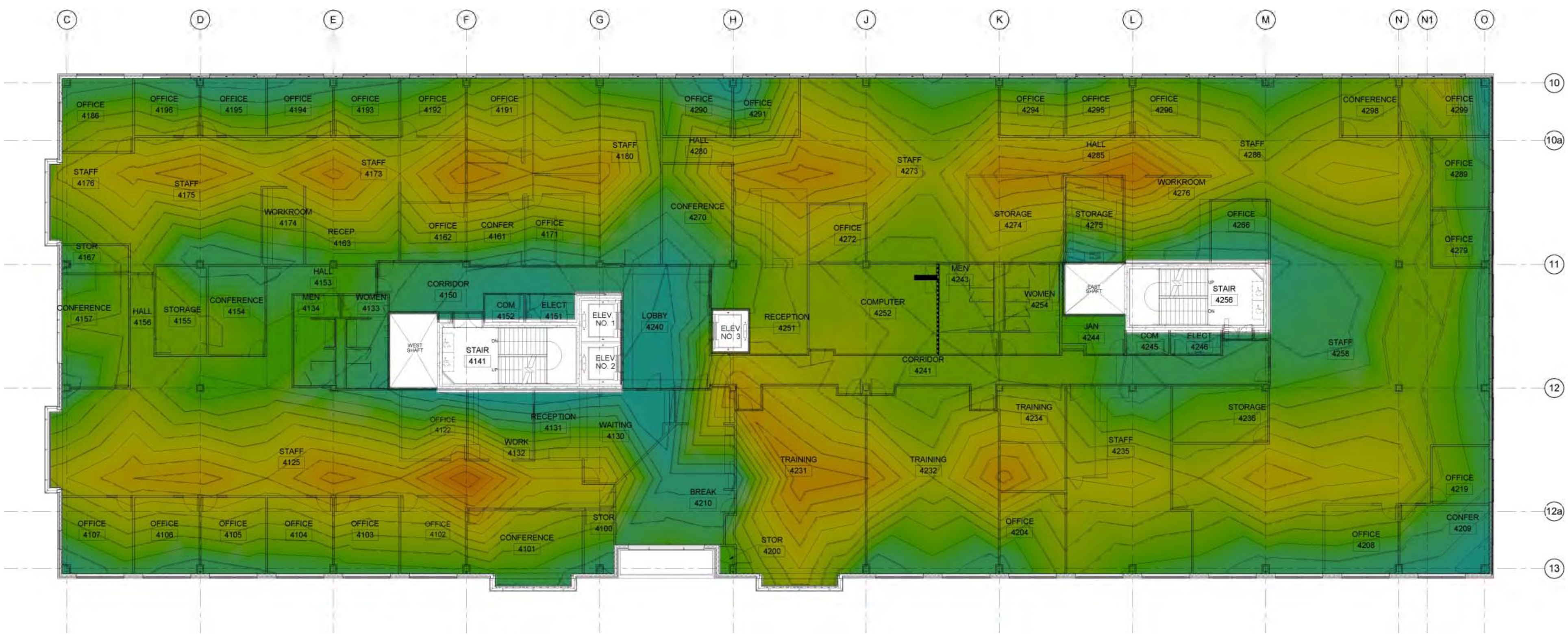
Second Floor

OBSERVED SLAB DEFLECTION



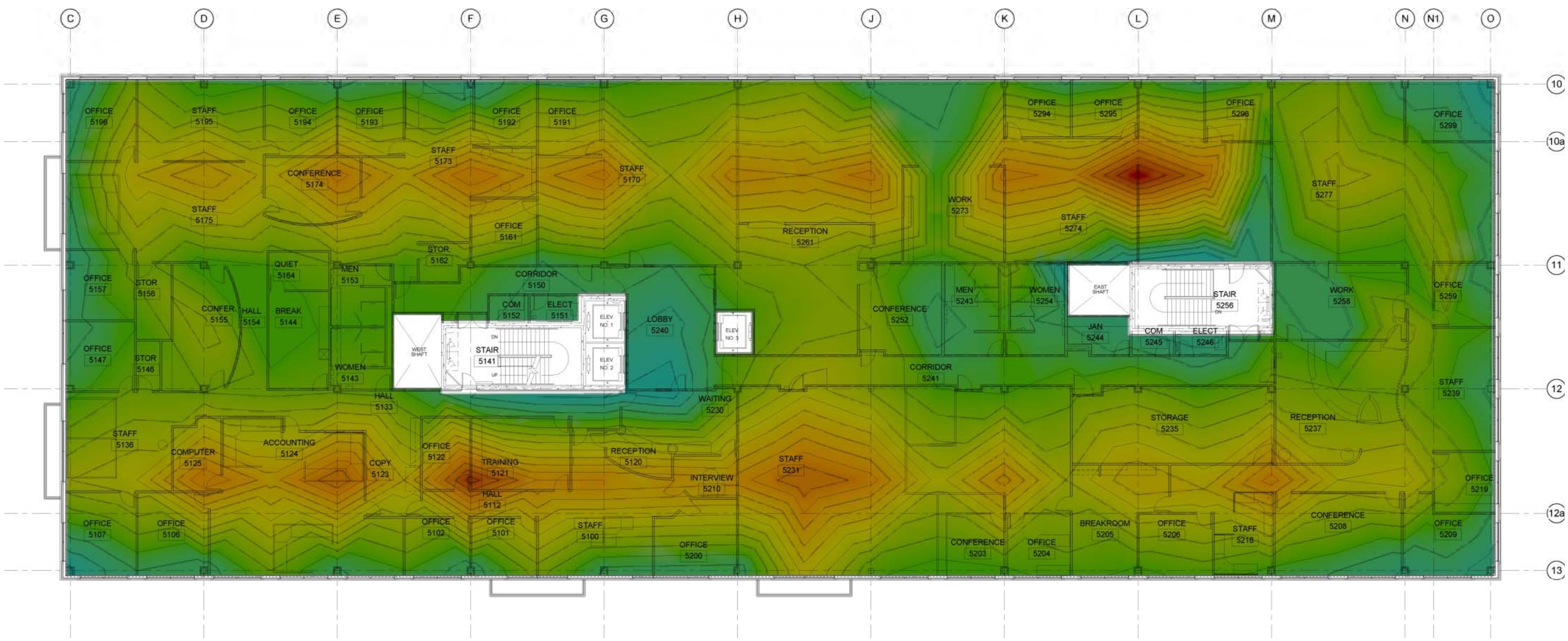
Third Floor

OBSERVED SLAB DEFLECTION



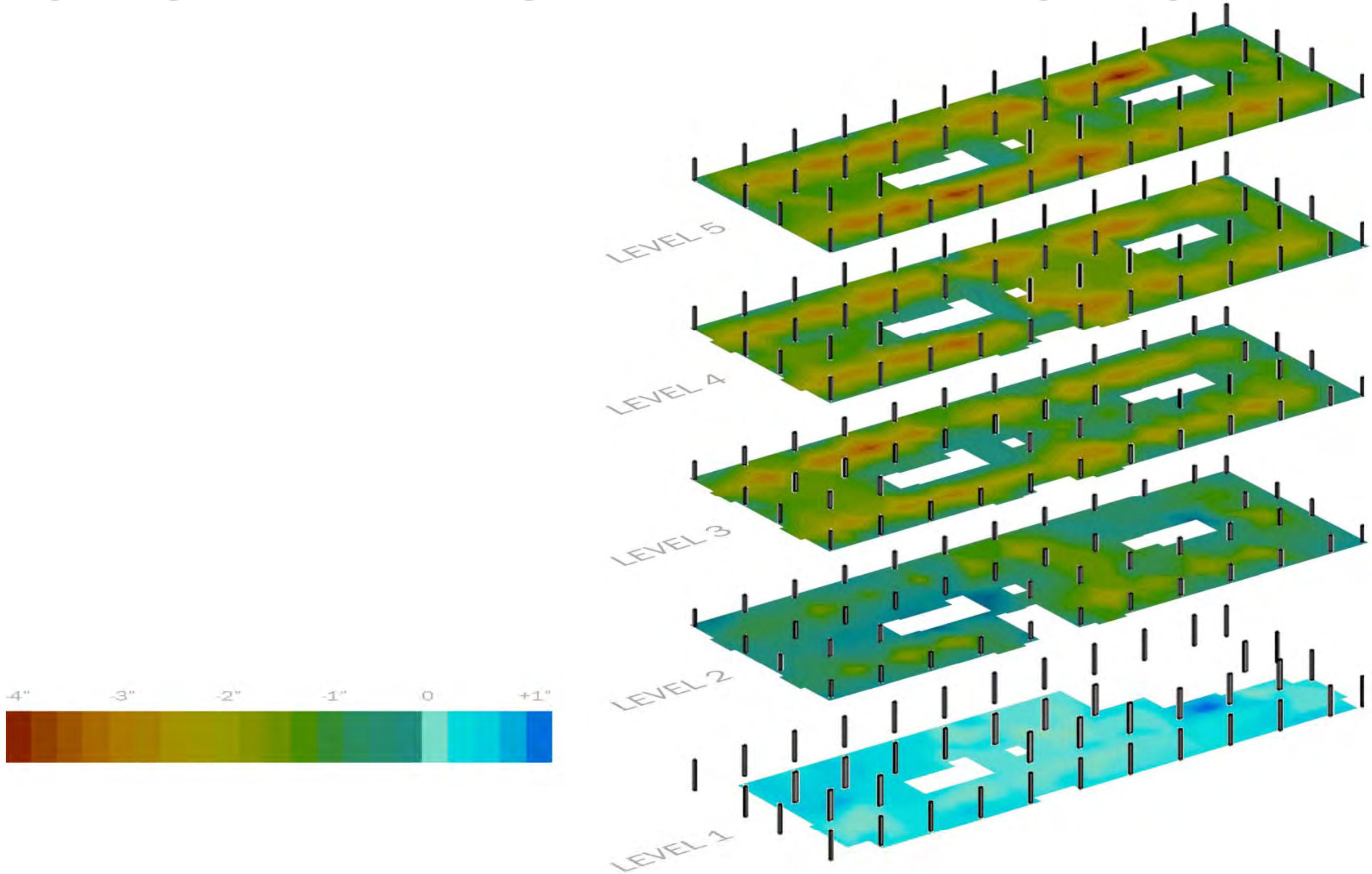
Fourth Floor

OBSERVED SLAB DEFLECTION



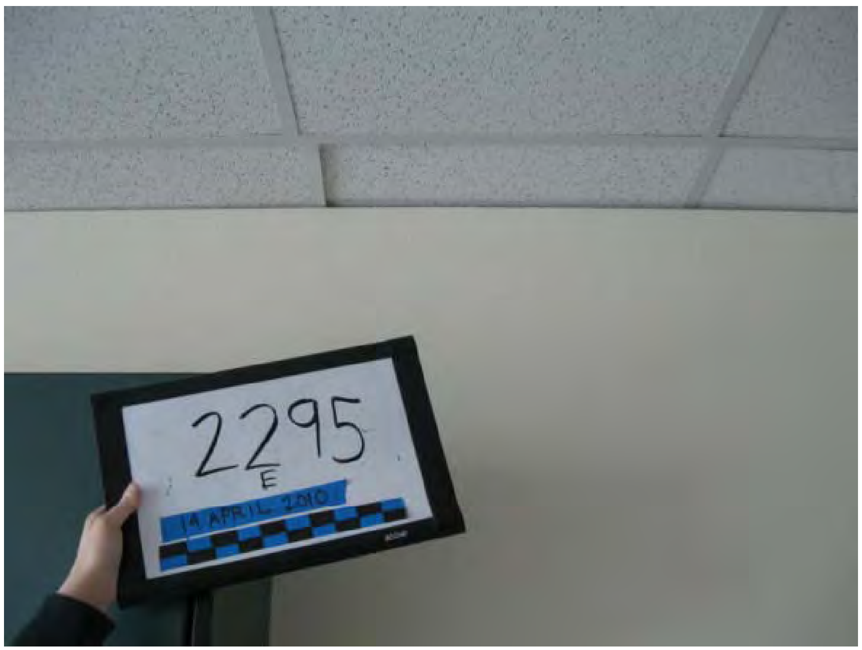
Fifth Floor

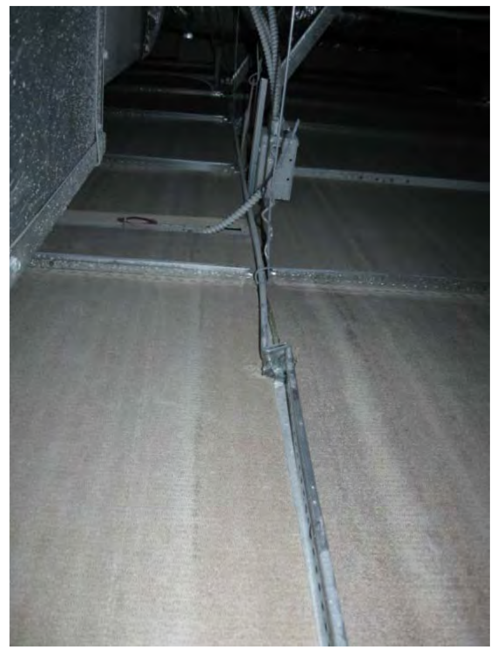
OBSERVED SLAB DEFLECTION



WALLS

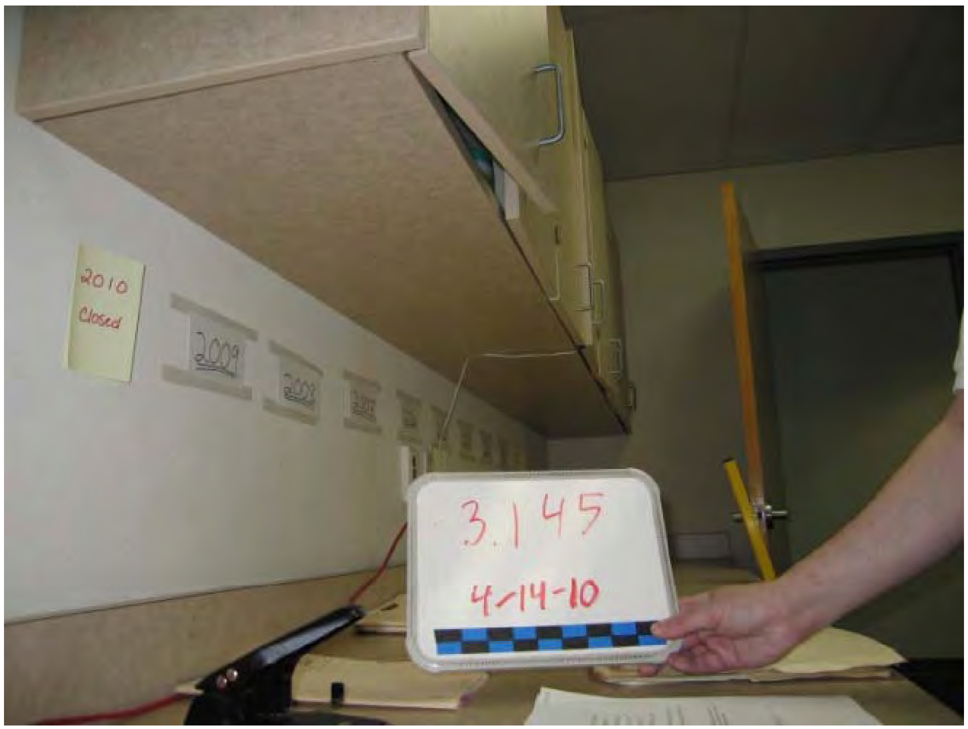
CEILINGS



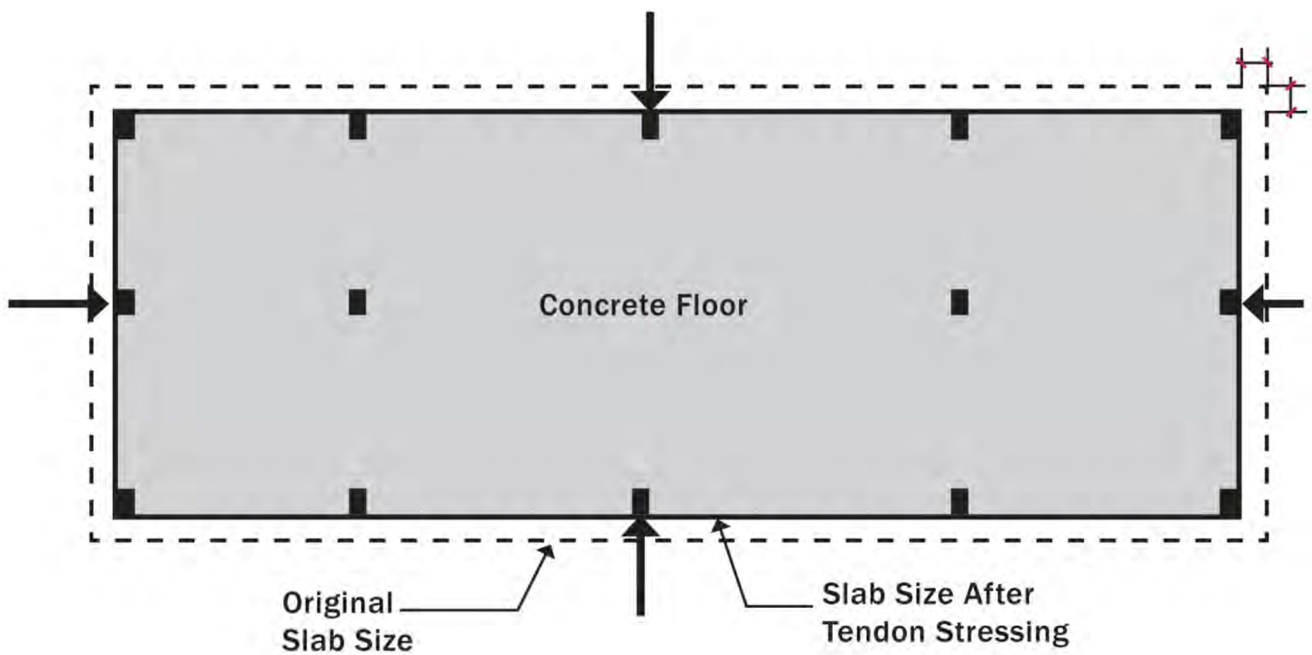


DOORS

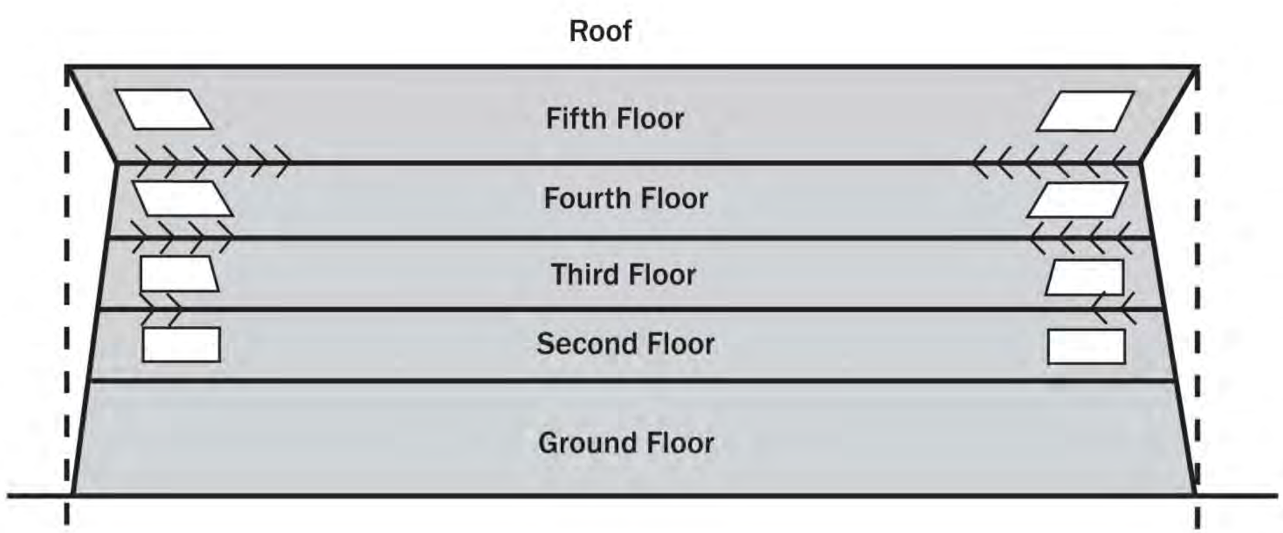
CASEWORK



SHRINKAGE/SHORTENING



SHORTENING PER FLOOR



BUILDING STRUCTURE

SE Corner

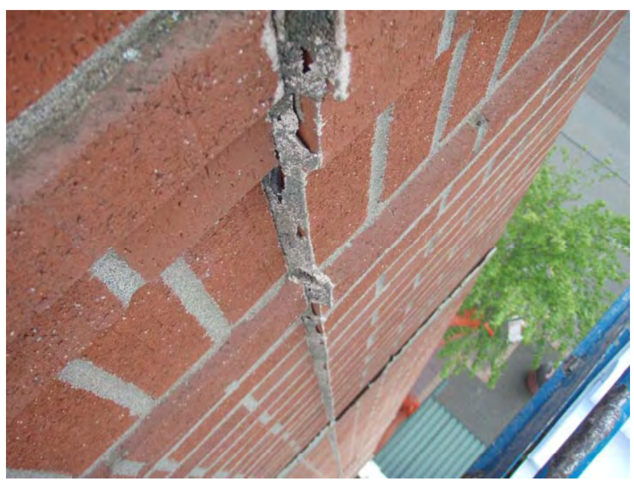
SW Corner

BUILDING STRUCTURE

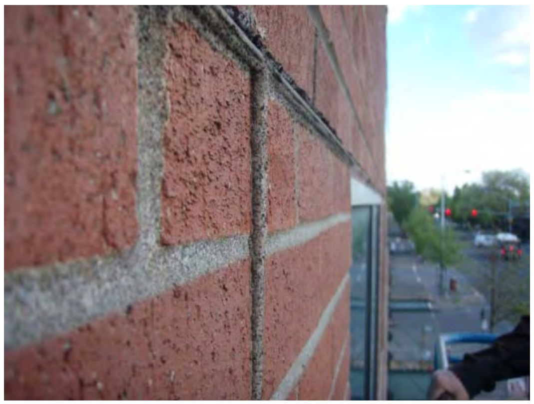
BUILDING ENVELOPE & WATERPROOFING

Exterior Observation found:

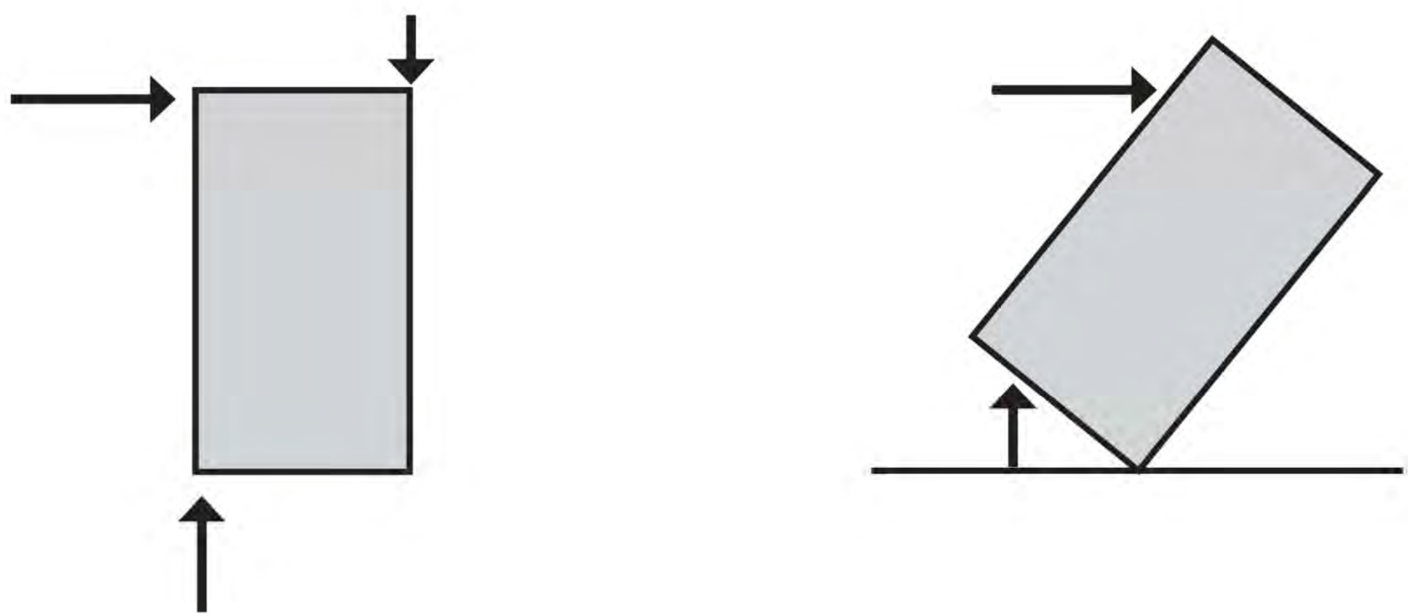
- Water infiltration issues at the curtain walls including failed window units
- Window frames out of alignment
- Brick control and expansion joints not uniform
- Window sealant at the end of it’s useful life



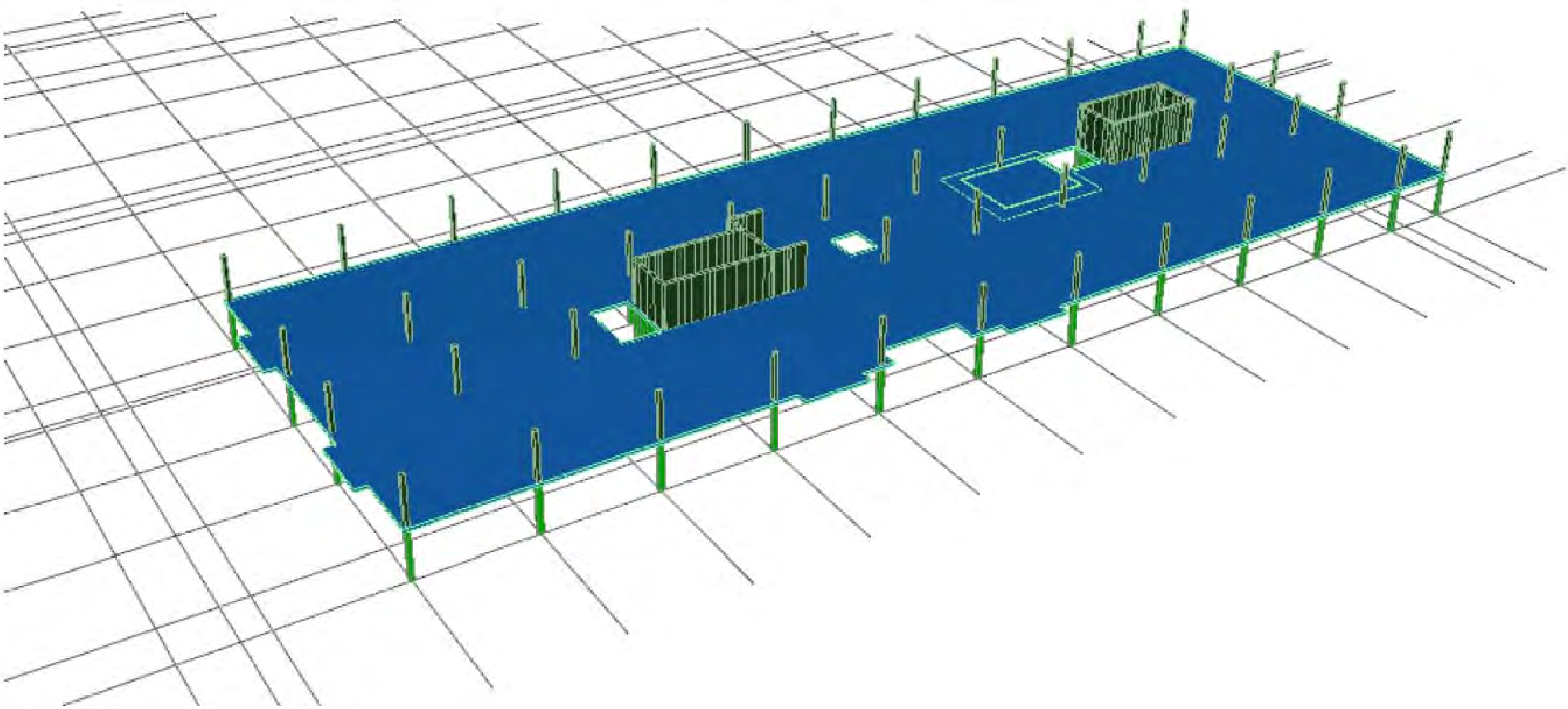
BUILDING ENVELOPE & WATERPROOFING



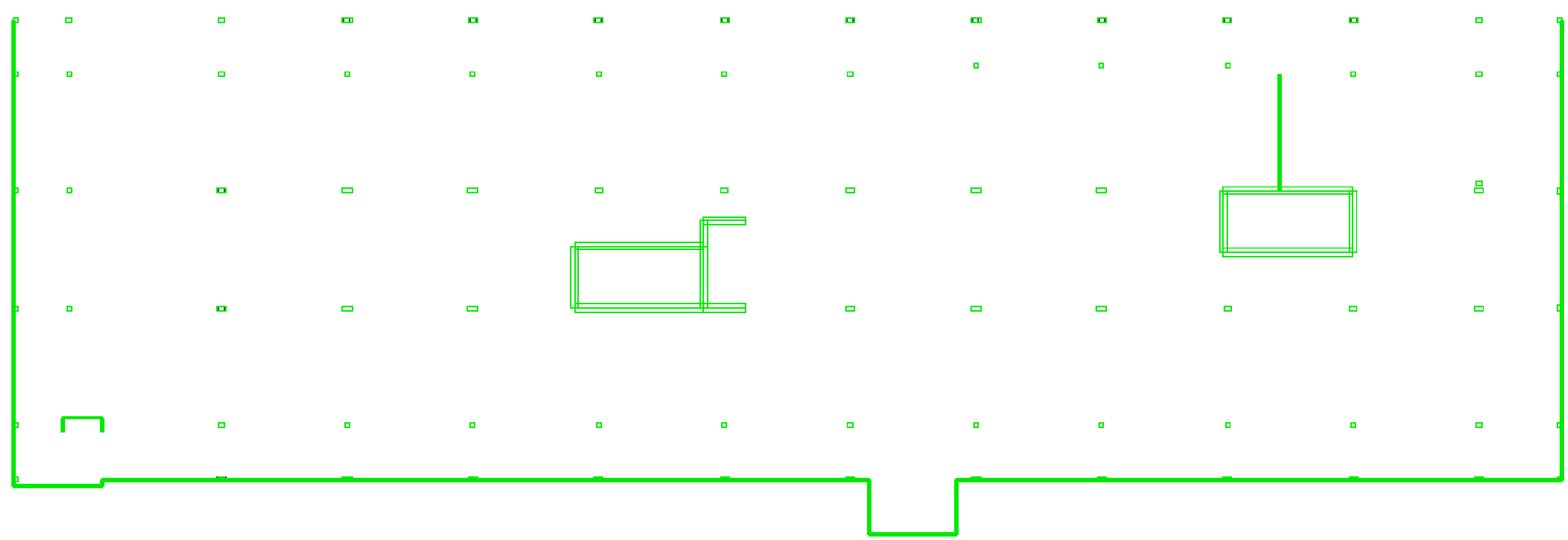
SEISMIC RESISTANCE



LATERAL RESISTIVE ELEMENTS

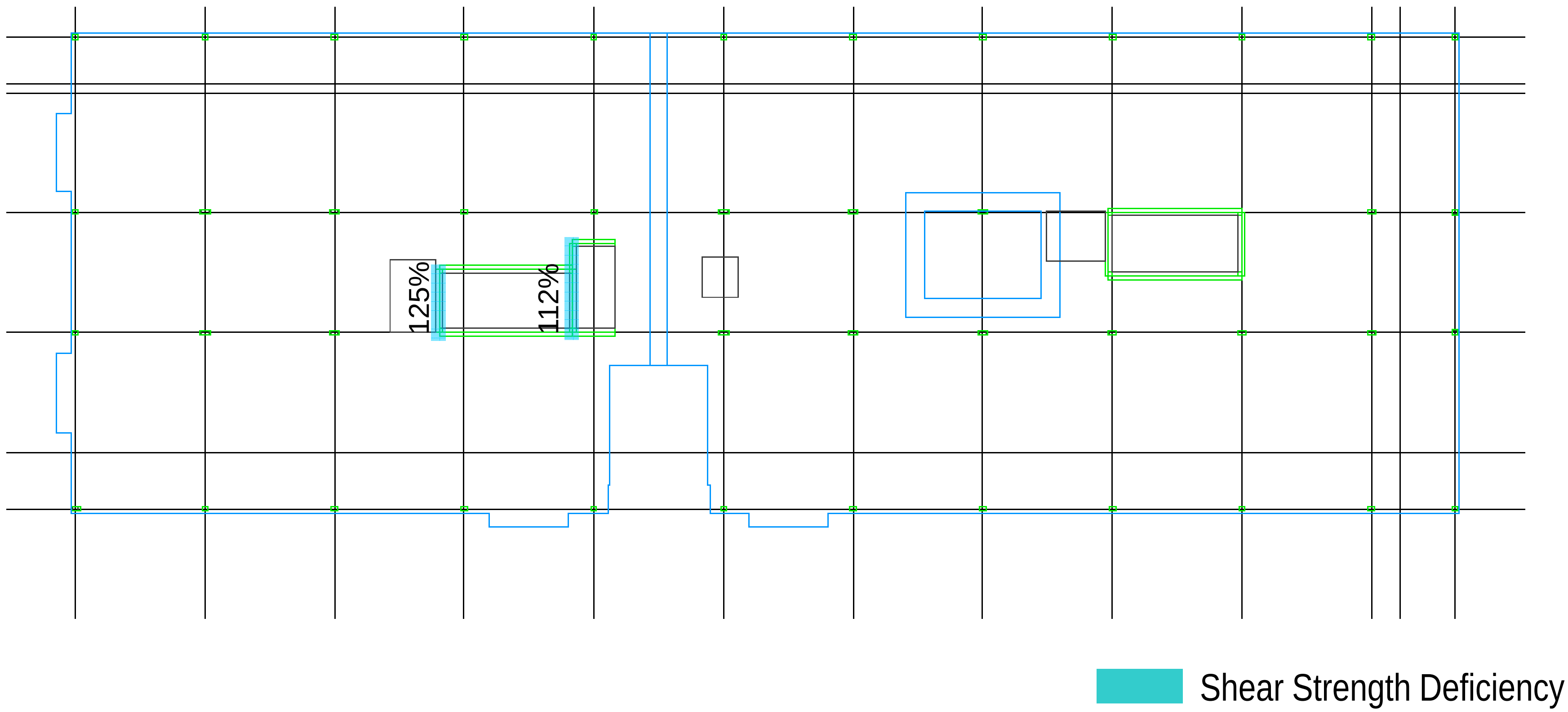


First Floor Shear Wall Deficiencies

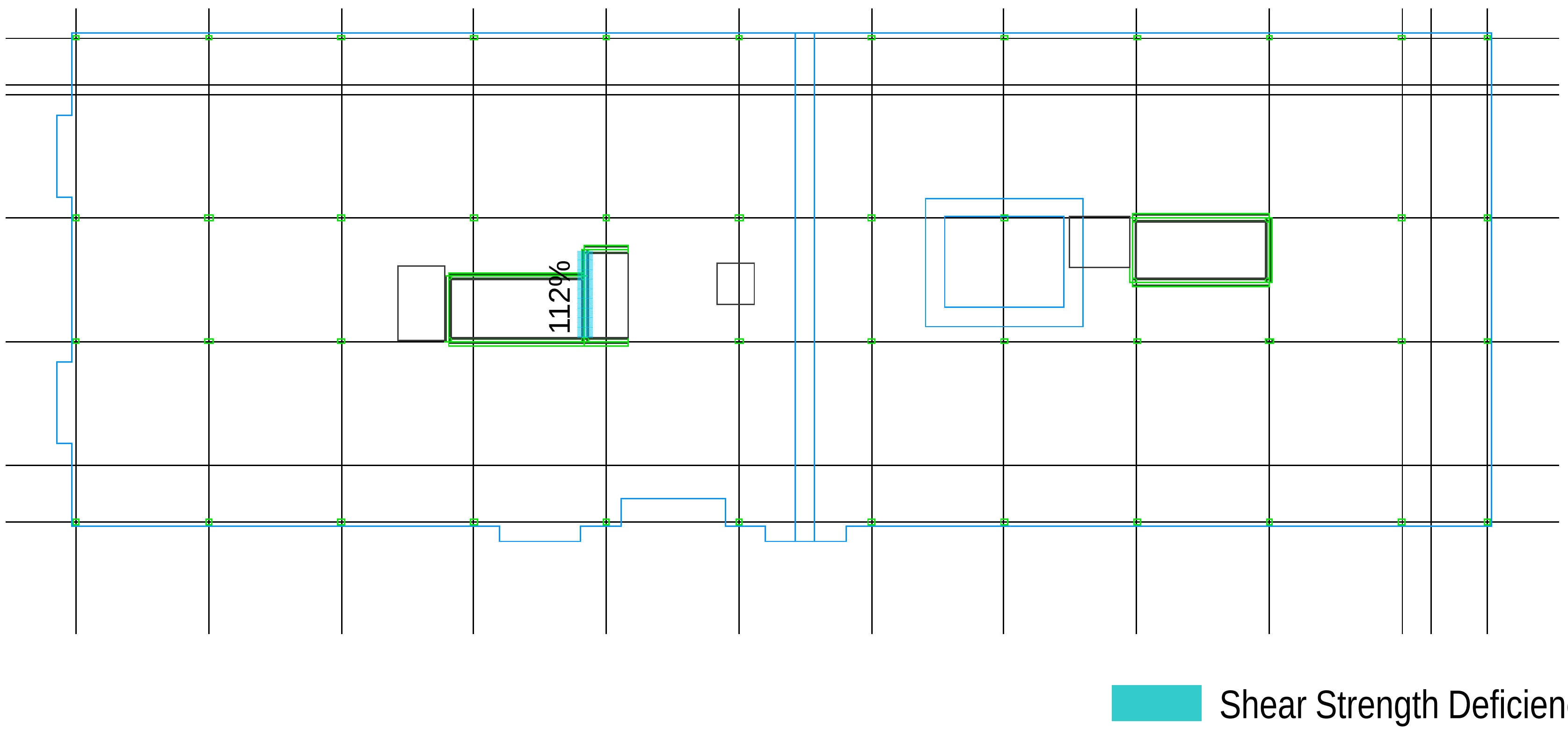


Shear Strength Deficiency

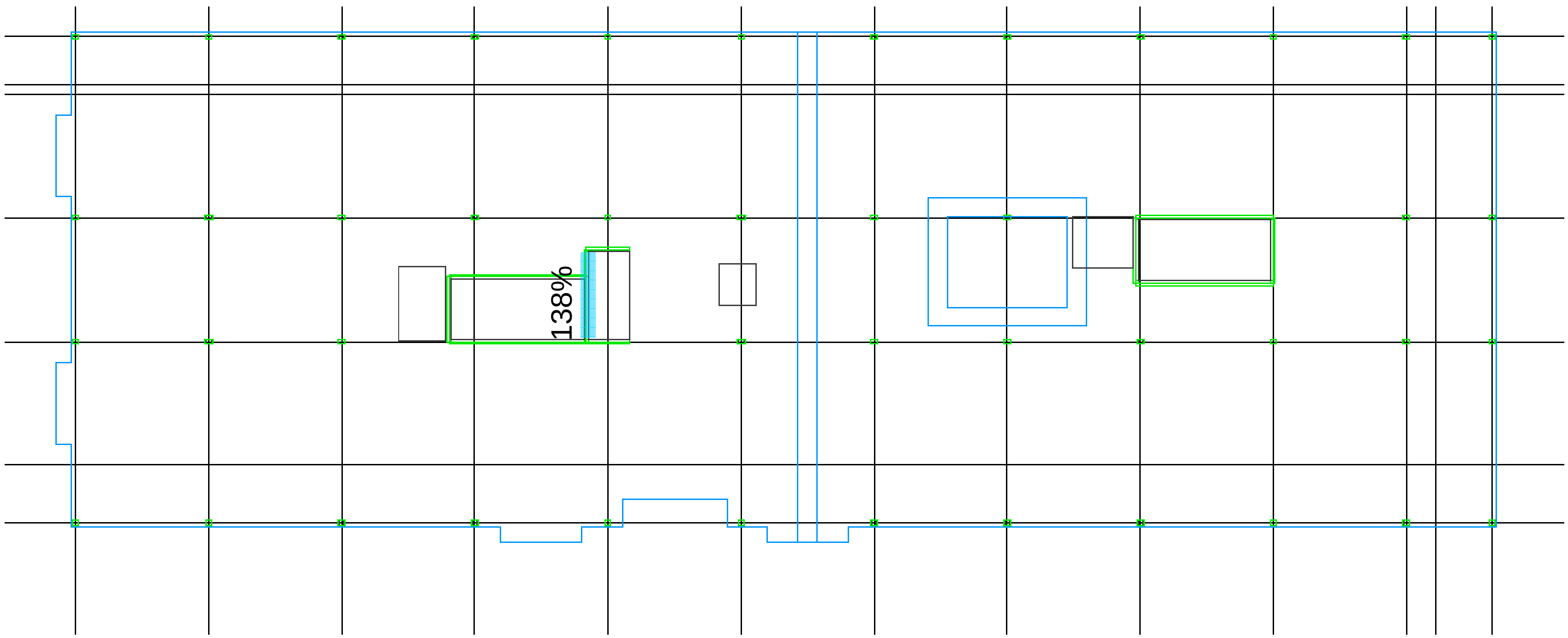
Second Floor Shear Wall Deficiencies



Third Floor Shear Wall Deficiencies

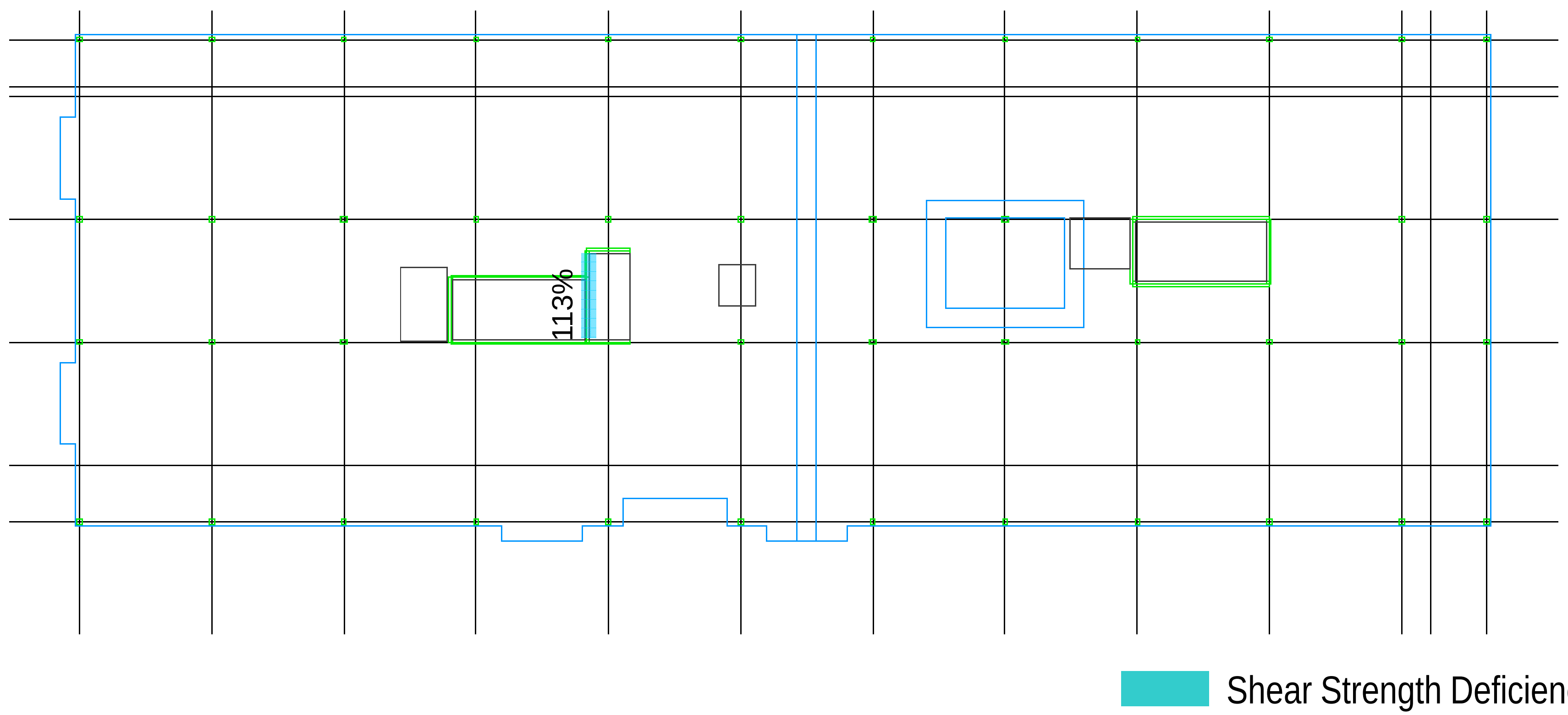


Fourth Floor Shear Wall Deficiencies

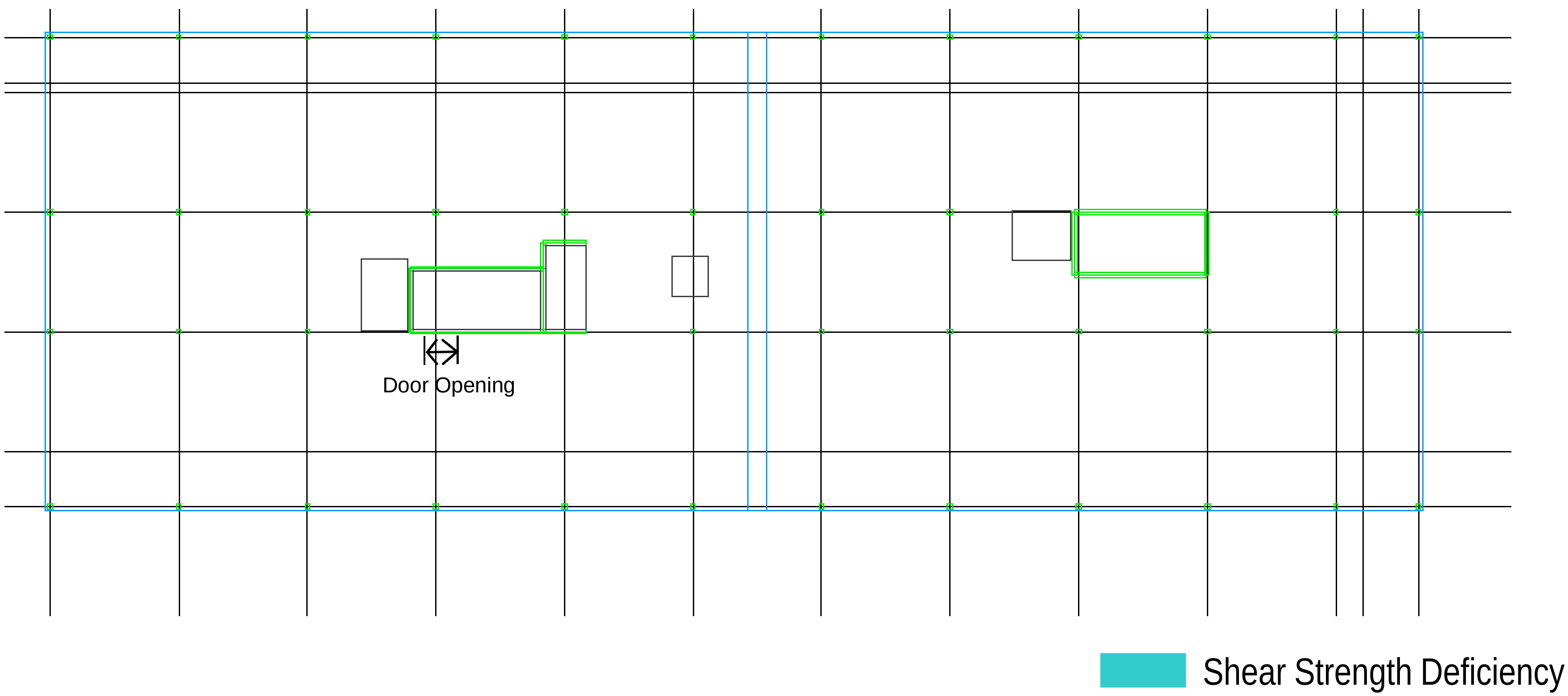


Shear Strength Deficiency

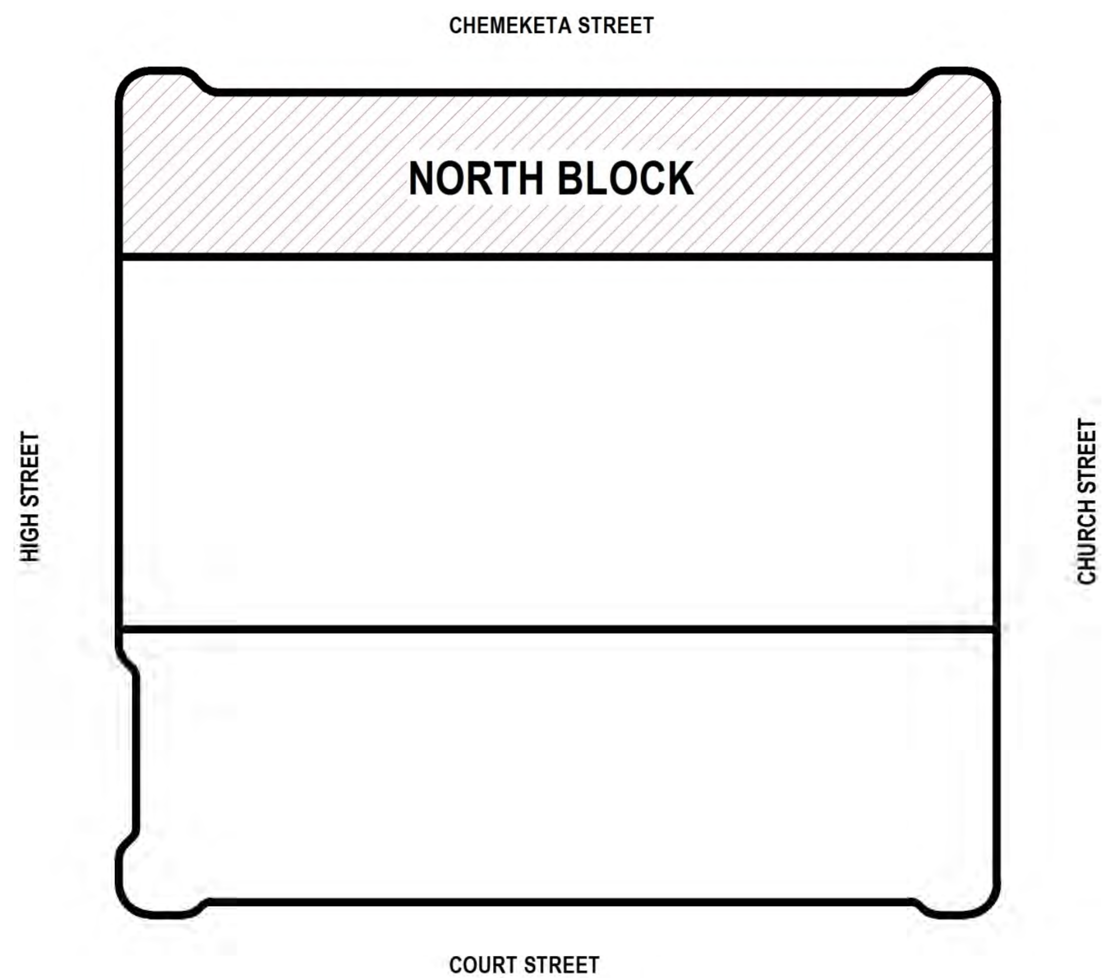
Fifth Floor Shear Wall Deficiencies



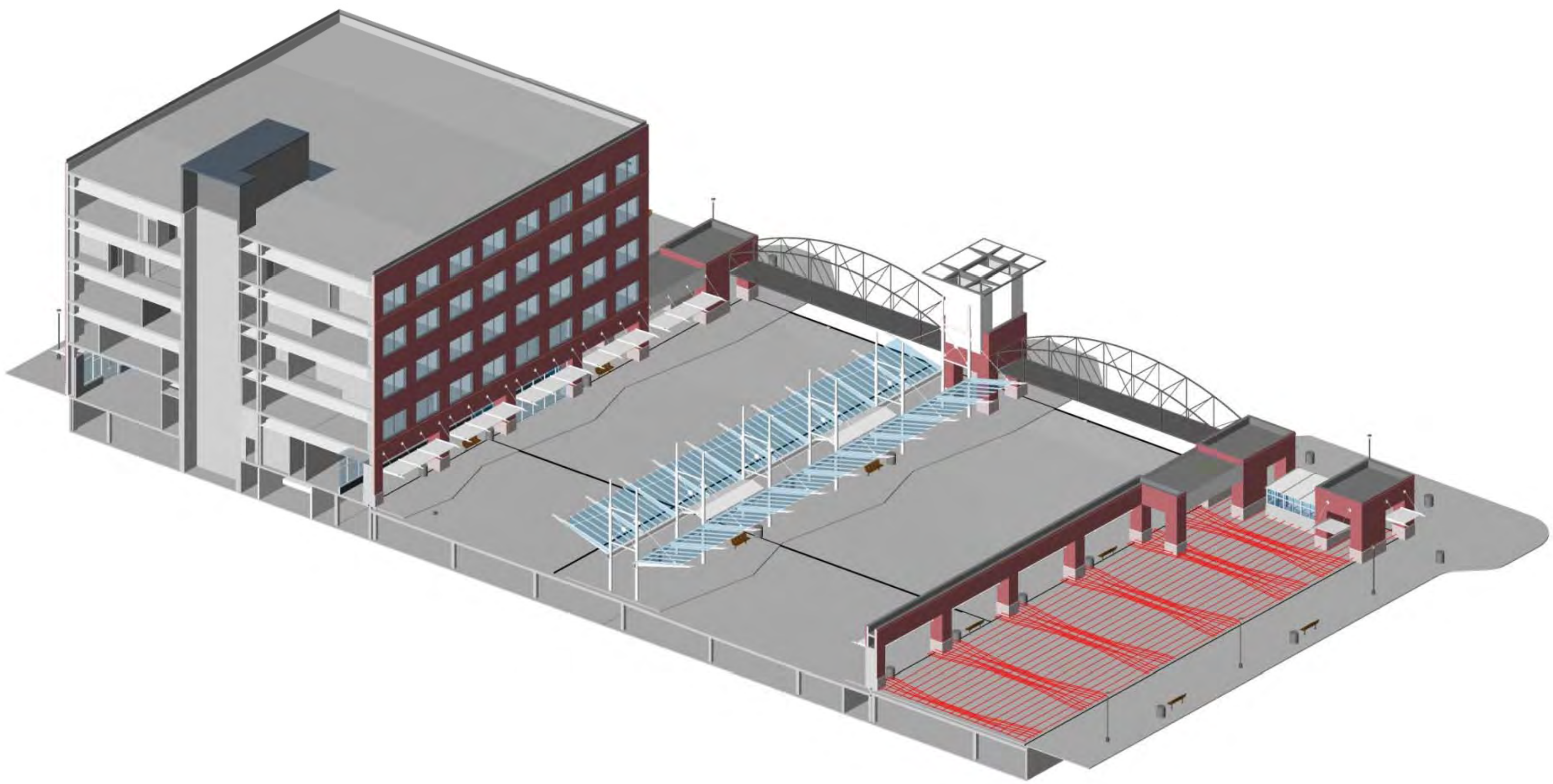
Roof Shear Wall Deficiencies



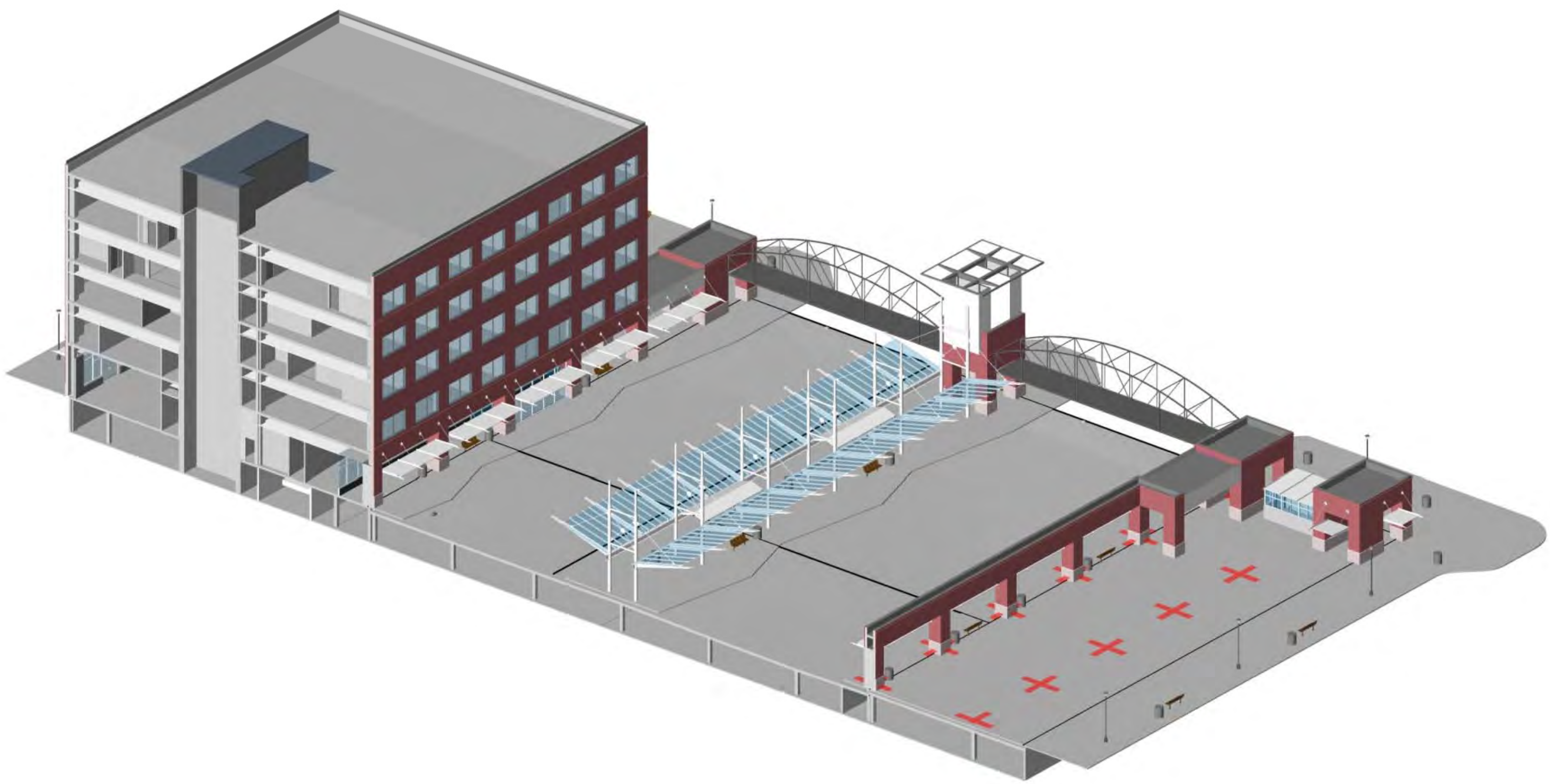
NORTH BLOCK


CHEMEKETA STREET
NORTH BLOCK
HIGH STREET
CHURCH STREET
COURT STREET

NORTH BLOCK



NORTH BLOCK



NORTH BLOCK

North Block Site Observation

a. Cracked concrete, water penetration in walls and slab, bearing problems

b. Areas injected have failed – 3 methods used

   i. Epoxy Injected

   ii. Cleaned out & Applied Sealant

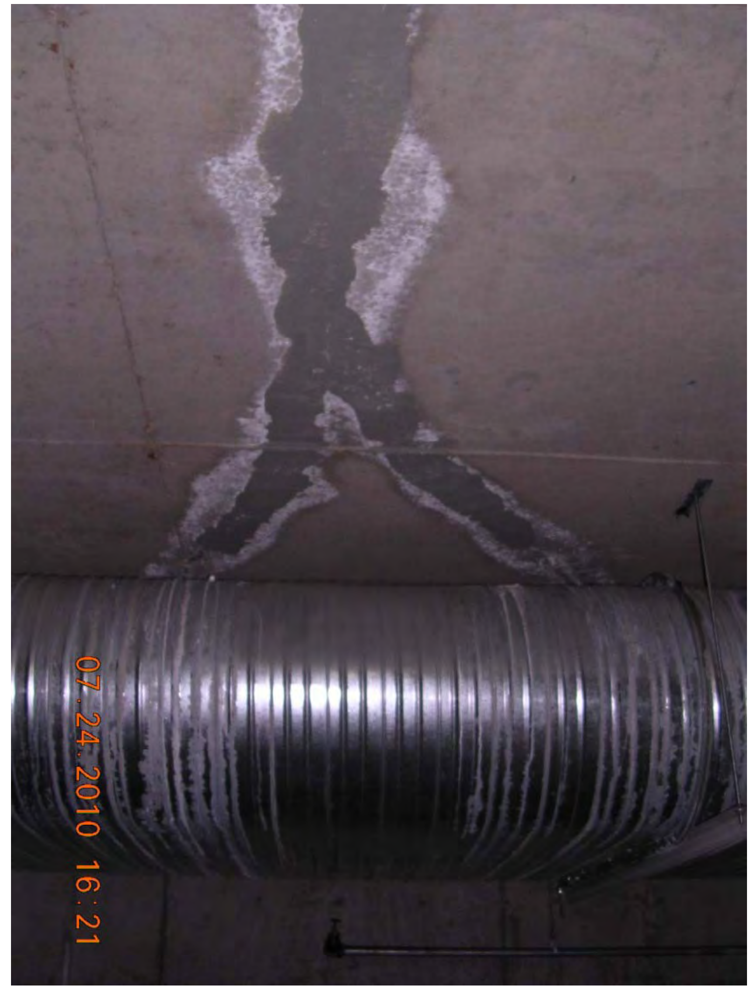
   iii. Top Coat

c. Procedure for destructive testing of slab and inspection of steel tendons ongoing

d. Records and data are poor and incomplete.

NORTH BLOCK

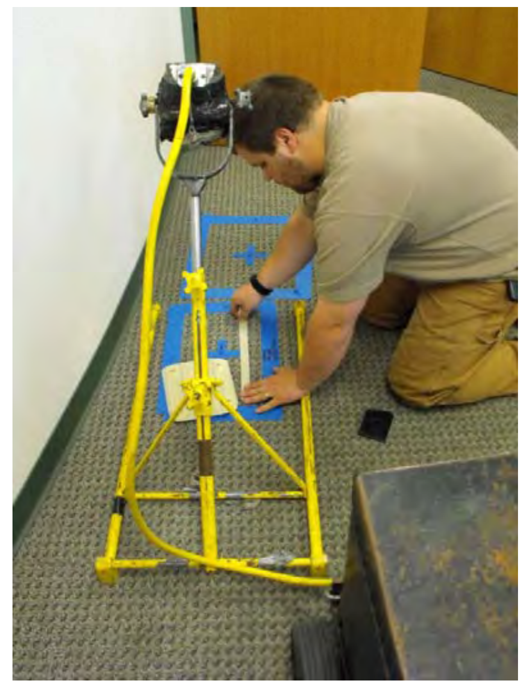
NORTH BLOCK



MATERIAL TESTING

Full building survey informed where material samples were to be taken:

- Gather data from perceived ‘good’ and ‘bad’ locations at each floor
- Each side of slab’s pour strip
- Used a combination of GPR and x-ray to locate cores



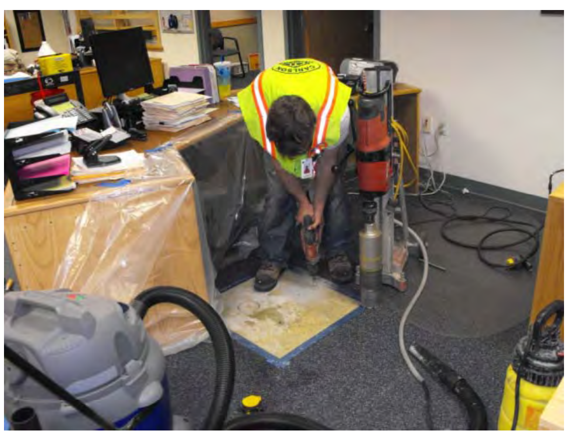
MATERIAL TESTING: Compressive Tests

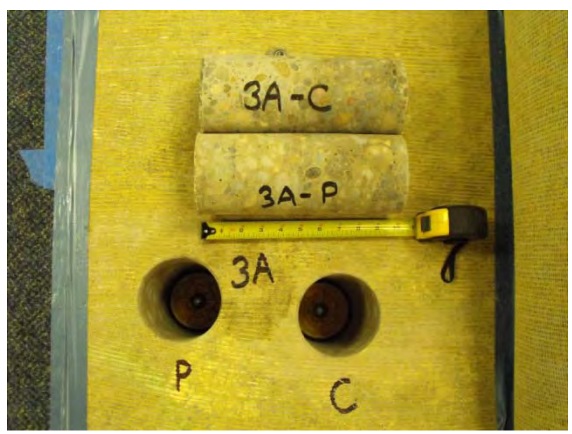
Concrete testing results showed less than designed strengths of 5000psi:

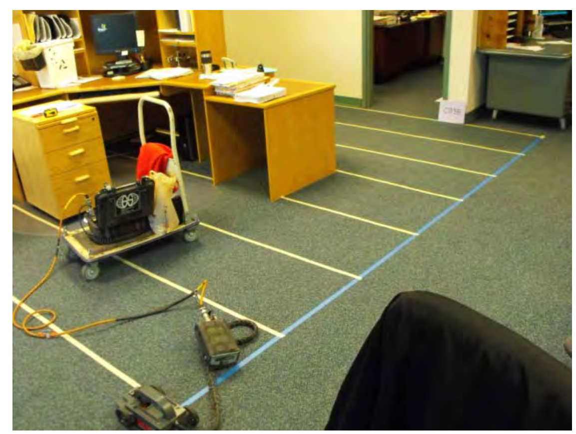
Actual strengths are:

- Ground Floor = 4360psi, 4600psi, 4424psi
- Second Floor = 3460psi, 4210psi , 3710psi, 4080psi
- Third Floor = 3960psi, 3490psi, 3800psi, 3500psi
- Fourth Floor = 4310psi, 3730psi, 4860psi, 4520psi
- Fifth Floor = 5150psi, 4240psi, 4520psi, 4510psi

Computer modeling protocol stipulates using the ACI 214 Design Manual.







MATERIAL TESTING:
PETROGRAPHIC RESULTS

Some variation in slab thickness

- ACI 117 permits up to 1/4” variation

pH low on top surface likely due to curing compound used

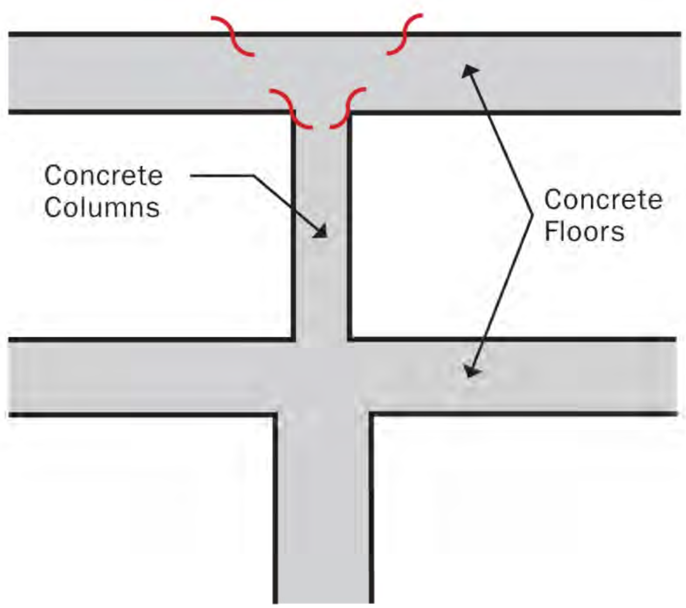
- Not a structural issue

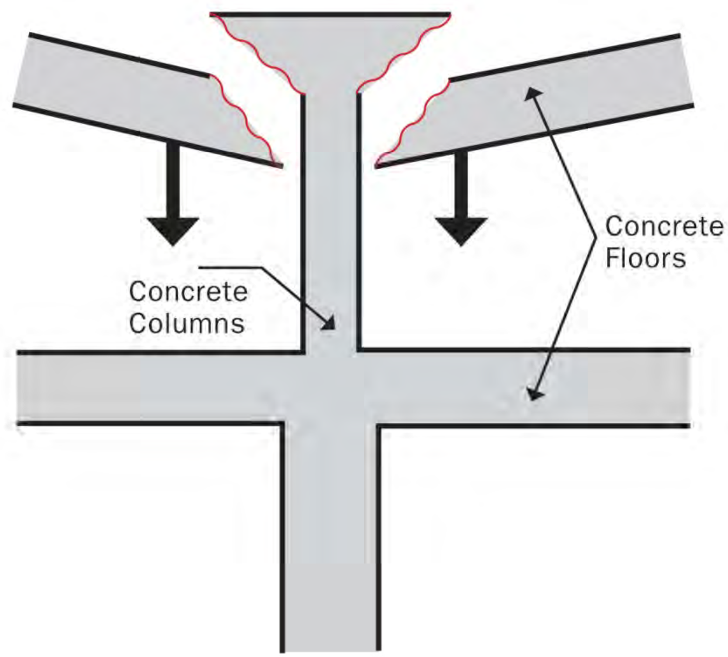
pH is high for remainder of slab which is desirable for corrosion protection

Percent of unhydrated cement

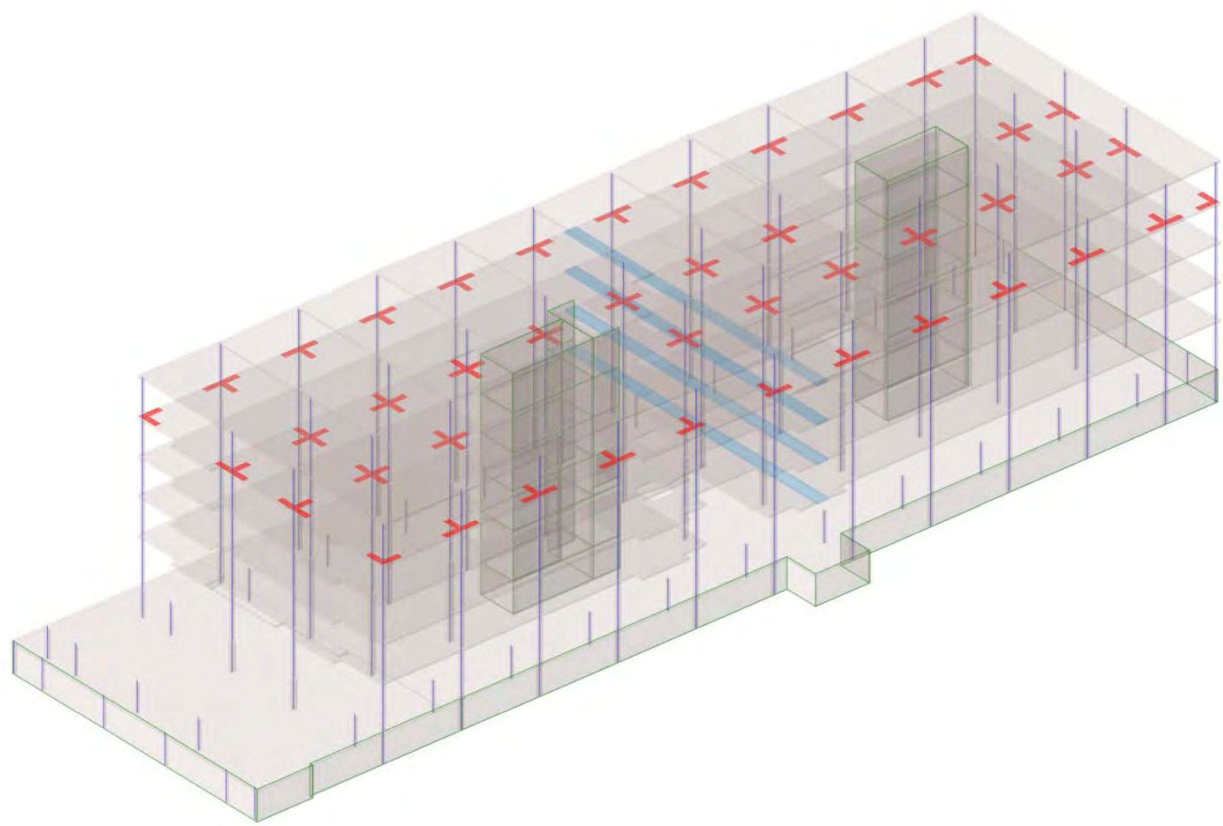
- If concrete wasn’t cured properly, water could evaporate from the mix which would not allow all particles to be hydrated (chemical curing process)

PUNCHING SHEAR





PUNCHING SHEAR



PUNCHING SHEAR

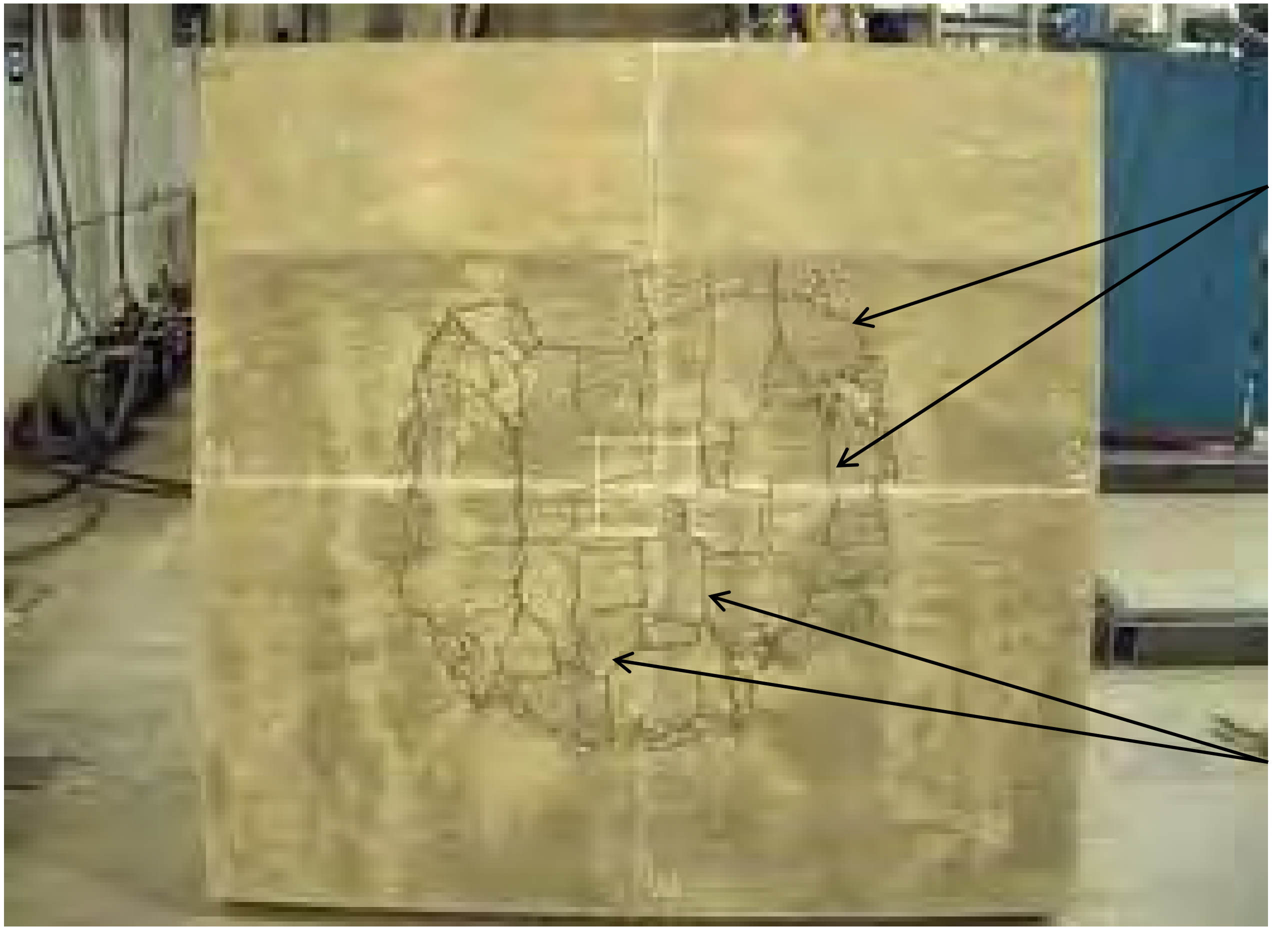
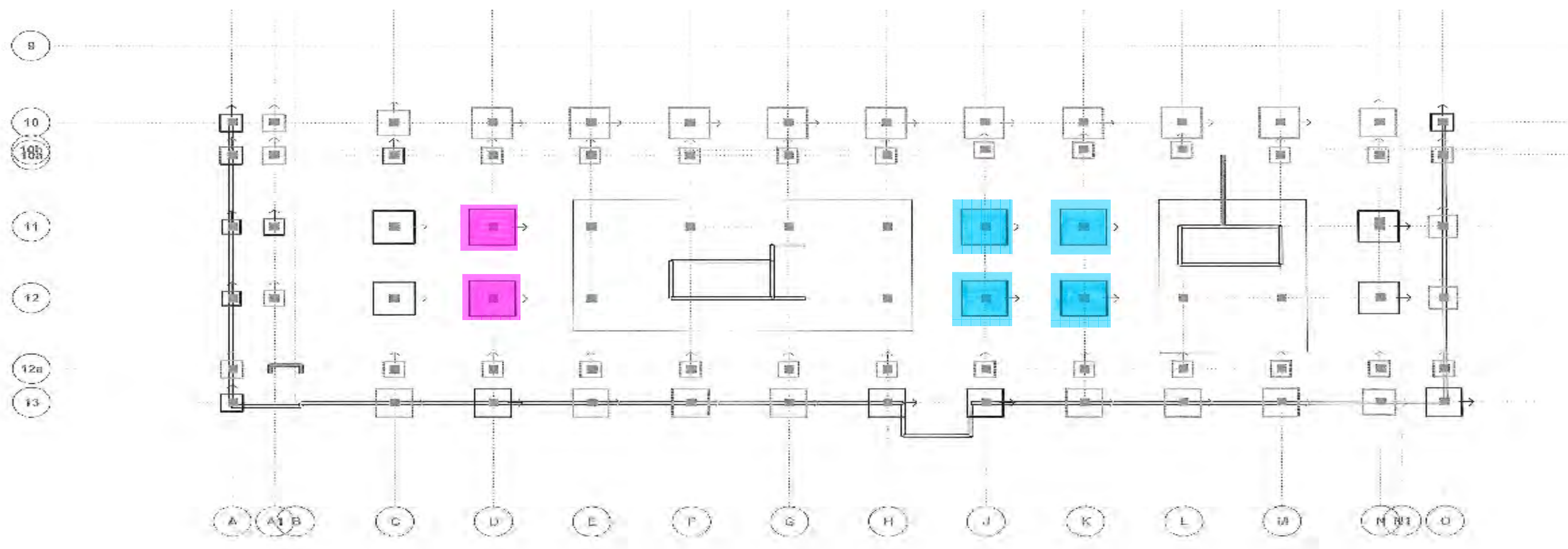


Image Source: University of Michigan-
http://www-personal.umich.edu/~gjpm/NEES%20Project%20Website/Slab.htm

PUNCHING SHEAR

PUNCHING SHEAR

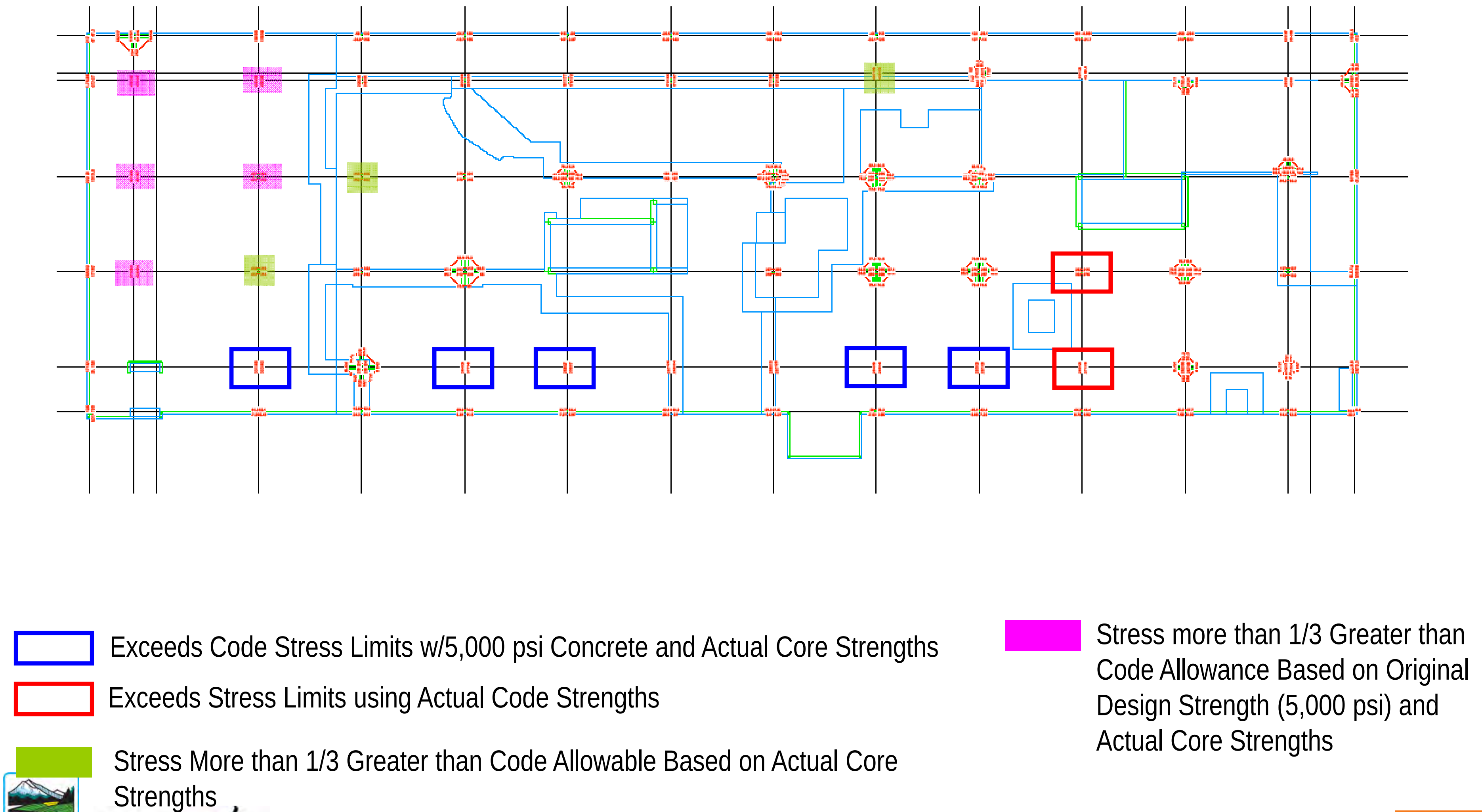
Building Footing Deficiencies



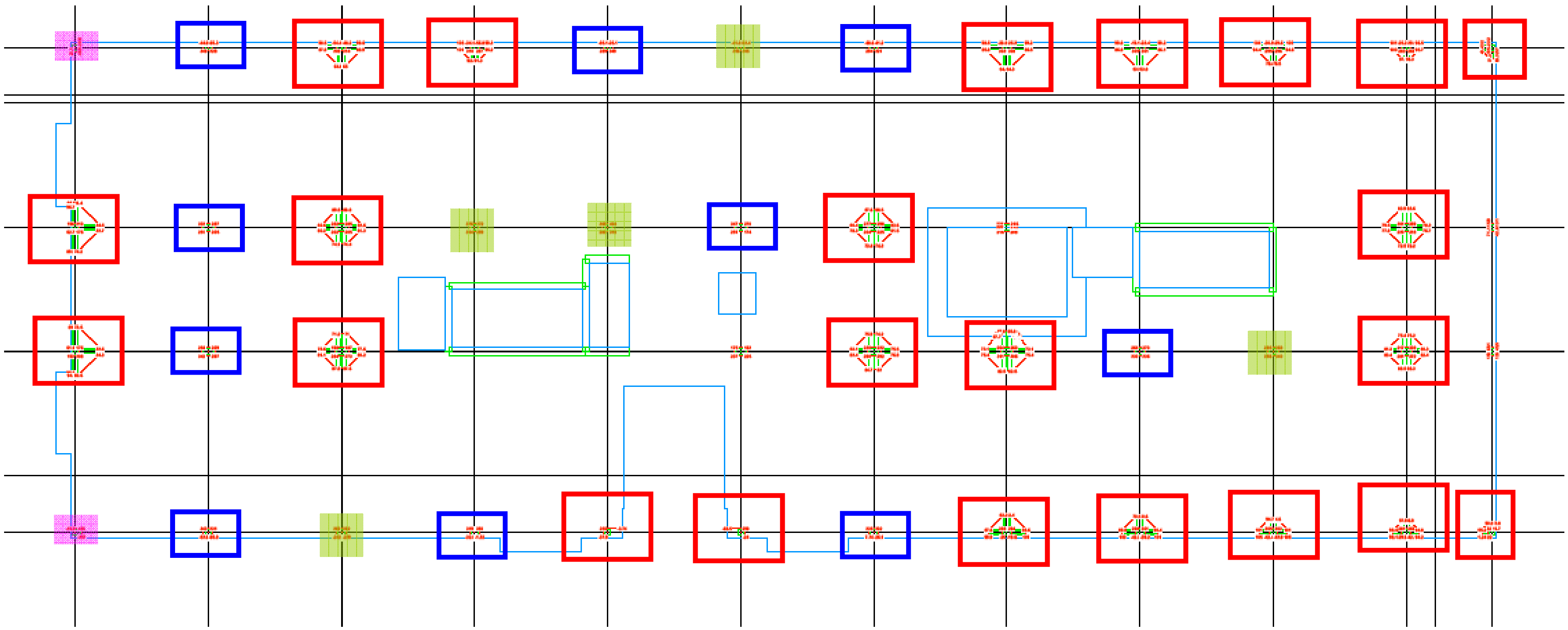
Punching Shear Stress More Than 1/3 Greater Than Code Allowance

Punching Shear Stress More Than 10% Greater Than Code Allowance

First Floor: Punching Shear Stress Plan



Second Floor: Punching Shear Stress Plan



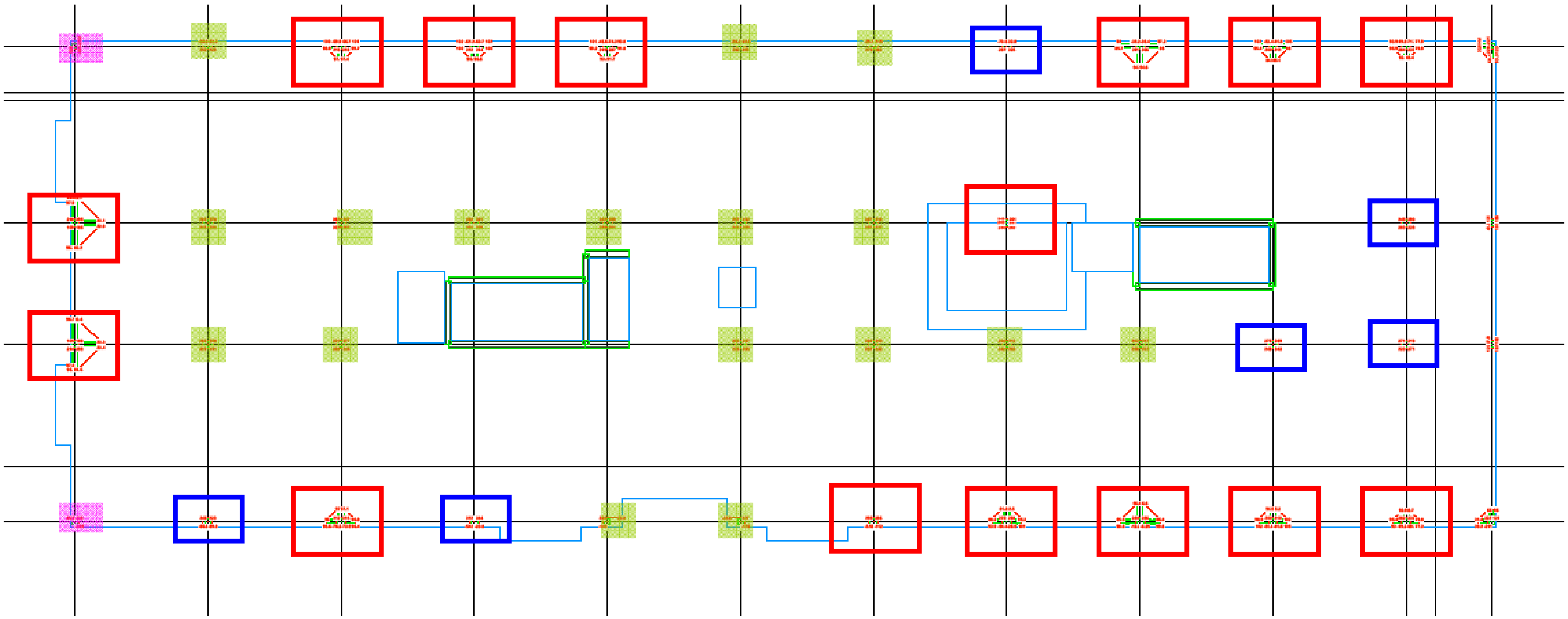
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 1/3 Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

Stress more than 1/3 Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

Third Floor: Punching Shear Stress Plan



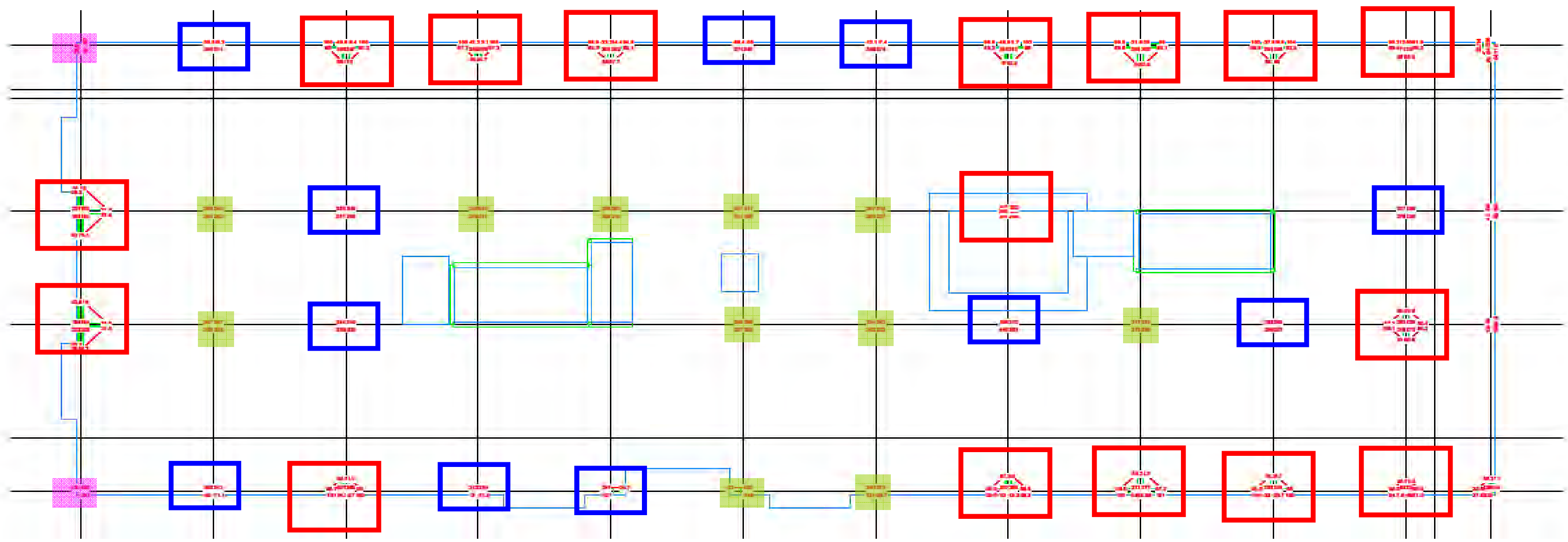
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 1/3 Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

Stress more than 1/3 Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

Fourth Floor: Punching Shear Stress Plan



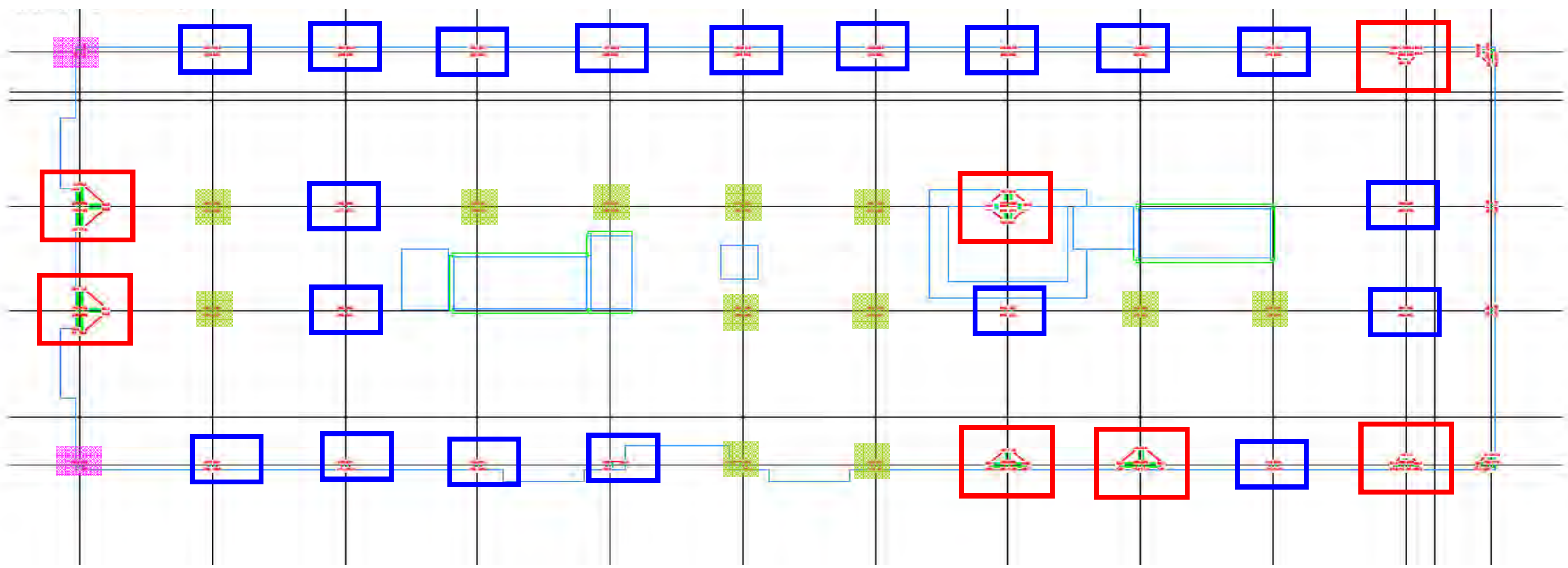
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 1/3 Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

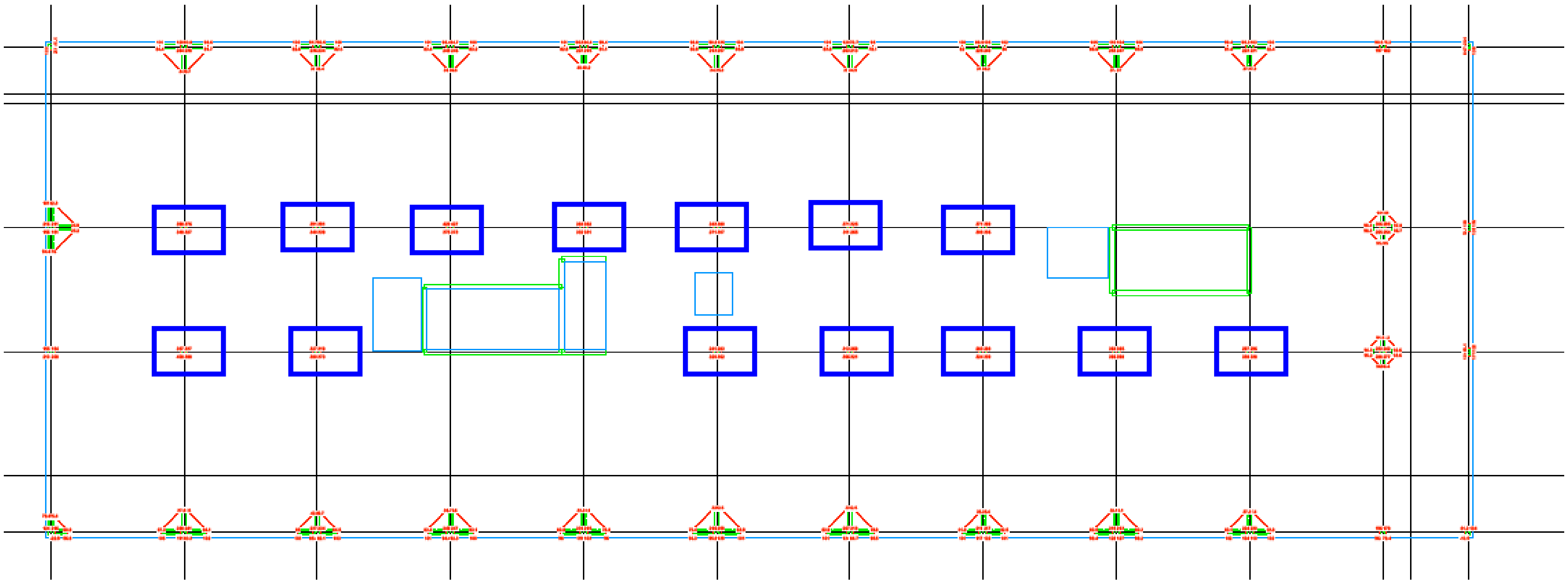
Stress more than 1/3 Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

Fifth Floor: Punching Shear Stress Plan



- Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength
- Exceeds Stress Limits using Actual Code Strengths
- Stress More than 1/3 Greater than Code Allowable Based on Actual Core Strengths (“Dangerous” Condition)
- Stress more than 1/3 Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths (“Dangerous” Condition)

Roof: Punching Shear Stress Plan



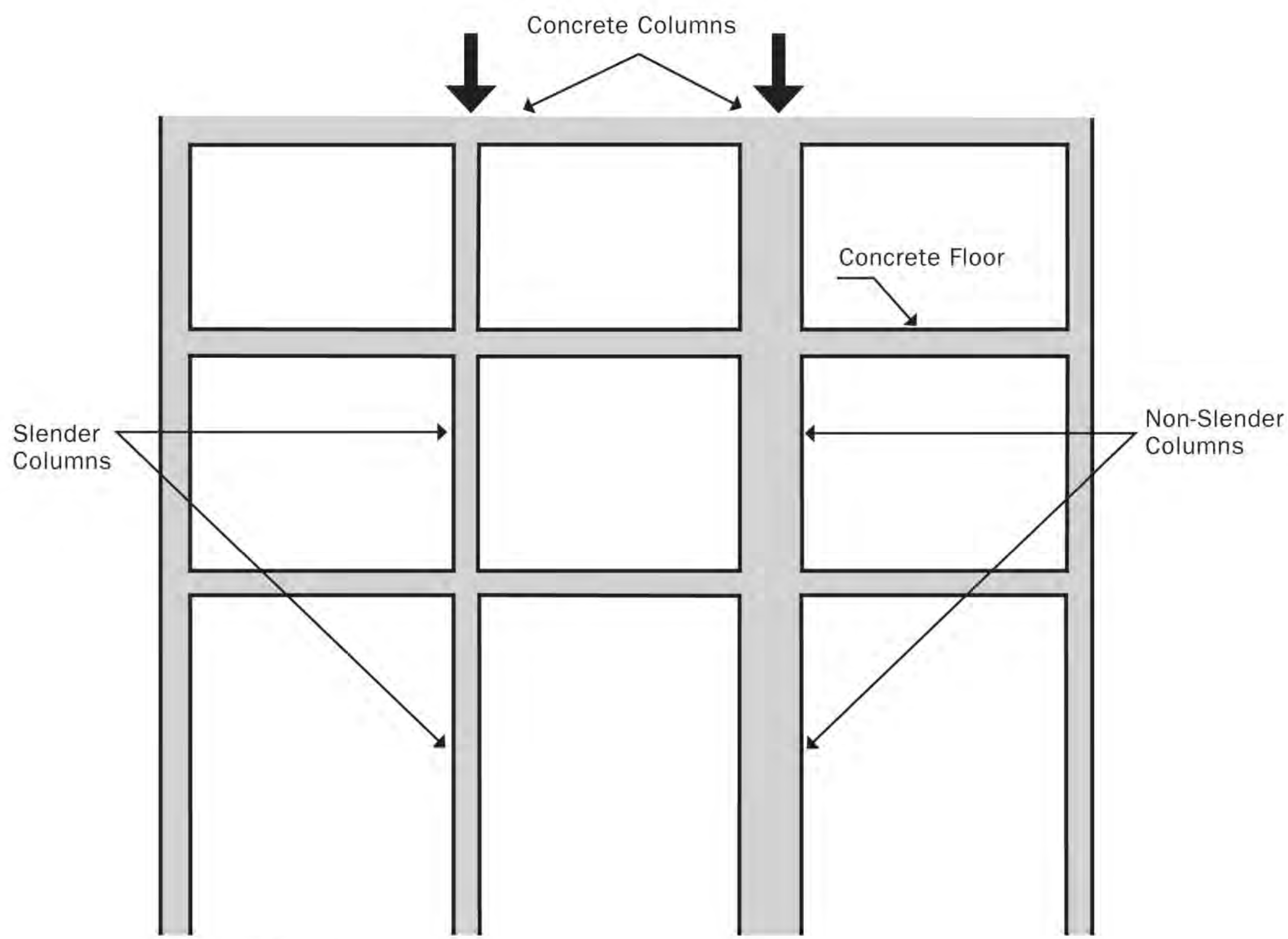
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 1/3 Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

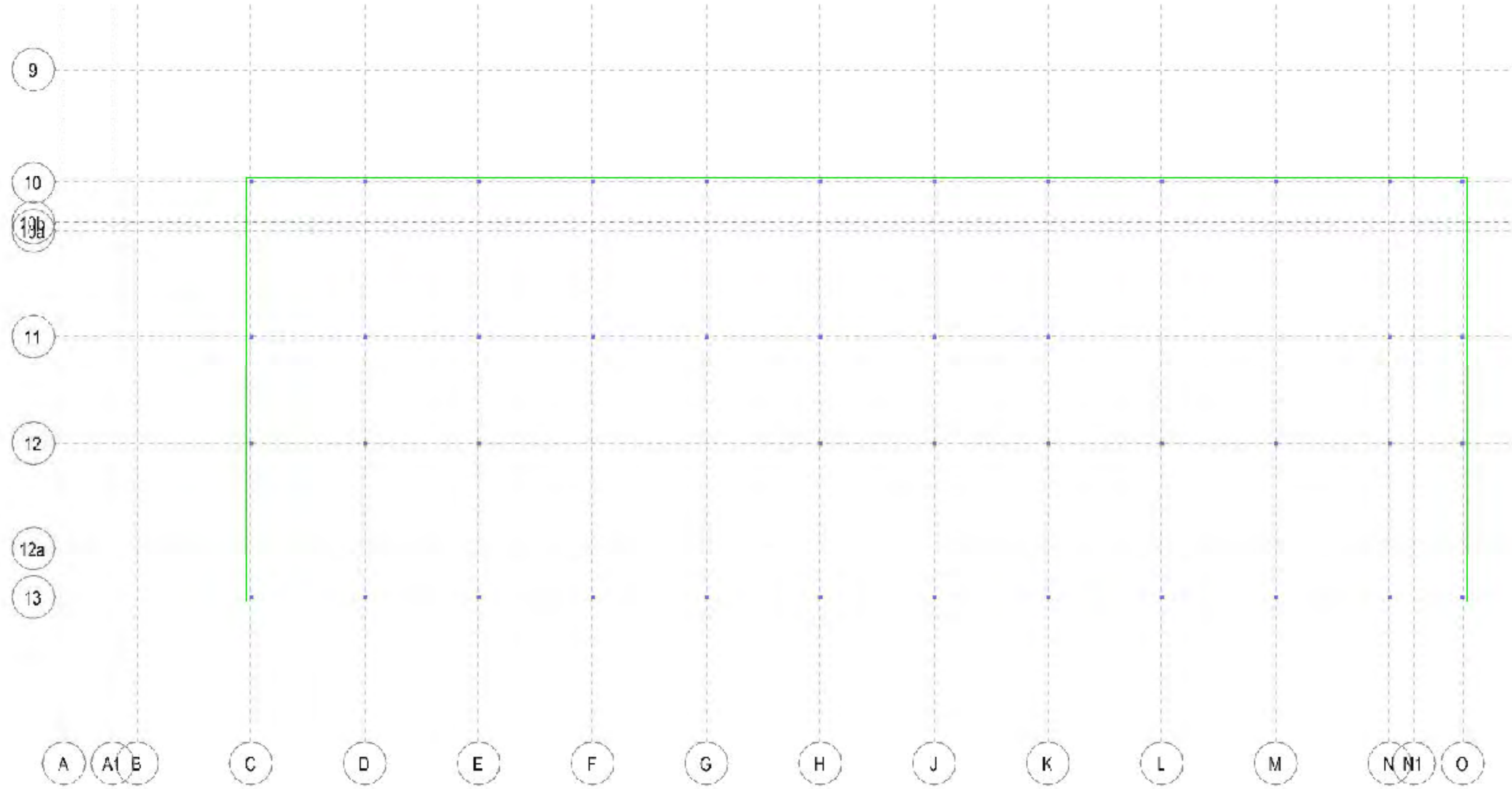
Stress more than 1/3 Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

COLUMN DESIGN



Column Design

Roof Columns

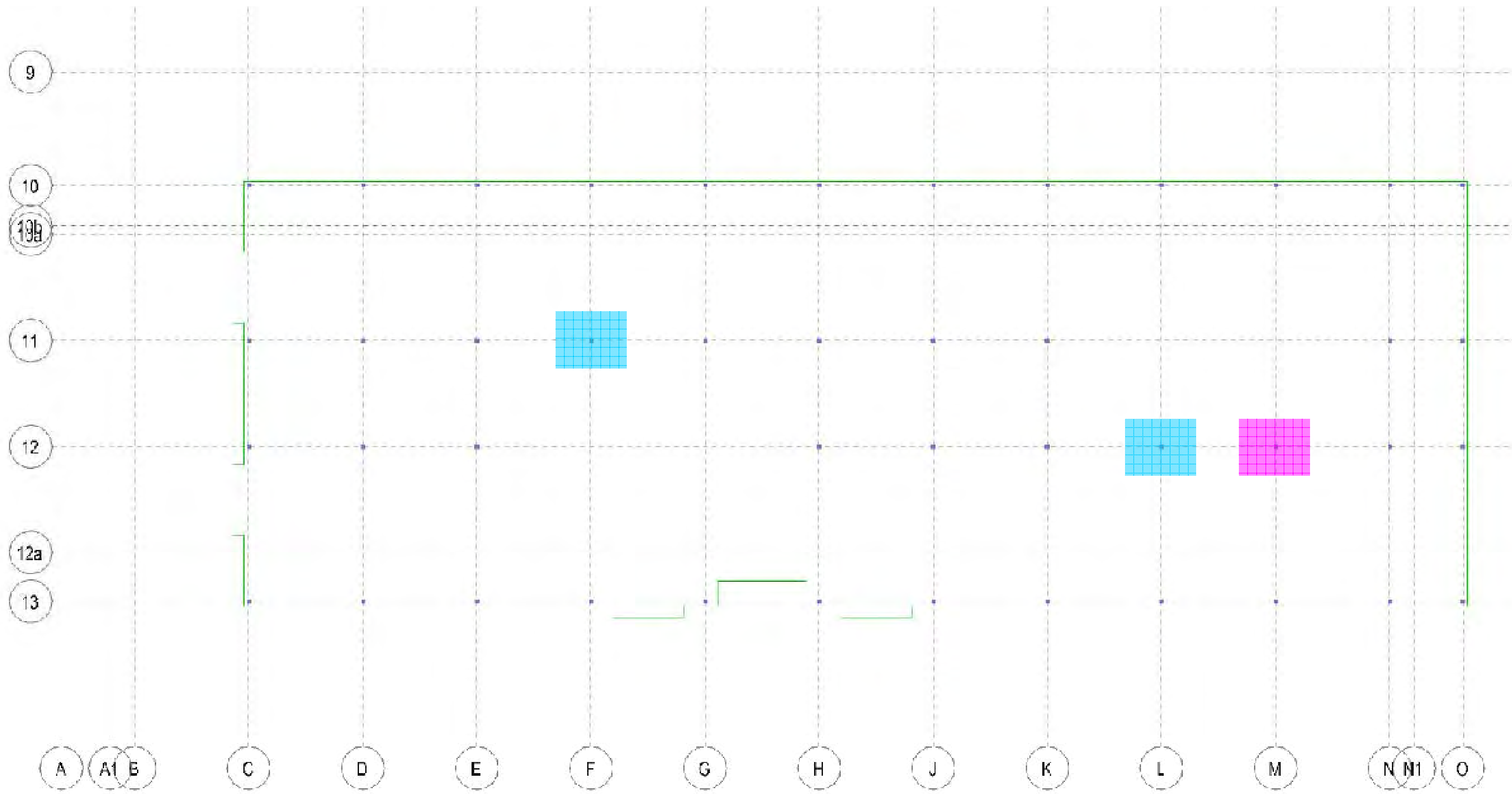


All Columns within 10% of Design Capacity

More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

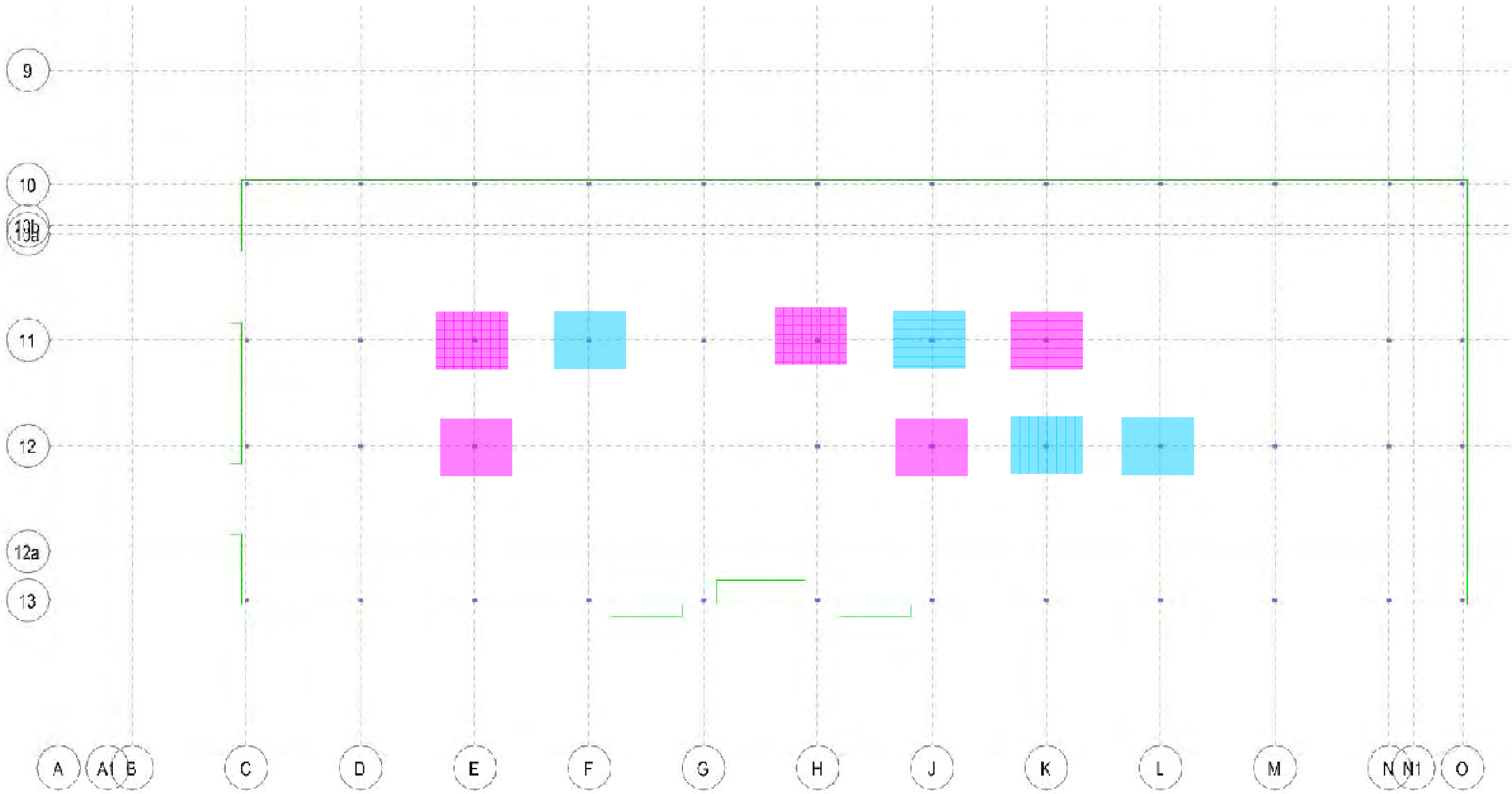
Fifth Floor Columns



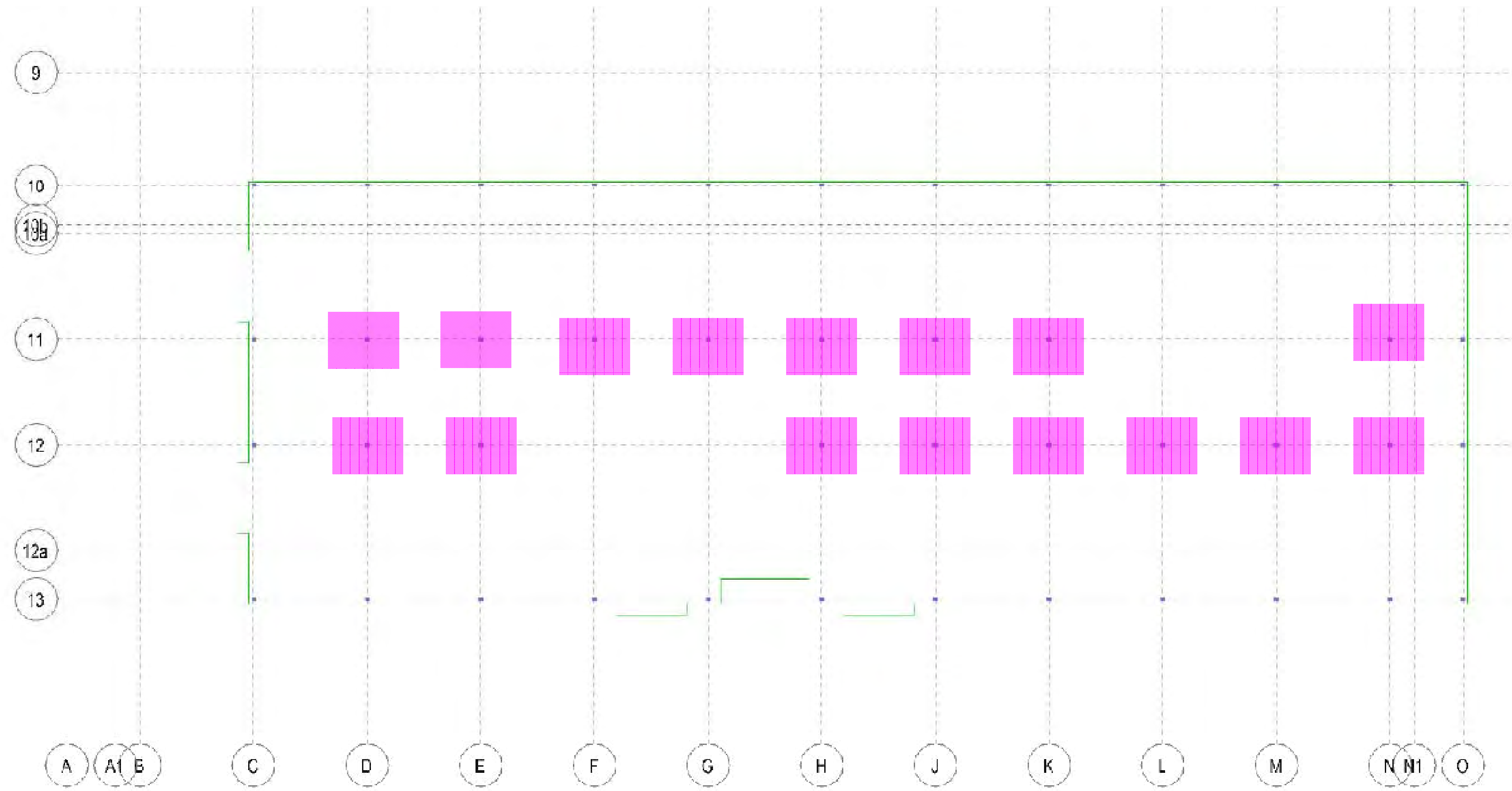
More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

Fourth Floor Columns



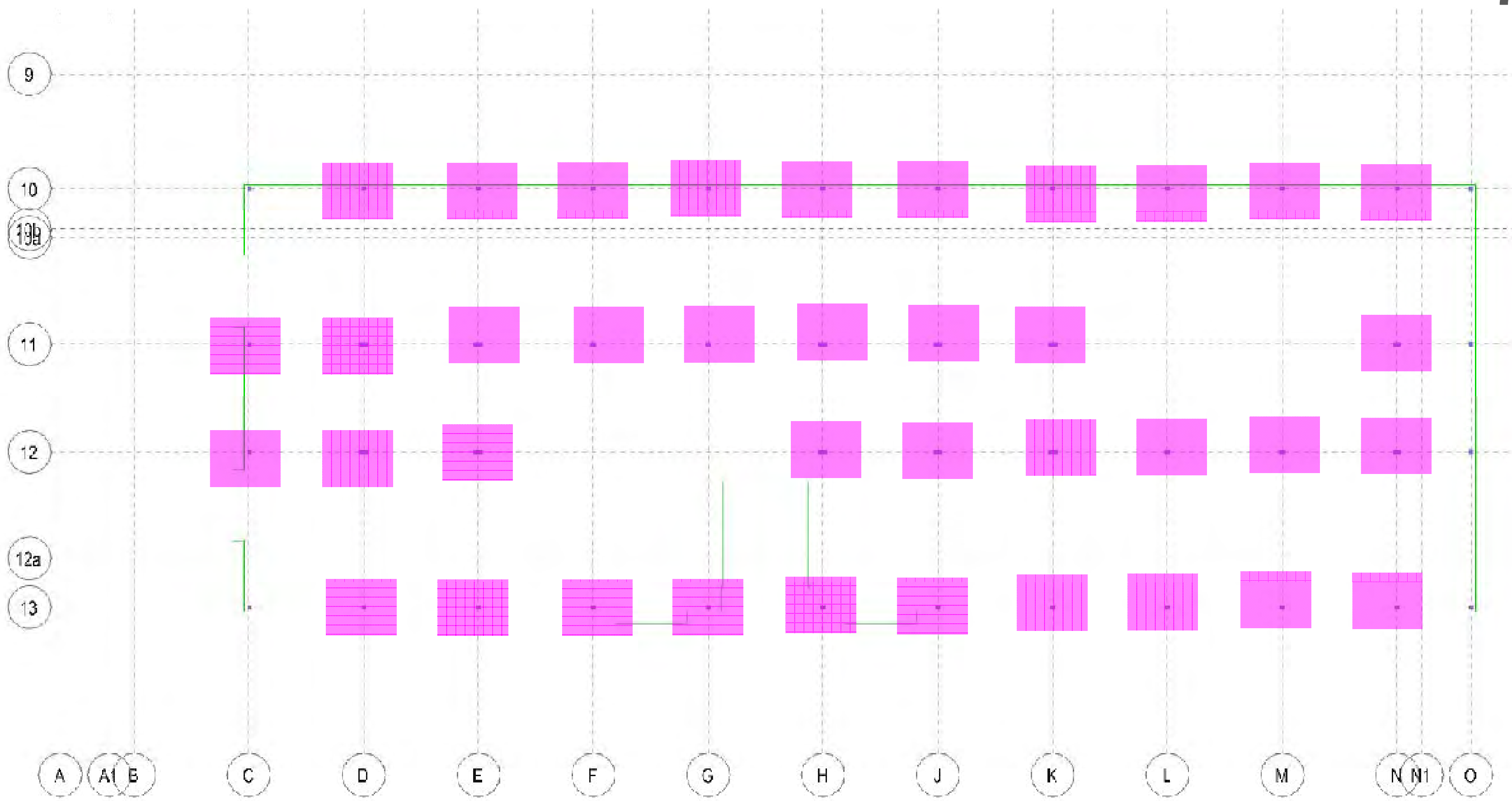
Third Floor Columns



More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

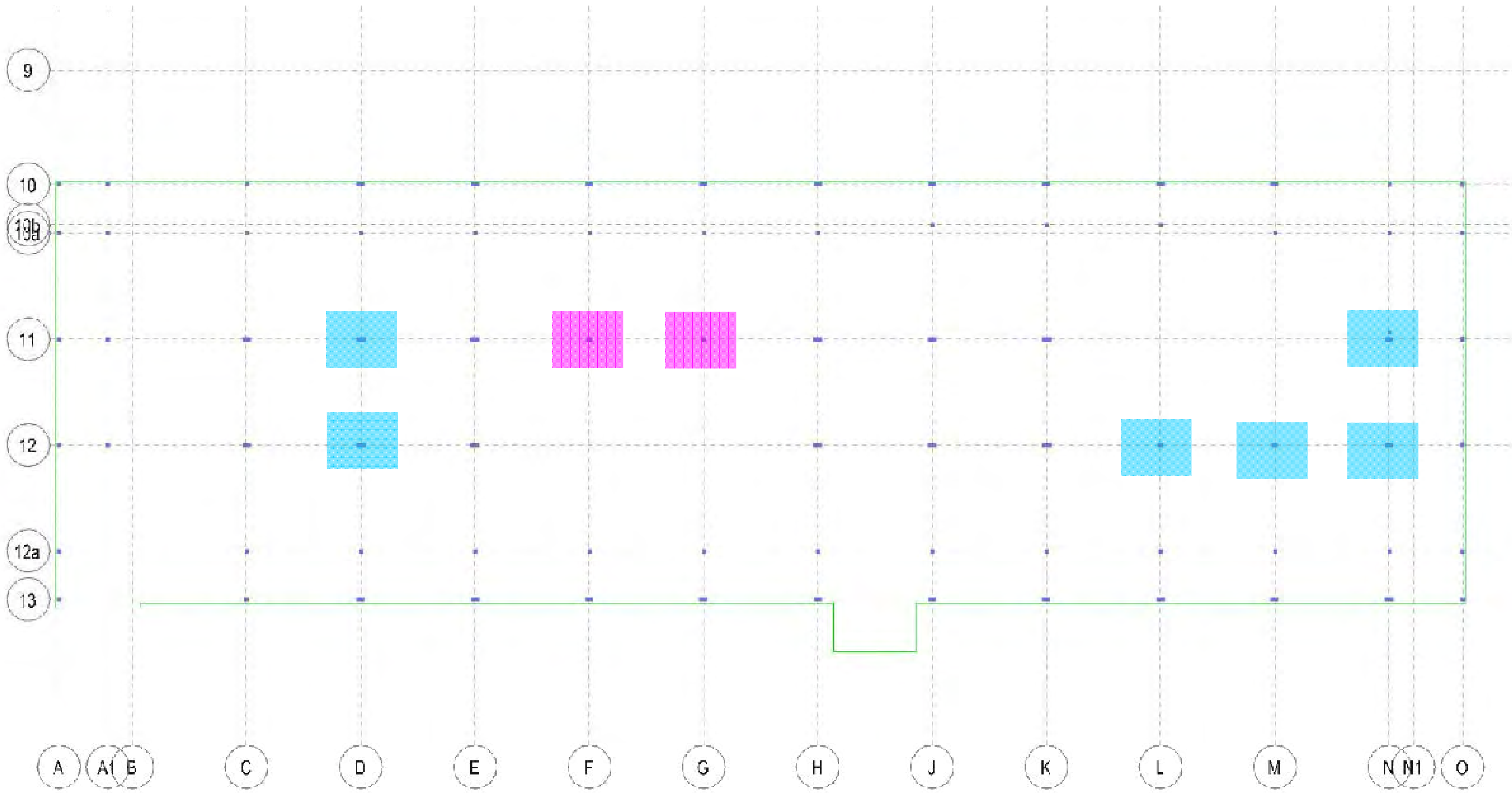
Second Floor Columns



More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

First Floor Columns



More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

OTHER OBSERVATIONS

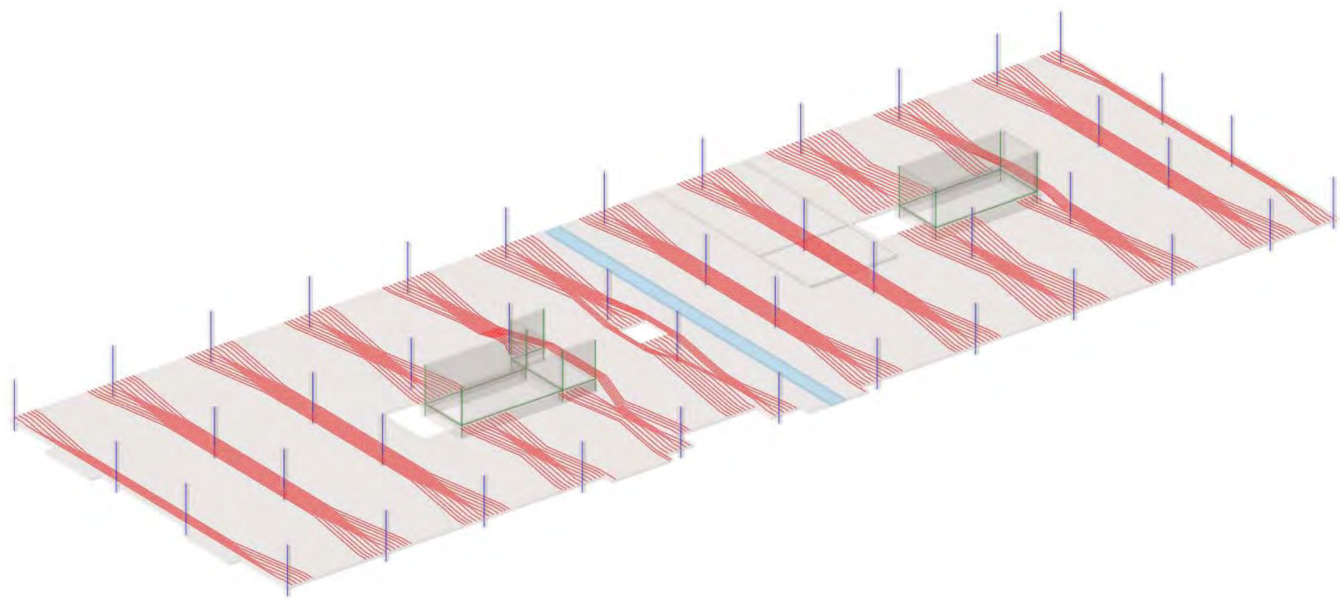
- Design Issues
- Construction Issues
- Material Quality Issues
- Building Equipment
- Geotechnical Survey

DESIGN ISSUES: Detailing

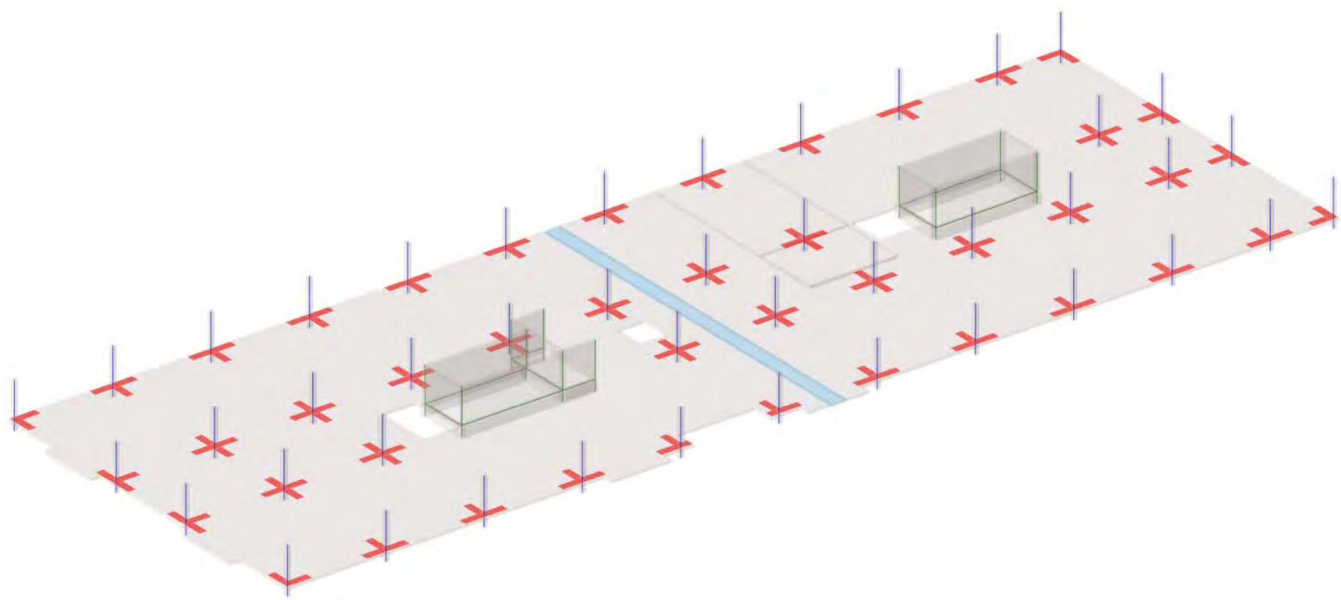
DESIGN ISSUES: Detailing

DESIGN ISSUES: Detailing

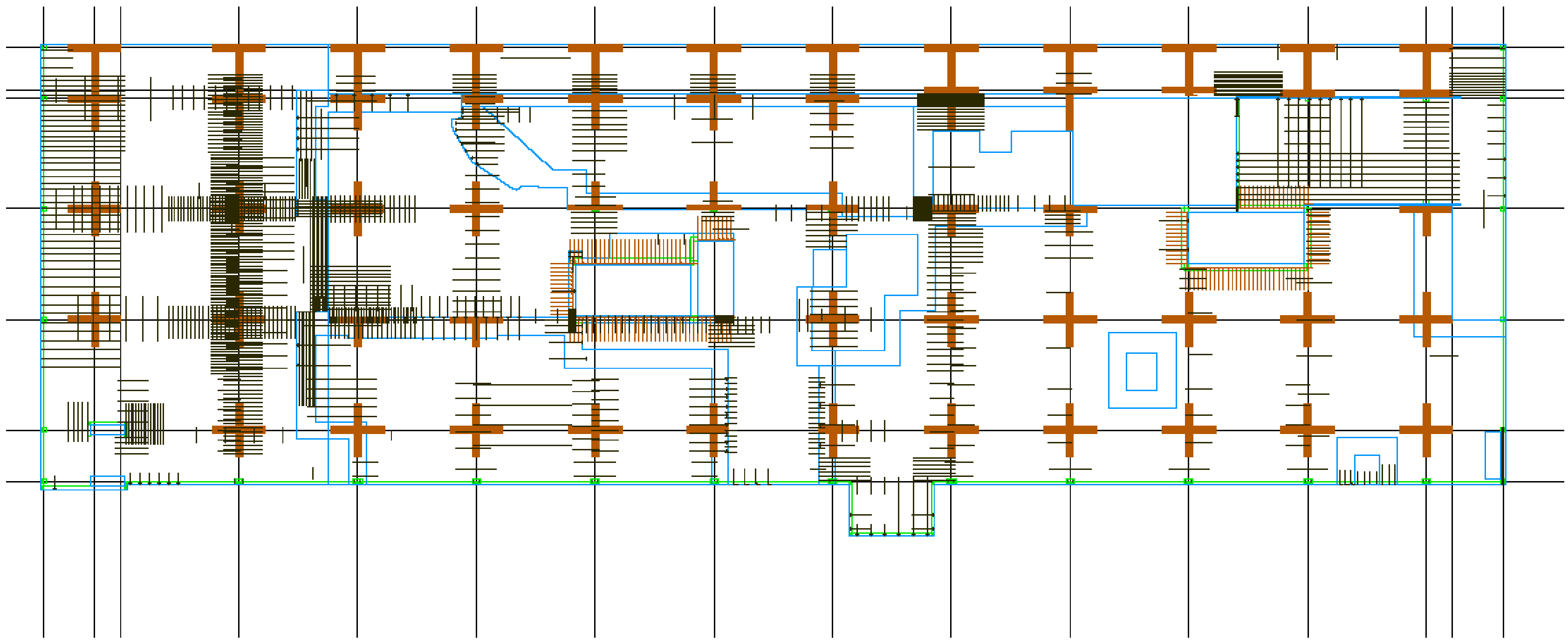
DESIGN ISSUES: Structural Design



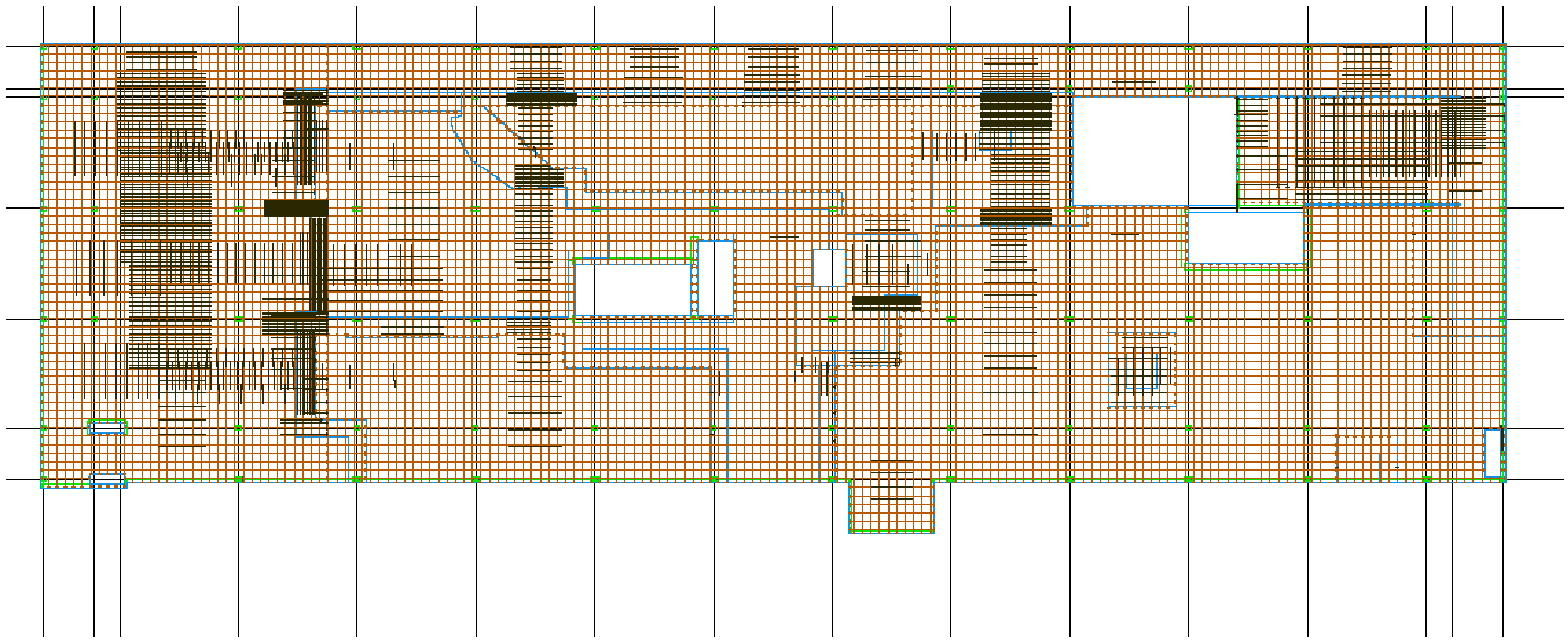
DESIGN ISSUES: Structural Design



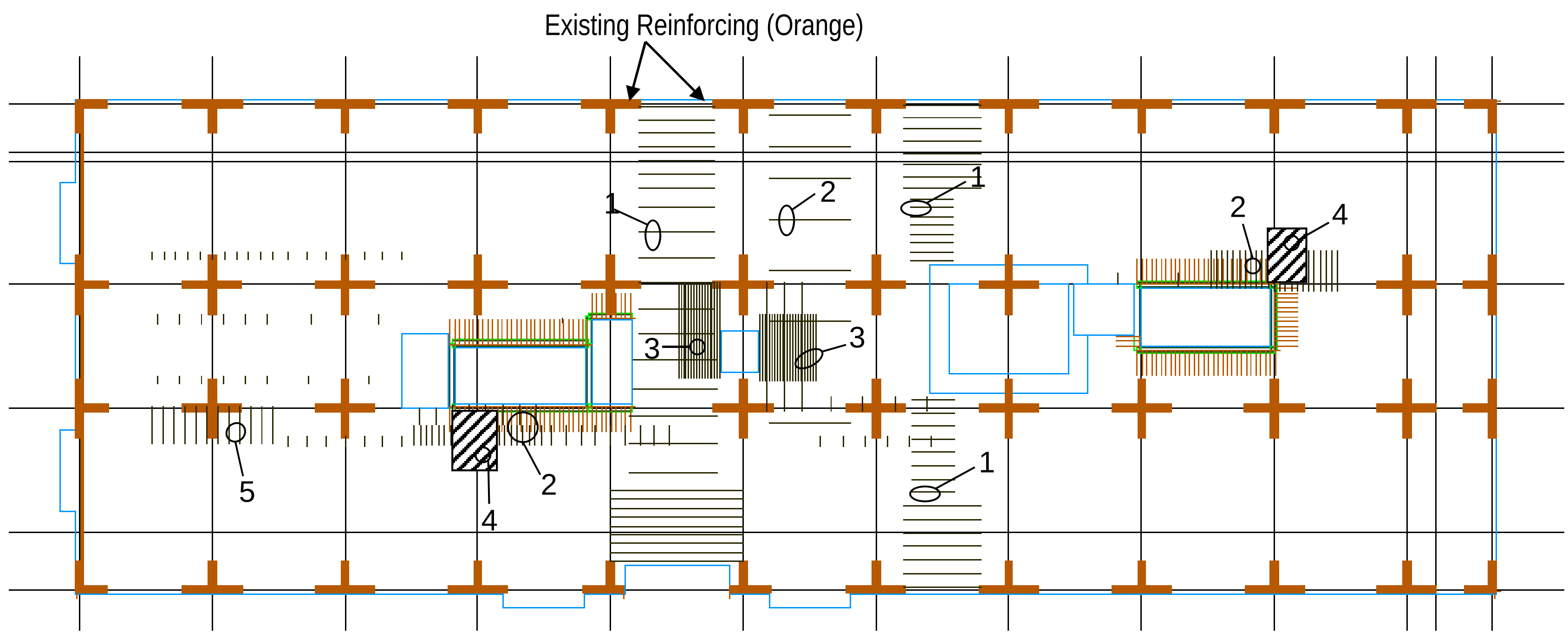
Typical Slab Top Reinforcing Steel Deficiencies at First Floor



Typical Slab Bottom Reinforcing Steel Deficiencies at First Floor



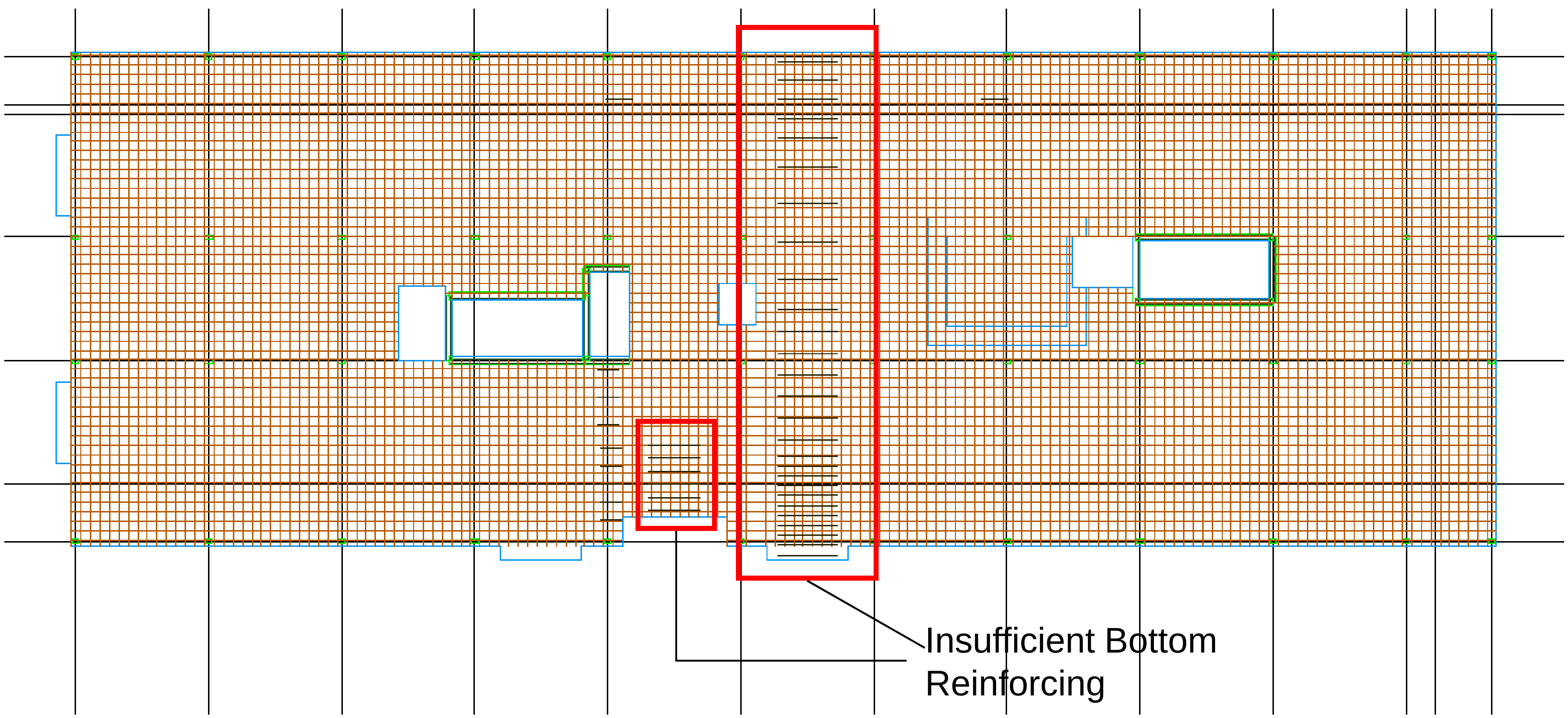
Typical Slab Top Reinforcing Steel Deficiencies at 2nd-5th Floors + Roof



<u>Keynotes</u>

1. Insufficient Top Reinforcing under Service Loads
2. Insufficient Top Reinforcing for Flexural Strength
3. Insufficient Top Reinforcing for Service and Strength
4. Column strip top Stress Exceeded
5. Insufficient Top Reinforcing Steel at 3rd, 4th Floors

Typical Slab Bottom Reinforcing Steel Deficiencies at Floors 2 - Roof



DESIGN ISSUES: Structural Design

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Page: 9
12/29/1998 @ 02:39:56pm

4 = EDGE COLUMN (PARALLEL TO SPAN)
5 = BEAM OR WALL (PUNCHING SHEAR CHECK NOT APPLICABLE)
6 = STRIP TOO NARROW TO DEVELOP PUNCHING SHEAR

SE......... 1 = STRESS WITHIN SECTION #1 GOVERNS (COL.CAP OR SLAB)
2 = STRESS WITHIN SECTION #2 GOVERNS (DROP PANEL OR SLAB)

		FACTORED ACTIONS		<- PUNCHING SHEAR STRESSES IN psi->					
		shear	moment	due to	due to		allow-	STRESS	
JNT	COND.	k	k-ft	shear	moment	TOTAL	able	RATIO	CASE
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
1	5	-------	-------	------	------	------	------	----	--
2	1	612.91	80.06	785.21	63.88	849.09	316.62	2.68	1
3	1	588.31	66.73	753.71	53.25	806.95	316.62	2.55	1
4	1	515.48	74.86	660.40	59.74	720.13	291.12	2.47	1
5	1	189.53	8.06	242.81	6.43	249.24	291.12	.86	1
6	1	501.09	79.19	641.96	63.19	705.15	291.12	2.42	1
7	1	590.86	53.52	756.97	42.71	799.67	291.12	2.75	1
8	5	-------	-------	------	------	------	------	----	--

STRESS RATIOS EXCEED ALLOWABLE VALUES, REVISE SECTION GEOMETRY.

CONSTRUCTION ISSUES

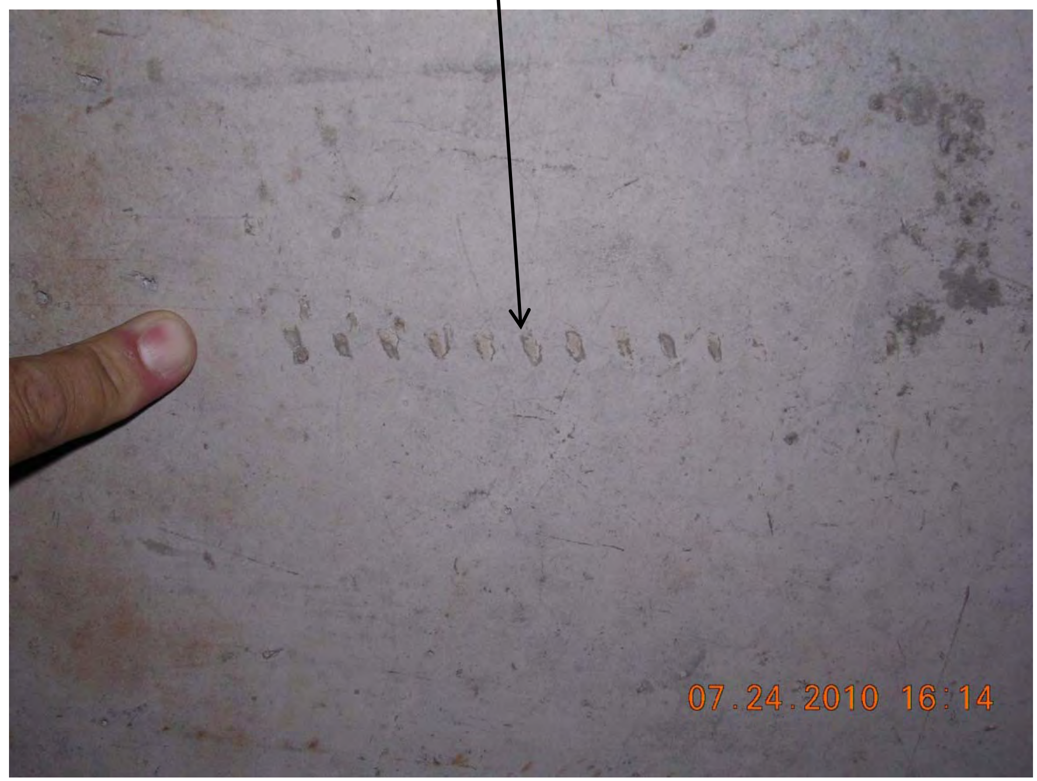
Wood Chips Cast Into Concrete Column

Poor construction methods were used during the construction of the slab; as a full layer of debris was allowed to be cast into the concrete column at Fourth Floor Grid D-13 effectively placing a bond breaker approximately 2' below the fifth floor slab. The screw driver was easily driven approximately 2" into the concrete column.

CONSTRUCTION ISSUES

CONSTRUCTION ISSUES

Reinforcing bar exposed at the bottom of the Bus Mall slab.

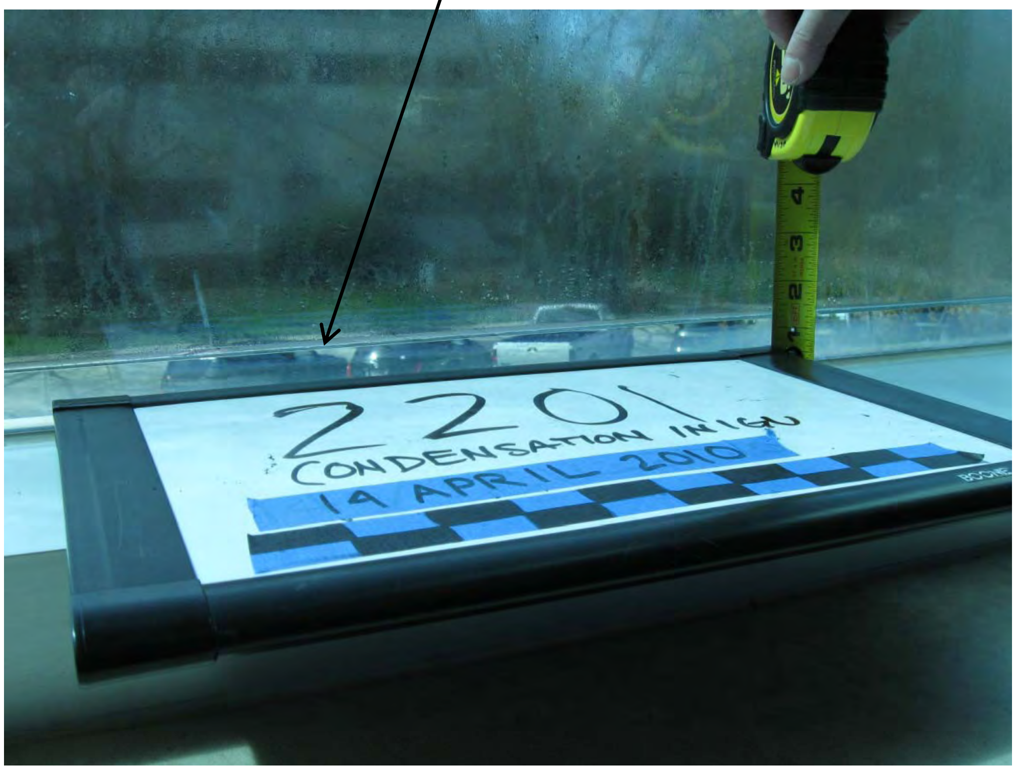


CONSTRUCTION ISSUES

Debris on the form work cast into the Bus Mall slab.

MATERIAL QUALITY ISSUES

Standing water in window



MATERIAL QUALITY ISSUES: Concrete Design

- Concrete Strength- Designed for 5000psi; tested on average of 4151psi.
- Fiber reinforcement was designed in but not found in the concrete. Fiber is used for ductility and to reduce cracking from shrinkage.
- All concrete mixes required air entrainment. This created more than normal voids.

BUILDING EQUIPMENT

Areas visually observed include:

- Main duct risers (east and west shafts)
- Ductwork, sprinkler piping, electrical equipment above ceiling at worst deflection
- Basement fan rooms and duct connections
- Gas pipe riser at the street

BUILDING EQUIPMENT

Equipment damaged related to building movement include:

- Intake louver at parking garage ramp
- Fan room wall cracks in the Basement
- Fan housekeeping pad cracked

BUILDING EQUIPMENT

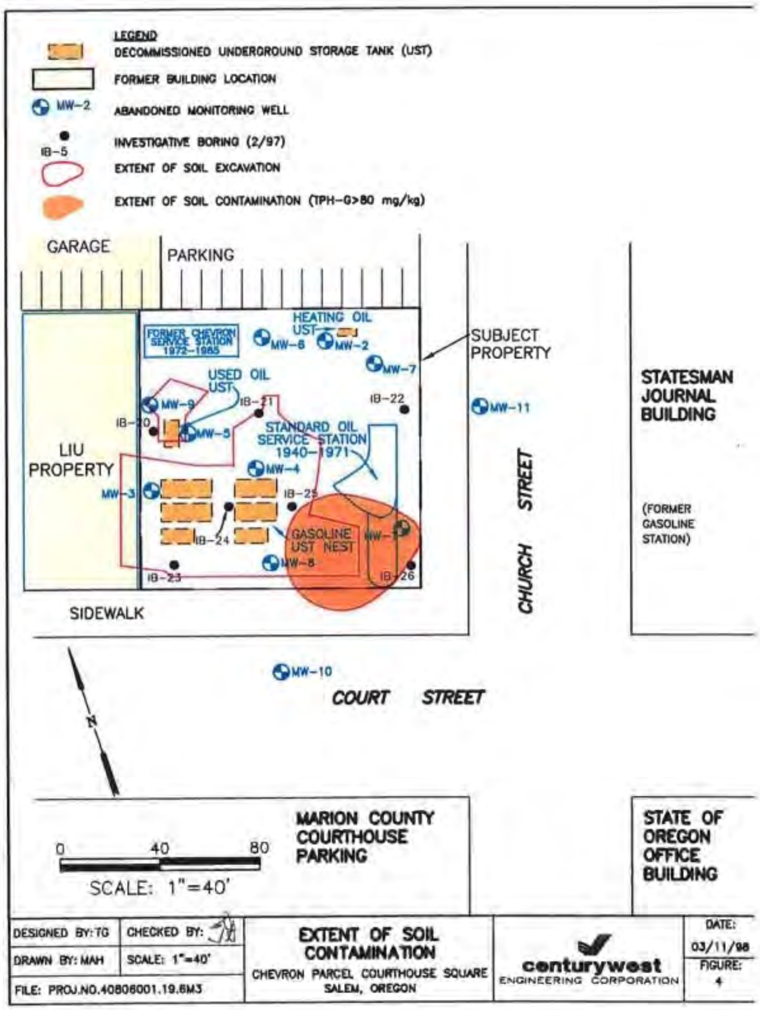
A note of special concern

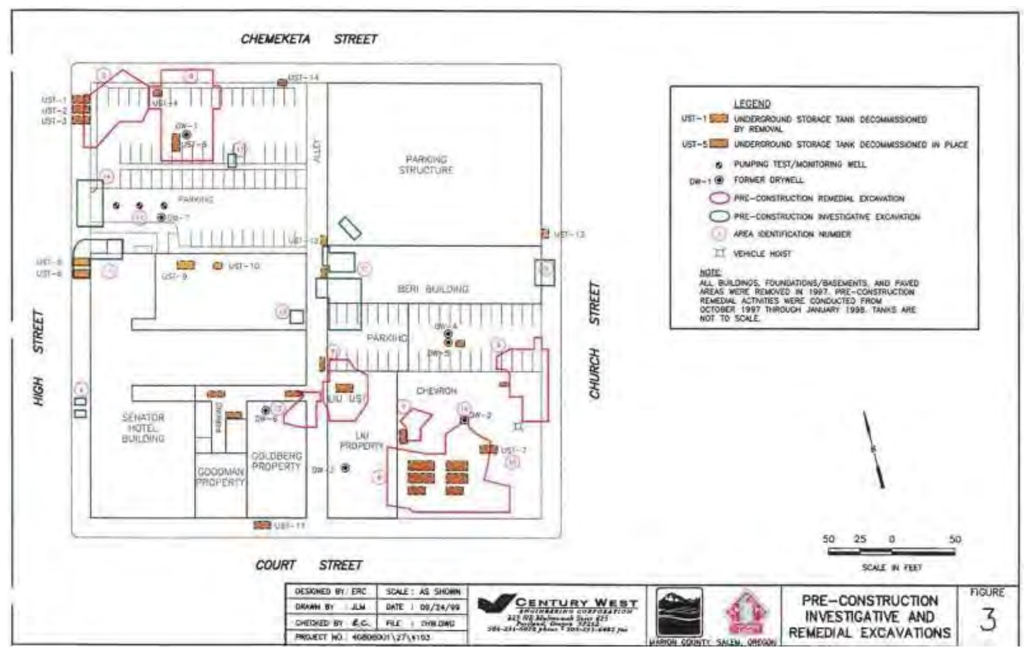
- Fire/ smoke damper access panels should be installed at west shaft
- Equipment wear and tear

GEOTECHNICAL SURVEY

- Remediation excavations up to 20 feet prior to site development
- Century West reports indicated placement of temporary loose soils but didn't document removal
- Excavations were backfilled and compacted according to specifications.

GEOTECHNICAL SURVEY





GEOTECHNICAL SURVEY

Summary of structure based on as-designed conditions

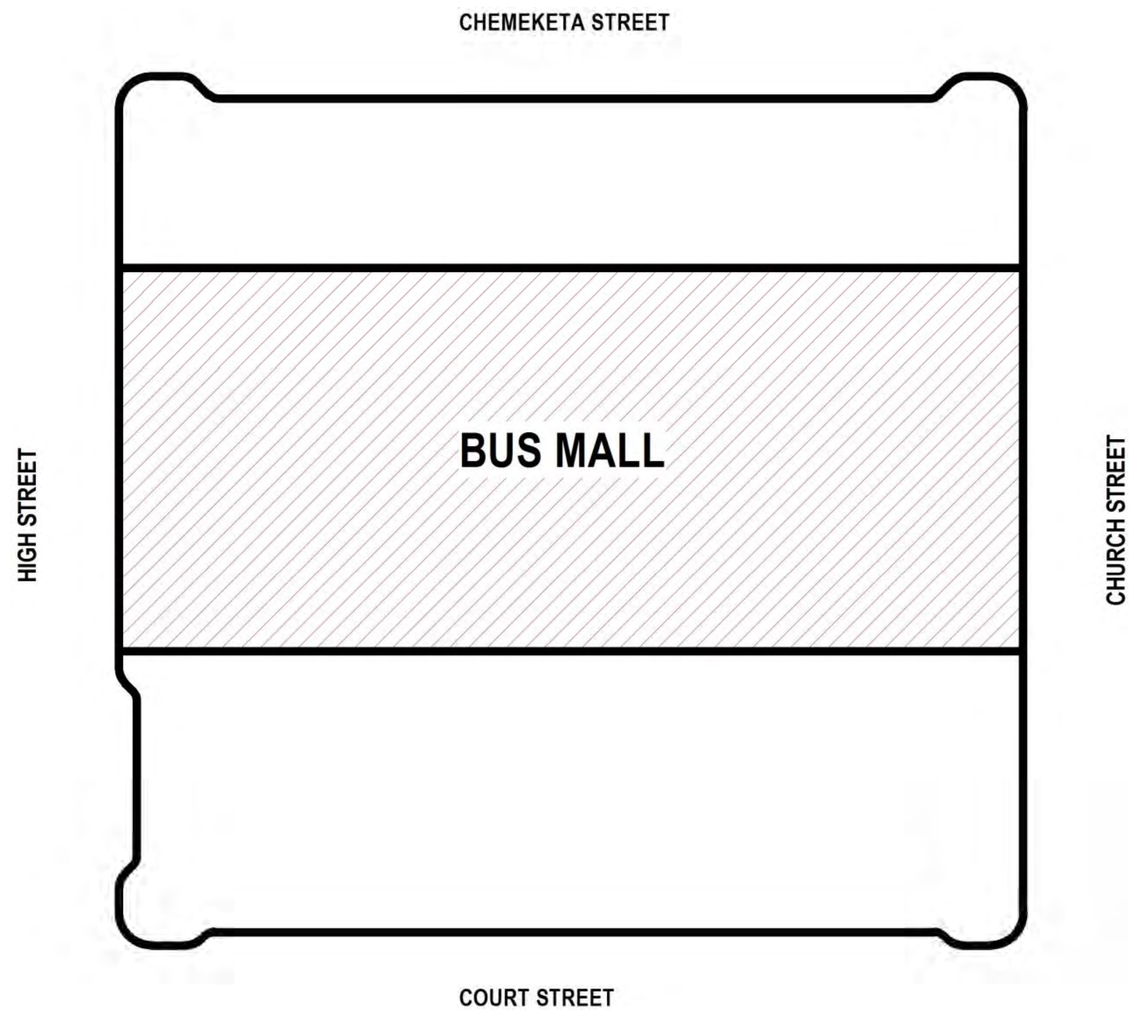
Foundation/Soil

a. Appears all footings designed for 6,000 psf
b. Per discussions w/GeoDesign, likely to have structural fill present below all footings
c. Original geotech report notes to use 2,500 psf for footings on fill. However, GeoDesign still would expect only 1-2” of immediate settlement of footings on fill. Would not continue long term
d. Foundation soil bearing not likely to be contributing factor to condition of structural problems

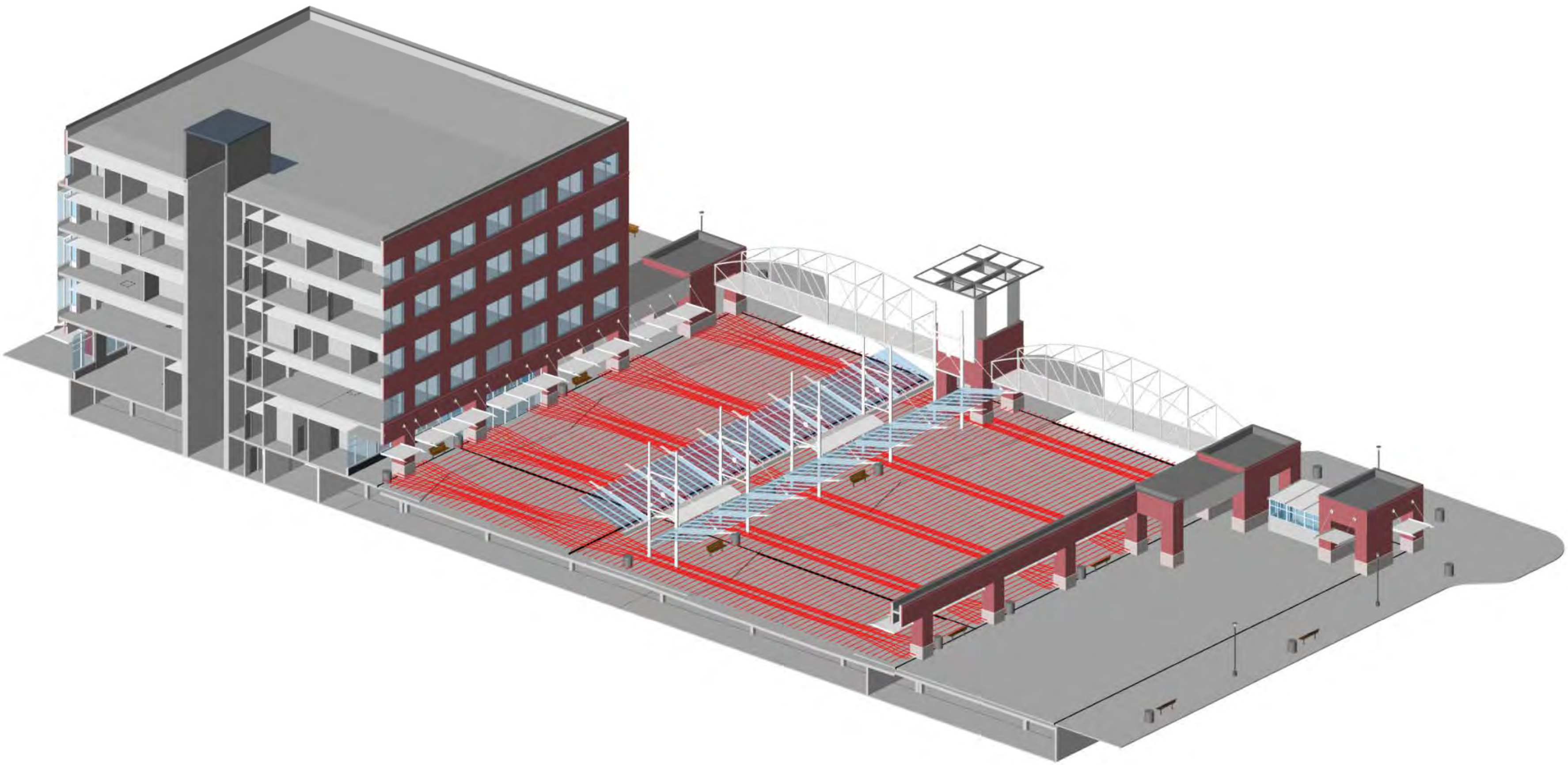
WHAT HAS CHANGED?

- Bus Mall Structure
  - Action Plan and immediate Action
- Building Structure
  - Action Plan and Immediate Action
- Bus Mall Pavers

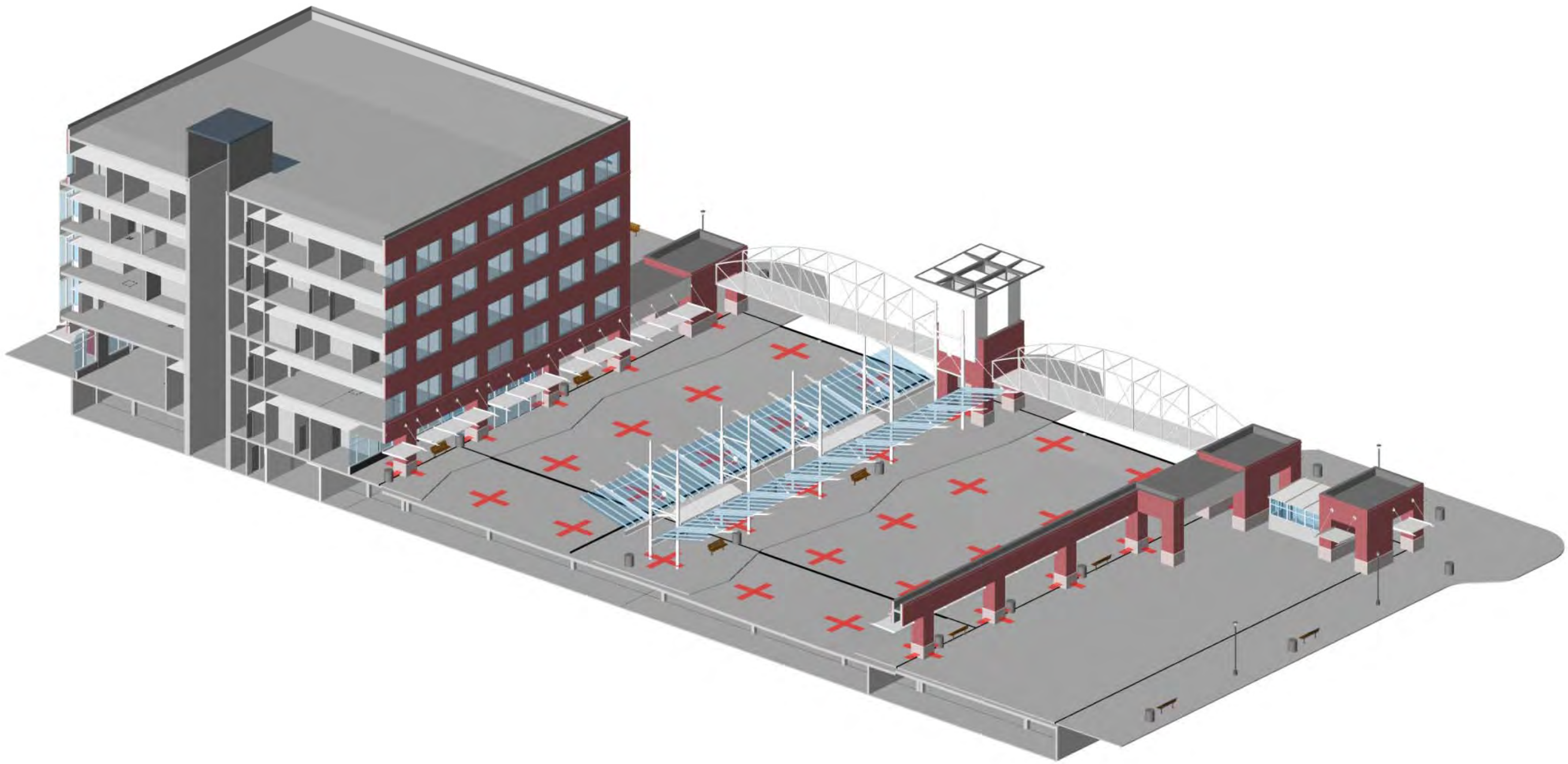
BUS MALL STRUCTURE



BUS MALL STRUCTURE



BUS MALL STRUCTURE



BUS MALL SITE OBSERVATION

BUS MALL SITE OBSERVATION

Observations include:

- Cracking of the foundation wall
- Cracking of non-structural members
- Cracks at columns with significant damage due to water infiltration

BUS MALL WATER INTRUSION

Significant Cracking in Concrete Column at Grid M-10a

Cracking has occurred at the concrete column at Grid M-10a, as well as moisture penetrating through the basement concrete walls and causing damage to the concrete structure.

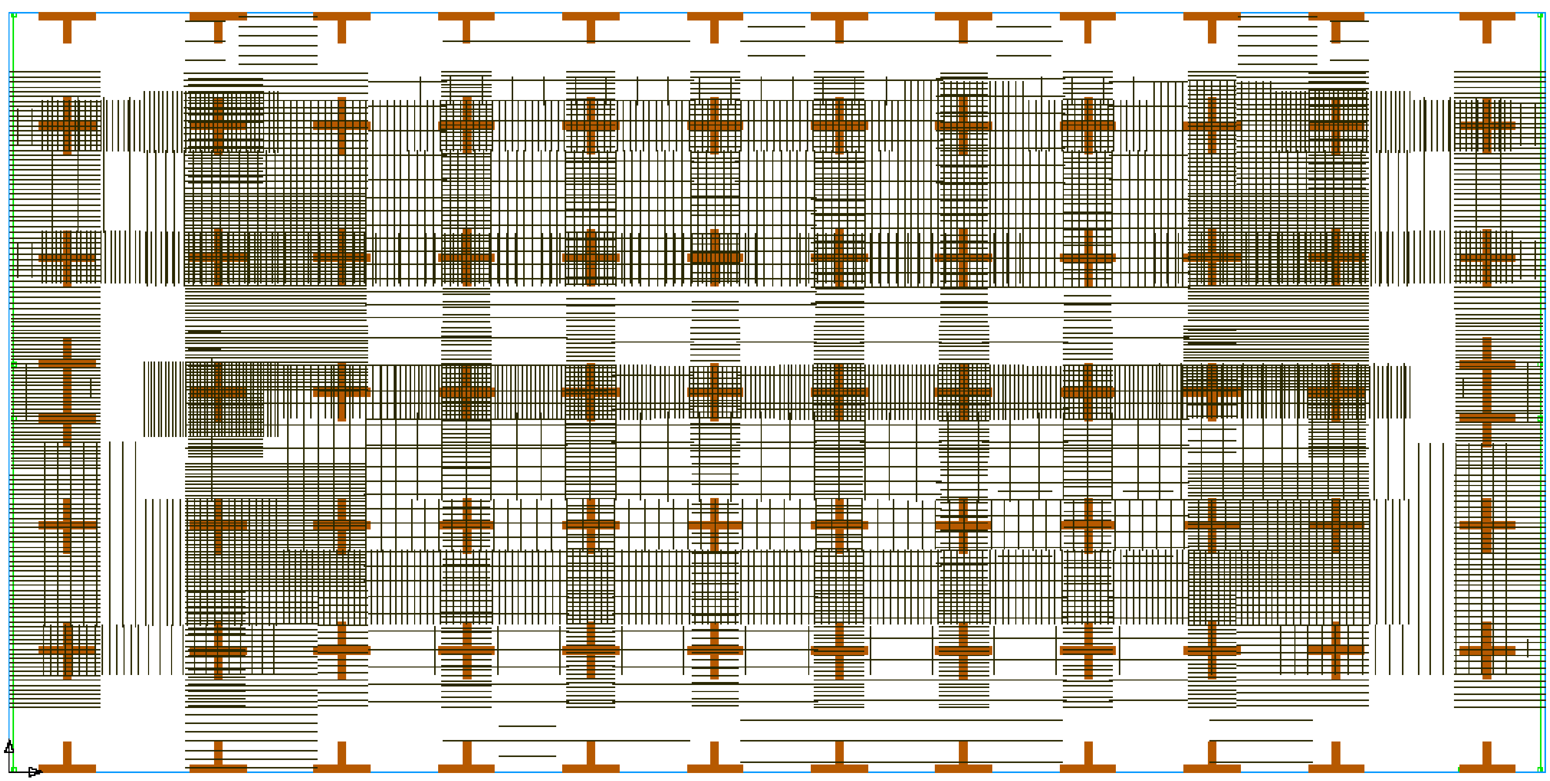
PUNCHING SHEAR

PUNCHING SHEAR

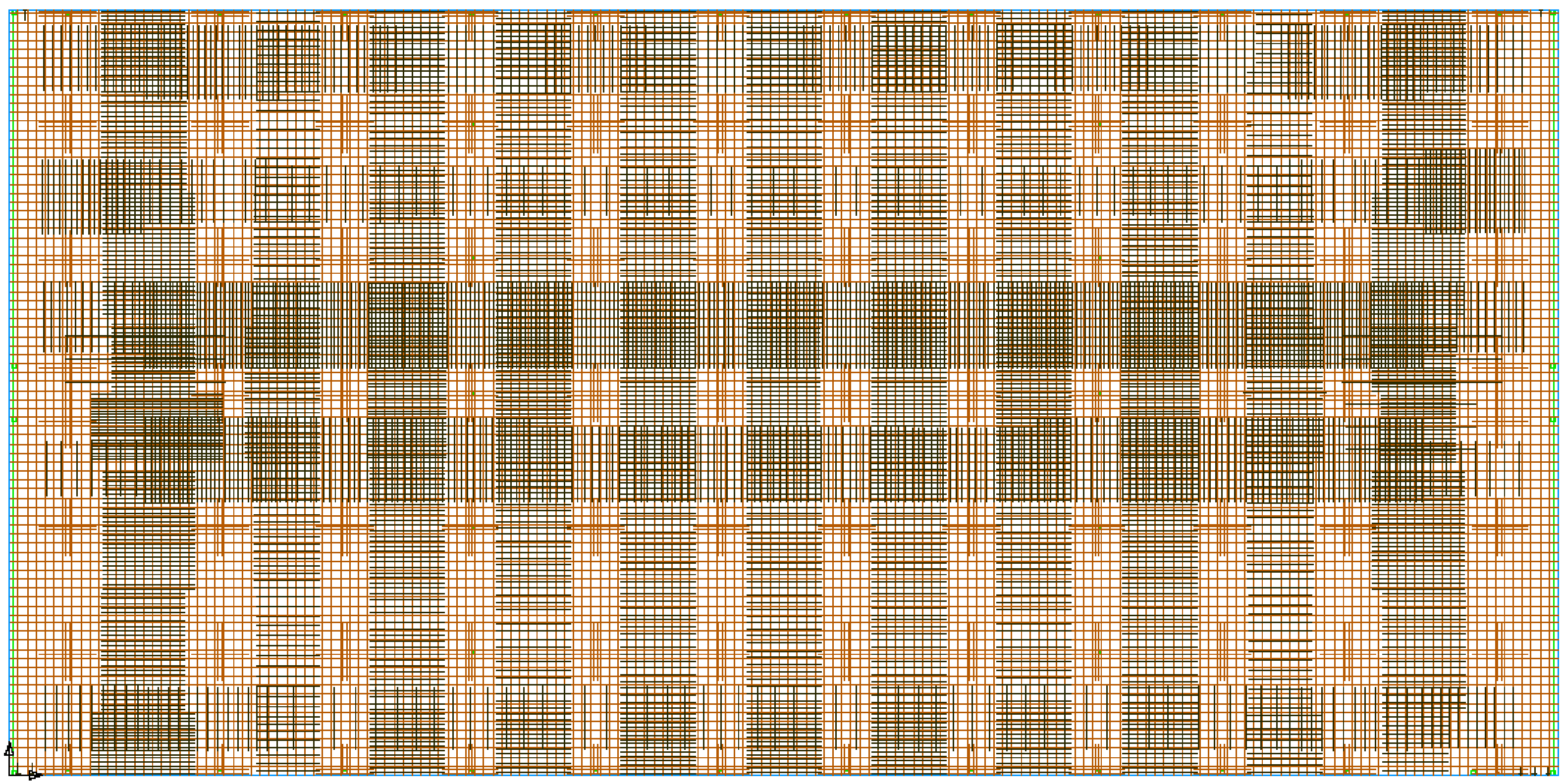
Bus Mall Footings

Punching Shear Stress and Soil Bearing Stress Exceeds Allowable Values by 17%

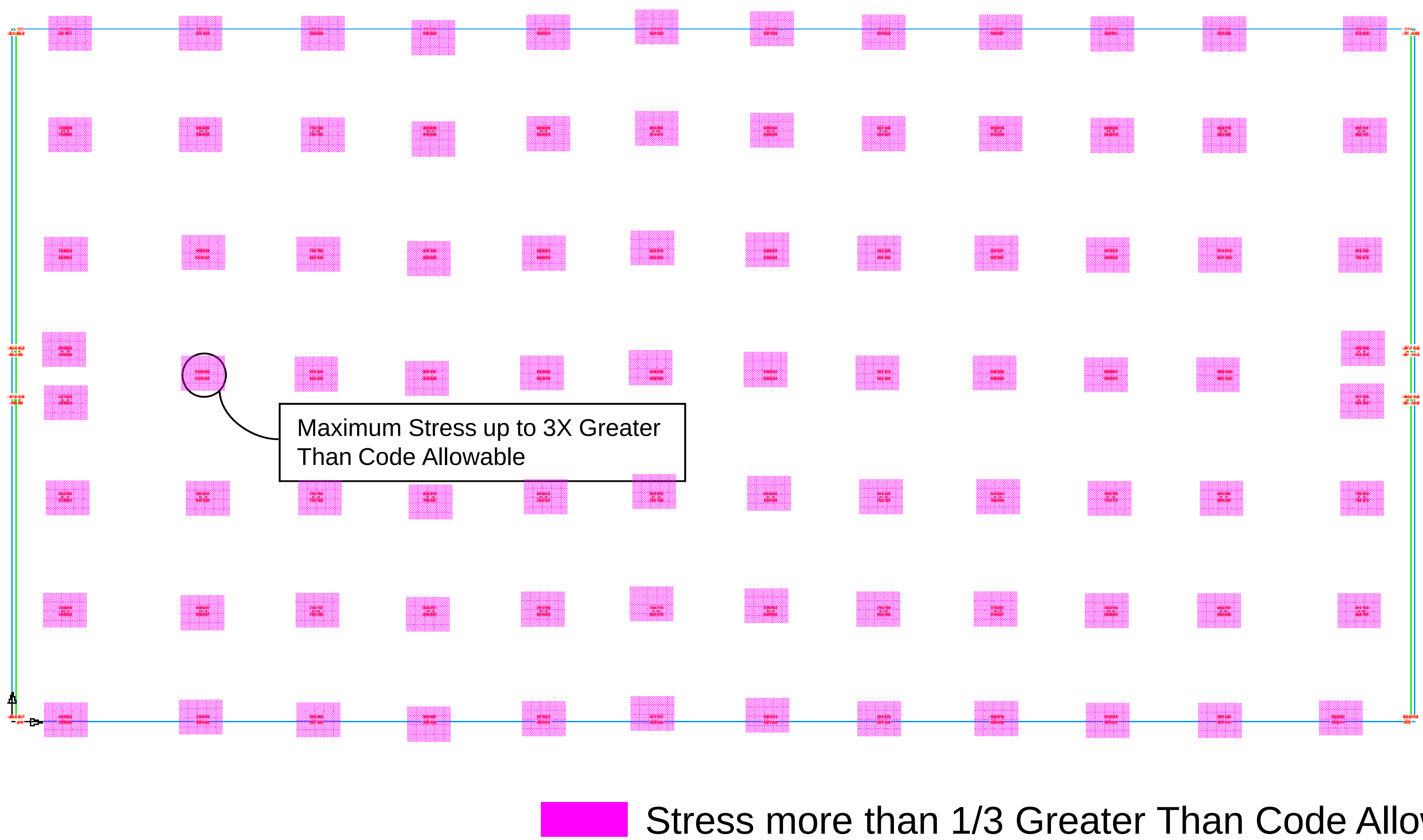
Typical Slab Top Reinforcing Steel At Bus Mall



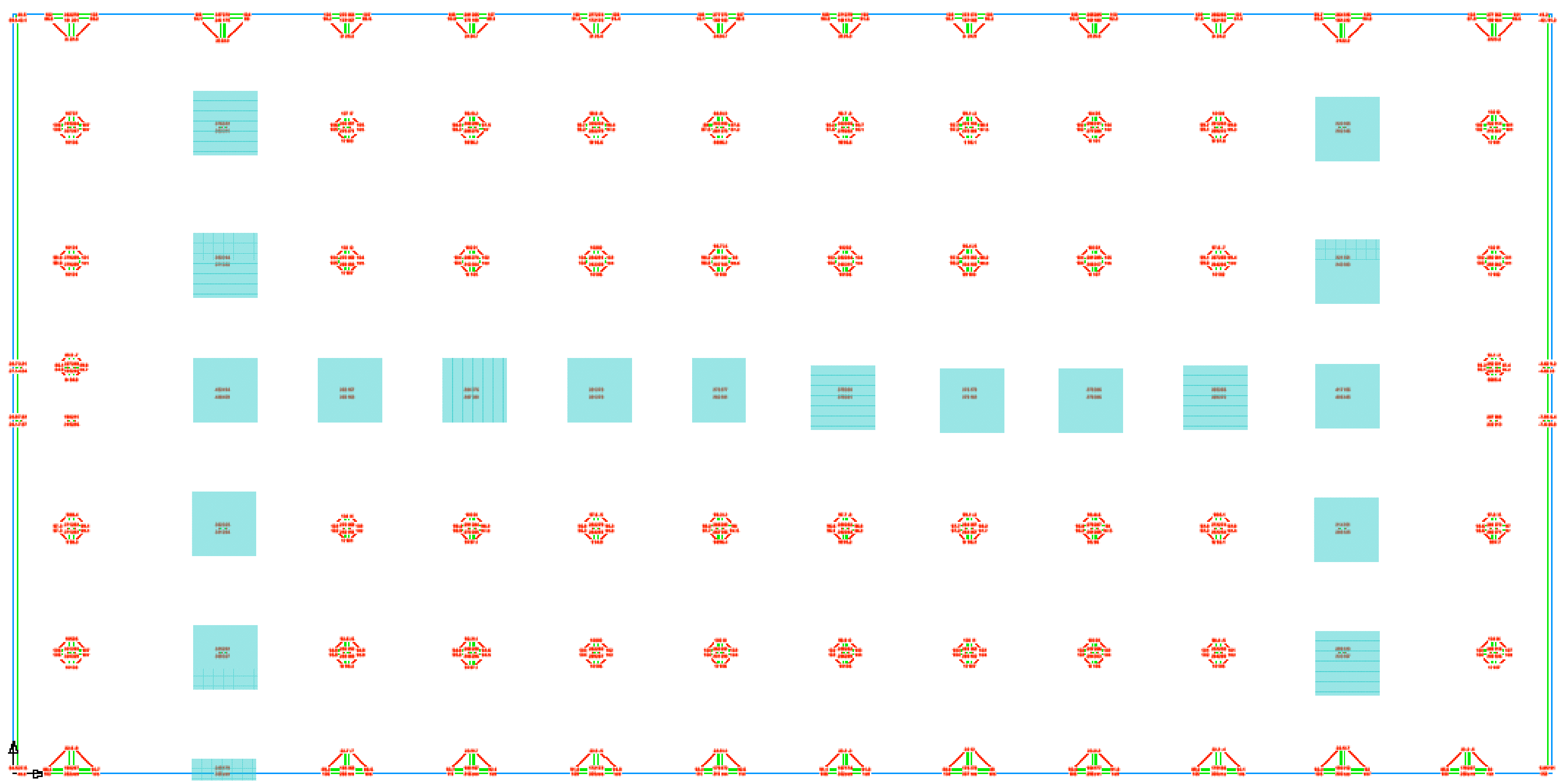
Typical Slab Bottom Reinforcing Steel At Bus Mall



Bus Mall Punching Shear Stress

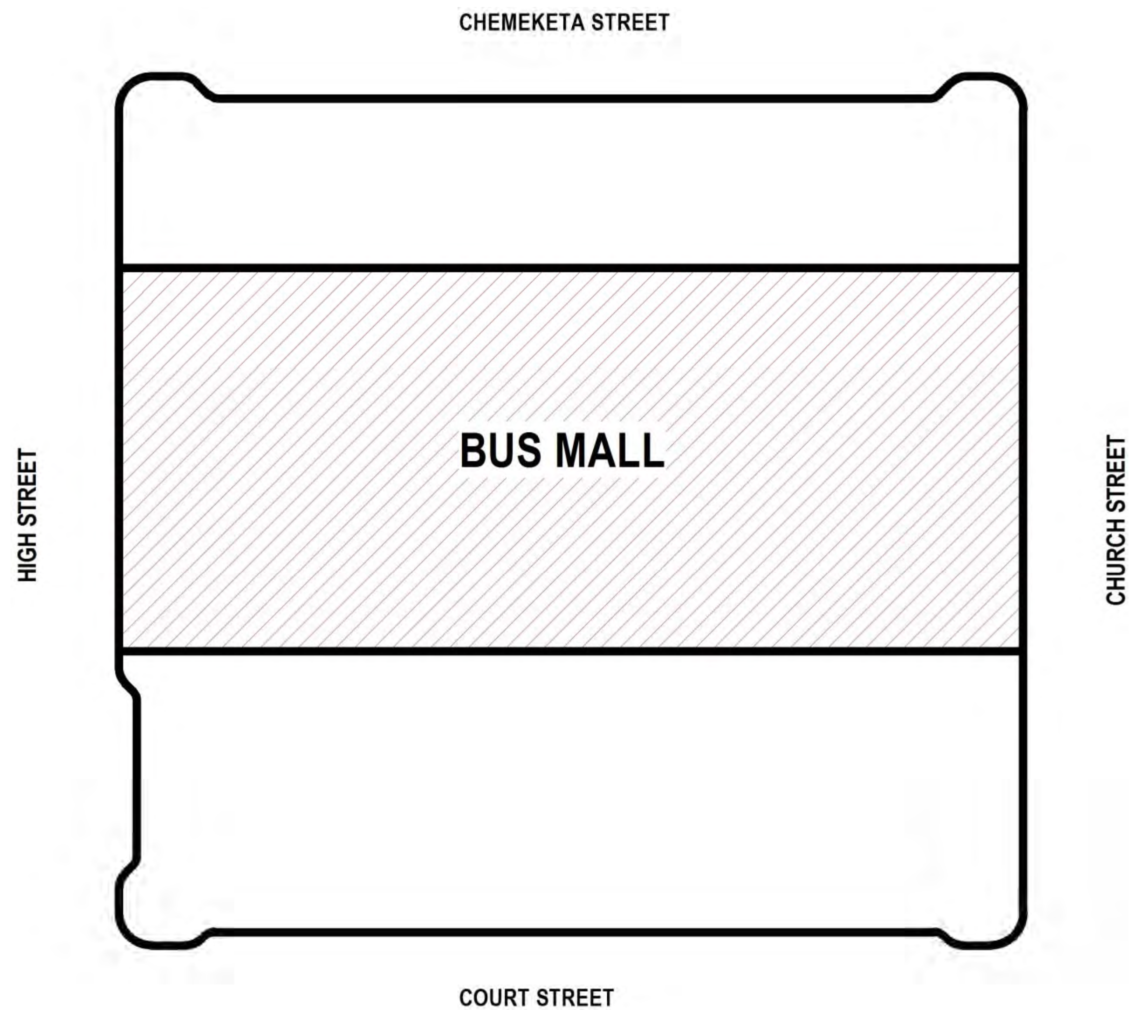


Bus Mall Punching Shear Stress



Column Exceeds Code Limits
Under Dead Load Only

BUS MALL PAVERS



PAVERS

PAVERS

WHAT ARE THE NEXT STEPS?

- Impact to Agencies
- Current Work
- Next Steps

IMPACT TO AGENCIES

Summary: Investigation is ongoing. Information and analysis is evolving.

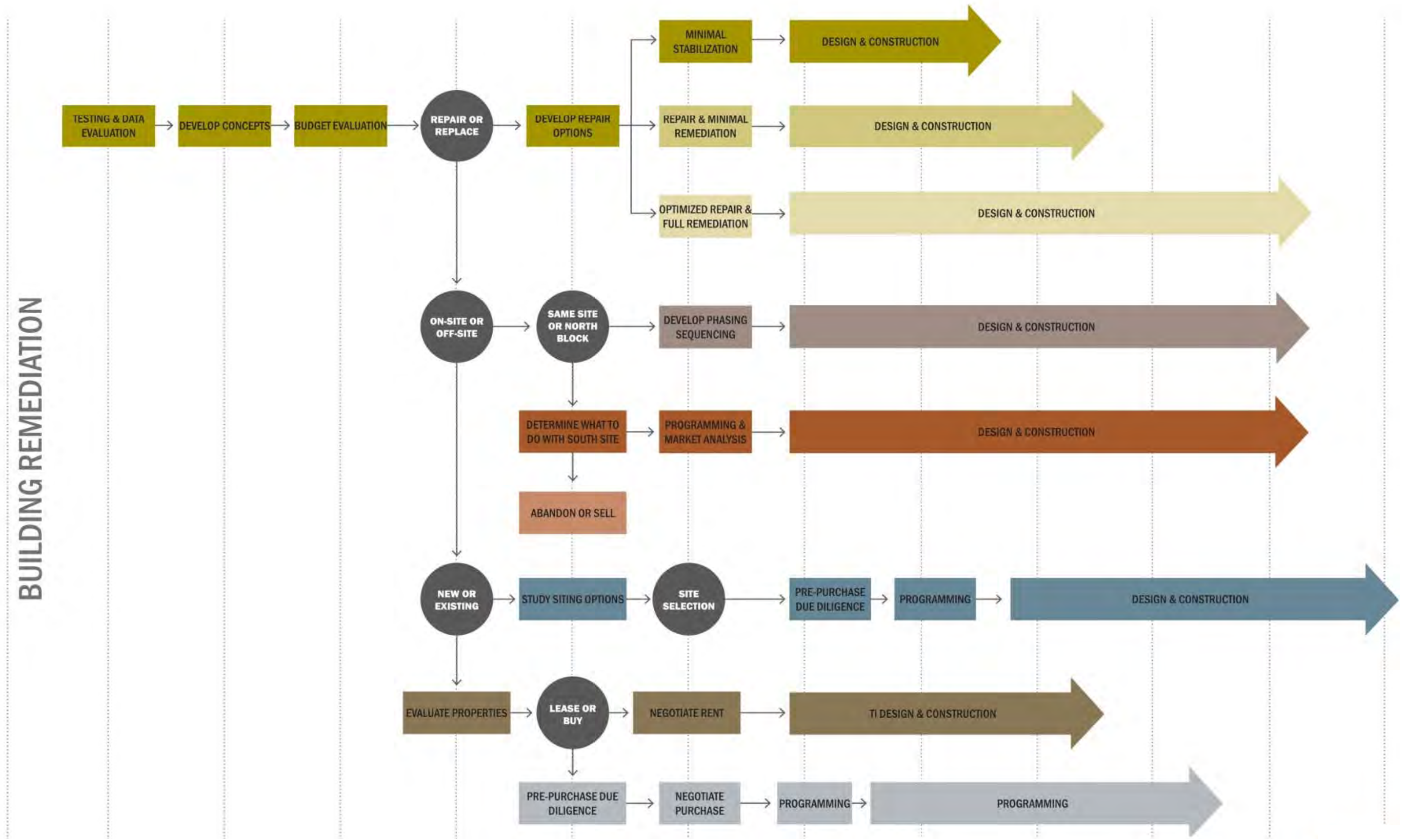
Bus Mall: Determined to be "imminently dangerous". Based on analysis of the week of June 19, 2010.
Bus Mall and parking garage closed and temporarily relocated.

Building: Determined to be "dangerous". Based on analysis of the week of July 19, 2010. Decision to relocate operations and employees within 90 days.

CURRENT WORK

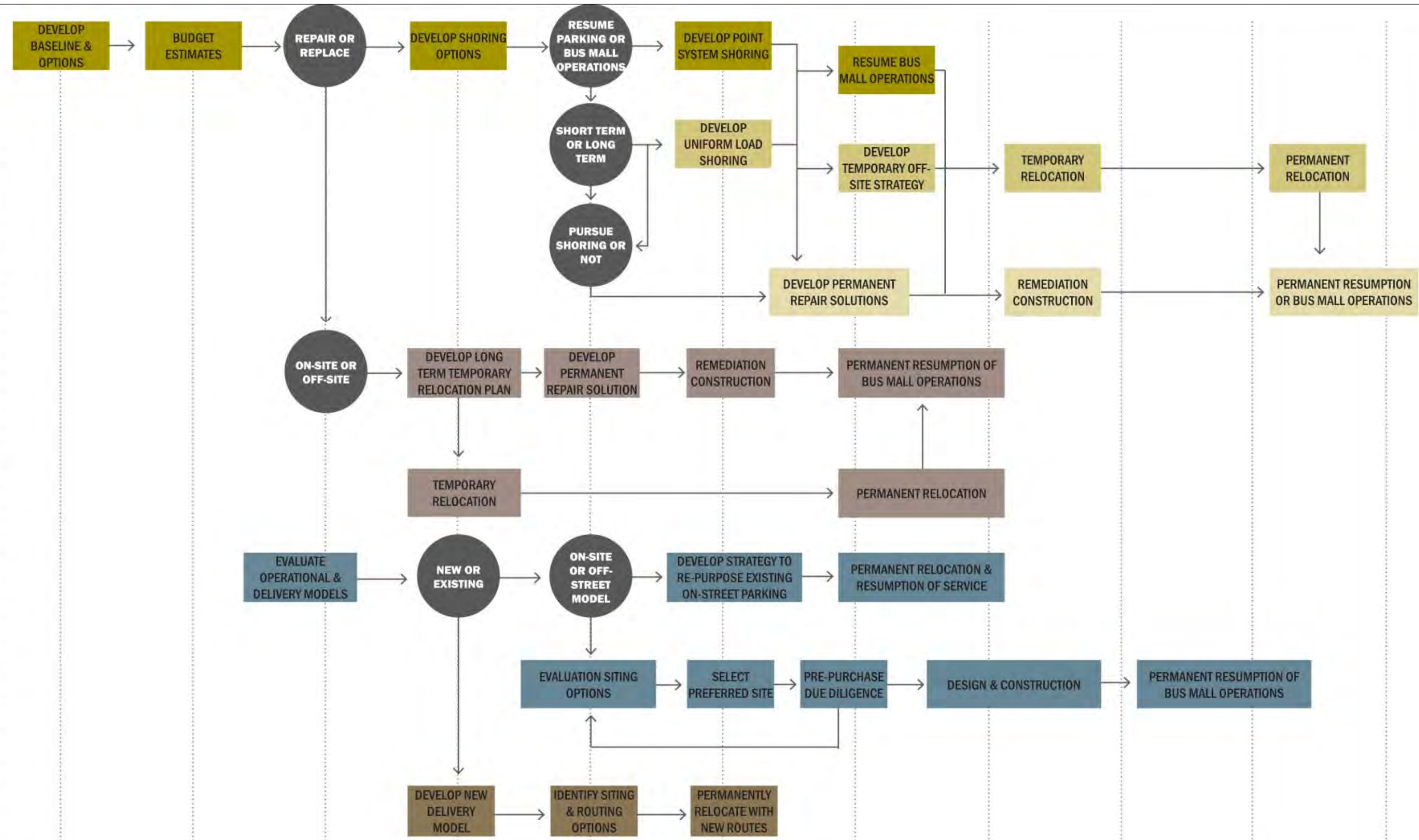
- Building occupants relocated within 90 days.
- Testing for evidence of failure mechanisms.
- Testing for Tendon Strength & Tension
- Testing for Shear Wall & Column Concrete Strength
- Ongoing monitoring for potential Tendon ruptures.

BUILDING NEXT STEPS



BUS MALL NEXT STEPS

PARKING GARAGE/BUS MALL STRUCTURE REMEDIATION



MILESTONES & KEY EVENTS

Implementation of 90-Day Relocation Plan	July 19, 2010
On-site observation of Building columns	July 24, 2010
Remediation Options for entire site	Mid-August through Mid-November 2010
All Building occupants relocated	End of October 2010

QUESTIONS?

Marion County Courthouse Square
Structural Remediation Project Summary
October 26, 2010

TEAM MEMBERS

MARION COUNTY
Building Owner, Client

SERA ARCHITECTS
Project manager and team coordinator
Building assessment
Sustainability Resources
Interior Design

MILLER CONSULTING ENGINEERS
Structural engineering

RDH BUILDING SCIENCES
Building envelope and waterproofing

PSI
Material Testing

SALEM KEIZER TRANSIT DISTRICT
Building Owner, Client

FORTIS CONSTRUCTION
Construction Manager, General Contractor
Cost Modeling, Constructability Review

PAE CONSULTING ENGINEERS
Mechanical, Electrical, Plumbing engineering

H&A CONSTRUCTION
Cost Modeling, Constructability Review

GEODESIGN
Geotechnical engineering

DAVID EVANS & ASSOCIATES
Building Survey

CARLSON TESTING, Inc.
Material Testing

PROGRESS REPORT - PAST

To get to our July 26, 2010 Presentation the team:

- Conducted thorough, methodical and efficient investigations broken out by team member.
- Determined that the building and transit mall had enough significant structural deficiencies which required an efficient relocation of building personnel.
    - Punching Shear
    - Concrete Strength
    - Inadequate gravity load capacity
- Through geotechnical analysis; determined that there were no settlement issues associated with sub-grade deficiencies or foundations.
- The geotechnical firm did not find any evidence of an underground river or creek.
- The buoyancy plugs appear to be installed and working as intended.
- The differential settling between the building and the sidewalk is a result of the sidewalk being built over an inadequately compacted fill.

PROGRESS REPORT - PRESENT

Following our July 26, 2010 Presentation the team:

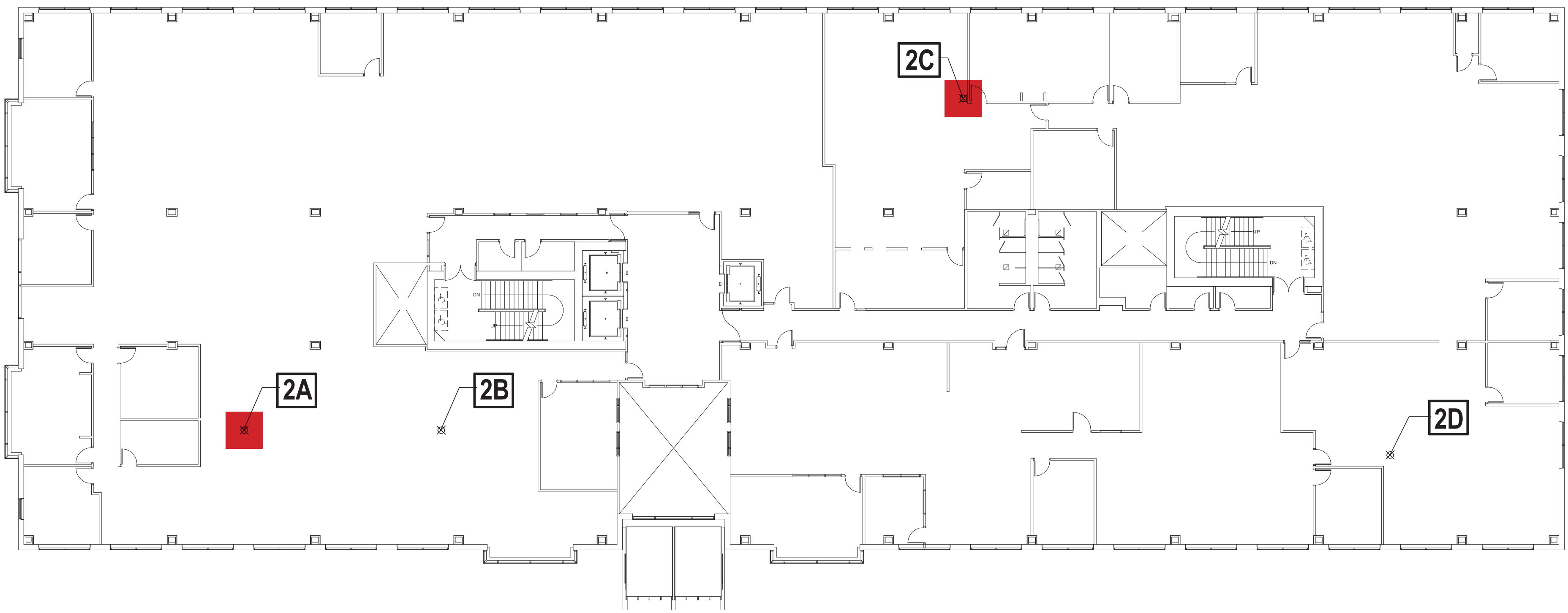
- Determined we may need a materials scientist to augment the investigation.
- Generated a number of building remediation scenarios and are proposing a few of those for further development (see executive summary for other options)

BUILDING	BUS MALL	NORTH BLOCK	OVERALL
Demolish existing building to bare land	Demolish to bare land	Demolish to bare land	Demolish to bare land
Minimum remediation for occupancy	Open top / parking below	Eliminate hazard	Convert entire building to parking + add new transit and MC office and other partners on current property
Replace / Repair for 100% intended use	Transit on top / no parking below		
	Replace / Repair for 100% intended use		

- Working to provide a cost estimate for the full demolition of the building.
- Brought on another 3rd party materials testing firm (PSI) to do an independent analysis.

Here are the current test results from PSI and their comparison to Carlson Testing, Inc.:

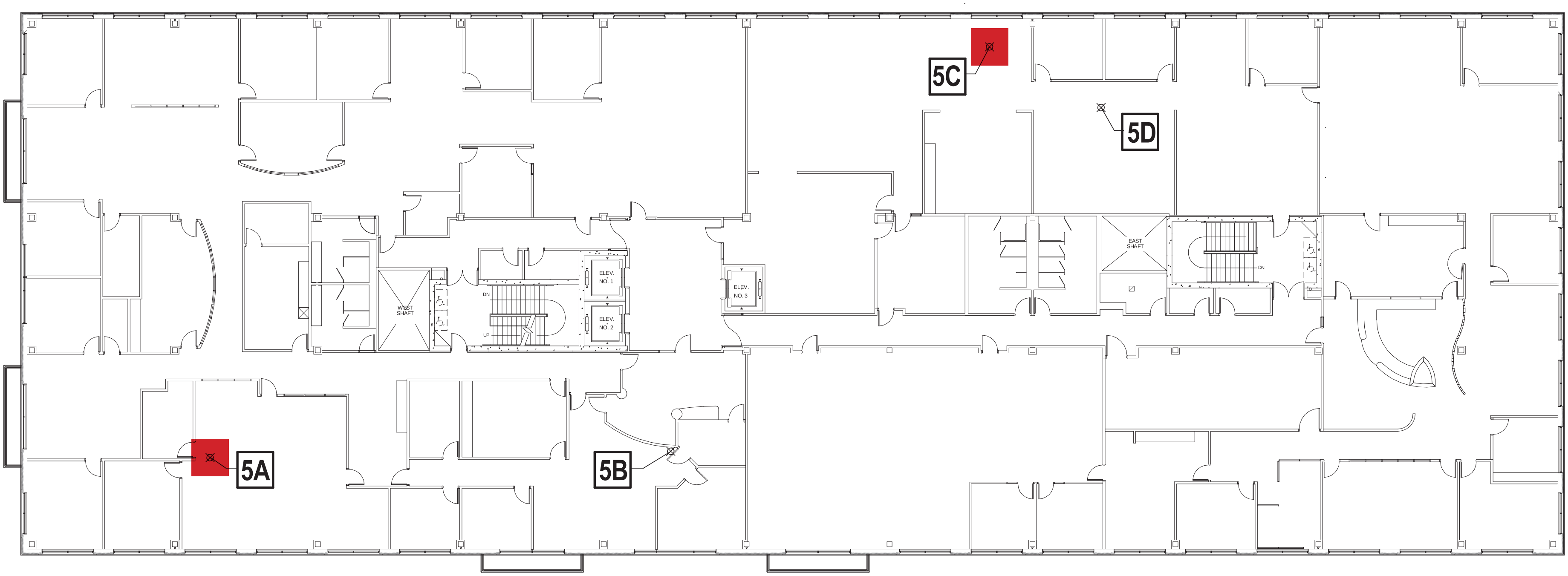
Testing Locations - Second Floor



Testing Locations - Third Floor

Testing Locations - Fourth Floor

Testing Locations - Fifth Floor



Concrete Compressive Core Strength Test Comparison

	Testing Locations	Carlson lbs/in^2 (psi)	PSI lbs/in^2 (psi)
Fifth Floor	5A-2	5150	4360
	5A-3		4240
	5C-1	4520	3690
	5C-2		3680
Fourth Floor	4B-1	3730	3480
	4B-2		3810
	4C-1	4860	4020
	4C-2		4600
Third Floor	3B-1	3490	3330
	3B-2		3480
	3C-1	3800	3600
	3C-2		3620
Second Floor	2A-2	3460	3040
	2A-3		3770
	2C-1	3710	3270
	2C-2		3360

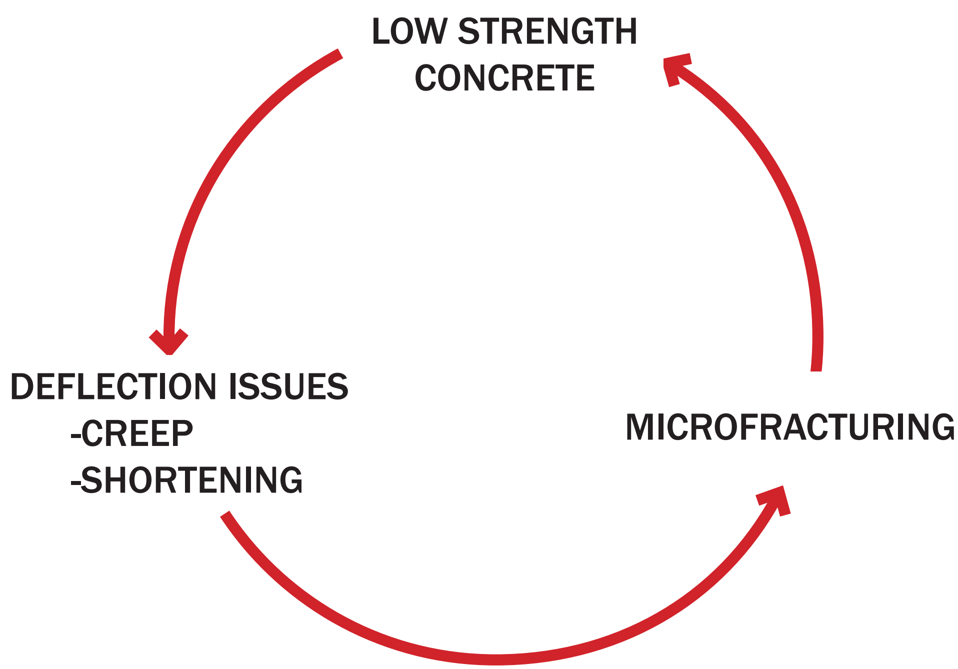
Petrographic Test Comparison

Carlson	PSI
4 - 6% VOIDS	1.25 - 1.4% VOIDS
Indicating **high** void content concrete	Indicating abnormally **low** void content concrete
3% voids is the average standard for concrete	

Water:Cement Ratio Test Comparison

Carlson	PSI
NORMAL WATER TO CEMENT RATIO	**HIGH** WATER TO CEMENT RATIO
Indicating a Stiffer/**Stronger** Mix	Indicating a More Workable/**Weaker** Mix

Micro-fractures in the Concrete

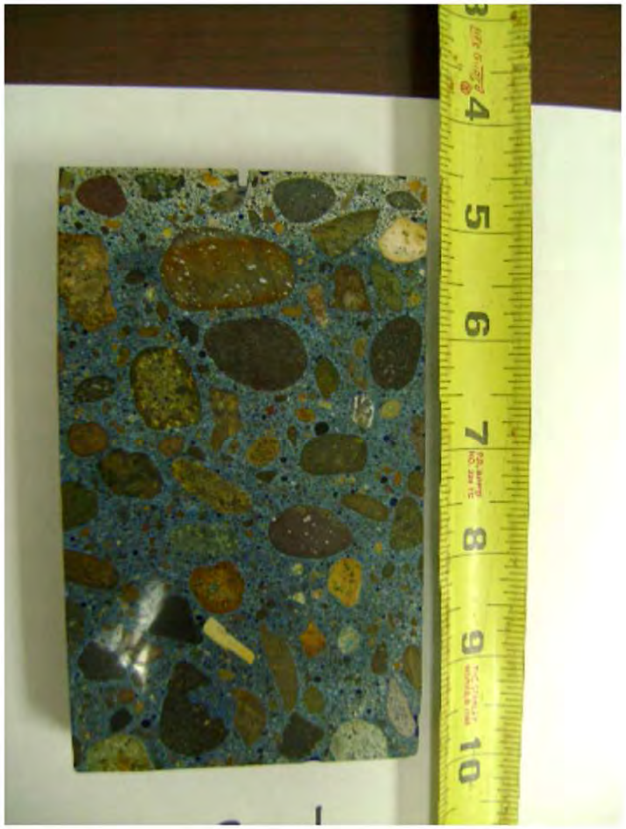


Carlson	PSI
MINIMAL	EXCESSIVE

Excessive Micro-fractures would tend to indicate overstressed concrete and a potential for leading to in place concrete strength degradation.

(It gets weaker.)

PHOTOGRAPHS



Photograph #1 - Sample 06033-1. Change in paste color can be seen at top surface and lower right corner.

Photograph #2 - Sample 06033-2. Color change can be seen in paste at top surface as well as the bulk paste.

PROGRESS REPORT - FUTURE

The Next Steps:

- Work with the respective Boards to determine which options they want the project team to pursue.
- Develop those options to a sufficient level for rough cost estimating and decision making purposes.
- Perform the tendon strength and tension test for use in analyzing the options chosen.
- Present those options and costs to the respective Boards.
- The Boards will then need to provide the project team direction.


QUESTIONS?

Marion County Courthouse Square Structural Remediation Project Summary

January 20, 2011

MILLER CONSULTING ENGINEERS, INC.

SERA

TEAM MEMBERS

MARION COUNTY
Building Owner, Client

SALEM KEIZER TRANSIT DISTRICT
Building Owner, Client

SERA ARCHITECTS
Project manager and team coordinator
Building assessment
Sustainability Resources
Interior Design

FORTIS CONSTRUCTION
Construction Manager, General Contractor
Cost Modeling, Constructability Review

PAE CONSULTING ENGINEERS
Mechanical, Electrical, Plumbing engineering

MILLER CONSULTING ENGINEERS
Structural engineering

H&A CONSTRUCTION
Cost Modeling, Constructability Review

RDH BUILDING SCIENCES
Building envelope and waterproofing

GEODESIGN
Geotechnical engineering

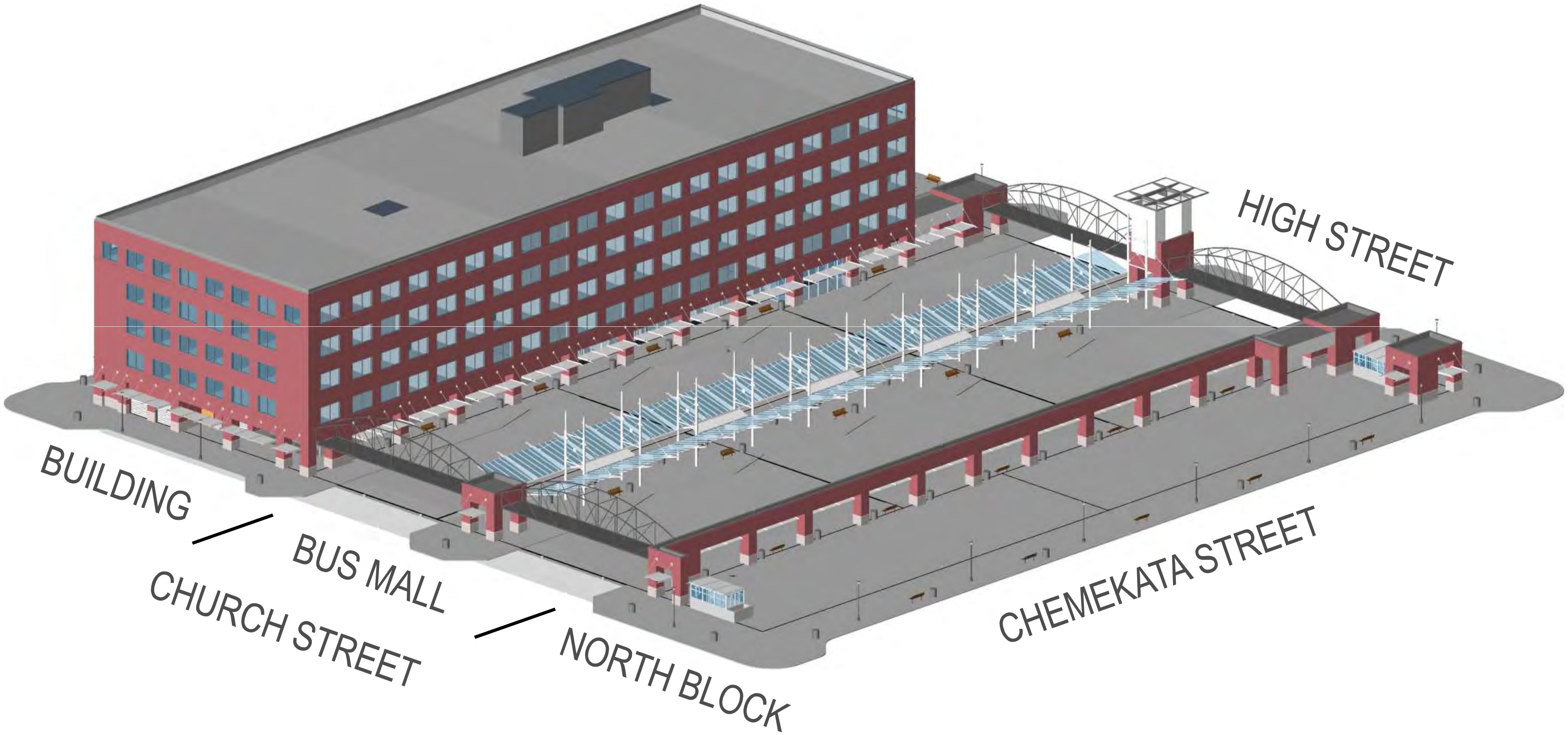
PSI
Material Testing

CARLSON TESTING, Inc.
Material Testing

CTL GROUP
Material Testing

DAVID EVANS & ASSOCIATES
Building Survey

SITE ORIENTATION:
ANALYZED IN THREE PARTS



SUMMARY OF KEY ACTIVITIES

- Conducted **thorough**, **methodical**, and **efficient investigations** broken out by team member.
- Determined that **the building and transit mall** had enough **significant structural deficiencies** which required an efficient relocation of building personnel.
  - **Punching Shear**
  - **Concrete Strength**
  - **Inadequate gravity load capacity at columns and foundations**
- Through geotechnical analysis; determined that there were **no settlement issues** associated **with sub-grade deficiencies** or foundations.
- The **differential settling** between the building and the sidewalk is a result of the **sidewalk** being **built over inadequately compacted fill**.
- Brought on two 3rd party materials testing firm (PSI and CTL Group) to do independent analyses.

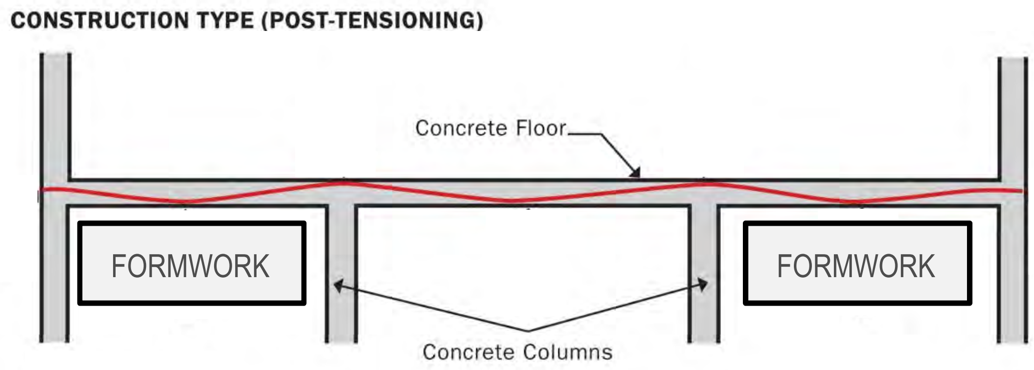
MILESTONES & KEY EVENTS

Project kickoff meeting	March 10, 2010
On-site investigations	April through May
Initial material testing	May through July
Building surveys	April 2010, September, January 2011
Bus mall closure	July 2, 2010
Building closure and Relocation	August through September
Second material testing	September and October
Third material testing	December 2010
Final report and presentation	January 2011

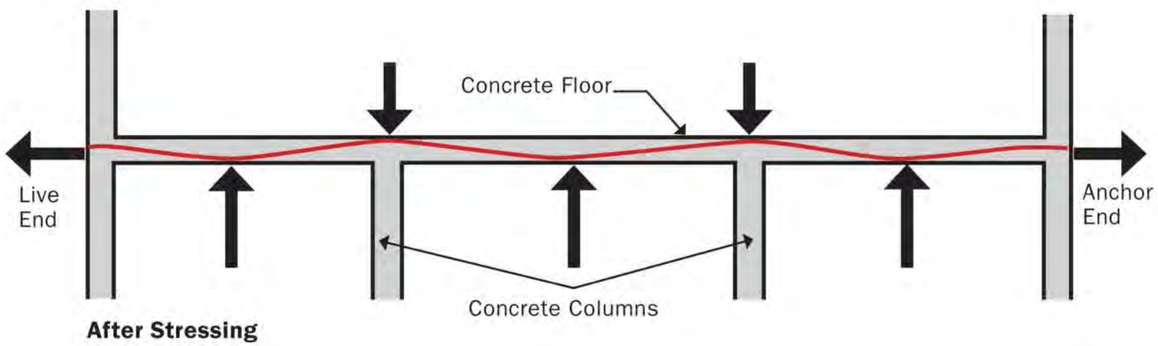
HOW INFORMATION IS PRESENTED

- Design
  - Floors : Columns : Seismic system
- Materials
  - Compressive Tests : Void Analysis : Water to Cement Ratio : Microfractures
- Construction Issues
- Results of Design, Materials, and Construction Issues
- Impacts
- Remediation Options
- Appendices

FLOOR DESIGN BASIC CONCEPTS:
HOW POST TENSIONED (PT) CONCRETE WORKS



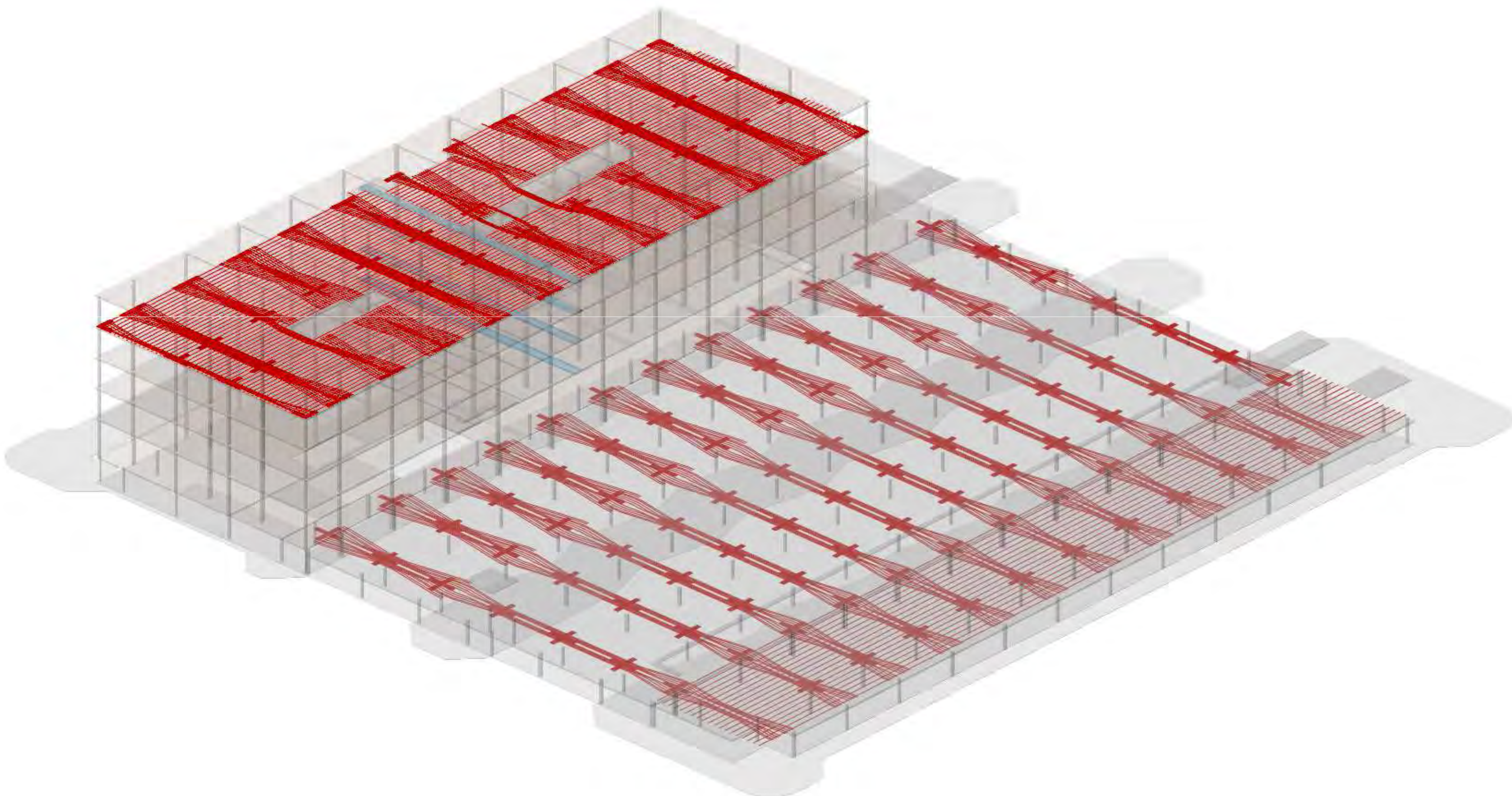
- PLACE FORMS
- PLACE TENDONS
- POUR CONCRETE



- CONCRETE ACHIEVES MINIMUM STRENGTH
- TENSION CONCRETE
- REMOVE FORMS

FLOOR DESIGN BASIC CONCEPTS:

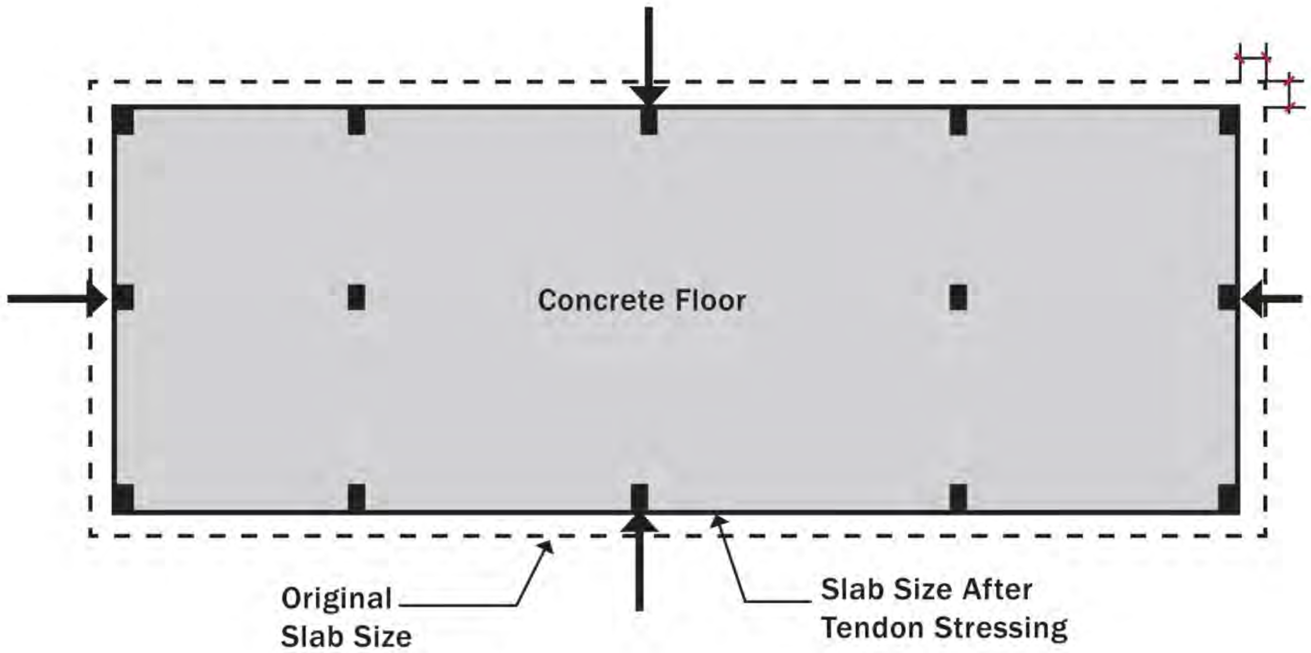
PT SLAB DIAGRAM



FLOOR DESIGN ACTUAL CONDITIONS:

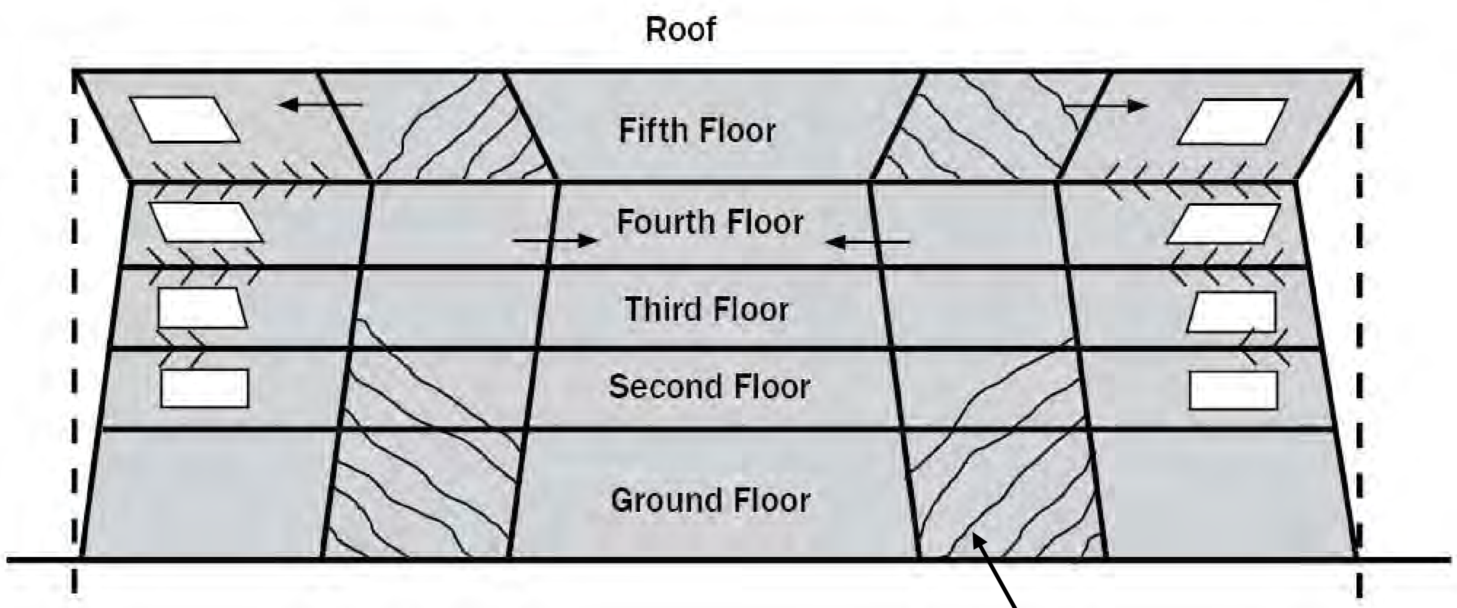
SHRINKAGE AND SHORTENING

- Shortening due to high pre-compressive stress and dead load balancing
- Shrinkage due to material challenges



FLOOR DESIGN ACTUAL CONDITIONS:
SECTION DIAGRAM

- Observed column crack patterns are consistent in building and bus mall



FLOOR DESIGN ACTUAL CONDITIONS:

BUS MALL SHRINKAGE AND SHORTENING

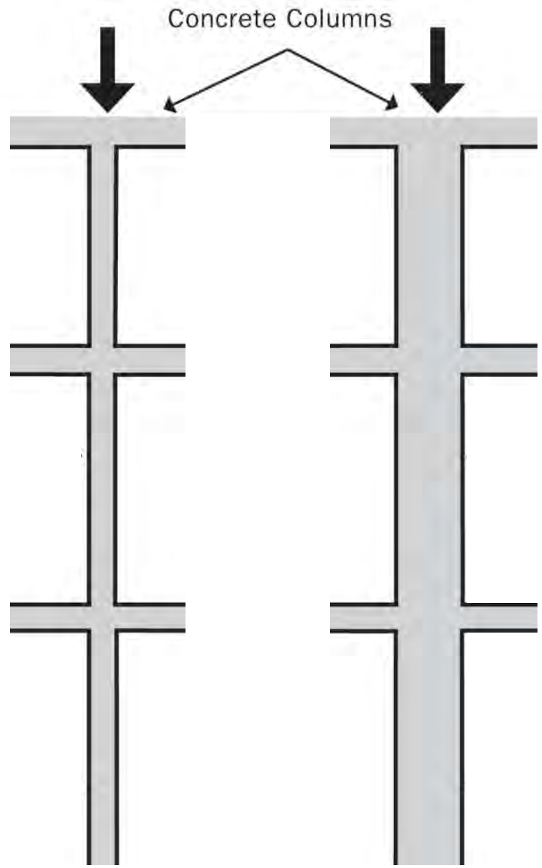
FLOOR DESIGN ACTUAL CONDITIONS:

NORTH BLOCK SHRINKAGE AND SHORTENING

APRIL 2010

DECEMBER 2010

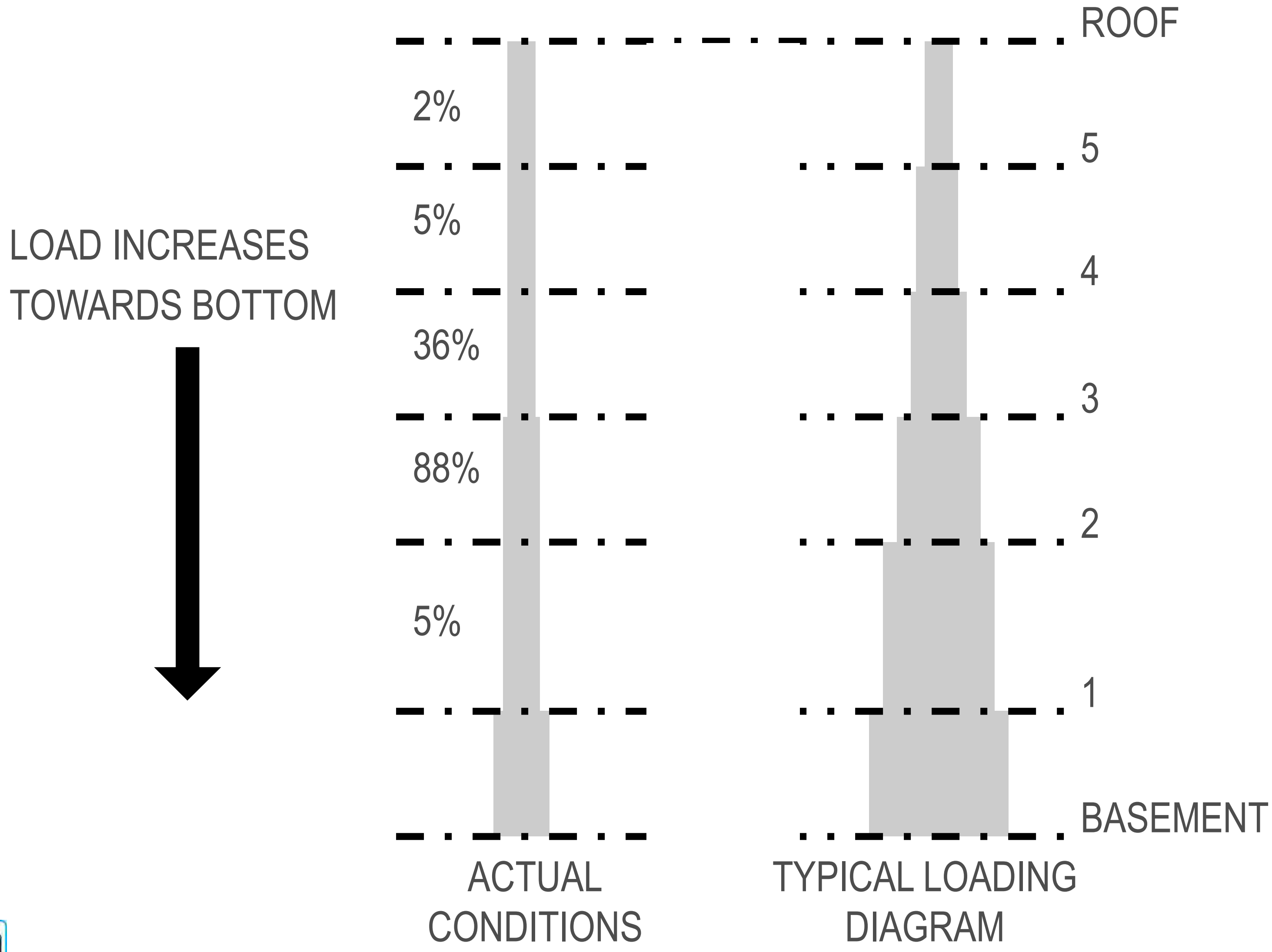
COLUMN DESIGN BASIC CONCEPTS



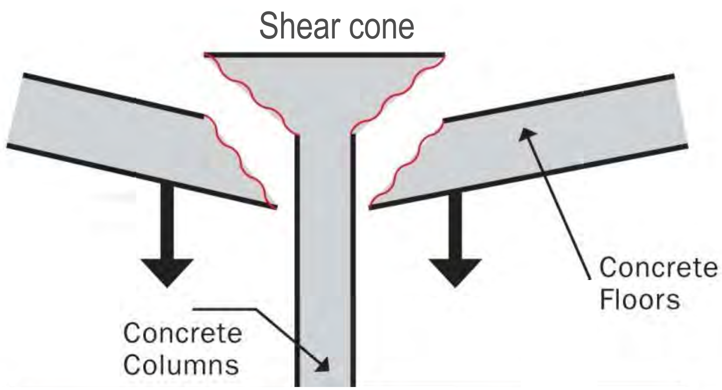
WHAT WAS DESIGNED AND INSTALLED

TYPICAL COLUMN THICKNESS

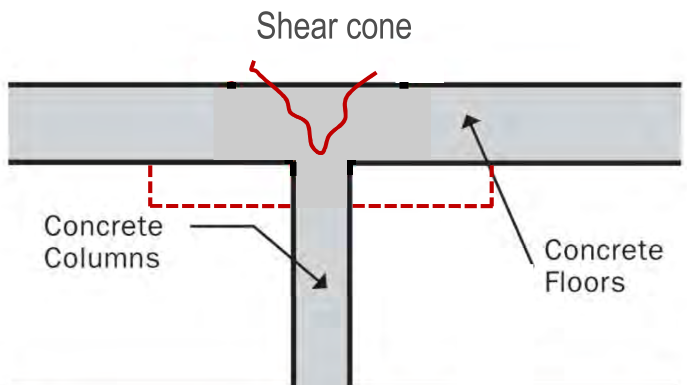
COLUMN DESIGN BASIC CONCEPTS



COLUMN DESIGN BASIC CONCEPTS



INSUFFICIENT CAPACITY



SUFFICIENT CAPACITY

- Appropriate slab thickness and transition reinforcing
- Column capitals can supplement

COLUMN DESIGN ACTUAL CALCULATIONS:

Punching Shear

File: g:\share\portland\structur\open\40903\00104\adapt\2druns\crthbdc1.res

Page: 9
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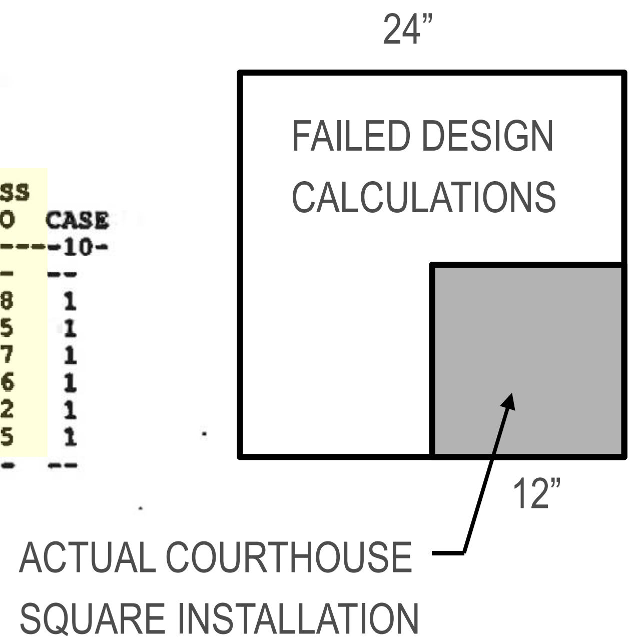
4 = EDGE COLUMN (PARALLEL TO SPAN)
5 = BEAM OR WALL (PUNCHING SHEAR CHECK NOT APPLICABLE)
6 = STRIP TOO NARROW TO DEVELOP PUNCHING SHEAR

SE........ 1 = STRESS WITHIN SECTION #1 GOVERNS (COL.CAP OR SLAB)
2 = STRESS WITHIN SECTION #2 GOVERNS (DROP PANEL OR SLAB)

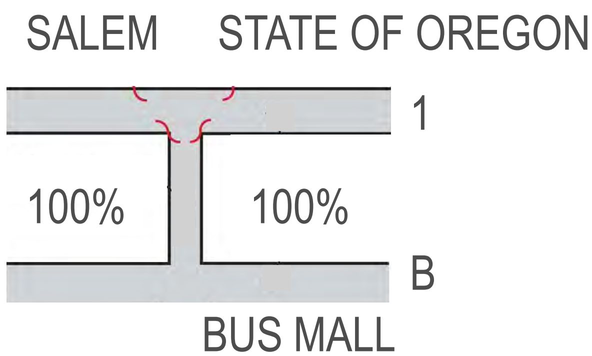
JNT	COND.	FACTORED ACTIONS shear k	moment k-ft	<- PUNCHING SHEAR STRESSES IN psi-> due to shear	due to moment	TOTAL	allow-able	STRESS RATIO	CASE
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-
1	5	-------	-------	------	------	------	------	----	--
2	1	612.91	80.06	785.21	63.88	849.09	316.62	2.68	1
3	1	588.31	66.73	753.71	53.25	806.95	316.62	2.55	1
4	1	515.48	74.86	660.40	59.74	720.13	291.12	2.47	1
5	1	189.53	8.06	242.81	6.43	249.24	291.12	.86	1
6	1	501.09	79.19	641.96	63.19	705.15	291.12	2.42	1
7	1	590.86	53.52	756.97	42.71	799.67	291.12	2.75	1
8	5	-------	-------	------	------	------	------	----	--

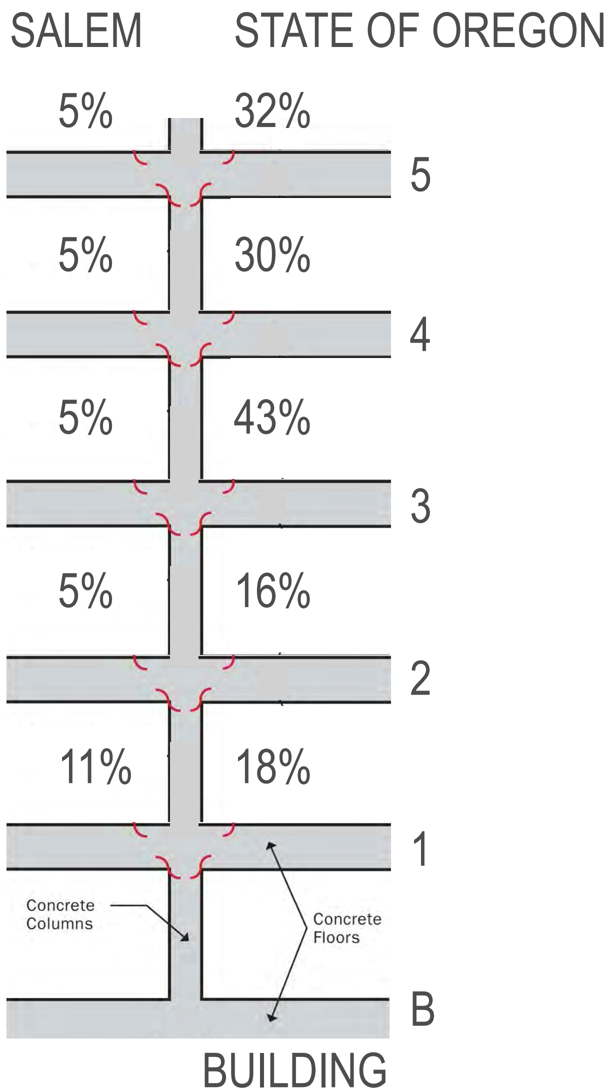
STRESS RATIOS EXCEED ALLOWABLE VALUES, REVISE SECTION GEOMETRY.



COLUMN DESIGN ACTUAL CONDITIONS:

PERCENTAGE OF COLUMN FAILURE





COLUMN DESIGN:
LABORATORY TEST EXAMPLE

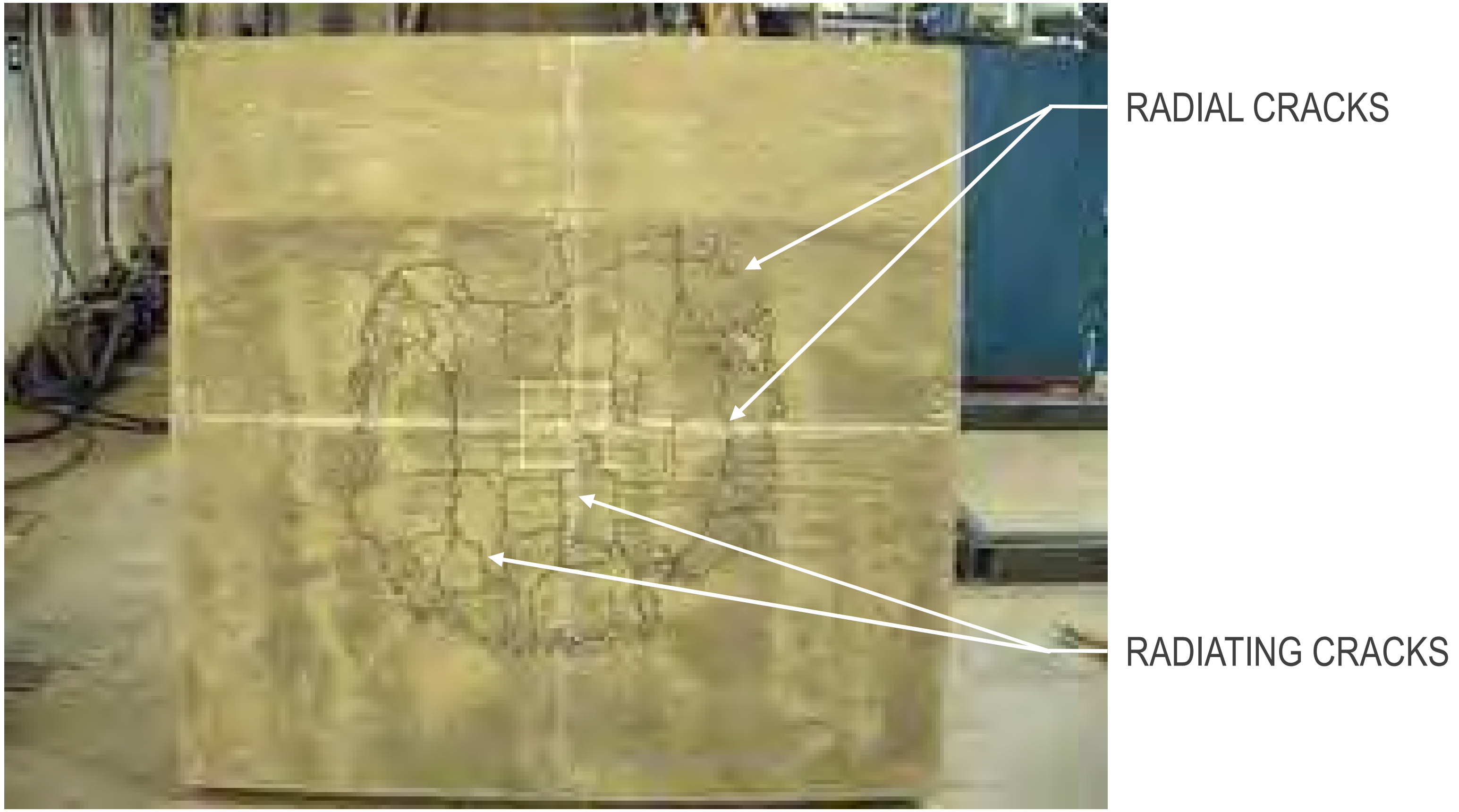
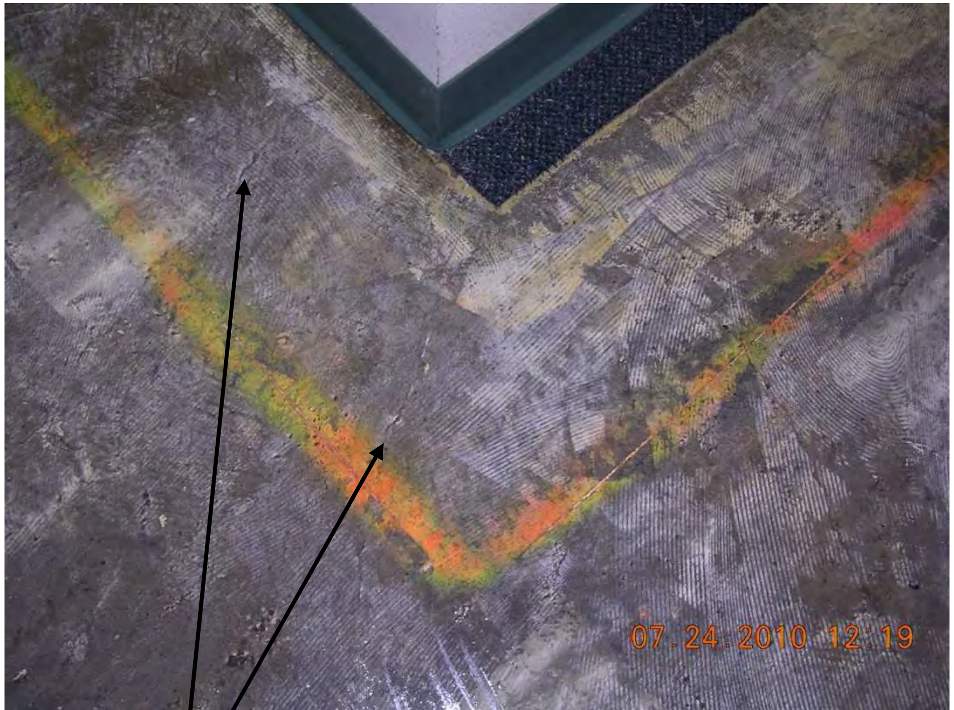


Image Source: University of Michigan-
http://www-personal.umich.edu/~gjpm/NEES%20Project%20Website/Slab.htm

COLUMN DESIGN ACTUAL CONDITIONS:

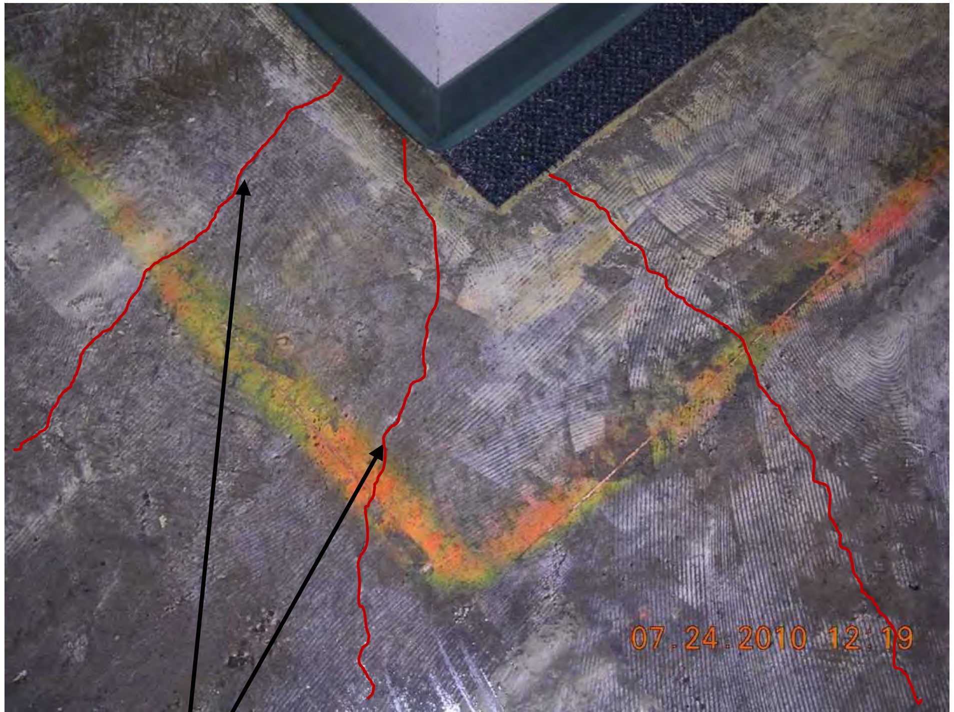
BUILDING PUNCHING SHEAR



PUNCHING SHEAR CRACKS

COLUMN DESIGN ACTUAL CONDITIONS:

BUILDING PUNCHING SHEAR



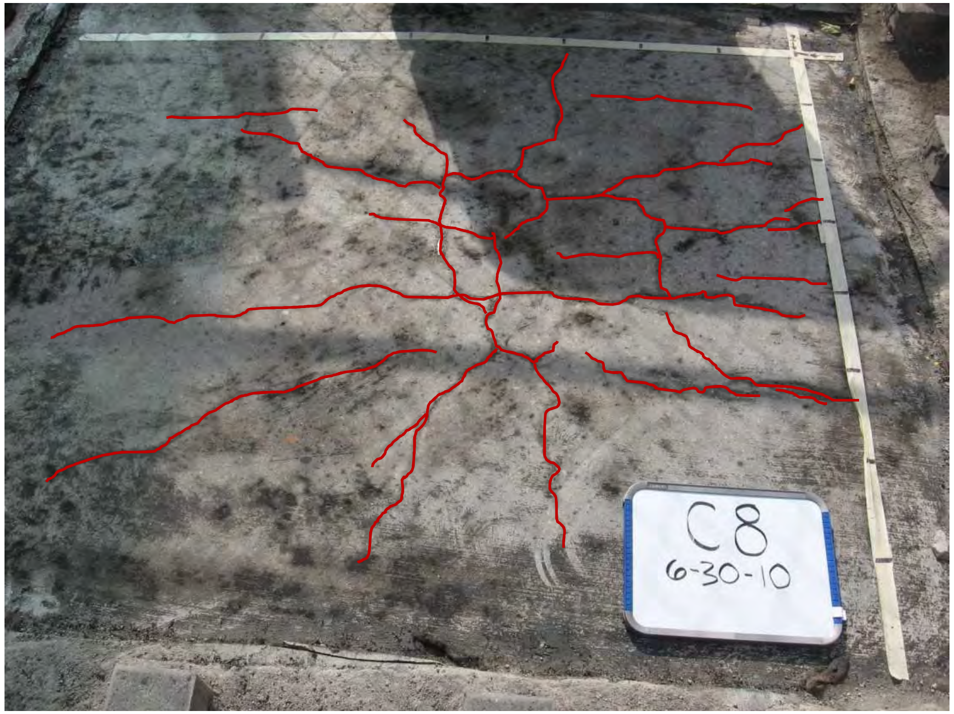
PUNCHING SHEAR CRACKS

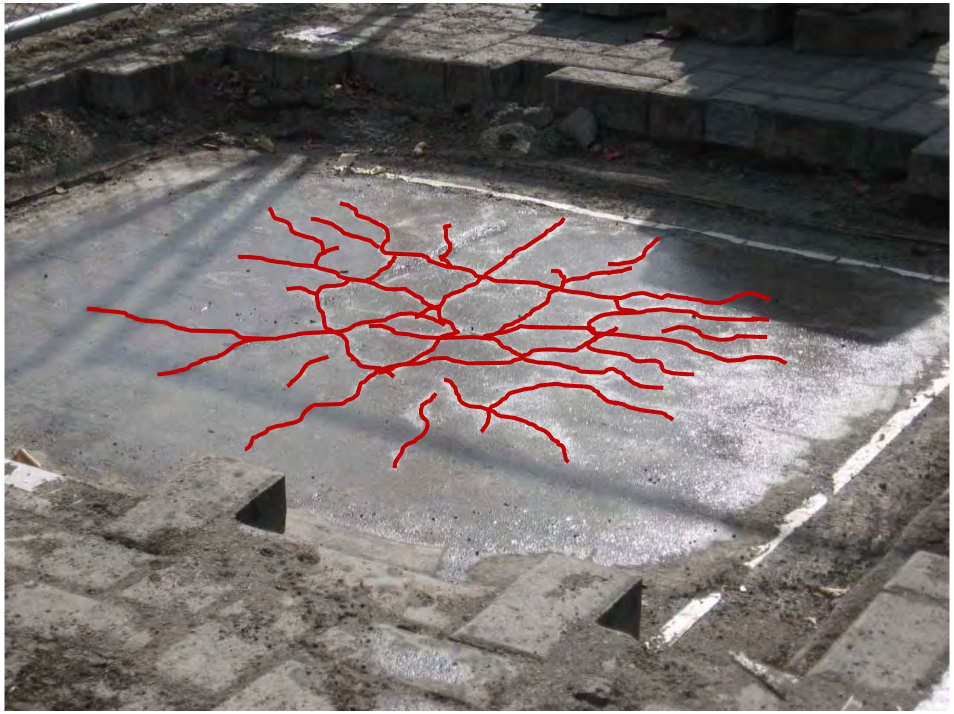
COLUMN DESIGN ACTUAL CONDITIONS:

BUS MALL PUNCHING SHEAR

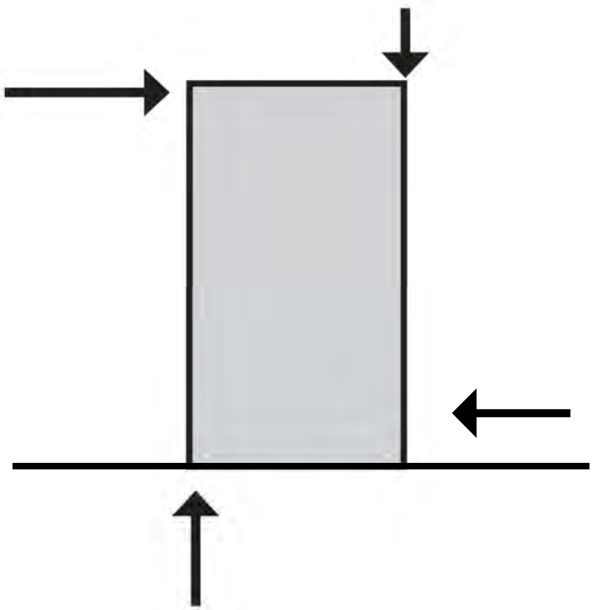
COLUMN DESIGN ACTUAL CONDITIONS:

BUS MALL PUNCHING SHEAR

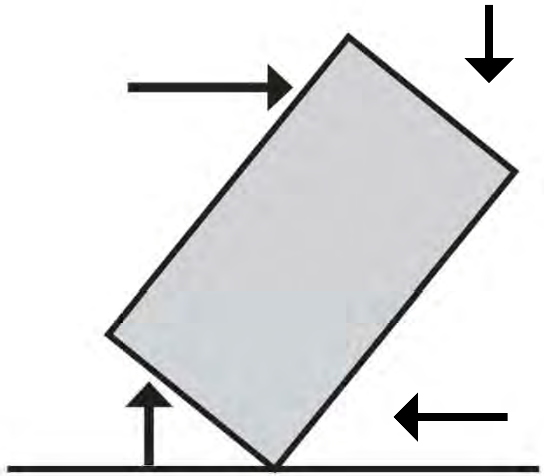




SEISMIC DESIGN BASIC CONCEPT



TYPICAL SEISMIC
FORCES

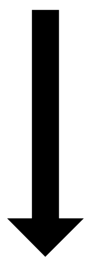


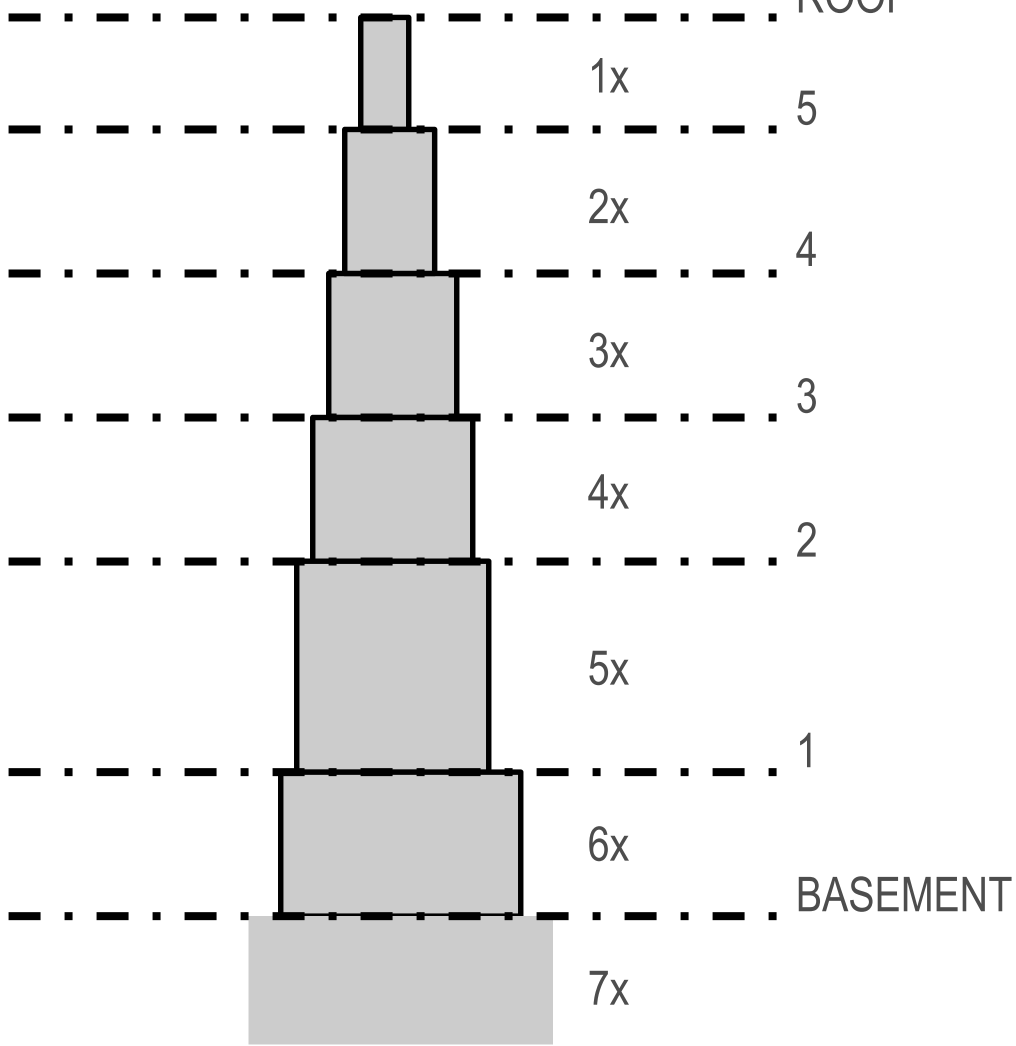
FORCES WANT TO
ROTATE BUILDINGS

SEISMIC DESIGN BASIC CONCEPT:

LOAD DIAGRAM AND BOUNDARY ELEMENTS

LOAD INCREASES TOWARDS BOTTOM

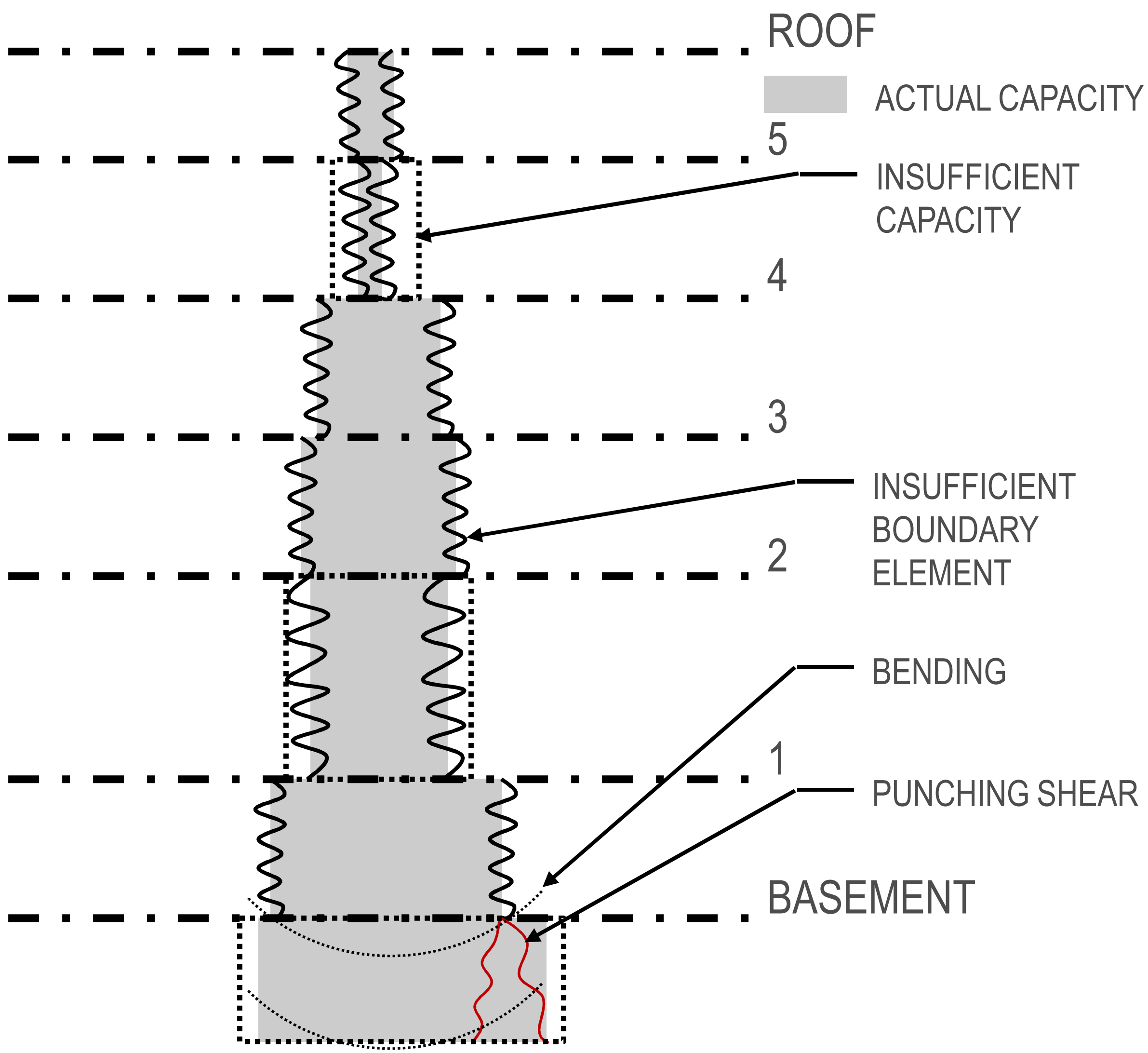




SEISMIC DESIGN ACTUAL CONDITION:

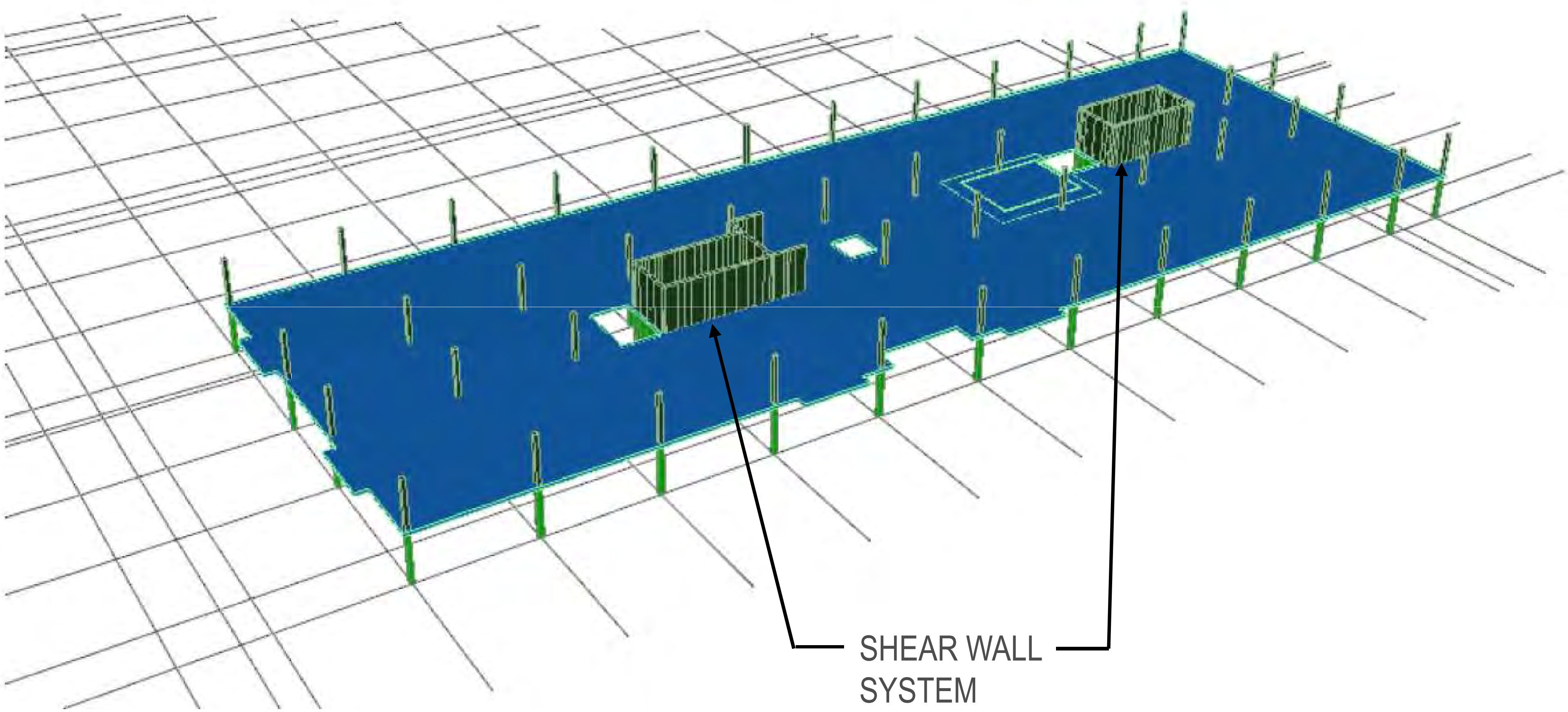
LOAD DIAGRAM AND BOUNDARY ELEMENTS

LOAD INCREASES TOWARDS BOTTOM



SEISMIC DESIGN BASIC CONCEPT:

LATERAL RESISTIVE ELEMENTS



MATERIALS:

CONCRETE COMPRESSIVE CORE STRENGTH TEST COMPARISON

		Carlson MAY 2010	PSI SEPT 2010
Testing Locations		Lbs/in^2 (psi)	Lbs/in^2 (psi)
Fifth Floor	5A-2	5150	4360
	5A-3		4240
	5C-1	4520	3690
	5C-2		3680
Fourth Floor	4B-1	3730	3480
	4B-2		3810
	4C-1	4860	4020
	4C-2		4600
Third Floor	3B-1	3490	3330
	3B-2		3480
	3C-1	3800	3600
	3C-2		3620
Second Floor	2A-2	3460	3040
	2A-3		3770
	2C-1	3710	3270
	2C-2		3360

PSI results corroborate Carlson results

MATERIALS:

2010 VOID ANALYSIS COMPARISON

Carlson 11 TESTS	PSI 2 TESTS	CTL Group 8 TESTS
4 - 6% VOIDS	1.25 - 1.4% VOIDS	1 - 5% VOIDS
Indicating high void content concrete	Indicating low void content concrete	Indicating low to high void content concrete
3% voids is the average standard for concrete		

CTL Group results corroborate PSI results

Void content directly relates to concrete strength

MATERIALS:

2010 WATER : CEMENT RATIO TEST COMPARISON

Carlson	PSI	CTL Group
NORMAL WATER TO CEMENT RATIO	HIGH WATER TO CEMENT RATIO	HIGH WATER TO CEMENT RATIO
Indicating a Stiffer / Stronger Mix	Indicating a More Workable / Weaker Mix	Indicating a More Workable / Weaker Mix

CTL Group results
corroborate
PSI results

MATERIALS:

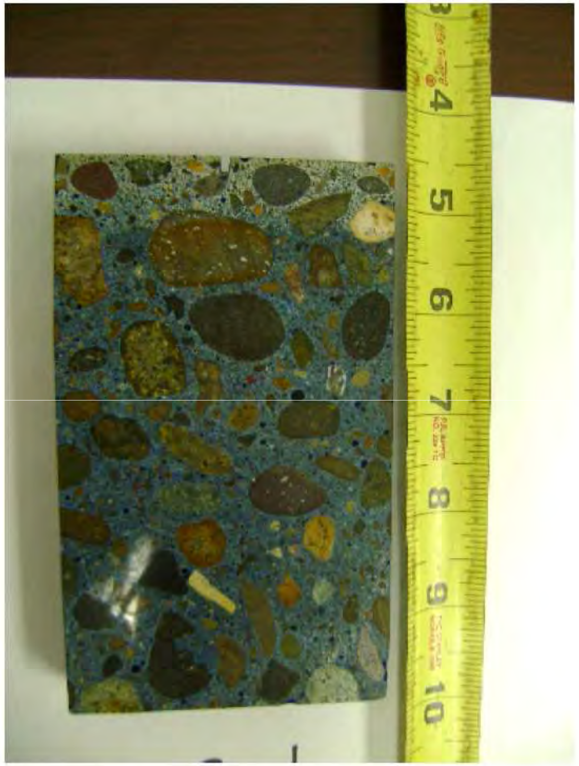
WATER : CEMENT RATIO

1999 CONSTRUCTION SUBMITTAL	1999 CONSTRUCTION DELIVERY	2010 IN-SITU (PSI & CTL)
Mix Design	Batch Tickets	Calculations based on Petrography and chemical test
Cement: 585 lbs Water: 0.41	Cement: 611-680 lbs Water: 0.38	Cement: 612-654 lbs* Water: 0.50 +/-0.05

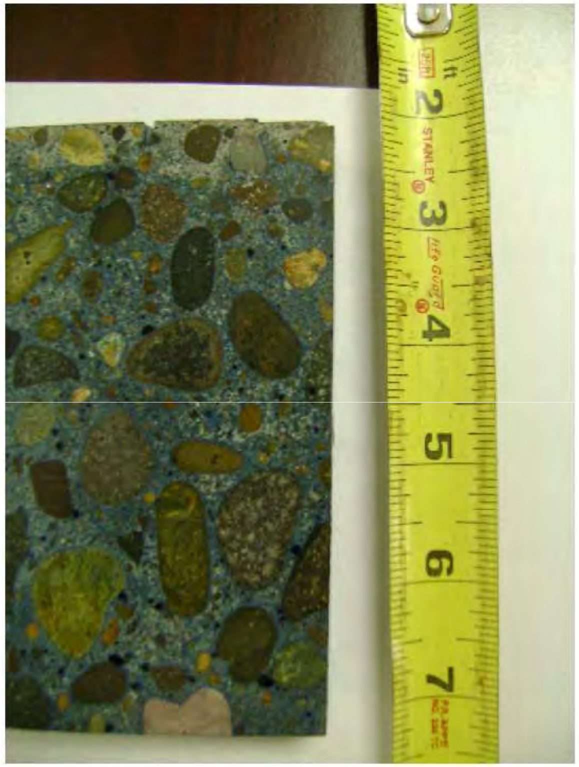
Measured per cubic yard of concrete.

* As calculated per ASTMC1324.

MATERIALS:
WATER : CEMENT RATIO



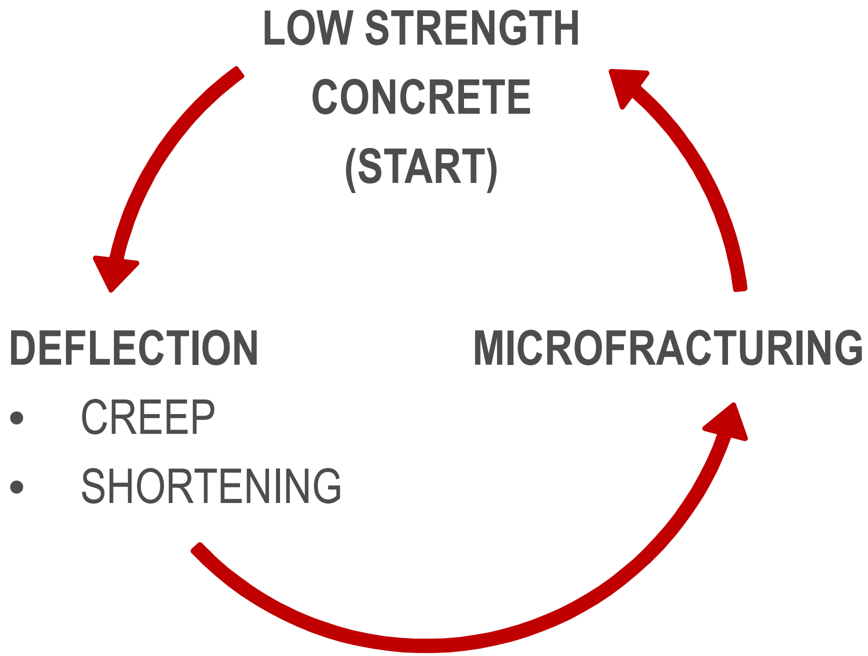
Photograph #1 - Sample 06033-1. Change in paste color can be seen at top surface and lower right corner.



Photograph #2 - Sample 06033-2. Color change can be seen in paste at top surface as well as the bulk paste.

Please see Volume 2 for the complete PSI report dated January 14, 2011

MATERIALS:
MICROFRACTURES IN THE CONCRETE



Carlson	PSI	CTL Group
MINIMAL	**EXCESSIVE**	**EXCESSIVE**
Excessive Microfractures would tend to indicate overstressed concrete and a potential for leading to in place concrete strength degradation. (It gets weaker.)		

MATERIALS:
DEBONDING

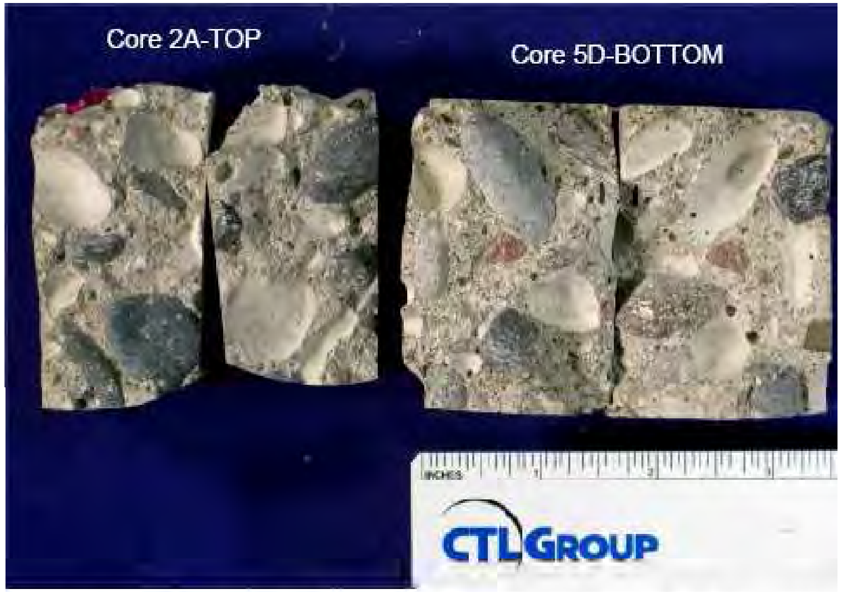


Fig. 7 Image showing freshly fractured surfaces of Cores 2A-TOP and 5D-BOTTOM. The fracture surfaces pass around almost all coarse aggregate particles indicating a weak paste-aggregate bond. Scale is marked in inches.

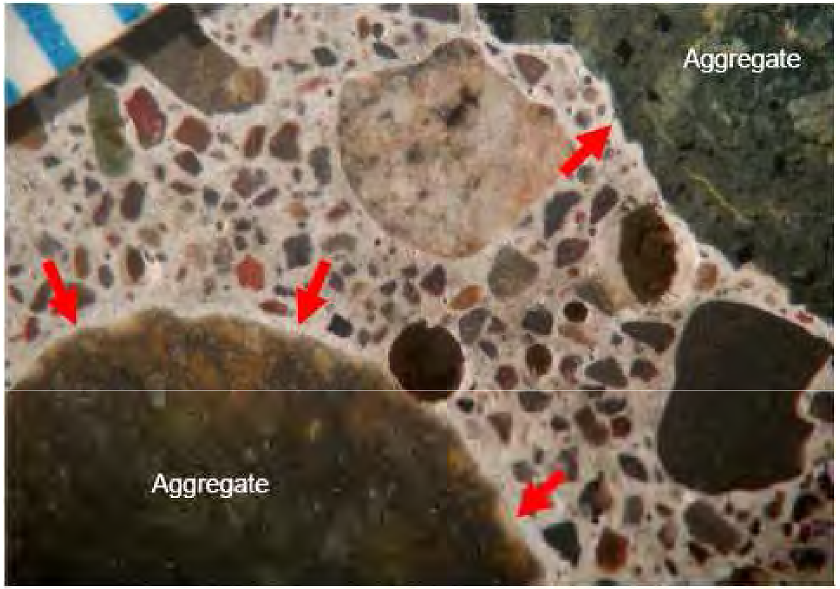


Fig. 8 Stereomicroscope image of a cut and lapped cross-sectional surface of Core 3C-MIDDLE, showing coarse aggregate particles exhibiting lighter paste rims (arrows). Scale increments are 0.04 in.

CTLGROUP
www.CTLGroup.com

Please see Volume 2 for the complete
CTL Group report dated December 15, 2010

MATERIALS:
DEBONDING AND MICROFRACTURING

Fig. 9 Stereomicroscope image of a cut and lapped cross-sectional surface of Core 5D BOTTOM, showing microcracks along the periphery of coarse aggregate particles and in the nearby paste (arrows). Scale increments are 0.04 in.

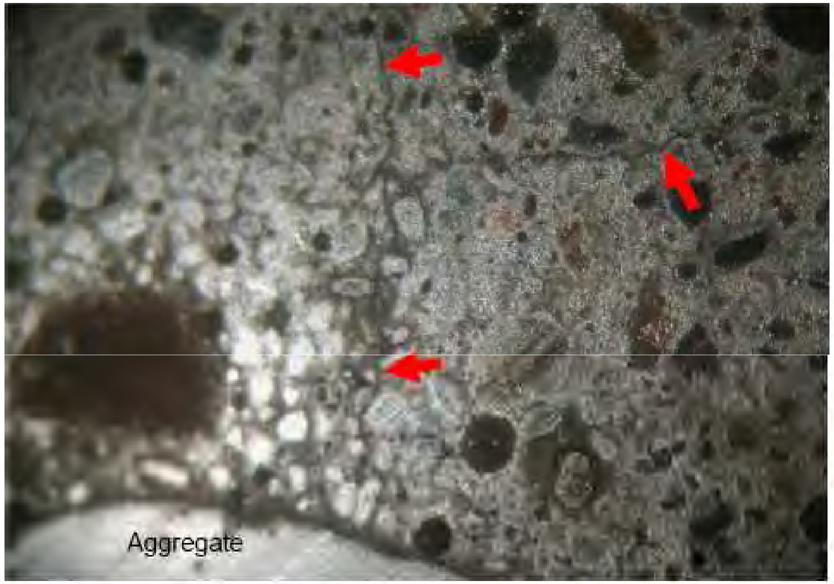


Fig. 10 Stereomicroscope image of a cut and lapped cross-sectional surface of Core 3C-MIDDLE, showing microcracks in the paste between coarse aggregate particles (arrows). The image was taken using oblique illumination shortly after the surface was wetted to highlight the microcracks. Field of view is approximately 0.5 in. across.

CTL GROUP www.CTLGroup.com

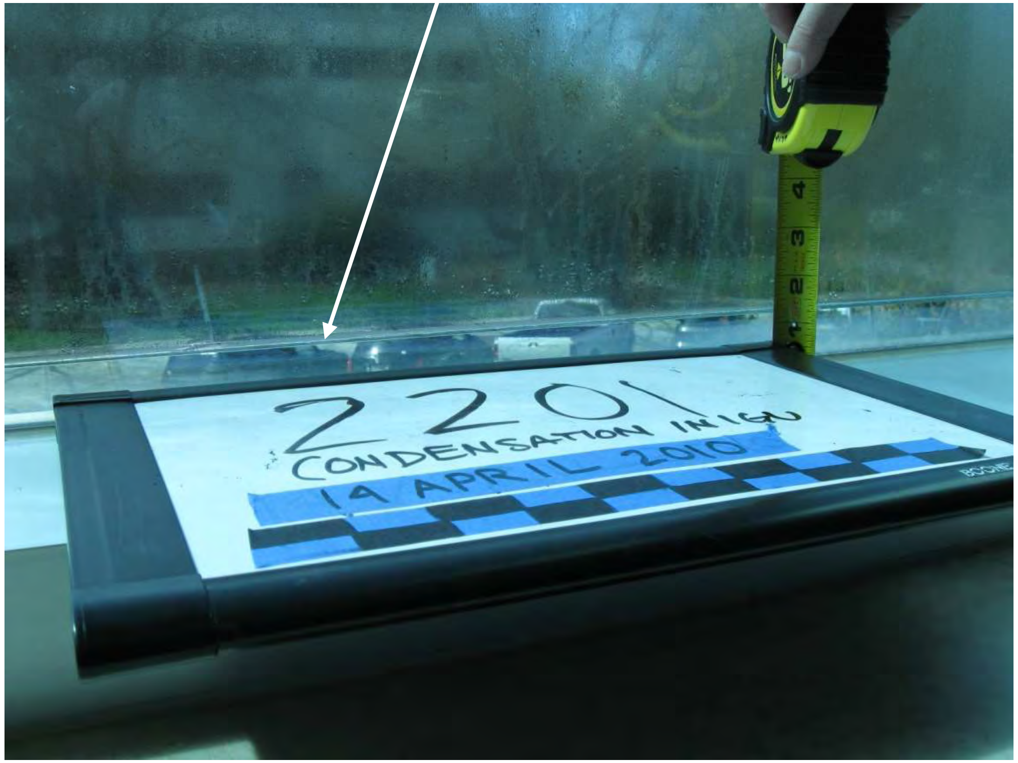
Please see Volume 2 for the complete CTL Group report dated December 15, 2010

MATERIALS:

SEALANT

MATERIALS:
CURTAINWALL SELECTION

STANDING WATER IN WINDOW



CONSTRUCTION ISSUES:

INSTALLATION ISSUES

REINFORCING BAR EXPOSED AT THE BOTTOM OF THE BUS MALL SLAB

CONSTRUCTION ISSUES:
SITE CLEANUP

DEBRIS ON THE FORM WORK CAST INTO THE BUS MALL SLAB

CONSTRUCTION ISSUES:
INCORRECT INSTALLATION

DEBRIS IN CASTING BED

REINFORCING BARS LAYING IN CASTING BED

REBAR BENT AND NOT REPAIRED DURING CONSTRUCTION

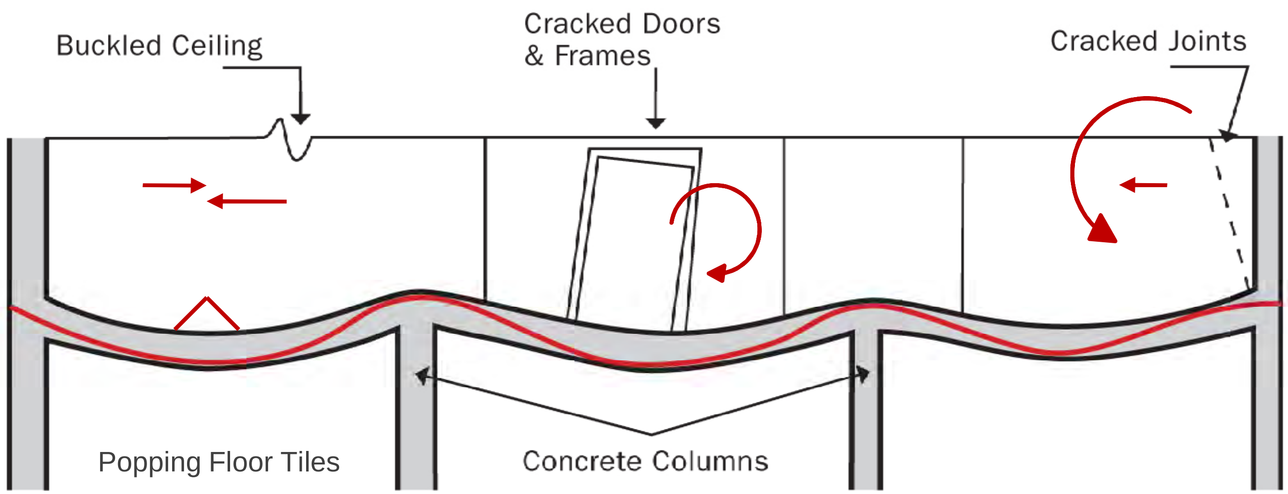
PROBLEMATIC CONSTRUCTION:
SITE SUPERVISION

Wood Chips Cast Into Concrete Column

SCREWDRIVER WITH
2 INCHES OF
EMBEDMENT

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

BASIC DIAGRAM



Please see Appendix 3 for a fully detailed survey

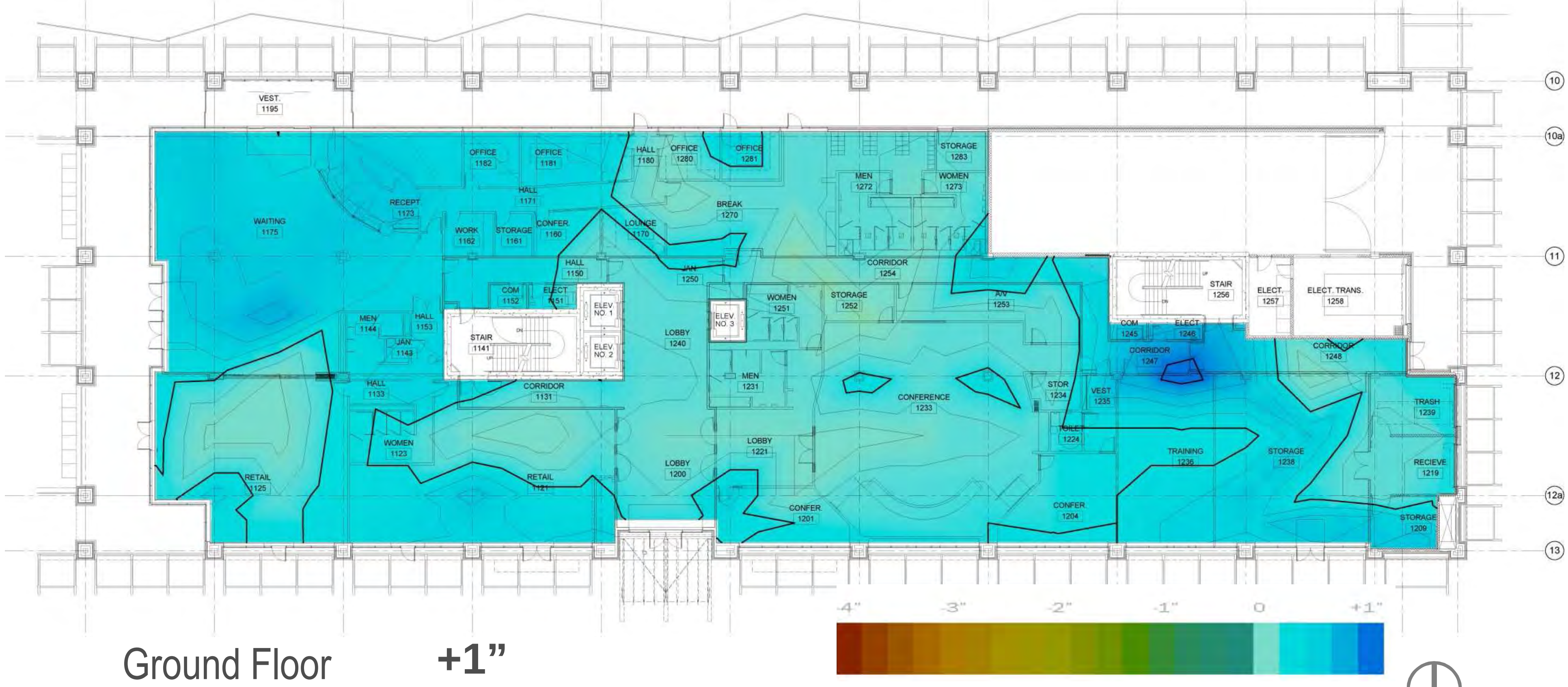
RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

CONCRETE FLOOR SLAB BEHAVIOR

- Initial low strength concrete leads to more deflections
- Long term creep contributes to the deflections
    - Deflections create stress in the slab
    - This stress manifests into microfractures
    - Microfractures contribute to lower strength concrete

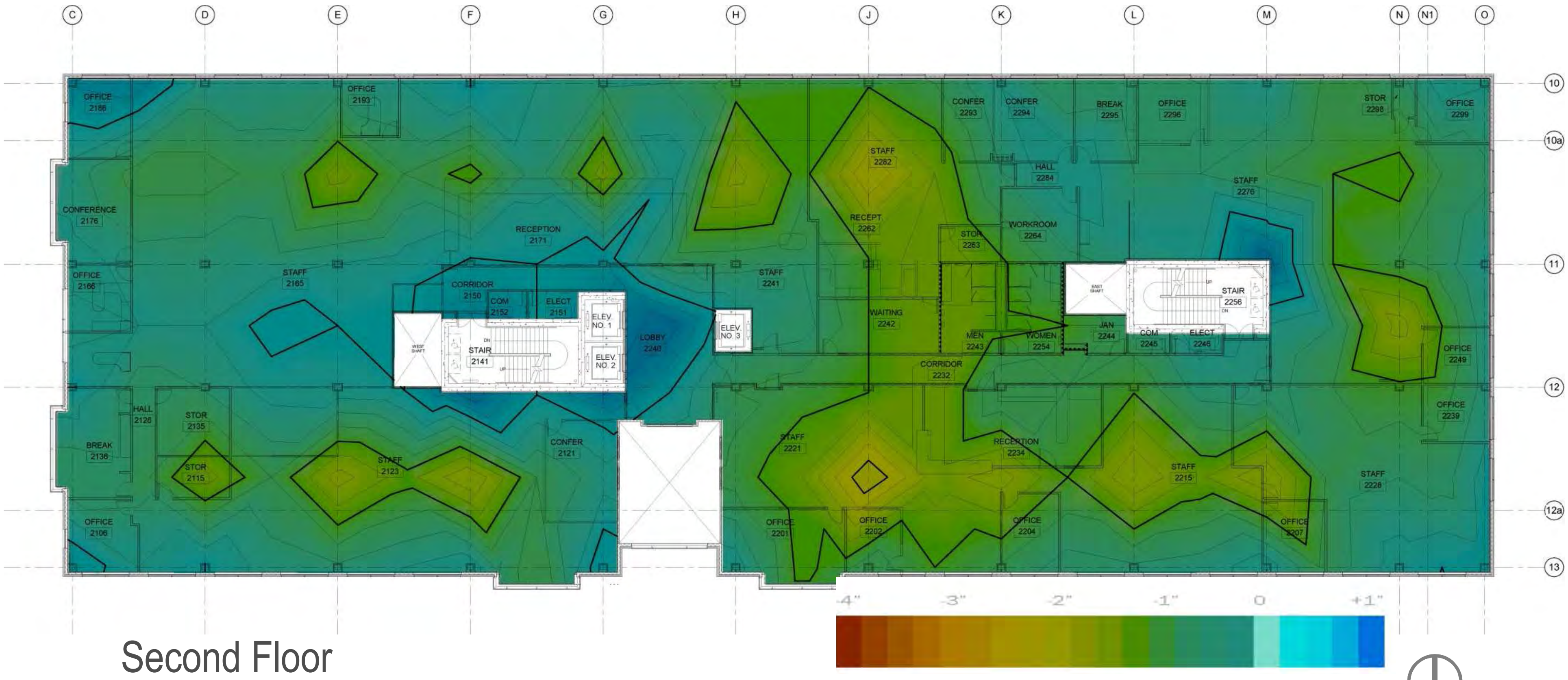
RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

OBSERVED SLAB DEFLECTION



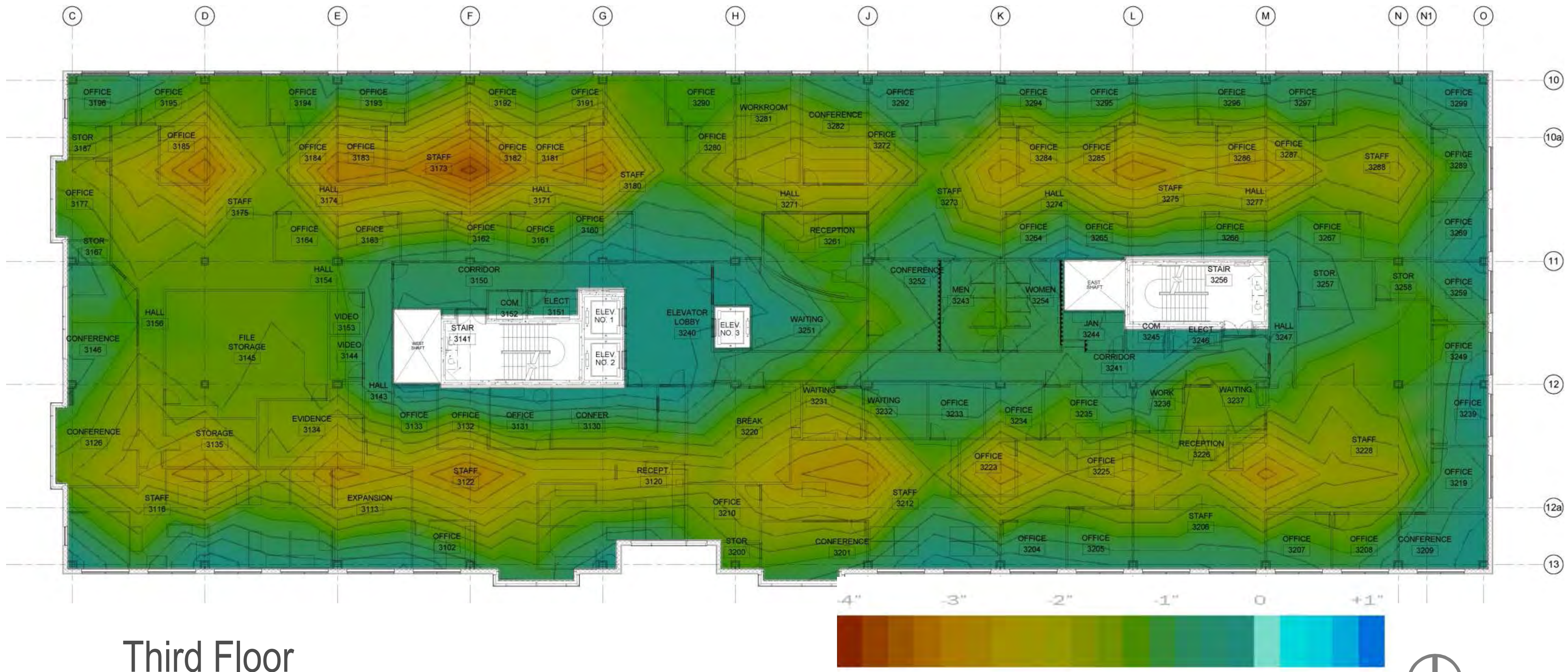
RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

OBSERVED SLAB DEFLECTION



RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

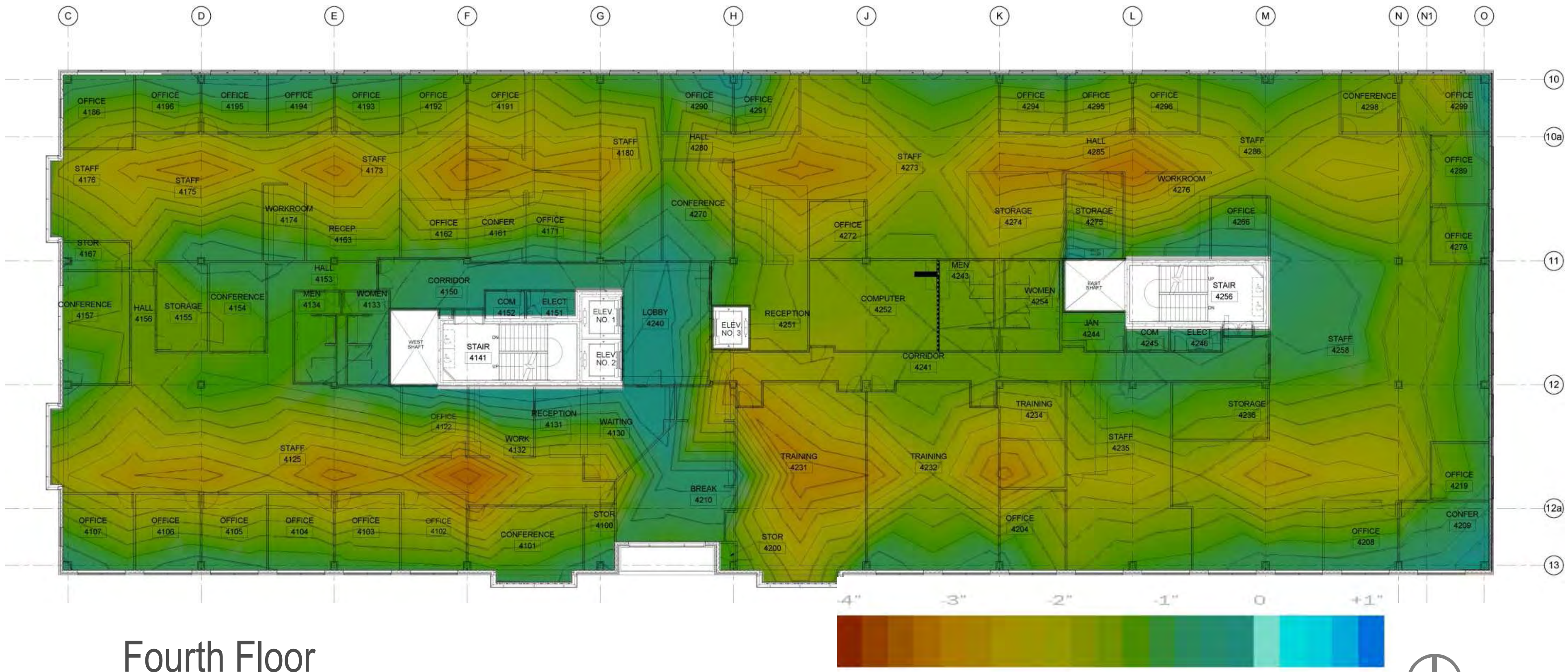
OBSERVED SLAB DEFLECTION



Third Floor

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

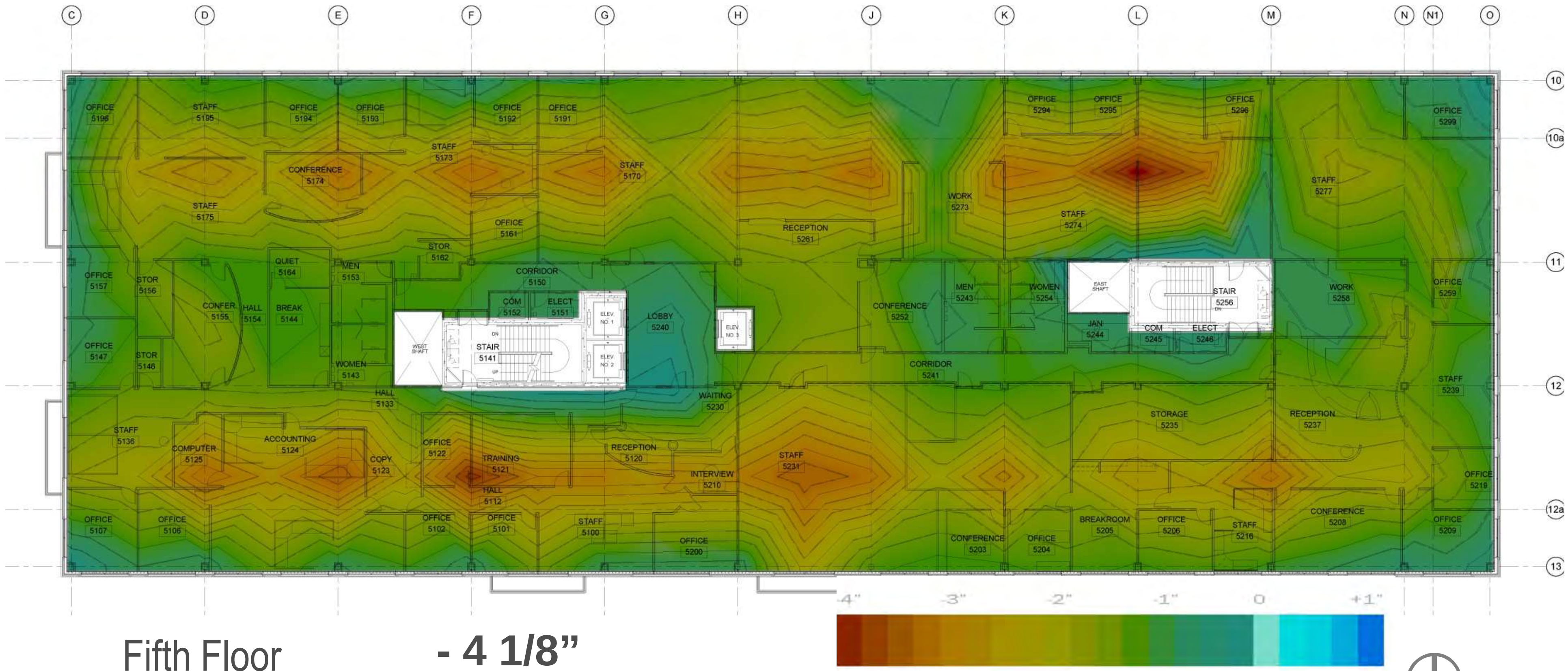
OBSERVED SLAB DEFLECTION



Fourth Floor

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

OBSERVED SLAB DEFLECTION

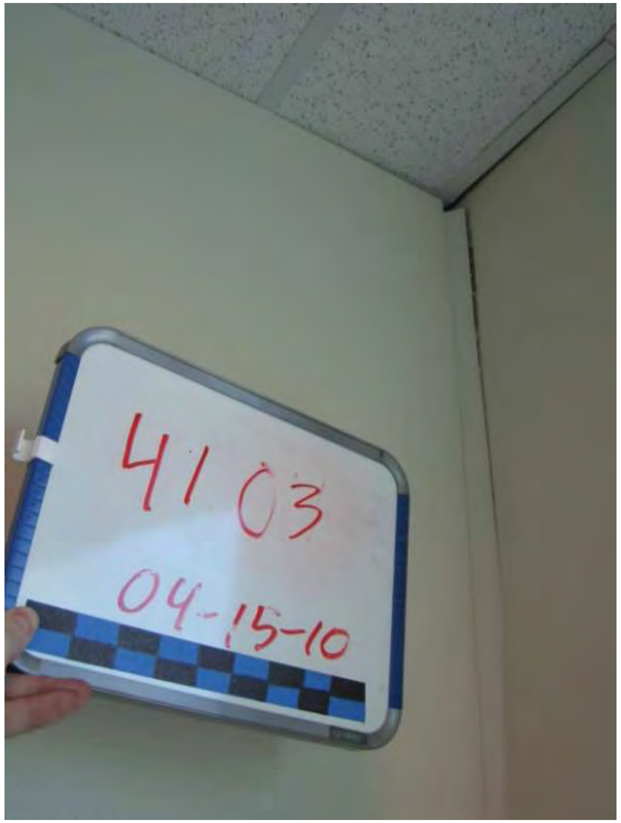


Fifth Floor

- 4 1/8”

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

WALLS

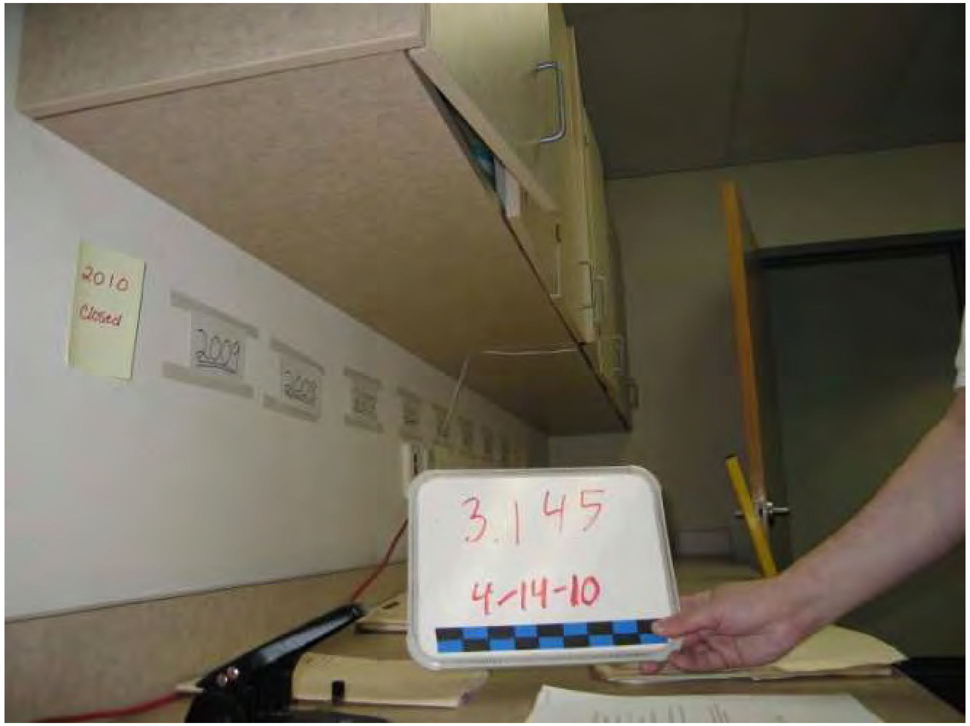


RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

DOORS

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION ISSUES:

CASEWORK



RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION:

SHRINKAGE AND SHORTENING

BRICK RESISTANCE

SE Corner SLAB MOVEMENT

BRICK RESISTANCE

SW Corner SLAB MOVEMENT

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION:

BUILDING STRUCTURE

BRICK RESISTANCE

NE Corner ← SLAB MOVEMENT

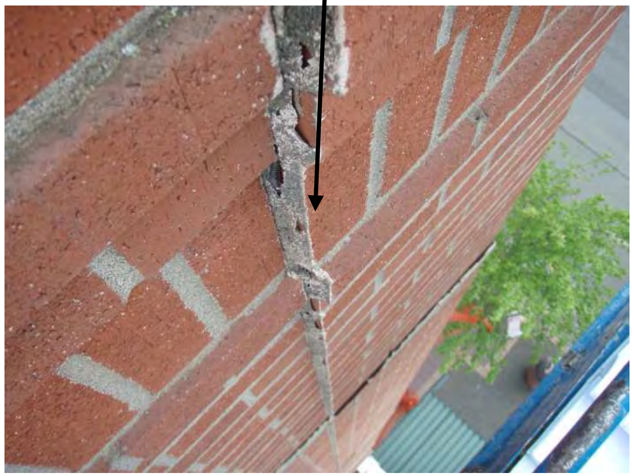
BUCKLED STEEL STUD

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION:

BUILDING ENVELOPE

SHEARED SEALANT

OUT OF PLANE MOVEMENT

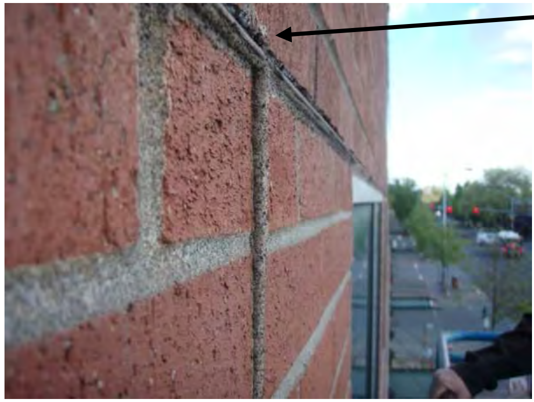


DEBONDED MORTAR JOINT

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION:

BUILDING ENVELOPE

COMPRESSED SEALANT



SEPARATED FLASHING

RESULTS OF DESIGN, MATERIALS, AND CONSTRUCTION:

COLUMN GAP AT THE BUS MALL SLAB

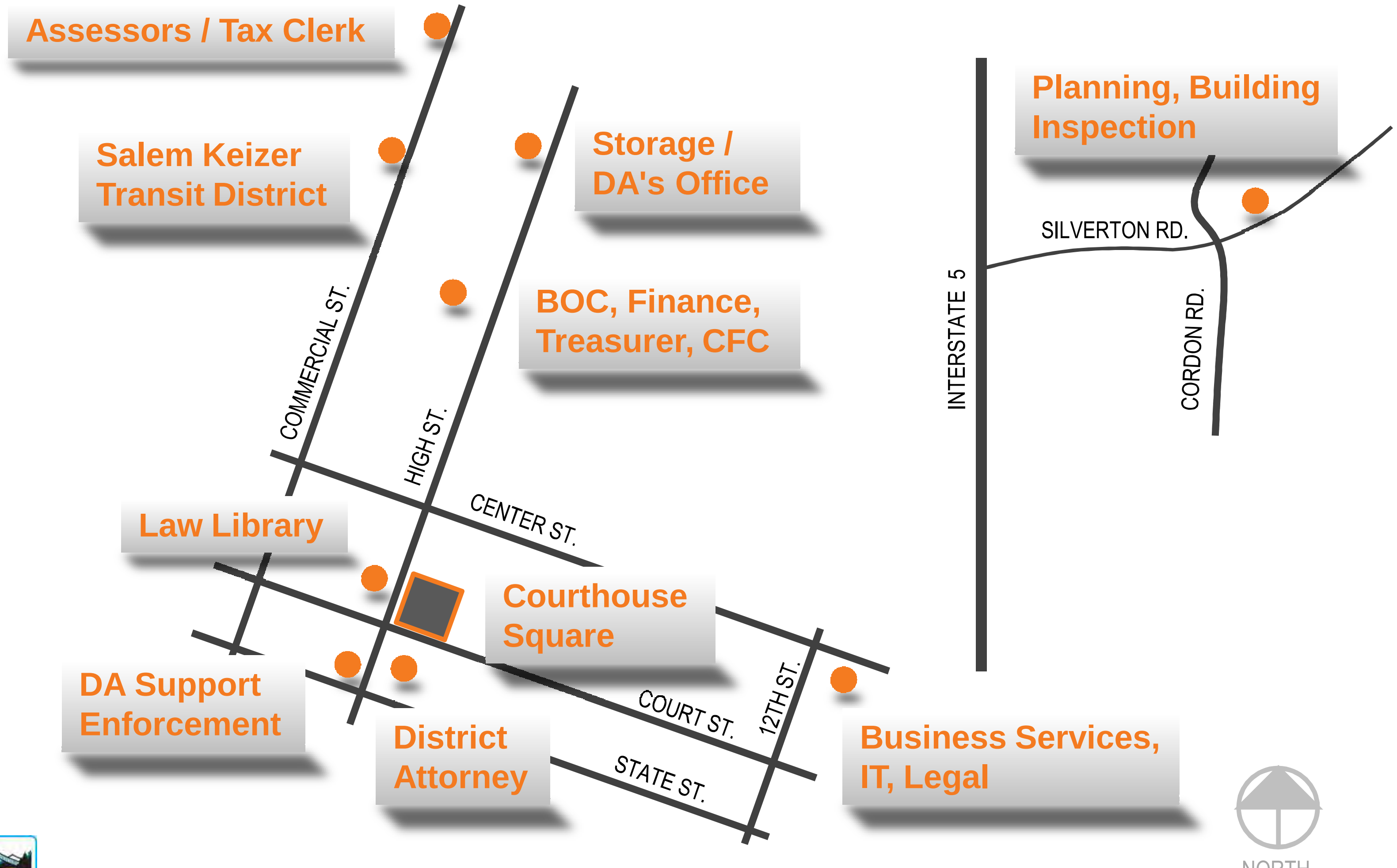
4 ½ INCHES
AT TOP

3" INCHES
AT BOTTOM

IMPACTS:
OVERALL

- Relocation of all tenants within 60 days
- Closure of the Bus Mall and Parking Garage
- Bus Mall has moved to three different locations
- Unanticipated Costs
- Public Discourse

IMPACTS:
DEPARTMENTAL RELOCATION



REMEDIATION OPTIONS:

CONSIDERED

- Fiber reinforced polymer (FRP) to strengthen existing slab
  - In-place concrete too weak, dead load balancing too great
  - Slab can't support itself
  - Needs drop panels or slab bands for punching shear
  - Needs to relieve stress in existing slab
- External post-tensioning
  - In-place concrete too weak, dead load balancing too great
  - Slab can't support itself
  - Needs drop panels or slab bands for punching shear
  - Needs to relieve stress in existing slab
- Additional structural slab on top
  - Must be post-tensioned (thicker than existing) at 12-16 inches, or . . .
  - Conventional slab but substantially thicker at 16-20 inches, and . . .

    Drop beams below existing slab or rely on existing slab to perform as intended with tendon testing
  - Significant column, foundation and shear wall modifications

REMEDIATION OPTIONS:

CONSIDERED

- Fiber reinforced polymer (FRP) to strengthen existing slab
  - In-place concrete too weak, dead load balancing too great
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  - Must be post-tensioned (thicker than existing) at 12-16 inches, or . . .
  - Conventional slab but substantially thicker at 16-20 inches, and . . .
  - Drop beams below existing slab or rely on existing slab to perform as intended with tendon testing
  - Significant column, foundation and shear wall modifications

TECHNICALLY INFEASIBLE

REMEDIATION OPTIONS:
PROPOSED

BUILDING

- Create additional structural system
  - Steel beams to divide column bays

- Augment existing structure
  - Increase size of columns
  - Increase size of foundations
  - Install FRP on top of floor slabs in limited locations
  - Increase thickness of shear walls

REMEDIATION OPTIONS:
PROPOSED

- Mechanical system changed from air-based to water based radiant system
  - Demolish existing air handlers, ducts and terminal units
  - Cooling tower on roof
  - Chillers and pump room in basement
  - Boiler room in basement
  - Radiant panels as new ceiling
  - Uses significantly less energy than current air-based system
  - Unified system: Not ad-hoc or mismatched

REMEDIATION OPTIONS:

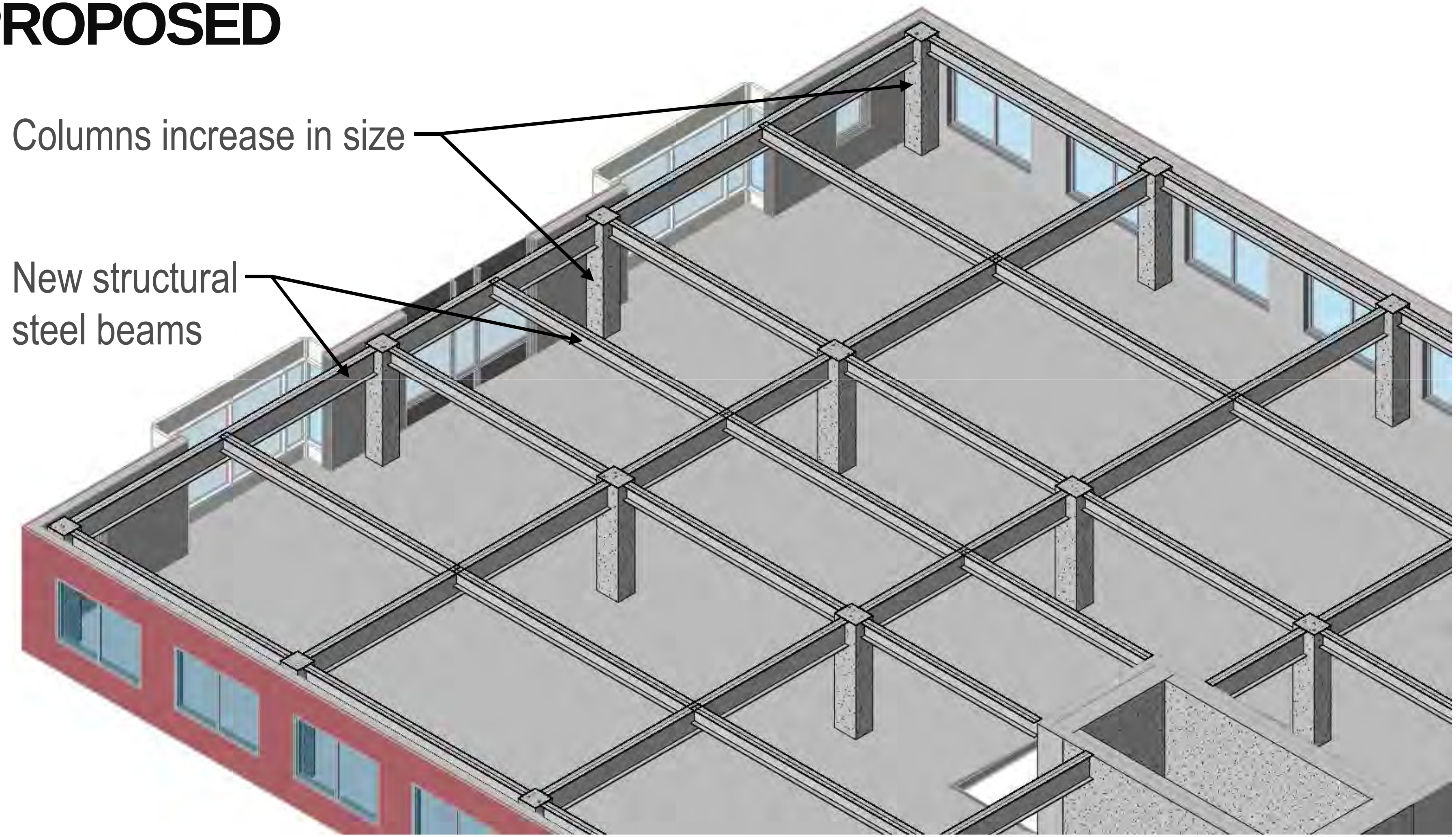
PROPOSED

- Other building systems will need significant modification
  - Electrical distribution from the main risers
  - Telecommunications from the closets
  - Lighting system
  - Fire sprinklers from the main riser
  - Ceilings, grids and registers

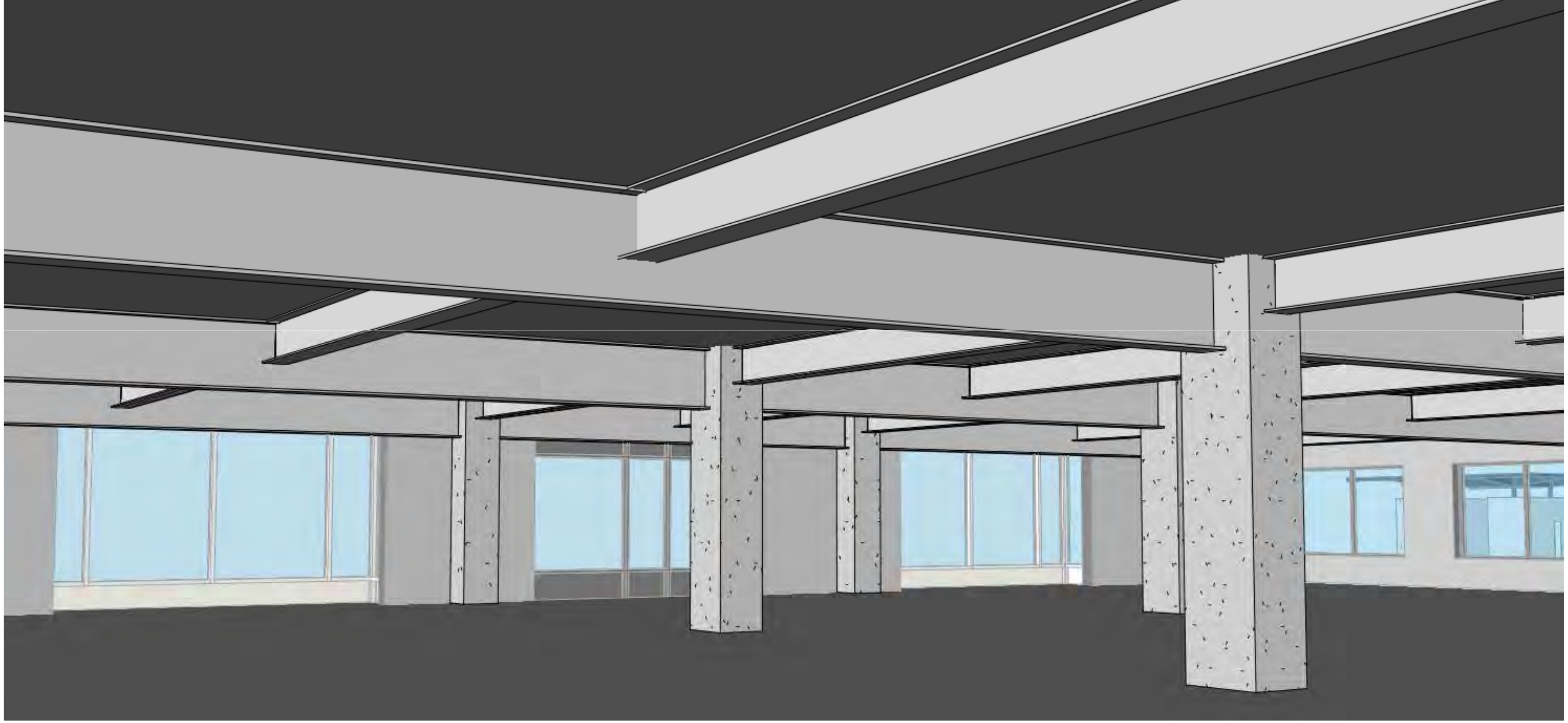
REMEDIATION OPTIONS:
PROPOSED

Columns increase in size

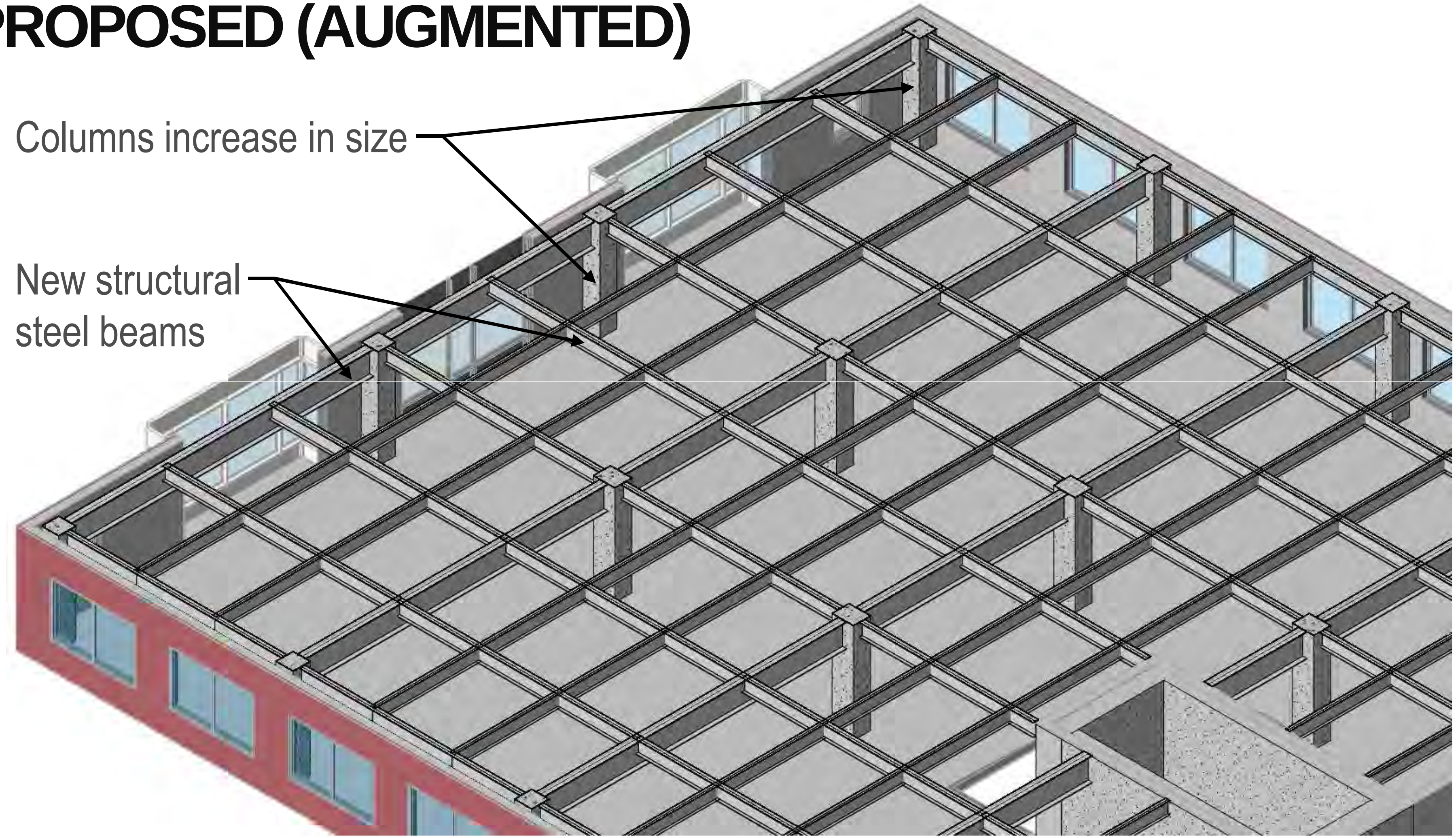
New structural
steel beams



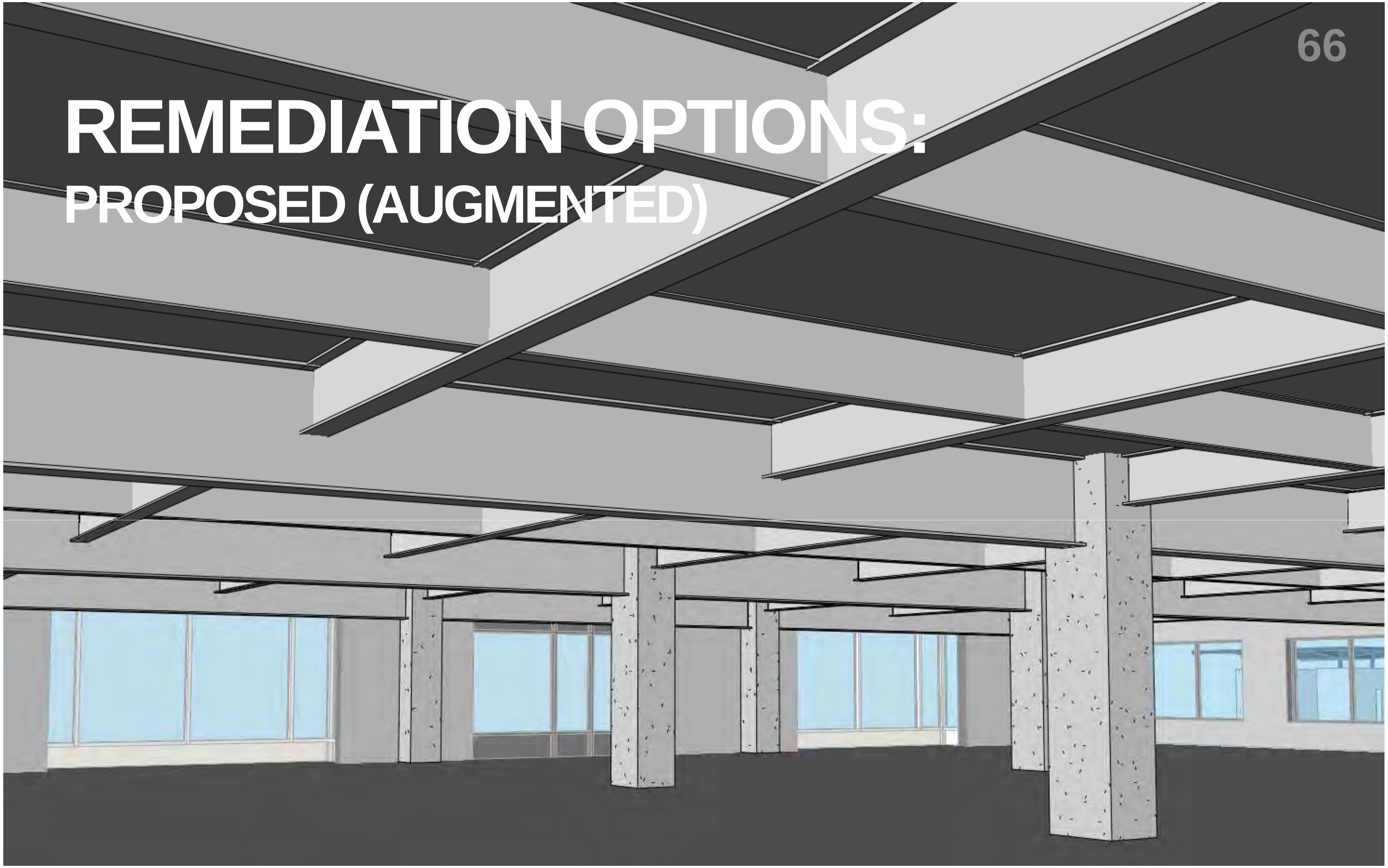
REMEDIATION OPTIONS:
PROPOSED



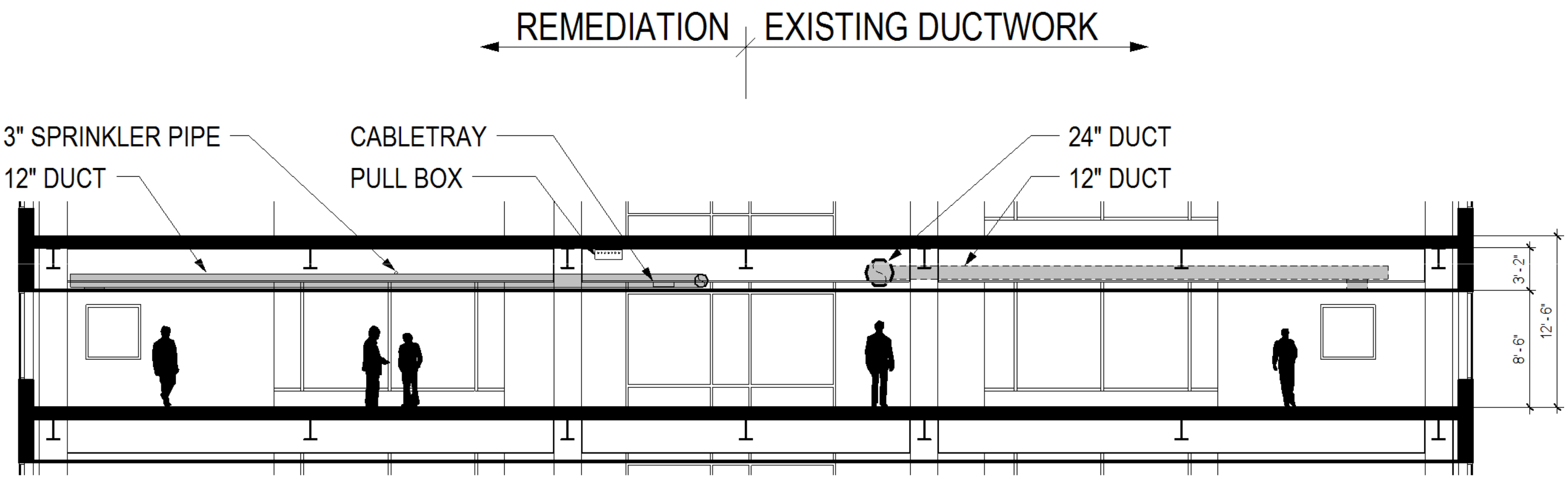
REMEDIATION OPTIONS:
PROPOSED (AUGMENTED)



REMEDIATION OPTIONS:
PROPOSED (AUGMENTED)



REMEDIATION OPTIONS:
PROPOSED



- Radiant Panel (water)
- Existing ceiling height maintained
- Air-based system can't fit into space

REMEDIATION OPTIONS:

CONSIDERED

BUS MALL

- Create additional structural system
  - Steel beams to divide column bays

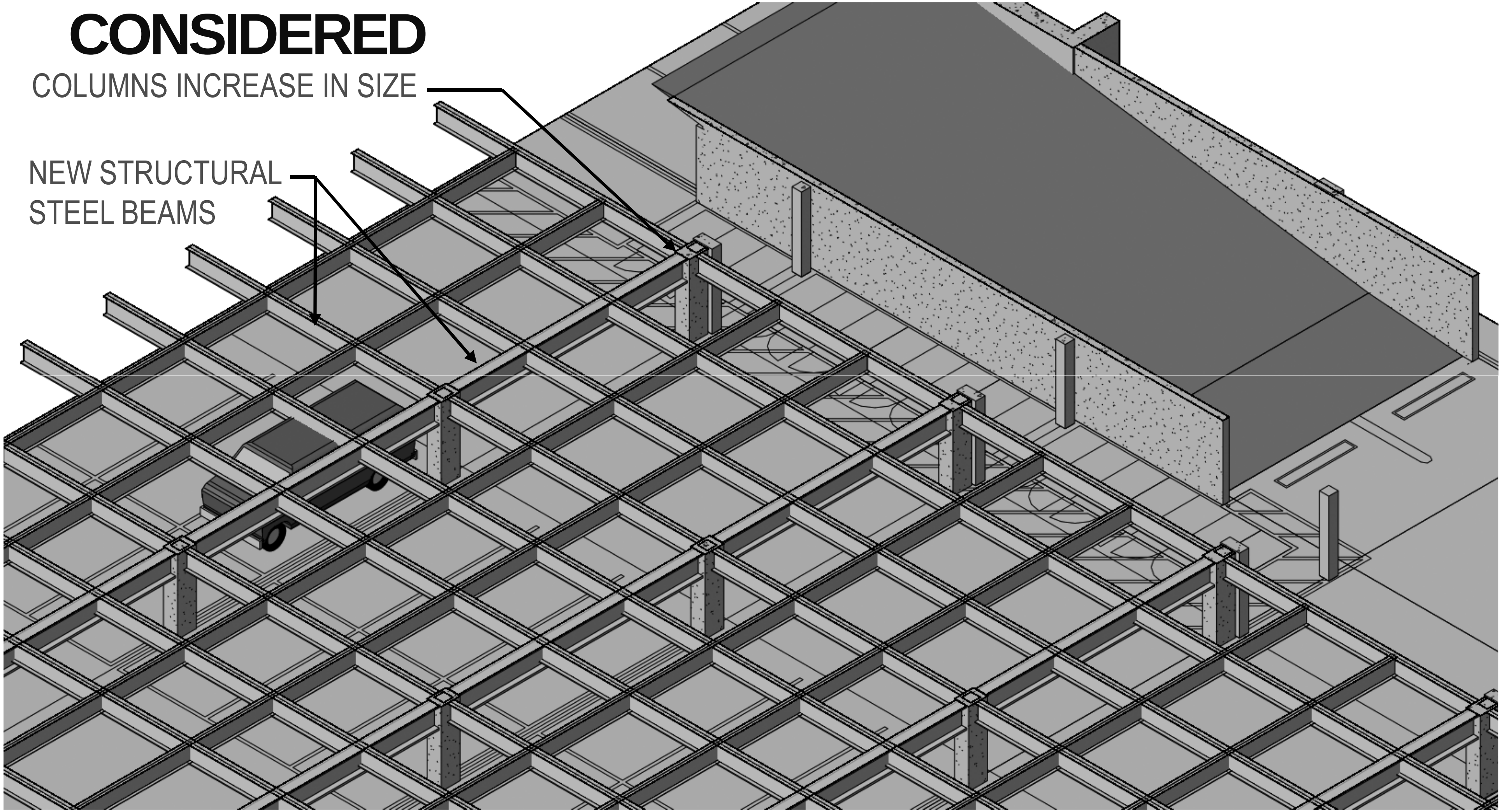
- Augment existing structure
  - Increase size of columns
  - Increase size of foundations
  - Install FRP on top of floor slabs in limited locations
  - Increase thickness of shear walls
- Locations for different car sizes heavily controlled

PROPOSED

- Demolish existing and rebuild new

REMEDIATION OPTIONS:

CONSIDERED



REMEDIATION OPTIONS:
CONSIDERED

• Max 7’-0” clearance unless additional excavation is undertaken

REMEDIATION OPTIONS:

PROPOSED

NORTH BLOCK

- Existing damage is extensive
- Additional testing could be done
- Value of asset compared to extent of repairs is less
- Demolish

REMEDIATION OPTIONS:
SUMMARY

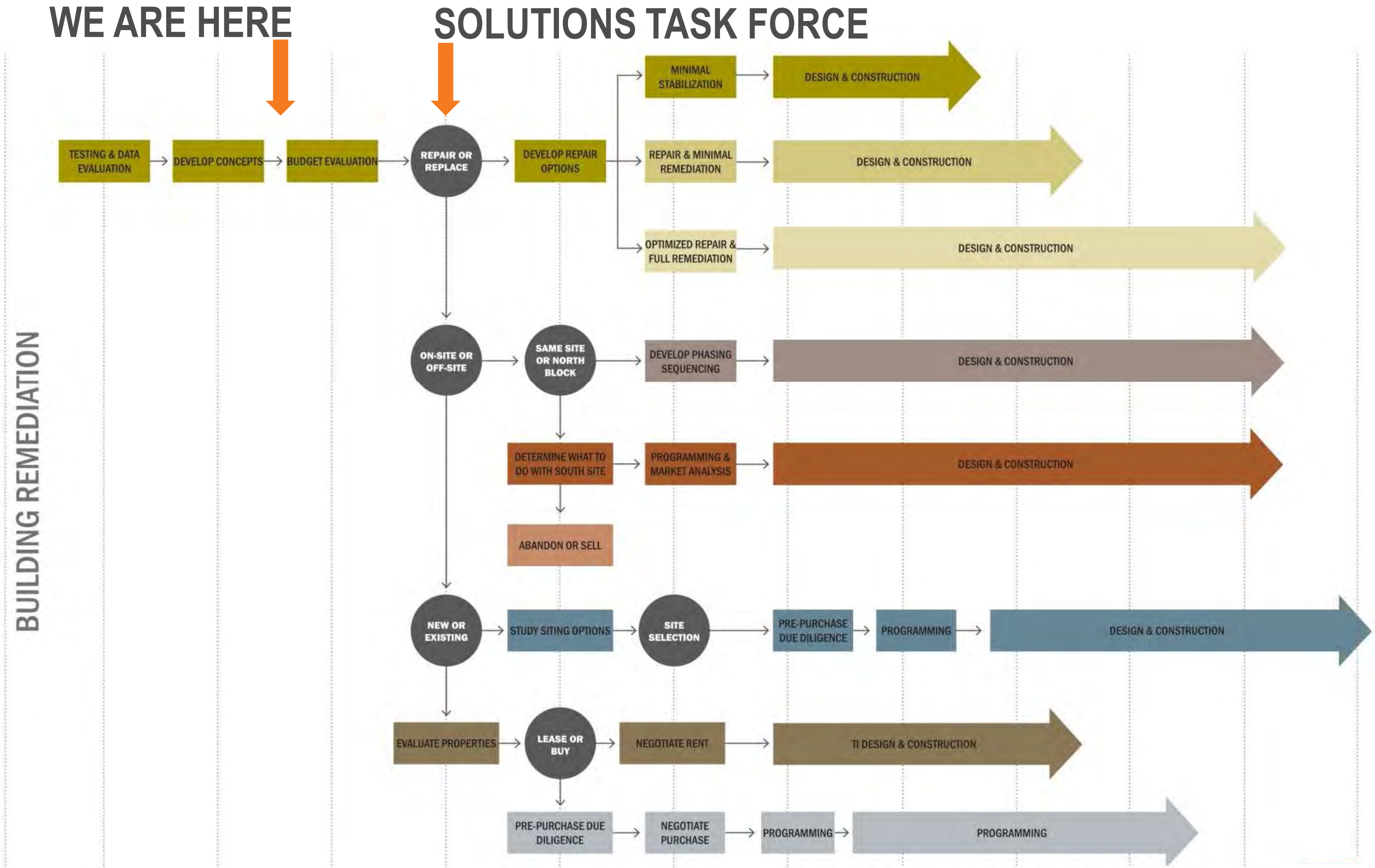
CONSTRUCTION COSTS

	Demolition	Remediation	Replace
Courthouse Square	$1,588,475	$28,800,027	$33,623,272
Bus Mall	$291,423	$7,827,685	$7,127,773
North Block	$122,462	$2,879,460	$2,432,198

TOTAL PROJECT COSTS

	Demolition	Remediation	Replace
Courthouse Square	$2,011,535	$39,696,585	$46,336,530
Bus Mall	$368,509	$10,375,284	$9,660,695
North Block	$147,926	$3,421,730	$3,141,935

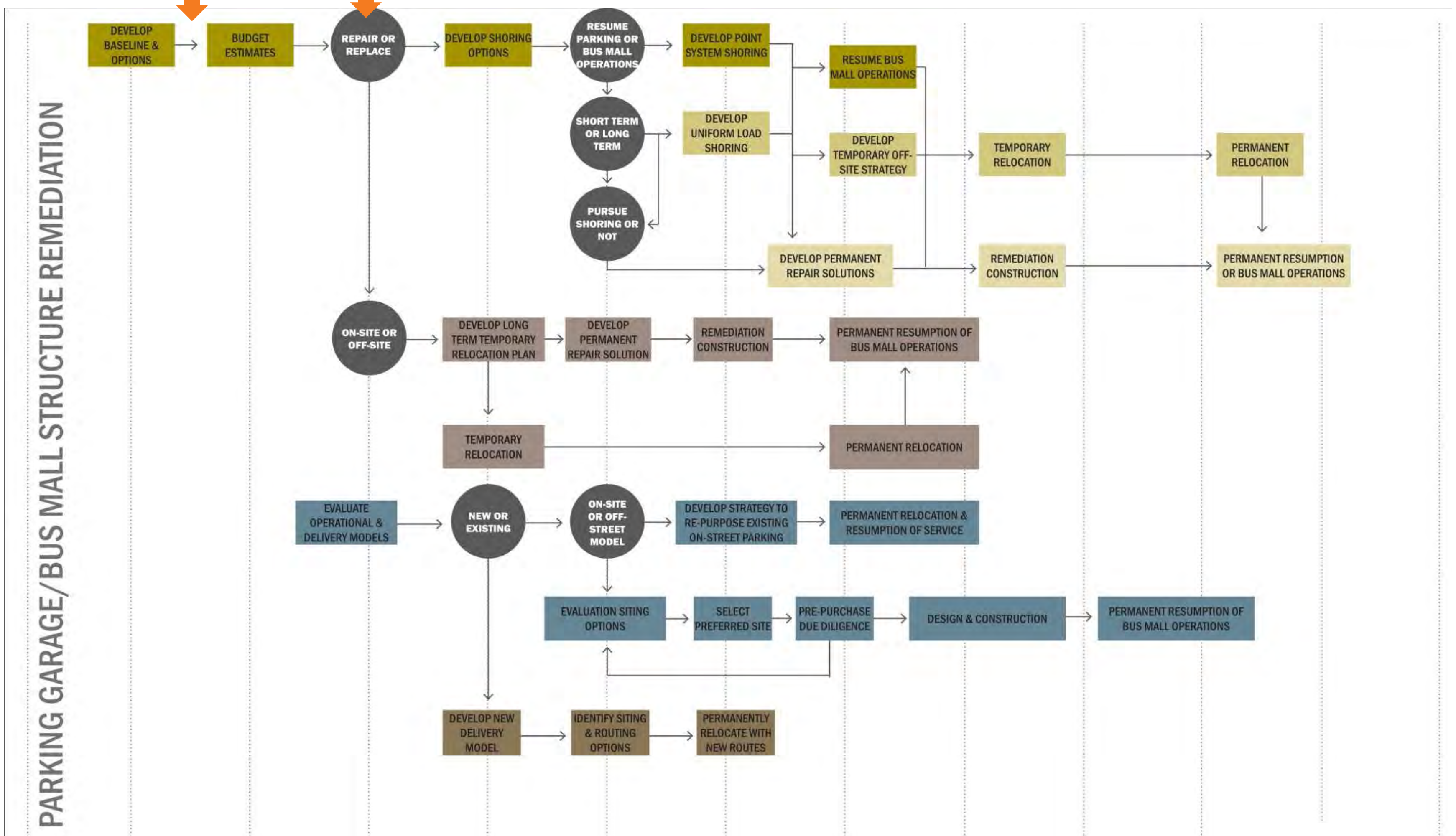
NEXT STEPS



WE ARE HERE
SOLUTIONS TASK FORCE
BUILDING REMEDIATION
TESTING & DATA EVALUATION
DEVELOP CONCEPTS
BUDGET EVALUATION
REPAIR OR REPLACE
DEVELOP REPAIR OPTIONS
MINIMAL STABILIZATION
DESIGN & CONSTRUCTION
REPAIR & MINIMAL REMEDIATION
DESIGN & CONSTRUCTION
OPTIMIZED REPAIR & FULL REMEDIATION
DESIGN & CONSTRUCTION
ON-SITE OR OFF-SITE
SAME SITE OR NORTH BLOCK
DEVELOP PHASING SEQUENCING
DESIGN & CONSTRUCTION
DETERMINE WHAT TO DO WITH SOUTH SITE
PROGRAMMING & MARKET ANALYSIS
DESIGN & CONSTRUCTION
ABANDON OR SELL
NEW OR EXISTING
STUDY SITING OPTIONS
SITE SELECTION
PRE-PURCHASE DUE DILIGENCE
PROGRAMMING
DESIGN & CONSTRUCTION
EVALUATE PROPERTIES
LEASE OR BUY
NEGOTIATE RENT
TI DESIGN & CONSTRUCTION
PRE-PURCHASE DUE DILIGENCE
NEGOTIATE PURCHASE
PROGRAMMING
PROGRAMMING

NEXT STEPS

WE ARE HERE SOLUTIONS TASK FORCE



QUESTIONS?

APPENDICES

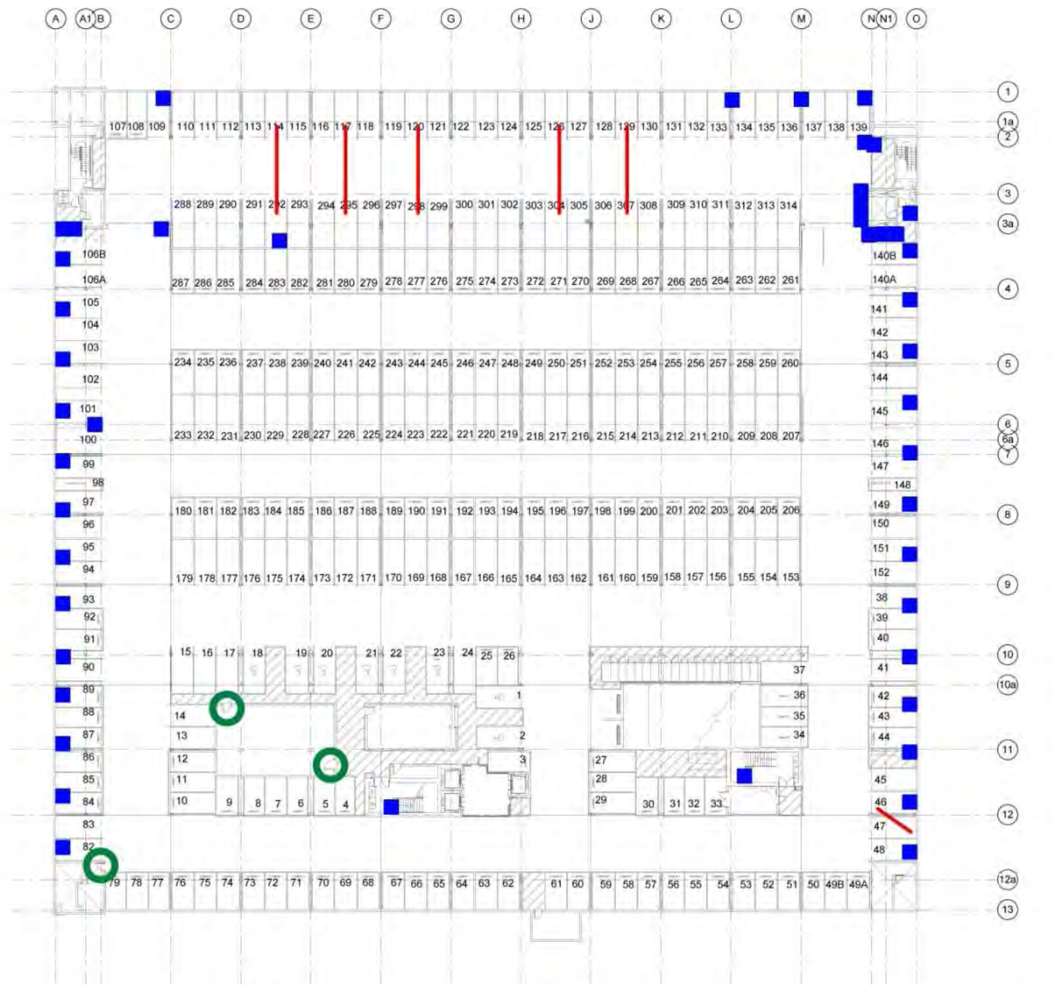
- Building Overview
- Testing Locations
- Punching Shear Locations
- Column Loading
- Slab Reinforcing Deficiencies
- Shear Wall Deficiencies

MILLER CONSULTING ENGINEERS, INC.

BUILDING OVERVIEW

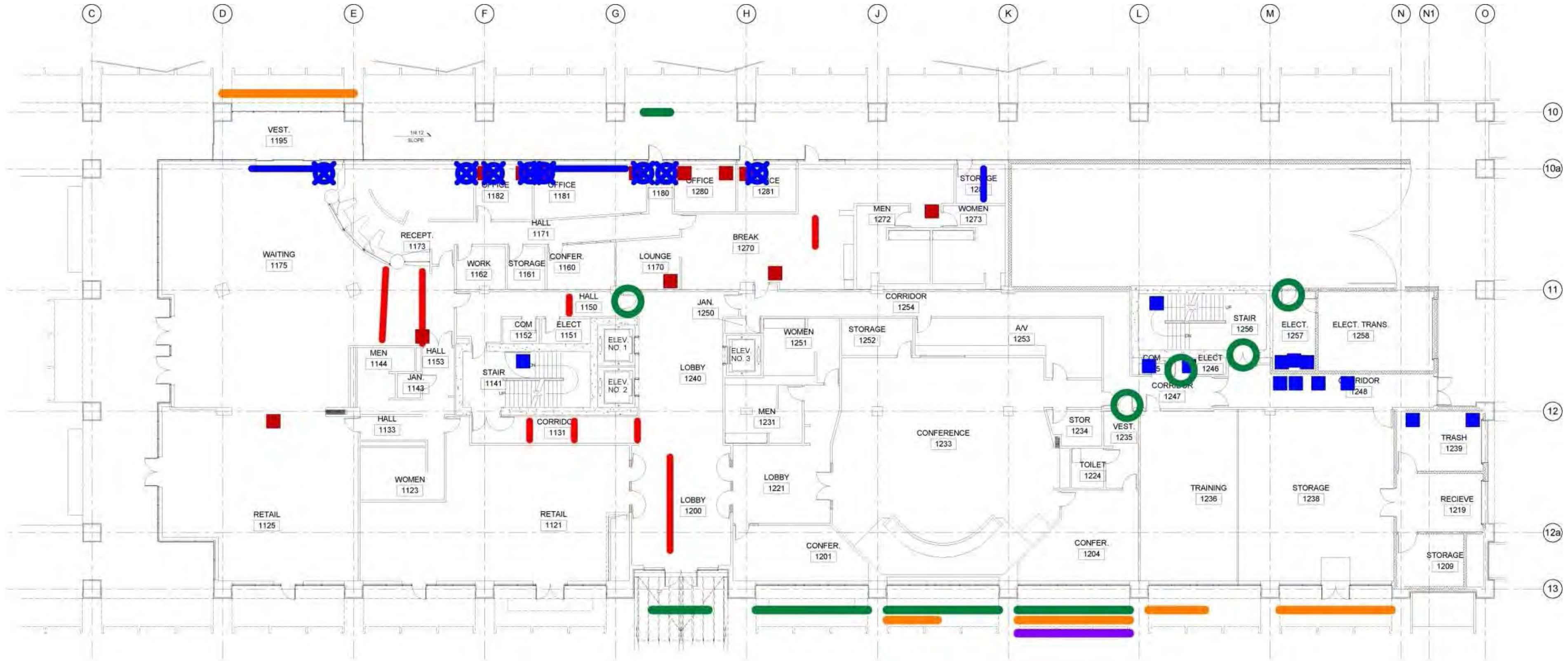
- WINDOW SILL CRACK
- GYP WALL CRACK
- CMU/CONC WALL CRACK
- CASEWORK/FURN ISSUE
- DOOR FUNCTION ISSUE
- CEILING GRID BUCKLE IN FIELD
- CEILING/SOFFIT ISSUE

- CEILING WALL ANGLE BUCKLING
- FLOOR/SLAB CRACK
- WINDOW; CRACK OR DETERIORATION/ DEFORMATION AT EXTERIOR WALL
- WINDOW; BROKEN/DEFECTIVE IGU
- WINDOW; STAINING & EVIDENCE OF WATER AT WINDOW/SILL
- WINDOW; STAINING & EVIDENCE OF WATER AT WALL OR CLG
- WINDOW; INTERIOR GASKET SHORT/INCOMPLETE



Garage Levels

BUILDING OVERVIEW



- WINDOW SILL CRACK
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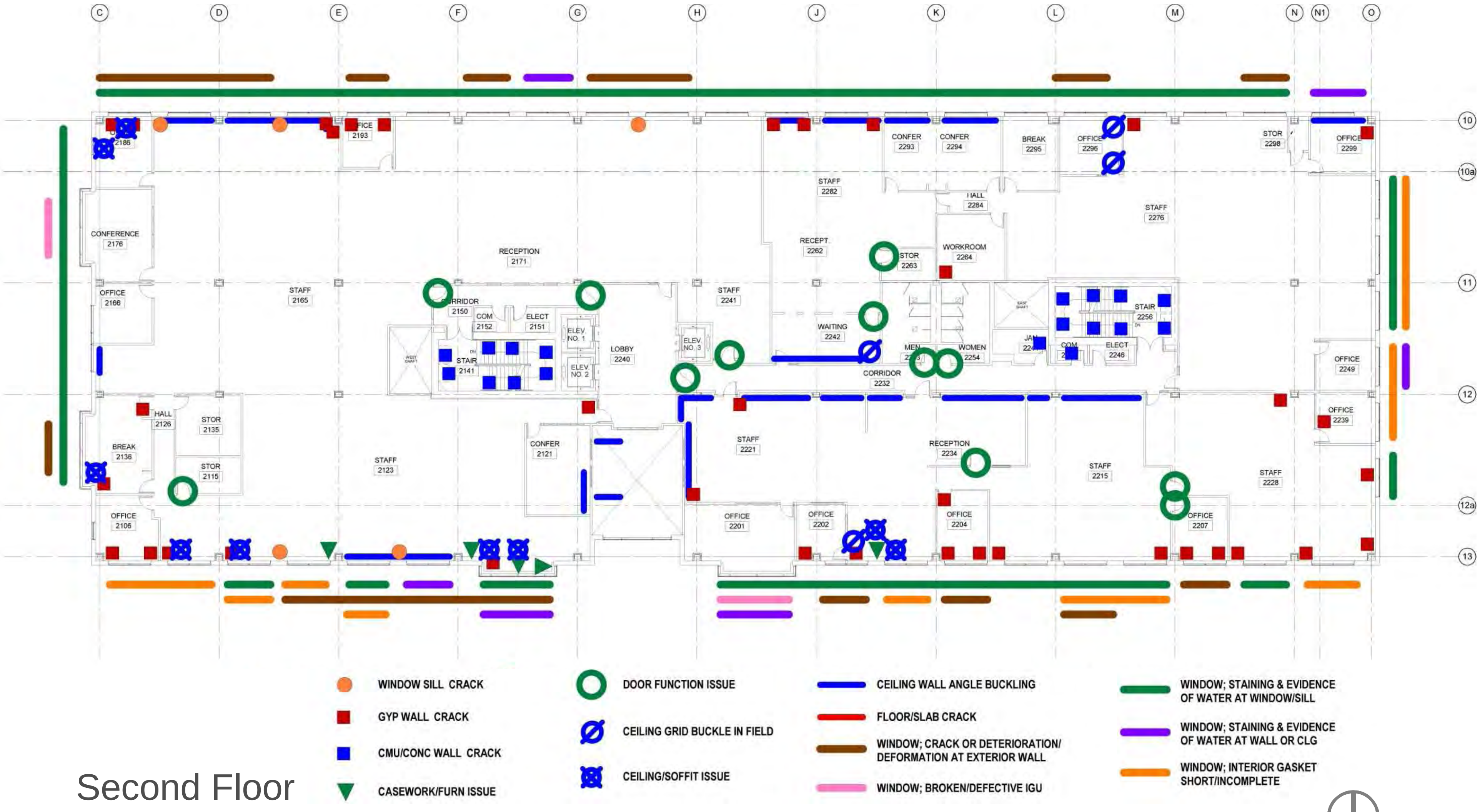
- WINDOW; STAINING & EVIDENCE OF WATER AT WALL OR CLG
- WINDOW; INTERIOR GASKET SHORT/INCOMPLETE

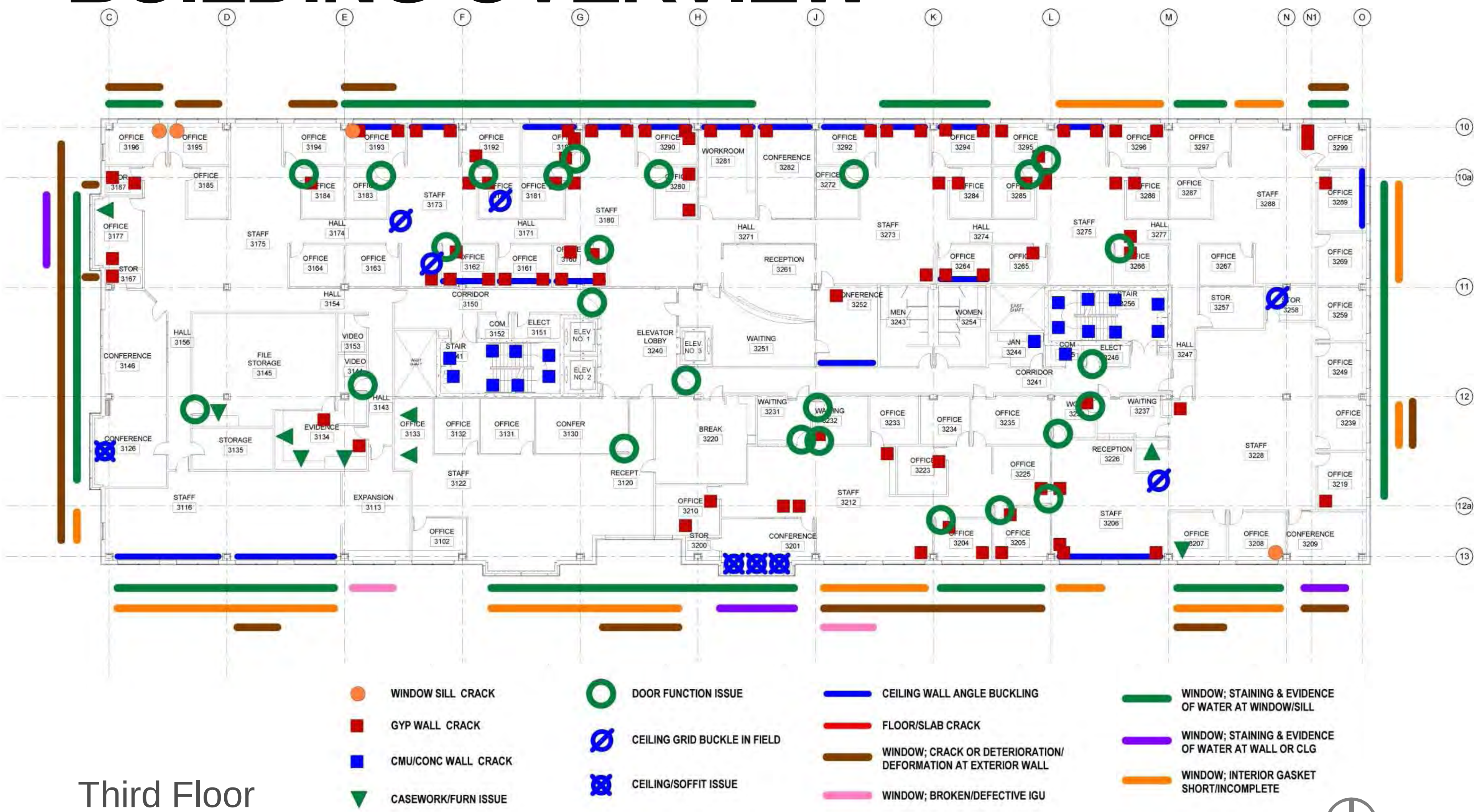
Ground Floor

BUILDING OVERVIEW



Second Floor

BUILDING OVERVIEW

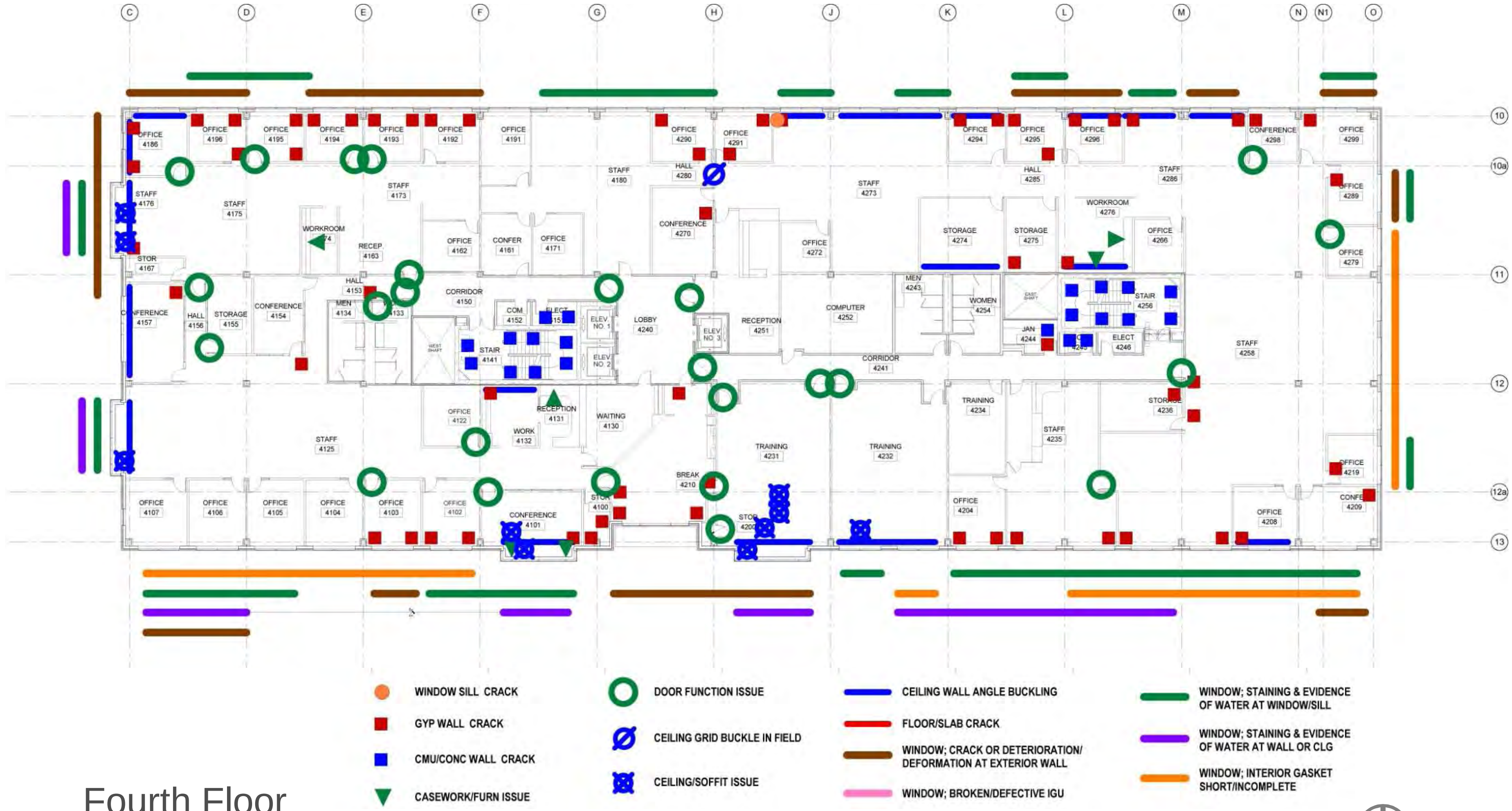


Third Floor

MILLER CONSULTING ENGINEERS, INC.

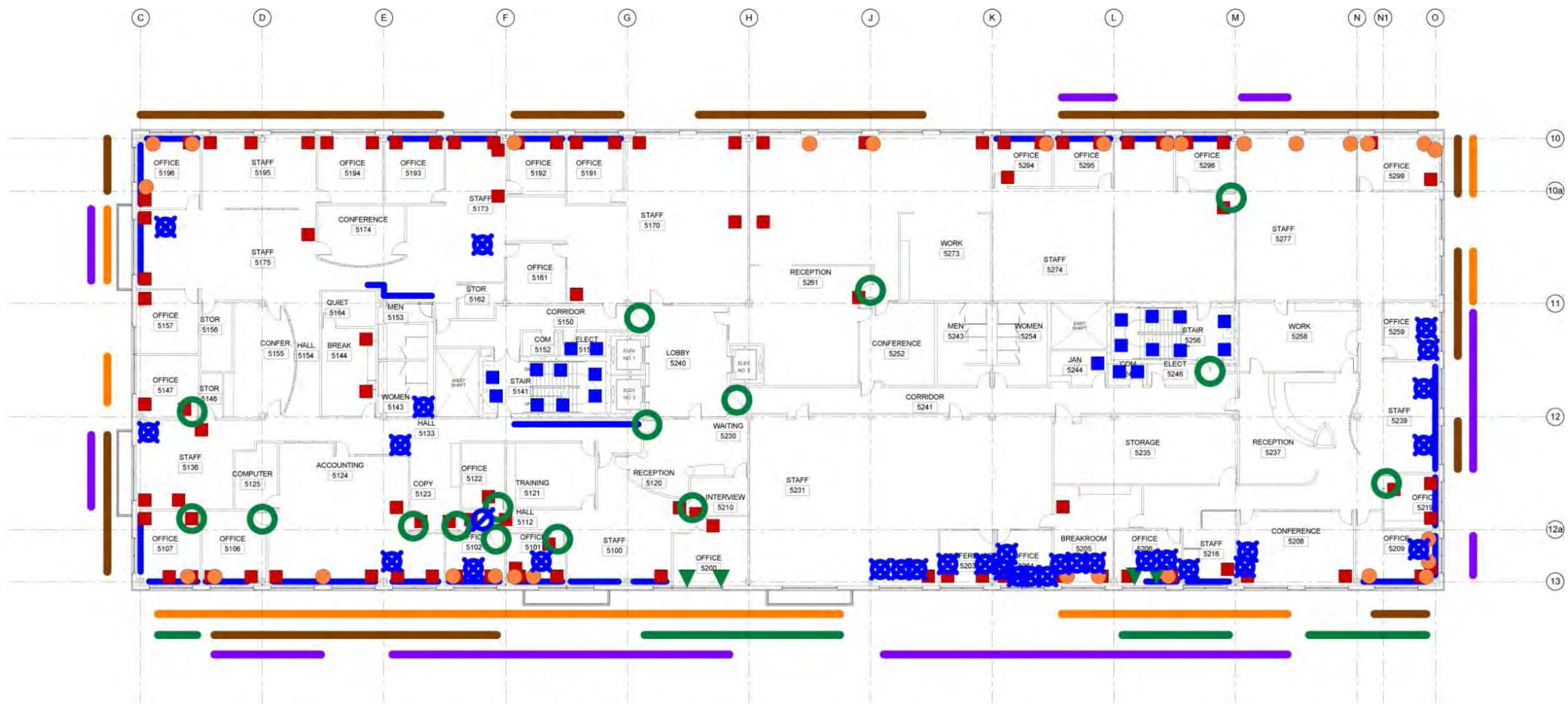
SERA

BUILDING OVERVIEW



Fourth Floor

BUILDING OVERVIEW



WINDOW SILL CRACK

GYP WALL CRACK

CMU/CONC WALL CRACK

CASEWORK/FURN ISSUE

DOOR FUNCTION ISSUE

CEILING GRID BUCKLE IN FIELD

CEILING/SOFFIT ISSUE

CEILING WALL ANGLE BUCKLING

FLOOR/SLAB CRACK

WINDOW; CRACK OR DETERIORATION/ DEFORMATION AT EXTERIOR WALL

WINDOW; BROKEN/DEFECTIVE IGU

WINDOW; STAINING & EVIDENCE OF WATER AT WINDOW/SILL

WINDOW; STAINING & EVIDENCE OF WATER AT WALL OR CLG

WINDOW; INTERIOR GASKET SHORT/INCOMPLETE

Fifth Floor

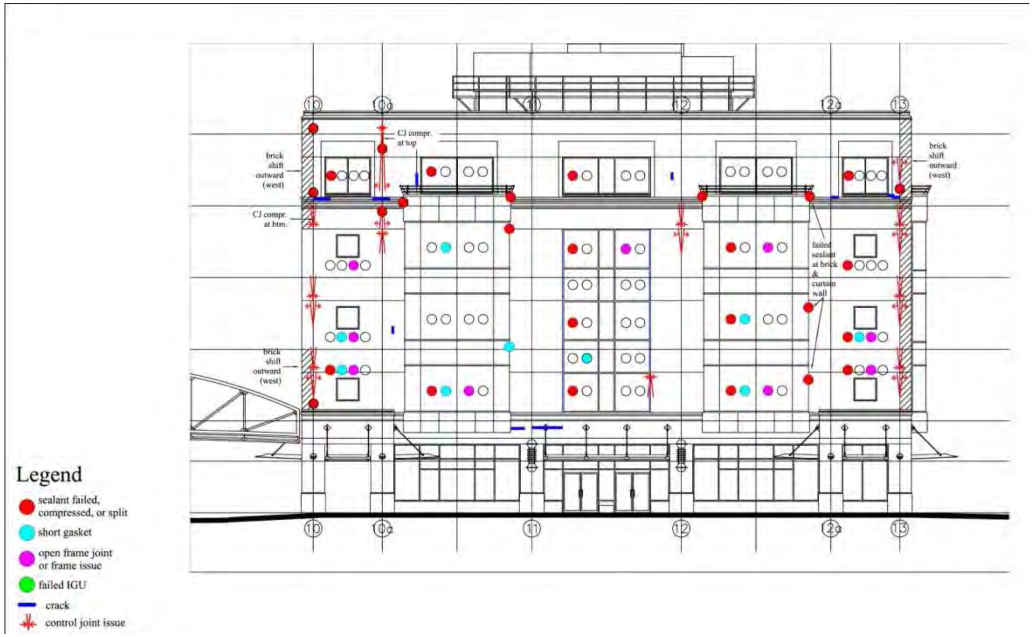
BUILDING OVERVIEW

South Elevation

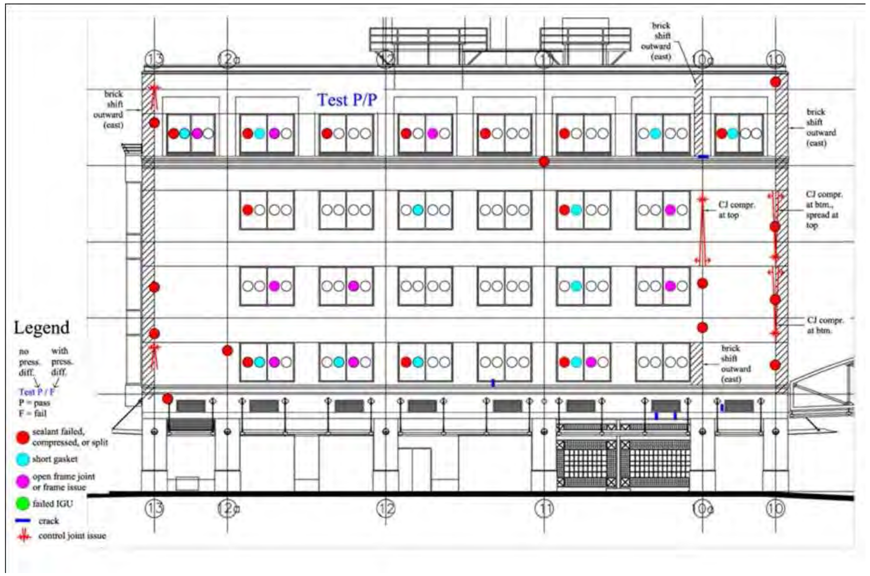
BUILDING OVERVIEW

North Elevation

BUILDING OVERVIEW



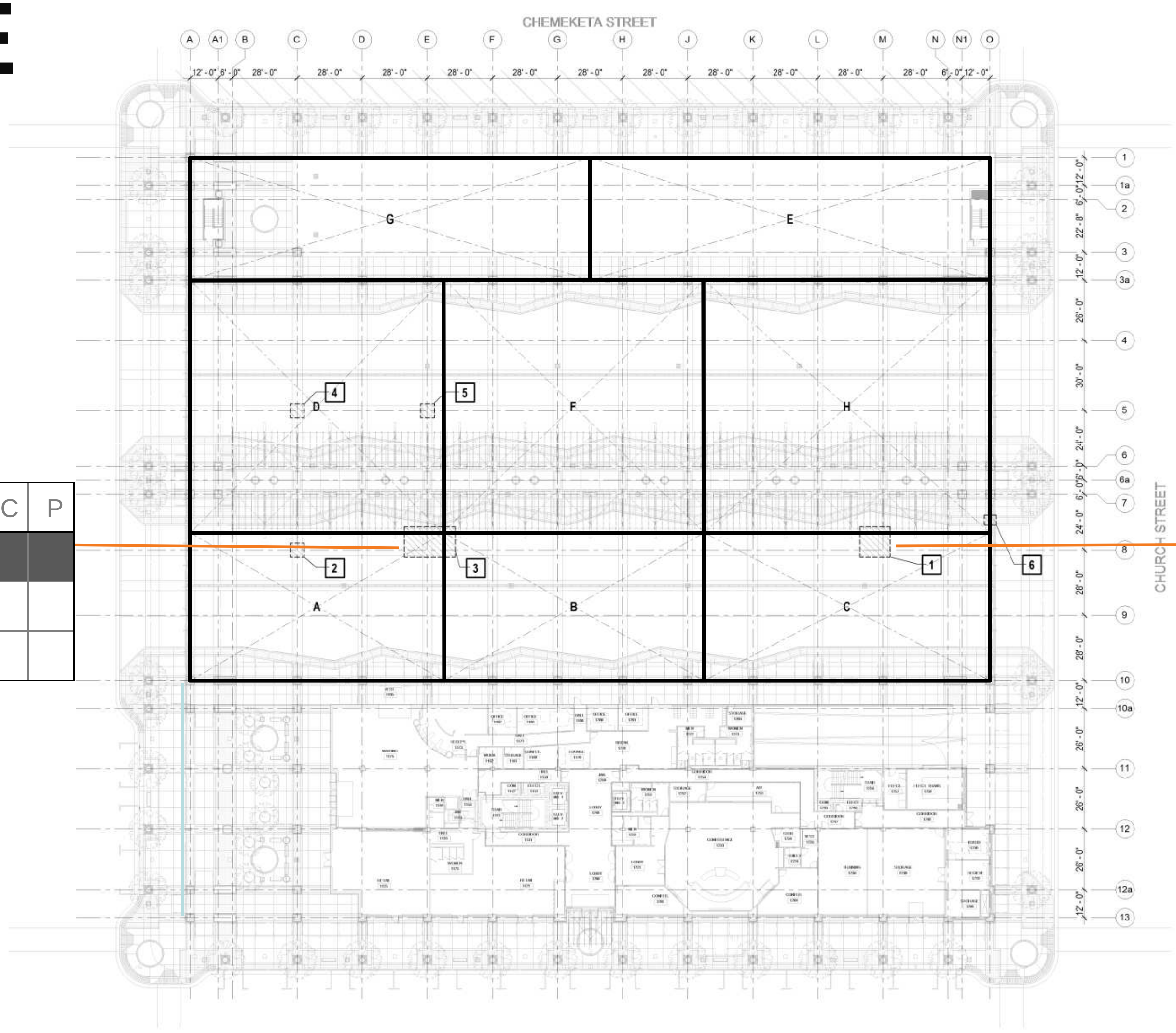
West Elevation



East Elevation

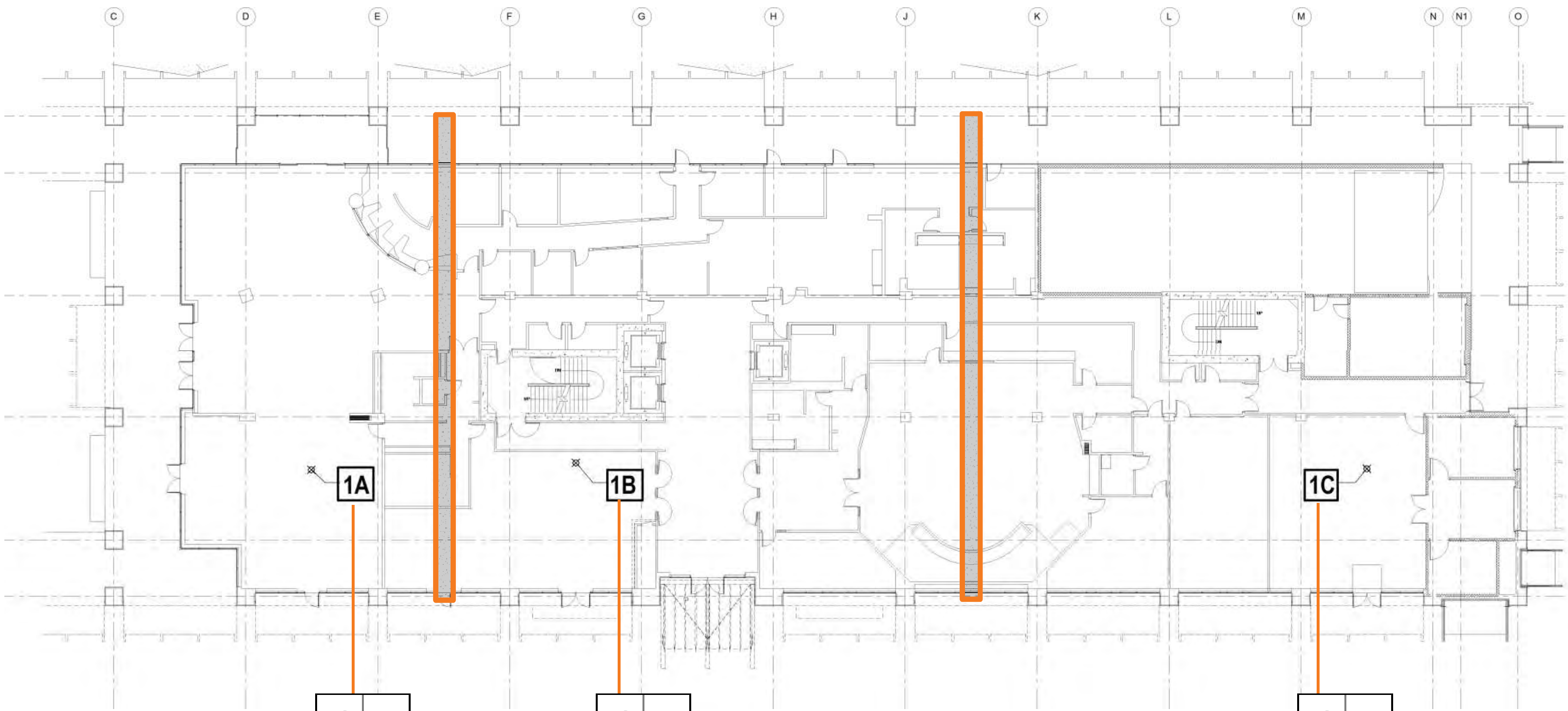
TESTING LOCATIONS – BUS MALL SITE

	C	P
CARLSON		
PSI		
CTL		



	C	P
CARLSON		
PSI		
CTL		

TESTING LOCATIONS – GROUND FLOOR



1A

	C	P
CARLSON		
PSI		
CTL		

1B

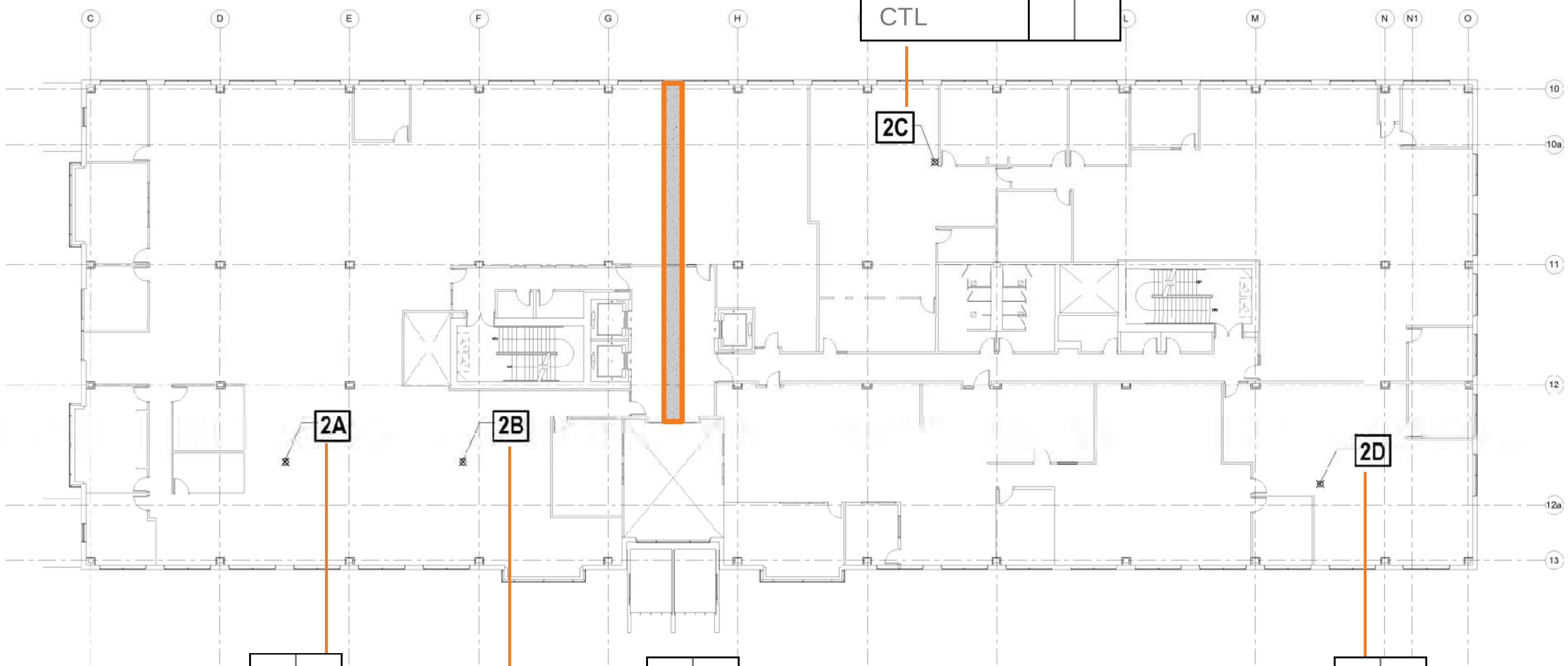
	C	P
CARLSON		
PSI		
CTL		

1C

	C	P
CARLSON		
PSI		
CTL		

Pour Strips

TESTING LOCATIONS – SECOND FLOOR



2C

	C	P
CARLSON	■	
PSI	■	
CTL		

2A

	C	P
CARLSON	■	■
PSI	■	■
CTL		■

2B

	C	P
CARLSON	■	
PSI		
CTL		

2D

	C	P
CARLSON	■	■
PSI		
CTL		

Pour Strips

TESTING LOCATIONS – THIRD FLOOR

3A

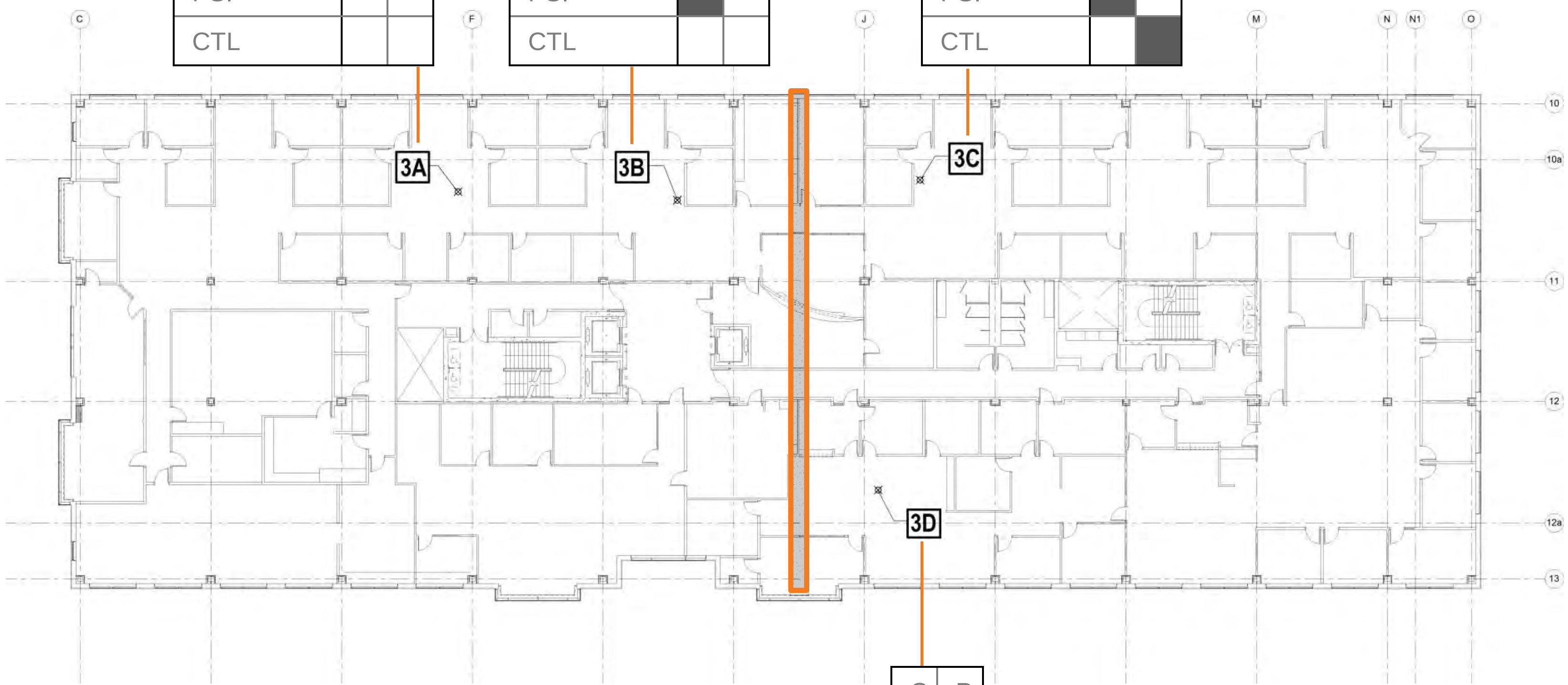
	C	P
CARLSON	■	■
PSI		
CTL		

3B

	C	P
CARLSON	■	
PSI	■	
CTL		

3C

	C	P
CARLSON	■	■
PSI	■	
CTL		■

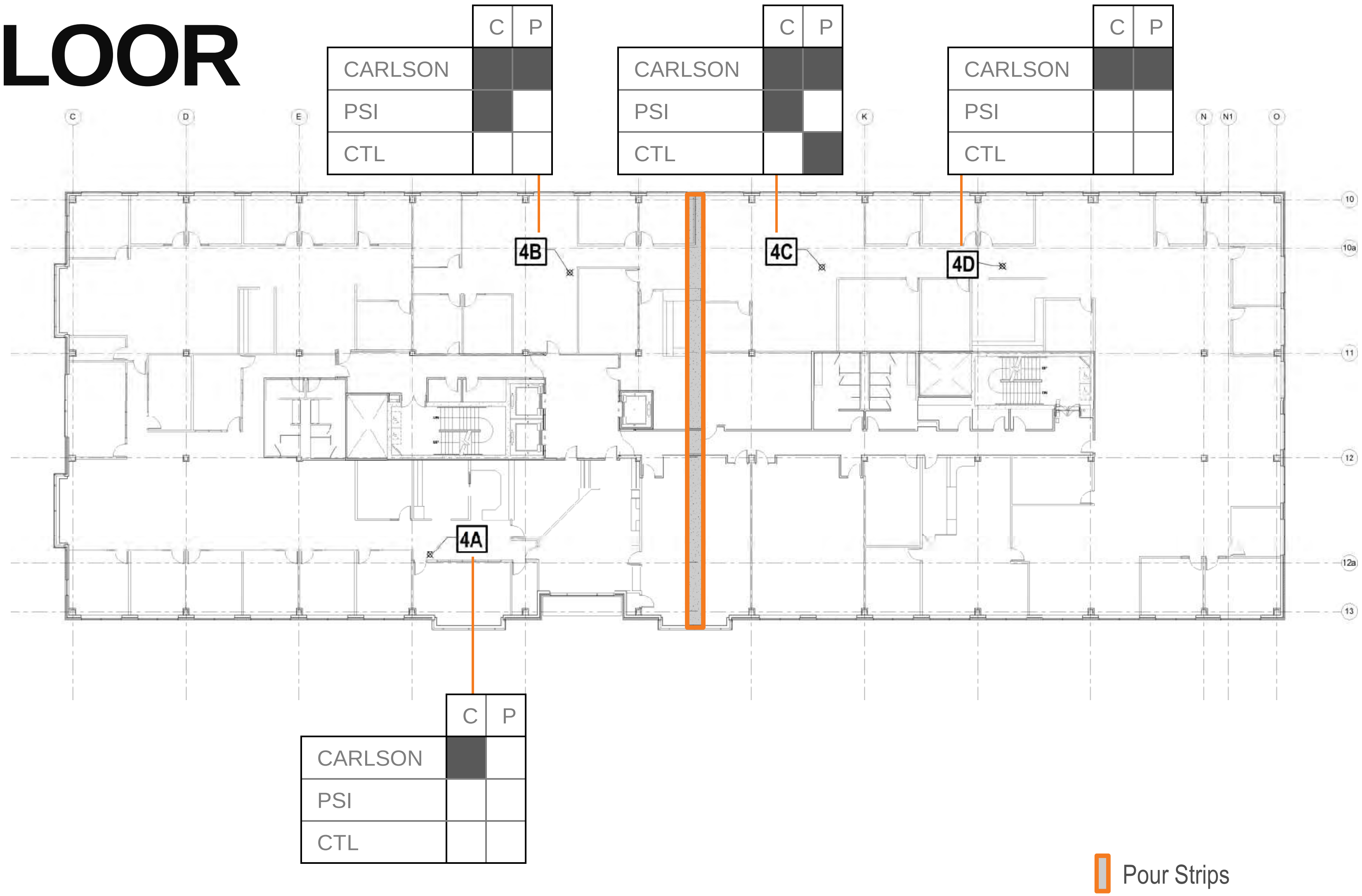


3D

	C	P
CARLSON	■	■
PSI		
CTL		

Pour Strips

TESTING LOCATIONS – FOURTH FLOOR



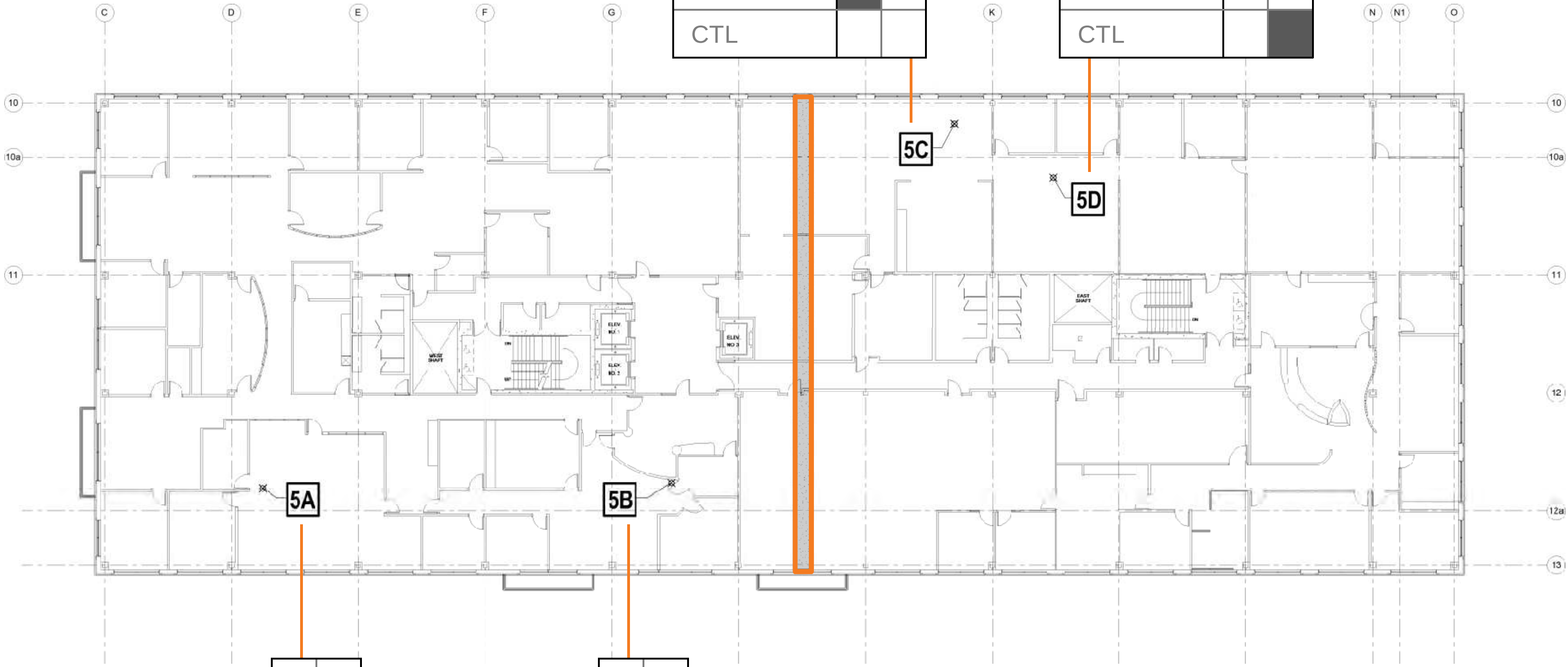
TESTING LOCATIONS – FIFTH FLOOR

5C

	C	P
CARLSON		
PSI		
CTL		

5D

	C	P
CARLSON		
PSI		
CTL		



5A

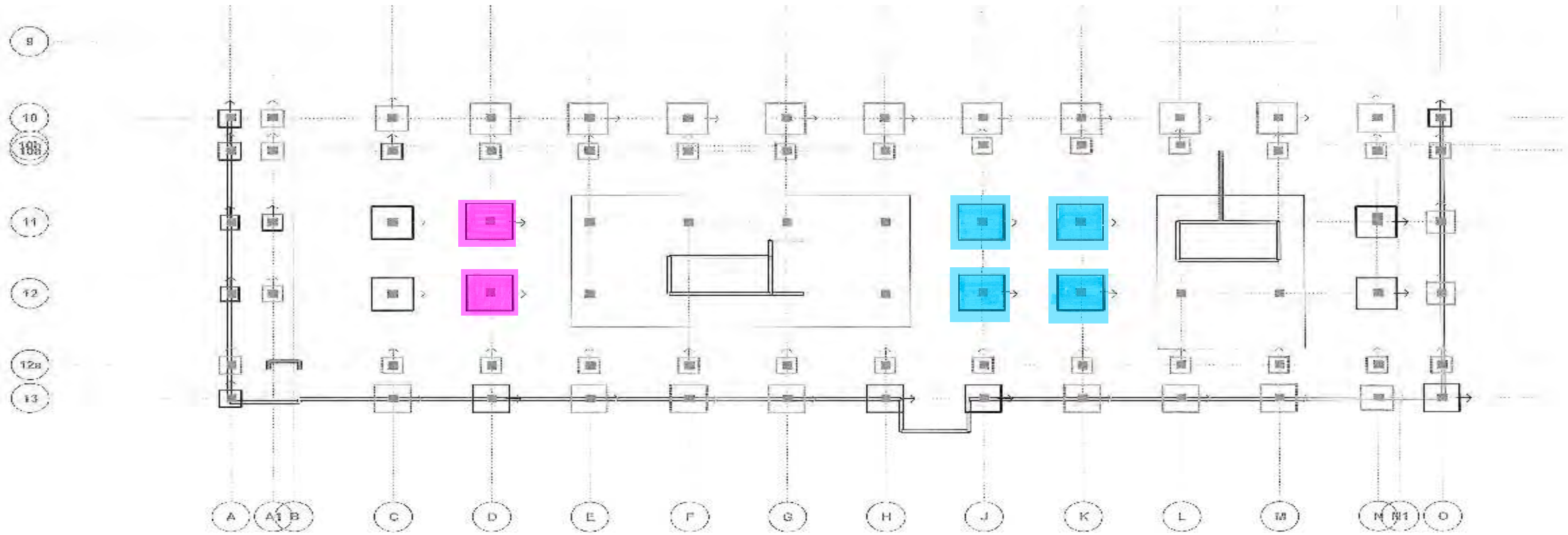
	C	P
CARLSON		
PSI		
CTL		

5B

	C	P
CARLSON		
PSI		
CTL		

Pour Strips

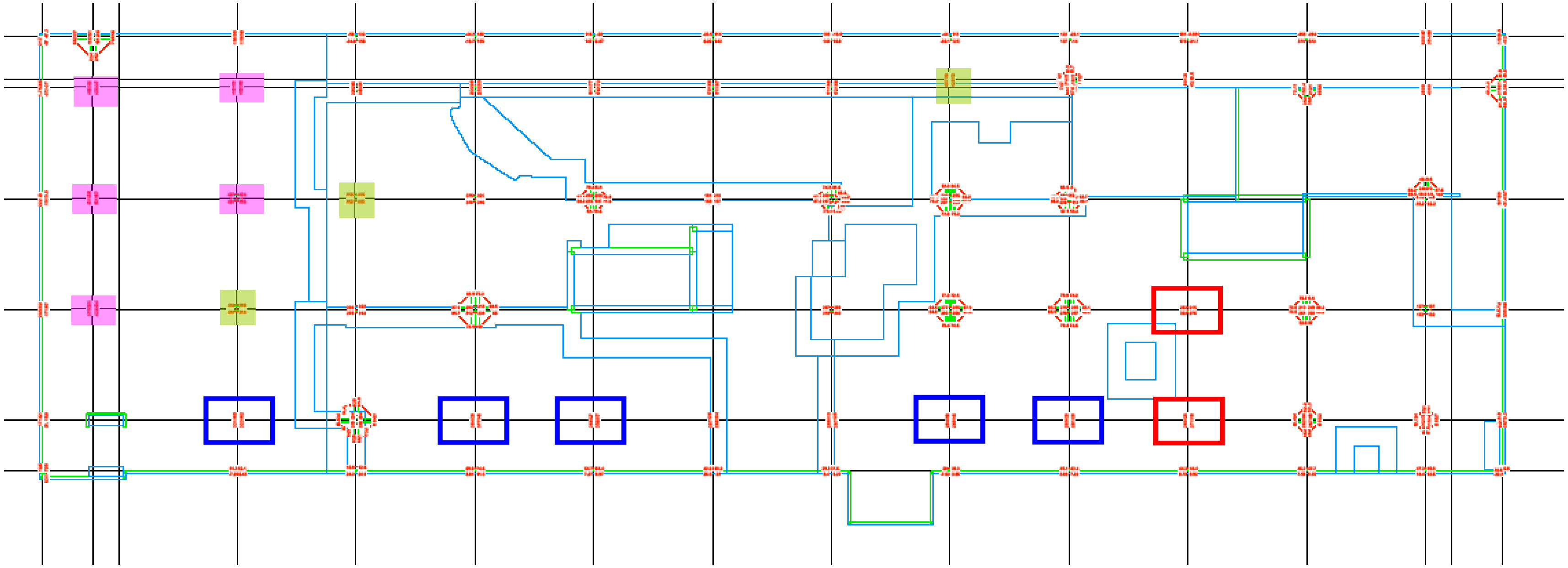
BUILDING FOOTING DEFICIENCIES



Punching Shear Stress More Than 33% Greater Than Code Allowance

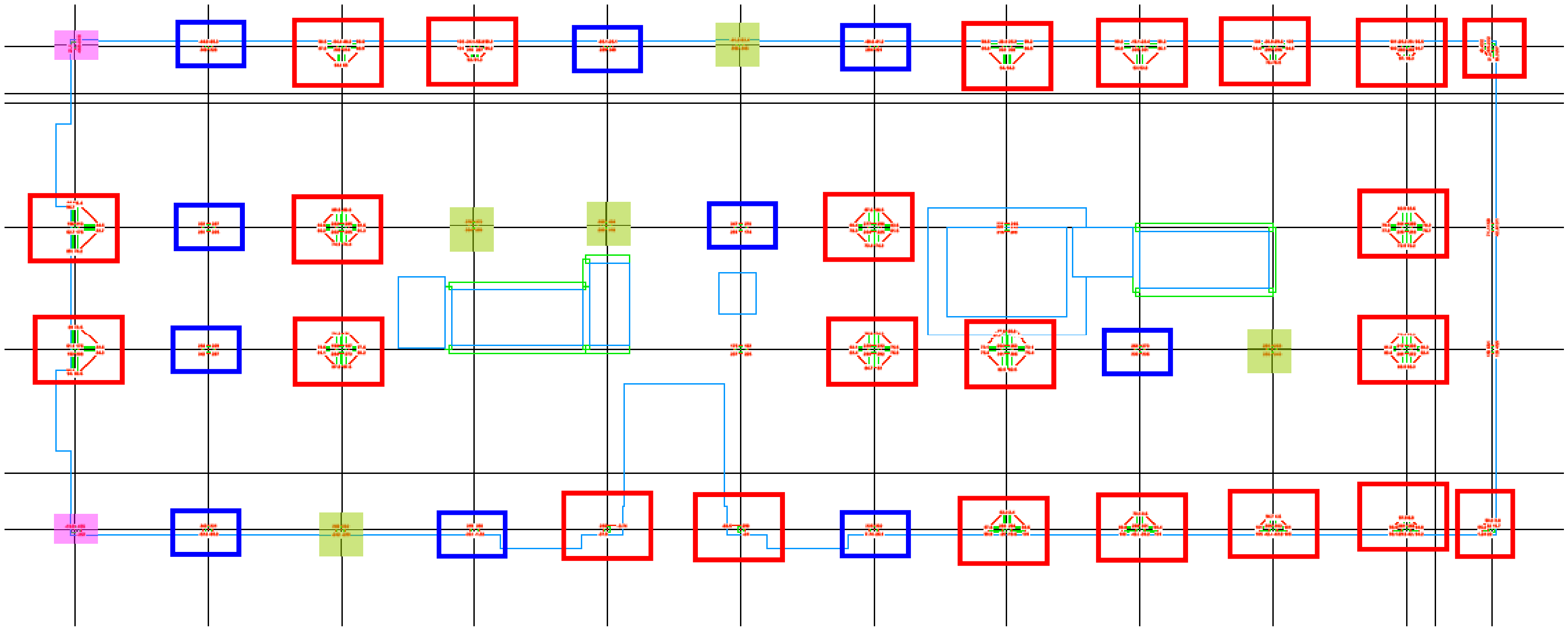
Punching Shear Stress More Than 10% Greater Than Code Allowance

FIRST FLOOR: PUNCHING SHEAR STRESS PLAN



- Exceeds Code Stress Limits w/5,000 psi Concrete and Actual Core Strengths
- Exceeds Stress Limits using Actual Code Strengths
- Stress More than 33% Greater than Code Allowable Based on Actual Core Strengths
- Stress more than 33% Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths

SECOND FLOOR: PUNCHING SHEAR STRESS PLAN



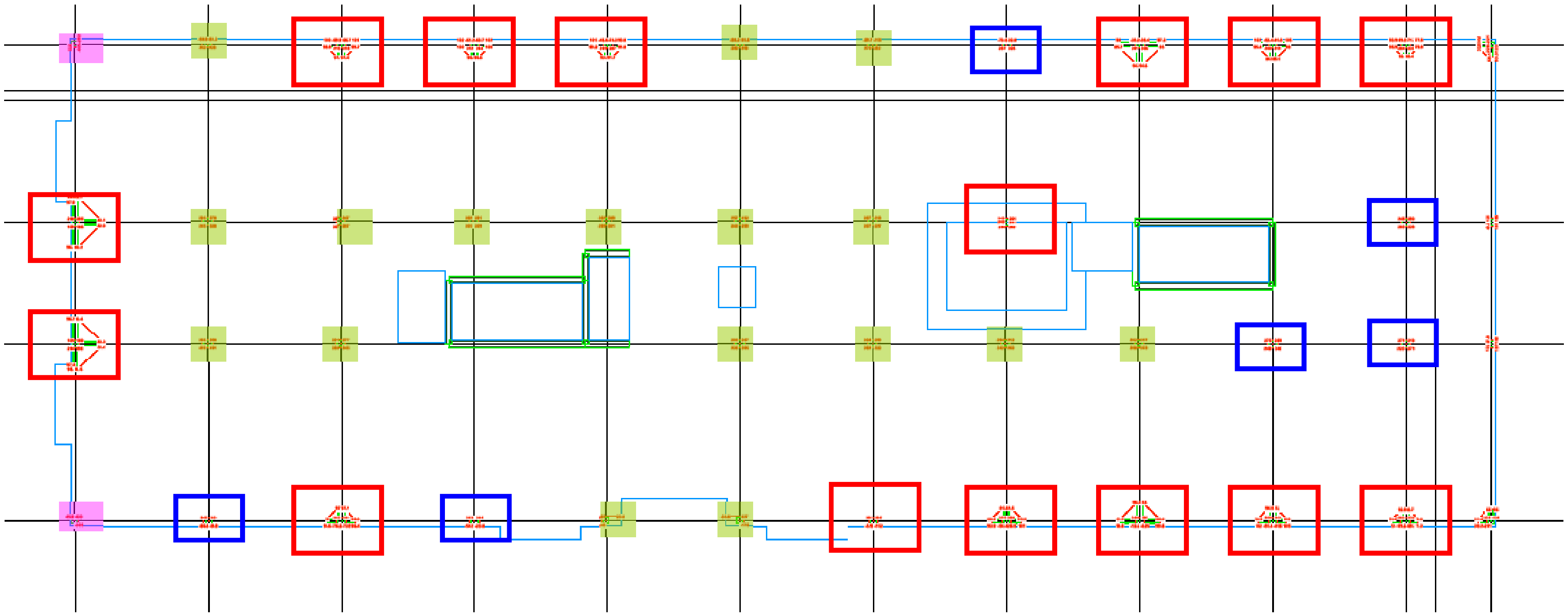
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 33% Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

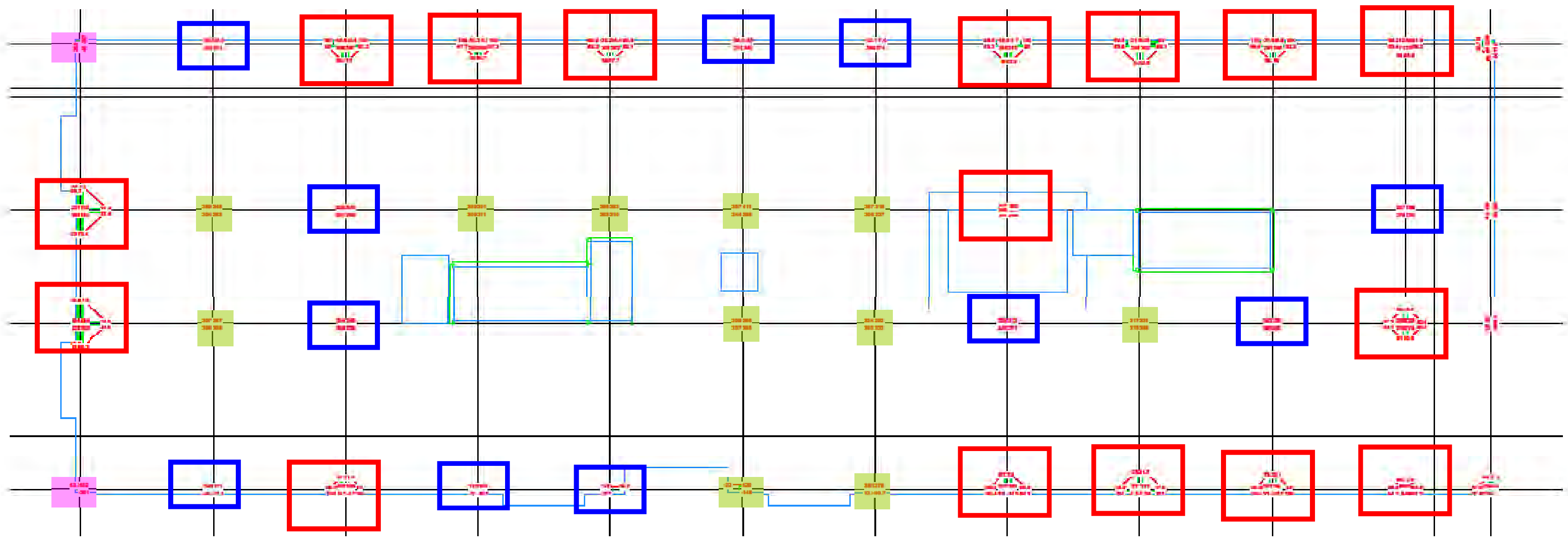
Stress more than 33% Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

THIRD FLOOR: PUNCHING SHEAR STRESS PLAN



- Blue box: Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength
- Red box: Exceeds Stress Limits using Actual Code Strengths
- Green: Stress More than 33% Greater than Code Allowable Based on Actual Core Strengths (“Dangerous” Condition)
- Magenta: Stress more than 33% Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths (“Dangerous” Condition)

FOURTH FLOOR: PUNCHING SHEAR STRESS PLAN



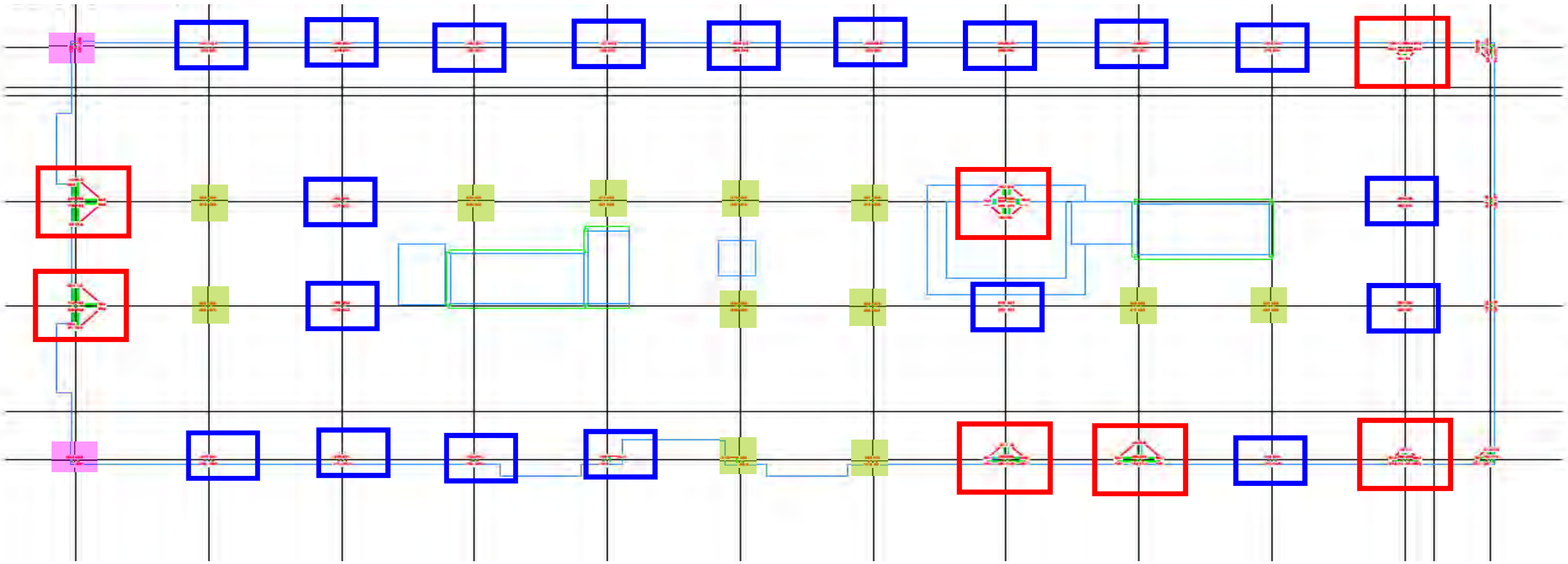
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 33% Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

Stress more than 33% Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

FIFTH FLOOR: PUNCHING SHEAR STRESS PLAN



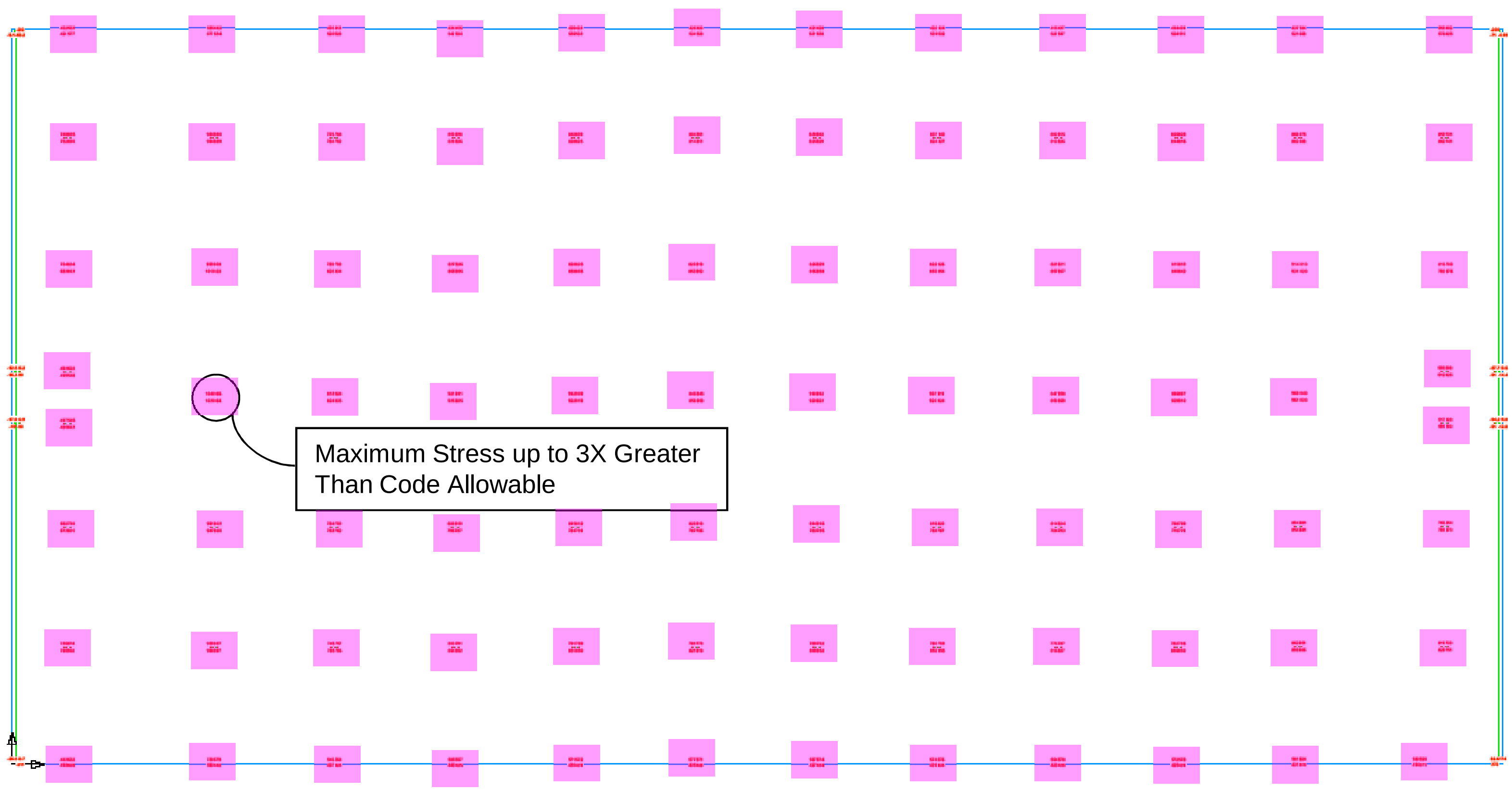
Exceeds Code Stress Limits w/5,000 psi Concrete Design Strength

Exceeds Stress Limits using Actual Code Strengths

Stress More than 33% Greater than Code Allowable Based on Actual Core Strengths ("Dangerous" Condition)

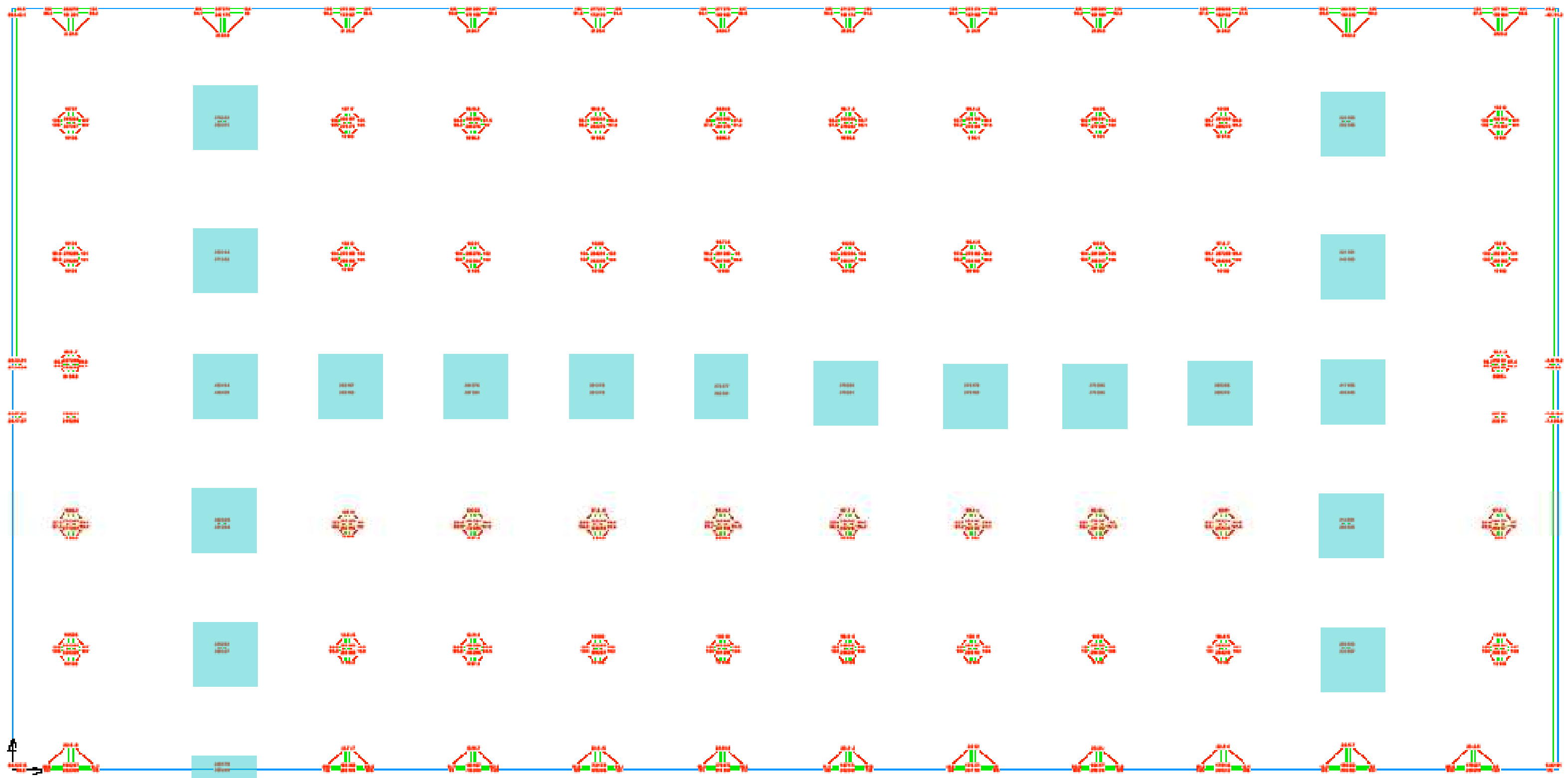
Stress more than 33% Greater than Code Allowance Based on Original Design Strength (5,000 psi) and Actual Core Strengths ("Dangerous" Condition)

BUS MALL: PUNCHING SHEAR STRESS PLAN



Stress more than 33% Greater Than Code Allowance

BUS MALL: PUNCHING SHEAR STRESS PLAN



Column Exceeds Code Limits Under Dead Load Only

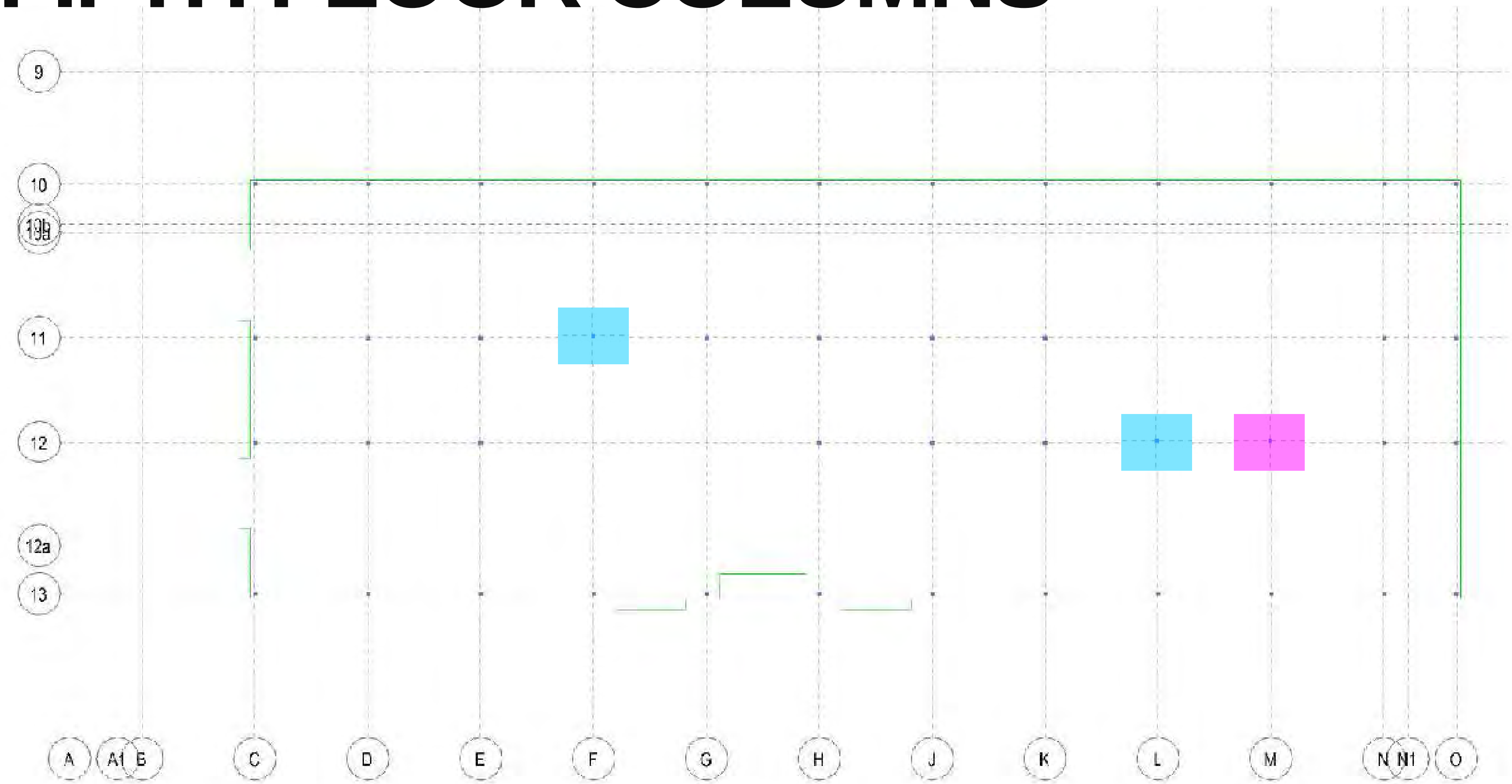
ROOF COLUMNS

All Columns within 10% of Design Capacity

More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

FIFTH FLOOR COLUMNS



More than 10% Beyond Code Limit

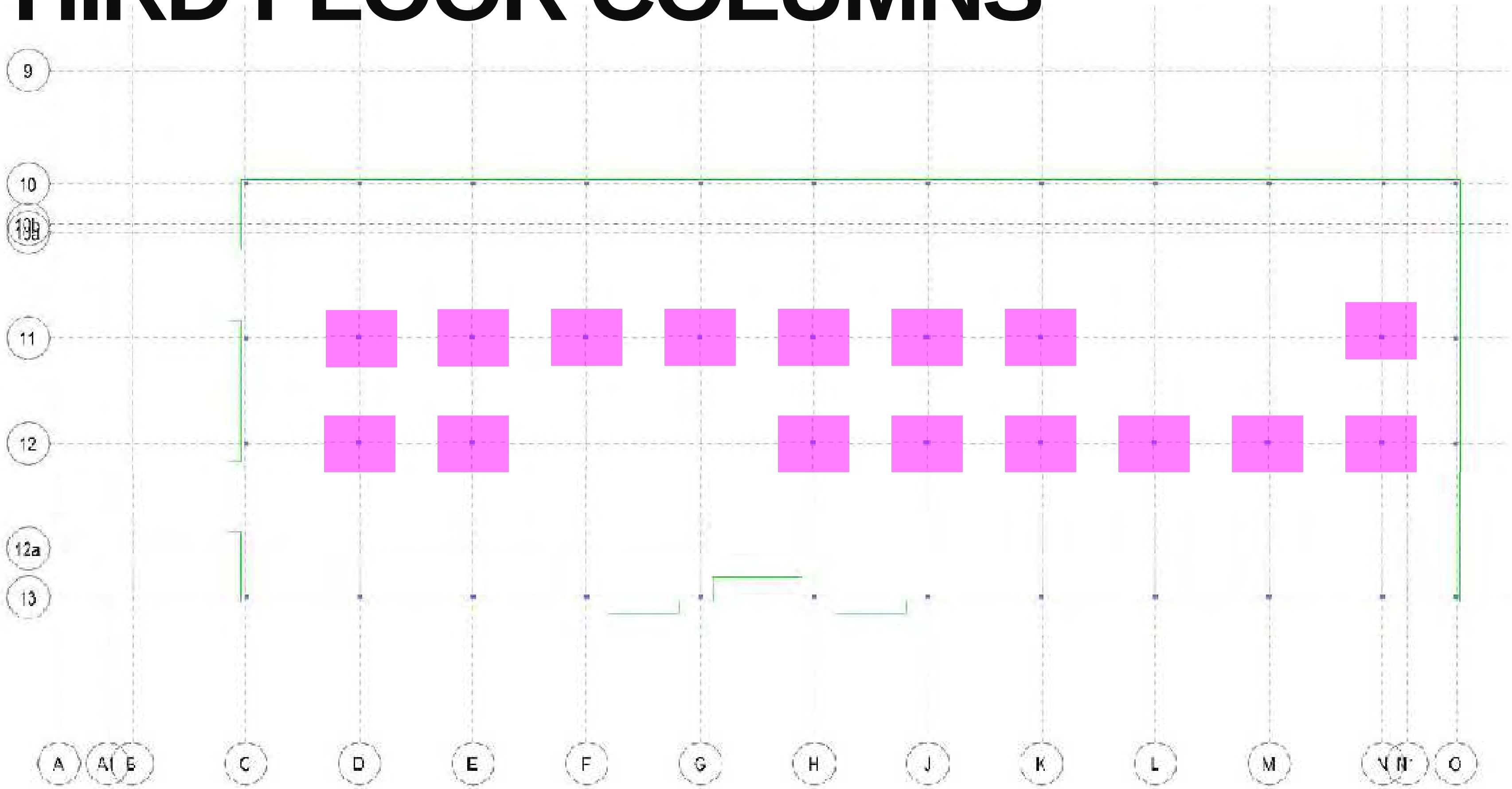
More than 33% Beyond Code Limit

FOURTH FLOOR COLUMNS

More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

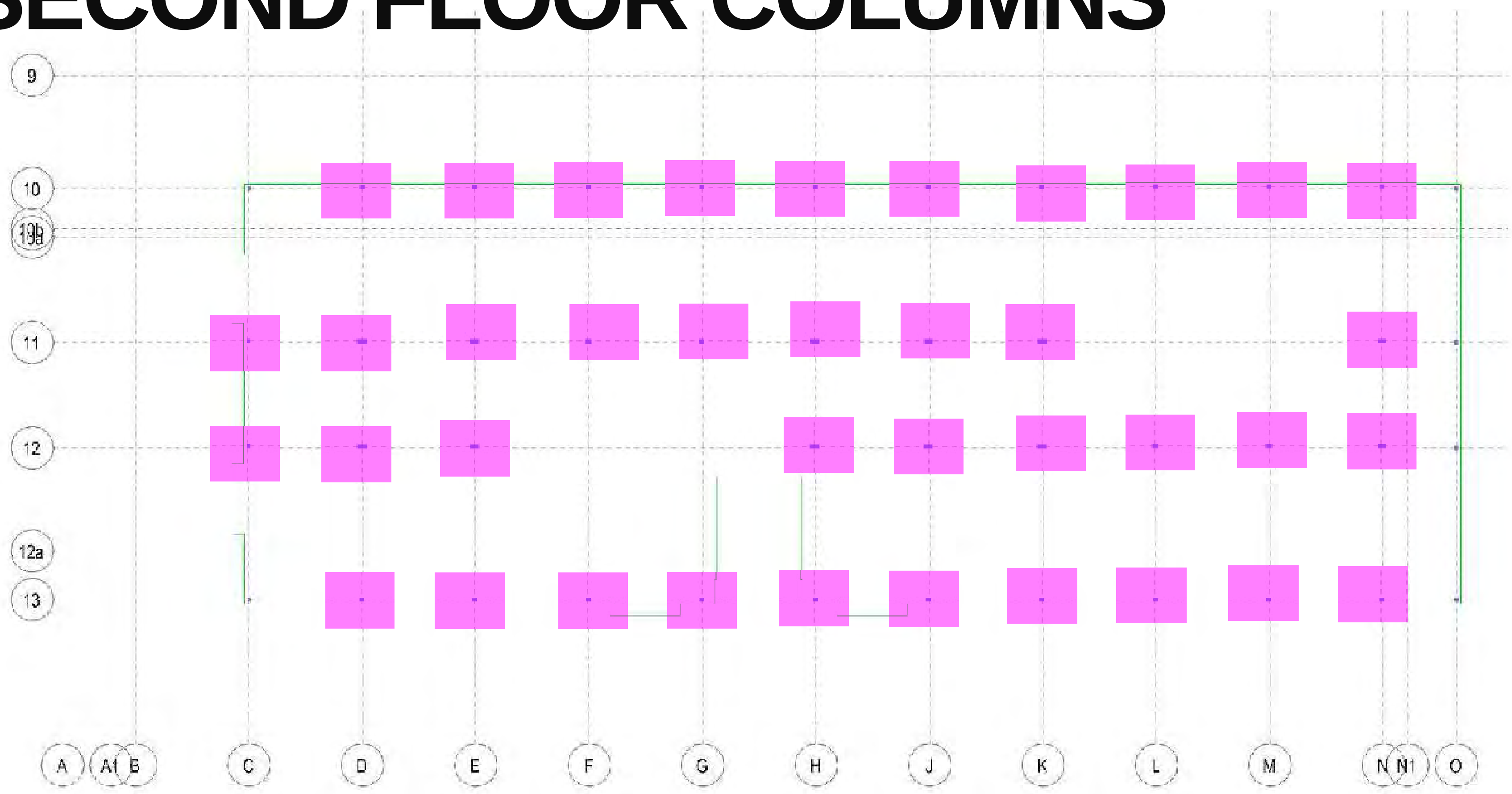
THIRD FLOOR COLUMNS



More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

SECOND FLOOR COLUMNS



More than 10% Beyond Code Limit

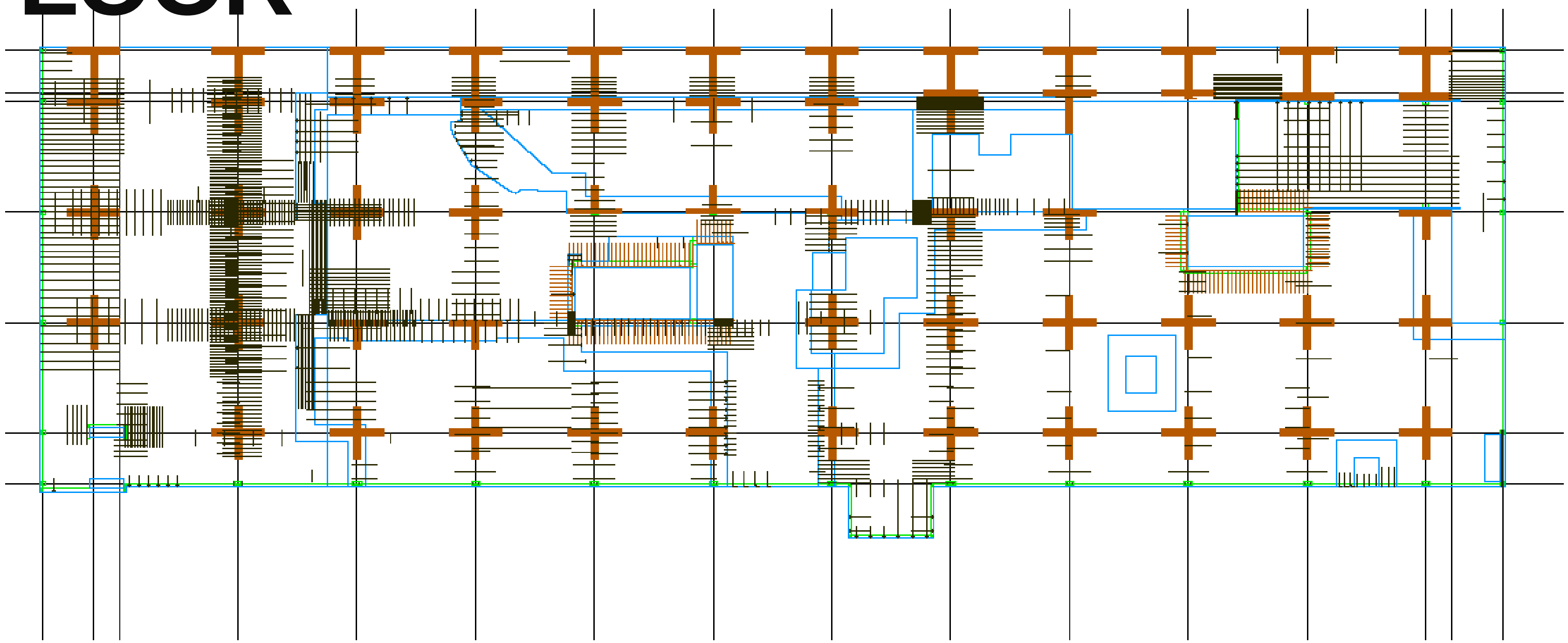
More than 33% Beyond Code Limit

FIRST FLOOR COLUMNS

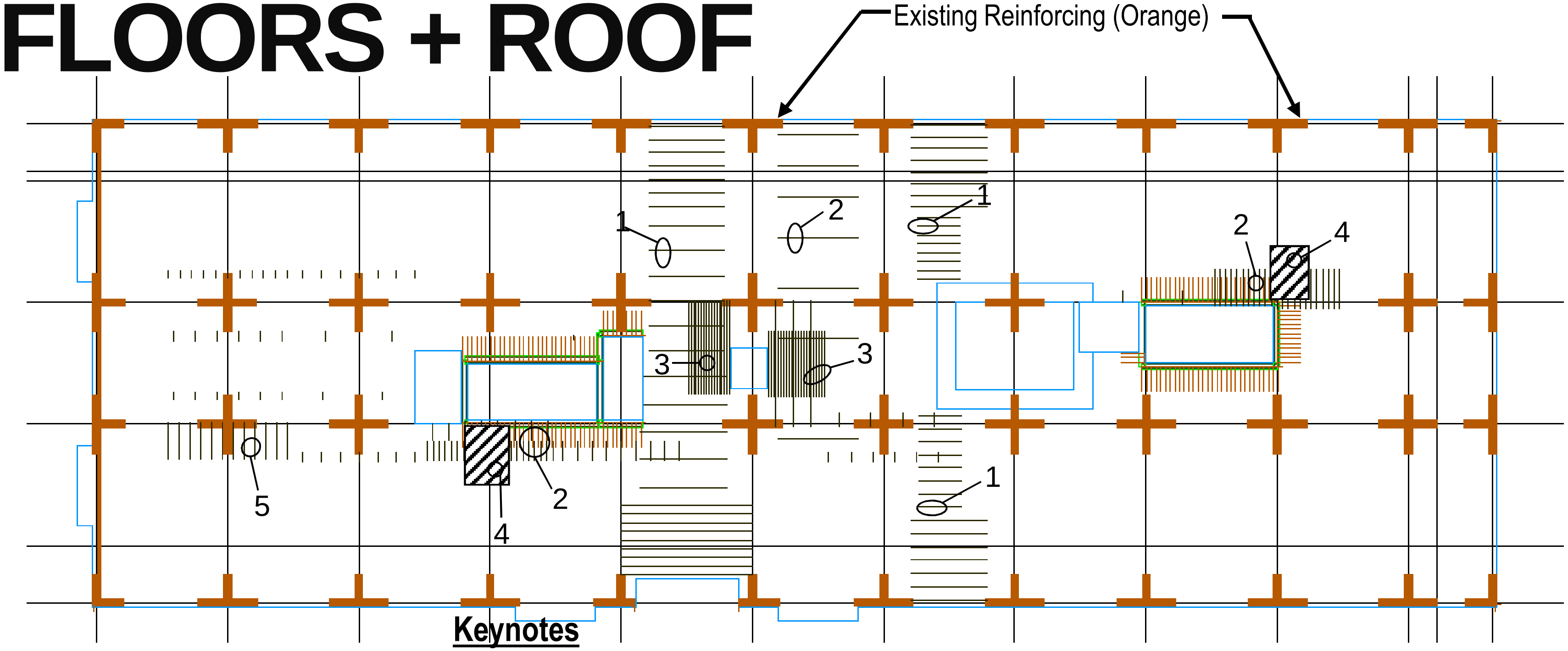
More than 10% Beyond Code Limit

More than 33% Beyond Code Limit

TYPICAL SLAB TOP REINFORCING STEEL DEFICIENCIES AT FIRST FLOOR



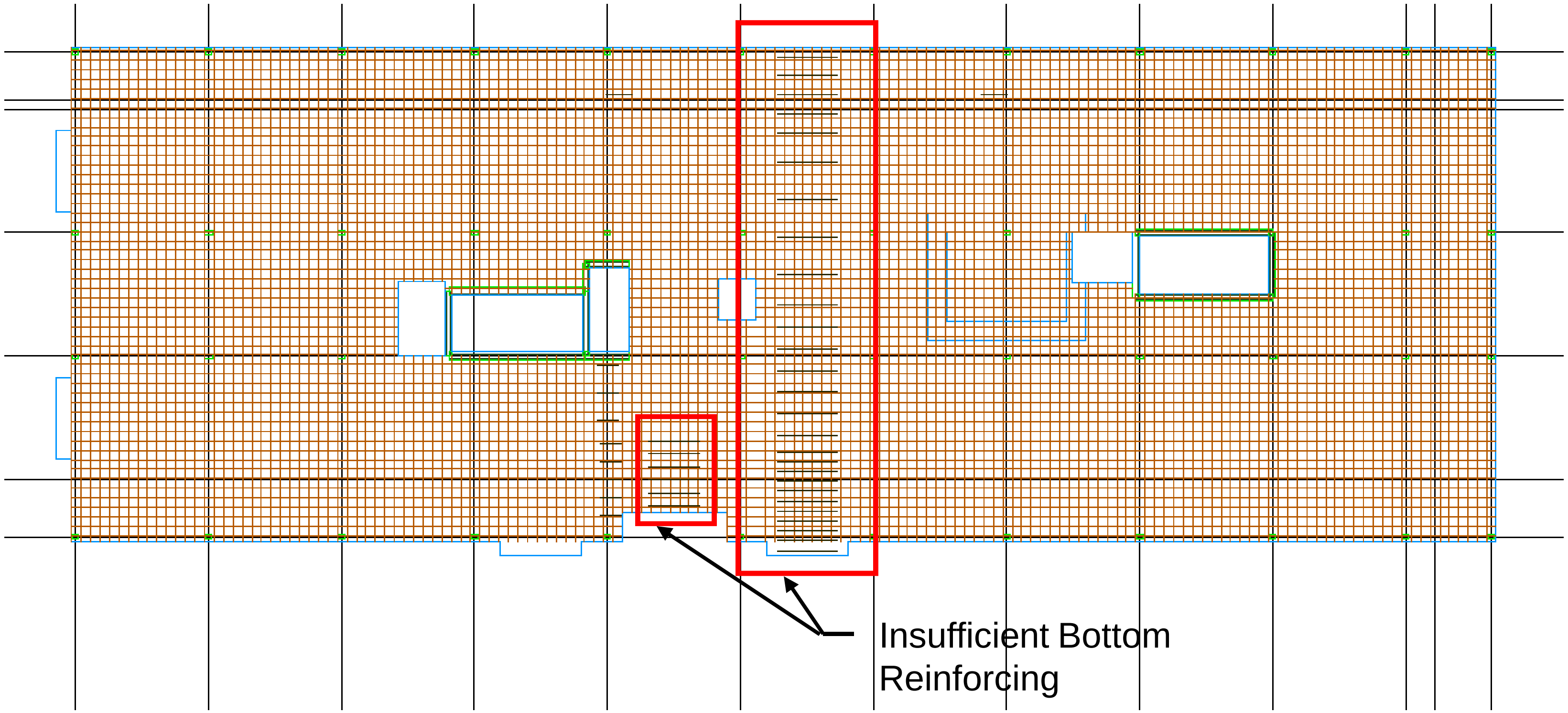
TYPICAL SLAB TOP REINFORCING STEEL DEFICIENCIES AT 2ND-5TH FLOORS + ROOF



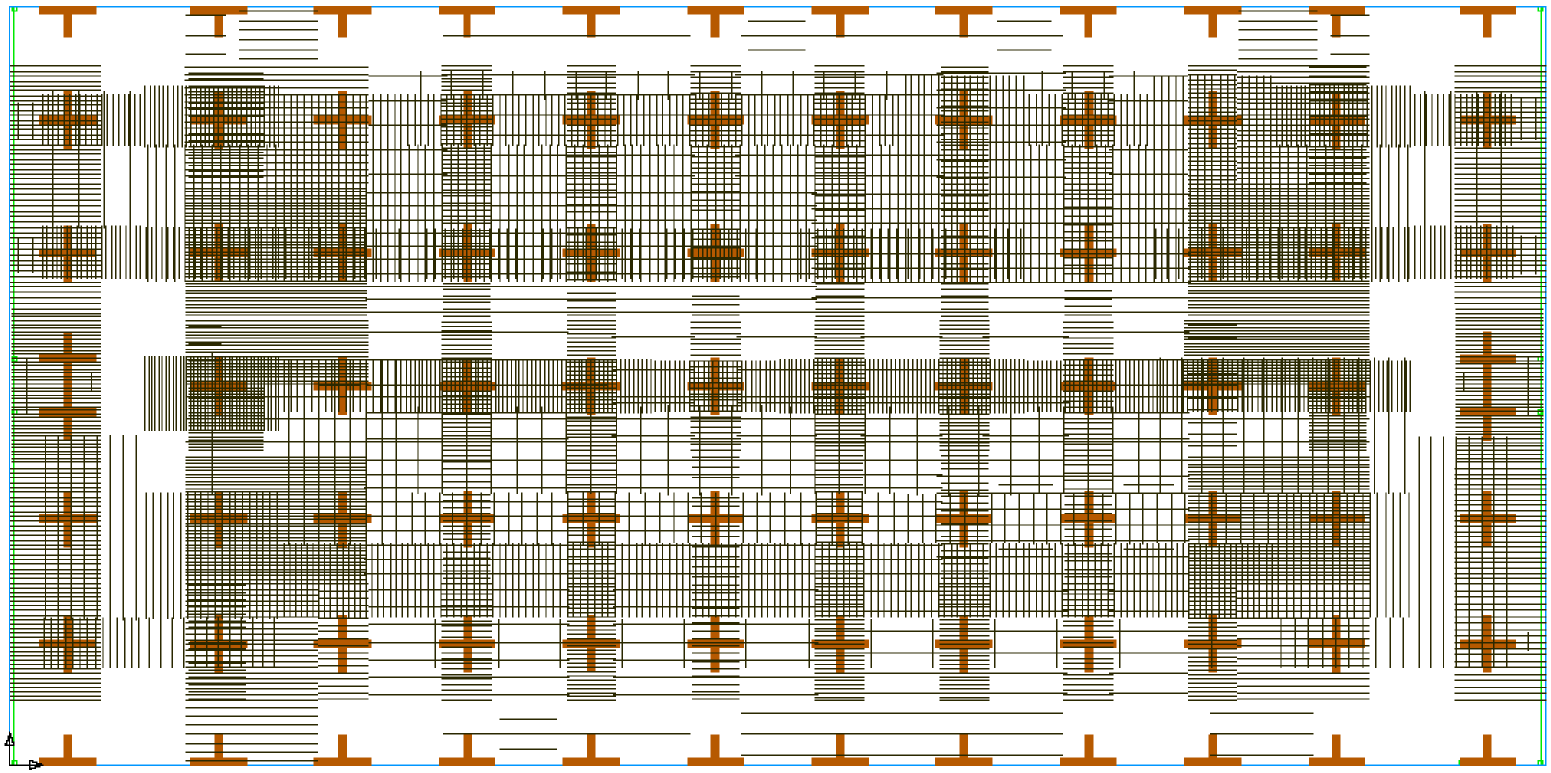
Keynotes

1. Insufficient Top Reinforcing under Service Loads
2. Insufficient Top Reinforcing for Flexural Strength
3. Insufficient Top Reinforcing for Service and Strength
4. Column strip top Stress Exceeded
5. Insufficient Top Reinforcing Steel at 3rd, 4th Floors

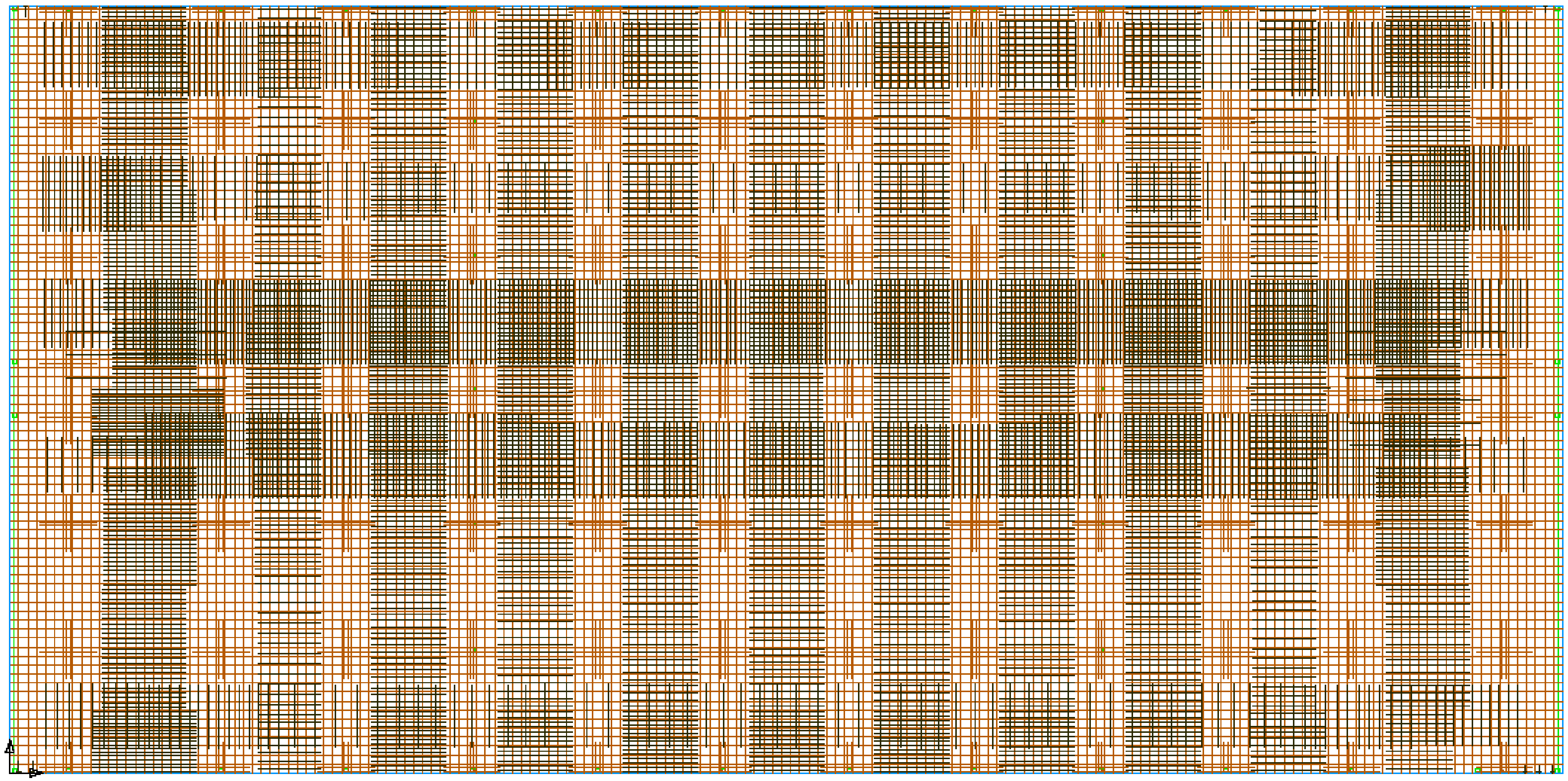
TYPICAL SLAB BOTTOM REINFORCING STEEL DEFICIENCIES AT FLOORS 2 - ROOF



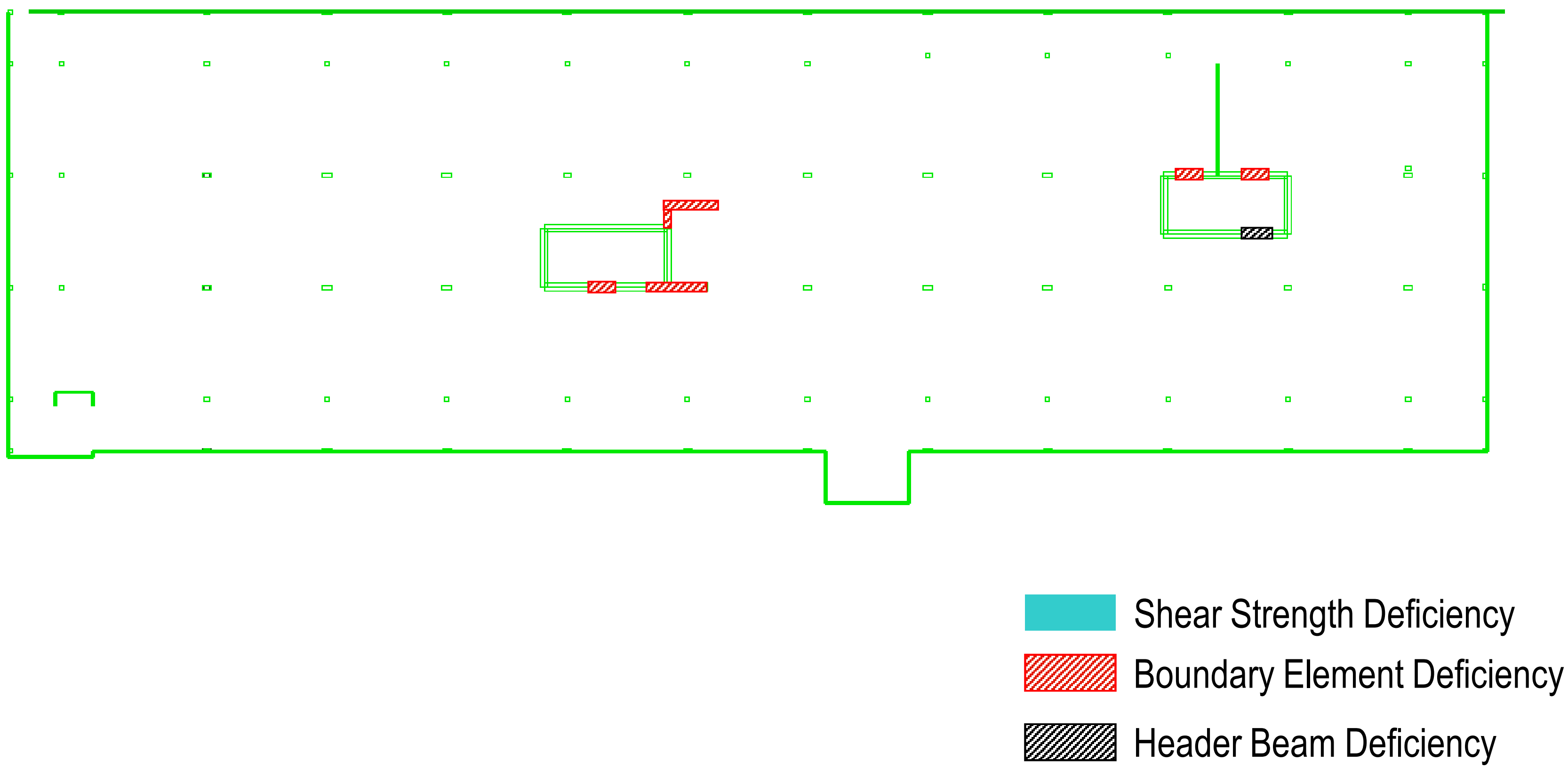
TYPICAL SLAB TOP REINFORCING STEEL AT BUS MALL



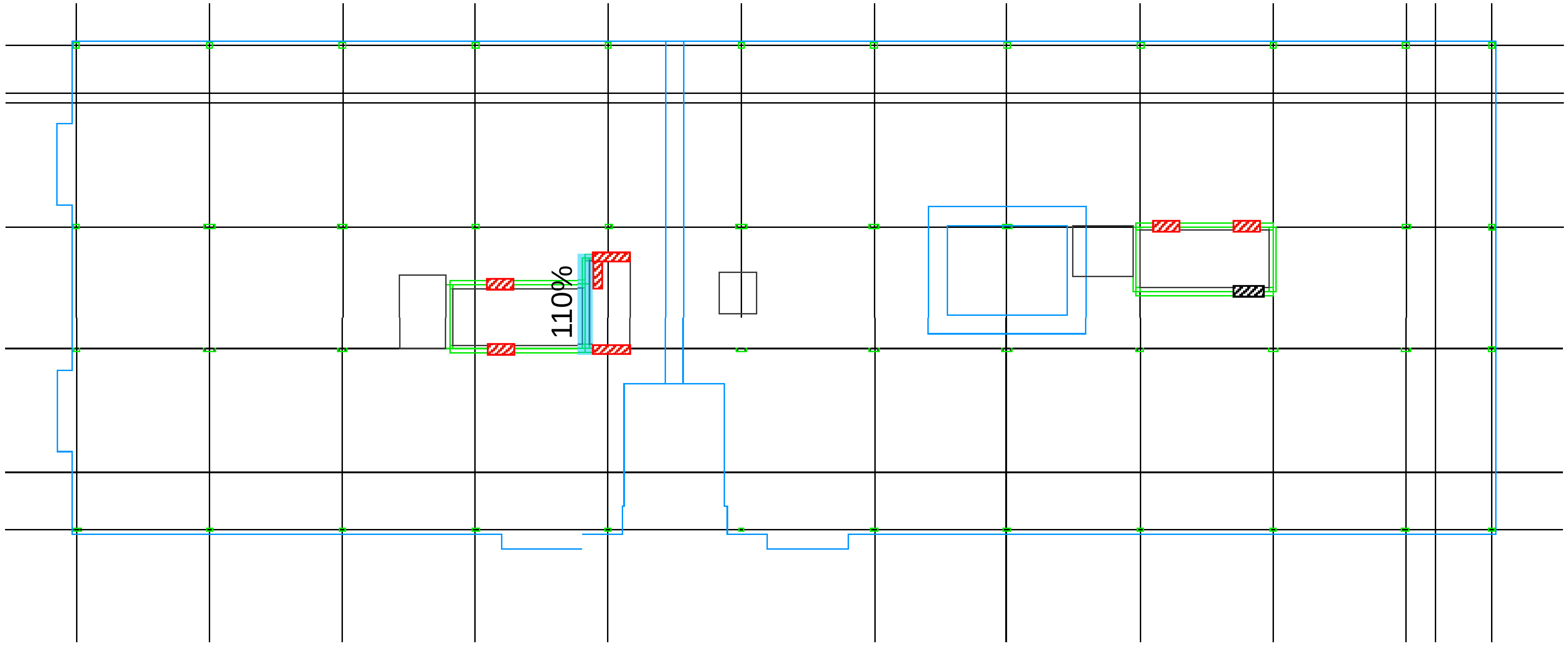
TYPICAL SLAB BOTTOM REINFORCING STEEL AT BUS MALL



FIRST FLOOR SHEAR WALL DEFICIENCIES



SECOND FLOOR SHEAR WALL DEFICIENCIES



Shear Strength Deficiency

Boundary Element Deficiency

Header Beam Deficiency

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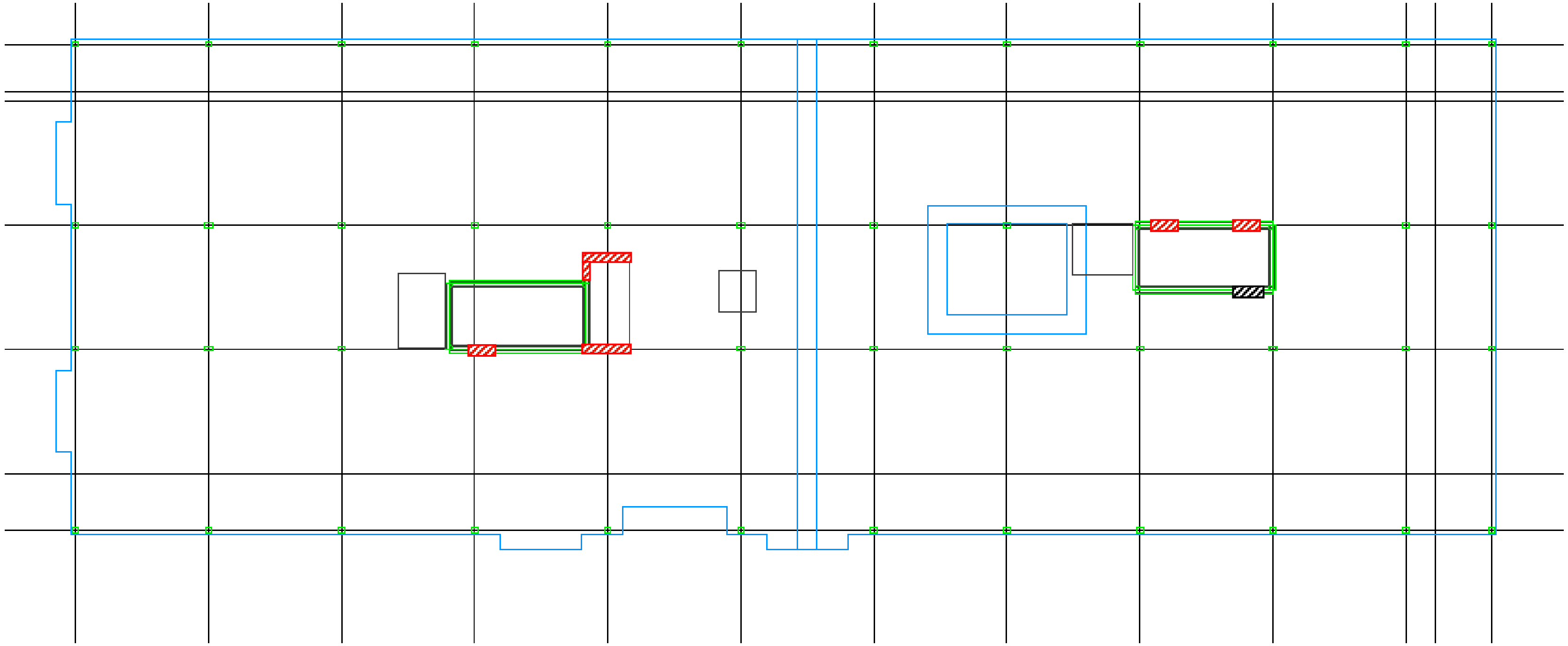
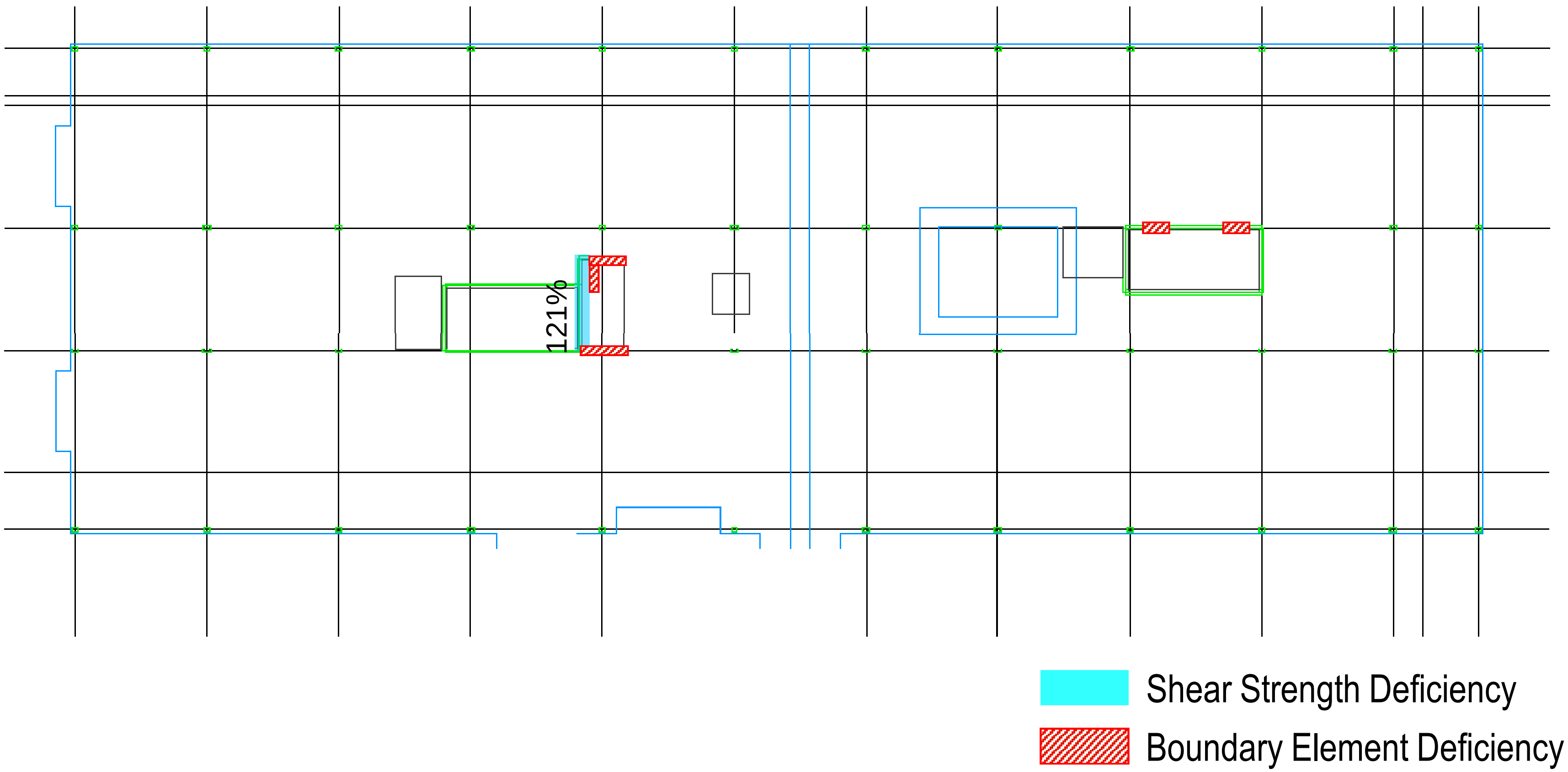
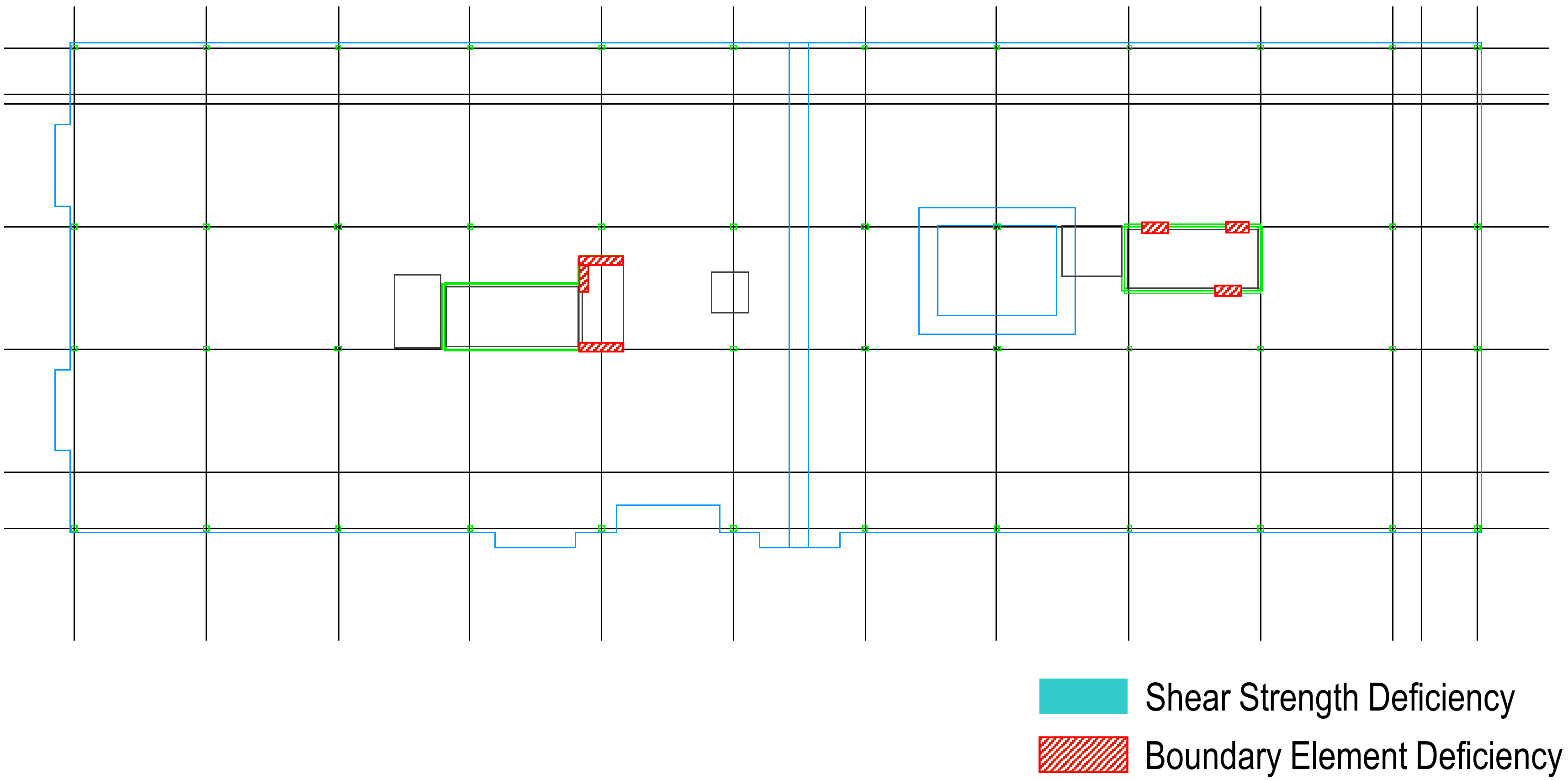
THIRD FLOOR SHEAR WALL DEFICIENCIES



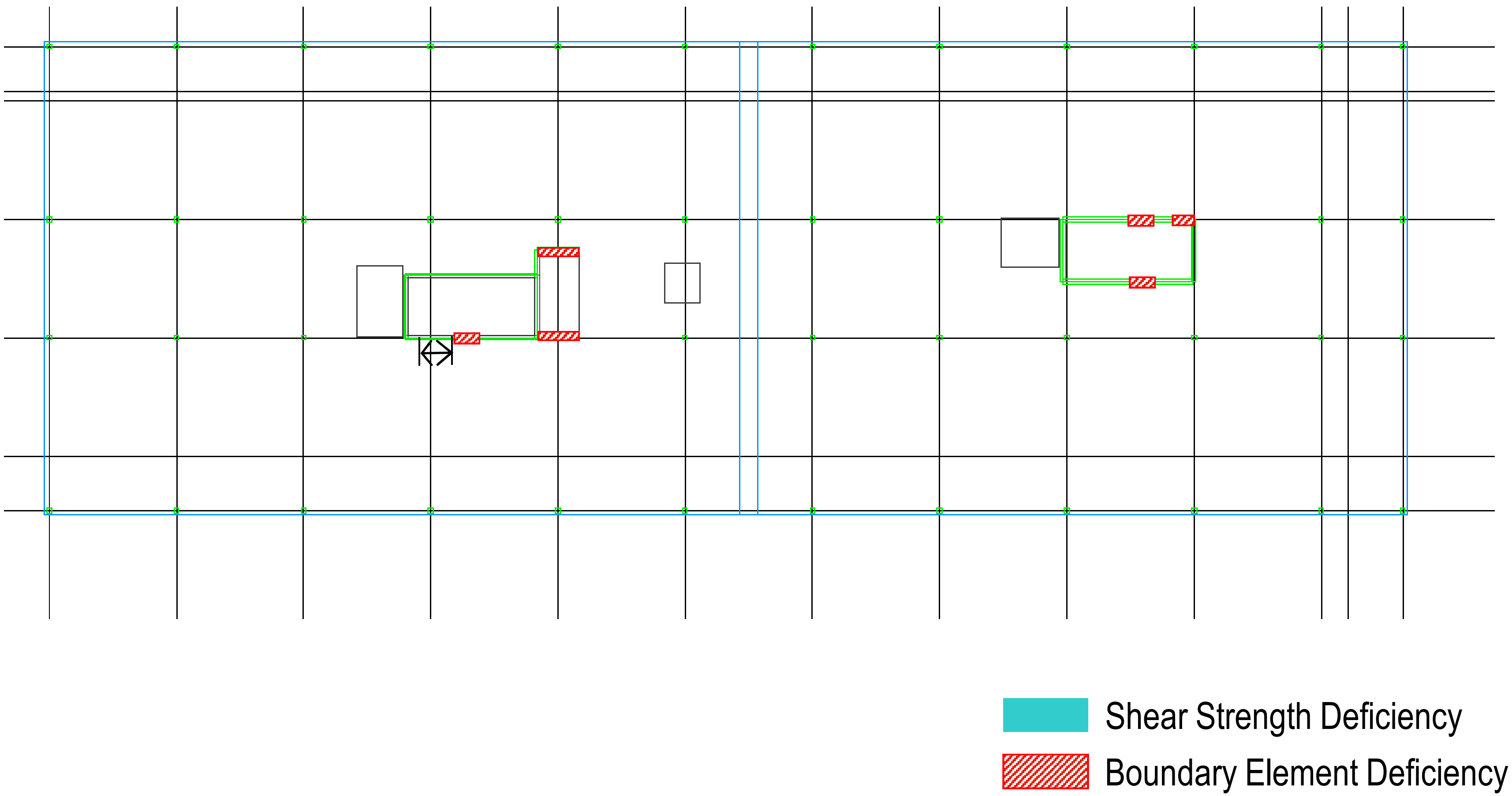
FOURTH FLOOR SHEAR WALL DEFICIENCIES



FIFTH FLOOR SHEAR WALL DEFICIENCIES



ROOF SHEAR WALL DEFICIENCIES



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