Alterations of Existing Buildings

"ASK THE STRUCTURE"

WJE

Outline

- Introduction
- Topic - Alterations of Existing Buildings
- Case Study 1 – New RTU Installation
- Case Study 2 – Partition Wall and File Room
- Case Study 3 – Mechanical Penetrations
- Q&A


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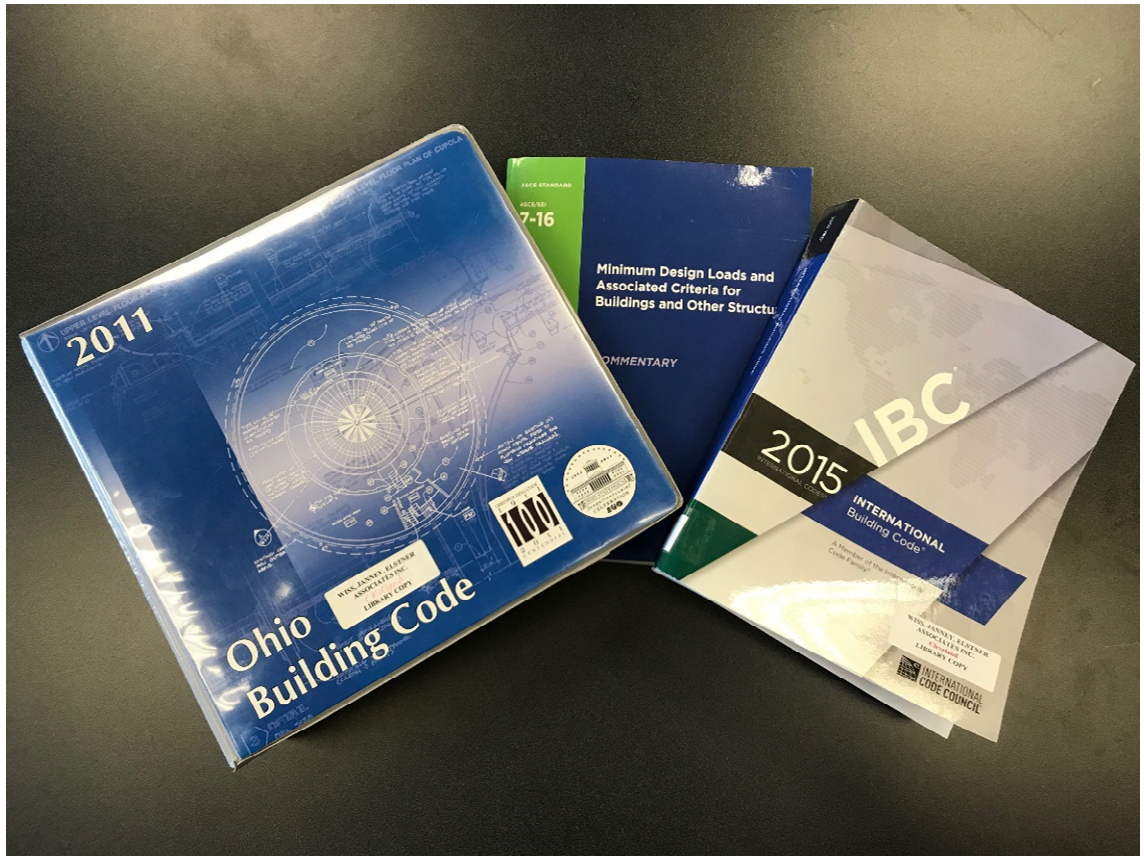
Code Requirements

- Ohio Building Code
  - Requirements for modifications to existing structures



From the Code…

102.7 Existing structures. *The provisions of Chapter 34 shall control the alteration, repair, addition, maintenance, and change of occupancy of any existing structure.*

201.4 EXISTING STRUCTURE. *A structure regulated by this code that was erected or one for which a plan approval has been issued.*

Possible

ALTERATION. *Any construction or renovation to an existing structure other than repair or addition.*

~~REPAIR~~. *The reconstruction or renewal of any part of an existing building for the purpose of its maintenance or to correct damage.*

~~ADDITION~~. *An extension or increase in floor area, number of stories, or height of a building or structure.*

MAINTENANCE. *Work necessary to assure that equipment, systems, devices and safeguards continue to operate in good working order and in accordance with the approval.*

CHANGE OF OCCUPANCY. *A change in the purpose or level of activity within a building that involves a change in application of the requirements of the code.*

3403.3 Existing structural elements carrying gravity load. *Any existing gravity load-carrying structural element for which an addition and its related alterations cause an increase in design gravity load of more than 5 percent shall be strengthened, supplemented, replaced or otherwise altered as needed to carry the increased load required by this code for new structures. Any existing gravity load carrying structural element whose gravity load-carrying capacity is decreased shall be considered an altered element subject to the requirements of Section 3404.3.*

However…

3412.1 Compliance. *The provisions of this section are intended to maintain or increase the current degree of public safety, health and general welfare in existing buildings while permitting repair, alteration, addition and change of occupancy without requiring full compliance with Chapters 2 through 33, or Sections 3401.1.1, and 3403 through 3409, except where compliance with other provisions of this code is specifically required in this section.*

3412.4 Investigation and evaluation. *For proposed work covered by this section, the building owner shall cause the existing building to be investigated and evaluated in accordance with the provisions of this section.*

3412.4.1 Structural analysis. *The owner shall have a structural analysis of the existing building made to determine adequacy of structural systems for the proposed alteration, addition or change of occupancy. The analysis shall demonstrate that the building with the work completed is capable of resisting the loads specified in Chapter 16.*

For Your Information

- Chapter 34 of the OBC includes topics beyond structural elements, including but not limited to:

- Fire resistance
- Building materials
- Flood hazard areas
- Egress
- Fire escapes
- Glass replacement
- Accessibility
- Elevators
- Fire alarm systems
- Smoke control
- Standpipes
- Sprinklers

I'd like to add a mezzanine in my manufacturing facility.

This is a(n)…

a. Alteration
b. Repair
c. Addition
d. Maintenance
e. Change of Occupancy

I need to address deterioration on my building's facade.

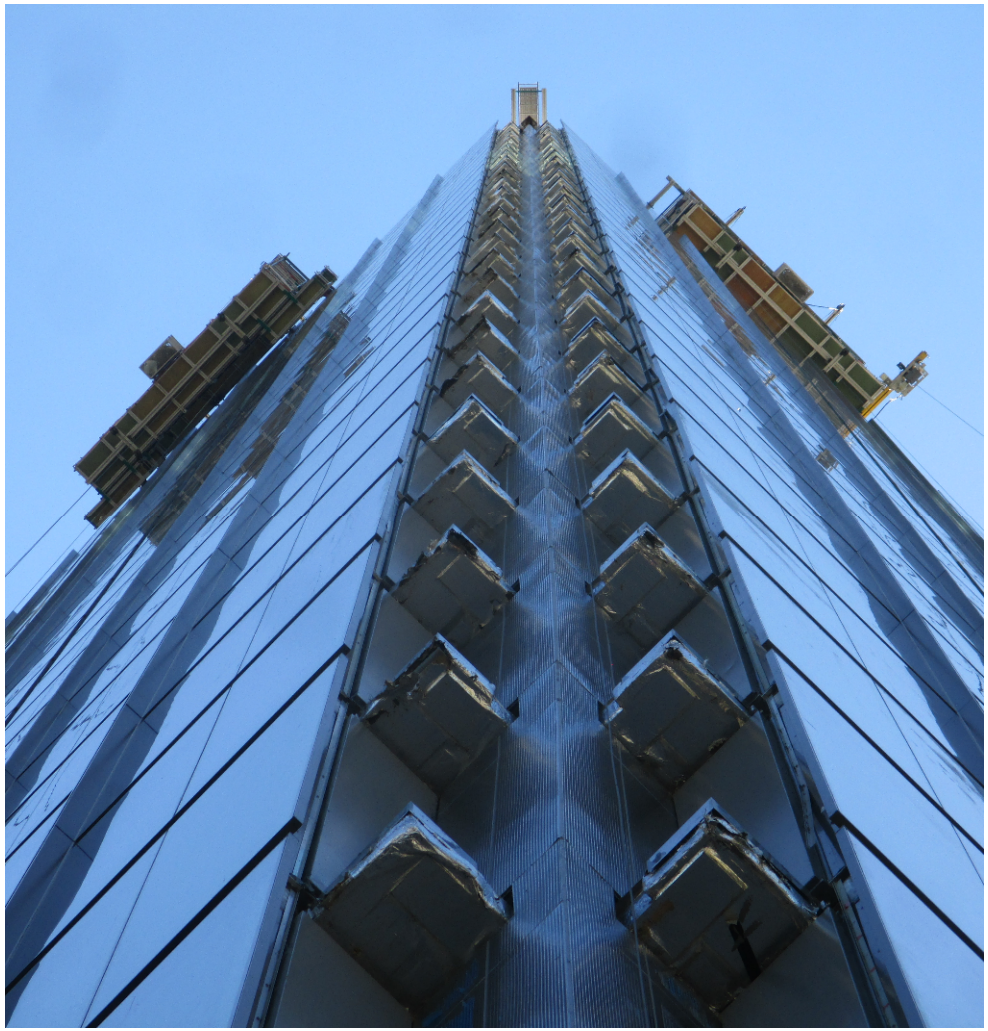
This is a(n)…

a. Alteration
b. Repair
c. Addition
d. Maintenance
e. Change of Occupancy

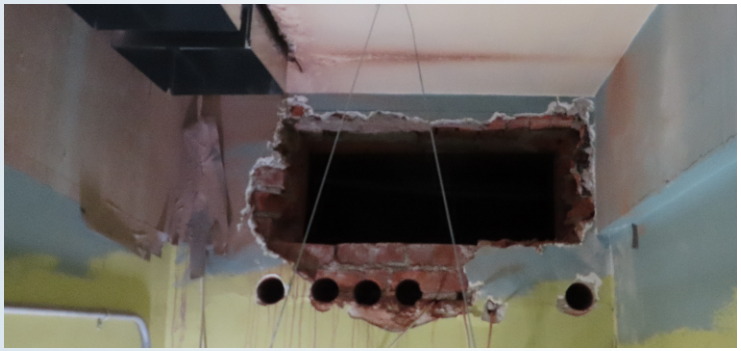
I'd like to add new exterior glazing to my building.

This is a(n)…

a. Alteration
b. Repair
c. Addition
d. Maintenance
e. Change of Occupancy



- **Does the alteration:**
  - *Increase* the load on the structure?



  - *Decrease* the strength of the structure?
  - *Change* the orientation or location of the load?

I'd like to alter my building.

(but, before you do…)

Ask the structure!

- Building owners alter buildings to suit the needs of the structure's inhabitants, but *structural limitations* must be considered as well

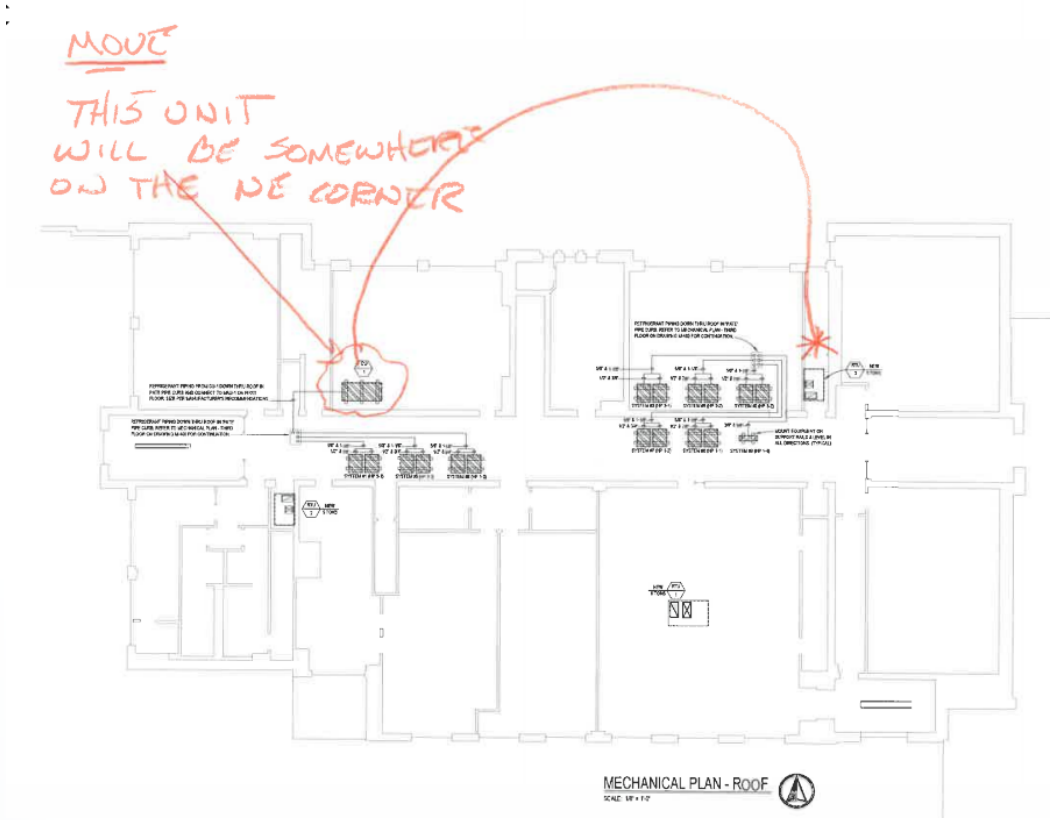
- When we say "**Ask the structure**," we mean:
  - Consider:
    - Structural effects
    - Alternate locations or orientations
    - Load reduction
    - Structural capacity, and not simply code requirements

Case Study 1 – Installation of new RTUs

- **New HVAC System Installation**
  - Review Contractor's proposed placement plan and provide strengthening details if required.

Case Study 1 – Installation of new RTUs

- **Contractor's Proposed Unit Placement Plan**
  - Units located to minimize duct and piping lengths
  - Some unit locations conflict with existing roof penetrations



Case Study 1 – Installation of new RTUs

- **Evaluation**
  - Assess the as-built conditions
  - Compare the new loading based on code specified 5 percent threshold.
  - Consider alternate locations
  - Consider strengthening

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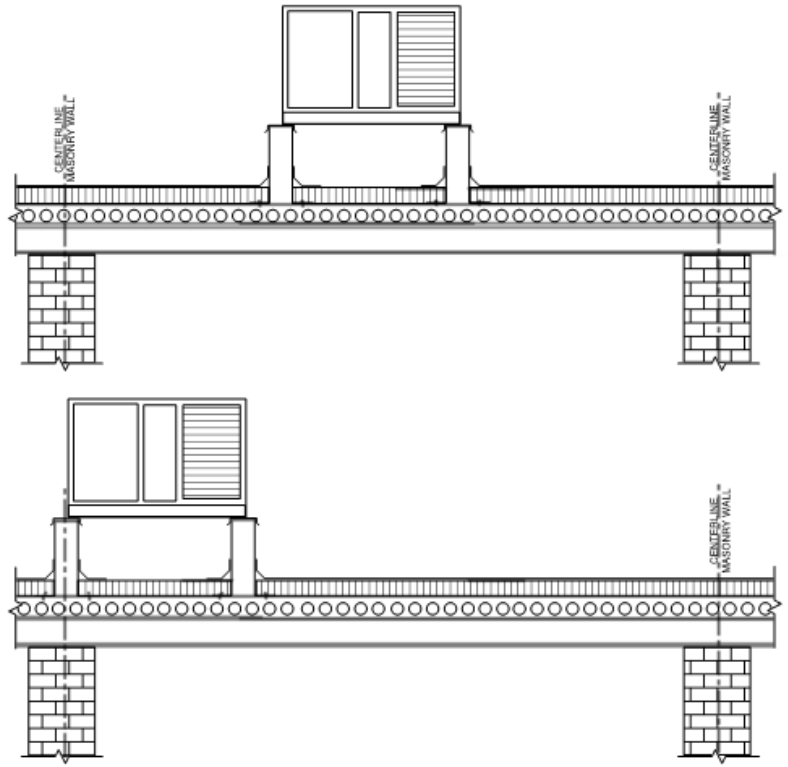
Case Study 1 – Installation of new RTUs

- **Results**
  - Contractor's Placement of RTUs on roof without considering the structure.
  - Analysis based on Structural Engineer's placement

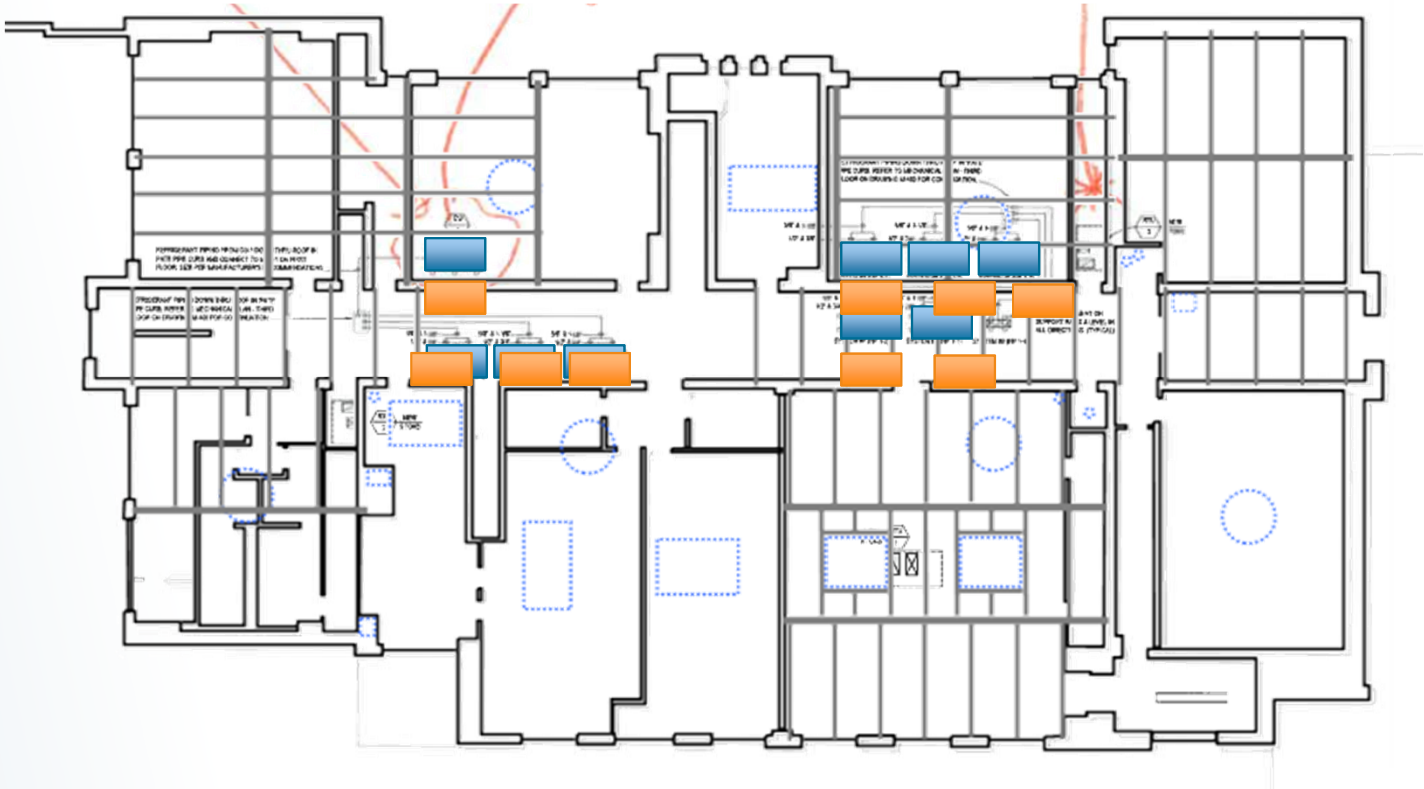
Code threshold exceeded

No strengthening required



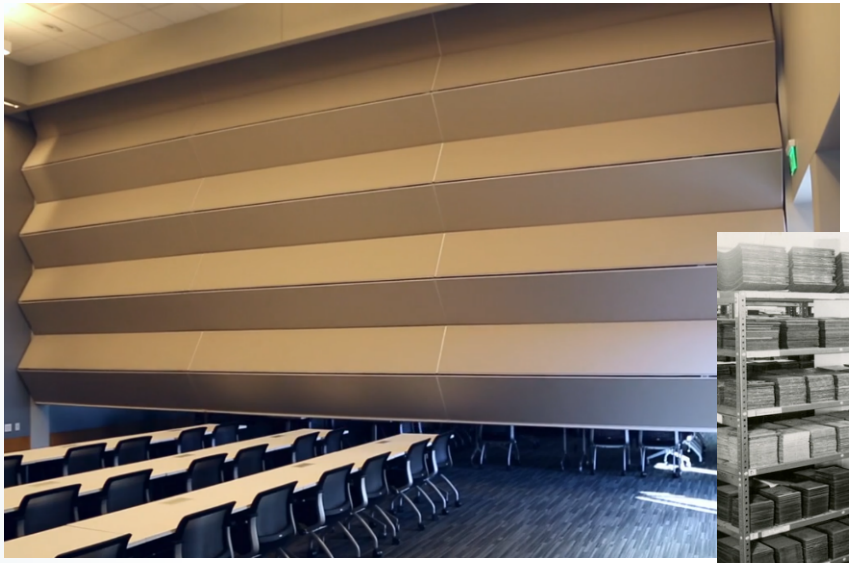
Case Study 1 – Installation of new RTUs

- **Solution**
  - Placement based on Structural Engineer's recommendations
  - No structural strengthening required.
  - Increase in duct and piping lengths



Case Study 2

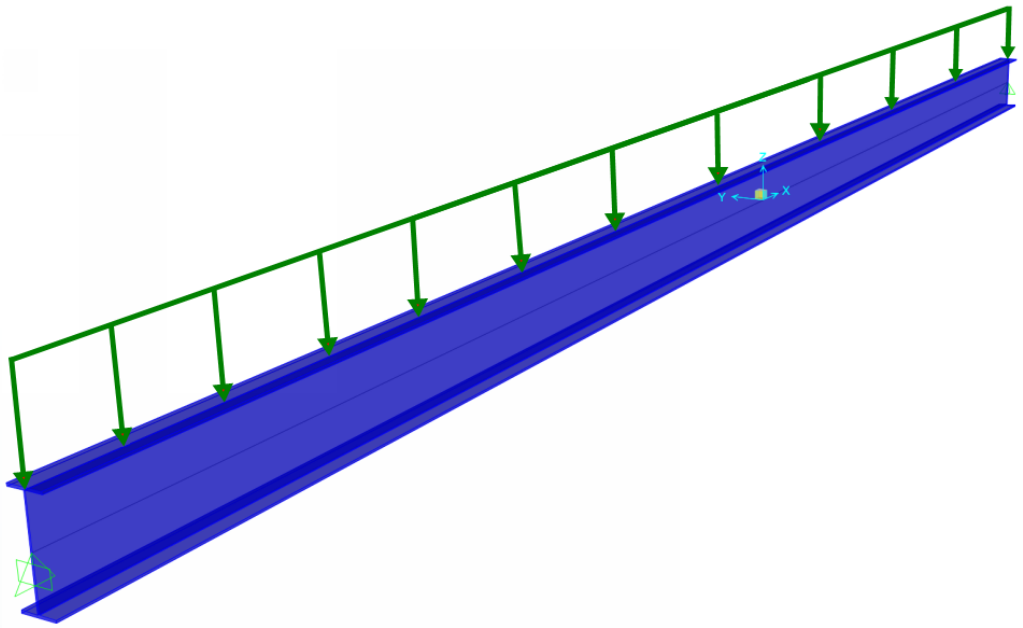
- **Office space renovation**
  - Installation of new, retractable partition wall
  - Relocation of a file room



Case Study 2- Partition Wall

- **Building information**
  - Constructed in the late 1980s
  - Design live load= 50 psf
  - Collateral live load (partitions)= 20 psf
  - Calculated dead load= 43 psf
  - Steel frame with concrete deck

Dead Load + Live Load = Original Loads

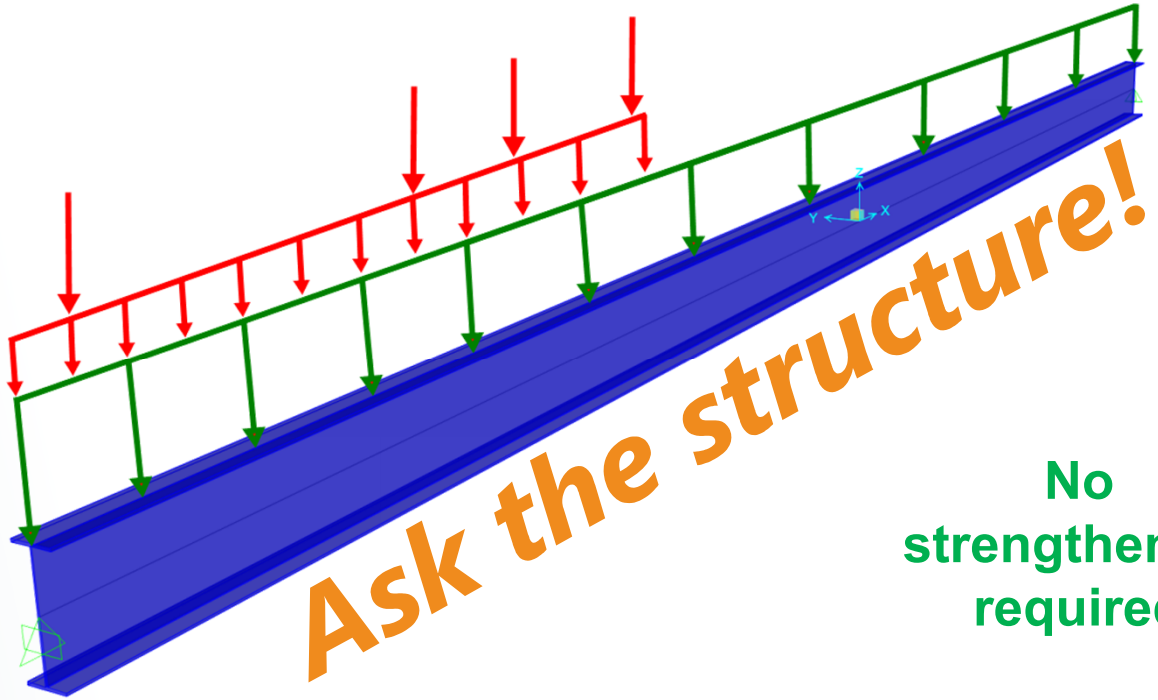


Case Study 2- Partition Wall

- **Partition information**
  - Four, ~550 pound point loads at connection points to existing structure
  - Do additional loads increase the design gravity load by more than 5%?

Original Loads + Partition Loads =

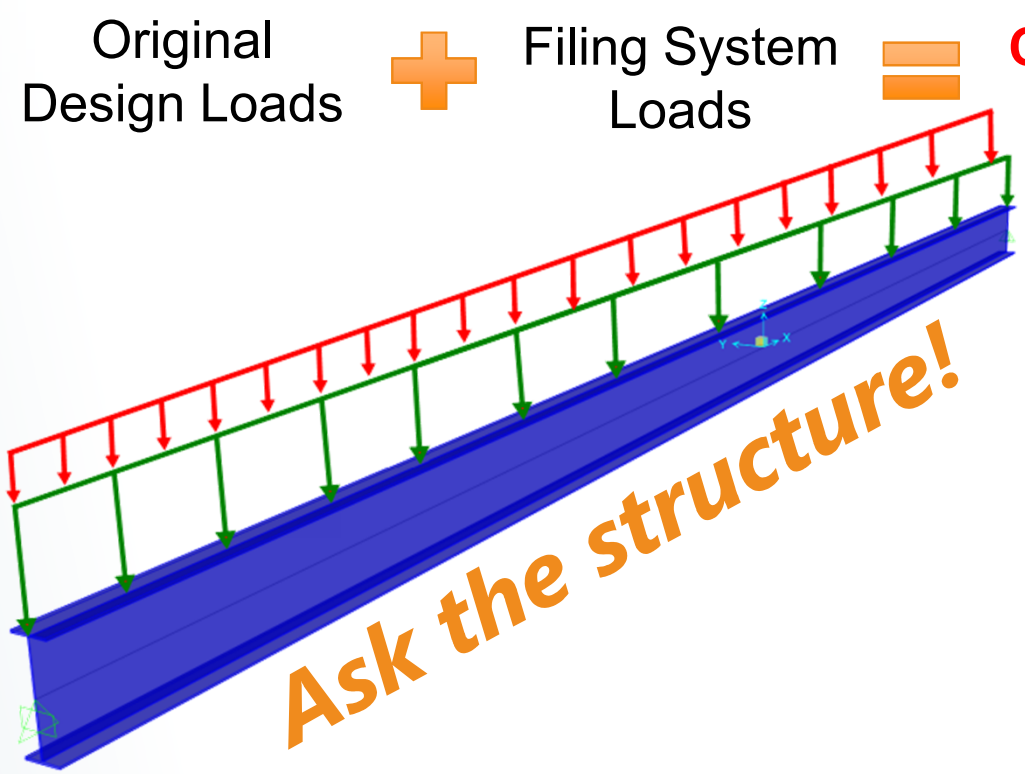
Code threshold exceeded



No strengthening required

Case Study 2- File Room

- **Load information**
  - Design live load= 50 psf
  - Collateral live load (partitions)= 20 psf
  - Calculated dead load = 43 psf
  - Filing system loads= 200 plf to 400 plf
  - **Considering both code requirements and member capacity, strengthening is needed**



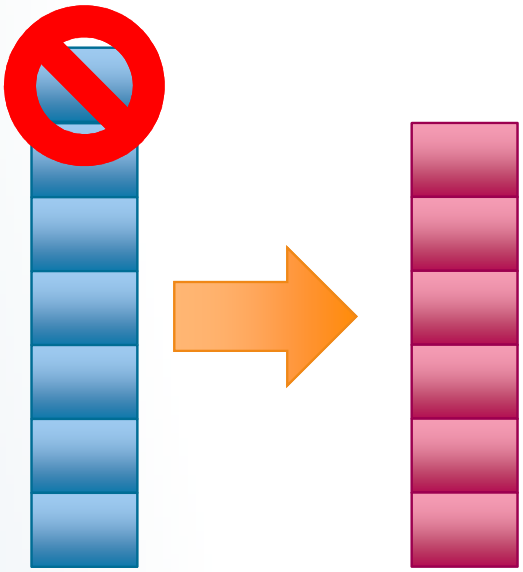
Case Study 2- File Room

- **Considerations**
  - Installation of strengthening would be difficult
    - Remove and replace interior finishes
    - Remove and replace fire-proofing
    - Disrupt building occupants
  - Size and placement of file system is flexible

Case Study 2- File Room

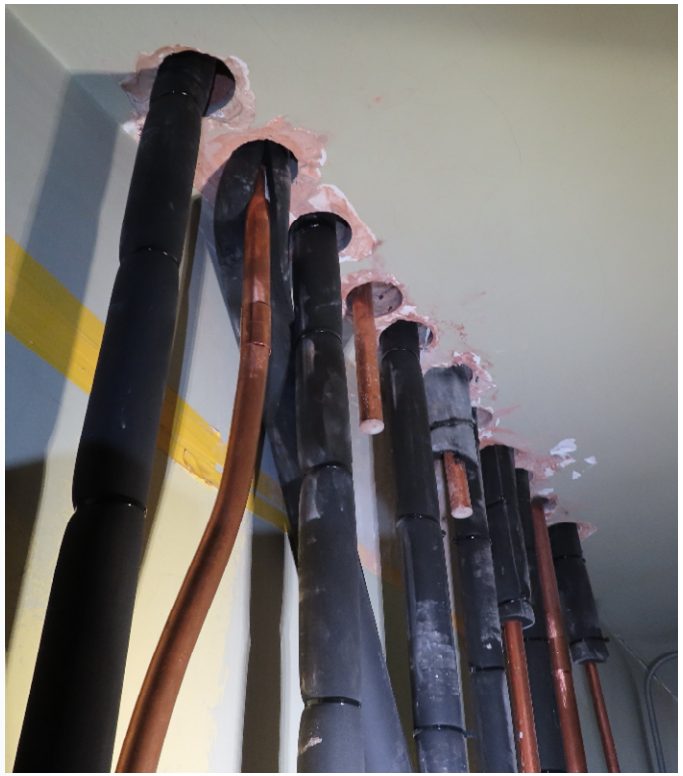
- **Load Reduction**
  - Utilize live load reduction as allowed by code
  - No partitions = No collateral live load
  - No live load under file footprint
  - Use 6-level stack instead of 7-level
  - Limit location of stacks

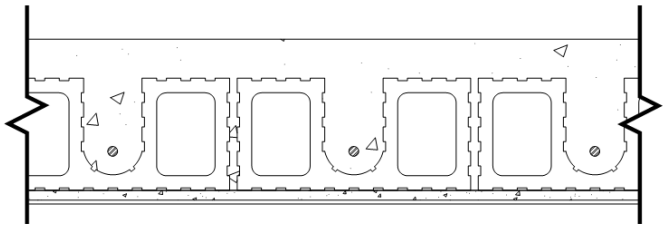
- **Consider load reduction and placement limitations**



Case Study 3 – Mechanical Penetrations

- **Penetrations for refrigerate lines**
  - Nine, 3″ diameter core holes cut through existing flooring
  - Flooring consists of “Precast Joistile” system with reinforcing bars spaced at 12¼″ on center
  - Reinforcing cut at multiple core holes
  - Decrease in existing load carrying capacity

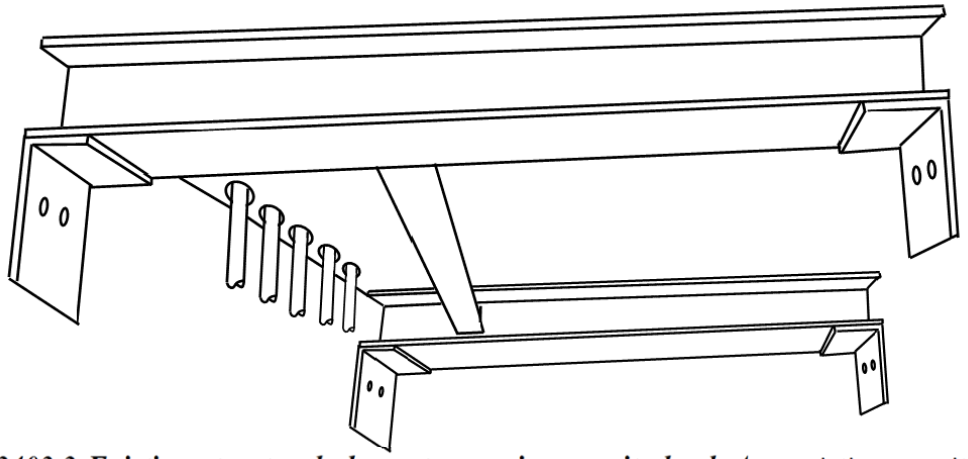




Case Study 3 – Mechanical Penetrations

- **Design / Repair**
  - Evaluation of as-built conditions
  - Structural analysis and design of new framing to accommodate decrease in floor capacity
  - Development of permit drawings
  - Fabrication/Construction

Increase in project duration and cost



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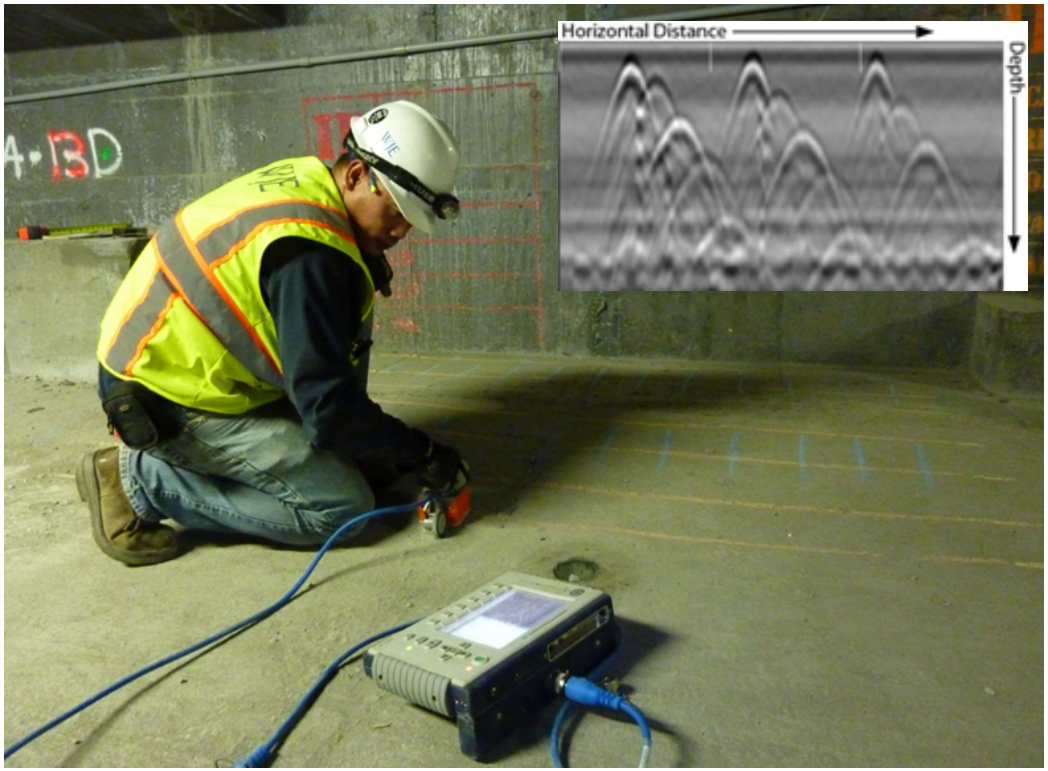
OR

Case Study 3 – Mechanical Penetrations

- **Prior to Construction**
  - Nondestructive evaluation
    - Reinforcement detection using GPR
- **General Recommendations**
  - Align new 3" diameter core holes with hollow core of Joistile floor
- **No additional reinforcing required.**



Ask the structure!

Case Study 4 – Load Testing

- **Evaluation**
  - Limited documentation
  - Difficult access
- **Analysis**
  - Complicated
  - Traditional methods using conservative assumptions
- **Solution**
  - Load test to confirm structural adequacy

Ask the structure!

Summary

- **Alterations**
  - Increase the load on the structure?
  - Decrease the strength of the structure?
  - Change the orientation or location of the load?
- **Ask the structure**
  - Review the original drawings
    - Compare new loads to design loads
  - Evaluate the structure
    - Consider alternate locations or orientations
  - Perform analysis
    - Consider load reduction
    - Structural capacity, and not simply code requirements

Thank you!

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