

2020 NEHRP PROVISIONS

IT5: NONSTRUCTURAL COMPONENTS

PUC Update
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FEMA



Building Seismic Safety Council
a council of the National Institute of Building Sciences

IT5 Working Groups

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Scoping Group – Bill Holmes

Lateral Force Group – Bret Lizundia

Nonbuilding Structures/Nonstructural Component
Groups – Greg Soules



IT5/IT6 Joint Meeting

- IT5/IT6 met on March 7, 2019
- Focused on coordination of the nonbuilding structures and nonstructural components design criteria
 - Penthouses
 - Supports for nonstructural components
 - Size limits for items that could be in either chapter



Chapter 13 and 15

- Chapter 15 has extensive design and detailing requirements, including design coefficients
- Chapter 15 references Chapter 12 or Chapter 13 for the procedures to calculate lateral forces
- While Chapter 15 can be referenced for detailing requirements for items like penthouses and component supports, the design force calculations must remain in Chapter 13

NBS – NSC Group (IT5/IT6)

- Coordinate with IT6, Nonbuilding Structures to clearly identify those items to be designed as nonstructural components and those to be designed as nonbuilding structures.
 - Reference Chapter 15 for nonstructural components include penthouses, billboards, “large” tanks and vessels.
 - Reference Chapter 15 for design supports for nonstructural components such as frames, platforms and pipe racks.



Penthouses

- Currently designed as a nonstructural component
 - $a_p=2.5$, $R_p=3.5$
 - No restrictions on system selection or detailing
 - No discussion of design of penthouses in Chapter 13



Penthouses

- Vary in size from small enclosures at the top of stairs and elevators to large structures covering 30% of the roof area
- In many cases the penthouse lateral system might not be permitted as the primary lateral force-resisting system for a structure, such as an ordinary braced frame (currently acknowledged in Chpt. 12)

Proposal Approach

- Penthouses will remain in Chapter 13
- For detailed design requirements, reference Chapter 15 criteria for “nonbuilding structures similar to buildings”
 - Chapter 15 includes provisions that allow some ordinary systems to be used for nonbuilding structures similar to buildings
- The exceptions for vertical combinations of systems for rooftop structures in Section 12.2.3.1 will be reviewed (should not be triggered by a penthouse).

Penthouse Proposal

- Add provisions for penthouses
 - Retain simplified criteria for small rooftop structures (stair enclosures, elevator machine rooms)
 - Design coefficients in Table 13.5-1 or pointers to coefficients in Table 15.4-1 for penthouses that are “bigger than small”, up to 25% of total building weight
 - Explicitly exclude ordinary or plain concrete and masonry lateral systems for penthouses in regions of high seismicity
 - Included penthouses in analysis of the building lateral force-resisting system if greater than 25% of building weight (coordinate with Chapters 12 and 15)

Components Group Topics

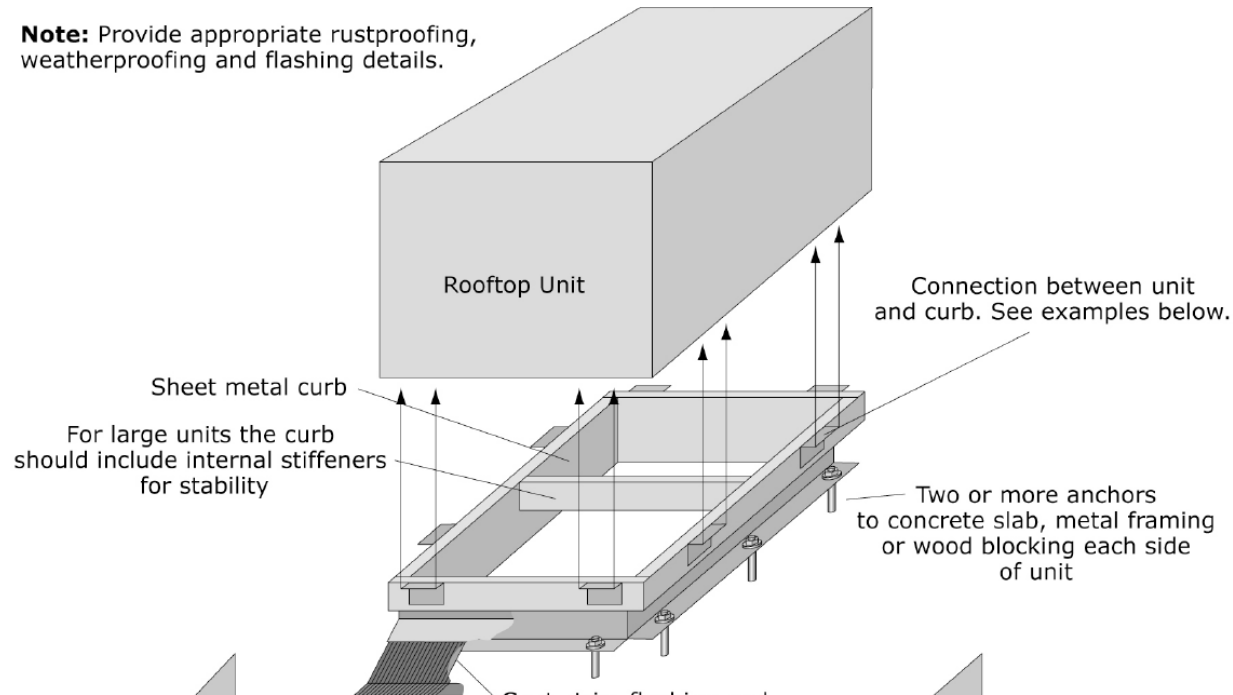
- Design of supports for nonstructural components (*in progress*)
- Displacements of nonstructural components – distribution systems, mostly (*in progress*)



Supports for Nonstructural Components

“Those members, assemblies of members, or manufactured elements, including braces, frames, legs, lugs, snubbers, hangers, saddles, or struts, and associated fasteners, that transmit loads between nonstructural components and their attachments to the structure.”

Note: Provide appropriate rustproofing, weatherproofing and flashing details.



Component Supports - Issues

- Supports use the same a_p and R_p factors as the component they support
- For $I_p = 1.0$, the range of ratios for a_p/R_p for MEP equipment and systems is 0.21 to 0.67

$$F_P = \frac{0.4 a_p S_{DS} W_p}{\left(\frac{R_p}{I_p} \right)} \left(1 + 2 \frac{z}{h} \right)$$

Component Supports - Issues

- References to industry design standards for pipe supports are provided (NFPA 13, MSS SP-58)
- Little guidance for design and detailing for built-up supports
- When multiple components are installed on platforms or skids, it may be unclear how to determine the design force for the platform

Support Condition Categories

- Integral with component (legs, skirts, saddles)
- Skid mounted (isolated, non-isolated)
- Simple supporting structures (frames, walls)
- Separate, discrete bracing (bracing systems for distribution systems, pipe racks)
- Platform systems (multiple components on an elevated framing system)

Integral Supports

Continue to use
same a_p , R_p for
components
and supports



Skid-mounted Components

- One or more components mounted on a rigid structure (the skid)
 - Directly attached to a floor or slab-on-grade
 - Supported on vibration isolators that are attached to a floor or slab-on-grade



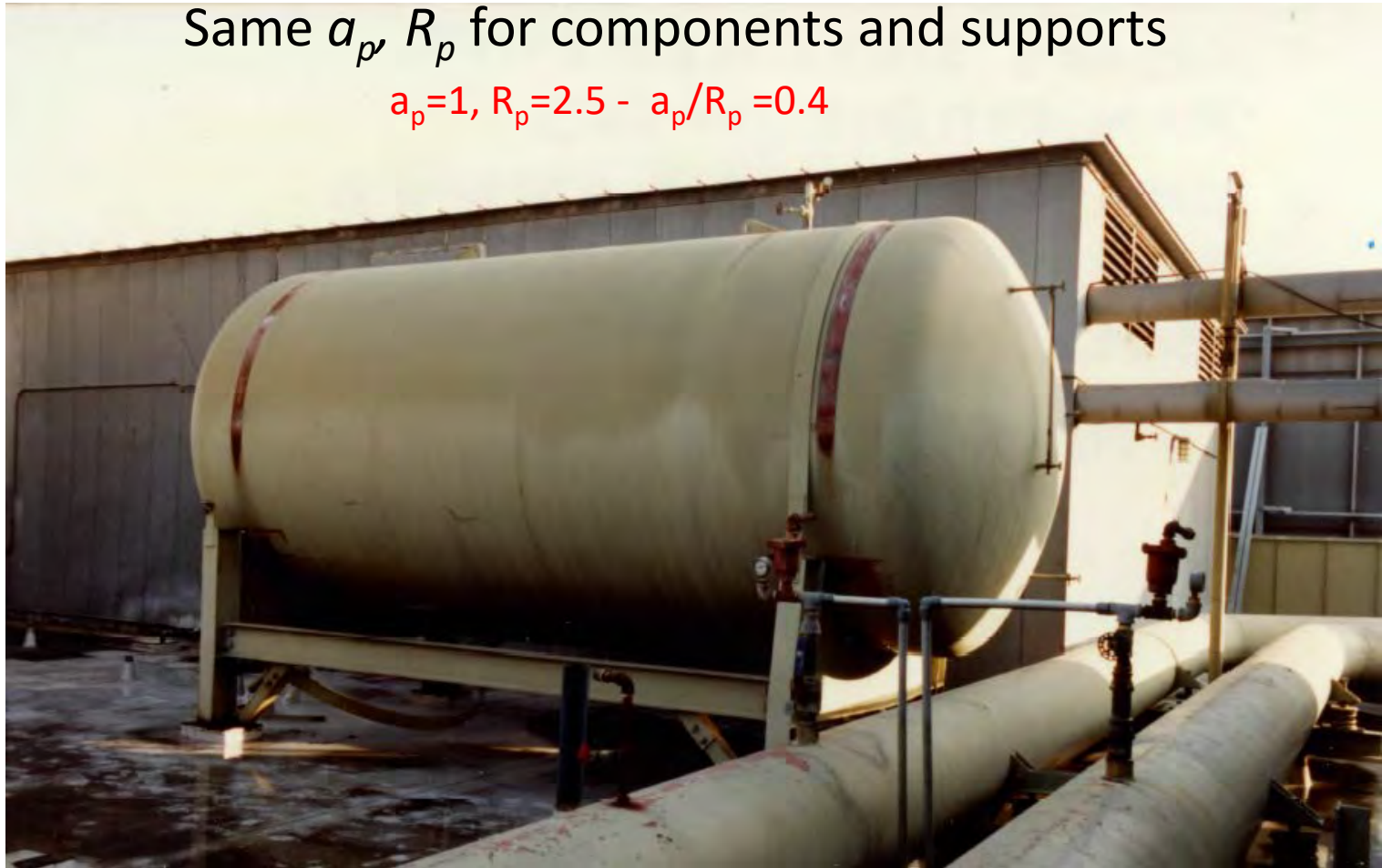
Design Force for Skid Mounted Components

- Skid directly attached to the deck
 - Use the a_p , R_p for the components for design of the skid/supports
 - Need guidance for skids with multiple components (example – skid supporting isolated and non-isolated components)
- Isolated skids use a_p , R_p for vibration isolated components

Simple Support

Same a_p , R_p for components and supports

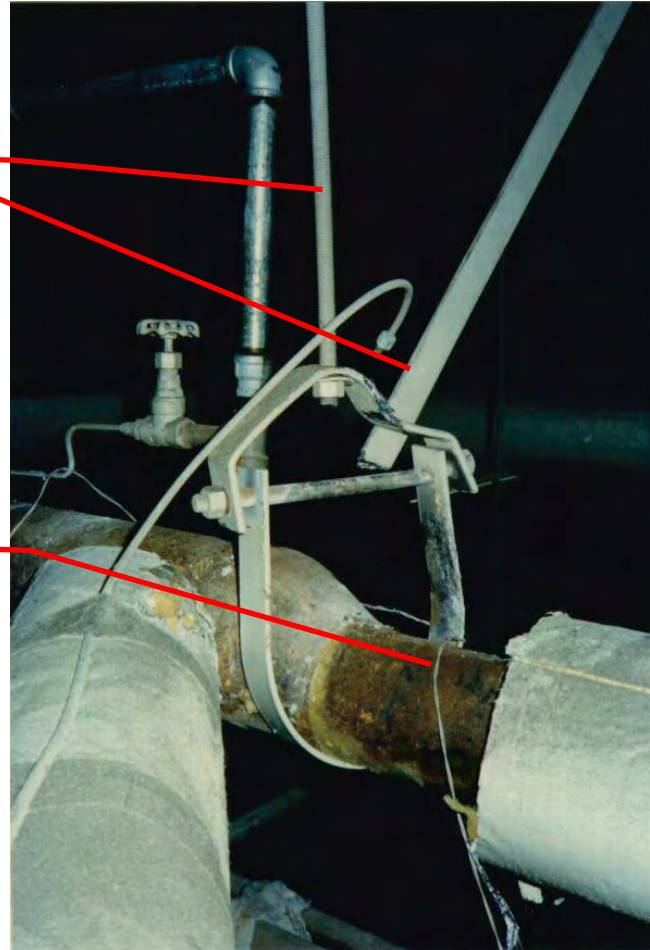
$$a_p=1, R_p=2.5 - a_p/R_p=0.4$$



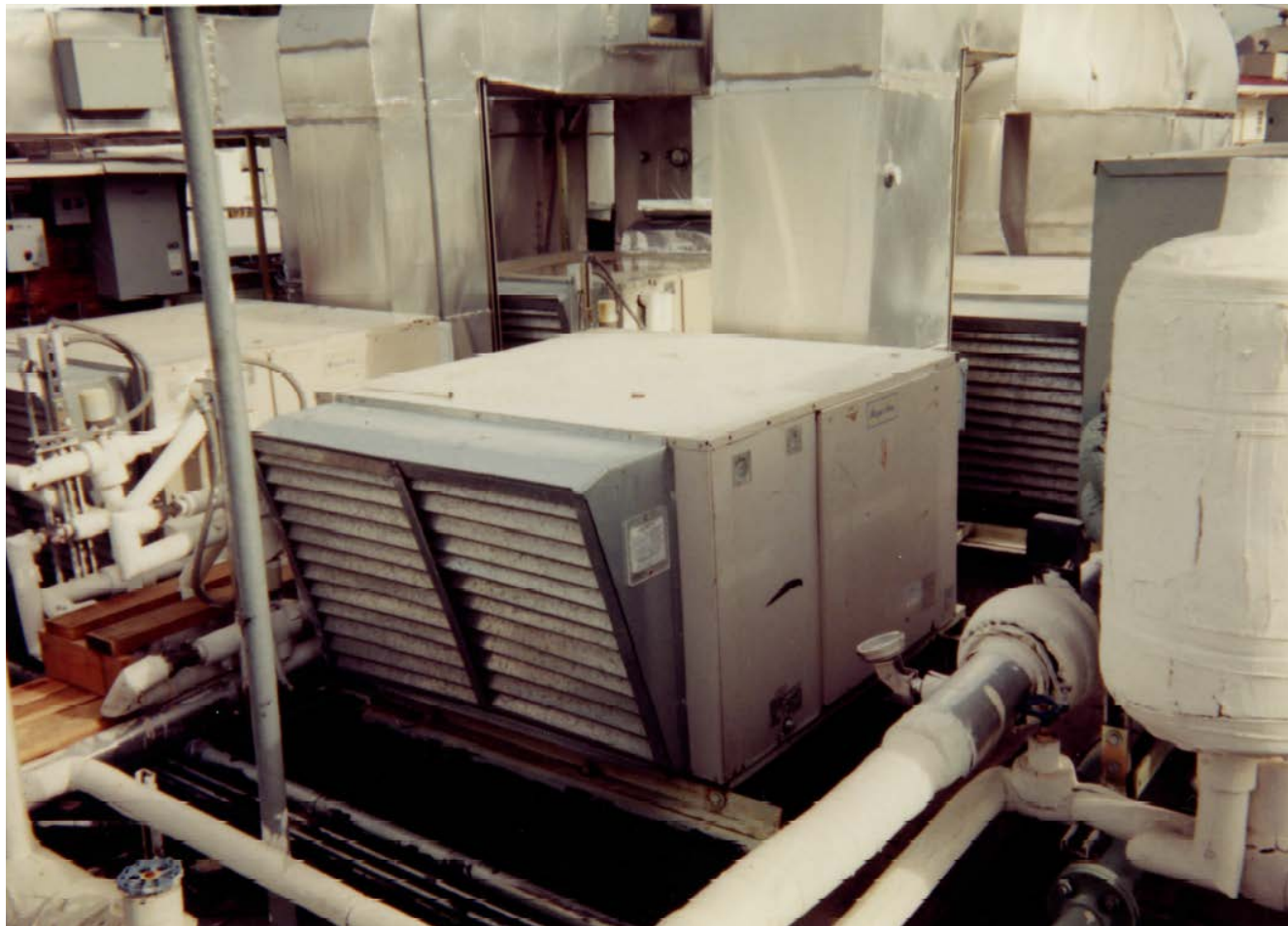
Discrete Bracing - Piping System

Pipe Bracing
 $a_p=1$, $R_p=9$, $a_p/R_p=0.28$

Welded Steel Pipe
 $a_p=2.5$, $R_p=9$ - $a_p/R_p=0.28$

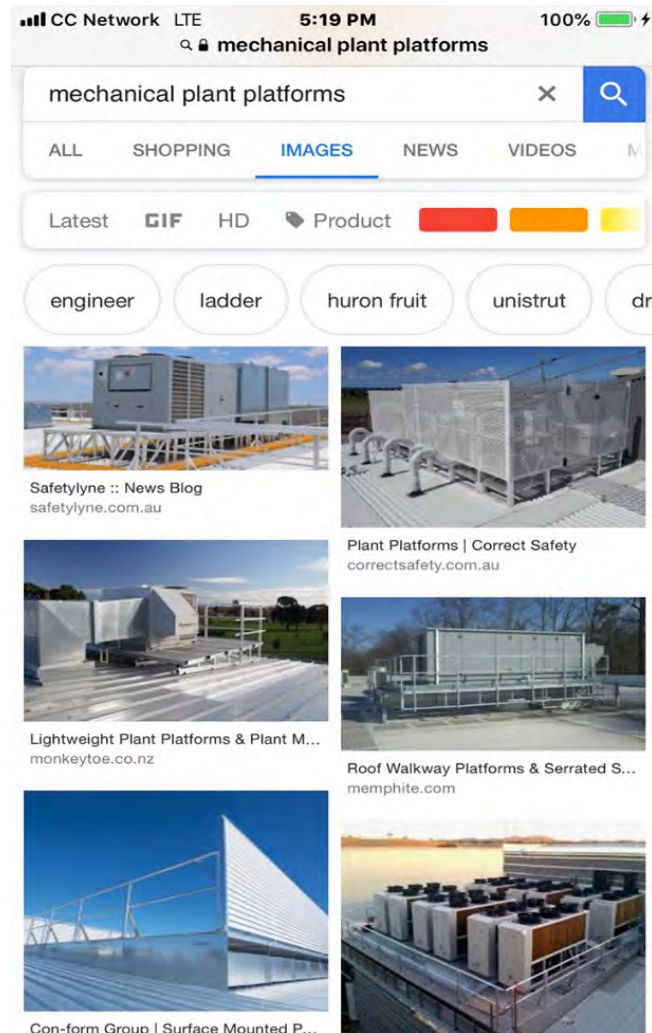


Components on Platforms



Platforms

- All shapes, sizes and systems
- Structural configuration is similar to buildings
- How should design forces for platforms supporting various components and piping systems be determined?



Component Support Proposal

- Design forces for integral supports remain the same as that for the component
- For simple supports and platform systems, design requirements per Chapter 15 using an R_p based on the platform lateral system
 - System for calculating loads from supported components
- Design forces for isolated skids per Table=13.6-1 for isolated components
- Design forces for non-isolated skids based on the sum of lateral forces for supported components
- For distributed systems, separate design coefficients for bracing assemblies



Flexibility of Distribution Systems

- The existing provisions for accommodating displacements between supports and equipment are very general
- Full requirement:

***“13.2.4 Flexibility.** The design and evaluation of components, their supports, and their attachments shall consider their flexibility and their strength.”*

Distribution Systems

- Excerpt from commentary:

“C13.2.4 . . . Components or their supports and attachments must be flexible enough to accommodate the full range of expected differential movements; some localized inelasticity is permitted . . . ”



Distribution Systems Proposal

- Identify conditions where pipe stiffness and relative displacements must be checked for distribution systems (some may apply to both $I_p = 1.0$ and 1.5):
 - Pipe (and duct?) risers
 - Pipe, duct and conduit drops to equipment.
 - Conditions where, due to changes in direction, pipe deflections impose loads at bracing points.
- Methods for accounting for system displacement between supports, where interaction with essential components or systems is possible. Not intended for $I_p=1.0$ systems or components. Possibly commentary.

Scoping Group

- Revisions to extends Chapter 13 scope to nonstructural components and their supports and attachments that are located in or on a building or located outside a building but providing services to the building (*have draft*)
- Draft definitions for temporary and movable components (*have draft*)
- Limitations on use of nonductile materials (prohibit URM partitions, nonductile systems for supports)

Lateral Force Group

- ATC-120 being finalized
- Working on a strategy introduce the revised force equation into NEHRP Provisions



IT5

The 25% Rule

Greg Soules



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