



NAC Executive Insights

Safety Insight: Unsafe Sequencing and Missing Temporary Bracing

Key Points

- Unsafe sequencing and missing temporary bracing are among the most recurrent and deadly failure mechanisms in structural construction.
- These failures often occur during retrofits, member removals, or temporary support transitions—especially when sequencing plans are informal or absent.
- The collapse risk is amplified when crews rely on visual judgment rather than engineered load paths and verified bracing.
- Governance interventions—such as sealed sequencing plans, permit-to-remove protocols, and stop-work authority—are critical to prevention.
- This insight outlines the operational signature, governance triggers, and training priorities needed to address this failure mode.

A Pattern of Collapse Rooted in Sequencing Blind Spots

In structural construction, sequencing decisions are often made in the field—sometimes under time pressure, sometimes based on experience, and sometimes without formal engineering review. When those decisions involve the removal or repositioning of structural members, the consequences can be catastrophic.

Unsafe sequencing failures typically occur when temporary bracing is omitted, improvised, or misjudged. The assumption is that the remaining structure will hold. But without a sealed plan and verified load path, that assumption can be fatal.

These failures are not limited to one structure type. They appear in tower retrofits, tilt-up panel installations, billboard frame replacements, and truss erections. What they share is a breakdown in procedural control: no engineered sequencing plan, no verified bracing, and no stop-work authority tied to structural risk.

Representative Case: Tower Retrofit Collapse

During a tower retrofit, a crew removed diagonal members without installing engineered bracing. No sequencing plan had been sealed by a professional engineer. No load path diagram had been reviewed. The assumption was that the remaining members would maintain stability.

They didn't.

The tower collapsed within seconds, killing two workers and triggering multiple regulatory citations. The incident wasn't just a failure of engineering—it was a failure of governance. No one had the mandate to halt the work until bracing was verified. The collapse was preventable, but the controls weren't in place.

Why This Failure Mode Persists

Unsafe sequencing failures are deceptively simple. They often occur in routine operations, where crews are familiar with the structure and confident in their judgment. That confidence can be dangerous.

Several systemic factors contribute to this failure mode:

- **Retrofit Complexity:** Partial demolition, legacy materials, and undocumented load paths make retrofits inherently risky.
- **Visual Assumptions:** Crews often rely on visual cues to judge stability, which can be misleading or incomplete.
- **Bracing as an Afterthought:** Temporary bracing is rarely treated as a design element. It's often improvised or omitted entirely.
- **Lack of Stop-Work Protocols:** Few sites empower field staff to halt work over sequencing concerns.
- **Documentation Gaps:** Sequencing plans, if they exist, are often informal and not traceable to engineering review.

These factors combine to create a governance blind spot—one that can only be addressed through upstream controls and cultural change.

Governance Triggers and Operational Controls

To prevent unsafe sequencing failures, governance must intervene before the first member is removed. The following controls are recommended:

- **PE-Sealed Sequencing Plans:** Any removal or repositioning of structural members must be governed by a sealed plan that includes load path analysis and bracing requirements.

- **Permit-to-Remove Protocols:** Before any member is removed, a permit must be issued based on engineering review and field verification.
- **Stop-Work Authority:** Field supervisors must have the authority—and the obligation—to halt work if bracing is inadequate or sequencing is unclear.
- **Bracing Verification Audits:** Daily safety briefings must include bracing checks tied to the sequencing plan.
- **Photographic Documentation:** Before-and-after photos of bracing installations should be logged and reviewed.

These controls are not burdensome. They are essential safeguards—especially on retrofit projects where sequencing risks are highest.

Training Priorities and Cultural Shifts

Addressing this failure mode requires more than technical knowledge—it demands a cultural shift in how sequencing is planned, communicated, and enforced. Recommended training modules include:

- **Bracing Literacy:** Field crews must understand how temporary bracing works, how it fails, and how to verify it.
- **Sequencing Discipline:** Crews must be trained to follow sealed plans and resist improvisation.
- **Load Path Awareness:** Visual diagrams and case studies should be used to teach how loads shift during member removal.
- **Regulatory Compliance:** OSHA 1926.550 and ANSI/AISC codes must be embedded in daily practice, not just in manuals.
- **Case History Briefings:** Real-world failures should be studied to reinforce the consequences of sequencing errors.
- **Safety Culture Activation:** A mature safety culture ensures that sequencing risks are not left to field judgment alone. Toolbox talks, Accident Hazard Analyses, and pre-task planning must embed sequencing hazards into daily routines. Leadership must model safety-first behaviors, empower stop-work authority, and reinforce the expectation that every crew member is responsible for verifying bracing and challenging unsafe assumptions.

Sequencing is not just a technical process—it is a safety-critical operation governed by shared values, proactive communication, and continuous reinforcement. When safety culture is strong, sequencing failures become preventable.

Why This Insight Matters

Unsafe sequencing and missing bracing are not rare anomalies. They are recurring fault lines in construction safety—especially in retrofit contexts where structural assumptions are most fragile. These failures are preventable, but only if governance mechanisms are in place to catch them before they cascade.

This Executive Insight provides a roadmap for prevention. It shows where procedural controls must be enforced, where training must evolve, and where operational discipline must be embedded. It's not just a lesson from the past—it's a mandate for the future.

About the Author

Bob Prieto was elected to the National Academy of Construction in 2011. He is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries. Bob received the 2024 ASCE OPAL Award (Outstanding Projects and Leaders) for his Outstanding Lifetime Achievement in Management.

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