

NAC Executive Insights

Safety Insight: Construction Failures are Avoidable

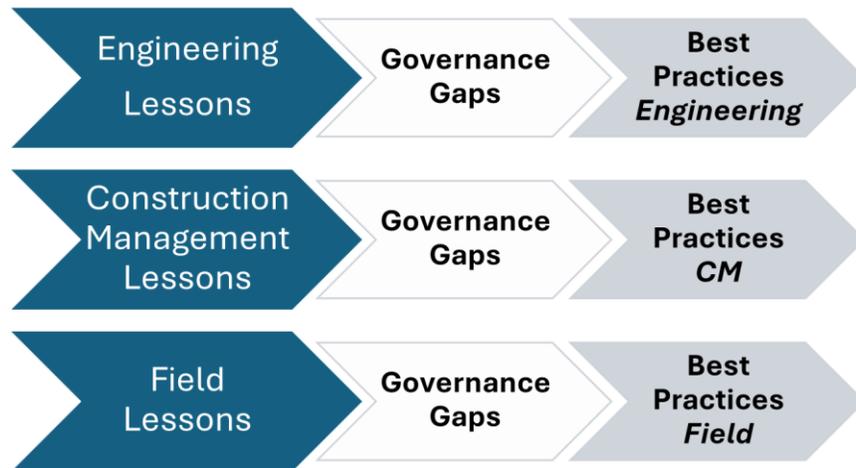
Key Points

- Failure signatures for five accident types are identified.
- Training is an accident avoidance activity.
- Audit protocols represent a second learning and improvement opportunity.
- Good governance is a prerequisite for good and safe management.
- Core insights for five specific construction accident types are identified.
- Construction injuries and fatalities are avoidable.

Introduction

A review of select, recurring construction failures has shown an identifiable need to address the translation of lessons observed into best practices. In this Executive Insight we look at five common construction failure types with the goal of:

- Identifying observable lessons
- Highlighting gaps in governance which contribute to their severity and impede their translation to a set of best practices
- Putting forward a candidate set of best practices



The lessons observed, gaps identified and best practices put forward are not intended to be exhaustive and others likely exist.

We look at construction failure types from three perspectives:

- Engineering
- Construction Management (CM)
- Field construction

The five construction failure types we have identified and assessed include:

- Unsafe sequencing/lack of temporary bracing
- Temporary works, including shoring and scaffolding failures
- Design deficiencies, including shortcomings in Quality Control (QC) and peer review
- Weather related factors including wind loads and other environmental factors
- Material degradation and inspection gaps

Failure Signatures

In reviewing a select set of construction accidents we identified a set of failure signatures associated with each accident type. These represent the dominant signatures and a point of attention in construction planning and execution. These are summarized for each accident type in the following table.

Failure Signatures				
Unsafe Sequencing	Temporary Works	Design Deficiencies	Weather	Material Degradation
Removal of structural members without engineered sequencing	Collapse of scaffolds, shoring, or formwork due to overload, under-design, or premature removal	Structural collapse due to calculation errors, detailing gaps, or missed inspection triggers	Collapse of scaffolds, rebar cages, or suspended systems during wind events	Collapse due to corroded, fatigued, or reused components
Absence of temporary bracing during retrofit or demolition	Lack of anchorage, lateral bracing, or load case analysis	Lack of independent peer review or traceable QC documentation	Inadequate tie-ins, anchorage, or rigging geometry	Visual inspection failed to detect internal degradation
Collapse triggered by unbalanced load paths or unsupported spans	Failures during concrete placement, demolition, or facade work	Field crews unaware of design sensitivities or critical nodes	No wind threshold policies or onsite measurement tools	No traceability or tagging system for reused materials

In subsequent sections we will look at some lessons that must be learned, not merely observed, from this failure record. These have been segregated into:

- Engineering lessons
- Construction Management, and
- Field lessons

First, however, we will look at the governance gaps that existed and resulted in construction accidents.

Governance Gaps

A review of a set of construction failures results in a set of governance gaps that repeat and which are addressable in policy and practice, but only if we are aware of them. In part, this executive summary seeks to raise this awareness.

Governance gaps are segregated into the five identified accident types covered in this Executive Insight, with lessons observed following this section.

Governance Gaps				
Unsafe Sequencing	Temporary Works	Design Deficiencies	Weather	Material Degradation
No “permit-to-remove” protocol tied to engineering review	No inspection logs tied to scaffold erection and use	No peer review log or resolution tracking	No stop-work policy tied to wind speed	No traceable tagging system for reused gear
No stop-work authority linked to bracing absence	No removal permits for temporary supports	No QC documentation tied to field inspections	No wind exposure audit for temporary structures	No inspection protocol for legacy or marine-exposed components
No retrofit-specific hazard briefings in pre-task planning	No audit trail for formwork design and field modifications	No integration of design briefings into pre-task planning	No training on environmental risk response	No replacement intervals based on exposure and service duration

Engineering Lessons Observed

Engineering lessons observed represent the most upstream opportunity to avoid construction failures, especially those with a high probability of resultant injury or death. These have been segregated by the five accident types. The list of observable lessons is not necessarily comprehensive but represents those most readily and repeatably observed.

Engineering Lessons Observed				
Unsafe Sequencing	Temporary Works	Design Deficiencies	Weather	Material Degradation
Always model load redistribution during member removal	Design all temporary works with staged load cases and wind exposure	Require peer review for all critical spans, nodes, and connections	Design temporary systems for site-specific wind loads	Ban reuse of structural components without certified inspection
Require sealed sequencing plans for retrofit and partial demolition	Require PE-sealed drawings for scaffolds >125 ft and shoring systems	Flag design assumptions and load paths for field briefings	Include wind load cases in rigging and lift plans	Require NDT for marine-exposed or legacy materials
Flag critical members for staged removal and bracing audits	Include anchorage and tie-in details in temporary works packages	Document QC hold points and acceptance criteria in ITPs	Specify tie-in requirements and gust thresholds in drawings	Implement tagging systems linked to inspection records

Construction Management Lessons Observed

Construction Management lessons observed occur at the junction between engineering and field activities. An experienced construction manager supported by rigorous construction planning and inspection represents a second opportunity to mitigate construction accident risks.

Where identifiable, these lessons have been included in the following table.

Construction Management Lessons Observed				
Unsafe Sequencing	Temporary Works	Design Deficiencies	Weather	Material Degradation
Document bracing installation with timestamped photos	Verify formwork geometry and pour rate staging before placement		Suspend work during gusts exceeding defined thresholds	

Field Lessons Observed

The final opportunity to mitigate construction risks, especially those potentially resulting in injury or fatalities, is during field operations. Experienced supervision, well-developed daily work plans and Job Hazard Analysis (JHA) prevent avoidable injuries and fatalities.

The division between Construction Management and Field operations may vary from sector-to-sector and project-to-project.

Field lessons observed are presented in the following table.

Field Lessons Observed				
Unsafe Sequencing	Temporary Works	Design Deficiencies	Weather	Material Degradation
Never remove diagonals, struts, or panels without bracing verification	Inspect scaffolds before use, after weather, and at defined intervals	Stop work if distress, cracking, or misalignment is observed	Use anemometers—not forecasts—for real-time decisions	Inspect reused components before installation
Use tension monitoring on guyed structures during sequencing	Never remove shoring before concrete reaches design strength	Verify rebar embedment, weld quality, and concrete strength against design	Rig suspended loads to minimize sway and rotation	Flag corrosion, cracking, or deformation for engineering review
		Request clarification on ambiguous or undocumented details		Replace any component with unknown service history

Best Practices

In this section we look beyond the best practices identifiable from the lessons learned for each construction failure category and take a broader look at improvement opportunities related to:

- Training
- Audit Protocols
- Governance

Training

Training is an accident avoidance activity. It provides a neutral forum to discuss potentially severe off-normal, off-plan events and how to best eliminate them or at worst mitigate their effects. It helps build a common understanding across the workforce as well as a common vocabulary. Finally, it represents the repository where future lessons observed can be integrated, further strengthening the education and mitigation role of training.

In effective training we:

- Build role-specific modules using these granular lessons
- Include case history visuals and failure signatures
- Reinforce stop-work triggers and escalation protocols

- **Embed Safety Culture Activation:** A mature safety culture ensures that training is not just informational—it's transformational. Toolbox talks, Accident Hazard Analyses, and pre-task planning must embed safety-critical behaviors into daily routines. Leadership must model safety-first decisions, empower field-level accountability, and reinforce the expectation that every crew member is responsible for identifying, communicating, and mitigating risk.

Safety culture is the invisible architecture behind safe operations. When it's strong, technical controls are upheld, risks are surfaced early, and lives are protected. When it's weak, even well-designed systems can fail.

Audit Protocols

Audit protocols represent a second learning and improvement opportunity. Effective audit protocols:

- Map each lesson to regulatory standards (OSHA, ANSI, ACI, AISC)
- Create checklists tied to failure mode categories
- Track compliance metrics and inspection logs

Governance

Governance is an often overlooked improvement opportunity. Good governance is a prerequisite for good and safe management. Good governance practices:

- Visualize lessons by structure type, owner type, and severity tier
- Flag repeat failure modes for targeted intervention
- Link lessons to training completion and field audit outcomes

Conclusion

This Executive Insight looks at five construction accident types and is extracted from a deep dive across twenty-nine significant construction accidents. We have looked at a risk and mitigation chain that begins with identification of failure signatures and governance gaps and moves forward to identify lessons observed affecting engineering, construction management and field operations.

We highlighted broad areas for best practices related to training, audit protocols and governance. Strengthening these areas has a broader benefit than just that associated with the five selected accident types.

As we looked at the five specific construction accident types we identified some key core insights. These included:

- Structural members must never be removed or repositioned without engineered sequencing and verified temporary bracing.
- Temporary structures must be treated with the same engineering rigor as permanent ones.
- Design flaws often go undetected without independent review and rigorous QC documentation.

- Wind is a structural load—not a background condition—and must be integrated into planning and execution.
- Reused or marine-exposed components must be inspected and certified—visual checks alone are not enough.

Construction injuries and fatalities are avoidable through good practice and diligent awareness of the tasks at hand and the field conditions present.

About the Author

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