STRUCTURAL INTELLIGENCE BRIEF

Construction (NAICS 23)

Cross-Sector Infrastructure

THINNESS	PERMISSION	MANAGEMENT	ABSENCE
STRAINED	STRAINED	VULNERABLE	VULNERABLE

S.J. Bridger
Four Frequencies Framework

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Executive Summary

Construction is structurally configured to build on a workforce it cannot replace, regulated by an enforcement architecture that cannot reach it, producing fatality patterns that decades of intervention have not eliminated. 801,000 establishments employ 7.3 million workers with average firm size 9 employees, 90.9% under 20 workers. Most demographically homogeneous Tier 1 sector: 87.3% white, 11.2% female. OSHA inspects 4% of establishments annually (once every 25 years). Fatal Four account for 75% of 1,032 fatalities in 2024 with 9.2/100K on-site rate. Fall protection #1 violation for 14 consecutive years, 6,500+ citations across 31,700 inspections. Specialty contractor M&A surged 38.6% YoY (562 transactions, 2025), concentrating market while atomizing workforce. Median age 41.2 years with 22.3% over 55 (doubled from 11.5% in 2003). 26% foreign-born workforce with ~25% undocumented, 33% of firms affected by immigration enforcement.

Two frequencies score STRAINED, two score VULNERABLE. The structural pattern: fragmented workforce dependency with compressed regulatory reach and unresolved fatal patterns.

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Sector Structural Profile

Construction encompasses general contracting and specialty trade work across residential, commercial, and heavy & civil engineering. Cross-sector infrastructure designation (not standalone CISA sector). Regulatory oversight spans OSHA, MSHA (tunneling), EPA, DOL, state labor agencies, and local building authorities. The sector employs 7.3 million workers across 801,000 establishments with median firm size 9 employees. Most fragmented of Tier 1 sectors. Structural Intelligence implications: published failures include Fern Hollow Bridge (January 2022, 10 killed, design and construction integration failure) and Francis Scott Key Bridge (March 2024, 6 killed, structural significance).

Workforce Fragmentation and Demographic Homogeneity

801,000 establishments averaging 9 employees with 90.9% under 20 workers. Most demographically homogeneous Tier 1 sector: 87.3% white, 11.2% female. Specialty contractor consolidation accelerating: 562 M&A transactions in 2025, 38.6% YoY increase. Top 50 firms hold 22–26% of segment revenue. Large firms absorb market share while establishments remain atomized. Union density 15.4% (2.6x private sector average) but concentrated in few regions and trades. ~25% undocumented workforce, 33% of construction firms affected by immigration enforcement actions. 26% of workforce foreign-born (3 million workers), specialty trades 45–61% foreign-born. The structural condition: workforce scattered across

801,000 establishments with concentrated demographic profiles and 25% undocumented status.

Aging Workforce and Retirement Cascade

Median age 41.2 years, 22.3% over 55 (doubled from 11.5% in 2003). 41% expected to retire by 2031. 200,000 active apprentices with only 25% completion rate and 40%+ cancellation. Union apprenticeship programs achieve 47% completion vs. employer programs 30%. 439,000–723,000 additional workers needed annually. 92% of firms report difficulty hiring. The structural condition: acute aging concentration with inadequate replacement pipeline and no recovery mechanism for lost knowledge.

Four Frequency Assessment

Thinness: Structural Slack and Capacity

STRAINED -- Specialty contractor consolidation concentrates market while atomized establishments reduce distributed capacity.

801,000 establishments with 90.9% under 20 workers distribute workforce thinly. M&A consolidation (38.6% YoY, 562 transactions 2025) concentrates market: top 50 firms hold 22–26% of segment revenue. Specialty contractor functions consolidate to fewer firms while general contractor establishments remain atomized. Result: market consolidation in select functions with structural slack eliminated at transaction volume level but not functionally distributed. The structural condition: capacity thinness masked by workforce count until consolidation reduces redundancy at specialty trade level.

Permission: Decision Authority and Governance

STRAINED -- OSHA inspection frequency cannot reach establishments, union density limits distributed voice.

OSHA inspects 4% of establishments annually (once every 25 years). 31,700 inspections, $127.4M in penalties. Fall protection #1 violation for 14 consecutive years with 6,500+ citations indicating persistent non-compliance. Union density 15.4% (2.6x private sector average) but concentrated in subset of regions and trades, leaving 84.6% non-union without distributed safety voice. ~25% undocumented workforce with constrained ability to report violations without risk of deportation. 33% of firms affected by immigration enforcement actions, reducing employee willingness to raise safety concerns. Board composition at large firms shows concentrated inside directors. The structural condition: regulatory authority cannot reach 96% of establishments annually, workforce voice mechanisms limited by immigration status.

Management: Safety Systems and Operational Intelligence

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VULNERABLE -- Fatality patterns unchanged despite decades of fall protection focus and intervention.

1,032 fatalities in 2024, highest private industry. On-site fatality rate 9.2/100K (3.8x national average). Fatal Four: falls 38% (391), struck-by 24% (247), electrocutions 8% (82), caught-in 5% (51) = 60%+ of all fatalities. Fall protection #1 OSHA violation for 14 consecutive years (unchanged since 2011). Fern Hollow Bridge (January 2022, 10 fatalities, design-construction integration failure). Francis Scott Key Bridge (March 2024, 6 fatalities, structural integrity). Management systems present (injury reporting, incident investigation) but signal interpretation systematized toward liability containment rather than corrective action velocity. The structural condition: safety intelligence present, corrective action delayed or reframed as acceptable cost of operations.

Absence: Knowledge Continuity and Skill Pipeline

VULNERABLE -- Critical construction knowledge departing faster than apprenticeship pipeline can restore it.

Median age 41.2 years (3.2 above all-industry average). 22.3% over 55 (doubled from 11.5% in 2003). 41% expected to retire by 2031. 200,000 active apprentices, 25% completion, 40%+ cancellation. Union programs 47% completion vs. employer programs 30%. 439,000–723,000 workers needed annually, 92% of firms report difficulty hiring. 26% foreign-born workforce with specialty trades 45–61% foreign-born dependency. Immigration enforcement actions affect 33% of firms. The structural condition: knowledge exit is permanent in trades where apprentices drop out or leave sector entirely. Foreign-born workers carry specialized knowledge (concrete finishing, masonry, framing). Deportation or enforcement actions eliminate knowledge without training transfer.

Federal Data Evidence Base

This assessment draws on 13 federal data metrics from BLS, OSHA, SEC, Census, and DOL sources. The metrics below provide measurement points for the structural conditions described in the Four Frequency Assessment above.

Source	Metric	Current Value	Structural Signal
Census	Total establishments	801,000	Highly fragmented sector structure
Census	Avg establishment size	9 employees	Median firm has 5–10 workers
Census	Firms under 20 workers	90.9%	Distributed capacity, limited redundancy
BLS	Demographic homogeneity (white)	87.3%	Most homogeneous Tier 1 sector
BLS	Female workforce	11.2%	Lowest gender diversity among sectors

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M&A Data	Specialty contractor consolidation (8.6%)	38% increase	Market concentration acceleration
M&A Data	M&A transactions (2025)	562 deals	Peak consolidation activity
Census/SEC	Top 50 firms market concentration	22–26%	Oligopolistic specialty trade control
BLS	Median age	41.2 years	3.2 years above all-industry avg
BLS	Workforce over 55	22.3%	Doubled from 11.5% in 2003
BLS	Expected retirements by 2031	41%	Majority of experienced workforce
BLS	Apprentice completion rate	25%	75% attrition or cancellation
BLS	Annual worker shortage	439K–723K	Structural replacement gap
OSHA	Annual inspection rate	4% (once/25 years)	Regulatory reach compressed
OSHA	2024 fatalities	1,032	Highest private industry
OSHA	On-site fatality rate per 100K	9.2	3.8x national average
OSHA	Fall violations (14 consecutive years)	6,500+ citations	Persistent non-compliance pattern
Census	Foreign-born workforce	26% (3M workers)	Specialty trades 45–61%
Census/DHS	Undocumented workforce estimate	≈25%	Immigration enforcement exposure

Sources: BLS (QCEW, JOLTS, SOII, CFOI), OSHA, SEC 10-K filings, U.S. Census Bureau (annual survey of construction), DOL apprenticeship data, DHS, Associated General Contractors of America.

Structural Risk Scenarios

The Four Frequencies assessment reveals structural patterns, not event predictions. These scenarios describe how the measured conditions interact under stress. Whether a specific organization experiences them depends on its internal structural profile.

Scenario 1: Immigration Enforcement Action Removes 25% of Workforce While Replacement Apprentices Cancel

Stress event: ICE enforcement action or workplace verification raid at major specialty contractor. Structural condition: ~25% undocumented workforce, 33% of firms affected by immigration enforcement, specialty trades 45–61% foreign-born. Absence VULNERABLE means imported knowledge departs without transfer. Thinness STRAINED and M&A consolidation mean losing 25% workforce reduces project execution capacity. Outcome: Specialized trades halted immediately. General contractors cannot backfill from 439,000–723,000 annual shortage. Simultaneously, apprentice cancellation rate 40%+ means

training programs cannot absorb acceleration demand. Recovery timeline extends from weeks to months.

Scenario 2: Fatality Cluster at Major Project Triggers Inspection Surge While Experienced Workers Retire

Stress event: Multiple fatalities on large commercial or heavy & civil project, triggering OSHA enforcement surge. Structural condition: 1,032 fatalities in 2024, fall protection #1 violation 14 consecutive years, Fern Hollow and Francis Scott Key precedent. Management VULNERABLE means fatal pattern persists despite intervention. Absence VULNERABLE means 22.3% over 55 (doubled from 2003), 41% retiring by 2031. Outcome: OSHA increases inspection intensity, requiring experienced crew leaders and safety managers to manage compliance. Simultaneously, experienced workers exit (retirement acceleration following fatality event). Project timeline extends while organization rebuilds safety competence with junior staff. Fatality cascade risk increases as less-experienced crews manage hazard-intensive work.

Scenario 3: M&A Integration Eliminates Distributed Regional Safety Culture While Labor Shortage Prevents Backfill

Stress event: Large regional specialty contractor acquired by national consolidator pursuing cost reduction. Structural condition: M&A 38.6% YoY (562 transactions 2025), top 50 firms consolidate to 22–26% market concentration. Thinness STRAINED means consolidation eliminates redundant functions. Permission STRAINED means union density 15.4% concentrated regionally. Outcome: Acquisition standardizes safety protocols, eliminating regional-specific safety culture. Regional experienced workers exit post-merger downsizing or in response to cultural consolidation. Acquisitor cannot backfill from 439,000–723,000 annual shortage because supply flows to immediate demand. Regional project capacity contracts as safety violations cluster during organizational learning curve. Apprentice dropout 40%+ compounds because younger workers perceive culture shift as signal to exit construction.

Each scenario describes a pattern measurable in sector data today. Whether a specific organization experiences it depends on its internal structural profile.

The Diagnostic Gap

This brief assesses structural conditions visible from federal data and public sources. The Four Frequencies framework measures 20 dimensions. Fifteen are assessable from public data. Five require diagnostic access to an organization's internal structural patterns through behavioral intelligence from raters inside the organization.

What Public Data Reveals (15 Dimensions)

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The 15 public dimensions capture sector-level structural conditions: workforce fragmentation and demographic homogeneity, specialty contractor consolidation, aging workforce and retirement pipeline, OSHA inspection frequency, fatality rate persistence, and immigration enforcement exposure. These are the dimensions scored in this brief. They describe the structural environment that every organization in construction inhabits.

What Requires Diagnostic Access (8 Dimensions)

T2 Substitution Readiness

Whether specialty trade functions continue when experienced workers retire or depart. Federal data shows 22.3% over 55, 25% apprentice completion, 40%+ cancellation. It cannot assess whether your specific crews have cross-trained backup workers or documented procedures for knowledge transfer before departure.

T4 Recovery Architecture

How fast crew composition recovers after worker departure, immigration enforcement action, or project fatality. Sector data shows ~25% undocumented workforce and 92% of firms report hiring difficulty. It cannot measure whether your organization has pre-planned crew reconstitution, cross-training sequencing, or alternative supplier arrangements.

P2 Decision Velocity

How fast safety violations trigger work stoppage rather than deferral. OSHA inspection rate 4% annually and fall protection #1 violation for 14 consecutive years indicate systemic non-compliance. It cannot assess whether your organization halts work when safety signals indicate risk or whether schedule pressure overrides safety response velocity.

P3 Override Patterns

Whether schedule pressure, cost targets, or client demands override safety protocols. 1,032 fatalities with 9.2/100K rate and Fatal Four unchanged for 14 years indicate systematic override. It cannot identify whether your organization's culture sustains safety when project pressure mounts.

P4 Escalation Integrity

Whether safety and operational concerns from frontline workers and crew leaders actually reach decision-makers with sufficient force to halt work. Demographic homogeneity (87.3% white, 11.2% female) and undocumented worker constraints suggest limited distributed voices. It cannot identify which concerns reach leadership in your organization.

P5 Boundary Enforcement

Whether quality limits and safety boundaries hold under deadline or cost pressure. With ~25% undocumented workforce constrained from reporting and OSHA reaching 4% annually, boundary enforcement is externally weakened. It cannot measure whether your organization maintains internal quality and safety limits independent of external enforcement gaps.

M2 Channel Integrity

Whether information from field hazards, crew concerns, and equipment failures actually reaches general contractors and project managers in real time or gets reinterpreted/delayed. With 801,000 atomized establishments and 90.9% under 20 workers, communication channels are locally fragmented. It cannot assess whether your specific information architecture reliably transmits field hazards to decision-makers.

M3 Noise Ratio

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Whether safety signals stand out against compliance documentation volume. Management systems present (incident logs, near-misses, inspections) but signal interpretation directed toward liability containment rather than corrective action. It cannot measure the signal-to-noise ratio in your specific safety and operational intelligence systems.

The gap between what is publicly visible and what is structurally real is where organizational risk lives. The brief tells you the sector weather. The diagnostic tells you whether your crews can hold.

Methodology

The Four Frequencies framework measures structural resilience across four dimensions: Thinness (depth of critical capacity), Permission (distribution of decision authority), Management (quality of information systems and operational responsiveness), and Absence (gaps in critical functions and their consequences). Each frequency is assessed across five dimensions, for a total of twenty structural measurements.

Sector-level assessments draw on federal data mapped to the fifteen publicly-measurable dimensions. Organization-level diagnostics add behavioral intelligence from internal raters to score all twenty dimensions. The combination produces the Structural Resilience Index (SRI), a composite score calibrated to a six-band severity scale.

Severity terminology: RESILIENT (structural depth across all frequencies), STABLE (adequate structural capacity with minor gaps), STRAINED (measurable structural pressure in one or more frequencies), VULNERABLE (significant structural gaps with compounding risk), FRAGILE (structural conditions that amplify disruption), CRITICAL (structural failure in progress or imminent).

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What This Means for Your Organization

This brief describes the structural environment your organization operates inside. Whether these sector-level conditions are amplified or mitigated within your specific organization depends on your internal structural profile.

The Four Frequencies diagnostic measures all 20 dimensions for a single organization, producing a 40-page structural analysis with the Structural Resilience Index.

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About S.J. Bridger

S.J. Bridger is a structural resilience diagnostics practice. We analyze the structural conditions that determine whether organizations hold together when key people leave, when systems fail, and when the relationships that carried institutional knowledge disappear. The Four Frequencies framework was developed through forensic analysis of organizational failures across multiple sectors and refined through diagnostic engagements that measure what traditional assessments miss.

Structural Intelligence Briefs are published assessments of sector-level conditions. They are updated quarterly as federal data sources release new information. The Construction brief joins the Manufacturing and Energy/Mining briefs in a series covering all CISA critical infrastructure sectors.

DISCLAIMER: This Structural Intelligence Brief is a sector-level structural assessment based on publicly available federal data and the Four Frequencies analytical framework. It does not constitute advice to any specific organization. It does not establish a consulting engagement, advisory relationship, or professional obligation between S.J. Bridger and any reader or recipient.

Sector-level structural conditions described in this brief may or may not apply to any individual organization within the construction sector. Organizational structural profiles vary based on internal conditions that are measurable only through diagnostic engagement. Decisions regarding organizational strategy, workforce planning, risk management, or any other operational matter should not be based solely on the sector-level findings in this document.

The severity scores, structural risk scenarios, and analytical observations in this brief reflect conditions as of the publication date. Federal data sources update at varying intervals. This brief will be updated quarterly. Prior versions should not be relied upon after a subsequent version has been published.

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