Critical Infrastructure Needs Controlled Material Decisions.

A strategic technical white paper on Steelike UHPC for validated deployment, lifecycle extension, resilience-focused infrastructure decisions, and controlled protection concepts across land, energy, coastal and subsea-critical assets.

Performance matters. Validation decides.

Contents

Structure of the technical white paper for controlled Steelike UHPC deployment in high-consequence critical infrastructure assets.

> **Not every repair needs Steelike UHPC. But every material decision in critical infrastructure needs discipline, validation and controlled specification.**

Controlled material decision chain

Asset risk -> material role -> validation route -> execution control -> acceptance evidence -> lifecycle governance

This process connects engineering judgement, project-specific evidence and long-term infrastructure responsibility.

Controlled material decisions connect asset risk, engineering validation and long-term infrastructure governance.

1. Executive Summary

Critical infrastructure is not ordinary civil inventory. Bridges, tunnels, airports, logistics corridors, ports, energy facilities, substations, transformer yards, subsea pipelines, power cables, data cables and coastal landing zones are continuity systems.

When these assets degrade or are damaged, the problem is rarely limited to a local defect. A weakened bridge zone, exposed cable interface, pipeline protection failure, transformer outage, or damaged access node can become a broader issue of continuity, safety, operations, and governance.

For this reason, material decisions in critical infrastructure require a higher level of discipline. The question is not only whether a material can achieve high mechanical performance. The question is whether it can support the asset's operational role, exposure conditions, installation method, maintenance strategy, validation route and lifecycle responsibility.

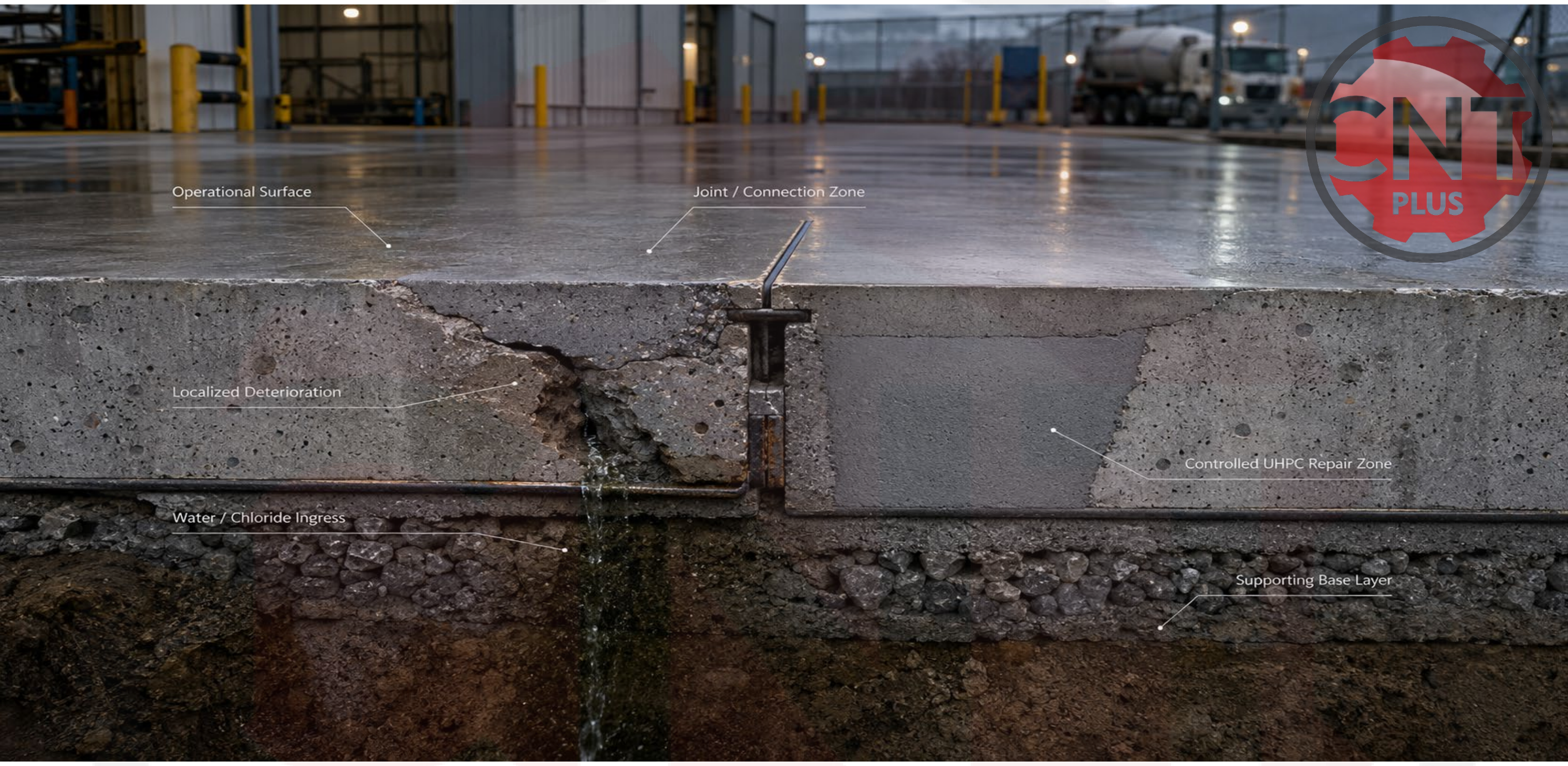
CNT Plus, powered by STEELIKE, positions Steelike UHPC Composite as a targeted Ultra-High-Performance Composite system for durability-led rehabilitation, lifecycle extension, rapid return-to-service logic, local hardening and resilience-focused infrastructure deployment.

This white paper presents a decision framework for evaluating where Steelike UHPC Composite may deliver measurable infrastructure value in visible and hidden continuity systems, including transport, energy, utility, coastal and subsea-adjacent assets.

The objective is not universal adoption. The objective is controlled, evidence-based deployment.

<u>Core message</u>
Critical infrastructure does not need stronger material claims alone. It needs controlled material decisions, a defined role, documented evidence, validated execution and owner-approved acceptance criteria.

2. The Infrastructure Problem: Critical Assets Are High-Consequence Systems



Critical infrastructure assets are not only physical structures. They are operating systems for mobility, energy, logistics, defence readiness, digital communication, industrial production, public services and emergency response.

Critical infrastructure is also not limited to visible civil assets such as bridges, tunnels, roads, airports and logistics corridors. It includes hidden and exposed continuity systems: subsea pipelines, power cables, data cables, coastal landing zones, energy substations, transformer stations, industrial utility corridors and transfer nodes.

A bridge is not only a bridge when it carries a strategic corridor. A tunnel is not only a tunnel when it controls access to a port, airport or energy asset. A subsea cable is not only a cable when it supports power transfer, data continuity or interconnector capacity. A transformer yard is not only a fenced technical site, but also one where an outage can affect public services, industrial operations and emergency response.

In ordinary infrastructure, a defect may be treated as a local maintenance issue. In critical infrastructure, the same defect can create access restrictions, service interruption, safety exposure, repair-window pressure, public accountability and lifecycle risk.

This is why material decisions for high-consequence assets cannot be based solely on unit cost, generic strength, standard repair habit or short-term procurement logic.

A controlled material decision starts with the consequence of failure, the exposure mechanism and the required infrastructure function, not only with the specification sheet.

Why high-consequence assets require a different material decision model

Ordinary repair logic	Critical infrastructure decision logic
Restore local geometry	Protect operational availability
Compare the initial repair cost	Compare lifecycle value and downtime exposure
Select based on familiar material class	Select based on validated role and acceptance criteria
Focus on strength at handover	Focus on durability, interface, execution and service interval
Treat repair as a technical task	Treat repair as a risk, continuity and governance decision

Core message

In critical infrastructure, material selection is not only a technical choice. It is a risk decision that must connect asset consequence, exposure, execution control, validation and lifecycle responsibility.

3. Why Conventional Material Decision Logic Struggles

Sometimes, the first thing to break is not the concrete. It is the old decision logic behind the repair.

Conventional repair materials can be suitable for ordinary maintenance, moderate exposure and low-consequence assets. They are familiar, widely available and often cost-effective at installation.

Critical infrastructure operates under a different standard.

For high-consequence assets, the repair decision cannot be based solely on the familiar material class, initial cost, nominal strength, or short-term availability. Bridges, tunnels, airfield pavements, energy facilities, industrial assets, logistics corridors, and dual-use infrastructure are exposed to conditions in which repeated repair cycles, downtime, and premature degradation can have consequences far beyond the repair zone.

In this context, conventional materials may restore local geometry but fail to deliver the long lifespan required by the asset. They may meet a basic strength requirement, but remain vulnerable to ingress, cracking, abrasion, freeze-thaw exposure, chloride attack, interface weakness or repeated operational loading.

This is where Steelike UHPC Composite becomes relevant.

Steelike UHPC Composite is positioned as an Ultra High Performance Composite system for targeted use in infrastructure zones where durability, low ingress, high mechanical performance, bond potential, validated reopening logic and lifecycle extension are essential to the engineering case. Its value is not only higher strength. Its value lies in the ability to support a longer service interval, reduce repair-cycle burden, and improve confidence in asset availability when properly designed, validated, and executed.

Evidence note: *FHWA describes UHPC as a fibre-reinforced cementitious composite with mechanical and durability properties suited to infrastructure deterioration, repair and replacement, including reduced liquid ingress. NMSU research on bridge deck overlays notes that common overlay options can face service-life, chloride permeability, cost, or availability limitations, and that UHPC may increase overlay service life and reduce maintenance costs. Steelike and* ***CNT Plus*** *documentation records Steelike-specific data, such as an average compressive strength of 157.5 MPa for* ***CNT Plus****-tested samples, approximately 1.31% water absorption, and a testing scope that includes chloride permeability, freeze-thaw, abrasion, bond, and surface resistivity.*

Can this material extend the asset's useful life, reduce the risk of future intervention, and meet the acceptance criteria required by this project?

From conventional repair logic to UHPC-based lifecycle thinking

Conventional material logic	Steelike UHPC decision logic
Restore the damaged area	Extend the service life of the critical zone
Focus on the initial repair cost	Evaluate lifecycle value and reduced intervention burden
Meet basic strength requirements	Validate strength, durability, ingress resistance and interface performance
Treat repair as a local task	Treat repair as part of asset continuity and resilience planning
Accept recurring maintenance cycles	Target a longer lifespan and fewer disruptive repair campaigns

Core message
For ordinary repairs, conventional materials may be sufficient. For critical infrastructure, sufficiency is not enough. Steelike UHPC should be assessed as a targeted high-performance solution for long-lifespan, durability-led rehabilitation and controlled lifecycle extension.

Page references: FHWA Design and Construction of Field-Cast UHPC Connections, FHWA-HRT-14-084 / FHWA-HRT-19-011. New Mexico State University / Tran-SET, Bridge Deck Overlays Using Ultra-High Performance Concrete, 2018. ***CNT Plus*** *// Steelike documentation is summarised in Appendix A of this Critical Infrastructure White Paper.*

4. Controlled Material Decisions: A Different Decision Model

A controlled material decision is not a product preference. It is an engineering and governance process.

In critical infrastructure, material selection should not start with what is familiar, available or cheapest at the point of installation. It should start with the consequences of the asset, the degradation risk, the required service life, and the level of confidence required before the asset returns to operation.

This changes the decision model. For ordinary repairs, the process often begins with the visible defect and the repair product. For critical infrastructure, the process must begin with the asset's function. What happens if a bridge lane remains closed? What happens if a tunnel section requires repeated intervention? What happens if an airfield pavement, energy facility, logistics corridor or dual-use route cannot be restored quickly and predictably?

Only after those questions are understood should the material be evaluated.

Steelike UHPC Composite becomes relevant where the required material role is directly connected to durability, long lifespan, reduced ingress, high mechanical performance, interface reliability, validated return-to-service criteria, lifecycle extension and ECO logic based on reduced repair-cycle burden. Its value is not only that it can achieve high performance. Its value is that when properly specified and validated, it can support a more resilient material decision for assets where failure, downtime, or repeated repair cycles have wider consequences.

But even high-performance materials require discipline. The material role must be defined. The exposure must be understood. The substrate must be assessed. The interface must be designed. The execution method must be realistic. Tests must be selected before work begins. The reopening criteria must be clear. The approval path must be documented.

The purpose of controlled material decisions is not to make every project more complex. The purpose is to prevent high-consequence infrastructure from being treated as ordinary repair work.

Controlled Material Decision Model

Decision step	Why it matters
Asset consequence	Defines what is at risk if the asset fails, degrades or remains unavailable.
Material role	Clarifies whether Steelike UHPC is acting as a repair layer, overlay, strengthening layer, protective layer, joint system, panel or structural component.
Exposure and degradation drivers	Identifies chloride exposure, moisture, freeze-thaw, abrasion, impact, chemical exposure, fatigue or heavy operational loading.
Substrate and interface	Determines whether the existing asset can support a durable and integrated UHPC intervention.
Execution method	Controls mixing, placement, curing, access, sequencing, weather conditions, safety and site constraints.

Decision step	Why it matters
Testing and QA/QC	Connects performance requirements to evidence, mock-ups, site testing and acceptance checks.
Approval and acceptance criteria	Defines who signs off the work, when the asset can reopen and what evidence is required.
Lifecycle governance	Links the intervention to service interval, inspection planning, maintenance strategy and long-term asset value.

Decision pathway

Asset Consequence > Material Role > Exposure > Interface > Execution > Testing > Approval > Lifecycle Governance

> **Core message**
> A controlled material decision asks more than whether a material can perform. It asks whether the material can perform the right role, in the right location, under the right execution conditions, with the right evidence and the right acceptance route.

5. Material Logic: Where Steelike UHPC Composite Becomes Relevant

Strategic premise

For many critical infrastructure questions, the answer is not another conventional repair material. It is a controlled material decision supported by a market-available Ultra High Performance Composite platform capable of combining strength, durability, low ingress, interface performance, deployability, and long-lifespan logic when properly designed, validated, and executed.

For years, infrastructure owners and engineers have been asking the same difficult questions. How can a degraded asset be kept in service longer? How can repairs be completed with less downtime? How can repeated intervention cycles be reduced? How can vulnerable interfaces be protected when the consequences of failure are high?

In many cases, the problem is not solved by selecting another conventional repair material. It requires a more disciplined material role: structural, protective, interface-related, containment-related, rehabilitation-focused or lifecycle-driven.

This is where Steelike UHPC Composite becomes relevant.

Steelike UHPC Composite, represented in the EU by ***CNT Plus*** powered by STEELIKE, should be understood as a market-available Ultra-High-Performance Composite system for targeted use in infrastructure zones where conventional material logic may struggle with durability, ingress, abrasion, bond, return-to-service time, or protection of vulnerable nodes.

The same material logic may apply differently across bridge overlays, tunnel interfaces, coastal structures, subsea-adjacent protection zones, pipeline corridors, cable landing areas, energy substations and transformer protection zones. The asset category alone does not define relevance; the required function does.

The documented Steelike and ***CNT Plus*** data support this high-performance positioning. Available documentation indicates Steelike and ***CNT Plus***-specific performance evidence, including high compressive strength, low absorption, chloride-related performance, freeze-thaw resistance, abrasion resistance, bond-related testing and other material data. These results should remain separate from general UHPC literature and verified against current ***CNT Plus*** / Steelike documentation before specification.

This does not mean that every critical asset requires Steelike UHPC Composite. It means that where the consequences of failure are high, the material decision should be connected to exposure, degradation mechanisms, operational downtime, execution control, and validation evidence.

Performance logic for critical infrastructure

Steelike UHPC capability	Why it matters	Infrastructure value
High compressive strength	Supports high-load, thin-section and strengthening applications when properly designed.	Enables targeted rehabilitation of slabs, overlays, bridge elements and load-transfer areas.
Low absorption	Limits moisture uptake in exposed or cyclic environments.	Supports durability in freeze-thaw, wet-dry and aggressive exposure conditions.
Chloride resistance / low ingress logic	Reduces pathways for chloride and contaminant movement.	Supports longer service intervals in bridges, coastal assets, parking structures and transport infrastructure.
Abrasion, freeze-thaw and scaling test scope	Addresses surface wear and environmental durability drivers.	Relevant for airfield areas, industrial floors, logistics corridors, ramps and exposed surfaces.
Bond and pull-off test scope	Critical where UHPC is applied to an existing substrate.	Helps assess whether rehabilitation behaves as an integrated system rather than a surface patch.
Rapid deployment and lifecycle logic	Shorter closure windows and reduced repair cycles matter where downtime is expensive.	Supports bridges, airports, energy assets, logistics routes, retrofit-before-replacement and ECO logic.

Core message

Steelike UHPC is not the answer because it is simply stronger. It becomes the answer when critical infrastructure requires a controlled combination of strength, durability, low ingress, interface performance, deployability, and long-life logic within a single, market-available technology platform.

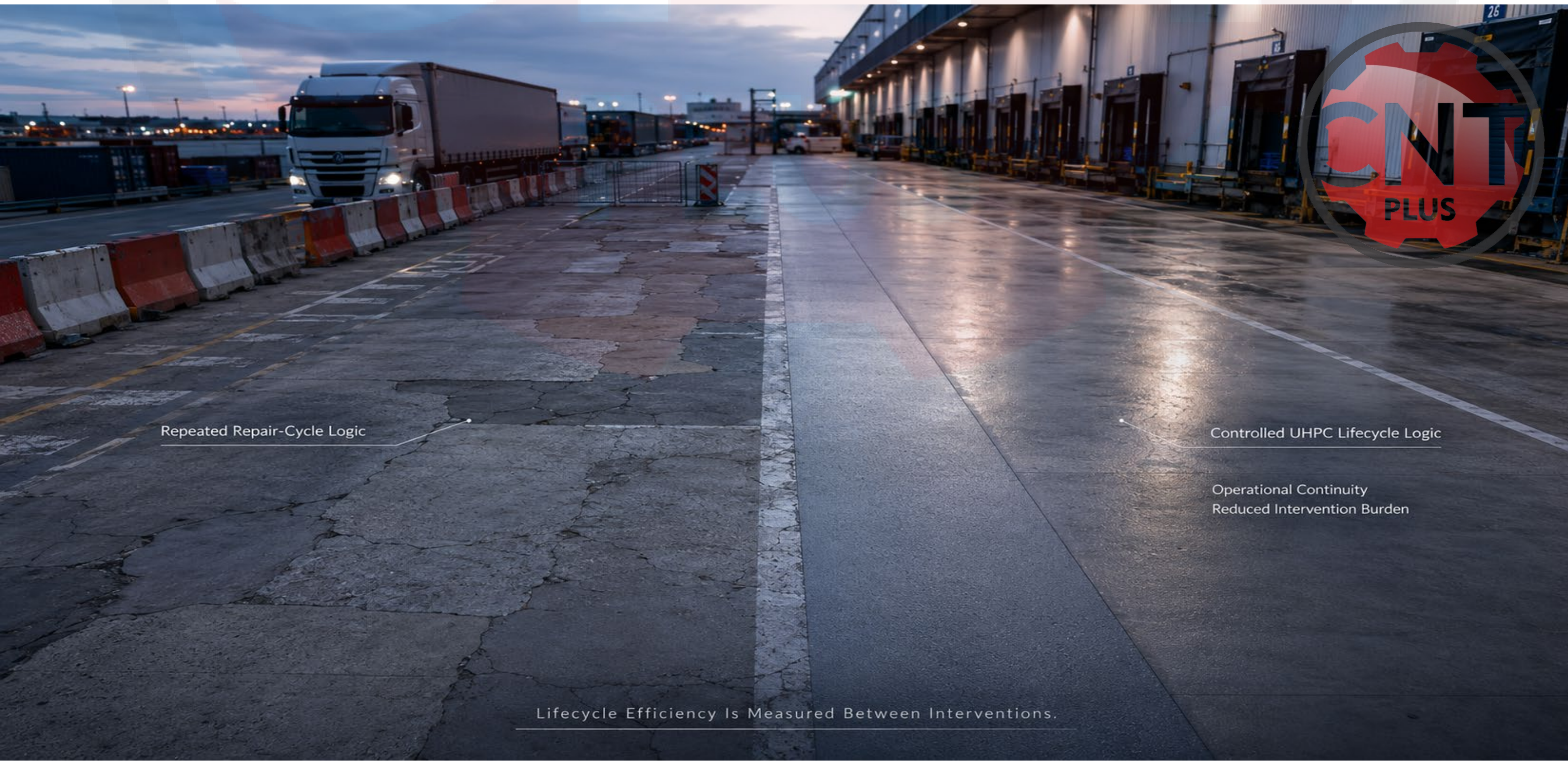
Evidence note

Steelike UHPC performance claims in this white paper should be tied to ***CNT Plus*** and Steelike documentation, including compressive strength, absorption, chloride permeability and durability-related test scope. General UHPC literature supports the broader category logic, but should not be used to transfer non-Steelike performance claims onto Steelike UHPC without project-specific validation.

---

6. ECO Logic: Lifecycle Efficiency, Not Generic Green Claims

In critical infrastructure, ECO is not a label. ECO is a lifecycle decision.



Infrastructure owners, public authorities, defence organisations and international institutions are under pressure to reduce environmental impact, improve resilience and justify material choices on the basis of long-term value. UNEP promotes integrated, systems-level sustainable infrastructure, while the OECD links infrastructure governance with resilience, long-term value and public-sector decision quality.

The same direction is visible in the security, transport, and resilience policies. NATO has adopted climate change and security as part of its strategic agenda. The European Commission Sustainable and Smart Mobility Strategy points toward a green, digital and more resilient transport system. The World Bank and GFDRR reported an estimated USD 4.2 trillion net benefit from investing in more resilient infrastructure, with approximately USD 4 in benefit for each USD 1 invested.

The ECO logic of Steelike UHPC should therefore be positioned carefully and confidently. It is not a generic green claim. It is a lifecycle argument based on longer service intervals, reduced repair-cycle burden, targeted rehabilitation, retrofit-before-replacement logic and improved asset availability when properly designed, validated and executed.

A material is not meaningfully ECO if it enables a repair today but contributes to repeated demolition, repeated mobilisation, repeated closures, traffic disruption and premature replacement tomorrow. The environmental cost of infrastructure is also driven by poor durability, emergency maintenance, replacement works, and loss of asset availability.

Steelike UHPC is presented here as an Ultra High Performance Composite technology platform that may support ECO objectives, provided project-specific validation confirms that higher durability, lower ingress, lower absorption, long lifespan, and reduced intervention frequency can improve lifecycle performance.

The critical sustainability question is:

Can the material extend useful life, reduce repeat repair cycles, avoid premature replacement and support operational continuity with documented performance evidence?

ECO logic for Steelike UHPC

ECO dimension	What it means	Critical infrastructure relevance
Long lifespan	Longer service intervals where the application is properly designed and validated.	Fewer repair campaigns and lower disruption over the asset lifecycle.
Reduced repair-cycle burden	Less repeated demolition, mobilisation, access restriction and reinstatement.	Lower maintenance burden and reduced operational interruption.
Material efficiency	High performance may support targeted or thinner-section applications where engineered.	Potential reduction of material volume in selected designs.
Retrofit before replacement	Extend the useful life of existing assets instead of full demolition or replacement.	Supports circular infrastructure logic and asset preservation.
Operational continuity	Shorter or fewer closures can reduce disruption to transport, logistics, energy and public services.	Sustainability value is linked to reduced interruption and system resilience.
Documented validation	ECO claims should be connected to data, assumptions and project-specific acceptance criteria.	Protects the owner, engineer and supplier from unsupported sustainability claims.

Evidence note

UNEP, OECD, NATO, the European Commission and the World Bank point in the same direction: infrastructure decisions are increasingly evaluated in terms of resilience, lifecycle performance, sustainability and continuity. For Steelike UHPC, the ECO argument should be tied to measurable project assumptions, documented material performance, lifecycle logic and project-specific validation.

Source links: UNEP | OECD | NATO | European Commission | World Bank

Core message: The ECO logic of Steelike UHPC is not a slogan. It is a lifecycle argument: extend asset life, reduce repeated interventions, use high performance where it matters and avoid premature replacement where validated retrofit can deliver measurable value.

7. Priority Critical Infrastructure Scenarios

Priority critical infrastructure scenarios should be assessed by consequence, exposure and operational continuity, not only by asset category. Steelike UHPC Composite should not be considered a universal material for every repair. Its strongest relevance appears where asset consequence, exposure severity, access constraints, downtime pressure and lifecycle risk justify a controlled high-performance material assessment.

This includes visible infrastructure such as bridges, tunnels, ports, airports, and logistics corridors, as well as less visible systems such as subsea pipelines, power cables, data cables, cable landing zones, utility corridors, substations, and transformer protection zones.

The following scenarios do not represent automatic applications. They identify areas where a controlled Steelike UHPC Composite assessment may be justified, subject to engineering validation, owner acceptance and project-specific specification.

For ***CNT Plus*** powered by STEELIKE, the implication is clear. Critical infrastructure is no longer evaluated only as a civil asset. It is evaluated as an operational continuity system, where resilience, lifecycle responsibility and validated deployment matter as much as initial repair cost.

Priority scenarios for technical assessment

Infrastructure scenario	Critical risk	Where Steelike UHPC may be relevant
Bridges and viaducts	Chloride exposure, freeze-thaw, fatigue, joint deterioration, deck wear, lane closures and military mobility constraints.	Thin-section overlays, deck rehabilitation, joint zones, edge beams, local strengthening, durability-led repair and strategic route resilience.
Tunnels and underground infrastructure	Moisture, abrasion, access constraints, safety restrictions, difficult repair windows and continuity risk.	Technical floors, walls, portals, local strengthening, protective layers and time-sensitive repair zones are subject to project-specific acceptance criteria.
Airports and airfield infrastructure	High downtime consequence, concentrated wheel loads, abrasion, impact and strict reopening windows.	Aprons, taxiways, service zones, local slab repairs, validated return-to-service interventions and high-load transfer areas.
Energy substations and transformer protection zones	Continuity risk, exposed equipment, transformer outage consequence, local mechanical damage, flying debris, vandalism, unauthorised access and selected drone-related risk scenarios.	Engineered shielding elements, protective walls, equipment screens, transformer-area barriers, cable-entry protection, local enclosure systems and other controlled protection concepts, subject to threat assessment and validation.
Strategic roads and logistics corridors	Mobility disruption, heavy traffic, route dependency, repeated maintenance burden and defence-readiness implications.	Critical slabs, bridge approaches, ramps, load-transfer zones, overlays and time-sensitive repair sections with defined acceptance criteria.
Industrial and high-load facilities	Abrasion, impact, point loads, chemical exposure and production downtime.	Industrial floors, machinery foundations, loading bays, protective overlays and repair of high-wear zones.
Urban critical infrastructure	Service disruption, limited access, public safety, constrained construction windows and institutional accountability.	Transit assets, utility access structures, retaining elements, pedestrian or vehicle interfaces and targeted rehabilitation.
Dual-use and defence-adjacent infrastructure	Readiness, mobility, logistics continuity, energy security and high consequence of unavailability.	Routes, ramps, staging areas, logistics zones and protective hardening concepts, subject to project-specific testing and certification where required.
Subsea pipeline and cable corridor protection	Abrasion, impact, scour effects, seabed movement, anchor drag, fishing gear interaction, accidental mechanical damage, leakage-control interfaces and difficult access for repair.	Protective covers, localised hardening elements, transition-zone reinforcement, repair of exposed concrete interfaces, containment-related components and durable protective systems around vulnerable pipeline or cable corridors.

7.1 Subsea Pipeline and Cable Corridor Protection

Critical infrastructure does not stop at the shoreline. Subsea pipelines, power cables, data cables and coastal landing zones are continuity-critical systems. They support energy transfer, offshore production, interconnector networks, digital communication, industrial operations and public-sector resilience.

Figure 1. Shore landing and coastal transition protection concept. Conceptual Steelike UHPC protective arrangement for the critical transition zone between subsea pipeline, power cable or data cable corridors and land-based infrastructure. Final geometry, cover thickness, bedding layer, installation method and acceptance criteria require project-specific engineering review and validation.

These systems may be exposed to abrasion, impact, local degradation, scour effects, seabed movement, anchor drag, fishing gear interaction, accidental mechanical damage, and deterioration at transition zones between the seabed, coastal, and land-based infrastructure.

For subsea and coastal-adjacent infrastructure, the material challenge is often not only structural capacity. It is also protection, durability, interface control and lifecycle reliability in aggressive or difficult-to-access environments.

Steelike UHPC Composite may be considered for selected protective, containment, interface-reinforcement, or rehabilitation roles where high durability, low absorption, bond performance, abrasion resistance, and controlled execution are relevant. Potential applications may include protective covers, localised hardening elements, transition-zone reinforcement, repair of exposed concrete interfaces, containment-related components and durable protective systems around vulnerable pipeline or cable corridors.

In pipeline-related environments, protective concepts may also support risk reduction around local leakage-control zones, containment interfaces or exposed technical nodes. Such applications require specific engineering review and cannot be treated as generic repair work.

Any use in subsea, coastal, or transmission-corridor environments requires project-specific validation, exposure assessment, installation-method review, hydraulic and mechanical loading analysis, where relevant, and acceptance criteria agreed with the asset owner, designer, and competent authorities.

7.2 Energy Substations and Transformer Protection Zones

Electrical substations, transformer yards and grid transfer nodes are high-consequence infrastructure assets. Their operational value is not limited to the equipment inside the fence. They support energy continuity, industrial production, public services, transport systems, data infrastructure and emergency response capacity.

These sites may require protective hardening measures against accidental impacts, local mechanical damage, flying debris, unauthorised access, vandalism, and selected drone-related risk scenarios. In this context, Steelike UHPC Composite may be considered for engineered shielding elements, protective walls, equipment screens, transformer-area barriers, local enclosure systems and other controlled protection concepts.

This should not be presented as a generic anti-drone product, ballistic-certified system, blast-certified system or defence-certified solution unless project-specific testing and certification confirm that role. The correct positioning is an engineered protective hardening concept, subject to threat assessment, structural design, impact modelling, installation constraints, operational access requirements and project-specific validation.

Figure 2. Energy substation and transformer protection zone concept. Conceptual Steelike UHPC protective arrangement for continuity-critical transformer yards, including transformer-area barriers, equipment shielding panels, cable-entry protection, local enclosure systems and controlled maintenance access. Final geometry, protection assumptions, installation method and acceptance criteria require project-specific engineering review and validation.

For substations and transformer protection zones, the value of Steelike UHPC Composite may lie in its ability to combine high mechanical performance, durability, reduced maintenance exposure, compact protective geometry, and rapid deployment logic, all of which are essential when operational downtime must be minimised.

Potential use cases may include protective barriers around transformers, shielding panels for exposed equipment, hardening of technical rooms, local protection of cable entries, enclosure elements for vulnerable components and modular protection concepts for selected high-risk zones within the energy asset.

Visual integration captions

In the subsea and coastal infrastructure context, subsea cables, pipelines, and coastal transition zones are part of the same critical infrastructure system as bridges, roads, substations, and logistics corridors. Their protection requires controlled material decisions where access, downtime and failure consequences are high.

Pipeline and cable corridor protection: Pipeline and cable corridors may be exposed to abrasion, anchor drag, fishing gear interaction, seabed movement and local mechanical damage. Protective material concepts must be matched to the actual exposure, installation method and validation route.

Energy substation hardening context: Substations and transformer yards are continuity-critical energy nodes. Protective hardening concepts may include shielding elements, equipment screens, barriers and local enclosure systems, subject to threat assessment and engineering validation.

Evidence note

NATO, the European Commission, the U.S. Department of Defence and the UK Ministry of Defence all point to the same strategic reality: infrastructure is increasingly judged by resilience, continuity, climate adaptation, military mobility and lifecycle performance, not only by initial construction or repair costs.

Key references include:

NATO resilience and civil preparedness,
European Commission military mobility,
U.S. DoD 2024-2027 Climate Adaptation Plan
UK MOD Climate Change and Sustainability Strategic Approach.

Core message
Steelike UHPC becomes most relevant where the infrastructure question is not only "how do we repair this defect?" but "how do we extend the useful life of this critical asset, reduce future intervention risk and protect operational continuity?"

8. Controlled Specification Framework

High-performance materials do not fail only in laboratories. They fail in specification when their role, substrate, execution method and acceptance criteria are not controlled.

A Steelike UHPC application should not move into critical infrastructure specification because the material is strong, innovative or market-available. It should move forward only when the project team can define what the material is required to do, how the substrate will be prepared, how the interface will be verified, how placement and curing will be controlled, which tests will be accepted, and who will sign off on the asset before reopening or loading.

Controlled engineering review supporting project-specific specification, validation, execution control and lifecycle governance for Steelike UHPC.

This is where technical discipline matters. UHPC systems are not ordinary repair mortars. They are Ultra High Performance Composite technologies whose value depends on correct role definition, mix handling, fibre distribution, curing, bond, geometry, thickness, edge detailing, reinforcement interaction and site QA/QC.

Public UHPC guidance and bridge-sector research point in the same direction: UHPC deployment requires application-specific design, construction control, inspection and performance verification rather than generic product substitution. FHWA guidance on field-cast UHPC connections discusses material and construction specifications, including storage, formwork, mixing, in-field testing, placement and curing.

For engineers, this means the specification cannot be reduced to compressive strength. For decision-makers, it means Steelike UHPC Composite should be evaluated as a controlled infrastructure decision that integrates asset risk, technical evidence, execution confidence, lifecycle governance, and procurement accountability.

Controlled specification pathway: technical requirements, not a duplicate approval checklist

Specification step	Technical question	What must be controlled
1. Asset condition	What is the real condition of the asset?	Condition evidence, defect mechanism, geometry, access and repair history.
2. Exposure and degradation drivers	What is actively damaging the asset?	Exposure class, active ingress routes and relevant degradation mechanisms.
3. Operational criticality	What happens if the asset remains unavailable or fails again?	Downtime consequence, route dependency, safety, continuity and accountability.
4. Material role definition	What exactly must Steelike UHPC do?	Defined function: repair, overlay, strengthening, protection, joint, panel, wearing surface or structural component.
5. Product data alignment	Which Steelike UHPC data are relevant?	Current Steelike / ***CNT Plus*** evidence relevant to the defined role, verified before specification.
6. Substrate and interface design	Can the existing asset and the UHPC layer function as a single system?	Surface preparation, moisture condition, interface criteria, edge detailing, reinforcement interaction and compatibility.
7. Execution methodology	Can the material be reliably executed on site?	Method statement, batching, fibre dispersion, placement, finishing, curing, temperature limits and contingency controls.
8. Testing and QA/QC	What evidence proves the work is acceptable?	Trial batch or mock-up where required, sampling plan, test regime, inspection hold points and acceptance thresholds.
9. Reopening and loading criteria	When can the asset return to service?	Early-age evidence, load restrictions, curing assumptions, inspection records, engineer sign-off and owner approval.
10. Approval and handover	What documentation protects the decision?	Product data, method records, deviations, approvals, handover file and lifecycle assumptions.

Specification principle
Section 8 defines what the technical specification must control. It should remain concise: role, evidence, interface, execution, QA/QC, reopening criteria and handover.

Evidence note
Steelike and ***CNT Plus*** documentation provides the material-specific basis for Steelike UHPC positioning, including compressive strength values up to 168 MPa, water absorption of approximately 1.31 percent, chloride permeability data and durability-related test scope. These values must be checked against the latest ***CNT Plus*** / Steelike evidence package before use in specification, tender or procurement documents. General UHPC literature, including FHWA materials on field-cast UHPC connections, structural design with UHPC and the FHWA Structural Design with UHPC Workshop Manual, supports the broader principle that UHPC applications require design control, material characterisation, construction verification and project-specific acceptance rather than generic substitution.

Source references: FHWA field-cast UHPC connections | FHWA-HRT-23-077 | FHWA-RC-24-0006

Core message
Controlled specification turns Steelike UHPC from high-performance material potential into infrastructure value. Without role definition, interface control, execution discipline, and evidence of acceptance, performance remains only a claim.

9. Validation Gates Before Specification

Turning high-performance material potential into auditable infrastructure confidence.

In critical infrastructure, validation gates are not bureaucracy. They are the mechanism that makes innovation acceptable.

A high-performance material should not enter specification because it sounds advanced, because it has strong laboratory results or because it offers a compelling lifecycle argument. Those factors matter, but they are not enough. In high-consequence assets, performance must be translated into a controlled engineering decision before it becomes a tender requirement, design note, method statement or execution package.

This is especially important for Steelike UHPC. As an Ultra High Performance Composite technology platform, Steelike UHPC can support demanding infrastructure applications where long lifespan, low ingress, high mechanical performance, durability-led rehabilitation, validated reopening logic and retrofit-before-replacement logic are relevant. But the value of the material is realised only when the project team defines exactly what the material is expected to do and proves that the design, substrate, execution conditions and acceptance criteria support that role.

For engineers, validation gates reduce technical uncertainty. For owners, they protect the availability and governance of assets. For contractors, execution risk is clarified. For public-sector decision-makers, they create an audit trail. For ***CNT Plus*** powered by STEELIKE, they protect the credibility of the material platform.

The purpose is simple: do not specify potential. Specify validated function, documented evidence and clear responsibility.

A bridge deck overlay, a tunnel repair layer, an airfield slab intervention, a logistics ramp, an energy facility protective layer and a dual-use mobility route may all be critical infrastructure applications. They should not be treated as the same specification problem. Each has different exposure, load case, geometry, access, reopening requirements, inspection controls and approval routes. Validation gates force those differences to be addressed before the material decision becomes irreversible.

Validation gates for Steelike UHPC specification: formal evidence and sign-off

Validation gate	Decision question	Approval record before specification
Gate 1: Asset problem verified	What problem is the project actually solving?	Recorded condition evidence and root-cause note accepted by the project engineer.
Gate 2: Consequence classified	What happens if the asset fails, degrades again or remains unavailable?	Written consequence classification accepted by the owner or asset manager.
Gate 3: Steelike UHPC role defined	What exactly must Steelike UHPC do in this application?	Signed material-role statement: what Steelike UHPC must do and what it is not being asked to do.
Gate 4: Product data matched	Which Steelike UHPC properties are relevant to this role?	Current ***CNT Plus*** / Steelike evidence package checked for relevance to the defined role and exposure.
Gate 5: Load case and design basis confirmed	What mechanical demand must the intervention resist?	Design basis or calculation route confirmed by the responsible engineer for structural demand.
Gate 6: Substrate and interface controlled	Can the existing asset and Steelike UHPC intervention behave as an integrated system?	Interface preparation and acceptance criteria are approved before procurement or site execution.
Gate 7: Execution method proven	Can the proposed method be reliably executed under real site conditions?	Method statement reviewed, including mixing, placing, curing, access, temperature and contingency controls.

Validation gate	Decision question	Approval record before specification
Gate 8: Trial or mock-up completed where required	Has the execution concept been demonstrated before full deployment?	Trial batch, mock-up or test panel completed where required, with results recorded and deviations closed.
Gate 9: QA/QC and inspection route defined	How will the project prove that the installed material meets the requirement?	QA/QC plan approved, including sampling, testing, inspection hold points, non-conformance handling and documentation duties.
Gate 10: Reopening and loading criteria approved	When can the asset return to use, and on what evidence?	Reopening or loading criteria approved by the engineer and owner before operational return.
Gate 11: Approval and certification path confirmed	Who accepts the design, execution and final performance?	Approval route confirmed, including owner, designer, authority, independent review or certification where applicable.
Gate 12: Lifecycle governance documented	How will the intervention be managed after handover?	Lifecycle governance record created: inspection assumptions, monitoring needs, warranty boundaries and asset-file handover.

Why validation gates matter

Validation gates make the difference between using Steelike UHPC as a product and deploying Steelike UHPC as an engineered infrastructure solution. Section 8 defines what the specification must control. This section defines what must be evidenced, approved and documented before the project proceeds.

Without Gate 1 and Gate 2, the project may treat a symptom while ignoring the real risk. A visible crack, surface loss, or damaged joint may be the consequence of a deeper issue: water ingress, chloride contamination, reinforcement corrosion, inadequate prior repair, fatigue, abrasion, vibration, or repeated impact.

Without Gate 3, the specification may become vague. Steelike UHPC cannot be responsibly specified as simply a high-strength material. The project must define whether it is being used for durability protection, structural strengthening, overlay performance, time-sensitive repair, load transfer, interface improvement, hardening logic or lifecycle extension.

Without Gate 4 and Gate 5, the material data may not match the engineering demand. Compressive strength is important, but it is not the only decision parameter. For many applications, absorption, ingress resistance, abrasion resistance, bond strength, fibre-reinforced behaviour, curing, and early-age performance may be equally important to the project outcome.

Specification discipline

The strongest Steelike UHPC applications will not be the ones with the broadest claims. They will be the ones with the clearest validation path.

CNT Plus, powered by STEELIKE, should therefore position validation as part of its value proposition. This does not weaken the material claim. It strengthens it. It tells engineers and decision-makers that Steelike UHPC is not being pushed as a generic substitute, but is introduced through a controlled route in which the material's role, limits, evidence, and acceptance responsibilities are explicit.

Public UHPC guidance and bridge-sector deployment experience support this discipline. FHWA guidance on field-cast UHPC connections includes design guidance, UHPC specification, construction engineer inspection, case study, and deployment sections. FHWA structural design guidance also treats UHPC as a material class that requires design control and material conformance rather than as a generic substitution. Research on UHPC bridge deck overlays, including the NMSU / Tran-SET report, further demonstrates why substrate bond, field implementation and long-term monitoring are part of the performance question.

> ***Validation principle***
> *No Steelike UHPC application should move into critical infrastructure specification until the project team can answer four questions with documented evidence: What is the asset risk? What is the Steelike UHPC role? How will execution be controlled? What evidence proves acceptance?*

Evidence note

FHWA, NMSU / Tran-SET, NATO, and European Commission sources support the broader principle that critical infrastructure and UHPC deployment require resilience logic, application-specific design, construction control, inspection and verification. For Steelike UHPC, material-specific statements should remain tied to the current ***CNT Plus***/Steelike documentation, including compressive strength values up to 168 MPa, water absorption of approximately 1.31 per cent, chloride permeability data, and the durability-related test scope. General UHPC publications support category logic, but should not be used to transfer non-Steelike performance claims onto Steelike UHPC without project-specific validation.

Referenced sources for this section

- FHWA, Design and Construction of Field-Cast UHPC Connections, FHWA-HRT-14-084
- FHWA, Structural Design with Ultra-High Performance Concrete, FHWA-HRT-23-077
- NMSU / Tran-SET, Bridge Deck Overlays Using Ultra-High Performance Concrete
- NATO, Resilience, civil preparedness and Article 3
- European Commission / CINEA, Military Mobility and dual-use transport infrastructure

> *Core message*
> ***In critical infrastructure, performance is not accepted on claim alone. It is accepted because it is validated.***

Practical outcome for project teams

A validation gate process gives every stakeholder a clearer basis for decision-making before specification, procurement, site execution, reopening, and lifecycle handover.

Stakeholder	What validation provides
Engineers	Convert material performance into design role, interface requirements, test criteria and sign-off logic.
Asset owners	Link material selection to availability, lifecycle value, risk reduction and auditable governance.
Contractors	Understand method statements, mixing, placement, curing, access limits, QA/QC and acceptance hold points before mobilisation.
Decision-makers	Defend innovation with evidence, not assumptions, and align the specification with resilience, sustainability, and continuity objectives.

10. Limits of Claim and Engineering Responsibility

> *The strongest technical position is not the broadest claim. It is the claim that can be designed, tested, executed, inspected and accepted.*

High-performance materials need limits of claim because critical infrastructure has limits of tolerance. A bridge, tunnel, airfield pavement, energy facility, logistics corridor or dual-use route cannot be governed by general product enthusiasm. It must be governed by design basis, exposure, execution control, inspection evidence and owner acceptance.

Steelike UHPC Composite can be assessed for demanding infrastructure applications, including structural strengthening, durability-led rehabilitation, protective hardening, selected containment-related civil components, coastal and subsea-adjacent interfaces, energy and utility protection zones, and dual-use infrastructure. This assessment does not create automatic approval for blast, ballistic, STANAG, fire-resistance or anti-drone claims.

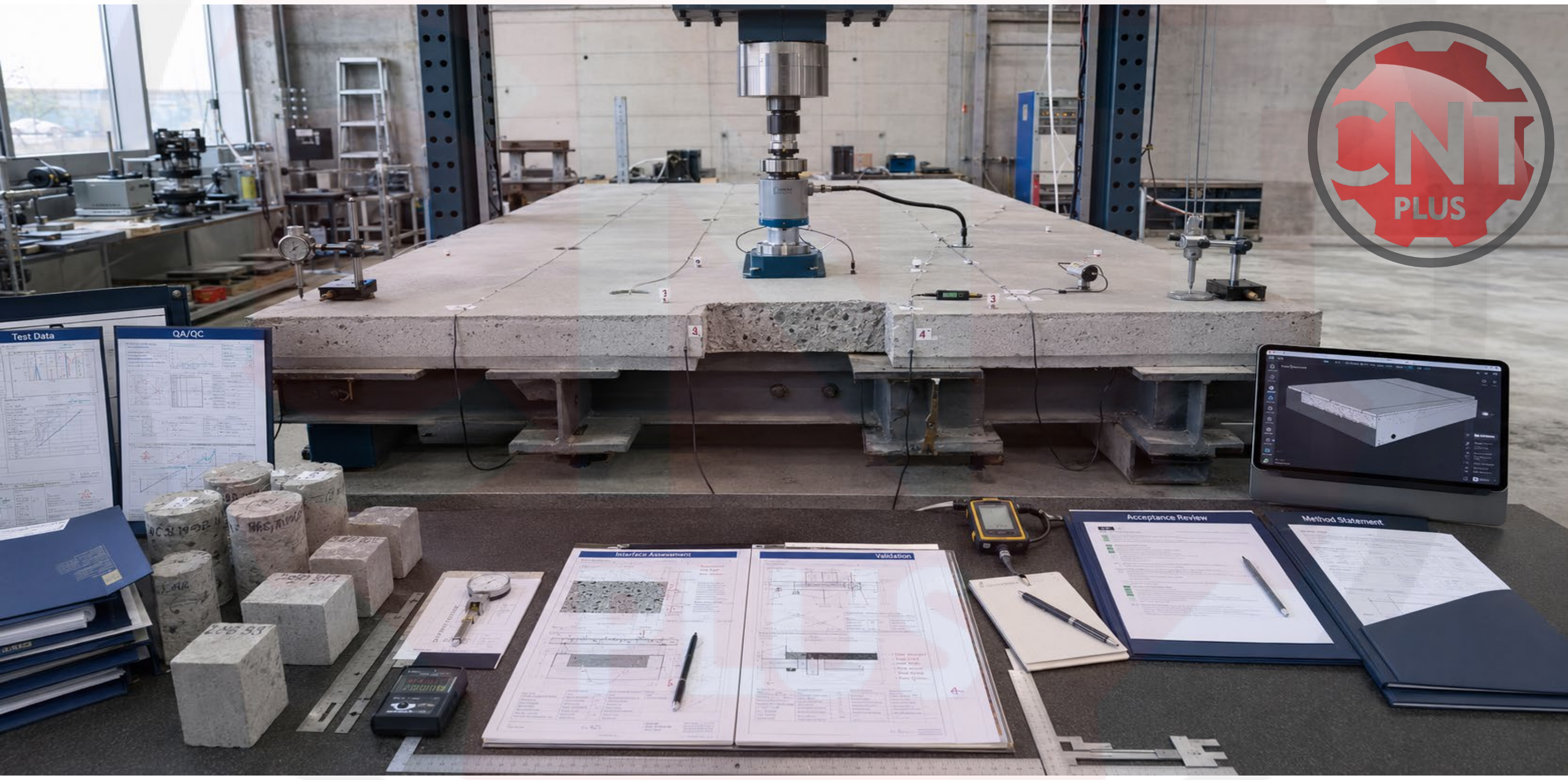
In practical engineering language, this distinction matters. A project team may assess Steelike UHPC Composite for protective hardening or critical asset shielding concepts, but the approved claim must be tied to the actual threat scenario, engineering model, test method, acceptance criteria, and certification route, where required.

In critical infrastructure, engineering responsibility means knowing where the material claim ends and where project-specific validation begins. This does not weaken the Steelike UHPC position. It strengthens it. It shows that ***CNT Plus***, powered by STEELIKE, is positioning the material as an engineered infrastructure technology rather than an unlimited claim.

Public UHPC guidance supports this discipline. FHWA guidance on field-cast UHPC connections is organised around design guidance, specifying UHPC, construction engineer inspection, case study evidence and deployments. FHWA structural design work also frames UHPC in terms of material behaviour, design provisions, and engineering judgement rather than as a generic substitution. This is the same logic that should govern Steelike UHPC in critical infrastructure.

Responsible claim boundaries

Claim area	Responsible technical position
Structural strengthening	Requires design calculation, load case definition, material role statement, structural review and engineer approval.
Durability and long lifespan	Requires exposure-specific validation, documented material data, service-life assumptions and owner acceptance criteria.
Validated return-to-service	Requires early-age performance evidence, curing control, reopening criteria, inspection records, engineer approval and owner sign-off.
Bond and overlay performance	Requires substrate assessment, surface preparation, moisture control, pull-off or bond criteria, edge detailing and QA/QC.
ECO value	Requires lifecycle logic, measurable project assumptions and avoidance of unsupported generic green claims.
Protective hardening	Can be discussed as a potential use case, subject to project-specific engineering assessment, testing and validation.
Ballistic, blast or STANAG performance	No claim unless supported by current Steelike/***CNT Plus***-specific certification or project-specific testing and acceptance.
Fire classification	No claim unless supported by relevant testing, classification documentation and defined application conditions.
Maintenance-free performance	Avoid. Use a reduced repair-cycle burden, a longer service interval, or a lower intervention frequency where validated.
Automatic structural replacement	Avoid. Structural equivalence requires project-specific calculation, detailing, material role definition and approval.



Material performance establishes potential. Project-specific validation defines the approved claim, application limits and acceptance route.

Case-study logic for responsible claims

Bridge-sector UHPC experience shows why responsible claim boundaries matter. FHWA's Every Day Counts materials position UHPC for bridge preservation and repair by enhancing durability and improving life-cycle cost performance, while FHWA Innovator reporting documents the growth of UHPC use in bridge applications over two decades. These are strong signals of market adoption, but they also point to designed, controlled applications rather than unrestricted material substitution.

Research and field implementation work on UHPC bridge deck overlays, including reports from New Mexico State University and Tran-SET, further support this point. Overlay performance depends on more than the UHPC mix. It depends on surface preparation, bond to the existing concrete, construction methodology, inspection, evidence of acceptance, and long-term monitoring. The lesson for critical infrastructure is clear: the material platform matters, but the installed system is what must be validated.

Source references: FHWA, Design and Construction of Field-Cast UHPC Connections; FHWA, Structural Design with Ultra-High Performance Concrete; FHWA EDC-6, UHPC for Bridge Preservation and Repair; FHWA Innovator, The Evolution of UHPC; New Mexico State University / Tran-SET, Bridge Deck Overlays Using Ultra-High Performance Concrete, Final Report, October 2018.

Specification discipline

The strongest Steelike UHPC applications will not be the ones with the broadest language. They will be the ones with the clearest validation path.

CNT Plus powered by STEELIKE should therefore position limits of claim as part of the value proposition. Engineers and decision-makers do not need to be given unlimited promises. They need defined performance, assumptions, tests, approvals, and a handover record.

> ***Core message***
> *Steelike UHPC should not be positioned through unlimited claims. It should be positioned through controlled, validated performance for the right asset, the right role, the right exposure and the right acceptance route.*

11. Lifecycle and Governance Advantage

The cost of a material is visible at procurement. The cost of repeated failure is often hidden in operations.

For critical infrastructure, this distinction matters. A lower-cost repair material may appear efficient at the point of purchase but becomes expensive when the same asset requires repeated interventions, traffic restrictions, emergency mobilisation, additional inspections, premature replacement, or prolonged downtime.

Critical infrastructure assets do not operate in isolation. Availability, intervention frequency, and lifecycle decisions affect the wider mobility, logistics, and energy systems

This is where Steelike UHPC Composite should be evaluated differently.

Steelike UHPC Composite is not positioned as the lowest-cost commodity repair material. It is positioned as a high-performance Ultra High Performance Composite system for situations where higher material performance can reduce an asset's lifecycle burden. The economic argument is not simply stronger material. The economic argument is fewer disruptive interventions, longer service intervals, lower exposure to downtime, more predictable maintenance planning and better protection of critical asset availability.

In high-consequence infrastructure, the most expensive repair is often not the one with the higher material cost. It is the one that has to be repeated.

Critical assets rarely fail in isolation. A bridge closure affects traffic flow. A tunnel intervention affects access and safety planning. A damaged cable corridor can affect power or data continuity. A pipeline protection failure can create environmental, operational and regulatory exposure. A transformer outage can disrupt multiple downstream users.

Steelike UHPC Composite becomes relevant where a controlled, validated intervention can shift the decision from short-term repair to long-term asset performance.

Available ***CNT Plus*** and Steelike documentation supports this positioning through compressive strength values up to 168 MPa, water absorption of approximately 1.31 per cent, chloride permeability data, and a durability-related testing scope. These values should be checked against the latest ***CNT Plus***/Steelike documentation before use for specification or procurement. They do not automatically guarantee lifecycle savings in every project, but they provide the technical basis for assessing Steelike UHPC where long lifespan, low ingress, reduced repair-cycle burden and durability-led rehabilitation are economically relevant.

The cost logic changes in critical infrastructure

Conventional cost view	Lifecycle and governance view
Compare the material unit cost	Compare the total intervention cost over the asset lifecycle
Minimise initial repair budget	Reduce repeated repair cycles and downtime exposure
Treat repair as a local technical task	Treat repair as an availability and resilience decision
Accept familiar material with lower upfront cost	Assess whether higher performance can reduce future risk
Focus on the completion date	Focus on service interval, reopening confidence and long-term reliability
Document basic compliance	Build an auditable technical record for the owner, engineer and procurement confidence

Where Steelike UHPC can create economic value

Steelike UHPC can create value where one or more of the following conditions exist:

Value driver	Why it matters
Reduced intervention frequency	Fewer repair campaigns can reduce labour, access, mobilisation, traffic management, inspection escalation and operational disruption.
Longer service interval	A longer-performing repair zone improves maintenance planning and reduces the probability of repeated emergency work.
Validated return-to-service logic	Shorter closure windows can create direct operational value where early-age performance, curing control and owner acceptance criteria are proven.
Targeted high-performance use	UHPC does not need to be used everywhere. It should be focused on zones where the consequences of failure and exposure justify it.
Retrofit before replacement	Extending the useful life of existing infrastructure can avoid demolition, replacement costs, waste and programme risk.
Better governance record	A defined role, validation, QA/QC, acceptance criteria, and handover documentation make the decision easier to defend.
ECO lifecycle value	Reduced repair cycles, lower intervention burden and asset preservation support the ECO logic without relying on generic green claims.

Governance advantage

For public-sector owners, infrastructure managers and critical asset operators, the value of Steelike UHPC is not only material performance. It also supports a more defensible decision.

A controlled Steelike UHPC specification can provide a clearer reason for selecting a high-performance material, a documented link between asset risk and material role, measurable acceptance criteria, a QA/QC trail, evidence for reopening or loading decisions, better handover documentation, a stronger basis for lifecycle planning and a more transparent procurement justification.

This matters because critical infrastructure decisions are increasingly scrutinised not only for cost but also for resilience, sustainability, public accountability, defence readiness, operational continuity, and long-term value.

The commercial logic is therefore not that Steelike UHPC is cheaper as a material. The commercial logic is that, in the right application and with validated assumptions, it may be the lower-risk lifecycle decision.

External references supporting lifecycle and resilience logic

• FHWA EDC-6: UHPC for Bridge Preservation and Repair
• FHWA: Ultra-High Performance Concrete for Bridge Deck Overlays
• World Bank / GFDRR: Lifelines, The Resilient Infrastructure Opportunity
• OECD Infrastructure Governance and Resilience

> **Core message**
> *The value of Steelike UHPC is not only what it costs at installation. It is what it may prevent over the lifecycle of a critical asset.*

12. Conclusion and Call to Technical Dialogue

Critical infrastructure needs material decisions that can be defended technically, economically, operationally and institutionally.

Critical infrastructure cannot be treated as ordinary repair work. Bridges, tunnels, airfields, logistics corridors, ports, energy facilities, substations, transformer yards, subsea pipelines, power cables, data cables and coastal landing zones are part of wider continuity systems.

When these assets degrade, the consequence is rarely limited to the damaged zone. A local defect can become a lane closure, a restricted-access route, a delayed operation, a safety concern, an emergency repair campaign, a procurement challenge, or a governance issue. In this environment, the material decision is no longer only a technical detail. It is a resilience decision.

At a continuity-critical cargo airport, a local pavement intervention can influence the availability of the entire operational system. Interface control, validation and reopening criteria connect material performance with operational continuity.

Steelike UHPC Composite, represented in the EU by ***CNT Plus*** powered by STEELIKE, should be assessed as a market-available Ultra-High-Performance Composite system for targeted use, where durability, lifecycle extension, rapid return-to-service, local hardening, interface protection, and reduced downtime can be validated for the specific asset role.

The position of this white paper is not that every repair requires Steelike UHPC. That would be technically weak and commercially unrealistic. The stronger position is that critical infrastructure requires controlled material decisions, and Steelike UHPC Composite should be assessed where the asset consequence, exposure, material role, and validation route justify a high-performance composite intervention.

For engineers, Steelike UHPC Composite should be considered where the material role can be defined, the substrate can be assessed, the load case can be reviewed, the interface can be controlled, and the required performance can be verified. For decision-makers, the value should be assessed based on total lifecycle cost, downtime exposure, intervention frequency, governance risk, and resilience value, not only the initial material price.

For critical infrastructure, the right pathway is clear: screen the asset, define the role, validate the evidence, control execution, document acceptance and govern the lifecycle.

Call to technical dialogue

CNT Plus powered by STEELIKE invites infrastructure owners, public-sector stakeholders, engineering consultants, contractors, operators, asset managers and defence-adjacent infrastructure planners to engage in project screening and feasibility review for Steelike UHPC applications.

Technical dialogue should focus on asset condition, exposure, operational consequence, material role, validation route, execution methodology, **QA/QC**, acceptance criteria and lifecycle value. This is the route that turns high-performance material potential into controlled infrastructure value.

Technical dialogue focus areas

Focus area	Decision purpose
Asset screening	Confirm whether the asset consequence, degradation mode and downtime exposure justify UHPC assessment.
Role definition	Clarify whether Steelike UHPC is repair, overlay, strengthening, protection, joint, panel or structural function.
Validation route	Match performance requirements to documented product data, project testing and acceptance evidence.
Execution control	Define substrate preparation, mixing, placement, curing, QA/QC, inspection and reopening criteria.
Lifecycle case	Assess service interval, reduced repair-cycle burden, ECO logic, governance value and total lifecycle cost.

Core message

Not every repair needs Steelike UHPC. But every material decision in critical infrastructure needs discipline, evidence and controlled specification.

Performance matters.

Validation decides.

Lifecycle proves the decision.

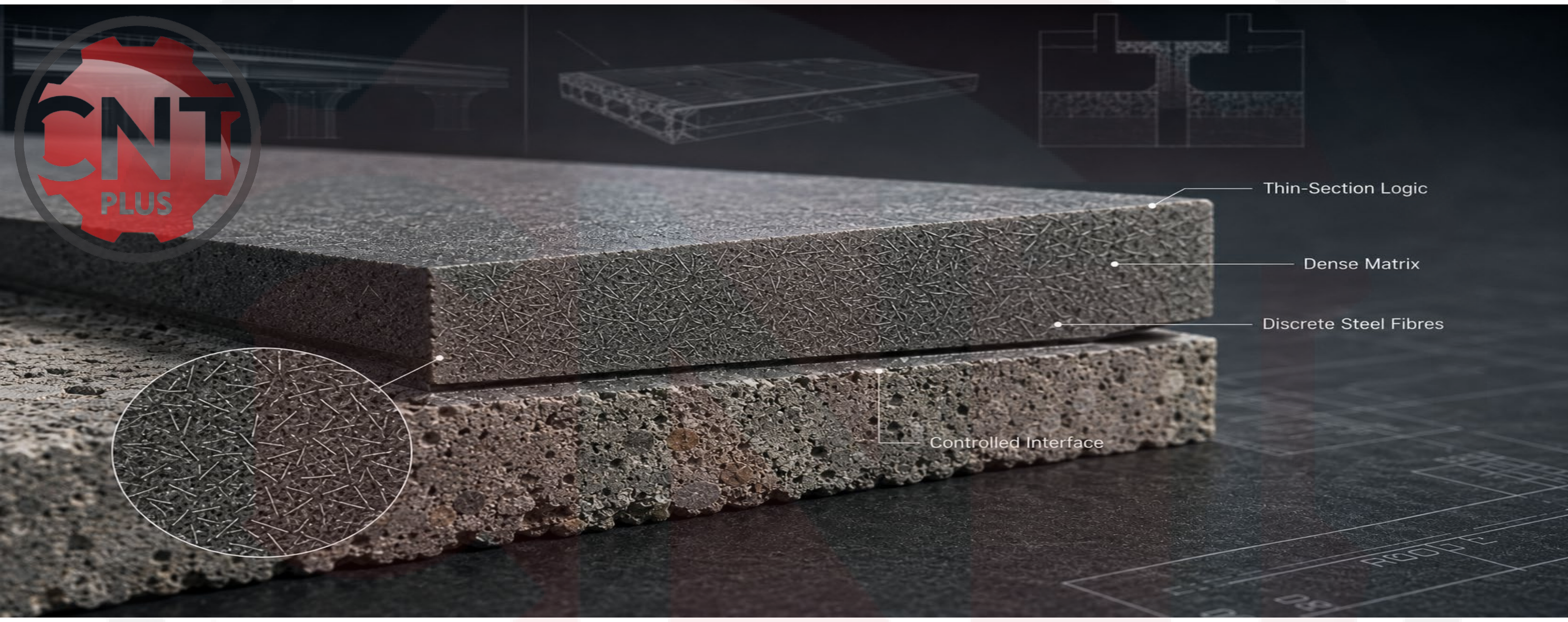
Appendix A. Documented *CNT Plus* / Steelike Data Used

This appendix identifies the ***CNT Plus*** and Steelike-specific data points used in this white paper. The purpose is technical discipline: claims about Steelike UHPC Composite should be traceable to Steelike or ***CNT Plus*** documentation, while general UHPC literature should be used only to support the broader category logic.

For engineers, this distinction matters. A material platform is not specified responsibly because a similar UHPC system performed well elsewhere. It is specified responsibly when the required role is matched to current product data, project-specific test evidence, substrate conditions, execution methodology and owner-approved acceptance criteria.

For decision-makers, the same distinction protects procurement confidence. It separates documented material capability from unsupported performance transfer. It also makes the final decision easier to defend in an audit, technical review, public-sector evaluation or lifecycle asset-management discussion.

The values and test scopes below should be verified against the latest ***CNT Plus*** / Steelike product documentation, test certificates, project-specific laboratory reports and owner requirements before tender submission, specification, public-sector procurement use or project approval.



Technical data basis

Data point	Documented value or scope	Source basis	Use in this white paper
Compressive strength	***CNT Plus*** test documentation indicates compressive strength values up to 168 MPa. Steelike technical documentation includes compressive strength test data for UHPC with 2 per cent steel fibre.	***CNT Plus*** laboratory reports; Steelike technical lab certificate package.	Supports high-performance material positioning. It should not be used as an automatic structural equivalence without project-specific design and verification of current evidence.
Water absorption	***CNT Plus*** test documentation indicates a water absorption of approximately 1.31 per cent.	***CNT Plus*** / BARG test reports.	Supports low-absorption and durability-led positioning for exposed or cyclic environments. Project relevance depends on exposure, detailing, execution and current evidence verification.
Chloride permeability and low ingress logic	Steelike documentation includes rapid chloride permeability data and chloride-related performance evidence in the available test package.	Steelike technical lab certificate package.	Supports chloride resistance and low-ingress discussion where exposure conditions require them. Current certificates should be checked before specification.
Durability-related test scope	Available Steelike documentation includes freeze-thaw, scaling resistance, abrasion resistance, bond or pull-off, pull-out and surface resistivity test categories.	Steelike technical lab certificate package.	Supports discussion of durability, overlays, rehabilitation, interface performance and lifecycle logic. The test selected must match the project risk.
Density/unit mass	***CNT Plus*** and Steelike material documentation includes density or unit mass references around 2420 kg/m3.	***CNT Plus*** laboratory reports; Steelike product data references.	Useful for dead-load discussion, logistics, section assessment and engineering review. It is not a standalone performance claim.
Stiffness, shrinkage and set-time references	Available Steelike documentation includes static modulus, shrinkage and setting-time references.	Steelike product data sheet and technical documentation.	Useful for detailing, curing, construction planning, early-age behaviour and engineering review where project requirements make these values relevant.
ECO logic	ECO positioning is based on lifecycle efficiency, material efficiency, reduced repair-cycle burden and retrofit-before-replacement logic.	***CNT Plus*** strategic positioning supported by lifecycle and resilience logic.	Supports sustainability discussion only when connected to measurable project assumptions. It should not be presented as a generic green claim.
Limits of claim	No Steelike / ***CNT Plus***-specific claim is made in this white paper for STANAG certification, ballistic certification, blast-proof performance, fire classification or maintenance-free performance.	Positioning discipline and engineering responsibility.	Prevents overclaiming. Defence-adjacent, hardening, and critical infrastructure applications remain potential use cases, subject to testing, validation, and certification where required.

Technical interpretation

The data above does not remove the need for engineering judgement. In critical infrastructure, performance values must be interpreted in light of the material's role. A compressive strength value can be relevant for high-load zones, thin-section concepts or strengthening logic, but it does not automatically define flexural capacity, bond performance, fatigue resistance, section equivalence or service-life outcome.

Likewise, absorption, chloride permeability, freeze-thaw, abrasion, and bond-related data are only valuable when linked to actual exposure and execution conditions. A bridge joint, tunnel lining, airfield slab, industrial floor, energy asset, and dual-use logistics route may each require different validation logic, even when the same Steelike UHPC platform is considered.

This is the human factor behind the technical specification. Engineers and asset owners do not need more unsupported performance language. They need data that can be connected to the asset problem, the design basis, the site method, the inspection route and the handover file. That is how a high-performance material becomes a defensible infrastructure decision.

Core message

Steelike-specific claims should be based on Steelike / *CNT Plus* documentation. General UHPC literature may support category logic, but should not be used to transfer non-Steelike performance claims onto Steelike UHPC without project-specific validation.

Practical use in project screening

This appendix should be used as a technical evidence map during early project dialogue. It helps the project team distinguish between what is already documented and what must be validated for the specific asset. That distinction is important for both engineering confidence and procurement confidence.

Project team question	How Appendix A should be used
What Steelike UHPC property is relevant?	Identify the material property that connects directly to the asset risk, such as strength, low absorption, chloride resistance, abrasion resistance, bond or early-age performance.
Is the evidence Steelike-specific?	Use ***CNT Plus*** / Steelike documentation for Steelike-specific claims. Use FHWA, AASHTO, academic or industry literature only as category context.
What must be proven on this project?	Define the missing evidence, such as substrate bond, pull-off, trial placement, mock-up, early-age performance, curing behaviour or reopening criteria.
Who needs the evidence?	Identify whether the evidence is needed by the designer, owner, contractor, public authority, insurer, auditor or third-party reviewer.
How is the decision recorded?	Connect the selected data to the method statement, QA/QC plan, inspection records, acceptance criteria and handover file.

Human factor

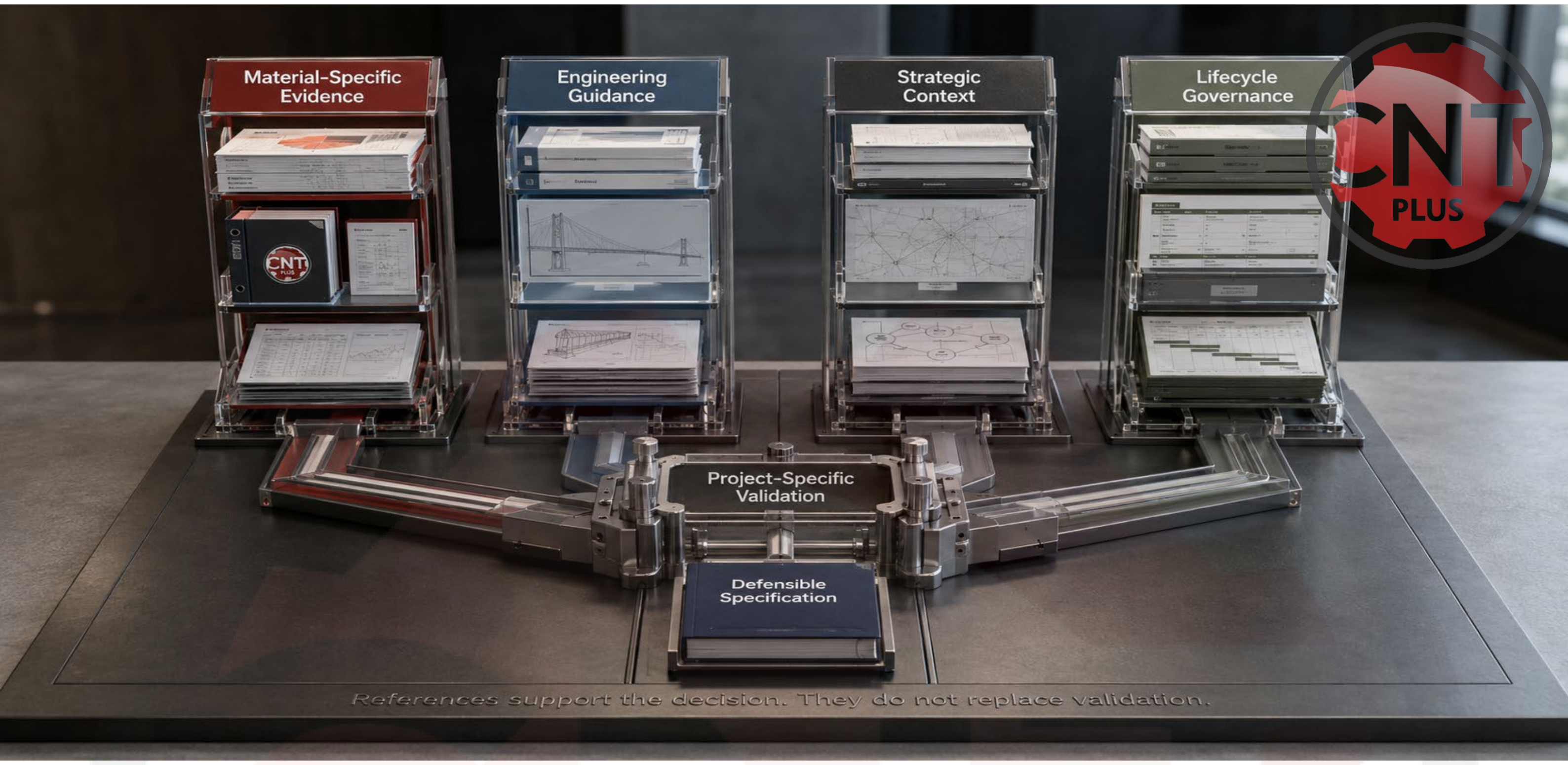
The technical data do not make the decision by themselves. ***People do***. Engineers must decide whether the data match the load case. Asset owners must decide whether the intervention supports service continuity. Contractors must decide whether the method can be executed reliably on site. Public-sector decision-makers must decide whether the evidence is sufficient to justify the procurement route. Appendix A is therefore not only a data table. It is a discipline for making material decisions transparent, reviewable, and defensible.

Appendix B. Selected Technical References

This appendix lists selected technical, institutional and material references used to support the engineering logic, resilience context, lifecycle argument and UHPC category discussion in this white paper.

The references are not used interchangeably. Steelike-specific performance statements should be based on ***CNT Plus*** / Steelike documentation. External UHPC literature and public guidance support broader category logic, design discipline, validation principles, lifecycle thinking and critical infrastructure context.

For engineers, this distinction is practical. A published FHWA bridge connection document can support the need for controlled design, specification and construction inspection. It cannot replace Steelike-specific test data. Likewise, a NATO or European Commission reference can support the strategic relevance of resilience, civil preparedness or dual-use transport infrastructure. It does not certify any material performance.



B1. Steelike / *CNT Plus* documentation

These documents provide the Steelike/***CNT Plus***-specific evidence base for statements regarding the material platform. They should be checked against the latest issue before use for specification, tender submission, or public-sector procurement.

Reference	Use in this white paper
Steelike UHPC technical lab certificate package	Material-specific test basis for compressive strength, chloride permeability, freeze-thaw, scaling, abrasion, bond-related tests, pull-out and surface resistivity categories.
***CNT Plus* / BARG laboratory reports**	Project-specific laboratory evidence, including compressive strength values up to 168 MPa and water absorption of approximately 1.31 per cent for tested samples; verify the latest issue before specification or procurement use.
Steelike PDS 2024	Product data basis for engineering review, including material parameters relevant to stiffness, setting, handling and technical screening.
Steelike SDS	Safety documentation for handling, site planning and contractor control. Safety data should be used alongside product- and project-specific technical data.
CNT UHPC CS capability sheet	Capability and deployment framework reference, including use-case triggers, engineering validation gates and RAPID-style feasibility review logic.

B2. UHPC engineering guidance and technical literature

These references support the broader UHPC engineering context: design discipline, application-specific performance verification, construction inspection, bridge preservation, overlays, connections and structural design. They should not be used to transfer non-Steelike performance results directly onto Steelike UHPC.

Reference	Technical relevance	Link/source
FHWA, Design and Construction of Field-Cast UHPC Connections, FHWA-HRT-14-084	Official FHWA guidance covering common connections, design guidance, specifying UHPC, construction engineer inspection, case study and deployments.	Official link
FHWA, Structural Design with Ultra-High Performance Concrete, FHWA-HRT-23-077	Structural design reference for UHPC, supporting the principle that material behaviour must be translated into design provisions, material conformance and engineering acceptance.	Official link
FHWA, Ultra-High Performance Concrete: A State-of-the-Art Report	Category-level UHPC background for infrastructure applications and performance discussion.	Official link
FHWA EDC-6, UHPC for Bridge Preservation and Repair	Infrastructure deployment context for UHPC in preservation and repair, including durability and lifecycle performance logic.	Official link
FHWA EDC News, UHPC overlays for bridge preservation	Applied infrastructure context for UHPC overlays, including low permeability, freeze-thaw and abrasion resistance, strength, stiffness and bond-to-substrate category logic.	Official link
New Mexico State University / Tran-SET, Bridge Deck Overlays Using Ultra-High Performance Concrete	Research and field implementation context for UHPC overlays, bond to substrate, constructability and long-term monitoring logic.	Uploaded technical source
German Guideline for Ultra-High Performance Concrete / DAfStb-related paper	European engineering context for UHPC guideline development, structural applications, concrete technology and quality control.	Uploaded technical source

B3. Critical infrastructure, resilience and dual-use context

These references support the strategic context: critical infrastructure is increasingly evaluated in terms of resilience, civil preparedness, continuity, military mobility, climate adaptation, and dual-use infrastructure value.

Reference	Strategic relevance	Link
NATO, Resilience, civil preparedness and Article 3	Supports the argument that resilience, civil preparedness, essential services and critical infrastructure are relevant to deterrence, defence and crisis response.	Official link
NATO, Climate Change and Security Action Plan	Supports the link between climate adaptation, security planning and institutional resilience.	Official link
European Commission, Military Mobility	Supports the relevance of transport infrastructure, rapid movement of troops and equipment, and civil-military mobility requirements.	Official link
European Commission / CINEA, dual-use transport infrastructure funding	Shows EU-level support for upgrades to transport infrastructure for both civilian and defence purposes.	Official link
U.S. Department of Defense, climate adaptation and installation resilience materials	Supports the link between installation resilience, climate adaptation, mission resilience and recovery from disruptions.	Official link
UK Ministry of Defence, Climate Change and Sustainability Strategic Approach	Supports the defence-sector framing of climate change, sustainability, adaptation and resilience as strategic issues.	Official link

B4. Sustainability, ECO and lifecycle governance

These references support the ECO and lifecycle logic used in the white paper. They provide context for sustainable infrastructure, lifecycle governance, resilient infrastructure investment and mobility systems, but do not replace material-specific evidence.

Reference	Lifecycle / ECO relevance	Link
UNEP, International Good Practice Principles for Sustainable Infrastructure	Supports integrated, systems-level thinking across infrastructure planning, delivery and management.	Official link
OECD, infrastructure governance and resilient infrastructure materials	Supports the need for governance, long-term value and resilient infrastructure decision-making.	Official link
World Bank / GFDRR, Lifelines: The Resilient Infrastructure Opportunity	Supports lifecycle and resilience investment logic, including the argument that resilience can generate large economic benefits by reducing disruption and losses.	Official link
European Commission, Sustainable and Smart Mobility Strategy	Supports the policy direction toward greener, more resilient transport systems.	Official link

Core message

Technical references strengthen the decision pathway, but they do not replace project-specific validation. For critical infrastructure, the final specification must still be based on asset condition, material role, documented evidence, execution control and owner-approved acceptance criteria.

Appendix C. Project Screening Checklist

This checklist is intended to turn the white paper into a practical project-screening tool. It is not a substitute for design, testing, owner approval or certification. It is a structured first conversation for engineers, asset owners, contractors, public-sector stakeholders, and critical infrastructure decision-makers to assess whether Steelike UHPC warrants a feasibility review.

The checklist reflects the central principle of this document: a project should not move toward Steelike UHPC specification because the material is advanced. It should move forward because the asset problem, material role, validation route and lifecycle value are clear.

C1. Initial project screening questions

Screening area	Questions to answer before the feasibility review
Asset and location	What is the asset? Where is it located? What is its age, geometry and current use? Are drawings, inspection reports, photographs, surveys or previous repair records available? What access constraints exist?
Problem statement	What is the damage or degradation mode? Is the issue structural, durability-related, operational, protective or a combination of these? Is the problem recurring? What happens if no intervention is made?
Criticality and downtime	Is the asset critical to transport, energy, logistics, public services, emergency response or defence mobility? What is the consequence of closure? Are repair windows limited? Are validated return-to-service criteria required?
Exposure and load environment	Is the asset exposed to chlorides, freeze-thaw action, moisture, wet-dry cycles, abrasion, impact, chemical exposure, vibration, fatigue, concentrated wheel loads or heavy operational loading?
Intended Steelike UHPC role	Is Steelike UHPC being considered as a repair layer, overlay, strengthening layer, protective layer, joint system, panel, structural component or time-sensitive repair intervention? What must the material prove in this role?
Substrate and interface	What is the existing material? Is the substrate sound? What surface preparation is possible? Can bond or pull-off requirements be tested? Are edge terminations, joints and reinforcement interactions defined?
Validation route	What tests are required? Is a trial batch, mock-up or test panel needed? Is third-party testing required? Which standards, owner requirements or project acceptance criteria apply? Who defines acceptance?
Execution and QA/QC	Who will mix and place the material? What curing regime is required? What site controls are needed? What inspection hold points are required? What evidence is needed for handover?
Lifecycle and ECO logic	Is the objective to extend service life, avoid replacement, reduce repair-cycle burden, reduce intervention frequency, support material efficiency or improve operational continuity? What assumptions must be documented?

C2. Technical screening outcome

At the end of the first screening conversation, the project should be placed into one of three categories. This keeps the decision disciplined and protects all parties from premature specification.

Screening outcome	Meaning	Recommended next step
Proceed to the feasibility review	Steelike UHPC appears technically relevant because the asset consequence, degradation mode, material role and lifecycle value are sufficiently clear.	Request the project data package, define the validation scope, identify tests, and align on the owner and engineer acceptance route.
Request additional information	The project may be relevant, but asset condition, drawings, exposure, load case, substrate condition, repair history or acceptance criteria are incomplete.	Collect missing evidence before the technical recommendation. Do not specify until the role and validation route are clear.
Not currently suitable	The project lacks sufficient consequence level, technical justification, execution feasibility or validation pathway for Steelike UHPC at this stage.	Do not force the technology into the project. Reassess only if asset risk, exposure, scope or lifecycle requirements change.

C3. Human factor in project screening

A checklist is only useful if the people using it are honest about uncertainty. Critical infrastructure projects often involve incomplete drawings, legacy repairs, restricted access, time pressure, budget pressure and stakeholders with different risk tolerances. These conditions make disciplined screening more important, not less.

For engineers, the checklist helps define the technical problem before discussing the product. For owners, it connects material choice to downtime, lifecycle and governance. For contractors, it identifies execution risk early. For decision-makers, it creates a defensible record of why Steelike UHPC was considered, why it was advanced, or why it was not suitable at that stage.

Checklist principle

Screening is not a sales filter. It is an engineering discipline. A Steelike UHPC opportunity should advance only when the asset problem, material role, validation route, execution method, and lifecycle value can be clearly stated.

C4. Minimum data package for feasibility review

Data category	Minimum information requested
Asset information	Location, owner, asset type, function, age, geometry, drawings, photographs, inspection records and access constraints.
Damage and exposure	Defect description, degradation mechanism, environmental exposure, load environment, previous repairs and urgency.
Operational consequence	Downtime cost or consequence, route dependency, safety impact, logistics impact, energy or utility continuity relevance and required reopening window.
Proposed UHPC role	Intended function of Steelike UHPC, target area, approximate thickness or geometry, expected performance requirement and interface assumptions.
Validation and approvals	Applicable standards, owner requirements, tests required, third-party review needs, sign-off route and documentation expectations.

Core message

A project should move toward Steelike UHPC only when the technical case is sufficiently clear to define what the material must do, how it will be validated, how it will be executed, and how the owner will accept it.


Asset Information
Damage & Exposure
Steelike UHPC
Proposed UHPC Role
Operational Consequence
Validation & Approvals

Next Step: Technical Dialogue and Feasibility Review

Critical infrastructure projects should not move directly from interest in UHPC to the specification stage. The next right step is a structured technical dialogue.

CNT Plus, powered by STEELIKE, supports owners, engineering consultants, contractors, operators, and public-sector stakeholders in identifying where Steelike UHPC may be technically relevant, economically justified, and suitable for controlled validation.

The first discussion should focus on the asset, not the material: what is failing, why it matters, what happens if the asset remains unavailable, what exposure controls degradation and what evidence is required before reopening or approval.

Only after asset risk, Steelike UHPC role, execution route and validation pathway are understood should the project move toward feasibility review, pilot testing or specification.

Discuss > Screen > Validate > Specify > Deploy > Document

Asset problem | Role and consequence | Evidence and testing | Controlled acceptance | Execution and QA/QC | Handover and lifecycle

For a feasibility review, *CNT Plus* typically needs:

- asset type, location and operational function
- downtime constraints and reopening expectations
- photos, drawings, inspection reports or condition surveys
- intended Steelike UHPC role
- damage mode, degradation mechanism and repair history
- applicable standards, owner requirements or approval constraints
- exposure conditions and load requirements
- expected validation, testing and handover route

Contact

CNT Plus
Steelike UHPC systems for resilient infrastructure | www.cnt.gda.pl

***CNT Plus* sp. z o.o.** | ul. Leśna 7, 83-010 Straszyn, Poland

Przemyslaw Kerczuk | CEO | przemyslaw.kerczuk@cnt.gda.pl | +48 533 325 241

Maciej "Magic" Winnicki | Business Development Director, EMEA | maciej.winnicki@cnt.gda.pl | +44 (0) 730 868 7251