Policy Gap Analysis for Resilient Infrastructure Materials

Final Report

September 30, 2025

RISK + RESILIENCE TECH HUB

1. Introduction

An objective of the Risk + Resilience Tech Hub (RRTH) is to accelerate the adoption of innovative infrastructure technologies that increase resiliency. However, building codes and specifications—at the national, local, and project level—can restrict or slow the implementation of new materials and construction technologies. Therefore, this policy gap analysis evaluates how codes and specifications limit innovation for materials that improve resiliency. We make recommendations for how policy makers and specification writers can improve the codes and specifications and the process for writing and revising them to accelerate innovation while ensure safe, strong, durable, and resilient construction.

The policy gap analysis focuses on concrete, due to its wide use as an infrastructure material. However, many of these same policy gaps exist for other materials. While the analysis focuses on the four counties within the Tech Hub region (Monroe, Miami-Dade, Broward, and Palm Beach), many of the identified issues apply nationally.

2. About the Risk + Resilience Tech Hub

The Risk + Resilience Tech Hub (RRTH) advances South Florida's global economic leadership in resilient infrastructure by setting a new standard for next generation technology that cuts costs and protects people and property against the risk of extreme events. Building on the region's unique resources including its cluster of clean cement companies, expertise in coastal and marine infrastructure, resilient energy industries, and academic and research institutions, the RRTH jumpstarts innovation through the development, commercialization, and scaling of risk management technologies for national security alongside domestic and international commercial markets worth over $1 trillion. The U.S. Economic Development Agency (EDA) designated the South Florida Risk + Resilience Tech Hub as one if its 31 Tech Hubs across the United States, and one of 12 that was funded.

3. Research Methods Utilized

The policy gap analysis conducted the following to develop this report:

- Reviewed codes and specifications at the local, state, and national level.
- Conducted an email survey of municipal officials in the Risk + Resilience Tech Hub region.
- Conducted follow-up interviews with selected email survey respondents.

4. Codes, Specifications, and Procurements

Requirements for construction materials and methods are contained in codes, specifications, and procurement documents. Figure 1 summarizes how requirements for buildings are established starting nationally and then ultimately for an individual project through a series of codes, specifications, and procurements.

The building code is at the center of the process and is the law established by a local or regional jurisdiction that sets minimum requirements for construction or modification of buildings. It includes requirements to assure public life-safety. Specifications set additional requirements on materials, systems, and construction means and methods that are in addition to the building code. Once specifications are established, they are used in a procurement process to select the specific suppliers and vendors for a building project.

Building codes are set at a local level but are generally based on nationally-developed Model Codes, such as the International Building Code (IBC) developed by the International Code Council (ICC). These model codes typically reference standard codes and specifications that are created by standards organizations such as the American Society of Civil Engineers (ASCE), ASTM International, American Concrete Institute (ACI), and the American Institute for Steel Construction (AISC). These standards organizations consist of (generally volunteer) subject matter experts and follow consensus-based processes in accordance with American National Standards Institute (ANSI) requirements. The Model Codes are used as a basis for setting state codes, such as the Florida Building Code developed by the Florida Building Commission, which are then adopted at the local government level by Building Departments that set requirements that must be followed when applying for a building permit or inspection. Local and project-specific specifications may also refer to Reference Standards.

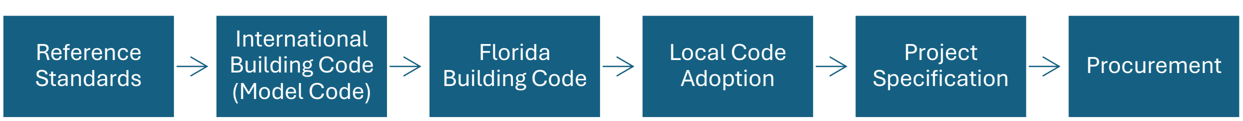

Figure 1: Typical hierarchy for codes and specifications for buildings.

While the Florida Building Code establishes the baseline construction standards statewide—covering structural design, materials, energy efficiency, and safety—Miami-Dade County enforces additional requirements due to its designation as a High Velocity Hurricane Zone (HVHZ). As a result, all building envelope materials, including windows, doors, shutters, and roofing systems, must obtain a Notice of Acceptance (NOA) from the county's Product Control Section. This certification ensures that materials meet rigorous performance criteria, such as impact resistance and wind load capacity. To qualify for use in the HVHZ, materials must undergo testing in accordance with specific standards, including TAS 201 (Impact Testing), TAS 202 (Cyclic Wind Pressure Loading), and TAS 203 (Uniform Static Air Pressure Difference), which are essential for assessing their performance under hurricane conditions.

Aside from buildings, other standards relevant to infrastructure include:

- The Florida Department of Transportation (FDOT) establishes comprehensive guidelines for construction materials through its Standard Specifications for Road and Bridge Construction, which are updated annually to reflect current engineering practices and regulatory requirements. These specifications encompass a wide range of materials, including concrete, asphalt, and steel, ensuring that all components meet stringent quality and performance criteria.
- Uniform Guide Facility Specifications (UFGS), developed by the US Army Corps of Engineers, Naval Facilities Engineering System Command, and Air Force Civil Engineering Command sets requirements for construction for the US military.
- ACI 350-20: Code Requirements for Environmental Engineering Concrete Structures sets requirements for environmental structures such as containment structures for "conveying, storing, or treating liquid or other materials such as solid waste" and typically include water and wastewater treatment facilities.

5. Landscape of Specifying Entities

There are numerous entities that set specifications at the project level, both for private and public projects, as well as the standards and requirements that these project specifications reference. The following indicate a selection of standards at various levels.

5.1. National Level

- **U.S. Army Corps of Engineers (USACE)** – Provides engineering standards, project specifications, and material selection guidance for federal and federally funded projects.

- **ASTM International** – Develops consensus standards for material testing and performance (e.g., concrete, asphalt, metals).
- **ANSI / ISO Standards** – International and U.S. standards influencing construction materials and testing methods.

5.2. State Level

- **Florida Building Code (FBC)** – Baseline statewide construction standards covering structural design, materials, energy efficiency, and safety.
- **Florida Department of Transportation (FDOT)** – Standard specifications for Road and Bridge Construction, material selection, and testing protocols.
- **Florida Department of Environmental Protection (DEP)** – Material standards for projects impacting water, wetlands, and environmental sustainability.

5.3. County/Local Level

- **Miami-Dade County Code of Ordinances** – Local construction regulations and amendments to the FBC.
- **Product Control Section (Miami-Dade County)** – Approves building envelope materials (windows, doors, roofs) via Notice of Acceptance (NOA) process.
- **Miami-Dade County Public Works/Engineering Department** – Oversees specifications for public works and infrastructure projects.

5.4. Industry & Professional Bodies

- **American Concrete Institute (ACI)** – Guidelines for concrete mix design, durability, and testing.
- **Cement and Concrete Associations (e.g., ACA, NRMCA)** – Provide best practices and recommended specifications.
- **Manufacturers & Material Suppliers** – Provide technical data and performance certifications that influence specification decisions.
- **MasterSpec** – Created by the American Institute of Architects (AIA), these establish a standard format used by most construction specifications.

Within the four counties of the RRTH, each of the four counties has departments that are responsible for construction, either by the public or by and/or for the department. In addition, there are multiple cities and towns that have the same versions of these departments. See Table 1 for a partial listing.

Table 1: Entities in RRTH region with departments that set requirements for construction.

County	Monroe	Miami Dade	Broward	Palm Beach
County-Wide	Monroe County	Miami-Dade County	Broward County	Palm Beach County
Major Cities and Towns	Marathon Key Largo Islamorada Key West	City of Miami North Miami Miami Beach Coral Gables Doral Hialeah Homestead Miami Gardens North Miami Beach Kendall	Fort Lauderdale Pembroke Pines Hollywood Weston Miramar Coral Springs Davie Plantation Pompano Beach Deerfield Beach	West Palm Beach Boca Raton Boynton Beach Lake Worth Beach Wellington Delray Beach

Some of the major departments common in each county and city or town are as follows:

- Building Department – These departments are responsible for setting building code requirements, issuing building permits, and performing inspections.
- Operational Departments – Build and improve facilities and infrastructure for fulfilling their missions.
  - Schools
  - Airport Authority
  - Public Works and Transportation
  - Public Housing
  - Water and Sewer
  - Parks and Recreation
- Environment, Sustainability, Resiliency – While these and similar departments often do not build directly, they advise operational departments on requirements and best practices for building.

- Procurement – Set additional requirements for materials and construction beyond specifications and codes.
  - Architecture, Engineering, Design
  - Construction Services
  - Testing and Inspection Services

Within the procurement process on a project, there are many entities involved from the ultimate owner of the project to the supplier of the raw materials used on the project. A typical representation is shown in Figure 2 for commercial construction. This greatly complicates the selection of new materials and other construction technologies, as multiple parties must be aligned.

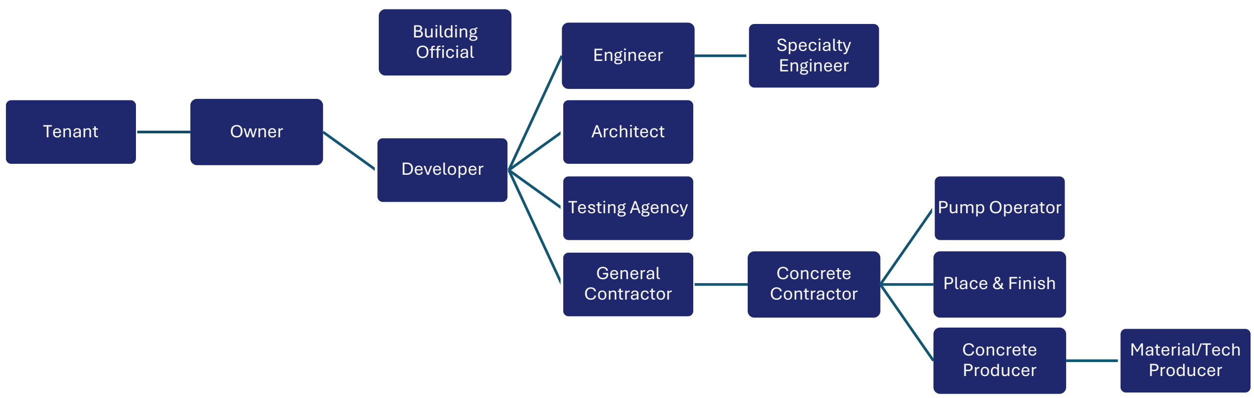

Figure 2: Typical construction value chain for commercial construction

6. Policy Gaps and Challenges

6.1 Potential Technologies

Innovative infrastructure technologies generally fall into one or more categories:

- **Technologies that meet Code, standard specifications, and project specifications.** These can technically be used on the project. However, they may be less preferred due to factors such as unfamiliarity within the project team, limited time for evaluation, or a perception of greater risk.
- **Technologies that meet code and standard specifications but not project specifications**. For example, the Florida Building Code permits the use of cements meeting ASTM C1157 (Standard Performance Specification for Hydraulic Cement). However, many specifications only allow cements that meet ASTM C150 (Standard Specification for Hydraulic Cement). ASTM C1157, which is a performance-based specification, allows a wide range of cement compositional characteristics while still

requiring performance testing, thereby allowing more innovative materials, compared to the prescriptive ASTM C150.

- **Technologies that do not meet code and standard specifications.** Changes to codes and specifications can take many years. There are processes for alternative acceptance of materials that do not meet building codes and standard specifications, but this requires complex and extensive testing that can take multiple years and must be repeated for multiple organizations.
- **Technologies that contribute special attributes.** Examples include properties related to resiliency, circularity, emissions reduction, and life cycle impacts. Challenges include measurement, reporting, and verification (MRV) of these attributes and demonstrating the benefits relative to a business-as-usual baseline. Some technologies that contribute these special attributes that are desired by owners and specifiers may not meet existing codes and specifications.

6.2 Potential Challenges and Gaps

Some specific challenges identified in the policy gap analysis include:

- **Significant time for changes made to national standard codes and specifications to take effect at an individual project level.** For example, as of September 2025, the current version of the Florida Building Code was published in 2023 and is based on the 2021 International Building Code, which references the 2019 ACI 318 Building Code, representing a 6-year gap. The ACI 318 building code is updated every 3 to 5 years, which means most changes to this document began as early as 2014. Therefore, changes to ASTM standards referenced by ACI 318 would have started prior to 2014. This means that new referenced standards, such as ASTM standards, would likely require more than a decade to take effect locally within the Florida Building Code.
- **Infrequent update of national specifications.** As mentioned previously, many national and state level codes and standard specifications are updated on a 3-to-5-year cycle. These specifications are maintained by committees of subject matter experts that serve on a part-time basis and are often unpaid.
- **Infrequent updates of local or project specifications.** Local and project specifications are issued frequently for new projects, they are not typically comprehensively updated. In many cases, the Policy Gap Analysis team found specifications that are more than 20 years old (see Appendix).

- **Specifications requiring special attributes without expanding the range of materials that can be used to achieve these attributes.** For example, some specifications set requirements for reduced embodied emissions of materials, but require the use of conventionally specified materials that do not meet the embodied emissions requirements.
- **Specifications referencing older versions of standards.** Standards that are updated on a regular basis typically include a year designation. For example, the current version of ASTM C94/C94M-25 (Standard Specification for Ready Mix Concrete) includes “25” to designate the 2025 version. Individual specifiers can reference either a specific version (e.g. ASTM C94/C94M-25) or simply refer to the latest version. The policy gap analysis found examples of specifications that reference ASTM standards that are more than 20 years old and that have been revised many times since then.
- **Use of prescriptive instead of performance specifications.** Prescriptive specifications require the use of specific materials, products, or means and methods. Performance specifications allow a wider range of materials, products, or means and methods while ensuring relevant performance.
- **Lack of available data to support changes.** Although there are established processes in some departments and via the International Code Council to permit the evaluation of alternative materials, these may require extensive long-term exposure data or field service record, which new materials may not have. The amount of testing required or the time to perform the testing may be prohibitive for many startups.
- **Large number of entities responsible for specifications.** As described in the previous section, there are numerous specifiers maintaining unique specifications. Addressing each one individually is prohibitive, especially for start-ups with limited resources.
- **Lack of coordination between municipalities and departments.** Many departments maintain their own specifications, despite having similar requirements to other departments and municipalities. For example, a common specification for public works across the RRTH region could be feasible.

See the Appendix for a review of two selected specifications from within the RRTH region that illustrate some of these policy gaps.

7. Recommendations

The following are recommended policy actions to accelerate the adoption of innovative resilient materials and systems.

1) Accelerate the time to implement state-of-the-art codes and specifications.
   - Specification writers should reference the latest version of standards when possible. For concrete, this includes codes and specifications published by ACI, ASTM, and AASHTO. Avoid using a year designation of reference codes and specifications unless there is a need to invoke a certain historical provision.
   - Agency leaders should establish a cadence for making updates to codes and specifications. For example, FDOT updates their standard specifications once per year and adopts special provisions in the interim.
   - Agency leaders should facilitate the sharing of specifications across agencies and projects.
   - Funding authorities should ensure sufficient funding and resources are available to agencies to make these updates.
   - Specification writers and building officials should reference standards wherever possible and not implement requirements that are more restrictive than state or national requirements unless there is a specific reason to do so.
   - Agency leaders should have designated employees who lead code/specification update efforts as part of their job description.
2) Use performance-based specifications.
   a. Specification writers should establish requirements based on industry standard performance tests, such as those for strength and durability, and avoid use of prescriptive requirements, such as material type or chemical properties.
   b. Specification writers should establish performance requirements on the end product or system level instead of the individual material or constituent.
   c. Specifications writers should consider the life cycle analysis when considering relevant performance requirements.
   d. Specification writers should avoid requirements on means and methods.

3) Create, publicize, and implement processes for evaluating materials and systems that do not meet existing specifications, especially national specifications.
    a. Agencies should establish a process where the public can submit materials and systems that do not meet existing specifications.
    b. Specifications writers should allow substitutions that demonstrate equivalent performance utilizing established test methods were possible.
    c. Policy makers should ensure departments, agencies, cities, and counties have a coordinated process so that alternate materials do not need to go through multiple substantially identical evaluations.
    d. Policy makers should establish test beds/demo projects for use of novel materials and systems in low-risk settings where results can be monitored over time. Approval processes for such test beds/demo projects should be straightforward.
    e. Policy makers should ensure adequate funding for agency and project-level initiatives.
    f. Risks should be clearly identified to determine the party responsible for those risks and how those risks can be addressed.
4) Create, publicize, and implement processes for ensuring special performance, such as resiliency, circularity, and emission reduction.
    a. Policy makers should establish clear metrics for priorities such as resiliency, circularity, and other aspects.
    b. Specification writers should ensure that codes and specifications do not restrict the use of materials and systems that can enable special performance while still meeting other performance needs such as strength and life-safety. For example, specifications that require an improvement in performance but require use of legacy materials should be avoided.
    c. Procurement departments should consider life-cycle analysis—considering design, construction, use and end-of-life phases.
    d. Specification writers should use industry standard methodologies, where available, to evaluate special performance. Where established methodologies do not exist, special tests may be considered. Examples include Environmental Product Declarations developed in accordance with ISO standards.

8. Appendix

8.1. Email Survey

Survey on Municipal Construction Material Standards & Policies

Estimated Completion Time: 5–10 minutes

Purpose: This survey supports a regional policy gap analysis being conducted by the Risk + Resilience Tech Hub with support from partners across South Florida. The goal is to assess how cities with counties evaluate and incorporate new construction materials (e.g., concrete, steel, asphalt, aggregates, and glass) in public and private projects.

Your input will be very much appreciated. Thank you in advance for your time.

1) Full Name
2) Title
3) City/County
4) Department Name
5) Does your department maintain standard specifications for materials such as concrete, steel, asphalt, aggregates, glass etc.?
    a. Yes
    b. No
    c. Unsure
    d. In Progress
6) If yes, please upload the standard(s) used or share sample specifications from recent projects.
7) How and how often does your department update material specifications?
8) How are now construction materials evaluated or approved for use?
9) Which codes and standards do you reference in material selection or construction design?
    a. Florida Building Code
    b. ASTM
    c. FDOT
    d. LEED

    e. MasterSpec
    f. Not applicable
    g. Other

10) Do you consider any of the following life cycle factors in evaluating materials?
    a. Durability
    b. Environmental sustainability
    c. Maintenance costs
    d. Total life cycle cost
    e. Recyclability or reusability
    f. Availability/supply chain risk
    g. Not applicable
    h. Other
11) Are your codes and material standards aligned with nearby municipalities in South Florida?
    a. Yes
    b. No
    c. Partially
    d. Unsure
    e. Not applicable
12) If yes or partially, please list which codes
13) Are there additional requirements for materials used in private construction beyond what's required in the Florida Building Code?
    a. Yes
    b. No
    c. Unsure
    d. Not applicable
14) If yes, please explain
15) Would you be open to a 30-minute meeting with our Tech Hub Policy Gap team to discuss these topics in more detail?
16) Any additional comments/questions?

9. Specification Reviews

9.1. MDWASD (Accessed Online September 19, 2025)
https://www.miamidade.gov/global/service.page?Mduid_service=ser148156625339722
Section UC-033 – Concrete Mortar and Grout (Short)

- The current version available on the Miami-Dade County website as of September 2025 was from June 2005, which is more than 20 years old.
- Section 2.01.A.1 requires that 4,000 psi concrete use 564 pounds per cubic yard of Type I Portland cement and use a water/cement ratio to achieve a slump of 4 +/- 1 inch. Similar requirements are set for other classes of concrete, such as sidewalk and tremie concrete. These are prescriptive requirements on composition that limit what materials can be used and do not set criteria for evaluating performance.
- Section 2.01.A.1 sets requirements based on 28-day strengths. Some emerging materials gain strength at a slower pace and should be evaluated at 56 or 91 days, which is more representative of the in-service performance of the concrete.
- Section 2.01.B.1 requires use of Type I or Type II cement meeting ASTM C150 and requires that cement be produced within the continental United States. According to the USGS, which tracks cement use nationally, only 21% of the cement used in Florida meets ASTM C150. Therefore, this specification prohibits the use of the most widely used types of cement in Florida, namely those classified under ASTM C595 as blended cement.
- Section 3.02A sets a maximum mixing time of 30 minutes unless otherwise approved by the Engineer of Record. The latest version of ASTM C94 does not have a mixing time and includes the following statement to explain the reason:

  > NOTE 10—This specification previously included a 1 1⁄2 h time limit to end of discharge since its original publication in 1935. There are many options available to the producer to provide the required quality of concrete with end of discharge limits beyond 1 1⁄2 h or less than 1 1⁄2 h. The purchaser should consult with the producer for available options to establish a time limit to end of discharge prior to or at the time concrete is ordered. Selection of a time limit to end of discharge should consider ambient conditions, types of cementitious materials and admixtures used, placement procedures, and projected transportation time between the batch plant and the point of delivery.

Section 03300 – Cast-In-Place Concrete, Reinforcing, and Formwork

- The current version available on the Miami-Dade County website as of September 2025 was from May 2009, which is more than 16 years old.
- Section 1.03 references certain ACI standards from 1990, 1995, and 1996. These should reference the latest versions of the documents.
  - ACI 301-96 Specifications for Structural Concrete (Current Version is 2020)
  - ACI 318-95 Building Code Requirements for Reinforced Concrete (Current Version is 2025)
  - ACI 117-90 Standard Specifications for Tolerances for Concrete Construction and Materials (Current Version is from 2010)
- Section 2.01.A.1 requires the use of ASTM C150 Type I or Type II cement only. The cement must be domestically produced. As stated previously, this requirement prohibits the use of the most widely used cement in Florida.
- Section 2.01A.2 only permits fly ash and slag as mineral admixtures, and sets limits on the amount as 20 and 30%, respectively. There are new mineral admixture (also known as supplementary cementitious materials, SCMs) such as natural pozzolan and calcined clay that offer equal or better performance. The limits on quantities are prescriptive requirements instead of performance requirements. The slag must meet the 1993 version of ASTM C989, while the current version of this standard is from 2025. Limits on fly ash and slag content are typically due to freezing-and-thawing conditions, which are not relevant in Florida.
- Section 3.02.C.2.b.2 requires use of a specific admixture, or approved equal, for concrete exposed to salt or brackish water. The named admixture is no longer commercially available and no criteria are established for establishing equivalency to a product that no longer exists. The basis for why this specific admixture is needed is not clear and likely outmoded, as many other admixtures are used in concrete exposed to salt or brackish water.
- Multiple sections set a maximum water-cement ratio, which is a prescriptive and not performance requirement.
- Section 3.02.C.2.b.2 sets a maximum slump and water content. This is related to contractor means and methods and does not affect the long-term performance of the concrete. Therefore, it should not be set in the project specifications.

- Section 3.02 requires ferrous reinforcement. This does not allow substitution of innovation fiber reinforcement polymer reinforcement.

9.2. School Board of Broward County Design Standards (Accessed Online September 19, 2025)

http://www.broward.k12.fl.us/constructioncontracts/DivisiononeDesignStandards.html

The County website states the following: “Project Consultants shall use the Design and Material Standards as master guide documents for their Construction Specifications. Project Consultants shall amend the D&MS as necessary to be project specific.”

Section 03300 Cast-in-Place Concrete

- This section was last revised 3/15/22, which is more than 3 years old.
- Cites ASTM C150 but not ASTM C595 and ASTM C1157. As previously discussed, these restrict the use other cements that are more widely used today.
- Cites ISO 14021-1999 for “Environmental Labels and Declarations”. The requirements for Environmental Labels and Declarations are being frequently updated and a reference to a standard from 1999 is outdated.
- Requires reporting of environmental attributes, such as recycled content and use of regional materials, but severely limits the range of materials that can be used, such as the requirement to use ASTM C150 cements.
- Section 2.1 A requires only use of ASTM C150 Type I or Type II cement, although ASTM C595 cements are the most widely used in Florida and are capable of meeting the same performance requirements.
- Limits fly ash and slag to 20 and 30% of the cementitious material, respectively. As discussed previously, these are prescriptive limits and restrict the achievement of other goals in the specification, such as use of recycled materials and achieving of LEED criteria. These limits are typically implemented due to freeze-and-thawing conditions, which is not relevant in South Florida.
- Section 2.1.F cites multiple admixture products that are no longer on the market.
- Section 2.3C sets slump limits. As stated previously, slump is related to concrete means and methods and does not affect long term performance of the concrete.