ADVANCING STANDARDS
TRANSFORMING MARKETS

EMERGING AIRSPACE

HEALTH AND SAFETY

BUILT ENVIRONMENT AND INFRASTRUCTURE SYSTEMS

ADVANCED MANUFACTURING

CLEAN ENERGY AND DECARBONIZATION TECHNOLOGY

Standardization Impact Report

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Built Environment and Infrastructure Systems

RELEVANT ASTM COMMITTEES

Committee A01 on Steel, Stainless Steel and Related Alloys

Committee C01 on Cement

Committee C09 on Concrete and Concrete Aggregates

Committee C11 on Gypsum and Related Building Materials and Systems

Committee C24 on Building Seals and Sealants

Committee D07 on Wood

Committee D18 on Soil and Rock

Committee D19 on Water

Committee D20 on Plastics

Committee D34 on Waste Management

Committee E05 on Fire Standards

Committee E06 on Performance of Buildings

Committee E17 on Vehicle-Pavement Systems

Committee E35 on Pesticides, Antimicrobials, and Alternative Control Agents

Committee E50 on Environmental Assessment, Risk Management and Corrective Action

Committee E53 on Asset Management

Committee E60 on Sustainability

Committee F42 on Additive Manufacturing Technologies

The global population continues to grow, spurring the demand for new housing and infrastructure. However, the construction industry has a large carbon footprint, generating a significant amount of waste. To counter this, the industry is refocusing on sustainability as a critical goal. Communities also face challenges from extreme weather events and droughts. In the face of these events, there is a need for increased emphasis on resilience of the built environment and globally sustainable practices for water stewardship.

In addition, new construction methods and materials are being explored to increase recycling and decrease carbon emissions. Likewise, innovations such as permeable concrete for stormwater management and nature-based solutions to protect infrastructure offer ways to increase community resilience. New standards, codes, and regulations will be needed to accelerate and support the safe adoption of new technologies and materials. Education and training for communities in their use will be critical next steps to adoption.

Built Environment and Infrastructure Systems
Construction

There is a current global demand for housing, driving an enormous surge in construction. This has created an urgent need for faster innovation, more materials, and stronger standards than ever before. The construction sector currently accounts for nearly 40% of all carbon dioxide (CO_2) emissions in the United States,[1] and nearly 40% of global energy and process-related CO_2 emissions.[2] In addition, construction accounts for an estimated one-third of global waste,[3] and roughly half of all extracted material resources are used in the built environment.[4] In response to these challenges, sustainability has become a key issue in the construction industry. New, lower-carbon building materials and innovative construction methods such as 3D printing are gaining traction as potential pathways to decrease carbon emissions and increase recycling of materials.

FUTURE OF CONSTRUCTION

ASTM NEWS STORIES

- 3D Printing Transforms Construction
- New Concrete, New Standards
- Standards Enable Construction Innovation
- A New Way to Build
- The Shape of Concrete to Come
- New Cementitious Materials Aid in the Quest for Net-Zero

ADDITIONAL RESOURCES

- Advances in Civil Engineering Materials Journal
- Roadmap on Advanced Technologies for Digitalization of the Construction Industry

U.N. Sustainable Development Goals Supported

MARKET GROWTH

The global market for sustainable construction materials is projected to grow from $270B in 2020 to $711B by 2030.[5] Another projection suggests this market will be worth nearly $940B by 2030.[6]

CIRCULAR ECONOMY FOR THE CONSTRUCTION INDUSTRY

Wastage of Potentially Reusable Materials. More than 85% of construction and demolition waste debris comprises concrete and asphalt concrete.[7] An estimated 75% or more of construction industry waste has a residual value but is not recycled or reused due to the lack of a circular economy framework.[8]

Potential to Lower Emissions Through Reuse. According to the Ellen MacArthur Foundation, implementing circular economy principles in the construction industry could reduce global CO_2 emissions from building materials by 38%, or 2B metric tons by 2050.[9]

DECARBONIZATION OF BUILDINGS

Need to Reduce Building CO_2 Emissions. To achieve 2050 net zero carbon emissions goals, the International Energy Agency (IEA) says that direct building CO_2 emissions will need to decrease by 50% by 2030.[10]

Construction Emissions Trending in the Wrong Direction. CO_2-eq (CO_2 equivalent of all greenhouse gas emissions) from global construction currently comprise 28% of total new building emissions and are projected to increase to 50% of total new building emissions by 2050.[11]

EXAMPLES OF LOW CARBON CONSTRUCTION MATERIALS

Mass Timber. Mass timber—or cross-laminated timber (CLT)—could reduce the "global warming potential" of buildings by an average 26.5% compared with traditional concrete-constructed buildings.[12] The use of prefabricated mass timber slabs can reduce material waste, speed up construction by an average of 25%, and reduce construction traffic by 90%.[13]

Nanocellulose. Cellulose—the world's most abundant organic polymer[14]—has various attributes that lend itself to sustainable building, including resistance

Built Environment and Infrastructure Systems
Construction

to mold and fire, as well as airtightness,[15] which makes it a potential thermal insulator.[16] Although commercial applications are currently limited, nanocellulose and other bio-based materials[17] are the subjects of extensive studies to develop sustainable bio composite materials for construction and many other next-generation applications.[18]

Reduction of High-Carbon Ingredients. Substituting a key ingredient[19] in cement production known as clinker with new sources of supplementary cementitious materials (SCMs) or alternative fillers could contribute to decarbonization goals.[20]

Need for Energy Solutions. Due to the large thermal energy demands for making cement, fossil fuel alternatives or new technologies will likely still be needed to achieve full decarbonization of cement production.[21]

Digital Tools Can Help Enable Decarbonization. Digital tools could play a key role in enabling decarbonization through functions such as oversight of transportation and quarry operations, predictive analytics in clinker and cement production, and guided decision-making for optimized concrete mixing.[22]

Support from the U.S. General Services Administration (GSA). The GSA announced in 2022 that it would use the federal government's purchasing power to support the deployment of low-carbon concrete and other next-generation sustainable products.[23]

ASTM IMPACT ACTIVITY E60 Sustainability Roundtable		ASTM convened its E60 Sustainability Roundtable to apprise other committees on the status of E60's activities and to support their sustainability efforts. Interested parties from across the manufacturing sector were invited to identify the standards required to help extend the life and enhance the recovery of materials and products through reuse, repair, remanufacturing, and recycling (i.e., a circular economy).
ASTM IMPACT ACTIVITY Collaboration with U.S. Environmental Protection Agency (EPA)		E60 is collaborating with the U.S. Environmental Protection Agency to draft new resilience-based standards.
ASTM IMPACT ACTIVITY ASTM International and NEU Sign Memorandum of Understanding		ASTM International and NEU, An ACI Center of Excellence for Carbon-Neutral Concrete have signed a memorandum of understanding (MoU) aimed at reducing and eliminating the carbon footprint of concrete in the built environment. Learn more.
RELEVANT ASTM STANDARD Standard Classification System for Specifying Plastic Materials	D4000	The purpose of this classification system is to provide a method of adequately identifying plastic materials in order to give industry a system that can be used universally for plastic materials. It further provides a means for specifying these materials by the use of a simple line call-out designation.

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Construction

RELEVANT ASTM STANDARD (HIGH IMPACT) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m$_3$))	D698	These test methods cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils (compaction curve) compacted in a 4 or 6-in. (101.6 or 152.4-mm) diameter mold with a 5.50-lbf (24.5-N) rammer dropped from a height of 12.0 in. (305 mm) producing a compactive effort of 12 400 ft-lbf/ft^3 (600 kN-m/m$_3$).
RELEVANT ASTM STANDARD (HIGH IMPACT) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m$_3$))	D1557	These test methods cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils (compaction curve) compacted in a 4- or 6-in. (101.6- or 152.4-mm) diameter mold with a 10.00-lbf. (44.48-N) rammer dropped from a height of 18.00 in. (457.2 mm) producing a compactive effort of 56 000 ft-lbf/ft^3 (2700 kN-m/m$_3$).
RELEVANT ASTM STANDARD Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings	E1971	This guide provides a basic reference for the development and preservation of a building environment that is considered safe and healthy for occupants, while reducing the stress on the overall environment as a result of routine maintenance.
RELEVANT ASTM STANDARD Standard Practice for Data Collection for Sustainability Assessment of Building Products	E2129	A practice for data collection for the purpose of assessing the sustainability of building products. Such data can inform decisions relative to construction, renovation, repair, and maintenance of buildings with the goal of promoting sustainability and sustainable development.
RELEVANT ASTM STANDARD Standard Guide for General Principles of Sustainability Relative to Buildings	E2342	This guide covers the fundamental concepts and associated building characteristics for each of the general principles of sustainability.
RELEVANT ASTM STANDARD (HIGH IMPACT) Standard Test Methods for Determining the Biobased Content of Solid, Liquid, and Gaseous Samples Using Radiocarbon Analysis	D6866	This is a test method that teaches how to experimentally measure biobased carbon content of solids, liquids, and gaseous samples using radiocarbon analysis.
RELEVANT ASTM STANDARD (HIGH IMPACT) Standard Specification for Labeling of Plastics Designed to be Aerobically Composted in Municipal or Industrial Facilities	D6400	The purpose of this specification is to establish standards for identifying products and materials that will compost satisfactorily in commercial and municipal composting facilities.

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RELEVANT ASTM STANDARD Standard Specification for Evaluation of Structural Composite Lumber Products	D5456	This standard provides specifications for evaluating structural composite lumber, which includes mass timber elements like cross-laminated timber (CLT).
RELEVANT ASTM STANDARD Standard Performance Specification for Hydraulic Cement	C1157	This performance specification classifies cements based on specific requirements for general use, high early strength, resistance to attack by sulfates, and heat of hydration.
RELEVANT ASTM STANDARD Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete	C618	This specification addresses the use of fly ash in concrete. Utilizing fly ash as a supplementary cementitious material in concrete can reduce the carbon footprint of concrete production.
RELEVANT ASTM STANDARD Standard Specification for Slag Cement for Use in Concrete and Mortars	C989	This specification covers three strength grades of finely ground granulated blast-furnace slag (Grades 80, 100, and 120) for use as a cementitious material in concrete and mortars. Similar to fly ash, slag can be used as a substitute for some portion of Portland cement, reducing emissions.
RELEVANT ASTM STANDARD Standard Specification for Blended Hydraulic Cements	C595	This specification pertains to blended hydraulic cements for both general and special applications, including specifications for different types of blended cements that can help reduce the carbon intensity of concrete.
STANDARD IN PROGRESS Standard Guide for Principles for Circular Product Design	WK83603	These proposed principles will provide guidelines and supplementary context for product designers to better understand, apply, and qualify design decisions advantageous for the introduction of products to the Circular Economy.
STANDARD IN PROGRESS New Guide for Circular Plastics	WK87117	This proposed guide covers general guidance, requirements, terms and definitions to assist in the development, manufacturer and recovery of plastics within the circular flow of resources. The standard covers plastics, components, compounding ingredients, inputs, and all materials associated with the manufacture or recovery of plastic.

Built Environment and Infrastructure Systems
Building and Infrastructure Resilience

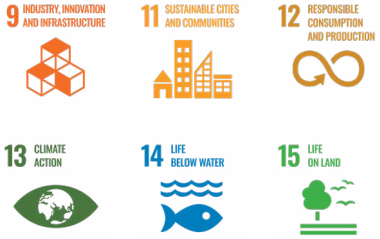
Community resilience is closely tied to the built environment, including infrastructure systems such as water, electricity, and power.[24] With extreme weather events expected to increase in the coming decades, it is increasingly important to design buildings and infrastructure to limit, prevent, and withstand exposure to natural hazards and to equip communities to rapidly recover and restore services after an incident. Many of the design practices, codes, standards, and regulations currently in use were developed independently of one another, resulting in inconsistent performance in response to hazard events. In addition, current design practice often does not account for changing environmental conditions.[25] Harmonized activity is needed to promote adaptation of built structures for anticipated future changes such as sea-level rise in coastal communities and increased frequency of wind or flooding events.[26]

FUTURE OF BUILDING AND INFRASTRUCTURE RESILIENCE

ASTM NEWS STORIES

- Resilience = Durability + Sustainability
- Standards and the SEC's Proposed Climate Disclosure Rules
- Identifying PFAS and Aluminum Contamination in Water
- Case Study on Standards: Infrastructure
- Revised Liability and Climate Change Disclosures Standards
- Financial Disclosures Related to Climate Change
- Climate and Community Standards
- Building to Weather the Storm
- A Road Map to ESG
- New Standard Supports Karst Terrain Real Estate Assessment
- Standardizing Sustainability for Today and Tomorrow

U.N. Sustainable Development Goals Supported



INCREASED SEVERITY AND FREQUENCY OF EXTREME WEATHER IN THE UNITED STATES

Rising Costs. Since 1980, there have been 330+ weather-related disasters that reached or exceeded $1B in damages, with total costs exceeding $2.295T.[27, 28] The average annual cost of these disasters is also significantly increasing; for example, the average costs have risen $18.4B between 1980–1989 to $84.5B between 2010–2019.[29, 30]

Sharp Increase in Frequency. The frequency of extreme weather events is increasing; the annual average from 1980 to 2020 was 7.1 events, and the annual average for 2016 to 2020 was more than double that at 16.2 events.[31, 32]

U.S. CITY INFRASTRUCTURE NEEDS EXCEED AVAILABLE FUNDING

In a 2021 survey of local city leaders, 9 out of 10 U.S. cities indicated that insufficient funding was the most important factor in infrastructure decision making.[33] The Kinder Institute for Urban Research at Rice University estimates that there is approximately $660B in local infrastructure needs, with demand far exceeding available resources.[34]

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE) IDENTIFIED RESILIENCE AS A KEY NEED

ASCE's recommendations included integrating projections about climate into long-term goal setting and capital improvement plans, incentivizing and enforcing the use of building codes and standards, and adopting nature-based infrastructure solutions that reduce negative impacts on the environment.[35]

DROUGHT RESILIENCE

Increasing Frequency and Impact of Droughts. Globally, the number and duration of droughts have increased 29% since 2000.[36] Droughts have led to $124B in global economic losses between 1998 and 2017.[37]

Vulnerable Communities Anticipate Inability to Meet Water Needs. Due to population growth, water scarcity, and water quality issues, many communities are projecting an inability to accommodate future water needs.[38, 39]

Built Environment and Infrastructure Systems
Building and Infrastructure Resilience

UN Projects Severe Consequences if No Action Is Taken
- 700M people could be at risk of displacement by drought by 2030.[40]
- One in four children will live in areas with extreme water shortages by 2040.[41]
- Droughts may affect three-quarters of the world's population by 2050.[42]

U.S. 2021 Bipartisan Infrastructure Law Will Support Resilience Projects. This law allocates $210M for projects to improve water infrastructure and drought resilience in the western United States. As part of a broader allocation of $8.3B for water infrastructure projects over the next 5 years targeted at drought resilience and clean water access.[43]

U.S. Federal Emergency Management Agency's (FEMA) Building Resilient Infrastructure and Communities (BRIC) Program. This program provides grants for hazard mitigation projects to help improve the resilience of states, local communities, tribes, and territories.[44]

FLOOD RESILIENCE

Increasing Cost of Flooding. Annual flood losses in the United States have cost approximately $17B annually between 2010 and 2018, quadrupling from approximately $4B per year in the 1980s.[45]

Lack of Adequate Planning for Flooding. According to the Urban Institute, even as flooding becomes more frequent in the United States, most States and territories are not adequately prepared to address flooding hazards.[46,47] More than half of the plans surveyed were developed in time frames too short (i.e., one year or less) to include meaningful public engagement,[48] and nearly one-third relied exclusively on historical data that do not account for future risks based on current and changing climate conditions.[49]

U.S. FEMA Flood Mitigation Assistance (FMA) Is Rapidly Expanding. This program, which funds flood mitigation projects, increased by a factor of five to $800M in FY2022.[50]

U.S. 2021 Bipartisan Infrastructure Law Will Support Resilience Projects. This law provides $3.5B in Flood Mitigation Assistance grants for 2022–2026, which is more than triple the amount of available funding compared with previous years.[51]

Permeable Concrete Can Improve Stormwater Management
- Benefits of Permeable Concrete—Permeable concrete could help overcome stormwater runoff issues from traditional, impervious concrete[52] and advance sustainable development goals by reducing runoff-based pollution, protecting watersheds and ecosystems, reducing heat island effects, and removing the need for collection and detention systems.[53]
- Barriers to Use of Permeable Concrete—Durability issues related to freezing susceptibility, deicing chemicals, and clogging phenomena currently prevent its widespread implementation.[54]

Built Environment and Infrastructure Systems
Building and Infrastructure Resilience

NATURE-BASED SOLUTIONS FOR SUSTAINABLE AND RESILIENT INFRASTRUCTURE

There is growing interest in the use of nature-based solutions (NbS), cost-effective systems that protect infrastructure assets from natural hazards while reducing infrastructures' negative impact on the environment.[55]

Need for Alignment with Environmental Commitments. According to the Organisation for Economic Co-operation and Development (OECD), adopting NbS requires that countries align their infrastructure policies and plans with international climate policies and other well-known environmental commitments.[56]

Local Governments Can Play a Significant Role. Local governments can promote NbS through its integration into building codes, such as requiring green space areas on and around new buildings and permeable ground materials for increasing water absorption and retention capacities.[57]

Demonstrating the Value of NbS Is Challenging. Public procurement offices may be unwilling or reluctant to adopt NbS because the costs and benefits are difficult to quantify.[58]

ASTM IMPACT ACTIVITY
Climate Change, Resiliency, and Justice

- E50 develops standards for the environment through terminologies; a guide for environmental, social, and governance (ESG) investigating natural water-source depletion, and methods for addressing the specific needs of the various tribal communities.
- The committee has a robust training program which includes live training, e-learning, and on-demand courses focusing on environmental site assessments, regulatory compliance, vapor encroachment screening, and more.

ASTM IMPACT ACTIVITY
UNDRR Private Sector Alliance for Disaster Resilient Societies (ARISE)

ASTM is a member of the United Nations Office for Disaster Risk Reduction (UNDRR) Private Sector Alliance for Disaster Resilient Societies (ARISE). ASTM's commitment to the Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals (SDGs), and Paris Climate Agreement has brought an invaluable perspective to ARISE and the global disaster risk reduction community. Learn more.

ASTM IMPACT ACTIVITY
ASTM Webinar Series: Resilience in Construction

ASTM provides complimentary, on-demand, and webinar-based training sessions that explore developments in construction resilience and feature such topics as windborne debris in hurricanes, wind-resistant roofing, and reducing the vulnerability of buildings to wildfires. The programs also provide attendees with the latest versions of standards from the industry leaders who helped to develop them. Learn more.

ASTM IMPACT ACTIVITY
ASTM to Participate in UN COP29 Conference

ASTM International has been granted provisional observer status at the 29th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change. Learn more.

Built Environment and Infrastructure Systems
Building and Infrastructure Resilience

ASTM IMPACT ACTIVITY Subcommittee B05.08 on Recycled Materials		In response to the growing need for uniformity and concerns about impurities and traceability in copper recycling, ASTM International's committee on copper and copper alloys (B05) established the subcommittee on recycled materials (B05.08). This subcommittee unites scrap producers, processors, and consumers to standardize key aspects of copper recycling, aiming to reduce scrap contamination and enhance the circularity of copper within the metal system.
ASTM IMPACT ACTIVITY ASTM Sustainability Reference Database		ASTM's Sustainability Reference Database offers a wide range of resources to help evaluate sustainable practices, products, programs, and development, addressing environmental, social, and economic aspects of sustainability. It includes standards, guidelines, practices, model codes, and certification protocols. Learn more.
RELEVANT ASTM STANDARD (HIGH IMPACT) Standard Guide for Friction-Limited Aircraft Braking Measurements and Reporting	**E3266**	U.S. and international guidance advocate that transport aircraft perform a time-of-arrival landing assessment for all runway conditions to include dry, wet, and contaminated surfaces. The function of this assessment is to provide an operator with a standardized means for anticipating the level of braking action upon landing.
RELEVANT ASTM STANDARD Standard Specification for Basalt and Glass Fiber Reinforced Polymer (FRP) Bars for Concrete Reinforcement	**D8505**	This specification covers basalt and glass fiber reinforced polymer (BFRP and GFRP, respectively) bars, provided in straight (longitudinal) cut lengths, of solid round cross-section, and having a surface enhancement for internal concrete reinforcement applications. Bars covered by this specification shall meet the requirements for geometric, material, mechanical, and physical properties as described herein.
RELEVANT ASTM STANDARD Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials	**E1866**	This test method evaluates the performance of exterior windows, curtain walls, doors, and impact protective systems when subjected to missile impacts and cyclic pressure differentials. It simulates conditions such as those experienced during hurricanes or severe storms, where debris can be thrown at high speeds, and fluctuating pressures can affect the structural integrity of building components. The standard outlines procedures to assess the ability of these systems to withstand such impacts and pressures, ensuring they meet safety and performance requirements.
RELEVANT ASTM STANDARD Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes	**E1996**	This standard specification establishes performance requirements for exterior windows, curtain walls, doors, and impact protective systems when impacted by windborne debris during hurricanes. The standard defines the types of debris, impact levels, and testing procedures to simulate the effects of hurricane conditions. It ensures that these building components can withstand the forces of windborne debris and provide adequate protection, maintaining structural integrity and safety during severe weather events.
RELEVANT ASTM STANDARD Standard Practice for Installation of Exterior Windows, Doors and Skylights	**E2112**	Proper installation of a building's windows, doors, and skylights is critical to the performance of buildings. This practice provides installers with technical guidance for fenestration units in low-rise residential and light commercial structures. The use of this practice can help ensure the correct installation of these critical features of a building, thus enhancing the building's resilience.

Built Environment and Infrastructure Systems
Building and Infrastructure Resilience

RELEVANT ASTM STANDARD Standard Practice for Infrastructure Management	**E3210**	This practice provides a framework for an authority to assess, plan, and execute: (1) the construction of new systems of tangible and intangible infrastructure; and (2) operate, maintain, monitor, and repair existing systems of infrastructure assets to maximize their use value by providing desired services for the benefit of infrastructure asset service recipients of the authority's unit of government or private sector organization.
RELEVANT ASTM STANDARD Standard Guide for Process of Sustainable Brownfields Redevelopment?	**E1984**	This guide covers redevelopment of a Brownfields property for all stakeholders, identifying impediments to Brownfields development and suggested solutions to facilitate redevelopment.
RELEVANT ASTM STANDARD Standard Guide for Climate Resiliency Planning and Strategy	**E3032**	This guide addresses adjustment strategies and planning made by a group of people or ecosystems to limit negative effects of extreme weather. It also addresses taking advantage of opportunities that long term extreme weather patterns may present.
RELEVANT ASTM STANDARD Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference	**E1105**	This test method covers the determination of the resistance of installed exterior windows, curtain walls, skylights, and doors to water penetration when water is applied to the outdoor face and exposed edges simultaneously with a static air pressure at the outdoor face higher than the pressure at the indoor face.
RELEVANT ASTM STANDARD Standard Practice for Periodic Inspection of Building Facades for Unsafe Conditions	**E2270**	This standard practice is intended to establish the minimum requirements for conducting periodic inspections of building facades to identify unsafe conditions that could cause harm to persons and property. It addresses the required content of the facade inspection to convey to the specifying authority the condition of the facade and provide information necessary to mitigate the threat of harm, injury, damage, or loss to persons or property from unsafe conditions on subject facades.
RELEVANT ASTM STANDARD Standard Guide for Environmental, Social, and Governance (ESG) Disclosure Related to Climate and Community	**E3377**	This guide provides an overview of frameworks used for environmental, social, and governance (ESG) disclosures applicable to a variety of organizations. This guide provides users with information on the history of ESG disclosure frameworks, the components that comprise ESG disclosures, the target audience of these disclosures, and the challenges associated with this topic.
RELEVANT ASTM STANDARD Standard Guide for Financial Disclosures Attributed to Climate Change	**E2718**	This guide is intended for use voluntarily by a reporting entity that provides disclosure in its financial statements regarding financial impacts attributed to climate change.

Built Environment and Infrastructure Systems
Building and Infrastructure Resilience

RELEVANT ASTM STANDARD Standard Guide for Disclosure of Environmental Liabilities	**E2173**	This standard provides guidance on how organizations should disclose environmental liabilities in a clear and consistent manner, including obligations or potential costs associated with environmental damage, regulatory compliance, or cleanup efforts. This helps organizations improve environmental accountability and promote clear communication of potential financial risks to investors, regulators, and the public.
RELEVANT ASTM STANDARD Standard Guide for Property Resilience Assessment	**E3429**	This guide provides a generalized, systematic approach for conducting a property resilience assessment (PRA) on a voluntary basis for parties such as real estate investors, owners, operators, lenders, and insurers (Users) who wish to better understand the natural hazards, including those made more extreme by climate change, that may be affecting a property. A PRA obtained using this guide can be used during real estate investment, development, risk management and reporting, facilities management, capital planning, operations and maintenance, underwriting, or financing activities. The provisions of this guide establish a baseline standard of practical and reasonable steps for conducting and preparing PRAs and guidelines by which the Provider of a PRA can communicate observations, opinions, and conclusions to a User in a manner that is meaningful and transparent.
RELEVANT ASTM STANDARD Standard Practice for Preliminary Karst Terrain Assessment for Site Development	**D8512**	This practice defines and summarizes various procedures for assessing specific sites for potential adverse impacts that karst conditions might have on site development including proposed construction or site management and impacts to the resource.
STANDARDS IN PROGRESS New Guide for Resilience-Based Design of Culverts Exposed to Flood Events	**WK71997**	This proposed guide provides a framework, including best practices, mitigation measures, and design checks, to enhance the resilience of these systems when exposed to flood events. This guide also provides terminology for the covered approaches.
STANDARDS IN PROGRESS Standard Guide for Climate and Community Mapping	**WK76938**	This proposed guide will facilitate a standardized approach for data driven climate and economic justice screening tools to identify communities threatened by the cumulative impacts of climate change, racial inequality, and multi-source environmental pollution.
STANDARDS IN PROGRESS Standard Guide for Climate Resiliency in Nature-based Solutions for Inland Flood Mitigation	**WK85259**	This proposed guide provides a set of options, with technical guidance, for the use of nature-based solutions in the mitigation of increased precipitation driven flood impacts to inland waterways under changing environmental conditions. It includes adapting improved management strategies for watersheds, wetlands, streams, reservoirs, and rivers.

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Building and Infrastructure Resilience

STANDARDS IN PROGRESS Standard Practice for Green Grids	WK91815	This proposed practice defines stakeholders impacted by proposed grid changes and provides them a process to assess these changes. The purpose of this assessment is to ensure that the proposed changes satisfy the Federal Energy Regulatory Commission (FERC)'s Statutory design requirements, which are that electric power grids supply enough reliable, resilient, affordable, and safe electricity for everyone. Additionally, it will facilitate policy maker's ability to understand and make informed decisions about achieving green grid goals and objectives.
STANDARDS IN PROGRESS New Practice for Characterization of Rigid Vinyl Recycled Content	WK89382	This proposed classification system covers rigid PVC and CPVC compounds derived from recyclate in extruded, molded, or calendared form composed of polyvinyl chloride, chlorinated polyvinyl chloride, polyvinyl chloride copolymers containing at least 80% polyvinyl chloride and the necessary compounding ingredients. The recycled materials shall be characterized to inform users of potential issues related to ingredient compatibility and safety, to avoid process contamination, and to help users select materials for a given performance requirement.
STANDARDS IN PROGRESS Work Items from Subcommittee B05.08 on Recycled Materials	B05.08	This package of work items is intended to help copper and copper alloy product producers overcome technical barriers to using recycled content in copper and copper alloy products which are used extensively in the built environment and infrastructure systems.

Built Environment and Infrastructure Systems
Water Stewardship

Improved water stewardship—including globally sustainable approaches to design, construction, and operation of water and wastewater services[59] —will be important in overcoming water-related stresses worldwide. These challenges include water scarcity and access issues related to contamination of water sources by pollutants from human activity and increased difficulty sourcing sufficient water for agriculture.

FUTURE OF WATER STEWARDSHIP

ASTM NEWS STORIES

- 6 Standards for Cleaner Water
- Petroleum in Drinking Water
- New Subcommittee To Focus on Chemical Substances in Consumer Products
- Standards Address Forever Chemicals
- Water Desalination
- Determination of PFAS in the Environment
- PFAS Concentrations in Water Supplies
- New Standard Supports Bacteria Testing for Multiple Water Types

U.N. Sustainable Development Goals Supported

POLLUTION FROM PER- AND POLY-FLUOROALKYL SUBSTANCES (PFAS)

Emerging Data Raising Concerns. A growing body of data indicates that PFAS, which have been used in various global industries for 80+ years, can adversely affect human health and the environment when present in air, soil, water, and groundwater.[60]

Disproportionate Impact on Low-Income Communities. Several known and potential sources of PFAS contamination are located near low-income communities, including underserved rural areas and communities of color.[61]

United States Environmental Protection Agency (EPA) Strategy. EPA recently developed a three-year PFAS Strategic Roadmap, which sets goals and objectives including researching the health and environmental impacts of PFAS, preventing future PFAS contamination, and accelerating cleanup efforts to treat, remediate, and mitigate PFAS contamination.[62]

WATER SCARCITY AND ACCESS

Increasing Agricultural Water Scarcity. As of 2019, agriculture accounted for 70% of global water demand.[63] Agricultural water scarcity is expected to intensify in more than 80% of the world's croplands by 2050.[64] By 2040, approximately 40% of all irrigated agriculture is projected to be under significant water stress.[65]

Increasing Demand and Water Use. According to one projection, global water demand for agriculture is expected to increase by 19% by 2050,[66] and global water use for industrial, domestic, and agricultural applications will increase by 20–50% by 2050.[67]

Global Water Scarcity Concerns. As of 2020, approximately 2.1B people across the globe faced insufficient access to safe drinking water or unreliable water service.[68] Nearly 500M people currently experience water scarcity throughout the year.[69] By 2050, more than half of the global population is projected to live in areas affected by water scarcity at least one month annually.[70]

Inefficiency of Water Use. Inefficient and unsustainable irrigation and planting practices contribute to water scarcity issues; an estimated 50% of global water for irrigation is oversupplied or routed to incorrect crops.[71]

SUSTAINABLE FOOD PRODUCTION

Agriculture currently accounts for an average of 70% of global freshwater withdrawals.[72] In order to support an estimated increase of 50% in global food

Built Environment and Infrastructure Systems
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		needs for the growing population by 2050, sustainable solutions will be needed to increase agricultural productivity while conserving natural resources.[73, 74]
ASTM IMPACT ACTIVITY APEC Workshop: Regulatory and Policy Best Practices for Addressing the Mitigation and Elimination of Plastics Pollution		The results of this workshop will help develop a toolkit for policymakers responsible for addressing plastic pollution and responding to the UNEA Treaty on Plastics' call for national plans to mitigate and eliminate plastic waste. This project offers standards as a resource for policymakers and regulators required to create national strategies in line with UNEA's mandate for a legally binding instrument on plastic pollution.
RELEVANT ASTM STANDARD Standard Test Method for Determination of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous Matrices by Co-solvation followed by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	D8421	PFAS chemicals have been detected in soils, sludges, surface, and drinking waters. This is a quick, easy, and robust method to quantitatively determine these compounds at trace levels in water matrices.
RELEVANT ASTM STANDARD Standard Test Method for Determination of Per- and Polyfluoroalkyl Substances in Water, Sludge, Influent, Effluent, and Wastewater by Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS)	D7979	This test method helps to determine PFAS at trace levels in water matrices for understanding of the sources and pathways of exposure.
RELEVANT ASTM STANDARD Standard Test Method for Quantification of Culturable Waterborne Bacteria Using a Defined Culture Medium Coated Plate	D8516	This test method will help with identifying water quality or water system problems or evaluate compliance with maintenance protocols.
RELEVANT ASTM STANDARD Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials in the Marine Environment by a Defined Microbial	D6691	This test method is used to determine the degree and rate of aerobic biodegradation of plastic materials (including formulation additives) exposed to pre-grown population of at least ten aerobic marine microorganisms of known genera or the indigenous population existing in natural seawater.
RELEVANT ASTM STANDARD Standard Test Method for Weight Attrition of Non-floating Plastic Materials by Open System Aquarium Incubations	D7473	The goal of this test method is to obtain data that can be used to assess the potential for physical degradation of the test material. Such potential for physical degradation will be affected by real-life environmental conditions.

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RELEVANT ASTM STANDARD Standard Guide for Sampling Wastewater With Automatic Samplers	D6538	This guide covers the selection and use of automatic wastewater samplers, including procedures for their use in obtaining representative samples. Automatic wastewater samplers are intended for the unattended collection of samples that are representative of the parameters of interest in the wastewater body.
STANDARD IN PROGRESS Standard Specification for Non-Floating Biodegradable Products in the Aquatic Environment	WK75797	This proposed specification covers non-floating polymeric materials and products that are designed to be biodegradable under aerobic marine environmental conditions in an open water column, in the event of inadvertent loss or leakage.
STANDARD IN PROGRESS Standard Test Method for Ultrashort-Chain PFAS in Waters by LC-MS/MS	WK80687	Recently found ultrashort-chain PFAS (C1 - C4) in the environment especially with rainfall and snowfall, reversed phase liquid chromatography (LC) separation may not have proper retention or provide good peak shapes for these early eluting PFAS analytes. Adopting existing liquid chromatography–mass spectrometry (LC-MS/MS) methodology without the need of ion chromatography for separation can expand the PFAS analysis to ultrashort-chain range successfully.

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End Notes/References

CONSTRUCTION

1 "The U.S. Green Building Council (USGBC) has found that the construction industry accounts for 39% of all CO2 emissions in the United States alone — more than any other sector and more than any other country, except China." https://www.thomasnet.com/insights/building-a-more-sustainable-construction-sector/

2 "The buildings and construction sector accounted for ... 39% of energy and process-related CO2 emissions in 2018, 11% of which resulted from manufacturing building materials and products such as steel, cement and glass." https://www.iea.org/reports/global-status-report-for-buildings-and-construction-2019.

3 https://environment.ec.europa.eu/topics/waste-and-recycling/construction-and-demolition-waste_en

4 https://www.bbc.com/future/article/20211215-the-buildings-made-from-rubbish

5 According to ReportLinker, the global sustainable construction materials market is expected to grow from $270 billion in 2020 to $711 billion in 2030 at a CAGR of 10.16%. https://www.reportlinker.com/p06191807/Green-Building-Materials-Market-By-Product-By-Application-By-End-User-and-Region-Global-Analysis-of-Market-Size-Share-Trends-for-and-Forecasts-to.html.

6 According to Market Research Future, the global sustainable construction materials market is expected to reach $939.79 billion by 2030. https://www.globenewswire.com/news-release/2022/09/13/2514877/0/en/Green-Building-Materials-Market-Worth-USD-939-79-Billion-by-2030-at-a-CAGR-of-12-Report-by-Market-Research-Future-MRFR.html.

7 https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf

8 https://www.epa.gov/sites/default/files/2021-01/documents/2018_ff_fact_sheet_dec_2020_fnl_508.pdf

9 https://ellenmacarthurfoundation.org/completing-the-picture

10 https://globalabc.org/resources/publications/2021-global-status-report-buildings-and-construction

11 https://ellenmacarthurfoundation.org/completing-the-picture

12 https://www.sciencedirect.com/science/article/abs/pii/S2352710219302542

13 https://awc.org/issues/mass-timber-2/

14 https://ww3.rics.org/uk/en/modus/natural-environment/renewables/the-future-of-sustainable-building-materials.html

15 https://sn.astm.org/features/greening-built-environment-nd13.html

16 https://sn.astm.org/features/greening-built-environment-nd13.html

17 E.g., lignin, cork, wood particles

18 https://link.springer.com/article/10.1007/s42247-021-00319-x

19 https://www.volvoce.com/global/en/news-and-events/news-and-stories/2019/six-sustainable-building-materials-of-the-future/

20 https://www.third-derivative.org/blog/low-carbon-cement-2

21 https://www.commerce.wa.gov/washington-industrial-emissions-analysis-green-cement-case-study-july-30-2021-draft/

22 https://www.chathamhouse.org/2018/06/making-concrete-change-innovation-low-carbon-cement-and-concrete-0/3-overcoming-barriers

Built Environment and Infrastructure Systems
End Notes/References

BUILDING AND INFRASTRUCTURE RESILIENCE

23 https://www.gsa.gov/about-us/newsroom/news-releases/gsa-announces-actions-to-reduce-emissions-from-building-materials-02152022
24 https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=932279
25 https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=932279
26 https://tsapps.nist.gov/publication/get_pdf.cfm?pub_id=932279
27 https://www.ncei.noaa.gov/access/billions/overview
28 https://www.ncei.noaa.gov/access/billions/events/US/1980-2020?disasters[]=all-disasters
29 https://www.americanprogress.org/article/extreme-weather-cost-u-s-taxpayers-99-billion-last-year-getting-worse/
30 https://www.ncei.noaa.gov/access/billions/events/US/1980-2020?disasters[]=all-disasters
31 https://www.americanprogress.org/article/extreme-weather-cost-u-s-taxpayers-99-billion-last-year-getting-worse/
32 https://www.ncei.noaa.gov/access/billions/events/US/1980-2020?disasters[]=all-disasters
33 https://www.nlc.org/post/2021/05/10/91-of-cities-say-insufficient-funding-delaying-critical-infrastructure-investments/
34 https://www.nlc.org/post/2021/05/10/91-of-cities-say-insufficient-funding-delaying-critical-infrastructure-investments/
35 https://www.infrastructurereportcard.org/wp-content/uploads/2020/12/2021-IRC-Executive-Summary.pdf
36 https://reliefweb.int/report/world/drought-numbers-2022-restoration-readiness-and-resilience
37 https://reliefweb.int/report/world/drought-numbers-2022-restoration-readiness-and-resilience
38 https://knowledge.uli.org/-/media/files/research-reports/2022/uli-water-wise-final-report.pdf
39 https://reliefweb.int/report/world/drought-numbers-2022-restoration-readiness-and-resilience
40 https://reliefweb.int/report/world/drought-numbers-2022-restoration-readiness-and-resilience
41 https://reliefweb.int/report/world/drought-numbers-2022-restoration-readiness-and-resilience
42 https://reliefweb.int/report/world/drought-numbers-2022-restoration-readiness-and-resilience
43 https://www.doi.gov/pressreleases/biden-harris-administration-announces-210-million-drought-resilience-projects-west
44 https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities
45 https://science.house.gov/imo/media/doc/Grimm Testimony.pdf
46 https://www.urban.org/sites/default/files/2022-03/state-flood-resilience-and-adaptation-planning-challenges-and-opportunities.pdf
47 https://www.pewtrusts.org/en/research-and-analysis/articles/2022/03/08/these-5-flood-resilience-and-adaptation-challenges-offer-opportunities-for-states
48 https://www.urban.org/sites/default/files/2022-03/state-flood-resilience-and-adaptation-planning-challenges-and-opportunities.pdf

Built Environment and Infrastructure Systems
End Notes/References

49 https://www.pewtrusts.org/en/research-and-analysis/articles/2022/03/08/these-5-flood-resilience-and-adaptation-challenges-offer-opportunities-for-states
50 https://www.fema.gov/press-release/20221115/one-year-later-biden-harris-administration-fema-highlight-progress-made
51 https://www.fema.gov/press-release/20211115/infrastructure-deal-provides-fema-billions-community-mitigation-investments
52 https://sn.astm.org/features/greening-built-environment-nd13.html
53 https://sn.astm.org/features/greening-built-environment-nd13.html
54 https://www.sciencedirect.com/science/article/abs/pii/S0959652618
55 https://www.oecd.org/gov/infrastructure-governance/resilience-maintenance/
56 https://www.oecd.org/gov/infrastructure-governance/resilience-maintenance/
57 https://www.oecd.org/gov/infrastructure-governance/resilience-maintenance/
58 https://www.oecd.org/gov/infrastructure-governance/resilience-maintenance/

WATER STEWARDSHIP

59 https://www.astm.org/e2728-19.html
60 https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf
61 https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf
62 https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf
63 https://www.nature.com/articles/s41545-019-0039-9
64 https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1029/2021EF002567
65 https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-water
66 https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-water
67 https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-water
68 https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-water
69 https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-water
70 https://unesdoc.unesco.org/ark:/48223/pf0000261424
71 https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-water
72 https://openknowledge.fao.org/handle/20.500.14283/i7959en
73 https://unesdoc.unesco.org/ark:/48223/pf0000380721
74 https://openknowledge.fao.org/handle/20.500.14283/i7959en

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100 BARR HARBOR DRIVE
P.O. BOX C700
WEST CONSHOHOCKEN, PA 19428-2959
USA

Tel +1.610.832.9500

Web go.astm.org