Case study n°7

ASTM International Standards Supporting Sustainable Concrete Construction

Country: Zambia

Level: Local

SDG Addressed: SDG 11 – Sustainable Cities and Communities

Summary

The objective of this case study is to show how ASTM International Standards on Concrete and Concrete Aggregates have been used in Zambia, the United States and other twenty countries with two main goals. The first is to increase the potential for recycling building materials and in particular concrete, reducing the amount of these materials that end in landfills. The second is to codify practices for adding water, notably allowing for the use of recycled water, to concrete at a job site. The implementation of this second standard led to water conservation, and enhanced quality of raw materials used in the construction industry.

This contributes to the achievement of different SDG Goals and Targets, including: SDG 11.1 "By 2030, ensure access for all to adequate, safe and affordable housing" and SDG 1.6 "By 2030, reduce the adverse per capita environmental impact of cities".

Background

Concrete is a sustainable infrastructure component due to properties such as: durability, recyclability, allowable variation in constituent materials, and relatively low energy consumption in production when compared to an alternate building material such as steel.

Strategy

The featured standards assist in addressing practices for reuse/recycling of concrete or constituent materials. Recognizing the increase in sustainable construction practices and working to address practical issues encountered in the production and use of concrete, ASTM Technical Committee C09 on Concrete and Concrete Aggregates developed standards that can be applied universally regardless of the material, its source, and location of application. The first two standards address better practices for adding water, notably allowing for the use of recycled water, to concrete at a job site.

These ASTM International standards are: (i) C1602, covers mixing water for producing hydraulic cement concrete; and (ii) C1603, details measuring solids in water; used to determine the solids content of mixing water for concrete when one or more of the water sources is wash water from the work site.

The second two ASTM International standards address the use of recycled industrial materials in concrete production. They are: (i) C1697, covers blended supplementary cementitious materials for use in concrete or concrete production. These supplementary materials include reuse of industrial materials which improves workability, cohesiveness, finish and durability while consuming less energy, improving efficiency and enhancing building performance; and (ii) C1798 covers the use of returned fresh concrete for use in new batch ready-mixed concrete.

Results and Impact

The new standard allows industry to develop a more sustainable construction practice, in which millions of cubic yards of concrete can now be recycled in a way that is safe for end-users and provides a more conscious approach to environmental stewardship. Further, the stamdard creaters enhanced environmental stewardship due to: reused materials that might otherwise be placed in landfills, and water conservation on account of acceptable use of recycled water on the job site.

Zambia's experience confirms the aspects of lower costs and environmental stewardship while also pointing to sustainable construction. In Zambia, the National Construction Council compels the national standards body, the Zambia Bureau of Standards (ZABS), to identify standards needed for the construction industry rather than allowing industry to self-identify needed standards. For this reason ZABS has adopted C1697 and C1603.

With respect to ASTM C1697, the diversification in the use of different raw materials in the Zambian Construction Industry to enhance cohesion and durability in the formulation of mortar or concrete led to the adoption of the standard to ensure quality of materials used. Regarding ASTM C 1603, the standard was adopted to ascertain the content of impurities (solids) in the water to ensure quality raw materials are used by industry

The use of these standards promotes the recycling of the materials to be used in the construction industry. This has the effect of reducing the number of landfills and supports environmental preservation (land and water bodies).

Challenges and Lessons Learned

Challenges include educating regulators, industry representatives and consumers of the suitability and benefits of using recycled constituent materials. This may include addressing any reluctance or resistance to using constituent materials and correcting misconceptions regarding the performance of concrete.

Driven by market or regulatory need, the desire to improve sustainable construction practices serves as the impetus for modifications to long-standing specifications for concrete. Identifying ways to lessen environmental impact also enhances economic feasibility (lower production costs and therefore lower market costs to end users) of concrete as a construction product. The end result is improved economic growth and social prosperity (more affordable, sustainable housing), without being detrimental to performance. Demonstrated market acceptance will support regulator acceptance of the newly specified product.

Potential for Replication

Concrete is a local material, insofar as it is not traded across borders but rather produced and transported to nearby local work sites. In addition to the United States, twenty other nations located in Africa, Asia, the Caribbean, Latin America and the Middle East report citing one or more of the listed standards.

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[1] Strubel, L. & Godfrey, J. (May, 2004). How Sustainable is Concrete? Proceedings of the International Workshop on Sustainable Development and Concrete Technology. Paper Presented at International Workshop on Sustainable Development and Concrete Technology, Beijing, China (201-211)