

# “SUSTAINABILITY FOR REPAIRING AND MAINTAINING CONCRETE AND MASONRY BUILDINGS”

BY H. PETER GOLTER

**A**s you are aware, ICRI has been rooted in the repair and protection of existing concrete and masonry structures for over 25 years. You may be old enough to recall several decades ago when the concrete industry shunned away from even acknowledging that there were issues related to concrete. Yes, gone are the days and myths that concrete is indestructible, permanent, and completely maintenance-free. Rather, concrete structures are a composite of different materials. Basic concrete has a composition consisting of potable water, portland cement, small aggregate, and large aggregate.

Concrete is great in compression but less desirable in tension. The running joke for a number of years has been: “How many types of concrete are there?” The answer is “Two.” The second part of the joke is: “What are the two types of concrete?” The answer is “Cracked and Going-to-Crack.” In fact, concrete only cracks when tensile stress exceeds tensile capacity. Thus, to increase tensile capacity, we add another element to the concrete via embedded steel reinforcement. Consider that we now have two dissimilar materials that are continuously exposed to real-world conditions. Therefore, we must design and plan accordingly to address these conditions—that is, freezing and thawing, moisture intrusion, chloride intrusion, sulfate attacks, alkali-aggregate reactions, abrasion, and carbonation, just to mention a few.

ICRI Committee 160, Sustainability, is chaired by Leo Whiteley with input from a diverse group of active committee members. The white paper, “Sustainability for Repairing and Maintaining Concrete and Masonry Buildings,” is scheduled to be published by the end of September 2014. Look for it on the ICRI website, where a free download will be available courtesy of ICRI.

So what is sustainability? According to the U.S. Environmental Protection Agency, “Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environ-

ment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations. Sustainability is important to making sure that we have and will continue to have, the water, materials, and resources to protect human health and our environment” (Source: [www.epa.gov](http://www.epa.gov)).

Growing up as a first-generation American, at my house we had a much shorter version of sustainability: “Waste not, want not” (Source: Papa Golter).

What we are really talking about with sustainability is to take a common-sense approach. What is common sense? It is defined as: “Good sense and sound judgment in practical matters.” According to George Bernard Shaw, “Common sense is instinct, enough of it is genius.”

**Sustainability Objective:** The purpose of this committee’s white paper is to educate manufacturers, contractors, design professionals, and building owners on the benefits of sustainable design, maintenance, repair, and adaptive use for concrete and masonry structures. The goal is to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Concrete is by far the number-one used material on new and existing structures. Virtually every construction project, whether it is a building or infrastructure, starts with a sound foundation made of concrete. Adding reinforcing steel to the member and admixtures to the ready mixed concrete allows us to address project-specific requirements. Research and science are continually identifying new technologies and improvements to existing technology to enhance concrete mixture designs and steel reinforcement. Lastly, combine design, improved materials, and our imagination to create one-of-a-kind, aesthetically pleasing concrete structures designed for the long term.

Today’s building codes now include fire safety and energy-efficiency compliance mandated by

the government. For existing structures, the new ACI 562, “Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings and Commentary,” will be part of our lives starting in 2016. The purpose of the new repair code is to ensure that structures requiring a major restoration are brought up to date with today’s more stringent building code requirements. Case in point, today’s building code references ACI 318, “Structural Concrete Building Code.” A more recent requirement from ACI 318 is that embedded steel is to have an effective concrete cover of 2 in. (50 mm). Going from the previous 1.5 in. (38 mm) cover to 2 in. (50 mm) cover significantly reduces voids and honeycombs at the surface of the concrete structure. The 2 in. (50 mm) cover allows a 3/4 in. (19 mm) aggregate in the concrete mixture to flow around the embedded reinforcing steel without getting hung up during the placement process.

Sustainability takes this process one step further. Quoting a portion of the introduction from this white paper, “The most effective sustainability strategy for concrete and masonry structures is to avoid the need for repairs altogether. The Building Research Establishment, a well-known entity in the United Kingdom, concurs that prevention through monitoring, inspection, and maintenance can result in a huge savings over the life cycle of a structure.”

Sustainability is a journey, not just a one-time application encountered during the design and construction process. Monitoring begins during the construction process and continues throughout the life of the structure. Periodic inspections provide insight on how the structure is performing. Sometimes testing (nondestructive and destructive) is required to identify the root cause of a problem and not merely treating the symptom. Identified problems treated early enough can be corrected by routine maintenance or minor repairs. For existing structures that have been ignored for too long, the sustainable approach would include a repair, protect, and enhance strategy. Delaying the treatment will result in more costly repairs and if left untreated possibly catastrophic failure. Lastly, sustainability takes into consideration a green approach. Material selection criteria include: volatile-organic-compound-based versus water-based or high-solids-based product solutions. Perhaps CO<sub>2</sub> production based on the different solutions—that is, repair versus replacement.

So, now it is time for a trivia question: How much energy does it take to construct a new typical 50,000 ft<sup>2</sup> (4650 m<sup>2</sup>) commercial office building like the one shown in Fig. 1?

Answer: It requires the same amount of energy needed to drive a car 20,000 miles (32,000 km) per year for 730 years.



Fig. 1: Office building

Photo courtesy of Fullmer Co., Inc. ([fullmerco.com](http://fullmerco.com))

Building owners, municipalities, counties, states, and the federal government are all using life-cycle analysis to run a number of different scenarios based on implementing a repair and protection strategy, or delaying it, and the financial impact that decision has on the life of the structure and their budgets. Bottom line, sustainability is a holistic approach to today’s structures with an eye to the future.

This white paper summarizes a number of best practices for consideration from various industry sources (globally) as well as several case studies detailing the environmental impact on maintaining an existing structure versus replacing it. This committee is now working on two sustainable guidelines: one for concrete structures and the other for masonry structures. Also included in this committee’s activities are procedures for other ICRI technical committees to consider sustainability in the documents that they are producing, as well as a category for future “Project of the Year” submittals. If you would like to be part of this committee, please do not hesitate to contact Leo Whiteley, ICRI, or myself.



**H. Peter Golter** is a Business Development Manager at 3M for the Building and Construction Markets group. Golter is a licensed professional engineer with 30 years of construction experience. He has been an ICRI member for nearly 20 years and is currently a member of ICRI Committee 160, Sustainability—the committee responsible for preparing this document. Golter is also Chair of ICRI Committee 710, Coatings and Waterproofing, as well as a member of ICRI Committee 150, ICRI Notes on ACI 562 Code Requirements, and the ICRI Publications Committee.