Building (for) the Future

BY LUKE JOHNSON, SE, PE

As the vocabulary for earth-friendly buildings increases and lots of buzzwords get thrown around, the most important thing to design for is the future.

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GREEN. EARTH-FRIENDLY. DURABLE. Sustainable. Resilient.

These words have all gained popularity in the building world over the past several years, and demand for projects that advertise themselves using any of them continues to grow across the United States.

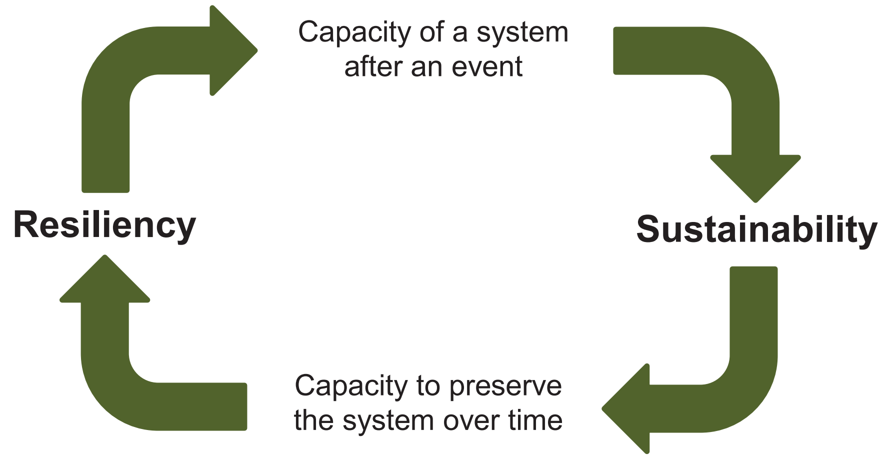
And for good reason. Sustainable and resilient buildings not only provide a better working and living environment for tenants and residents, but they are also better equipped to handle extreme events, both naturally occurring and man-made, increasing the possibility of returning the building back to full occupancy and use shortly after the event. For this reason, building owners and occupants continue to drive the need for structures built using sustainable materials and resilient designs.

As this movement continues to grow, more and more architects, engineers and contractors are realizing the benefits of selecting structural steel framing systems as a means of achieving both sustainable design and long-term building resilience. Therefore, it is important to understand what sustainability and resiliency—and related terms—mean when it comes to structural framing systems, and how these concepts can work hand-in-hand to provide better long-term framing options for buildings and their occupants.

Sustainability

A sustainable resource is defined as being harvested or used so that it is not depleted or permanently damaged. Building materials that are sustainable should consider the following characteristics: the recycled content within the material, the recyclability of the material, the recovery rate of the material and the material's ability to be reused. Domestically produced structural steel contains an average recycled content of 93%, as these structural shapes are created from steel scrap, making the steel industry the largest recycler of waste by mass in the United States.

And all structural steel is 100% recyclable at the end of its useful life—i.e., steel that was used in an automobile or household appliance can be recycled and used to create new structural steel shapes for use in a new building. While many materials may be recyclable, not all building materials are easy to recover at the end of their useful life and therefore may end up in a landfill instead of being recycled. On average, 81% of all domestic steel products and materials are recovered and recycled into new steel products, with 98% of structural steel being recovered at the end of its life.



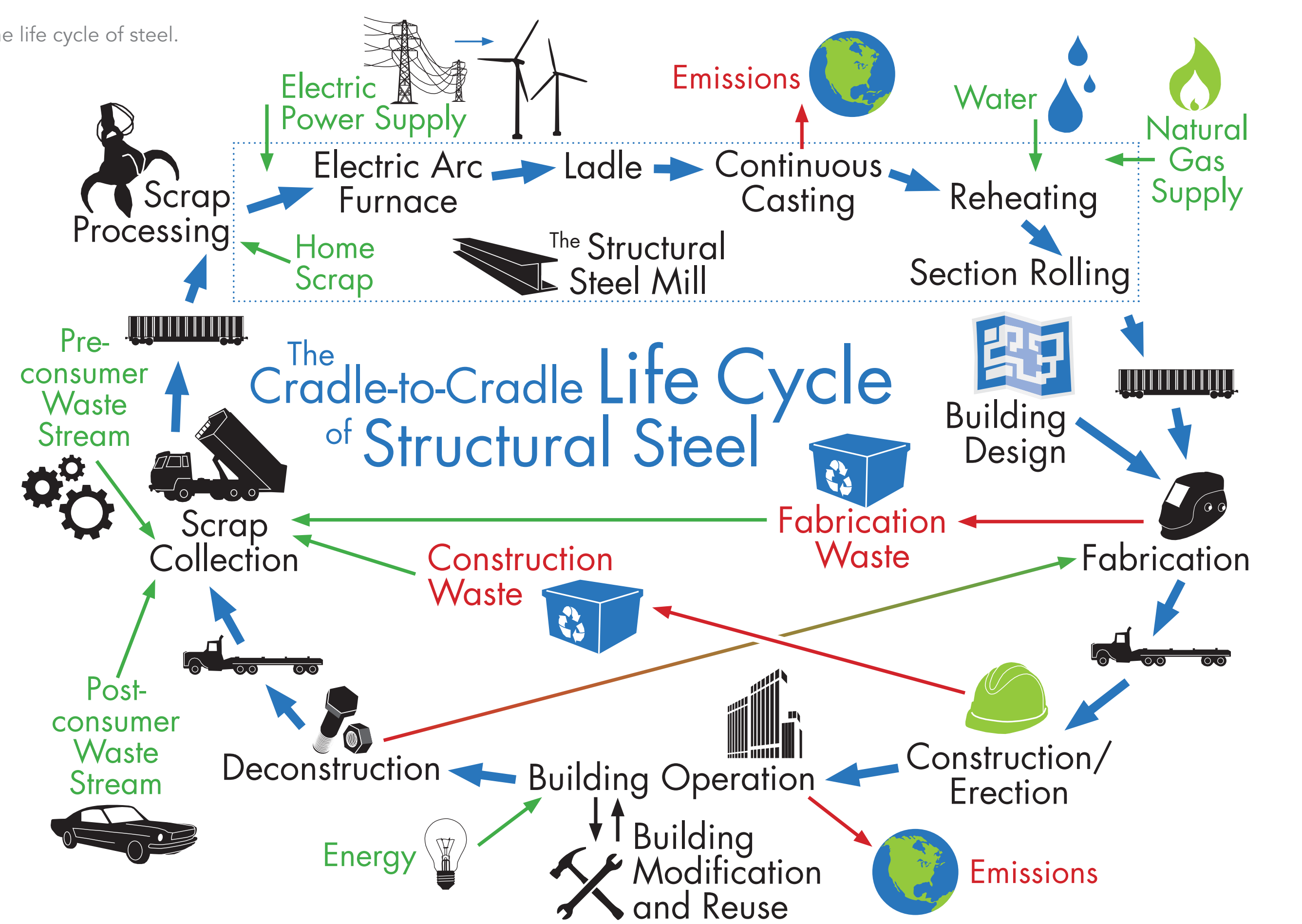
The cycle of resiliency and sustainability.

Think of it this way: Recycling one ton of steel avoids the consumption of 2,500 lb of iron ore, 1,400 lb of coal and 120 lb of limestone. (Note that the vast majority of domestic structural steel is created using the electric arc furnace process, which creates new steel shapes out of recycled scrap.) While structural steel is very commonly recycled, it can also be reused and repurposed at the decommissioning of a building or facility. While only a small amount of recovered structural steel is re-fabricated and directly reused in new building projects, a significant amount of structural steel is reclaimed from the waste stream of deconstructed buildings for reuse in non-building applications such as pipe racks, shoring and scaffolding.

Resiliency (and Other "R" Words)

Next, let's discuss **resilience**, which is defined as the ability to recover from or adjust easily to misfortune or change. As the global climate continues to change, along with the ever-present danger of terrorist events, more and more attention is being

The life cycle of steel.



paid to the resiliency of communities, buildings, structural framing systems and construction materials. A building material's resiliency can be measured by taking a closer look at the following four characteristics: robustness, resourcefulness, recovery and redundancy.

Robustness measures a building's ability to remain operational during and after an extreme event. This becomes most critical for essential facilities that contain services such as health care, power management, transportation and communications. A building's robustness is a direct result of the integrity of the structural framing system, as well as the strength of the framing material used. The strength, elasticity, durability, non-combustibility and resistance to decomposition of structural steel make it the most robust building material available.

Resourcefulness is the ability to be best prepared for and accurately respond to an extreme event. Structures having "as-built" plans available, structural engineers to perform on-demand investigations of damage to the structural frame and material suppliers identified for providing repair materials greatly increase resourcefulness. As structural steel is stocked in service centers throughout the entire country, steel can be rapidly delivered to a structural steel fabricator, who can quickly customize the steel sections required to implement the repairs identified by the structural engineer.

Recovery is the ability of a building to restore key operations as quickly and efficiently as possible after an extreme event, with the goal of returning to full operation as quickly as possible. The time required to perform a certain level of recovery is a direct relationship to the robustness, redundancy and ease of repair of the structural system, as well as the availability of resources to complete the repair. While it would be impossible and impractical to design a building to withstand every extreme event, the robustness and wide availability of structural steel make it a building material capable of fast recovery.

Redundancy in a building can be best described as the ability of the framing system, as well as the structural material used, to provide additional load carrying capacity and alternative load carrying paths as the transfer of loads becomes necessary. The specifications for the design of structural steel are based on past successful usage along with current research and result in structures with reserve capacity "built in" to the design process. In addition, current design practice for essential facilities provides additional redundancy so that key supporting members, such as columns, can be damaged or completely removed from the structure without collapse.

When all of the above criteria are considered in a building design, structural steel is the ideal choice when it comes to building resilience.

Buildings that are constructed from both a) sustainable materials and b) resilient framing systems provide better overall living and working environments for their occupants, deliver structures capable of resisting impacts imposed by extreme events and reduce overall environmental impacts by reducing landfill waste, raw material consumption and greenhouse gas emissions. Not only are they themselves built to last, but they are also built to help the environment and our natural resources last as well. In other words, they are built with the future in mind—and structural steel checks both boxes. ■

For resources on domestically fabricated structural steel and sustainability, see ***www.aisc.org/sustainability***.