Self-Healing Concrete: The Solution to the Dismal Report Card Grade for Bridges in America

**America’s Bridge Despair**
- 9.1% of bridges nationwide are deemed structurally deficient
- Bridges are classified as structurally deficient if their load carrying capacities are significantly lower than designed
- On average, there are 188 million trips across structurally deficient bridges each day
- Most bridges in America were designed for a lifespan of 50 years with 39% of the current bridges in America being at that lifespan or older
- An estimated 123 billion dollars in repairs are needed to fully fix the bridge problem with funding decreasing each year

**Self-Healing Concrete**

**Background**
- Self-Healing concrete contains bacillus bacteria and calcium lactate which produces limestone in a chemical reaction once in contact with water
- As concrete cracks, the bacteria and calcium lactate will react to produce limestone which will fill in the cracks protecting the steel rebar from rusting
- The bacteria can lie dormant for as long as 200 years

**Chemical Process**
- The type of reaction involved is a Urealysis reaction for the hydrolysis of urea into carbonate and ammonium
- The bacteria draws calcium cations from the environment that reacts with carbonate to create the limestone

**Structural Improvements**
- The integration of self-healing concrete into the substructure of bridges reduces need for repair and replacement of piers/columns and abutments
- Abutments
  - Main purpose is to support the bridge at its extremities
  - Self-healing concrete seals cracks caused by leaky expansion joints
- Piers and Columns
  - Main purpose is to transfer the load from the superstructure to the foundation
  - Self-healing concrete seals cracks caused by applied loads and exposure to the environment
- Self-healing concrete reduces the need for human intervention to fix structural issues in the substructure of bridges

**Miscellaneous Improvements**
- Carbon Dioxide Emissions
  - Concrete accounts for 4.5% of greenhouse gases
  - Longer lasting concrete will overall reduce concrete production, reducing carbon dioxide emissions
- Reduced Spending on Repairs and Replacement
  - Self-healing concrete eliminates the need for renovation processes by filling cracks on its own
  - This allows the funding for bridge repair to be better allocated to other trouble areas
- Increased Safety and Strength
  - Self-healing concrete can have an increase strength of 22-24%

**Pennsylvania’s Bridge Despair**
- Pennsylvania has the second most structurally deficient bridges in the nation
- Pittsburgh has roughly 800 structurally deficient bridges and Philadelphia has roughly 900 structurally deficient
- Annually, 300 bridges in Pennsylvania are added to the list of structurally deficient

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*Anthony Gansor and Mathew Engler*