Lightweight Concrete Extends Service Life of the I-26 Green River Bridge

Infrastructure rehabilitation projects often present engineers with a common challenge: improving the performance of aging structures without significantly increasing loads on the existing system. A recent engineering challenge involving the rehabilitation of the I-26 Green River Bridge highlights how structural lightweight concrete helped address this challenge while increasing the traffic capacity and extending the service life of one of North Caolina's most notable bridges. Located along I-26 in the mountains of western North Carolina, the Green River Bridge carries interstate highway traffic approximately 225 feet above the valley below, the tallest interstate highway traffic carrying bridge in the state. Originally constructed in 1968, the steel girder bridge required significant rehabilitation to meet modern performance and safety expectations while maintaining and expanding traffic operations on this critical corridor.

One of the key strategies implemented during the rehabilitation was the replacement of the existing bridge deck with structural lightweight concrete. By incorporating lightweight aggregate produced from expanded shale, clay, or slate (ESCS), engineers were able to significantly reduce the dead load imposed on the existing steel superstructure. The consulting design engineer proposed a 100 pcf in-place, equilibrium density, concrete mixture for both the new bridge deck and barrier rails. By using a combination of ESCS coarse and fine aggregates, two (2) concrete mixtures were able to be produced to meet both workability and structural performance requirements.

Dead load reduction is particularly important in rehabilitation projects involving older bridges. Because dead loads are permanent and continuously applied, reducing the weight of major structural components can have an immediate impact on the stresses experienced by girders, connections, and supporting members. In the case of the Green River Bridge, the use of structural lightweight concrete helped reduce demands on the existing steel girders while maintaining the strength and stiffness required for modern traffic loads. The lighter deck system also allowed engineers to improve the composite action between the

deck and the steel girders by adding shear studs during construction. This enhancement increased the structural efficiency of the bridge without requiring full replacement of the superstructure, and the ability to expand the number of usable traffic lanes. As a result, the rehabilitation strategy preserved much of the existing structure while delivering improved performance and extended service life.

Beyond weight reduction, structural lightweight concrete offers several additional advantages for bridge deck applications. ESCS lightweight aggregates provide durable concrete with excellent freeze-thaw performance, reduced cracking potential, internal curing, and improved long-term durability. These characteristics are especially valuable for transportation structures exposed to heavy traffic, environmental cycles, and deicing chemicals. Another important benefit of lightweight concrete is its ability to support efficient construction and rehabilitation. Because the material reduces overall weight of the structure, engineers can often strengthen or upgrade existing bridges rather than replacing them entirely. This approach can significantly reduce construction costs, shorten project schedules, and minimize traffic disruptions.

Projects like the Green River Bridge rehabilitation demonstrate how lightweight aggregates can help engineers solve complex structural challenges while preserving critical infrastructure. By reducing dead load, improving structural efficiency, and enhancing durability, ESCS lightweight aggregates continue to play an important role in extending the service life of bridges across the country. For agencies responsible for maintaining aging bridge networks, structural lightweight concrete remains a proven and practical solution for modern bridge rehabilitation.