Lightweight Concrete Bridges: Recent Data Reveal New Opportunities

Reid Castrodale

Castrodale Engineering Consultants, Concord, NC, USA

Contact: reid.castrodale@castrodaleengineering.com

Abstract

Recent tests and production experience reveal that structural lightweight concrete made with lightweight aggregates manufactured in the USA has potential benefits for the design and construction of bridges. Lightweight aggregates and their properties are briefly introduced; then engineering properties of lightweight concrete made with these aggregates are presented using recent data. Material properties discussed include density, design compressive strength (up to 70 MPa), tensile strength (approximately equal to strengths expected for normal weight concrete), modulus of elasticity, creep and shrinkage (comparable to normal weight concrete), durability (including both reduced permeability and cracking tendency), ductility, and thermal properties (possibly beneficial for mass concrete). Several bridges that used lightweight concrete are highlighted, showing that the material provides an economical and durable solution for bridges.

Keywords: bridges, lightweight concrete, material properties, compressive strength, tensile strength, modulus of elasticity, creep, shrinkage, durability, ductility.

1 Introduction

Structural lightweight concrete has been used in bridges and other structures for nearly 100 years, including central portions of the main span of several of the longest concrete box girder bridges in the world, such as the current world record main span of 301 m for the Stolma Bridge in Norway (see Section 3.3.4). However, owners, design engineers and contractors are often reluctant to use this material for bridges because of their lack of experience with or knowledge about the material, even though information has been available for many years on the appropriate use of lightweight concrete [1,2]. Recent test results and production experience for modern lightweight concrete presented in this paper reveal that the material, which in most cases has properties equal to or superior to conventional concrete, offers significant opportunities for improved efficiency, economy and durability for bridges and other structures, even those exposed to extreme environmental conditions.

2 General instructions

Structural lightweight aggregate in the USA is produced using shale, clay and slate. The materials are expanded at high temperatures in a rotary kiln to produce a porous aggregate in which the vitrified material has a hardness similar to quartz. Properties of lightweight aggregate vary between sources, but structural lightweight concrete can be produced using aggregate from all sources.

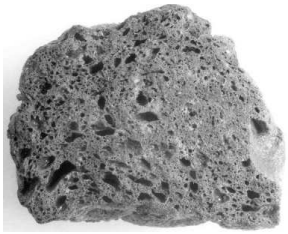

Figure 1. Lightweight aggregate particle

https://doi.org/10.2749/stockholm.2016.2084