LTRC Technical Summary Report 443
LTRC Proj. No. 06-2ST ~ State Proj. No. 736-99-1391

January 2009

Louisiana Transportation Research Center
4101 Gourrier Ave., Baton Rouge, LA 70808

Elimination of Deck Joints Using a Corrosion Resistant FRP Approach

Introduction

In the literature survey of fiber reinforced polymer (FRP) grid reinforced concrete structures, a limited number of studies were found on FRP grid stiffened concrete slabs in bridge deck applications and other non-structural applications in buildings. No open publications were found that focused on link-slab for deck joint applications. In the material and specimen tests, the focus was on manufacturing and testing the structural behavior and physical properties of two types of FRP grid reinforced concrete slabs, control concrete slabs, and FRP slabs. Finally, the focus was on evaluating the structural behavior of the link-slab simulating the actual structural conditions through full-scale testing and numerical simulation using finite element analysis. This study lays a solid basis for field-level applications of FRP grid reinforced concrete link-slab for jointless bridge deck design.

Objective

The objective of this study is to investigate the material and structural behavior of FRP grid reinforced full-scale concrete link-slab in expansion joint through material testing, specimen testing, and full-scale beam testing as well as finite element modeling.

Scope

In this study, two types of FRP grid reinforcement were prepared and tested in eleven different slabs. Physical properties such as surface abrasion, shrinkage, and coefficient of thermal expansion were also tested according to ASTM standards. Two full-scale FRP grid reinforced concrete beams, which simulated the actual link-slab for an expansion joint in bridge deck, were experimentally tested; finite element modeling per commercial software package ANSYS was used to model the performance of the link-slab as an actual bridge deck joint. The test results and modeling results were analyzed and some meaningful conclusions were obtained.

Cont'd on Back

LTRC Report 443

Principal Investigator:
Guoqiang Li, Ph.D.

LTRC Contact:
Walid Alaywan, P.E.
Phone (225) 767-9106

Louisiana Transportation Research Center

Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

4101 Gourrier Avenue
Baton Rouge, LA 70808-4443
www.ltrc.lsu.edu

Research Approach

The research presented herein describes the development of durable link slabs for jointless bridge decks based on using FRP grid for reinforcement. Specifically, the ductility of the FRP material was utilized to accommodate bridge deck deformations imposed by girder deflection, concrete shrinkage, and temperature variations. It would also provide a cost-effective solution to a number of deterioration problems associated with bridge deck joints.

The structural behavior of two types of FRP grid reinforced concrete slabs was investigated. A total of eleven slabs were prepared and tested. Three slabs were made of plain concrete as controls. Three slabs were reinforced by commercially available FRP grids. Three slabs were reinforced by lab-fabricated FRP grids. The remaining two slabs were the pure grid panel (one from commercial source and the other fabricated in the lab). All the slabs were tested per a three-point bending test configuration. Physical properties such as surface abrasion, shrinkage, and coefficient of thermal expansion were also tested.

The design concept of link slabs was then examined to form the basis of design for FRP grid link slabs. Improved design of FRP grid link slab/concrete deck slab interface was confirmed in the numerical analysis. The mechanical properties between the FRP grid and concrete were evaluated. The behavior of the link slab was investigated and confirmed for durability.

Conclusions and Recommendations

The results indicated that the technique would allow simultaneous achievement of structural (lower flexural stiffness of the link slab approaching the behavior of a hinge) and durability need of the link slab. The overall investigation supported the contention that durable jointless concrete bridge decks may be designed and constructed with FRP grid link slabs. It is recommended that the commercial FRP grid be used for bridge decks. It is also recommended that the link slab technique be used during new construction of bridge decks. Furthermore, it is recommended that the advantages of using the FRP grid link slab technique in repair and retrofit of bridge decks are considered along with the amount of intrusive field work required to develop the required mechanical properties at the bridge deck joints. Finally, it is recommended that future research focus on cyclic tests of full-scale bridge link slab be compared with those of a conventional concrete link slab.