Transportation Geotechnics xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Transportation Geotechnics

journal homepage: www.elsevier.com/locate/trgeo

Research and construction of geosynthetic-reinforced soil integral bridges

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ARTICLE INFO

Article history:
Available online xxxx

Keywords:
Earthquake
Full-height rigid facing
Geosynthetic-reinforced soil retaining wall
GRS integral bridge
Maintenance
Tsunami

ABSTRACT

Geosynthetic-reinforced soil (GRS) integral bridge was developed to overcome several inherent serious problems with conventional type bridges comprising a simple-supported girder (or multiple girders) supported via bearings typically by RC abutments retaining unreinforced backfill (and a pier or piers for multiple girders). The problems include: (a) relatively high construction and maintenance costs with relatively long construction time resulting from the use of bearings and massive abutment structures usually supported by piles; (b) bumps immediately behind the abutments; and (c) a relatively low stability of the girders supported by roller bearings and the approach embankment against seismic and tsunami loads. For a GRS integral bridge, a pair of GRS walls (and an intermediate pier or piers if necessary for a long span) are first constructed. After the deformation of the supporting ground and the backfill of the GRS walls has taken place sufficiently, steel-reinforced full-height-rigid (FHR) facings are constructed by casting-in-place concrete on the wall face wrapped-around with the geogrid reinforcement. Finally a continuous girder is constructed with both ends integrated to the top of the FHR facings. The girder is also connected to the top of an intermediate pier, or piers, if constructed. The background and history of the development of GRS integral bridge is described. The first four case histories, one completed in 2012 for a new high-speed train line and the other three completed in 2014 to restore a railway damaged by a great tsunami of the 2011 Great East Japan Earthquake, are reported.

Introduction

Geosynthetic-reinforced soil (GRS) retaining wall (RW) having staged-constructed full-height rigid (FHR) facing (Fig. 1) was developed in the mid-1980s (Tatsuoka et al., 1997a). By extending this GRS RW technology, GRS bridge abutment, placing a girder via a hinged bearing on the top of FHR facing of a GRS RW, or via a pair of hinged and roller bearings on the top of FHR facings of a pair of GRS RWs, was developed in 1990s (Aoki et al., 2005; Tatsuoka et al., 2005). In 2000s, GRS integral bridge, integrating without using bearings both ends of a continuous girder to the top of the FHR facings of a pair of GRS RW (and also an intermediate pier, or piers if constructed for a long span), was developed (Tatsuoka et al., 2008, 2009, 2012, 2014a,b, 2015). GRS integral bridge is now becoming one of the standard bridge types for railways in Japan (RTRI,

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http://dx.doi.org/10.1016/j.trgeo.2016.03.006
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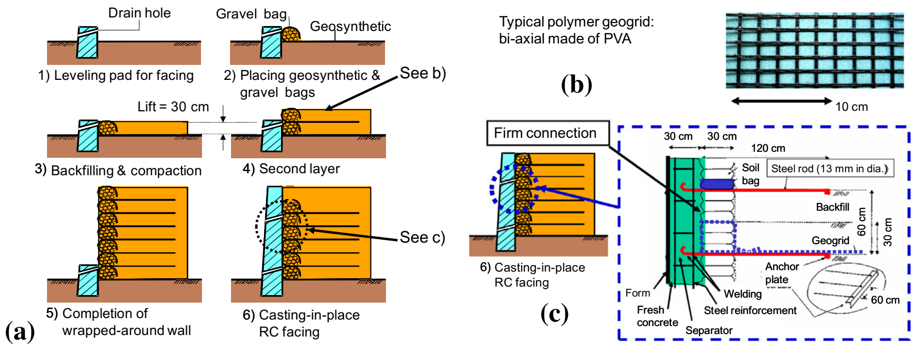

Fig. 1. GRS RW with FHR facing: (a) staged construction; (b) a typical geogrid type; and (c) details of facing construction at stage 6.

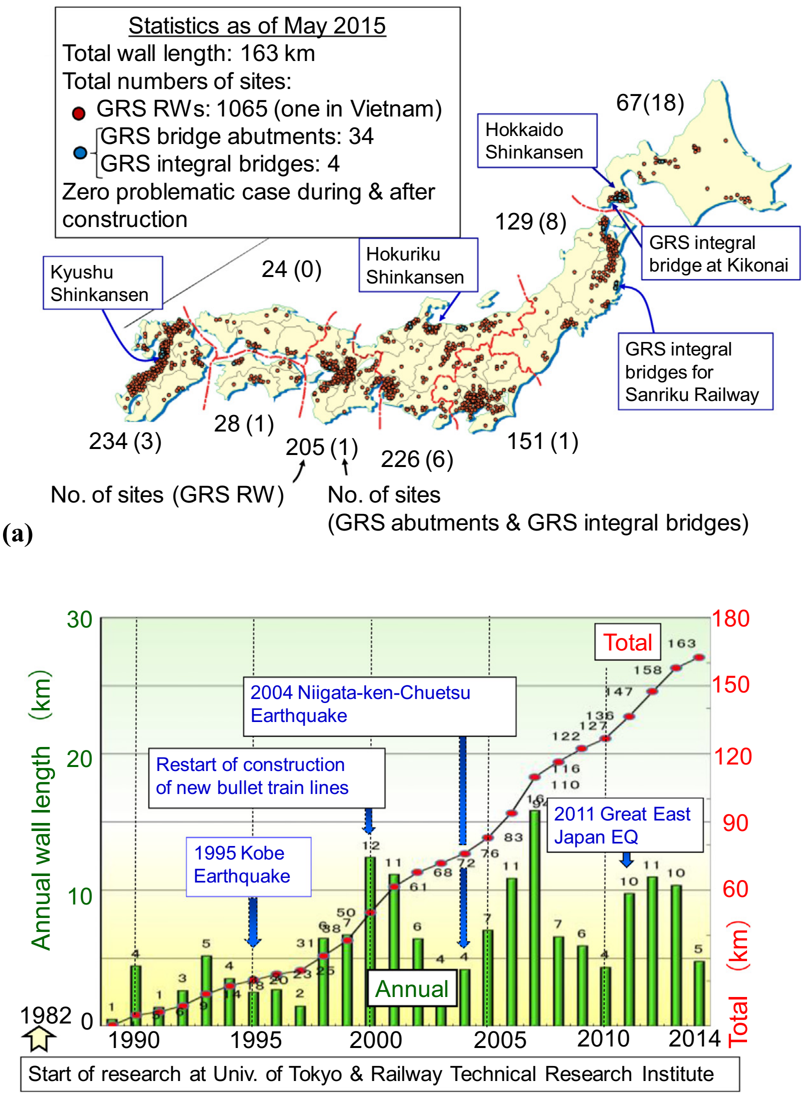

Fig. 2. (a) Construction sites; and (b) history of GRS structures including RWs with a staged-constructed FHR facing, GRS abutments and GRS integral bridges (as of May 2015).