,

Stretto di Messina

Concessionaria per la progettazione, realizzazione e gestione del collegamento stabile tra la Sicilia e il Continente Organismo di Diritto Pubblico
(Legge n° 1158 del 17 dicembre 1971, modificata dal D.Lgs. n°114 del 24 aprile 2003)

EurolinK

PONTE SULLO STRETTO DI MESSINA

PROGETTO DEFINITIVO

EUROLINK S.C.p.A.

IMPREGILO S.p.A. (MANDATARIA)
SOCIETÀ ITALIANA PER CONDOTTE D'ACQUA S.p.A. (MANDANTE)
COOPERATIVA MURATORI E CEMENTISTI - C.M.C. DI RAVENNA SOC. COOP. A.R.L. (MANDANTE)
SACYR S.A.U. (MANDANTE)
ISHIKAWAJIMA - HARIMA HEAVY INDUSTRIES CO. LTD (MANDANTE)
A.C.I. S.C.P.A. - CONSORZIO STABILE (MANDANTE)

IL PROGETTISTA	IL CONTRAENTE GENERALE	STRETTO DI MESSINA	STRETTO DI MESSINA
Ing E.M.Veje COWI EurolinK Dott. Ing. E. Pagani Ordine Ingegneri Milano n° 15408	Project Manager (Ing. P.P. Marcheselli)	Direttore Generale e RUP Validazione (Ing. G. Fiammenghi)	Amministratore Delegato (Dott. P. Ciucci)

Unità Funzionale	OPERA DI ATTRAVERSAMENTO	PS0193_F0
Tipo di sistema	SISTEMI SECONDARI	
Raggruppamento di opere/attività	ARTICOLAZIONI	
Opera - tratto d'opera - parte d'opera	Bearings and Expansion Joints	
Titolo del documento	Performance Specification - Roadway Expansion Joints	

CODICE: C G 1 0 0 0 P S P D P S S A 0 A M 0 0 0 0 0 0 0 3 0

REV	DATA	DESCRIZIONE	REDATTO	VERIFICATO	APPROVATO
F0	20-06-2011	EMISIONE FINALE	HPJE	OVS	SOLA

NOME DEL FILE: PS0193_F0.docx

INDICE

1 Introduction

1.1 The Project

The Messina Strait Bridge will span the Messina Strait between Calabria on the Italian mainland and the island of Sicily. The suspension bridge crossing comprises a 3,300 m main span, which will be longest in the world when constructed.

The bridge carries four marked vehicle lanes, two emergency lanes and two rail lines. The bridge superstructure comprises three separate orthotropic deck steel box girders, one for each of the Sicily and Italy bound roadways and one for the railway. The three box girders are connected by transverse steel box cross girders spaced at 30 m. The superstructure is supported by pairs of hanger cables connected to each cross beam end. The hangers are connected to pairs of main cables on each side of the bridge (four main cables), with each main cable having a diameter of 1.24 m. The main cables are anchored at each bridge end in massive reinforced concrete anchor blocks. The main cables are supported by two steel main towers, each with a height of 399 m above mean sea level. The main towers are founded on reinforced and post-tensioned concrete footings, which are supported on underlying rock formations.

1.2 Scope

This performance specification specifies the requirements for the design, manufacture, installation and testing of the eight roadway expansion joints at the Messina Bridge. The locations are:

- Calabria approach spans/terminal structure (2*E8);
- Terminal structure/suspension bridge (2*E3);
- Suspension bridge/terminal structure on Sicily (2*E3);
- Terminal structure/approach spans Sicily (2*E6).

The roadway expansion joints include:

- cover plates and drains at edge beams
- expansion joints at service lanes and between service lane and roadway

- expansion joint at roadway
- details regarding the crash barrier and wind screens.
- birds net to cover access to the space between girder ends.

Further the works include delivery of spare parts for the first 5 years use in accordance with the maintenance manual.

1.3 References

1.3.1 Design Specifications

1 GCG.G.03.04. Various works, Section 2. Stretto di Messina, 2010, July 15

2 GCG.G.02.01 rev.0. Construction of the street and railway connections: Norm for the execution of the civil work - street and railway infrastructures. Stretto di Messina, 2004 July 6.

3 CG.10.00-P-RG-D-P-GE-00-00-00-00-00-02-A - “Design Basis, Structural, Annex,” COWI 2010

4 GCG.F.05.03 rev. 1. Technical specifications for the definitive and the executive project of the bridge - Design development requirements & guidelines. Stretto di Messina, 2004 October 22.

5 GCG.G.03.02. Technical specifications for the construction of the suspension bridge - Structural steel works and protective coatings, Stretto di Messina, 2004 July 30.

1.3.2 Material specifications

6 EN ISO 12944:2000. Paints and varnishes - Corrosion protection of steel structures by protective paint systems

7 EN 10025-1:2004 Hot-rolled products of structural steels

8 EN 10025-2:2004 Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels

9 EN 10164:2005 Steel products with improved deformation properties perpendicular to the surface of the product – Technical delivery conditions.

10 EN ISO 898-1:2009 Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs.

11 EN 20898-2:1994 Mechanical properties of fasteners – Part 2: Nuts with special proof load values – coarse thread (prEN ISO 898-2:2010).

12 EN 14399-3:2005 High-strength structural bolting assemblies for preloading - Part 3: System HR - Hexagon bolt and nut assemblies

13 EN ISO 14555:2006 Welding-Arc stud welding of metallic materials.

1.3.3 Drawings

The basic requirements and principle for the road way expansion joint are shown on the following drawings:

14 GC10.00-P-DX-D-P-SS-A0-GE-00-00-00-01-A. Articulation system - Expansion joints, Overview

2 Design by contractor

2.1 Type of expansion joint

The expansion joint design, that the manufacturer propose, shall have been used for similar sizes (50% of required ULS movement) and under similar conditions with satisfactory results for a period of at least 5 years. It is of importance that the joint type has demonstrated satisfactory results under similar extreme wear conditions as specified for this bridge. The manufacturer shall submit reference list for the proposed expansion joints.

The joint at the roadway girder shall be a watertight. The joint type at the service lane and the inclined side of the roadway girder may be of another type than the one on the roadway girder, but the joint at the sloping side of the girder shall not let water into the space between the girder ends.

The joint shall be easy to clean on top surfaces.

All road expansion joints with a movement capacity exceeding 1000 mm shall be coated with an anti skid coating.

2.2 Loads and movements

Loads and design rules are defined in [3].

Joint number, movements and rotations for the completed bridge are stated on [14]. These movements include the additional 10% that is required according to doc. [4], section 10.5.

Special attention shall be paid to the durability of the joints. The bridge type and the size of the bridge lead to large maximum movements and very large accumulated movement. The maximum movements will occur only few times. However, the bridge girder will move longitudinally due to traffic loads and wind loads even the bridge is held by hydraulic buffers in longitudinal direction. These movements will be relatively small but will happen many times a day and with a fluctuating nature. There will be a large number of stop and starts in alternating directions. The estimated velocity and acceleration of the longitudinal movements are stated in Table 1. It means that the wear of the moveable parts will be considerable.

The sliding elements shall last at least 20 years before they have to be replaced.

	Joint type and location			
	Approach span/Terminal Structure E6 and E8	Terminal Structure/ Suspension bridge E3	Side Span/ Deck element at Tower E2	Deck element at Tower/ Main span E1
Accumulated movement pr. year	0.1-1 km	1- 10 km	<0.1km	0.1-1 km
Expected max. velocity of frequent movement	<1 mm /sec	~20 mm/sec	NA	~20 mm/sec

Expected acceleration of frequent movement	<20 mm/sec^2	~20 mm/sec^2	NA	~ 20 mm/sec^2

Table 1 Estimate of accumulated movement pr. year, velocity and acceleration of expansion joints movements.

2.3 Expansion joint arrangement

The joints shall be arranged and fastened in such a way that inspection and maintenance can be performed easily and unhindered.

The joint shall be arranged so that all moveable parts can be replaced easily and without disruption of the traffic.

The joints shall be watertight. The joint shall be arranged so that rainwater drains away from the joint by itself (self drained).

The joint must be divided into various sections so that they may allow for the substitution on one section at a time, independent of the adjacent sections, leaving to be operating at least one lane for each carriageway. It shall be possible to replace on section of the joint in 24 hours.

A covering, e.g. a net or similar, shall be arranged to avoid access of birds to the space between the two structures that the expansion joint join.

3 Materials

3.1 General

Materials shall comply with the requirement of the [5].

High performance sliding materials with increased load capacity and durability shall be applied in the sliding surfaces.

The manufacturer shall document that the rubber seals and rubber bearings can last at least 20 years with regard to UV radiation and salinity concentration.

The manufacturer shall prepare a quality plan for manufacturing and installation

The joints shall function in ambient air temperatures in the interval +45°C and -5°C.

3.2 Corrosion protection

The surface treatment shall meet the requirements of corrosive category C5-M, durability "High" in accordance with [6].

The primer of the surface treatment shall be 80 µ thermally metal sprayed with zinc and sealed with a sealer that is compatible with the intermediate and top coat.

The colour of the top coat shall be the same as on the girders.

4 Execution

4.1 General

In the factory the joints shall be sufficiently assembled and packed in such a way that they will not be damaged during transport and installation. The consignment shall be accompanied by a detailed instruction regarding installation of the joint. A specialist fitter from the joint manufacturer shall be present at the installation.

The expansion joints shall have the same longitudinal slope as the bridge deck vertical alignment.

4.2 Factory test

A test assembly of the joint type E3 in its entirety shall be performed in the shop. Erection and replacement procedure shall be illustrated and replacement of moveable parts shall be demonstrated.

The force required to move the joint in longitudinal and transverse direction shall be measured.

4.3 Site test

The fatigue design of typical elements of the E3 joint shall be verified by measuring the stress on the actual structure on site. The stress under static load and dynamic load shall be measured.

The measuring devices (strain gauges) shall be part of the work and shall be permanent on the structure after the test is finished.

5 Tolerances

The top line of the joints shall follow the theoretical transverse road profile with a maximum deviation of ±2.0 mm

The top line longitudinal slope of the joint may deviate ± 1.0 ‰ from the theoretical vertical alignment of the roadway.

The horizontal position of the joint shall deviate less than 10 mm from the theoretical position.

Deviations shall be smooth and even with angular bends not exceeding 2 ‰.

6 Submissions

6.1 Documentation

The manufacturer shall prepare and submit for acceptance by the Works Supervision calculations and detailed drawings of the expansion joints.

The manufacturer shall prepare a quality plan for manufacturing and installation.

Plan for and test results from full scale workshop presentation of a typical joint.

Plan for and test results from "fatigue test" on site.

The manufacturer shall submit a declaration of compatibility, stating that the joints are suitable for functioning under the actual conditions regarding sup-port and general arrangement of the adjacent structure.

The manufacturer shall supply a maintenance manual in Italian and English language.

The manufacturer shall supply As Built Records.