

ACI EXCELLENCE AWARDS 2022

THE REHABILITATION OF THE CORNICHE KENNEDY IN MARSEILLE (FRANCE)

Project information

Category: Repair and Restoration

Name of Project: The rehabilitation of the Corniche Kennedy

Address: Marseille, France

Figures: 740 m³ concrete for the prefabrication of the new slabs

310 m³ UHPFRC for the prefabrication of new benches and parapets

2 600 m² of surfaces protected by cathodic protection by impressed current

218 reinforced corbels

Length: 1,7 kilometers

Construction period: 1957-1965

Restoration project: 2016-2017

Restoration work: 2018-2022

Project description (300 words)

The Corniche Kennedy is an emblematic road of the city of Marseille that runs along the Mediterranean Sea. It was widened in the 1960s to create a pedestrian promenade of 1,7 kilometers corbelled over the sea. Renamed Corniche du Président John Fitzgerald Kennedy in 1963 in homage to the American president, the structure is made up of 384 corbels anchored in a retaining wall or in crossing structures, spaced every 4 meters, on which slabs rest. The superstructure consists of two sidewalks separated by a bench, "the longest in the world", and a parapet.

For more than 60 years, the Corniche has been subjected to sea spray and splashing waves and, as a result, presents many disorders. The Metropole Aix Marseille Provence, owner of the project, has decided to undertake a vast rehabilitation operation.

The works consisted in reinforcing or replacing the structural elements according to their state of deterioration. As the structure is located near the Maregraphe, a listed monument, the new benches and parapets were designed in agreement with the Architect of the Bâtiments de France. An architectural work has been done on the shape of the parapet. It was designed to meet the height standards while preserving the shadow of the existing. During the preparation period, several elements were submitted to the architect's opinion to choose the perfect color.

The location of the structure, between busy traffic lanes on one site and the sea and rocks on the other, required the adaptation of the traffic road and the development of a soft lane. Special means of access were used: a rolling negative platform, scaffolding anchored to the retaining walls, and a negative bucket truck.

After four phases of work and a start in 2018, the Corniche John Fitzgerald Kennedy was reopened to the public in spring 2022.

Concrete description (500 words)

Due to its position as a balcony overlooking the sea, the Corniche Kennedy is in permanent contact with sea spray and waves. The diagnosis carried out on the structure in 2014 showed that the main pathology is corrosion of the rebars. Electrical potentials measurements and chemical analyses revealed active corrosive activity and chloride contamination of the concrete to an average depth of 6 cm, which is greater than the concrete cover of the rebars. The rehabilitation project was designed to use innovative, high-performance materials to prevent corrosion of the reinforcement and increase the life of the structure.

The existing benches and parapets were removed and replaced by new elements, prefabricated in ultra high performance fiber-reinforced concrete (UHPFRC). The use of synthetic fibers, as well as the low porosity of the concrete resulting from two factors: a reduction in water content ($W/C < 0.15$) and an increase in compactness by the use of several granular classes and a reduction in the diameter of the aggregates, make it an excellent material for combating external aggression. The high strength of the UHPFRC associated with the absence of reinforcement, allowed its use for the realization of the complex forms of the bench and the parapet. It allowed to reduce the thicknesses and consequently to lighten the prefabricated elements. The use of UHPFRC was also chosen to obtain a neat architectural aspect with a colorable texture and a great fineness of facing (sanded texture).

The slabs that were not reinforced during previous works have been replaced by new elements, prefabricated with a concrete whose formulation was carried out by a performance approach. The purpose of the performant approach is to ensure the durability of the structure by defining requirements on the following durability indicators: apparent chloride diffusion coefficient ($D_{app} < 3 \cdot 10^{-12} \text{ m}^2 \text{ s}^{-1}$), gas permeability ($K_{gaz} < 150 \cdot 10^{-18} \text{ m}^2$), water absorption capacity by immersion under vacuum ($Peau < 11\%$) and electrical resistivity (ρ). The limits of the indicators were defined according to the exposure classes of the structure (NF EN 1992-1-1 standard), namely XC4 alternating moisture and drying and XS3 tidal zones, areas subject to splashing or spray, as well as the duration of use of the project.

The corbels, which were in an advanced state of deterioration, were strengthened by encapsulating them with new corbels anchored in the retaining wall. The existing and new corbels were equipped with a cathodic protection by imposed current allowing to cathodically polarize the structure to be protected by circulating a direct electric current through anodic ribbons. The dimensioning is based on a 50-years lifespan, and follows these steps:

- Estimation Concrete surface and developed surface of rebars,
- Definition protection current density (15 mA/m^2) and required currents,
- Definition length anodic ribbons following currents required,
- Definition length titanium conductor required to supply ribbons,
- Definition system architecture: cables, monitoring elements...

The reinforcements were concreted on site with a self-compacting concrete to fill the formwork completely and to compact by the only gravitational effect while maintaining its homogeneity despite the strong density of rebars.

Construction Team

Owner: Métropole Aix Marseille Provence (MAMP)

Representative: Anatole Caulet – Project manager Pôle infrastructure – Direction des ouvrages d’art et d’aménagement

+ 33 (0) 4 91 99 71 22

anatole.caulet@ampmetropole.fr

2 bis quai d’Arenc

13 567 Marseille Cedex 02

Engineering firm: Setec TPI (lead contractor)

Representative: Tancrede de Folleville – Project director

+ 33 (0) 1 82 51 60 96

tancrede.de-folleville@setec.com

42-52 quai de la Rapée

75 583 Paris Cedex 12

Engineering firm: Setec Diades (co-contractor)

Representative: Loriana Pace – Project manager

+ 33 (0) 6 67 34 30 53

loriana.pace@setec.com

7 chemin des Gorges de Cabriès

13 127 Vitrolles

Engineering firm: Setec Organisation (Co-traitant)

Representative: Pierre Garrigues – Project manager

+ 33 (0) 4 84 35 00 51

pierre.garrigues@setec.com

4 place Sadi Carnot

13 002 Marseille

Architect : André Mascarelli Architecte

Representative: André Mascarelli

+ 33 (0) 6 27 17 82 40

andre@mascarelli.archi

4 rue André Isaïa,

13013 Marseille

External control company: Ginger CEBTP

Representative: Cyrielle Boy

+ 33 (0) 4 42 99 27 15

c.boy@groupeginger.com

1030 rue JRGG de la Lauzière

13 290 Aix-en-Provence

General Contractor Company 2018 – 2019 (phase 1) : Bouygues TPRF (Lead contractor)

Representative: François Petit – Construction manager

+ 33 (0) 6 65 98 07 33

f.petit@bouygues-construction.com

1060 Rue René Descartes,

13290 Aix-en-Provence

General Contractor Company 2018 – 2019 (phase 1) : Corexco (co-contractor)

Representative: Bruno Seris

+ 33 (0) 4 37 42 32 32

brunos@corexco.fr

47 avenue des Bruyères

69150 Décines

Concrete Contractor Company (UHPFRC) 2018 – 2019 (phase 1) : Innobéton

Representative: Jean-Christophe Laugé

+ 33 (0) 6 63 36 40 30

contact@innobeton.fr

2 rue Georges Charpak

34420 Portiragnes

General Contractor Company 2019 – 2022 (phases 2 to 4) : Eiffage Génie Civil (Lead contractor)

Representative: Nicolas Bennati – Construction manager

+ 33 (0) 6 23 51 23 06

nicolas.bennati@eiffage.com

4 rue de Copenhague

13 745 Vitrolles Cedex

General Contractor Company 2019 – 2022 (phases 2 to 4) : GTM Sud (co-contractor)

Representative: Thibault Gélain – Project manager

+ 33 (0) 6 12 01 51 92

thibaut.gelain@vinci-construction.fr

29 rue de Rome

13 127 Vitrolles

General Contractor Company 2019 – 2022 (phases 2 to 4) : Freyssinet (co-contractor)

Representative: Alessia Gaia – Works Engineer

+ (0) 6 01 08 14 16

alessia.gaia@freyssinet.com

235 avenue de Coullins

13 420 Gemenos

General Contractor Company 2019 – 2022 (phases 2 to 4) : Colas (co-contractor)

Representative: Dorian Zapata – Works Engineer

+ 33 (0) 7 61 40 21 48

dorian.zapata@colas.com

28 chemin de la Carrère « Le Pas des Lanciers »

13730 St Victoret

Concrete Contractor Company (UHPFRC and slabs) 2019 – 2022 (phases 2 to 4) : Méditerranée

Préfabrication

Representative: Jean-Baptiste Mercey

+ 33 (0) 6 09 24 68 76

jean-baptiste.mercey@vinci-construction.fr

44 Av. Henri Dunant

13700 Marignane

Concrete manufacturing company 2018-2022 (phases 1 to 4): Cemex

Representative: Jean-Christophe Marcheschi

+ 33 0 (4) 42 24 61 02

jeanchristophe.marcheschi@cemex.com

6 Boulevard des bassins de Radoub,

13002 Marseille

Entry Submitted By:

Loriana Pace - Setec Diades -Construction project manager

+ 33 (0) 6 67 34 30 53

loriana.pace@setec.com

7 chemin des Gorges de Cabriès

13 127 Vitrolles

Sponsoring Chapter:

ACI Paris Chapter

Representative of the Sponsoring : François Toutlemonde, president of ACI Paris Chapter

Photographs



Photo 1 – General view of the renovated Corniche Kennedy (2020)



Photo 2 – Detail of the reinforced corbels (2021)



Photo 3 – Detail of the new bench in UHPFRC (2021)



Photo 4 – General view of the renovated structure between traffic lane and beach (2021)



Photo 5 – Removal of existing slabs and reinforcement of corbels (2020)

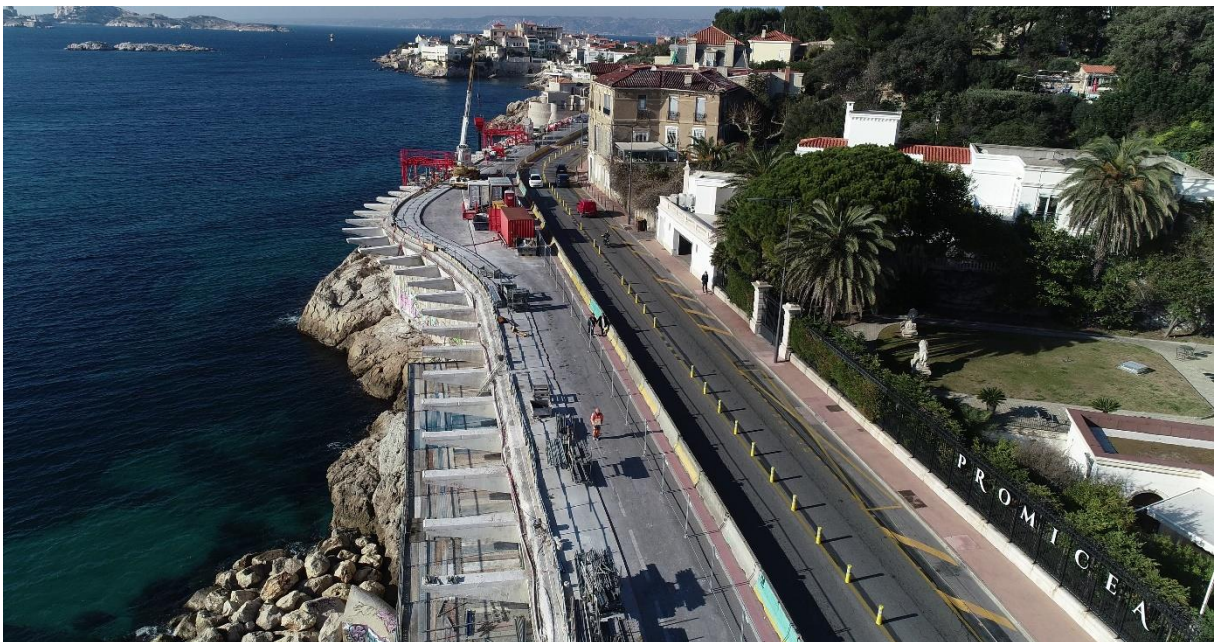


Photo 6 – Reinforcement works with adaptation of the road traffic (2019)



Photo 7 – Installation of new parapets in UHPFRC (2021)



Photo 8 – Interface between the existing structure and the rehabilitated structure (2019)