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CONCRETE-FILLED FRP TUBULAR MEMBERS IN MARINE AND BRIDGE STRUCTURES

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SUMMARY

Concrete core of the concrete-filled tubes (CFTs) with circular cross-section is in the case of an axial compression subjected to a spatial state of compressive stresses. This state leads to enhancement in the concrete strength. The enhancement is utilized in Eurocode 4 design procedures for CFSTs (i.e. CFTs with tube made of steel). The structural design of CFFTs (i.e. CFTs with tube made of Fibre Reinforced Polymer - FRP) is normalized in LFRD Guide Specifications released by AASHTO in 2012. The mathematical model of confined concrete adopted in these design guidelines has also regard to the concrete strength enhancement. The differences between the both models of triaxially compressed concrete are discussed in the paper.

The latter model was used in an author's computer program developed to calculate the load-carrying capacity of 15 CFFT columns which were previously experimentally investigated in the axial and eccentric compression. The calculated and experimentally obtained capacities are compared. The auctorial program predicted the columns load-carrying capacity with a safety margin of 33% on average.

Keywords: *Columns, FRP tube, concrete, marine and bridge structures, modeling strength enhancement, experiment.*

1. THE USE OF CONCRETE-FILLED TUBES IN STRUCTURAL ENGINEERING

Concrete-filled steel tubes (CFSTs) are used as columns for several dozens of years. The use of them as structural members is well established in many countries. Their design procedures are normalized in national and international codes, including Eurocode 4 [1]. A novel and non-typical column type is concrete-filled tube made of fibre-reinforced polymer (FRP). Such columns are called in literature CFFTs. They are used relatively seldom, primarily as piles in marine structures and as arches in bridge structures. Thy only design guide for the CFFTs which is known to the author is LFRD Guide Specifications released by AASHTO [2].

An important advantage of both types of concrete-filled tubes (CFTs) over classic reinforced concrete columns is accelerating of constructional works thanks to integrating formworks (steel or FRP tubes) with the column structure. Any additional concrete formwork is not needed for the columns. Structures supported by CFT columns are often distinguished by their aesthetics (Fig 1).

The most important disadvantage of the CFTs in comparison with classic reinforced concrete columns is their low fire resistance. That is the reason why the concrete-filled tubes are not as popular in building structures as they are in bridge and marine structures.

However, the environment of bridges and coastal structures is strongly corrosive for steel and concrete as the component materials of columns. It concerns both reinforced concrete columns and CFST columns. The deterioration is caused by chemical and biological corrosion.

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