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DESIGNING OF COMPRESSED CONCRETE FILLED STEEL TUBULAR ELEMENTS JOINTS

The flowchart classification of concrete filled steel tubular elements joints is suggested. The possible implementation options for connections are analyzed, including new types of concrete filled steel tubular elements joints that have not been previously used namely detachable joints with smooth reinforcement and threaded joints.

***Keywords**: concrete filled steel tubular elements, joints, classification.*

Introduction. Modern construction is noteworthy for rising the height of buildings and spans of overlap, increasing crane load and the weight of technological equipment. This requires the use of rods as pillars, columns, trusses compressed elements, arches which would have exceptionally high load capacity with small cross-sections. Concrete filled steel tubular elements fully meets these requirements.

Specific characteristics of materials are effectively used in concrete filled steel tubular elements. It allows to save steel and concrete significantly which reduces the cross-sectional structural elements and consequently decreases their weight and transportation costs. Concrete filled steel tubular elements have all the advantages of rational tubular metal structures, which are increasingly used in construction. Nowadays tubular profile are regarded as the most progressive which requiring a minimum number of welding operations and additional items. The inner surface of pipes is protected from corrosion by concrete. Compared to reinforced concrete structures concrete filled steel tubular elements are more industrial when produced and assembled. They are lightweight and transportable, they well resist mechanical damage and have a good look. Their production doesn`t need formwork, reinforcing frames or embedded parts. Therefore the questions of research and classification of concrete filled steel tubular structures and their joints are important.

Overview of recent research and publications. Joints are important elements of concrete filled steel tubular structures. For recent years the interest to concrete filled steel tubular elements with joints has increased significantly. In our University a series of studies devoted to concrete filled steel tubular elements and their joints have been done by L.I. Storozhenko [2], O.I. Lapenko [6], V.F. Pents [5], D.A. Ermolenko [8], O.V. Semko [4], V.M. Tymoshenko [7], V.I. Efimenko [3]. And of course the concrete filled steel tubular elements have been studied in foreign countries by M. Johansson [10], J. F. Hajjar [11], H. Nakahara [9] and in Eurocode [1].

Concrete filled steel tubular structures are used as frame columns of residential and public buildings, in crane trestles, bridge structures, as well as piles. Special attention is paid to use of tubular structures in bridges construction. When designing joints it is necessary to ensure compatible operation in steel pipe shell and the concrete core. This feature is significant for tubular elements.

A constructive approach to the production of tubular structures joints should ensure their strength, stiffness, durability and reliable effort transmission. Nodes design may have different options. However at present no clear detailed classification of tubular structures joints have been developed.

The purpose of the article is to create a detailed classification of compressed concrete filled steel tubular elements joints and its further analysis to suggest new more reliable or less expensive types of concrete filled steel tubular elements joints.

The basic material and research results. Based on this problem the classification of compressed concrete filled steel tubular elements joints is suggested. It includes the following criteria. Type of connection, assembling method, design of elements, type of fasteners and specific details of joint (Fig. 1).

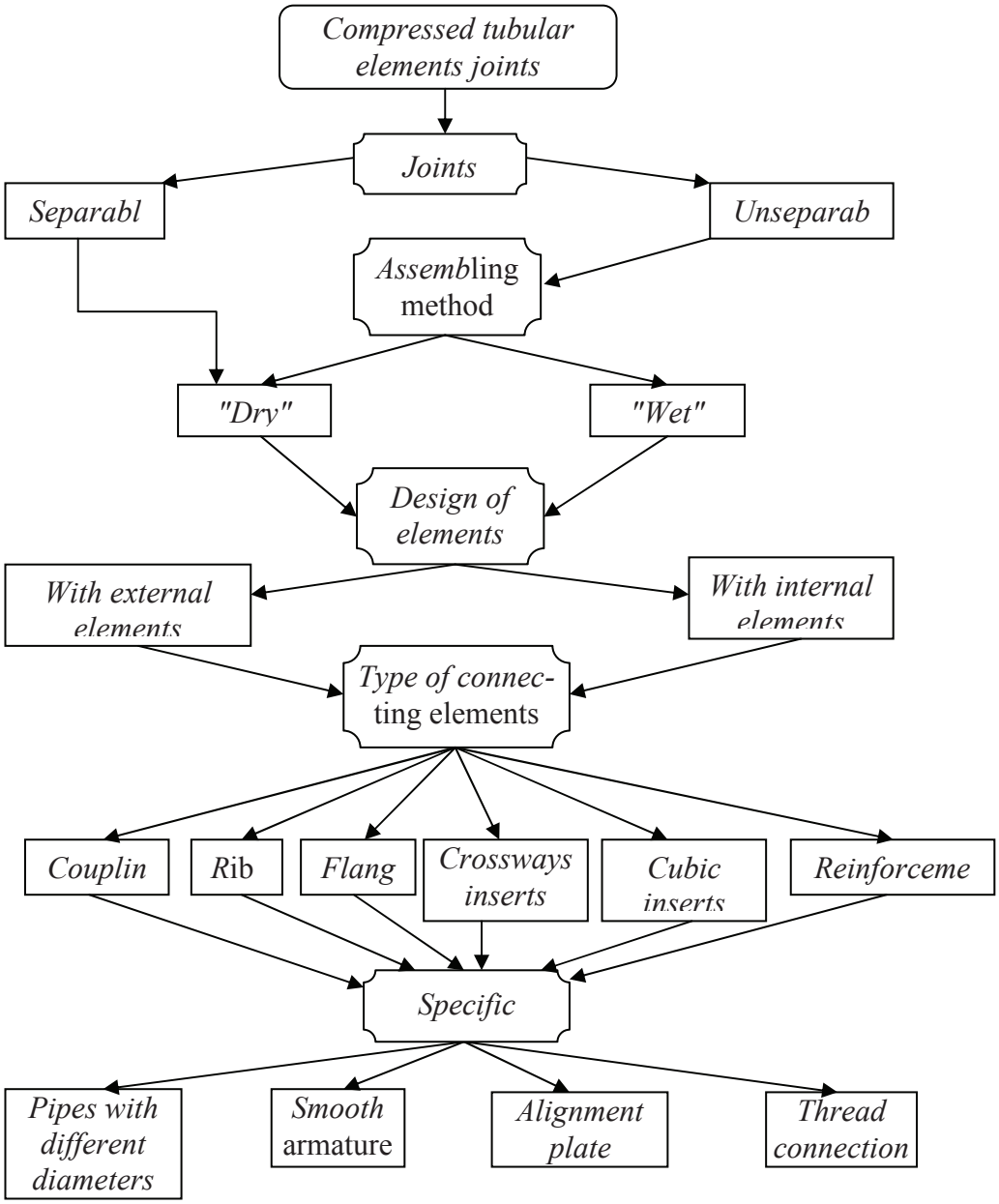

Figure 1. Classification flowchart of compressed tubular elements joints

By type of connection the joints are divided into separable and unseparable. Unseparable joints are easier in production, but their dismantling almost impossible compared to designs with separable joints.

Unseparable joints of elements of concrete filled steel tubular structures are efficiently performed by welding. By the method of execution there may be "dry" and "wet" joints. The simplest in this case is the so-called "dry" joint. In elements that are joined in this way concrete thoroughly aligned flush with the end face of the pipe. The welding elements are performed without any additional embedded parts or concrete. It`s possible to use more hermetic "wet" joint in some cases. For creation "wet" joints in the ends of the elements in process of concreting remains a cavity that is filled solution through the hole after welding. "Wet" joint is more difficult to make, it is less reliable in operation because it is difficult to get sturdiness of injected solution that equal to sturdiness of main concrete filling.

The designs of connecting elements are divided into joints which using external elements or\and internal elements. The external connecting elements includes: ribs; couplings that facilitate of structure assembling and increase the reliability of joints; steel flanges; cross or cubic inserts that are placed between two concrete filled steel tubular elements and improve the effort transmission between the concrete cores.

To the internal connecting elements belongs alignment steel plate which depends on its size and can be used for ease of assembling and for improving of the effort transmission. Also possible to execute concrete filled steel tubular elements joints with smooth reinforcement like sockets in electrical engineering. The tubular element would be like a socket and few rods of smooth reinforcement serving over a surface of other tubular elements - the role of plug. This joint is suggested to perform in places where predicted zero moments.

Also possible the variant of joint where the tubular element has a pipe with diameter greater or less than other in that case elements could be fixed with help of connecting screws that allow to execute joint without flanges. Another option could be threaded joint of concrete filled steel tubular elements with trapezoidal or conical thread which similar to the one which used in connecting of drill pipe where both threaded elements are combined by steel coupling.

Conclusions. The flowchart (Fig. 1) detailed classification of compressed concrete filled steel tubular elements joints is suggested in this article. It should be noted that due to its relevance and importance this question requires further experimental studies and technical and economical comparison for the determination of most appropriate type of joints for each situation. It also should be noted that two new embodiment of the detachable joints were suggested, namely by means of threaded joints and smooth armature.

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ПИТАННЯ КОНСТРУЮВАННЯ СТИКІВ СТИСНУТИХ ТРУБОБЕТОННИХ ЕЛЕМЕНТІВ

Запропонована класифікація стиків стиснутих трубобетонних елементів у вигляді блок-схеми. Проаналізовані можливі варіанти виконання з'єднань, у тому числі розглянуті нові типи стиків трубобетонних конструкцій, що раніше не застосовувались, а саме роз'ємні стики з гладкою арматурою та різьбові з'єднання.

Ключові слова: *трубобетонні конструкції, стики, класифікація.*

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ВОПРОСЫ КОНСТРУИРОВАНИЯ СТЫКОВ СЖАТЫХ ТРУБОБЕТОННЫХ ЕЛЕМЕНТОВ

Предложена классификация стыков сжатых трубобетонных элементов в виде блок-схемы. Проанализированы возможные варианты исполнения соединений, в том числе рассмотрены новые типы стыков трубобетонных конструкций, которые ранее не применялись, а именно разъемные стыки с гладкой арматурой и резьбовые соединения.

Ключевые слова: *трубобетонные конструкции, стыки, классификация.*

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