
TECHNICAL APPROVAL PROCESS FOR LARGE DIMENSIONS NON-STANDARDIZED REINFORCED SEWAGE ELEMENTS

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ABSTRACT

The aim of this paper is to present the experimental research carried out in order to ensure compliance with the EU law, when placing on the construction market elements larger than those framed in the harmonized European standard. The research methodology followed experimental testing components of the reinforced concrete type manholes with an inner circular section whose nominal dimensions exceed DN 1250. An important issue for local communities has been collecting household waste water, industrial wastewater and rainwater and treating them to be carried back to watercourses. By building sewage systems and providing drinking water supply will protect the population against the negative effects of the wastewater over the human health and the environment.

Keywords: waste water; concrete manholes; sewage systems.

REZUMAT

Scopul acestei lucrări este de a prezenta cercetările experimentale efectuate pentru a asigura respectarea legislației UE, atunci când se introduc pe piața construcțiilor elemente mai mari decât cele încadrate în standardul european armonizat. Metodologia de cercetare a urmat componente experimentale de testare a căminelor de vizitare cu o secțiune circulară internă ale căror dimensiuni nominale depășesc DN 1250. O problemă importantă pentru comunitățile locale a fost colectarea apelor uzate menajere, a apelor reziduale industriale și a apei de ploaie și tratarea acestora pentru a fi transportate înapoi la cursurile de apă. Prin construirea de sisteme de canalizare și furnizarea de apă potabilă se va proteja populația împotriva efectelor negative ale apei reziduale asupra sănătății umane și a mediului.

Cuvinte cheie: ape uzate, cămine din beton, sisteme de canalizare

1. INTRODUCTION

The collection of domestic and industrial wastewater, stormwater and their treatment to be returned to the watercourses was an important problem of the local communities. By carrying out of the sewage works and drinking water supply, the population is protected from the negative effects of wastewater on human health and on the environment. Water pollution occurs naturally or artificially and it is a process through which water changes its composition, appearance and structure. The waste waters differ depending on their origin and the existing sewage system, which can be separative, unitary or mixed (Ianculescu et al., 2001; Giurconiu et al., 2002).

The wastewater contains different substances, of chemical and / or biological nature,

and untreated, it is a danger to public health. The water infiltration into the soil leads to the infestation of groundwater, which can never be used for drinking water supplies. The direct discharge of wastewater into the watercourses leads to the damage of the fauna and flora of the respective areas. Currently, it cannot be possible to imagine a modern city, an industrial area, farms etc. without proper water supply and sewerage facilities.

Although at present this is the principle stage, the water supply and sewerage networks have gone through several stages over the time. About 4500 years ago, in Egypt, open canals were built for wastewater disposal. At Nineveh and Babylon, canals and ditches were built to remove such waste. In Rome, in the year 514 BC the first collecting channel was

built under the name of “Cloaca Maxima”, the sewerage network was then developed under the exhortation of the emperors Sevius Tullius and Agripa (Negulescu, 1978).

With the beginning of the industrialization and cities development, the need to build channels became a priority. Thus, in England, in the year 1531, during Henry VIII, the first legislation was drawn up regarding the evacuation of meteoric and domestic waters. In Paris, in the seventeenth century, 3 km long canals were built; around 1850 their length was about 100 km (Negulescu, 1978).

In our country, the sewage systems construction began in 1828; in Bucharest city, the canal evacuated the wastewater from the streets “Colței”, Băneasa and the Enei Church in the Dâmbovița River; it had a rectangular cross-section, made of oak frames (Negulescu, 1978).

In Romania, in order to carry out the sewerage works, suitable qualitatively, and to achieve their proper functioning without affecting the environment, it was necessary to elaborate of specific laws; at present, these are adapted to the European legislation.

The sewer assembly classification, according to the collection destination and to the wastewater transport, are:

- Sewer assemblies for the the domestic wastewater taking;
- Sewer assemblies for the industrial wastewater taking;
- Sewer assemblies for the the meteoric waters taking.

The sewer assemblies for the wastewater taking are made for the purpose of taking the wastewater that comes from the populated centers, their evacuation through a sewerage network and their treatment in special wastewater treatment plants. Wastewater, after purification, reaches a degree of purity that is no longer hazardous to the watercourse, so it can be discharged into watercourses (RWA, 2016; MEF, 2010; MRDPA, 2013; Chira et al., 2019; Ionescu et al., 2019).

In the case of industrial wastewater, due to the diversity of industrial production processes, it results wastewater with different impurities, each requiring a separate treatment sys-

tem before being discharged into the common network.

To construct and operate a sewerage network, as well as to maintain it, several annex constructions are executed, such as: visiting (connection) manholes; passage manholes - alignment; intersection manholes; slope breaking manholes; changing size manholes; slope changing manholes; slope breaking manholes; washing manholes (Luca et al., 2016, 2017; Dimache and Mănescu, 2006).

The annex elements of the sewerage networks are standardized according to the harmonized European standard "Concrete manholes and inspection chambers, unreinforced steel fiber and reinforced". The European standard establishes the performance requirements and describes the test methods regarding prefabricated concrete elements for connection or inspection manholes designed to have a level of the slab not exceeding 2 m deep and manholes with a circular or rectangular interior section, or at least, elliptical, made of concrete, weak reinforced concrete and reinforced concrete, whose nominal dimensions and nominal lengths do not exceed DN 1250 (for elements with inner circular section) or LN 1250 (for elements with rectangular or elliptical section).

The elaboration purpose of this work is to present experimental research carried out on the sewers elements with larger dimensions than those provided in the harmonized European standard.

2. MATERIALS AND METHODS

Reinforced concrete visiting or inspection manholes were made available to NIRD URBAN-INCERC, Cluj-Napoca Branch. A lot of tests to establish their characteristics and Technical Approvals were issued, as follows:

- manholes, with nominal diameter DN160, have the following components: the basic element, the straight element, the trunk head, and the cover plate with nominal diameter DN80;
- manholes, with nominal diameter DN200, have the following components: the basic element and the straight element.

In order to perform the tests on these drainage elements, the necessary laboratory tests were identified, according to the specific European standard, as follows:

a) Appearance - through visual examination;

b) Geometrical characteristics - by direct measurement;

c) Water absorption determination - by calculating the water absorbed by the sample brought to constant mass;

d) Crush resistance - the ultimate strength (breaking) was recorded for the straight type elements with the DN160 nominal diameter and with the DN200 nominal diameter;

e) Water tightness determination - it was observed the water leaks occurrence for the basic element and for the straight element of the manhole with nominal diameter DN160, for a duration of 15 minutes, by the action of a constant hydrostatic pressure;

f) The concrete strength - it was made testing the compressive strength of the elements concrete core;

g) The element resistance under the vertical load - the cracks were observed and the maximum ultimate force (breaking) was recorded for the manhole trunk head, with the nominal diameter DN160 and the cover plate with dimensions 180 x 180 x 20 cm.

3. RESULTS AND DISCUSSIONS

Regarding their dimensions and aspect, no irregularities were observed that prevent the achievement of a durable watertight sewer assembly and no cracks of greater opening than 0,15 mm (Table 1 and Table 2).

From the water absorption point of view, it was experimentally found that this was around 4.5%. According to the specific European standard, the maximum limit is 6%, which indicates that the tested elements are compliant and have a satisfactory behavior in terms of durability.

The tests regarding the elements resistance under the vertical load have indicated a maximum breaking force of 41.8 kN / m, in the case of the manhole straight element, with the nominal diameter DN160, respectively

35.2 kN / m, in the case of the manhole straight element, with the nominal diameter DN200. (Figures 1-4).

Table 1. The geometrical characteristics of the manhole elements, with DN 160

Element type	Inside diameter (mm)	Wall thickness (mm)	Height (mm)
Cone head	1600/600	100	600
Basic element	1600	150	1000
Vertical circular pipe	1600	150	1000
Cover plate	800	80	88

Table 2. The geometrical characteristics of the manhole elements with DN 200

Element type	Inside diameter (mm)	Wall thickness (mm)	Height (mm)
Basic element	2000	150	2300
Vertical circular pipe	2000	150	2000



Fig. 1. Manhole straight element with DN160, during testing



Fig. 2. Manhole straight element with DN160, after cracking, at failure



Fig. 3. Manhole straight element with DN200, during testing



Fig. 4. Manhole straight element with DN200, after cracking, at failure

After the water tightness testing of the elements, they met the established requirements showing no loss of water through the walls

during the application of the prescribed hydrostatic pressure.

The tests regarding the concrete strength were performed through the compressive strength test on the concrete core, performed on cylindrical samples taken from the drainage elements; this resulted in an average value of the compressive strength of 52.1 N/mm^2 . Concerning the resistance under vertical load tests, the following sewage elements were tested, as presented in Table 3, together with the obtained results:

Table 3. Resistance under vertical load

Element type	$F_u(\text{kN})$
Element type with dimensions Cone head $160 \times 60 \times 60 \text{ cm}$	380
Cover plate $180 \times 180 \times 20 \text{ cm}$	>400



Fig. 5. Manhole element with DN160, during testing



Fig. 6. Manhole element with DN160, after cracking, at failure



Fig. 7. Manhole cover plate type element, 180 x 180 x 20 cm (B x L x h), during testing



Fig. 8. Cover plate element cracking mode – 180 x 180 x 20 cm (B x L x h)

4. CONCLUSIONS

The sewerage elements execution with large, non-standardized dimensions, qualitatively compliant, leads in time to a good functioning and maintenance of the sewerage networks, these being subjected to complex demands due to their location, hydraulic regime, maintenance mode etc.

As a result of the presented tests, it can be concluded that the manhole types with larger dimensions than those provided in the harmonized European standard, approved through national technical agreements done in accordance with the current legislation regarding constructions quality, satisfy the requirements regarding their introduction on the national market.

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