



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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Technical code for concrete-filled steel tube arch bridges

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1 General provisions

1.0.1

This Code is formulated to meet the needs of bridge construction and ensure that the design, construction, maintenance of concrete-filled steel tube (CFST) arch bridges meet the requirements of safety, reliability, durability, advanced technology, economic rationality.

1.0.2 This Code applies to the design, construction, maintenance of concrete-filled steel

tube (CFST) arch bridges, particularly urban and highway bridges.

1.0.3 In addition to complying with this Code, the design, construction, maintenance of concrete-filled steel tube (CFST) arch bridges shall also comply with the provisions of relevant current national standards.

2.1.1 Concrete-filled steel tube (CFST) arch bridge

A bridge whose primary load-bearing structure is an arch rib, which is formed by circular concrete-filled steel tubes as the basic unit.

2.1.2 CFST arch rib

An arch rib whose primary load-bearing unit is concrete-filled steel tubes.

2.1.3 Steel tube arch rib

An arch rib whose steel tube is not filled with concrete.

2.1.4 Concrete in tube

Concrete poured inside a steel tube, also known as core concrete.

2.1.5 CFST member

A member in which concrete is poured inside a steel tube, with the load shared by the steel tube and the concrete.

3.1 Steel

3.1.1

The steel tubes in the concrete-filled steel tube arch ribs should be carbon structural steel or low-alloy high-strength structural steel of quality grade B or higher.

Their quality requirements shall comply with the current national standards "Carbon structural steels" GB/T 700 or "High strength low alloy structural steels" GB/T 1591.

3.1.2

The steel tubes may be rolled welded tubes or seamless steel tubes. When the rolling requirements are met, straight seam welded tubes should be used.

3.1.3

The main strength indicators of the steel shall be adopted according to Table 3.1.3.

3.1.4

The physical properties of steel may be adopted according to Table 3.1.4.

3.2 Concrete

3.2.1

The concrete grade within the concrete-filled steel tube arch rib shall not be lower than C30, which should be C40 ~ C60.

3.2.2

The standard value of the axial compressive strength f_{ck} , the design value of the axial compressive strength f_{cd} , the standard value of the axial tensile strength f_{tk} , the design value of the axial tensile strength f_{td} , the elastic modulus E_c of the concrete shall be adopted according to Table 3.2.2. The concrete's shear deformation modulus G_c may be 40% of the elastic modulus E_c in Table 3.2.2; the concrete Poisson's ratio μ_c may be 0.2.

3.3 Concrete-filled steel tubes

3.3.1

The following material combinations may be used to match the steel tube and the concrete within the tube.

- 1 Q235 steel for concrete of strength grades C30 ~ C40.
- 2 Q345 steel for concrete of strength grades C40 ~ C60.
- 3 Q390 steel for concrete of strength grades C60 or above.

3.3.2

The wall thickness of the steel tube in concrete-filled steel tube members shall not be less than 8 mm. The ratio λ of the outer diameter D of the steel tube to the wall thickness t should be $35 \times (235/f_y) \sim 100 \times (235/f_y)$. The standard value f_y of steel strength shall comply with the provisions of Table 3.1.3 of this Code.

3.3.3

The design value of the confinement or hooping coefficient ξ_0 for concrete-filled steel tubes should not be less than 0.60; the cross-sectional steel content ρ_{sc} should be 0.04 ~ 0.20. The ξ_0 and ρ_{sc} shall be calculated according to the following formulas.

Where.

ξ_0 - Design value of the confinement or hooping coefficient for concrete-filled steel tubes;

ρ_{sc} - The cross-sectional steel content of concrete-filled steel tubes;

A_s - The cross-sectional area of the steel tube (mm²);

A_c - The cross-sectional area of the concrete in the steel tube (mm²);

f_s - The design value of the tensile, compressive, flexural strength of the steel plate (N/mm²);

f_{cd} - The design value of the axial compressive strength of the concrete (N/mm²).

3.4.1 High-strength steel wire for suspenders and tie cables should be $\Phi 5$ mm or $\Phi 7$

mm hot-dip galvanized steel wire. The standard strength should not be less than 1670 N/mm²; the performance requirements shall comply with the current national standard "Hot-dip zinc or zinc-aluminium coated steel wires for bridge cables" GB/T 17101.

3.4.2 Steel strands for suspenders and tie cables should be high-strength, low-relaxation

prestressed galvanized or other protective steel strands. The standard strength should not be less than 1860 N/mm²; the performance requirements shall comply with the current national standard "Steel strand for prestressed concrete" GB/T 5224.

3.4.3 Steel used for anchors and connectors for suspenders and tie cables shall be high-

quality carbon structural steel or alloy structural steel; the performance requirements shall comply with the relevant current national standards. Protective materials used for suspenders and tie cables shall not contain components that are corrosive to steel.

4.1 General requirements

4.1.1

This Code adopts a limit state design method based on probability theory; the designs are performed according to the design expressions of partial coefficients.

4.1.2

CFST arch bridges shall be designed according to the following two limit states.

1 Bearing capacity ultimate state. It corresponds to a state in which the CFST arch or its components have reached their maximum bearing capacity, or have undergone deformation