NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

GB/T 51446-2021

Technical standard for concrete-filled steel tubular hybrid structures

Issued on: September 8, 2021 **Implemented on: December 1, 2021**

Issued by: Ministry of Housing and Urban-Rural Development of the People's Republic of China;
State Administration for Market Regulation

Table of Contents

1 General
2 Terminology and symbols
2.1 Terminology
2.2 Symbols
3 basic rules
3.1 General provisions
3.2 Function and function combination
3.3 Construction regulations
4 Carry out structural calculations in the construction phase and the use phase.
5.2 Calculation indicators

1 General

1.0.1 This standard is formulated in order to implement the country's technical and economic policies in the steel pipe concrete hybrid structure project, to achieve safety and applicability, advanced technology, economical rationality, and quality assurance.

1.0.2 This standard applies to the design, construction and acceptance of steel tube concrete hybrid structures in housing construction, railway, highway, electric power, port and other projects.

1.0.3 The design, construction and acceptance of the steel tube concrete hybrid structure shall not only comply with this standard, but also comply with the current relevant national standards.

2.1 Terminology

2.1.1 Concrete-filled steel tubular (CFST) h ybrid struc ture is a structure in which concrete-filled steel tubular (CFST) h ybrid struc ture uses concrete-filled steel pipe as the main component and is mixed with other structural components (parts) and works together, including concrete-filled steel tubular structure, steel tube concrete reinforced hybrid structure, etc.

2.1.2 trusse d co ncrete-filled steel tubular (CFST) hy brid structure It is a joint structure composed of circular steel tube concrete chords and steel tubes, steel tube concrete or other steel webs.

2.1.3 Concrete-encased concrete-filled steel tube lar (C FST) hybrid structure It is a

structure formed by mixing the inner circular steel tube concrete part and the outer steel tube reinforced concrete part.

2.1.4 Limiting value of initial stress in the steel tube The allowable value of the steel tube stress before the steel tube and concrete work together for the steel tube concrete member.

2.1.5 Tolerance limit of concrete void in steel tube limit tin g va lue of core conc rete void in the steel tube The limit value of the void rate of circular void or spherical crown void formed between circular steel pipe and concrete in the tube Or allowable clearance height.

2.1.6 Confinement factor confinem ent factor The ratio of the steel pipe section to the nominal axial compression bearing capacity of the concrete section inside the steel pipe.

2.1.7 Equivalent slenderness ratio Equivalent slenderness ratio In the calculation of the overall stability of the CFST analytical hybrid structure under axial compression, the corresponding slenderness ratio when the CFST analytical hybrid structure is converted into a CFST member.

3.1.1 The design of steel tube concrete hybrid structure shall include the following contents.

1 Structural scheme design, including structural selection and structural layout;

2 material selection and section selection;

3 Action and action effect division;

4 Limit state checking of the structure;

5.Construction of structures, components and connections;

6 Production, transportation, installation, anti-corrosion and fire protection requirements;

7Special performance design to meet the special requirements of the structure.

3.1.2 This standard adopts the limit state design method based on probability theory, and uses the partial coefficient design expression for design.

3.1.3 The concrete-filled steel tube composite structure shall be designed for the limit state of bearing capacity, and except for accidental design conditions, the design for the limit state of normal service shall be carried out, and shall meet the following requirements.

1 When carrying out limit state design of bearing capacity, the basic combination, accidental combination or seismic combination of actions shall be adopted;

2 When carrying out limit state design for normal service, the standard combination, frequent combination or quasi-permanent combination of effects shall be adopted.

3.1.4 The safety level and design working life of the steel tube concrete hybrid structure shall comply with the relevant provisions of the current national standard "Unified Standard

for Reliability Design of Engineering Structures" GB 50153.The safety level of the steel tube concrete hybrid structure should not be lower than the safety level of the overall engineering structure.

3.1.5 When designing the concrete-filled steel tube composite structure, materials, structural schemes and construction measures should be reasonably selected to meet the strength, stiffness and stability requirements of the structural components during construction and use, and should meet the requirements for anti-corrosion and fire protection.

3.1.6 The deformation and crack width of the steel tube concrete hybrid structure shall meet the safety and use requirements. According to the category of the project, the allowable value of the deformation and crack width of each part of the structure should comply with the relevant current national standards.

3.1.7 The maximum applicable height, anti-seismic grade, internal force adjustment and structural measures of the concrete-filled steel tube composite structure shall comply with the relevant provisions of the current national standards on concrete-filled steel tube structures and steel-concrete structures according to the project category.

3.1.8 The concrete-filled steel tube composite structure should combine construction technology and actual engineering conditions, select reasonable construction methods, and formulate technical requirements.

3.2 Function and function combination

3.2.1 The determination of the load standard value, load combination sub-item coefficient, and combination value coefficient of the steel tube concrete hybrid structure shall be based on the project category and comply with the relevant current national standards. For steel pipe-concrete mixed structures directly bearing dynamic loads, when calculating component strength, stability, connection strength, and fatigue, the representative value of dynamic loads should be multiplied by the dynamic coefficient. The value of the power coefficient should comply with the current relevant national standards.

3.2.2 When checking the strength, stability and connection strength of the steel tube concrete hybrid structure, the load design value should be used; when performing the fatigue check calculation of the steel tube concrete hybrid structure, the load standard value should be used.

3.3 Construction regulations

3.3.1 The structure of the steel tube concrete in the steel tube concrete hybrid structure shall meet the following requirements.

3.3.2 The concrete-filled steel tube truss hybrid structure under eccentric compression

should adopt the form of diagonal webs; when the distance between the chords is small or there are requirements for use, the form of flat webs can also be used. The structure of the web member of the concrete-filled steel tube truss hybrid structure shall meet the following requirements.

5.1.2 When the structure has multiple stress conditions during the construction phase and the use phase, the structural analysis shall be carried out separately to determine the most unfavorable action combination for the structure, and shall meet the following requirements.

1 When the structure is subjected to accidental actions such as rare earthquakes, fires, impacts, etc., corresponding structural analysis should be carried out in accordance with the requirements of the current relevant national standards;

2 When the indirect effects of concrete shrinkage, creep, support settlement, temperature change, corrosion and other indirect effects in the structure endanger the safety or normal use of the structure, the corresponding effect effect analysis should be carried out, and corresponding technical measures should be taken measure;

3 Structural analysis in the use stage shall take into account the influence of internal force and deformation formed during the construction process on the mechanical performance of the structure.

5.1.3 Structural analysis shall meet the following requirements.

1 Satisfy the mechanical balance condition;

2 Meet the deformation coordination conditions, including the constraint conditions of nodes and boundaries, etc.;

3 Use a reasonable material constitutive model;

4 Carry out structural calculations in the construction phase and the use phase.

5.1.4 The following calculations shall be carried out for the main construction stages of the steel tube concrete hybrid structure.

1 Calculation of the strength, deformation and stability of the steel structure during the fabrication, transportation and installation of steel pipe members;

2 Calculation of strength, deformation and stability of steel structure during concrete pouring in steel pipe 3 For the concrete-filled steel tube reinforced hybrid structure, the strength, deformation and stability calculation of the steel structure and concrete structure during the pouring of the steel tube outsourcing concrete.

5.1.5 In the structural analysis of the construction stage, the actual functions and effects occurring during the whole construction process shall be taken into account, including the