

# Research on fire performance of concrete filled steel tube column

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## Abstract

In the past ten years, China's high-rise buildings have developed rapidly. Due to population growth and land scarcity, high-rise buildings have become the future development trend. As the building height increases, the gravity load becomes larger and larger, making the vertical components of the structure, especially the section of the column larger and larger. In order to solve this problem, concrete-filled steel tube columns are used in the design of tall buildings. Therefore, it is very important and necessary to carry out reasonable fire resistance design and research. Both the rescue and the structural reinforcement after fire are of great significance.

## Keywords

Concrete filled steel tube column, fire-resistant design.

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## 1. Advantages of concrete filled steel tube

Concrete-filled steel tube structure is the fifth structural system developed after steel structure, wood structure, reinforced concrete structure and masonry structure. It is a new composite structure formed by pouring concrete into steel tube [1]. Concrete-filled steel tube can be divided into circular concrete-filled steel tube, square concrete-filled steel tube and polygonal concrete-filled steel tube according to the shape of section. Compared with traditional reinforced concrete structure, concrete-filled steel tube has many advantages. In terms of materials, concrete-filled steel tube organically combines steel and concrete, which can not only improve the stability of steel tube wall under compression, but also improve the compressive strength and ductility of steel tube. In terms of construction, concrete filled steel tube can be used as a steel framework or even a template, which is light in construction and hoisting, fast in progress, and saves steel quantity. At the same time, the force is reasonable, material consumption is small, space saving, economic benefits are significant, has been widely used.

## 2. Working characteristics and failure modes of components under fire

The experimental results show that the concrete filled steel tube column under design load has good performance when it is subjected to fire. Member deformation is stable. When fire resistance limit is reached, good integrity is maintained. After the fire, the steel pipe strength at the yielding section of the component was restored to different degrees with the reduction of the external temperature. The mechanical properties of the section were improved compared with that at high temperature, and the structural integrity was also improved compared with that in the fire. This not only provides a safe working environment for the reinforcement of the structure, but also reduces the workload of the reinforcement. This is different from the reinforced concrete structure and steel structure after the fire. For reinforced concrete structures, the mechanical properties and integrity of the modified failure

section cannot be restored or improved due to the decrease of temperature. The unstable and twisted members of the steel structure will not bring more safety at room temperature [2].

### 3. Factors affecting fire resistance limit

In order to systematically study the change law of fire resistance limit of concrete-filled steel tube column and find out the main factors that affect the fire resistance limit. Literature [3] and [4] put forward the theoretical calculation model of fire resistance limit of concrete-filled steel tube column based on determining the stress-strain relationship between steel and concrete composed of steel tube coagulation at high temperature. The results have been verified by experiments, and a large number of parameter analysis results show that the fire resistance limit of concrete-filled steel tube members under the design load is mainly related to the section size and slender-length ratio of the members and the thickness of the fire protection layer. However, the effects of steel content and load eccentricity on the fire resistance of concrete filled steel tube, steel yield limit and concrete strength are not obvious.

The section size is too small to have a great impact on its fire resistance limit. The smaller the size of the section, the smaller the size of the core concrete, the worse the heat absorption ability, the shorter the fire resistance limit; On the contrary, the larger the section size, the stronger the heat absorption capacity, the longer the fire resistance limit. The typical influence law of slenderness ratio on fire resistance limit of concrete-filled steel tube column. On the contrary, the smaller the slenderness ratio, the higher the fire resistance limit. In order to make the concrete filled steel tube members reach the required fireproof limit, the thickness of fireproof coating is proportional to the fireproof limit. As long as proper fire protection is carried out on the components, it can meet the requirement of fire resistance limit of column structure in the code for fire prevention design of high-rise civil buildings gb50045-95 [5].

### 4. Conclusion

According to the above research on the fire resistance characteristics of concrete filled steel tube, it can be seen that steel tube and concrete have better fire resistance when working together. Therefore, in the fire resistance design, only in its external use of appropriate fireproofing coatings as protection can achieve the required fireproof limit. Due to the high cost of the research on the fire resistance limit of steel tube concrete column, the research work in this field is relatively few in our country. Therefore, it is of urgent theoretical significance and practical value to study the fire resistance of concrete-filled steel tube column and determine its fire resistance design method.

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