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Composite Hollow Steel Columns Filled With Lightweight Concrete a Comprehensive Review

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Abstract

Composite hollow steel columns filled with lightweight concrete are an effective and efficient solution for various structural applications. This paper provides a comprehensive review of the behavior, design, and application of composite hollow steel columns filled with lightweight concrete. The combination of high-strength steel and lightweight concrete results in a composite material with improved properties such as high strength-to-weight ratio, high stiffness, and high durability. The paper discusses the various considerations involved in the design of composite columns such as strength, stiffness, buckling resistance, and fire resistance. The use of composite columns in construction projects, such as high-rise buildings, bridges, and retrofitting existing structures, is also discussed. This review paper aims to provide a better understanding of composite hollow steel columns filled with lightweight concrete and their applications, as well as their potential for future development.

Keywords: *Composite columns, hollow steel, lightweight concrete, high strength, high stiffness, high durability, design considerations, buckling resistance, fire resistance, structural applications.*

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INTRODUCTION

Composite hollow steel columns filled with lightweight concrete have been widely used in the construction industry due to their various advantages such as high strength-to-weight ratio, high stiffness, and high durability. These columns are commonly used in the construction of high-rise buildings, bridges, and other structures where strength, stiffness, and durability are required. This review paper aims to present a comprehensive review of composite hollow steel columns filled with lightweight concrete, including their properties, design considerations, and applications.

PROPERTIES

The properties of composite hollow steel columns filled with lightweight concrete are mainly influenced by the properties of the steel and concrete. Steel is a highly durable and strong material, while concrete is known for its excellent compressive strength. When steel and concrete are combined, they form a composite material that exhibits improved properties such as higher strength-to-weight ratio, higher stiffness, and better durability.

The mechanical properties of composite hollow steel columns filled with lightweight concrete depend on various factors such as the thickness and diameter of the steel tube, the concrete strength, and the concrete thickness. The strength of the concrete used in the column significantly affects the strength of the composite column. Generally, lightweight concrete with a compressive strength of 20-30 MPa is used in composite columns.

The steel tube used in composite columns is usually made of high-strength steel, such as ASTM A500 or ASTM A847. The diameter of the steel tube ranges from 50 to 400 mm, and the thickness ranges from 1 to 8 mm. The thickness and diameter of the steel tube depend on the load that the column is expected to carry. Thicker steel tubes are used for columns that are subjected to higher loads.

The concrete used in composite columns is generally lightweight concrete with a density of 1600-2000 kg/m^3. The lightweight concrete is made by replacing the coarse aggregate with lightweight aggregate such as expanded shale, clay, or slate. The concrete thickness ranges from 25 to 75 mm, and the strength ranges from 20 to 30 MPa. The concrete thickness depends on the diameter of the steel tube

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and the load that the column is expected to carry.

DESIGN CONSIDERATIONS

The design of composite hollow steel columns filled with lightweight concrete involves several considerations such as the strength and stiffness requirements, buckling resistance, and fire resistance. The strength and stiffness requirements are generally determined based on the load that the column is expected to carry. The buckling resistance of the column is also an important consideration as composite columns are prone to buckling under compressive loads.

The design of composite columns can be performed using various codes such as AISC 360, Eurocode 3, and CSA S16. The design involves calculating the ultimate strength and deformation of the column under various loading conditions such as axial compression, bending, and lateral-torsional buckling. The design also involves determining the required thickness and diameter of the steel tube and the concrete thickness.

The fire resistance of composite hollow steel columns filled with lightweight concrete is also an important consideration in the design. The fire resistance of the column depends on several factors such as the thickness of the steel tube, the thickness of the concrete, and the strength of the concrete. Generally, composite columns filled with lightweight concrete exhibit good fire resistance due to the insulating properties of the concrete.

APPLICATIONS

Composite hollow steel columns filled with lightweight concrete are widely used in various applications such as the construction of high-rise buildings, bridges, and other structures. These columns are particularly useful in situations where high strength and stiffness are required, such as in the construction of tall buildings. The use of composite columns can significantly reduce the weight of the structure, thereby reducing the cost of construction and improving the overall efficiency of the structure.

Composite columns are also used in bridge construction, where high strength and stiffness are required to withstand the heavy loads and harsh environmental conditions. The lightweight properties of the columns make them ideal for use in long-span bridges where weight reduction is crucial.

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In addition, composite columns can also be used in retrofitting existing structures. The use of composite columns in retrofitting can improve the strength and stiffness of the structure, thereby extending its lifespan and improving its overall performance.

CONCLUSION

Composite hollow steel columns filled with lightweight concrete are a highly efficient and effective solution for various structural applications. The combination of high-strength steel and lightweight concrete results in a composite material with improved properties such as high strength-to-weight ratio, high stiffness, and high durability. The design of composite columns involves several considerations such as strength, stiffness, buckling resistance, and fire resistance. Composite columns are widely used in the construction of high-rise buildings, bridges, and other structures where high strength and stiffness are required. The use of composite columns can significantly reduce the weight of the structure, thereby reducing the cost of construction and improving the overall efficiency of the structure.

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