

Seismic Design for Reinforcement and Reconstruction of Viaduct

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Abstract: Combining with topography, geological conditions, engineering scale and earthquake damage experience, reasonable selection of bridge type, pier and abutment and foundation form is made. (2) In the same bridge, the combination of high piers and large span should be avoided as far as possible, and the structural form that reduces the self-weight of superstructure and is beneficial to seismic resistance should be adopted. (3) Simple in shape, light in weight, uniform in stiffness and mass distribution, low in center of gravity, easy to construct. _The connection mode is helpful to improve the integrality of the structure. The pier and abutment structure adopts relevant measures to improve its ductility and fast vibration attenuation. When necessary, seismic isolation bearings and plastic hinges are installed. _The structural system with advanced technology, reasonable economy and easy repair and reinforcement should be adopted as far as possible. (5) Further research and application of shock absorption and isolation bearings should be carried out; ductility analysis and calculation of reinforced concrete piers should be strengthened to determine the range of plastic hinge area of piers. _For special bridges with high piers and long span, special seismic design and research should be carried out.

1. Introduction

Energy dissipation technology is to design some components of the structure into energy dissipation components, or install energy dissipation devices in some parts of the structure. When the wind or small earthquake acts, these energy dissipation components or devices have enough initial stiffness, are in elastic state, and the structure has enough lateral stiffness to meet the normal use requirements; when there is strong wind or earthquake, with the increase of lateral deformation of the structure, the energy dissipation components or devices first enter the inelastic state, resulting in greater damping, and consume a large amount of input structure. Earthquake or wind vibration energy can avoid obvious inelastic state of the main structure, and rapidly attenuate the seismic or wind vibration response (displacement, velocity, acceleration, etc.) of the structure, and protect the main structure and components from damage or collapse in strong earthquakes or strong winds, so as to achieve the purpose of seismic mitigation and anti-seismic.

Energy dissipation components (energy dissipation components or energy dissipation devices and their connectors) can be divided into energy dissipation support, energy dissipation shear wall, energy dissipation support or suspension components, energy dissipation nodes and energy dissipation connections according to different "component types".

The dampers in energy dissipation components are divided into velocity-dependent dampers such as viscous fluid dampers, viscoelastic dampers, viscous dampers, viscous dampers, viscoelastic dampers, displacement-dependent dampers such as metal yield dampers, friction dampers, and other types such as frequency-modulated mass dampers (TMD), frequency-modulated liquid dampers (TLD).

Compared with the traditional anti-seismic structure system, the structure system using energy dissipation technology has the characteristics of large earthquake safety, economy and technical rationality.

2. Reinforcement Technology of Concrete Members by Adhering Carbon Fiber, Steel Bonding and Steel Cladding

Main Technical Contents

Carbon fiber bonding and steel bonding reinforcement technology for concrete structures is to use specially configured modified epoxy adhesives to paste carbon fiber sheets or steel plates on the surface of structural members (mostly in the tension zone) to form a composite stress system, so that both of them can work together to improve the flexural, shear and tension bearing capacity of structural members, so as to achieve the purpose of strengthening and reinforcing the members.

Steel-encased reinforcement method is a kind of reinforcement method of steel-encased around reinforced concrete beams and columns, which can be divided into dry and wet types. The wet encased steel reinforcement method is to use modified epoxy resin chemical grouting method to bond between the encased steel and the components, so that the steel and the original components can work together as a whole. Compared with the wet method, the dry method is more convenient in construction, but the improvement of bearing capacity is not as effective as the wet method.

The design calculation and structural adhesives for the reinforcement of carbon fibers, bonded steel and encased steel should conform to the requirements of GB50367 and JGJ116 of Technical Regulations for Seismic Reinforcement of Concrete Structures, and the design and construction requirements of steel and weld seams should conform to the requirements of GB50017 of the current national standard code for design of steel structures.

The bonded carbon fiber reinforcement technology is suitable for reinforced concrete flexural, axial compression, large eccentric compression and tension members. The bonded steel reinforcement technology is suitable for reinforced concrete flexural, large eccentric compression and tension members. Both of them are not suitable for plain concrete members, including the longitudinal reinforcement ratio is lower than the minimum reinforcement stipulated in the current national standard "Code for Design of Concrete Structures" GB50010. Reinforcement of rate components. The strength grade of reinforced concrete structural members measured in situ shall not be lower than C15, the positive tensile bond strength of concrete surface shall not be lower than 1.5 MPa, and the ambient temperature for long-term use shall not be higher than 60 C.

The steel-encased reinforcement technology is suitable for reinforced concrete beams and columns which need to improve the bearing capacity and seismic capacity of the section.

The reinforcement technologies of carbon fibre, steel bonding and steel cladding have been applied in the reinforcement and reconstruction projects of Beijing Railway Station, Beijing Workers'Stadium and China National Museum.

3. Reinforcement Technology of Steel Strand Mesh Polymer Mortar

Steel hinged wire mesh-polymer mortar reinforcement technology is a new type of reinforcement technology. It is to lay the steel hinged wire mesh on the tension part of the strengthened component after the interface treatment of the strengthened component, and then coat it with polymer mortar. The steel hinged wire is the main part of the force, which exerts its higher tensile strength than the ordinary steel bar in the reinforced structure; the polymer mortar has good permeability, good resistance to chloride and general chemical products, high bonding strength and compactness. On the one hand, it protects the steel hinged wire mesh, on the other hand, it bonds the steel hinged wire mesh to the original structure to form a whole, so that the steel hinged wire mesh and the general chemical products have good permeability, good bonding strength and compactness. The deformations of original structural members are coordinated and work together to effectively improve their bearing capacity and stiffness.

In addition to the excellent reinforcement effect, the steel hinge wire mesh-polymer mortar reinforcement technology has better environmental protection, durability, high temperature resistance, anticorrosion and fire protection performance than the traditional reinforcement technology. The construction is fast and convenient, and the site environmental pollution is small. Because of the thin reinforcement layer, the self-weight of the structure is not significantly

increased after reinforcement, which has no effect on the appearance and use space and function of the building.

4. Demolition Technology of Unbonded Prestressed Concrete Structure

The unbonded prestressing concrete demolition is to cut the unbonded prestressing tendons in the unbonded prestressing concrete beams and slabs which have been stretched and treated at the end, and then to demolish the beam and slab concrete. Its technical contents mainly include erection of unloading frame, determination of the position of prestressing steel bar, manual chipping to find prestressing steel bar, temporary fixing of prestressing steel bar and unloading anchor, concrete removal in a specified range, re-tensioning of prestressing steel bar and head.

(1) It conforms to the Technical Regulations for Unbonded Prestressed Concrete Structures JGJ92.

(2) Technological process: erecting unloading bracket detecting and determining the position of prestressing tendons removing prestressing tendons releasing anchors, removing concrete reinforcing treatment at the end of prestressing tendons (pouring concrete and additional reinforcement) re-stretching of prestressing tendons sealing head

(3) Determine the position of the prestressing steel bar: After the support system is set up, refer to the original construction drawings of the prestressing steel bar, and combine with some detection instruments, such as radar detectors, determine the exact position of the prestressing steel bar and the position of the prestressing joint, and make a mark.

1) In the reconstruction of pre-stressed concrete, three openings will be cut at the location of each pre-stressed steel bar in the demolished component. The first and third openings are located at the edge of the component to be demolished, and the middle openings are located in the middle of the component to be demolished. After the first opening 1 and the third opening 3 are chiseled, the prestressing tendons at the first opening 1 and the third opening 3 are fixed by temporary anchorage, and the prestressing tendons are cut off at the middle opening 2 by hot melt method.

2) Different methods of opening and temporary fixing are adopted according to different situations. Then, the prestressing steel bar in the opening can be cut off by air cutting method, and the prestressing force can be released slowly. Before burning, the prestressing steel bar tension end must be protected reliably. After the prestressing steel bar is cut and stretched at the opening, the prestressing state of the surrounding structure should be restored, and the tension force should be carried out according to the original prestressing force of the structure. It must be noted that when the prestressing tendons are stretched and re-stretched, the strength of the concrete at the end of the tensioning tendons is difficult to meet the construction requirements and the position of the prestressing tendons at the end of the tensioning tendons is difficult to ensure the ideal state. Therefore, the end of the prestressing tendons must be strengthened before stretching to meet the requirements of local compression of concrete.

3) The prestressing steel bars in the beams are arranged in the form of group bundles. There are many prestressing steel bars in the concrete of the original structure in each beam. At the end of the beam, the group bundles of prestressing steel bars are located at the middle and upper ends of the beams. Because the prestressing re-tensioning needs to separate the prestressing reinforcement, it is necessary to re-pour a part of the concrete after the demolition of the concrete and place the bearing plate, and allocate a certain number of additional reinforcement to bear the local pressure of the prestressing reinforcement. After the strength of this part of concrete reaches 85%, the pre-stressed steel bar can be tensioned again, and the tension control stress can be carried out according to the requirements of the original structure. With the size of anchorage and the thickness of concrete cover, the first pouring of concrete requires at least 300 mm, and the rest of the concrete is poured for the second time or several times.

5. Summary

Seismic design of bridge structure is an important link in bridge design. At the time of large-scale construction of expressways and railways in China, the safety of bridge structure can not be ignored. In the design of bridges, a series of effective seismic measures should be taken to further improve and perfect the safety, applicability, durability and social effects of bridges.

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