Research on Development and Comparative of the Damping Control Technology of Building Structure

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Abstract. The new specification for seismic isolation technology promulgate is putting forward new requirements for construction project engineering and technical personnel of the participation of all parties. The seismic isolation technology is one of the damping control technology, but the engineering structure damping control is the frontier field of the civil structural control. Research on development and present situation of the building structure damping control theories, and compare with the traditional aseismic theories are more prominent superiority and applicability of the building structure damping control theories. It is great significance of promotion and application about damping control technology, and it is helpful to the engineering technical personnel in the future work better application.

Keywords: Building Structure, Damping Control Technology, Anti-seismic Technological, Application Range.

1. Introduction

When an earthquake occurs, ground vibrations will cause the seismic response of the building structure. In order to avoid the disaster, the earthquake response of the structural system must be controlled. First proposed and widely used in seismic theory is rigid architecture. Seismic response of such a system close to the ground shake, but it is difficult to achieve, but also very economical, it is proposed later ductility architecture. Firstly, it is proposed that the seismic theory is a rigid structure system. The structural seismic response of the system is close to the ground motion, but it is difficult to achieve, and it is not economical, and therefore, the ductile structure system is put forward. This system makes the structural components in the inelastic state when the earthquake, and has a large ductility, to consume seismic energy, to reduce the seismic response, so that the structure is cracked and not fall. But the structural system also has limitations. For example, for general construction, if more than fortification intensity earthquake occurs, the deformation is difficult to repair. As for the importance of the building, the design specification does not allow it to enter the inelastic state, these defects make the application ductile structural system has been greatly restricted. With the continuous exploration of new seismic structure system, engineering structural vibration control system that has a good safety and applicability of new seismic system without additional cost generated.

2. Development and present situation of vibration control technology of building structure

2.1 Development of building structural vibration control technology

(1) Establishment of new concept and its research stage: In the 70's in twentieth Century, the concept of seismic control was established, which includes isolation, energy dissipation, passive and active control. And started the theory research and experiment research.

(2) Pilot project phase: This phase began in the 1980s. Construction of a building or structure of the first control technology, and successfully subjected to seismic test, the formation of the technological development of the breakthrough points and milestones.

(3) Stage of popularization and Application: After the success of the pilot project began in some applications, and improve the relevant theories and methods, summarize the corresponding technical and economic indicators and social and economic benefits to the technology to mature stage, the final

preparation of the corresponding design and construction instructions, technical specifications, technical specifications, so that to promote the use of the technology to the benefit of mankind.

2.2 Engineering structural vibration control technology status

There are five main technologies of building structure vibration control: isolation technology, energy dissipation technology, quality and frequency modulation technology, active control technology, hybrid control technology. The mature degree, application range and application conditions of the vibration reduction control technology are described in this paper.

Isolation technology. (1)Technical maturity: the damping effect of isolation technique is obvious, the theoretical and experimental results are more abundant and perfect At present, a large number of rubber cushion isolation building and bridge, subway and other structures have been built, which have been successfully tested. In several large earthquakes. In ensuring the rubber materials and products through comprehensive and rigorous testing and quality control of various properties, and the use of proper design methods and techniques to calculate the premise could be extended in the project.

(2)Application conditions: the isolation device must use the production conditions and technical conditions to complete the production of the manufacturer, to ensure the quality of the isolator. To ensure the durability of the materials, long-term performance stability, the sensitivity of structural restoration to ground subsidence, and the quantitative calculation of seismic isolation technology, etc. In order to make the construction of operational, save the cost.

(3)Application: can be used in layers of one to thirty layers of building or aspect ratio is not more than to make all kinds of multi-storey buildings, the superstructure horizontal stiffness greater variety of structures, bridges, equipment, instruments.

Energy dissipation. (1)The degree of maturity of the technology: Energy Dissipation is safe and reliable, enrich the research of theory and experiment results, has been successfully used in high-rise buildings, bridges, and towers of wind and earthquake resistant and can be applied in engineering.

(2)Application conditions: making energy dissipation device is simple to install, make sure that the energy dissipation means a larger deformation in structural members, cracks or damage before you can give full play to the role of energy dissipation. To ensure durability, long-term performance stability of energy dissipation devices.

(3)Application scope: the higher the soft structure, damping energy dissipation effect is more significant. So it can be applied in many layers (15 storey), greater height, horizontal stiffness is smaller, the horizontal displacement of the obvious multi-level, high-level, high-rise buildings, long-span bridges, pipelines, towers, towering structure.

Quality frequency modulation shock absorption technology. (1)Degree of maturity of the technology: at present is still in technology is mature stage of development trend, the main vibration type is a distinct and stable structure is more effective, more theoretical research and experimental results have been obtained, and has been applied in some projects.

(2)Application conditions: tuning means production should be simple, damping effect to go through the full and theoretical arguments and a large proportion of shaking table validation.

(3)Scope of application: many layers (more than 20 layers), height is quite large, and the main vibration mode is more obvious and stable multi-layer, high-rise and super high-rise buildings, long-span bridges, towers, high-rise structure.

Active control technology. (1)Technical maturity: some theoretical research and experimental results have been achieved, the shock absorption effect is very obvious, and has been used in a few projects. But there are some technical problems remain to be unsolved, such as hysteresis and effectiveness of the control system hardware and software, the normal supply of external energy issues of sudden earthquake normal supply, annual maintenance equipment problems effectively while wind and seismic control issues. Therefore, the current technology has not yet entered a mature stage.

(2)Applications: seismic (or wind) requirements, requirements for the control of the more important buildings modes, high-rise buildings, important bridges, special structures etc.

2.2.5 Hybrid control technology

(1)Technical maturity: as long as reasonable selection of optimum combination of control technology, control technology to draw all the advantages and avoid the shortcomings or problems, can form a more effective combination of mature and advanced control technology.

(2)Application scope: all kinds of different types and different requirements of building structure.

(3)Application conditions: According to different requirements of different seismic wind building, structure, technical reliability and cost economy, choose isolation, energy dissipation, quality tuning active control of two (or more) control technology to reach the damping effect, safe and reliable, cost economy, realistic goal.

3. Comparison between seismic control of building structure and traditional seismic theory

The following from the seismic methods, according to the design, protection object and scope of application of the old and the new seismic system are compared:

3.1 Different ways and means of shock resistant

(1)Traditional seismic technology is followed in the "hard" way that is, the reinforcing structure, bold component section, Increase reinforced component and improve the structure rigidity method to resist earthquake. However, due to the larger the structural stiffness, the greater the earthquake action, a vicious circle, so it is not economic, but also not necessarily safe.

(2)Vibration control technology is the use of isolation, energy dissipation, adjust the dynamic characteristics and other methods to isolate an earthquake or seismic response reduction purposes, both effective shock absorption, more secure, but also more economical.

3.2 Different design basis

(1)Traditional seismic design method is in accordance with a predetermined ‘intensity’ defining the seismic capacity of the structure. When the actual earthquake exceeds a predetermined ‘intensity’ (a lot of Chinese and foreign destructive earthquake more than the predetermined intensity), the structure is in an unsafe condition.

(2)Structural vibration control design is based on the characteristics and features of the site dynamic structures, using different isolation, energy dissipation, vibration control technology, consider the case and may produce sudden super-intensity earthquake in the area, structure earthquake response is still controlled in a safe range, ensure that the structure and the structure of the people, equipment, apparatus, security and proper use of the environment. Therefore, the structure of damping technology is more secure than traditional seismic techniques.

3.3 Different objects protection

(1)Conventional seismic techniques only consider the seismic capacity of the structure itself, without taking into account the structure of the equipment, instruments, and decoration protection requirements.

(2)Structural vibration control technology according to the different requirements of the structure itself safety requirements and internal equipment, equipment, decoration of seismic isolation, energy dissipation and damping control, both to protect the safety of structure itself, and also protect the structure of the equipment, instruments, decoration and normal use of the environment. Therefore, it is more consistent with the modern society to protect the formation of higher and higher requirements.

3.4 Different application scope

(1)According to the traditional seismic design of engineering structures, mainly rely on the structure itself to provide seismic capacity. For some insufficient seismic capacity of existing engineering structures (for example super high-rise buildings), if the structure itself ability is insufficient, it is difficult to use "strengthen" the method to make up for.

(2)Structure vibration control technology mainly does not depend on the structure itself, but by the addition of a device to carry out seismic isolation, energy dissipation or shock absorption. So that it can be used not only in the new design of engineering structures, also applies to the lack of seismic performance of engineering structures was improved, reinforcement, which meets the demand of seismic or wind).

4. Conclusions

Through the above comparison studies, you can see structural vibration damping control system can effectively, without too many restrictions on building structure design, and easy to check and repair, safe economy is strong, can meet the requirements of modern society, and wide application many advantages. Regardless of design, construction, supervision and other parties participating in the construction of engineering and technical personnel should be prepared to better understand this new technology damping isolation plays a huge role in its economic and social development.

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