Comprehensive Analysis on Seismic Design of Tall Building Structure Method

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ABSTRACT For a high-rise structure design, the problems encountered may be perplexing, concrete analysis of concrete problems only. Engineering practice shows that the design process of the high-rise structure, design personnel only seismic conceptual clarity, structure measure analysis software three organic combinations to achieve more satisfactory results in the process of seismic structural weight in structure calculation structure properly applying the appropriate. This paper makes a theoretical analysis of necessity for building seismic design concept, in order to explore the method of high-rise building to take the necessary anti-seismic measures.

KEYWORDS
High-rise building
Seismic
Structural design

1. Development of high-rise buildings before

In the eighties, it is the stage of the tallest building in all aspects of design calculations and construction technology fast development. General construction of major cities around 100 m in height or steel-based building 100 m or more, building layers and height increasing functionality and more complex types, architecture is becoming more diverse. More representative of the high-rise buildings in Shanghai Jinjiang Hotel, it is a modern luxury hotel, with a total height 153.52 m, all using the framework of an all-steel core wall system Shenzhen Development Centre Building, 43-storey 165.3 m, plus the height of the antenna a total of 185.3 m, which is one of China's first large-scale high-rise steel buildings. In the 1990s the design and construction of high-rise building construction technology has entered a new stage. Not only architecture and building materials appeared at the height of the diversification and long pieces have a great leap forward. Shenzhen in June 1995 capped King Building, 81-storey, 385.95 m for the steel structure, which ranks fourth in the world architecture.

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2. Seismic analysis theory

2.1. Building seismic norms

Seismic building norms that countries actually experienced seismic building with authoritative summary guide Seismic Design (including structural dynamic calculation, structural seismic measures and seismic analysis of foundation and other major content) statutory documents It reflects each country's economic age and level of construction, but also reflect the specific seismic practical experience of individual countries. Although it is guided by the theory of earthquake-related scientific, technical and economic rationality to the direction of development, but it also needs to have a firm foundation engineering practice, to give top priority to the safety of construction works, cannot tolerate any risk and untrue. It is with this understanding, some provisions of the modern norms are classified as mandatory provisions, some provisions with a "no, cannot, must not, should not" and reflect the different degrees restrictive and "must, should, it is appropriate can" and other terms reflect the different degrees of flexibility.

2.2. Seismic design theory

Quasi static theory is a theory of the 20th century, 10 to 40 years to develop, and it is estimated that at the time of earthquake structure, only the structure is assumed to be rigid, in the center of mass of the structure or component seismic force level role. Magnitude earthquake force when multiplied by a constant of proportionality (seismic coefficient) in the weight of the structure.

Response spectrum theory was developed in 1940 to 60 years plus, it is to study the observed strong motion acceleration recorded increase and better understanding of earthquake ground motion characteristics and structural dynamic response characteristics, based on the Canadian Institute of Technology an important outcome after some research scholars on the characteristics of earthquake acceleration records obtained were analyzed. Power Theory. Dynamic theory 1970—Earthquake Dynamic Theory of widely used for 80 years. In addition to its development since the 1960s, based on the development of computer technology and external test technology for all kinds of people in the earthquake structural linear and nonlinear reaction process with more understanding and with the continued strong earthquake observation stations increased seismic response record various damaged structures have continued to increase. Further power drive theory, also known as seismic analysis theory, it is the earthquake as a time process, choose a representative ground motion acceleration time history as seismic input, building a multi-degree of freedom system simplifies, calculated every time a building seismic response, thus completing the seismic design work.

3. Seismic design of tall building structure

3.1. Earthquake measures

In the seismic design of the structure, in addition to consider the conceptual design, structural seismic checking outside, after the previous earthquake people in building height restrictions to improve the ductility (confinement structure type and structure of the material), and other aspects of the experience has been summed seismic codes in some countries attention. Currently, the three conceptual design, seismic and structural measures to start checking in seismic design basis of the seismic and vibration absorber (ductility) combined on the establishment of a dual design specifications and design seismic force structure requirements of mutual influence and ductility method, until further through a number of structural measures (isolation measures energy Dissipation measures) to damping, seismic action that is so reduced structural and seismic performance of buildings with good economy is the contemporary seismic design code development in the earthquake direction. Moreover, strong column weak beam, the role of strong shear weak bending and strong nodes weak member in terms of improving ductility of the structure has been generally recognized.

3.2. Seismic design of tall buildings

China's "Seismic specification" (GB50011-2001) to seismic construction proposed "three-level, two-stage" requirements "three levels" or "minor earthquake, the earthquake can repair, earthquake does not fall." When the first fortification intensity earthquake hit the area that is lower than the seismic intensity of multi earthquake, the structure in elastic deformation stage, the building is in normal use. Buildings are generally not damaged or without repair can continue to use. Therefore, the requirements of building structures to meet the multi encounter the ultimate limit state earthquake checking, it requires the elastic deformation of the building does not exceed the elastic deformation limit. When confronted with a second fortification intensity earthquake is equivalent to the basic seismic intensity seismic intensity of the region, yielding the structure into a non-elastic deformation stage, the building may be a certain degree of damage. But after general repair or no repair, it can continue to use. Therefore, the structure requires a considerable ductility capacity (deformation) of brittle fracture does not occur cannot be repaired. When the earthquake hit third fortification intensity that is higher than the region's seismic intensity when the rare earthquake, structural damage, although heavier, but the collapse of inelastic deformation structures are still some distance away from the structure. It wills not collapse or life-threatening serious damage, in order to protect the safety of personnel. Therefore, the requirements of the building has sufficient deformation capacity, its plastic deformation plastic deformation does not exceed the specified limits.

Earthquake intensity level of three levels, according to three different exceedance probability (or return period) to distinguish: Multiple earthquake: 50 years 63.2% probability of exceedance return period of 50 years; seismic fortification intensity (primary seismic): 50-year probability of exceedance 10%, return period 475 years; rare earthquake: 50 years 2–3% probability of exceedance return period 1641–2475, the average is about 2000. The three levels of the building seismic fortification requirements, through the "two-stage" designed to achieve, its steps are as follows: The first stage: first use and first level of intensity of ground motion parameters corresponding, first calculate the structure Earthquake action effects elastic state, with wind, gravity load effect combinations, and the introduction of the seismic bearing capacity adjustment factor, conducted section design to meet the strength requirements of a first-class; the second step is to use the same ground motion parameters to calculate the structure inter-layer displacement angle, it does not exceed the limits specified in seismic codes; seismic structure while using appropriate measures to ensure that the structure has sufficient ductility and plastic deformation energy, thereby automatically meet the requirements of the second level of deformation. The second stage: The third level of vibration corresponding to the parameters between the calculated structures (especially the weak floors and seismic weaknesses) elastic-plastic story drift, so that less than seismic specification limits. And to adopt the necessary seismic structural measures to meet the requirements of the third level of the anti-collapse.

3.3. Seismic design method of tall buildings

China's "Seismic Design of Buildings" (GB50011-2001) seismic calculation method should be used for all types of building structures made the following provisions: height not exceeding 40m, and the shear deformation in mass and stiffness is more evenly distributed along the height simplified method of structure, and the structure is similar to the single particle system, can be the base shear method; exception of one paragraph of the building structure, should adopt the modal response spectrum method; particularly irregular building, Class A buildings and restrictions height range of high-rise buildings, multi encounter additional calculations under earthquake desirable time history curve more than the greater of the average of the results of modal response spectrum method should be used to calculate the results of time history analysis.

4. Seismic conceptual design of the basic principles and requirements

4.1. Choose a favorable venue

Because building damage is multifaceted, site conditions is one of them. Due to damage caused by space factors often particularly serious, and in some cases relying solely on engineering measures to compensate for it it is very difficult. Therefore, when you select the project site, should conduct a detailed investigation, find out the terrain, geological conditions favorable for Seismic selected location, as far as possible to avoid the adverse seismic building lots, under no circumstances should be built on earthquake hazard area Buildings cause casualties or economic losses may be greater. Seismic favorable for the lot, generally it refers to hard or compacted soil sites located in the flat areas of open space even in hard soil. Built on the site of such buildings generally do not cause damage occurred due to the failure of the foundation, which can mitigate the effects of earthquakes on buildings fundamentally. Seismic unfavorable for the lot, on the terrain, it generally refers to the top of the strip projecting spur, isolated hills and ridge height difference larger platform edge, the edge of the non-rocky steep slopes, river banks and slopes; the soil on the site, it generally refers to the soft soil, easily liquefied soil, so the river, fault fracture zone, Buried Creek valley or semi-dug pond half-filled foundations, as well as the distribution of the causes of the plane, lithology, state clearly uneven lot.

4.2. Using reasonable flat building facade

Dynamic performance of buildings depends essentially on its architectural layout and structure of the fabric disposal. Building layout is simple and reasonable, consistent with the seismic structure cloth Ge principle, we can guarantee the fundamental house has a good seismic performance. Experience shows that simple rule, symmetrical building seismic capability, not easy to damage during an earthquake; the other hand, if the houses irregular shape, the plane protruding recessed facade scattered high and low, prone to damage during an earthquake. Moreover, simple rules, symmetrical structure easily and accurately calculate its earthquake response, we can ensure earthquake with a clear direct pathway, easy to take structural measures and carry out detailed seismic processing.

4.3. Select reasonable structure

Seismic structural system is a key issue for seismic design should be considered. According to the structure material classification, structural system applications are currently the main masonry structure, steel, reinforced concrete structures, steel - concrete structure; classification according to the structure, there are now common frame structure, wall structure, frame shear wall structure, simplified structure. Determine the structure of the system is affected by seismic intensity, building height, site conditions and construction materials, construction conditions, economic conditions and other factors, it is a comprehensive technical and economic issues, the need for careful consideration of the establishment. Seismic norms of building structural systems are the following provisions: (1) structural system should have a clear and rational calculation diagram earthquake pathway; (2) architecture should have multi-channel seismic line of defense, should be avoided due to the destruction of part of the structure or member causes the entire System loss seismic capacity or gravity load bearing capacity; (3) architecture should have the necessary seismic capacity, good deformation capacity and energy dissipation capacity; (4) architecture should stiffness and bearing capacity of a reasonable distribution, to avoid weakening or partial mutagenesis weak parts, excessive stress concentration or concentration of plastic deformation on weak parts possible measures should be taken to improve the seismic capacity; (5) structure in the dynamic characteristics of the two principal axes should be similar to the structure of the cloth at disposal, should Follow disposal symmetry plane cloth, cloth facade disposal uniform principles to avoid the center of mass and the center of rigidity caused by torsional vibration do not coincide and produce weak layers.

4.4. Improve the ductility of the structure

Definable structure ductility inelastic deformation capacity of the structure occurs at a significantly reduced carrying capacity without precondition. Ductile deformation structure reflects the capacity of the structure is to prevent one of the key factors in the earthquake collapsed. Good ductility helps to reduce earthquake, seismic energy absorption and dissipation, avoiding structural collapse. The size of the structure ductility and energy consumption, failure modes and plasticizing process depends member, ductile bending member is far greater than the shear component, component bending yield seismic input energy consumption until the destruction, but also much higher than the member shear failure of the energy consumed. Thus, the structural design should seek to avoid shear failure member, to attract more members to achieve bending failure. Always follow the “strong column weak beam, fried weak bending strong, strong nodes, weak anchoring” principle.

Destruction and quit working member, the entire structure of transition from one system to another stable stabilizing system, resulting periodic structure is changed, in order to avoid resonance effects of seismic predominant period of prolonged duration of action caused.

4.5. To ensure structural integrity

Structure is composed of many members to connect a whole combination, and to effectively resist the seismic action by coordinating the work of each member. If the structure under earthquake loss of integrity, the seismic capacity of the structure of each member cannot fully become so easy to make maneuvering body structure collapsed. Therefore, to ensure structural integrity is an important condition for each part of the structure under seismic action coordination, to ensure structural integrity is an important part of seismic conceptual design. In order to give full play to the seismic capacity of each member, to ensure structural integrity in the design process should follow the following principles: (1) Structure should have continuity. Continuity of the structure is to make the structure at the time of the earthquake can be an important means of maintaining overall. (2) Ensure a reliable connection between components. Improve the seismic performance of buildings, to ensure that all member full capacity, the key is to strengthen the connection between members, so that it can meet the strength requirements of seismic force transfer and adaptation requirements ductile deformation of large earthquakes. (3) Enhance Housing vertical stiffness. In the design, it should make the structure along the longitudinal and transverse two directions have sufficient overall vertical stiffness, and house foundation with strong integrity, the foundation may occur when uneven settlement to resist earthquakes and ground fissures through the house when the harm caused.

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