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硕 士 学 位 论 文

基于屈服机制的高层框架-筒体结构

抗震性能设计

**The Performance-based Seismic Design Of Tall Frame-Tube
Wall Structure Based On Yield Mechanism**

陈家伟

指导教师姓名: 石建光 教授
专业名称: 结构工程
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摘要

随着科技和经济的发展，对于高层建筑结构的抗震设计提出了更高的要求，从以往的单纯满足规范要求的指令式的设计方式，转变为满足不同抗震性能要求的设计方式，特别是抗震性能设计思想被引入规范之后，针对高层超限结构往往需要进行性能设计。但现在的性能设计主要还是停留在构件层次，即小震、中震、大震下对应结构构件应该达到怎样的性能目标，这往往使结构性能设计仅局限于构件层次。而从屈服机制角度来探讨结构的抗震性能，实际将构件层次与整体结构层次连系起来，使得结构整体性能目标的确定更加明确，而且更易于构件控制，同时便于工程师从概念角度理解性能设计。

针对以上问题，本文提出基于屈服机制的抗震性能设计思想，以结构的屈服机制来指导抗震性能设计。本文具体内容如下：(1) 论文首先总结了抗震性能设计的内容、要求、意义、研究现状以及与屈服机制的联系；(2) 其次对某一实际高层框架-筒体结构进行了性能设计，给出性能目标与屈服机制的对应关系；(3) 通过构件布置调整，对核心筒体的两个方向补开结构洞，增加连梁耗能能力，将核心筒由单一大筒转换为多子筒形式；经过弹塑性分析，发现高层框架-筒体结构的总体屈服机制为连梁—墙肢—外框架，但是当核心筒体转换为多子筒后，结构表现的屈服机制细分为“子筒间连梁—子筒上连梁—墙肢—框架”和“子筒上连梁—子筒间连梁—墙肢—框架”。对于屈服机制为“子筒间连梁—子筒上连梁—墙肢—框架”的结构，综合结构整体性能目标（包括层间位移角、楼层剪力、基底剪力、剪力时程、位移时程等）和损伤情况，发现在地震作用下能够更好的实现事先设定的抗震性能目标，具有这种屈服机制的结构，连梁损坏后地震力下降明显，结构构件在大震下的损伤基本发生在连梁而非墙肢，墙肢仅发生较轻的损伤，虽然层间位移角结果略大一些，但是仍然能够满足大震不倒的要求，同时具有更加优异的经济性。说明在满足合理屈服机制的前提下，结构能够更好的实现性能目标。(4) 综合以上基于屈服机制的抗震性能设计思想，实施了另一实际高层框架筒体结构的抗震性能设计，进一步验证其可行性和合理性。

关键词：高层框架-筒体结构；多子筒；抗震性能设计；屈服机制；弹塑性

时程分析；

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ABSTRACT

With the development of technology and economic, higher requirements are put forward for the seismic design of tall buildings. It is turned from the past command-style design approach simply to meet the codes to the design approach to meet the different requirements of the seismic performance. Especially after the seismic performance design is introduced to the codes, the tall building structures beyond code-specification are usually needed to be designed by seismic performance-based method. But now the performance-based design still remains in the member level, that is what performance objectives the corresponding structural members should achieve under appropriate frequent earthquake, medium earthquake and rare earthquake. Such structural performance-based designs tend to make only limited to member level. However, from the perspective of the yield mechanism to investigate the seismic performance of the structure, it connects the member level with the whole structure level, which makes the performance objectives to determine more clearly and allows engineers to understand from a conceptual point of performance design.

To solve the above problem, this paper presents the seismic performance-based design idea based on the yield mechanisms. Details of the paper are as follows:(1)Firstly this paper summarizes the contents of the seismic performance design, requirements, significance, research status and contact with the yield mechanism.(2) Secondly, elastic-plastic analysis software are used for seismic performance-based design of a real tall frame-tube wall structure, to investigate the relation between the performance targets and yield mechanism of the structure. (3)By adjusting members arrangement and opening up holes in both directions of the core tube of the structure, the coupling beam energy dissipation capacity is increased and the core tube changes from a single large tube to a sub-tubes form. After elastoplastic analysis, the yield mechanism of the tall frame-tube wall structure is found to be

coupling beams—wall—frame .But when the core tube change to sub-tubes, the yield mechanism of the structure is to be coupling beams between the sub-tubes—coupling beams of the sub-tubes — wall—frame and coupling beams of the sub-tubes—coupling beams between the sub-tubes—wall—frame. For the structure with the yield mechanism of the coupling beams between the sub-tubes—coupling beams of the sub-tubes—wall—frame, the structural overall performances (including the interlayer displacement angle, floor shear, base shear, shear duration, displacement and other process)and damage are considered. The structure is found under earthquake to better achieve the seismic performance goal set in advance and to be more economical. Specifically in the following areas, the force of the earthquake of the structure with the yield mechanism drops significantly after the damage of the coupling beams. Structural members' damage in the earthquake occurs basically in coupling beams instead of walls. The walls occur only minor damage. Although the results of the interlayer displacement angle is slightly larger, the structure does not fall down, which meets the requirements of codes under rare earthquake. If the structure meets the reasonable yield mechanism, it will achieve performance goals better. (4)Finally, another real tall frame-tube wall structure is designed based on the seismic yield mechanism to verify the feasibility , economy and rationality of the ideas.

Keywords: Tall Frame-tube Wall Structure; Sub-tubes; Seismic Performance Design; Yield Mechanism; Nonlinear Time-history Analysis;

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