YENİ NESİL
DEPREM YÖNETMELİKLERİ
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NEW GENERATION OF SEISMIC CODES AND NEW TECHNOLOGIES IN EARTHQUAKE ENGINEERING

Yeni Türkiye Deprem Yönetmeliğinde Yüksek Binaların Tasarımı

Design of Tall Buildings in the Next Turkish Seismic Code

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INTRODUCTION

Performance-based seismic engineering
has brought new dimensions to tall building design,
leading to a major transformation
from
traditional / prescriptive strength-based design approach
based on
linear response
under reduced seismic loads
to
explicit / non-prescriptive deformation-based design approach
based on
nonlinear response.

In line with this development,
special seismic design recommendations / guidelines and consensus documents
for tall buildings based on performance-based design principles
have been developed and published in the last decade by several institutions.

LATBSDC – Los Angeles Tall Buildings Seismic Design Council (2005, 2008, 2011, 2013, 2014)

"An Alternative Procedure for Seismic Analysis and Design of Tall Buildings Located in the Los Angeles Region – A Consensus Document"

SEAONC – Structural Engineers Association of Northern California (2007)

"AB-083: Recommended Administrative Bulletin on the Seismic Design & Review of Tall Buildings Using Non-Prescriptive Procedures", prepared for San Francisco Department of Building Inspection by *Tall Buildings Task Group*

CTBUH – Council on Tall Buildings and Urban Habitat (2008)

"Recommendations for the Seismic Design of High-rise Buildings – A Consensus Document", prepared by *Seismic Working Group*

PEER/TBI – Pacific Earthquake Engineering Research Center
Tall Buildings Initiative (2010)
"Guidelines for Performance-Based Seismic Design of Tall Buildings",
prepared by *Guidelines Working Group*

SFDBI – San Francisco Department of Building Inspection (2014)
"Requirements and Guidelines for the Seismic Design of New Tall Buildings using Non-Prescriptive Seismic Design Procedures",
Administrative Bulletin No. AB-083.

Istanbul Metropolitan Municipality – IMM (2008)
"Istanbul Seismic Design Code For Tall Buildings", Draft Version IV,
prepared by *Department of Earthquake Engineering,*
Kandilli Observatory and Earthquake Research Institute, Istanbul

Current Performance-Based Seismic Design Methodology for Tall Buildings

Recent tall building seismic design guidelines / consensus documents (TBI 2010, SFDBI 2014, LATBSDC 2014)
are all based on the same, well – established design methodology, starting with
a preliminary design
followed by
two performance evaluation stages.

A) Preliminary Design

- Tall building structural system is preliminarily proportioned and reinforced in accordance with ***capacity design principles*** *where* ***linear analysis*** *are generally used to determine the required strength of yielding actions*.

- San Francisco practice (SFDBI 2014) treats the preliminary design as a ***code-level evaluation stage*** where selected ***prescriptive*** provisions including ***minimum base-shear requirement*** of the San Francisco Building Code are required to be applied in addition to ***capacity design principles***.
  Thus, SFDBI (2014) formally applies a ***three-stage procedure*** for tall building design.

- However, other recent guidelines (TBI 2010, LATBSDC 2014) do not formally define the preliminary design as a design stage and insist on a ***non-prescriptive two-stage performance evaluation scheme*** by completely eliminating the prescriptive code provisions.

B) Performance Evaluation Stages

1 – Serviceability evaluation stage

under the so-called

service earthquake with a 50% probability of exceedance in 30 years, corresponding to a 43 year return period. Damping is taken 2.5%.

Performance criterion:

Tall building structural system is required to remain

essentially elastic

or nearly elastic with almost negligible nonlinear behavior

2 – Collapse level evaluation stage

under the so-called

maximum considered earthquake with a 2% probability of exceedance in 50 years, corresponding to a 2475 year return period. Damping is taken 2.5%.

Performance criterion:

Tall building structural system is required to have a

reasonably low risk of partial or total collapse,

corresponding to an acceptable level of damage in terms of ductile response quantities, while keeping all other brittle response quantities, e.g., internal forces below their strength capacities, thus preserving the gravity load carrying capacity.

SPECIFICATION FOR DESIGN OF BUILDINGS UNDER EARTHQUAKE ACTION (2015)

CHAPTER 13 – SPECIAL PROVISIONS FOR TALL BUILDING DESIGN UNDER EARTHQUAKE ACTION (Draft – November 2014)

13.6. DESIGN STAGE II: VERIFICATION / IMPROVEMENT / DESIGN UNDER MAXIMUM CONSIDERED EARTHQUAKE

13.6.1. Objective and scope
13.6.2. Stage II structural system modeling
13.6.3. Stage II seismic analysis
13.6.4. Stage II performance evaluation
13.6.5. Design of foundations

13.7. DESIGN STAGE III: VERIFICATION UNDER SERVICE EARTHQUAKE

13.7.1. Objective and scope
13.7.2. Stage III structural system modeling
13.7.3. Stage III seismic analysis
13.7.4. Stage III performance evaluation

13.8. SEISMIC INPUT FOR TALL BUILDING DESIGN

13.8.1. Response spectra
13.8.2. Selection and scaling of earthquake records seismic analyses

13.9. INDEPENDENT EVALUATION SYSTEM FOR TALL BUILDING SEISMIC DESIGN

13.9.1. Independent Evaluation Board
13.9.2. Earthquake Engineering Higher Commission for Tall Building Design

13.10. HEALTH MONITORING SYSTEMS FOR TALL BUILDINGS

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Thank you for your attention