CEN/TS 1998-1-101: Characterisation & qualification of structural components for seismic applications by means of cyclic tests

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Scope

Contains rules for qualification by cyclic testing of structural elements:

• to be used in design of structures for earthquake resistance (EN1998)
• potentially new elements for use in seismic applications
• provides general indications for the definition of cyclic tests
• does not preclude the development of specific European standards
Table of contents

• Section 4: Conditions for pre-qualification

• Section 5: Testing provisions

• Section 6: Loading history (depending on type of element or device)

• Section 7: Test reporting requirements

• Section 8: Verification of limit states

• Section 9: Instrumentation

• Section 10: Testing provisions for material specimens
Section 4: Conditions for pre-qualification

- Loading histories for deformation-controlled quasi-static cyclic loading
- Generally in planar loading conditions
- Enough tests on enough test specimens should be performed (reliability)
  - Number of tests should be established by relevant authority or National Annex
- Test specimens should have representative geometric and material properties
- Test data, numerical studies and design models:
  - sufficient to provide the required deformation demands of structural systems according to EN1998-1-1:2022 and EN1998-1-2:2022
Section 4: Conditions for pre-qualification (cont.)


- No further testing is required if within the pre-qualification limits
Section 5: Testing provisions

Provisions for test subassembly

• Shall replicate closely the demand & boundary conditions that occur in the prototype during seismic action
Section 5: Testing provisions (cont.)

Qualification record

- A summary of quality control and quality assurance procedures should be provided.
Section 5: Testing provisions (cont.)

Qualification record

Storey Drift Angle: $\theta_{tot} = \delta / h_i$

- Should include a description of the expected behaviour of structural elements and dissipative zones

Image source: El Jisr and Lignos (2022)
Section 6: Loading history

Loading sequences per material and element type

- Antiseismic devices
- Structural elements in concrete buildings
- Structural elements in steel buildings
- Lightweight steel systems
- Structural elements in composite steel-concrete buildings
- Structural elements in timber buildings
- Structural elements in masonry buildings

Generally, follows the outline of EN1998-1-2:2022
Section 6: Loading history

Loading sequences (cont.)

Storey Drift Angle: $\theta_{\text{tot}} = \frac{\delta}{h_i}$
Section 7: Test reporting requirements

For each test specimen, a written report should be provided

• Loading history

• Pertinent deformation quantities

\[
\begin{align*}
&\text{Beam contribution} & \text{Column contribution} & \text{Joint contribution} \\
&\delta_b & \delta_c & \delta_{pz} \\
&\theta_b & \theta_c & \theta_{pz} \\
&h_b & h_c & h_{pz} \\
&L_b & L_c & L_{pz}
\end{align*}
\]
Section 8: Verification of limit states

Verification criteria apply according to DC2, DC3 in **EN1998-1-2:2022**

- Example: Reinforced concrete shear walls

![Graph](image)

Chord Rotation $\theta$ [rad]

Moment [kN·m]

Storey Drift Angle [rad]

$0.01\text{rad (DC2)}$

Source: Choun and Park (2015)
Section 8: Verification of limit states

Verification criteria apply according to DC2, DC3 in **EN1998-1-2:2022**

- Example: Full strength beam-to-column joint

![Diagram showing chord rotation and moment relationship](image)

Source: Landolfo (2022)
Section 9: Instrumentation

- Should permit the measurement and the calculation of all pertinent quantities
- A drawing should be developed that identifies the location of each instrument
- Sensor calibration (as per ISO/IEC 17025:2017) range should be identified
- Should permit measurements of the elastic deformations of the test rig
  - These should be removed from the reported results
Section 10: Testing provisions for material specimens

Testing provisions for concrete

• Geometric properties of concrete mixture aggregates should be reported

• At least three cylinders of concrete should be tested at 28 days and at the day of testing

Testing provisions for structural and reinforcing steel materials

• Tensile tests should be conducted according to EN10002-1

• The measured strengths at yield, $f_{y,m}$ and at ultimate, $f_{u,m}$ should be reported
Section 10: Testing provisions for material specimens (cont.)

Testing provisions for masonry

• Tensile & compressive strength should be determined from mortar prisms

• The masonry mortar compressive strength should be determined according to EN1015-11:2009

• The shear strength of masonry and the shear modulus of masonry should be determined from simple diagonal compressive tests on masonry wallets
Thank you for your kind attention!

Questions?

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