# Theory and Reality in the Design of Viscous Dampers for Structural Applications

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## Summary

Viscous dampers are energy dissipators to be employed in particular for protection of structures against earthquake and/or certain service load cases. Designers specify design parameters and thus the characteristics of viscous dampers that shall be required as seismic protection of a certain structure. While it seems to be relatively simple to determine the theoretical design parameters by way of a computer simulation, the reality is often a different one when viscous dampers in the structure do not perform as specified as either the basic function needs were neglected or the real occurring function is different to the desired one.

It will be shown that the four standard design parameters of a viscous damper, to be “response force”, “stroke”, “damping constant” and “damping exponent” will be insufficient for a qualified specification, and that additional design parameters such as compressibility as well as function and geometric tolerances will make a deciding difference.

**Keywords:** Viscous dampers, lock-up, reliability, fatigue, wear

## 1. Introduction

Viscous dampers (VD) are meanwhile widely spread and provide on many fields of structural engineering a flexible buffering and damping support with velocity dependent reaction forces in one certain function direction along the centre line of the VD.

The real damper function performance is often not matching with the ideal performance the structural designer had in mind. The reasons can be found either in wrong modeling or in a lack of the real damper performance. At the hand of reference projects in bridges and building structures, the authors will highlight that the specifications which are issued by a designer may often not suffice to guarantee the desired performance of the employed damper system within the real structure. Even worse, after some time viscous dampers may already display leakage in service stage, even before an earthquake will have occurred.

During the design stage the design engineer often has no feel for the actual efficiency of the employed VDs, and that a computer modeling which is based on the four basic damper design parameters “response force”, “stroke”, “damping constant” and “damping exponent” may not suffice to determine the exact structural performance.

## 2. Desired theoretical performance characteristics for the VDs

In general the VDs shall have long service life times (20-50 years or even longer), while their performance shall be reliable, not change or even degenerate over the life time. For various applications the requirements to be fulfilled by the VDs are different and have to be adapted, evaluated and determined individually to each project.

### 2.1 Slow thermal movements

For slow thermal movements – velocity less than 0,1mm/s - the VD shall not respond with

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