

Viscous Damper Systems

For the Seismic Retrofitting of Industrial Structures

Executive Summary

Supplemental damping aims to reduce structural response by dissipating part of the earthquake input energy. Viscous dampers can be an important option for existing industrial facilities where conventional strengthening would require extensive intervention.

1. Energy-Based Approach

During an earthquake, ground motion transfers energy to the structure. Supplemental damping provides an additional mechanism for dissipating part of this energy. The objective is to control structural response, rather than eliminate movement.

2. Device Behaviour

A simplified force-velocity relationship is $F = C \times |v|^\alpha \times \text{sgn}(v)$, where F is the damper force, C is the damping coefficient, v is the relative velocity, and α is the velocity exponent. Actual device properties are established through project-specific engineering and testing.

3. Structural Integration

The complete load path must be considered: Damper → Connection → Supporting Steelwork → Existing Structure → Foundation. Every component must be verified.

4. Potential Benefits

Depending on the project, viscous dampers may reduce interstorey drift, demands on selected members and seismic deformations. Any benefit must be demonstrated by analysis.

5. Advantages in Operating Facilities

A well-designed system concentrates interventions at selected locations, potentially reducing demolition, wet trades and disruption to production.

6. Placement Optimisation

Mode shapes, floor plans, drift distribution, torsion, existing capacity, access and architectural constraints should be considered together.

7. Connections and Foundations

Device forces may create significant local demands in steel frames, gusset plates, anchors, collectors and foundations.

8. Installation and Quality Assurance

A typical sequence comprises an as-built survey, preparation, installation of supporting steelwork and connections, device installation, alignment, inspection and verification. Certification, factory testing, traceability and site inspections are essential.

Conclusion

Viscous dampers are a powerful engineering tool, but they are not a universal solution. Their selection must be based on the actual needs of the structure.