BRANZ FACTS

SEISMICALLY RESILIENT NON-STRUCTURAL ELEMENTS #4

Seismic clearance at penetrations

NZS 4219:2009 *Seismic performance of engineering systems in buildings* requires 50 mm clearance at penetrations through a structure, such as walls and floors. This clearance is intended to avoid interactions between the service and the structure due to differential seismic movement.

THERE ARE SOME EXCEPTIONS:

- Where the service is fixed/braced to the structure it penetrates, the differential movement will be negligible, so the 50 mm seismic clearance between the service and that structural element is not required.
- Where service penetrations are required to be fire rated, it is unlikely to be practicable to provide 50 mm seismic clearance and comply with the fire stop manufacturer's certified installation details.

Instead, designers should develop case-specific solutions. The following sections provide guidance to design through floor, beam and wall penetrations. Note, though, that there may be other reasons why there should be some clearance, such as if pipe expansion may result in undue stress on the pipe or the structure.

Floor penetrations

Linear components passing through floors, including those where fire or acoustic stopping is required, shall typically be anchored or guided to the floor structure. Seismic clearance is not required.

Where the penetration does not require fire or acoustic stopping and component anchoring or guiding is not required at the penetration, provide 50 mm seismic clearance.

Beam penetrations

Differential movement between a floor structure and beams supporting that structure is negligible. Seismic clearance only needs to cater for linear component deflection between adjacent lateral restraints, which will vary depending on the lateral restraint spacing and linear component stiffness. Options where linear components are suspended from the floor above and pass through floor support beams:

- Provide 50 mm clearance (for example, where the penetration does not require fire or acoustic stopping and the size of the beam penetration is acceptable to the structural engineer).
- Brace the penetrating service (or otherwise protect it from impact) at the penetration. Seismic clearance is not required.

Wall penetrations

Differential movement between a linear component supported by a primary structure and a wall penetration will depend on whether the wall includes seismic slip joints and, if so, the position of the penetration relative to the slip joint.

Where slip joints are provided

Assuming the slip joint is at the top of the wall, to provide negligible differential seismic movement between the wall and penetrating service, where practicable, locate penetrations as follows:

- Where the components are suspended

from a structure above, penetrate above the slip joint.
- Where the components are supported by a structure below, penetrate below the slip joint.

Options to protect the penetrating service:
- Provide 50 mm clearance (for example, where the penetration does not require fire or acoustic stopping).
- Brace the penetrating service (or otherwise protect from impact) at the penetration. Seismic clearance is not required.

Where slip joints are not provided

Options where it is not practicable to position the penetration relative to slip joints as described above or the walls do not have slip joints:
- Provide 50 mm seismic clearance where practicable (that is, where the penetration does not require fire or acoustic stopping).
- Restrain the linear component to the wall at the penetration. Design the runs either side to allow for the differential seismic movement at the applicable limit state for the penetrating service component category.

Options are to:
- place restraints at the maximum allowable spacing on either side of the penetration and rely on the inherent flexibility of the linear component
- use flexible connections within the linear component.

For electrical and data cable support systems, stop and restrain the cable support system on either side of the penetration. Provide sufficient surplus cable length to allow differential seismic movement at the applicable limit state for the penetrating service component category.

Plasterboard partition walls

Where the wall penetration must be fixed or restrained to a timber or metal-framed plasterboard partition wall, do not use the wall to provide longitudinal restraint of linear components. Instead, design other restraints (remote from the wall) for seismic loads along the line of the linear component.

Where the lateral seismic load (at the applicable limit state for the penetrating service component category) imposed on the wall exceeds the plasterboard crush limit, add a frame around the penetration or brace to transfer loads directly to the wall framing rather than via the wall lining.

Depending on the specific fire or acoustic stopping method being used, penetrations often require framing around the penetration to contain the stopping materials.

For walls with slip joints, where the lateral seismic load (at the applicable limit state for the penetrating service component category) imposed on the wall exceeds the lateral force limit, verify that the wall has adequate strength or provide flexible connections in the linear component to reduce the load on the wall below the lateral force limit.

For multiple adjacent penetrations (for example, through a riser shaft or plantroom wall), the lateral force limit must consider the cumulative seismic load applied to the wall section being assessed.

Fire and smoke dampers

The installation of fire and smoke dampers (in accordance with AS/NZS 1668.1:1998 *The use of ventilation and airconditioning in buildings - Fire and smoke control in multi-compartment buildings* and the manufacturer's written requirements) generally includes the following:
- Fire dampers retained within the fire partition using flanges fixed to the fire damper sleeve but not fixed to the wall (to allow thermal expansion during a fire).
- Clearance between the fire damper sleeve and the penetration should allow for thermal expansion during a fire (for example, one manufacturer requires 24–35 mm total clearance (sum of both sides) with the gap packed with compressible, non-combustible material).
- Break-away joints between the fire damper and its associated ductwork (for example, slip joints or duct-to-damper fixings with a fusion temperature less than 700ºC) to prevent the fire damper's performance being impaired by failure or collapse of the duct or its supports during a fire.
- Both gravity and seismic loads associated with the fire damper and its mounting sleeve must be supported by the fire partition. Break-away joints cannot be relied upon to transfer fire damper and mounting sleeve seismic loads to the ductwork (or vice versa). Other methods of transferring fire damper/sleeve seismic loads to another structure will compromise fire damper performance in a fire event.

The connections between the fire and smoke dampers and the associated ductwork should also provide the following seismic resilience:
- **P4 (life safety) duct systems**. Connections must retain duct integrity during an ULS event, including (where applicable) allowance for differential movement between the fire separation and the structure supporting the ductwork either side of the fire damper. Since break-away joints alone cannot be assured of satisfying this requirement, provide both flexible duct connections and break-away joints between ductwork and dampers.
- **Other duct systems**. Connections must retain duct integrity during the applicable SLS event, including (where applicable) allowance for differential movement between the fire separation and the structure supporting the ductwork either side of the fire damper. This requirement can be assumed to be satisfied without using flexible duct connections by locating the nearest duct restraints at the maximum allowable lateral restraint spacing.

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