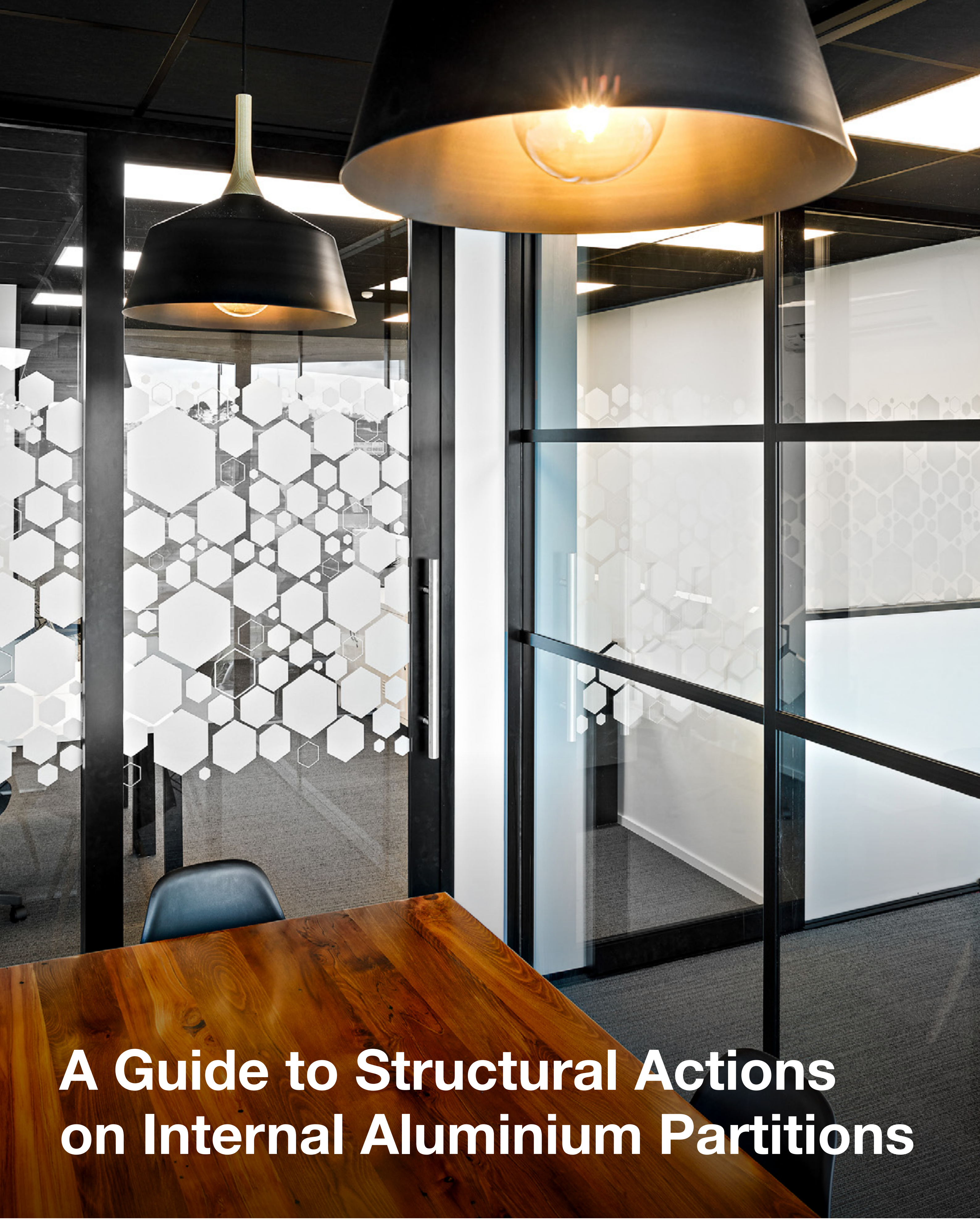

A Guide to Structural Actions on Internal Aluminium Partitions

POTTER INTERIOR SYSTEMS | CSR

INTRODUCTION

Elements commonly referred to as "non-structural", including partitions and ceilings, may experience substantial loads due to wind and earthquake forces, the weight of permanent fixtures and fittings, and dynamic loads imposed by furniture, equipment, and occupants in the building. Therefore, they necessitate proper engineering design and installation.

In the past, internal partitions were primarily constructed using heavier materials like brick due to the need for increased structural stability. More recently, the growing adoption of lightweight systems and the expansion of building size and height mean that the effects of internal pressures from wind, earthquakes, and other loads have become much more significant.

Clause B1 Structure of the New Zealand Building Code requires that all building elements have a low probability of failure when exposed to loads likely to be experienced within their lifetime.[1] In this whitepaper, we examine several of the key actions that affect the design of internal aluminum partitions—from seismic and wind loads to fittings, fixtures and even loads caused by occupants and moving objects in the building.

SEISMIC ACTIONS

Effects of earthquake forces

An earthquake can produce forces that impact a building's structure dynamically in both horizontal and vertical directions. The ground trembles during an earthquake, producing inertia and accelerating the building both laterally and vertically. The structure is stressed by these dynamic pressures; its stability and integrity depend on its capacity to withstand or absorb these forces.

In order to improve a building's resistance to seismic forces, engineers implement elements like bracing systems, dampers, and flexible structural materials that lessen the impact of seismic movement. Although non-structural elements do not support a building's structural load, they are nonetheless susceptible to the dynamic horizontal and vertical forces that arise during an earthquake and must also be engineered appropriately.[2]

Internal partitions, which are typically timber or aluminium-framed walls lined with plasterboards on both sides, do not support gravity loads. The building experiences lateral and vertical accelerations due to the weight of these partitions, which adds to the inertial forces. Because aluminum framing is typically lighter than timber framing, the total mass of the partition is decreased, attracting less seismic load compared to its timber counterparts during an earthquake event.

Seismic bracing

Seismic bracing on internal partitions enhances occupant safety, distributes loads more evenly, ensures the integrity of partitions, and reduces the effect of seismic forces. This allows for a durable and well-balanced response to seismic events.

Seismic bracing is required to comply with the seismic requirements in NZS 1170.5 "Structural design actions - Part 5: Earthquake actions - New Zealand"and AS/NZS 2785:2020 "Suspended ceilings - Design and installation". Under NZS 1170.5, non-structural elements are classified as "parts". An element's "part" classification is significant since it establishes the necessary seismic bracing.

Bracing the top of the wall to the underside of the floor structure above is the most common method. The floor structure needs to be appropriately planned and constructed in order to give lateral support to partitions and other non-structural features like building services.

Partition walls must not be braced to the ceiling grid, as per AS/NZS 2785. If partition walls or glass lines are fixed to the suspended ceiling, the ceiling may collapse as a result of the horizontal deflection of these components during a seismic event. Partition walls and glazing lines must have independent bracing and be supported through the ceiling with seismic gaps that accommodate the calculated loads.

WIND ACTIONS ON INTERNAL WALLS

Calculating internal design pressures

Every building that has any kind of permeability is subject to internal pressures. When there are heavy winds, forces are applied to a structure's surfaces. Considerable internal pressures may be generated if a building's exterior is connected to its interior through openings or facade leakages. Internal wind pressure on walls can exert significant forces, leading to structural damage, deflection and movement, stress on connections, and other dynamic effects.

AS/NZS 1170.2:2021 "Structural design actions: Wind actions" (referred to as AS/NZS 1170.2 or the "Wind Code") sets out procedures for determining wind speeds and resulting wind actions to be used in structural design.

To determine internal design pressures applicable to any partitioning system, three basic steps need to be followed:

Step 1. Identify external design pressure based on project location, geometry, and key variables like building importance, terrain, and height. Account for topography, wind direction, and shielding.

Step 2. Assess how external design pressure enters the building, considering facade type, openings, and structure permeability.

Step 3. Determine how internal pressure acts across framing systems like walls or ceilings. Factors include facade characteristics (e.g sealed curtain walls, operable openings, and so on), whether the wall or ceiling system being considered provides a pressure seal between two spaces, and construction type (e.g. single stud or discontinuous).

Recent changes to AS/NZS 1170.2

The key changes effected by the 2021 revision to AS/NZS 1170.2 are summarised below:

- **New region maps.** Stronger winds are experienced in some wind zones of New Zealand than in others. AS/NZS 1170.2 provides the procedure for determining a site's wind speed and basic external design pressure. The 2021 revisions to the Standard include new region maps that will affect this calculation.
- **Changes to terrain categories.** A site's level of wind exposure is determined by its terrain category; the higher the category number (which ranges from 1 to 4), the lower the final design pressure.
- **Climate change multiplier.** The climate change multiplier allows for possible changes in climate affecting extreme winds during the life of the structure.
- **Internal pressure coefficient.** The revised Wind Code introduces a new factor that will adjust internal pressure coefficient ($C_{p,i}$) for buildings with "dominant" wall openings based on the internal volume exposed to that opening.
- **Area reduction factor.** The area reduction factor (K_a), which previously was limited to roofs and side walls perpendicular to the wind direction, can now be applied to windward and leeward walls.
- **Volume factor.** The revised Wind Code introduces volume factor (K_v), which modifies $C_{p,i}$ for structures with dominant wall openings based on the internal volume exposed to that opening.
- **Action combination factors.** The calculation of the impact of wind load on various surfaces, including walls, roofs, and internal pressures, involves the use of action combination factors (K_c). In the revised Wind Code, under Clause 5.4.3, internal surfaces are no longer considered effective if $|C_{p,i}| < 0.4$, which is an increase from $|C_{p,i}| < 0.2$.

"Although non-structural elements do not support a building's structural load, they are nonetheless susceptible to the dynamic horizontal and vertical forces that arise during an earthquake."

OTHER TYPES OF ACTIONS AND LOADS

Frame deflections resulting from inter-story drift can induce vertical forces on partition walls. These loads may be caused by events like wind or earthquake loading. Additionally, vertical movement can be caused by the presence of live or dead loads on the floor above.

The structure supports the dead load, including its own weight as well as the weight of permanent non-structural partitions and any fixtures and fittings such as book shelving. As part of the specification process, the partition's structural performance should be evaluated in relation to the anchorages and fixtures it is expected to support. The partition should be capable of supporting any fixtures without loosening, detaching, or damaging the partition.

The structure is subjected to dynamic loads from movable objects within the building, including desks, cupboards, filing cabinets, and people. These loads can impact the design of internal partitions. For example, in spaces where there is a potential for crowds, such as auditoriums, event venues, or public areas, the forces imposed by crowd pressure can be significant. "Crowd pressure" refers to the load exerted by a group of people leaning against the partition wall. Internal partitions need to be designed to withstand such loads to ensure structural integrity and safety.

Internal partitions may also face thermal loads, where temperature fluctuations can lead to material expansion or contraction, potentially affecting stability and alignment over time. Vibration loads are another type of action, originating from machinery or heavy equipment and transmitting through the building structure. Additionally, partitions are susceptible to impact loads caused by collisions or heavy objects striking them.

LOADS ON GLAZED PARTITIONS

Architects and designers need to consider solutions that ensure interior partitions will not be crushed or pulled apart and prevent interior glazing from popping out of the aluminium pockets. Specialised framing systems that incorporate glass infills utilise aluminum extrusions that can integrate gaskets, wedges, and blocking, akin to exterior aluminum joinery. Certain systems also boast unique features designed to support glass under low internal pressures and human impact. The NZBC references NZS 4223.3:2016 "Glazing in buildings - Human impact safety requirements" as the acceptable solution with regard to glazing in internal partitions.

Potter Aluminium Partitioning Systems

Potter Interior Systems excels in aluminium interior partitioning, offering a diverse range of structurally tested wall systems. The New Zealand-based company specialises in tailoring comprehensive aluminium partitioning solutions for offices, retail spaces, and commercial installations, ensuring their products meet the highest standards of strength, robustness, and design flexibility.

The **A Series 105-132 Aluminium Partition System** is ideal for both plasterboard and glazing applications. With features such as seamless integration with various wall structures, three standard profile sizes, glass thickness options, and compatibility with a wide range of door thicknesses, this system ensures reliability without compromising versatility.

When it comes to creating functional and aesthetically pleasing spaces, the **C Series 45 Aluminium Partition System** has been designed specifically as a cost-effective commodity system without compromising on quality or style. Thanks to its slim profile and versatile design options, this system can help you achieve a sleek and modern appearance while maintaining structural integrity under various loads.

DF Series Aluminium Partitions have been acoustically and structurally tested and designed to help with exposed full-height aluminium partitions in modern office designs that tend not to have a traditional panel ceiling. The DF Series can also be used as a base-build wall starter that will allow movement between existing structures and internal partitions.

Other options include the **E Series 105-132 Aluminium Partitions**, which provide an edgeline single or twin glazing design to provide a clean front profile or twin glass option, and **Soho Series Aluminium Partitions**, an innovative alternative to traditional glazing that allows you to achieve a stunning industrial-inspired aesthetic.

Offering an integrated solution, **DS Series Doors and Sliders** are designed to fit with other Potter aluminium partition suites. Available in 36mm-thick doors only, they are an ideal solution for any commercial environment to create either an open space or a completely new room.

"Internal wind pressure on walls can exert significant forces, leading to structural damage, deflection and movement, stress on connections, and other dynamic effects."

REFERENCES

[1] New Zealand Government. “B1 Structure.” Building Performance.
https://www.building.govt.nz/building-code-compliance/b-stability/b1-structure (accessed 26 November 2023).

[2] Filiatrault, A. “Seismic Design of Nonstructural Building Components: The New Frontier of Earthquake Engineering.” Australian Earthquake Engineering Society Virtual Conference, November 18-20, 2020.
https://aees.org.au/wp-content/uploads/2021/05/AEES-2020-all-papers.pdf (accessed 26 November 2023).

All information provided correct as of January 2024

POTTER
INTERIOR SYSTEMS

CSR