

Determination 2026/036

**Regarding the compliance of a modular dwelling with
Clauses B1, B2, E1, E2, E3, and G9**

4/1526 Waimea Highway, Mandeville

Summary

This determination considers the compliance of a modular dwelling constructed partly offsite and partly at the owners' property under two separate building consents granted by two authorities. The determination discusses the compliance of the as-built work with several clauses of the Building Code, primarily relating to the dwelling's structure, weathertightness, gutters, bathroom linings, and electrical fixtures.



Figure 1: Aerial photo of the modular dwelling (in foreground), on-site in Mandeville.

Contents

1.	The matter to be determined.....	3
2.	Background.....	4
3.	Building work.....	6
4.	Clause B1 – <i>Structure</i>	12
	Discussion.....	12
	Conclusion.....	25
5.	Clause B2 - <i>Durability</i>	26
	Discussion.....	26
6.	Clause E1 – <i>Surface water</i>	27
	Discussion.....	27
	Conclusion.....	29
7.	Clause E2 – <i>External moisture</i>	29
	Discussion.....	30
	Conclusion.....	37
8.	Clause E3 – <i>Internal moisture</i>	37
	Discussion.....	37
	Conclusion.....	40
9.	G9 – <i>Electricity</i>	40
	Discussion.....	40
	Conclusion.....	43
10.	Decision.....	43
	Appendix A – Summary of issues in dispute.....	44

In this determination, unless otherwise stated, references to “sections” are to sections of the Building Act 2004 (“the Act”) and references to “clauses” are to clauses in Schedule 1 (“the Building Code”) of the Building Regulations 1992.

1. The matter to be determined

- 1.1. This is a determination made under due authorisation by me, Peta Hird, for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment (“the Ministry”).¹
- 1.2. The parties to the determination are:
 - 1.2.1. K and M McClure, the owners of 4/1526 Mandeville Highway (“the owners”), who applied for this determination.
 - 1.2.2. Gore District Council, the authority concerned with the building consent² for the foundations and site services, carrying out its duties as a territorial authority or building consent authority.
 - 1.2.3. Invercargill City Council, the authority concerned with the building consent³ for the construction and assembly of the housing modules, carrying out its duties as a territorial authority or building consent authority.
 - 1.2.4. K Archer, the Licensed Building Practitioner builder concerned with the building work (“the builder”) who carried out and supervised the construction of the dwelling.
 - 1.2.5. D Kensington, the Chartered Professional Engineer⁴ concerned with the building work (“the structural engineer”) who carried out the design of the dwelling’s structure and supervised parts of its construction.
- 1.3. The matter to be determined, in terms of section 177(1)(a) of the Act, is the compliance of some elements of the building work with Building Code clauses B1 *Structure*, B2 *Durability*, E1 *Surface water*, E2 *External moisture*, E3 *Internal moisture*, and G9 *Electricity*.
- 1.4. In making this determination, I will consider compliance of the following (with reference to the summary of issues raised by the owners set out in Appendix A):
 - 1.4.1. The dwelling’s structure with clause B1 *Structure*, including foundations, floor and wall elements.

¹ The Building Act 2004, section 185(1)(a) provides the Chief Executive of the Ministry with the power to make determinations.

² Building consent 210933, issued 7 June 2023.

³ Building consent BDG/2023/394, issued 30 June 2023.

⁴ Under section 291 of the Act, Chartered Professional Engineers are treated as if they are licensed in the building work licensing class Design 3 and Site 3.

- 1.4.2. External metal surfaces of the SIPs walls and roof cladding with clause B2 *Durability*.
- 1.4.3. The gutters collecting water runoff from the roof with clause E1 *Surface Water*.
- 1.4.4. The wall and roof cladding with clause E2 *External moisture*, as well as elements such as windows and roof vents.
- 1.4.5. The internal showers, adjacent floor linings and cutouts behind some power outlets with clause E3 *Internal moisture*.
- 1.4.6. The power outlets and switchboard with clause G9 *Electricity*.
- 1.5. This determination considers compliance of the as-built work at the time the determination application was completed on 28 March 2025. Where relevant, building consent documentation is used to inform my understanding of the as-built work.
- 1.6. The matter being determined does not include building work or disputes beyond that set out in paragraphs 1.3 and 1.4, such as decisions made by the authorities, whether building work complies with its respective building consents, or contractual matters such as workmanship.
- 1.7. In making my decision, I have considered the report by the independent expert ("the expert") commissioned by the Ministry to advise on matters concerning clause B1.
- 1.8. I have not been provided with substantive submissions from all parties about all compliance matters being considered. Submissions that have been received are summarised where relevant.

2. Background

- 2.1. The owners' building is a 117.6m² floor area single storey detached dwelling ("the dwelling"), located on a flat site in Mandeville. The dwelling is located to the north-western corner of the site, set back approximately seven metres from the northern boundary to an adjoining airfield. The approved plans state that the dwelling is located in a high wind zone⁵.
- 2.2. The dwelling comprises two adjoining modules on timber foundations. The northern module contains an open-plan living, dining and kitchen area, with an adjoining walk-in pantry, and one bedroom with an ensuite bathroom. The southern module contains two bedrooms, each with an ensuite bathroom. There is no internal access

⁵ The structural engineer's calculations state a ULS wind speed of 41m/s.

between the modules or between the two bedrooms in the southern module. There are external doors in each of the three bedrooms, the kitchen, and the living area.

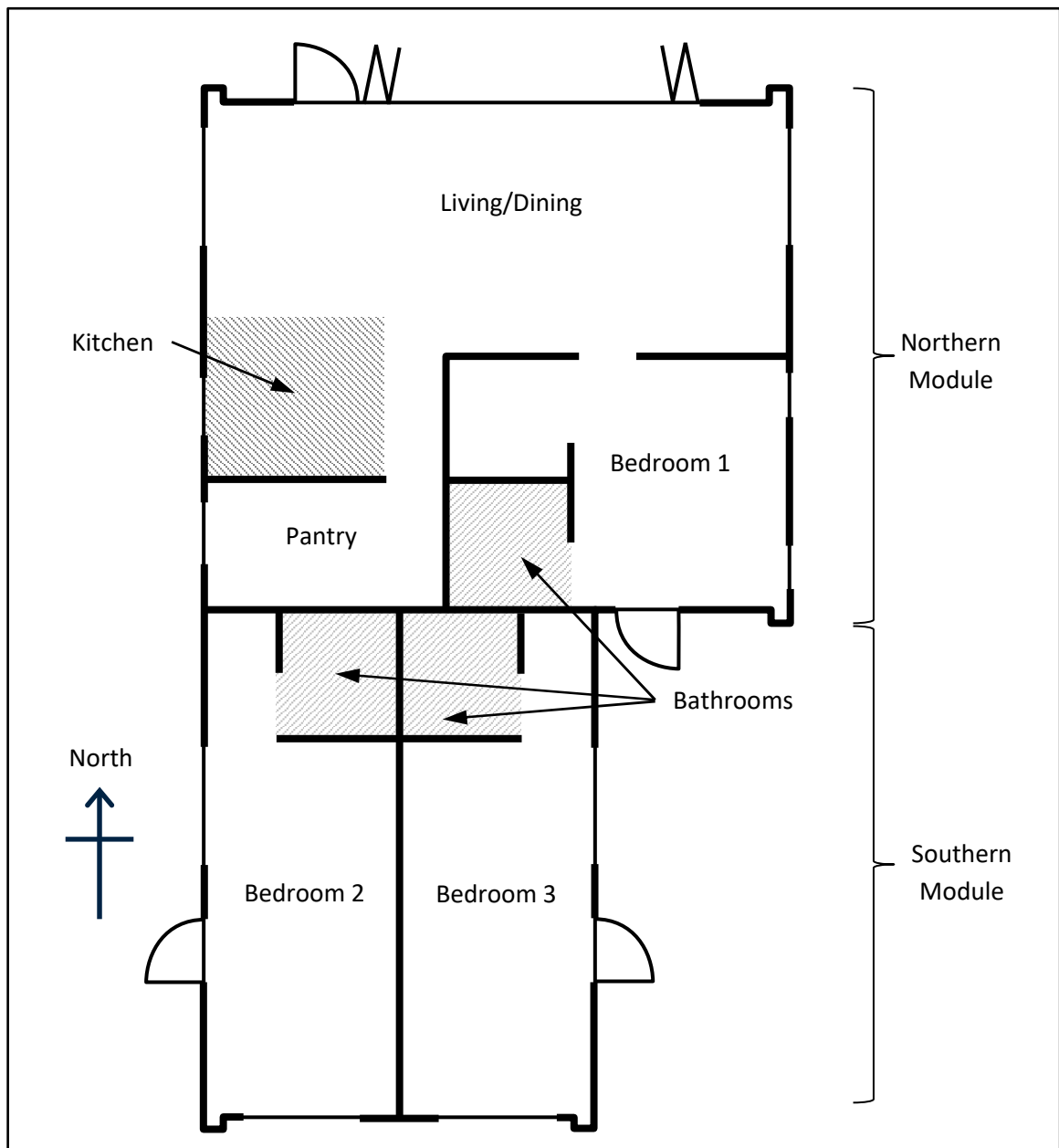


Figure 2: Layout diagram of the dwelling. Not to scale.

2.3. The building work was carried out under two separate building consents:

- 2.3.1. Building consent 210933 (“the first building consent”) was issued by Gore District Council (“the first authority”) on 7 June 2023 for the timber pile foundations for the dwelling, site services, and site works at the owners’ property in Mandeville.
- 2.3.2. Building consent BDG/2023/394 (“the second building consent”) was issued by Invercargill City Council (“the second authority”) on 4 July 2023

for construction of the modules in Invercargill, including the timber joists and bearers, and for connection of the modules to each other in Mandeville and finishing works to fit out and clad the modules.

- 2.4. Construction of the modules began off-site in Invercargill in late 2023, with the second authority commencing inspections on 9 November 2023. The modules were transported to the owners' property on 30 April 2024. Further building work and inspections by both authorities were carried out for work on-site at Mandeville across the remainder of 2024, including installation of the modules on new driven timber pile foundations, joining the modules together to form the dwelling, and services connections.
- 2.5. In an inspection on 9 December 2024, the second authority recorded that it had "accepted as-built plans showing minor changes to bi-fold doors" located in the northern elevation of the northern module.
- 2.6. On 14 February 2025, the second authority approved a minor variation to remove the installation of a gas water heater from the scope of the second building consent.

3. Building work

Foundations and floor

Piles

- 3.1. The dwelling's foundations consist of 53 driven timber piles, with an approximate height above ground level of 500mm at the south end and 750mm at the north. Approved plans set out that 32 of the piles act as cantilever piles for the sub-floor bracing. They are specified as 140mm small-end diameter piles, increasing along their height to a diameter of approximately 160mm.
- 3.2. The as-built piles differ from the layout shown in the approved plans, with piles out-of-plumb by up to 60mm per metre. The heights of the piles were measured as being out of level by up to 15mm, though the owner states they subsequently levelled the piles.
- 3.3. Hold-down fixings between the piles and bearers are specified as "stainless steel 6kN fixings", except for four piles along the front elevation specified in the first building consent as having 12kN fixing. As-built, the four piles to each corner of the foundations have been installed each with two proprietary hold-down fixings. These fixings have been installed as an angled bracket, with between four and six screws to each face of the bracket and bearer or pile.
- 3.4. The northwest corner pile ("the modified pile") has been modified during construction, having scarf cuts to the eastern and western sides at the top of the

pile, perpendicular to the line of the bearer above. The top face of the pile has been reduced to a dimension of approximately 70mm x 160mm.

- 3.5. There are cracks apparent in the surface of the as-built piles, running vertically along their grain. The modified pile is measured as having a 70mm deep crack, running approximately two-thirds the height of the pile above ground level. A full-height crack to ground level is observed in two other piles under the northern module, with one of those piles having a crack of up to 60mm in depth.

Bearers and joists

- 3.6. The piles support 2/140mm x 45mm bearers, with a maximum loaded dimension of 1500mm and a maximum span of 1506mm as shown on the approved plans. As-built, bearers are attached in off-centre positions above some piles. In two locations under the northern module, a bearer is shown overhanging the edge of the pile by approximately 30-40mm.
- 3.7. The bearers are not spaced as set out in the approved plans, with an increase in spacing of up to 115mm. The as-built joists, being 140mm x 45mm at 400mm centres, therefore have a maximum span of 1930mm.
- 3.8. In several locations where the joists run across the bearers, photos show those joists not resting on the bearers below; rather the joists sit high with a gap between the bottom of the joist and the top of the bearer. The owner states that they have installed packers to some, though not all, locations where these gaps have been observed.

Flooring

- 3.9. 19mm plywood sheeting forms the flooring over the joists. During construction, after the modules were transported to the owners' property, the plywood flooring was overlaid with compressed wood-fibre board sheeting ("the wood-fibre sheeting"). There is no indication of waterproofing of the wood-fibre sheeting in the bathrooms or kitchen.
- 3.10. The wood-fibre sheeting is overlaid with vinyl lining or tiling, except for bedroom 1, which is carpeted. The vinyl lining and tiling is bonded to the wood-fibre sheeting with an adhesive, though the approved plans and specifications do not detail the adhesive used or its properties.
- 3.11. Photos of the kitchen and living spaces show unevenness in the vinyl lining, indicating a variation of up to 10mm across two metres in horizontal distance. Photos of the vinyl tiling in the bathrooms show gaps of 1-2mm between tiles.

Walls

Structural insulated panels

- 3.12. Full-height structural insulated panels (“SIPs”) form the external walls on the eastern and western elevations of both modules. The SIPs are a proprietary product, consisting of a 100mm thick expanded polystyrene core with 0.6mm steel sheeting adhered to either side. A proprietary coating and painted finish is applied to the steel sheeting.
- 3.13. SIPs in the northern module are 3227mm high on the eastern elevation and 2620mm high on the western elevation. In the southern module they are 2822mm high on the eastern elevation and 2420mm high on the western elevation.
- 3.14. Approved plans show SIPs, with a 75mm polystyrene core, form the internal walls for bedroom 1 and bathroom 1.
- 3.15. The external SIPs are fixed to the plywood flooring and timber subfloor by an L-shaped angle running along the external face of the SIPs. The angle is fixed with 75x12g screws at 200mm centres through the plywood to the joists below and 6-3 rivets at 100mm centres to the external steel sheeting of the SIPs. The external face of this junction is covered by a horizontal flashing (“the base flashing”), face fixed via rivets to the bottom of the SIPs. The base flashing then covers the external sides of the plywood flooring and joists, with the approved plans showing the base flashing packed off the face of the joist with a timber batten.
- 3.16. At the external corners of the dwelling, the SIPs, timber subfloor framing, and plywood flooring below, are built out to form a 300mm square nib wall. An angle flashing (“the external corner flashing”) is installed to the external corners of the nib walls, with the approved plans noting a “continuous bead of ... sealant” between the flashing and SIP behind.⁶ Photos of the as-built nib walls indicate that the sealant was either not installed or no longer forms a seal between the external corner flashings and SIPs.
- 3.17. Vertical joints between the SIPs are formed via crimped folds in the steel sheeting either side of the polystyrene core. These create an interlocking joint between adjacent panels, with the manufacturer’s details showing a line of sealant running the height of the joint. Photos show that, as-built, several joints have areas where the sealant has pulled away from one side of the joint.
- 3.18. The junction between the SIP walls and panels forming the roof structure is detailed with two angles riveted to both panels at 250mm centres, one to the internal side of the junction, the other to the exterior.
- 3.19. The as-built SIPs have scratches and deformations to the external steel sheeting on both east and west elevations of both modules.

⁶ The approved specifications set out that the sealant is a proprietary silicone-based product.

- 3.19.1. Scratches are apparent in several areas, with some scratches extending through the painted finish and coating of the external steel sheeting.
- 3.19.2. The external steel sheet of the SIP adjacent to the door for bedroom 2 has a deformation (a crease), extending approximately 200mm out from the top corner of the cutout for the door.
- 3.19.3. A bulge in the external steel sheeting of the SIP adjacent to the pantry window extends diagonally up from the top corner of the joinery cutout to the top of the panel.
- 3.19.4. Photos show an uneven 'ripple-like' external surface to the top 200mm of the SIPs on the west elevation of both modules, and similar unevenness on the east elevation of the northern module.
- 3.19.5. A similar uneven external surface is apparent adjacent to joinery installed in the west elevation of both modules, though to a lesser extent of approximately 10mm in width, running the full height of the jambs.

Joinery installed in the structural insulated panels

- 3.20. The approved plans detail that aluminium framed window and door joinery installed in the external SIP walls is fixed, over flashing tape, to the external steel sheeting of the SIPs with rivets at approximately 600mm centres. Sealant was to be applied between the external flanges of the joinery and the SIP behind. At the head junction, a flashing, extending 40mm either side of the joinery, was to be fixed with rivets to the external steel sheeting of the SIP above.
- 3.21. At sill junctions for door joinery, the top of the base flashing is folded to form a sill flashing for the joinery, with the detail stating that the base of the door joinery is to be "screw fixed into [the plywood flooring]".
- 3.22. Photos during construction show the door sill flashing was not installed before joinery was installed, nor was the flashing tape applied to head, jamb, or sill junctions. The joinery units were subsequently removed and sill flashings and tape applied. Later photos of the joinery in bedroom 2 show that sealant, applied between the joinery and SIP, has pulled away from the flange of the joinery jamb.
- 3.23. The approved plans show L-shaped angles fixed with rivets to the internal steel sheeting of the SIPs at head, jamb, and sill junctions. Details show an unidentified element connecting the joinery to these angles. However, these angles have not been installed, with timber reveals used at head, jamb, and sill junctions instead.

The pantry window

- 3.24. During construction, the installed pantry window on the western elevation of the northern module was moved 75mm north along that elevation. The resulting gap between the window jamb and adjacent SIP was patched, with the owners stating

that this consists of a piece of steel sheeting. The patch is riveted to the window jamb, and sealant has been applied where it abuts the SIP. The sealant is approximately 10mm wide up the length of the patch, and up to 40mm in width at the bottom.

Timber-framed walls

- 3.25. The external walls on the north and south elevations of the northern module, and south elevation of the southern module, are timber framed with 90mm x 45mm studs at 300mm centres. Timber framing also forms the internal walls (except for those around bedroom 1 and bathroom 1), with 90mm x 45mm studs at 400mm centres.
- 3.26. Internal linings to the timber-framed walls are a mix of 12mm plywood sheeting and a proprietary plasterboard lining, which is installed to provide lateral bracing. Photos show fixings to these linings in bedroom 2 sitting either proud of or over screwed into the lining's surface.
- 3.27. The external elevations of the timber-framed walls are clad with a proprietary timber sheet cladding, installed over 20mm ventilated cavity battens and building wrap.
- 3.28. Manufacturer's details for vertical butt joints between panels of the timber sheet cladding show those joints aligned over cavity battens behind, with a 2mm gap between panels. A 100mm back flashing runs behind this joint, with a line of sealant between each panel and the flashing behind. Photos show in four locations back flashings were not installed, and, in one location, no sealant applied between panels and the batten behind. Subsequently sealant was applied to the gap between panels.
- 3.29. The timber sheet cladding has internal corner junctions where it meets the SIP nib walls described in paragraph 3.16. An angle flashing ("the internal corner flashing") is installed to the face of this junction, with the approved plans stating it is to be "sealed to [the SIP] panel". At the south-western corner of the dwelling the internal corner flashing was removed and sealant applied between the cladding and adjacent SIP before refitting the flashing. Where the base flashings on the SIP walls meet the internal corner flashings, the base flashing laps over the top – this differs to the external corner flashings which have the base flashing behind them.
- 3.30. Aluminium framed window and door joinery is installed to the external timber-framed walls. The head flashings have a downturn where they lap over the head of the joinery behind. As-built, this downturn has a horizontal gap of approximately 6mm to the joinery behind. The as-built sill junction for the window joinery on the southern module has a 1-2mm gap between the bottom flange of the joinery and the top of the cladding below.

Roof

- 3.31. Both modules have parallel 3.9-degree single pitch skillion roofs, primarily formed of 200mm thick SIPs, falling towards the west. The southern module's roof sits 200mm lower than the northern module's roof.
- 3.32. Asymmetric trapezoidal profile metal roof cladding is installed on 60mm metal purlins, which are riveted to the SIP roof structure. A proprietary coating and painted finish are applied to the roof cladding. Hex-head screws, with rubber washers, are fixed through the ribs of the roof cladding to the purlins. Photos show the screws fixed askew, with washers in some cases either crushed into the screw hole or sitting proud of the roof cladding.
- 3.33. Box-profile gutters are installed to the western elevation of both modules. Each module has its own gutter intended to fall to a downpipe at the south end of each module.
- 3.34. The approved plans show foam profile closures to the ribs of the roof cladding above the gutter, but the closures were not installed.
- 3.35. The roof has three penetrations for ventilation fans in the three bathrooms. Soaker flashings around the penetrations run back up to the eastern high point of the roof. The penetrations have a proprietary malleable boot flashing covering the junction between the ventilation pipe and adjacent soaker flashing, fixed with hex-head screws. The edges of the as-built boot flashings sit unevenly, with askew fixings and gaps between the boot and soaker flashings. These were later filled with sealant.
- 3.36. The as-built roof cladding and flashings have scratches to their surface along ribs of the roof cladding, at folds in barge flashings, and adjacent to screw fixings. The scratches appear in photos to extend through the painted finish and coating.

Bathrooms

- 3.37. All three bathrooms include a sink, corner shower, and toilet in the same arrangement, with bathroom 2's layout a mirror image of the others.
- 3.38. The showers are proprietary units consisting of a seamless pre-formed acrylic wall liner to two sides and curved sliding doors to the other two sides. At the base of the shower, the wall liner laps over an acrylic tray. The top of the shower is closed with a clear acrylic dome. Photos show bowing of the wall liners in bathrooms 1 and 2 in several areas, including where it laps over the acrylic tray below.

Electrical work

- 3.39. The electrical work in question involves power outlets in the southern module, to both SIP and timber-framed walls, and a switchboard installed in bedroom 1.
- 3.40. The installation of the power outlets and switchboard was carried out by a registered electrician ("the electrician"), who issued two "Combined Certificate of Compliance and Electrical Safety Certificates" relating to the work in question on

19 December 2023 (for work carried out in Invercargill) and 2 May 2024 (for work carried out at the owners' property).

- 3.41. Both certificates state that the work "has been done in accordance with Part 2 of AS/NZS 3000".
- 3.42. Installation of power outlets to the external SIP walls have a cutout in the panel behind the outlet, with some of the polystyrene core removed. Photos show that the as-built cutouts to the panels are oversized for the outlets, with secure screw fixings to only one side of the outlet.
- 3.43. Photos also show one outlet, installed to a timber-framed wall, with the plastic wire sheathing stopping several millimetres short of the rear of the power outlet and one wire strand for the earth wiring unsecured and sitting loose.

4. Clause B1 – *Structure*

- 4.1. The matter regarding clause B1 relates to the owners' concerns about the dwelling's piles, bearers and joists, and walls (for issue numbers in brackets, refer to Appendix A):
 - 4.1.1. Piles – specifically the structural performance of the piles, including the modified pile located at the north-western corner of the dwelling (issues 35-37).
 - 4.1.2. Subfloor framing and flooring – specifically the structural performance of the subfloor bearers and joists, and of the flooring (issues 7, 8, 35, 36, and 45).
 - 4.1.3. Walls – in particular the structural performance of the SIPs panels in relation to pre-construction storage, alleged deformation and delamination, junctions to other building elements, joinery installed in the SIPs, and the structural performance of internal plasterboard linings in relation to their fixings (issues 1-5, 9, 10, 12, 13, 23, and 32).

Discussion

- 4.2. The relevant objectives of clause B1 are to safeguard people from injury caused by structural failure and loss of amenity caused by structural behaviour.
- 4.3. The building work is required to comply with the relevant performance requirements of the Building Code, and by doing so the objective and functional requirements will be achieved.
- 4.4. In this case, the relevant performance requirements that must be met are:

- B1.3.1** Buildings, building elements and sitework shall have a low probability of rupturing, becoming unstable, losing equilibrium, or collapsing during construction or alteration and throughout their lives.
- B1.3.2** Buildings, building elements and sitework shall have a low probability of causing loss of amenity through undue deformation, vibratory response, degradation, or other physical characteristics throughout their lives, or during construction or alteration when the building is in use.
- 4.5. When considering the stability of buildings, building elements, and sitework, clause B1.3.3 requires account to be taken of all physical conditions likely to affect that stability, and gives a non-exhaustive list of examples. For the dwelling, these conditions include vertical loads such as self-weight or imposed gravity loads arising from use, and lateral loads such as wind and earthquake loads, among others.

Piles

Submissions

- 4.6. In relation to the piles, the owners submit:
- 4.6.1. “[the piles] were 10 to 15mm out of level with the end of [the dwelling] left cantilevered off 3 to 4 piles”. The owner stated they subsequently levelled the piles, so [the] weight of the [dwelling] was then supported evenly on the piles”.
- 4.6.2. The piles are out of plumb, and the owners’ building surveyor (“the building surveyor”) commented that piles vary “between 20mm and 60mm per metre out of plumb”⁷ “and in opposite directions to each other”. The building surveyor concluded that only 16 piles met the details in NZS 3604 for the plumbness of driven piles.⁸
- 4.6.3. The pile to bearer fixings at the four external corners of the dwelling do not secure it properly, because there are too few screws and the screws are operating in tension rather than shear. The building surveyor stated that “this methodology is not supported in the [proprietary hold down fixings] manual nor seems to follow the [engineer’s] site instructions”.
- 4.6.4. The modified pile is “structurally unsound and severely compromised with only 60mm [out of the] 150mm [diameter] of the pile remaining for the bearing surface ... as the rest has been cut away”.
- 4.6.5. The building surveyor noted that “some piles contain extensive cracks, with one pile crack/split [in the modified pile] measuring 70mm deep”. The

⁷ *Investigation of Building with Pending Application for a CCC report dated 16 February 2026.*

⁸ *New Zealand Standard 3604:2011 Timber framed buildings.*

owners raised concerns about “water driven into wood fibres [in these cracks], affecting the structural integrity of the pile”.

- 4.7. The first authority stated that the as-built piles “appear to be in question as to whether they comply with the consent”. It noted that compliance with clause B1 could be established using the producer statement provided by the structural engineer, along with site inspection records. Any differences with the approved plans and specifications could be addressed by way of a minor variation or an amendment to the building consent.⁹

Expert’s report

- 4.8. As noted in paragraph 1.7, the Ministry engaged an expert to carry out a site visit and provide a report. The expert’s views regarding the piles are (in summary):
- 4.8.1. There are discrepancies between the ‘hammer weight and drop’ testing regime undertaken onsite and the method set out in NZS3604. However, “the piles are suitable for the expected gravity loads [as] loads on the piles are small, given the [dwelling] is lightweight and the piles are closely spaced”.
- 4.8.2. While it is clear some of the piles are not vertical, “the measured pile tilt is of negligible structural concern because the [dwelling] is lightweight, the piles are closely spaced, and the piles themselves are large”.
- 4.8.3. “Most piles have multiple cracks in the surface. This is typical shrinkage checking of timber piles and is of no structural concern”.
- 4.8.4. “... structurally [the crack in the modified pile] is of minor consequence. The crack does not extend far down the pile, so will not reduce the pile strength and stiffness where the lateral load bending demand is greatest”.
- 4.8.5. “[The proprietary hold down fixings] are likely to at least satisfy the 6kN capacity as specified in [the approved plans and specifications]”.

The Ministry’s view

- 4.9. The dwelling includes structural elements, such as the SIPs, which require specific engineering design outside the scope of NZS 3604.¹⁰ Nonetheless, in my assessment I have taken into consideration the standard’s details for piles because the dwelling is a single-storey lightweight structure. In the following paragraphs I address the plumbness, hold down fixings, cracks in the piles and the modified pile.

⁹ Section 45A provides for minor variations. See also *Guidance to building consent amendments* (1 September 2008) <<https://www.building.govt.nz/projects-and-consents/build-to-the-consent/making-changes-to-your-plans/guidance-to-building-consent-amendments>>.

¹⁰ At section [1.1].

- 4.10. Section 6.3 of NZS 3604 provides for the setting out of piles, and 6.4.1 their height. Leaving for the moment the impact to the bearers and joist of variances in pile spacing (refer paragraphs 4.23 - 4.28), the number of piles and their height are in accordance with NZS 3604.
- 4.11. The plumbness of several piles exceeds the tolerance of 15mm per metre in pile height set out in paragraph 6.6.6.3 of NZS 3604. Where piles are not plumb, ongoing vertical loads are increasingly resisted through bending loads in the piles (rather than through compression). However, I agree with the expert's views that the impact of this is limited given the weight of the building, and the pile spacing and size.
- 4.12. I note also the as-built piles are not uniformly out of plumb in a single direction or to the same degree. This does not suggest of movement under vertical and/or lateral loads, which would more likely result in a uniform movement of the piles.
- 4.13. Regarding the proprietary hold down fixings (see paragraph 3.3), these are typically installed as a flat plate connecting the piles to the bearers and resisting uplift loads. While the as-built fixings differ from the manufacturer's details, I agree with the expert's views that they are likely to at least achieve a 6kN capacity as set out in the second building consent.
- 4.14. Cracks in piles, also referred to as 'checking', often occur over time, including after they are installed, as the inner heartwood and outer sapwood dries at different rates. NZS 3605¹¹ describes checks as separations of fibres along the grain forming a gap in the pile's surface but not extending through the pile or pole. The standard prescribes grade limitations for round timber piles, and states cracks across piles are not permitted. It further notes that these kinds of seasoning checks in piles are expected and are not defects.¹²
- 4.15. There are cracks in three piles, (refer paragraph 3.5). In two of the piles the cracks run down to ground-line. The expert notes that cracks can be significant where they are located at the ground-line of the pile. This is because they impact the pile's ability to resist lateral loads, such as wind loads or earthquakes, through bending, and the ground-line is where those demands are the greatest.
- 4.16. The modified pile has cracked at the top, where bending motions are lesser. Given the length and depth of the checks in relation to the pile's height and diameter, I do not consider this would result in a more than low probability of rupture or loss of stability
- 4.17. The piles are specified as having a minimum diameter of 140mm (paragraph 3.1), which reflects the minimum diameter in paragraph 6.4.2(d) of NZS 3604. The modified pile, with a top face approximately 70mm x 160mm differs from that

¹¹ New Zealand Standard 3605:2001 *Timber piles and poles for use in building*. Paragraph 6.4.3.3 of NZS 3604 provides that materials for timber piles should comply with NZS 3605.

¹² Ibid. [4.1.4.3 and 5.6.1]

detail.¹³ The smaller dimension reduces the bearing surface between the modified pile and the bearer above.

- 4.18. While the capacity of the three piles (ie the modified pile with crack and a reduced bearing surface, and two other piles with cracks) to resist those vertical and lateral loads is affected, the impact of this is limited. All 53 piles are connected via bearers, joists and other structural elements. Any reduced capacity in the three piles will be spread across the other 50 piles. In turn, those three piles are unlikely to independently lose stability or rupture due to those same connections.
- 4.19. Considering the overall characteristics of the piles and foundation assembly as discussed above, I agree with the expert's view that the piles will have sufficient capacity to account for expected vertical and lateral loads. I conclude the piles comply with clause B1.

Subfloor framing and flooring

Submissions

- 4.20. In relation to the subfloor framing, the owners submit:
- 4.20.1. In some locations bearers are sitting proud of the piles below and joists are sitting proud of bearers indicating that the dwelling has "ruptured". As a result, the owners levelled the piles (refer to paragraph 4.6.1) and placed packers in gaps between the joists and bearers.
 - 4.20.2. Furthermore, "bearer positions have been adjusted to accommodate incorrectly placed plies" and are "not aligned to pile centres" and no longer spaced as set out in the approved plans".
 - 4.20.3. The building surveyor notes the altered pile layout resulted in changes to the bearer spacing which in turn resulted in increased joist spans for the northern module. The bearer spacing differs from the approved plans, with the as-built measured distance increasing by a maximum of 115mm.
- 4.21. Regarding the flooring, the owners submit:
- 4.21.1. The as-built plywood flooring "had delaminated from the joist" and "the floor was creaking ... and on inspection [had] lifted and has movement up and down at the screws". While the plywood flooring was re-screwed and sanded, "it now has undulations between the joists".

Expert's report

- 4.22. The expert's views regarding the subfloor framing and flooring are (in summary):

¹³ In a site report dated 15 May 2024, the engineer noted this discrepancy and provided a revised construction detail. However, this work was not carried out.

- 4.22.1. "Floor framing complies with NZS 3604 and is therefore considered compliant with the B1 provisions."
- 4.22.2. "The owners have provided photographs of some of the floor joists sitting proud of the bearer, with a clear gap of up to approximately 10mm visible. This gap allows unintended flex of the joists under imposed loads and may lead to noticeable floor deflections and vibrations."

The Ministry's view

- 4.23. As with the piles (see paragraph 4.9), for the purpose of the following discussion I have taken into consideration the details in NZS 3604 in relation to bearer span, overhang of bearers, and joist span.
- 4.24. Varying degrees of plumbness in the piles have affected the span of the bearers. I have not been provided with specific measurements of the as-built bearer spans. Accounting for the worst-case scenario, of piles being out of plumb by 60mm per metre, the maximum span of the bearers could be approximately 1600mm. This still falls within the maximum span set out NZS 3604, which provides for a maximum span of 2000mm.¹⁴
- 4.25. However, above two piles in the northern module, the as-built bearers are not centred on the piles, with overhangs of approximately 40mm. I note the bearers are built-up from two 140x45 elements nailed together. While NZS 3604 sets out that bearers can be built-up in this way, this means that one of those elements is almost wholly unsupported by the pile, relying instead on nailing to transfer loads to the adjacent element and then to the pile.¹⁵
- 4.26. It is not clear how the as-built bearers, above these two piles, will account for vertical loads, which will likely be transferred to the pile below in an uneven manner. In this regard, I do not have sufficient information to reach a conclusion on compliance with clause B1.3.1.
- 4.27. In addition to varying degrees of plumbness, differences in the set out of the as-built piles and resulting changes to the location of the bearers have increased the joist span, with the maximum as-built span for the joists measured at 1930mm. The joists (being 140 x 45mm members at 400mm centres, and continuous over two or more spans) are within the maximum span of 2970mm set out in NZS 3604.¹⁶
- 4.28. Accordingly, I consider that in relation to their as-built spans the joists comply with clause B1.3.1.
- 4.29. Photos of the subfloor show gaps between the bearers and joists, with the expert noting there is potential for deflection as a result. I consider this to be a

¹⁴ At [6.12.2.1].

¹⁵ At [2.4.4.7].

¹⁶ At [7.1.1.1].

contributing factor to the unevenness observed in the floors of the kitchen and living spaces.

- 4.30. While this does not by itself indicate non-compliance with clause B1.3.1, it does have potential impacts regarding compliance with clause B1.3.2, which relates to ensuring that buildings and building elements have a low probability of causing loss of amenity through undue deformation, vibratory response, degradation, or other physical characteristics.
- 4.31. Clause A2 – *Interpretation* defines amenity as “an attribute of a building which contributes to the health, physical independence, and well being of the building’s users but which is not associated with disease or a specific illness”.
- 4.32. Small variations in floor level can affect a person’s ability to move around safely without tripping, and a floor that has sudden or unexpected changes in level increases the risk of a trip or fall.
- 4.33. The change in flooring level indicates a variation of up to approximately 10mm across two metres in the kitchen and living spaces (as photographed). This variation is sloping, with no rapid changes which might catch a person’s foot when stepping.
- 4.34. While I acknowledge the floor is uneven, with gaps in the subfloor structure and potential deflections affecting flooring. However, I do not consider the degree and nature of the unevenness gives rise to a loss of amenity. Accordingly, I conclude that the as-built flooring complies with clause B1.3.2.

Walls

Submissions

- 4.35. The owners note that the structural integrity of the panels relies on an intact bond of the steel sheets and polystyrene core forming a panel that can be a load bearing and bracing element in the dwelling. In relation to this, the owners submit:
- 4.35.1. The “SIPs ... [were] stored outside without cover and [were] stored level for eight months”, whereas the technical specifications state “panels should always be kept dry and if placed on site, stored off the ground, slightly inclined, allowing adequate drainage and ventilation”.
- 4.35.2. As the panels have been exposed to external moisture, “freezing and thawing of water in [the polystyrene core] has [a] detrimental [effect] over time, leading to delamination of [steel sheeting]”, especially when considering local winter conditions.
- 4.36. The owners submit that damage and defects suggest the building was subjected to excessive loading, resulting in deformation of the SIPs and associated fixings that impact on the structural performance of the building:

- 4.36.1. Due to how the modules were installed, they were “overstressed” and “bent”, resulting in damage to the SIPs as well as structural fixings such as rivets.
 - 4.36.2. Several SIPs, to both eastern and western elevations of both modules, have been deformed or are showing signs of delamination. These indicate “over stress of [the dwelling]” or that it is “not structurally capable of withstanding loads”.
 - 4.36.3. The owners provided photos of internal areas where they state that the “[steel sheeting] was glued back by builder after delivery”, including one location where two SIPs had shifted out of alignment.
 - 4.36.4. When the southern module arrived on-site it was missing internal corner angles, at the vertical junction between the external SIPs and timber-framed walls, as detailed on the approved plans. While these angles were later installed, a “deformation crease” had already occurred to the western SIP wall of bedroom 2, adjacent to the door.
 - 4.36.5. Furthermore, sealant in vertical joints between SIPs has been “stretched to the point of rupture”.
 - 4.36.6. At the junction between the SIP walls and the roof, “a row of rivets on both sides of the [dwelling]” had failed due to “deformation and creasing of the panels”. While the builder had replaced the rivets to the eastern SIP walls, the owners maintain that the fact the rivets failed indicates those junctions experienced significant loading.
- 4.37. The owners also raised concerns about the fixing of the wall panels and performance under face loading, submitting:
- 4.37.1. There are “... no bottom angles on wall panels, tying internal [steel sheeting] to floor system” meaning the structure is unable to “act as a whole”.
 - 4.37.2. While the approved plans do not detail a bottom angle tying the internal steel sheeting to the floor structure, manufacturer’s details for the SIP system “clearly state [that a] C channel [is] to be used to secure SIPs”. Under face loading (for example, from wind) the uncontained polystyrene core and internal steel sheeting will detach under the resulting bending motions, leading to “delamination and failure”.
- 4.38. In relation to the bracing capacity of the walls, the owners submit:
- 4.38.1. SIPs rely on “intact bonded [steel sheeting] to the [polystyrene core] to form a structural element that then is able to be a load bearing and bracing element”. This is compromised where SIPs have been deformed or are showing signs of delamination.

- 4.38.2. Screw fixings to plasterboard linings were “over screwed to the point that the [plasterboard lining] was coming loose”. Photos provided by the owners show several fixings for the internal plasterboard linings in bedroom 2 sitting either proud of the surface or over screwed.
- 4.39. The structural engineer submits that “the vertical load capacity of the full height [SIPs] is more than adequate to support the applied vertical loads...”. In relation to the bracing capacity of the walls, the structural engineer submits:
- 4.39.1. “The vertical joints are also sealed full height with [a proprietary] sealant which helps significantly, to bond the rebated tongue and groove type panel joints together”.
- 4.39.2. “[A]s far as we can establish no specific bracing unit capacity and performance testing has been undertaken by [the SIP manufacturer] in accordance with the BRANZ P21 bracing element testing regime”. The structural engineer’s approach therefore has been, with reference to section 5 of NZS 3604, “that the applied loads derived are well distributed throughout the structure”, including “the use of the interlocked roof panels as extensive stiff roof diaphragms to transfer loads to bracing elements”.
- 4.39.3. In addition, the structural engineer notes that each SIP element forms a discrete bracing wall element with “top and bottom fixing angles to transfer shear loads into the subfloor system, together with the use of additional thick plates and heavy screw fixings ... as specific hold down fixings”, comparing the approach to “sheet material faced” bracing elements used in “usual residential construction” as well as other SIP buildings constructed in New Zealand.
- 4.39.4. They consider the bracing system for the dwelling complies with clause B1, “provided it is not damaged and remains well maintained”.
- 4.40. In relation to the joinery installed in SIP walls, the owners submit:
- 4.40.1. Joinery is “face fixed” to the external steel sheeting of the SIPs via rivets, with no internal angle installed to connect the joinery to the internal steel sheeting, as set out in the approved plans. While timber reveals have been installed around joinery openings instead, these are not fixed to the internal steel sheeting of the SIPs.
- 4.40.2. For door joinery, this will “directly load the outside [steel sheeting] of [the] panel when doors are open”.
- 4.40.3. While an internal angle is installed to the horizontal junction between the top of the SIP wall and roof elements, it includes joints in the angle over joinery units such as the 1.8m wide window in bedroom 2.

- 4.40.4. For some joinery units (including the window noted above) the depth of the SIPs, acting as the lintel over the window, is as little as 200mm. This is exacerbated in situations where joinery spans are greater than the width of a single SIP, with resulting whole width SIPs above the joinery only secured by way of the metal angle installed to the junction between the top of the SIP wall and roof elements and sealant to adjacent SIPs.

4.41. In relation to joinery installed in SIP walls, the structural engineer submits:

- 4.41.1. “The bottom edge of the panel lintel is [riveted] at each joint as well as to the internal angle above the window. This forms a sheet steel lintel with the angles taking the tension and compression forces.”
- 4.41.2. Joinery penetrations in the SIP walls are bridged by roof panels, interlocked with roof purlins, and internal and external angles installed to the horizontal junction between the roof and wall SIPs. It is “unlikely that any failure would occur from either upward or downward roof loads”.
- 4.41.3. “[W]hether the lower-level lintel angles have been installed in the [dwelling] requires further investigation before further comment can be made.”

4.42. In relation to the pantry window, the owners submit:

- 4.42.1. The patching “has resulted in this area becoming non-structural”. The deformation seen in the SIP adjacent to the patch indicates that its structural integrity “is now possibly compromised”.
- 4.42.2. Furthermore, sealant used to join the patched area to the adjacent SIP has failed and “is now displaying water oozing from it after rain”. This failure may be due to the “effect of the temperature change in the metal”.

4.43. In relation to the pantry window, the structural engineer submits:

- 4.43.1. “The [SIP] roof will likely be able to span over this isolated zone and is also partially supported by the substantial timber framed and parallel wall below”. They state that the SIP in question “is not relied upon as a wall bracing element”.
- 4.43.2. While they consider it unlikely that the roof will fail, “the long-term durability due to weathertightness could lead to further delamination over time which could affect the rivet fixing capacity of the roof fixing angles”. In addition, they consider “the fact that the pantry window has also been relocated sideways leaving additional wall joints and [which] appears poorly flashed means the panel strength could possibly be compromised in the longer term”.

Expert's report

4.44. The expert's views regarding the SIPs are:

- 4.44.1. The full-height panels have sufficient capacity for the expected gravity loads.
- 4.44.2. The uneven surface seen at the top of most of the SIPs "does not appear to be a structural integrity concern with no indication of panel skin debonding".
- 4.44.3. In relation to the connection between the base of the SIPs and the floor, the expert comments that the SIP manufacturer's "span tables apply where the standard [manufacturer's] details are followed". The manufacturer's details show the base of the SIP sitting in a C-shaped channel and fixed on the exterior side. This is "similar to the single fixing provided by the [angle] at this property", "vertical uplift loads are likely to be resisted by the connections as provided".
- 4.44.4. However, because the as-built detail uses an L-shaped angle, not a C-shaped channel, "only the outer [steel sheeting] of the SIP is restrained. Under face loading, the performance of the [SIP] fixing to the angle is unknown. Debonding of the [steel sheeting] from the [polystyrene] core material is possible." They conclude that "performance of the SIP panel base fixing under the largest expected face loads is unpredictable".

4.45. Regarding the bracing capacity of the walls, the expert said (in summary):

- 4.45.1. "A length of two [SIPs] with a total length of 2000mm has been assessed with calculations of the hold down and shear at the base fixings." The expert does not consider that to be "an appropriate method of design". In their view "connection between adjacent panels is minimal and consists only of the angle section riveted to the top and bottom of the panel. How this assembly will perform cannot be reliably assessed by calculation".
- 4.45.2. While the structural engineer has considered lateral loads in terms of bracing units, as defined by the standard NZS 3604, the "bracing unit capacities of wall assemblies are typically determined via a specific testing system", which "accounts for the actual performance of the panel and fixings distortions under high lateral loads". The expert considers that "the bracing should have been specified using bracing unit capacities as determined for specific panel lengths via tests", however they are "unaware if [the manufacturer] have bracing capacity information for their panels".
- 4.45.3. "While the [sealant between abutting wall panels] will provide some stiffness and strength to the overall wall construction, this cannot be

reliably quantified". The expert commented that reliance on this would require "reliable application and robust quality control", which "is not clear was the case for the construction of these panels".

- 4.45.4. Considering the elevated timber floor, mono-pitch roof, timber-framed walls and SIP panel elements with a floor to ceiling height of 3.5m, the dwelling is "quite different to a typical SIP ... building" and "outside the typical application for SIP ... construction".

4.46. Regarding the joinery installed in the SIP walls, their views are:

- 4.46.1. "While we are unable to verify the capacity of the wall to [roof] panel connection, and [wall] panel to floor connections, we believe it likely these have sufficient capacity to resist wind uplift loads...".
- 4.46.2. They state that, for the window they were able to inspect in bedroom 2, the metal angle shown to the top of the window opening in the approved plans was not installed.
- 4.46.3. The "as-built load path for roof support at the [joinery] opening locations is not clear." While they "expect the roof loads are taken by the cove angle connecting the wall to the roof and the joinery unit", "the window joinery is not intended as a structural element to withstand vertical loads, and therefore its performance under the largest expected loads is unpredictable."

4.47. Regarding the pantry window and in relation to the deformation seen in the adjacent SIP, the expert comments that "[SIPs] are a composite material with strength dependant on the bond of the steel and [polystyrene] core. As-built, this delaminated panel does not comply with the B1 structural integrity provisions".

The Ministry's view

- 4.48. The structural engineer and expert are of the view that the as-built SIPs have sufficient capacity to withstand vertical loads, such as self-weight and imposed gravity loads.
- 4.49. Other aspects of their as-built construction may affect their performance, including under lateral load, and in the following paragraphs I consider the deformation in the panels, their fixings, bracing, lack of lintels to joinery, and the patched panel.
- 4.50. The uneven external surface observed at the top of the panels could be due to a combination of factors. Regardless, this deformation is located at the top 200mm of the SIPs, where the panels connect to the roof structure and are subject to bending actions under out-of-plane loads. The deformation suggests that degradation of the bond between the metal sheeting and polystyrene core may be occurring in places. No investigation has been carried out to confirm the underlying state of the panel in this location, and I have not been provided with sufficient evidence to conclude that

the bond has degraded and the extent to which that impacts on the structural capacity of the panels.

- 4.51. Regarding the junction between the SIPs and floor structure, I agree with views of the owner and expert that the absence of an angle restraining the internal steel sheeting may cause it to detach from the polystyrene core at this junction when subject to out-of-plane loads, such as wind loading. I therefore conclude that there is a more than low probability of the external SIPs rupturing at the floor junction, meaning they do not comply with B1.3.1 in relation to out-of-plane loads.
- 4.52. The bracing system for the dwelling, resisting lateral loads such as wind or earthquake loads, consists of mixed structural systems. SIP wall elements running north-south are intended to primarily resist in-plane lateral loads in that direction. Proprietary plasterboard linings are intended to do the same in the east-west direction.
- 4.53. As noted in the manufacturer's documentation for the plasterboard lining, specific fixings and layouts are necessary to ensure the system performs as intended. The extent of the fixings which sit proud or are over screwed into these linings is not clear, so I am not able to draw conclusions regarding their potential impact on the bracing capacity they provide.
- 4.54. The approved plans and specifications set out that the SIPs provide the necessary bracing capacity by way of the "bracing units" they provide. Comment C5.1.3 of NZS 3604 states that bracing units are calculated by way of the BRANZ Technical Paper P21 test ("P21 test") and notes that, where bracing units are used in specifically engineered designs, "reduction factors may be appropriate". In this case a P21 test does not appear to have been carried out for the SIP system, as noted by both the structural engineer and the expert. The expert notes that they are otherwise unable to calculate the bracing capacity of the SIPs panels.
- 4.55. The structural engineer compared the bracing system for the dwelling to other SIP construction buildings in New Zealand. However, I agree with the expert's comment that the differences between this dwelling's structure and other common SIPs construction, as described in paragraph 4.45.4, means a comparison of the likely bracing performance against in-service history of other common SIPs construction cannot be made without due consideration of those differences.
- 4.56. On the information available to me, I am unable to reach a conclusion that the as-built SIPs will achieve the necessary bracing capacity to account for those lateral loads. Given the lack of evidence regarding the performance of the as-built SIP walls under lateral loading, I do not have sufficient information to be satisfied that the SIPs comply with clause B1.3.1 in this regard.
- 4.57. The as-built joinery is fixed to the exterior steel sheeting of the SIPs as described in paragraph 3.20. As noted in paragraph 3.23, L-shaped angles have not been installed to the head or jambs of the openings on the internal face of the SIPs.

Instead, timber reveals have been installed, and it is unclear how the reveals are fixed to the SIPs.

- 4.58. Building elements above the joinery work to transfer roof loads, such as self-weight or uplift, to either side of the joinery units. While the angles connecting the SIP wall panels to the roof panels will assist in laterally transferring those loads, it is not clear to what degree they will do so. Furthermore, I note that the sealant between some panels has failed above the joinery units. When also accounting for the missing angles around the joinery openings, I agree with the expert's views that the paths for roof loads above joinery elements is unclear.
- 4.59. Photos show uneven panel surfaces where the as-built joinery is fixed to the exterior steel sheeting of the SIPs. It is not clear whether this has occurred as part of cutting the SIPs to fit the joinery, or from fixing the joinery to the external skin, or if it indicates debonding of SIP elements due to loading from the joinery. Regardless, I consider that reliance on face-fixing to transfer loads is not an arrangement that either the joinery or the SIPs are intended to accommodate.
- 4.60. In conclusion, I consider the exterior-only fixing of joinery units, the missing internal angles above and around joinery openings, and the unclear gravity and uplift load paths through building elements above (and into) the joinery, result in a more than low probability of rupture for joinery units or adjacent SIP elements. Accordingly, the SIPs walls do not comply with clause B1.3.1 in this regard.
- 4.61. Having discussed the joinery installed in the SIPs more generally, specific concerns have been raised about the patch of the SIP adjacent to the pantry window.
- 4.62. While it is unclear exactly how the patch has been installed, I consider it unlikely to follow manufacturer's details (as described in paragraph 3.17), leaving the pantry window inadequately secured on one side. Furthermore, photos show delamination of the external steel sheeting in the SIP adjacent to the patch, propagating from the top right corner of the patch through to the top of the panel, indicating damage to the bond between the external steel sheeting and polystyrene core.
- 4.63. Due to a lack of secure fixings and damage already present, I consider there is a more than low probability of the patch rupturing. I therefore find that it does not comply with clause B1.3.1.

Conclusion

- 4.64. With regard to Clause B1 *Structure*, I conclude:

- 4.64.1. The as-built piles, including the modified pile, and the joists and flooring comply with clause B1.3.1.
- 4.64.2. The as-built SIP walls do not comply with clause B1.3.1 with respect to the connection to the floor structure. Furthermore, the joinery units installed

to the SIPs, including the patch adjacent to the pantry window, do not comply with clause B1.3.1.

- 4.64.3. There is insufficient evidence to establish that the as-built dwelling will comply with clause B1.3.1 in relation to the transfer of loads to the piles where bearers overhang and the in-plane loads to the SIP walls.

5. Clause B2 - *Durability*

- 5.1. The matter regarding clause B2 relates to concerns regarding the scratches to the external metal surfaces of the external SIP walls and roof cladding, including the southern barge flashing (issues 39 and 40).

Discussion

- 5.2. The objective of clause B2 is to ensure that a building will continue to satisfy the other objectives of the Building Code throughout its life. The relevant performance requirement regarding this matter is clause B2.3.1, which states that:

B2.3.1 Building elements^[17] must, with only normal maintenance, continue to satisfy the performance requirements of this code for the lesser of the specified intended life of the building, if stated, or ... [a specified durability period in subclause (a), (b), or (c) that applies to the building element].

- 5.3. Subclauses (a), (b) and (c) then set out the minimum durability periods for different types of building elements, being 50, 15, or 5 years respectively. The variance in the durability periods depends on the nature and function of the building elements, including how easy the building elements are to access, replace and maintain and whether failure to comply would go undetected during normal use and maintenance.
- 5.4. Building elements contributing to a building's structural stability, those difficult to access or replace, or those where failure to comply would go undetected during normal use and maintenance must perform for the minimum durability period of 50 years. Building elements forming the external envelope must perform for the minimum durability period of 15 years.

Submissions

- 5.5. Regarding the external metal surfaces, the owners submit that scratches through the finished paintwork to the underlying metal will result in rust and corrosion, and failure to achieve the durability periods.

¹⁷ 'Building elements' is defined in clause A2 as any structural and non-structural component or assembly incorporated into or associated with a building.

- 5.6. Regarding the southern barge flashing, the owners submit that the as-built flashing has “ragged sharp exposed steel edges”, and that this, alongside “multiple scratches will rust”.

The Ministry’s view

- 5.7. The roof cladding and southern barge flashing, as part of the external envelope of the dwelling, must achieve a minimum durability period of 15 years. The steel sheeting contributes to the structural stability of the SIPs and the dwelling overall, and is difficult to replace. Therefore, it must achieve a minimum durability period of 50 years.
- 5.8. Details of the SIP and roof cladding products’ performance included in the approved specifications note that the coating and painting of the metal surfaces contribute to their ability to meet durability requirements. Photos show scratches to exterior metal surfaces of the SIP walls and roof cladding, including the southern barge flashing, that are more than minor, running through the paint and coatings of those elements’ metal surfaces.
- 5.9. Without repainting, corrosion is likely to occur to the steel sheeting, roof cladding, and southern barge flashing. This will impact those elements’ ability to continue to satisfy the performance requirements of clauses B1 and E2. In this regard I consider that without timely attention to the scratches the requirements of B2.3.1(a) and (b) will not be met.

6. Clause E1 – *Surface water*

- 6.1. The matter regarding clause E1 relates to two alleged issues with the gutters:
- 6.1.1. Fall of guttering – surface water not being adequately conveyed by the gutters due to inadequate fall (issue 21).
- 6.1.2. Guttering is not continuous – a gutter that includes a joint resulting in a horizontal kink, meaning the gutter is unable to adequately convey surface water (issue 22).

Discussion

- 6.2. The objectives of clause E1 include the safeguarding of “people from injury or illness, and other property from damage, caused by surface water” and protection of “the outfalls of drainage systems”. The functional requirement in achieving these objectives requires that “buildings and sitework shall be constructed in a way that protects people and other property from the adverse effects of surface water”.¹⁸

¹⁸ Clauses E1.1 and E1.2.

6.3. Surface water is defined in clause A2 as:

surface water all naturally occurring water, other than sub-surface water, which results from rainfall on the site or water flowing onto the site, including that flowing from a drain, stream, river, lake or sea.

6.4. In this case, the relevant performance requirement is clause E1.3.3(a):

E1.3.3 Drainage systems for the disposal of surface water shall be constructed to:

- (a) convey surface water to an appropriate outfall using gravity flow where possible,
- (b) avoid the likelihood of blockages, ...

Submissions

6.5. Regarding the fall of the guttering, the owners submit:

6.5.1. Both modules arrived at the owners' property having "no fall". The gutter to the southern module was subsequently altered to achieve the "correct fall". However, issues with the fall in the northern module gutter remain, including that the gutter is "not running down to [the downpipe] but to [the] blind end where it is also leaking".

6.5.2. To support this, they provided a photograph showing "[a builders'] level sitting on gutter" indicating there is "no fall[,] water doesn't drain out" as well as photos of standing water in the northern module gutter.

6.6. Regarding the continuity of the guttering, the owners submit that the southern module guttering is not continuous, as is stated on the approved plans. They state that as a result it is "now kinked at the [joint]".

The Ministry's view

6.7. I consider the gutters form part of the drainage system which is intended to dispose of surface water by conveying it to an outfall, in this case to on-site water tanks and overflow connections into the wider stormwater network.

6.8. I note while a gutter may not always be a requirement in order to comply with clause E1, where gutters have been provided as part of a building's drainage system, as in this case, they must (among other requirements) convey surface water, using gravity flow where possible, and avoid the likelihood of blockages.

6.9. Photos show standing water in the northern module gutter, as well as a build-up of organic matter/sediment. This evidence indicates the northern module gutter, as-built, does not convey surface water to the outfall using gravity flow (as intended and described in the approved plans and specifications).

- 6.10. Furthermore, the build-up of organic matter and sediment increases the likelihood of vegetation growth in the gutter with resulting blockages in the gutter and/or downpipe.
- 6.11. As the northern module gutter does not convey surface water to the outfall using gravity flow or avoid the likelihood of blockages, it does not meet the performance requirements of clause E1.3.3(a) or (b).
- 6.12. The owners allege the inclusion of a joint in the southern module gutter means that it is not 'continuous' as stated on the approved plans. While there is a joint to this gutter as-built, I have not seen evidence establishing that the joint affects the gutter's ability to convey surface water. The owners' submissions state that the southern module gutter has the "correct fall" and I therefore consider it complies with clause E1.3.3(a).

Conclusion

- 6.13. Regarding Clause E1 *Surface water*, I conclude:

- 6.13.1. The as-built northern module gutter does not comply with clause E1.3.3(a) or (b) with respect to its fall.
- 6.13.2. The as-built southern module gutter complies with clause E1.3.3(a) with respect to the joint in the gutter.

7. Clause E2 – *External moisture*

- 7.1. The matter regarding clause E2 relates to concerns regarding the weathertightness of the dwelling's roof, walls, and joinery:
- 7.1.1. Weathertightness of roofing elements – in particular that elements of the roof, including vent penetrations, and fixings, are not preventing the penetration of moisture (issues 16, 33, and 42).
- 7.1.2. Weathertightness of the timber sheet cladding– in particular that it does not prevent the penetration of moisture at joints between the sheets, internal corner junctions to SIP walls, and at the head and sill of the joinery (issues 18 to 20).
- 7.1.3. Weathertightness of the SIP walls – in particular that the SIPs are not preventing the penetration of moisture at external corner junctions, at joints between panels, at the base of panels, and around window and door joinery, including where one of the panels has been patched (issues 6, 11, 13-15, 17, 24, and 34).

Discussion

7.2. The objective of clause E2 is to safeguard people from illness or injury that could result from external moisture entering the building. The functional requirement in achieving this objective is that buildings must be constructed to provide adequate resistance to penetration by, and the accumulation of, moisture from the outside.¹⁹

7.3. The relevant performance clauses are E2.3.2 and E2.3.5:

E2.3.2 Roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to *building elements*, or both.

E2.3.5 Concealed *spaces* and cavities in *buildings* must be constructed in a way that prevents external moisture being accumulated or transferred and causing condensation, fungal growth, or the degradation of *building elements*.

7.4. The meaning of the terms “undue dampness” and “damage” in clause E2.3.2 have been considered in determination 2014/062.²⁰ In particular, damage does not have to have occurred for the test of undue dampness to be met.

Roof

Submissions

7.5. Regarding vent penetrations in the roof, the owners submit:

7.5.1. The flashings around the vent penetrations for all three bathrooms had been “installed in a ... substandard fashion” with the owners reporting water ingress to a light fixture in bathroom 1. The owners stated that “the builder has since resealed the [vent flashings]”.

7.5.2. The building surveyor stated that, despite the subsequent work, “the [vent flashings] need to be replaced”.

7.5.3. The owner later provided photos showing water ingress through a bathroom ventilation fan after two rain events within the span of a three weeks, stating the “leak is presumably from the roof somewhere, as the house itself is not connected to a water supply”.

7.6. Regarding the profile closures, the building surveyor commented that the profile closures were necessary to “prevent wind blown rain”.

7.7. Regarding fixings for the roof cladding, the owners submit that “roof screws in the bedroom unit were over screwed ... [forming] dimples on the ribs of the [roof cladding] with water pooling around the screws”. They also stated that other screws

¹⁹ Clauses E2.1 and E2.2.

²⁰ Determination 2014/062 *Regarding the refusal to issue a code compliance certificate and the issue of a notice to fix for an 11-year-old house with mixed claddings* (issued 19 December 2014), at [8.3].

were not installed perpendicular to the roof cladding, with “washers not seated properly” meaning a “[likelihood] of water ingress”.

The Ministry’s view

- 7.8. The as-built boot flashings around vent penetrations do not sit flush against the soaker flashing below. While gaps between the flashing elements were subsequently filled with sealant, later evidence shows water has penetrated the roof and leaked through the ventilation fan in one of the bathroom ceilings forming a shallow puddle on the floor.
- 7.9. Clearly there is inadequate resistance to penetration by moisture. Water penetrating the roof is subjecting underlying building elements, such as the ventilation fan and associated electrical work, to recurring wetting and drying cycles that, in my opinion, is likely to cause damage over time. Consequently, the boot flashings to the vents as built do not comply with clause E2.3.2.
- 7.10. Foam profile closures were not installed to the ribs of the roof cladding above the eaves, and the owners raised concerns about the potential impacts of wind-driven rain.
- 7.11. Occasional or intermittent moisture penetrating through a building’s external envelope, or accumulating within concealed spaces, does not necessarily mean there has been a failure to comply with E2.3.2 or E2.3.5. I must also consider the potential impacts of that moisture, in this case within the concealed space between the roof cladding and SIPs below.
- 7.12. E2/AS1 notes profile closures shall not be used at eaves for profile metal roof cladding.²¹ Further commentary in section 10.10 of The NZ Metal Roof and Wall Cladding Code of Practice notes the use of closures restricts ventilation within the ribs of profile metal roof cladding, and their use should be limited.²²
- 7.13. The lack of profile closures allows for ventilation and drying of the concealed space below the roof cladding. This means moisture will not remain in the concealed space for prolonged periods, and not to the extent that it would cause undue dampness or damage to underlying elements, or moisture accumulated or transferred such that it would cause condensation or fungal growth. Consequently, I find this aspect of the as-built work complies with E2.3.2 and E2.3.5.
- 7.14. As-built, roof fixings through the ribs of the roof cladding sit askew, with washers compressed into or sitting proud of the screw hole, though the washers appear intact in photos provided by the owners. I consider there is potential for water penetration through the poorly sealed fixings into a concealed space below the roofing

²¹ Acceptable Solution E2/AS1 External Moisture (3rd edition, amendment 10, effective 5 November 2020) at [8.4.15]. This is the version that was current at the time of the work was being undertaken.

²² NZ Metal Roof and Wall Cladding Code of Practice (version 25.09, September 2025).

7.15. Considering the size of the gaps and the ventilation to the profile ribs, as discussed in paragraph 7.12, I do not consider the potential degree of water penetration and accumulation will rise to the level of causing undue dampness, degradation of building elements, or similar. Accordingly, I conclude that the roof fixings through the asymmetrical trapezoidal profile metal roof cladding comply with clauses E2.3.2 and E2.3.5.

Timber sheet cladding

Submissions

7.16. Regarding the timber sheet cladding generally, the owners submit:

- 7.16.1. The manufacturer of the timber sheet cladding requires a “back flashing system behind, with continuous beads of sealant either side” for vertical joints between the sheets. On the southern module it has been installed with a flashing behind the joint but no sealant, and on the northern module, with no flashing or sealant.
- 7.16.2. When the modules arrived at the owners’ property, sealant was not applied to the internal corner flashings at the junction between the timber sheet cladding and SIPs. They stated that “evidence of the internal framework could be seen ... through the corner from the outside”. Subsequently, the owners removed the internal corner flashing and applied sealant, providing photos of that work.

7.17. Regarding joinery in external walls with timber sheet cladding, the owners submit:

- 7.17.1. The head flashing to joinery in external walls with timber sheet cladding has “gaps [of] >5mm” and the “window head flashing ... is not sealed or fitted with close tolerances” as shown in the approved plans. This will allow “direct water ingress into the [dwelling]” noting that the dwelling is in a high wind zone and close to an active airfield runway.
- 7.17.2. The window joinery for bedroom 2 in the southern module is “non-compliant with a gap under [the] window [sill]”.

The Ministry’s view

- 7.18. As-built, vertical butt joints between timber sheet cladding panels rely on sealant run in the gap between the panels and the ventilated cavity construction behind to manage external moisture. Internal corner junctions to the SIPs walls have a similar arrangement, though include the face-fixed internal corner flashings.
- 7.19. The sealant run between these joints will offer initial protection from the penetration of moisture through these joints. For the internal corner junctions, the internal corner flashings will offer an additional initial layer of protection.

- 7.20. Where moisture can track past the sealant, I note that the cavity battens behind are a plastic product which will not be detrimentally affected by that moisture. I consider the ventilated cavity behind the timber sheet cladding will be sufficient to dry and/or drain the levels of moisture which might track further through to that concealed space. Consequently, I conclude that the vertical joints and internal corner junctions comply with clauses E2.3.2 and E2.3.5.
- 7.21. Turning now to the as-built head flashings with a horizontal gap of approximately 6mm to the joinery behind. Although the timber sheet cladding is a proprietary product outside the scope of E2/AS1, I consider the Acceptable Solution details relevant to my assessment of this junction because the head flashings, as detailed in the approved plans and manufacturer's documentation, are comparable to the details for joinery in plywood sheet cladding set out in E2/AS1.²³
- 7.22. E2/AS1 does not specify a dimension for the horizontal distance between the bottom lip of the head flashing and the joinery behind but sets a minimum cover of 10mm vertically over the window head flange. E2/AS1 notes that sealant between the head flashing and joinery is only necessary in very high and extra high wind zones.²⁴ This is reflected in the manufacturer's documentation as well. These details indicate that, for this dwelling in a high wind zone, tolerances requiring the two elements to be flush fit or sealed together are not necessary to prevent penetration of moisture that might cause undue dampness or damage.
- 7.23. I am of the view that the as-built gap between the head flashing and joinery complies with clauses E2.3.2 and E2.3.5.
- 7.24. On the southern elevation, vertical gaps of 1-2mm have been observed between the bottom flange of the window joinery and the top of the timber sheet cladding below. This gap will allow moisture ingress in behind the cladding at this location. However, this area of cladding is approximately 100-200mm in height and installed over a drained and ventilated cavity. I consider the level of moisture ingress through this gap would not be to the degree that the ventilated cavity would not be able to drain and/or dry that moisture. Accordingly, I conclude that the sill for the window joinery in bedroom 2 complies with clauses E2.3.2 and E2.3.5.

SIP walls

Submissions

- 7.25. Regarding external corner junctions, the owners submit that the flashings covering the external corner junctions for the SIP walls are "not sealed properly ... allowing water ingress to panels".
- 7.26. Regarding the vertical joints between SIP wall panels on the east and west elevations, the owners submit:

²³ At [9.8.8.2].

²⁴ At [9.1.10.4(e)] of E2/AS1.

- 7.26.1. “There is panel joint failure [on] both sides of the [dwelling] with water ingress”. On the east elevation “the external sealant joint ... has ruptured”.
 - 7.26.2. As a result, water ingress was observed coming through the “failed SIPs ... joint after rain”. Subsequently “a bead of silicone [sealant] was introduced onto the outside of the ruptured panel joint as a fix”, though photos included in the building surveyor’s report include comment that one of the joints was “never repaired”.
 - 7.26.3. Ongoing concerns remain given the size, colour, solar gain, and possible expansion and contraction of the SIPs. The owners raised concerns regarding relying on the sealant as the “only” prevention of water ingress at the panel joints.
- 7.27. Regarding the flashing to the base of the SIP walls, the owners submit:
- 7.27.1. It is “subject to expansion and contraction through temperature fluctuations” with a risk that rivets and sealant in the flashing may fail and “lead to water ingress”. Furthermore, “major deformation of [the base flashings] is already evident”.
 - 7.27.2. The building surveyor commented that the arrangement of the base flashing lapping over the internal corner flashing “will allow ... direct water into this overlap”.
- 7.28. Regarding joinery in SIP walls, the owners submit that when the modules were delivered to the owners’ property, sill flashings had not been installed. The owners state that sill flashings were later installed, after “all the doors and windows were replaced due to ... failed windows leaking water into the [dwelling]”. However, while the sill was rectified, “none of the window and door penetrations [in the SIP walls] ... are framed with flashing tape”.
- 7.29. Regarding the pantry window, the owners submit:
- 7.29.1. It is now “out of level, not plumb, [with the window sash] not covering [the window] frame”. As a result, there is a “direct path for water ingress” and mitre joints in the window frame have been “forced open”. A patch has been installed to the SIP adjacent to the window, but the sealant installed to the joint between the patch and SIP “is unable to cope with the effect of the temperature change” and “has broken”.
 - 7.29.2. Comments on photos of the pantry window noted “corrosion, aluminium oxide coming out of mitres”.
- 7.30. The owners also provided photos of moisture ingress into the dwelling. The photos show moisture tracking to the interior of the dwelling at the base of the SIPs, where they meet the plywood flooring substrate, as well as water stains seen at the base

of timber reveals for window and door joinery. The owners state this has required replacement of vinyl tiling adjacent to window and door joinery.

The Ministry's view

- 7.31. The arrangement of building elements for the SIP nib walls at external corners of the dwelling is described in paragraphs 3.16 and 3.29. Of specific consideration are indications that sealant to the external corner flashings was either not applied or no longer forms a seal to the SIPs behind and the base flashing lapping over the internal corner flashings.
- 7.32. Without a seal between the external corner flashings and the SIPs behind that form the nib walls, moisture can track behind the flashings and down the external corner junctions between the SIPs. Furthermore, the installation of the base flashings lapping over the internal corner flashings forms a gap between the base flashings and SIPs at this junction, allowing moisture to track behind those flashings as well.
- 7.33. The plywood flooring and timber subfloor has been built out below the nib walls. Moisture penetrating behind the flashings, as described above, could subject those timber elements to recurring wetting and drying cycles or prolonged periods of elevated moisture, causing degradation and an inability to meet their durability requirements.
- 7.34. Accordingly, I find the external corner flashings for the SIP nib walls, and the base flashings where they lap over the internal corner flashings, do not comply with clause E2.3.2.
- 7.35. Vertical joints between the SIPs rely on sealant run between panels to prevent moisture ingress. Photos show instances where sealant has come away from one side of the joint. Furthermore, vertical joints between the SIPs sit slightly recessed from the external face of the panels. As the base flashing is face fixed to the SIPs, there is a gap between the flashing and the recessed vertical joints.
- 7.36. Joints where sealant has come away from one side of the joint will allow external moisture to penetrate those joints and track down to the plywood flooring and timber subfloor below. Regardless, the gap between the base flashing and recessed vertical joints allows external moisture to track down to those timber elements even where the joint sealant remains intact.
- 7.37. As described in paragraph 7.30, photos show moisture ingress along the base of the SIP walls, including at areas below vertical joints in the SIPs. I consider this is evidence that the vertical joints between the SIPs and base flashing are failing to prevent the penetration of external moisture. As noted in paragraph 3.9, the plywood flooring was overlaid with wood-fibre sheeting. It is a product susceptible to damage even when subject to short durations of wetting, with the owners stating that flooring has had to be re-laid in these areas already. I therefore find that

vertical joints between the SIPs, and the base flashing at these locations, do not comply with clause E2.3.2.

- 7.38. Photos show moisture ingress around joinery installed in the external SIP walls, with water stains at the base of adjacent internal timber reveals. The owner has raised specific concerns regarding flashing tape not being applied to jamb and header junctions, but I also note that, in at least one location, sealant applied between the jamb and SIP has pulled away from the flange of the joinery jamb.
- 7.39. Weathertightness around this joinery relies on several elements working together, including deflection of external moisture via the head flashing, sealant preventing moisture ingress between the joinery and SIPs behind, drainage along the jamb, and diversion of that moisture back to the exterior via the sill flashing. Flashing tape is one aspect of this overall system, and it is not clear whether its application, or lack thereof, would materially affect the compliance of these junctions.
- 7.40. However, as already noted, moisture ingress has been observed around the base of the joinery installed in the SIP walls and adjacent flooring has had to be re-laid. I consider this evidence that moisture is penetrating in areas around the joinery, such as where the sealant has pulled away, and causing damage. I therefore find that the joinery installed in the SIP walls does not comply with clause E2.3.2
- 7.41. Paragraph 3.24 describes how the pantry window was relocated during construction, resulting in a patch between the window and adjacent SIP.
- 7.42. It is unclear exactly how the patch has been installed. I note, among other provisions, the sealant manufacturer states a maximum joint width of 35mm but the sealant at the base of the patch is approximately 40mm. Given the amount of sealant used and the appearance of the as-built joints, I consider it unlikely to prevent the penetration of water which could cause undue dampness or damage to elements such as timber reveals or internal wall linings. Accordingly, I find the patch adjacent to the pantry window joinery does not comply with E2.3.2.
- 7.43. Regarding the window joinery itself, photos show a build-up of white residue at unsealed gaps in mitre joints at corners where the aluminium joinery framing abuts. The residue indicates likely oxidation of the aluminium framing. Joinery framing includes drainage pathways and weepholes which allow for moisture within the frame to drain to the exterior. However, I consider the occurrence of this residue is evidence that moisture is accumulating through gaps in the framing with a frequency and/or duration which is causing degradation and damage. I therefore consider the window joinery does not comply with E2.3.2.

Conclusion

7.44. Regarding compliance with Clause E2 *External moisture*, I conclude:

- 7.44.1. The flashings to the vents in the roof as constructed do not comply with clause E2.3.2.
- 7.44.2. The lack of profile closures, and the fixings through the roof cladding, comply with clauses E2.3.2 and E2.3.5.
- 7.44.3. The vertical joints between the timber sheets, the internal corner junction to adjacent SIPs, and the head flashing and sill junction to the joinery comply with clauses E2.3.2 and E2.3.5.
- 7.44.4. The external corner flashings to SIPs nib walls, vertical joints between SIPs, the base flashing where they overlap internal corner flashings, the joinery installed in SIP walls, and the patch adjacent to the pantry window do not comply with E2.3.2.

8. Clause E3 – *Internal moisture*

8.1. The matter regarding clause E3 relates to two compliance concerns, with four issues:

- 8.1.1. Imperviousness of floor surfaces – gaps between vinyl tiles in both bathrooms 2 and 3 in the southern module meaning the flooring is not impervious (issue 28).
- 8.1.2. Water splash penetrating behind shower linings – shower wall liners in bathrooms 1 and 2, and the shower tray in bathroom 3, are not adequately bonded to their substrate linings and so do not prevent water splash from penetrating into concealed spaces (issues 25-27).
- 8.1.3. Moisture accumulation behind power outlets – removal of the polystyrene core insulation behind the outlets leading to issues with moisture accumulation within those cavities (issue 43).

Discussion

8.2. The relevant objective of clause E3 is to safeguard people against illness, injury, or loss of amenity that could result from the accumulation of internal moisture. To achieve this objective the relevant functional requirements are that buildings be constructed to avoid the likelihood of fungal growth or the accumulation of contaminants on linings and other building elements, and to avoid the likelihood of damage to building elements caused by the presence of moisture.²⁵

²⁵ Clauses E3.1(a) and E3.2(a) and (c).

Bathroom linings

Submissions

- 8.3. Regarding the floor surfaces, the owners submit that the wood-fibre sheeting was installed as the plywood flooring was “structurally unsuitable as a bearing surface for the [vinyl tiling] to adhere to”. This is not in accordance with the approved plans and specifications, and the owners stated they “have concerns about [the wood-fibre sheeting] in the wet area blowing... especially with the [vinyl tiling] having gaps between them”.
- 8.4. Regarding the shower linings, the owners submit that the linings, in areas, have not bonded to the substrates. For the shower tray, this is due to it being installed over the wood-fibre sheeting “which was not intended for installation”. Because of temperature fluctuations the unbonded areas will get worse and, in some areas, will lead to “possible water ingress to wall area behind”.
- 8.5. The junction between the shower wall lining and tray, in bathroom 2, was described by the owners as having “no sealer”.
- 8.6. The building surveyor also commented on the above issues, stating that the wood-fibre substrate “is not suitable in a wet area without waterproofing”, and noting the shower in bathroom 1 “has the potential to leak under the liner and onto the timber floor”.

The Ministry’s view

- 8.7. The relevant performance requirement for the bathroom flooring is clause E3.3.3, which states that, “Floor surfaces of any space containing sanitary fixtures or sanitary appliances must be impervious and easily cleaned”.
- 8.8. Therefore, the vinyl tiling and any associated elements which contribute to forming the floor surface must collectively form an impervious surface which does not allow the passage of moisture.
- 8.9. In this case, evidence shows there are gaps between the vinyl tiling in bathrooms 2 and 3, meaning the tiling alone does not form an impervious surface. There is no further evidence that sealants or other elements underneath the vinyl tiling would act to make the overall floor surface impervious, and I therefore conclude the requirements of clause E3.3.3 are not met.
- 8.10. The shower liners and trays are likely to be splashed, with concerns specifically raised about water penetrating behind the linings. The relevant performance requirement is clause E3.3.6, which states:

Surfaces of building elements likely to be splashed must be constructed in a way that prevents water splash from penetrating behind linings or into concealed spaces.

- 8.11. The owners' submissions highlight several areas where the shower linings in bathrooms 1 and 2, and the shower tray in bathroom 3, appear to either not have been attached or have since detached from the underlying substrate. The liners and trays, in and of themselves, are impervious elements. However, risk of water splash penetrating behind the linings arises at the junction between the two.
- 8.12. The bowing of the wall liners in bathrooms 1 and 2 indicates there is not a continuous seal between the liner and shower tray elements.²⁶ Therefore, it cannot be established that this joint prevents water splash from penetrating into the concealed space between the liner elements or through to the underlying wall elements. Accordingly, I consider junctions between the shower liner and tray for bathrooms 1 and 2 do not meet the performance requirements of clause E3.3.6.
- 8.13. Submissions for bathroom 3 relate only to the bonding of the shower tray itself. There is no indication that this has led to the junction between the tray and liner allowing water splash to penetrate behind the linings or into concealed spaces. Therefore, I conclude the shower tray for bathroom 3 complies with clause E3.3.6.

Power outlets

Submissions

- 8.14. Regarding the power outlets, the owners state that "all the foam has been erroneously removed at the back of the power points to the outside metal [sheeting] in 3 locations" and that "this leads to direct condensation ... to the inside of the SIPs ... and degradation of the EPS foam core from that moisture".

The Ministry's view

- 8.15. Clause E3.3.1 sets out that:

An adequate combination of thermal resistance, ventilation, and space temperature must be provided to all habitable spaces, bathrooms, laundries, and other spaces where moisture may be generated or may accumulate.

- 8.16. Meeting this performance requirement ensures that these spaces meet the functional requirements of clause E3 in relation to fungal growth, contaminants, and damage to building elements due to the presence of moisture.
- 8.17. Photos of the outlets provided in relation to other issues (29 and 30) show some of the polystyrene core removed to make space for the outlets, but the photos do not show instances of the full thickness having been removed.
- 8.18. There has been no evidence provided of an accumulation of moisture on the interior surfaces around these sockets, evidence of fungal growth or damage to building elements, or information that would suggest there is no longer adequate

²⁶ I note the approved plans and specifications do not show how this joint is to be detailed.

thermal resistance on these walls. Accordingly, I conclude the SIPs comply with regard to the installation of the power outlets.

Conclusion

8.19. Regarding Clause E3 *Internal moisture*, I conclude:

- 8.19.1. The as-built vinyl tiling in bathrooms 2 and 3 does not comply with clause E3.3.3.
- 8.19.2. The as-built junctions between the shower liner and tray for bathrooms 1 and 2 do not comply with E3.3.6.
- 8.19.3. The as-built shower liner and tray for bathroom 3 complies with clause E3.3.6.
- 8.19.4. There is insufficient evidence to establish that the alleged power outlets with the polystyrene core fully removed do not comply with clause E3.3.1.

9. G9 – *Electricity*

- 9.1. The matter regarding clause G9 relates to alleged issues with the power outlets and the switchboard, specifically:
 - 9.1.1. Exposed wires and incorrectly constructed cutouts and support to power outlets in the southern module (issues 29 and 30).
 - 9.1.2. The switchboard is not adequately secured (issue 31).

Discussion

- 9.2. The relevant performance clause of the Building Code concerning the concerns raised about the electrical installations is:

G9.3.1 The electrical installation shall incorporate systems to:

- (a) protect people from contact with parts of the installation which are live during normal operation, and to prevent parts of the installation or other building elements becoming live during fault conditions, ...

Submissions

- 9.3. Regarding the power outlets, the owners submit:

- 9.3.1. The cutouts for the power outlets in the SIP walls were “oversized to the point of failure in normal use” and that “no metal was left for holes to be

drilled for screw fixture[s] on one side”. When trying to pull a plug out of the power outlet it “pulled off the wall”.

- 9.3.2. This raises safety issues, “especially considering the entire wall and roof linings are metal [i.e.] conductive”.
- 9.3.3. Furthermore, for power outlets in timber framed walls, “wires were dangerously exposed... with one strand of wire from the earth wire close to shorting out i.e. almost touching the active wire”. Other power outlets were found with plastic wire sheathing not reaching the rear of the power outlet, leaving live wire strands exposed behind the outlet.
- 9.4. Regarding the switchboard, the owners submit:
 - 9.4.1. “...the electrical [switchboard] in the eastern bedroom [was] secured on one side only” and was “... able to move in and out and ... liable to fail as [there was] only thin plastic securing [it] on one side”.
 - 9.4.2. The owners provided a photo of them pushing in on the switchboard, showing a gap between the plasterboard lining in front and switchboard behind. They subsequently “had to reinforce the box to satisfy code requirements”.

The Ministry’s view

- 9.5. In determining the compliance of the work with clause G9.3.1(a) I must consider the compliance pathways that relate to the power outlets and switchboard.
- 9.6. Compliance with the Building Code can be established via several pathways. Section 19 sets out specific pathways that a building consent authority must accept, such as Acceptable Solutions or Verification Methods, as establishing compliance with the Building Code.
- 9.7. For clause G9, Verification Method G9/VM1²⁷ sets out that electrical installations within the scope, and complying with, the Electricity (Safety) Regulations 2010 meet the performance requirements of clause G9, including G9.3.1(a). Regulations 59 through 61A of those regulations set out provisions for low and extra-low voltage installations, such as the power outlets and switchboard, including that they must be in accordance with AS/NZS 3000.²⁸
- 9.8. The electrician has stated that the work has been carried out in accordance with part 2 of AS/NZS 3000. I have seen no evidence that an alternative solution or a certified design, prepared in accordance with part 1 of AS/NZS 3000, has been

²⁷ Verification Method G9/VM1 *Electricity* (first edition, amendment 7, effective 5 November 2020).

²⁸ Schedule 2 of the Electricity (Safety) Regulations 2010 states that the specific standard referred to in those regulations is AS/NZS 3000:2018: Electrical installations (known as the Australian/New Zealand Wiring Rules), including amendments 1, 2, and 3.

proposed.²⁹ I will therefore consider the as-built power outlets and switchboard against part 2 of AS/NZS 3000.

- 9.9. Section 4.4 of AS/NZS 3000 sets out standards for power outlets.³⁰ Paragraph 4.4.2.2 states that power outlets must be installed so that “they will not be subjected to undue mechanical stress or damage in normal service”. Where this provision is not met the power outlet risks coming loose or otherwise failing during normal operation. This potentially exposes people to parts of the power outlet that are live or could cause building elements to become live.
- 9.10. Power outlets in the external SIPs are not installed so that they avoid undue mechanical stress or damage in normal service. Only one side of the outlet is securely fixed to the SIPs, and they have come loose from the wall during normal operation when plugs are removed. This means people are no longer protected from live elements behind the power outlet, and there is a risk of adjacent building elements, such as the steel sheeting in the SIPs, becoming live. Therefore, those power outlets do not meet the requirements of G.9.3.1(a) by way of paragraph 4.4.2.2 of AS/NZS 3000.
- 9.11. AS/NZS 3000 notes in 3.7.2.5 that “the ends of stranded conductors shall be secured ... so as to prevent the spreading or escape of individual strands”. This ensures that loose wiring does not cause a short-circuit fault condition, causing parts of the power outlet, wiring, or adjacent building elements to become live.
- 9.12. Photos show a power outlet with an unsecured wire strand sitting loose and at risk of creating a short-circuit with the adjacent active wire. It therefore does not meet the requirements of G9.3.1(a) by way of paragraph 3.7.2.5 of AS/NZS 3000.
- 9.13. Section 2.10 of AS/NZS 3000 sets out construction standards for switchboards, stating in paragraph 2.10.3.2 that they shall be suitable to withstand “mechanical stresses”. The risk with switchboards being insecure is that wiring systems may be unable to withstand those mechanical stresses, becoming damaged or exposed in a way where people may come into contact with live elements.
- 9.14. While there appears to be some inward movement of the switchboard, the evidence does not establish that the movement to such an extent that it would expose people to live elements during normal operation. Furthermore, the owners state they subsequently secured the switchboard. I therefore consider that the switchboard meets the requirements of clause G9.3.1(a) in this regard, by way of paragraph 2.10.3.2 of AS/NZS 3000.

²⁹ Alternative solutions are allowed under the Act in relation to complying with clause G9; however, I note the Electricity Act 1992 also sets out separate requirements in relation to electrical work and installations which, although outside my purview, must be complied with.

³⁰ Power outlets are referred to in AS/NZS 3000 as ‘socket-outlets’.

Conclusion

9.15. Regarding Clause G9 *Electricity*, I conclude:

- 9.15.1. The power outlets installed to the external SIPs that are secured on only one side of the outlet do not comply with clause G9.3.1(a) by way of paragraph 4.4.2.2 of AS/NZS 3000.
- 9.15.2. The power outlet with loose strands of wiring does not comply with clause G9.3.1(a) by way of paragraph 3.7.2.5 of AS/NZS 3000.
- 9.15.3. The switchboard, in regard to being adequately secured, complies with clause G9.3.1(a) by way of paragraph 2.10.3.2 of AS/NZS 3000.

10. Decision

10.1. In accordance with section 188 of the Building Act 2004, I determine that some aspects of the as-built work, as described in this determination, do not comply with clauses B1, B2, E1, E2, E3, and G9.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 7 October 2026.

Peta Hird

Lead Determinations Specialist

Appendix A – Summary of issues in dispute

The following list outlines the issues raised by the owners, as summarised from the original application for a determination.

Issues 38, 41 and 44 were not determinable matters. However, the numbering is left unchanged for consistency.

1. Structural performance in relation to the effects of the storage of the SIPs panels.
2. Structural performance in relation to a deformation crease of the bedroom unit western wall.
3. Structural performance in relation to delamination of SIPs steel sheeting – external.
4. Structural performance in relation to delamination of SIPs steel sheeting – internal.
5. Structural performance of the SIPs wall panels without connection to the internal bottom edge.
6. External moisture performance of the joints between SIPs on western elevation.
7. Structural performance of the plywood flooring in relation to delamination.
8. Structural performance of the building in regard to joists not resting on bearers below.
9. Structural performance of the junctions between SIPs walls and roof junctions in relation to ruptured rivets.
10. Structural performance of joints between SIPs on eastern elevation in relation to panel joint deformation.
11. External moisture performance of reinstalled pantry window on western elevation.
12. Structural performance of SIPs panel adjacent to pantry window in relation to external moisture ingress.
13. Structural and external moisture performance of SIPs panel adjacent to pantry window in relation to delamination bubble in the steel sheeting.
14. External moisture performance of multiple windows in the bedroom unit.
15. As per item 14, in relation to resulting damage in vinyl flooring.
16. External moisture performance of exhaust vent on roof.
17. External moisture performance of panel nib walls without sealant to external angle trims.
18. External moisture performance of window head flashings in relation to cover and sealant.
19. External moisture performance of the corner junctions between panel cladding and SIPs in relation to angles not installed.
20. External moisture performance of the panel cladding as installed.

21. Disposal of surface water in relation to the fall of the gutters.
22. Disposal of surface water via guttering that is not continuous.
23. Structural performance of SIPs wall on the western side of the bedroom unit, in relation to structural angles not installed prior to delivery.
24. External moisture performance at the bedroom unit doors in relation to lack of sill flashings and tape.
25. Imperviousness of the shower liner bathroom 2 regarding its bond to wall.
26. Imperviousness of the shower tray in bathroom 3 regarding its bond to the floor.
27. Imperviousness of the shower liner bedroom 1 regarding its bond to the wall.
28. Imperviousness of the vinyl tiles in bathrooms 2 and 3.
29. Installation of power outlets in relation to cutouts and support.
30. Installation of power outlets in relation to exposed wiring.
31. Installation of electrical sub board in relation to its support.
32. Structural performance of plasterboard linings in relation to screw fixings.
33. External moisture performance of roof fixings.
34. External moisture performance of the base/sill flashing to the bottom of external walls.
35. Structural performance of the dwelling in relation to the as-built pile layout and construction of the bedroom layout.
36. Structural performance of the dwelling in relation to the as-built pile layout and construction of the living unit.
37. Structural performance of the dwelling in relation to modified piles.
38. [not determinable matter].
39. Durability and external moisture performance in relation to scratches and damage to metal surfaces.
40. External moisture performance of the as-built barge capping.
41. [not determinable matter]
42. External moisture performance of the roof without profile closures.
43. Moisture accumulation at power socket cutouts with SIPs polystyrene core insulation removed.
44. [not determinable matter]
45. Structural performance of the dwelling in relation to changes in bearer layout from building consent.