



Determination 2013/057

Regarding the refusal to issue a building consent and the code-compliance of precast wall panels to be fixed on a proposed warehouse building at 6 Edwin Feist Place, Solway, Masterton

1. The matter to be determined

- 1.1 This is a determination under Part 3 Subpart 1 of the Building Act 2004¹ (“the Act”) made under due authorisation by me, John Gardiner, Manager Determinations and Assurance, Ministry of Business, Innovation and Employment (“the Ministry”), for and on behalf of the Chief Executive of the Ministry.
- 1.2 The parties to the determination are
- the building owner, Wairarapa Scrap Metals Ltd (“the applicant”), acting through their design engineer (“the design engineer”)
 - Masterton District Council carrying out its duties and functions as a territorial authority or a building consent authority (“the authority”).
- 1.3 This determination arises from the decision of the authority not to issue a building consent for a proposed warehouse building (“the warehouse”). The authority is not satisfied that the proposed building work will comply with Clause B1² Structure of the Building (First Schedule, Building Regulations 1992) because precast concrete panels (“the precast panels”) that form a large part of the exterior fabric of the warehouse had been designed as an integral part of the structure, and not as a building “part” as described in the loadings standard.
- 1.4 The matter to be determined³ is whether the authority correctly exercised its powers when it refused to issue a building consent for the warehouse. In making my decision I must consider
- whether the precast panels are considered “parts” as described in Section 8 of Part 5 of NZS 1170⁴
 - whether the precast panels comply with of the Building Code Clause B1 Structure.

¹ The Building Act, Building Code, Compliance documents, past determinations and guidance documents issued by the Ministry are all available at www.dbh.govt.nz or by contacting the Ministry on 0800 242 243.

² In this determination, unless otherwise stated, references to sections are to sections of the Act and references to clauses are to clauses of the Building Code.

³ Under sections 177(1)(b) and 177(2)(a) of the Act

⁴ NZS 1170.5:2004 Structural design actions - Part 5: Earthquake actions - New Zealand

1.5 In making my decision, I have considered the submissions of the parties, the report of the expert commissioned by the Ministry to advise on this dispute (“the expert”), and the other evidence in this matter.

1.6 The relevant clauses of the Building Code and New Zealand Standards are set out in Appendix A.

2. The building work

2.1 The proposed building is a single-storey industrial portal frame building (“the warehouse”), incorporating two-storey offices, with an area of 1002m². The warehouse is supported on UB portal frames and the perimeter wall fabric comprises of precast concrete wall panels.

2.2 The horizontally spanning panels, which are the subject of the determination, are specified as being 150mm thick with typical dimensions of 7000mm x 2800mm. They are centrally reinforced horizontally with DH16 rods @ 200mm centres and vertically with DH12 rods @ 200 centres. The panels are typically two-high, with the lower panel continuously supported at foundation level. The upper and lower panels are connected together by cast-in anchor plates that are site welded during construction. The end fixings of the panels comprise 150 x 150 x 12mm mild-steel plates set into the panels (2 per end) that are welded to the UB portal column flanges.

3. Background

3.1 The owner applied for a building consent in late 2012. As part of the application, the design engineer submitted plans and specifications as well as a Producer Statement PS1 – Engineering Design dated 15 February 2012.

3.2 The authority engaged a firm of consulting engineers (“the consultants”) to review the design, and subsequent correspondence took place involving the design engineer, the consultants, and the authority. The correspondence mainly related to requests for clarification and for additional information as regards the structural design of the warehouse.

3.3 In consultation with a firm of chartered engineers, the design engineer concluded that the panels should not be considered as “parts” for the purposes of NZS 1170.5 and provided amended drawings to the authority on that basis.

3.4 In a letter to the design engineer dated 22 April 2012 the authority set out a number of issues it considered needed to be addressed, and included the following:

Please provide calculations for the panel under seismic face load designed as “parts”, calculations and details for the panel-to-panel leg connections, and calculations to show adequacy of the portal legs to support the panels under seismic load.

3.5 The matter remained in dispute between the design engineer and the authority and the Ministry received an application for a determination on 23 May 2013.

4. The submissions

4.1 The applicant

4.1.1 The design engineer provided a submission dated 13 May 2013, on behalf of the applicant, that described some of the background to the dispute and the construction of the warehouse and a description of the precast panels. The design engineer stated that the specific item for consideration was:

Whether the proposed precast panels should be considered as building “parts” in context of AS/NZS 1170.5:2004.

4.1.2 The design engineer is of the opinion that as the wall panels formed part of the structural system and were supported on the ground, they did not need to be treated as a “part” or component supported by the structure.

4.1.3 The submission went on to describe the definition in NZ 1170.5 as regards the term “building part”, holding the view that the precast panels by definition should not be designed as a building part. The design engineer described the definition of a “part” within the scope of NZ 1170.5, and also set out Table C8.1 of the standard, which listed examples of “part categories”. The design engineer is of the view that the closest example in the table to the precast panels in question is that listed under Category P1 as “Cladding panel”, but that, in the context of the other items listed, the traditional meaning of “cladding panel” is meant rather than a primary structural building element such as the subject precast panels. The design engineer considered that it was not the intent of the standard that “significant panel items” be treated as being building “parts”.

4.1.4 The design engineer noted that the scope did not preclude primary elements being considered as a building part when it said that in regard to a part:

It may be an element of the main structural system which can be loaded by earthquake action in a direction not usually considered in the design of that element, such as face loading on a masonry shear wall, or upwards loading on a cantilever.

However, the engineer was of the opinion that this did not indicate that the “significant panel” should be designed as a part, as its capacity had already been, and usually was fully considered in orthogonal directions.

4.1.5 The submission also referred to the consultants’ questioning of the adequacy of the portal legs to support the portals under seismic face load. The design engineer was of the view that the precast panels were likely to dominate the dynamic response of the building. If the consultants’ approach as accepted by the authority was adopted, the design engineer considered it would require the capacity of the portals to be increased ‘by almost 500% which is not the intent of [the relevant part] of the standard’.

4.1.6 The design engineer also stated the view that when a standard permitted a certain degree of engineering judgement to be applied, that responsibility should rest primarily with the design engineer and not with a reviewing engineer.

4.1.7 The applicant supplied copies of

- the structural plans
- some design calculations

- the Producer Statement PS1 Engineering Design
- the correspondence with the authority and the consultants.

4.2 The authority

- 4.2.1 The authority forwarded a submission dated 20 May 2013 to the Ministry. The authority noted in its submission that consent applications that include specific engineering design are routinely reviewed by the consultants on behalf of the authority; the authority also responded to two administrative matters that had been raised by the design engineer.
- 4.2.2 The authority stated its opinion that it is the intent of NZS 1170.5 to treat the precast panels as a “part” for face loading. As the standard required “parts” loading to be considered for such an element and its connection to the supporting structure, the authority had requested design calculations for the panels subject to seismic “parts” loading. While the authority had requested calculations that showed the adequacy of the portal legs to support seismic face-loading, it was not requesting seismic “parts” face loading to be considered for these elements.
- 4.2.3 The authority supplied copies of
- the plans and specifications
 - additional consent documentation
 - the Producer Statement PS1 Engineering Design.
- 4.3 A draft determination was issued to the parties for comment on 6 August 2013. Despite two further requests, neither of the parties provided any further comment or response to the draft.

5. The expert’s report

5.1 General

- 5.1.1 As described in paragraph 1.5, I engaged the services of an expert, who is a Chartered Professional Engineer, to assist me. The expert produced a report dated 5 July 2013, based on the documents provided by the Ministry and in terms of Clause B1 of the Building Code and NZS 1170.5. Copies of this report were forwarded to the parties on 12 July 2013.
- 5.1.2 The report described the background to the dispute and gave a general description of the basic structure of the building and the precast panels. For the purpose of evaluation, the expert used panel Type H2 that was shown on the mid-length of the south elevation (Sheet 06 of the plans). This was on the grounds that this panel was representative of all the horizontally spanning wall panels in the building.
- 5.1.3 The expert was of the opinion that the disputed issues to be considered in order to establish compliance with Clause B1 were:

Issue No 1: Provision of calculations to verify the design of the horizontal spanning wall panels in terms of seismic actions standard NZS 1170.5:

- (i) as a “part” in terms of Section 8; in lieu of
- (ii) an element of primary structure in terms of section 5.

Issue No 2: Provision of calculations of the panel-to-(UB) portal leg connections.

Issue No 3: Provision of calculations to show the adequacy of the portal legs to support the panels under seismic face load.

The expert noted that the calculations within the context of Issues 2 and 3 would depend on the outcome of the first issue.

- 5.1.4 In considering these issues, the expert noted that the design engineer intended the precast panels to:
- (a) perform a primary structural function by acting as structural brace panels to ensure the stability of the building in the longitudinal direction; and
 - (b) act as secondary, non-structural, cladding and fire-rated components laterally supported by the primary structure, and in particular, to the site boundaries on the south and west elevations.
- 5.1.5 The expert considered each of the issues in detail and I summarise the conclusions that were reached below.

5.2 Issue No 1

- 5.2.1 The expert did not accept the arguments put forward by the design engineer (see paragraph 4.1.2) that the wall panels need not be treated as a part or component supported by the structure. The expert's opinion was based on the grounds that the wall panels relied on the primary structure for their lateral support. The steel portal frame is subject to horizontal displacement when subject to earthquake ground motion, and any mass restrained horizontally by it will be subject to "in-structure" accelerations.
- 5.2.2 In addition, the situation applied whether the panels are
- ground supported
 - spanning vertically as cantilevers whilst also connected to the upper parts of the roof structure
 - layered and span horizontally between the portal frame columns.
- 5.2.3 The expert was of the opinion that various parts of Section 8 and its commentary, such as Table 3.1 for example, were very clear and there was no avoiding the "parts" provision of the standard when preparing designs for this type of element. Accordingly, the "parts and components" of Section 8 contained the applicable evaluation to ensure compliance with Clause B1.

5.3 Issue No 2

- 5.3.1 The expert noted that the details of the panel weld plates as to size, orientation, and weld lengths, were missing from the plans. The expert considered that the design engineer needed to demonstrate by calculation that both the weld plate to the wall panel and the weld plate to UB steel flange connections had the required seismic demand capacity.
- 5.3.2 The expert was of the opinion that a compliant design would require at least 30% of the in-plane seismic action to be considered as applying concurrently with the face load. The expert considered the weld plate connection concepts were 'relatively

brittle' and offered little capacity to resist overload under severe seismic conditions. The drawings relating to this connection were insufficiently detailed to indicate how it is to be constructed in terms of anchorage of reinforcement into the body of the concrete panel, and the design engineer's calculations appeared not to refer to it specifically. Consequently, the expert was unable to offer an opinion as to the sufficiency of the design.

5.4 Issue No 3

5.4.1 The expert said that the UB flanges are required to have a dependable resistance sufficient to support the weld plate connection attaching to it (refer paragraph 5.3.1), and that a second level check was required to ensure that the portal frame columns, when they are spanning vertically between the ground and the rafters could resist the applied face loading consistent with their own ductility. Apart from this check, the design of the primary portal frame structure would only need to comply with the requirements of NZS 1170.5, section 5.

5.5 Conclusions

5.5.1 The expert concluded that in his opinion, the design of the wall panels:

- (a) should be undertaken as a "part" as per NZS 1170.5 section 8, with appropriate levels of ductility selected for panel and connection; and
- (b) does not require that the primary structure providing lateral restraint to the panel be designed to resist forces derived for the part: but
- (c) does require the flange etc within the column itself, being the element which connects the part into the primary portal frame structure, be sufficiently strong to transmit the forces of this part through the connections.

5.5.2 In addition, the expert noted that the current plans and specifications were insufficient to demonstrate compliance with Clause B1 in that

- while correctly described within the design engineer's calculations, the reinforcing in the panels was incorrectly described on the plans
- the weld plate connections into the concrete panels had not been detailed
- the panel connections to the UB portal frame flanges had not been detailed.

It was also noted that the design engineer's calculations and sketches did not relate to the weld plate and panel connections.

5.5.3 The expert queried whether the design engineer had reviewed the drawings sufficiently to confirm that his design intentions had been properly reproduced in the completed plans.

5.5.4 The expert also provided calculations to show how the rules set out in Section 8 could be applied to the wall panels.

6. Discussion

6.1 The expert has carried out a detailed analysis of the structural issues that are the subject of this determination and I am prepared to accept the opinions that are expressed in the expert's report.

- 6.2 Accordingly, I am of the opinion that
- the “parts and components” of Section 8 of NZS 1170.5 contains the applicable evaluation to ensure compliance with Clause B1
 - the panel weld plates lack sufficient detail both as regards their design and plan detailing to demonstrate compliance with Clause B1
 - a further analysis is required to ensure that the portal frame columns when they are spanning vertically between the ground and the rafters could resist the applied face loading consistent with their own ductility.
- 6.3 These observations lead me to conclude that the precast panels as designed at present do not meet the requirements of the Building Code, and accordingly that the authority was justified in refusing to issue a building consent for the warehouse based on the plans that were provided.

7. What happens next?

- 7.1 The design engineer should take account of the findings set out in this determination and reconsider the design of the precast panels. He should also ensure that the original structural calculations and any amendments that are made to the design elements have been correctly interpreted on the plans that are ultimately to be forwarded to the authority.
- 7.2 Once the design engineer is fully satisfied that all of the structural design is correctly represented on the plans, the revised plans can be forwarded to the authority for approval.

8. The Decision

- 8.1 In accordance with section 188 of the Building Act 2004 I hereby determine that
- the precast panels are considered “parts” as described in Section 8 of Part 5 of NZS 1170, and as such
 - the precast panels, including their connections to the main structure, do not comply with Clause B1 the Building Code;
- accordingly the authority correctly exercised its powers when it refused to issue a building consent for the warehouse and I confirm the authority’s decision.

Signed for and on behalf of the Chief Executive of the Ministry of Business, Innovation and Employment on 27 September 2013.

John Gardiner
Manager Determinations and Assurance

Appendix A

A.1 The relevant Clauses of the Building Regulations 1992 are:

CLAUSE B1—STRUCTURE

FUNCTIONAL REQUIREMENT

B1.2 Buildings, building elements and sitework shall withstand the combination of loads that they are likely to experience during construction or alteration and throughout their lives.

PERFORMANCE

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.

A.2 Relevant definitions from AS/NZS 1170.5:2004

APPENDIX A: DEFINITIONS (Normative)

Building part A member that is either attached to, and supported by, the structure but is not part of the structural system or an element of the structural system that can be loaded by an earthquake in a direction not usually considered in the design of that element.

Part An element that is not intended to participate in the overall resistance of the structure to horizontal displacement under earthquake conditions, for the direction being considered.

Section 8: Requirements for parts and components

8.1 GENERAL

8.1.1 Scope

Where required by Section 2, all parts of structures, including permanent, non-structural components and their connections, and permanent services and equipment supported by structures, shall be designed for the earthquake actions specified in this Section.

For category P.1, P.2 and P.3 parts the scope is limited to parts that weigh more than 10kg and are able to fall more than 3 m onto a publicly accessible area.

Where the mass of the part is in excess of 20% of the combined mass of the part and the primary structure and its lowest translational period is greater than 0.2 seconds, a special study shall be carried out to determine the dynamic characteristics of the part.

8.1.2 Classification of parts

Parts shall be classified into the categories shown in Table 8.1.

TABLE 8.1
CLASSIFICATION OF PARTS

Category	Criteria	Part risk factor R_p	Structure limit state ¹
P.1	Part representing a hazard to life outside the structure ²	1.0	ULS
P.2	Part representing a hazard to a crowd of greater than 100 people within the structure ²	1.0	ULS
P.3	Part representing a hazard to individual life within the structure ²	0.9	ULS
P.4	Part necessary for the continuing function of the evacuation and life safety systems within the structure	1.0	ULS
P.5	Part required for operational continuity of the structure ³	1.0	SLS2
P.6	Part for which the consequential damage caused by its failure are disproportionately great	2.0	SLS1
P.7	All other parts	1.0	SLS1

NOTES:

- 1 Refer to Section 2 for the return period of exceedance appropriate for this limit state.
- 2 To be considered in this category, the part must weigh more than 10 kg, and be able to fall more than 3 metres onto a publicly accessible area.
- 3 Only parts essential to the operational continuity of structures with importance level 4 will be classified as P.5. Non-essential parts and parts within structures of other importance levels will be otherwise classified.