

# ***Safety net to safeguard people from falling***

## **1 THE MATTER TO BE DETERMINED**

- 1.1 The matter before the Authority is a doubt as to whether safety nets provide an adequate safeguard against injury from falling from the deck of a house.
- 1.2 The Authority takes the view that it is being asked to determine whether the safety nets comply with clauses B2 “Durability” and F4 “Safety from falling” of the building code (the First Schedule to the Building Regulations 1992), and if not whether it would be reasonable to grant a waiver of the clause concerned.
- 1.3 In making its determination the Authority has not considered any other aspects of the Building Act 1991 or of the building code.

## **2 THE PARTIES**

- 2.1 The applicant was the owner of the house acting through a firm of architects. The other party was the territorial authority.

## **3 BACKGROUND**

- 3.1 The house was designed by the architects, and has a series of decks at various levels with timber barriers complying with the acceptable solution F4/AS1 in Approved Document F4. The territorial authority issued a building consent on that basis.
- 3.2 The applicant subsequently sought an amendment to the building consent to dispense with the barrier on one of the decks and substitute safety nets below the unprotected edges of those parts of the deck from which it is possible to fall more than 1 m. The territorial authority refused to grant the amendment, and the applicant disputes that refusal and has submitted the dispute to the Authority for determination.

## **4 THE SAFETY NETS**

- 4.1 The safety nets are to be similar to cargo lifting nets. They will be made from 12 mm diameter black UV stabilised polypropylene rope in a 100 mm x 100 mm square weave pattern. The rope has a weight of 6.6 kg per 100 m.
- 4.2 There are to be six nets, ranging in size from 3 m x 2.2 m to 3 m x 3 m. The nets are to be attached at the outer end to vertical poles set into the ground beyond the deck. At the inner end the nets are to “tuck back” in from the edge of the deck to be

secured to the poles supporting the deck. Thus the nets are to effectively extend approximately 1800 mm horizontally out from the edges of the deck. The nets are to be secured to 12 mm diameter galvanised eye-bolts fixed through the poles at 750 mm below the deck level with galvanized steel shackles to each corner of the net secured through specially formed eyes. Where nets are adjacent to each other they are to be lashed together at 100 mm intervals with separate lengths of the 12 mm diameter rope.

## **5 CLAUSES B2 AND F4 OF THE BUILDING CODE AND F4/AS1 IN APPROVED DOCUMENT F4**

### **5.1 The relevant provisions of clause B2 of the building code are:**

**B2.3.1** Building elements 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) The life of the building, being not less than 50 years, if:
  - (i) Those building elements (including floors, walls, and fixings) provide structural stability to the building, or
  - (ii) Those building elements are difficult to access or replace, or
  - (iii) Failure of those building elements to comply with the building code would go undetected during both normal use and maintenance of the building
- (b) 15 years if:
  - (i) Those building elements (including the building envelope, exposed plumbing in the subfloor space, and in-built chimneys and flues) are moderately difficult to access or replace, or
  - (ii) Failure of those building elements to comply with the building code would go undetected during normal use of the building, but would be easily detected during normal maintenance.
- (c) 5 years if:
  - (ii) Failure of those building elements to comply with the building code would be easily detected during normal use of the building.

### **5.2 The relevant provisions of clause F4 of the building code are:**

#### **Clause F4—SAFETY FROM FALLING**

##### **OBJECTIVE**

**F4.1** The objective of this provision is to safeguard people from injury caused by falling.

##### **FUNCTIONAL REQUIREMENT**

**F4.2** Buildings shall be constructed to reduce the likelihood of accidental fall.

## PERFORMANCE

**F4.3.1** Where people could fall 1 metre or more from an opening in the external envelope or floor of a building, or from a sudden change of level within or associated with a building, a barrier shall be provided.

**F4.3.2** Roofs with permanent access shall have barriers provided.

**F4.3.4** Barriers shall:

- (a) Be continuous and extend for the full extent of the hazard,
- (b) Be of appropriate height,
- (c) Be constructed with adequate rigidity,
- (d) Be of adequate strength to withstand the foreseeable impact of people and, where appropriate, the static pressure of people pressing against them,
- (e) Be constructed to prevent people from falling through them, and
- (g) Restrict the passage of children under 6 years of age when provided to guard a change of level in areas likely to be frequented by them.

5.3 The acceptable solution F4/AS1 in Approved Document F4 provides in effect that a minimum barrier height of 1000 mm is acceptable for external decks. A barrier that will not allow the passage of a 100 mm sphere is acceptable in houses.

## 6 THE SUBMISSIONS

### 6.1 Clause B2 Durability

6.1.1 A statement from the supplier said that the rope was not affected by water or bacterial decay, was resistant to dilute acids and alkalis, and was highly resistant to ultra-violet light. The supplier also said:

“We confirm that Rope nets manufactured from 12mm **Black** U.V. Stabilised Polypropylene would last ten years continual exposure to weather providing the nets were not exposed to abrasion or constant high loading. We also confirm that we would inspect these ropes annually or whenever requested for damage caused by any other elements i.e. damage from falling debris etc. . . .”

6.1.2 The applicant submitted:

“ . . . any failure of the safety nets to comply with the building code would be easily detected during the normal use of the building and as such a durability of 10 years is considered appropriate given the manufacturer’s recommendations, and especially on the basis that the ropes will not be subject to continual loading or abrasion, nor will they be continually exposed to sunlight given their location at the south eastern corner of the house.”

6.1.3 The territorial authority submitted that:

“The [region in which the house is located] is described by NZS3604 1999 as being Zone 4, exposed and in a location other than sea spray or geothermal. Two types of protection/material are recommended, 304 stainless steel or galvanised plus extra protection. It is our opinion that galvanised (plus additional protection) is excluded because of possible friction wear being caused by wind (or children playing). Stainless of 304 grade should therefore be considered the minimum.”

6.1.4 The applicant responded that:

“Our interpretation of NZS3604:1999 Table 4.1 is that for Zone 4 outside sea spray zone and geothermal hot spots is that galvanized steel fastenings are sufficient. It is submitted that it would be reasonable for the life of the fasteners to be similar to that of the safety nets themselves. The fasteners are similar to the nets, are readily accessible for periodic inspection and replacement if required. It is our opinion that it is unlikely that friction induced wear from wind will [be] of any significance in terms of the serviceability of the shackle fasteners given their proposed 12 mm diameter, and especially considering the exposure environment. It is our experience that even galvanized shackles on trailer safety chains, which are subject to constant friction from vehicle movement and regular immersion in salt water, last considerably longer than 10 years.”

**6.2 Clause F4 Safety from falling**

6.2.1 The applicant submitted that:

“ . . . the proposed safety nets will safeguard people from injury caused by falling by ensuring that the maximum height of fall will be no more than 1 metre. . . .

“In any case the likelihood of injury associated with a fall . . . onto the safety net is not an issue since the building code does not concern itself with the landing surface, but only with the height of fall.

“ . . . the change of level at the outer edge of the . . . nets where people could fall more than 1 meter is not considered relevant since the nets are not designed to be practicably walked on, nor is there any likelihood of people being at the outer edge of the safety nets.”

6.2.2 The territorial authority submitted that:

“[The distance of fall] could be likened to a fall into water, being the distance to the ground under the water. By this we are suggesting that the natural sag of the net is not necessarily the extent of the (possible) fall. The point load on contact may extend that fall, which would vary depending on the weight of the faller. Obviously the net could be raised to ensure that the fall is 1.0 m regardless of weight but that may not be the only issue. The intended mesh size is 100 mm, however, it may be possible for a foot to force its way through (if the faller was vertical). Depending on the age of the faller, the point of arrest could be the thigh or crotch. The point of impact would be

considerably greater than 1.0 m. It might even be possible for a faller to make contact with the net with their feet and the net skew sideways, thereby toppling the faller over the outer edge (or end) of the net. The fall from this net is certainly greater than 1.0 m.

“ . . . The structure would be a permanent ‘jungle gym’ in the back yard. This would draw children like a magnet. . . .

“However, it is not the degree of use that we are debating but the level of risk to even the occasional user by reducing the likelihood of an accidental fall.”

6.2.3 In respect of the height of fall, the applicant responded that:

“If the nets are securely fastened from each corner at a height of 750 mm below the adjacent deck level, as proposed, it is unlikely that the net would deflect more than 1 metre below the level of the deck even if the faller were unusually large. Given the diameter of the safety net rope and the close 100 mm weave it is unlikely that the rope would stretch to such an extent that the sag would be more than 250 mm. If upon installation, however, this was found to be an issue the net fixing height could easily be raised to compensate, as suggested by the Council.

“ . . . Even if [a faller’s foot passed through an opening in the mesh] the maximum height of fall would still only be 1 metre since the height of fall is from the deck level to the point of contact, which is from deck to crotch and not from deck to foot.”

6.2.4 As to the whether a faller might topple over the edge of the net, the applicant submitted that:

“ . . . it is most unlikely that the faller would topple over the edge of the net on the basis that the net extends out a distance of 1800 mm from the edge of the deck above. If the faller was, for some reason, to land closer to the edge of the net, the natural sag would still tend to throw the faller back towards the centre of the net rather than over the edge. In any case the nature of the net is such that, in the unlikely event as suggested by the Council, a possible topple from the edge of the net would most likely be avoided since it would be easy for the faller to obtain a firm grasp on the safety net rope given the close 100mm mesh weave.

“If the safety net were to be used as a ‘jungle gym’ as suggested by Council and children were to crawl across it, there is unlikely to be any injury from a fall given that the ground below the safety net is sloping and characterised by dense vegetated ground cover. A fall would also be unlikely, again on the basis of the ease of obtaining a grasp on the . . . ropes.”

## **7 DISCUSSION**

### **7.1 General**

- 7.1.1 The applicant said that it relied on Determination 2001/2, which was concerned with a canopy serving much the same purpose as the safety net with which this determination is concerned.
- 7.1.2 The canopy of Determination 2001/2 was a horizontal framework of stainless steel tubes strung with a continuous stainless steel wire passing through cleats welded to the tubes at 100 mm spacings. It protected the edge of a deck beyond a parapet less than 1000 mm in height. The canopy was at the same elevation as a deck, and extended 1.5 m beyond the edge of the deck along the length of the parapet.
- 7.1.3 In Determination 2001/2, the Authority determined that the canopy “complies with clause F4 of the building code” but “has not been shown to comply with clause B2”.
- 7.1.4 The Authority recognises the relevance of Determination 2001/2, and has approached this determination on the same basis. However, there are several significant differences between the two situations, so that Determination 2001/2 does not of itself establish that the safety net complies with clause F4 of the building code for the same reasons as the canopy did.

### **7.2 Clause B2 Durability**

- 7.2.1 The Authority understands that the black polypropylene does not change colour or show other visible signs when its strength deteriorates. The Authority agrees with the territorial authority that frictional wear between the shackles and the eye-bolts is likely to remove galvanising.
- 7.2.2 The Authority was given no evidence on which it could be satisfied that normal maintenance for the nets involves their regular inspection and replacement as necessary. That is not to cast any doubts on the applicant’s intention to undertake such inspections, but to recognise that in the absence of a statutory mechanism such as a compliance schedule there can be no adequate assurance that such inspections will continue to be undertaken by future owners in 20 or 50 or more years time.
- 7.2.3 Accordingly, the Authority considers that the safety nets come within clause B2.3.1(a)(iii) because deterioration of the netting or the shackles, or both, is likely to go undetected until somebody falls onto the netting and it gives way beneath them.
- 7.2.4 Thus the safety nets are required to last for the intended life of the building. There is no suggestion that the building consent was issued on the basis that the house has a specified intended life of 50 years or less in terms of section 39 of the Building Act, so that the intended life of the building is indefinite.

7.2.5 The Authority therefore concludes that the safety net has not been shown to comply with clause B2 of the building code. The Authority offers no opinion as to whether the territorial authority would be justified in granting a waiver or modification of clause B2.

### **7.3 Clause F4 Safety from falling**

7.3.1 The applicant's submissions say that:

- (a) It is unlikely that people will be at the outer edge of the net.
- (b) It is unlikely that the net would deflect more than 1 metre below the level of the deck even if the faller were unusually large.
- (c) It is unlikely that the rope would stretch to such an extent that the sag would be more than 250 mm.
- (d) It is unlikely that a faller would topple over the edge of the net.
- (e) It would be easy for a faller to avoid toppling over the edge of the net by obtaining a firm grasp on the safety net rope.

None of those statements is supported by any objective evidence. They appear to be based on the professional judgment of the architects. The Authority recognises that professional judgment might amount to reasonable grounds for belief, but only in respect of matters with which the person making the judgment is familiar on a professional level.

7.3.2 Furthermore, the applicant's submissions are inconsistent. In one place they say, correctly, that "the building code does not concern itself with the landing surface", but in another place they say "there is unlikely to be any injury from a fall given that the ground below the safety net is sloping and characterised by dense vegetated ground cover".

7.3.3 The territorial authority raised concerns about the height of fall, about the possibility that someone who fell onto the net might topple off it, and about the level of risk implied because the nets "would draw children like a magnet".

7.3.4 As to the necessity to consider the risk to children, the acceptable solution F4/AS1 provides that for the purposes of clause F4.3.4(f) of the building code a house is always a "location likely to be frequented by" children under 6. There appears to be nothing about this house that would justify any other approach.

7.3.5 As to the height of fall, in *Northland RC v Fletcher Construction*<sup>1</sup>, the High Court held that:

“ . . . when a person falls from a structure on to water . . . the person goes on falling until that fall is arrested, either by buoyancy arresting the downward motion, or by striking the bottom.”

Those words related to the words “possible for a person to fall more than 1 metre” in paragraph (i) of the third Schedule to the Building Act, but the Authority takes them to apply equally to clause F4.3.1 of the building code. The Authority also takes that approach to apply to a fall onto any resilient material as well as to a fall into water.

7.3.6 The Authority considers that simple experimentation would establish the height below the deck at which the net must be fixed to ensure that when a person falls onto the net that fall is arrested before the person has fallen more than 1 m.

7.3.7 The Authority considers that the net would be difficult to walk across for a person who was on the net but not at its outer edge, and that children who did fall or jump safely onto the net would be unlikely to crawl across it then fall over the edge.

7.3.8 As for the possibility that someone who fell onto the net might then topple off it, the Authority notes, as it said in Determination 2002/4, that barriers complying with clause F4:

“ . . . are appropriate to safeguard people standing beside or moving towards [the] barrier from falling over it. They are also appropriate to safeguard people from falling through the barrier, and to restrict children from climbing over [them].”

7.3.9 The reference to people moving towards the barrier is appropriate to this case, in which there is a real possibility that people could accidentally step over the edge of the deck, or deliberately jump onto the netting as if it were a trampoline. Given that the net is 750 mm below the deck, and the outer edge of the netting is 1800 mm beyond the edge of the deck, a person running or jumping over the edge of the decking might land on the netting with sufficient forward momentum to tumble over the edge, or might even jump over the netting entirely.

7.3.10 The Authority takes the view that adults are not likely to accidentally run over the edge at any great speed, and that a safety barrier is not required to safeguard adults against the consequences of a deliberate jump.

7.3.11 However, in this case the safety barrier is required to “restrict the passage of children under 6 years of age”. The Authority considers that the design of the barrier must take account of the possibility that such children might run over the edge of the deck. In the absence of any evidence as to how fast children under 6 can run, the Authority concludes that it has no reasonable grounds on which to be satisfied that the safety net extends far enough beyond the edge of the deck to comply with clause F4.3.4(g) of the building code.

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<sup>1</sup> *Northland RC v Fletcher Construction NZ and South Pacific Ltd* 24/4/97, Tompkins J, HC Whangarei CP41/96



7.3.12 Accordingly, the Authority has not been given sufficient evidence to be satisfied that the netting extends far enough beyond the edge of the deck to comply with clause F4 of the building code.

## **8 THE AUTHORITY'S DECISION**

8.1 In accordance with section 20 of the Building Act, the Authority hereby determines that the proposed safety net:

- (a) Does not comply with clause B2 of the building code; and
- (b) Has not been shown to comply with clause F4 of the building code.

Signed for and on behalf of the Building Industry Authority on this 1st day of July 2002

W A Porteous  
Chief Executive