BRANZ

ISSUE 520 BULLETIN

Conservatories

February 2010

- Conservatories added to existing buildings must comply with Building Code performance requirements and may require a specific building consent.
- Conservatories must be carefully located and constructed to address structural connections, the potential for leaks, glazing safety, very high interior day-time temperatures and night-time heat loss.
- This Bulletin replaces Bulletin 340 of the same name.

1.0 INTRODUCTION

1.0.1 A conservatory is a glazed, enclosed space attached to a dwelling. Its use as an extension to the house distinguishes it from a horticultural greenhouse.

1.0.2 A conservatory can provide the opportunity to enjoy outdoor living without the disadvantages of wind and rain, which is attractive to many homeowners.

1.0.3 Conservatories take many forms, ranging in size from extended bay windows to large rooms, sometimes enclosing a spa or swimming pool. The diversity in shape, size, use and materials has resulted in problems when important design considerations are overlooked.

1.0.4 Recommendations to minimise the risk of problems:

- Have the project carried out by a person experienced in conservatory design and construction.
- Use purpose-designed conservatory sections manufactured by a reputable firm (for aluminium, a current member of the Window Association of New Zealand) and in accordance with New Zealand standards.
- Use a specialist in conservatory installation.
- Have as much of the structure as possible factory assembled.
- Do not use a conservatory to enclose a spa or pool unless the indoor environment is specifically designed to accommodate the levels of moisture present.

1.0.5 A conservatory with an area greater than 5 m² will require a building consent. Although smaller conservatories do not require a building consent, all conservatories must comply with the relevant performance requirements of the Building Code. A building consent will also be required where the existing building is altered structurally to accommodate the conservatory design.

2.0 BUILDING CODES AND STANDARDS

2.0.1 Conservatories must be built to meet the performance requirements of the relevant New Zealand Building Code clauses.

2.0.2 Check with the building consent authority (BCA) before starting the project as it is easier to resolve any potential problems early in the design process. Most BCAs will apply relevant parts of the New Zealand Building Code (NZBC) and several related documents. The most frequently used references relating to conservatories are listed below (see 2.0.3 and 2.0.4).

2.0.3 New Zealand Building Code sections that may be applicable to conservatories include:

- B1 *Structure*
- B2 *Durability*
- E2 *External moisture*
- E3 *Internal moisture* (if the conservatory is unable to be closed off from a habitable space)
- D1 *Access routes*
- F2 *Hazardous building materials*
- F4 *Safety from falling* (where the conservatory may incorporate fall distances of 1 metre or more)
- G4 *Ventilation*
- G7 *Natural light*
- H1 *Energy efficiency*.

2.0.4 Applicable standards include:

- AS/NZS 1170 *Structural design actions* for design loadings
- NZS 4211 *Specification for performance of windows* for window performance requirements (air and water leakage, deflection of structural members under wind loading, and opening and closing vents)
- NZS 4218:2004 *Energy efficiency – Small building envelope* as modified by H1/AS1 (note that the 2009 version of this standard incorporates these changes but is not called up in the Acceptable Solution)
- NZS 4223 *Code of practice for glazing in buildings* – Part 1 for glass selection and glazing, Part 3 for human impact safety requirements and Part 4 for wind, dead, snow and live loads
- NZS 3604 *Timber framed buildings* for non-specific structural design information for foundations and floors; however, this is not directly relevant to conservatories and may result in higher design standards than are necessary.

2.0.5 Most territorial authorities will generally require an engineer's producer statement to confirm structural adequacy. Some proprietary designs may have available calculations that are acceptable.

3.0 DESIGN AND INSTALLATION

3.0.1 The following are general guidelines for design and installation of conservatories (see Figure 1).

3.1 LOCATION

3.1.1 The siting of all conservatories must comply with the territorial authority planning requirements under the Resource Management Act, which set site coverage, building height and yard requirements.

3.1.2 Space and outlook will often dictate the location of a conservatory, but it is important to consider the daily sun positions. A common complaint is excessive heat gain in summer or unwanted shading from trees or buildings in winter. A deciduous tree may provide a solution by offering welcome shade in summer and extra sunlight in winter.

3.1.3 Locating a conservatory on the east side of a building will maximise early morning heat gain when the space is cool but avoid some of the midday heat gain. Similarly, a west-facing conservatory will miss some of the midday sun but will be warmed late in the afternoon as the day cools.

3.1.4 For conservatories that extend an existing room, installing doors between the conservatory and the original space will allow closing off of the conservatory at night or when it is cold outside – see section 3.6 on energy efficiency requirements. This will reduce heating requirements for the home.

3.2 DESIGN LOADINGS

3.2.1 The design and fixing in place (floor structure, existing building) must cater for loadings caused by wind, dead weight, snow (if applicable), human impact and maintenance work, for example, replacing a damaged roof panel. Because of the light construction, wind and live loads are likely to provide the most severe loading, and seismic loadings can generally be ignored.

3.2.2 For designs to AS/NZS 1170, the 0.5 and 1.1 kN point loads required by the standard will dominate design and many plastic glazing options will not be suitable.

3.2.3 Information on appropriate structural performance criteria for conservatories is available in BRANZ Study Report 30 *Structural performance of conservatories*. (Note that this study report was written before the adoption of AS/NZS 1170.)

3.3 LIGHT AND VENTILATION TO EXISTING SPACES

3.3.1 Where a conservatory encloses windows or glazed doors of another room, the NZBC requirements for light and ventilation must be provided for by the conservatory or by other external windows to the room. Where the conservatory is an extension of an existing room with no dividing wall, only the requirement for ventilation needs to be met. Acceptable Solution G7/AS1 to the Building Code requires the total window area to be at least 10% of the total room floor area.

3.4 VENTILATION

3.4.1 The installation of permanent vents is recommended to provide sufficient continuous ventilation in conservatories to reduce heat and humidity and provide fresh air. Best results are achieved by installing a vent low in the windward wall and another high in the opposite wall of the roof. Alternatively, place inlet vents low on both end walls and an adjustable outlet in or near the roof. A range of adjustable ventilators that slot into the window sash or frame are readily available from most window manufacturers, as are roof vents. Vents have the advantage of being able to be left open without compromising security. For room-sized conservatories, a clear vent area of 16,000 mm^2 (two 200 mm x 40 mm or two 80 mm x 100 mm vents) should provide adequate background ventilation. (This is double the minimum permanent ventilation requirements for domestic habitable spaces required by Acceptable Solution G4/AS1, which requires opening windows for ventilation to be at least 5% of the total room floor area.)

3.4.2 While vents have the advantage of continuous ventilation, there is still a need to provide for rapid ventilation in hot conditions. This is achieved by being able to open doors and windows to the outside to flush out hot air. The openable window area of 5% of the floor area required by the Acceptable Solution to NZBC G4 *Ventilation* should be the minimum provided – providing more with cross ventilation optimised is recommended, as north and west facing conservatories can become very hot.

3.5 SAFETY FROM FALLING

3.5.1 Opening sashes installed to provide ventilation, vertical fixed glazing and doors opening out onto decks may need to be designed to meet the safety from falling requirements of Building Code clause F4 *Safety from falling*, which states: "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."

3.5.2 For opening windows where the possible height of fall is more than 1 m measured from the inside floor level adjacent to the window, F4/AS1 specifies that the opening sashes comply with paragraphs 2.1.1–2.1.4 of the Acceptable Solution.

3.6 ENERGY EFFICIENCY

3.6.1 Fully glazed conservatories lose heat readily, even if double glazed.

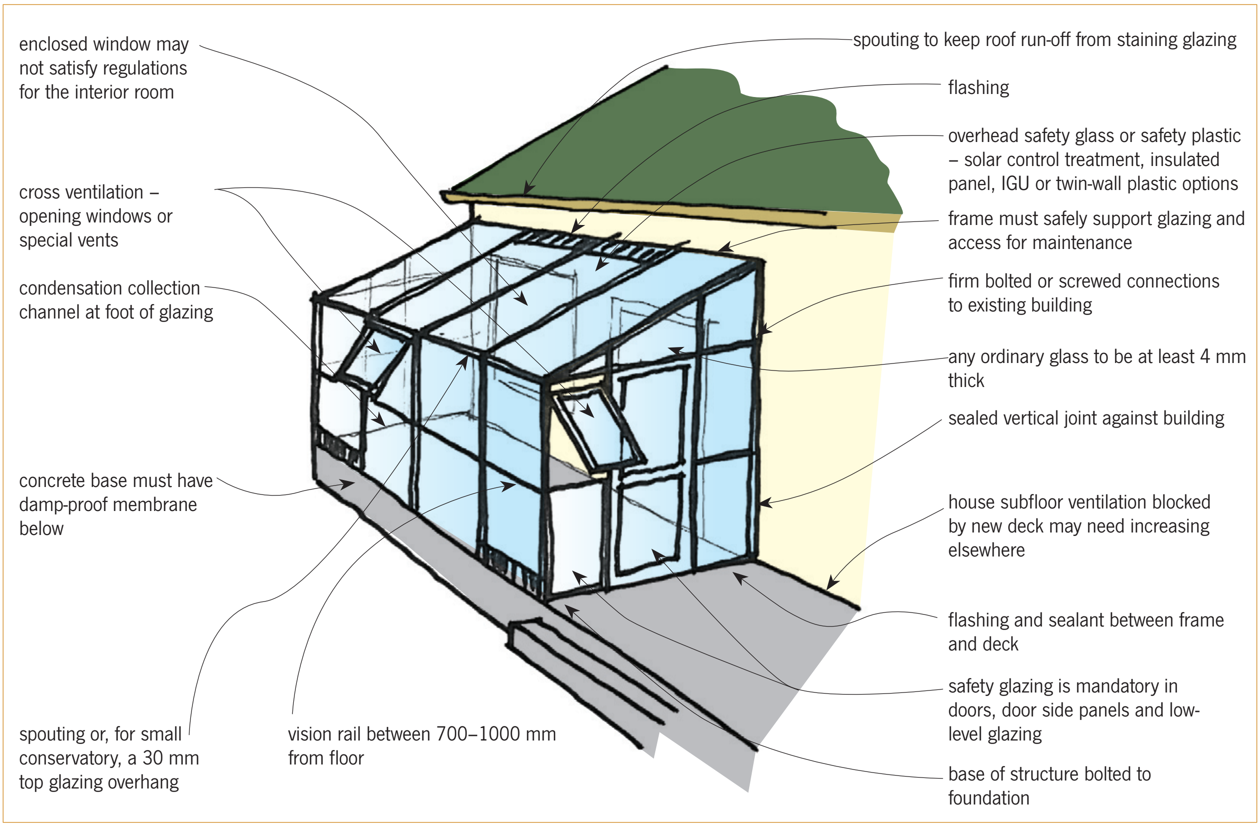

Figure 1: Design recommendations for conservatories.

3.6.2 Where a conservatory space in a new building is designed to be outside the thermal envelope of the building – that is, the adjacent spaces can be closed off from the conservatory and any walls, doors and windows between the two spaces meet the insulation requirements of Building Code clause H1 – no specific thermal performance requirements apply to the conservatory. If the conservatory space is not separate from adjacent spaces, the conservatory must be considered as part of the thermal design of the building, which makes achieving the requirements of clause H1 more difficult due to the heat loss that will occur from the conservatory, even if double glazed.

3.6.3 For a conservatory added to an existing building, the thermal performance of the building must not be made any worse by the addition of the conservatory. As with new buildings, if the conservatory is simply attached to the existing building with no alteration to that building (for example, access to the conservatory is through existing doors), no specific energy efficiency requirements apply to either the existing building or the conservatory. However, if the existing building is modified so that the conservatory forms part of the thermal envelope, the thermal performance of the building will need to be upgraded to be no worse than it was before the conservatory was added.

3.7 FLOORS

3.7.1 An exposed concrete or tiled concrete floor provides thermal mass and the ability to store heat then reradiate it to the space when the conservatory cools.

3.7.2 Concrete floors on the ground must have a concrete underlay (see Acceptable Solution E2/AS1 for requirements) to prevent moisture from the ground being absorbed into the concrete. Options for damp-proofing existing concrete slabs (such as an existing patio where no underlay was installed):

- Lay a damp-proof membrane or concrete underlay on the existing slab and install a new concrete topping at least 75 mm thick.
- If space is not available to accommodate new concrete, apply a proprietary water-based epoxy coating to the concrete.

3.7.3 To avoid problems of dampness and of vinyl flooring material lifting, do not lay floor coverings or tiled finishes until the concrete is dry. This could be 2–6 months after pouring. BRANZ Bulletins 329 *Thin flooring (1) materials and maintenance* and 513 *Timber composite overlay flooring* describe a flooring hygrometer test for estimating the dryness of concrete floors.

3.7.4 Suspended timber-framed floors should have minimum subfloor ventilation (E2/AS1) of 3,500 mm² for every 1.0 m² of floor area, spaced evenly around the perimeter. Conservatories erected against a building with a suspended timber floor must not block the subfloor ventilation to the existing building. Covering the ground with polyethylene sheet is acceptable where subfloor ventilation levels are less than the minimum required for suspended floors.

3.7.5 Timber strip floors are not recommended for conservatories because of problems of summer shrinkage and winter swelling of the timber.

3.8 WALL BRACING TO EXISTING BUILDINGS

3.8.1 Where the whole or part of a wall in an existing building is removed (for which a building consent will be required), ensure the bracing of the existing structure is not compromised. If bracing is removed, new bracing will have to be added elsewhere to maintain the integrity of the structure.

3.9 SHADING AND TEMPERATURE CONTROL

3.9.1 In strong sunlight, ventilation alone may not be sufficient to keep the temperature within the conservatory at a comfortable level. Options to control solar gain through the roof include using high performance tinted or reflective solar control glass, metal skin insulated panels in the roof or installing adjustable external blinds or covers. If this is not practical, interior blinds are an alternative but not as effective. They should be light in colour to reflect the heat, but such blinds can create thermal stress problems with some glass types. Another option is to eliminate roof glazing or use partial glazing only (such as a skylight).

3.9.2 Designers should advise homeowners to choose furnishings that do not fade or deteriorate in strong sunlight. However, laminated and reflective coated solar control glass can also reduce fading.

3.10 STORMWATER DISPOSAL

3.10.1 Generally, the control of stormwater should be to the standard required for any residential building, by using spouting and downpipes to a stormwater disposal system. Uncontrolled stormwater can cause leaks and unnecessary staining of glass. Specialist aluminium conservatory systems usually incorporate a gutter as a standard item. In small conservatories (bay window type), the spouting can be omitted, but the roof glazing should extend a minimum of 30 mm beyond the vertical window face to reduce the amount of water running down the glazed wall.

3.11 CONDENSATION

3.11.1 Because single glazing retains very little heat, condensation readily occurs when external temperatures are colder than the interior (the glass and/or frame is colder than the dew point temperature of the air). The situation is worse in an occupied conservatory or if moist warm air from the adjoining room (particularly if it contains a spa pool) is free to enter. Condensation is usually worse on the roof.

3.11.2 Double glazing (insulating glass units or IGUs) will reduce the amount of heat loss and the risk of condensation. However, as glass areas are relatively large, conservatories will lose heat quickly once the sun has set. Further information on double glazing is available in BRANZ Bulletin 471 *Insulating glass units*.

3.11.3 Specifying high performance IGUs with low-E glass and/or argon gas and/or insulated panel roofing (polystyrene sandwiched between sheets of prefinished metal or a twin-wall plastic) to the roof is likely to reduce condensation risk.

3.11.4 Ensure the design of the roof edge allows moisture running down the underside of the roof to drain to the outside. If it meets an obstruction, it will drip to the floor.

3.11.5 To assist in managing condensation, keep the conservatory well ventilated and close doors or windows between the conservatory and other rooms in cold weather. To deal with condensation that does occur, provide condensation trays or channels at the foot of glazed walls. Draining the

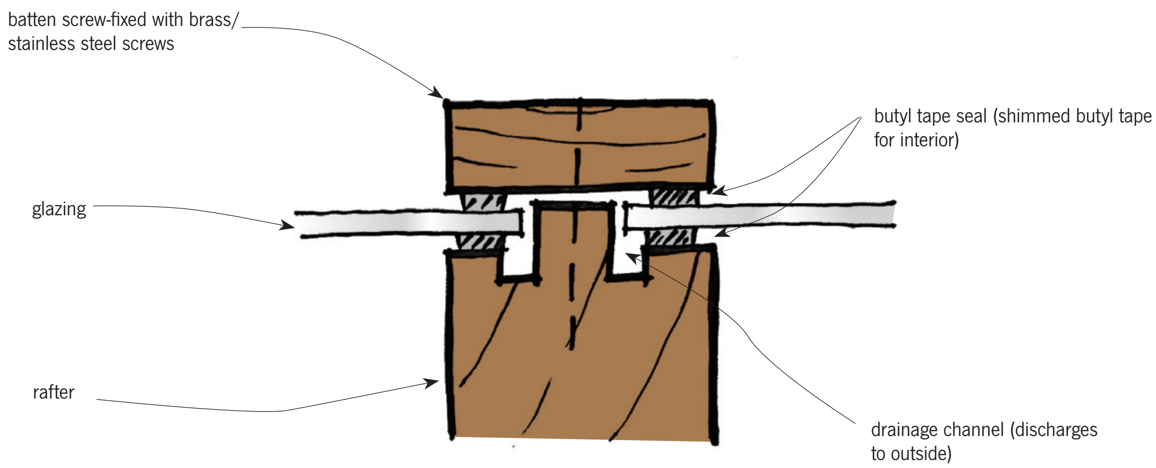

Figure 2: Roof glazing detail for timber rafters.

resultant water to the outside is preferable, but if it is left in the collection channels, it will generally evaporate when temperatures rise.

3.11.6 Do not allow condensation water to run onto the floor, particularly if the area has a particleboard floor or is carpeted, as rot and mould may occur.

3.12 LEAKS

3.12.1 The most common complaint of conservatory owners is leaks from inadequate weatherproofing. Leaks occur mainly:

- between the conservatory and the structure to which it is attached
- around the glazing, particularly the roof.

3.12.2 Leaks at the building junction can be eliminated by using flashings with adequate cover for the wind zone and adequate roof slope. For an aluminium conservatory, use purpose-made extrusions where it connects to an existing building.

3.12.3 Where the conservatory is fitted against the existing cladding, the detail used to prevent water migrating between the conservatory and the cladding will depend on the existing cladding. Ensure that the flashing at the junction of the conservatory roof and the house wall is inserted behind the wall underlay and not just the weatherboards. Unless this junction is tucked in under a roof overhang or behind a fascia board, wind-driven rain can enter between upper board laps and will then run down the building paper onto the conservatory roof rather than into the living space.

3.12.4 Conservatory detailing must prevent wind-driven water being forced in between frame and base. Where the conservatory is built over an existing concrete deck, consider constructing a new floor 25 to 50 mm above the exterior deck level. Embedding a metal flashing in a saw cut in the concrete around the wall perimeter is an effective alternative solution. At a minimum, apply a bead of sealant for the full length of the joint between the concrete base and bottom section of the conservatory frame.

3.12.5 Leaks around glazing may result from thermal expansion and contraction (greater for plastics than glass) with temperature changes, poorly designed fixings or inadequate sealing of frame joints. The problem is greater in lightly constructed frames that move under wind loads. Such faults can be avoided with careful design detailing and installation.

3.12.6 Roof glazing that is fitted directly into timber roof framing requires careful design of the waterproofing details at joints so that the roof will not leak (see Figure 2). One design option is to use an aluminium glazing bar directly above the timber rafter at junctions in the roof cladding. (The aluminium is not visible from the inside, thus maintaining the timber appearance.) Timber battens can be used to cover the joints but leaking can occur if the timber warps.

3.12.7 Sealants are not a substitute for flashings. However, they are a valuable supplement in weatherproofing joints, provided the correct sealant is used and the manufacturer's recommendations are followed. Further information on sealants is available in BRANZ Bulletin 441 *Sealed joints in external claddings (2) sealants*.

4.0 FRAMING MATERIALS

4.0.1 Aluminium is the most common material used for conservatories incorporating purpose-designed conservatory sections or suites. Aluminium is available in anodised or powder-coated finishes to give a wide range of colour options.

4.0.2 Durable and stable timber such as cedar or redwood can be used for conservatory construction. Finish options for timber are:

- paint
- stain or clear finish
- unfinished.

5.0 GLAZING

5.0.1 Many types and thicknesses of glass and glazing plastics are available. The individual choice will depend on the circumstances and requirements of each conservatory, by taking into account:

- wind loading
- live loads (maintenance)
- pane size
- frame type
- location within the structure
- solar control requirements
- human impact safety requirements
- visibility of the glazing.

5.0.2 In all cases, safety and the effects of exposure to high winds should be priority considerations.

5.0.3 Design each conservatory according to the human impact safety requirements of NZS 4223 Part 3. Safety glazing material (laminated or toughened glass, or safety plastic) is mandatory for:

- overhead glazing (for glass, laminated glass is preferable because of its penetration resistance)
- hinged doors where the area of glass is more than 0.5 m^2
- full-height glass side panels to doors wider than 500 mm
- sliding doors that do not have a mid or vision rail (transom)
- designs incorporating low-level glazing, window seats, unimpeded paths of travel and differences in level at the line of the glazing.

5.0.4 BRANZ considers it prudent to:

- specify Grade A safety glass generally – if annealed (ordinary) glass is used, have a minimum thickness of 4 mm unless 5 mm or thicker is required by NZS 4223 Part 3
- use safety glazing material for at least the first metre above floor level, where the room is subject to a lot of human traffic or for glazing exposed to external threat, such as projectiles from lawnmowers
- install vision rails (transoms) on vertical panels at between 700 mm and 1000 mm above floor level.
- install vision strips (marking) as a warning on vertical panels that can be mistaken for an unimpeded path of travel.

5.0.5 Wired glass should not be used. Although it does control glass fall-out when damaged, it has only half the strength of ordinary annealed glass of the same thickness and is more prone to thermal fracture.

5.0.6 When using double glazing (IGUs), ensure the correct glass is selected for both the inner and outer layers. Refer to AS/NZS 4666 *Insulating glass units*.

5.1 GLASS

5.1.1 Glass is a durable material that maintains its appearance indefinitely if cleaned regularly. It is the most popular glazing for conservatories.

5.1.2 Using tinted and reflective solar control glass, low-E glass and safety glass in appropriate places allows considerable flexibility in satisfying specific requirements. Further information on solar control glass is available in BRANZ Bulletin 450 *Solar-control glass selection and installation*.

5.1.3 Apart from accidental damage, the main damage to conservatory glass is mechanical stress cracking. Providing clearance between the glass and frame along all edges allows for movement. A tight fit in the frame will cause stress on the glass and cracking when the structure moves as a result of thermal expansion or wind loadings. Cracking will also occur if edges come in contact with raised objects such as rivets or screw heads.

5.1.4 Thermal stress cracking can also occur with some glass types. The chances of stress-induced cracking in glass are increased significantly in solar control glasses and if the glass edges are not clean cut and contain chips or flaws.

5.1.5 Mechanical and thermal stress cracks normally only occur on annealed and laminated glass and can be avoided by using toughened glass.

5.2 PLASTICS

5.2.1 Plastics suitable for glazing are acrylic, polycarbonate (PC), polyvinyl chloride (PVC) and glass-fibre reinforced polyester (GRP). GRP is translucent; the others can be provided in either transparent or translucent sheets. Safety plastic is material that has been tested to and passed the impact resistance, weathering and ageing requirements of AS/NZS 2208.

5.2.2 Some acrylics and PC sheets are produced in multiple-skin cellular construction, making them much stiffer than solid sheets of similar weight. The air space also provides some thermal insulation.

5.2.3 The benefits of plastic glazing compared to glass are:

- lighter weight
- greater impact resistance
- the ability to bend to curved profiles on site
- the absence of dangerous shards (if safety plastics)
- lower cost than some suitable glass alternatives
- lower heat transmittance.

5.2.4 Drawbacks of plastic glazing compared to glass are:

- lower resistance to scratching
- lower resistance to weathering – if the appearance is important, replacement may be necessary within 5–20 years (depending on the type of plastic and weathering exposure) due to discolouration
- damage to polycarbonate sheets by alkalis and bird droppings
- discolouration of PVC sheets caused by localised heat absorption, such as over supporting battens
- moisture entry and green algal growth in the cells of poorly end-sealed hollow core sheets (sheet ends must be well sealed to prevent moisture entry)
- distortion or removal (by wind suction) because the sheets are flexible – sheets can be bent and/or sucked out by strong winds if the glazing supports are too widely spaced or edge cover is insufficient
- greater expansion and contraction (fixing details must allow for movement)
- occurrence of solvent stress cracking if glazing wedges and sealants are incompatible with the plastic – avoid using PVC glazing wedges with polycarbonate
- inability to cope with maintenance live loads (point loads).

5.2.5 Further information is available in BRANZ Bulletin 322 *Glazing plastics (1) types and durability*.

6.0 MAINTENANCE CONSIDERATIONS

6.0.1 Designs must cater for the expected maintenance requirements of both the conservatory and any building to which it is attached, particularly live loads impacting on the framing and the glazing where roof access is required for maintenance.

6.0.2 Replacing glass or seals, painting the frames and the wall of the main building and cleaning the glass are all likely to be needed at some stage. Ease of access and sufficient frame strength to carry maintenance loads are essential.

6.0.3 Both glass and aluminium frames can be permanently damaged by staining and etching from dirt carried by wind or rainwater run-off from other parts of the building (particularly from new brickwork). Salt deposits from coastal atmospheres can be particularly damaging to frames and glass. Wash glazing and aluminium frames monthly with ample clean water and dry with a squeegee if possible. Further information is available in BRANZ Bulletin 337 *Protecting window glass from surface damage*.

6.0.4 Some frames are designed for lightweight plastics and may not be suitable for replacement with glass.

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ISSN 1170-8395