



**TS 04940:1.0**  
T MU SS 70001 ST  
**Standard**

# **Foundations and Tie-Downs for Portable Buildings**

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1.0	22 July 2015	First issue as T MU SS 70001 ST
1.0	17 July 2025	First issue as TS 04940, superseding T MU SS 70001 ST, version numbering recommenced in line with new designation. Updated onto new template, changes from the previous version include updating of references to meet the TfNSW operational model.

## Preface

This standard supersedes T MU SS 70001 ST *Foundations and Tie-Downs for Portable Buildings*, version 1.0 and is a first issue as TS 04940.

This document sets the minimum requirements for foundations, tie-downs and substructure elements for portable buildings within the TfNSW transport network.

The intention of this document is to define the performance outcomes to be achieved across asset life cycles.

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# 1 Scope

This standard sets out the minimum requirements for foundations, tie-downs and substructure elements for new portable buildings within the TfNSW transport network.

The scope of this document is limited to the substructure of portable buildings only. This document does not cover the design of portable building superstructures, which are generally proprietary products.

# 2 Application

This document applies to all personnel involved in the life cycle of foundations for portable buildings. TAOs are responsible for the design, erection, inspection, and dismantling of portable buildings and their substructures.

The requirements of this document apply to all new portable building substructures, and upgrades or alterations to existing portable building substructures from the date of issue.

This document is a supplement to relevant Australian and TfNSW standards, and should be read in conjunction with those standards.

# 3 Referenced documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

## **Australian standards**

*AS 1170.4 Structural design actions – Part 4: Earthquake actions in Australia*

*AS 1726 Geotechnical site investigations*

*AS 2159 Piling – Design and installation*

*AS 2321 Short-link chain for lifting purposes*

*AS 2870 Residential slabs and footings*

*AS 3600 Concrete structures*

*AS 4100 Steel structures*

*AS 4678 Earth-retaining structures*

*AS 4797 Stainless steel chain for lifting purposes*

*AS/NZS 1170.0 Structural design actions – Part 0: General principles*

*AS/NZS 1170.1 Structural design actions – Part 1: Permanent, imposed and other actions*

*AS/NZS 1170.2 Structural design actions – Part 2: Wind actions*

AS/NZS 1170.3 *Structural design actions – Part 3: Snow and ice actions*

#### **Transport for NSW standards**

TS 01506.1 *Development of Technical Maintenance Plans – Part 1: Development Process*

TS 01658 (T HR CI 12003 ST) *Civil Infrastructure Construction*

TS 03500 (ESC 215) *Transit Space*

#### **Legislation**

*Environmental Planning and Assessment Act 1979* (NSW)

*Work Health and Safety Act 2011* (NSW)

#### **Other referenced documents**

Australian Building Codes Board, *National Construction Code*

## **4 Terms, definitions and abbreviations**

The following terms, definitions and abbreviations apply in this document.

**NCC** National Construction Code

**portable building** a building designed and built to be movable rather than permanently located

**TAO** Technically Assured Organisation

**TfNSW** Transport for NSW

## **5 General requirements for foundations and tie-downs for portable buildings**

All portable building foundations, tie-downs and substructure elements shall be designed in accordance with the requirements of this document and Australian standards as specified in this document. Additional requirements for portable building foundations are set out in the NCC.

Construction materials for foundations, foundation tie-downs, superstructure ties to foundation piers, connectors, bracings and all other substructure elements shall be made of steel or reinforced concrete.

The installation of portable buildings within the rail corridor shall comply with horizontal and vertical clearances outlined in TS 03500.

A service search shall be undertaken prior to any works taking place. Foundations and tie-downs shall be designed in such a way that they are clear from all underground services, and the integrity of those services is unaffected by them.

Where existing portable building substructures do not comply with this document, an assessment to identify the risks of non-compliance and appropriate action shall be taken.

## 6 Environmental requirements

The design and location of portable building substructures shall take into account environmental impacts over the whole life cycle, including the construction, operation, maintenance, and demolition phases, with a view to minimise such impacts. The design and location shall take into account sustainability initiatives, such as energy conservation through passive design, sustainable material selection and water conservation. Additional requirements are set out in the *Environmental Planning and Assessment Act 1979*.

## 7 Safety requirements

Requirements for the design, construction, operation, and demolition of portable building substructures are set out in the *Work Health and Safety Act 2011*. In addition, requirements for the safe design and construction of all portable building substructures are set out in the NCC.

## 8 Foundation design requirements

### 8.1 General requirements

The foundation design shall be carried out by a TAO that has considerable knowledge of soil and substructure interaction, and of the related structural design procedures, using limit state design principles in accordance with Australian standards for the building classification. Building classification requirements are set out in the NCC.

### 8.2 Site investigation

A geotechnical investigation of the proposed site shall be carried out, prior to the commencement of any foundation design, by a TAO in accordance with AS 1726. A geotechnical investigation shall be undertaken to enable an accurate profiling of the subsurface condition. The depth of the investigation shall be undertaken beyond the depth of influence of the proposed foundation system.

### 8.3 Foundation design standards

The foundation design shall comply with the following standards:

- AS 2159
- AS 2870
- AS 3600
- AS 4678
- AS/NZS 1170.1.

AS 2870 is applicable for the design of foundations for certain types of non-residential buildings, and allows for the modification of standard designs using engineering principles.

## 8.4 Design life

The design life of the building foundation shall be 50 years.

## 8.5 Foundation depth, uplift and stability

Foundations shall be erected at an adequate depth below the natural ground level to avoid any topsoil layers where shrinkage or heave of the soil is a problem. The depth of the foundation shall be determined by a TAO.

If uplift is anticipated at the base of the building, suitable tie-downs, kentledges, ground anchors or friction piles shall be provided to ensure stability. Pile foundations shall be designed in accordance with AS 2159. Modes of failure, such as cone failure and bond failure, shall be taken into account for foundations that are subject to uplifting forces.

Interference between adjacent foundations in terms of load settlement behaviour and ultimate bearing capacity shall be taken into account in the design of foundations.

Adequate resistance to sliding, overturning, uplifting and stability shall be provided in accordance with AS 2870.

## 8.6 Ground anchors

Ground anchors shall be designed in accordance with AS 4678.

Anchor installation shall be in accordance with the manufacturer's specifications and guidelines, and TS 01658.

## 8.7 Sloping grounds

Where possible, foundation bases shall be erected on level ground. However, if this is not practicable and the foundation base needs to be erected on sloping ground, then steps shall be cut into the sloping ground.

The foundation shall have full and even contact with the ground. Any depression shall be filled with compacted granular materials.

The bearing capacity of foundations on a step shall be reduced, depending on the slope of the surrounding ground. This reduction shall be allowed for in the design. A geotechnical engineer shall take into account slope stability issues as part of the design process.

All slopes shall be reinstated and protected from any soil erosion to ensure long-term stability after completion of the foundation works or after any demolition of the portable building substructures.

## 8.8 Design information

Construction drawings shall include the following design information:

- foundation loads on erection drawings, including vertical compression loads, uplift forces, and lateral loads
- typical methods of transferring the loads to the ground
- the estimated depths of soil layers
- the types of foundation materials, including soil and rock names, class of rock, ultimate bearing capacities, and the geotechnical strength reduction factors that correspond to each layer.

## 8.9 Site drainage

All stormwater drainage design shall be carried out by a TAO. Flooding can reduce the load-bearing capacity of the ground or wash away the ground from under the foundations. Where possible, sites for portable buildings shall not be subject to flooding. However, if this is not practicable, a suitably deep foundation shall be designed to prevent the foundation from being undermined from flooding and scouring.

Rainwater pipes from the roof of portable buildings shall be connected to approved stormwater outlets to prevent any water ponding, flooding or scoring at the foundation level. Clearances from relevant authorities shall be obtained prior to the foundation design and connection to stormwater outlets.

Stormwater run-offs from the site, including during the earthworks and construction phases, shall not discharge into the rail corridor.

# 9 Structural design requirements

## 9.1 General requirements

Structural design shall be carried out by a TAO using limit state design principles and Australian standards. Additional requirements are set out in the NCC.

## 9.2 Structural design standards

The structural design shall comply with the following standards:

- AS/NZS 1170.0
- AS/NZS 1170.1
- AS/NZS 1170.2

- AS/NZS 1170.3
- AS 1170.4
- AS 2870
- AS 3600
- AS 4100.

## 9.3 Materials, minimum strengths and grades

All substructure elements, including plinths, footings, piers, piles, ground anchors, bracket connections, bolts, steel straps, chains and bracings shall be made of steel or reinforced concrete.

Structural steel shall meet the following requirements in accordance with AS 4100:

- minimum structural steel grade of 300
- minimum bolt grade of 4.6
- minimum nominal tensile strength of weld metal of 430 MPa.

Structural reinforced concrete shall meet the following requirements in accordance with AS 3600:

- minimum characteristic compressive strength of concrete of 25 MPa
- minimum reinforcement grade of R250N for plain bars and D500N for deformed bars.

### 9.3.1 Chains

If structural chains are proposed as tie-downs, they shall be designed and detailed by a TAO in accordance with the requirements of AS 2321 or AS 4797.

## 9.4 Loadings

All portable building foundations and substructure elements shall be designed to safely resist all possible design actions, in accordance with the following standards (additional requirements are set out in the NCC):

- AS/NZS 1170.0
- AS/NZS 1170.1
- AS/NZS 1170.2
- AS/NZS 1170.3
- AS 1170.4.

The design actions shall also include notional horizontal loads. Notional loads are intended to take account of the geometrical imperfections of the columns, such as lack of alignment of piers.

Multi-storey steel structures are more sensitive to notional loads. Refer to AS 4100 for further information.

## 9.5 Structural analysis and design

When the applied loadings on portable buildings and their substructures are established, the substructure shall be analysed for all possible load cases and combinations to determine the internal member forces and foundation reactions. All substructure elements, such as transfer beams, floor to substructure connections, steel ties, piers, cross bracings and foundations shall be checked for strength and serviceability.

Loads shall be able to be transferred safely from the superstructure to substructure through satisfactory connections. As a minimum, all superstructure supports shall be positively connected to the substructure using two M20 structural bolts or an equivalent restraining. If there is any uplifting of the building due to horizontal or vertical forces, TAOs shall ensure that these forces are safely transferred from the building to the foundations.

Both the supplier of the portable buildings and the TAO responsible for portable building substructures shall liaise with one another to ensure the adequacy of the floor beams, connections and tie-downs.

The overall stability shall be examined for sliding, uplifting and overturning for the worst possible load combinations.

Raised portable buildings on upstand substructure frames shall be checked against acceptable lateral drift in accordance with AS/NZS 1170.0, AS 3600, AS 4100, as appropriate to satisfy serviceability requirements.

The robustness criteria shall be taken into account in the design of all portable building structures. See Section 9.8 for further information.

## 9.6 Wind action

Wind is a potential hazard during the erection, operation and dismantling of portable buildings.

Wind actions shall be determined in accordance with AS/NZS 1170.2. Additional requirements are set out in the NCC.

Any wind funnelling and increased wind speeds occurring between parallel structures shall be taken into account prior to design development.

As portable buildings are light compared to buildings made from traditional building materials, they can be overturned or moved from their supports due to horizontal forces, such as wind actions, if not restrained.

As portable buildings are sensitive to wind actions, any additions or modifications to portable buildings, such as the fixing of frames to mount advertising signs, shall not be carried out without prior consent from a TAO. If additions or modifications are proposed, the entire proposal and design shall be reviewed by a TAO prior to any addition or modification work.

## **9.7 Stability of raised portable buildings and multistorey portable buildings**

All raised portable buildings shall be designed for wind uplifting forces beneath the raised building, in addition to other loadings. Raised plinths or piers shall be capable of transferring the design actions safely to the foundations. If necessary, lateral and longitudinal bracings shall be added to stabilise the piers below buildings. All such bracing elements shall be designed, detailed and documented in accordance with AS 4100 or AS 3600.

All raised portable buildings undercroft spaces shall be accessible to allow for the inspection of substructure elements, and assist drainage and vermin control.

Horizontal design actions, such as wind forces acting on the building, are increased in multi-storey buildings. TAOs shall ensure that the strength, serviceability and stability of substructures are satisfactory.

## **9.8 Structural robustness**

Structural robustness is determined by the ability of a structure to withstand events such as fires, explosions and impacts without being damaged to an extent disproportionate to the original cause.

All portable buildings shall be tied to the substructure in horizontal and vertical directions. Structural robustness shall be provided in accordance with AS/NZS 1170.0.

## **9.9 Erection and dismantling of portable buildings**

To ensure adequate provision against overturning during erection, temporary strutting may be necessary. Bracings shall be arranged to provide stability at all stages of the erection and dismantling process. All temporary works shall be designed by a TAO prior to erection or dismantling of portable buildings.

## **10 Type approval of new or infrequently used products**

New or infrequently used products specified in the design of portable buildings shall be type approved. The TAO shall be satisfied that the manufacturer, constructor and maintainer understands any special requirements or practices relating to the product prior to release of the design documentation.

## **11 Inspection of new portable building substructure**

All portable building substructure elements shall be inspected by a TAO during the construction and erection of portable buildings to ensure that the substructure is constructed in accordance with the construction drawings, and to ensure that the portable building is tied down to the substructure as designed.

## **12 Risk assessment**

A risk assessment dealing with all whole-of-life risks shall be carried out by a TAO for all portable building projects as part of the design process, ensuring that all identified risks are assessed and, where possible, eliminated. All residual risks shall be listed on hand over.

## **13 Maintenance**

Technical maintenance plans shall be developed for new portable buildings and their substructures in accordance with TS 01506.1.