



Transport
for NSW

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Standard

Foundations and Tie-Downs for Portable Buildings

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Standard governance

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1.0	First issue

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Preface

The Asset Standards Authority (ASA) is an independent unit within Transport for NSW (TfNSW) and is the network design and standards authority for defined NSW transport assets.

The ASA is responsible for developing engineering governance frameworks to support industry delivery in the assurance of design, safety, integrity, construction, and commissioning of transport assets for the whole asset life cycle. In order to achieve this, the ASA effectively discharges obligations as the authority for various technical, process, and planning matters across the asset life cycle.

The ASA collaborates with industry using stakeholder engagement activities to assist in achieving its mission. These activities help align the ASA to broader government expectations of making it clearer, simpler, and more attractive to do business within the NSW transport industry, allowing the supply chain to deliver safe, efficient, and competent transport services.

The ASA develops, maintains, controls, and publishes a suite of standards and other documentation for transport assets of TfNSW. Further, the ASA ensures that these standards are performance-based to create opportunities for innovation and improve access to a broader competitive supply chain.

This standard sets the minimum requirements for foundations, tie-downs and substructure elements for portable buildings. It has been developed through consultation with stakeholders across TfNSW.

This standard is a first issue.

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1. Introduction

Securing portable buildings to the substructure and foundation is critical to the stability of portable buildings. Portable buildings that are not properly secured can be affected by strong winds, earthquakes and impacts and can become a safety risk to people inside and in close proximity to the building.

2. Purpose

The purpose of this standard is to specify the requirements for foundations and tie-downs for portable buildings.

2.1. 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 standard is limited to the substructure of portable buildings only. This does not cover the design of portable building superstructures, which are generally proprietary products.

2.2. Application

This standard applies to Transport Assets as defined in the Asset Standards Authority Charter.

This standard applies to all personnel involved in the life cycle of foundations for portable buildings. The competent persons are responsible for the design, erection, inspection, and dismantling of portable buildings and its substructures.

The requirements of this standard shall apply to all new portable building substructures and upgrades or alterations to existing portable building substructures from the date of issue. Where existing portable building substructures do not comply with this standard, an assessment is required to identify the risks of non-compliance and appropriate action shall be applied.

This standard is a supplement to relevant Australian and TfNSW standards, and shall be read in conjunction with those standards (refer to Section 3 for relevant standards).

3. Reference 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 Investigation

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 5100.2 Bridge design – Design loads

AS 5100.3 Bridge design – Foundations and soil supporting structures

AS/NZS 1170.0 Structural Design Actions – 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

EP 12 10 00 21 SP Low voltage installations Earthing

EP 12 20 00 01 SP Bonding of Overhead Wiring Structures to Rail

ESC 215 Transit Space

ESB E001 Low Voltage Electrical Standard

SPC 301 Structures Construction

T HR EL 00004 ST Buildings and Structures under Overhead Lines

T HR EL 12002 GU Electrolysis from Stray DC Current

T MU AM 01003 ST Development of Technical Maintenance Plans

Legislation

Environmental Planning and Assessment Act 1979 (NSW)

Heritage Act 1977 (NSW)

Work Health and Safety Act 2011 (NSW)

Other reference documents

Asset Standards Authority Charter

National Construction Code Series

4. Terms and definitions

The following terms and definitions apply in this document:

competent person means a person who has acquired through training, qualifications and experience the knowledge and skills to carry out the task

NCC National Construction Code

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

SFAIRP so far as is reasonably practicable

TfNSW Transport for New South Wales

Transport Assets means those assets listed in the Asset Standards Authority Charter which are vested in or owned, managed, controlled, commissioned or funded by the NSW Government, a NSW Government Agency or a Transport Agency

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 standard, the National Construction Code (NCC) and Australian standards as specified in this document.

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 ESC 215 *Transit Space*.

The specifications detailed in SPC 301 *Structures Construction* shall be incorporated in the design and construction documentation of portable buildings.

A services 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 will not affect the integrity of those services.

6. Electrical requirements

The design and siting of portable buildings shall comply with the following electrical requirements:

- T HR EL 00004 ST *Buildings and Structures Under Overhead Lines* for minimum clearance requirements to 1500 V dc overhead traction wiring and equipment
- EP12 20 00 01 SP *Bonding of Overhead Wiring Structures to Rail* and EP 12 10 00 21 SP *Low Voltage Installations Earthing* for touch potential and earthing and bonding requirements
- T HR EL 12002 GU *Electrolysis from Stray DC Current* for requirements regarding the potential effects of stray electrical currents and electrolysis in the electrified area of the rail network
- AS/NZS 3000, AS/NZS 3001 and AS/NZS 3012, as appropriate
- ESB E001 *Low Voltage Electrical Standard*

7. Environmental and heritage 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 consider sustainability initiatives, such as energy conservation through passive design, sustainable material selection and water conservation. The *Environmental Planning and Assessment Act 1979* shall be complied with.

The Heritage Act 1977 is designed to protect, maintain and manage environmental heritage in NSW, including items of archaeological significance. When changes are proposed to items that have heritage significance, the following provisions and principles apply:

- for items listed on the State Heritage Register, the provisions of the Heritage Act shall be met
- for items listed on a state agency Section 170 Heritage and Conservation Register, the principles and relevant guidelines contained within the *State Agency Heritage Guide* shall be followed

Where a portable building is proposed within a heritage listed precinct and in the vicinity of a heritage listed item, the identified significance of the heritage items shall not be compromised.

8. Safety requirements for portable buildings

The design, construction, operation and demolition of portable building substructures shall comply with the *Work Health and Safety Act 2011*. In addition, compliance to the National Construction Code (NCC) shall apply at all times with regard to the safe design and construction of all portable building structures.

The siting of portable buildings shall avoid any risk of derailment impacts, risk of the structure falling onto the track, risk of impacts from road vehicles and risk of impacts from any other source. A safety risk assessment is required to demonstrate that safety risks are eliminated or reduced so far as is reasonably practicable (SFAIRP). This could be undertaken as part of the overall risk management process required in Section 13.

9. Foundation design requirements

The foundation design shall be carried out by a competent person who has considerable knowledge of soil and structure interaction, and of the related structural design procedures using limit state design principles in accordance with the Australian standards appropriate for the building classification. The building classification shall be determined in accordance with the NCC.

9.1. Site investigation

A geotechnical investigation of the proposed site shall be carried out, prior to the commencement of any foundation design by a competent person in accordance with AS 1726 *Geotechnical Site Investigation*. 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.

9.2. Foundation design standards

The foundation design shall comply with the following standards:

- AS 2870 *Residential Slabs and Footings*
- AS 2159 *Piling – Design and installation*
- AS 4678 *Earth Retaining Structures*
- AS 5100.3 *Bridge design – Foundations and soil supporting structures (as required)*
- AS 5100.2 *Bridge Design – Design Loads (as required)*

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.

Portable building foundations that fall outside the scope of AS 2870 shall be identified by a competent person prior to carrying out any foundation design. The design of portable building foundations not covered by AS 2870 shall be carried out using AS 5100. If AS 5100.3 is used for the design of foundations, the design actions and load combinations shall be determined using the corresponding bridge standard, AS 5100.2 for consistency.

9.3. Design life

If the portable building foundations fall within the scope of AS 2870, the design life of the foundation shall be 50 years. Building foundation not within the scope of AS 2870 shall have a design life of 100 years.

9.4. Foundation depth, uplift and stability

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

If uplift is anticipated at the base of the building then suitable tie-downs, kentledges, ground anchors or friction piles shall be provided to ensure stability. All ground anchors shall be designed in accordance with AS 4678, and pile foundations in accordance with AS 2159. Modes of failure such as cone failure and bond failure shall be considered for foundations that are subject to uplifting forces.

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

Adequate resistance to sliding, overturning, uplifting and stability shall be provided in accordance with AS 2870 and AS 5100 as appropriate.

9.5. Ground anchors

Ground anchors shall be designed in accordance with AS 4678 *Earth Retaining Structures* and SPC 301. Anchor installation shall be in accordance with the manufacturer's specifications and guidelines, and SPC 301.

Ground anchors can be difficult to install accurately. This can lead to eccentricities which will give rise to bending moments in the structure or in the foundations which needs to be accounted for in the design.

9.6. Sloping ground

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 competent geotechnical engineer shall consider 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.

9.7. Design information

Construction drawings should include the following design information:

- foundation loads on erection drawings including vertical compression loads, any 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

9.8. Site drainage

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 should 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 scouring at the foundation level. Clearances from appropriate authorities shall be obtained prior to the foundation design and connection to stormwater outlets.

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

All stormwater drainage design shall be carried out by a competent person.

10. Structural design requirements

Structural design shall be carried out by a competent person using limit state design principles, the NCC and Australian standards. The classification of portable buildings shall be determined in accordance with the NCC.

The design life shall be in accordance with Section 9.3 of this standard.

10.1. Structural design standards

The structural design shall comply with the following standards:

- AS/NZS 1170.0 *Structural Design Actions – 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*
- AS 1170.4 *Structural Design Actions – Part 4: Earthquake Actions in Australia*
- AS 3600 *Concrete Structures*
- AS 4100 *Steel Structures*
- AS 2870 *Residential Slabs and Footings*
- AS 5100.2 *Bridge design* (as required)

10.2. 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

10.2.1. Chains

If structural chains are proposed as tie-downs, they shall be designed and detailed by a competent person in accordance with the requirements of AS 2321 *Short-link chain for lifting purposes* or AS 4797 *Stainless steel chain for lifting purposes* as appropriate.

10.3. Loadings

All portable building foundations and substructure elements shall be designed to safely resist all possible design actions in accordance with the NCC and the following standards:

- 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 and any dynamic loads.

Notional loads are intended to take account of the geometrical imperfections of the columns, such as lack of alignment of piers which transfer the loads from the floors to the foundations.

Multistorey steel structures are more sensitive to notional loads. Refer to AS 4100 *Steel structures* for further information.

Dynamic loads will only be significant when any crowd movement is synchronised and periodic.

10.4. Structural analysis and design

When the applied loadings on the portable buildings and its 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 M16 structural bolts or an equivalent restraining system. If there is any uplifting of the building due to horizontal forces, the designer shall ensure that these forces are safely transferred from the building to the foundations using appropriate restraints.

Both the supplier of the portable building and the designer of portable building substructure 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 up stand substructure frames shall be checked against the permissible lateral drift in accordance with AS/NZS 1170.0 *General principles*, AS 3600, AS 4100, as appropriate to satisfy serviceability requirements.

The robustness criteria shall be considered in the design of all portable building structures. See Section 10.7 for further information.

10.5. Wind action

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

Wind actions shall be determined by a competent person in accordance with AS/NZS 1170.2 *Structural Design Actions – Part 2: Wind Actions* and the NCC.

Any wind funnelling and increased wind speeds occurring between parallel structures shall be considered 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 appropriately 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 competent person. If additions or modifications are proposed, the entire proposal and design shall be reviewed by a competent person prior to any addition or modification work.

10.6. 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 as appropriate.

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 multistorey buildings. A competent person shall ensure that the strength, serviceability and stability of the substructure are satisfactory.

10.7. 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.

10.8. 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 competent person prior to erection or dismantling of all portable buildings.

11. 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 designer 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.

12. Inspection of new portable buildings

All portable building substructure elements shall be inspected by a competent person 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.

13. Risk assessment

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

14. Maintenance

Technical maintenance plans shall be developed for both new and existing portable buildings and its substructures in accordance with T MU AM 01003 ST.