0001c Design Checklist - Structure

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Table of contents

List of tables

List of figures

No table of figures entries found.

00 Design principles

0.01 Main considerations

It is a requirement to undertake the 00 PLANNING AND DESIGN/ 0001R - DESIGN REFERENCE and GLOSSARY OF TERMS information into all aspects of design, detailing and delivery when developing the content here within. Clear demonstration of adherence to these requirements is part of the services and will be called upon at key points in the project and during at the discretion of the Department of Education (DoE).

General

The structure of the building includes a complete building system that will ensure that the building elements and fabric are stable and remain in place for the useful life of the facility.

Structural design must consider both the short-term functional requirements and a realisation that schools usually have a long service life. Consequently, flexible structural solutions that allow for future adaptability to suit changing planning needs must be considered.

In general terms, framed structures with large column free internal spaces are preferable to load bearing walls.

Structural materials must be chosen from a Whole of Life (WoL) perspective using a select range of preferably sustainable materials designed to provide:

- Value for Money
- Long life span
- Low maintenance requirements
- Durability
- Serviceability and maintainability

0.02 Documents

Show clearly all member sizes and connections on the drawings.

0.03 Footings

Design of footings must consider the following:

- Reactive clay foundation will have special requirements as appropriate e.g. cut off walls, perimeter paving slabs, articulation of structures and masonry walls.
- The removal of all topsoil from under buildings, walkways and pavements. The effects of trees, both existing and to be planted as part of the works and any future planting. The Structural design drawings must state that the design allows for the effects of trees in close proximity.
- Aggressive soils - these may need special cements or protection of footings.
- All footings must be on a similar bearing stratum unless effects of differential settlement are catered for in the design.
- Presence of groundwater that may be encountered at depths for pile/pier footings.

Footings and slabs, etc. in the vicinity of sewers, pipelines etc. are to comply with the requirements of the relevant Authority

0.04 Design Loads

Permanent, Imposed and other actions shall be determined in accordance with current Australian Standards (AS) for loading unless specified here within.

The structures must be detailed so that all parts of the structure are tied together both in horizontal and vertical planes.

The design actions and loads, including values, are to be clearly indicated on the drawings.

0.05 Wind Loads

Design for wind actions shall be based on a minimum Importance Level 3. Use a higher Importance Level where required by the Building Code of Australia (BCA).

Determine the appropriate Terrain Category for the site.

The design drawings are to include details of the Terrain Category, Importance Level, Average Recurrence Interval (R), Regional Wind Speed (VR), Wind Direction Multiplier (Md) and any other design factors determined in accordance with the current ASs for wind actions.

Design for internal wind pressures as if some windows are broken with the impact of debris.

0.06 Snow Loads

State on the structural drawings the design snow load on roof, ground snow load and probability factor as determined in accordance with the current AS.

0.07 Earthquake Design

The design drawings are to include details of the values adopted for the annual probability of exceedance, probability factor, hazard factor, site sub-soil class and the Earthquake Design Category as determined in accordance with the current AS.

If unreinforced masonry is to be used as lateral force resisting elements, the whole structure is to be classified as non-ductile.

Provide adequate separation between structural frames and non-ductile (brittle) elements so that in case of movement during an earthquake, the latter do not attract shear loads unless specifically designed to do so.

0.08 Seismic and Wind Resistance

Where appropriate, tie all walls to floors/ceilings/roofs and design the latter to act as plate diaphragms to prevent collapse of walls during seismic ground movements.

Ensure parts of buildings such as window sills, window heads, ceiling system and similar elements have sufficient stability and security to remain completely in place when subjected to either earthquake or wind loading.

0.09 Thermal Effects

Take into consideration thermal effects in the design of the structure.

0.10 Mine Subsidence

Where the project is located within a Mine Subsidence Area, design the structures to comply with the requirements of the Mine Subsidence Board and submit application with plans to the Board for approval. Submit work-as-executed plans to the Board.

The effects of mining-induced ground movements must be added to those due to the normal building movements arising from foundation settlement and seasonal moisture changes of the supporting soil.

Deflections in the building structures, arising from mine subsidence are to be considered as additional to all other deflections caused by vertical and lateral loads, as well as by foundation movements caused by soil moisture variations.

Comply with the deflection criteria given in **Table 04** below for wall construction to meet mine subsidence requirements, where required.

0.11 Live Loads

Design the structures for a minimum floor live load of 3 kPa, or as specified in Table 01 or in accordance with current AS:

Table 01: Live Load capacity schedule

Location	Live Load
Wood/ metal store	10 kPa
Bulk stores, specialised unit materials store rooms, kiln area, library (all areas) and stages	7.5 kPa
Other stores, canteen, gymnasium, technology, food, preparation areas, applied studies, computer areas, visual arts, plant rooms	5kPa
Framed walkways / exterior ways	1kN concentrated load

Design free standing walls to withstand an impact load of 1kN applied laterally at the top. Assume an impact factor of 2.

Gymnasiums

Design roof structure to support basketball frames and their lifting mechanism, and wall structure to support a horizontal bar at a height of 3600mm from the floor and the associated loads.

Design at least one roof beam to support the following live loads associated with gymnastics (impact effect has been included in values):

Climbing Ropes

- 6 ropes spaced 750mm apart
- Design live loads as in Table 02.

Table 02: Designed Live Loads

	Vertical Load	Horizontal Load (any direction)
Any one rope	5 kN	1 kN
6 ropes simultaneously	2 kN	0.3 kN

Roman Rings

- 2 pairs of Roman rings
- Rings in each pair spaced 560mm apart
- Corresponding ring in each pair spaced 2300mm apart
- Load on each ring 3 kN

Critical Loading

Design the beam(s) to support the most critical combination of the above live loads located anywhere on the one beam.

0.12 Structural Deflections

For the design life of the structure ensure that the maximum deflections of structural members and their effect on finishes comply with the serviceability requirements of the structure. In the case of visual elements like facias, adopt stringent deflection criteria, considering the high visibility of the elements. In addition to meeting or exceeding the suggested serviceability limit state criteria table provided in AS/NZS 1170.0, comply with the specific deflection criteria given in Table 03.

Table 03: Deflection criteria - specific requirements:

Item	Structural element	Maximum deflection
(i)	Supporting face masonry walls	span/1000
(ii)	Supporting rendered masonry walls	span/1800
(iii)	Floors not supporting brittle elements	span/500
(iv)	Floors supporting brittle elements	limit to provide adequate serviceability of brittle elements
(v)	Stud walls under lateral loading	span/500
(vi)	Roof members under:	

Item	Structural element	Maximum deflection
	a) Dead Load	span/360
	b) Live Load	span/250
	c) Wind Load	span/150
	d) Snow Load	span/250
(vii)	Relative horizontal deflection between adjacent frames at eaves level	less than the smaller of floor to eaves height/ 250 and frame spacing/200

For members supporting walls or partition elements the relevant deflection is that which occurs after addition or attachment of walls or partition elements.

0.13 Mine Subsidence Requirements

Deflections in the building structures, arising from mine subsidence are to be considered as additional to all other deflections caused by vertical and lateral loads, as well as by foundation movements caused by soil moisture variations.

Comply with the deflection criteria given in Table 04 below for wall construction to meet mine subsidence requirements, where required.

Table 04: Deflection Criteria - Mine Subsidence Requirements

Item	Wall element	Maximum deflection
(i)	Load bearing face masonry	span/3000
(ii)	Load bearing rendered masonry	span/4000
(iii)	Non-Load bearing face masonry	span/1500
(iv)	Non-Load bearing rendered masonry	span/2000
(v)	Non-Load bearing articulated face masonry	span/500
(vi)	Non-Load bearing articulated rendered masonry	span/800
(vii)	Non-Load bearing face masonry veneer	span/300
(viii)	Non-Load bearing rendered masonry veneer	span/500
(ix)	Non-Load bearing non-masonry	span/200

The deflections in the above table are those due to mine subsidence which occur after addition or attachment of walls or partition elements.

0.14 Bushfires

Design the structures to comply with the requirements current AS for bushfire protection. Refer to the Building Code of Australia section of the Design Guide.

0.15 Building Flexibility

Position structural members considering the future flexibility of the structure. Avoid ad hoc placing of columns internally, giving preference to uniformity in layout. Design all internal walls as non-load bearing to enable future flexibility.

0.16 Building Floor Slab on Ground

If reinforced concrete is used for building floor slab on ground, other than a waffle slab, the slab shall be minimum 110mm thick and reinforced with not less than SL72 mesh at top.

Provide a thicker slab and/or heavier reinforcement where the design requires.

0.17 Bracing

The use of cladding in any form E.g. roof sheeting, wall linings etc., is not acceptable as bracing

0.18 In Ground Concrete Elements

Where aggressive soils are identified in the Geotechnical Report, pay special attention in the design of in-ground unprotected concrete elements due to high acid-sulphate content in subsoils. Use special cements, or protect concrete from direct contact with soils with membrane and the like.

0.19 Wall Stability

Show clearly on the drawings any wall stabilising columns or other elements. Identify on the drawings any walls acting as lateral force resisting

0.20 Steel

Documents

Prepare drawings for all steelworks, showing layout plans, framing elevations and sections and working details, so that normal Structural Steelwork shop drawings can be prepared and reviewed.

Bolts

All bolts (except for purlins) are to be minimum M16-8.8/S. Use larger diameter bolts as the design requires. All bolts, nuts and washers are to be hot dipped galvanised. Holding down bolts may be black steel bolts if fully encased in concrete.

Unless the design dictates otherwise all bolt holes are to be 2mm larger in diameter than the bolt for a bolt not exceeding 24mm in diameter, and not more than 3mm larger for a bolt of greater diameter.

Purlins

Bolt fixings of purlins are to be in accordance with manufacturer's details.

Do not hang any load from purlin flanges. Any suspender for ceilings & services etc. must be fixed to the web of purlins.

Provide additional purlins as required for supporting services etc.

Welds

All welds shall be shop welds. Site welding is not to be used, unless approved by the Principal.

Deflection Control

Design all steelwork, especially beams and purlins, to ensure deflections are within acceptable limits. Pay particular attention to:

- Beams and lintels carrying masonry
- Dead load and wind deflections of purlins and girts
- Sideways or deflection of all columns stabilising masonry walls
- Members restraining and carrying windows
- Members supporting accordion doors - design to resist lateral and torsional loadings in addition to vertical loads

Window Heads and Sills

Design steel support members, as required, to stabilise all window heads and sills and, where deemed necessary, the method of attachment of windows to such structure. Design similar members at other openings in walls.

Corrosion Protection

For 15 years to first maintenance nominate corrosion protection for all structural steelwork whether external or internal, in accordance with the requirements of AS 2312 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. Protect internal steelwork as for external. Determine atmospheric environment/classification for the site from AS 2312.

If the Atmospheric Corrosivity Category is either C: Medium, D: High, or E: Very High, according to AS 2312 Clause 2.3, use a galvanised system for all exposed external steelwork and those elements which are not easily accessible for future maintenance (e.g. columns in a wall). Based on this system, use further coating mass in terms of galvanising or painting to comply with the 15 years guarantee requirement, as necessary.

Select member sizes and fabrication details which safeguard against warpage and distortion.

When selecting the protection system, ensure compatibility of the primer and top-coats. Do not use products containing lead or chrome bases.

Notwithstanding any other requirements, all cold-formed steel shall be zinc coated with a minimum coating mass of 300g/sqm. Provide additional protection as the design requires.

Provide protection to steelwork directly in contact with the ground, by providing encased concrete protection or covering steelwork below ground level with tar epoxy paint.