

# Technical Directive – IPD04-01 - Fabric Shade Structures

<b>Owner</b>	Infrastructure Delivery	<b>Amended by</b>	Technical Specifications
<b>Manager</b>	Specification Services	<b>Amendment date</b>	11 December 2023
<b>Date of effect</b>	25 May 2004	<b>Reviewed by</b>	<i>Xoell Timonide</i>
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<b>Number</b>	IPD04-01	<b>Endorsed by</b>	Executive Director, Infrastructure Delivery
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## Scope

This Technical Directive is a policy which applies to all tensioned membrane structures, including fabric shade structures and structures utilising waterproof membranes, regardless of size and whether attached to other structures or as independent structures, if they are to become Northern Territory Government Assets.

The policy is applicable to all regions in the Northern Territory.

## Goal

The aim of this shade structure policy is to provide guidance to clients and assistance through the provision of technical specifications, to provide structures that;

- are aesthetically pleasing and durable,
- are properly designed and constructed,
- do not pose a risk to the public or the operators,
- do not generate high maintenance and operating costs related to dismantling in advance of episodes of high wind and subsequent re-erection, and
- do not create additional workload and responsibilities for operators during episodes of high wind.

## BAC Policy

### Refer to BAC/2014/01

Do not utilise the Building Advisory Committee (BAC) Policy No. BAC/2014/01 – Concessionary Wind Loading.

Do not use weak links.

The policy BAC/2014/01 concessions for siting requirements (setbacks) may be utilised.

## Acts, codes and standards

The shade structure shall be designed and installed in accordance with the National Construction Code (NCC), and the relevant Australian Standards.

Relevant acts, codes and standards include, but are not limited to, the following;

- *Building Act 1993* and its Regulations
- *Work Health and Safety (National Uniform Legislation) Act 2011* and its Regulations and applicable Codes of Practice
- National Construction Code (NCC)
- AS 1170 – Structural design actions
- AS 3600 – Concrete structures
- AS 2870 – Residential slabs and footings
- AS 1671 – Steel reinforcing materials
- AS 1554 – Structural steel welding
- AS 4100 – Steel structures
- AS 4174 – Synthetic shade cloth
- AS 2001 – Methods of test for textiles
- AS 1530 – Methods of fire tests on building materials, components and structures

## Definitions

Term	Definition
Class 10a Building	As defined in the National Construction Code of Australia. This is a non-habitable building not falling into any other building class.
Cyclonic region	Regions B, C, and D as defined in AS 1170.2
Design ultimate strength	The upper or lower bound of strength that has less than 5% probability of being exceeded.
Membrane	A thin and flexible sheet of fabric material
Non-cyclonic region	Wind region A4 defined in AS 1170.2
Shade cloth fabric	A knitted fabric designed for external use with a weave designed to provide a specified amount of shade.
Waterproof PVC fabric	The fabric is a composite of a woven polyester yarn coated on both sides with PVC (Poly Vinyl Chloride). The PVC provides a protective weather barrier surrounding the polyester yarns.
Shade structure	A tensioned membrane structure having the primary purpose of providing shade to an area of ground.
SWMS	Safe Work Method Statement
Tensioned membrane	A thin cloth or sheet that is held in a predetermined 2- or 3- dimensional shape, under permanent tension. The shape and the tension are interrelated and designed to safely carry the applied loads (such as wind) in a predictable manner.
Tensioned membrane structure	The total structure comprising the tensioned membrane(s), supporting structures, rigging, foundations, footings, and existing structures to which they are attached.

Table – Definitions – Technical Directive – Fabric Shade Structures	
Term	Definition
Useful life	The earliest estimated age of the membrane at which it can no longer carry its design ultimate loads.
Weak link	A connection assembly having a reliably known strength and identified by permanent marking. The estimation of strength shall take into consideration all applicable joint eccentricities under all conditions of loading, wear and tear, structural details and weaknesses, and possible load directions.

## Background

Shade structures have evolved from small triangles of shade cloth over back yard swimming pools to major structures of considerable size for commercial and institutional applications.

Previous structural failures and potential problems in larger shade structures have highlighted the need for this Department to develop a design policy and a specification for shade structures suitable for application in the Northern Territory.

The National Construction Code (NCC) does not treat shade structures differently from conventional buildings and various jurisdictions provide directives on particular requirements for shade structures in their areas.

Tensioned membrane structures can be successfully designed for cyclonic region winds and severe storm incidents, and can be designed and constructed to last, and to be maintenance free, for a substantial time.

They are highly complex and uncertain engineering structures that can require a great deal of time, knowledge and experience to design and construct successfully. They often generate significantly higher forces than conventional buildings comprised of alternative solid roof structures.

The cost of a structure is not directly proportional to the design wind velocity and the corresponding wind force. Increasing the design wind force requires a proportionally much smaller project cost increase although sometimes it will be found economical to alter the form of the structure to better carry the forces.

## Design requirements

Design structures to the following parameters:

Design and construct tensioned membrane structures in the same manner and for the same wind and other loads as conventional structures whether the structure requires building approval or not.

Design and construct the structure and rigging of all tensioned membrane structures for the same nominal useful life as conventional structures. Do not treat the structures as temporary unless they are definitely going to be demolished and disposed of at a pre-determined date in the short term future of less than one year and not including the cyclone period in cyclonic regions.

Design and construct the structure so that the useful life, routine maintenance costs and the membrane replacement frequency and cost during the life cycle of the structure is comparable to that of a conventional structure.

The design, fabrication and erection of tensioned membrane structures are highly specialised activities. For the design use Northern Territory registered engineers who can provide a Section 40 Certificate of Compliance for the design.

For the fabrication and erection utilise suitably experienced people with a demonstrated knowledge in this field.

Do not design the structures to allow for the detachment and storage of the membranes in advance of severe storms or cyclones.

Do not use weak links.

## Design and construction robustness

Design and construct fabric shade structures so that they can survive anticipated cyclonic conditions without severe damage.

The removal of shade fabric from large structures prior to cyclonic wind action is not feasible for several reasons.

The staff at institutional centres have other duties to perform during a cyclone warning period and generally they would not have the ability or resources to dismantle large areas of shade fabric.

Also the attempted removal of shade fabric in winds above 10 knots (17.5 Km/h) is considered dangerous through flogging of disconnected cables.

Tensioned membrane structures often require special equipment and procedures to dismantle and the membranes are frequently very heavy and often cannot be safely manhandled.

## Building certification

The shade structures must be designed in accordance with the Building Act 1993, the Building Code of Australia, the relevant Australian Standards, and require building certification as for other structures.

Although small, free standing shade structures with membrane area of 30 square metres or less are exempt from building approval this Department requires that they comply with the structural requirements of this policy.

## Structural design

Design tensioned membrane structures in accordance with the Australian Standard wind loading code AS/NZS 1170.2

Do not use the apparent design wind velocities and pressure coefficients implied in BAC Policy No 2014/01.

Do not use weak links.

Use the values in the **Table – Regional design wind speeds**.

<b>Table - Regional design wind speeds</b>				
<b>Average Recurrence Interval (ARI)</b>	<b>Application</b>	<b>Region C (V<sub>R</sub>) m/s</b>	<b>Region B (V<sub>R</sub>) m/s</b>	<b>Region A (V<sub>R</sub>) m/s</b>
R = 200 years	Includes, but not limited to: <ul style="list-style-type: none"> <li>• Schools,</li> <li>• NTG facilities,</li> <li>• Public Structures</li> </ul>	64	52	43

Designers must ascertain the behaviour of the structure and determine the appropriate range of lift and drag wind pressure coefficients and apply them in conjunction with the design ultimate limit state wind velocities.

Designers should consider all possible or likely construction or dismantling sequences in the structural design.

Existing or new buildings that are used to support shade structures must be checked and be able to withstand the additional loading imposed on them.

## Protective coatings to steel work

All steelwork shall be hot-dip galvanised, or otherwise primed, and painted, prime to be 75 microns inorganic zinc silicate (after blast cleaning to a class 2.5 finish).

All structural bolts, nuts, washers, turnbuckles and shackles are to be hot-dip galvanised or be of 316 stainless steel.

All steel components fixed to, or cast-in to, concrete must be hot-dip galvanised or be of 316 stainless steel.

Bases of all columns shall be coated with “Epireze 215”, extended from 100 mm above to 100 mm below slab surface. Where concrete collar is used extend coating to 100 mm above collar finished surface.

Bases of all columns surrounded by natural ground shall be encased with a reinforced concrete collar with top surface sloping away from the column and finishing not less than 100 mm above natural ground level. Concrete grade and cover to steel reinforcement in collar to be in accordance with AS 3600.

## Durability of fabric

Consider life cycle costs, design to minimise costs associated with;

- Maintenance
- Replacement of the fabric at the end of its useful life
- Susceptibility to vandalism and misuse and
- Damage from storm or cyclone-borne debris.

Good quality fabric can be expected to last from 10 to 12 years, but may be accompanied by a progressive loss of colour and strength due to UV degradation.

The seams and bindings etc. may require re-stitching after approximately 6 years.

Waterproof membranes can be expected to give a 12 to 15 year service life and the welded seams of this material should last for the life of the membrane.

## Site assembly and disassembly

Site assembly or disassembly shall only be performed by suitably qualified contractors experienced with shade structure construction or removal.

The contractor must plan the erection or dismantling sequence in stages and develop work and safety procedures prior to commencing site work. The SWMS must be provided to the Superintendent.

The contractor shall not leave the structure in an unstable state or unsafe manner at the completion of each stage during the course of erection or dismantling.

The contractor must adhere to all relevant WHS legislation.

## Technical Specifications

When producing contract documents use the technical specification worksection titled Fabric Shade Structures, which is available in the Major Building Works master using the Template Documents Online (TDO) system.

This specification should be used to specify the requirements for any tensioned membrane structure to be built as Northern Territory Government infrastructure, whether the process is managed by this Department or by others such as Department of Education. Where relevant, provide a copy of this Technical Directive and the technical specification to assist others in this process.

## Feedback

If you have any suggestions for improvement, such as additional or modified text, please contact the Manager Specification Services, e- mail to [specification.services@nt.gov.au](mailto:specification.services@nt.gov.au)

## Endorsement



David Kirkpatrick  
Executive Director  
Infrastructure Delivery

12 December 2023

~~January 2024~~