Technical Specification

Transport and Main Roads Specifications
MRTS73 Manufacture of Prestressed Concrete Members and Stressing Units

July 2017

Queensland Government

Feedback: Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

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1 Introduction

This Technical Specification applies to the manufacture of precast prestressed pre-tensioned concrete deck units, kerb units, girders (including T girders) and piles where the strands are straight for the full length of the product. This Technical Specification also applies to the supply of transverse post-tensioning units. Products with deflected strands are not covered by this Technical Specification.

Prestressed concrete noise barrier panels are to be constructed in accordance with MRTS72 *Manufacture of Precast Concrete Elements* and with Clauses 9, 10, and 12 of this Technical Specification used for prestressing operations.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications,* MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

The requirements for the manufacture of precast prestressed concrete members and stressing units include the use of suppliers and products for the items listed in Table 1 that are registered by the Department of Transport and Main Roads.

Table 1 – Items requiring use of registered suppliers and approved products

Clause	Category of Work
5	Prestressed concrete member supplier
9.2.1	Prestressing strands
9.2.2	Transverse stressing units
6.5, 9.3	Cast-in items including proprietary lifting anchors
6.5.2, 6.5.3, 13	Approved cementitious repair mortar
6.5.3, 13	Surface tolerant epoxy compound

For information regarding registered suppliers and approved products, refer to https://www.tmr.qld.gov.au/business-industry/Business-with-us/Approved-products-and-suppliers/Bridges-and-other-structures-approved-products-and-suppliers or:

Department of Transport and Main Roads
Bridge Construction Maintenance and Asset Management (BCMAM)
GPO Box 1412
Brisbane Qld 4001.

2 Definition of terms

The terms used in this Technical Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

In addition, terms listed in Table 2 are applicable to this Technical Specification.

Table 2 – Definition of terms applicable to MRTS73

Term	Definition
Applied load per anchor	The dead weight of the prestressed concrete member multiplied by the sling angle factor and the dynamic factor and divided by the number of effective lifting points used in the lift
Designer	RPEQ Engineer responsible for the design of the element
Dynamic factor	A multiplying factor to account for dynamic effects during lifting
Factor of Safety	The ultimate capacity (lower characteristic strength) of the lifting anchor divided by the applied load per anchor
Lifting anchor	A cast-in, bolted-on or otherwise attached device anchored to the unit at the lifting point, which is provided exclusively for lifting the prestressed concrete member
Lifting attachment	Lifting device used to attach a lifting anchor to the hoisting equipment
Lifting point	The designed location of a lifting device to be used for lifting a prestressed concrete member
Lift off test	A test to determine the force in a strand after stressing is complete independent of the main multi-wire stressing system
Rigging diagram	Diagram showing the method for attaching hoisting equipment to the prestressed concrete member, the required sling angles, and load sharing requirements
Sling angle factor	The factor by which the tension in a sling increases according to the included angle between the slings
Super-workable concrete (SWC)	Concrete that is able to flow and consolidate under its own weight, completely filling the formwork or bore hole even in the presence of dense reinforcement, whilst maintaining homogeneity and generally without the need for additional compaction
Working Load Limit	The maximum load which may be applied to a lifting anchor, device or attachmen.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 1012.20 (1992)	*Methods of Testing Concrete – Determination of Chloride and Sulfate in Hardened Concrete and Concrete Aggregates*
AS 1366.3 (1992)	*Rigid cellular plastics sheets for thermal insulation – Rigid cellular polystyrene – Moulded (RC/PS – M)*
AS 1379 (2007)	*Specification and Supply of Concrete*
AS 2193 (2005)	*Calibration and classification of force-measuring systems*
AS 5100 (2007)	*Bridge Design*
AS/NZS 4672.1 (2007))	*Steel prestressing materials – General Requirements*
AS/NZS 4672.2 (2007)	*Steel prestressing materials – Testing Requirements*
AS/NZS 4680 (2006)	*Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

Reference	Title
AS/NZS ISO 9001 (2008)	*Quality management Systems – Requirements*
Design Criteria	*Design Criteria for Bridges and Other Structures*
MRTS01	*Introduction to Technical Specifications*
MRTS50	*Specific Quality System Requirements*
MRTS70	*Concrete*
MRTS71	*Reinforcing Steel*
MRTS71A	*Stainless Steel Reinforcing*
MRTS72	*Manufacture of Precast Concrete Elements*
MRTS78	*Fabrication of Structural Steelwork*
Q480	*Test Method Q480 – Relaxation of Pre-stressing and Post Tensioning Material, Volume 4, Materials Testing Manual*
SMP-PC01 (BCM-P-016)	*Procedures Manual: Registration of Approved Suppliers of Precast Concrete Products*
TN45	*Technical Note 45: Treatment of Surfaces of Precast Octagonal Piles*
TN50	*Technical Note 50: Treatment of Top Surface and 'Construction Joints' on Decks Units and Girders*

4 Quality system requirements

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications.*

The Hold Points, Witness Points and Milestones applicable to this Technical Specification are summarised in Table 4.1.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestone
5.4	1. Manufacture of prestressed concrete elements		Manufacture of precast prestressed concrete elements (14 days)
5.5	2. Approval of new plant or process		Manufacturing procedures (28 days)
7.1		1. Measurement of dimensions	
7.4.9	3. Approval of alternative void or tub length dimensions		
8.2.1	4. Restraint system for void formers		
11.3	5. Approval to place concrete in the first member of each type	2. Placement of concrete	
16	6. Acceptance of Members	3. Inspection of product	

4.2 Conformance requirements

The conformance requirements which apply to work covered by this Technical Specification are summarised in Table 4.2.

Table 4.2 – Conformance requirements

Clause	Conformance requirement
7.3.6, 7.4.5	Tolerances
10.4	Stressing records
12.1, and MRTS70	Concrete
12.3	Transfer procedure
16	Acceptance

4.3 Testing frequency

The minimum testing frequency for work covered by this Technical Specification is for each member manufactured with the exception of concrete slump and strength which is as defined in MRTS70 *Concrete*.

5 Conditions for manufacture of prestressed concrete members

5.1 Specification

All prestressed concrete members shall be manufactured in accordance with the details shown on the Drawings and in accordance with this Technical Specification.

5.2 Manufacture by registered suppliers

Prestressed concrete members shall be manufactured only by a registered supplier. The requirements for registration are outlined in the document SMP-PC01. For a copy of this document, refer to the contact details in Clause 1.

To be eligible for registration as a registered supplier, a supplier shall:

a) operate a quality system certified to a minimum of AS/NZS ISO 9001; certification shall be by a JAS / ANZ accredited certifier

b) establish procedures for manufacture of prestressed concrete members, and

c) have an inspection and test plan, including Hold Points, acceptable to Transport and Main Roads for manufacturing prestressed concrete members which demonstrates compliance with this Technical Specification. The inspection and test plan shall address supply of materials.

Registration as a registered supplier of prestressed concrete members shall be reviewed at intervals varying from six months to three years depending on registration level, or earlier if unsatisfactory performance is noted.

5.3 Registration status

Information regarding registered status can be obtained from Transport and Main Roads. Refer to Clause 1.

5.4 Manufacture of prestressed concrete members

At least 14 days before manufacture is due to commence, the Contractor shall submit to the Administrator the identity and address of the proposed supplier and a copy of the program for manufacture of members. **Milestone**

All kerb units, deck units, or girders used in any one span of a structure shall be manufactured by the same supplier.

Manufacture of precast prestressed concrete elements shall not commence until approval has been granted by the Administrator. **Hold Point 1**

5.5 Manufacturing procedures

Procedures for manufacturing prestressed concrete elements, and details of stressing beds, must be included in the supplier's registration (refer Clause 5.2). Proposed new procedures or details of new beds must be submitted for inclusion in registration scope not less than 28 days prior to establishment of the process. Significant changes to procedures or beds must be likewise submitted. **Milestone**

Manufacture shall not occur until approval and registration of the new procedure or bed has been granted. **Hold Point 2**

6 Product design

6.1 Design life

The design life of all prestressed concrete members manufactured under this Technical Specification shall be 100 years in accordance with AS 5100.5 and the Design Criteria.

> This means that 95% of prestressed components shall remain in a serviceable condition with negligible maintenance for 100 years.

6.2 Design

Design of product shall be in accordance with the Design Criteria, AS 5100 and this Technical Specification. All products shall be manufactured to the details shown on the RPEQ Certified Project Drawings.

6.3 Exposure classification

The minimum exposure classification shall be B2 in accordance with AS 5100.5.

Exposure classifications shall be determined in accordance with AS 5100.5, with the exception of the following environments:

a) brackish, saltwater, and marine applications in accordance with Table 6.3(a), and

b) Potential Acid Sulphate Soil (PASS) and Acid Sulphate Soil (ASS) environments in accordance with Table 6.3(b).

Table 6.3(a) – Concrete exposure classifications for prestressed concrete members in brackish, saltwater and marine applications

Location	Chloride content of water	Exposure Classification
Brackish water permanently submerged or zones subject to repeated wetting or drying	2000 ppm to 8000 ppm	B2
Permanently submerged in marine or saltwater	Above 8000 ppm	C
Spray zones in marine or saltwater	Above 8000 ppm	C
Tidal splash zones, or zones subject to repeated wetting and drying in marine or saltwater	Above 8000 ppm	C2

1. Tidal splash zone is the zone 1 m below lowest astronomical tide (LAT) to 1 m above highest astronomical tide (HAT).
2. Spray zone is the zone from 1 m above HAT where the structure is exposed permanently to salt spray or built over the sea.
3. Soffits of bridges and other structures which are in occasional contact with saltwater shall be Exposure Classification C

Table 6.3(b) – Concrete exposure classifications for prestressed concrete members in (PASS / ASS)

SO_4 in groundwater (mg/l or ppm)	**Acidity (pH)**			
	< 3.5	**≥ 3.5 to < 4.5**	**≥ 4.5 to < 5.5**	**≥ 5.5**
< 3000	C2	C1	C	B2
≥ 3000 to < 6000	C2	C2	C	B2
≥ 6000	C2	C2	C2	C

1. Full isolation of the concrete surface exposed to the environment by either protective coating, membrane, or use of controlled backfill is also required for Exposure Classification C2.

Additional information is provided in this clause of MRTS73 *Manufacture of Prestressed Cioncrete Members and Stressing Units* as AS 5100.5 (2004) does not adequately address exposure classifications for aggressive environments including salt water environments Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS).

6.4 Cover to reinforcement

Cover to reinforcement shall be as defined in AS 5100.5 except for the following exclusions:

a) all members in Exposure Classification C2 in salt water or marine applications as defined in Table 6.3(a), 70 mm with rigid forms and intense vibration

b) piles in Exposure Classification B2 Environments, 50 mm with rigid forms and intense vibration, and

c) piles in Exposure Classifications C, C1 and C2, 70 mm with rigid forms and intense vibration.

In the case where super-workable concrete is used, intense vibration is not mandatory.

Additional information is provided in this Clause of MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units* as AS 5100.5 (2004) does not adequately address cover to reinforcement for aggressive environments including salt water environments, and Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS).

Tolerances for cover are given in Clause 7.

6.5 Provision for lifting

6.5.1 General

Each prestressed concrete member shall be provided with approved lifting points and these lift points shall be shown on the drawing. Approved lifting points shall comply with the following:

a) The designer shall be responsible for certification of the lifting points. A rigging diagram shall be shown on the drawing. The rigging diagram shall include details of the required load sharing to equalise loads between lifting points and the included angle between the slings.

b) The minimum factor of safety for the design of the lifting points for both lifting anchor and concrete pull out capacity shall be 4.0.

c) The minimum allowance for dynamic effects (dynamic factor) shall be 1.5. Higher values shall be used in the following cases:

- lifting with a crawler crane travelling on an even surface with the load suspended (1.7)
- lifting with a rubber tyred mobile crane either stationary of travelling on an even surface with the load suspended (2.0), and
- suspension of prestressed concrete members from cranes while travelling on rough or uneven ground is not permitted.

d) At precast yards only, where lifting is vertical using gantry cranes on steel rails, the allowance for dynamic effects (dynamic factor) may be reduced to 1.2. A maximum of five lifts shall be permitted.

e) Cast-in proprietary lifting anchors shall comply with Clause 9.3 and shall fail in a ductile manner as evidenced by visible distortion prior to failure.

f) Cover to reinforcement at any lifting anchor recess shall be maintained in accordance with this Technical Specification.

g) Cover to the lifting anchor is not required provided any recess is filled with an approved cementitious repair grout and:

- for piles in Exposure Class C2 stainless steel lifting anchors are used
- for kerb units and piles in all other exposure classifications, the lifting anchor shall be hot dip galvanised to AS 4680, and
- for deck units and girders lifting anchors do not need to be galvanised.

h) All proprietary lifting anchors shall be permanently marked with the safe working load limit, which shall be clearly visible when installed.

i) Lifting of product shall be in accordance with the rigging diagram utilising the number of lifting devices as set out in Clauses 6.5.2 and 6.5.3 for the relevant members.

j) Lifting anchors which are damaged shall not be used without inspection and certification by an RPEQ Engineer.

'Rough or uneven ground' refers to any ground that is not pavement in good smooth condition.

6.5.2 Piles

Lifting points shall be either strand loops or proprietary lifting anchors as shown on the Drawings. Any lifting point recesses shall be filled with an approved cementitious repair mortar (refer Clause 1) after use.

6.5.3 Decks units, kerb units, and girders

Lifting points shall be either strand loops or proprietary lifting anchors as shown on the drawings. A minimum of two separate lifting points shall be provided on each end of the member either side of the longitudinal centroid of the member as shown on the Drawings. In addition, these points shall ensure that the member can be landed at the required level during final installation. Any lifting point recesses shall be filled with an approved cementitious repair mortar (refer Clause 1) after use. Lifting anchors which protrude shall be cut off after use and coated with three coats of an approved surface tolerant epoxy (refer Clause 1) unless a cast slab is to be installed on top.

In addition to the requirements of MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units*, the following should also be considered:

a) details of any temporary bracing, tie-down or support requirements during transport or erection should also be included by the Designer

b) for design purposes it should be assumed that the products are lifted 20 times

c) it should also be noted that the Working Load Limit shown on the lifting anchor may not correspond to a Factor of Safety of 4.0 as required by MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units*; the manufacturer's specifications and the certified lifting design should always be consulted before installation of lifting anchors, and

d) allowance for falsework or any other additional temporary works are the responsibility of the contractor.

The following describes the various responsibilities concerning lifting:

a) designer – anything on the Drawing, lifting points

b) anchor Fabricator – manufacturing anchor to published Specification

c) precaster – installing anchors as per Drawings and fabricator's instructions, handling product in yard, and

d) transporter – securing elements as per Drawing.

7 Tolerances

7.1 General

Prestressed concrete members shall comply with the tolerances specified in Clauses 7.2 to 7.4 inclusive. The tolerances specified herein shall be applied to the completed work.

The supplier shall make allowance for creep and shrinkage effects taking into account effects nominated in the design and actual properties. The length and hog of the first cast units for a structure shall be measured. Adjustments shall be made to the manufacturing process if required to ensure that all subsequent units are within tolerances.

Subsequently, the length, and hog, of all units shall be measured and recorded at transfer and at 28 days.

Final acceptance of members with respect to all dimensional tolerances shall apply at 28 days from the date of manufacture. The determination of compliance of members in relation to dimensional tolerances shall be based on dimensions measured by the supplier during a period 21 to 35 days from the date of manufacture.

The measurement of dimensions for acceptance of product shall be a **Witness Point 1.**

Early delivery of units does not negate the need for 28 day dimensional checks.

7.2 Piles

7.2.1 Dimensional tolerances

Piles, and segments for spliced piles, shall be manufactured to the following dimensional tolerances:

a)	cross-sectional dimensions	± 5 mm
b)	total length	± 50 mm
c)	deviation from a straight line:	
	• less than 10 m long	10 mm
	• 10 m to 20 m long	1 mm/m, and
	• greater than 20 m long	20 mm
d)	head out of square	2 mm in width of head
e)	deviation of head from a straight edge	2 mm
f)	clear cover to reinforcement and strands	± 5 mm
g)	strand exit holes in formwork end plates	± 2 mm
h)	strand location along pile	± 5 mm
i)	splice joint locations (female)	± 2 mm, and
j)	splice joint locations (male)	± 5 mm.

7.2.2 Shoe location

The approved shoe shall be firmly bonded to the pile, within ± 10 mm of centreline and in line with the pile axis.

7.2.3 Pile head

The head form shall be flat across any diameter to within 2 mm and shall be secured in the formwork so that its maximum out-of-squareness is 2 mm in the width of the head. The method of fixing the head form shall be fully detailed in the construction procedure.

Measurements of out-of-squareness shall be made with a square of 1 m length placed along the corner folds of the steel forms.

7.3 Deck units and kerb units

7.3.1 Cross-section

At any cross-section, dimensions shall be accurate to within ± 5 mm.

7.3.2 Length

The overall length of any unit and the length from centre to centre of the bearings or locating holes at each end shall not vary by more than 0.06% from the specified length with a maximum variation of 20 mm. Centre-to-centre spacing of holes for transverse stressing bars shall not vary by more than 10 mm from the specified position as measured from the transverse centreline of the unit. The vertical position and diameter of holes for transverse stressing bars, and the position of other holes and cast-in fittings shall not vary by more than 5 mm from the specified dimensions.

Where a ferrule group or other cast-in items are required to be attached to the same element, the relative tolerance between these ferrules or cast-in items shall be ± 2 mm or as specified on the Drawings.

7.3.3 Location of strands and reinforcing steel

The following tolerances shall apply to the location of strands and steel reinforcing:

a) strand pattern plates ± 2 mm

b) cover to strands and reinforcement (includes cover to internal voids), and ± 5 mm

c) vertical / horizontal position of the strand location at any point in unit ± 5 mm.

7.3.4 Void location

Voids shall be located within:

a) ± 10 mm vertically measured from the soffit

b) ± 5 mm transversely measured from the longitudinal centreline of the unit

c) + 5 mm or – 20 mm longitudinally where a positive dimension is the void or void position being longer than specified and a negative dimension is the void or void position being shorter than specified, and

d) voids shall not be longer than 2 m.

7.3.5 Out of square

On any transverse cross-section, the adjacent faces shall not be out of square by more than 5 mm per metre or 5 mm overall, whichever is the greater.

On any longitudinal cross-section, the slope of the end face shall not deviate from that specified by more than 15 mm per metre, to a maximum of 12 mm overall.

7.3.6 Hog

The hog values of similar units of the same age, which are to be used in the same span, shall lie within a maximum range of 20 mm for units up to 20 m long and of 25 mm for units over 20 m long. The design hog, and assumptions used to calculate this hog, shall be shown on the Drawings. Any unit with a measured hog greater than the design hog plus 50%, or less than the design hog minus 50% shall be rejected. **Nonconformance**

7.3.7 End kick

The vertical alignment of the end of a deck or kerb unit measured as an offset of the top of the end of the unit versus the bottom of the end of the unit, shall be within ± 5 mm of the specified value. Where no value is specified on the drawings, it will be assumed that the end of the deck unit shall be perpendicular to a straight line joining the two bearing support points at 30 days from the date of casting.

7.3.8 Bow

At any section, the longitudinal centreline shall not deviate in the transverse direction from a straight line joining the centre points of the ends of the unit (bow) by more than the following:

a) for units up to 15 m long 10 mm

b) for units over 15 m up to 20 m long 12 mm, and

c) for units over 20 m long 17 mm.

Notwithstanding these tolerances, the dimensions and side bow of 596 mm wide deck units shall be such that each unit shall fit between two parallel vertical planes spaced 610 mm apart for units to 20 m and between two parallel vertical planes spaced 615 mm apart for units longer than 20 m. Where deck units of other widths are required, the designer shall nominate the spacing of these vertical planes.

7.3.9 Twist

With one end cross-section taken as a reference, the rotation of any cross-section shall not exceed 5 mm per metre for the edge being checked.

7.4 Girders

7.4.1 Cross-section

7.4.1.1 All girders

At any cross-section, dimensions shall be accurate to within ± 5 mm.

7.4.1.2 T girders only

The tolerance described in this clause shall take precedence over all other geometric requirements.

At any location along the length of a girder, the dimension from the theoretical centreline of the girder to the outer extreme of the top flange (including lateral bowing of the girder resulting from stressing)

shall lie within a ± 5 mm tolerance of the corresponding dimension shown in the Drawings. The theoretical centreline is defined as a line which joins the centre point at each end of the girder.

7.4.2 Length

The overall length of any girder and the length from centre to centre of the bearings at each end shall not vary by more than 0.06% from the specified length, with a maximum variation of 20 mm. The location and diameter of any transverse or vertical holes and cast-in fittings shall not vary by more than 5 mm from the specified dimensions.

Where a ferrule group or other cast-in items are required to be attached to the same element, the relative tolerance between these ferrules or cast-in items shall be ± 2 mm or as specified on the Drawings.

7.4.3 Location of strands and reinforcing steel

The following tolerances shall apply to the location of strands and steel reinforcing:

a) strand pattern plates ± 2 mm

b) cover to strands and reinforcement ± 5 mm, and

c) vertical / horizontal position of the strand location along girder ± 5 mm.

7.4.4 Out of square

On any transverse cross-section, the adjacent faces shall not be out of square by more than 5 mm per metre or 5 mm overall, whichever is the greater.

On any longitudinal cross-section, the slope of the end face shall not deviate from that specified by more than 15 mm per metre to a maximum of 12 mm overall.

7.4.5 Hog

The hog values of similar deck units and girders of the same age, which are to be used in the same span, shall lie within a maximum range of 20 mm for spans up to and including 20 metres and 25 mm for spans exceeding 20 metres.

The design hog shall be as shown on the Drawings. Any unit or girder with a measured hog greater than the design hog plus 50%, or less than the design hog minus 50%, shall be rejected.

Nonconformance

7.4.6 End kick

The vertical alignment of the end of a girder measured as an offset of the top of the end of the girder versus the bottom of the end of the girder shall be within ± 5 mm of the specified value. Where no value is specified on the drawings, it will be assumed that the end of the girder shall be perpendicular to a straight line joining the two bearing support points at 30 days from the date of casting.

7.4.7 Bow

At any section, the longitudinal centreline shall not deviate in the transverse direction from a straight line joining the centre points of the ends of the girder (bow) by more than 20 mm.

7.4.8 Twist

With one end cross-section taken as a reference, the rotation of any cross-section shall not exceed 5 mm per metre for the edge being checked.

7.4.9 Tolerances for voids or tub location

Voids or tubs in T girders are to be positioned such that the following tolerances apply:

a) cover to strands and reinforcement as per Clause 7.4.3

b) overall thickness of cross section as per Clause 7.4.1.1, and

c) lengths of voids or tubs shall be positioned such that the final dimensions are within ± 10 mm of the specified dimensions. No individual void or tub shall be longer than 5 m. Approval of alternative void or tub length dimensions shall be obtained before casting commences. **Hold Point 3**

8 Formwork (including voids)

8.1 Formwork

Formwork shall be manufactured from metal and shall be substantial enough so that it does not deflect beyond the tolerance limits during casting. Where rigid forms and intense vibration is specified, external form vibrators shall be used.

Chamfers, and other corner treatments, shall be straight and true to shape and line.

Cores for forming transverse holes in the finished work or other forming devices which would restrict longitudinal strains in the member shall be loosened so that concrete shrinkage and thermal movements are not restrained.

Where a transverse or vertical hole is shown in the concrete on the drawing, the formwork or void former shall be removed after casting. Permanent hole formers are not accepted, unless shown on the drawing.

Formwork shall be kept clean of adhering slurry so that cast surfaces are smooth. Water, excess form oil, dirt, tie wires, sawdust and other foreign matter shall be removed from the formwork prior to casting.

Seals shall be fitted to prevent loss of cement paste through joints in the formwork.

8.2 Voids

8.2.1 General

The void formers shall be positively restrained so that the applicable tolerance limits of either Clause 7.3 or 7.4 are achieved. No damage to voids shall occur during casting operations. Void formers shall not be secured to the designed product strands or surrounding reinforcement. Systems which require or rely on floatation of the void for the void to achieve its final position are not permitted.

The restraint systems for deck and kerb unit void formers shall be approved by the Administrator prior to placing the concrete. **Hold Point 4**

Precautions shall be taken to prevent occurrence of cracks over the voids.

Removable void formers for girders shall be removed carefully in a manner that does not damage or crack the girder. Methods such as the use of air pressure to release void formers or cold water or other fluid to cool the void former are not permitted.

8.2.2 Circular voids

Circular voids shall be manufactured from material approved by the Administrator. The ends shall be sealed to stop the entry of water and grout into the void.

8.2.3 Non-circular voids

Non-circular voids shall be manufactured from cellular polystyrene Grade SL to AS 1366.3.

8.3 Fillets

Internal corners and external edges of all precast concrete culverts shall be finished with curved or straight fillets appropriate to the application.

Specified cover also includes cover to fillets.

9 Steel reinforcement, stressing units and cast-in items

9.1 Normal steel reinforcement

Steel reinforcing shall comply with the requirements of MRTS71 *Reinforcing Steel* or MRTS71A *Stainless Steel Reinforcing* as applicable.

9.2 Stressing strands and units

9.2.1 Longitudinal prestressing strand

Strand used for longitudinal stressing shall be 7-wire ordinary strand compliant with AS/NZS 4672.1 and AS/NZS 4672.2, with the addition that the maximum projected relaxation loss at 10,000 days shall be 5.0% when stressed to 80% of the characteristic minimum breaking force specified in AS/NZS 4672.1. Testing for relaxation shall be in accordance with Test Method Q480. Strand shall be a registered product (refer to Clause 1) and be either of the following designations as shown on the drawings:

a) AS/NZS 4672.1 – 7-wire ordinary – 12.7 – 1870 – Relax 2, and

b) AS/NZS 4672.1 – 7-wire ordinary – 15.2 – 1750 – Relax 2.

9.2.2 Transverse stressing units

A transverse stressing unit shall consist of a stressing bar complete with necessary nuts, washers, anchor plates and couplers where shown on the Drawings. Stressing units shall be an approved product (refer Clause 1).

Unless stated otherwise on the Drawings, stressing bars shall be plain 29 mm nominal diameter with a coarse thread to AS/NZS 4672.1 and AS/NZS 4672.2 and shall have the following designation:

a) AS/NZS 4672.1 – bar – 29 – 1030 – P.

Anchor plates shall be fabricated in accordance with MRTS78 *Fabrication of Structural Steelwork* and be hot dip galvanised to AS/NZS 4680.

All components shall be supplied by the supplier of the stressing bar.

9.2.3 Test certificates for strands and stressing bars

Copies of suppliers' test certificates for the strand shall be made available by the prestressed concrete member supplier on request. Copies of test certificates for stressing bars shall be made available by the supplier on request.

All coils of strand and stressing bars shall be capable of being identified with the test certificates. Strand in members shall be able to be traced to the coil used and the relevant test certificate.

9.2.4 Testing of strand and stressing bars

In general, physical testing of strand shall not be required while satisfactory correlation (as defined in Clause 10.5.2 and 10.5.3) is obtained between the jacking force and extension during the stressing operation. If such correlation is not obtained, or if the strand exhibits any peculiarities, as referred to in AS/NZS 4672.1, the use of such strand shall cease until physical tests demonstrating compliance of the strand have been carried out at a laboratory registered by NATA.

The samples shall be tested for:

a) ultimate tensile strength

b) 0.1% proof stress

c) 0.2% proof stress

d) secant modulus of elasticity at stressing load, and

e) percentage elongation at rupture on a 600 mm gauge length.

9.2.5 Storage and cleaning

Stressing units and coils of prestressing strand shall be stored undercover, protected from the weather and shall not be placed in direct contact with the ground. Under no circumstances shall water be allowed to collect or pond in the strand coil or packaging.

Any lubricant used in the manufacture of the strand shall be thoroughly removed by a suitable degreasing agent. All loose rust shall be removed from the strand before use.

Badly rusted or pitted steel shall not be used. A very light film of rust which can be easily removed by rubbing with a finger is not considered detrimental providing that the steel is not visibly pitted.

Any foreign matter adhering to the strand, including form release agent, shall be removed before placement of concrete. The cleanliness of the strand shall be such that bond with the concrete is not impaired.

Examples of strand with unacceptable levels of corrosion

9.2.6 Straightening

Strand shall be supplied in coils large enough to be self-straightening. Kinked or damaged strand shall not be used in prestressed concrete members.

9.3 Cast-in items

Cast-in items, including, but not limited to ferrules, formwork anchors, bearing attachment plates, pile shoes, proprietary lifting anchors, and pile splices shall be either:

a) fabricated by an approved fabricator in accordance with MRTS78 *Fabrication of Structural Steelwork*, or

b) proprietary items as specified in the Drawings shall be supplied by an approved supplier, or approved equivalent.

10 Stressing

10.1 General

Prestressing operations shall be carried out only under the direction of an experienced and competent supervisor and all personnel operating the stressing equipment shall have been properly trained in its use. In addition to the normal precautions against accidents which shall be taken at all times for the whole of the works, special precautions shall be taken when working with or near strands which have been tensioned or are in the process of being tensioned.

The supplier shall have an independent RPEQ certification for each stressing bed and stressing system stating the safe capacities and eccentricities for the system.

10.2 Debounding of strands

Where sheathing of pre-tensioned strands is required to prevent bond over a specified length, it shall consist of plastic tubing or other material, of a quality, diameter and thickness such that bond shall be effectively prevented. This sheathing shall be fastened to the strand in such a manner that the efficiency of the bond-break shall not be impaired by the entry of cement mortar, and such that it shall not move along the strand during placement of concrete.

10.3 Tensioning equipment

All equipment used for verification of pre-tensioning and testing shall be calibrated in accordance with AS 2193 and shall meet the readability, repeatability and mean error requirements of Class B for the range of forces used in the pre-tensioning or testing. The maximum period between calibrations shall be as given in Clause 3.8 of AS 2193 with the maximum interval between calibrations being one year.

10.4 Stressing records

The following information relating to the prestressing operation shall be recorded:

a) identification numbers of load cells, gauges, pumps and jacks

b) identification particulars of the strands including traceability to the strand coil number

c) required overall elongation

d) calculated jacking force after allowing for all appropriate losses

e) force (or pressure) at the time strands are marked initially for measurement of elongation

f) final force applied if load cell is used, alternatively final pump or jack pressure

g) draw-in losses, bed-movement (if any), other losses

h) elongation remaining immediately after anchoring, and

i) records of lift off test values.

Stressing records shall be supplied to the Administrator within seven days after transfer.

Nonconformance

10.5 Stressing procedures

10.5.1 General

The pre-tensioning force at stressing stated in the Drawings is defined as the average force remaining in the strands, within the length of any member, immediately after release of the tensioning jacks and before concreting. The maximum variation in force between strands shall be 5% of the jacking force.

The actual tensioning force applied shall allow for any anticipated movement of the anchorage devices and friction through forms.

The method of tensioning shall ensure that the required force is evenly applied to all strands.

Strands shall not remain fully stressed for longer than 36 hours before the concrete is poured.

10.5.2 Procedure

Prior to establishing a datum mark on each strand for the purpose of measuring elongation, a known initial tension of from 15% to 30% of the jacking force shall be applied to each strand (mono-stressing) to lift it off the bed floor and to equalise sag effects. The measurement of elongation shall commence from this mark. At the completion of the initial mono-stressing, the first strands stressed shall be checked and restressed if necessary to ensure that the actual force as defined in Clause 10.5.1 remains in the strands and that no losses have occurred due to sequential bed shortening during stressing. If losses have occurred then all strands shall be rechecked in the order of stressing.

The true extension shall be considered to be the sum of the measured elongation and the calculated value of the extension obtained by application of the initial tension minus the amount of pull-in at anchorages and anchorage movements (if any).

The measured elongation shall correlate to the jacking force applied from the initial tension within an accuracy of 5%.

A uniform load shall be maintained throughout the entire length of all strands and locked off as close as possible to the pre-tensioning force at stressing stated on the Drawings as defined in Clause 10.5.1.

Under no circumstances shall the force applied to a strand exceed 80% of the minimum breaking load specified in AS/NZS 4672.1.

Elongation is to be calculated using elastic modulus of the stress / strain curve taken from the test certificate supplied with every coil of strand.

10.5.3 Measurement of tension in strands

The method of measuring the prestressing force shall always be such that the final accuracy of measurement is within ± 2%.

The prestressing force shall be determined by measuring both the elongation of the strand and the final jacking force and shall meet the requirements of Clause 10.5.1 and 10.5.2. Jacking force shall be determined by reading from the multi-wire stressing jacks or by way of lift off test.

Elongation shall be calculated on the basis of the secant modulus of the material being used.

After completion of stressing, a lift off test on the strands in the product shall be conducted to verify the tension in the strand. This test shall be conducted at the opposite end of the bed to the main stressing operation and no longer than six hours before the concrete is poured in the member. When the force in a multi-wire stressing operation is not measured during stressing, the frequency of lift off testing shall be one strand per cast per strand coil.

When the force is measured during the multi-wire stressing operation, the frequency shall be:

a) one test for one strand for the first cast of a product per strand coil, and

b) one test for one strand for each new strand coil introduced into the process thereafter.

11 Concrete

11.1 General

The manufacture, placement and surface finish of concrete shall be carried out in accordance with MRTS70 *Concrete* and Clauses 11.2 to 11.6 of this Technical Specification.

11.2 Concrete strength grade and additional concrete mix design requirements

11.2.1 Minimum concrete strength grade and aggregate size

Pre-stressed concrete members shall be manufactured from concrete with a characteristic 28 day strength of not less than 50 MPa to MRTS70 *Concrete* with the following additional requirements.

11.2.2 Maximum aggregate size

The nominal maximum aggregate size shall be 20 mm unless shown otherwise on the Drawings.

There has been some history with increased shrinkage and cracking of product with 10 mm nominal maximum aggregate mixes in larger products.

11.2.3 Additional requirements for B2 Exposure Class concrete mixes

The following requirements shall be met in addition to MRTS70 *Concrete* for B2 Exposure Class concrete mixes:

a) minimum total cementitious content and maximum water cementitious ratio to be as per MRTS70 *Concrete*

b) cementitious material to be a blend compliant with either of the following criteria with the combined total adding to 100%. Blend tolerances to be as per AS 1379:

- 65% to 75% GP cement, 25% to 35% fly ash, or
- 50% to 55% GP cement, 20% to 25% ground granulated blast furnace slag, and 25% to 30% fly ash, or
- 65% to 71% GP cement, 4% to 8% amorphous silica, and 25% to 31% fly ash.

c) maximum chloride ion content of hardened concrete to be 0.60 kg/m³.

11.2.4 Additional requirements for Exposure Class C, C1, and C2 concrete mixes

The following requirements shall be in addition to MRTS70 *Concrete* for Exposure Class C, C1, and C2 concrete mixes:

a) maximum chloride ion content of hardened concrete to be 0.40 kg/m³

b) minimum total cementitious content and maximum water cementitious ratio for C Exposure Classifications to be as per MRTS70 *Concrete*; for C1 and C2 Exposure Classifications minimum total cementitious content to be 500 kg/m³ and maximum water cementitious ratio to be 0.4

c) cementitious material to be a blend compliant with either of the following criteria with the combined total adding to 100%. Blend tolerances to be as per AS 1379:

- 50% to 55% GP cement, 20% to 25% ground granulated blast furnace slag, and 25% to 30% fly ash, or
- 65% to 71% GP cement, 4% to 8% amorphous silica, and 25% to 31% fly ash.

There is a strong evidence to demonstrate that concrete mixes containing a ternary blend of cementitious materials provide significantly enhanced durability. This is particularly critical in aggressive environments. Use of supplementary cementitious materials, such as fly ash and ground granulated blast furnace slag, also significantly decreases the environmental impacts associated with cement production and also controls Alkali Silica Reaction (ASR).

Under no circumstances, in any environment, will the use of only GP cement be considered due to the risk of ASR. Thus a blended cement is specified in all applications.

11.2.5 Determination of chloride content of hardened concrete

The following method shall be used to determine the chloride ion content by testing ground samples of hardened concrete in accordance with AS 1012.20.

a) Take the samples from a minimum 1.2 kg portion of the hardened concrete. Crush and grind the 1.2 kg of hardened concrete to a maximum size of 150 microns and then oven dry at 110 ºC ± 5 ºC for a minimum of one hour before taking the samples for analysis.

b) Analyse five randomly selected samples of 20 ± 0.1 grams of the ground concrete for chloride ion content.

c) Use the Volhard titration method calibrated against a concrete with known chloride content for the tests. Modify the procedure of AS 1012.20 and use standard solutions for the analysis that bracket the expected chloride ion concentration. Alternatively, use the AS 1012.20 XRF (X-Ray Fluorescence) method in accordance with AS 1012.20.

Report the following:

a) chloride ion content of each of the five samples

b) the average chloride content, and

c) standard deviation of the five samples.

The average mass of acid soluble chloride ion per unit volume of hardened concrete as placed must not exceed the values given in Clause 11.2.3(c) or 11.2.4(a) as appropriate.

Tests are to be undertaken by a NATA accredited laboratory, and be submitted with the mix design. Tests are to be repeated annually.

11.3 Placement

Before placement of concrete for the first member of each type, the mould set up shall be inspected. Approval to place concrete in the first member of each type for the project shall be a **Hold Point 5**. Thereafter, placement of concrete in subsequent member types shall be a mandatory hold point in the supplier's Quality Management System. The supplier shall also advise the Administrator.
Witness Point 2

11.3.1 Strand debonding

Concrete placement techniques shall ensure that the debonding material remains against the end of the form. The pour shall start at least 1 m from the end of the unit then proceed back to the end of the form. Only when this is complete shall the pour proceed along the member.

11.3.2 Elements containing voids

Voided units shall be poured in 600 mm, or half the unit depth, layers. A minimum of two internal vibrators are to be used simultaneously, one each side of the void in conjunction with the external vibrators.

In end blocks and other areas of congested reinforcing, more than two internal vibrators may be required in conjunction with external form vibrators.

11.3.3 Installation of lifting devices

Lifting anchors shall be fixed securely in place before placement and compaction of concrete. Where the lifting anchor has a recess, cover shall be maintained to the recess.

> Puddling in of lifting anchors into wet concrete is not permitted.

11.4 Curing

All piles, girders, deck units and kerb units shall be steam cured in accordance with MRTS70 *Concrete*.

In addition to meeting these requirements, the supplier must ensure the production and curing cycles are consistent from day-to-day to achieve compliance with either Clause 7.3 or 7.4 as appropriate.

Alternative methods of heat accelerated curing, such as hot water curing methods, may be used subject to the approval of the Director (Bridge Construction Maintenance and Asset Management) or delegated authority.

11.5 Prevention of cracking

As per the requirements of MRTS70 *Concrete*, the supplier shall plan and control the placing, compacting, curing and finishing operations of the concrete to prevent cracking.

11.6 Finish

11.6.1 Surface condition

The concrete shall be dense and hard and free from chipped edges, fins, protrusions and surface roughness including air holes.

Any lifting recesses in piles shall be filled with an approved cementitious repair grout (refer Clause 1) to the satisfaction of the Administrator before piles are transported from the place of manufacture.

Prestressed concrete members shall not be coated with cement wash or any other preparation not specified or otherwise approved by the Administrator.

11.6.2 Defects, dents and bulges

Prestressed concrete piles shall be free from cracks and fractures.

Prestressed concrete deck units, kerb units and girders shall have:

a) no fractures, fissures and cracks wider than 0.15 mm

b) no individual crack longer than 300 mm, and

c) a cumulative crack length of no longer than 1000 mm in any one member.

Dents not exceeding 3 mm in depth and bulges not exceeding 3 mm in height shall be permitted provided these do not extend over the surface for a distance of more than 180 mm and specified cover to reinforcement is maintained.

> The intention of MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units* is that prestressed concrete members are produced crack free. Failure to address repetitive cracking issues due to manufacturing issues will not be accepted.

11.6.3 Air holes

Air holes exceeding 12 mm in lateral dimension or having a depth greater than 3 mm shall be filled in accordance with MRTS70 *Concrete*.

The intention of MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units* is that prestressed concrete members are generally produced with very few air holes. Excessive air holes are a strong indication that suitable manufacturing processes are not being observed in the production process and are not acceptable. TN45 provides some further advice with respect to surface finish on piles and is available on the departmental website.

11.6.4 Top surfaces – exposed

Exposed surfaces and the top surface of piles shall be steel float finished.

11.6.5 Top surfaces – asphalt overlay

The top surfaces of transversely stressed deck units, and associated kerb units, where an asphalt running surface is to be applied, shall be a coarse wood float or broom finish. The coarse wood float or broom finish shall comply with TN50.

11.6.6 Top surfaces – cast-insitu concrete overlay

The top surface of deck units and girders where a cast-insitu deck is to be applied to the surface shall be a construction joint in accordance with MRTS70 *Concrete*. Some areas may be nominated to have a steel float finish as per the Drawings. Subject to the approval of the Administrator, an alternate finish to the construction joint finish may be used. This surface finish must provide an acceptable macro texture as defined in TN50.

TN50 provides further guidance and illustrations on surface finishes for decks and girders and is available on the departmental website.

12 Transfer of prestress

12.1 Strength of concrete at transfer

Transfer of prestress shall not be carried out until all the concrete has attained or exceeded the specified transfer strength as proved by appropriate test cylinders from each concrete sample, manufactured and cured for this purpose.

Members where transfer of prestress has occurred before the specified transfer strength has been achieved in all concrete samples shall be rejected by the Administrator. **Nonconformance**

12.2 Preliminary check

Prior to transfer of the prestressing force from the abutments of the casting bed to the members, strands shall be examined for tightness and the presence of any loose strand shall be reported to the Administrator. Members with loose strands may be rejected by the Administrator.

12.3 Transfer procedure

The prestress shall be transferred to the members in such a manner that all strands are released gradually and simultaneously.

Large differences of tension between the strands shall be avoided. No shock release of stress is to occur during de-tensioning operations. De-tensioning equipment used shall have adequate capacity to completely release all strands in one operation. Flame release of strands or strand by strand release by any other method is not permitted.

If the tension is released from one end only, or if there are several moulds in line, provision shall be made for the members to slide, allowing a transfer of the force all along the tensioned line.

Where there are several moulds in line, cutting strand between members shall proceed after de-tensioning and shall proceed in sequence from the de-tensioned end.

If shock release of stress occurs due to any cause, members adjacent to the shock-released strand may be rejected by the Administrator. **Nonconformance**

12.4 Precautions for delayed transfer

If de-tensioning is delayed beyond 24 hours, cooling and shrinkage of the member will increase the stress in the free strand and can cause sudden failure.

If de-tensioning is delayed beyond 24 hours after casting, precautions shall be taken to limit stresses in the free strand to a maximum of 80% of minimum breaking load by covering the member and keeping it warm, insulating forms, or partial de-tensioning based on rational engineering calculations.

13 Trimming ends of strands

After the transfer of prestress, strands shall be trimmed flush with the end of the member by power grinders. De-bonded strands shall be sealed with an approved cementitious repair mortar (refer Clause 1) prior to painting. Except for piles, the ends of the strands and the area immediately adjacent to the strands shall then be painted with three coats minimum of a registered surface tolerant epoxy compound (refer Clause 1) with each coat to provide a minimum film thickness at least 0.3 mm dry or 0.6 mm wet. Ends of strands for piles need not be painted.

14 Surface preparation for cross girders

Where shown on the Drawings, all surfaces of girders at the interface area with any cross girders to be constructed after erection shall be roughened by scabbling, sand blasting, or use of a surface retarder to achieve a construction joint finish.

An example of an acceptable construction joint finish at a cross girder.

15 Marking, handling and storage

15.1 Marking

15.1.1 Prestressed concrete piles

Each pile shall have a unique identification number, date of casting, pile mass, supplier's name and length marks clearly and permanently marked on the pile. Length marks shall be placed at 0.25 m intervals commencing at 3 m from the toe of the pile and extending to the head of the pile. Length marks shall be permanently numbered at 1 m intervals with figures 75 mm high, showing the length of the pile from the toe.

15.1.2 Prestressed concrete deck and kerb units and girders

Each deck and kerb unit and girder shall have the date of casting, unit mass, supplier's name, unique identification number and type clearly and permanently marked on both end vertical faces. In addition, each deck and kerb unit shall have the identification number and casting date scratched in the top surface immediately after casting.

Where the consistency of the concrete is such that scratches are not immediately visible markings should be made as soon as concrete will accept them.

Where the surface finish of the concrete is such that scratches are not visible approval should be sought for an alternative method.

15.2 Supplier's labels

If the supplier desires to attach advertising labels or supplier's name or logo to the members other than the end vertical faces on dispatch from the storage yard, these shall be fastened in such a way that removal of the labels at the delivery point is simple.

If these labels are firmly glued or painted on to the members and removal is difficult, the supplier shall be responsible for the removal, or alternatively shall pay for the cost of removal.

15.3 Handling, transport and storage

15.3.1 General

The method of handling and storage shall be such as to avoid the danger of fracture by impact, undue bending, twisting and whipping.

Prestressed concrete members shall be moved only while fully suspended. In no case shall they be moved by dragging across the terrain.

All quality checks shall be performed and repairs carried out prior to placing units in a stack where access to individual units cannot be gained.

No prestressed concrete member shall be transported from a supplier's yard until a minimum of seven days has elapsed from the date of casting.

15.3.2 Prestressed concrete piles

Piles shall not be lifted or handled until the destressing process is fully completed.

In general, piles shall be lifted from the mould using the lifting anchors shown on the Drawings, and then subsequently by means of a suitable bridle or sling attached to the pile at points specified below. Other methods of lifting proposed by the supplier shall be subject to the approval of the Administrator before use.

Piles shall be protected at all times so as to avoid chipping or spalling of the edges by the handling slings, support timbers or any other cause.

Piles shall be stored clear of the ground on adequate timber supports, located directly under the lifting points as shown in Figure 15.3.2(a) or 15.3.2(b) and placed on firm ground which is not liable to subsidence, when wet or dry, under the weight of the piles. Where piles are stacked in layers (maximum 3 piles high), timber supports for each layer shall be placed directly above those of the preceding layer.

For piles up to and including 23 m in length, a two-point support system with lifting points located as shown in Figure 15.3.2(a) shall be used.

For piles over 23 m in length, a four-point support system with lifting points located as shown in Figure 15.3.2(b) shall be used. These piles shall only be stored where flat, level and stable ground conditions are available. The vertical deviation from level between the four support points shall be no more than ± 10 mm from a straight line through the four points. Once piles have reached a minimum concrete compressive strength of 50 MPa and seven days have passed since casting, lifting may revert to the two-point system in Figure 15.3.2(a).

Figure 15.3.2(a) – Pile support and lifting points as a function of the pile length for piles ≤ 23 m in length

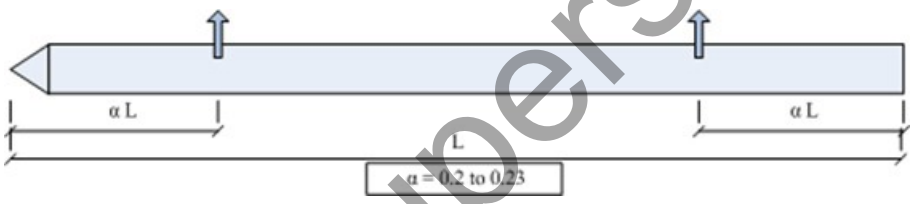
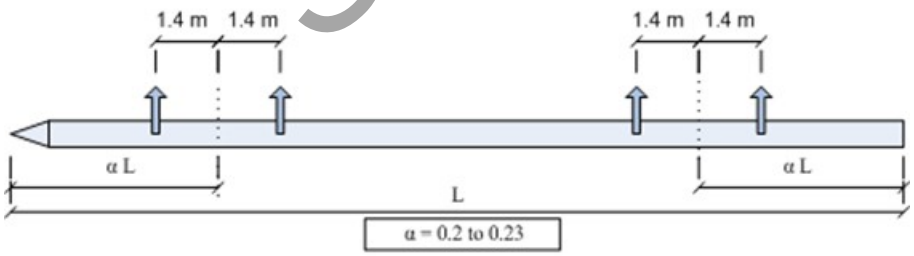


Figure 15.3.2(b) – Pile support and lifting points as a function of pile length for piles > 23 m and ≤ 28 m in length



Where the length of piles requires the use of an articulated vehicle for transport, the piles shall be supported and rigidly attached to the vehicle only at the specified lifting points.

Adequate protection shall be provided to prevent damage to the concrete by the restraints. The trailing jinker shall be connected to the prime-mover by a rigid pole which pivots at the leading end at the same point as the pile support.

Timber packers shall be used between the sides of individual piles to prevent contact between the piles during transport.

Four-point lifting is specified for piles > 23 m and ≤ 28 m to limit bending and prevent the need for cumbersome lifters.

15.3.3 Prestressed concrete deck and kerb units and girders

Prestressed concrete deck and kerb units, and girders shall be held in such a position that the top surface is uppermost at all times during handling, transport and storage. All units shall be lifted by the lifting devices incorporated in the units.

Deck units and girders shall be stacked on two supports positioned one at each end, in the case of girders immediately under each lifting device with a tolerance of plus or minus 300 mm, and, in the case of deck and kerb units, within the end distance shown in Table 15.3.3. For non-standard widths, the designer shall nominate a maximum overhang.

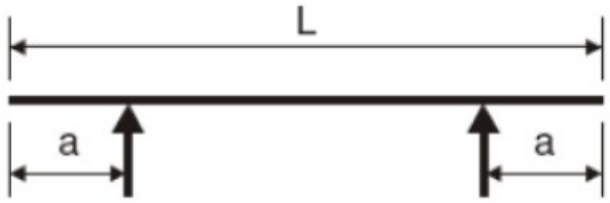
The support timbers shall be sufficiently large to store the units clear of the ground and to avoid subsidence under the supported weight when the ground is wet. The ground beneath the units shall be levelled so as to maintain the same clearance, or greater, as at the supports.

Units and girders shall not rest on any support at locations between the approved support points during handling, transport and storage.

To avoid twisting of units, all stacking areas are to be an even plane from one end of the unit to the other. Where practical, the units shall be stacked so that access for inspection of all units is possible at any time.

Where units or girders are stacked in layers, the supports for each layer shall be directly over the proceeding layer within a tolerance of 100 mm. In the precast yard stacks of deck units shall not exceed 3.5 m in total height and girders shall not be stacked more than two girders high. The manufacturer shall be responsible for the safety and stability of product storage at all times.

Table 15.3.3 – Maximum overhang beyond supports during transport and storage of deck units

Unit type	Nominal length † (L) (metres)	Maximum overhang † (a) (metres)
596 mm wide deck units	L ≤ 13	L / 8
	13 > L ≤ 14	1.3
	14 > L ≤ 16	1.2
	L > 16	1.0
350 mm wide kerb units.	All lengths	L / 8
		

† Measured along centreline of unit.

15.3.4 Transverse stressing units

Transverse stressing units shall be handled and stored in a manner such that no damage is incurred and the bars remain straight. They shall be supported well clear of the ground, with threads covered and protected at all times.

The following hazards should be monitored and avoided: welding, welding splatter, heat, stray electrical currents, mud splatter, dust, chemicals.

16 Acceptance

Prestressed concrete members shall remain available for inspection at the supplier's yard for a minimum of seven days from the date of manufacture. **Witness Point 3**

Access to elements should be maintained by good storage management, for example, waiting seven days before stacking another element on top of a newly constructed item.

The acceptability of prestressed concrete members in accordance with this Technical Specification shall be determined by inspection on the basis of both visual inspection during manufacture and completed product inspections, geometric measurement, measurement of clear cover to reinforcement, reinforcement and cast-in item spacing and location, specified transfer and 28 day concrete strength and inspection of curing records.

Acceptance of prestressed concrete members by the Administrator shall be a **Hold Point 6**.

Prestressed concrete members may be rejected if the products fail to meet any of the requirements of this Technical Specification. **Nonconformance**

Any damage to the prestressed concrete member during handling or transporting to site shall be assessed in accordance with this Technical Specification.

MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units* states that 'prestressed concrete members may be rejected should the products fail to meet any of the requirements of this Technical Specification'. It should be noted that manufacture of defect free product in accordance with MRTS73 *Manufacture of Prestressed Concrete Members and Stressing Units* is always the preferred outcome. However, where issues exist, early submission of nonconformances in accordance with the contract to the Administrator may assist with resolving issues. Acceptance of nonconforming or defective product is always at the discretion of the Administrator.