

## SECTION 614 - FORMWORK

~~##This section cross-references Sections 175, 610 and 689.~~

~~If any of the above sections are relevant, they should be included in the specification.~~

~~If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent.~~

### 614.01 GENERAL

This section specifies the requirements for the design and construction of formwork required to produce the finished concrete to the shape, lines and dimensions shown on the drawings, and in accordance with the finishes and tolerances specified in Section 610.

### 614.02 STANDARDS

#### (a) Australian Standards

Australian Standards are referenced in an abbreviated form (e.g. AS 3610).

AS 1366	Rigid cellular plastics sheets for thermal insulation - Rigid cellular polystyrene – Moulded (RC/PS - M)
AS/NZS 1594	Hot-rolled steel flat products
AS 2271	Plywood and Blockboard for Exterior Use
AS 3610	Formwork for Concrete
AS 5100	Bridge Design Set

#### (b) Additional Documents

Occupational Health and Safety Act 2004

Occupational Health and Safety Regulations 2017

Section 175 details the relevant references to these documents.

### 614.03 DEFINITIONS

**Formwork:** A temporary structural system comprising the form that contacts the concrete, and includes the supporting members, bracing and other fixtures used to give the required shape, lines and dimensions and to support the freshly placed concrete while it is setting and gaining sufficient strength to be self supporting.

**Void Former:** Prefabricated or solid light weight material, including associated anchorages and fixtures for the purpose of forming circular or irregular shaped voids in concrete components.

### 614.04 FORMWORK DESIGN

Formwork shall conform to the requirements of AS 3610 and the additional requirements of this section.

Formwork shall be rigid, watertight, braced and tied together to confine freshly placed concrete and maintain position and shape during construction, and shall be constructed in such a way that it can be removed without damage to the concrete. Where formwork is to be re-used, the formwork design shall allow for the deterioration of materials through use and handling.

The submission of formwork documentation and certification for the various concrete members shall be in accordance with the requirements of Table 614.041, and Attachments A, B and C to this section.

Table 614.041

Concrete members	Formwork documentation	Certification of formwork design	Proof Engineering of formwork design	Certification of erected formwork
(a) Abutments, pilecaps, footings, solid piers, pier columns and walls, with heights less than or equal to 2.0 metres	N/A	N/A	N/A	Contractor's Engineer (Attachment C, as per Clause 614.08)
(b) Abutments, pilecaps, footings, solid piers, pier columns and walls, with heights greater than 2.0 metres	Design drawings and specifications	Design Engineer	Proof Engineer (Attachment A, as per this clause)	Contractor's Engineer and Design Engineer (Attachment B, as per Clause 614.08)
(c) All other concrete members				
(d) Any member for which self-compacting concrete is proposed				

Where formwork requires design and the production of design drawings and specifications as stated in Table 614.041, the Contractor shall submit to ~~the Superintendent~~ Council for review its detailed drawings and specifications of the proposed formwork not less than two weeks prior to the commencement of formwork construction.

The formwork design shall be certified as stated in Table 614.041 by a Design Engineer who is a member of Engineers Australia and with a minimum of 5 years experience in the design and construction of formwork of similar complexity. The formwork design shall be verified in accordance with the Contract to confirm that design satisfies the performance requirements of the formwork.

The formwork design shall also be proof engineered as stated in Table 614.041 by a Proof Engineer, who is independent of the design consultant's firm and is prequalified at Level PE under the VicRoads' prequalification scheme.

**HP The Proof Engineering Certificate of Compliance shall be forwarded to the Superintendent Council at least two days prior to the construction of any formwork. The Proof Engineering Certificate of Compliance shall be in accordance with the form included as Attachment A to this section.**

Any amendment to the design after the issue of the Proof Engineering Certificate of Compliance shall be referred to the Proof Engineer for review and written confirmation that the Certificate of Compliance remains valid.

The formwork drawings shall include all details of formwork, formwork joints, sealing procedures, ties, size and spacing of framing and details of any proprietary fittings or systems proposed to be used. Where vibration is to be applied externally, the design of formwork shall include details of external vibrators to ensure efficient compaction and to avoid surface blemishes. The requirements of the Occupational Health and Safety Regulations 2017 shall be satisfied with respect to all formwork.

#### 614.05 FORMWORK MATERIALS

The formwork surface material for exposed concrete surfaces shall be steel plate conforming to AS/NZS 1594 or plywood conforming to AS/NZS 2271, unless otherwise shown on the drawings.

The type and condition of formwork sheeting and lining, and the ability of the formwork and its supports to withstand distortion caused by the placement, lateral pressure and compaction of the fresh concrete, and the standard of workmanship used in the formwork construction shall be such that a uniform concrete surface texture is produced, and the finished surfaces of the concrete will conform to the requirements of the specifications and drawings.

All formwork panels shall be placed in a neat, symmetrical pattern such that the exposed panel joints do not detract from the geometry or from the final appearance of the structure. The proposed soffit and side formwork panel arrangements shall be detailed on the formwork drawings.

Formwork panels shall be supplied in the maximum practicable width and length to minimise the number of joints. Plywood panels shall be placed with the grain of the outer plies in the direction of the span.

## 614.06 FORMWORK CONSTRUCTION

Formwork shall be constructed and shall be of sufficient stiffness to tolerate the rate of concrete placement and high frequency vibration, and shall be of uniform stiffness to avoid causing varying vibration amplitudes over the formwork surfaces during compaction of the concrete. The constructed formwork shall be solidly braced and tight and maintain correct position and shape and achieve the specified dimensions, levels, cover to steel reinforcement and geometry of the finished structural component in accordance with the tolerance requirements of Section 610.

The use of wires or bolts extended to the surface of the concrete will not be permitted. Any embedded ties shall remain embedded and shall terminate not less than the minimum clear cover specified on the drawings. All recesses shall be filled with a shrinkage compensating cementitious mortar in accordance with Section 689.

Errors in line or level of the formwork, or positioning and/or quantity of steel reinforcement shall be corrected prior to placing concrete. The Contractor will be responsible for any defects to the formwork, reinforcement, embedded components, or the formed concrete surface, which may become apparent during or after casting the concrete.

Formwork shall not be placed in locations where steel reinforcement and other fixtures cannot be inspected, until evidence that the reinforcement and other fixtures conform to the requirements of the specifications and the drawings has been obtained and recorded by the Contractor.

All corners of cast-in-place or precast concrete shall have 20 mm x 20 mm chamfers or fillets. Chamfers and fillets shall be formed and cast integrally with the concrete member. Cutting or grinding of chamfers shall not be allowed.

The interior surface of formwork shall be thoroughly cleaned out and treated with form oil or lubricant to prevent adhesion of the exposed concrete surface, in accordance with the manufacturer's instructions. The form oil or lubricant shall be of the non-staining type and shall not discolour the surface of the concrete. The oil or lubricant shall be applied uniformly in a thin film and any surplus removed prior the concrete placement. Reinforcement and other embedments shall not be soiled by the form oil or lubricant.

Prior to commencement of the concreting operations all tie wire ends, wood chips and other debris shall be removed from the forms.

Formwork shall be sufficiently tight at joints to prevent loss of slurry or mortar while the concrete is in its freshly placed state, consistent with the method of placement and compaction. Formwork shall also be mortar tight where holes are needed to facilitate projecting reinforcement or fixing devices.

All relevant requirements of the Occupational Health and Safety Act 2004 and Occupational Health and Safety Regulations 2017 shall be satisfied with respect to all formwork.

## 614.07 VOID FORMERS

### (a) General

Formers used for the purpose of forming voids in concrete components shall be as follows:

- (i) prefabricated formers, including associated end caps and anchorages, for circular voids;
- (ii) solid formers made of lightweight material, including associated anchorages, for voids with irregular shapes.

### (b) Void Former Details

**The Contractor shall submit the void former details for review by the Superintendent Council not less than 4 weeks prior to the placement of concrete. Concrete shall not be placed until the void former details have been reviewed by the Superintendent Council.**

The void former details shall include the following:

- (i) a full technical description of the proposed void former, including documented evidence of previous use and performance;
- (ii) the material type;
- (iii) the method of construction and installation;
- (iv) the type and spacing of anchors and supports to hold down the void former;
- (v) the maximum pressure head and maximum height differential between the two sides of the void former which shall be consistent with the most adverse conditions that may exist during the concreting operations.

(c) Certificates of Compliance of Materials and Components

The Contractor shall submit for review by the ~~Superintendent~~ Council not less than 4 weeks prior to the proposed use of materials and components, a signed statement including relevant test reports demonstrating the compliance of the materials and components with the requirements of Clause 614.07(d).

The Contractor shall also submit for review by the ~~Superintendent~~ Council not less than 4 weeks prior to the proposed use of materials and components, computations carried out and certified by a design engineer confirming the ability of anchors and supports to securely restrain the void former in position during and after the concreting operations and confirm compliance with this section. The design engineer shall be experienced and qualified in structural design, with a minimum of five years experience in the design and construction of formwork and shall be verified in accordance with the requirements of Section 160.

(d) Materials

The void formers shall be made watertight to prevent ingress of concrete slurry and sufficiently strong and tough to withstand handling, transport, storage and installation and the placing and compaction of the concrete without suffering damage or deformation. Void formers and associated fixtures shall remain dimensionally stable and retain their physical properties under normal conditions of use, shall be resistant to fire, shall not cause staining or discolouration and shall not alter physically or chemically by contact with concrete slurry or moisture.

As a minimum solid formers shall be rigid cellular expanded polystyrene complying with Class S as stated in AS 1366.3.

(e) Fabrication

Void formers shall be fabricated such that after the concreting operations they maintain correct position and shape and achieve the specified dimensions, levels and geometry of the finished structural component in accordance with the specified tolerance requirements.

Any stiffening ribs of prefabricated void formers shall project inwards to ensure a smooth outer surface profile and seams shall be watertight, recessed to present a smooth outer surface and mechanically overlapped when fabricated from spirally-wound strip material. Joints to any fixtures shall be sealed and watertight.

Void formers and associated fixtures shall not be dented, cracked, spalled or porous, exhibiting signs of corrosion or are otherwise damaged in any way prior to installation, to prevent local instability of the void former under pressure from the wet concrete.

Void formers shall be fabricated to the following tolerances:

- (i) outside dimension/diameter to within  $\pm 3$  mm (for cylindrical formers diameters measured at right angles);
- (ii) overall length, with required fixtures in place to within + 0 to – 20 mm;
- (iii) diagonal dimensions for solid void formers to within  $\pm 3$  mm;
- (iv) for horizontal bow the deviation of the void former from the required profile shall not exceed 0.06% of the length of the void former or a maximum of 8 mm.

(f) Installation

The void former shall be securely restrained in position during and after the concreting operations. Large uplift forces acting as a result of the buoyancy effect and any lateral pressure due to concrete placement shall be resisted by external means and not by securing the void former to the steel reinforcement.

Joints between void former segments shall be watertight.

The tolerance on final position of the void former at any location shall be within  $\pm 7$  mm.

#### 614.08 CERTIFICATION OF FORMWORK

Further to the requirements of Clause 614.04 and parts (b), (c) and (d) of Table 614.041, the Contractor shall arrange for the design engineer who certified the formwork drawings to carry out an on site inspection and any other activities necessary to certify that the erection of the formwork has been completed in accordance with the certified design drawings.

The Contractor shall submit to ~~the Superintendent~~ Council a Certificate of Compliance – Formwork Inspection for the constructed formwork signed by the Contractor and the Design Engineer responsible for the certification of the formwork drawings, and shall be in the form shown in Attachment B to this section.

Further to the requirements of Clause 614.04 and part (a) of Table 614.041, the Contractor's Engineer responsible for designing, supervising and certifying the erection of the formwork shall be a member of Engineers Australia who is experienced in the design and construction of formwork of similar complexity. As part of the certification, the Contractor's Engineer shall carry out an onsite inspection and any other activities necessary, to certify in accordance with the form included as Attachment C to this section, that the erection of the formwork has been completed in accordance with the specified requirements.

The relevant Certificate of Compliance – Formwork Inspection for the constructed formwork shall be submitted to ~~the Superintendent~~ Council not less than two days prior to the application of any load.

**HP The application of any load shall not proceed until the signed Certificate of Compliance - Formwork Inspection of the constructed formwork has been reviewed and accepted by the ~~Superintendent~~ Council.**

#### 614.09 REMOVAL OF FORMWORK

The period of time before formwork and formwork supports can be removed shall be in accordance with the minimum formwork removal times and requirements as specified in Section 610.

Formwork shall be so constructed as to allow for its undisturbed dismantling and removal from the cast concrete without shock or damage. Shock or damage to the cast concrete shall also be prevented when removing formwork in the vicinity of projecting reinforcement or fixing devices.

All formwork shall be removed on completion.

All relevant requirements of the Occupational Health and Safety Act 2004 and Occupational Health and Safety Regulations 2017 shall be satisfied with respect to removal of all formwork.

**ATTACHMENT A TO SECTION 614**

**PROOF ENGINEERING CERTIFICATE OF COMPLIANCE**

(Form to be used by the Proof Engineer at intermediate stages and final completion of design and construction)

**For concrete members as stated in parts (b), (c) and (d) of Table 614.041**

I ..... **certify that I have:**

- (1) undertaken an independent engineering review in relation to the design represented by the drawings and specifications provided by the Contractor as listed in the attached schedule;
- (2) carried out a detailed check of individual structural elements and the structure as a whole including the specified material properties;  
~~##(3), (4) and/or (5) below if these aspects are not included in the specified scope of proof engineering):~~  
 ##:(3) reviewed the Site Conditions Information Report in accordance with AS5100 – Bridge Design, the appropriate foundation investigation, the recommended design values, material properties and possible failure mechanisms;
- ##:(4) reviewed the hydrologic and hydraulic design parameters including design flood discharges and levels, stream velocities and afflux as well as evaluation of potential for and protection against scour and bank erosion;
- ##:(5) reviewed the proposed construction procedure and the aspects of temporary works critical for structural integrity and safety.

**In performing the function of Proof Engineer I have used due skill, care and diligence and from my review and in my opinion as a professional engineer I consider that:**

- A. all relevant design actions and design criteria are covered by the design and that these actions and criteria and overall concept meet the requirements of the Principal’s Project Requirements;
- B. the strength, stability and serviceability and other Limit State requirements as defined in the Principal’s Project Requirements are met; and
- C. the construction drawings and specifications accurately describe the following matters critical to the structural integrity –  
~~##(3), (4) and/or (5) below if these aspects are not included in the specified scope of proof engineering)~~  
 : (a) the detailing and dimensions,  
 (b) the required material properties, and  
 (c) the construction procedure and temporary works.

**Signed** .....

**Name** (please print) .....

**On behalf of** ..... **(Company)**

**Date** .....

**ATTACHMENT B TO SECTION 614**

**CERTIFICATE OF COMPLIANCE – FORMWORK INSPECTION**

**For concrete members as stated in parts (b), (c) and (d) of Table 614.041**

**CONTRACTOR’S ENGINEER**

I..... , the undersigned  
(Please print person’s name)

am responsible for supervising the construction of formwork detailed on the following listed final drawings and specifications certified by the Proof Engineer. Using due skill, care and diligence, I have reviewed the relevant geometric surveys and test reports and made inspections during the construction of the formwork and certify that the completed formwork complies with the certified drawings and specifications.

Signed .....

On behalf of (Company) .....

Date .....

**DESIGN ENGINEER**

I..... , the undersigned  
(Please print person’s name)

am responsible for the design of formwork detailed on the following listed drawings and specifications certified by the Proof Engineer. Using due skill, care and diligence, I have made an inspection of the completed formwork and certify that it complies with the certified drawings and specifications.

Signed .....

On behalf of (Company) .....

Date .....

Contractor to Schedule all Drawings and Specifications of formwork certified by the Proof Engineer, applicable to this joint Certificate of Compliance.

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