

STANDARD OPERATING PROCEDURE - FORMWORK REINFORCEMENT CONCRETE PLACEMENT



1. Purpose

This Standard Operating Procedure (SOP) sets out the mandatory health and safety standards to be applied on all Perkins project sites in relation to Formwork, Reinforcement and Concrete placement as defined in this document.

2. Definitions

Formwork	For the purpose of this SOP includes conventional and engineered formwork systems used for the structural support of concrete for suspended slabs, penetration in-fills (e.g. where a stair void is being filled in), columns and walls.
Reinforcement	The strengthening structure or material employed in reinforced concrete or plastic. This includes reinforcing steel bar or mesh and mono strand post tensioning for concrete placement greater than 10m3

3. Mandatory Requirements

Formwork

'Formwork' for the purpose of this SOP includes conventional and engineered formwork systems used for the structural support of concrete for suspended slabs, penetration in-fills (e.g. where a stair void is being filled in), columns and walls, including;



- Traditional Timber Formwork (e.g. steel frames, timber bearers, plywood decking)



- Self-climbing Formwork (i.e. crane or hydraulic assisted lifting formwork systems such as Slip Forms and Jump Forms)



- Table Form Systems with handrail installed before being placed in position;



- Proprietary Formwork systems (e.g. Peri Deck, Airodek, Crownhead propping such as per image)

Note: the intent is to ensure adequate structural integrity of formwork systems used in situations where the formwork supports a significant load (including materials, workers, steel and concrete) but would not for example apply to edge boards for a slab on ground.

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Formwork Design

Formwork Systems are to be designed by a qualified engineer in accordance with the requirements set out in AS 3610 – *Formwork for Concrete* and AS 3600 - *Concrete Structures*;

A copy of the Formwork design documentation is to be held on site and is to include:

- The engineers name and qualification;
- Any necessary preparation of the foundation (e.g. filling, compaction drainage);
- Any footing design assumptions, such as foundation material description, safe bearing values, limitations on settlement during erection of formwork;
- Plans, elevations or sections sufficient to depict the arrangement of formwork and to identify/locate all members, components and bracing including;
 - component types and spacing;
 - maximum jack extensions;
 - bearer and joist timber type, dimensions and spacing
 - prop sizes and maximum extensions;
 - form ply size, thickness and grade;
 - methods for tying the structure together and spacing between ties (if required);
- Details sufficient to fully describe important or unusual features of the design;
- The areas of the forms designed to carry stacked loads together with the maximum allowable load, and the minimum strength of concrete to be achieved prior to materials being stacked, including maximum allowable point loading to be applied and any additional propping requirements at any specific loading area;
- Sequence of concrete placement and minimum elapsed time between adjacent placements;
- Where required, location of weep holes, vibrator holes, clean-out holes and inspection openings;
- Footing design where not placed on structural concrete slabs;
- Identification of proprietary formwork items/systems;
- Back propping required after formwork removal;
- Certification or engineer's design documents for lifting points for formwork shutters;

Formwork Materials

All materials and equipment used in formwork must be fit for the intended purpose, meet design specifications and be designed to conform to relevant Australian Standards. Evidence of which should be made available by the supplier;

Formwork Installation

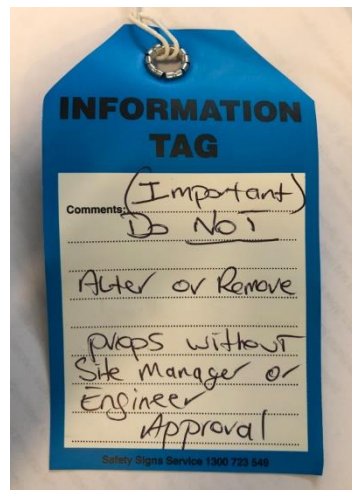
- The installation, erection and dismantling of formwork is to be performed by appropriately trained and competent persons;
- All engineered formwork is to be erected and used in accordance with the manufacturer's instructions;

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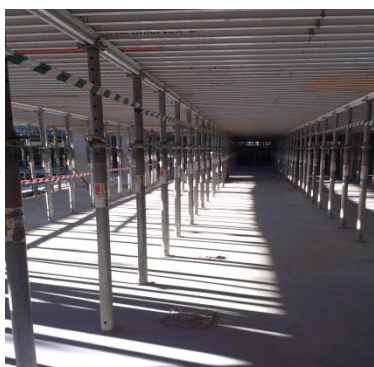
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- Base plates are to be provided under props and standards on formwork frames unless the prop or standard has an integral foot or a competent engineer documents that a base plate is unnecessary;



- Sole boards designed to suit the ground conditions shall also be used under props and standards on natural ground, unless a competent engineer documents otherwise;
- Signage or information tags stating Props are not to be removed/alterd without Site Manager or Engineer approval should be erected
- Frames and props must be located on a firm base which is ground that will not subside, fail or get washed away. Adequate drainage for stormwater run-on/run-off shall be provided to prevent scouring of formwork foundations and footings. Where foundations are located on batters, these need to be protected against scour by directing drainage away from the base of frames;
- As the erection of frames continues, designated access ways are to be indicated by the use of bunting or by other means. However areas underneath where formwork is incomplete or otherwise unsafe to access (e.g. during concrete pour) are to be isolated by signage and suitable barriers to ensure no unauthorised access;



- Temporary lighting is to be installed in all access ways with emergency exit signs in place;

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- The risk of falling from one level to another is to be controlled during the installation of Formwork Systems and may include:
 - **Working from underneath** which may include platform ladders and mobile scaffold;
 - **Intermediate working decks** may be constructed in a manner similar to a final formwork deck (that is, using bearers, joists and sheeting) or may be a further extension of a catch platform;
 - **Temporary working platforms** must be a minimum of 450 mm wide (2 planks) as required by AS 1576; Temporary working platforms should be erected on the horizontal cross members of the frames. Cleats can be used to prevent planks from slipping off the frames;
 - **Catch platforms** may be temporary working platforms that are extended and may be built from a combination of bearers, sheeting and planks or metal transoms and planks;
 - **Handrails/Guardrails** at the perimeter of the building or deck openings must be at least 900 mm in height above the final working surface and have a top rail, mid rail / Kick Board;
 - **Scaffolding** complete with guardrails and toeboards can provide effective protection against falls at the perimeter of a building, providing the guardrail of the scaffolding extends at least 900 mm in height above the proposed finished concrete level. The scaffold platform should be positioned or constructed to prevent persons or materials falling between the scaffold platform and the edge of the formwork;
 - **Perimeter Screens** consisting of an outer mesh screen erected at the edge of the concrete slab to protect personnel erecting and dismantling formwork and other trades associated with the construction of the concrete slabs and columns and to contain materials on the upper floors prior to the installation of a safety handrail system or other fall prevention system.
 - **Penetrations** - Plywood covers must be structurally graded and sound, securely fixed and marked with appropriate wording, e.g. 'Peno' or 'Danger penetration below.' Engineering approval is required where the span of a plywood cover exceeds the design criteria for the plywood deck, i.e. joist to joist.

Small penetrations in concrete slabs (less than 300mm may include cast-in-mesh as a back-up system. The mesh should be of a small aperture, for example 50 x 50 mm mesh size or smaller and made of material capable of withstanding the potential imposed loads. Where mesh or other physical fall protection material is to be provided for larger penetrations this is to be included in the slab design specifications to ensure it can withstand potential loads including those applied by people, equipment and material.

Formwork Inspection

- A certificate from a qualified engineer is to be obtained for all completed formwork, as defined in this SOP, prior to concrete placement and is to include:
 - The engineers name
 - Project name
 - An inspection date no greater than 2 working days prior to the proposed pour
 - Location of formwork (e.g. level, area)
 - A statement saying:

"This is to certify that the Formwork identified as _____ for the above project has been inspected and is considered to be adequate to support the design loads in accordance with the relevant Australian Standards including AS 3610 Formwork for Concrete. The works have been inspected and is considered to be adequate to support the design loads in accordance with the relevant SAA Codes including AS 3610 – Formwork for Concrete".

Note: All remedial work identified during an inspection of the formwork is to be completed and verified as complete by an appropriate, competent person. Re-inspection of remedial work by the engineer is to be as directed by the engineer.

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Formwork Removal

- Formwork shall not be stripped until verification of sufficient concrete strength is obtained in writing from the engineer;
- Formwork stripping shall be undertaken by appropriately trained persons;
- Sufficient exclusion zones shall be established prior to the commencement of stripping; Signage is to be erected stating 'Formwork stripping in progress, authorised entry only'
- All formwork material shall be stripped in a controlled manner. No material is permitted to be dropped during the stripping of formwork (no drop stripping);
- All material shall be de-nailed before stacking;

Reinforcement and Post Tensioning

For the purpose of this SOP, 'Reinforcement' includes reinforcing steel bar or mesh and mono strand post tensioning for concrete placement greater than 10m³;



▪ Traditional reinforcement



▪ Mono strand post tensioning reinforcement

Reinforcement / Post Tensioning Installation

The reinforcement storage locations are to be in accordance with information supplied by the formwork engineer and must be capable of supporting the placing of reinforcing/stressing equipment and material to be installed. Additional propping and or support locations may be required e.g. placing of coil;

Reinforcement workers are not permitted to be within Formwork exclusion zones; Bar caps or other means of protection are to be placed on the end of strands when not in use;

A sufficient exclusion zone by use of signage and appropriate barricading is to be established around the unstrapped stressing strand coil and support frame (Bripac) during stressing operations;

Anti-burst reinforcement must be installed for all post tensioning systems;

Strands are to be placed inside a conduit at distance not greater than 4 meters from the bripack feed and no greater than 4 meters from the strand pusher;

All penetrations greater than 225mm X 225mm are to have steel mesh cast in during construction with size of mesh to suit penetration span and approved by engineer;

Initial stress shall not exceed 30% of final stress;

Stressing is not commence until:

- written confirmation is received from an appropriate person that concrete compression tests indicate appropriate transfer strength has been reached;
- exclusion zones of at least 2 meters are established with barricades and signage erected at all live and anchorage ends of tendons being stressed;

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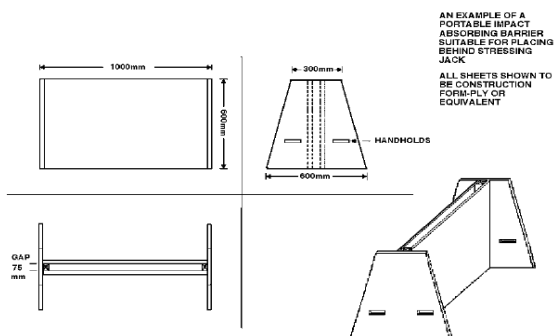
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- a compliant impact absorbing barricade is established behind the jack (In the case of double live end tendons, ensure that barricades are erected at both ends even if only stressing from one end);
- the stressing area has been appropriately flagged and warning signs displayed;
- a trained observer is present to monitor the anchorage end during stressing and a line of communication can be maintained;
- no persons are standing between the jack and the impact absorbing barricade and within 2 meters of any live or anchorage ends;
- the operator has checked that the area has been cleared and there is no person standing between the jack and the barricade or within 2 m of any live end anchorage;
- the operator has ensured that there are adequate clearances available for the jack to prevent possible skewing or lifting during stressing;
- concrete compression tests indicate transfer strength has been reached. Advice should be confirmed in writing if possible; and
- All exposed reinforcement bar ends are to be capped.

Barricading

An adequate barricade is one that has been designed to restrain and reduce impact from strands or jacks if strands snap or release under tension or if the system fails in some other way. They are generally constructed from timber and two separated layers of 17 mm form ply sheets and are placed behind jacks during final stressing and de-tensioning.



Concrete Placement

Concrete Boom Pumps

For the purpose of this SOP, 'Concrete Placement' includes the use of all static or mobile concrete placement booms, Concrete line pumps and the use of a kibble;

Inspection

Concrete placing units are to be registered via the Perkins plant induction process;

Concrete placing units (truck mounted with boom) must be registered with Relevant Statutory Authority;

Consultation must occur with other operators plant such as the tower crane, prior to the set-up of concrete placement booms;

Concrete pump line thicknesses test certificates are to be confirmed as adequate (Minimum of 2mm thickness for lengths of pipe, note elbows are required to have a thicker minimal thickness) and obtained on a regular basis. Thickness tests are to be carried out monthly;

Concrete kibles are to have a current lifting certificate;

The operator of a truck mounted concrete boom pump and static boom pumps must hold the required certificate of competency (e.g. high risk work licence);

Barricading/Signage is to be installed so as to ensure no workers are allowed to access the immediate area beneath the section of formwork during concrete placement activities;

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Concrete placement plant use

Concrete placement boom pumps shall:

- not come into contact with scaffolding, structure or plant;
- not be used as a crane;
- not be erected until stabilisers/outriggers are established and locked in position;
- Maintain safe distances from power lines;
- have the boom folded in the travel position before raising the outriggers, when making any positioning adjustments;
- be established in an sufficiently level and solid so as to ensure safe operation;
- not lift, drag, luff upwards or slew the concrete placement boom in any direction if the concrete delivery line is:
 - Stuck or caught on an object;
 - Are connected to two or more pieces of concrete line (Metal or rubber)
 - Not in sight of the operator.

Concrete placement boom pump stabilisers/outriggers shall:

- Have stabilisers/outriggers set out in areas free from excavations, trenches or holes in the ground, inadequately compacted or soft ground, cellars, basements, pits or back-filled ground, unless approved in writing by a qualified engineer.
- Barricading and signage around outriggers to eliminate worker moving into slew zone.
- Have adequate packing of sufficient strength and load bearing area available for the outrigger stabiliser pads:
 - Packing may include engineered bog mats or suitable timbers.
 - The use of loose softwood timbers is not recommended;

Be fully extended:

- if outriggers are not fully extended, the reduced safe operating radius must be known and recorded;
- regular inspections of the outrigger pads to check for subsidence and loss of stability;
- Where the general public are in close proximity of any part of the concrete placement operation, consideration should be given to:
 - the endorsed traffic and pedestrian management plan:
 - (a) directing the public to an alternative footpath; or
 - (b) providing an alternative pathway
 - the installation of protective screens to prevent concrete splashing on the public
 - the installation of a suitable ramps over concrete placement lines
 - the erection of barricades and warning signs necessary to comply with council requirements;

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Concrete placement lines

- All concrete placement plant and accessories are to be visually inspected prior to the commencement of concrete placement.
- The wall thickness of each pipeline segment shall be tested using ultrasonic testing instrument or other suitable methods determined by the manufacturer and not exceed 30 days and with a register to keep wall thickness results;
- All concrete lines joints are to be clamped and fixed closed prior to concrete placement
- Includes 'R' pins in quick clamps and bolts through fixed lines
- No metal couplings are to be at the end of the concrete placement line
- Rubber lines here connected to a boom are to be secured by a safety chain, sling or other retaining device;
- The length of flexible hose suspended from a concrete boom pump must be in accordance with the manufacturers specifications the length of hose may vary due to the diameter of the hose as follows:
 - 3 metres for 125mm diameter pipe;
 - 4 metres for 100 diameter pipe;
- To prevent damage to the boom, the boom is not to be luffed upwards or slewed whilst there is more than 3m (for 125mm hose) and 4m (for 100mm hose) suspended from the end of the boom at any time. This is particularly important that the boom is not moved in any way when the hose is filled with concrete;
- The rubber delivery end-hose should:
 - Where connected to a boom, secured by a safety chain, sling or other retaining device;
 - Be inspected for excessive wear or damage prior to being fitted;
 - Not be longer than specified by the pump manufacturer;
 - Delivery hose end has no metal sleeve.
- Concrete placement plant is to be disengaged (Switched off) when hoses are being connected or disconnected;



Concrete placement plant completion and monitoring

- Concrete placement lines are to be 'blown' in a controlled manner and is to be controlled so as to ensure no workers are in the immediate vicinity whilst this operation is taking place;
- Excess concrete is to be placed in the appropriate location;
- Excess concrete is not to have reinforcement bar inserted into it and used for the purpose of lifting;
- Continual monitoring of boom and hoses by boom operator.

4. References

- Work Health and Safety (General) Regulations 2022
- AS 3610 Formwork for Concrete
- AS 3600 Concrete Structures
- SafeWork Australia Guide to Formwork

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