

HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

APPROVED CODE OF PRACTICE FOR THE
**SAFE ERECTION AND
USE OF SCAFFOLDING**



DEPARTMENT OF
LABOUR
TE TARI MAHI

ISSUED AND APPROVED
BY THE MINISTER
OF LABOUR
SEPTEMBER 1995

Published by the Occupational Safety and Health Service,
Department of Labour, Wellington, New Zealand.

First edition 1963

Revised 1970

Reprinted 1972

Revised 1976

Reprinted 1980

Revised 1985

Revised 1988

Revised 1989

Reprinted 1991

Revised 1995 and published as an approved code of practice

ISBN 0-477-03550-5

\$10 (Incl. GST)

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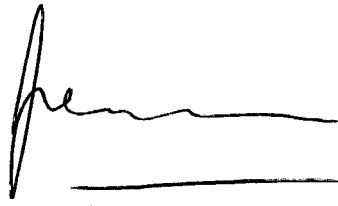
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NOTICE OF ISSUE

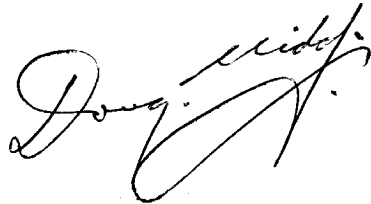
I have issued this *Approved Code of Practice for the Safe Erection and Use of Scaffolding*, being a statement of preferred work practices or arrangements for the purpose of ensuring the health and safety of persons to which this code applies and persons who may be affected by the activities covered by this code.

A handwritten signature in black ink, appearing to read 'J. M. Chetwin', written over a horizontal line.

J. M. Chetwin
Secretary of Labour
September 1995

FOREWORD

I have approved this statement of preferred work practices, which is an *Approved Code of Practice for the Safe Erection and Use of Scaffolding*, under section 20 of the Health and Safety in Employment Act 1992. When a code is approved, a Court may have regard to it in relation to compliance with the relevant sections of the Health and Safety in Employment Act. This means that if an employer in an industry or using a process to which an approved code applies can show compliance with that code in all matters it covers, a Court may consider this to be compliance with the provisions of the Act to which the code relates.

A handwritten signature in black ink, appearing to read 'Doug Kidd', with a stylized flourish at the end.

Hon. Doug Kidd
Minister of Labour
September 1995

PREFACE

This revised publication on scaffolding includes changes in the legislation which took effect from 1 April 1993. It is essential for everyone involved in the erection and use of scaffolding to be aware of these new provisions.

The book also sets out minimum standards for the erection, use and dismantling of scaffolds, and provides the basis of study material for persons wishing to obtain a certificate of competency as a scaffolder.

A SUMMARY OF THE HEALTH AND SAFETY IN EMPLOYMENT ACT 1992

The principal object of the Health and Safety in Employment Act 1992 (HSE Act) is to prevent harm to employees at work. To do this, it imposes duties on employers, employees, principals and others, and promotes excellent health and safety management by employers. It also provides for the making of regulations and codes of practice.

REGULATIONS

Regulations are promulgated from time to time under the HSE Act. Regulations may, among other things, impose duties on employers, employees, designers, manufacturers, and others relating to health and safety. These regulations may apply with respect to places of work, plant, processes or substances and may deal with particular problems that have arisen.

APPROVED CODES OF PRACTICE

“Approved Codes of Practice” are provided for in the HSE Act. They are statements of preferred work practice or arrangements, and may include procedures which could be taken into account when deciding on the practicable steps to be taken. Compliance with codes of practice is not mandatory. However, they may be used as evidence of good practice in court.

EMPLOYERS’ DUTIES

Employers have the most duties to ensure the health and safety of employees. Employers have a general duty to take all practicable steps to ensure the safety of employees while at work. In particular, they are required to take all practicable steps to:

- (a) Provide and maintain a safe working environment;
- (b) Provide and maintain facilities for the safety and health of employees at work;
- (c) Ensure that machinery and equipment is safe for employees;
- (d) Ensure that working arrangements are not hazardous to employees; and

- (e) Provide procedures to deal with emergencies that may arise while employees are at work.

Taking “all practicable steps” means doing what is reasonably able to be done in the circumstances, taking into account:

- (a) The severity of any injury or harm to health that may occur;
- (b) The degree of risk or probability of that injury or harm occurring;
- (c) How much is known about the hazard and the ways of eliminating, reducing or controlling it; and
- (d) The availability, effectiveness and cost of the possible safeguards.

HAZARD MANAGEMENT

Employers must identify and regularly review hazards in the place of work (existing, new and potential), to determine whether they are significant hazards and require further action. If an accident or harm occurs that requires particulars to be recorded, employers are required to investigate it to determine if it was caused by or arose from a significant hazard.

“Significant hazard” means a hazard that is an actual or potential cause or source of:

- (a) Serious harm; or
- (b) Harm (being more than trivial) where the severity of effects on any person depend (entirely or among other things) on the extent or frequency of the person’s exposure to the hazard; or
- (c) Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.

Where the hazard is significant, the HSE Act sets out the steps employers must take:

- (a) Where practicable, the hazard must be eliminated.
- (b) If elimination is not practicable, the hazard must be isolated.
- (c) If it is impracticable to eliminate or isolate the hazard completely, then employers must minimise the likelihood that employees will be harmed by the hazard.

Where the hazard has not been eliminated or isolated, employers must, where appropriate:

- (a) Ensure that protective clothing and equipment is provided, accessible and used;
- (b) Monitor employees’ exposure to the hazard;
- (c) Seek the consent of employees to monitor their health; and
- (d) With informed consent, monitor employees’ health.

INFORMATION FOR EMPLOYEES

Before employees begin work, they must be informed by their employer of:

- (a) Hazards employees may be exposed to while at work;
- (b) Hazards employees may create which could harm other people;
- (c) How to minimise the likelihood of these hazards becoming a source of harm to themselves and others;
- (d) The location of safety equipment; and
- (e) Emergency procedures.

Employers are also required to inform employees of the results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected.

EMPLOYERS TO INVOLVE EMPLOYEES IN THE DEVELOPMENT OF HEALTH AND SAFETY PROCEDURES

Employers need to ensure that all employees have the opportunity to be fully involved in the development of procedures for the purpose of identifying hazards and dealing with significant hazards, or dealing with or reacting to emergencies and imminent dangers.

TRAINING OF EMPLOYEES

Employers must ensure employees are either sufficiently experienced to do their work safely or are supervised by an experienced person. In addition, employees must be adequately trained in the safe use of equipment in the place of work, including protective clothing and equipment.

SAFETY OF PEOPLE WHO ARE NOT EMPLOYEES

Employers are also responsible for the health and safety of people who are not employees. Employers must take all practicable steps to ensure that employees do not harm any other person while at work, including members of the public or visitors to the place of work.

EMPLOYEES' AND SELF-EMPLOYED PERSONS' DUTIES

Employees and self-employed persons are responsible for their own safety and health while at work. They must also ensure that their own actions do not harm anyone else. However, these responsibilities do not detract from the employers' or principals' responsibilities.

ACCIDENTS AND SERIOUS HARM (RECORDS AND NOTIFICATION)

The HSE Act requires employers to keep a register of work-related accidents and serious harm. This includes every accident that harmed (or might have harmed):

- (a) Any employee at work;
- (b) Any person in a place of work under the employer's control.

Employers are also required to investigate all accidents, harm and near-misses to determine whether they were caused by a significant hazard.

Employers are required to notify serious harm that occurs to employees while at work to the Secretary (in practice, the nearest OSH office), as soon as possible. In addition, the accident must also be reported on the prescribed form within 7 days. (Forms are included in the Workplace Accident Register available from OSH offices and selected stationers.)

If a person suffers serious harm, the scene of the accident must not be disturbed unless to:

- (a) Save life or prevent suffering;
- (b) Maintain public access for essential services, e.g. electricity, gas;
- (c) Prevent serious damage or loss of property.

The OSH office will advise whether it wishes to investigate the accident and what action may be taken in the meantime.

DEFINITIONS

Act: The Health and Safety in Employment Act 1992.

Anchorage: Component cast or fixed into the building or structure for the purpose of attaching a scaffold or tie; it also means the holding down system for cantilevered beams when referring to suspended scaffolding and cantilevered platforms.

Base plate: A metal plate with a spigot for distributing the load from a standard or raker or other load-bearing tube. An adjustable base plate is a metal base plate embodying a screw jack.

Bay: The portion of a scaffold situated between two adjacent pairs of standards measured longitudinally and extending the full height of the scaffold. The bay length is the longitudinal distance between the two adjacent pairs of standards.

Brace: A member placed diagonally with respect to the vertical or horizontal members of a scaffold and fixed to them to afford stability.

Castor: A swivelling wheel secured to the base of a vertical member of the scaffold for the purpose of mobilising it.

Construction work: (a) Means any work in connection with the alteration, cleaning, construction, demolition, dismantling, erection, installation, maintenance, painting, removal, renewal, or repair of —

- (i) Any building, chimney, edifice, erection, fence, structure or wall, whether constructed wholly above or below, or partly above and partly below, ground level:
- (ii) Any aerodrome, cableway, canal, harbour works, motorway, railway, road, or tramway:
- (iii) Any thing having the purpose of drainage, flood control, irrigation or river control:
- (iv) Any distribution system or network having the purpose of carrying electricity, gas, telecommunications, or water:
- (v) Any aqueduct, bridge, culvert, dam, earthwork, pipeline, reclamation, reservoir, or viaduct:
- (vi) Any scaffolding; and

(b) Includes any work in connection with any excavation, preparatory work, or site preparation carried out for the purposes of any work referred to in paragraph (a) of this definition; and

(c) Includes any work referred to in paragraph (a) or paragraph (b) of this definition carried out underwater, including work on buoys, obstructions to navigation, rafts, ships, and wrecks; and

(d) Includes the use of any materials or plant for the purposes of any work to in any of the paragraphs (a) to (c) of this definition; and

(e) Includes any inspection or other work carried out for the purposes of ascertaining whether any work referred to any of paragraphs (a) to (c) of this definition should be carried out; but

(f) Does not include any work in any mine, quarry, or tunnel.

Coupler: A fitting used to fix scaffold tubes together.

Employee: Subject to section (3) of the Act, means a person employed by any other person to do any work (other than residential work) for hire or reward; and, in relation to any employer, means an employee of the employer.

Employer: Means a person who or that employs any other person to do any work for hire or reward; and, in relation to any employee, means an employer of the employee.

Factor of safety: The ratio of the load that would cause failure of a member or structure to the load that is imposed upon it in service, and, unless otherwise prescribed or directed, shall be a minimum of 3.

Free-standing scaffold: A standing scaffold which is not attached to any other structure and is stable against overturning on its own account or, if necessary, assisted by rakers and anchors.

Guardrail: A rail or barrier secured to standards or upright members, and erected along the exposed sides and ends of working platforms to prevent persons from falling. A lower rail which is fixed to standards midway between the guardrail and platform is termed a midrail.

Hanging scaffold: A working platform suspended by tubes, bolts, fixed rope slings or other methods and not intended for raising or lowering while in use.

Health and safety inspector: An officer of the Department of Labour appointed under section 29 of the Health and Safety in Employment Act 1992.

High: In relation to scaffolding, means the vertical height of the actual scaffold (referred to in 2.2 and 2.10).

Height: In relation to scaffolding or part of scaffolding, means the greatest vertical distance from which any article may fall from the highest working platform of the scaffolding to the ground or structure on which the scaffolding is supported or above which the scaffolding is suspended or fixed, as the case may be. In determining the distance which an article may fall, no account shall be taken of any obstruction which may delay or stop the fall unless there is no possibility of the fall continuing after the obstruction is reached.

Ladder: Means a portable appliance consisting of two stiles joined by steps or rungs and designed for the purpose of climbing and descending.

Ladder bracket: A bracket designed to be attached to at least two rungs of a ladder for the purpose of supporting a plank for a person to work on.

Ledger: A horizontal member placed in the longitudinal direction between standards for the purpose of supporting putlogs.

Lift: The assembly of ledgers and putlogs forming each horizontal level of a scaffold. The lift height is the vertical distance between two lifts, measured centre to centre.

Live load: That portion of a load which does not include any part of the scaffolding or decking supporting the load, and comprises the weight of workers and/or materials.

Notifiable work: Means (a) Any restricted work, as that term is defined in regulation 2(1) of the Asbestos Regulations 1983:

(b) Any logging operation or tree-felling operation, being an operation that is undertaken for commercial purposes;

(c) Any construction work of one or more of the following kinds:

- (i) Work in which a risk arises that any person may fall 5 metres or more, other than—
 - (A) Work in connection with a residential building up to and including 2 full stories:
 - (B) Work on overhead telecommunication lines and overhead electric power lines:
 - (C) Work carried out from a ladder only:
 - (D) Maintenance and repair work of a minor or routine nature:
- (ii) The erection or dismantling of scaffolding from which a person may fall 5 metres or more:
- (iii) Work using a lifting appliance where the appliance has to lift a mass of 500 kilograms or more a vertical distance of 5 metres or more, other than work using an excavator, a fork-lift, or a self-propelled mobile crane:
- (iv) Work in any pit, shaft, trench or other excavation in which any person is required to work in a space more than 1.5 metres deep and having a depth greater than the horizontal width at the top:
- (v) Work in any drive, excavation or heading in which any person is required to work with a ground cover overhead:
- (vi) Work in any excavation in which any face has a vertical height of more than 5 metres and an average slope steeper than a ratio of 1 horizontal to 2 vertical:
- (vii) Work in which any explosive is used or in which any explosive is kept on the site for the purpose of being used;
- (viii) Work in which any person breathes air that is or has been compressed or a respiratory medium other than air.

Outriggers (needles): Cantilevered beams from which a swinging stage is suspended.

Putlog (or bearer or transom): A horizontal member placed in the transverse direction between ledgers, standards, or other supports and used to support a working platform.

Raker: An inclined load-bearing member.

Right-angle coupler: A coupler used to join tubes at right angles.

Registered engineer: An engineer registered under the Engineers Registration Act 1924.

Safe working load (SWL): The maximum load calculated in accordance with sound and accepted engineering practice, which can be supported safely under normal working conditions.

Scaffolder: A scaffolder is a person skilled and experienced in the erection, altering and dismantling of scaffolding. A scaffolder aspires to or holds a certificate of competency as a scaffolder.

Scaffolding: (a) Means any advanced scaffolding, basic scaffolding, or suspended scaffolding or any framework or structure, of a temporary nature, used or intended to be used —

- (i) For the support or protection of persons carrying out construction work or work connected with construction work, for the purpose of carrying out that work; or
- (ii) For the support of materials used in connection with any such work; and

- (b) Includes any scaffolding constructed as such and not dismantled, whether or not it is being used as scaffolding; and
- (c) Includes any coupling, device, fastening, fitting or plank used in connection with the construction, erection, or use of scaffolding.

Scaffolding process: The planning for, design and erection of, inspection of, and use of any scaffold.

Scaffold register: A written record of inspections carried out for scaffolding.

Standard: An upright member used for transmitting the weight of the load from the working platforms to the base of the scaffolding.

Suspended scaffold: A working platform suspended from overhead and intended to be raised or lowered while in use.

Swivel coupler: A coupler for joining tubes at an angle other than a right angle.

Sole plate: A timber, concrete or metal bearer used to distribute the load from a standard or base plate to the ground.

Sound and accepted engineering practice: Means engineering practice generally regarded as sound by those members of the engineering profession mainly concerned with the practice and accepted as such by the Secretary of Labour.

Span: Means the distance measured along the member between the centre lines of adjacent supports of the member.

Special scaffold: A scaffold which differs from the standard requirements for standing and suspended scaffolds.

Standing scaffold: A scaffold which is supported wholly or partly from its base.

Tie: The attachment by which scaffolding is attached to a structure; it also means “tie and spreader” and includes the attachments used in conjunction with the spreader or putlog extension to secure a scaffold to a building or structure to prevent movement.

Toeboard: An upstand or vertical barrier at the edge of a platform intended to prevent materials, or workers’ from slipping off the platform.

Transom: A lube or beam spanning across ledgers to form the support for boards forming the working platform or to connect the outer standards to the inner standards (see Putlog).

Working platform: That part of a scaffolding on which workers and/or materials are supported for the purpose of carrying out construction work.

1. REQUIREMENTS

1.1 INTRODUCTION

This approved code of practice has been prepared to provide guidance on the planning for, erection of and subsequent use of scaffolding. It has been prepared for the scaffolding industry in particular and the construction industry in general. It is intended to provide a link between the performance requirements of the Health and Safety in Employment Act 1992 and the specific requirements of scaffolding standards such as the joint AS-NZS 1576 series and the joint Australia-New Zealand Standard *Guidelines for Scaffolding 1995*.

The Health and Safety in Employment Act 1992 (HSE Act) and the Health and Safety in Employment Regulations 1995 (HSE Regulations) prescribe safety provisions for all employment categories, including the construction and scaffolding industries. All persons engaged in scaffolding work are required to comply with these provisions. A summary of the HSE Act and HSE Regulations is provided in the introductory section of this document.

Suitable and sufficient scaffolding must be provided where the construction work cannot be carried out safely by other means. Standing scaffolds, suspended scaffolds or special scaffolds may be used.

1.2 DEFINITIONS OF SCAFFOLDING AND SCAFFOLDING PROCESS

For the purposes of this document:

Scaffolding is defined as any structure, framework, swinging stage, suspended scaffolding, or boatswain's chair, of a temporary nature, used or intended to be used for the support or protection of workers engaged in or in connection with construction work, for the purpose of carrying out that work or for the support of materials used in connection with any such work; and includes any scaffolding constructed as such and not dismantled, whether or not it is being used as scaffolding; and also includes any plank, coupling, fastening, fitting or device used in connection with the construction, erection, or use of scaffolding.

Scaffolding process is defined as the planning for, the design of, the erection of, the inspection of, the use of, and the dismantling of any scaffolding. The scaffolding process does not include the erection of structures constructed using scaffolding components, such as falsework, temporary grandstands, lighting towers, etc.

Notwithstanding the above definitions, those planning or constructing temporary grandstands, falsework, lighting towers, etc., may find some of the information in this code useful and relevant.

Further definitions are included in Appendix B of this document.

1.3 THE BUILDING ACT

Scaffolding as defined in this code and in the Building Act is not a “building” and as such a Building Consent is not required for a scaffold. The Territorial Authorities may impose requirements for the scaffold to protect people or property from the building activity. This may include the need to provide screening on the scaffold, catch fans, barriers or lighting.

The Building Code is the first schedule of the Building Regulations 1992. Clause F5.2 of the Building Code requires that building or demolition work be performed in a manner that avoids the likelihood of:

- (a) Objects falling on to people, on or off the site;
- (b) Objects falling on property off the site;
- (c) Other hazards arising on the site affecting people off the site and other property;
- (d) Unauthorised entry of children to hazards on the site.

Clause F5.3.1 requires that suitable construction methods be used to avoid the likelihood of tools or materials falling on to places where people might be present. Clause F5.3.3 requires that where a site contains hazards that might attract children, the hazard be enclosed to restrict access by children. Clause F5.3.4 requires suitable barriers to provide a safe route for public access where lifting equipment creates a risk from objects falling, or where a similar risk occurs. (Note: The Building Act, Building Regulations and the Building Code should be consulted for the most current requirements).

1.3.1 TEMPORARY GRANDSTANDS AND THE LIKE

Structures such as temporary grandstands, lighting towers and similar, constructed from scaffolding materials, are not scaffolding as defined in this code, and hence require a building consent. Persons involved in the process of planning or erecting such structures should seek clarification from the Territorial Authority.

1.4 MATERIALS

The HSE Regulations and various standards prescribe scaffolding made of timber, steel tubes, aluminium tubes or prefabricated frames. Other materials, provided they are suitable and adequate in strength, may be used subject to the approval of the Secretary of Labour. All scaffold materials must be in sound condition and be examined by a competent person before use.

1.5 SCAFFOLD PLANKS

All scaffold planks must meet the performance requirements specified in Part I of NZS 3620:1985 *Specification for scaffold planks* (this is reproduced in Appendix F).

A health and safety inspector may require a test report or certificate from a recognised testing authority for planks purporting to comply with NZS:3620 but not bearing the New Zealand Standard Certification Mark.

Planks must be frequently examined during use for splits, cracks, mechanical damage, excessive wear and decay. Planks which are defective must be rendered unfit for further use.

1.6 ERECTION, ALTERATION AND DISMANTLING

All scaffolding, whether notifiable or not, must be erected, altered and dismantled by competent workers under proper supervision.

Scaffolding must not be used unless the employer or employer's representative on the work is satisfied that it is safe for use and complies with the regulations. Scaffolding must not be altered or interfered with except on the instructions of the employer or employer's representative. Scaffolders must ensure that members of the public are not endangered while they are erecting, altering or dismantling scaffolds. They should also ensure that the lower working platforms are not used while the upper lifts are being worked on unless a fully decked platform, with screens if necessary, separates the part being erected or dismantled from the lower part in use.

All scaffolders should have a basic knowledge of rigging (some useful hints are given in Appendix E).

1.7 SUPERVISION

Standing scaffolding over 5 m high or intended to extend over 5 m, hanging scaffolds of any height and suspended scaffolding of any height may be erected, altered or dismantled only under the direct supervision of a person who holds an appropriate certificate of competency as a scaffolder issued under the regulations.

1.8 CERTIFICATES OF COMPETENCY

The Health and Safety Regulations require that persons who erect scaffolding, any part of which is 5 metres or more above the ground, must hold a certificate of competency in one of the following classes:

Basic Scaffolding: The equipment range is to include free-standing modular system scaffolding, ropes, gin wheels, static lines and fall arrest systems.

Advanced Scaffolding: The equipment is to include free-standing modular systems, tube and coupler scaffolding including tube and coupler covered ways and gantries, scaffolding associated with perimeter safety screens and shutters, cantilevered hoists with a load limit not exceeding 250 kg (materials

only), ropes, gin wheels, safety nets for public protection, and catch nets, static lines and fall arrest systems, bracket scaffolds (tank and formwork), cantilevered load platforms from a scaffold, cantilevered and spurred scaffolds, barrow ramps and sloping platforms, mast climbers, and hung scaffolding including scaffolding hung from tubes, wire ropes and chains.

Suspended Scaffolds: The equipment range is to include hand-haul and mechanical boatswain's chairs, building maintenance units and hand-haul and mechanical swinging stages.

1.9 DUTIES OF PRINCIPALS, CONTRACTORS, SCAFFOLDING ERECTORS AND USERS OF SCAFFOLDS

All those involved in the construction work have responsibilities for the scaffolding process, and for the protection of those who use the scaffold in the course of their work. While the actual scaffolding process can vary from project to project, it is up to those involved to clarify the various responsibilities. The following may provide some assistance in the clarification of roles.

Property developers have responsibilities as principals under the HSE Act. Main contractors, project management consultants, and subcontractors who plan or order a scaffold erected have responsibilities as principals and as employers under the HSE Act with respect to the scaffold. Scaffolding contractors who erect the scaffold, and contractors and subcontractors who use the scaffold, have responsibilities as employers under the HSE Act. Employees of all the above have responsibilities as employees under the HSE Act.

(Note that each party can have responsibilities as both principal and employer at the same time.)

Specific duties of each party to the scaffolding process may include the following.

(a) Property developers, project management consultants, owners, and persons who control the workplace need to ensure that:

- (i) Adequately qualified contractors and consultants are employed on the project.
- (ii) Sufficient monies are available to fund the works and the temporary works so that provisions can be made to protect employers, employees and others against the various hazards that may arise.

(b) Main contractors, project management consultants or subcontractors who engage others or contract for the erection of a scaffold need to:

- (i) Plan the work to be carried out from the scaffold and to specify any special requirements for the scaffold, e.g. any loads the scaffold may be expected to carry.
- (ii) Co-ordinate the erection, use and dismantling of the scaffold.
- (iii) Ensure the safety of others who may be in the vicinity of the scaffold, including members of the public.

- (iv) Provide for public protection including gantries, screening. This may include co-ordination with local authorities and obtaining permits as necessary.
- (v) Provide information about the foundation conditions for the scaffold, including information about the strength of verandahs and suspended slabs upon which the scaffold is to be erected.
- (vi) Provide information about the proximity of power lines and protective methods.
- (vii) Clearly communicate via specifications, drawings, or other informations, the scope and all requirements for the scaffold required, to the scaffolding erector.
- (viii) Co-ordinate/delegate all subsequent inspections and alterations needed to ensure the safety of the scaffold and those using the scaffold. This will include the need to ensure that a scaffold register or scaffold record system is kept up to date (see clause 1.9.1).
- (ix) Ensure protection of the scaffold from construction vehicles or other vehicles in the vicinity, including co-ordination of crane activities over the scaffold.

(c) Scaffolding erection companies must:

- (i) Develop a clear understanding of the scaffold required and the work that is to be carried out from the scaffold, including the need for protective gantries, screening, foundation conditions, power cables.
- (ii) Design and plan the scaffold and the erection process, including co-ordination with other employers who are in the vicinity, to ensure safety during construction, use, alteration and later dismantling of the scaffold.
- (iii) Provide a scaffold that complies with the manufacturer's specification and the code of practice.
- (iv) On completion of the erection of the scaffold, inspect and certify that it is safe to use, and to hand over the scaffold to their principal. The hand over must include any information that could affect subsequent users of the scaffold, and any limitations of the scaffold.
- (v) Co-ordinate with the principal on the need for subsequent inspections and alterations as work proceeds on the project, e.g. alteration of working platforms, increasing the height of the scaffold, etc.

(d) Users of the scaffold must:

- (i) Understand any limitations of the scaffold that could affect their work, e.g. load limits.
- (ii) Not alter the scaffold in any way that could affect its safety.
- (iii) Liaise with the main contractor or the scaffold erector to have ties, work platforms, relocated or altered, etc., as necessary.
- (iv) Carry out their own works so as not to endanger others in the vicinity.

1.9.1 SCAFFOLDING REGISTER AND INSPECTION OF SCAFFOLDS

All suspended scaffolds and all other scaffolds which exceed 5 m in height, or from which a person could fall 5 m or more, are to be inspected before first use and at regular intervals. Details of these inspections are to be recorded in an on-site scaffold register or in a suitable scaffold record system and signed by person carrying out the inspection. These inspections may be carried out by a certificated scaffolder of the appropriate class, or by a competent person such as a registered engineer.

(a) Initial inspection

Before first use, the scaffold is to be finally inspected and any defects found are to be rectified before use.

(b) Subsequent inspections

The scaffold is to be inspected at the following intervals:

- (i) Daily in the case of suspended scaffolds, or weekly in the case of all other scaffolds while the scaffolds are in use.
- (ii) After each structural alteration, addition or change to the nature of the scaffold or its anchorages or ties.
- (iii) Monthly while the scaffold is set up but not in use.
- (iv) After any storm or occurrence that could adversely affect the safety of the scaffolding.

Should any defect be found during these inspections, the defect must be rectified prior to being reused.

Sample registers and checklists are included in Appendix A, although these are offered for guidance only.

1.10 PROTECTION AND MAINTENANCE

All scaffolding must be protected against accidental damage from traffic or other causes and should, where necessary, be barricaded or, alternatively, be well stayed or braced to avoid damage from vehicles (fig. 1).

1.11 ACCESS TO WORKING PLATFORMS

Access must be adequate and safe for the working conditions and type of work carried out. Employers should give consideration to the number of users of the scaffold and their need to carry materials, tools and equipment to the working platforms. Access may be provided by permanently installed stairways, temporary stairways or portable inclined ladders. Employees should not be expected to climb vertical ladders, or to climb the scaffold structure to gain access to working platforms.

Portable ladders should comply with the following:

- (a) Ladders should be pitched at a slope of not less than 1 in 4 and not more than 1 in 6.

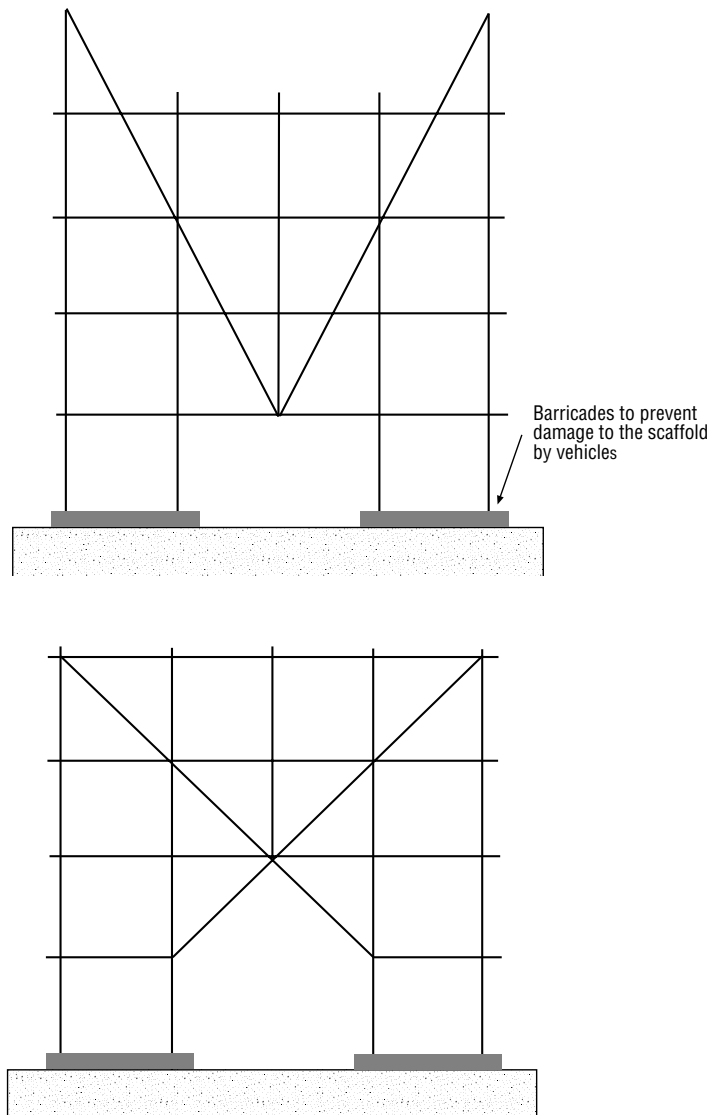


Fig. 1 Vehicle entrances.

- (b) Ladders should be securely tied to prevent them moving.
- (c) Ladders should be provided with landings top and bottom, and the landings should be properly guarded.
- (d) Maximum height between landings should not exceed 6.3 m.
- (e) Ladders should extend at least 1 m above landings.
- (e) The base of the ladder should be offset from the head of the ladder below, so that the ladders do not form a single continuous ladder.

1.12 SCAFFOLDING NEAR ELECTRIC POWER LINES

No person shall erect any scaffold at any distance, in any direction, less than that shown in the table (from NZECP 34:1993 Section 4) to any conductors of an overhead electric line.

*MINIMUM DISTANCE IN ANY DIRECTION FOR CONSTRUCTION OF
SCAFFOLDING AND OTHER STRUCTURES NEAR CONDUCTORS*

Line Voltage	Minimum Distance Under Normal Conditions
Not exceeding 66 kV (maximum span 125 metres)	4.0 metres
Exceeding 66 kV (maximum span 25 metres)	5.0 metres
Any voltage (span greater than 125 metres but less than 250 metres)	6.0 metres
Any voltage (span greater than 250 metres but less than 500 metres)	8.0 metres
Any voltage (span exceeding 500 metres)	As agreed with the owner of the line but not less than 8 metres

1.13 SCAFFOLDING OVER VERANDAHS, GANTRIES OR ROOFS

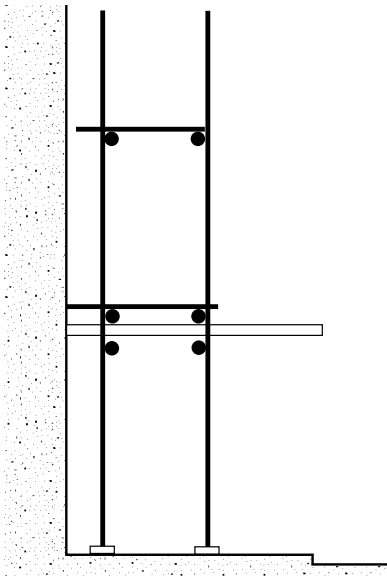
Verandahs, gantries or roofs used to support scaffolding must be certified as safe for the purpose by a competent person such as a registered engineer. The layout of the scaffold, including details of sole plates and the propping system, if any, must also be provided.

1.14 LIFTING APPLIANCES MOUNTED ON SCAFFOLDING

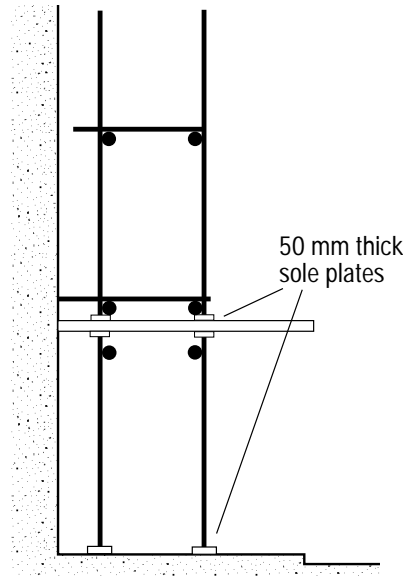
Hoists, winches and other lifting appliances may be mounted on scaffolding only if the scaffold framework is adequate in strength or is specially strengthened and tied back to reduce vibration and whip.

The strengthening must be calculated with reference to an effective static load of not less than two times the safe working load of the lifting appliance.

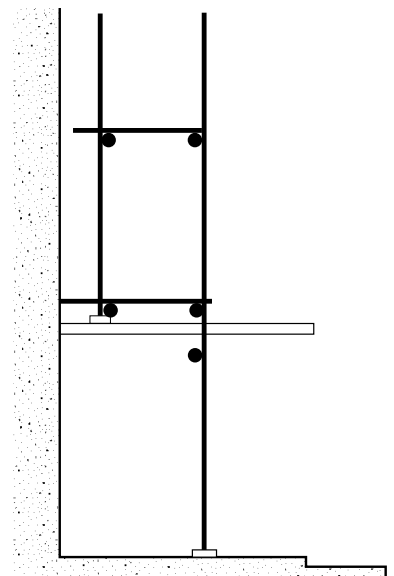
Where the lifting capacity exceeds 250 kg (2450 N), the scaffold must be strengthened to the design requirement of a registered engineer.



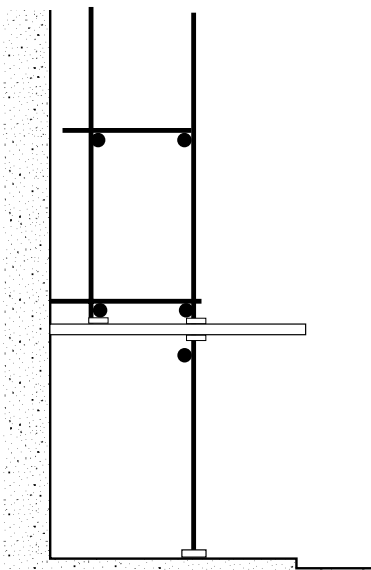
(a) Standards passing through verandah



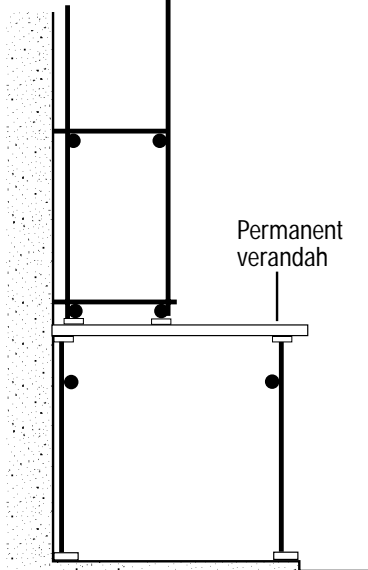
(b) Props directly under standards



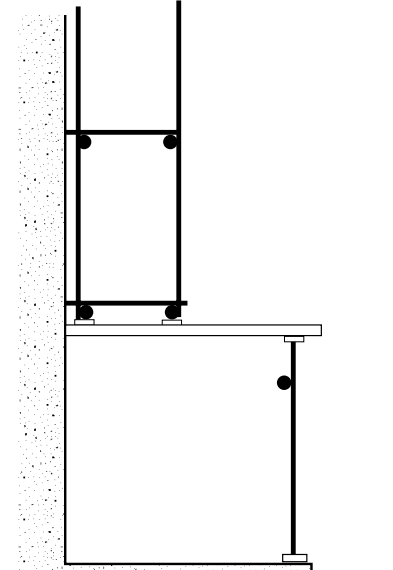
(c) Standard passing through verandah



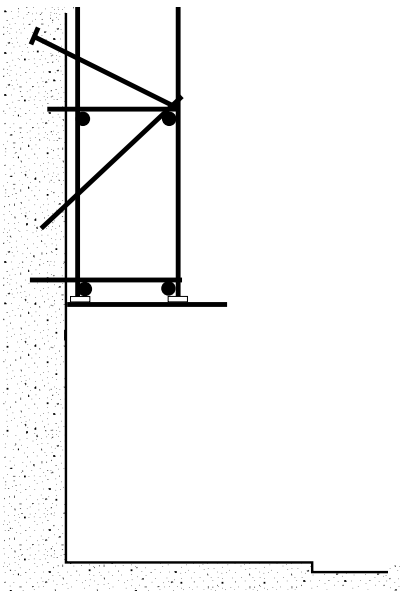
(d) Props directly under standard



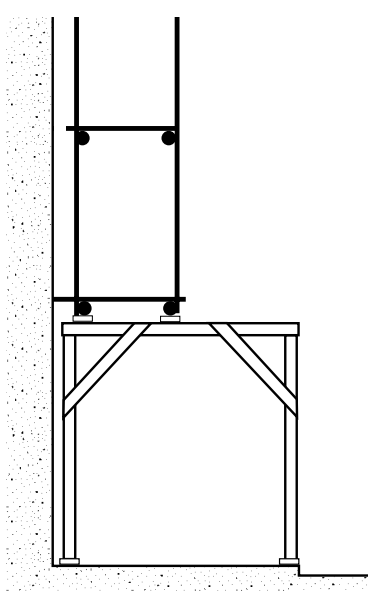
(e)



(f) Inside prop removed if verandah connection is sound



(g) Sound cantilever verandah



(g) Gantry

Fig. 3 Some methods of supporting scaffolding on or over verandahs.

NOTES

(a) to (f) built on a permanent verandah.

(c) to (g) All require a registered engineer's certificate.

(c), (d), (e), (f) and (g). These could be used only where verandah connection to building is sound and strong. Use 50 mm thick sole plates at all times. Sole plates on top of verandah or gantry to be at right angles to main members. Scaffold should be protected to avoid being damaged by passing traffic.

2. DESIGN REQUIREMENTS

2.1 PRINCIPLES OF DESIGN

The design of the scaffold shall take into account the following:

- (a) The strength, stability and rigidity of the supporting structure;
- (b) The handling normally associated with scaffolding;
- (c) The safety of persons engaged in the erection, alteration and dismantling of the scaffold;
- (d) The safety of persons using the scaffold;
- (e) The safety of persons in the vicinity of the scaffold.

2.2 BASIS OF DESIGN

The design of the structural members and components of a scaffold shall comply with NZS 3404.1, NZS 3603, AS 1538 or AS 1664.

Welding shall comply with AS 1554.1, AS 1665 or NZS 4701, as appropriate.

2.3 LOAD COMBINATIONS

Where scaffolding is designed, it shall be designed for the most adverse combination of dead loads, live loads and environmental loads that can reasonably be expected during the period that the scaffold is expected to be in service.

Load combinations for strength limit states shall be in accordance with NZS 4203, except that dead and live load combinations shall be as follows:

$$2.0G + 2.0Q$$

where

G = dead load

Q = live load (including impact, if any).

Where environmental loads will be such that work is unlikely to proceed under those conditions, then the worst case may be restricted to dead loads, expected live loads from stacked materials and environmental loads.

For permissible stress design, the sum of the dead and live loads applied shall be increased by 15 percent, to allow for re-use of materials.

2.4 DESIGN LOADS

2.4.1 DEAD LOAD

The dead load (G) shall include the self-weight of the scaffold structure and components including working platforms, catch platforms, access platforms, stairways, ladders, screens, sheeting, platform brackets, suspension ropes, secondary ropes, traversing ropes, tie assemblies, scaffolding hoists, electrical cables and any other attachments, where appropriate.

2.4.2 ENVIRONMENTAL LOADS

Where appropriate, the environmental loads shall include the following:

- (a) Wind loads in accordance with NZS 4203 imposed on the scaffold, including any guardrails, toeboards, stacked materials, screens, sheeting, platform ropes, guy wires and other attachments;
- (b) Snow loads in accordance with NZS 4203;
- (c) Rain and ice loads, where it is considered likely that the scaffold and claddings will be subjected to rain or a build-up of ice;
- (d) Earthquake loads in accordance with NZS 4203.

2.4.3 LIVE LOADS

2.4.3.1 General. The live load (Q) shall include the following:

- (a) The weight of persons;
- (b) The weight of materials and debris;
- (c) The weight of tools and equipment;
- (d) Impact forces.

2.4.4.2 Duty Live Loads. The live load applied to a working platform shall be categorised by the following duty conditions:

- (a) Light-duty, a load of 2.2 kN per bay that includes a single concentrated load of 1 kN;
- (b) Medium-duty, a load of 4.4 kN per bay that includes a single concentrated load of 1.5 kN;
- (c) Heavy-duty, a load of 6.6 kN per bay that includes a single concentrated load of 2.0 kN;
- (d) Special-duty, the largest intended load but not less than heavy-duty.

For design purposes, the single concentrated load shall be assumed in the most adverse position within the bay.

2.5 SUPPORTING STRUCTURE

2.5.1 GENERAL

The supporting structure shall be capable of supporting the most adverse combination of loads applied by the scaffold during the period of its service.

2.5.2 STRENGTHENING OF SUPPORTING STRUCTURE

Where the supporting structure is not capable of supporting the most adverse combination of expected loads in Clause 2.5.1, it shall be strengthened by propping or other means.

2.5.3 SOLEPLATES

Where soleplates are required, they shall be designed to distribute the load from a scaffold to the supporting structure.

3. STANDING SCAFFOLDS

3.1 SCOPE

This part covers standing scaffolds which are supported wholly or partly from their base. The scaffolds may be either free-standing or held sideways by ties, rakers or other means.

The kinds of scaffolds generally used are:

- (a) Timber scaffolding;
- (b) Tube scaffolding in steel or aluminium; and
- (c) Scaffolding with proprietary equipment.

3.2 FOUNDATIONS

Scaffolding foundations must be adequate to carry the whole weight of the scaffold, including the imposed loads, and must be maintained in a stable condition during the life of the scaffold. Steel base plates must be used under all standards.

When scaffolds are supported on the ground, suitable sole plates must be used to spread the load. The sole plates should preferably be long enough to support at least two standards. (See fig. 4).

Timber sole plates must be not less than 200 x 38 x 500 mm long. Bricks, blocks and similar loose material are unsuitable as they are liable to fall over or split, and are easily driven into the ground.

Where the foundation is levelled concrete of adequate thickness or of a similar hard surface, the sole plate may be omitted, but steel base plates must be provided at the bottom of all standards.

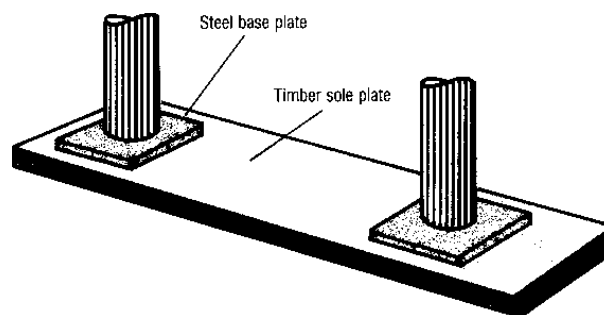


Fig. 4 Support for tubular scaffold standards.

3.3 WORKING PLATFORMS

Working platforms are classified as light-duty, medium-duty, heavy-duty or special-duty.

3.3.1 LIGHT-DUTY PLATFORMS

For light-duty platforms, the maximum longitudinal standard spacing is 2.4 m and the maximum standard spacing is 1.5 m.

3.3.2 MEDIUM- OR HEAVY-DUTY WORKING PLATFORMS

For medium- or heavy-duty working platforms, the following additional requirements must also be complied with:

- (a) Where the span exceeds 2.0 m, one intermediate putlog must be provided at mid-span to support timber scaffold planks; this requirement does not apply to metal planks (fig. 5).
- (b) When the live load is not evenly distributed over the platform, as in the case of a blocklayer's scaffold which has bricks or concrete blocks stacked on the outside edge of the platform, the outside ledger which carries most of the load must be supported by an additional standard, with intermediate putlog placed at mid-span (fig. 5).
- (c) When the total live load of 4.4 kN or 6.6 kN is not uniformly distributed but is concentrated at mid-span, e.g. concrete blocks stacked on pallets, an additional pair of standards with intermediate putlog must be provided at mid-span.

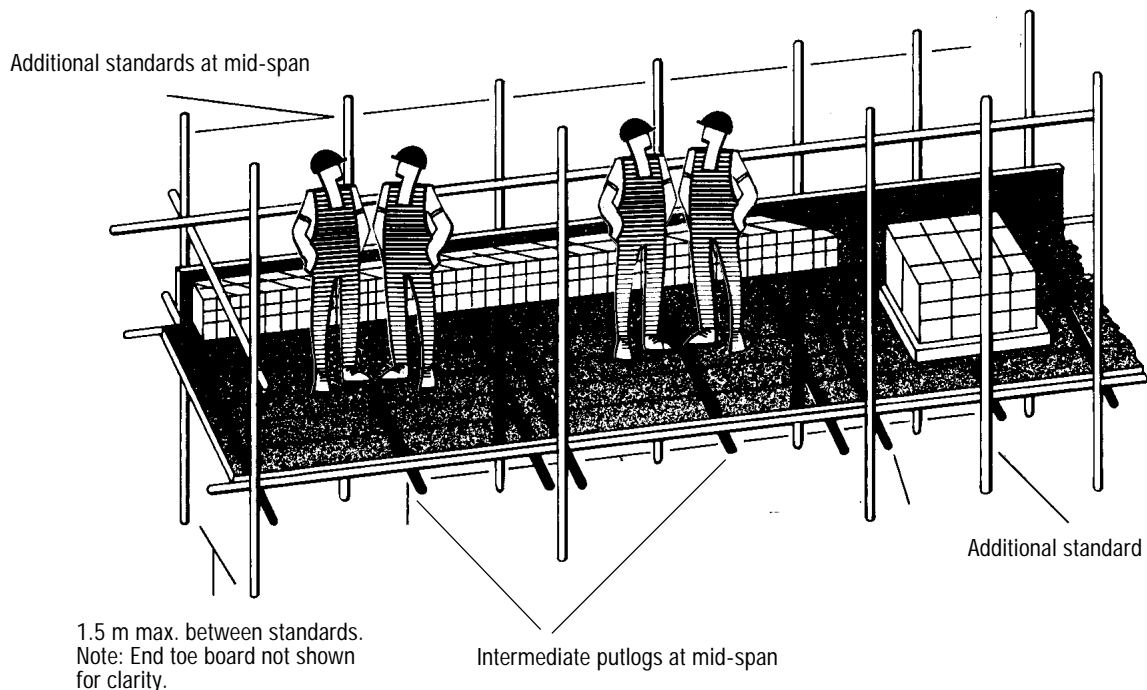


Fig. 5 Medium- or heavy-duty load.

3.3.2 HEAVY-DUTY PLATFORMS

For heavy-duty platforms, the maximum longitudinal standard spacing is 1.8 m and the maximum transverse standard spacing is 1.275 m.

2.4.3 SPECIAL-DUTY WORKING PLATFORMS

Special-duty working platforms are platforms that do not conform to the requirements of either a light-duty or heavy-duty platform with respect to loading and/or dimensions. The platform must be of adequate strength and stability. The health and safety inspector may require a registered engineer's design certificate for a special-duty platform.

3.4 PLATFORM DECKING

The decked width must be not less than 675 mm, with sufficient additional width to leave 450 mm minimum clear walkway at all times (fig. 6).

The distance between the outer edge of the platform to be guarded and the projection of the inner vertical face of a guardrail must not exceed 200 mm. Scaffold planks must be so placed, locked or secured as to prevent tipping or displacement during normal use, or movement by strong wind. End overhang must be 80 mm minimum to 220 mm maximum.

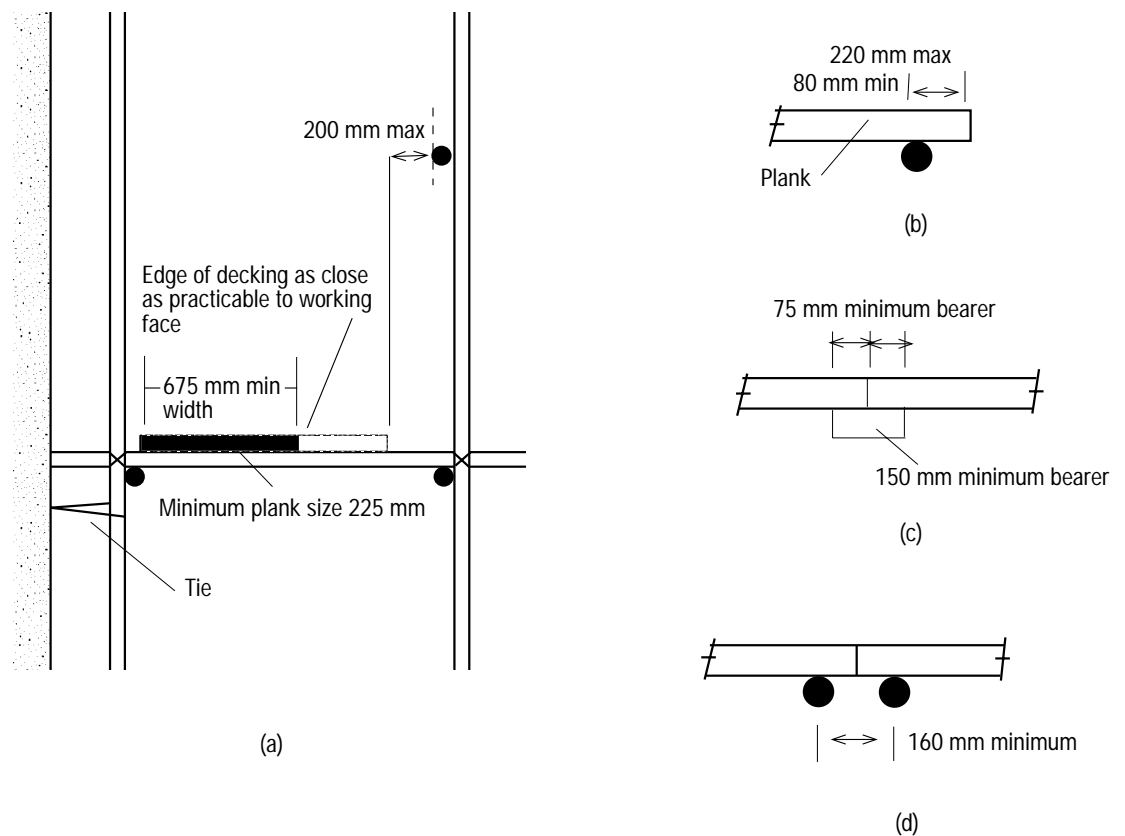


Fig. 6 Decking.

It is good practice to butt planks in a decked platform. When butted, each end bearing shall be not less than 75 mm. When lapped, the amount of overlap must be not less than 150 mm. Decking planks which are lapped must be fitted with wedge cleats or fillets to reduce the risk of tripping or facilitate the wheeling of loads.

Every working platform must be decked as close as practicable to the working face of the structure it is being used with.

Where the height is greater than 3 m, a guardrail or other protection must be provided within 200 mm of the outer edge of the plank

3.5 GUARDRAILS AND MIDRAILS

Guardrails, including midrails, must be provided on the exposed sides and ends of all working platforms more than 3 m in height (fig. 7). The height to the top of the guardrail must be not less than 0.9 m or more than 1.1 m from the deck to be protected.

A midrail is not required on a working platform which:

- (a) Is provided with a toeboard of 225 mm minimum height; or
- (b) Is provided with equivalent protection.

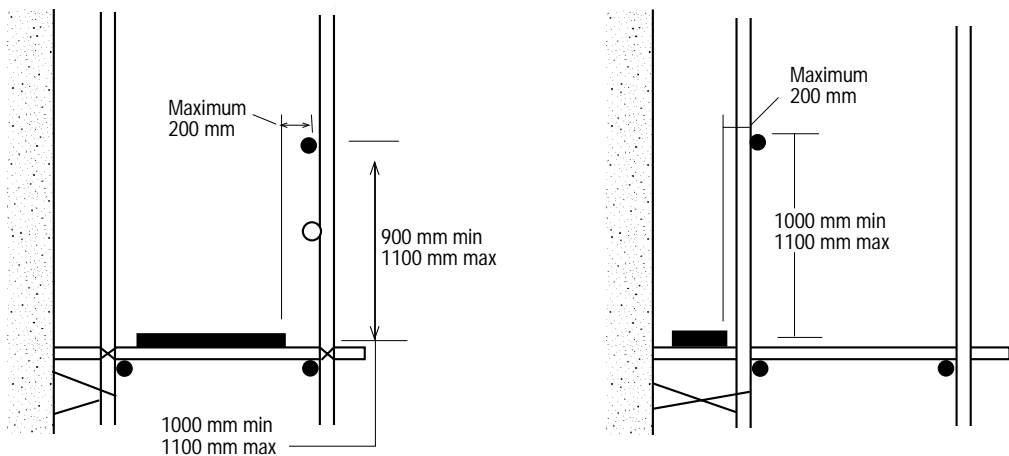


Fig. 7(a) Guardrails.

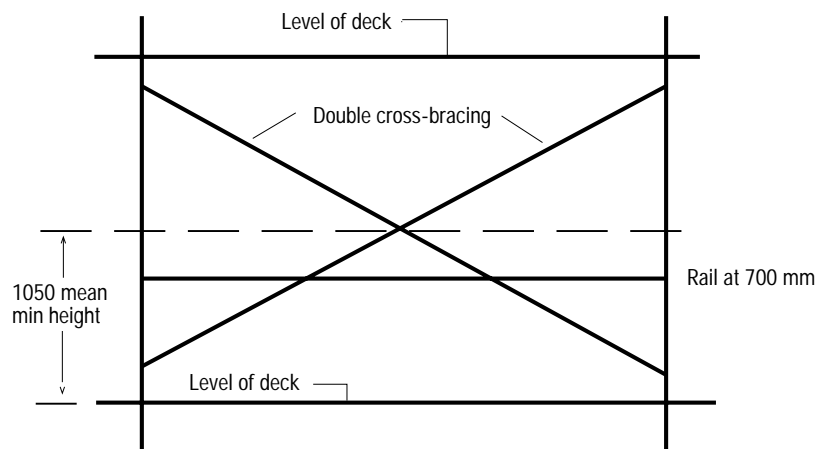


Fig. 7(b) Guardrails.

A guardrail, including a midrail, must be:

- (a) In a plane parallel with the outside ends or exposed edges to be guarded;
- (b) Secured to the inside of the standard; and
- (c) Kept in place except when removed temporarily for access.

Cross-bracing (double) as used in some frame scaffolds is acceptable in place of a guardrail, if the platform is decked out to within 200 mm horizontally from the cross-bracing, and the braces cross within 50 mm of the mean guardrail height of 1050 mm above the platform. However, a rail at height 700 mm above deck level must be provided (fig. 7(b)).

The guardrail may be fixed to the outside of the standard. To facilitate the movement of materials, guardrails and toeboards may be temporarily removed, but they must be replaced as soon as practicable.

Each rail, when secured to the standards or upright members, must be capable of sustaining without failure or undue deflection a force at any point of 70 kg (690 N) vertical and 45 kg (440 N) horizontal, acting separately.

3.6 TOEBOARDS

A toeboard or equivalent protection must be fitted on the outside edge of every working platform more than 3 m in height, if materials and tools are placed on the platform and are likely to be dislodged (fig. 8). The toeboard must be of sufficient height and strength to prevent the tools or materials from falling and must be secured to the inside of the standards. A scaffold plank of 225 mm minimum width may be used as a toeboard.

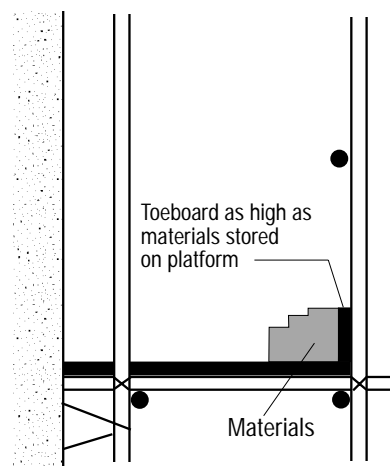


Fig. 8 Toeboard.

3.7 SCREENS

Where the scaffold platform is above a public thoroughfare, and due to the nature of the work falls of material are possible with injury to passers-by, special precautions must be taken. Special protection may consist of:

- (a) Screening the working platforms with robust screens or steel mesh to a height of at least 1 m. The mesh opening shall not exceed 50 mm.
- (b) Providing catch screens where the horizontal distance from the scaffolding is more than half the vertical distance between the screen

and the middle of the topmost working platform of the scaffold.

Containment sheeting may be used to provide protection to the public from the construction works being carried out or to provide weather protection for construction workers working on or about the scaffolding.

Containment sheeting increases the dead load on the scaffold, and greatly increases the wind load on the scaffold. It is unlikely that black wire ties commonly used to tie scaffolds, will be sufficient where containment sheeting is used. *For this reason it is essential that scaffolds that are to be sheeted be designed and approved by a competent person such as a registered engineer experienced in scaffold design.*

When selecting containment sheeting the following should be considered:

- Degree of weather protection required;
- Degree of protection to the public that is required;
- Light transmission to the workface;

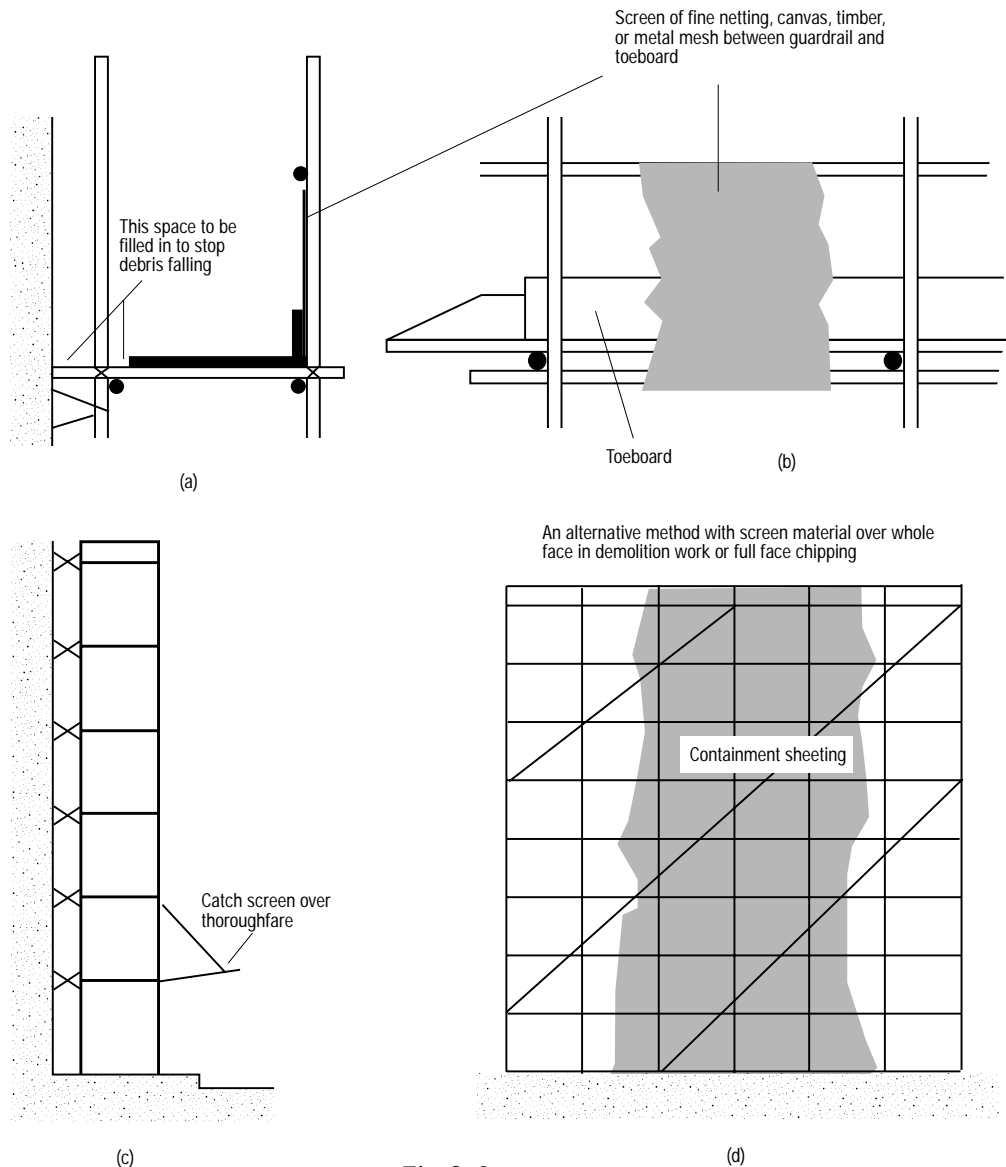


Fig. 9 Screens.

- Self-weight and wind load onto the supporting surface;
- Size of the sheets, the frequency and pattern of fixing points (some sheeting may require additional ledgers);
- Flammability of the sheeting;
- Ventilation of the material.

It may be necessary to provide caps on putlogs and transoms to minimise chaffing to the sheeting.

(Hessian is not considered a suitable material for containment sheeting as it is not sufficiently robust and it has a high fire risk.)

3.8 HEADROOM AND LIFTS

A scaffold platform used as a regular walkway or for the wheeling of loads must have a clear headroom of at least 1.8 m along the mid-half width (fig. 10).

Where a succession of platforms is used to work up or down a face, the vertical spacing of lifts must not exceed 2.1 m except for the first lift, which if

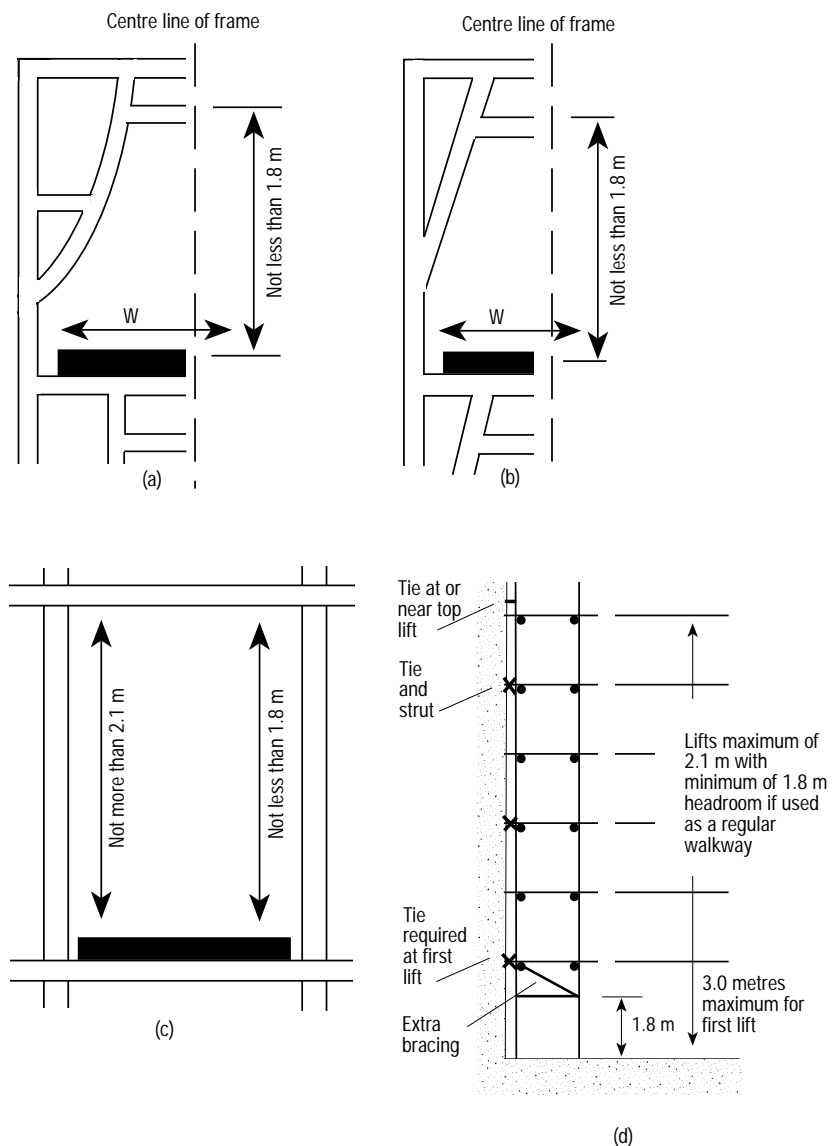


Fig. 10 Headroom.

necessary may be up to 3 m to allow for satisfactory working conditions at ground or floor level. When the height of the first lift exceeds 2.1 m, extra bracing must be provided on each pair of standards, commencing at approximately 1.8 m from the ground.

3.9 HEIGHT OF SCAFFOLDING

The height of any scaffolding depends upon its foundation, the size and type of material used in the construction of the standards, spacing of ties, and the lateral stability in all directions of the scaffolding as a whole. The maximum height of a scaffold constructed in accordance with this code of practice is 33 m. Scaffolds in excess of 33 m must be subject to specific design and require a registered engineer's certificate.

3.10 TIES

Ties must be provided to prevent inward and outward movement of the scaffold and to assist the standards to act as load-carrying vertical members (fig. 11). Ties must be fixed to standards and as close as practicable to ledger intersections. Ties must also be uniformly spaced, vertically and horizontally, over the face of the scaffolding, including the level of the topmost working platform. The tie spacing must be in accordance with the spacings

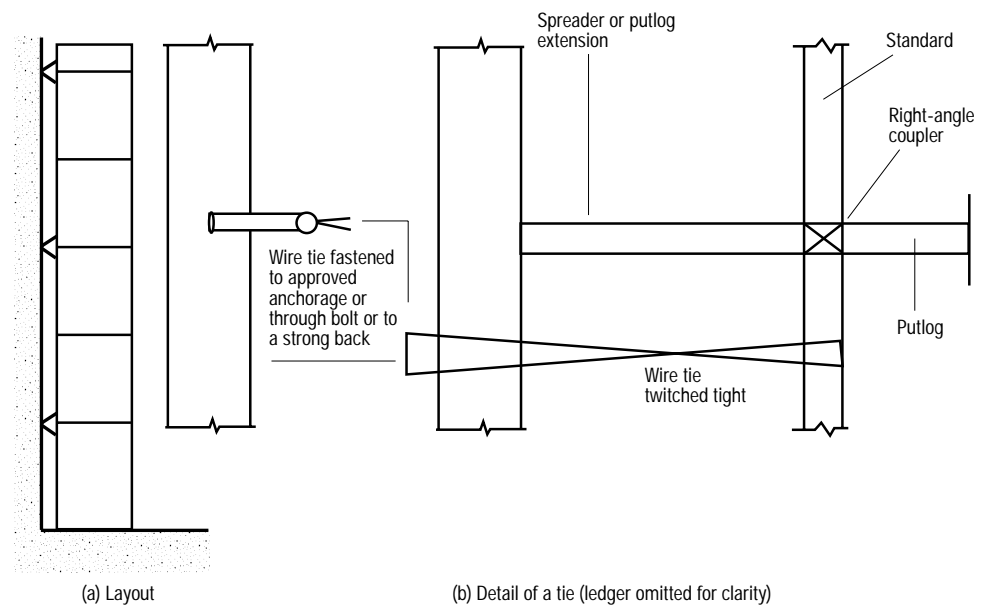


Fig. 11 Ties.

A tie must be capable of safely withstanding a horizontal force equivalent to 10 percent of the weight of the scaffold plus the full live load on the area of scaffolding in the vicinity of each tie, or the environmental loads of NZS 4203.

The safe load of a tie must not exceed one-quarter of the breaking load of tie and anchorage.

A tie that is not capable of transmitting tension and compression must be used in conjunction with a spreader or putlog extension. They must be placed close to each other and be adequately held in position.

A wire tie must be fastened to a structure by an approved anchorage, a through bolt or tied to a strong back. The strength of the building structure at the location of the tie must be checked for its adequacy to sustain the loads which will be transferred to it.

When intending to fix cast-in and drilled-in anchorages, the manufacturer's recommended safe working load may be used.

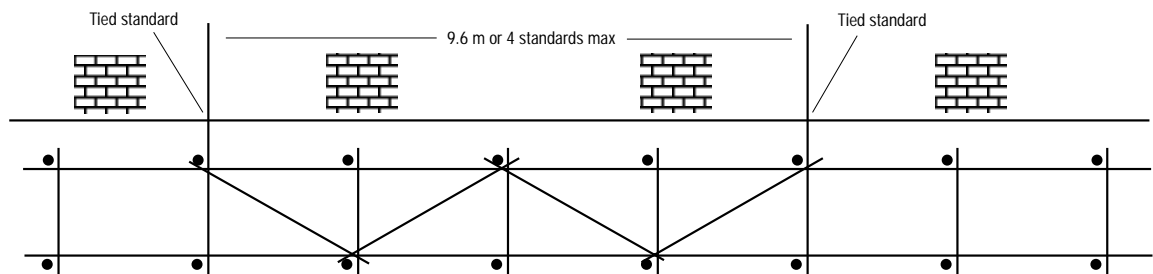
Where the tie spacing of table 1 cannot be complied with, additional plan bracing or dogleg bracing shall be provided between tie points.

3.11 BRACING

Adequate bracing must be provided as follows:

3.11.1 PLAN BRACING

Where the horizontal tie spacings cannot be complied with, plan bracing shall be provided. Even with this bracing provided, the maximum horizontal distance between tie points shall not exceed 9.6 m. (Fig 12(a)).



**Fig. 12 (a) Plan bracing where horizontal tie distance is excessive.
Note that substantial ties are required.**

3.11.2 DOGLEG BRACING

Where it is impracticable to fit ties at the vertical spacing specified, dogleg bracing shall be provided. With such bracing the distance between tie points shall not exceed 8.4 m or 4 lifts. (Fig.12 (b)).

Temporary ties may be required to ensure stability of the scaffold during erection and dismantling.

When plan or dogleg bracing is used, the ties are required to carry substantial loads. The ties shall be capable of carrying this load.

- (a) Transverse diagonal bracing must be fixed to each end pair of standards and at not more than every tenth pair of standards along the scaffold. This bracing may be temporarily removed on a working lift to facilitate movement of materials but must be replaced as soon as practicable. This bracing is not required when dogleg bracing is used in lieu of ties.

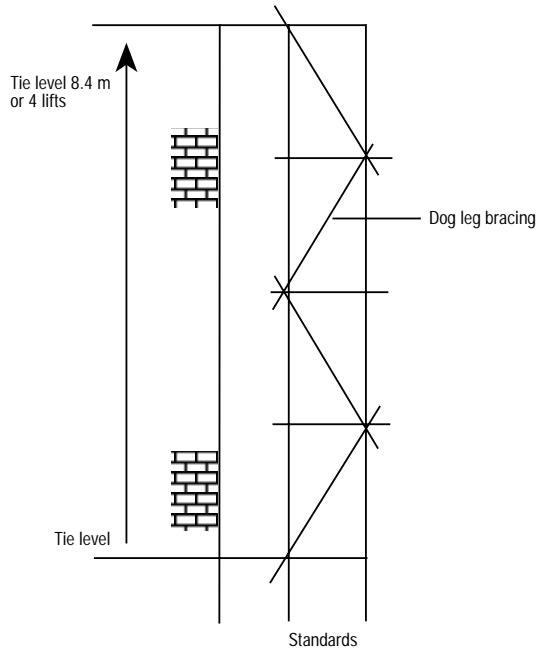


Fig. 12 (b) (Cross section) Dogleg bracing used when vertical distance between ties is excessive. Note that substantial ties are required.

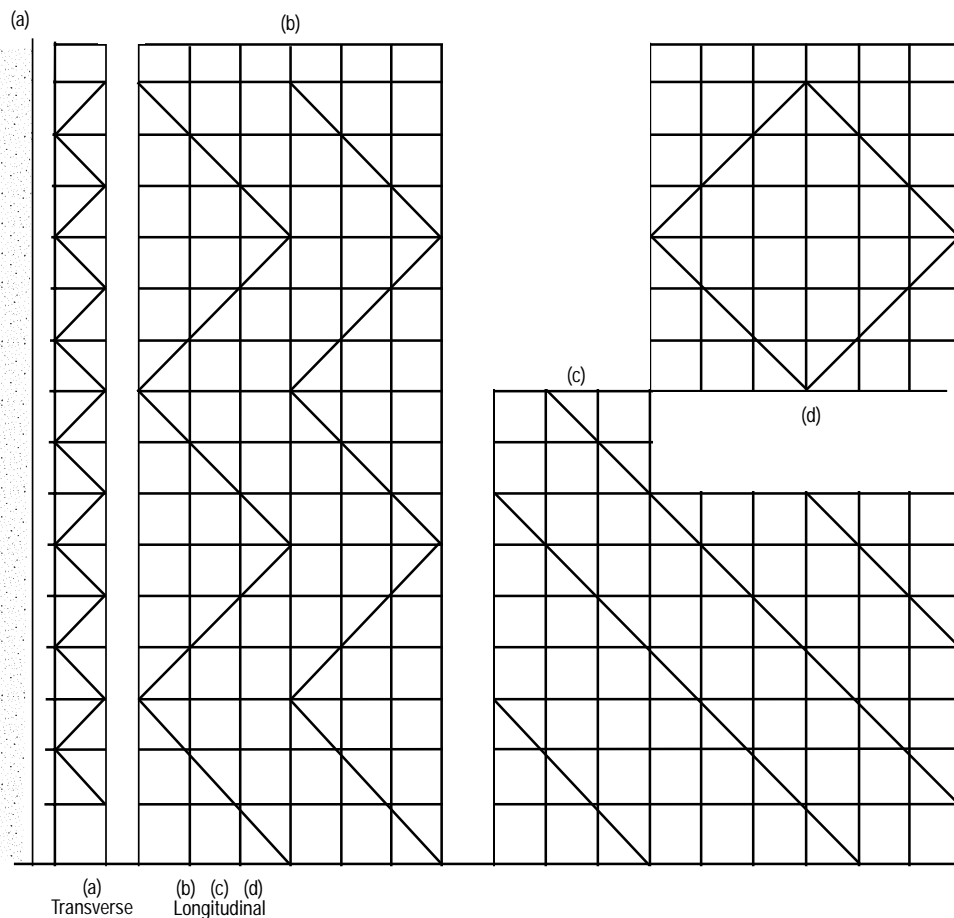


Fig.13 Bracing.

- (b) Longitudinal diagonal bracing must be fixed to the external face of the scaffold, and at regular intervals along its length. The bracing, which is required to resist wind and earthquake forces in particular, must be capable of withstanding a horizontal force of not less than one-tenth of the total of the weight of the scaffold and the full live load on the working platforms. Some methods of arranging diagonal bracing for scaffolds are illustrated in fig. 13.

4. TIMBER SCAFFOLDING

4.1 SCOPE

This part refers to standing scaffolds which comprise standards, ledgers, guardrails and putlogs made of timber.

4.2 QUALITY OF TIMBER AND FITTINGS

Radiata pine and Douglas fir are suitable timbers for use in timber scaffolding and must be either No.1 framing grade or standard building grade as specified in NZS 3631:1978 *Classification and grading of New Zealand timber*.

Other species of timber may be used if they are of equivalent strength and quality.

All timber used in scaffolding should be preservative treated in accordance with an appropriate commodity specification of the Timber Preservation Authority.

Commodity Specification C7 is suitable for external scaffolding except when standards and sole plates are in direct contact with the ground, in which event it is necessary to treat to C3 Commodity Specification. For indoor scaffolding, boron-treated timber is satisfactory. Untreated timber may be acceptable if the timber is sound and unlikely to deteriorate during the life of the scaffold.

Fittings used for connecting joints between standards ledgers and braces must be of adequate strength and be maintained in good condition.

4.3 SPECIFIC REQUIREMENTS

The design and construction of timber scaffolding for the support of both light-duty and heavy-duty working platforms must be carried out in accordance with sound engineering and trade practices and conform to appropriate New Zealand Standards. The requirements for single-standard (pole) light-duty scaffolds with putlogs cleated to wall or frame and for use up to 5 m high are summarised below and illustrated in fig. 15.

4.3.1 STANDARDS

100 mm x 50 with a maximum spacing of 2.4 m.

4.3.2 PUTLOGS

150 mm x 25 mm or 100 mm x 50 mm for a maximum span of 1.2 m or 2/150 mm x 25 mm for a maximum span of 1.5 m.

4.3.3 BRACING

Each standard must be tied to the wall by a putlog and braced longitudinally by a ledger and at least two diagonal braces in the length of the scaffold. An additional diagonal brace at 40° to 50° slope must also be provided for every 20 m length of scaffold. Minimum size of brace to be 100 mm x 50 mm or 150 mm x 25 mm.

4.3.4 GUARDRAIL AND MIDRAIL

Minimum size 100 mm x 50 mm.

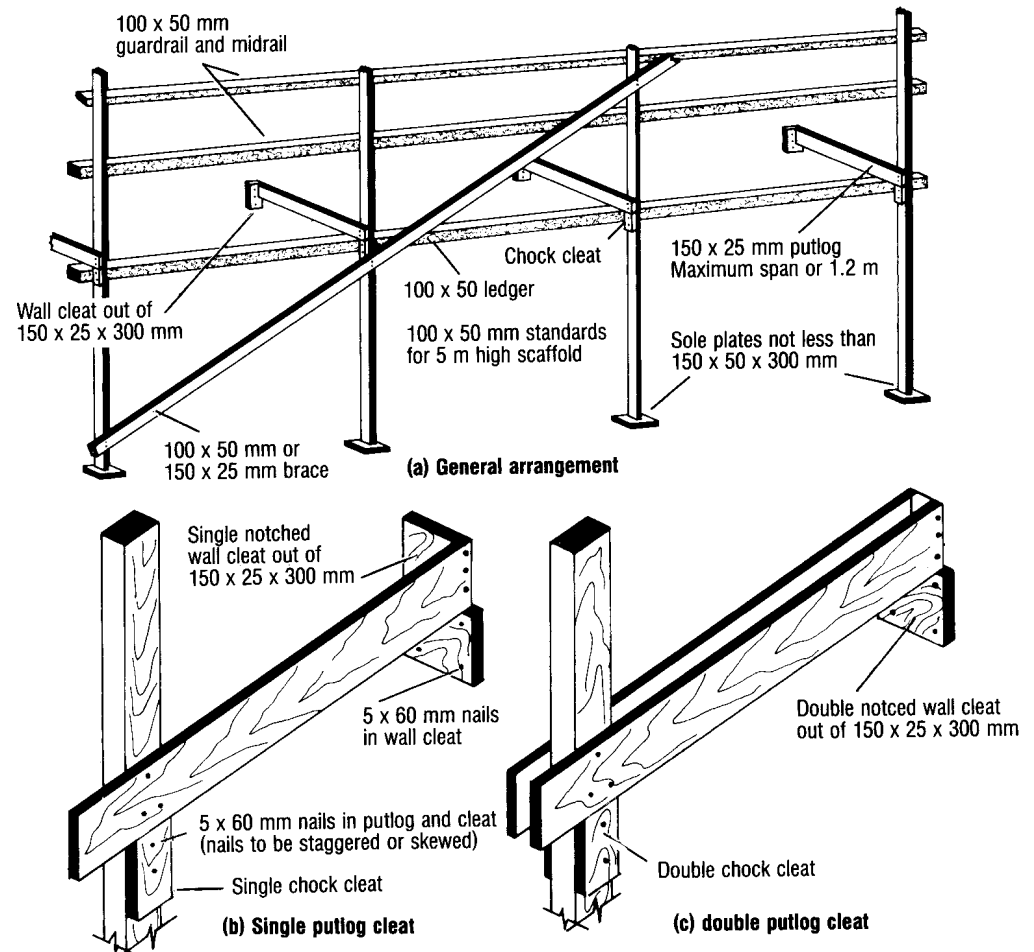


Fig. 14 Single standard light-duty scaffold

5. TUBE SCAFFOLDING IN STEEL OR ALUMINIUM

5.1 SCOPE

This part deals with standing scaffolds where the standards, ledgers guardrails, midrails and putlogs are made of steel or aluminium tubes. The general rules may be applied to hanging scaffolds made of metal tubing.

5.2 GENERAL REQUIREMENTS

The general requirements for metal tubes and fittings of steel or aluminium are:

- (a) Metal tubes must be purpose made with outside diameters accurately gauged to fit properly into the metal couplings and to allow complete interchangeability.
- (b) Tubes in use on a scaffold must be in good condition, free from bends and defects that might affect strength, reasonably free from corrosion and cut square at the ends. Tubes which are 3 m and over in length should be reamed, if cut, to ensure safety when using internal joiners.
- (c) When the loss of metal by corrosion or other causes reduces any cross section of a tube so that its corresponding weight is less than 90 percent of its original weight, the affected length of tube is to be discarded and rendered unfit for further use in scaffolding.
- (d) Steel tubes must be hot-dipped galvanised or painted when used in scaffolds which are exposed for prolonged periods to marine or corrosive atmospheres.
- (e) Fittings and couplings must be specially made for the tubes in use and must be of a satisfactory quality as to strength and performance.
- (f) Fittings must be carefully maintained in good order and condition. They must not be left lying around but stored in bags, boxes or bins, and kept well oiled and protected from rusting.

Special attention must be given to the care and checking of screw threads and nuts; worn or distorted parts must be discarded or replaced. Cracks or other flaws must be watched for.

5.3 MATERIALS

5.3.1 STEEL TUBES

Steel tubes shall comply with AS 1576.3 or BS 1139 and meet the following requirements:

Minimum yield strength	200 MPa
Outside diameter	48.3 mm
Minimum wall thickness	4.0 mm

Where steel tubes complying with BS 6323 parts 1 to 4, and with a minimum outside diameter and wall thickness 48.3 mm and 3.2 mm respectively are used for scaffolding, such tubes shall be galvanised in accordance with Annex A of BS 1139 section 1.1.

5.3.2 ALUMINIUM TUBES

Aluminium tubes shall comply with AS 1576.3 or BS 1139 part 1.2 and meet the following requirements:

Minimum yield strength	241 MPa
Outside diameter	48.4 mm
Minimum wall thickness	4.47 mm

5.3.3 COUPLERS AND ACCESSORIES

Couplers and accessories shall comply with AS 1576.2 or BS 1139 as appropriate for scaffold system being considered.

5.4 SPECIFIC REQUIREMENTS FOR STANDING SCAFFOLDS

5.4.1 STANDARDS

Standards must be pitched on base plates and set up vertically with spacings in accordance with table 1. Joints in standards must be staggered and must not occur:

- (a) In adjacent standards in the same lift, i.e. joints should be two bay lengths apart; or
- (b) In the same standard in adjacent vertical lifts, i.e. joints should be two vertical lift heights apart.

Sleeve couplers or spigot fittings shall be used to connect standards.

5.4.2 LEDGERS

Ledgers must be:

- (a) Continuous for the full length of the scaffold;

- (b) Attached to both rows of standards at the level of each lift; and
- (c) Horizontal and fixed with right-angle couplers to the inside of the standards.

Joints in ledgers shall be staggered and shall not be located in the middle third of the distance between adjacent standards, or in horizontally or vertically adjacent ledgers in the same bay.

Sleeve couplers or spigot fittings shall be used to connect ledgers.

Ledger spacings must conform to table 1.

5.4.3 PUTLOGS

Putlogs must be placed at each pair of standards for all scaffolds.

For a medium-duty scaffold, one intermediate putlog must also be provided in each bay to support timber scaffold planks when the span exceeds 2 m.

For a heavy-duty scaffold, one intermediate putlog must be provided to each bay to support timber scaffold planks when the span exceeds 1.6 m.

Putlogs may be connected to ledgers with either right-angle couplers or putlog couplers. However, right-angle couplers only must be used when putlogs are required to transmit forces, that is when:

- (a) Putlogs are underslung from ledgers;
- (b) Putlogs are used as ties and spreaders;
- (c) Putlogs are placed adjacent to ties and spreaders;
- (d) Putlogs are to be connected to braces.

Putlog spacings must comply with table 1.

5.4.4 TIES

Ties must be uniformly spaced over the face of the scaffolding in accordance with table 1.

5.4.5 BRACES

Braces comprising scaffold tubes must be connected as close as practicable to standard ledger intersections.

Where required:

- (a) Transverse diagonal bracing must be fixed at each lift, either to ledgers with right-angle couplers or to standards with swivel couplers.
- (b) Longitudinal diagonal bracing must be fixed to every standard with swivel couplers and/or to extended putlogs on every lift with right-angle couplers.

Diagonal bracing must be continuous and be joined with sleeve couplers.

The detailed requirements for steel and aluminium tubular scaffolds are summarised in table 1.

TABLE 1: TUBULAR SCAFFOLDS IN STEEL AND ALUMINIUM

Member	Light-Duty	Medium-Duty	Heavy-Duty	Notes
1. Working Platforms				
Number per bay that may be used at one time, when				(i) Maximum height of scaffold must not exceed 33 m. (ii) Height of each lift must not exceed 2.1 m, except for the first lift which may be up to 3 m in height.
(a) height does not exceed 33 m	2	1	1	
(b) height does not exceed 13.5 m	4	2	2	
2. Scaffold Planks				
(a) Timber planks (solid or laminated)	2.4 m	2.0 m	1.2 m	When the span of a medium-duty platform decked with timber planks exceeds 2.0 m, one intermediate putlog must be used. One intermediate putlog must be used on heavy-duty platforms decked with timber planks.
(b) Metal planks (steel or aluminium)	2.4 m	2.4 m	1.8 m	
3. Standards				
(a) Longitudinal spacing	2.4 m (max)		1.8 m	(i) All members, including bracing, guardrails and midrails, consist of either steel tubes for steel scaffolds, or aluminium tubes for aluminium scaffolds. Aluminium tubes and steel tubes must not be mixed unless it is a requirement of a special design. (ii) Putlogs are connected to ledgers at each pair of standards. (iii) Guardrails and midrails are fixed to the inside of standards. (iv) All dimensions are from centre to centre of the respective members.
(b) Transverse spacing	1.55 m (max)		1.27 m	
4. Ledgers				
(a) Horizontal spacing (between standards)		1.45 m		
(b) Vertical spacing (i.e. lift height)	2.1 m (max) 1.8 m (min)			
5. Putlogs				
Maximum span		1.45 m	1.27 m	
6. Ties				
(a) Horizontal spacing	4.8 m (i.e. on alternative pair of standards)			(i) One tie must be provided at or as near as practicable to the top-most working platform. (ii) The vertical tie spacing may be increased to 8.4 m provided one substantial tie is placed at the top-most working platform and that transverse dogleg bracing is used on alternate pairs of standards. (iii) The horizontal tie spacing may be increased to 9.6 m provided that substantial ties are placed at the end pairs of standards and that plan bracing is placed at the level of the ties.
(b) Vertical spacing	4.2 m (i.e. on alternative lifts)			
7. Bracing				
(a) Transverse diagonal				At each end of standards and at not more than every tenth pair of standards along the scaffold. This is not required when dogleg bracing is used in lieu of ties.
(b) Longitudinal diagonal				One diagonal for every 3 bays or less in length, and 3 lifts in height of scaffold, on outer face and at approximately 40° slope, arranged either in a zigzag pattern from bottom to top or sloping continuously from bottom to top (see fig. 13).

6. SCAFFOLDING WITH PROPRIETARY EQUIPMENT

6.1 SCOPE

This part deals with standing scaffolds made from proprietary components and comprises prefabricated frames and members, or unit-assembled equipment.

6.2 GENERAL REQUIREMENTS

Where equipment comprises a complete set of components of unique design, the supplier of the system must provide a complete set of instructions for the safe erection and use of the scaffold. The supplier's instructions for use must always be followed. When properly assembled, with all fittings tightened, the scaffold must be equivalent in strength to the standard tubular scaffold of similar height and width. It must be sufficiently robust to resist deformation under normal handling conditions and to provide adequate transverse stiffness to each pair of standards.

Scaffolds must be properly braced by cross-bracing or diagonal braces, or both, for securing vertical members together laterally, and the cross braces must be of such length as will automatically square and align vertical members so that the erected scaffold is always plumb, square and rigid. All brace connections must be made secure.

Scaffold legs must be set on either plain or adjustable bases.

Where it is necessary to extend the legs of frames because of uneven foundation levels, special care must be taken. Adjustable screw extension pieces must have at least 200 mm length of spigot inside the upper tube (fig. 15). Packing that is built up to provide a firm footing must be so arranged as to avoid possible displacement, with the least plan dimension of the packing being twice its height.

All equipment must be either hot-dipped galvanised or suitably painted when used in scaffolds which are exposed for prolonged periods to marine or corrosive atmospheres.

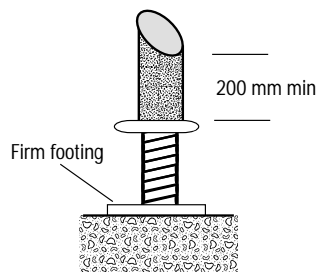


Fig. 15 Adjustable screw extension.

6.3 FRAME SCAFFOLDING

Frame scaffolding in this context means the portal-frame type scaffolding assembled on the site from prefabricated frames and members. Frames of different proprietary types must not be intermingled. Where frames are super-imposed vertically, the connection must be such that:

- (a) The standards are held in linear alignment.
- (b) The panels are locked together vertically by joint pin couplers or other equivalent suitable means.

Number of working platforms should be the same as standard tubular scaffolding. Longitudinal bracing depends on the use of ledgers:

- (a) Without ledgers, both faces of the scaffold in each lift of each bay are to be cross-braced.
- (b) With ledgers, brace either with diagonal tubes as for tubular scaffolding, or cross-braced every bay for the first 12 m height of scaffold, reducing to one bay in two for the next 12 m height up, and one bay in four for the top 9 m of height (see fig. 16).

Guardrails and midrails must be provided at working platform levels when cross braces are removed.

6.4 UNIT-ASSEMBLED SCAFFOLDING

Unit assembled scaffolding means scaffolding assembled from prefabricated frames or members which are not single lift portal-frame type units. The specific requirements are:

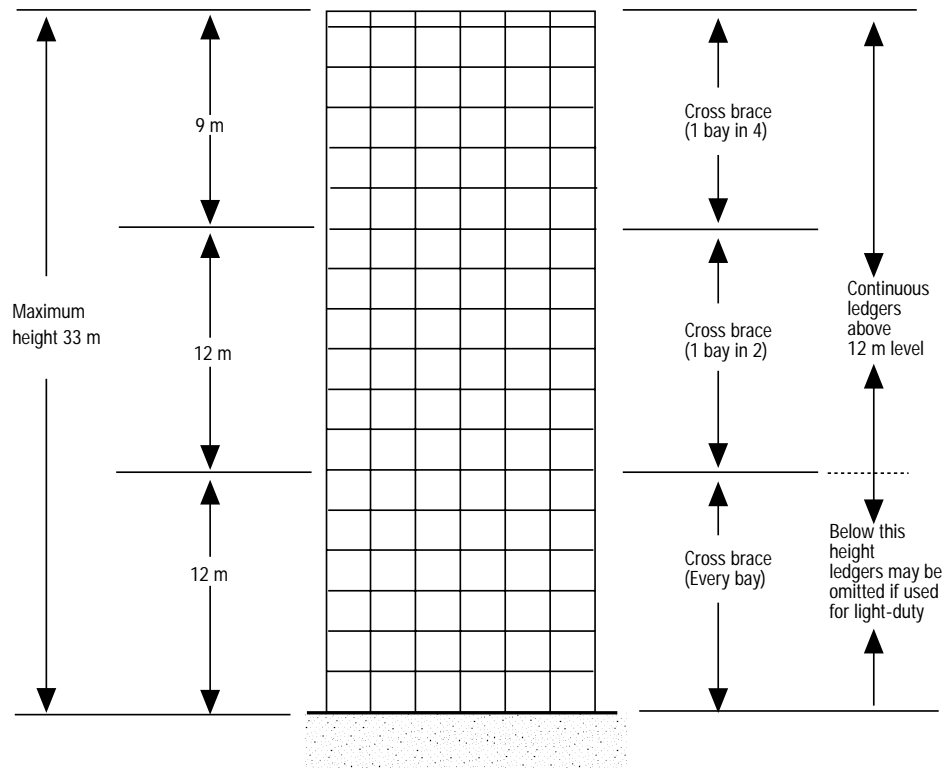
- (a) Erection must be carried out in accordance with the supplier's instructions and meet the requirements of this code.
- (b) Spacing of unit frames will, in general, be less than for tube and frame scaffolding unless ledgers are used.
- (c) Bracing will be the same as for the scaffolding.
- (d) Because of the lack of continuity in standards and of the lesser rigidity in the transverse corner joints, special attention must be given to provide an adequate number of ties to prevent lateral movement.
- (e) Scaffold constructed from light-weight aluminium tube (less than 2 mm wall thickness) shall not exceed 9 m in height unless subject to special design.

6.5 BRACKETS

6.5.1 PREFABRICATED SCAFFOLD BRACKETS

Prefabricated scaffold brackets which are attached to a structure to provide support for a working platform must:

- (a) Have adequate and suitable means of attachment to provide vertical support and to resist accidental sideways movement.



NOTE:
 (a) For medium-duty frame scaffolds, diagonal bracing must be used as for tubular scaffolding.

Fig. 16 Minimum bracing for light-duty frame scaffolds.

- (b) Be stable in the longitudinal direction of the platform under the applied horizontal force referred to in 2.2(b) and 2.2(c) and have a factor of safety of not less than 1.5.
- (c) Be fitted with a guardrail and a midrail when workers risk a fall of 3 m or more.

6.5.2 LADDER BRACKETS

Ladder brackets which are used for supporting a working platform for the purpose of painting only must satisfy the following requirements:

- (a) The brackets are attached to ladders which are not inferior to the requirements set out in either NZS 3609: 1978 *Timber ladders* or NZS 5233: 1981 *Portable ladders (other than timber ladders)*.
- (b) The ladders used for attaching the brackets to not exceed a maximum working length of 7.8 m.
- (c) The top rung to which each bracket is attached is not more than three-quarters of the ladder's working length from the foot of the ladder.
- (d) A guardrail and a midrail are provided when the working platform is more than 3 m in height; the working platform must also be underslung when it exceeds this height.

- (e) Precautions are taken to ensure that the feet and tops of the ladders are so supported that the ladders will not slide sideways or outwards.
- (f) Only one person works on the platform at one time and, if the platform is being used in a public place, a second standby worker is on hand to take preventive action against mishaps and to assist in setting up and moving ladders, brackets and scaffold planks.
- (g) The span and quality of the plank used complies with the provisions relating to light-duty working platforms.

7. FREE-STANDING SCAFFOLDS

7.1 FREE-STANDING SCAFFOLDS

7.1.1 DEFINITION

A free-standing scaffold is a standing scaffold which is not attached to any other structure and is stable against overturning on its own account or, if necessary, assisted by rakers and anchors (see fig. 17).

Free-standing scaffolds include:

- (a) Tubular scaffolds (with or without rakers);
- (b) Frame scaffolds (with or without rakers);
- (c) Mobile scaffolds (without ties or rakers); and
- (d) Trestle scaffolds (without ties or rakers).

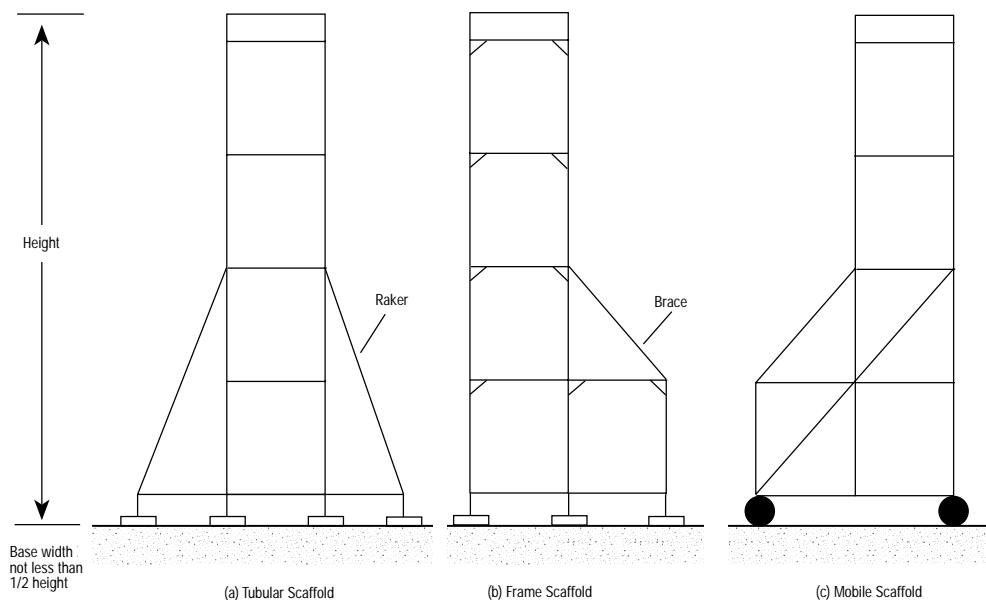


Fig. 17 Free-standing scaffolds.

7.1.2 GENERAL REQUIREMENTS

Working platforms may be designed for either light-duty or heavy-duty loading, and are normally restricted to one per scaffold.

Stability is dependent on the ratio of height to the least width of base, and this

must not exceed three, unless the special requirements set out in 7.1.3 are complied with. Raker frames may be included as part of the minimum base dimension.

Diagonal bracing is necessary on both faces and ends, except where frames with adequate built-in stiffness are used for one or two lifts in height. In these cases face bracing alone is necessary.

Access and egress from working platform to base must be provided. A free-standing scaffold may be converted temporarily into a laterally supported standing scaffold:

- (a) To support more than one working platform; and
- (b) To increase the height to width ratio; provided the converted scaffold with ties or rakers meets the code requirements for strength and stability.

Free-standing scaffold frames must be adequately restrained from vertical separation due to accidental causes.

7.1.3 STABILITY

All free-standing scaffolds must be stabilised against overturning forces. The factor of safety against overturning in any direction shall be not less than:

- (a) 1.5 for scaffolds not exceeding 3 m in height; and
- (b) 3 for scaffolds exceeding 3 m in height.

Note:

- (i) The factor of safety against overturning is the ratio of the righting moment to the overturning moment from forces acting on the scaffold;
- (ii) The overturning moment may be due to eccentric dead and live loads on the scaffold, and/or wind; and
- (iii) The righting moment is provided by the self-weight if suitably centred, added counterweight and the forces in the raker or anchor, if any.

7.2 MOBILE SCAFFOLDS

7.2.1 DEFINITION

A mobile scaffold is a special type of free-standing scaffold supported on wheels, castors or other devices for ease of movement on a firm level surface.

7.2.2 SPECIFIC REQUIREMENTS

Design and construction must be in accordance with sound engineering practice.

Scaffolds must be properly braced by cross-bracing or diagonal braces, or

both, for securing vertical members together laterally. Horizontal, diagonal or cross-bracing must be provided immediately above the wheels or castors (see fig. 18).

Castors should be of the swivel type and have a minimum wheel diameter of 125 mm. Wheels or castors must be fixed to scaffold uprights, or be socketed into the scaffold uprights, a minimum length of 150 mm, to avoid becoming dislodged during movement on uneven floors.

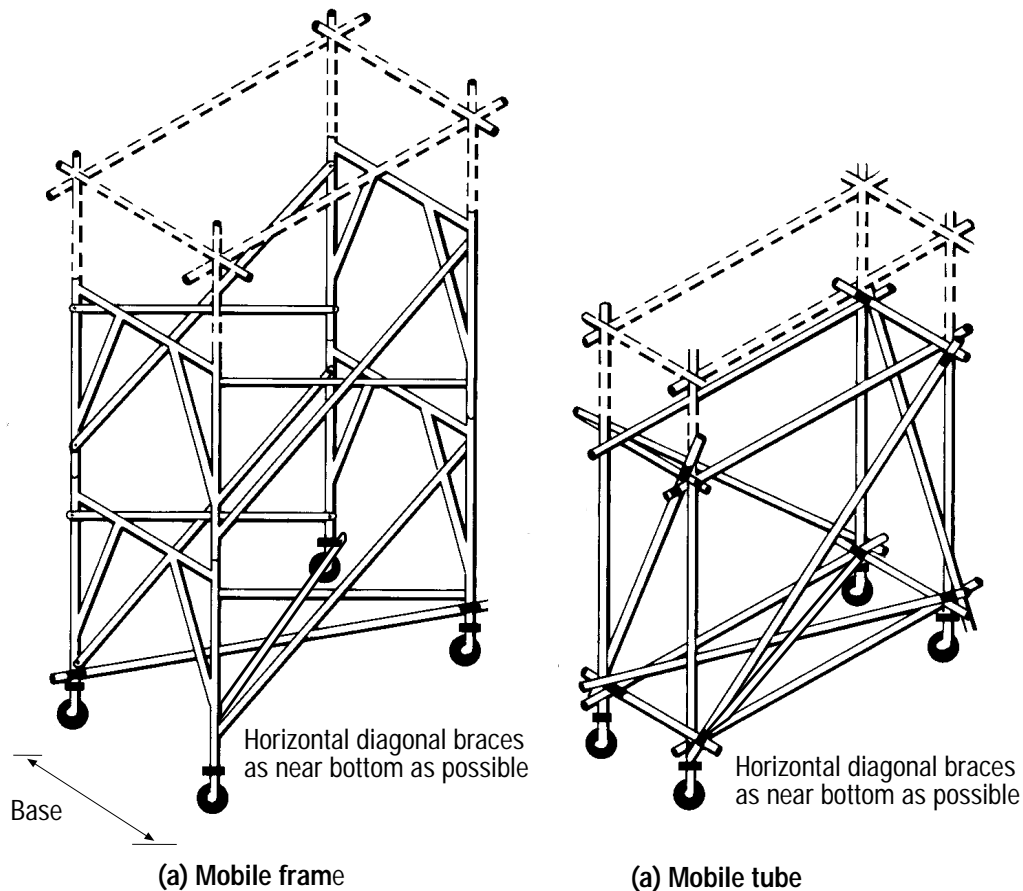


Fig. 18 Free-standing mobile scaffolds.

When the scaffold is in use, the wheels or castors must be effectively locked and should be turned outwards to increase base width.

A mobile scaffold must be used only on a firm level surface. Where the surface has a slight cross-fall, the level of the wheels must be adjusted to bring the scaffold back to plumb. Mobile scaffolds should not be used closer than 1 m to any slab edge or partition unless the edge is protected to prevent the wheels and scaffold from falling.

Access between working platform and base must be provided by means of securely fixed ladders or purpose-built rungs. Cross braces must not be used as a means of access. Work platforms must be fully decked and be provided with guardrails and toeboards in accordance with general requirements for scaffolding.

The force necessary to move a mobile scaffold must be applied near or as close to the base as practicable and provision must be made to stabilise the tower during movement from one location to another.

Do not ride on on a manually-propelled scaffold while it is being moved. Persons must not ride on mechanically propelled scaffolds unless the following conditions are satisfied:

- (a) Operating controls for movement of the scaffold must be located on the working platform.
- (b) The ground surface must be level, smooth and free from pits, holes or obstructions.
- (c) An effective braking system must be provided to prevent movement while in use.
- (d) A warning or alarm system must be available to alert workers of each movement in advance.
- (e) Toeboards must be provided to the working platform to prevent tools and materials from falling off.
- (f) As a safety precaution, workers should be provided with a safety harness when the scaffold is in motion; and
- (g) The rate of movement must not exceed 1.5 km per hour (a very slow walking pace).
- (h) The scaffold must be purpose-designed to allow movement with persons on it.

7.3 TRESTLES AND TRIPODS

7.3.1 DEFINITION

A trestle is a self-supporting metal or timber stand incorporating one or more horizontal members on which a working platform may be laid. Steel trestles are often telescopic, and of the folding type.

A tripod is a three-legged stand for supporting one end of a horizontal beam on which a working platform may be laid.

7.3.2 SPECIFIC REQUIREMENTS

The design and construction of steel trestles must be to a recognised standard such as AS/NZS 1576, Part 5.

Working height is normally restricted to a platform height not greater than 3 m because of the difficulty of fixing guardrails.

Loading of a working platform is restricted to light-duty (160 kg). Each support must also be capable of supporting a vertical load of 160 kg (1570 N) placed in any position over a 225 mm length of any cross member.

The ratio of height of trestle to spread of legs must not exceed 3 unless the special requirements set out in 7.1.3 are complied with.

The maximum span of scaffold planks used on trestles is 2.4 m.

8. SUSPENDED SCAFFOLDS

8.1 SCOPE

This part deals with suspended scaffolds, which are working platforms that:

- (a) Are suspended by ropes from overhead outriggers, parapet hooks or brackets fixed to a building or structure; and
- (b) Are capable of being raised and lowered by hand haulage on fibre ropes, or by hoists that are either manually or mechanically operated.

NOTE: A platform held by ropes or special hangers in a set position as a “hanging scaffold” is not a suspended scaffold but is classified as a special scaffold.

8.2 TYPES OF SUSPENDED SCAFFOLDS

The more usual suspended scaffolds are:

- (a) **Swinging stage (manual):** This has two points of overhead suspension and is raised or lowered by hand haulage on rope falls.
- (b) **Swinging stage (mechanical):** This has two points of overhead suspension and is raised or lowered by power-operated hoists controlled on the stage.
- (c) **Boatswain’s chair (manual):** This has a single overhead suspension and is self-raised or lowered by hand haulage on rope falls.
- (d) **Suspended safety chair (mechanical):** This has a single overhead suspension and is raised or lowered by a power-operated hoist controlled on the platform.
- (e) **Multi-point suspended platforms:** These are platforms that have more than two points of overhead suspension, with power- or manually-operated hoists.

NOTE: A boatswain’s chair and swinging stage (manual) must be raised or lowered from the platform unless otherwise approved by the inspector.

8.3 GENERAL REQUIREMENTS

8.3.1 HAND HAULAGE

Fibre rope tackle used for hand haulage consists of not less than four parts of

18 mm diameter natural fibre rope (to give a good hand grip) reeved through double and single sheaves, with separate tackle for each support position.

Fibre rope must have a factor of safety of at least 6, when new. Any rope which is in a doubtful condition must be replaced. Chemicals, detergents, solutions injurious to the rope fibre, sand-blasting, burning off, or the use of an open flame may prohibit the use of fibre ropes on scaffolds unless special precautions are taken.

Blocks for fibre rope must be of metal, or of wood strapped with metal, and must be not less than 100 mm in diameter (trade measurement accepted). Strapping on wooden blocks must extend from the top of the block down both sides and brought together for the Beckett attachment. The bottom of the groove should be rounded and wide enough so the rope fits loosely in it. The bottom blocks to which a stage is fastened should each have a large deep swivel hook so that the downhaul part of the tackle can be fastened to it with a suitable hitch. Otherwise, alternative means must be provided on the stage or chair for securing the downhaul part.

8.3.2 MECHANICAL OPERATION

Electric and air-operated hoists, including cable climbing devices, must be controlled from the stage platform. They must have a pushbutton or “dead-man” lever control that will stop and automatically lock the motor and hoist when pressure on the control switch or lever is removed. Hand-operated release to allow a faster descent than normal is not permitted. Each control must be individually operated. On no account must controls be tied or otherwise fixed in position. Ratchet and pawl manually-operated hoists must have a positive locking device so arranged that the stage may be securely held at any level and that the pawl automatically engages when released from hand control.

Wire ropes must be of suitable quality and of adequate strength and length. The factor of safety for new wire rope must be not less than 10. Wires must feed on to drums evenly and there must be sufficient space for all wire to be accommodated on the drum below the flanges.

8.3.3 ANCHORAGES

Hoisting wires or tackle must be anchored to a secure part of the structure, to outriggers, to specially designed brackets and parapet hooks, or directly to counterweights.

All structures, parapets, and other supports must be of such condition and design to support the anchorage without danger of failure or distortion and to give a factor of safety of at least 3 under the worst conditions. The employer may be required to supply a registered engineer’s report on the suitability of the structure, parapet or support.

8.3.4 OUTRIGGERS (NEEDLES)

Design: It is sound and accepted engineering practice to use either steel or aluminium outriggers to support mechanical powered swinging stages. For hand haulage, swinging stages and boatswain's chairs, either metal or timber outriggers may be used. The structural design used for outriggers must be based on and conform to the appropriate New Zealand Standard.

- (a) For a swinging stage with two points of suspension, each outrigger must be designed to carry half the dead load of the working platform including hoists, etc. together with the full live load due to persons and materials as these loads are capable of being positioned at either end of the stage (see example in Appendix B2).
- (b) For a swinging stage with more than two points of suspension, each interior outrigger must be capable of carrying the full dead and live load for each section between suspension points.

Unless specifically designed by a registered engineer, each outrigger for a mechanically-operated swinging stage must be:

- (a) At least equivalent in strength to a 152 mm x 89 mm x 17.09 kg/m rolled steel joist when suspending a maximum load of 400 kg.
- (b) At least 3.6 m in length when counterweighted.
- (c) Located so as not to project more than 1.5 m beyond the outer point of support on the building or structure.

The load exerted by an outrigger on a roof structure or parapet must be distributed by providing adequate packing at its points of support, i.e. at the outer or fulcrum end, and the inner or counterweighted end.

Stability and Counterweighting: Outriggers must be either counterweighted or secured to the building or roof structure by bolts or other structural fixing.

Where an outrigger is stabilised by counterweights, the factor of safety against overturning must be at least 3 (see Appendix B for a method of calculating counterweights required).

Where roof fixings are relied upon as the sole means of achieving stability, they must be capable of providing a factor of safety of 3 against uplift.

Roof fixings shall be designed according to the stresses appropriate to the material. No component in the system must be loaded to more than the manufacturer's recommendation.

Outriggers must be prevented from rolling over or moving laterally due to the end movement of the stage. Where counterweights are used to provide stability, they must be firmly attached to the outriggers by mechanical means so that they cannot become accidentally dislodged due to any work or weather condition.

When strops are used, these must be positively secured to the outriggers which must be provided with stop ends. Shackles must be moused.

Where counterweights are to be used behind parapets, etc. for direct securing to the top block strop, there must be sufficient weight to prevent movement when the stage or chair is subjected to shock-test loading. The weights should be positively secured one to another and to the strop and should be of a suitable size in relation to the parapet.

Counterweights must be stamped or marked with their weight, be of a size to be readily handled, be fitted with means to positively secure them on to another, be of uniform size, regular shape, and of a heavy material. Sand and water may not be used.

8.3.5 BRACKETS AND PARAPET HOOKS

Brackets, parapet hooks and attachments must be designed by a registered engineer. A minimum factor of safety of 3 is required on the combined dead and live loading of the scaffold. All welding for these structural components must be done by a certificated welder.

Parapet hooks and brackets may be used only if:

- (a) The parapet is structurally sound;
- (b) The hook fits the parapet snugly, and is so positioned that it cannot be dislodged; and
- (c) The parapet is deep enough to allow at least 300 mm of hook down the inside.

8.3.6 WORKING PLATFORMS, GUARDRAILS, MIDRAILS AND TOEBOARDS

Platforms may be of any acceptable material provided that they are strong enough for the purpose, and are designed, constructed and assembled according to sound and accepted engineering practice.

Guardrails and midrails must be provided on both sides and both ends of swinging stages where workers can stand, and on the outside and both ends of other suspended scaffolds.

Toeboards must be provided on all types of suspended scaffolds which carry tools and materials, with the exception of boatswain's chairs. Midrails may be omitted if the toeboards are of a minimum height of 225 mm.

The platform, toeboard, midrail and guardrail must be securely fixed together to form a complete unit.

8.3.7 SAFETY HARNESES AND LIFELINES

This section applies to all suspended working platforms.

Every worker on a suspended working platform must wear a safety harness that is secured to a fixed support or to an independent lifeline except:

- (a) Where the platform is a boatswain's chair that has more than one effective means of support; or
- (b) Where the platform is so designed and constructed that it would remain safely suspended notwithstanding the failure of one rope or suspension, in which case the harness may be secured to the platform.

A safety harness worn by a worker must, if the worker falls from the platform, suspend the worker not more than 1.5 m below the platform and must be so designed that the force arresting the fall does not exceed 8 kN.

A lifeline must be used by only one worker at a time, and must either extend to the ground or be provided with a positive stop to prevent the harness running off the end of the line. The line must have a minimum breaking strength of 29.4 kN and be of nylon at least 12 mm in diameter; or of polypropylene or other equally durable material at least 16 mm in diameter. Where a platform has only one rope at each support, the harness lanyard must be attached by a gravity lock device to an independent lifeline.

The independent lifeline may be fixed:

- (a) directly to an anchor set in the building that will withstand a vertical load of 24 kN;
- (b) to a separate anchorage on the same outrigger (needle) supporting the platform provided that:
 - (i) The distance along the cantilever section (from its support to the anchorage) is not more than 1/3 of the total cantilever length;
 - (ii) The counterweight, if used, is mechanically attached to the outrigger; and
 - (iii) The outrigger is secure against sliding.

Where a platform has two independent ropes at each suspension, the operator's safety belt lanyard may be attached to a suitable anchorage on the platform.

The two ropes used at each support of the platform may be attached to the same outrigger by separate anchorages, provided the outrigger is made of structural steel. For example, three lugs supporting a common pin is considered to provide two separate anchorages if one rope only is set between each pair of lugs.

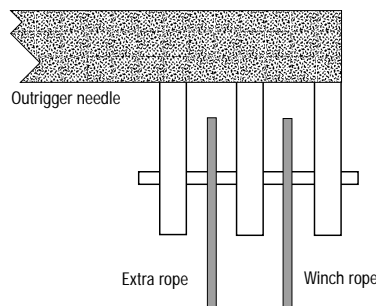


Fig. 19 Anchorage for ropes.

8.3.8 ANTI-TILT SWITCH DEVICES

All suspended working platforms must be fitted with tilt switches which cut off the motors in the event of the platform becoming more than 10° out of level.

8.3.9 ACCESS, WARNING NOTICES AND PROTECTION OF THE PUBLIC

Wherever reasonable and practicable, provision must be made at intermediate working levels for access to the working platform for workers and materials.

Where suspended scaffolds are above thoroughfares, adequate and prominent warning notices must be displayed. In addition, if any special danger exists, adequate protection of the public must be provided. The accumulation of surplus gear or materials on any suspended scaffold is hazardous and must be avoided.

8.3.10 ERECTION, ALTERATION AND DISMANTLING

Suspended scaffolds of any kind or height may be erected, altered or dismantled only under the direct supervision of a person who holds a certificate of competency for that kind of scaffold.

8.4 SPECIFIC REQUIREMENTS

8.4.1 SWINGING STAGE (HAND HOIST OR MANUAL)

The maximum live load permitted on a swinging stage (hand hoist) is the difference between 360 kg and the dead weight of the stage (including the weight of falls and blocks).

The decking, toeboards, midrails and guardrails must be fixed together to form a complete unit.

The relation of width of platform, height of point of suspension on the hanger, the weight of stage must be such that, under a load of 160 kg in the extreme position on any side, the cross tilt of the platform is not more than 1 in 6 of platform width, the width of platform being not less than 450 mm. (Generally it will be found that for a normal timber stage 450 mm wide, the eye of the hanger should be not less than 1.15 m above the deck; a wider platform will need a greater height.)

To prevent end tilt, the overhang of any end beyond the point of support must be such as to ensure that the platform is stable under a load of 160 kg at the extreme end.

The length of stage depends on the method and materials of construction, the positions of overhead support, and on the total dead weight of the stage. This must not be over 120 kg for use by three workers, and not over 200 kg for two workers.

8.4.2 SWINGING STAGE (MECHANICAL)

The maximum level load permitted on the swinging stage is the difference between 560 kg and the dead weight of the stage including the weight of the hoisting gear or cable climbers.

No more than three persons may use a stage at any one time. The safe working load for the section or length of stage in use must also be less than the safe lifting capacity of the hoisting gear, and must be clearly marked on the stage at all times while it is being used. The platform, decking and guardrails must comply with the requirements specified in 8.4.1. Where the stage is constructed in sections, a positive method of connection must be used, such as

through bolts, fishplates or other devices which cannot be dislodged. Overload cut-out devices must be used and must be kept so adjusted as to provide adequate safeguard should snags be encountered due to a projection or other restraint.

8.4.3 BOATSWAIN'S CHAIR (HAND HOIST OR MANUAL)

The total live load on a boatswain's chair must not exceed 115 kg.

When used by a worker in a sitting position, the chair must have a back rail or rope, and also a front rail, rope, or post not less than 250 mm above the seat.

A chair or platform entirely supported by fibre ropes must have rope slings not less than 12 mm diameter passing through cleats crossed underneath and adequately spliced together.

8.4.4 SUSPENDED SAFETY CHAIR (MECHANICAL)

The live load depends on the safe lifting capacity of the hoisting gear, and must be limited to 160 kg or a maximum of two persons.

The safe working load must be legibly and permanently marked on the stage.

The initial safe working load of the stage must not be reduced by replacing with inferior wire (rope must be fully accommodated between the drum flanges).

8.4.5 MULTI-POINTS SUSPENDED PLATFORMS

Whenever practicable, the live load should be limited to 240 kg (i.e. a maximum of three persons or a maximum of two persons and materials) per section of platform between suspension points.

The safe working load, including the maximum number of persons per section, must be legibly and permanently marked on the platform.

The platform must be strapped together from end to end and must be flexible enough to react without damage to moderate inequalities in level of points of support during moving operations. The width of platform must be not less than 675 mm. The platform must be held to avoid sway away from the work while in use.

Safe means of access and egress to the platform must be provided while it is in use by workers.

No worker is permitted to work or ride on the platform while it is being raised or lowered unless the controls on the platform are individually operated.

Workers may work on the platform if the controls are elsewhere, provided that the hoisting mechanism is effectively locked or the platform is independently supported in the working position.

8.5 ENGINEER'S CERTIFICATE

A registered engineer's design certificate for working loads in excess of the live loads specified for the various types of suspended scaffolds may be required by an inspector.

9. SPECIAL SCAFFOLDS

9.1 SCOPE

Special scaffolds are scaffolds which do not meet the standard requirements for standing or suspended scaffolds, and include:

- (a) Non-standard standing scaffolds;
- (b) Standing scaffolds with attachments;
- (c) Cantilever scaffolds; and
- (d) Hanging scaffolds.

9.2 DESIGN AND SUPERVISION

All special scaffolds must be designed in accordance with sound engineering practice, and must be erected, altered or dismantled only under the direct supervision of a certificated scaffolder who has an appropriate certificate. An inspector may require a registered engineer's certificate, certifying the adequacy of the design.

9.3 NON-STANDARD STANDING SCAFFOLD

A standing scaffold becomes a special scaffold when it differs from the standard in respect of any of the following:

- (a) Height exceeds 33 metres;
- (b) Maximum bay length exceeds 2.4 metres;
- (c) Width exceeds 1.5 metres; or
- (d) Loading exceeds the heavy-duty load described in this code.

9.4 STANDING SCAFFOLDS WITH ATTACHMENTS

Attachments include:

- (a) Cantilevered loading platforms, which are cantilevered structures erected from the main scaffold to serve as loading bays.
- (b) Protective screens which are fixed to the main scaffold to intercept anything which may fall from the structure.

9.5 CANTILEVER SCAFFOLDS

A cantilever scaffold is an independent tied standing scaffold constructed in accordance with this code but erected on beams cantilevering out from a building. It is used where it is impossible or undesirable to found the scaffold on the ground (fig. 20).

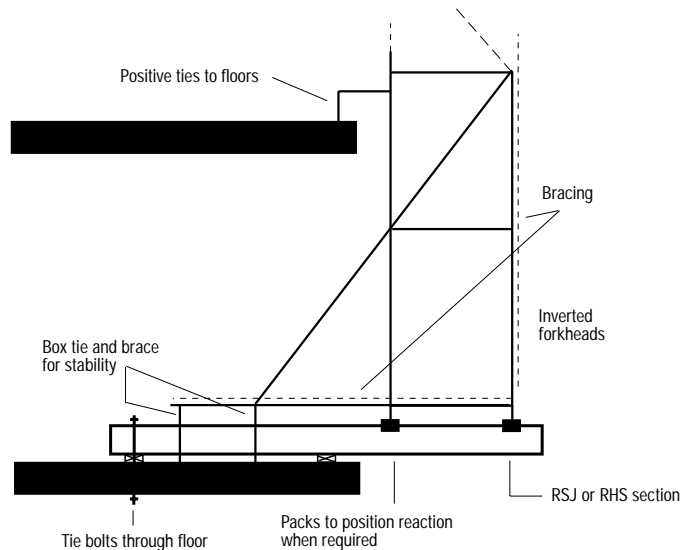


Fig. 20 Typical cantilever scaffold.

9.6 HANGING SCAFFOLDS

Hanging scaffolds are platforms suspended by tubes, bolts, fixed-rope slings, or other methods and not intended for raising or lowering while in use.

Any suspension point, member or attachment must be specially designed and formed in such a way that it cannot become dislodged or displaced by movement of the hanging scaffold.

The designer must be satisfied that the suspension points are strong enough to support the load and have a factor of safety of 3.

If the hangers are scaffold tubes, they must be assembled using right-angle couplers, *doubled up* at the suspension points. Sleeve couplers or joint pins must not be used for vertical axial joints.

Check clips must be fitted not only to the top of the hanger, but also below the bottom ledger. Clips must also be fitted in such a direction that in the event of the bolt failure, or if it is accidentally knocked open, the clip will still hold.

Wire rope used for slinging must have a factor of safety of 5 and be fixed to the suspension point and the scaffold by two round turns and 3 bulldog grips for wire up to 19 mm in diameter, or by using an eye and a shackle capable of safely carrying the loads. The shackle should be moused.

All lifting gear and means of suspension must be thoroughly inspected before and after it is installed and at regular intervals during use.

Because of the risk involved while erecting or dismantling hangers, workers must wear safety harnesses, secured to independent lifelines as specified in 8.3.7; or work from a machine-lifted platform.

APPENDIX A: SCAFFOLD REGISTER FOR ALL SCAFFOLDING FROM WHICH A PERSON COULD FALL 5 M OR MORE

- (1) A scaffold register must be kept on site and be available for inspection, for all scaffolding from which a person could fall 5m or more.
- (2) When complete, the scaffold register should record:
 - (a) Project name, address, or other clear identification.
 - (b) The location of the scaffold with respect to site coordinates or the location at the building or structure, so that the scaffolding can be clearly located.
 - (c) Miscellaneous details of the scaffold, (see sample scaffold register over page).
 - (d) A record of each inspection carried out.
- (3) The inspections must be carried out at the following intervals:
 - (a) Before the scaffold is first put to into use.
 - (b) Weekly while the scaffold is in use.
 - (c) After each structural alteration or addition.
 - (d) Monthly while the scaffold is set up but not in use.
 - (e) After any storm or occurrence that could adversely affect the safety of the scaffold.
- (4) The inspection must be carried out by either:
 - (a) A certificated scaffolder of the appropriate class; or
 - (b) A competent person such as a registered engineer.
- (5) The entries of each inspection in the scaffold register must be made and signed by the person who carried out the inspection.

SCAFFOLD REGISTER

The following information should be provided in the register (see sample over page):

Project name:

Address:

Main contractor (Name, address, contact name):

Location (Specify building grids etc):

Reason for scaffold (i.e. erect cladding, erect rainwater disposal system, etc)

Scaffold subcontractor (Name, address, contact name, phone number):

Subcontractors who are to use the scaffold (e.g. plumber, wall cladder, painter):

Overall dimensions (Length, height, width, etc.):

Number of working platforms:

Duty of scaffold (Light, medium, heavy, special, etc.):

Limitations (if any):

Other comments:

INSPECTION RECORD

- (a) Before first use (date, inspector, signed off).
- (b) Regular inspections (date, inspector, signed off).
- (c) After modification (date, inspector, signed off).
- (d) After storm or potentially damaging incident (date, inspector, signed off).

APPENDIX B: SUSPENDED SCAFFOLD REGISTER AND NOTES ON SUSPENDED SCAFFOLDING

- (1) A suspended scaffold register must be kept on site and be available for inspection, for all suspended scaffolding, boatswain's chairs, swinging stages, etc.
- (2) When complete, the suspended scaffold register should record:
 - (a) Project name, address, or other clear identification;
 - (b) The location of the scaffold with respect to site coordinates or the location at the building or structure, so that the scaffolding can be clearly located;
 - (c) Miscellaneous details of the scaffold, (see sample suspended scaffold register);
 - (d) A record of each inspection carried out.
- (3) The inspections must be carried out at the following intervals:
 - (a) Before the scaffold is first used;
 - (b) On each day while the scaffold is in use;
 - (c) After each structural alteration or change to the nature of the anchorage;
 - (d) Monthly while the scaffold is set up but not in use;
 - (e) After any storm or occurrence that could adversely affect the safety of the suspended scaffold.
- (4) The inspection must be carried out by either:
 - (a) A certificated scaffolder of the appropriate class (e.g. suspended scaffold); or
 - (b) A competent person such as a registered engineer.
- (5) The entries of each inspection in the suspended scaffold register must be made and signed by the person who carried out the inspection.

LIVE LOAD (I.E. PERSONS, TOOLS, MATERIALS)

Unless designed by a competent person such as a registered engineer, the following limitations apply:

- (a) For a swinging stage raised by hand haulage on fibre ropes, the maximum live load is the difference between 360 kg and the dead weight of the stage including falls and blocks, with the maximum number of persons not exceeding three.
- (b) For a swinging stage operated mechanically with two points of overhead suspension, the maximum live load is the difference between 560 kg and the dead weight of the stage including hoisting gear, with the maximum number of persons not exceeding three.
- (c) For a boatswain's chair, the maximum live load is 115 kg.
- (d) For a suspended chair operated mechanically with single supports, the maximum live load is limited to 160 kg or a maximum of two persons.
- (e) For multi-point suspended platforms, the maximum live load is limited to 240 kg or a maximum of three persons per section of platform between suspension points.

COUNTERWEIGHTING OF OUTRIGGERS

Where an outrigger is stabilised by counterweights, the factor of safety against overturning must be at least 3. To determine the counterweight required, the table below may be used; alternatively the counterweight may be calculated (see also 8.3.3) using the formula below. (See figure 21.)

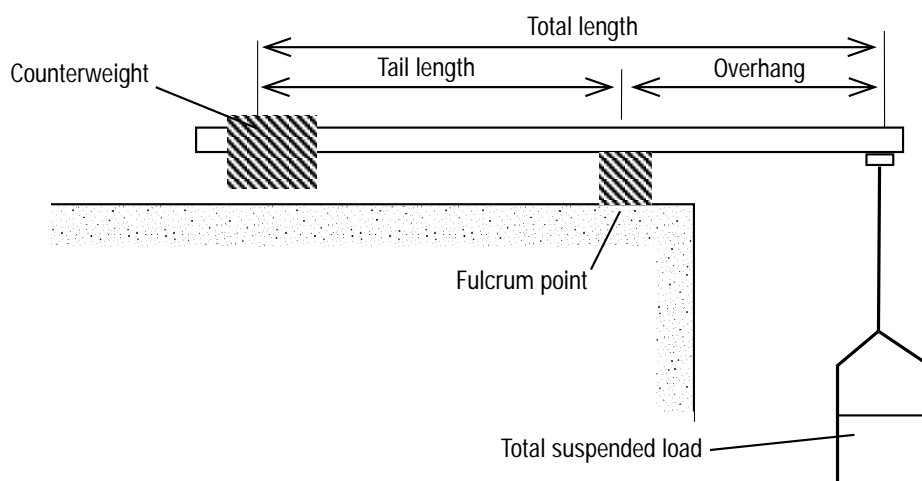


Fig. 21 Counterweighting of outriggers.

Overhang (mm)	Total Length (m)						
	3.6	4.0	4.4	4.8	5.2	5.6	6.0
500	193	171	154	140	133		
600	240	212	189	171	157	144	133
700	290	255	227	205	187	171	158
800	343	300	267	240	218	200	185
900	400	348	309	277	251	230	212
1000		400	353	316	286	261	240
1100			400	357	322	293	269
1200	Counterweight required (kg)			400	360	327	300
1300					400	363	332
1400						400	365
1500							400

COUNTERWEIGHT DETERMINED USING THE FORMULA

(Note: for a uniform two-outrigger suspended scaffold, the suspended load on one outrigger is assumed to be half the dead load plus the full live load.)

The *righting moment* is the tail length times the counterweight.

The *overturning moment* is the overhang times the suspended load.

At equilibrium, the righting moment equals the overturning moment. For safety the overturning moment is multiplied by the safety factor, increasing the required counterweight.

$$\text{Counterweight} = \frac{\text{overhang (in m)} \times \text{suspended load} \times 3}{\text{tail length (in m)}}$$

e.g. if the suspended load is 360kg, the overhang is 1.2m and the tail length is 4.1m, then the counterweight required is:

$$\begin{aligned} & \frac{1.2\text{m} \times 360\text{ kg} \times 3 \text{ counterweight}}{4.1\text{ m}} \\ & = 316\text{kg} \end{aligned}$$

SUSPENDED SCAFFOLD REGISTER

The following information should be provided in the register (see example over page):

Main contractor or client (address, contact name):

Location (specify building grids etc):

Reason for scaffold (i.e. erect cladding, erect rainwater disposal system, etc):

Scaffold subcontractor (name address, contact name, phone number):

Subcontractors who are to use the scaffold (e.g. plumber, wall cladder, painter):

Live load and/or number of persons:

Limitations (if any):

Other comments:

APPENDIX C: WEIGHTS OF MATERIALS USED ON SCAFFOLDING

(AS PLACED ON WORKING PLATFORMS — GUIDE ONLY)

Asbestos cement , corrugated super six	13.5 kg/m ²
Asbestos cement , plain sheets 4.5 mm	8.0 kg/m ²
6.0 mm	10.5 kg/m ²
9.0 mm	16.0 kg/m ²
Bricks dry (225 x 108 x 73 mm)	3.0 kg per brick
Bricks wet	3.5 kg per brick
Cement (at 25 bags to the tonne)	40.0 kg per bag
Cement Bulk	1500.0 kg/m ³
Concrete blocks	
400 x 200 x 200 mm hollow	19 kg per block approx
400 x 200 x 150 mm hollow	16 kg per block approx
400 x 200 x 100 mm hollow	13 kg per block approx
400 x 200 x 100 mm solid	16 kg per block approx
Concrete ready mixed — wet	2550 kg/m ³
Concrete in wheelbarrow (approx. 0.05 m ³)	136 kg
Total load of man and wheelbarrow	220 kg
Corrugated galv. iron	
24 gauge	4.5 kg per m ²
26 gauge	3.5 kg per m ²
Ropes	
Fibre 18 mm diam. dry	25 kg per 100 m
Fibre 18 mm diam. wet	30 kg per 100 m
Wire 8 mm diam	26 kg per 100 m
Wire 9 mm diam	31 kg per 100 m
Wire 13 mm diam	64 kg per 100 m
Wire 16 mm diam	96 kg per 100 m
Wire 19 mm diam	135 kg per 100 m
Wire 23 mm diam	185 kg per 100 m

Sand dry	1680 kg per m ³
Sand wet	1920 kg per m ³
Scaffold planks (timber) 250 mm x 50 mm x 2.7 m (aver.)	19 kg
Steel Rods	
6.5 mm diam	25 kg per 100 m
10 mm diam	67 kg per 100 m
12 mm diam	100 kg per 100 m
16 mm diam	165 kg per 100 m
20 mm diam	250 kg per 100 m
25 mm diam	416 kg per 100 m
Tube Steel (48.3 m) and fittings	
Tube 48.3 mm x 4 mm x 6 m length	27.0 kg
Tube 48.3 mm x 4.5 mm x 6 m length	28.5 kg
Fittings range 1 kg to 2 kg (average)	1.5 kg
100 m tube + 20 fittings) approx. total weight)	495.0 kg
Tube Aluminium (48.3 mm) and fittings	
Tube 48.3 mm x 4.5 mm x 6 m length	10.0 kg
Fittings 1 kg to 2 kg each (average)	1.5 kg
100 m tube + 20 fittings (approx. total weight)	195.0 kg
Tube Frame steel braced portal	22-32 kg
Timber	
Pinus, firs, and light timber per m ³	400 to 480 kg
Rimu, and medium weight per m ³	480 to 640 kg
Heavy timber per m ³	640 to 800 kg
Water per litre	1.0 kg
Worker (average)	80.0 kg

APPENDIX D: SCAFFOLDING MATERIALS TECHNICAL DATA

TABLE D1: DIMENSIONS AND PROPERTIES OF SCAFFOLD TUBES

Dimension and properties	Steel tubes to BS 1139 or AS 1576.3	Galvanised steel tube to BS 6323	Aluminium tubes to BS 1139 or AS 1576.3
1. Outside diameter (mm)	48.3 (± 0.5 tolerance)	48.3 (± 0.5 tolerance)	48.3 (± 0.5 tolerance)
2. Thickness (mm)			
(a) seamless	4.0 (± 0.5 tolerance)	3.2 (± 0.48 tolerance)	4.47 (± 0.56 tolerance)
(b) welded	4.0 (± 0.8 ; - 0.4 tolerance)	3.2 (± 0.32 tolerance)	
3. Mass per linear metre	4.37 kg/m	3.56 kg/m	1.67 kg/m
4. Minimum tensile strength	340 MPa	360 MPa	295 MPa
5. Yield strength	210 MPa	215 MPa	255 MPa
6. Radius of gyration	15.7 mm	16.0 mm	15.6 mm
7. Cross-sectional area	557 mm ²	453 mm ²	615 mm ²
8. Moment of inertia	138,000 mm ⁴	116,000 mm ⁴	149,000 mm ⁴
9. Elastic modulus	5700 mm ³	4800 mm ³	6180 mm ³

TABLE D2: SAFE WORKING LOADS FOR COUPLERS AND FITTINGS TO BS 1139 OR AS 1576.2

Description of coupler and fitting	Type of loading	Safe working load
1. Right-angle couplers	Slip along tube	6.25 kN (640 kg)
2. Swivel couplers	Slip along tube	6.25 kN (640 kg)
3. Joint pins (expanding spigot couplers)	Shear strength	21 kN (2140 kg)
4. Sleeve couplers	Tension	3.1 kN (315 kg)
5. Adjustable base plate	Axial	30 kN (3058 kg)

TABLE D3: SAFE WORKING LOADS FOR TIES AND GALVANISED WIRES

Description	Safe working load
1. Tie — double 3.15 mm 'black' wire, twisted	1.57 kN (160 kg)
2. Galvanised wire — for fixing gin wheel, block, guy, or light loads; using not less than two round turns on 48.3 mm tube or timber:	
(a) 8 gauge wire — 2 round turns	1.57 kN (160 kg)
(b) 8 gauge wire — 3 round turns	2.45 kN (250 kg)
(c) 8 gauge wire — 4 or more turns	2.94 kN (300 kg)
(d) 10 gauge wire — 2 round turns	1.18 kN (120 kg)
(e) 10 gauge wire — 3 round turns	1.57 kN (160 kg)
(f) 10 Gauge wire — 4 or more turns	1.96 kN (200 kg)

Note: The above strength values are a guide for good-quality materials under average conditions of use on construction work. Where special materials of known quality and of established strength are used, the safe working loads may be varied in accordance with accepted engineering practice.

APPENDIX E: RIGGING FOR SCAFFOLDERS

GENERAL

Scaffolders need to know how to tie knots that may be used to erect, alter or dismantle scaffolds and the rigging of crane-lifted loads of scaffolding. This appendix is limited to rigging for scaffolders.

SUSPENDED LOADS

Hooks that anchor ropes or pulleys on suspended scaffolds must be moused to prevent accidental unhooking. Shackles used in scaffolding shall have their SWL clearly marked and when in use the pin shall be securely screwed in and moused to the D.

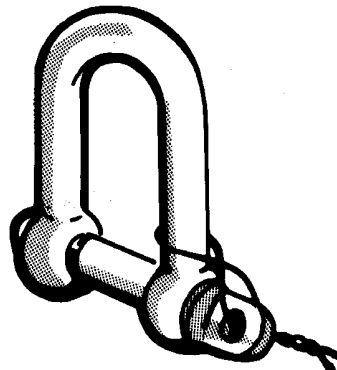


Fig. 23 D Ring.

When using a shackle to form a running noose always fit the back of the D to the standing or running part of the rope.

This practice ensures that the shackle pin is not either overtightened or unscrewed.

SCAFFOLD TUBE

When using a fibre rope to lift or lower a scaffold tube always use a stopper or rolling hitch.

Because the hitch tightens as the weight is taken, always position it to one end, ensuring that the direction of pull is as shown in fig. 23.

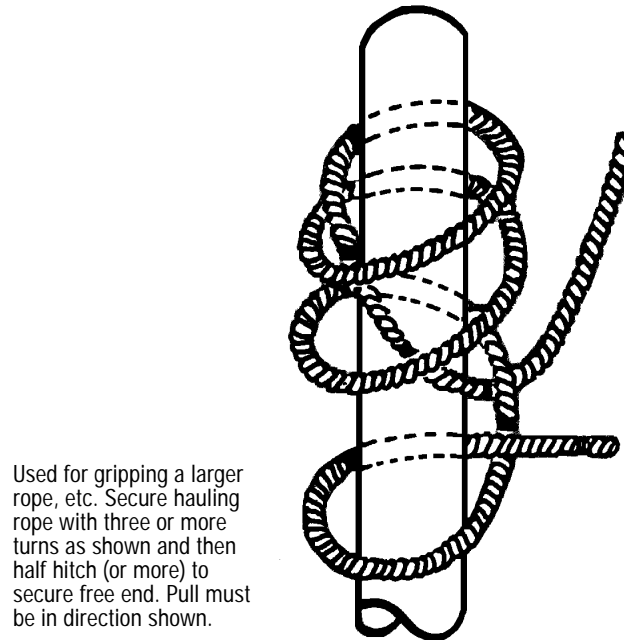


Fig. 23 Stopper or rolling hitch.

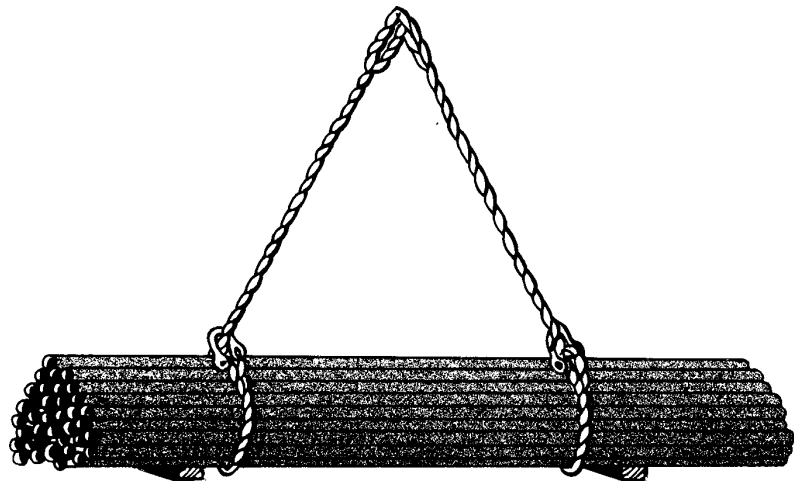


Fig. 24 Rigging crane-lifted bundle of tubes.

When rigging crane-lifted bundles of tube, always use two adequate-strength similar choker-reeved slings. Position the slings approximately one third in from each end and land the bundle on dunnage to prevent damage to the slings or tubes when they are withdrawn. Always use SWL marked shackles, of adequate capacity, to form choker slings.

Note: The included angle between two slings affects the slings' SWL. To calculate the SWL of two slings rigged as shown in fig. 24, multiply the SWL of one sling by 1.4. As an illustration, two slings each with an SWL of 2 tonnes and reeved as shown could safely lift 2.8 tonnes. ($2 \times 1.4 = 2.8$).

ROPE JOINS OR EYES

Where wire rope grips have been fitted by a qualified person, such as a crane maintenance fitter rigger, they may be used for lifting. If fitted by others, it should not be used for lifting purposes.

Wire rope grips must be correctly applied in order that the stresses within the terminal are evenly distributed.

Always fit the grips the same way round, with the bridge on the loaded or long part of the rope and the U-bolt on the short part.

On any wire rope a minimum of three grips must be used and spaced at a distance, centre to centre of grips, of six rope diameters (see fig. 25). The numbers of wire rope grips required are:

- (a) Up to and including 19 mm (3/4 in.) rope: 3 grips.
- (b) Over 19 mm and up to and including 32 mm (1 1/4 in.) rope: 4 grips.
- (c) Over 32 mm and up to and including 38 mm (1 1/2 in.) rope: 5 grips.
- (d) Over 38 mm and up to and including 44 mm (1 3/4 in.) rope: 6 grips.
- (e) Over 44 mm and up to and including 56 mm (2 1/4 in.) rope: 7 grips.

When joining fibre ropes, always use a double sheet bend or a carrick bend knot. Never use a reef knot to join ropes.

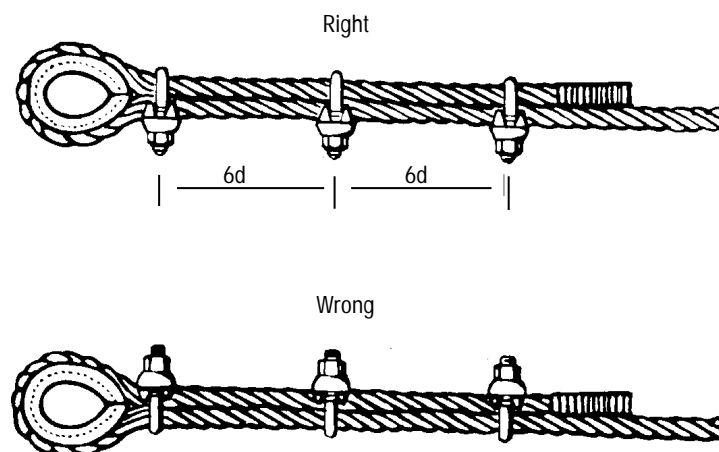


Fig. 25 Joining wire ropes.

CHECKLIST

The following represents some of the items used in rigging that should be regularly checked for safety:

- (a) **Fibre rope:** Cuts, flaking, decay or contamination by injurious substances.
- (b) **Wire rope** (including slings): Broken strands (not more than 6 broken strands in any 10 diameter length), worn strands, corrosion, sharp bends or overstressing.
- (c) **Fittings:**
 - (i) **Shackles:** Bent, worn, cracked, SWL not shown.
 - (ii) **Rope grips:** Correct size, nuts tight, worn or bent.
 - (iii) **Rope splices:** Mechanical splice (Talurit) — SWL shown, worn or deformed, manual splice — spragged ends, tucks unlaying or not locked.

APPENDIX F: PERFORMANCE REQUIREMENTS FOR SCAFFOLD PLANKS

The following is a reprint of NZS 3620: 1985 *Specification for scaffold planks*.

101 SCOPE

- 101.1** This Standard specifies the minimum requirements for scaffold plans.
- 101.2** This Standard does not preclude the use of materials other than those in Parts 2 to 5, provided that it can be established that they meet these requirements and comply with relevant NZ Standards or equivalent.
- 101.3** Planks that comply in all respects with a means of compliance set out in Parts 2 to 5 shall be deemed to satisfy the requirements of this Standard.

102 INTERPRETATION

In this Standard the word “shall” indicates a requirement that is to be adopted in order to comply with the Standard; the word “should” indicates a recommended practice.

103 DEFINITION

For the purpose of this Standard the following definition shall apply:

Scaffold plank: A plank that is intended to provide part of the support surface of any structure, framework or suspended scaffold of a temporary nature that is used to support workmen and materials.

104 DIMENSIONS

- 104.1** The minimum width of scaffold planks shall be 225 mm.

Note: For timber scaffold planks, the moisture content appropriate to the minimum width dimension shall be $16 + 2\%$.

105 IN-SERVICE STRENGTH REQUIREMENTS

A scaffold plank shall be capable of sustaining a total working load of 1.60 kN applied to the full-width of the plank as two equal loads 300 mm on either side of the centre of the span when it is simply supported at 2.4 m centres.

106 QUALITY CONTROL

Planks shall be subjected to quality control inspection and testing procedures at the time of manufacture or selection, as set out in the appropriate sections of Parts 2 to 5, Means of Compliance.

107 BRANDING

- 107.1** Planks shall be permanently branded on an edge, the brand reading NZS 3620.
- 107.2** Marking for ownership is permitted providing it does not detract from safety when the plank is in use.
- 107.3** Planks manufactured under the Standard Certification Mark Scheme shall be branded on an edge with the manufacturer's licence number.

Note: The Standard Certification Mark Scheme

As this Standard covers product safety, manufacturers are advised to apply for a licence to use the Standard Certification Mark.

Shown here is the Certification Mark of the Standards Association of New Zealand. This Mark may be used only by those manufacturers licensed by the Standards Association and must be accompanied by the number of the relevant New Zealand Standard and the number of the authorising licence. The presence of this Mark on or in relation to a product is an assurance that the goods are manufactured under a system of supervision, control, and testing, (including periodical inspection of the manufacturer's works by SANZ) designed to ensure compliance with the Standard.



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For further particulars apply to the Director, Standards New Zealand, Private Bag, Wellington.

108 MATERIALS

108.1 Timber planks

108.1.1 The species, grade, size and finish, preservative treatment, moisture content, methods of manufacture, and other relevant characteristics of timber shall be suitable for their end use.

108.1.2 Both faces of a timber scaffold plank shall be sawn finished or roughened to a similar finish.

108.2 Other materials

108.2.1 Planks shall have non-skid working surfaces to ensure safe working conditions.

108.2.2 Methods of manufacture, size, finish, resistance to corrosion and other relevant characteristics shall be suitable for their end use.

109 MEANS OF COMPLIANCE

109.1 For the purposes of this Standard, Parts 2 to 5 provide a means of compliance with Part 1 for scaffold planks made of solid and glue-laminated timber, steel, and aluminium.