Australian Standard™

Cranes, hoists and winches

Part 4: Tower cranes

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Australian Standard™

Cranes, hoists and winches

Part 4: Tower cranes

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PREFACE

This Standard was prepared by the Standards Australia Committee ME-005, Cranes.

The objective of this Standard is to provide nationally uniform requirements for the design of tower cranes for reference by importers, designers, users, and regulators.

Cognizance has been taken of the development of Standards for tower cranes as undertaken by the International Standards Technical Committee ISO/TC 96/SC7, Tower Cranes, at the time of developing this Standard.

Considerations for loads and load factors are based on ISO 8686-3, *Cranes, Design principles and load combinations*, Part 3: *Tower cranes*.

The term 'informative' has been used in this Standard to define the appendix to which it applies. An 'informative' appendix is for information and guidance only.

This Standard differs from the previous edition as follows:

(a) Requirements for limiting and indicating devices have been revised.

(b) Crane Standards have traditionally been based on the permissible stress method and problems arose when the various parts of AS 1170, *Structural design actions*, were revised based on the limit states design method. These problems have been addressed.

(c) Requirements for inspection and testing have been updated.

CONTENTS

Page

SECTION 1 SCOPE AND GENERAL
1.1 SCOPE 5
1.2 NEW DESIGNS AND INNOVATIONS 5
1.3 APPLICATION 5
1.4 TYPES 5
1.5 REFERENCED DOCUMENTS 6
1.6 DEFINITIONS 6

SECTION 2 GENERAL REQUIREMENTS FOR DESIGN
2.1 CLASSIFICATION AND LOAD RATING 7
2.2 CRANE LOADS 8
2.3 WIND ACTIONS 12
2.4 CRANE STRUCTURE DESIGN 13

SECTION 3 CRANE MECHANISMS
3.1 MECHANISMS 17
3.2 CLASSIFICATION OF MECHANISMS 17
3.3 REEVED ROPE, DRUM AND SHEAVE SYSTEMS 17
3.4 LIMITING DEVICES 17

SECTION 4 CONTROLS AND INDICATING DEVICES
4.1 CONTROLS 20
4.2 INDICATORS 21

SECTION 5 OPERATIONAL EQUIPMENT
5.1 ELECTRICAL EQUIPMENT AND CONTROLS 23
5.2 HYDRAULIC EQUIPMENT AND CONTROLS 23
5.3 PNEUMATIC EQUIPMENT AND CONTROLS 23

SECTION 6 OPERATIONAL DESIGN AND ACCESS
6.1 OPERATIONAL DESIGN 24
6.2 ACCESS 24

SECTION 7 MARKING AND MANUAL
7.1 MARKING ON CRANE 29
7.2 MARKING OF ACCESS AND SERVICE ISOLATORS 29
7.3 MANUAL 29

SECTION 8 INSPECTION AND TESTING
8.1 INSPECTION 31
8.2 OPERATION TESTS 31
8.3 TYPE TESTS 31

Page

APPENDICES
A INFORMATION TO BE SUPPLIED WITH AN ENQUIRY OR ORDER 32
B INFORMATION TO BE SUPPLIED BY THE MANUFACTURER 34
C TYPICAL ILLUSTRATIONS OF TOWER CRANES 37
D TYPICAL GROUP CLASSIFICATIONS OF THE TOWER CRANE AS A WHOLE 42
E TYPICAL GROUP CLASSIFICATIONS OF THE MECHANISMS OF TOWER CRANES 43

STANDARDS AUSTRALIA

Australian Standard
Cranes, hoists and winches

Part 4: Tower cranes

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements for tower cranes—

(a) that are dismantled when they have served their purpose; and

(b) of the permanently erected type,

as defined in AS 2549.

Horizontal jib and luffing jib and boom cranes which may be of the travelling, fixed, or climbing type, are also included.

Power-driven mobile cranes fitted with tower crane configurations are excluded except for the stability and foundation considerations when used in the capacity of a tower crane.

The Standard covers requirements from and including the hook to the anchorages of the tower crane as well as requirements for rail-mounted types.

NOTES:

1 Guidance on information to be supplied with an enquiry or order is given in Appendix A.

2 Guidance on information to be supplied by the manufacturer is given in Appendix B.

3 Guidance on selection and operation of tower cranes is given in AS 2550.4.

1.2 NEW DESIGNS AND INNOVATIONS

This Standard does not preclude the use of materials, designs, methods of assembly, procedures, and the like, that do not comply with a specific requirement of this Standard, or are not mentioned in it, but which can be shown to give equivalent or superior results to those specified.

1.3 APPLICATION

This Standard covers specific requirements for tower cranes and is intended for use in conjunction with AS 1418.1; however, requirements given herein take precedence over corresponding requirements of that Standard.

1.4 TYPES

The types of tower cranes within the scope of this Standard are power-driven cranes that have a vertical tower designed to be freestanding up to a specified height.

The general types of tower cranes are designated by specific features as follows:

(a) Ram luffing crane.

(b) Rope luffing crane.

(c) Trolley jib (horizontal jib) crane.

(d) Articulated trolley jib crane.

(e) Self-erecting crane.

NOTE: Typical illustrations of these types of tower crane are given in Appendix C.

1.5 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS
1000 The international system of units (SI) and its application
1359 Rotating electrical machines—General requirements
1359.101 Part 101: Rating and performance
1418 Cranes, hoists and winches
1418.1 Part 1: General requirements
1666 Wire-rope slings
1666.2 Part 2: Care and use
2549 Cranes (including hoists and winches)—Glossary of terms
2550 Cranes—Safe use
2550.4 Part 4: Tower cranes

AS/NZS
1170 Structural design actions
1170.2 Part 2: Wind actions

1.6 DEFINITIONS

For the purposes of this Standard, the definitions given in AS 2549 and those below apply.

1.6.1 Crane structure

All components of the crane excluding the crane support structure.

1.6.2 Crane support structure

The portion of the crane from the top of the tower to the foundation, including the transition piece (if used), grillages, ties and attachment to the building, and the foundation of the crane (whether it be rail-mounted or stationary).

1.6.3 Boom

The use of the term boom herein may also be applicable to jib.

1.6.4 Design installation life

The time that a loading action acts on a particular tower crane structural support system, e.g., foundation, building ties or combinations thereof.

1.6.5 Weathervane

A feature of a crane where the wind is able to slew the crane when out of service so that the boom provides the least resistance to the wind.

SECTION 2 GENERAL REQUIREMENTS FOR DESIGN

2.1 CLASSIFICATION AND LOAD RATING

2.1.1 Classification of tower crane

2.1.1.1 *General*

The basis of the classification of tower cranes is given in AS 1418.1, which establishes a classification of lifting appliances based on the number of operating cycles to be carried out during the expected life of appliance and a load spectrum factor that represents a nominal state of loading.

The classification of tower cranes is defined according to their category.

2.1.1.2 *Categories of tower cranes*

Tower cranes shall be divided into three general categories based on the service the tower crane is intended to endure, as follows:

(a) *Light* Tower cranes in irregular use or having a light state of loading.

(b) *Moderate* Tower cranes for general building construction.

(c) *Heavy* Tower cranes in regular use or having a heavy state of loading.

2.1.1.3 *Classification of the tower crane as a whole*

The classification of the tower crane as a whole shall be as given in Table 2.1.1.3 and shall be interpreted in accordance with AS 1418.1.

NOTE: Guidance on typical group classifications of the tower crane as a whole is given in Appendix D.

TABLE 2.1.1.3

CLASSIFICATION OF TOWER CRANES

Crane category	Crane classification		
	Class of utilization	State of loading	Group classification
Light	U_1 to U_4	Q1 and Q2	C1 to C4
Moderate	U_3 and U_4	Q2	C3 and C4
Heavy	U_4 and U_5	Q2 and Q3	C4 to C6

2.1.2 Crane rating

The tower crane shall be rated in terms of—

(a) the rated capacity of each hoisting motion; and

(b) the classification of the application of the tower crane or the use for which it is intended.

NOTE: The use of a tower crane may vary during its life.

2.2 CRANE LOADS

2.2.1 General

The proof of competence of components shall be determined by either the limit state method or the permissible stress method, as set out in AS 1418.1.

2.2.2 Loads and applicable factors

Table 2.2.2(A) specifies factors Φ_n for dynamic effects, which are used for load combinations listed in Tables 2.2.2(B1) and (B2).

The line numbers listed in the first column of Table 2.2.2(A) are those shown in column 3 of Tables 2.2.2(B1) and (B2).

Reduced partial load factors shall be applied to the masses of parts of the crane that act to reduce load effects and are therefore 'favourable' loads.

Where the masses and their centres of gravity are determined by experiment (weighing), the factors in accordance with favourable effects 1.2.1 of Table 2.2.2(B2), line 1, shall be used.

Where the masses and their centres of gravity are calculated based on final piece lists, the factors in accordance with favourable effects 1.2.2 of Table 2.2.2(B2), line 1, shall be used.

NOTE: Tables 2.2.2(B1) and 2.2.2(B2) categorize load combinations as follows:

A—frequently occurring load combinations.

B—infrequently occurring load combinations.

C—rarely occurring load combinations.

TABLE 2.2.2(A)

FACTOR Φ_n FOR DYNAMIC EFFECTS (APPLICABLE FOR BOTH PERMISSIBLE STRESS AND LIMIT STATE METHODS)

Line No. in Table 2.2.2(B)	Factor Φ_n	Guidance on values of factors Φ_n and load factors
1	Φ_1	$\Phi_1 = 1 \pm a$ $a = 0.1$ $\Phi_1 = 1$ for design against tipping
2	Φ_2 Φ_3	In accordance with AS 1418.1
3	Φ_7	$\Phi_7 = 1.1$ is recommended for building site crane. Other values may be used when the rail tracks tolerances (as agreed between user and manufacturer) vary from Standard
4 and 5	Φ_4	When using rigid body kinetic models: $\Phi_4 = 1.2$ if the acceleration or braking forces are changed with stepless control systems without backlash $\Phi_4 = 1.5$ in other control systems where drive forces are acting on the crane practically free of backlash $\Phi_4 = 2$ where considerable backlash exists Other values for Φ_4 may be used when substantiated or in accordance with AS 1418.1
6		Partial load factors shall be considered where appropriate
7		In-service wind load as specified in Clause 2.3.1(c)(i)
8		Snow and ice loads need only be considered in special cases and then in accordance with regional conditions
9		Loads due to temperature variations need only be considered where appropriate, according to regional and local conditions
10		Loads caused by skewing are negligible when using common undercarriages, otherwise requirements for AS 1418.1 apply
11	Φ_2	In accordance with AS 1418.1
12		Out-of-service wind load in accordance with AS/NZS 1170.2
13	Φ_5	In accordance with AS 1418.1
14	Φ_6	In accordance with AS 1418.1 Buffer forces need not be considered where the travelling velocity at contact with the buffer or end stop is less than 0.7 m/s
15		Tilting forces shall not be considered
16	Φ_4	In accordance with AS 1418.1
17		Loads caused by failure of mechanism or components shall be considered where appropriate
18		Excitation effects shall be considered where appropriate

TABLE 2.2.2(B1)

LOADS AND LOAD COMBINATIONS — TOWER CRANES—PERMISSIBLE STRESS METHOD

1	2			3	4				5					6							
Categories of loads	**List of the loads f_i**			**Line No.**	**Load combinations A**				**Load combinations B**					**Load combinations C**							
					A1	**A2**	**A3**	**A4**	**B1**	**B2**	**B3**	**B4**	**B5**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
Regular	Gravitation, acceleration, impacts	1 Weight of the crane	1.1 Unfavourable effects	1.1	Φ_1	Φ_1	1		Φ_1	Φ_1	1			Φ_1	1	Φ_1	1		1		1
			1.2.1 Favourable effects	1.2																	
			1.2.2 Favourable effects	1.3																	
		2.1 Weight of the gross load		2.1	Φ_2	Φ_3	1		Φ_2	Φ_3	1				1		1		1		1
		2.2 η*		2.2																	
		3 Weights of crane and hoist load travelling on uneven surface		3				Φ_7				Φ_7	Φ_7								
	Acceleration from drives	4 Weights of crane and gross load	4.1 Hoist drives excluded	4	Φ_4	Φ_4			Φ_4	Φ_4						Φ_4					
			4.2 Hoist drives included	5			Φ_4	Φ_4			Φ_4	Φ_4									
	Loads due to displacement	5 e.g., pre-stressing, uneven settlement of supports		6	1	1	1	1	1	1	1	1	1	1	1	1	1		1		1
Occasional	Effects of climate	1 In-operation wind loads		7					1†	1†	1†	1†	1†								
		2 Snow and ice loads		8					1	1	1	1	1		1						
		3 Temperature variations		9					1	1	1	1	1		1						
	Loads due to skewing	4 Acceleration acting on asymmetrical mass distribution		10									1								
Exceptional	1 Hoisting a grounded load			11										Φ_2							
	2 Out-of-operation wind loads			12											0.67‡						
	3 Test loads			13												Φ_5					
	4 Buffer forces			14													Φ_6				
	5 Tilting forces			15																	
	6 Emergency cut-out			16															Φ_4		
	7 Failure of mechanism			17																	
	8 Vibration of the crane's foundation			18																	1
	Load combination factor γ_n			19	1.0				0.9					0.8							

* η is the weight of that part of the hoist load remaining suspended from the appliance (e.g., magnetic or other grabs attached).

† This factor applies to the forces obtained using the working wind speed specified in Clause 2.3.1(c)(i).

‡ This factor converts the limit state wind forces 'F' obtained directly from AS/NZS 1170.2 into a working stress wind force.

TABLE 2.2.2(B2)

LOADS AND LOAD COMBINATIONS — TOWER CRANES—LIMIT STATE METHOD

1	2			3	4					5						6								
Categories of loads	**List of the loads f_i**			**Line No.**	**Load combinations A**					**Load combinations B**						**Load combinations C**								
					Partial load factors	**A1**	**A2**	**A3**	**A4**	**Partial load factors**	**B1**	**B2**	**B3**	**B4**	**B5**	**Partial load factors**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
Regular	Gravitation, acceleration, impacts	1 Weight of the crane	1.1 Unfavourable effects	1.1	1.22					1.16						1.1								
			1.2.1 Favourable effects	1.2	1.16	Φ_1	Φ_1	1		1.1	Φ_1	Φ_1	1			1.05	Φ_1	1	Φ_1	1		1		1
			1.2.2 Favourable effects	1.3	1.1					1.05						1.0								
		2.1 Weight of the gross load		2.1	1.34	Φ_2	Φ_3	1		1.22	Φ_2	Φ_3	1			1.1		1.0		1		1		1
		2.2 η*		2.2																				
		3 Weights of crane and hoist load travelling on uneven surface		3	1.22				Φ_7	1.16				Φ_7	Φ_7									
	Acceleration from drives	4 Weights of crane and gross load	4.1 Hoist drives excluded	4	1.34	Φ_4	Φ_4			1.22	Φ_4	Φ_4				1.1			Φ_4					
			4.2 Hoist drives included	5				Φ_4	Φ_4				Φ_4	Φ_4										
	Loads due to displacement	5 e.g., pre-stressing, uneven settlement of supports		6	1.16	1	1	1	1	1.1	1	1	1	1	1	1.05	1	1	1	1		1		1
Occasional	Effects of climate	1 In-operation wind loads		7						1.16†	1	1	1	1	1									
		2 Snow and ice loads		8						1.22	1	1	1	1	1	1.1		1						
		3 Temperature variations		9						1.16	1	1	1	1	1	1.05		1						
	Loads due to skewing	4 Acceleration acting on asymmetrical mass distribution		10						1.16					1									
Exceptional	1 Hoisting a grounded load			11												1.1	Φ_2							
	2 Out-of-operation wind loads			12												0.733‡		1						
	3 Test loads			13												1.1			Φ_5					
	4 Buffer forces			14												1.1				Φ_6				
	5 Tilting forces			15												1.1								
	6 Emergency cut-out			16												1.1						Φ_4		
	7 Failure of mechanism			17												1.1								
	8 Vibration of the crane's foundation			18												1.0								1
	Resistance coefficient			19	1.1					1.1						1.1								

* η is the weight of that part of the hoist load remaining suspended from the appliance (e.g., magnetic or other grabs attached).

† This factor applies to the forces obtained using the working wind speed specified in Clause 2.3.1(c)(i).

‡ This factor applies directly to the limit state wind forces obtained from AS/NZS 1170.2.

2.2.3 Load combinations—Inertia forces

The inertia forces acting on the crane structure during acceleration and deceleration shall be determined from the maximum driving forces arising in regular operations and combined as follows:

(a) When there is no restriction to operating different movements simultaneously:

(i) Hoist movement combined with one of—

(A) slewing and crab traversing;

(B) slewing and luffing; or

(C) slewing and crane travelling.

(ii) The inertia forces during slewing and deceleration shall be combined with centrifugal forces. For centrifugal forces, $\Phi_4 = 1$.

(b) When there are restrictions to operate different movements simultaneously, the inertia forces shall be combined so they can act simultaneously.

2.2.4 Load combinations

The appropriate load combinations as given in Tables 2.2.2(B1) and (B2) shall be used.

2.2.5 Rail-mounted installations

A rail-mounted tower crane shall be designed so that it is stable in operation and out of operation. For movement along rails, an anchorage system shall be provided to prevent the movement of the tower crane under the action of out-of-service wind loads.

2.3 WIND ACTIONS

2.3.1 Wind actions on tower cranes support structures

The wind actions on the support structure shall be determined in accordance with the relevant requirements of AS 1418.1, AS/NZS 1170.2 and with the following:

(a) The load combinations and coefficients shall be as given in Tables 2.2.2(B1) and (B2).

(b) *Out-of-operation conditions:*

(i) *General* The design Structure Importance Level, and the Reference Probability of Exceedance shall comply with the requirements of Tables 2.3.1(A) and 2.3.1(B). The regions shall be as designated in AS/NZS 1170.2.

The design annual probability of exceedance for a wind event on a tower crane installation for subsequent use in AS/NZS 1170.2 to determine design wind pressures, shall be determined as follows:

$$P = P_{\text{ref}} \times (5/N)$$

where

P = annual probability of exceedance

P_{ref} = reference probability of exceedance (see Table 2.3.1(B))

N = design installation life (years) i.e., the period of time the crane is on site

'N' shall be not less than 1 year.

A design installation life 'N' of greater than 5 years is beyond the scope of this Standard.

Due allowance should be made for a possible extension of time that the crane is installed on site.

(ii) *Weathervaning* The designer shall state in the information provided to the user whether the crane design relies on its ability to weathervane.

(c) *In-operation conditions:*

(i) *General* Tower cranes and their installations shall be designed for minimum permissible stress in-operation wind speed of 20 m/s.

(ii) *Special applications* For special applications where a tower crane is operating in higher wind conditions, consideration shall be given to the specific site requirements.

(d) *Tower crane boom and jib* Calculations for wind drag on lattice type boom and jibs shall be performed in accordance with the requirements for latticed towers, multiple frames, and oblique wind direction specified in AS/NZS 1170.2.

2.3.2 Wind actions on tower crane structure

The annual probability of exceedance for a wind loading event on the tower crane structure shall be determined in accordance with AS/NZS 1170.2 for a structure importance level and reference probability of exceedance relevant to the most severe of its intended uses and shall not be less than 1 in 50 years.

The design life of the crane structure shall be in accordance with AS 1418.1.

TABLE 2.3.1(A)

STRUCTURE IMPORTANCE LEVEL

Structure importance level	Examples of structure classes
1	Potential collapse zone over site only, Rarely applicable to tower cranes
2	Cranes in normal conditions, e.g., lifting over public areas
3	Cranes operating in the vicinity of post disaster function, e.g., servicing hospitals
4	Situations where failure of the crane could trigger a disaster posing extreme danger to large numbers of people or a large area. Such cranes require individual consideration outside the scope of this Standard, e.g., servicing a nuclear power station or cyanide factory

TABLE 2.3.1(B)

REFERENCE PROBABILITY OF EXCEEDANCE

Structure importance level	Reference probability of exceedance (P_{ref})
1	1 in 250
2	1 in 500
3	1 in 1000
4	1 in 2000

2.4 CRANE STRUCTURE DESIGN

2.4.1 Basis of design of the crane structure

The crane structure including the support tower or mast shall comply with the requirements of AS 1418.1.

2.4.2 Basis of design of the crane support structure

Considerations for the design of the crane support structure, including the support tower, shall include the design working life of the crane installation, which shall be in accordance with Clause 2.3.

2.4.3 Stability

The stability of the tower crane against overturning shall satisfy the requirements of each of the load combinations listed in Table 2.4.3. Each of the loads shown in Table 2.4.3 shall be multiplied by the ultimate coefficients given when calculating the ultimate overturning moments and the ultimate stabilizing moments due to that load.

The following relationship shall be satisfied:

$$\Sigma \text{ Ultimate stabilizing moments} > \Sigma \text{ ultimate overturning moments}$$

TABLE 2.4.3

SUPPORT STRUCTURE COEFFICIENTS

Load combination numbers		Description of loads	Coefficient
In-operation basic stability	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	1.6
	4	Horizontal Dynamic	0.0
	5	Wind (Operating)	0.0
	6	Wind (Out-of-operation)	0.0
In-operation dynamic stability (with wind)	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	1.35
	4	Horizontal Dynamic	1.0
	5	Wind (Operating)	1.0
	6	Wind (Out-of-operation)	0.0
In-operation backward stability	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	−0.3
	4	Horizontal Dynamic	0.0
	5	Wind (Operating)	1.0
	6	Wind (Out-of-operation)	0.0
In-operation dynamic stability (no wind)	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	1.45
	4	Horizontal Dynamic	1.0
	5	Wind (Operating)	0.0
	6	Wind (Out-of-operation)	0.0

(*continued*)

TABLE 2.3.1(A) (*continued*)

Load combination numbers		Description of loads	Coefficient
Out-of -operation (extreme wind)	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	0.0
	4	Horizontal Dynamic	0.0
	5	Wind (Operating)	0.0
	6	Wind (Out-of-operation)	1.2
Out-of-operation (during erection and dismantling)	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	1.25
	4	Horizontal Dynamic	1.0
	5	Wind (Operating)	0.0
	6	Wind (Out-of-operation)	1.0
In-operation (with wind)	1	Dead (Restoring)	0.9
	2	Dead (Overturning)	1.0
	3	Maximum Working Capacity	1.45
	4	Horizontal Dynamic	0.0
	5	Wind (Operating)	1.0
	6	Wind (Out-of-operation)	0.0

NOTES:

1 Horizontal dynamic effects include the effects of loads due to travel, slewing, luffing, or trolleying and their effects either individually or in any combination.

2 The footings, foundations, or tracks upon which the tower crane rests are to be assumed to be horizontal and rigid.

3 Loads need not be further multiplied by impact, dynamic, or other coefficients.

4 Load combinations are derived from the range of conditions to which a tower crane is subjected in the normal course of operation on site.

5 Restoring coefficient may be 1.0 if actual loads are confirmed.

2.4.4 Ballast

Where ballast is provided for crane stability, requirements for the location and the method of fixing shall be stated by the crane manufacturer or in the installation design. The various components that comprise the ballast shall be clearly and legibly marked with the centre of gravity of the component together with the tare mass.

2.4.5 Footings and foundations

The footing and foundations shall be designed in accordance with the relevant Australian Standards and with regard to the results of a report on geotechnical conditions specific to the location of the installation.

2.4.6 Tie frames and ties

The design of the tie frames and ties shall have regard to the expected period of use relative to out-of-operation wind in accordance with Clause 2.3.

2.4.7 Guying

Where used, guying will induce additional stresses in the crane structure and the crane support structure. Where used, guying shall be considered in the design of the crane installation.

2.4.8 Rail-mounted cranes

Rail-mounted cranes shall be checked for their resistance to wind-induced drifting in accordance with Tables 2.4.8(A) and 2.4.8(B).

If rail clamps or similar measures are necessary to prevent out-of-service drifting, the operator's manual shall clearly state that the clamps be applied if the design in-service wind speed has been exceeded.

TABLE 2.4.8(A)

LOAD COMBINATIONS FOR WIND-INDUCED DRIFTING CALCULATIONS

Load combination	Description	Load factor
In-service (with wind)	Loads induced by the dead weight	1.0
	Applied load	1.35
	Wind load (permissible stress)	1.2
	Inertia forces	1.0
Out-of-service (extreme wind)	Loads induced by the dead weight	1.0
	Applied load	1.0
	Wind load (permissible stress)	1.2
	Inertia forces	0.0

TABLE 2.4.8(B)

DATA FOR WIND-INDUCED DRIFTING CALCULATIONS

Ratio: Resistance to travel/radial load	Plain bearings	0.02
	Anti-friction bearings	0.005
Coefficient of friction between the track and a:	Braked wheel	0.14
	Rail clamp	0.25

NOTE: Higher coefficients of friction may be used if it can be shown that such coefficients are true for all surface conditions and qualities (e.g., oil, dirt, ice).

2.4.9 Seismic loading

Seismic loading, including loads transmitted by the supporting structure, shall be incorporated into the crane design and installation, where applicable.

SECTION 3 CRANE MECHANISMS

3.1 MECHANISMS

The mechanism that drives each motion shall comply with the relevant requirements of AS 1418.1 for crane mechanisms.

3.2 CLASSIFICATION OF MECHANISMS

The classification of the mechanisms of tower cranes shall be as given in the Table 3.2, and shall be interpreted in accordance with AS 1418.1.

NOTE: Guidance on typical group classifications of the mechanisms of tower cranes is given in Appendix E.

3.3 REEVED ROPE, DRUM AND SHEAVE SYSTEMS

Reeved rope, drum and sheave systems shall comply with AS 1418.1. Rope selection shall take into account the maintenance and discard criteria specified in AS 1666.2.

3.4 LIMITING DEVICES

3.4.1 Rated capacity limiter

3.4.1.1 *General*

Rated capacity limiters shall be fitted to all tower cranes and shall comply with the requirements of Clause 3.4.1. They shall operate automatically for a given configuration.

3.4.1.2 *Device activation*

When the rated capacity limiter operates due to a maximum load exceeding the rated capacity, hoisting shall be prevented between 105% and 110%.

When the rated capacity limiter operates due to the maximum load moment, the following applies:

(a) On tower cranes with horizontal jib or level luffing —

  (i) hoisting shall be prevented between 105% and 110%; and

  (ii) increase of the load radius shall be prevented between 95% and 100% of the rated capacity.

(b) On tower cranes with luffing jib —

  (i) hoisting shall be prevented between 105% and 110%;

  (ii) increase in the load radius shall be prevented between 95% and 100% of the rated capacity;

  (iii) where protected bridging is used (e.g., key-operated pushbutton, no locking function), luffing-in shall be possible; and

  (iv) the bridging switch may be omitted, when luffing-out is prevented at 100% of the rated capacity and luffing-in is prevented at 105% of the rated capacity.

3.4.1.3 *Speed selection protection*

Hoisting and lowering shall be prevented between 95% and 100% of the load limit in the respective speed for gears other than the gear used for the maximum load.

3.4.1.4 *Override*

The design of the rated capacity limiter override facility shall be such that it cannot be inadvertently activated.

3.4.2 Motion-limiting devices

3.4.2.1 *General*

Tower cranes shall be fitted with motion-limiting devices to prevent motion out of the service limits. These devices shall cause braking, including deceleration where appropriate, and stopping when the following extreme permissible positions have been reached:

(a) The highest and lowest positions of the hook.

(b) The extreme permissible operating positions of the jib where a luffing motion is part of normal working operations.

(c) The end positions of the trolley track on the jib.

(d) The end positions of horizontally telescoping or movable jibs.

(e) The position at the end of the tracks for rail-mounted travelling tower cranes. Where a crane is equipped with a means for travelling, end-of-travel devices shall be placed on the chassis of the crane.

The functioning of the devices mentioned above shall not prevent motion in the opposite direction after braking and stopping. The control of the motion opposite to the motion that has been stopped shall automatically reset into service.

3.4.2.2 *Hoisting*

The following means to control upper and lower limits shall be provided:

(a) *Control of upper limit* The upper limit of the hoisting motion shall be controlled by a motion-limiting device complying with the relevant requirements of AS 1418.1 for crane mechanisms and limit switches. A final limit switch preceded by a working limit switch shall be provided, and shall—

  (i) have its operation independently sourced; and

  (ii) not prevent reversal of the motion.

(b) *Restricted control of lower limit* Where the lower limit of the hoisting motion is not subject to natural control, e.g., by a fixed height of lower working level within the hoisting range of the crane, or the crane operator does not have a view of the lower range of the hoisting motion for a significant distance, e.g., when the hook or load passes through a hole in a floor, the lower limit of the hoisting motion shall be controlled by a self-resetting motion-limiting device complying with the relevant requirements of AS 1418.1.

3.4.2.3 *Luffing or trolleying*

A final limit switch preceded by a working limit switch shall be provided for luffing or trolleying motions.

3.4.2.4 *Crane travel*

Limitation of crane travel motion shall have regard to provision of travel limits to reduce speed at each end of the runway, prior to stopping.

Travel motion limits shall be attached to the crane and be activated by a device not attached to the crane.

TABLE 3.2

CLASSIFICATION OF CRANE MECHANISMS

Crane category	Class of utilization					State of loading					Group classification				
	L	O	R	D	T	L	O	R	D	T	L	O	R	D	T
Light	T_1 to T_4	T_1 to T_4	T_1 to T_3	T_1 to T_4	T_1 & T_2	L1 & L2	L3	L1 & L2	L1 & L2	L3	M1 to M4	M2 to M5	M1 to M3	M1 to M3	M2 & M3
Moderate	T_3 & T_4	T_3 & T_4	T_2 & T_3	T_2 & T_3	T_1 & T_2	L2	L3	L3	L2	L3	M3 & M4	M4 & M5	M3 & M4	M2 & M3	M2 & M3
Heavy	T_4 & T_5	T_4 & T_5	T_3 & T_4	T_3 to T_5	T_2 to T_5	L2 & L3	L2 & L3	L2 & L3	L2 & L3	L2 & L3	M4 to M6	M4 to M6	M3 to M5	M3 to M6	M2 to M6

LEGEND:
L = hoisting
O = slewing
R = luffing
D = direction
T = travelling

SECTION 4 CONTROLS AND INDICATING DEVICES

4.1 CONTROLS

4.1.1 General

The position and design of control devices shall prevent the tower crane and the hoisted load being set in motion by inadvertent action.

The forces to activate a control handle, control lever, or control pedal shall be within the following range:

(a) For a right-left lever .....5–40 N.

(b) For a backwards-forwards lever .....8–60 N.

(c) For a pedal .....10–150 N.

4.1.2 Basic control arrangement

4.1.2.1 *General*

The basic controls shall be arranged as follows:

(a) Right:.....hoisting and lowering of the load, travelling of the crane.

(b) Left:..... luffing and motion of the crab, slewing of the crane.

4.1.2.2 *Control levers of the ball-and-socket or universal joint type*

Where control levers of the ball-and-socket or universal joint type are used, the motions of the crane shall conform to the lever movements shown in Figure 4.1.2.2.

4.1.2.3 *Wheel control devices*

For wheel control devices, the motions of the crane shall conform to the wheel movements shown in Table 4.1.2.3.

Motion of the crane	*Direction of lever movement*
— hoisting of the load, luffing in, inward motion of the crab or jib, where the latter is capable of moving longitudinally	— towards the operator (lever backwards)
— lowering of the load, lowering of the jib, outward motion of the crab or jib, where the latter is capable of moving longitudinally	— away from the operator (lever forwards)
— slewing to the right	— lever to the right of the operator
— slewing to the left	— lever to the left of the operator
— travelling of the crane	— lever to the right or to the left of the operator depending on the direction of the motion and on the position of the crab in slew

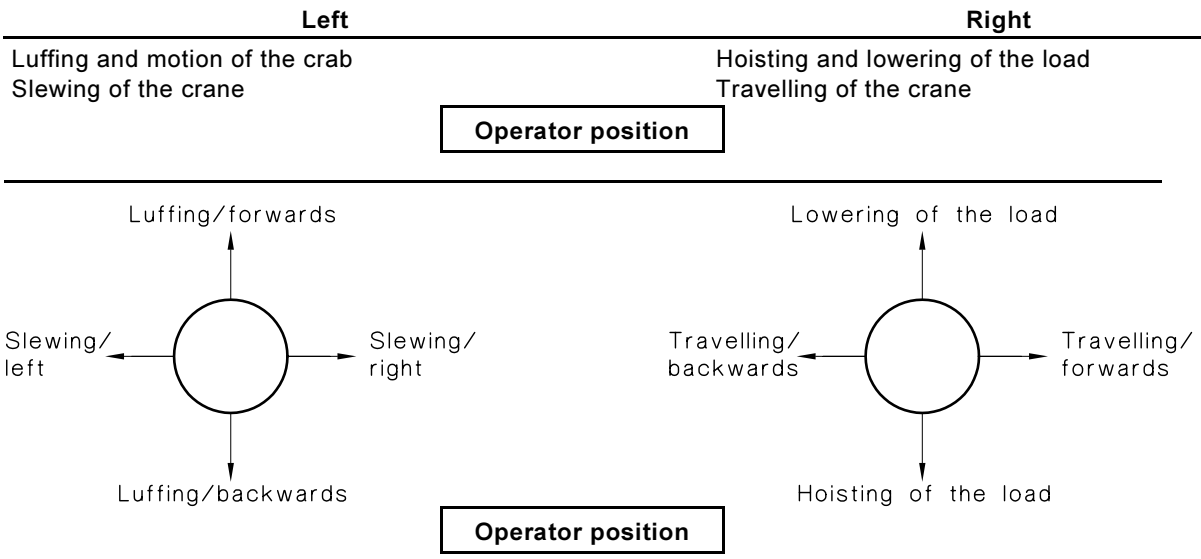


FIGURE 4.1.2.2. CRANE MOTIONS FOR BALL-AND-SOCKET OR UNIVERSAL JOINT TYPE CONTROLS

TABLE 4.1.2.3

ALLOWABLE CRANE MOTIONS FOR WHEEL CONTROL DEVICES

Motion of the crane	Direction of wheel movement
Hoisting of the load, luffing in, slewing right, inward motion of the crab or jib where the latter is capable of moving longitudinally	Rotation clockwise
Lowering of the load, luffing out, slewing left, outward motion of the crab or jib where the latter is capable of moving longitudinally	Rotation anticlockwise

4.2 INDICATORS

4.2.1 General

The information displayed by the indicating devices shall be readable by the operator while operating the crane, at all times during the lifting operation. For cranes operated remotely by pendent or remote control, the information shall be displayed on the control device Indicators shall—

(a) comply with the appropriate requirements of AS 1418.1;

(b) be in accordance with the crane manufacturer's recommendations; and

(c) where applicable, be effective for operation in an ambient temperature range of −20°C to 60°C.

4.2.2 Mandatory types of indicators

4.2.2.1 *Trolley position indicator for cranes with trolley jib*

The trolley position indicator shall depict the operating position of the trolley on the jib with an accuracy of −0, +4%. The position indicator may be incorporated in the working radius indicator required in Clause 4.2.2.4.

NOTE: Where the indicator is an electronic or like device, it may be appropriate, as a backup, to have jib lengths painted on the side of the jib.

4.2.2.2 *Load indicator*

The load indicator shall depict the mass being hoisted with an accuracy of +10, −3%. This may be part of the rated limiter required in Clause 3.4.1.

4.2.2.3 *Load moment system*

The following requirements apply to the rated capacity indicator:

(a) The rated capacity indicator shall continuously take into account the configuration of the crane and the position of the load, or both, without requiring manual resetting during the lifting cycle.

(b) It shall provide the driver with visual and acoustic warnings of the approach to the rated capacity of the appliance. Such warnings shall commence at not less than 90% and not more than 95% of the rated capacity. Any switch that permits the audible signal to be stopped whilst the indicator is giving warning shall automatically reset before the next approach to rated capacity.

(c) It shall give clear and continuous indication when the rated capacity is being exceeded. The warning shall be visual and audible at the operator's control station and audible to persons in the vicinity of the crane. Such warnings shall commence at not less than 102.5% and not more than 110% of the rated capacity.

(d) Where remote controls are used, the following applies:

  (i) Tower cranes provided with cable-connected controls shall have the warning signal of the approach to the rated capacity installed on the control panel.

  (ii) Tower cranes provided with cableless controls, for which the product of the radius and the rated capacity is less than 50 t, may have the warning signal of the approach to the rated capacity installed on the crane.

4.2.2.4 *Working radius indicator*

The working radius indicator shall depict the working radius (graduated in metres) consistent with the maximum rated capacity with an accuracy of +10, −3% of the actual radius.

NOTES:

1 Where the indicator is an electronic or like device, it should, as a backup, have a gravity pendulum radius or angle indicator for luffing jib cranes.

2 Where a crane is working at less than its maximum rated capacity, a variation in tolerance may be experienced in the operation of indicators covered by Clause 4.2.2.1.

4.2.3 Optional indicators

Other types of indicators are optional and may be fitted to the crane, e.g., crane motion indicator or hook height indicator.

SECTION 5 OPERATIONAL EQUIPMENT

5.1 ELECTRICAL EQUIPMENT AND CONTROLS

Electrical equipment and controls shall comply with the relevant requirements of AS 1418.1 for electrical equipment and control and, where applicable, with specific requirements appropriate to particular types of cranes as set out in this Standard.

Where the power source to the rotating section of the tower crane is provided by a cable, a slewing direction indicator shall be provided, and shall function continuously in operation.

5.2 HYDRAULIC EQUIPMENT AND CONTROLS

Hydraulic equipment and controls shall comply with the relevant requirements of AS 1418.1 for hydraulic equipment and controls and, where applicable, with specific requirements appropriate to particular types of cranes as set out in this Standard.

5.3 PNEUMATIC EQUIPMENT AND CONTROLS

Pneumatic equipment and controls shall comply with the relevant requirements of AS 1418.1 for pneumatic equipment and controls and, where applicable, with specific requirements appropriate to particular types of cranes as set out in this Standard.

SECTION 6 OPERATIONAL DESIGN AND ACCESS

6.1 OPERATIONAL DESIGN

The operational design shall comply with the relevant requirements of AS 1418.1 and, where applicable, with specific requirements appropriate to particular types of cranes as set out in this Standard.

6.2 ACCESS

6.2.1 General

All control stations and all other parts of the crane requiring an inspection or a regular maintenance shall be accessible by means of stairs, ladders, walkways, and landings or other effective means.

In order to carry out erection or dismantling operations, and inspection or repair of parts located above the ground, the crane, including the boom or jib, shall be provided with sufficient support equipment, handrails, handgrips, platforms, safety equipment, or other effective means, to ensure the safe access of personnel and to allow them access to places of work.

6.2.2 Stairs

Stairs should have the following nominal dimensions:

(a) Rise ..... 200 mm.

(b) Tread ..... 100 mm min.

(c) Width ..... 500 mm.

6.2.3 Ladders

Ladders should have the following nominal dimensions:

(a) Height between rungs ..... 300 mm max.

(b) Width between uprights ..... 300 mm.

(c) Free space behind rungs ..... 160 mm.

(d) Diameter of the rungs ..... 20 mm.

(e) Extension above the landing ..... 1.0 m.

6.2.4 Rest platforms

Except for automatic self-erecting cranes, ladders in the towers shall have rest platforms regularly spaced and placed in such a way that the first flight does not exceed 12.5 m in height and the following flight does not exceed 10 m in height. For automatic self-erecting cranes, the flight of 12.5 m may be exceeded, provided that suitable equipment, which provides at least an equivalent degree of safety (against falling as a result of fatigue), is installed.

6.2.5 Protection device for ladders in the tower

Hoop guards shall be provided except where ladders are less than 6000 mm in length or where the structural members ensure dorsal protection, as follows:

(a) Square with sides ≤750 mm (see Figure 6.2.5(A)).

(b) Equilateral triangle with sides ≤1100 mm (see Figure 6.2.5(B)).

(c) Right-angled isosceles triangle with the sides of the right angle ≤1100 mm (see Figure 6.2.5(C)).

(d) Tabular tower of diameter ≤1100 mm.

6.2.6 Walkways and landings

6.2.6.1 *Recommended dimensions*

The dimensions of walkways and landings should be as follows:

(a) Width of walkways.....minimum practicable greater than 225 mm.

(b) Width of landings.....minimum practicable greater than 450 mm.

(c) Height of the handrail.....1000 mm.

(d) Height of the intermediate guardrail..... 500 mm.

(e) Height of the toeboard (where required)..... 100 mm.

6.2.6.2 *Requirements for walkways in jibs or booms*

Where walkways are incorporated in the jib, a handrail, static line or like means shall be provided along the boom or jib to facilitate the attachment of a moving safety belt or harness. Configurations may include any of the following or a configuration giving a similar level of protection, all with a walkway of at least 225 mm wide:

(a) *Height of the jib ≤1.50 m (see Figure 6.2.6.2(A))* The walkway shall be fitted along the side of the jib or boom for a triangular cross-section and on top of a square cross-section.

NOTE: In this circumstance, the diagonal bars of a triangular cross-section have to be stepped over.

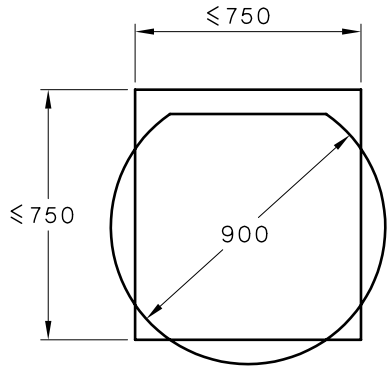
(b) *Height of the jib or boom >1.50 m <1.80 m (see Figure 6.2.6.2(B))* The walkway shall be fitted along the side of a triangular cross-section and on the lower chord of a square cross-section. The guide rail shown in Figure 6.2.6.2(B), acting as a protective device against falling, shall be fitted 1.50 m above the walkway on a triangular cross-section and in the top inside corner of a square cross-section.

NOTE: In this circumstance, the design requires the diagonal bars of a triangular cross-section to be stepped over.

(c) *Height of the jib or boom ≥1.80 m (see Figure 6.2.6.2(C))* The walkways shall be fitted to the centre of the longitudinal lower chords.

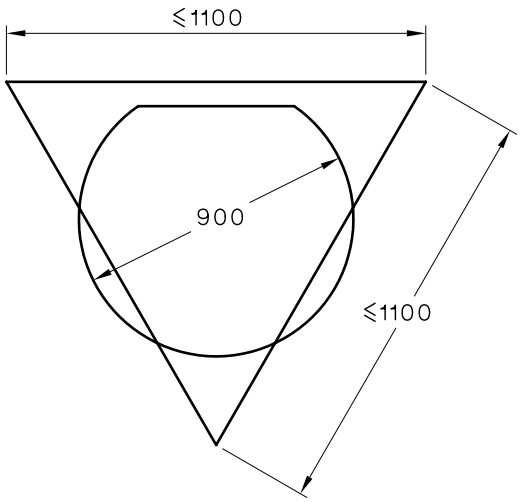
At a height of 1 m above the floor of the walkways, a handrail, static line, or like means shall be provided to act as protective devices against falling, at least on one side and preferably on both sides of a triangular cross-section and a square cross-section or, alternatively, with the latter in the top inside corner.

The means of access specified in Figures 6.2.6.2(A), 6.2.6.2(B), and 6.2.6.2(C) need not be installed in the jibs or booms where these can be lowered to enable a complete visual inspection, maintenance or repair to be carried out, or where provision is made in the construction for other appropriate means of carrying out a complete visual inspection, maintenance and repair.



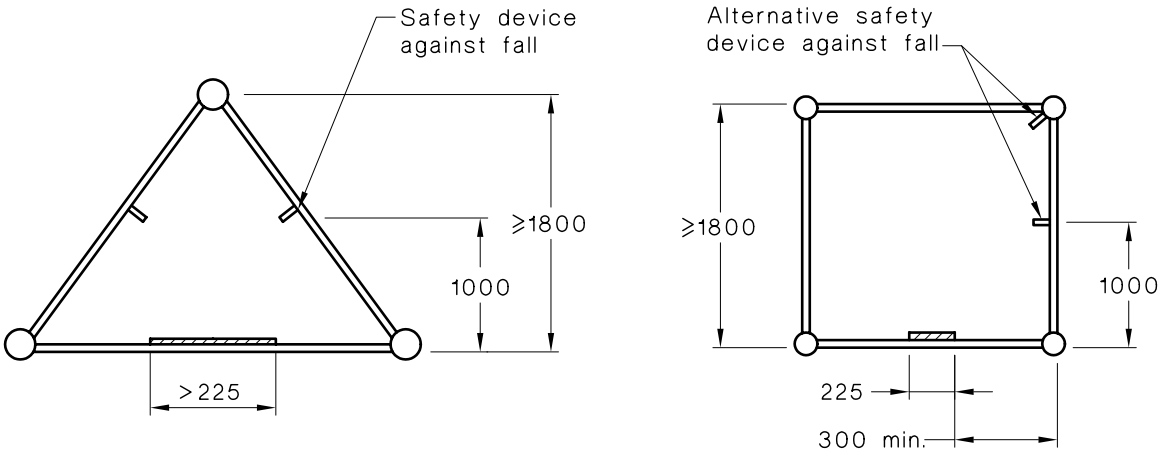
DIMENSIONS IN MILLIMETRES

FIGURE 6.2.5(A) DORSAL PROTECTION—SQUARE



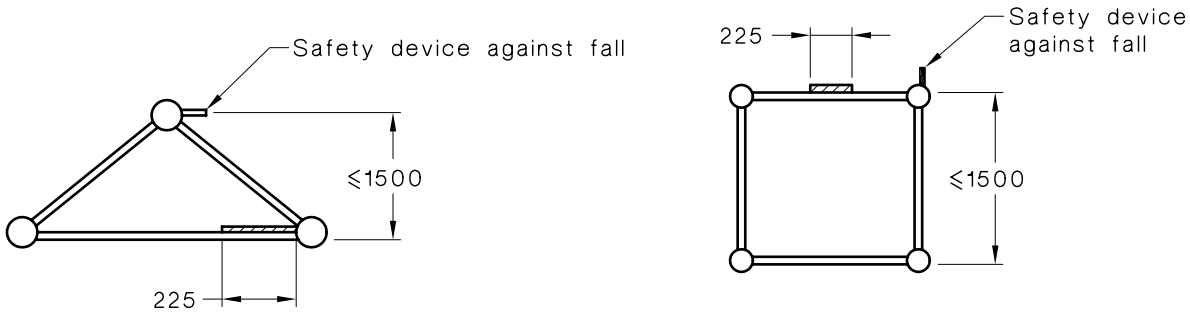
DIMENSIONS IN MILLIMETRES

FIGURE 6.2.5(B) DORSAL PROTECTION—EQUILATERAL TRIANGLE



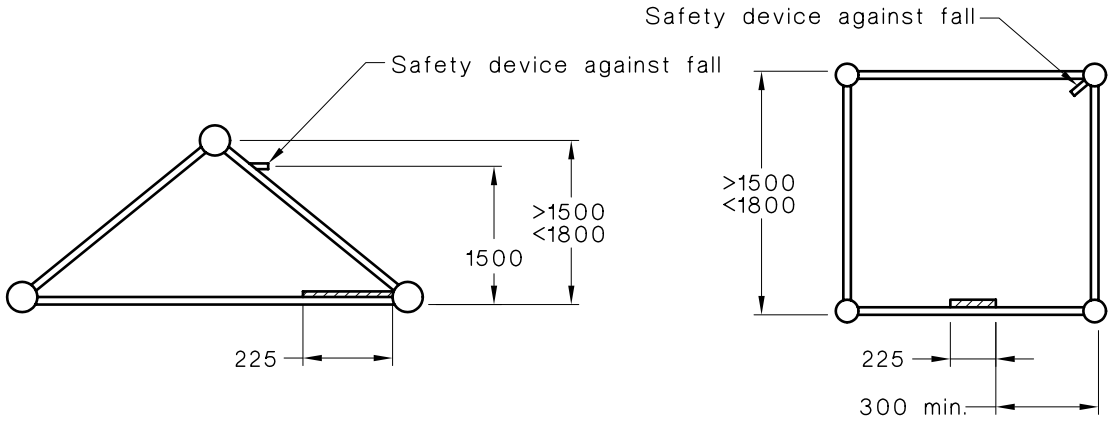
DIMENSIONS IN MILLIMETRES

FIGURE 6.2.5(C) DORSAL PROTECTION—ISOCELES TRIANGLE



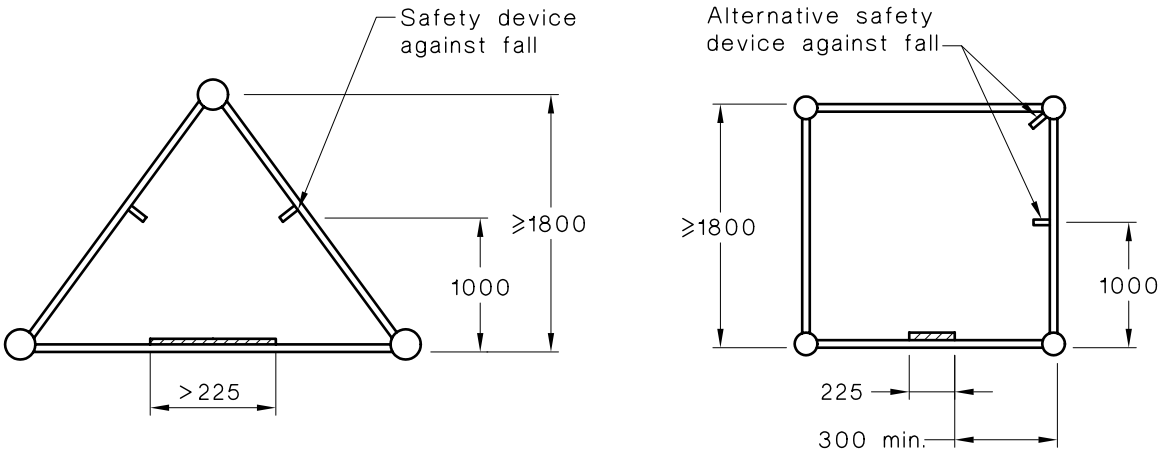
DIMENSIONS IN MILLIMETRES

FIGURE 6.2.6.2(A) WALKWAYS—HEIGHT OF JIB ≤1.50 m



DIMENSIONS IN MILLIMETRES

FIGURE 6.2.6.2(B) WALKWAYS—HEIGHT OF JIB >1.50 m <1.80 m



DIMENSIONS IN MILLIMETRES

FIGURE 6.2.6.2(C) WALKWAYS—HEIGHT OF JIB ≥1.80 m

SECTION 7 MARKING AND MANUAL

7.1 MARKING ON CRANE

Each of the crane's subassemblies shall be marked legibly and permanently, in a readily accessible location, with the following information:

(a) On each independent hoisting mechanism, the maximum rated capacity of the mechanism in either kilograms or tonnes, e.g., MRC 800 kg, MRC 10 t, or MRC 10 tonnes.

(b) Name or mark of the manufacturer or distributor of the crane.

(c) Manufacturer's serial number and year of manufacture.

NOTE: Sub-assemblies include but are not necessarily limited to tower sections, boom sections, mast/A-frame, pendants, power pack and counterweights.

Marking shall be in the English language, and values shall be in SI units (see AS 1000).

7.2 MARKING OF ACCESS AND SERVICE ISOLATORS

The access and service isolator shall be permanently, legibly, and clearly marked with the following information:

(a) Identification, e.g., 'SERVICE ISOLATOR TRAVEL MOTION ONLY'.

(b) A warning, e.g., 'WARNING: THIS ISOLATOR DOES NOT ISOLATE CRANE FROM POWER SOURCE'.

7.3 MANUAL

7.3.1 General

Manuals shall be in plain English, and values shall be in SI units (see AS 1000).

The manufacturer shall provide an operating, maintenance and spare parts manual for the specific tower crane, which shall include the following information:

(a) Construction of tracks or supports.

(b) Details of ballast, where required.

(c) Electricity supply, where required.

(d) Exact procedure for the assembly of all components and the whole crane.

(e) Method of connecting the various components.

(f) Mass and centre of gravity of each sub-assembly.

(g) Characteristics of any auxiliary equipment required.

(h) Method of slinging the components, where appropriate.

(i) Weather conditions under which the crane shall not be assembled.

(j) Weather conditions under which the crane shall not be operated.

(k) Details of steel wire rope used on crane, i.e., nominal size, grade (quality) and construction.

Information shall be provided to enable the design of the foundation.

NOTE: Guidance on information to be supplied by the manufacturer is given in Appendix B.

7.3.2 Operating manual

The operating manual shall have a face sheet that contains all of the information required in Clause 7.1. The operating manual shall include the following:

(a) *Tower crane height* Where the tower crane height is such that it is only stable in-service and out-of-service with anchorings for the design winds, then the operating manual shall specify that the tower crane shall operate only with these anchorings installed.

(b) *Track buffers* Data required for designing the track buffers shall be supplied by the manufacturer for each type of tower crane and shall specify that the fabrication and installation of the track buffers shall be such that the reactions transmitted to the tower crane act in a direction parallel to the track and shall not cause overturning or derailment of the tower crane.

SECTION 8 INSPECTION AND TESTING

8.1 INSPECTION

Inspection shall be carried out by a competent person, to ensure compliance with the requirements of this Standard in the following circumstances:

(a) Installation of a new crane.

(b) Installation of new associated equipment.

(c) Re-installation of crane.

(d) Re-installation of associated equipment.

(e) Modification of a crane.

(f) Modification of associated equipment.

8.2 OPERATION TESTS

For other testing to be carried out on a newly installed, reinstalled or modified crane, or its associated equipment, see AS 2550.4.

8.3 TYPE TESTS

Type tests shall be carried out in accordance with the designer's specifications.

APPENDIX A

INFORMATION TO BE SUPPLIED WITH AN ENQUIRY OR ORDER

(Informative)

The following particulars will enable the designer to design the most suitable crane from their range of manufacture to meet customers' requirements, or to suggest a modified standard product or a specially designed machine:

(a) Type of crane and nature of drive, i.e., electric or internal combustion engine (petrol or diesel).

(a) Nature of electricity supply:

  (i) a.c. or d.c., voltage, frequency in hertz, number of phases and number of wires.

  (ii) Any local bylaws that affect supply.

  (iii) Type and position of conductors or plug boxes.

  (iv) Whether or not plug boxes are to be supplied by purchaser.

  (v) If cable drum is required, state whether automatic or hand-operated.

  (vi) Types and rating of motors.

(b) Capacity of crane:

  (i) . . . . . t maximum rated capacity at . . . . m radius; or

  (ii) . . . . . t maximum rated capacity at maximum radius . . . . m.

(c) Maximum height of lift . . . . . .m at . . . . m radius.

(d) Maximum free standing height . . . . m.

(e) Working depth (below rail level or below base) . . . . m at . . . . m radius.

(f) Speeds (any special requirements should be indicated).

(g) Additional specifications, surveys, or statutory requirements to be complied with:

  (i) General.

  (ii) Ropes and rope attachments.

  (iii) Electrical equipment, e.g., heaters, limit switches.

(h) Type of work for which crane is intended.

(i) Other requirements such as maximum tail radius and clearance under jib or cantilever, together with sketches.

(j) Crane base.

(k) Nature of track on which crane is to run, if existing:

  (i) Distance between centres of track rails.

  (ii) Weight and type of rails (heads proud or flush with ground).

  (iii) Width of railhead and height of rail.

  (iv) Maximum permissible wheel load.

  (v) Radius of sharpest curve, if any.

(l) If the crane is to be erected and tested on site by manufacturer, and facilities available.

(m) Any special local conditions under which the crane would have to operate, e.g., extreme temperatures, high humidity, dusty conditions, corrosive atmospheres, high altitude, exposed sites. Whether special instruments such as anemometers are to be provided.

(n) Number of instruction books required.

(o) Whether cabin is required.

(p) Whether lighting is required.

APPENDIX B

INFORMATION TO BE SUPPLIED BY THE MANUFACTURER

(Informative)

The following information should be included in the manual:

(a) Type offered. Drawing number.

(b) Capacity of crane:

  (i) Loads and radii.

  (ii) Range of lift, above and below rail level or base.

(c) Horizontal increase in hook radius of crane at maximum moment condition, due to the deflection of the crane structure.

(d) Clearances required by crane structure for all positions of jib:

  (i) Jib length.

  (ii) Angle of slew.

(e) Speeds at maximum rated load of ..... t:

  Hoisting, slow gear, on .....(No.) falls of rope ..... m/s.

  Hoisting, fast gear, on .....(No.) falls of rope ..... m/s.

  Slewing .....r/min.

  Trolleying ..... m/s.

  Travelling ..... m/s.

  Luffing or trolleying (over range of motion) ..... m/s.

(f) Maximum allowable in-service wind velocity in metres per second.

(g) Maximum allowable out-of-service wind velocity in metres per second.

(h) Electric motors:

  (i) Particulars of power supply required.

  (ii) Number of motors, type, and enclosure.

  (iii) Load in kilowatts and speed of motors at full load.

  (iv) Class of rating, and limits of permissible temperature rise (see AS 1359.101).

  (v) Maximum current demand from mains.

  (vi) Particulars of controlgear, resistors, and other electrical equipment.

(i) Internal combustion engines:

  (vii) Make and type.

  (viii) Load in kilowatts and speed.

  (ix) Number of cylinders.

  (x) Two-stroke or four-stroke.

  (xi) Type of fuel.

  (xii) Cooling system.

  (xiii) Method of starting.

(j) Mechanical specification, including brakes, gearing, and bearings.

(k) Travelling wheels:

(xiv) Type.

(xv) Material.

(xvi) Tread diameter.

(xvii) Width of tread.

(l) Ropes:

	Hoisting	Luffing or trolleying	Other ropes
Parts of rope	.....	.....	.....
Tensile grade of wire	.....	.....	.....
Description of wire (e.g., galvanized)	.....	.....	.....
Construction	.....	.....	.....
Diameter	.....	.....	.....
Minimum breaking load in tonnes	.....	.....	.....
Ratio of minimum breaking load to working load	.....	.....	.....

(m) Hook particulars.

(n) Type of driver's cabin and machinery house.

(o) Type of indicating and safety devices.

(p) Tools and accessories supplied.

(q) Approximate total mass, excluding ballast, in tonnes.

(r) Mass of each component to be erected.

(s) Ballast or counterbalance (or both), if any, to be supplied by —

(xviii) manufacturer: . . . . . t of (material); and

(xix) purchaser: . . . . . t of (material).

Details of size and construction should be supplied if necessary.

(t) Maximum dimensions of components for transport.

(u) Crane track:

(xx) Distance between rail centres (or span).

(xxi) Rail section.

(xxii) Maximum load per wheel under in-service and out-of-service conditions.

(xxiii) Minimum radii of curve(s) at centre-line of track.

(xxiv) Increment on rail centres on curves.

(xxv) Minimum length of track and space required for erection of crane.

(xxvi) Details of all anchorage requirements to the support surface.

(v) Fixed base: all loads and moments applied to the base by the crane under all conditions, both in-service and out-of-service.

(w) Details of ties to secure the crane to a building, if appropriate, and the maximum loads carried by the ties.

(x) Climbing cranes: details of floor loadings and clearances.

(y) Manufacturer's comments on any information provided.

(z) Extent of testing at manufacturer's works.

(aa) Specific requirements for placing the tower crane in out-of-service condition.

APPENDIX C

TYPICAL ILLUSTRATIONS OF TOWER CRANES

(Informative)

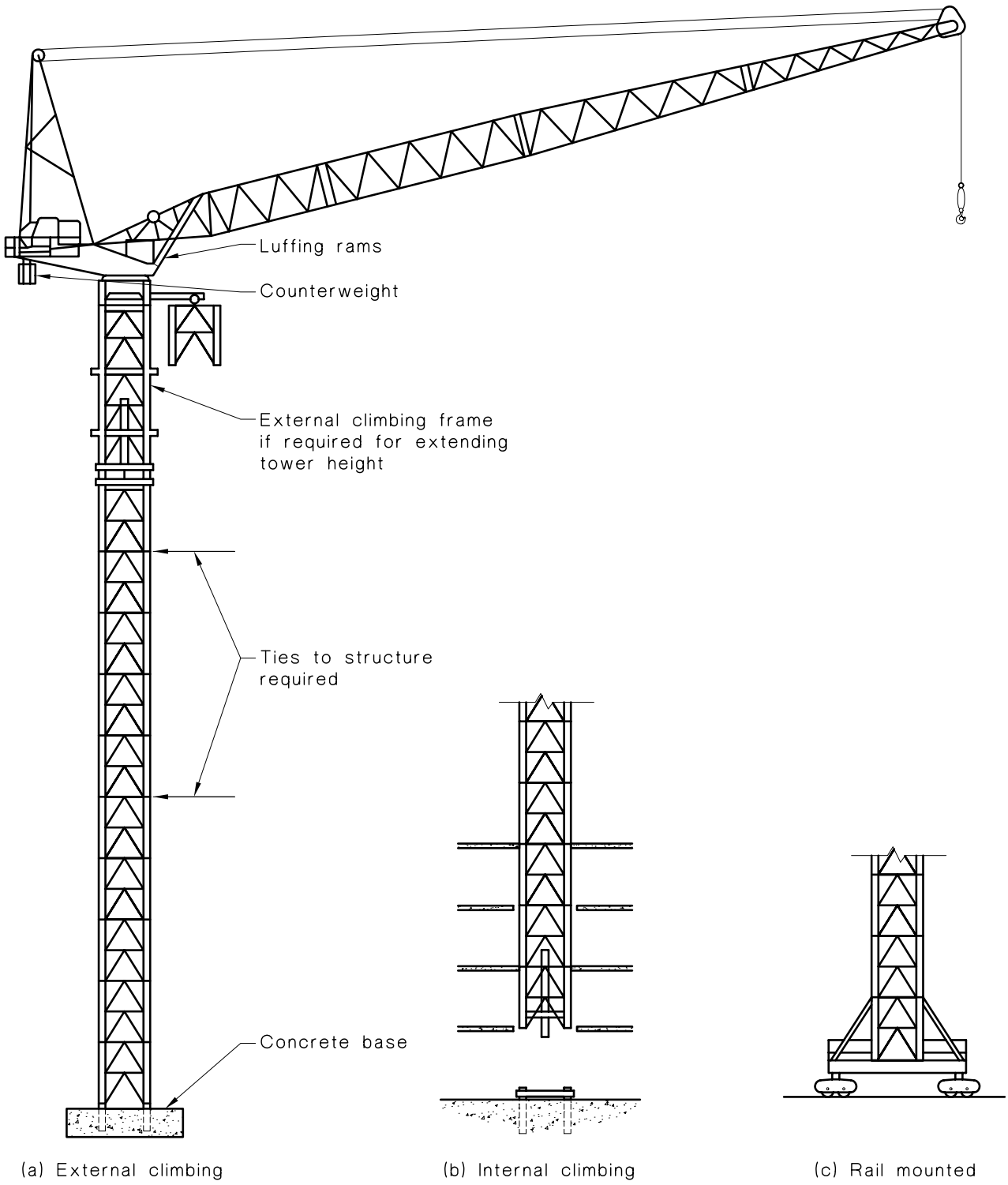


FIGURE C1 RAM LUFFING CRANE

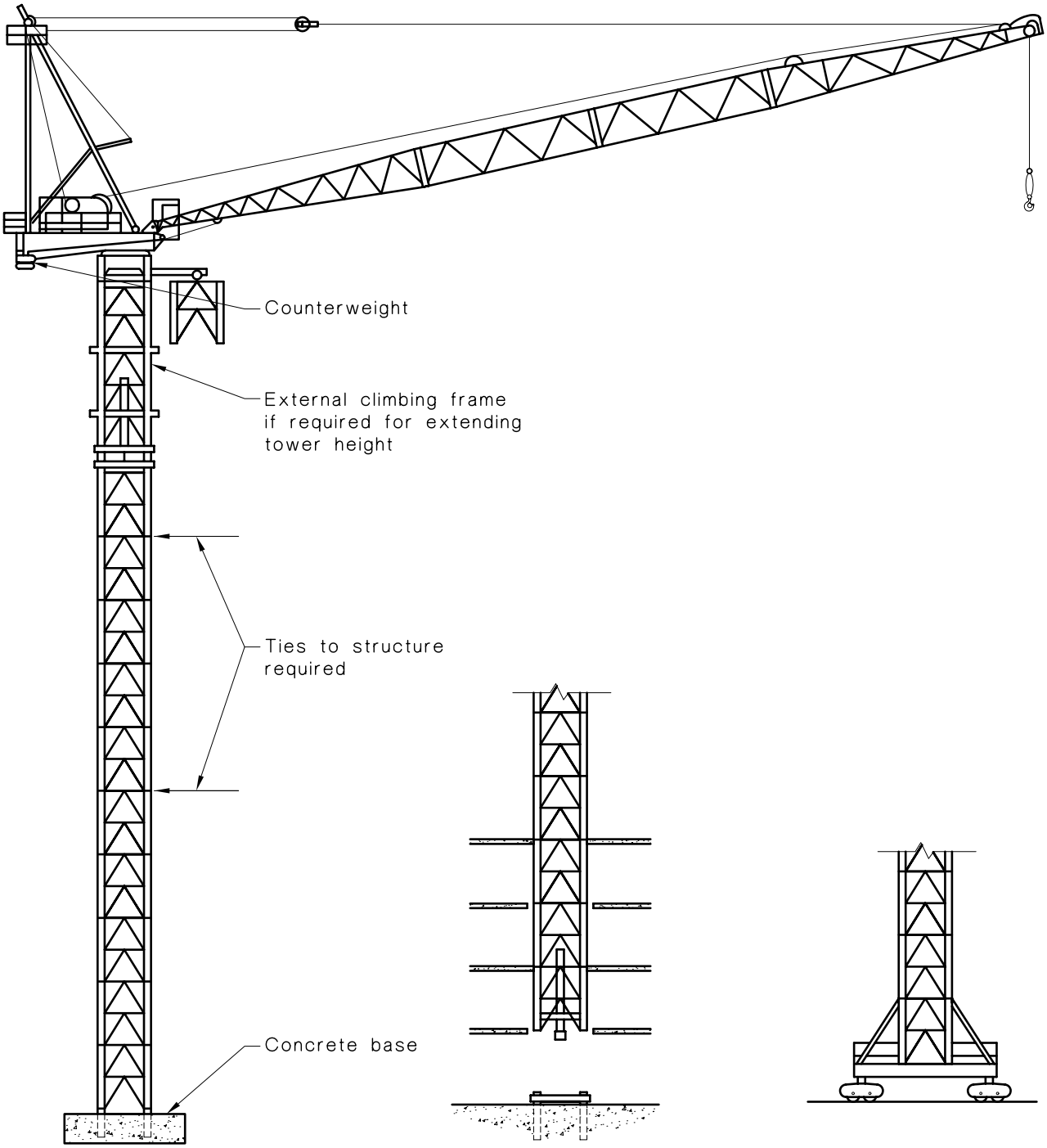


FIGURE C2 ROPE LUFFING CRANE

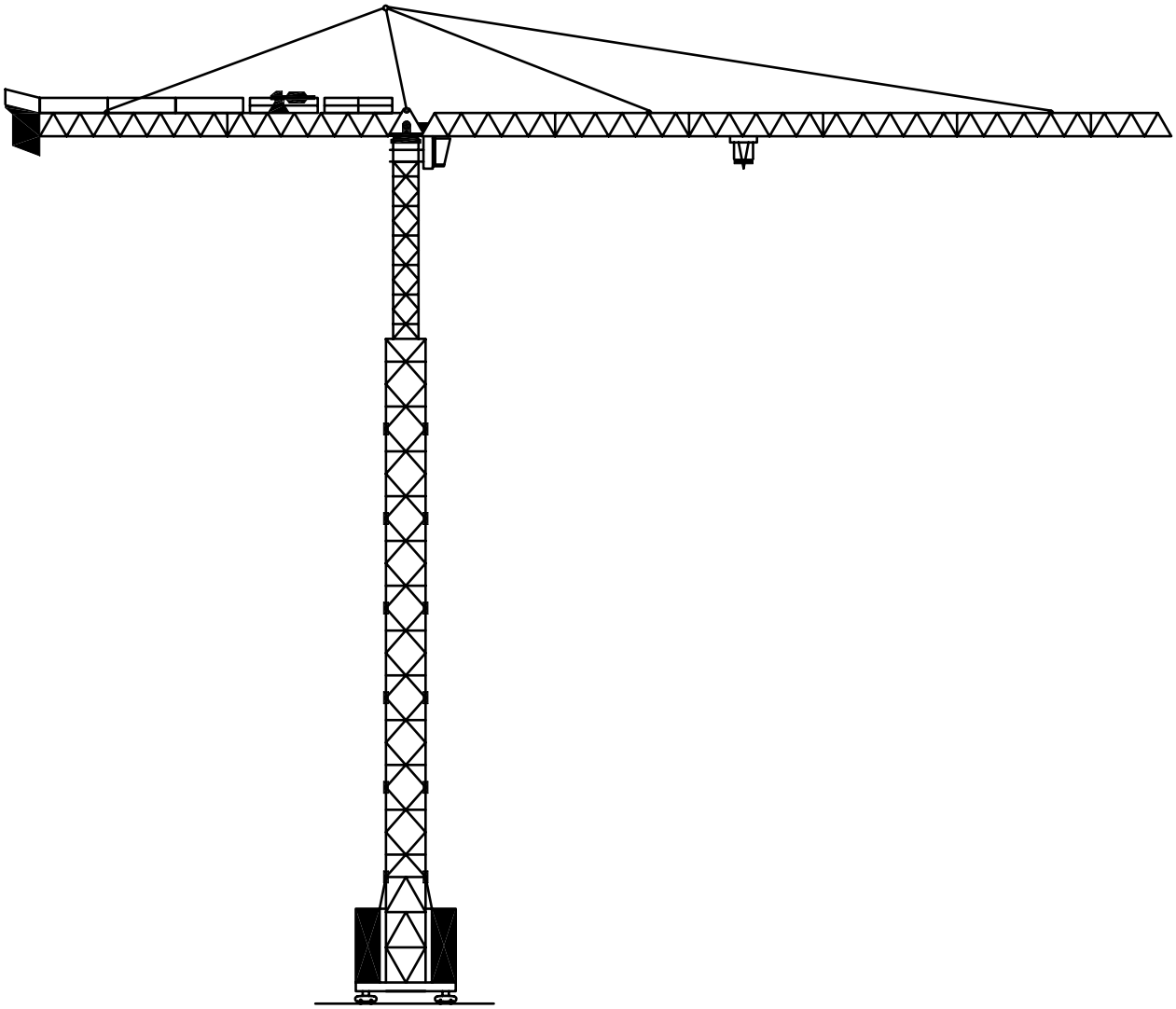


FIGURE C3 TROLLEY JIB (HORIZONTAL JIB) CRANE

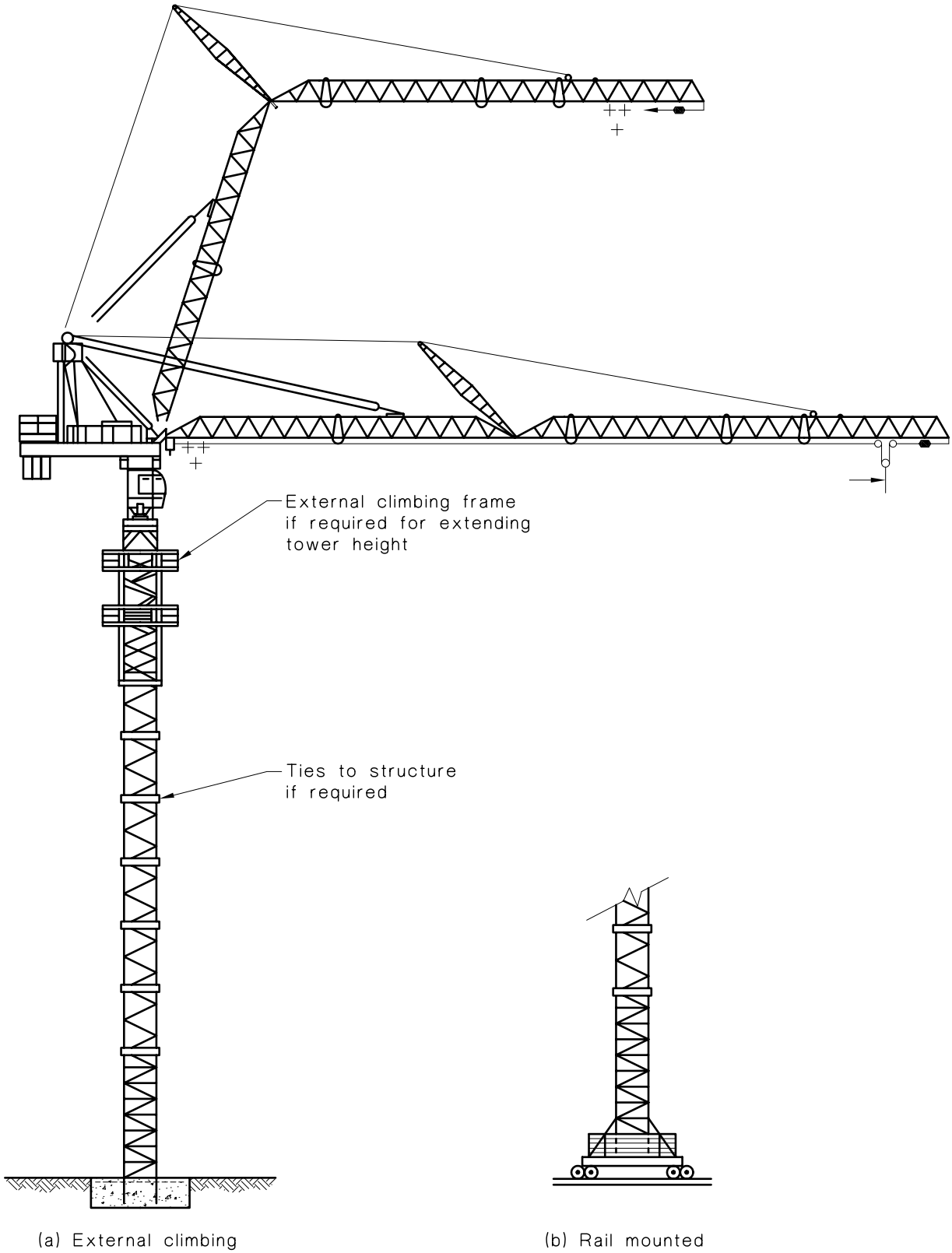
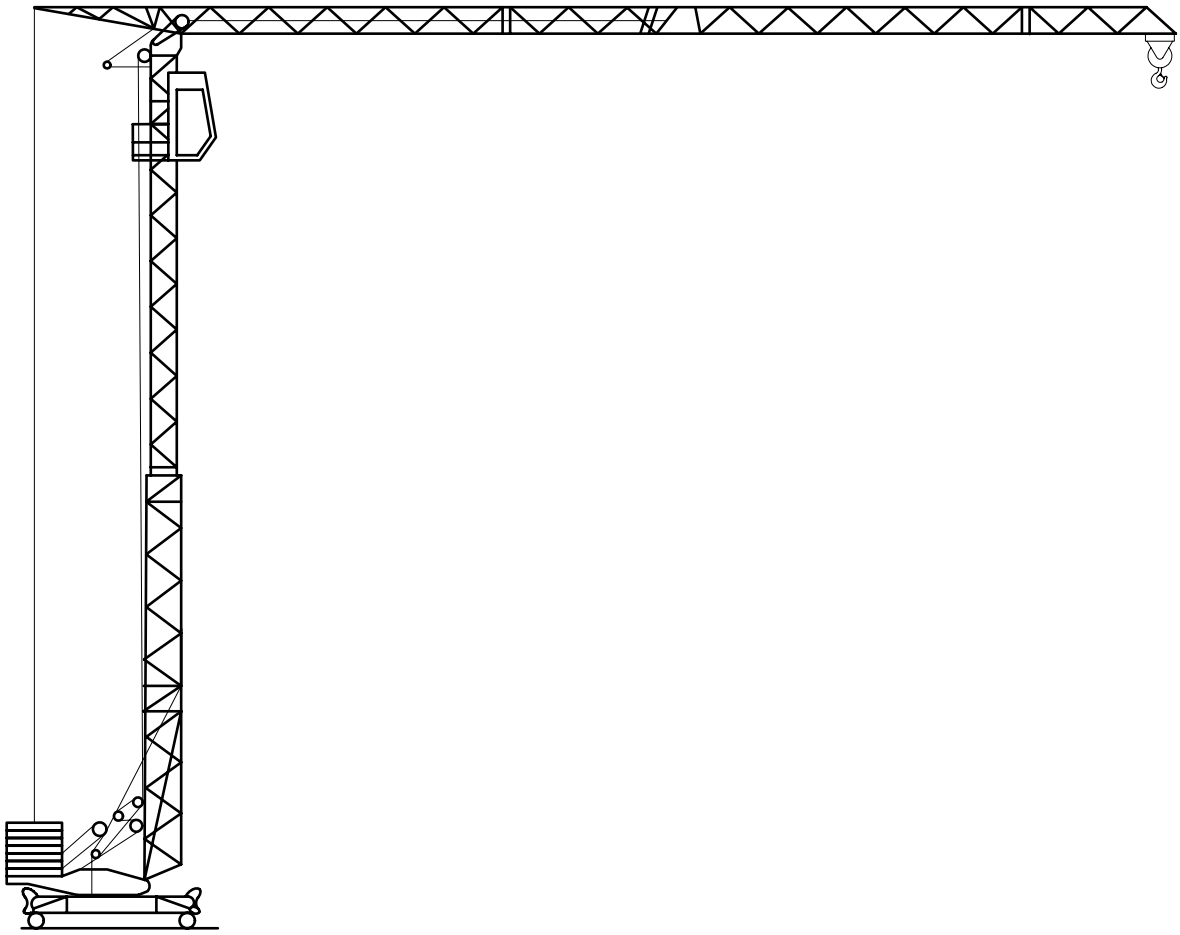


FIGURE C4 ARTICULATED TROLLEY JIB CRANE



NOTE: Not all tower cranes have cabins.

FIGURE C5 SELF-ERECTING CRANE

APPENDIX D

TYPICAL GROUP CLASSIFICATIONS OF THE TOWER CRANE AS A WHOLE

(Informative)

Table D1 nominates typical group classifications for the tower crane as a whole.

TABLE D1

TYPICAL GROUP CLASSIFICATION FOR A TOWER CRANE AS A WHOLE

Crane category	Tower crane application	Class of utilization	State of loading	Group classification
Light	Crane for irregular use	U_1	Q2	C1
	Storage yard crane for material handling	U_3	Q1	C2
	Crane for drilling platforms	U_3	Q2	C3
	Dockyard repair crane	U_4	Q2	C4
Moderate	Automatic self-erecting crane	U_3	Q2	C3
	Tower crane erected by parts	U_4	Q2	C4
Heavy	Dockyard fitting-out crane	U_4	Q2	C4
	Port crane for loading of containers	U_4	Q2	C4
	Ship construction crane	U_4	Q3	C5
	Grabbing crane	U_5	Q3	C6

APPENDIX E

TYPICAL GROUP CLASSIFICATIONS OF THE MECHANISMS OF TOWER CRANES

(Informative)

Table E1 sets out typical group classifications of the mechanisms of tower cranes.

TABLE E1

TYPICAL GROUP CLASSIFICATION OF MECHANISMS OF A TOWER CRANE

Category	Tower crane application	Class of utilization					State of loading					Group classification				
		L	O	R	D	T	L	O	R	D	T	L	O	R	D	T
Light	Crane for irregular use	T_1	T_1	T_1	T_1	T_1	L2	L3	L2	L2	L3	M1	M2	M1	M1	M2
	Storage yard crane for materials handling	T_1	T_3	T_2	T_2	T_1	L1	L3	L1	L1	L3	M2	M4	M1	M1	M2
	Crane for drilling platforms	T_3	T_3	T_2	T_2	T_1	L1	L3	L2	L2	L3	M3	M4	M2	M2	M2
	Dockyard repair crane	T_4	T_4	T_3	T_3	T_2	L2	L3	L2	L2	L3	M4	M5	M3	M3	M3
Moderate	Automatic self-erecting crane	T_3	T_3	T_2	T_2	T_1	L2	L3	L3	L2	L3	M3	M4	M3	M2	M2
	Tower crane erected by parts	T_4	T_4	T_3	T_3	T_2	L2	L3	L3	L2	L3	M4	M5	M4	M3	M3
Heavy	Dockyard fitting-out crane	T_4	T_4	T_3	T_3	T_5	L2	L3	L2	L2	L3	M4	M5	M3	M3	M6
	Port crane for loading of containers	T_4	T_4	T_3	T_4	T_2	L2	L2	L2	L2	L2	M4	M4	M3	M4	M2
	Ship construction crane	T_4	T_4	T_3	T_3	T_4	L3	L3	L3	L3	L3	M5	M5	M4	M4	M5
	Grabbing crane	T_5	T_5	T_4	T_5	T_2	L3	L3	L3	L3	L3	M6	M6	M5	M6	M3

LEGEND:
L = hoisting
O = slewing
R = luffing
D = direction
T = travelling

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