

BS EN 1808:2015



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Safety requirements for suspended access equipment — Design calculations, stability criteria, construction — Examinations and tests

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National foreword

This British Standard is the UK implementation of EN 1808:2015. It supersedes BS EN 1808:1999+A1:2010 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/514/39, Suspended access equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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EN 1808

April 2015

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English Version

**Safety requirements for suspended access equipment - Design
calculations, stability criteria, construction - Examinations and
tests**

Exigences de sécurité des plates-formes suspendues à
niveau variable - Calculs, stabilité, construction - Examen et
essais

Sicherheitsanforderungen an hängende
Personenaufnahmemittel - Berechnung, Standsicherheit,
Bau - Prüfungen

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Foreword

This document (EN 1808:2015) has been prepared by Technical Committee CEN/TC 98 “Lifting platforms”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2015 and conflicting national standards shall be withdrawn at the latest by October 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1808:1999+A1:2010.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This document also includes information that building designers, structural engineers and contractors need to consider before specific suspended access equipment (SAE) manufacturers/suppliers are appointed.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard is a type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards are covered are indicated in the scope of this standard.

It is assumed that:

- a) discussions take place between the manufacturer/supplier and purchaser/hirer about specific local installation conditions and expected duty;
- b) a risk analysis for each component that might be incorporated into a complete SAE installation has been made and rules have been drawn up;
- c) the safety requirements of this standard have been drawn up on the basis that the components are:
 - 1) designed in accordance with good engineering practice and calculation codes, including all failure modes;
 - 2) of sound mechanical and electrical construction;
 - 3) made of materials with adequate strength and of suitable quality;
 - 4) free of visible defects;
- d) harmful materials such as asbestos are not used;
- e) the equipment is maintained in good working order;
- f) any mechanical device manufactured in accordance with good practice and the requirements of this standard shall not be allowed to deteriorate to the point of creating a hazard without being detected;
- g) the working ambient temperature range is between $-10\text{ }^{\circ}\text{C}$ and $+55\text{ }^{\circ}\text{C}$;
- h) the structure on which the SAE is installed is of adequate strength to resist the expected imposed loads.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built in accordance with the provisions of this type C standard.

1 Scope

1.1 Application

This European Standard specifies the requirements, test methods, marking and information to be provided by the manufacturer/supplier for suspended access equipment (SAE).

It is applicable to both permanent and temporary equipment which can be powered or hand operated and which are defined in Clause 3.

The requirements of this standard include the rails, tracks and other support systems on which SAE depend for their integrity and safety as well as taking into account all associated loads and fixings to the building structure.

This document is not applicable to SAE which is manufactured before the date of its publication as an EN.

1.2 Hazards

This European Standard deals with significant hazards pertinent to SAE when they are used as intended and under the conditions foreseen by the manufacturer (see Clause 4). This European Standard specifies appropriate technical measures to eliminate or reduce risks arising from the significant hazards.

1.3 Exclusions

The following are not covered in this document:

- a) operation in severe and special conditions (e.g. extreme environmental conditions, corrosive environments, strong magnetic fields);
- b) operation subject to special rules (e.g. potentially explosive atmospheres, work on live overhead electrical lines);
- c) transportation of passengers from one level to another;
- d) handling of loads which could lead to a dangerous situation (e.g. molten metal, acids/bases, radioactive materials);
- e) working platforms suspended by cranes;
- f) silo access equipment;
- g) SAE using chains for the direct suspension of a platform;
- h) SAE using fibre ropes for the suspension of a platform;
- i) SAE intended to be used underground;
- j) SAE intended to be used in shafts;
- k) SAE directly powered by combustion engines.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 795, *Personal fall protection equipment — Anchor devices*

EN 1993 (all parts), *Eurocode 3: Design of steel structures*

EN 1999 (all parts), *Eurocode 9: Design of aluminium structures*

EN 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1)*

EN 60204-32:2008, *Safety of machinery — Electrical equipment of machines — Part 32: Requirements for hoisting machines (IEC 60204-32:2008)*

EN 60529, *Degrees of protection provided by enclosures (IP-code) (IEC 60529)*

EN ISO 4413, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413)*

EN ISO 4414, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13849-1:2008, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation (ISO 13849-2:2012)*

EN ISO 13850, *Safety of machinery — Emergency stop — Principles for design (ISO 13850)*

3 Terms and definitions, symbols and abbreviations

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply. They are classified in terms of key words.

3.1 building maintenance unit

BMU

SAE that are permanently installed on and dedicated to a specific building or structure and intended to be used for planned routine inspection, cleaning and maintenance of the particular building and where the general public might have access below the suspended platform when in operation

Note 1 to entry: BMUs may consist of a platform suspended from a suspension rig that is generally a trolley unit with hoist(s) operating either on a rail track or on a suitable running surface (e.g. concrete track).

Note 2 to entry: Monorails with traversing trolleys or other suspension rigs (e.g. davits) fixed to a building and from which a platform may be suspended should be considered as parts of a BMU and should only be used in conjunction with suspended platforms conforming to the requirements of this standard.

3.2

temporary suspended access equipment

TSAE

SAE systems that are temporarily installed on a building or structure in order to carry out specific construction tasks on a work site

EXAMPLE Work sites include cladding installation, painting, maintenance, repair and refurbishment of buildings, bridges, chimneys and other structures.

Note 1 to entry: TSAE may consist of a platform (TSP) and a suspension rig that are assembled at site prior to carrying out the task. TSAE are then dismantled and removed from site on completion of the work for which they were installed and may be reused elsewhere.

Note 2 to entry: Where a TSP is attached to a permanently installed suspension rig (e.g. roof trolley or monorail system) such installations are considered to be hybrid systems and the appropriate clauses of this document apply (see 12.6).

3.3

personnel

3.3.1

competent person

designated person, suitably trained, qualified by knowledge and practical experience and provided with the necessary instructions to carry out specified tasks safely

3.3.2

operator

designated person, suitably trained for working at height, qualified by knowledge and practical experience and provided with the necessary information to carry out operations safely from SAE

3.4

hoists and accessories

3.4.1

drum hoist

hoist with a drum on which the suspension ropes are reeled in one or more layers

3.4.2

traction hoist

assembly through which a wire rope is conveyed as a result of friction between the wire rope and the traction assembly with no tail load

3.4.3

twin capstan drum hoist

hoist system which lifts and lowers suspension rope(s) by passing the rope(s) around two gear driven grooved multi-wrap capstan drums and then to a wire rope winder designed to apply a tail load to the capstan drive system

3.4.4

jaw operated traction hoist

hoist where the traction assembly consists of two pairs of jaws

3.4.5

prime mover

source of power for the hoist

EXAMPLE This includes electric, hydraulic, pneumatic motors and hydraulic jacks.

3.4.6

rated speed

average speed measured during the upward and downward hoisting travel of a platform carrying its rated load for a travel length of 10 m or more and with the rated power supply applied

3.4.7

service brake

mechanical brake automatically applied by stored energy until released by an external sustained force, usually applied electrically, hydraulically or pneumatically, either under the control of the operator or automatically

EXAMPLE An example of stored energy is spring force.

3.4.8

secondary device

device intended to stop the descent of a platform under emergency conditions

EXAMPLE For example, breaking of a suspension wire rope or failure of a hoist.

3.4.8.1

fall arrest device

device acting directly on a secondary wire rope and which automatically stops and holds a platform in a fixed position

3.4.8.2

secondary brake

brake acting directly on a drum, traction sheave or final drive shaft and intended to stop the descent of a platform

3.4.9

anti-tilt device

device that detects when the longitudinal slope of a platform exceeds a pre-set angle

3.4.10

no-power descent

manually operated system that allows controlled descent of a power operated platform

3.4.11

manual lever/wheel/handle

device on the hoist that allows a platform to be lifted or lowered manually

3.4.12

wire (rope) winder

storage drum on to which a wire rope is reeled

3.4.13

cable reeler

storage drum on to which an electric cable is reeled

3.4.14

hoist operation cycle (for test purposes only)

one cycle that consists of lifting and lowering over a minimum vertical distance, this distance being where either

- the wire rope passes through all wire rope related parts of a traction hoist, its pulleys and reeler system, or
- the wire rope passes four turns around a drum hoist and its closely related pulleys

3.4.15

platform-mounted hoist

hoist that is mounted on a platform to raise and lower the suspended platform

3.4.16

roof-mounted hoist

hoist that is mounted on a suspension rig or trolley to raise and lower a suspended platform

3.4.17

materials (auxiliary) hoist

hoist that is mounted on a suspension rig or trolley to raise and lower other materials independently of a platform

3.4.18

overload detection device

device that trips and acts automatically to stop the upward motion of a platform if the load in the suspension wire ropes exceeds the tripping limit

3.4.19

tripping limit

static load that causes the overload detection device to operate

3.5

suspended platforms

3.5.1

suspended platform

that portion of SAE assembly designed to carry persons and their equipment

3.5.1.1

single point suspended platform

platform incorporating only one connection point

3.5.1.2

double point suspended platform

platform incorporating two connection points

3.5.1.3

multi-point suspended platform

platform incorporating three or more connection points and which is not hinged

3.5.1.4

hinged continuous platform

long platform incorporating more than two connection points and having articulated sections to ensure the correct tension is maintained in each suspension wire rope

3.5.1.5

multi-deck suspended platform

platform made up of two or more decks connected vertically

Note 1 to entry: See Figure 17.

3.5.1.6

cantilevered platform

platform where the deck extends beyond a connection point

3.5.1.7

suspended chair

chair that incorporates one connection point for one person only to use

3.5.2

restraint system

system connecting a suspended platform to mullions or fixed points on a building and which limits, whilst in use, the lateral movement of the suspended platform due to the wind

3.5.3

suspension wire rope restraint system

vertical series of attachment points on a building to which lanyards are connected to guide the suspension ropes of a suspended platform on descent and disconnected on ascent

Note 1 to entry: See Figure 18.

3.5.4

connection point

point provided on the platform or chair for the attachment of the hoist rope(s) or fall arrest device(s)

3.5.5

natural ground level

level from which the requirement for a platform restraint system is determined

3.6

loads

3.6.1

total suspended load

TSL

static load imposed on the suspension point(s) of a suspension rig comprising the rated load of the platform, the self-weight of the platform, the ancillary equipment, the wire ropes and the electric cable, if any

3.6.2

rated load

RL

rated load of persons and equipment that a suspended platform has been designated to carry by the manufacturer

3.6.3

working load limit

WLL

maximum load that a piece of equipment is authorized to sustain as designated by the manufacturer

3.6.4

hoist working load limit

HWLL

working load limit of a material hoist

3.6.5

working coefficient

arithmetic ratio between the maximum load designated by the manufacturer that a piece of equipment or SAE is able to hold and the WLL marked on the piece of equipment or SAE

3.6.6

test coefficient

arithmetic ratio between the loads used to carry out static or dynamic tests on a piece of equipment or SAE and the WLL marked on the piece of equipment or SAE

3.6.7

static test

test during which a piece of equipment or SAE is first inspected and then subjected to a force corresponding to the WLL multiplied by the appropriate static test coefficient and then re-inspected once the test load has been released to ensure that no damage has occurred

3.6.8

dynamic test

test during which the SAE is operated in all its possible configurations at its WLL, with account being taken of the dynamic behaviour of the SAE, in order to check that the SAE and its safety features are functioning correctly

3.6.9

hoisting cycle

sequence commencing when a platform is hoisted from the ground (or from the roof) and ending when the platform is returned to the starting position

3.7

steel wire ropes

3.7.1

calculated coefficient

ratio between the designated minimum breaking load of a steel wire rope and the maximum static load applied to that rope

3.7.2

minimum breaking load (of steel wire rope)

minimum breaking load of a steel wire rope as designated by the manufacturer

3.7.3

suspension rope

active steel wire rope carrying the suspended load

3.7.4

secondary rope

steel wire rope not normally carrying the suspended load but rigged to work in conjunction with a fall-arrest device

3.7.5

single active rope suspension system

two steel wire ropes attached to a suspension point, one rope being the suspension rope and the other being the secondary rope

3.7.6

double active rope suspension system

two steel wire ropes attached to one suspension point and sharing the suspended load

3.8

suspension rigs and track systems

3.8.1

suspension rig

portion of the SAE from which a platform is suspended

Note 1 to entry: This excludes the track system.

3.8.2

trolley

suspension rig mounted on wheels and designed to run on a track, runway or monorail to support a suspended platform

3.8.3

suspension point

designated position provided on a suspension rig assembly for the independent anchorage of the ropes, diverter pulleys or hoists

3.8.4

pivot point

device provided to equalize the loading imposed by the two suspension ropes of a double active rope suspension system

3.8.5

fulcrum

point or line about which the balancing moments of a suspension rig are calculated

3.8.6

stability coefficient

coefficient by which the overturning moment is multiplied

3.8.7

inboard portion

portion of a suspension rig that is on the building side of the fulcrum

3.8.8

outboard portion

portion of a suspension rig which projects from the fulcrum over the edge of a building

3.8.9

counterweights

weights that are attached to a suspension rig to counterbalance the overturning moments

3.8.10

counterweighted suspension beam

static beam where the stability is assured by counterweights

3.8.11

mechanically anchored suspension rig

suspension rig where stability is assured by mechanical anchors fixed to the building structure

3.8.12

stationary suspension rig

structure that is assembled and positioned before a platform is suspended from it

3.8.13

parapet clamp

structure attached to a roof parapet or similar static structure and dependent on the parapet for location and anchorage

Note 1 to entry: See Figure 13.

3.8.14

davit

structure fixed to a roof or similar static structure

Note 1 to entry: See Figure 12.

3.8.15

rail track

rails generally installed at roof level to support and guide a mobile suspension rig (trolley unit)

3.8.16

rail track support

braced or unbraced stanchion or cantilever supporting a rail track

3.8.17

sleeper

beam lying flat on a roof to support a rail track

Note 1 to entry: A sleeper is typically made of concrete or steel.

3.8.18

guide rail

rail generally installed at roof level to guide a mobile suspension rig (trolley unit)

3.8.19

monorail track

track generally fixed along the perimeter of a building to support and guide a mobile suspension rig (trolley unit)

3.8.20

lifting

operation that moves a suspended platform to a higher level

3.8.21

lowering

operation that moves a suspended platform to a lower level

3.8.22

platform rotation

circular horizontal movement of a suspended platform about a vertical axis passing through the platform itself

3.8.23

suspension rig slewing

circular horizontal movement of a suspension rig about a vertical axis

3.8.24

traversing

longitudinal horizontal movement of a suspension rig

3.8.25

luffing

rotational upward/downward movement of jib(s) about a horizontal axis to allow positioning of a suspended platform

3.8.26

jib telescoping

movement to extend or retract a jib to allow positioning of a suspended platform

3.8.27

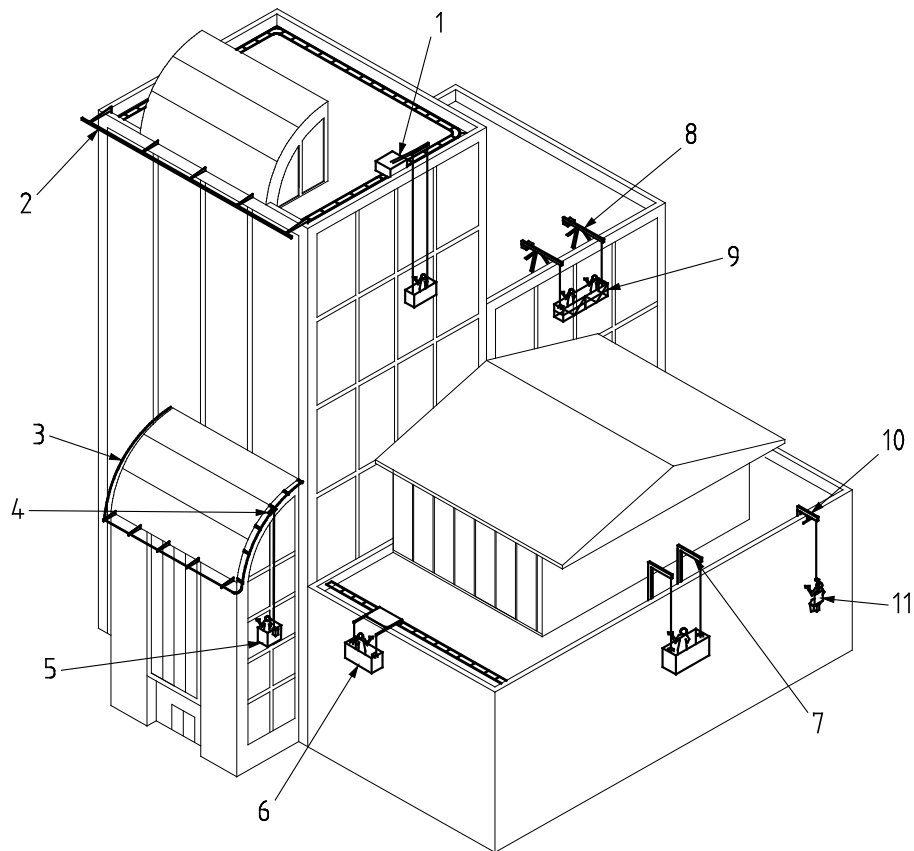
jib slewing

circular movement of jib(s) about a vertical axis to allow positioning of a suspended platform

3.8.28

LW

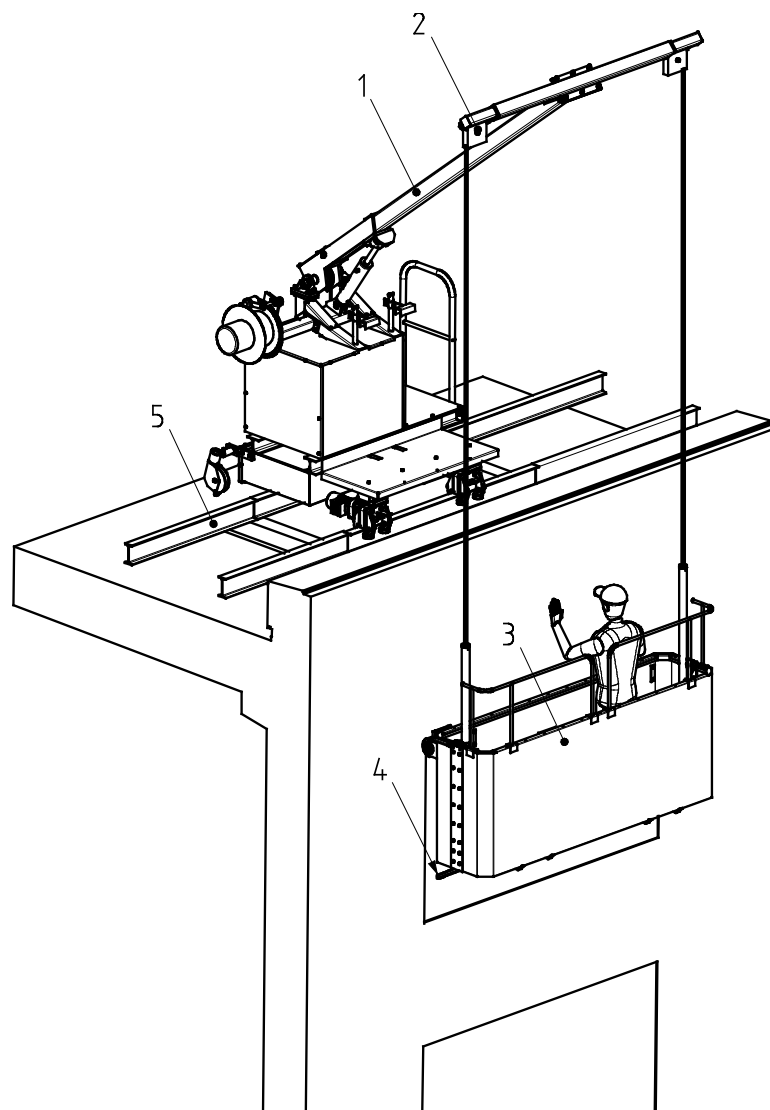
vertical distance from the track to the centre of the area of the suspension rig affected by wind



Key

- 1 roof trolley (BMU)
- 2 horizontal monorail
- 3 inclined monorail
- 4 monorail trolley
- 5 single point suspended platform
- 6 double point suspended platform
- 7 fixed davit
- 8 counterweighted suspension beam
- 9 suspended platform
- 10 parapet clamp
- 11 suspended chair

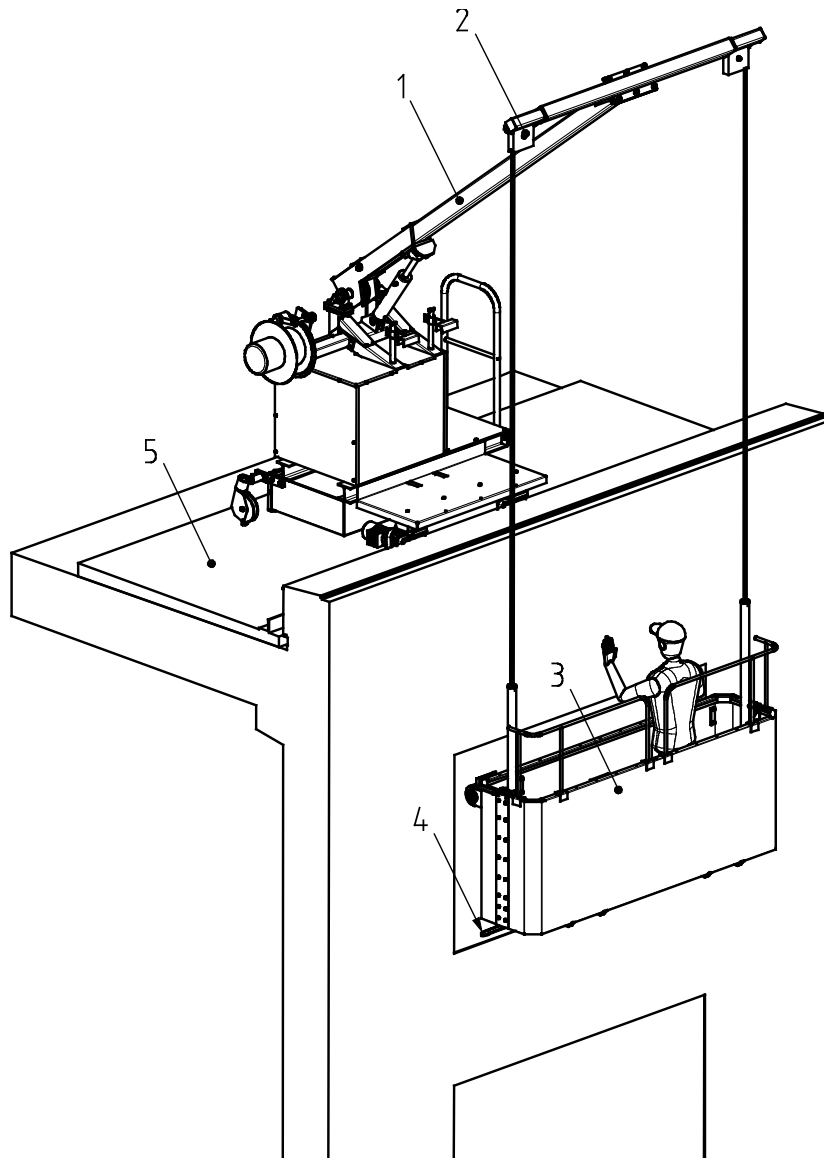
Figure 1 — Example of different types of SAE



Key

- 1 luffing jib
- 2 pulley
- 3 suspended platform
- 4 obstacle device
- 5 track system

a) Typical BMU suspension rig on twin track (fixed or free laid)

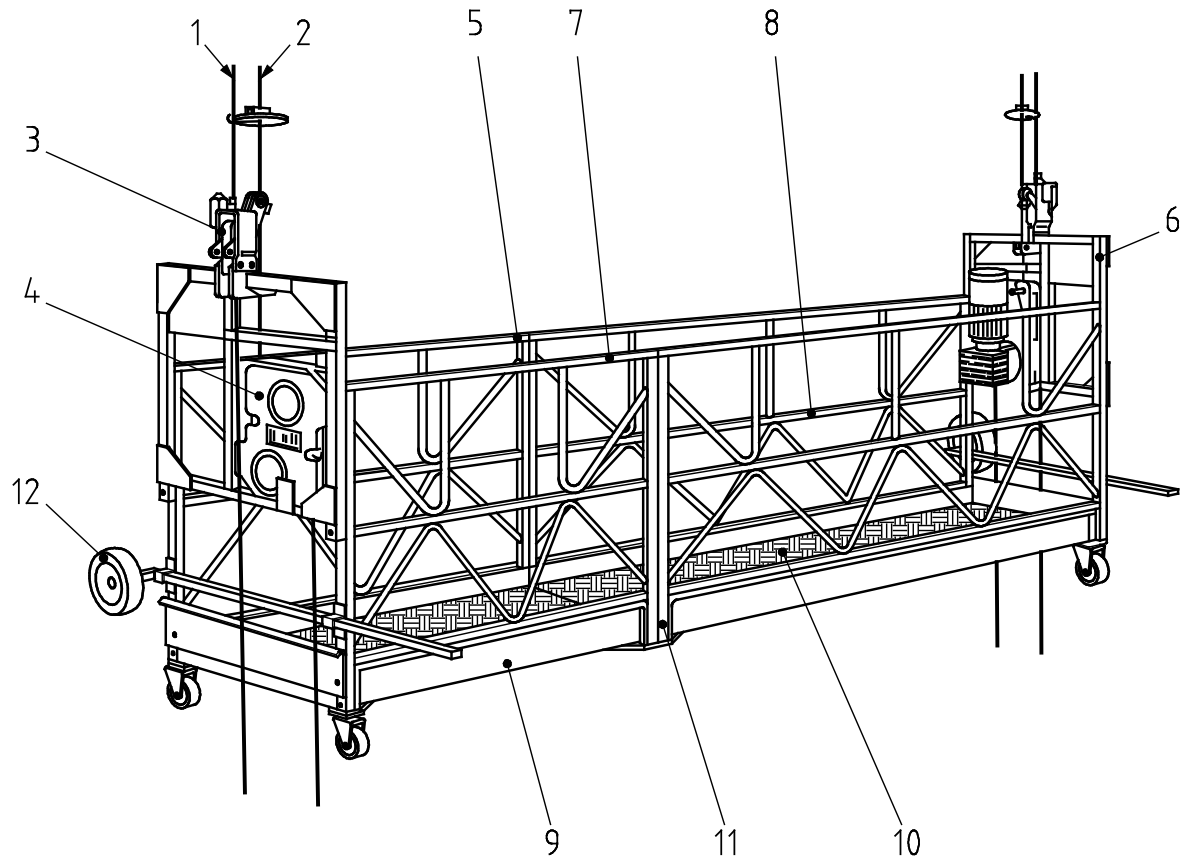


Key

- 1 luffing jib
- 2 pulley
- 3 suspended platform
- 4 obstacle device
- 5 roof or runway

b) Typical BMU suspension rig on concrete runway

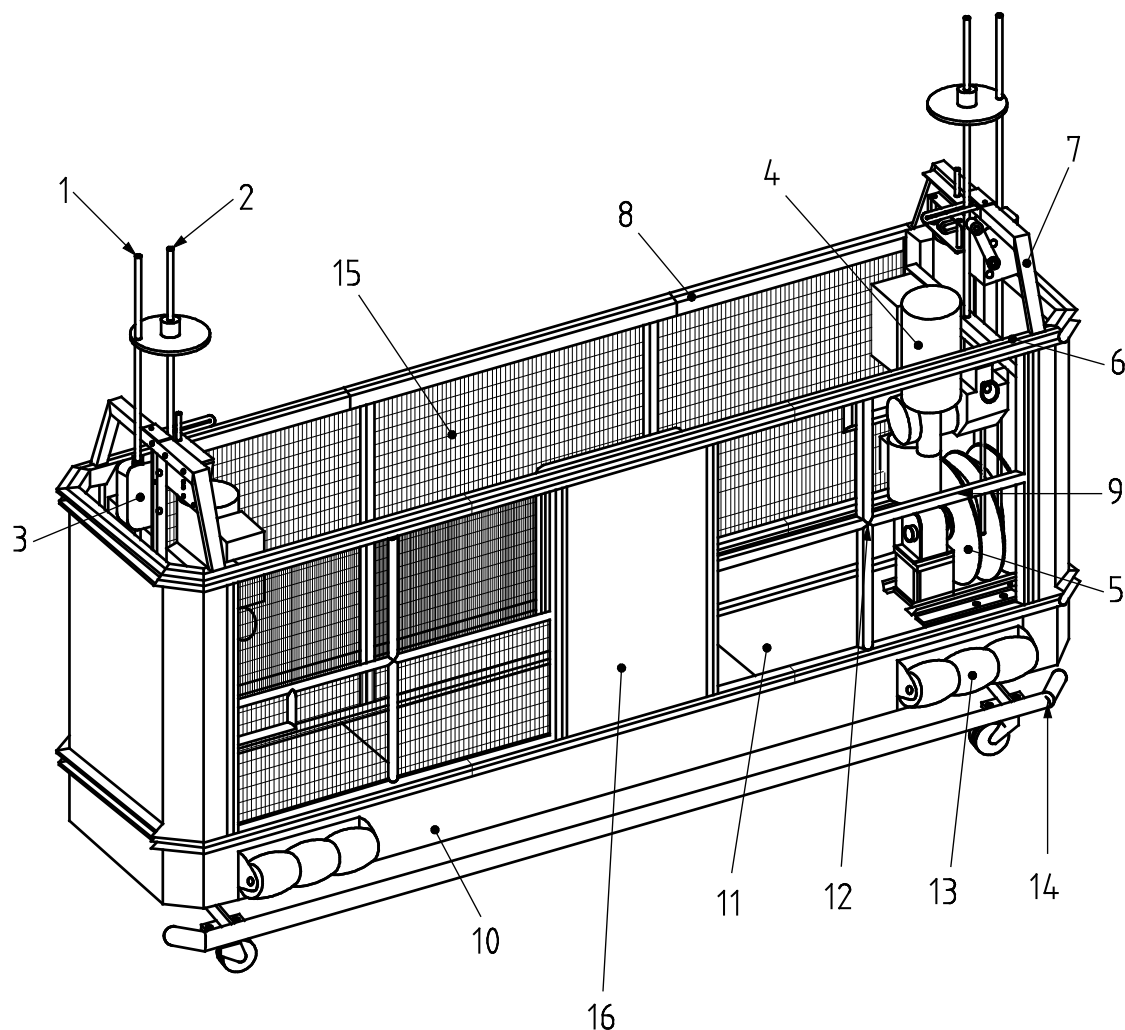
Figure 2 — Examples of BMU suspension rigs (trolley units)



Key

- | | |
|------------------------|---------------------------|
| 1 secondary wire rope | 7 rear guard rail |
| 2 suspension wire rope | 8 intermediate guard rail |
| 3 fall arrest device | 9 toe board |
| 4 traction hoist | 10 decking |
| 5 front guard rail | 11 vertical member |
| 6 stirrup | 12 wall roller |

a) — Example of typical TSP platform



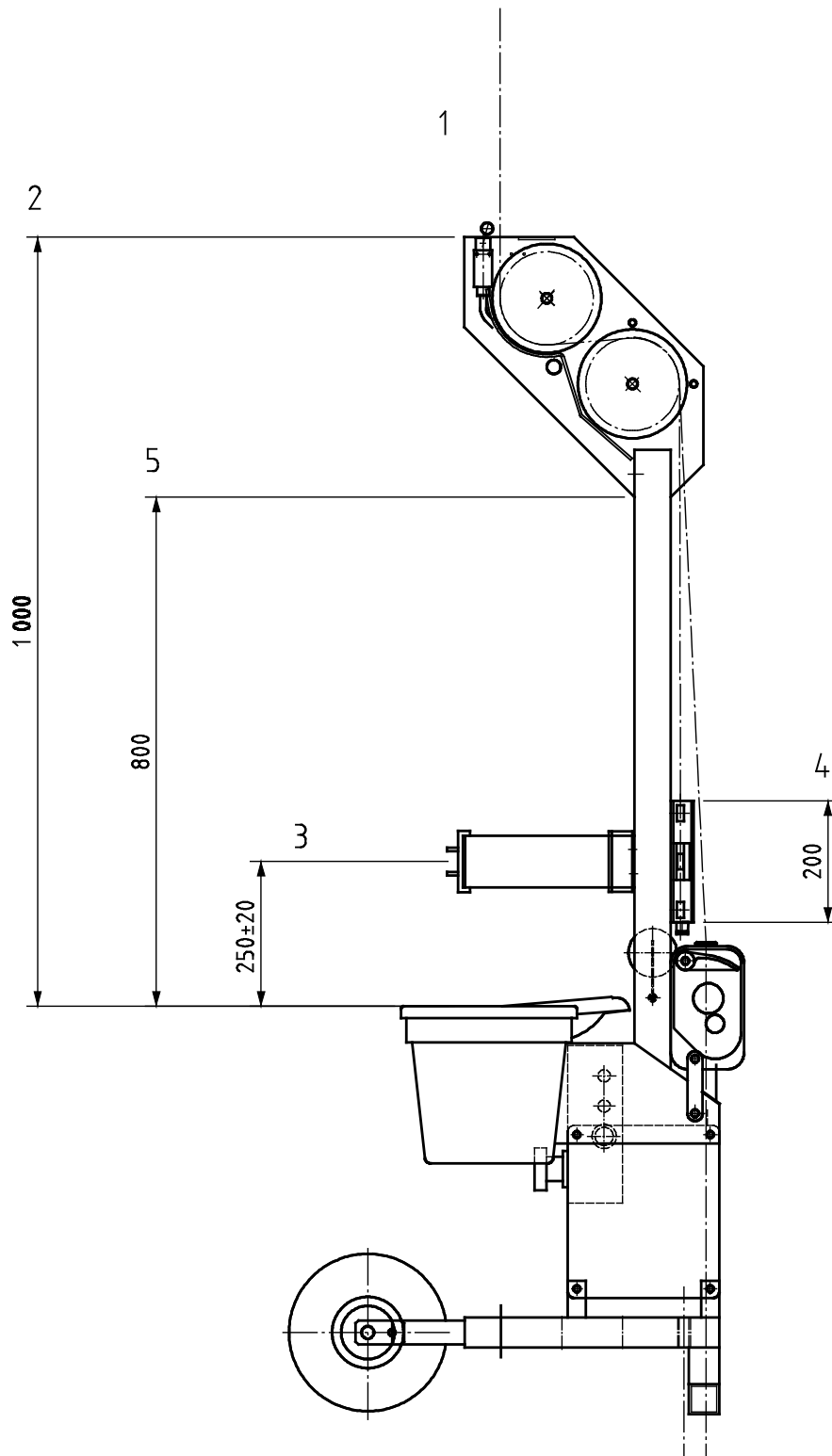
Key

1 secondary wire rope	9 intermediate guard rail
2 suspension wire rope	10 toe guard
3 fall arrest device	11 decking
4 traction hoist	12 vertical member
5 wire rope winder	13 soft rollers
6 front guard rail	14 obstacle device
7 stirrup	15 cladding or mesh
8 rear guard rail	16 control panel

b) Example of typical BMU platform with platform mounted hoists

Figure 3 — Examples of suspended platforms

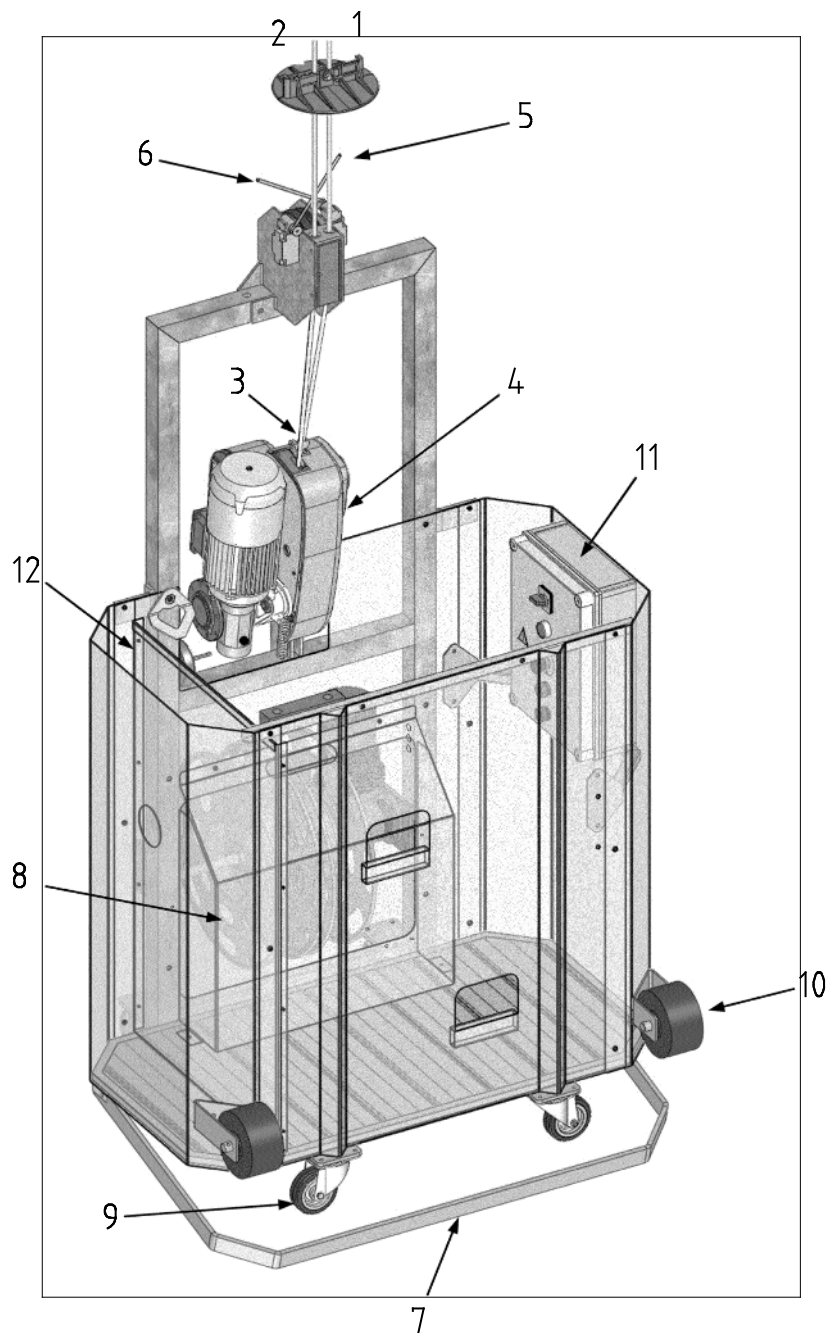
NOTE Some of the cladding or mesh (Key 15) has been omitted from the figure to show the interior of the platform more clearly. For requirements for cladding or mesh, see 7.3.2.



Key

- | | | | |
|---|--|---|--|
| 1 | wire ropes | 4 | minimum width of back support |
| 2 | minimum distance between seat and top sheave | 5 | minimum distance between seat and sheaving |
| 3 | position of back support and restraint belt | | |

a) Typical SAE single-point suspended chair



Key

- | | | | |
|---|---------------------------------|----|-------------------|
| 1 | striker plate (top limit plate) | 7 | obstacle device |
| 2 | suspension/secondary ropes | 8 | wire rope reelers |
| 3 | traction hoist | 9 | castor wheel |
| 4 | fall arrest device | 10 | wall roller |
| 5 | top limit switch | 11 | control box |
| 6 | ultimate top limit switch | 12 | cladding |

b) Typical SAE single-point suspended platform

Figure 4 — Example of typical single-point suspended chair and suspended platform

3.9 Symbols and abbreviations

A	Area exposed to wind	(m ²)
a	Deflection of the platform under load	(mm)
B	Width of the platform	(m)
b	Residual deflection of the platform	(mm)
BMU	Building maintenance unit	(–)
C	Shape factor	(–)
C _{wr}	Working coefficient for suspension rig	(–)
D	Pitch diameter of pulley or drum hoist	(mm)
F	Force	(N)
F _h	Horizontal force	(N)
F _o	Minimum designated breaking load of wire rope	(N)
F _v	Vertical force	(N)
F _s	Shearing force	(N)
F _{w1}	Wind force in service	(N)
F _{w2}	Wind force out of service	(N)
F _{wMH}	In-service wind force on material	(m ²)
H	Pitch ratio	(–)
HSW	Mass of all suspended materials hoist items	(kg)
HWLL	Hoist working load limit	(kg)
L	Length of platform	(m)
L _b	Distance between the fulcrum and the point where the self-weight of the suspension rig acts	(m)
L _c	Length of cantilevered section of platform	(m)
L _f	Free span of guard rail between two vertical members	(m)
L _i	Length of inboard portion of suspension rig	(m)
L _o	Length of outboard portion of suspension rig	(m)
L _{pi} /L _{po}	Horizontal projection between the fulcrum line and the point where SWP/W acts	(m)

Ls	Distance between the bolts or supports which withstand the overturning moment	(m)
Lmi/Lmo/Lsl/Lw/Lshml	Horizontal projection between the fulcrum and the point where SL, Mi, Mo, Fw and TSHML act	(m)
Mc	Mass of electric cable	(kg)
Me	The weight of personal equipment	(kg)
Mi	Mass of inboard portion of suspension rig	(kg)
Mm	Mass of material on work platform	(kg)
Mo	Mass of outboard portion of suspension rig	(kg)
Mp	Assumed mass of a person	(kg)
Mw	Mass of the counterweights	(kg)
Mwr	Mass of wire ropes when the platform is completely lowered	(kg)
N	Number of persons on the platform	(–)
Nr	Number of steel wire ropes or falls supporting the platform	(–)
Q	Wind pressure	(N/m ²)
Ra	Standard of smoothness	(µm)
RF	Minimum load capacity of platform deck	(kg/m ²)
Rh	Horizontal support reaction on suspension rig	(N)
RL	Platform rated load	(kg)
RLMH	Rated load material hoist	(kg)
Rv	Vertical support reaction on suspension rig	(N)
S	Maximum static force in a wire rope	(N)
Sa	Surface area of deck	(m ²)
SAE	Suspended access equipment	(–)
Sd	Shock load coefficient	(–)
SWR	Mass of a suspension rig (self-weight of rig)	(kg)
SWP	Mass of a platform (self-weight of platform)	(kg)
T	Length over which the load is distributed	(m)
Tm	Maximum traction force in the wire rope	(N)
TSHL	Total suspended hoist load	(kg)

TSL	Total suspended load	(kg)
TSP	Temporary suspended platform	(–)
V	Wind speed	(m/s)
W	Safe working load on the cantilevered deck	(kg)
WLL	Working load limit	(kg)
Wtd	Dynamic test load	(kg)
Wts	Static test load	(kg)
Zp	Calculated coefficient of steel wire rope	(–)
σ_E	Elastic yield limit	(N/mm ²)
σ_R	Ultimate limit	(N/mm ²)
σ_a	Allowable stress	(N/mm ²)
V_E	Safety coefficient compared to elastic yield limit	(–)
V_R	Safety coefficient compared to breaking limit	(–)

4 Hazards and preventative actions

This clause lists hazards and hazardous situations identified by risk assessments as being significant for SAE and which require action to eliminate or reduce the risk.

A hazard that is not relevant (NR), not significant (NS) or not dealt with in this standard (ND) is shown in the corresponding requirements column of Table 1.

Table 1 — List of hazards

Line No.	Hazards	Relevant clauses in this standard
1	Mechanical hazards:	
1.1	Generated by machine parts or work pieces caused by:	
1.1.1	Shape	9.4.1
1.1.2	Mass and stability (potential energy of elements which might move under the effect of gravity)	see Item 27.1.1 of this table
1.1.3	Inadequacy of mechanical strength	see Item 27.4 of this table
1.2	Accumulation of energy inside the machinery caused by:	
1.2.1	Elastic elements (e.g. spring loaded wire rope winder)	14.2.6
1.2.2	Liquids and gases under pressure	10.6
1.3	Elementary forms of mechanical hazards:	
1.3.1	Crushing hazard due to lack of clearance	Introduction, 9.3.2, 14.2.3

Line No.	Hazards	Relevant clauses in this standard
1.3.2	Shearing hazard	8.1.4, 8.10.6
1.3.3	Cutting or severing hazard	8.1.4, 8.10.6
1.3.4	Entanglement hazard	8.1.4
1.3.5	Drawing in or trapping hazard	8.3.4.5
1.3.6	Impact hazards due to swinging of the platform against the facade	7.7, 7.8
1.3.7	Stabbing or puncture hazard	NS
1.3.8	Friction or abrasion hazard	NS
1.3.9	High pressure fluid injection or ejection	10.6
2	Electrical hazards:	
2.1	Contact of persons with live parts (direct contact) shall be considered in relation to the degree of protection	10.6
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact) shall be considered in relation to: — main power supply protection — continuity of the protective bonding circuit	10.3 14.2.3
2.3	Approach to live parts under high voltage	ND
2.4	Electrostatic phenomena	NR
2.5	Thermal radiation or other phenomena such as the projection of molten particles and chemical effects from short circuits, overloads, etc.	NS
3	Thermal hazards resulting in burns by possible contact with persons	NS
4	Hazard generated by noise	9.2.5.1
5	Hazard generated by vibration	NS
6	Hazard generated by radiation	ND
7	Hazard generated by materials and substances	ND
8	Hazard generated by neglecting ergonomic principles in machinery design as hazards from:	
8.1	Unhealthy postures or excessive effort: — minimum free height — maximum force applied to a crank or lever — maximum weight of portable components	7.5.3 8.2.2, 8.2.3 9.4.2
8.2	Inadequate consideration of hand-arm or foot-leg anatomy: platform dimensions	7.1
8.3	Neglected use of personal protection equipment	14.2.5
8.4	Inadequate local lighting	14.2.5
8.5	Overload and underload	14.2.5
8.6	Human error, human behaviour Unintentional command by the operator Assembly of modular platforms using fool-proof connections	11.1 11.2, 11.3, 11.4 7.2.1
9	Combination of hazards	ND
10	Unexpected start-up, unexpected overrun/overspeed:	
10.1	Failure/disorder of the control system can result:	11.4

Line No.	Hazards	Relevant clauses in this standard
	— in being trapped on the platform — in unintentional movement	11.4
10.2	Restoration of energy supply after interruption	11.4
10.3	External influences on electrical equipment	10.6, 11.4
10.4	Other external influences	14.2.5
10.5	Error in the software	11.4
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and ability)	NR
11	Impossibility of stopping the machine in a safe condition	5, 8.1.6, 8.3.2, 11.1, 11.2, 14.2.5
12	Variations in the rotational speed of tools	NR
13	Failure of the power supply	8.3.4
14	Failure of the control circuit	11.4
15	Errors of fitting	7.2.1, 14.2.3
16	Break-up during operation	11.4, 14.2.5
17	Falling or ejected objects or fluid	7.1
18	Loss of stability/overturning of machinery	See Item 27.1.1 of this table
19	Slip, trip and fall of persons	See Item 27.2 of this table
Additional hazards and hazardous events due to mobility:		
20	Relating to the travelling function:	
20.1	Excessive speed of pedestrian controlled machinery	9.3.3
20.2	Excessive oscillation of platform when moving	9.3.3, 9.3.4, 9.3.5
20.3	Insufficient ability of machinery to be slowed down, stopped and immobilized	8.1.6, 8.3.2, 8.3.3, 9.3.3
21	Linked to work position:	
21.1	Fall of persons during access to the work position	Introduction, 9.3.2, 9.3.8
21.2	Mechanical hazards at the work position: — contact with the wheels — contact of persons with machine — pedestrian controlled machines	9.3.2 9.3.2 9.3.3
21.3	Insufficient visibility from work position	ND
21.4	Inadequate seating	7.6
22	Due to the control system:	
22.1	Inadequate location of controls/control devices	11.3, 11.4
23	From handling the machine, lack of stability	14.2.2
24	Due to the power source and to the transmission of power:	
24.1	Hazards from the batteries	9.2.5.3

Line No.	Hazards	Relevant clauses in this standard
25	From/to third parties:	
25.1	Unauthorized start-up/use	9.3.6, 11.3, 11.4, 14.2.5
25.2	Lack or inadequacy of visual or acoustic warning means	8.3.5.7, 9.3.3, 13
26	Insufficient instructions for the operator	14.2.5
Additional hazards and hazardous events due to lifting of the platform:		
27	Mechanical hazards and hazardous events:	
27.1	Hazards due to falling caused by:	
27.1.1	Lack of stability due to: — an excess of overhang — an insufficient quantity of counterweights — counterweights not properly located and fixed — insufficient strength of building structure	13.5 6.5 9.3.6 Introduction, 14.2.3
27.1.2	Uncontrolled loading - overloading - overturning moments exceeded due to: — unknown weight of load 6.5.2, 8.3.5 — under-hooking of the platform 8.3.9, 11.4 — interaction of two or more hoists with unequal load distribution on platform 8.3.5.2 — load self-oscillation in the rope by rapid switching of UP/DOWN controls 11	6.5.2, 8.3.5, 8.3.9, 11.4, 8.3.5.2, Clause 11
27.1.3	Uncontrolled amplitude of movements	7.7, 8.3.10, 9.2.2
27.1.4	Unexpected/unintended movements of loads	6.5.2, 8.9.2
27.1.5	Inadequate holding devices/accessories	6.5.2, 8.1.6, 8.3.2, 8.3.3
27.2	From lifting of persons and hazards due to falling shall be considered in relation to:	
27.2.1	Decking, sides guard rails and toe boards of platform	7.1
27.2.2	Control of the platform level	8.3.8, 8.9.3.9
27.2.3	Safe access to equipment	Introduction, 7.4
27.2.4	Safe access to the wire rope anchorage points	14.2.3
27.2.5	Falling objects from the platform	7.1, 7.2.3
27.2.6	Objects falling on to the platform	7.1.5
27.3	From derailment	9.3.1
27.4	From inadequate mechanical strength of parts	6
27.5	From inadequate design of pulleys, hoists etc.	8
27.6	From inadequate selection/integration into the machine of chains, ropes, lifting accessories	9
27.7	From lowering of the load by friction brake	8.1.6

Line No.	Hazards	Relevant clauses in this standard
27.8	From abnormal conditions of assembly/testing use/maintenance or mixing of components	14.2
27.9	From load-person interference (impact by load)	9.3.6
28	Electrical hazard:	
28.1	From lightning	14.2
29	Hazards generated by neglecting ergonomic principles:	See Item 8.1 of this table
29.1	Insufficient visibility for the operator	NS
30	Hazards due to hoisting of material	
30.1	Load falling on to persons on the platform	6.5.2, 8.12
30.2	Wind on the load	6.5.2, 8.12
30.3	Overload	6.5.2, 8.12
30.4	Material not in a vertical line with the material hoist	6.5.2, 8.12
30.5	Stability	6.5.2, 6.5.4.1, 6.5.4.2, 8.12

5 Safety requirements and/or measures

All SAE shall comply with the safety requirements and/or protective measures in Clause 6 to Clause 14 of this standard. In addition, the machine shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards, which are not dealt with by this document.

During the design of SAE appropriate provisions shall be made for their safe use. These provisions shall include recommendations for rescue.

NOTE See 14.1.

6 Structural, stability and mechanical calculations for SAE

6.1 General

The design calculations for all SAE shall be carried out in accordance with European codes and engineering practices including, if necessary, the effects of elastic deformations. All failure modes of materials shall be considered including fatigue and wear.

In the absence of a harmonized standard relevant FEM (European Federation of Materials Handling) rules for the method of calculation of lifting equipment should be referred to. The load cases are specified in the following standards:

- FEM 9.511, Rules for the design of series lifting equipment: Classification of mechanisms;
- FEM 9.341, Rules for the design of series lifting equipment: Local girder stresses;
- FEM 1.001, Rules for the design of hoisting appliances, booklet 2: Classification and loading on structures and mechanisms;
- FEM 1.001, Rules for the design of hoisting appliances, booklet 3: Calculating the stresses in structures;

- FEM 1.001, Rules for the design of hoisting appliances, booklet 4: Checking for fatigue and choice of mechanism components.

The design calculations may be carried out in accordance with the permissible stress method. If the limit state method is used it shall result in the same level of safety.

6.2 Safety margin allowed within the calculations

6.2.1 Calculating the stresses in structures

6.2.1.1 General

See also FEM 1.001 booklet 3.

For the three load cases defined in Table 2 and Table 3 the calculation of the different members is set out allowing a safety margin for the critical stresses. Taking the three common failure modes into account:

- yield strength exceeded;
- critical load for buckling exceeded;
- fatigue limit exceeded.

6.2.1.2 Allowable stresses

For carbon and stainless steels where the ratio between the elastic yield limit σ_E and the breaking limit σ_R is less than 0,7 refer to Table 2. Where the ratio is higher than 0,7 refer to FEM 1.001 booklet 2.

For aluminium, refer to Table 3.

The calculated stress shall not exceed the allowable stress σ_a obtained by dividing σ_E by a coefficient depending on the load cases set out in Table 2 and Table 3.

Load case 1: In-service conditions (i.e. SAE with RL, in-service wind)

Load case 2a: Occasional conditions (e.g. static and dynamic tests, tripping of overload detection device)

Load case 2b: Occasional conditions (e.g. out-of-service storm wind)

Load case 3: Extreme conditions (e.g. operation of the secondary device)

Table 2 — Value of v_E (Carbon steel and stainless steel)

	Load case 1	Load cases 2a and 2b	Load case 3
Value of v_E	1,5	1,33	1,1
Allowable stress σ_a	$\sigma_E / 1,5$	$\sigma_E / 1,33$	$\sigma_E / 1,1$

For the allowable stresses in welded steel structures, see EN 1993 (all parts) (*Eurocode 3*).

Table 3 — Value of v_E (Aluminium)

	Load case 1	Load cases 2a and 2b	Load case 3
Value of v_E	1,65	1,46	1,15
Allowable stress σ_a	$\sigma_E / 1,65$	$\sigma_E / 1,46$	$\sigma_E / 1,15$
AND (*)	$\sigma_R / 2,2$	$\sigma_R / 2$	$\sigma_R / 1,5$

For the allowable stresses in welded aluminium structures, see EN 1999-1-1 (*Eurocode 9*).

For extruded aluminium profiles the breaking limit is in general very close to the elastic yield limit and both conditions should therefore be satisfied.

6.2.1.3 Checks against fatigue

For SAE structures subject to fatigue the minimum number of cycles and load spectrum to take into account are set out in Table 4.

Table 4 — Parameters for checking against fatigue

Group of structure of the SAE	Number of hoisting cycles n max	Load spectrum factor Kp
A2 (U1 / Q3)	30 000	0,5
A3 (U1 / Q4)	30 000	1
A4 (U2 / Q4)	60 000	0,5
A4 (U2 / Q4)	60 000	1

6.2.2 Calculating the stress in mechanisms

6.2.2.1 General

The calculated stress shall not exceed the allowable stress derived from Table 5, using the breaking stress of the material.

The value of the allowable stress σ_a is given by the following formula:

$$\sigma_a = \frac{\sigma_R}{V_R}$$

Table 5 — Parameters for checking against breaking

	Load case 1	Load cases 2a and 2b	Load case 3
Value of V_R	4	2,2	1,5
Allowable stress σ_a	$\sigma_R/4$	$\sigma_R/2,2$	$\sigma_R/1,5$

6.2.2.2 Checks against fatigue and wear

For mechanical parts subject to fatigue and wear (except for surfaces in contact with wire ropes) the minimum number of operating hours and load spectrum to take into account are set out in Table 6.

Table 6 — Parameters for checks against fatigue and wear

Group of mechanism of the SAE	Total operating time (hours) T	Load spectrum factor
M4 (T2 / L4)	500	1
M6 (T4 / L4)	2 000	1

NOTE Refer to FEM 1.001 booklets 2 and 4.

6.3 Design loads and forces

6.3.1 General

The rated load (RL) of the SAE and the maximum number of persons (n) permitted on the SAE are to be stated by the manufacturer or supplier (see 3.6.2).

The WLL of each hoist shall be equal to or greater than the vertical reactions transmitted by the portion of suspended platform and the load suspended by that hoist.

All suspended loads should be taken into account (i.e. including power and suspension cables, tension weights on secondary suspension cables).

6.3.2 TSAE Compatibility

Since some TSAE incorporating platform mounted hoists are modular the WLL of the suspension rig and its accessories shall be equal to or greater than the WLL of the hoists plus the reaction transmitted by the weight of the safety ropes, tension weights and the power cable.

6.3.3 De-rating the WLL of hoist(s)

The WLL of hoists may be de-rated by the manufacturer or his appointed representative, providing the condition in 6.3.2 is satisfied.

The following steps shall be taken to de-rate a hoist:

- a) The hoist overload detection device shall be adjusted to trigger at a maximum of 125 % of the de-rated load.
- b) Additional safety devices shall be incorporated to set the de-rated load. Such additional devices could consist of one or more of the following:
 - 1) a current overload device which shall be set to stop the hoist motor at a maximum of 150 % of the de-rated WLL;
 - 2) thermal overload device which shall be set to stop the hoist motor at a maximum of 150 % of the de-rated WLL;
 - 3) the stalling load of the motor shall be less than 2,5 times the de-rated WLL of the hoist;
 - 4) a torque limiting device that shall be set to halt the raising/lowering of the platform if a load of 150 % of the de-rated WLL is applied to the hoist.
- c) The hoist shall be clearly marked with the de-rated WLL.

If the only action taken to decrease the WLL of a hoist is that as described in 1) above then the hoist is not regarded as being de-rated and the suspension rig calculations for mechanical strength and the amount of counter-weight needed should still use the WLL of the hoist as specified and certified by the manufacturer.

NOTE 1 For testing the hoist stalling load see B 1.6.

NOTE 2 For the purpose of calculations of SAE covered by this standard it is considered that a mass of 1 kg produces a force of 10 N.

6.3.4 Rated load on the platform

6.3.4.1 Platform for one person

$$RL = Mp + Me + Mm \quad (\text{Minimum RL} = 120 \text{ kg}) \quad (1)$$

Platform for two or more persons:

$$RL = (n \times Mp) + (2 \times Me) + Mm \quad (\text{Minimum RL for two person platform} = 240 \text{ kg}) \quad (2)$$

where

$$Mp = 80 \text{ kg};$$

$$Me = 40 \text{ kg};$$

Mm can be 0 kg or a specified figure.

NOTE 1 A maximum of two persons only are considered for Me .

NOTE 2 The calculation of the RL applies to all types of platforms covered by this standard.

6.3.4.2 Minimum load capacity

The minimum load capacity of the deck (RF) shall be 200 kg/m^2 .

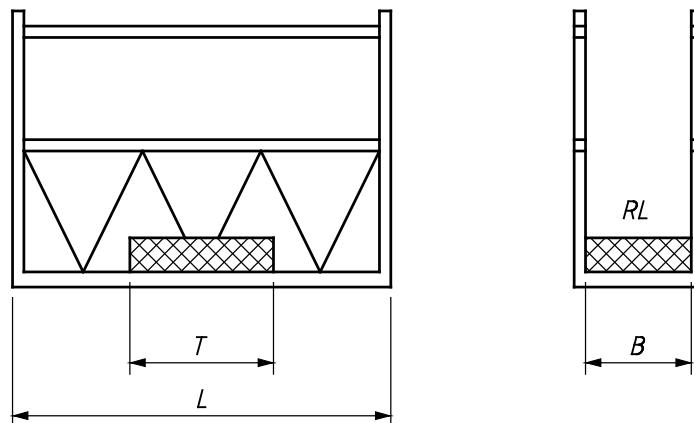


Figure 5 — RL distribution

6.3.4.3 Calculation of RL

The RL is calculated in accordance with the formulae (1) or (2) and distributed over a surface area Sa located on a length T :

$$Sa = B \times T \quad (3)$$

$$T = \frac{RL}{B \times RF} \quad (4)$$

6.3.4.4 Single point suspended platform or chair

The minimum RL shall be 120 kg.

6.3.4.5 Two point suspended platform

6.3.4.5.1 To prove the strength of the platform the RL, distributed over a length T , is assumed to be applied in the most unfavourable position.

6.3.4.5.2 If a two point suspended platform extends beyond a suspension point a stability coefficient against overturning of 2 shall be applied to the load (W) located on the cantilevered section of the platform to ensure adequate stability.

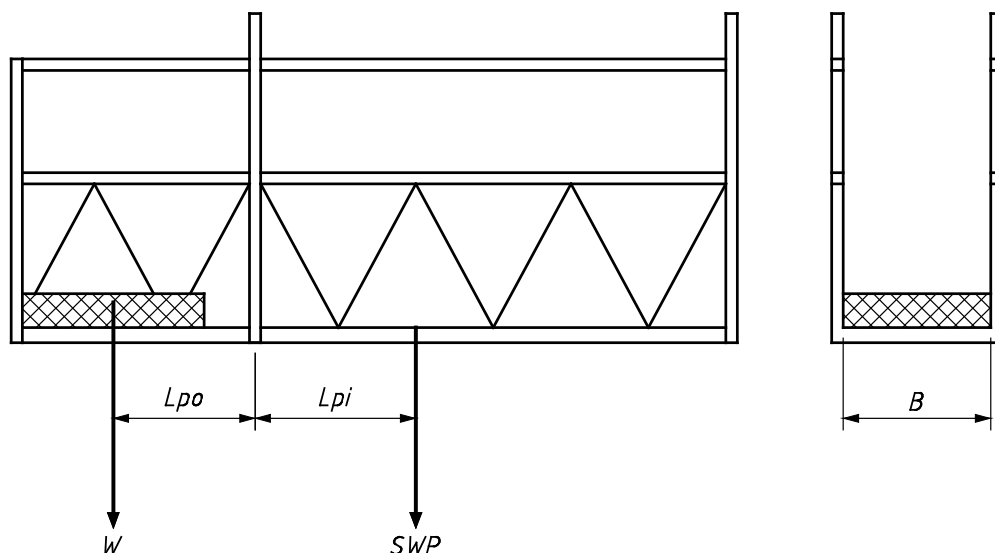


Figure 6 — Cantilevered platform

Calculation for example in Figure 6:

$$SWP \times Lpi \geq 2 \times W \times Lpo \quad (5)$$

$$W = Sa \times RF \leq RL \quad (6)$$

where

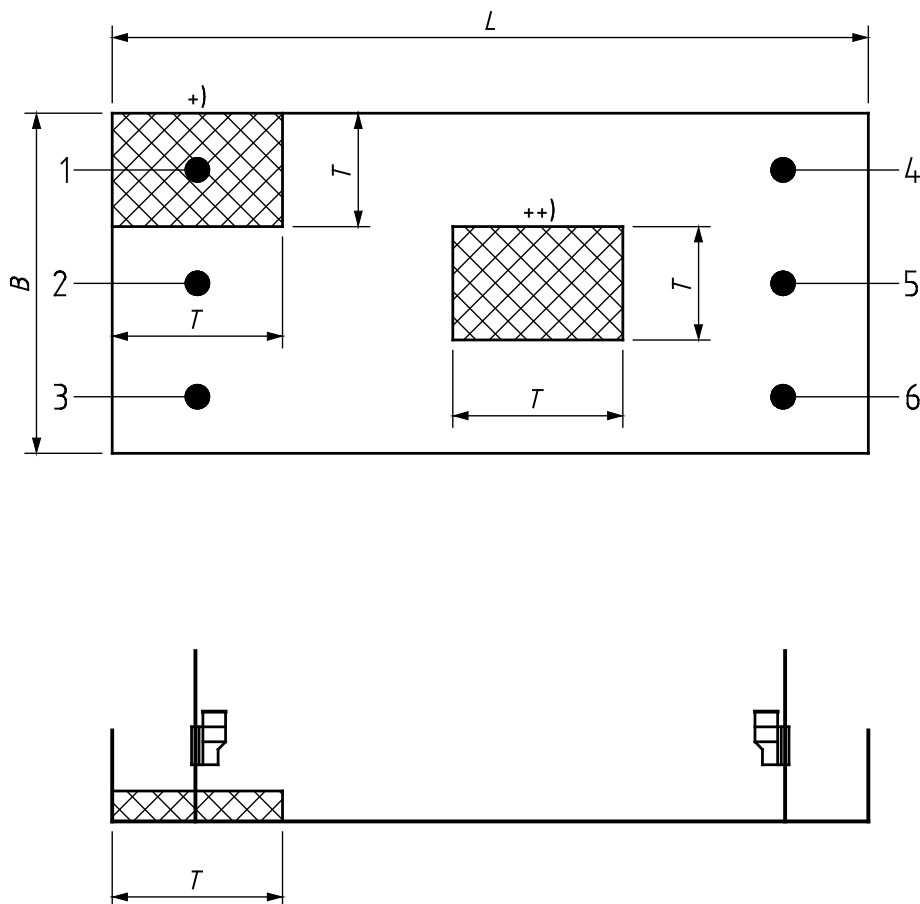
W shall be not less than 120 kg.

6.3.4.6 Multi-point suspended platform and hinged continuous platform

6.3.4.6.1 The RL is calculated in accordance with the Formulae (1) or (2) and distributed over a surface area Sa as shown in Figure 5.

6.3.4.6.2 For a wide work platform where $T < B$ as shown in Figure 7 Sa is a square area with a side dimension equal to:

$$T = \sqrt{\frac{RL}{RF}} \quad (7)$$



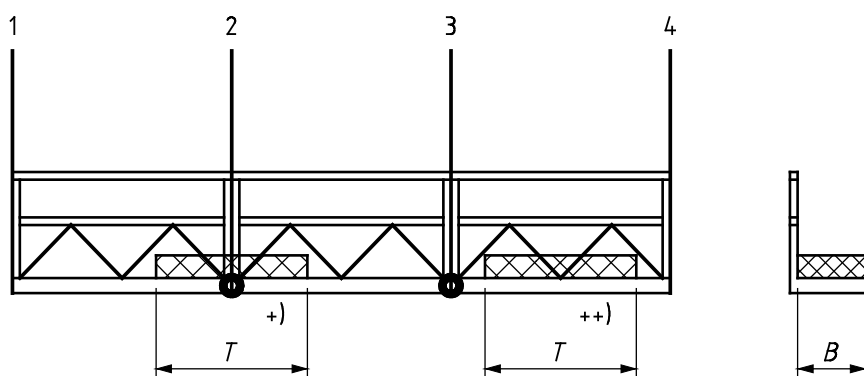
Key

1-6 suspension points

Figure 7 — Example of multi-point suspended platform

NOTE In Figure 7 the location of the load in position +) is used for the calculation of the force S in the suspension wire ropes. The location of the load in position ++ is used for the calculation of the strength of the platform.

6.3.4.6.3 For a hinged continuous platform the RL shall be assumed to apply at the most unfavourable position as shown in Figure 8.



Key

1-4 suspension wire ropes

Figure 8 — Example of hinged continuous platform

NOTE In Figure 8 the location of the load in position +) is used for the calculation of the force S in the suspension wire ropes. The location of the load in position ++ is used for the calculation of the strength of the platform.

6.3.5 Wind loads

6.3.5.1 Design wind speeds in accordance with Table 7 that should be considered for all SAE likely to be affected by wind when in service.

Table 7 — Wind pressure

Wind pressure in operation q (N/m ²)	Wind speed v (m/s)
Non-guided platforms = 125	14
Continuously guided platforms = 250	20

NOTE For shape factors applied to areas exposed to wind refer to FEM 1.001 booklet 2.

These wind speeds are the designed wind speeds for SAE. They do not represent the safe wind speeds for SAE when in service.

6.3.5.2 The full exposed area of one person standing on an open TSP platform is 0,7 m² with the person's effective centre of area 1 m above the platform floor.

The exposed area of one person standing on a TSP or BMU platform behind a clad section of the platform is 0.35 m² with the persons effective centre of area 1,45 m above the platform floor.

For the purposes of calculation the assumed exposed surface area of any material on a platform is 2 m².

6.3.5.3 Wind loads are assumed to act horizontally at the centre of the area of the component parts of SAE.

6.3.5.4 The wind loads acting on a platform shall be considered to be acting on the suspension points of the associated suspension rig.

6.3.5.5 For BMUs an additional calculation is needed for storm force winds with the machine in the parked position.

Table 8 — Storm wind

Intended height above ground (m)	Wind speed v (m/s)	Wind pressure q (N/m ²)
0 to 20	36	800
20 to 100	42	1 100
100 to 150	46	1 300
> 150	to be considered in accordance with local conditions (guidance can be obtained from EN 12158-1:2000+A1:2010, Annex A, building wind tunnel tests or the building structural engineer)	

6.3.5.6 Calculations shall be used to prove that a suspension rig will not move by wind forces alone, whether in service or in the parked position, when the service brake(s) have been applied. Where storm wind forces can move a suspension rig an anchoring device shall be provided at the parking position.

Calculations shall also be used to prove that jib(s) will not slew by wind forces alone, whether in service or in the parked position, when the service brake(s) have been applied. Where storm wind forces can move jib(s) an out-of-service anchoring device shall be provided.

6.3.6 Forces exerted by persons

6.3.6.1 The minimum value to be used for the forces exerted by persons on the guardrails or top edge of a rigid side of a platform is assumed to be 200 N for each of the first two persons on the platform and 100 N for each additional person, these forces acting in the horizontal direction at 500 mm intervals.

6.3.6.2 The guardrail or top edge of a rigid side of a platform shall be able to resist, without permanent deflection, a vertical load of 1 kN applied at the most unfavourable position.

6.3.6.3 The mesh or cladding of a platform shall not fail when a horizontal force of 200 N distributed over an area of 100 × 100 mm is applied at any location on the surface.

6.4 Platform structural calculations

The strength of the platform is to be proven by calculation for the load cases expressed below:

Load case 1: $1,25 \times (RL + SWP)$ (see 6.3.4)

+ $1,25 \times$ Wind loads in operation (see 6.3.5)

+ $1,25 \times$ Forces exerted by persons (see 6.3.6)

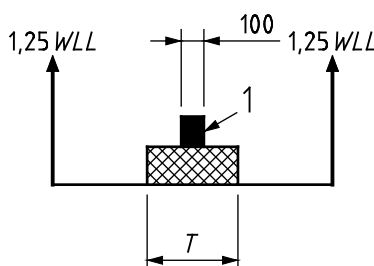
Load case 2: $1,5 \times RL + SWP$

Load case 3 (TSP): (e.g. triggering of the fall arrest device) $2,5 \times (RL + SWP)$

Load case 3 (BMU): (e.g. triggering of the fall arrest device) $0,8 \times S_d \times (RL + SWP)$

(Where S_d is shock load coefficient as derived in B.1.4 and B.1.5).

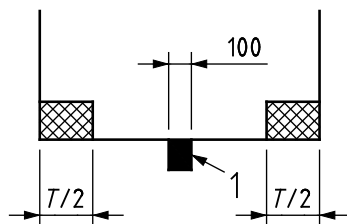
Load case 3 (TSP & BMU): (e.g. collision of the platform with an obstruction)
when lifting, see Figure 9 or lowering, see Figure 10)



Key

1 obstruction 1

Figure 9 — Obstruction when lifting



Key

1 obstruction 1

Figure 10 — Obstruction when lowering

The obstruction 1 shall be placed in the most unfavourable position.

NOTE The lifting force is assumed to be equal to $1,25 \times \text{WLL}$ of the hoist(s).

SWP should take into account the mass of wire rope winders, if installed.

6.5 Calculations for suspension rigs

6.5.1 General

Suspension rigs shall be designed and constructed to withstand the loads derived from the static and dynamic tests and any additional dynamic loads caused by a failure of a hoist or suspension wire rope.

In addition to having stability against overturning, suspension rigs should have sufficient lateral strength or be braced against the effects of lateral sway of the platform parallel to the face of the building or structure.

The forces producing lateral sway can be caused by wind, movement of the platform or surges caused by the starting and stopping of the traversing system.

Reaction forces for all SAE shall be calculated and the results given to the structural engineer responsible for the building or structure. This information should include the results of Load cases 1 and 2b and the stability calculations.

6.5.2 SAE incorporating auxiliary material hoist

Stability and strength calculations of the machine, including the materials hoist, to be performed in accordance with Table 9 or Table 10 and Table 11 or Table 12.

6.5.3 Structural calculations for suspension rigs

6.5.3.1 Structural calculations for BMU suspension rigs

The strength of BMU suspension rigs with either roof or platform-mounted hoists shall be proven by calculations for the load cases given in Table 9 (see Figure 11).

Table 9 — Load cases for BMU suspension rig

Load case	Total Suspended Load (TSL)	Weight of outboard portion	Weight of inboard portion	Horizontal force (Fh)
Load case 1 Working load	$1,25 \times \text{TSL} + 1,25 \times \text{TSHL}$	$1,25 \times \text{Mo (a)}$	$1,25 \times \text{Mi (a)}$	$1,25 \times \text{Fw1 Plat} + 1,25 \times \text{Fw1 Rig} + 1,25 \times \text{Fw}_{\text{MH}} \text{ (b)} + 2 \times \text{M} \times \text{acc (c)}$
Load case 2a	$1,5 \times \text{RL} + 1 \times \text{SWP} + 1,25 \times \text{HWLL} + 1 \times \text{HSW}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Load case 2b – Out of service conditions	generally 0	$1 \times \text{Mo}$	$1 \times \text{Mi}$	$\text{Fw2 Plat} + 1 \times \text{Fw2 Rig}$
Load case 3 – Triggering of the secondary device	$\text{Sd} \times \text{TSL} + 1,1 \times \text{TSHL}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Fw1 = In-service wind force Fw_{MH} = In-service wind force on material (assumed minimum 5 m² and a minimum of 625 N) Fw2 = Out-of-service storm wind force HWLL = Working load limit of materials hoist HSW = Mass of all suspended materials hoist items TSHL = Total suspended hoist load (TSHL = HWLL + HSW) Sd is actual value in accordance with test B.1.4 or B.1.5. The most unfavourable combination of the forces shall be considered for the calculation.				

- a) For static suspension rig use $1 \times \text{Mo}$ and $1 \times \text{Mi}$.
- b) Fw1 on platform: The minimum horizontal load on the suspension points of the ropes is $0,1 \times \text{TSL}$ in all directions.
- c) Acceleration forces for traversing suspension rig (trolley) are $2 \times \text{M} \times \text{acc}$.

M = mass of moving parts

acc = calculated acceleration of the drives

6.5.3.2 Structural calculations for TSP suspension rigs

The strength of a TSP suspension rig is to be proven for the load cases given in Table 10.

Table 10 — Load cases for TSP suspension rig

Load case	WLL of the hoist(s)	Weight of outboard portion	Weight of inboard portion	Horizontal force (Fh)
Load case 1 Working load	$1,25 \times \text{WLL} + 1,25 \times \text{TSHL}$	$1,25 \times \text{Mo (a)}$	$1,25 \times \text{Mi (a)}$	$1,25 \times \text{Fw1} + 1,25 \times \text{FwMH (b)}$
Load case 2a	$1,5 \times \text{WLL} + 1,25 \times \text{HWLL} + 1 \times \text{HSW}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Load case 3 Triggering of the secondary device	$2,5 \times \text{WLL} + 1,1 \times \text{TSHL}$	$1 \times \text{Mo}$	$1 \times \text{Mi}$	0
Out of service condition	generally 0	$1 \times \text{Mo}$	$1 \times \text{Mi}$	Fw2
WLL = Working Load Limit of platform winch Fw1 = In-service wind force FwMH = In-service wind force on material (assumed minimum 5 m² and a minimum of 625N) Fw2 = Out-of-service storm wind force HWLL = Working load limit of materials hoist HSW = Mass of all suspended hoist items TSHL = Total suspended hoist load (TSHL = HWLL + HSW) The most unfavourable combination of the forces shall be considered for the calculation.				

- a) For static suspension rig use $1 \times \text{Mo}$ and $1 \times \text{Mi}$.
- b) Fw1 on platform: The minimum horizontal load on the suspension points of the ropes is $0,1 \times \text{TSL}$ in all directions.

The WLL of the hoist is considered as the maximum calculated force in the wire ropes.

All parts of a temporary suspension rig shall be capable of being reused and re-erected and should be designed so as to prevent failure from fatigue or wear in normal use, including additional stresses which can be induced in assembly, dismantling, transportation and storage.

6.5.4 Stability calculations for suspension rigs

6.5.4.1 Stability calculations for BMU suspension rigs

This section applies to rail and non-rail mounted BMU suspension rigs with either roof or platform-mounted hoists. The rails may contribute to the resistance to the overturning moment if the anchoring system and roof structure have been designed accordingly.

A BMU suspension rig is regarded as adequately stable if, referring to the most unfavourable fulcrum in each case, the stability moment is equal or greater than the overturning moment in each of the load cases specified as follows.

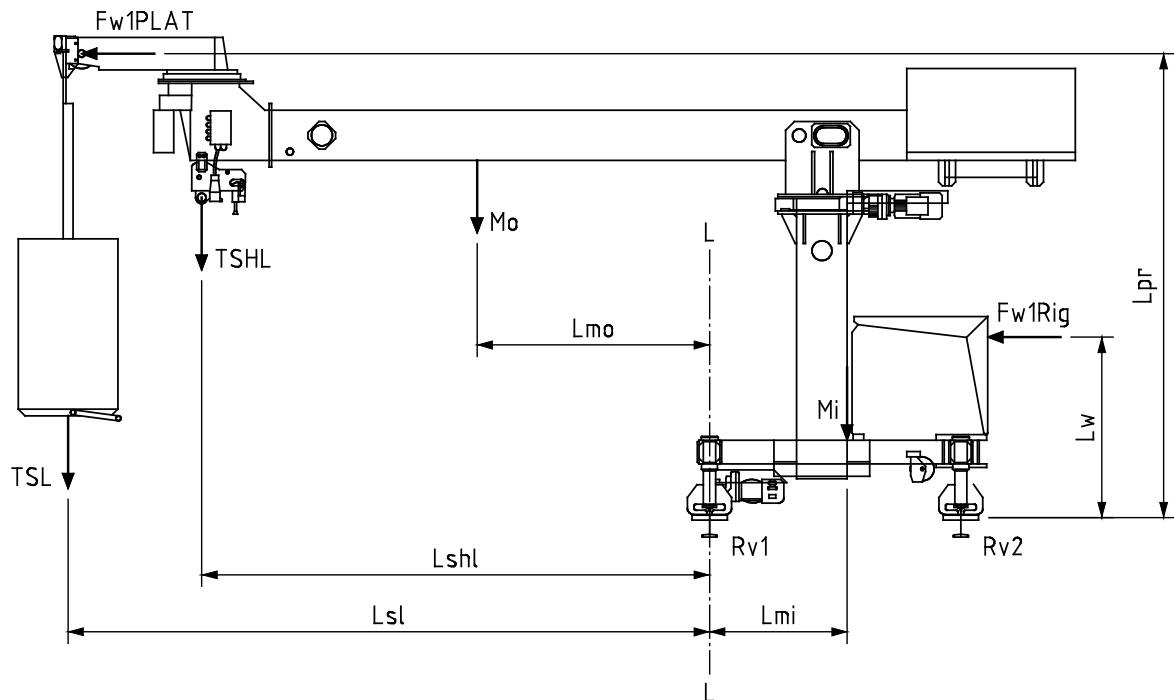


Figure 11 — Trolley unit stability calculation

The stability of a BMU suspension rig is to be proven by calculation using the coefficients given in Table 11.

$$TSL = RL + SWP + Mwr + Mc \quad (8)$$

BMU working position calculation:

$$\text{Prove that: } (2 \times TSL \times Lsl) + (1,25 \times Mo \times Lmo) + (1,25 \times Fw1 \text{ Rig} \times Lw) + (1,4 \times TSHL \times Lshl) + (1,25 \times Fw1 \text{ Plat} \times Lpr) < Mi \times Lmi \quad (9)$$

BMU parking position calculation:

$$\text{Prove that: } (Mo \times Lmo) + (Fw2 \text{ Rig} \times Lw) + (Fw2 \text{ Plat} \times Lpr) < Mi \times Lmi \quad (10)$$

All dimensions for calculations shall be the maximum for the particular system to ensure that the most unfavourable possible loading conditions are considered. The design reactions as a result of the above calculation shall be presented to the building structural engineer as detailed in Annex D.