

**Mobile access and working tower made of prefabricated
elements – Materials, dimensions, design loads, safety and
performance requirements**

可移动工作台——材料，尺寸，设计负载，安全和性能要求

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Foreword

前言

This document (EN 1004:2004) has been prepared by Technical Committee CEN/TC 53 "Temporary works equipment", the secretariat of which is held by DIN.

这个文件（EN1004：2004）由技术委员会 CEN/TC53 “临时工作设备”编制，有他的秘书处 DIN 持有。

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of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

这个欧洲标准是一个国家标准，最迟到 2005 年 6 月作为正文或文件出版，如果与国家标准有冲突将会被撤销，最迟到 2005 年 6 月。

This document supersedes HD 1004:1992.

这个标准代替 HD1004: 1992

The development of mobile access and working towers is from two roots:

---- scaffold manufacturers placed prefabricated unanchored scaffolds on four legs and castors and

---- ladder manufacturers began to construct mobile access towers with light-weight ladders using aluminum frames and castors.

可移动脚手架的发展有两个根源:

——脚手架制造商预制的四个支腿和脚轮的脚手架不安定

——扶梯制造商用铝结构和脚轮的较轻重量的扶梯建造可移动工作台

Taking this into account, CEN/TC 53 decided in 1980 to standardize the manufacture of mobile access and working towers in parallel with the European standardization of prefabricated service and working scaffolds EN 12810-2 and EN 12811-3.

鉴于此, CEN/TC53 在 1980 年决定, 制造的可移动脚手架的标准要与欧洲标准 EN12810-2 和 EN12811-3 水平相当。

For materials, this document refers only to valid documents. However, a large stock of equipment made of materials conforming to documents no longer valid is in use. The document does not cover this equipment.

对于材料, 这个文件只提到了有效文件。尽管这样, 制造设备的材料大量存货与文件一直, 使用中不再有效。这个文件不覆盖这个设备。

During discussion of the draft it was noted that the average height of people is increasing and that consideration will have to be given in later editions to altering vertical dimensions.

在草稿的讨论中人类的平均身高增长, 考虑到这些需要修改垂直高度。

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

根据 CEN/CENELEC 内部规定, 以下国家的国家标准组织会执行这个标准: 奥地利, 比利时, 塞浦路斯, 捷克, 丹麦, 爱沙尼亚, 芬兰, 法国, 德国, 希腊, 匈牙利, 冰岛, 爱尔兰, 意大利, 拉脱维亚, 立陶宛, 卢森堡, 马耳他, 荷兰, 挪威, 波兰, 葡萄牙, 斯洛伐克, 西班牙, 瑞典, 瑞士和英国。

1 Scope

1 范围

This document applies to the design of mobile access and working towers made of

prefabricated elements with a height from 2.5m to 12.0m (indoors) and from 2.5m to 8.0m (outdoors).

这个文件适用于可移动脚手架的设计，制造高度从 2.5m 到 12.0m（室内），宽度 2.5m 到 8.0m（室外）。

This document:

---- gives guidelines for the choice of the main dimensions and stabilizing methods;

---- gives safety and performance requirements; and

---- gives some information on complete towers.

这个文件：

——主要尺寸和稳定化处理的选择给出指导；

——安全和性能要求；

——完整工作台的一些信息。

NOTE In this document “indoors” means that the towers is not be exposed to wind, and “outdoors” means that the tower may be exposed to wind.

注 这个文件中“室内”是指工作台没有暴露在风里，“室外”是指工作台也许暴露在风里。

2 Normative references

2 标准参考

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies.

以下参考文件对于这个文件的运用是必须的。对于有日期的参考文件，只有引用的版本才适用。

EN74, Couplers, loose spigots and base-plates for use in working scaffolds and falsework made of steel tubes- Requirements and test procedures

EN1298, Mobile access and working towers – Rules and guidelines for the preparation of an instruction manual

EN1991-2-4, Eurocode 1: Basis of design and actions on structures – Parts 2-4: Actions on structures – Wind actions

EN1993-1-1: 2005, Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings

EN1995-1-1, Eurocode 5: Design of timber structures – Part 1-1: General rules and rules for building

EN1999-1-1, Eurocode 9: Design of aluminium structures –Part 1-1: General rules – General rules and rules for buildings

EN12810-2, Façade scaffolds made of prefabricated components – Parts 2: Particular methods of structural design

EN12811-2, Temporary works equipment – Part 2: Information on materials.

EN12811-3, Temporary works equipment – Part 3: Load testing

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3 条款和定义

对于此文件的用途，以下条款和定义适用。

3.1 mobile access and working towers

Scaffold structures which:

- are capable of being used free-standing;
- have one or more working platforms;
- are assembled using prefabricated components;
- have the dimensions fixed by the design;
- have normally four legs with at least four castors;
- are stable, by support on the ground and if necessary by support to a vertical construction by wall strut.

3.1 可移动工作平台

脚手架结构：

- 可以自由站立；
- 由一个或多个工作平台；
- 由预制组件组装；
- 有固定的设计尺寸；
- 通常由四个立柱，至少四个脚轮；
- 平稳得支撑在地面上，如果有必要，有垂直建构支撑墙面。

3.2 height (H)

Distance from the ground to the upper surface of the top platform

3.2 高度 (H)

从地面到顶部平台的上表面的距离。

3.3 castor wheel

Swiveling wheel secured to the base of a member to enable the tower to be moved

3.3 脚轮

可转脚轮固定在底部部分确保工作台可以移动

3.4 adjustable leg

incorporated into the structure only for plumbing a tower when situated on uneven or sloping ground. An adjustable leg may be fitted with either a castor wheel or a base

plate.

3.4 可调支脚

当平台放在一个不平坦斜坡上时，将可调制支脚垂直支在工作台上。可调支脚可以用脚轮或者底板。

3.5 platform component

unit of platform that supports a load on its own

3.5 平台组件

单个的平台可以支撑自身的负载

3.6 bracing member

means used to stiffen the structure

3.6 支柱

用来使结构稳定的装置

3.7 outrigger

component that increases the effective base dimensions of a tower, with provision for the attachment of a castor.

3.7 支腿

脚轮附件中对提高工作台底部有效尺寸的零件作出规定。

3.8 stabilizer

component that increases the effective base dimensions of a tower, without provisions for the attachment of a castor

3.8 稳定器

脚轮附件中对提高工作台底部有效尺寸的零件没有作出规定。

3.9 ballast

weights placed at the base of the tower to increase to overturning

3.9 压舱物

在工作台基部加载增加重量以免翻倒

3.10 wall strut

means for providing compressive restraint to prevent a tower overturning. It is normally a horizontal tubular member, one end of which is coupled to the tower, while the other end rests against a wall or other structure

3.10 支墙件

提供压力支撑以防工作台翻倒。通常它是水平管状的，一端连接工作台，另一端固定在墙上或其他结构上。

3.11 stairway

means of access intended for persons carrying tools or materials

3.11 梯子

可供人员带工具或材料上下

3.12 stairladder

means of access intended for persons not carrying tools or materials

3.12 扶梯

可供人员带工具或材料上下

3.13 inclined ladder

means of access intended for persons not carrying tools or materials with an inclination from 60° to 75°

3.13 斜梯

倾度在 60 到 75 度之间，供不带工具或材料上下的人员使用

3.14 vertical ladder

means of access intended for persons not carrying tools or materials with an inclination of 90°

3.14 垂直梯

倾度 90 度的供不带工具或材料上下的人员使用

3.15 platform

one or more platform components forming a working area

3.15 平台

一个或多个平台组成一个工作区域

3.16 length (L)

Greater of the two plane dimensions at the platform level (see Figure 1)

3.16 长度 (L)

平台表面两个平面尺寸较长的那个（参见图表 1）

3.17 width (W)

lesser of the two plane dimensions at the platform level (see Figure 1)

3.17 宽度 (W)

平台表面两个平面尺寸较短的那个（参见图表 1）

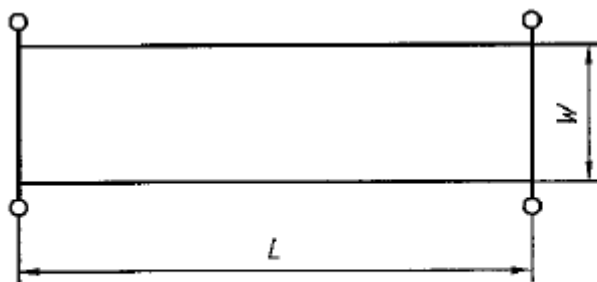


Figure 1 —Width (W) and length (L)

4 Classification

4 等级

4.1 Load classes

4.1 负载等级

The classes of uniformly distributed load are given in Table 1.

Tables 1 ---- Classes of uniformly distributed load

Load class	Uniformly distributed load q kN/ m ²
2	1.50
3	2.00

表 1 中给出的平均分配的负载等级

表 1——平均分配的负载等级

负载等级	平均分配负载 kN/ m ²
2	1.50
3	2.00

4.2 Access classes

Four options for access to the platform are described in 7.6.

4.2 路径等级

7.6 中描述了四种平台路径。

5 Designation

The following data are required for the designation of all prefabricated mobile access and working towers:

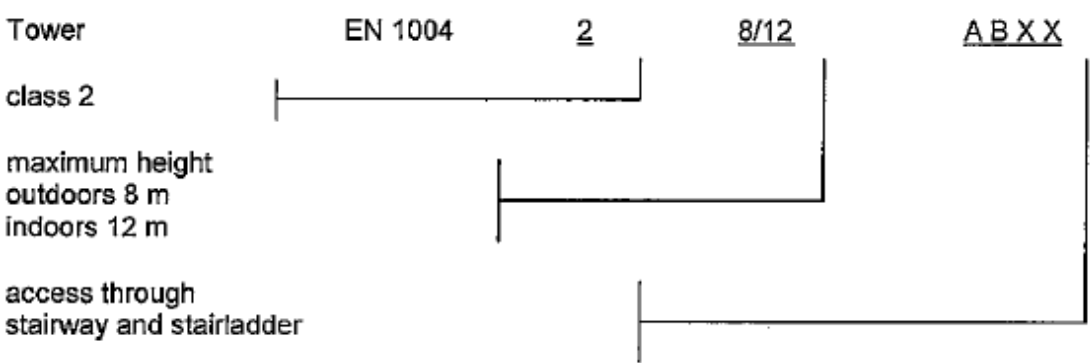
- a) class of uniformly distributed load (see 4.1);
- b) maximum height outdoors/indoors;
- c) access classes (see 4.2).

5. 说明

以下数据是对于所有预制可移动工作台的必须的说明：

- a) 平均分配的负载等级（参见 4.1）；
- b) 室内/室外最大高度
- c) 路径等级（参见 4.2）

EXAMPLE



6 Materials

6 材料

Materials shall fulfill the requirements given in documents where design data are provided. Information for the most commonly used materials are given in EN 12811-2.

材料必须完全履行设计数据的要求。常用材料在 EN12811-2 中有规定。

Steel shall be protected by one of the methods given in EN 12811-2, Clause 8 or zinc coated with an average thickness of 15 μ m.

钢材料应该参照 EN12811-2，第 8 条给出的方法或者镀锌厚度为 15 μ m 保护。

7 General requirements

7 总体要求

7.1 General

7.1 总述

The following sub clauses specify the minimum requirements for the mobile access and working tower including platforms.

以下条款列举了移动路径，工作塔及平台的最低要求。

It shall be possible to fix platforms for erection and dismantling purposes with vertical distances between platforms not exceeding 2.10m.

为了使平台能安装及拆卸，其间的垂直距离不能超过 2.10 米。

7.2 Dimensions

7.2 尺寸

The minimum width, W, of the platform shall be 0.60m and minimum length, L1, shall be 1.00m. The minimum clear height between platforms “H” shall be in accordance with Table 2.

平台的最小宽度（W）和最短长度（L1）分别为 0.60 米和 1.00 米。最低净高度则如以下表 2 所列：

Table 2---- Clear height classes 净高度分类

Clear height class 高度分类	Minimum clear height H in m 最低净高度（米）
H1	1.85
H2	1.90

7.3 Apertures within platforms

The aperture shall be as small as practicable, and it shall have a minimum clear opening of:

0.40m wide x 0.60m long

7.3 平台孔径

平台内部间隙应尽可能小，最小的净间隙口径为：

0.4 米宽 X0.6 米长

Apertures in platforms shall not exceed 25 mm in width. This does not apply to apertures like hand holes in hatches.

平台间隙宽度不能超出 25mm，但此标准不适用于人工开口的间隙。

Access to a working platform through an aperture in a platform shall be provided with means to prevent falling through.

穿越平台间隙到达工作平台的入口应配备有防脱落装置。

7.4 Side protection 护边

7.4.1 General 总述

For allowable dimensions see Figure 2.

容许尺寸参见图 2。

Dimensions in millimeters unless otherwise stated
如无特殊说明，尺寸用毫米表示。

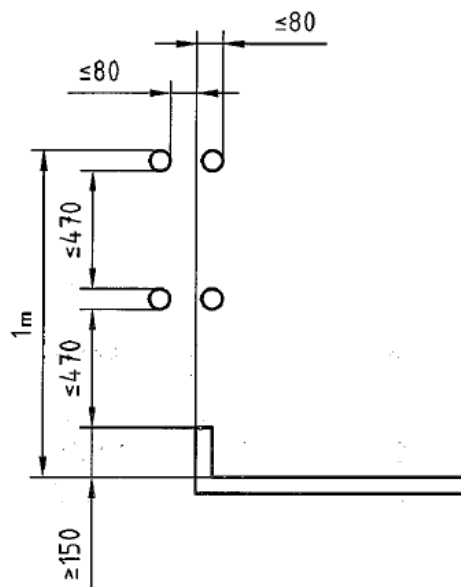


Figure 2-----Side protection dimensions 图 2—护边尺寸

Side protection components shall be incapable of removal except by direct intentional action.

除非故意，否则防护侧边的部件不能拆卸。

It shall be possible to erect protection at platform edges comprising:

- a) at least one principal guardrail and intermediate side protection;
- b) toe-board

建立平台边缘的防护应包含：

- a) 至少 1 个主要的护栏和中间护栏；
- b) 搁脚板。

7.4.2 Principal guardrail

7.4.2 主要护栏

The principal guardrail shall be fixed so that its top surface is 1 m or more above the adjacent level of the working area everywhere (minimum height 950 mm).1)

1) See A-deviation

主护栏需固定，其顶部表面比其他类似级别的工作区域要高出至少 1 米。

7.4.3 Intermediate side protection

7.4.3 中间护栏

Intermediate side protection shall be fixed between the principal guardrail and the toe-board.

中间护栏需固定在主护栏和踏脚板之间。

Intermediate side protection may consist of:

- one or more intermediate guardrails, or
- a frame, or
- a frame of which the principal guardrail forms the top edge, or
- a fencing structure.

中间护栏由以下部分组成：

- 一个或多个护栏，
- 或者框架
- 或由主护栏组成顶部边缘的框架
- 或者栅栏结构。

Openings in the side protection shall be so dimensioned so that a sphere with a diameter of 470 mm will not pass through them.

护栏的口径需测算，使直径为 470 毫米的球体无法通过。

7.4.4 Toe-board

7.4.4 踏脚板

It shall be possible to fix a solid toe-board such that its top edge is at least 150mm above the adjacent platform level.

坚固的侧板需固定，其顶部边缘相对于类似的平台要高出至少 150 毫米。

7.5 Castor wheels 脚轮

7.5.1 General 总则

Castor wheels shall be fixed to the tower in such a way that they cannot be accidentally detached. 脚轮应该安装好不能偶然地脱落。

7.5.2 Brakes 刹车

All castors shall have wheel brakes. They shall have swivel brakes unless by their design they are not eccentric when locked.

所有脚轮应该有轮子刹车；除非设计中锁好后形状奇怪，所有脚轮都应有旋转刹车。

The brake mechanism shall be designed in such a way that it can only be unlocked by a deliberate action.

刹车系统设计的只能是有意打开时才能打开。

The brake mechanism shall effectively prevent any rotation of the wheel when a horizontal force of 0,30 kN is applied through the vertical swivel axis of the castor as close as possible above the castor housing and in the rolling direction of the castor. The full value of the specified service load per castor wheel is to be applied when testing the castor brakes. A minimum of five control tests shall be carried out.

当一个**0.3kN**的水平力施向脚轮罩的上方垂直旋转轴上，顺着滚动方向时，刹车系统可以有效阻止脚轮的旋转。在测试脚轮刹车时，要使用脚轮载重要求的全值来测试。最少要实施**5**个控制测试。

7.5.3 Test loads 载重测试

The vertical service load per wheel given by the manufacturer of the MAT (Mobile Access Tower) shall be verified by a minimum of 5 tests.

制造商提供的每个脚轮的垂直载重（移动塔架）至少经过5次检测。

The test load shall be three times the service load per castor wheel derived from the most unfavourable load combination from Table 4.

测试的载荷应该是每个脚轮工作载荷的3倍，从图表4中的最不适宜的载重组合可看出。

When the brakes are locked, an initial vertical load of 0,50 kN shall be applied. The plate of the fork shall be taken as the origin for measurements of vertical displacement d_c and the residual deformation d_r . The load shall be increased to the maximum test load, maintained for one minute and the vertical deformation d_c shall be measured. The load shall be returned to 0,50 kN. After 30 min the residual deformation d_r shall be measured.

当刹车锁住时，50kn的初始垂直载荷是可以的。岔道里的弹簧片应该按照原始的垂直位移测量，剩余的变形 d_r 。载荷应该增加到最大测试载荷，维持一分钟，测量垂直变形。载荷回归到0.30分钟后，测试残余变形的数据。

The test shall meet both of the following requirements:

测试必须满足下面两个要求：

— residual deformation d_r after 30 min shall not be more than 1,5 mm;

30分钟后残余变形不应该大于1.5 mm

— total deformation d_c shall not be more than 15 mm.

总变形不应大于15mm。

The service load is verified if all five tests meet the test requirements.

如果所有五项测试都满足要求，工作载荷方可确认。

7.5.4 Wheels 轮子

Wheels shall be of punctureless type.

轮子应该是无孔类型。

7.6 Access to platforms

7.6 平台路径

7.6.1 General

7.6.1 总述

The access type is classified by a letter A, B, C, or D as follows:

平台路径可分为 A, B, C, D 四种类型：

---- Access type A: Stairway;

----Access type B: Stair ladder;

----Access type C: Inclined ladder;

----Access type D: Vertical ladder.

A- 楼梯;

B- 扶梯;

C- 斜梯;

D- 直梯。

Where a range of access types is provided, a combined classification is used.

如果知道了路径类型的范围，那么就可以使用组合分类。

EXAMPLES 例子

Type AXCX means that stairways and inclined ladders can be provided.

Type ABCD means that all four types of access can be provided.

NOTE: The X in the designation means that those types of access are not provided.

类型 AXCA 意味着路径中的楼梯和斜梯。

类型 ABCD 意味着所有的 4 种路径。

注：X 的意思不是其中任何一种。

7.6.2 General requirements

7.6.2 总体要求

Access to platforms in an assembled tower shall be within the main structural supports and shall:

---- be secured against unintentional loosening;

---- not rest on the ground;

---- have a distance from the ground to the first step or rung of 400 mm maximum (if the first step is a platform, 600 mm is allowable);

---- have steps/rungs with constant spacing and a slip resistant surface.

已装配脚手架的进入路径必须在脚手架的主要主结构内：

——确保安全不会松散；

——不能放置在地上；

——地面到第一个横杆的距离最大为 400 毫米，如果第一层是平台，则距离可以是 600 毫米；

——横杆必须保持固定的间距和防滑表面。

7.6.3 Requirements for stairway and stair ladder

7.6.3 楼梯和扶梯的要求

7.6.3.1 General

7.6.3.1 总述

The outside of stair flight shall be provided with a handrail which runs approximately parallel to the stairs. Where a flight of stairs is provided in a continuous dog-leg style, a handrail shall be also be provided on the inside. When flights of stairs are interrupted by platforms at ≤ 2.1 intervals, the inside handrail may be omitted.

楼梯外侧需配有扶手，要大致与楼梯平行。连续折向的楼梯内部也要有扶手。如

果某段楼梯在不到（含）2.1 米处有平台，则内部扶手可以省略。

Flights of stairs in a continuous dog-leg style shall have landings. Each of these stairs shall have a minimum of one landing and this shall have a minimum length of 300 mm.

连续折向的楼梯要有楼梯平台，每一个楼梯至少有一个楼梯平台，起最小长度为 300 毫米。

The minimum clear height for access measured between the steps and the supporting structure of the stairway or stairladder above shall not be less than 1.75m.

梯子踏板与支撑结构之间的最小净高不能小于 1.75 米。

7.6.3.2 Requirements for stairway class A (see Figure 3)

7.6.3.2 A 类云梯要求：见图 3

- Inclination $35^{\circ} \leq \alpha \leq 55^{\circ}$; 倾斜度
- vertical step depth $190\text{mm} \leq t \leq 250\text{mm}$; 垂直踏板深度
- Minimum step width $d=125\text{mm}$; 踏板最小宽度
- Minimum clear width 400mm; 最小净宽
- Horizontal gap between steps $0 \leq g \leq 50\text{mm}$; 踏板间水平间隙

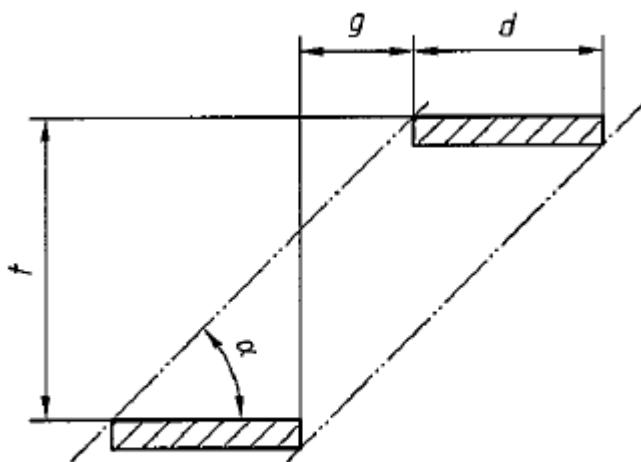


Figure 3 — Dimensions of stairway

7.6.3.3 Requirements for stairladder class B (See Figure 4)

- Inclination $35^{\circ} \leq \alpha \leq 55^{\circ}$; 倾斜度
- Vertical step depth $150\text{mm} \leq t \leq 250\text{mm}$; 垂直踏板深度
- Minimum step width $d=80\text{mm}$; 踏板最小宽度
- Minimum clear width 280mm; 最小净宽
- Horizontal gap between steps $0 \leq g \leq 160\text{mm}$; 踏板间水平间距

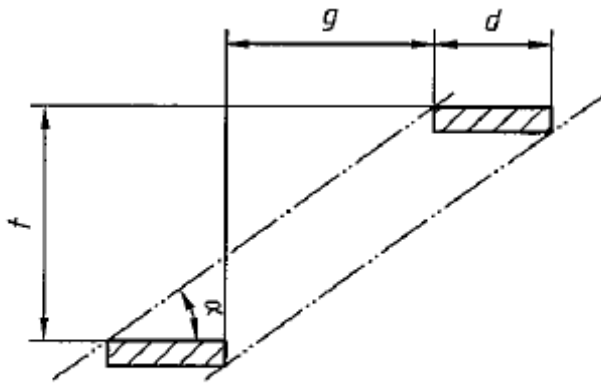


Figure 4 — Dimensions of stairladder

7.6.3.4 Requirements of inclined ladder class C (See Figure 5)

7.6.3.4 C 级斜梯的要求（参见图 5）

- | | |
|--|--|
| - Inclination 倾斜 | $60^{\circ} \leq \alpha \leq 75^{\circ}$; |
| - Step spacing 踏板间距 | $230\text{mm} \leq t \leq 300\text{mm}$; |
| - Step depth 踏板深度 | $d > 80\text{mm}$; |
| - Rung spacing 横档间距 | $230\text{mm} \leq t \leq 300\text{mm}$; |
| - Rung depth 横档深度 | $20\text{mm} \leq d \leq 80\text{mm}$; |
| - Minimum clear width 最小净宽 | 280mm ; |
| - Maximum vertical distance between different platforms
两个平台之间的最小垂直距离 | 4.2m ; |
| - Maximum distance between the ground and the first platform
从地面到第一个平台之间的最大距离 | 4.6m . |

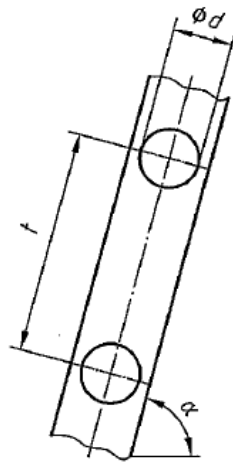


Figure 5 — Dimensions of inclined ladder

7.6.3.5 Requirements of vertical ladder class D (See Figure 6)

7.6.3.5 D 级直梯的要求（参见图 6）

From the front edge of the step or from the centre of the rung to any obstacle behind the stairway/ladder there shall be a horizontal distance of $s=150\text{mm}$ minimum (see Figure 6).

从踏板的前缘或者从横档的中间到楼梯/扶梯后部的任何障碍物，应该有一个最小水平距离 $s=150\text{mm}$ （参见图 6）。

- Rung spacing 横档间距 $230\text{mm} \leq t \leq 300\text{mm};$
- Rung depth 横档深度 $20\text{mm} \leq d \leq 51\text{mm};$
- Minimum clear width 最小净宽 $280\text{mm};$
- Maximum vertical distance between different platforms 不同平台之间的最小垂直距离 $4.2\text{m};$
- Maximum distance between the ground and the first platform 地面和第一个平台之间的最大距离 $4.6\text{m}.$

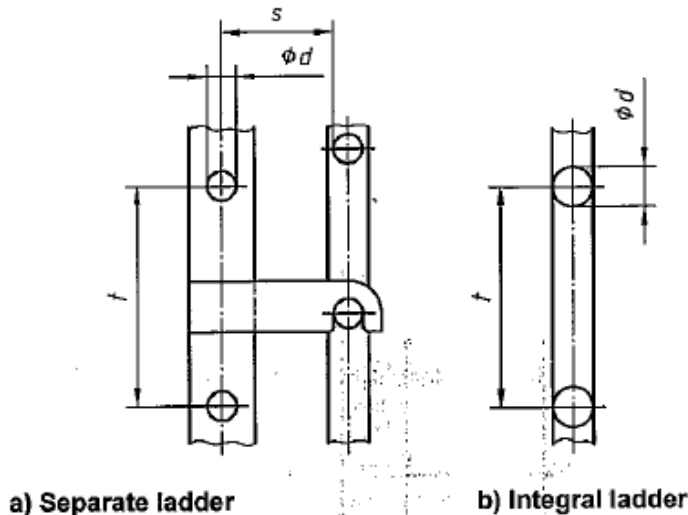


Figure 6 — Dimensions of vertical ladder

7.7 Means for stabilizing

7.7 稳定器的方式

7.7.1 Stabilizers and outriggers

7.7.1 稳定器和舷外支架

The stabilizers and outriggers of a tower shall be purpose designed as component of the main structure and shall provide means of adjustment to ensure contact with the ground.

工作台的稳定器和舷外支架应为主要结构的组成部分，并且提供调节方法以确保接触地面。

The method of fixing the stabilizer or outrigger to the tower shall have adequate strength and shall be such that the reaction loads in the stabilizer or outrigger are transferred to the tower without slip, rotation, or other movement of the stabilizer or outrigger.

将稳定器或舷外支架固定在工作台上的方法应有充分的强度，并且稳定器或舷外支架的反应力要传递到工作台上，稳定器或舷外支架不能打滑，旋转或移动。

7.7.2 Ballast

If ballast is necessary, it shall be securely positioned and made of rigid materials such as steel or concrete, but excluding liquids or granular materials.

7.7.2 压舱物

如果需要压舱物，那么要安全防止，并且坚硬材料如钢或混凝土，不能用流体或颗粒物材料。

7.8 Connections

7.8 连接件

7.8.1 General

7.8.1 概述

Each connection device shall be effective, easy to monitor and the components shall be easy to assemble. The securing of components forming part of the structure of the scaffold and side protection components shall make them incapable of removal except by direct intentional action.

每个连接装置都是有效的，易操控，并且组件易装配。除了直接有意的动作之外，脚手架结构的组件和侧边防护组件必须保证它们不能移动。

7.8.2 Vertical spigot and socket connection

7.8.2 垂直套管和孔型连接件

When assembled, the horizontal movement (slack or play) between upper and lower components shall not exceed 4 mm or a movement away from the centre line of 2 mm.

装配后，上下部件之间的水平移动（松动或运动）不应该超过 4mm 或者离中心线的移动不应该超过 2mm。

In all cases it shall not be possible to disconnect an upper component laterally until the upper component has been lifted more than 80mm.

在所有情况下上面部件都不能向侧边分离除非上面部件提升超过 80mm。

When the spigot and socket connection acts over a distance less than 150mm, the connection shall be provided with a positive locking device, such as a cross pin, to prevent the upper component from being lifted unintentionally.

当套管和孔型连接件连接长度少于 150mm 时，连接件必须有一个锁定装置，比如插销，防止上部组件无意被抬高。

The captive locking device shall be placed in such a way that its positive action can be monitored visually.

受控的锁定装置必须放在可视位置。

7.8.3 Other vertical connections

7.8.3 其他垂直连接件

There shall be equivalent provision related to 7.8.2 to limit the risk of accidental disconnections.

应该有等同于 7.8.2 的规定限制意外断开的风险。

NOTE Other strength requirements can impose further limitations on the arrangement of connections.

注 其他强度要求可以限制连接件的排列。

7.9 Platform components

Components of platforms shall be durable and shall have a slip-resistant surface. It shall be possible to secure these components so that overturning or removal by wind not possible.

7.9 平台组件

平台组件必须坚固并且有防滑表面。这些组件必须能防风侧翻或移动。

7.10 Erection and dismantling

The tower shall remain stable and resist all loads imposed on the components also during erection and dismantling.

7.10 安装和拆除

工作台在安装和拆除过程中应保持稳固并且能抵御各种施加在组件上的力。

9 Instruction manual

For each type of prefabricated equipment the manufacturer shall produce an instruction manual for use on site. The instruction manual shall include at least the data according to EN 1298.

9 使用手册

对于每一个预制装置，制造商都要提供一个使用手册。使用手册内容至少根据 EN1298。

10 Marking

10 标记

10.1 Components

10.1 组件

Each purpose designed component shall be marked with:

- a) a symbol or letter to identify the MAT system and its manufacturer;
- b) the year of manufacture, using the last two digits. Alternatively a code for tracing the year of manufacturer may be used.

Marking shall be so arranged that it will remain legible for the life of the component.

The size of the lettering may take account of the size of the component.

每个设计的组件必须标识：

- a) 用符号或字母标注 MAT 系统和他的制造商；
- b) 用最后两个数字表示制造年份。另外也可以追踪制造厂商年份代码。

标志应该可以清晰的辨认。字体的大小可以参考组建的尺寸。

10.2 Manufacturers plate

A manufacturer's plate showing the information below shall be displayed and visible from the ground level on all mobile access and working tower:

- a) manufacturer's mark;
- b) designation;
- c) "Instructions for erection and use to be followed carefully" in the respective language.

10.2 制造商板

可移动工作台上的制造商板上要显示以下信息，从地面上就可以清晰地看到：

- a) 制造商标记；
- b) 名称；
- c) 用各自的语言分别表述“搭建说明和使用说明”。

11 Structural design

11 结构设计

11.1 Basic design principle

11.1 基本设计原则

11.1.1 Introduction

11.1.1. 指南

Mobile access and working towers shall be designed for load bearing capacity, serviceability and resistance to overturning. Unless otherwise stated in this clause, the documents for structural engineering shall be applied.

可移动工作台设计要考虑负载，适用和防倾覆。除非这个条款有其他规定，结构工程的文件也适用。

The strength of joints and connections (e.g. welded joints, compressed connections, hollow type rivet connections) shall be verified.

连接点和连接件的强度（如，焊接点，压平连接，凹型铆钉连接）要核定。

Concepts relate to the limit state method.

Full scale or detail testing may be undertaken in accordance with EN 12811-3 to supplement calculation.

相关限制概念提出的方法。

根据 EN12811-3 进行全面或详细测试补充计算。

11.1.2 Structural design of components

11.1.2.1 Steel

The structural design shall be in accordance with EN 1993-1-1 taking into account EN 12811-2.

11.1.2 组件结构设计

11.1.2.1 钢

根据 EN1993-1 进行结构设计，并考虑 EN12811-2。

11.1.2.2 Aluminum

The structural design shall be in accordance with EN 1999-1-1 taking into account EN 12811-2.

11.1.2.2 铝

结构设计根据 EN1999-1-1，并考虑 EN12811-2。

11.1.2.3 Timber

The structural design shall be in accordance with EN 1995-1-1 taking into account EN 12811-2.

11.1.2.3 木料

结构设计根据 EN1995-1-1，并考虑 EN12811-2。

11.1.2.4 Other materials

Appropriate documents shall be applied for the structural design. If European document do not exist, International documents may be applied.

11.1.2.4 其他材料

适当的文献被用于结构设计。如果没有欧洲文献，国际文献也可以适用。

11.1.3 Limit states

The limit states are classified into:

---- ultimate limit states;

---- serviceability limit states.

11.1.3 限定声明

限定生命被分为：

——最终限定声明；

——适用限定声明。

At ultimate limit state the design value for the effect of actions, that is the design value of an internal force or moment, E_d , shall not exceed the design value of the corresponding resistance, R_d , in accordance with the expression

$$E_d \leq R_d$$

用极限值规定运动效果的设计值，此设计值是某一内力或瞬时力的设计值，根据下列方程式， E_d 不能超过相应阻力 R_d 的设计值。

$$E_d \leq R_d$$

The design value, E_d , for the effect of action is calculated from the characteristic of the actions specified in 8.2 and 8.3 by multiplying each by the corresponding partial safety factor, γ_F .

运动效果的设计值 E_d 是通过 8.2 和 8.3 段的运动特性值分别乘以相应的安全因素 γ_F 来计算的。

The design value of the resistance, R_d , is calculated from the characteristic values specified in 11.3 by dividing by a partial safety factor, γ_M .

抵抗力的设计值 R_d ，从 11.3 中的特征值除于一个部分安全因素 γ_M 得来。

At serviceability limit state the design value for the effect of actions specified in the serviceability criterion, E_d , shall not exceed the limiting design value of the relevant serviceability criterion, C_d .

$$E_d \leq C_d$$

适用限定声明，使用标准中规定的动作效果的设计值 E_d ，不能超过相关适用标准的限定设计值 C_d 。

11.2 Structural analysis

11.2.1 Choice of a model

11.2 结构分析

11.2.1 模式选择

The models adopted shall be sufficiently accurate to predict the structural behaviour level taking into account the imperfections given in 11.2.2.

被采用的模式要十分精确的预知结构特征水平，并考虑 11.2.2 中提到的不完整性。

The analysis carried out by checking separate planar systems shall consider the interaction.

验证独立平面系统的分析要考虑交互作用。

11.2.2 Imperfections

11.2.2 缺陷

11.2.2.1 General

11.2.2.1 概述

The effects of practical imperfections, including residual stresses and geometrical imperfections, such as out of vertical, out of straight and unavoidable minor eccentricities shall be taken into account by suitable equivalent geometrical imperfections.

实际缺陷的影响，包括残余压力和几何缺陷，如不垂直，不竖直和不可避免的较小的离心，都应考虑到。

The method of application shall be in accordance with the respective specifications of the relevant design documents, for example, for steel EN 1993-1-1, for aluminium EN 1999-1-1. Deviating from these specifications, the assumptions concerning imperfections in global frame analysis shall comply with 11.2.2.2.

运用的方法根据相关设计文件各自的规定，例如，钢 EN19930101，铝 EN1999-1-1。除了这些规定，关于全部结构分析上的缺陷的假设参照 11.2.2.2。

The equivalent geometric imperfections need not be geometrically compatible.

相同的几何缺陷不要求具有一致的几何特性

11.2.3 Rigidity assumptions

11.2.3 硬度假定

11.2.3.1 Joints between tubular members

11.2.3.1 管件的连接点

The joints between tubular members may be assumed to be rigid connections if the spigot permanently fixed to one document and if:

如果接头管永久固定地连接在一个部件上并同时符合以下的条件，则管件的连接点可视为刚性连接：

---- the overlapping length of the spigot is at least 150mm and

接头管搭接的最短长度为 150 毫米

---- the play between the nominal inner diameter of the tube and the nominal outer diameter of the spigot is not greater than 4mm.

管子的内部直径与接头管的外部直径之间的距离不超过 4 毫米。

Or 或者

---- the overlapping length of the spigot is at least 80 mm and

接头管搭接的最短长度为 80 毫米

---- the play between the nominal inner diameter of the tube and the nominal outer diameter of the spigot is not greater than 2mm.

管子的内部直径与接头管的外部直径之间的距离不超过 2 毫米。

This assumption applies to tubular members with external diameters not exceeding 60mm.

以上假设基于管件的外部直径不能超过 60 毫米。

If one of these requirements is not met, for example if spigots according to EN 74 are used, the joints shall be modeled as an ideal hinge. Alternatively, a detailed check on the spigot and standard may be made (see 11.3.3.2).

如果以上任何一条不符合要求，例如使用了 EN74 的接头管，则连接点要仿造成理想的铰链。不然，对于连接管个标准要进行一个详细的检查了。

11.2.3.2 Connecting devices

11.2.3.2 连接设备

The realistic load-deformation behavior of the connecting devices shall be incorporated in the model for the analysis. Alternatively joints may be modeled by assumptions which are on the safe side.

连接设备的实际载重变形应当成是模具分析的一个不可获缺的部分。或者出于安全考虑，连接点可以按照假定来仿造。

NOTE ENV 1993-2 and EN 12811-3 give some information on semi-rigid connections.

注意：ENV1993-2 和 EN12811-3 提供了一些半刚性连接的信息。

For the determination of the relevant parameters for semi-rigid connecting devices in prefabricated towers, see EN 12810-2.

对于预制塔的半刚性连接设备相关系数的确定，请参考 EN12810-2。

Where the connections to standards are made by prefabricated joints, for example in a modular system, the design moment-rotation characteristic of ledger-to-standard or transom-to-standard connections shall be determined.

11.2.4 Resistance

11.2.4 阻力

11.2.4.1 General

11.2.4.1 总述

The characteristic values of the resistance shall be calculated using the characteristic values of the mechanical properties (for example the yield strength $f_{y,k}$), which are given in EN 12811-2 or may be taken from relevant documents.

阻力的特征值应该使用 EN12811-2 或相关文件中给出的机械性能来计算（例如，抗屈服强度 $f_{y,k}$ ）。

For steel or aluminium members the resistances shall be determined in accordance with 5.4 of EN 1993-1-1:2005 or 5.3 of EN 1999-1-1 respectively.

对于钢件或铝件的阻力，其分别对应 EN 1993-1-1:2005 的 5.4 和 EN 1999-1-1 的 5.3。

11.2.4.2 Connecting devices

11.2.4.2 连接设备

To establish the characteristic values of resistance for:

视以下不同情况确定阻力的特征值：

- a) connections covered by the scope of structural engineering regulations: see relevant design documents;
- a) 建筑工程规章范围内的连接点：请参考相关设计文件
- b) semi-rigid connection devices for prefabricated tower: see EN 12811-3;
- b) 预制塔的半刚性连接设备：参照 EN12811-3
- c) other connection devices which do not comply with a document test shall be carried out. See e.g. EN 12810-2.
- c) 其他与文件测试不符的连接设备，请参照 EN12810-2

11.3 Verification

11.3 核实

11.3.1 General

11.3.1 总述

For the determination of internal forces and moments, elastic methods shall be used. For example for steel see ENV 1993-1-1:1993, 5.2.1.3.

对于内力和力矩的确定，应使用弹性方法。例如钢，请参照 ENV 1993-1-1:1993, 5.2.1.3.

The influence of the deflections on the internal forces and moments shall be taken into account; the equilibrium of the displayed system shall be calculated by the use of a second-order analysis or by the use of a first-order analysis with amplification factors. 应考虑内力和力矩偏差的影响，展览系统的平衡可使用第二顺序分析计算或者第一顺序分析附加扩大因素计算。

11.3.2 Partial safety factors

局部安全要素

11.3.2.1 Partial safety factors for actions, γ_F

局部安全要素， γ_F

Except when stated otherwise, the partial safety factor, γ_F , shall be taken as follows:

除非另有规定，否则局部安全要素 γ_F 应如下所示：

a) ultimate limit state

$\gamma_F=1.5$ for all permanent and variable loads;

$\gamma_F=1.0$ for accidental loads;

a)极限状态：

$\gamma_F=1.5$ ，对于所有不变的和可变动的负荷

$\gamma_F=1.0$ ，其他负荷

b) serviceability limit state

$\gamma_{Fl}=1.0$

b)正常使用极限状态：

$\gamma_{Fl}=1.0$

11.3.2.2 Partial safety factor for material resistances, γ_M

11.3.2.2 材料阻力的局部安全要素， γ_M

For the calculation of the design values of the resistance of steel or aluminium components the partial safety factor, γ_M , shall be taken from relevant documents.

对于钢部件或铝部件的结构参数阻力的计算，其局部安全要素 γ_M 需参照相关文件。

For the serviceability limit state, γ_M , shall be taken as 1.0.

正常使用极限状态， γ_{Fl} 的值为 1.0。

11.3.3 Ultimate limit state

11.3.3 极限状态

11.3.3.1 General

11.3.31 总述

At ultimate limit state it shall be verified, that the design values of the effects of actions do not exceed the design values of the corresponding resistances.

在极限状态下，需检验动力作用影响的计算值不能超出相应的阻力计算值。

11.3.3.2 Tubular members

11.3.3.2 管状部件

For the combination of actions, the interaction Equation (3) may be used:

考虑到合力的作用，应使用以下合力作用方程式：

$$\frac{M}{M_{pl,V,d}} \leq \cos \left[\frac{\pi}{2} \frac{N}{N_{pl,V,d}} \right] \quad (3)$$

where

$$N_{pl,V,d} = \frac{N_{pl,k}}{\gamma_M} \sqrt{1 - \left(\frac{V}{V_{pl,k} / \gamma_M} \right)^2}$$

is the design value of the resistance axial force with respect to the acting shear force V;

上式是轴向力关于剪切力 V 的阻力计算值：

$$M_{pl,V,d} = \frac{M_{pl,k}}{\gamma_M} \sqrt{1 - \left(\frac{V}{V_{pl,k} / \gamma_M} \right)^2}$$

is the design value of the resistant bending moment with respect to the acting shear force V and 上式是反抗弯矩关于剪切力 V 的计算值

$N_{pl,k}$ 是塑料抗轴向力 N 的特定值

$N_{pl,k}$ is the characteristic plastic resistance of the axial force N;

$M_{pl,k}$ 是塑料抗弯矩 M 的特定值

$M_{pl,k}$ is the characteristic plastic resistance of the bending moment M;

$V_{pl,k}$ 是塑料抗剪切力 V 的特定值

$V_{pl,k}$ is the characteristic plastic resistance of the shear force V;

M is the design value of the actual bending moment;

M 是实际弯矩的计算值

N is the design value of the actual axial force;

N 是实际轴向力的计算值

V is the design value of the actual shear force.

V 是实际轴向力的计算值

For the value of the partial safety factor, γ_M , see 11.3.2.2.

局部安全要素的值 γ_M , 见 11.3.2.2.

11.3.3.3 Joints between tubular members

11.3.3.3 管状部件间的连接点

When the requirements of a rigid connection between tubular members according to 11.2.3.1 are met, the spigot only needs to be verified for the design bending moment at the joint.

当管状部件之间的刚性连接都符合 11.2.3.1 的要求时，只需检验连接管连接点的弯矩。

When the overlap is less than 150mm-respectively 80mm- and the joint is not treated as an ideal hinge, see 11.2.3.1, the detailed structural design check shall include the bending stresses, shear stresses and local bearing stresses.

当交迭长度分别小于 150 毫米或者 80 毫米，连接点就不能视作是一个理想的铰链，见 11.2.3.1，详细的结构设计检查需包括弯曲应力，剪切应力和局部的承压应力。

11.3.3.4 Side protection

11.3.3.4 侧面防护

Components of the side protection shall withstand the accidental load specified in 8.3.2.1 without falling or disconnecting. A displacement from the original line of more than 300mm at any point is to be taken as failure. Where necessary the displacement may be calculated by assuming a plastic hinge, which transfers the plastic bending resistance of the component.

侧面防护的部件应能承受意外的负重（详见 8.3.2.1）并不脱落或拆开。任何点的移位距离超过 300 毫米就被视为失败。当有必要时，移位可由假定塑胶连接来计

算，这样可以转移部件的塑胶弯曲抵抗力。

11.3.4 Serviceability limit state

11.3.4 正常使用极限状态

It shall be verified that the deflection requirements specified in 8.4 are met.

如符合偏差要求（详见 8.4），则需检验正常使用极限状态。

11.4 Positional stability

11.4 稳定性

11.4.1 General

11.4.1 总述

The structure as a whole shall be stable in all conditions. This applies to overturning of free-standing towers. Overturning may be resisted by self-weight, added ballast, stabilizers and outriggers or combinations of these.

结构作为一个整体在任何情况下都应该稳固。这个适用于平台单独站立的倾覆。可以有自重，附加的压舱物，稳定器和舷外支架或这些的组合。

11.4.2 Load cases

11.4.2 负载情况

11.4.2.1 General

11.4.2.1 总述

Following load cases shall apply. Both load directions (parallel and perpendicular to the tower) shall be evaluated for each load case.

以下负载情况可以适用。每个负载情况，都有两个负载方向（水平和垂直）要评估。

NOTE When a tower which requires stabilizers or outriggers is used against a wall, wall struts may be used to provide stability. There should be a minimum of one wall strut on each vertical of the tower close to the wall. The wall struts should always be fitted at a level equal to or higher than the upper attachment point of the stabilizer or outrigger.

注 当一个工作台要求使用稳定器或舷外支架靠墙，墙的支撑可以提供稳定性。应该有一个最小的墙面支撑在工作台的垂直于墙面。墙面支撑总是要与稳定器或舷外支架的上部附件齐平或略微高出。

11.4.2.2 Load case 1

11.4.2.1.1 Safety factor

The safety factor against overturning shall be $S \geq 1.5$.

11.4.2.2 负载情况 1

11.4.2.1.1 安全系数

倾覆的安全系数 $S \geq 1.5$ 。

11.4.2.2.2 Vertical loads

11.4.2.2.2 垂直负载

---- Self-weight

---- vertical service load on a position of 100 mm from the most unfavourable edge of the top platform. The vertical service load to be taken into account is:

---- for platform length $L \leq 4$ m: 0.75kN;

---- for platform length $L > 4$ m: 2×0.75 kN.]

——自重

——从平台顶部最不利边缘 100mm 的位置的垂直使用负载。垂直使用负载:

——对于平台长度 $L \leq 4$ m: 0.75kN;

——对于平台长度 $L > 4$ m: 2×0.75 kN。

11.4.2.2.3 Horizontal loads

11.4.2.2.3 水平负载

----- Horizontal service load on the top platform. The horizontal service load to be taken into account is:

---- for platform length $L \leq 4$ m: 0.3kN;

---- for platform length $L > 4$ m: 2×0.3 kN.

——顶部平台的水平使用负载。水平使用负载:

——对于平台长度 $L \leq 4$ m: 0.3kN;

——对于平台长度 $L > 4$ m: 2×0.3 kN。

---- Wind load 0.1kN/m^2 on structure (see 8.2.2.2) and persons:

---- for platform length $L \leq 4$ m: 1 person;

---- for platform length $L > 4$ m: 2 persons.

——结构上（参见 8.2.2.2）风力负载 0.1kN/m^2 和人员:

——对于平台长度 $L \leq 4$ m: 一个人;

——对于平台长度 $L > 4$ m: 两个人。

For the wind load on persons:

---- projected area of one person: 0.7m^2 ;

---- shape factor of : 1.0;

---- centre of area: 1m above the top platform level.

The horizontal service load and the wind shall be not be combined. Only the most unfavourable of these horizontal loads shall be taken into account.

对于人身上的风力负载:

——人员受风面积: 0.7m^2 ;

——外形因素: 1.0;

——区域中心: 顶部平台表面以上 1m。

水平使用负载风载不能组合。只考虑水平负载的最不利条件。

11.4.2.2.4 Additional loads

Loads resulting from an inclined position of 1%.

11.4.2.2.4 额外负载

倾斜 1%位置的负载结果。

11.4.2.3 Load case 2

The safety factor against overturning shall be $S \geq 1.3$.

11.4.2.3 负载情况 2

倾覆安全系数 $S \geq 1.3$ 。

11.4.2.3.1 Vertical loads

---- self weight.

11.4.2.3.1 垂直负载

——自重。

11.4.2.3.2 Horizontal loads

---- wind load 0.1 kN.m^2 on structure (see 8.2.2.2)

11.4.2.3.2 水平负载

——结构上的风载 0.1 kN.m^2 （参见 8.2.2.2）

11.4.2.3.3 Additional loads

Loads resulting from an inclined position of 1%.

11.4.2.3.3 额外负载

倾斜 1%的位置的负载结果。

12 Tests

Being part of the structural design additional tests of a complete tower shall be made.

These tests shall be carried out in accordance with Annex A.

12 测试

完整工作台的部分机构设计需要额外测试。这些测试参照附录 A。

13 Assessment

13 评估

An assessment shall be carried out by a person or an organization different from the designing person and organization. On completion of a successful assessment a statement to that effect shall be given by the assessor. This statement shall identify the reference number of all examination and the tests report shall include:

---- identification of the particular set of components examined;

---- identification of the evaluated configuration;

---- structural data for components and connections as resistances and stiffnesses evaluated by tests.

人员或机构进行评估不同于计划人员和机构。成功评估的完成表明评估者要给出效果。这个声明需要鉴定所有检测和测试报告，包含：

——特殊组件测试的鉴定；

——评估结构的鉴定；

——评估测试组件结构数据和连接件抵抗力和钢度。

Annex B

附录 B

(informative)
(非格式化的)
National A-deviations
国家的差异

A-deviation: National deviation due to regulations, the alteration of which is for time being outside the competence of the CEN member.

A- deviation: 根据规章国家的差异，变化超出了 CEN 的能力。

This document does not fall under the Directive of the EC. In the relevant CEN countries these A-deviation are valid instead of the provisions of the document until they have been removed.

这个文件不在 EC 指令之下。相关 CEN 国家，这个 A-deviation 是有效的，可以代替文件的规定直到他们被取消。

Austrian national legislative deviation
奥地利国家立法机构的差异

According to § 8(1) – Guardrails, of Bauarbeiterschutzeroordnung (BauV) 1994, in the version of Bundesgesetzblatt 313/20002 shall be observed:

Principle guardrails shall be fixed so that its top surface is at minimum height 1.00m above from the adjacent level of the working area everywhere. This requirement refers to 7.4.2 of this document.

Bibliography

- [1] EN 39, Loose steel tubes for tube and coupler scaffolds – Technical delivery conditions
- [2] EN 1993-2, Eurocode 3: Design of steel structures – Part 2: Steel bridges
- [3] EN 10240, Internal and/or external protective coating for steel tubes – Specification for hot dip galvanized coatings applied in automatic plants
- [4] EN 12810-1, Façade scaffolds made of prefabricated components- Part1: Product specifications

中文翻译，仅供参考，如有疑义，以英文原文为准。