International Standard 4463

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Measurement methods for building — Setting out and measurement — Permissible measuring deviations

Méthodes de mesurage pour la construction — Piquetage et mesurage — Écarts de mesurage admissibles

First edition — 1979-12-15

UDC 69 : 72.011 : 531.7.08 **Ref. No. ISO 4463-1979 (E)**

Descriptors : construction, buildings, measurement, dimensional measurement, dimensional tolerances.

Price based on 14 pages

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4463 was developed by Technical Committee ISO/TC 59, *Building construction*, and was circulated to the member bodies in February 1977.

It has been approved by the member bodies of the following countries :

Australia	Ireland	Romania
Denmark	Israel	South Africa, Rep. of
Finland	Korea, Rep. of	Spain
France	Mexico	Sweden
Germany, F. R.	Netherlands	Turkey
Hungary	Norway	United Kingdom
Iran	Poland	Yugoslavia

The member body of the following country expressed disapproval of the document on technical grounds :

Belgium

Printed in Switzerland

Contents

		Page
0	Introduction	1
1	Scope	1
2	Field of application	1
3	Reference	1
4	Definitions	1
5	General	2
6	Establishment of primary points	7
6.1	Introduction	7
6.2	Primary system	7
6.3	Connection to existing systems	7
6.4	Permissible deviations of the position of a primary point	7
6.5	Marking	7
6.6	Measurements	7
6.7	Check measurements	7
6.8	Errors	8
7	Setting out of secondary points	8
7.1	Introduction	8
7.2	Secondary system	8
7.3	Permissible deviations of the position of a secondary point	8
7.4	Measurements	8
7.5	Check measurements	8
8	Setting out of position points	9
8.1	Introduction	9
8.2	Permissible deviations of a position point	9
8.3	Setting out	9

8.4 Measurements 9

8.5 Check measurements 9

9 Grids 9

10 *Vertical transfer of main points (secondary reference points) to other levels — Verticality deviation (plumbline deviation)* 12

10.1 Introduction 12

10.2 Permissible deviation of the position of a transferred point 12

10.3 Plumbing 12

10.4 Marking 12

10.5 Check measurements 12

10.6 Safety 12

11 Levelling of primary and secondary bench marks and position levels 12

11.1 Introduction 12

11.2 Permissible deviations of the difference in level 12

11.3 Setting out, levelling and check levelling 13

Bibliography 14

Measurement methods for building — Setting out and measurement — Permissible measuring deviations

0 Introduction

This International Standard forms one of a series concerning measurement methods for building, and can be regarded as a frame for further reference standards for all setting out work. The other documents of this series are currently under preparation.

1 Scope

This International Standard deals with the different stages of the setting out work, i.e. the measuring of the primary framework (traverses, grids, etc.) on the site, the setting out of reference lines (baselines), the transfer (plumbing up) of reference lines to other floors, the setting out of position points and the levelling procedure for these different stages.

It gives values for permissible deviations when measuring and setting out and recommends certain procedures and instruments to be used.

Guidance is given on how inaccuracies can be controlled during the setting out process when using instruments and methods which are currently in common use in building construction.

2 Field of application

This International Standard applies to all usual types of building construction. Specialist operations such as the setting out of precision machinery require individual treatment.

3 Reference

ISO 1803, *Tolerances for building — Vocabulary.* [1)]

4 Definitions

For the purpose of this International Standard, the following definitions apply.

4.1 primary point : Point which has been established by measurement. Primary points are referred to the national, municipal or other agreed reference systems and constitute the reference points for setting out the secondary points. These may have been adjusted locally.

4.2 secondary point : Point which, on its own or in combination to form lines, constitutes a reference point for the setting out of position points. A structural grid may be constituted from a system of secondary points.

4.3 position point : Point which marks the position of a certain detail of a building.

4.4 grid : Two sets of parallel horizontal lines which are at right angles to each other.

4.5 primary bench mark : Bench mark which has been established by levelling. Primary bench marks are referred to the national, municipal or other agreed reference systems and constitute the reference levels for the establishment of secondary bench marks. These may have been adjusted locally.

4.6 secondary bench mark : Transferred bench mark established by levelling, which constitutes the reference level for setting out the position levels.

4.7 position level : Point which marks the level of a certain detail of a building.

4.8 check measurement : Independent measurement to check the correctness and accuracy of a previous measurement.

1) At present under revision.

4.9 anblock method : Adjustment method by which adjacent local systems of measuring points, for example those determined by the polar measuring method from a number of instrument stations, are connected together in one co-ordinate system (a block).

NOTE — This method allows the number of necessary instrument stations to be reduced (compare figures 4 and 5).

4.10 discrepancy : Difference between the measured and calculated values of points with given co-ordinates (for example between the points 10 and 320 in figures 4 and 5).

4.11 deviation : [See definition in ISO 1803].

The deviations in this International Standard refer to the difference between the determined values of the distance, angles and levels and their given or calculated values (see figure 1).

4.12 permissible deviation (E) : Specified limit of deviation.

In this International Standard, the permissible deviations for given or calculated distances, angles and levels (vertical distances) are specified. It is assumed that permissible deviations are both positive and negative and of equal numerical value (see figure 2).

4.13 tolerance : [See definition in ISO 1803].

5 General

The setting out of buildings may be compared with the procedure for measuring topographic details for general mapping purposes.

The purpose of setting out is to indicate the position of proposed features. This may be contrasted with the purpose of land surveying which is to determine the position of existing features (topography or cadastral surveying). Such a survey is based on a number of previous measuring operations according to a general procedure.

Starting from first order triangulation points, the point to be located is usually reached after a long series of measuring operations (secondary and other lower order triangulation nets, polygons, etc.).

As all these measuring operations are subject to inaccuracies, the accuracy of the determined position of a certain point generally decreases in proportion to the number of operations according to the law of propagation of errors (see figure 3). For all measuring work, it is therefore very important to keep the number of operations as small as possible.

For general topographic or cadastral surveys (see figure 3), the accuracies obtained (mean standard errors between 5 mm and 30 mm) are usually sufficient, but they cannot be accepted for most technical work, for example, precision setting out and deformation measurements.

When setting out buildings, the accuracy requirements have to be related to internal accuracies (i.e. between points A, B, C and D in figures 3 and 4). The accuracy of setting out within a building is more critical than the accuracy of the location of a point, for example, in the national co-ordinate system.

Using different polygons for the setting out of the main points of a building (corner points or base lines as in figure 3) can lead to inaccuracies between the main points. This is because these polygons are often part of a measuring series with different grades of accuracy.

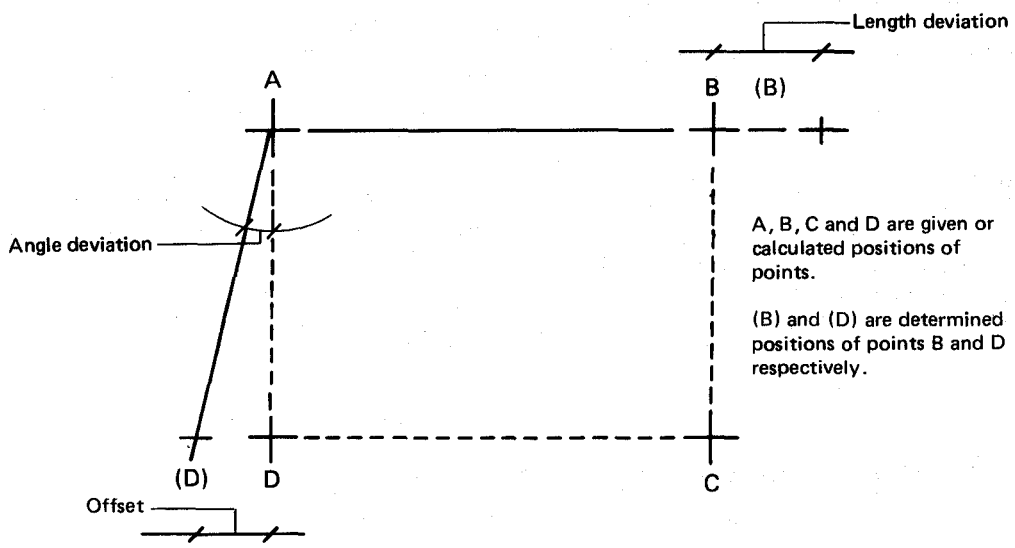


Figure 1 — Internal accuracies of setting out are checked by measuring angles and lengths

INTERNATIONAL STANDARD ISO 4463-1979 (E)/ERRATUM

Published 1981-12-15

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Measurement methods for building — Setting out and measurement — Permissible measuring deviations

ERRATUM

Replace the Erratum published on 1980-09-15 by the following :

Page 2

Figure 1, position (B) at the top right of the figure : the indication (B) at position B must be re-positioned approximately 7 mm to the right exactly above the cross situated at the extreme right of point B.

Page 7

Sub-clause 6.4.1, seventh line : replace the permissible deviation of the angles "± 0,004 5" by "± 0,045".

Page 9

Sub-clause 8.2, line 8 : "± 0,067 5/$\sqrt{L}$ degree" should read "± 0,067 $K/\sqrt{L}$ degree".

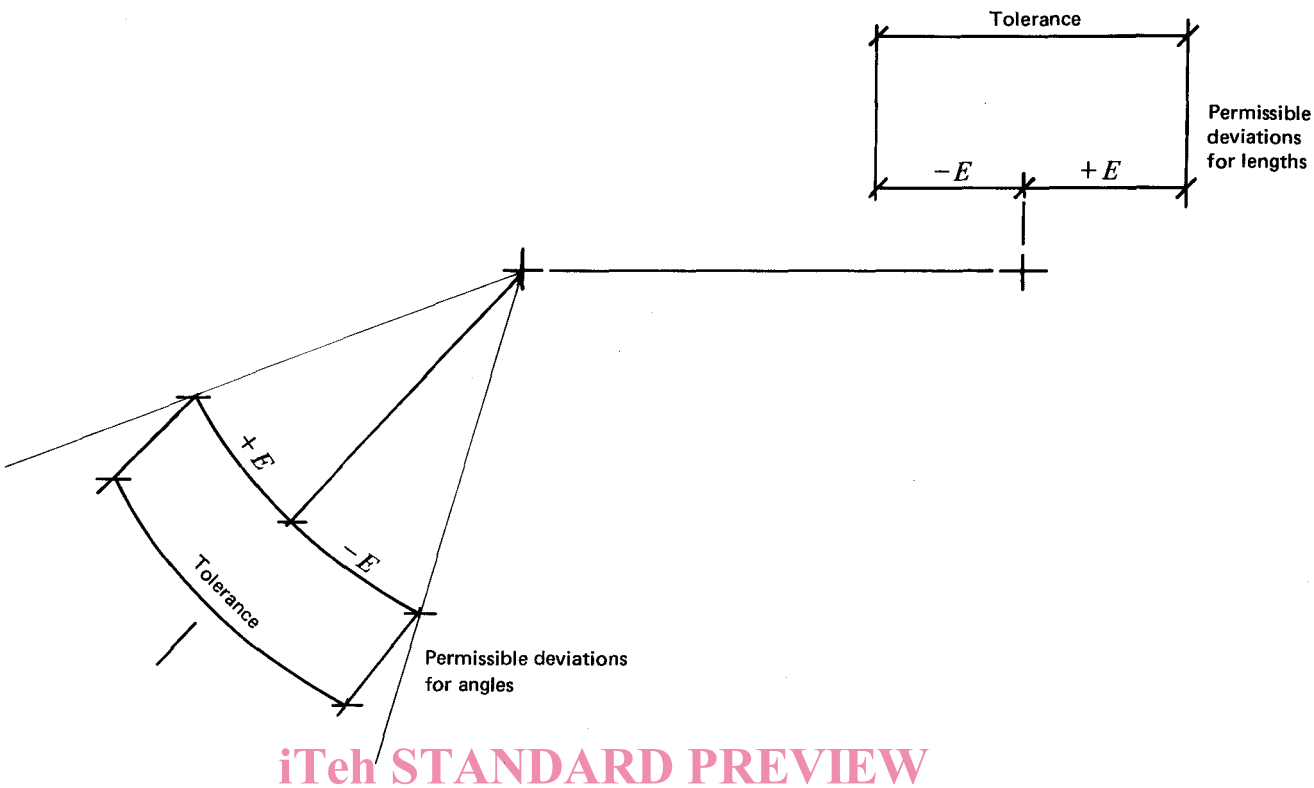


Figure 2 — The permissible deviations express the accuracy requirements as shown

Corner and base line points must be set out so as to limit inaccuracies. It is from these that the building elements and components, such as walls and columns, are located. If this is disregarded, serious practical problems are likely to arise during the erection of the building. For example, windows or other components may not fit between columns.

It is essential therefore that the setting out is carefully controlled throughout.

The setting out process can be controlled by dividing it into four stages. Figure 4 gives an example of the general principles.

Most setting out begins at one or more points in the national, municipal or other agreed co-ordinate system. For large projects, it is often necessary to set up a local traverse or a network of triangles containing primary points. From these primary points, the secondary points (points on base lines) can be established by means of intersection, resection, polar method, etc. Finally, the locations of columns, walls, etc. (position points) are determined from the secondary system.

Setting out small projects will usually commence with the secondary system or even position points. This can also be the case when the setting out has to be related to grids on the building site (see clause 9).

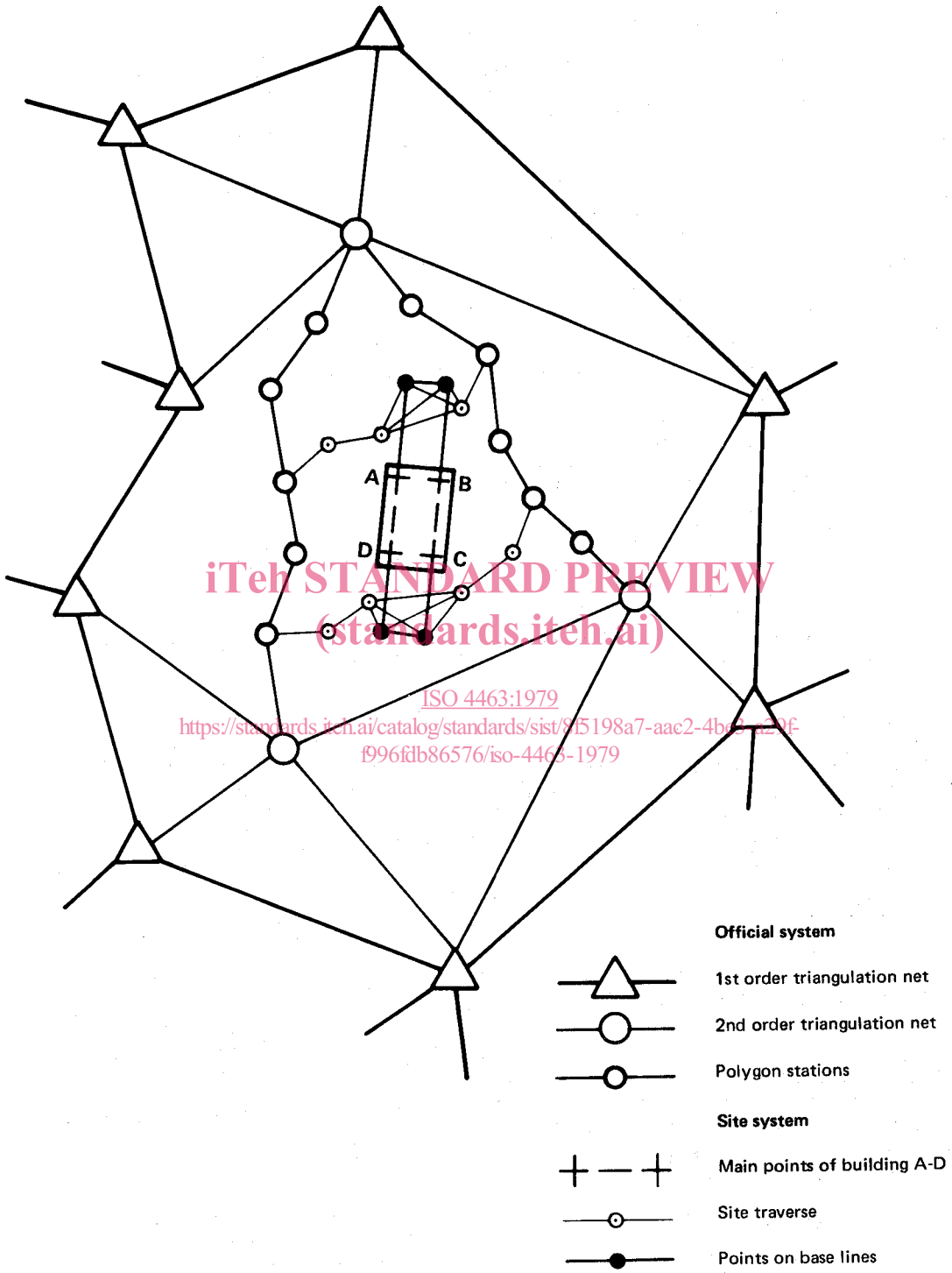
As emphasised above, the accuracy of setting out should not be influenced by discrepancies in the surrounding official reference points. It may therefore be necessary to make the adjustment of the measuring values within the primary system, i.e. as a free net, and not in relation to the points of the surrounding official reference system. In such cases, primary systems are only connected to the national, municipal or other agreed co-ordinate system.

This International Standard also gives guidance on this aspect of setting out and recommends that the establishment of primary systems should be entrusted to personnel with relevant professional qualifications, as the accuracy of primary points depends not only on the accuracy of the measuring operations but also on the configuration of the primary system. For the setting out of the secondary and lower order systems, an engineer or surveyor with detailed knowledge of building survey techniques should be engaged. The setting out of position points can usually be carried out by a foreman on the site.

Generally the connection of primary systems to the official co-ordinate system has to be carried out in consultation with the survey department of the local authority.

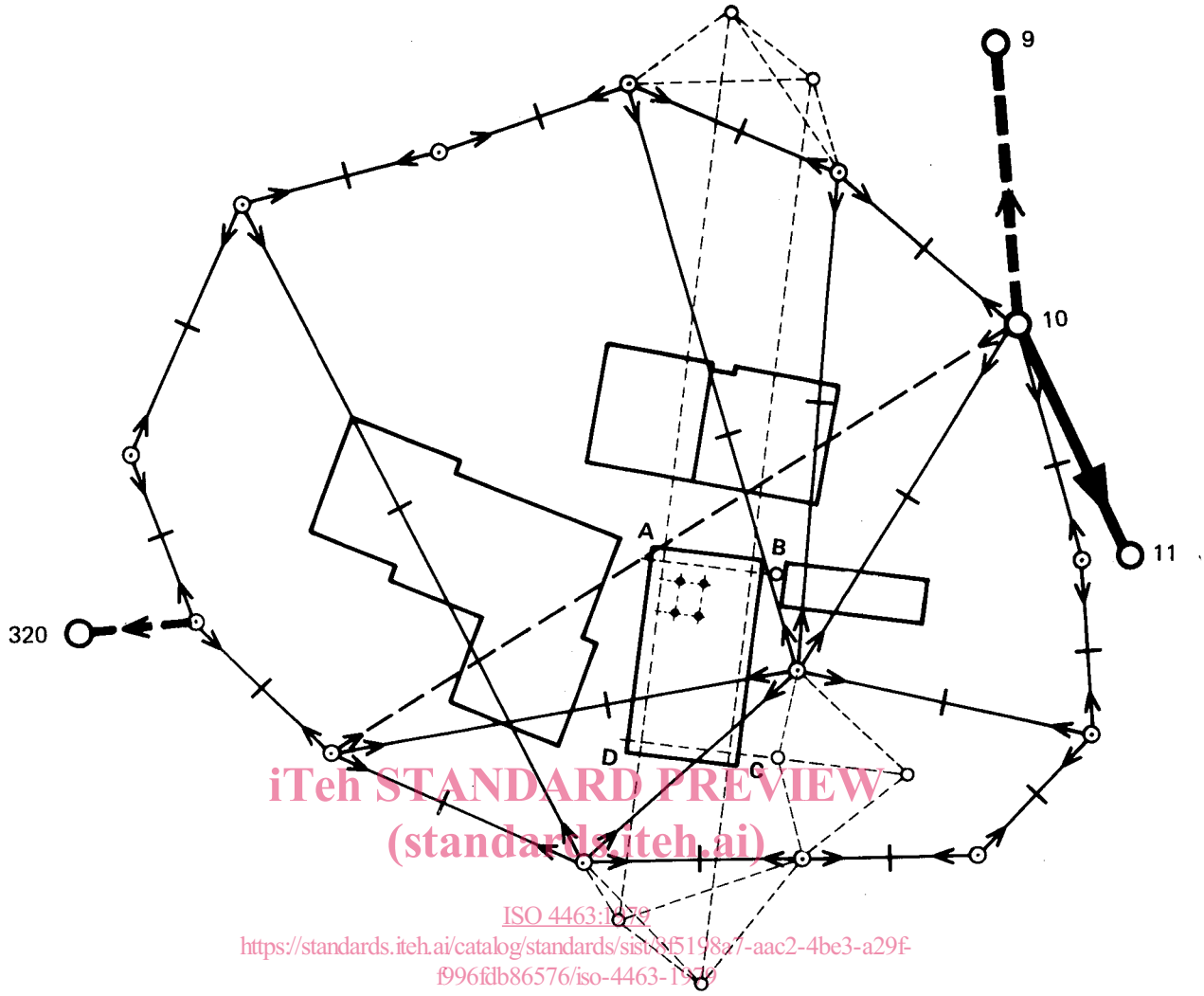
The accuracy requirements in this International Standard are expressed by permissible deviations (E)[1] for lengths, angles and levels, obtained as a result of measuring operations (see figure 2).

1) This International Standard does not deal with a priori investigations of the accuracies when designing measuring procedures, for example the configuration of the primary system. However, it recommends that for such investigations the relationship between permissible deviations (E) and relative mean standard errors (S), i.e. the internal accuracy between points, be expressed by the formula $E = \pm 2{,}5\,S$.



NOTE — This procedure is not recommended (see 6.2).

Figure 3 — Example of setting out related to different reference points in the surrounding official co-ordinate system



A free net. Co-ordinates of the primary points are determined from a network of traverses.

Reference point of the national, municipal or other agreed system

Reference point of the primary system

10 — 11 Reference direction

Direction measurement

10 Reference point

Length measurement

Position check, not to be used in the adjustment

Reference point of the secondary system (baselines to be set out from the primary system)

A — B
D — C Main points of building (part of the secondary system)

Position points (for example centre lines for columns)

NOTE — This free net is connected to the official co-ordinate system by one reference point (10) and one reference direction (10-11). This implies that the accuracies of the main points are not influenced by existing inaccuracies of the points in the national, municipal or other agreed reference system.

Figure 4 — Example of setting out related to a free net