SLOVENSKI STANDARD
SIST-TP CWA 18046:2024

01-julij-2024

Oznake položaja za digitalne aplikacije na gradbiščih, strukturni nadzor in BIM-aplikacije

Position markers for digital applications on construction sites, structural monitoring and BIM-applications

Positionsmarkierungen für digitale Anwendungen auf Baustellen, für Strukturmonitoring und BIM-Anwendungen

Marqueurs de position pour les applications numériques sur les chantiers, pour la surveillance structurelle et les applications BIM

Ta slovenski standard je istoveten z: **CWA 18046:2023**

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35.240.67	Uporabniške rešitve IT v gradbeništvu	IT applications in building and construction industry
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CEN

WORKSHOP

AGREEMENT

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English version

Position markers for digital applications on construction sites, structural monitoring and BIM-applications

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties, the constitution of which is indicated in the foreword of this Workshop Agreement.

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Contents

Page

European foreword

This CEN Workshop Agreement has been developed in accordance with the CEN-CENELEC Guide 29 "CEN/CENELEC Workshop Agreements — A rapid prototyping to standardization" and with the relevant provisions of CEN/CENELEC Internal Regulations — Part 2. It was approved by a Workshop of representatives of interested parties on 2023-11-07, the constitution of which was supported by CEN following the public call for participation made on 2023-01-18. However, this CEN Workshop Agreement does not necessarily include all relevant stakeholders.

The final text of this CEN Workshop Agreement was provided to CEN for publication on 2023-11-28.

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Introduction

The digitalization of the construction industry has brought numerous new digital technologies onto construction sites and existing infrastructure.

The spectrum ranges from digital measurement and quality control and the operation of robots and (partly) autonomous vehicles to visualization tasks using augmented and virtual reality systems (AR/VR). Each of these applications relies on precise geometric information about its own position and orientation. However, there are currently no common standards: these machines and applications use a wide variety of optical tags, some of which are proprietary, and all of them have their own data formats and processing strategies.

Precise position measurements on construction sites or in existing structures under monitoring are usually in the responsibility of surveyors. They create a network of control points (targets) whose positions are determined from the official survey points. These targets then serve as the basis for all further measurements. However, currently no standardized process has been available to make this geometry information available to other parties.

This workshop agreement aims to provide digital technologies with measured position data from surveys in a secure manner:

— by defining the properties of suitable position markers and showing example implementations

— by defining a flexible method with which any required tags can be attached at a defined distance to the marker in the course of the project

— by proposing an automated data transfer of the measurement data via «read-out tags»

— and allows to automatically provide/retrieve additional information, such as validity, accuracy of measurement, GUID of the associated BIM element or any other data relevant to the project.

The use of the defined position markers is advantageous:

— In the complexity of large construction sites, the many different trades and companies all use their own markers and tags without their content or information on their validity being accessible. The use of standardized markers avoids duplication and errors.

— Measuring and managing the survey data is in the hands of the commissioned surveyors or the BIM manager, so that the digital applications can work in the project coordinate reference system.

— The method described is ideally suited for use in BIM processes: It is recommended to store the position markers in a marker model in the BIM system. Authorized users can retrieve current, correct and uniform measurement data via the BIM system and password-protected “read-out tags”.

The position markers and their usage were originally developed and tested as part of the BIMprove project of the Horizon funding programme (No 958450). This document was commonly created by surveyors, drone scientists, VR specialists, BIM managers and BIM software specialists.

For the future revision of the CWA the authors are grateful for feedback on practical implementation and possible suggestions to marker@bimprove-h2020.eu.

1 Scope

This document is applicable to construction processes where the usual surveyor's control points are to be used not only for geometry control, but other applications such as laser scanning, localization of autonomous vehicles, photogrammetry, or VR/AR applications.

It provides a framework for making accurate survey point information available to digital applications and other trades. This includes the layout of markers, a naming convention for markers and a common digital interface for the read-out-data of markers.

The document builds on existing standards and conventions and collates them where applicable.

The document is intended to be used on construction sites and in existing buildings by planners (architects, civil engineers,…), surveyors, construction companies, software providers, UXV operators, BIM stakeholders, and on site machines/devices/systems.

The survey point information may be utilised not only during the construction but also during maintenance throughout the life of the facility.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 21778:2017, *Information technology — The JSON data interchange syntax*

ISO 19162, *Geographic information — Well-known text representation of coordinate reference systems*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1
marker
physical mark attached to a building or object with known spatial position, carrying a unique marker ID number and allowing for defined later positioning of human- and/or machine-readable tags

Note 1 to entry: The main purpose of the marker is to establish a unique relationship between its ID number and its spatial position. Both information will usually be provided in machine-readable way by a tag, placed in the proximity of the marker. Further tags can be placed next to the marker, such that their spatial position is defined.

3.2
survey targets
targets
crosshairs of varying types that are attached to buildings or objects

Note 1 to entry: The spatial position of their centre is measured by surveyors, i.e. with theodolites.

3.3
tag
human- or machine-readable mark, or digital identity used to communicate information about an entity

Note 1 to entry: A tag can contain information that can be read by sensors to aid in identification of the physical entity.

[SOURCE: ISO/IEC 20924:2021, 3.1.33]

3.4
fiducial tag
machine-readable mark, or digital identity used to determine the spatial position of a machine or device, i.e. augmented reality equipment or autonomous vehicles

3.5
building information modelling
BIM
use of a shared digital representation of a built object (including buildings, bridges, roads, process plants, etc.) to facilitate design, construction and operation processes to form a reliable basis for decisions

[SOURCE: ISO 29481-1:2016(en) 3.2, modified — Note 1 to entry has been deleted.]

3.6
BIM collaboration format
BCF
format that allows different BIM applications to communicate model-based issues with each other by leveraging IFC models that have been previously shared among project collaborators

[SOURCE: https://technical.buildingsmart.org/standards/bcf/]

3.7
project coordinate system
PCS
topocentric coordinate reference system of a facility or asset to which the project coordinates are referenced

Note 1 to entry: mandatory CRS that is always a three dimensional local Cartesian CRS [XYZ] specific to the asset or project (BIM coordinate system).

Note 2 to entry: In BIM context the term 'coordinate system' is often found in place of 'coordinate reference system'. These are different concepts: a coordinate system is a component of a coordinate reference system; to be unambiguous coordinates must be referenced to a coordinate reference system.

3.8
spatial coordinate reference system
SRS
national or international coordinate reference system to which a project is referenced or to which a site-specific coordinate reference system may be related

Note 1 to entry: The usage is optional.

Note 2 to entry: Not to be confused with a spatial reference system (ISO 19112:2003, 4.6) which could be a postcode or a street name.

Note 3 to entry: In colloquial usage the term 'coordinate system' is often found in place of 'coordinate reference system'. These are different concepts: a coordinate system is a component of a coordinate reference system; to be unambiguous coordinates must be referenced to a coordinate reference system.

4 Marker

4.1 Functionality

A marker is comprised of

a) two conventional survey targets at a defined distance.

NOTE It is assumed that the marker will only be mounted to sufficiently accurate vertical or horizontal components. Alternatively, a third survey target can be attached to the marker (important for the normal vector, see chapter 4.6 and Table 2).

b) a grid of crosses with defined spacing

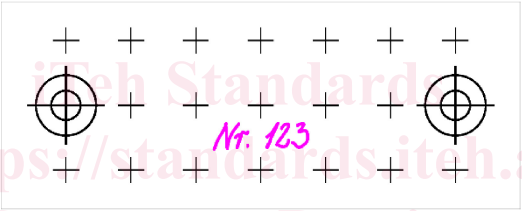
c) a human-readable marker ID number and

d) optional: a human- or machine-readable tag for data read-out (recommended)

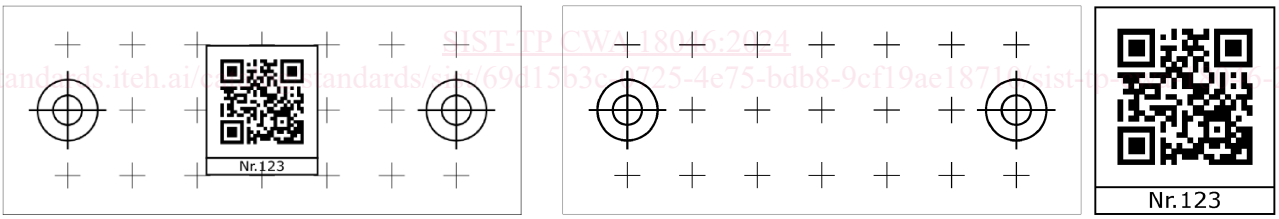
e) optional: further tags for applications

4.1.1 Examples

Examples of markers are given in Figure 1.



a) Marker with human-readable marker ID number



b) Markers with human-readable marker ID number and machine-readable tag for data read-out

Figure 1 — Examples for markers

4.2 Size and Layout

The size of the marker is defined by the distance between the survey targets.

4.2.1 Size

The marker size for general application is 150 mm.

If other sizes are required for markers to be read from very small or very large distances, the standard sizes as described in Table 1 should be applied:

Table 1 — Marker size

Marker size[a]	Distance between survey targets [mm]	Remarks
1	50	
2	100	
3	**150**	**Recommended for general application**
4	200	
5	400	
6	800	
NOTE Other sizes may be used, if beneficial for the project.		
[a] The marker size selected for the project, should be sufficient to be used with the tags of several envisaged users during project time.		

4.2.1.1 Use of markers of different size in same project

The use of markers of different size in the same project should be avoided.

If markers of different sizes are used in the same project,

— the number of different sizes should be minimised

— the numbering system might be adopted to different sizes

4.2.2 Survey targets

No special requirements. Survey targets can be of any commonly used design. They may be reflective or not. Objects like measuring bolts may also be used as targets, if the marker position can be accurately determined.

Although not recommended targets of different types may be combined in one marker, if required.

4.2.2.1 Examples of survey targets

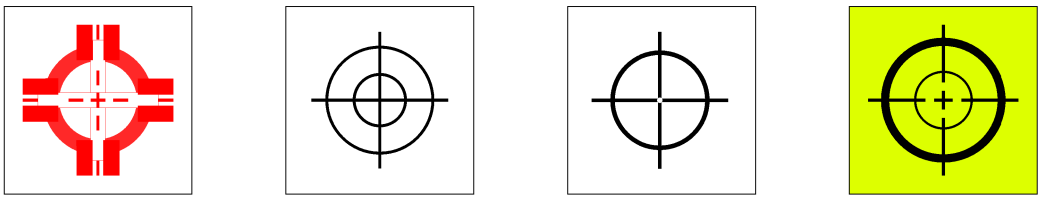


Figure 2 — Examples of survey targets

4.2.3 Grid

A grid of crosses with a horizontal and vertical distance of 25 mm shall be placed on the marker.

The central row as well as the first and last columns of crosses align with the survey targets. There shall be at least 1 row, the use of 3 rows is recommended.