

**CEN/WS CSBIM**

Date: 2023-07

**prCWA XXXXX:2023**

Secretariat: DIN

**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**

CCMC will prepare and attach the official title page.

This CEN and CENELEC Workshop Agreement is an agreement, developed and approved by an open independent workshop structure within the framework of the CEN-CENELEC system.

This CEN and CENELEC Workshop Agreement reflects the agreement of the registered participants responsible for its content, who decided to develop this document in accordance with the specific rules and practices available in CEN-CENELEC for the development and approval of CEN/CENELEC Workshop Agreements.

This CEN and CENELEC Workshop Agreement can in no way be held as being a European Standard (EN) developed by CEN and CENELEC, as it does not represent the wider level of consensus and transparency required for a European Standard (EN). Furthermore, it is not intended to support legislative requirements or to meet market needs where significant health and safety issues are to be addressed. For this reason, CEN and CENELEC cannot be held accountable for the technical content of this CEN and CENELEC Workshop Agreement, including in all cases of claims of compliance or conflict with standards or legislation.

The Workshop parties who drafted and approved this CEN and CENELEC Workshop Agreement, the names of which are indicated in the Foreword of this document, intend to offer market players a flexible and timely tool for achieving a technical agreement where there is no prevailing desire or support for a European Standard (EN) to be developed.

**The copyright of this document is owned by CEN and CENELEC, and copy of it is publicly available as a reference document from the national standards bodies of the following countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.**

<b>Contents</b>	<b>Page</b>
Foreword.....	4
Introduction.....	5
1 Scope .....	6
2 Normative references .....	6
3 Terms and definitions.....	6
4 Marker .....	7
4.1 Functionality .....	7
4.2 Size and Layout.....	8
4.3 Marker ID number.....	9
4.4 Tags for data read-out.....	10
4.5 Fiducial tags for machine applications .....	10
4.6 Handling and application.....	10
5 Tags for data read-out.....	10
5.1 Functionality .....	10
5.2 Content .....	11
5.3 Layout and size .....	13
5.4 Naming convention .....	13
5.5 Handling and application.....	13
5.6 How to set up the URL .....	13
6 Fiducial tags.....	13
6.1 Functionality .....	13
6.2 Content .....	14
6.3 Layout and size .....	14
6.4 Naming convention .....	14
6.5 Handling and application.....	14
7 Workflow .....	14
7.1 Introduction .....	14
7.2 Workflow scheme .....	15
Annex A (informative) Example of implementation on European pilot construction sites .	17
A.1 Use on construction sites .....	17
A.2 Markers .....	17
A.3 Use with different (fiducial) tags .....	19
A.4 Read-out data of QRcode.....	19
A.5 Example of folder location in project .....	23
Annex B (informative) Cybersecurity.....	24

## Foreword

This draft CEN and CENELEC 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 2023-07-17, the constitution of which was supported by CEN and CENELEC following the public call for participation made on 2023-01-18. However, this CEN and CENELEC Workshop Agreement does not necessarily include all relevant stakeholders.

The final text of this draft CEN and CENELEC Workshop Agreement was provided to CEN and CENELEC for publication on 2023-07-17.

Results incorporated in this draft CWA received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 958450 (BIMprove).

The following organizations and individuals developed and approved this draft CEN and CENELEC Workshop Agreement:

- Zurich University of Applied Sciences (Ruprecht Altenburger, Antje Sydow)
- AFGruppen AS (Øyvind Kjøllesdal)
- Catenda AS (Dag Fjeld Edvardsen, Torvald Andresen)
- DigitalTwin Technology GmbH (Rahul Tomar, Rehan Khan)
- Fraunhofer Gesellschaft IAO (Matthias Aust)
- HRS Real Estate AG (Antonio Lopez-Rios, Mehdi Mdidech)
- RWTH Aachen University (Jörg Blankenbach)
- SINTEF Manufacturing (Gabor Sziebig)
- Vías y Construcciones, S.A. (Manuel Menéndez Muñiz)

Attention is drawn to the possibility that some elements of this document may be subject to patent rights. CEN-CENELEC policy on patent rights is described in CEN-CENELEC Guide 8 “Guidelines for Implementation of the Common IPR Policy on Patent”. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

Although the Workshop parties have made every effort to ensure the reliability and accuracy of technical and non-technical descriptions, the Workshop is not able to guarantee, explicitly or implicitly, the correctness of this document. Anyone who applies this draft CEN and CENELEC Workshop Agreement shall be aware that neither the Workshop, nor CEN and CENELEC, can be held liable for damages or losses of any kind whatsoever. The use of this draft CEN and CENELEC Workshop Agreement does not relieve users of their responsibility for their own actions, and they apply this document at their own risk. The draft CEN and CENELEC Workshop Agreement should not be construed as legal advice authoritatively endorsed by CEN/CENELEC.

## 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 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 [christian.grunewald@din.de](mailto:christian.grunewald@din.de).

## 1 Scope

This CWA 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 CWA builds on existing standards and conventions and collates them where applicable.

The CWA 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.

## 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 *Information technology — The JSON data interchange syntax*

## 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 target target**

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 20924:2018, 3.1.31]

### 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]

### 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**

### 3.7

#### **spatial reference system**

##### **SRS**

system for identifying position in the real world

[SOURCE: ISO 19112:2003, 4.6]

## **4 Marker**

### **4.1 Functionality**

A marker is comprised of

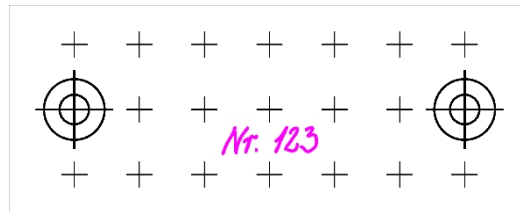
- a) two conventional survey targets at a defined distance.

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

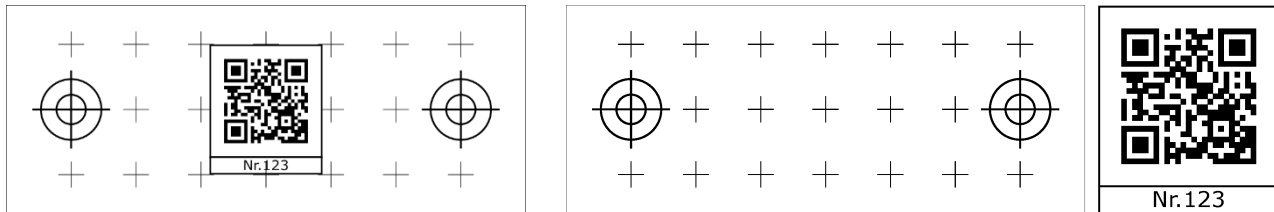
- b) a grid of crosses with defined spacing
- c) a human-readable marker ID number and
- d) optional: a human- or machine-readable tag for data read-out (recommended)
- e) optional: further tags for applications

### 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 <sup>a</sup>	Distance between survey targets [mm]	Remarks
1	50	
2	100	
<b>3</b>	<b>150</b>	<b>Recommended for general application</b>
4	200	
5	400	
6	800	
NOTE Other sizes may be used, if beneficial for the project.		
<sup>a</sup> 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.

##### 4.2.2.1 Examples of survey targets

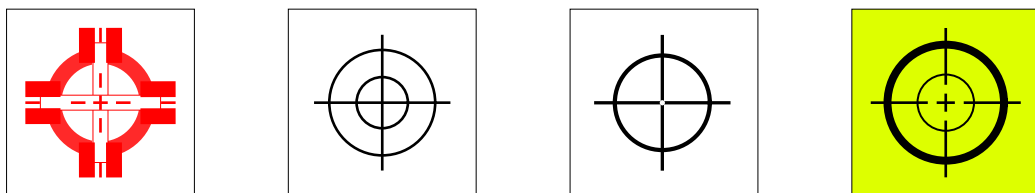


Figure 2 — Examples of survey targets

#### 4.2.3 Grid

A grid of crosses with a horizontal and vertical distance of 25mm 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.

#### 4.3 Marker ID number

Each marker in project shall be given a unique marker ID number. The number shall be positive and visible in a human-readable way.

#### 4.4 Tags for data read-out

The placement of a tag providing further information about the marker in a machine-readable format is strongly recommended. This may be via a URL as in an information link. (see Clause 5)

#### 4.5 Fiducial tags for machine applications

Fiducial tags may be positioned onto the marker grid as required in the project. (see Clause 6)

#### 4.6 Handling and application

If the marker is placed on vertical elements, it should be applied such that its orientation is roughly horizontal.

If the marker is placed on non-vertical elements, a marker with three targets shall be used. (see Figure 3)

Placement of markers on irregular elements (e.g. circular columns or free form structures), that are not plane or cannot be classified as either vertical or horizontal, shall be avoided.

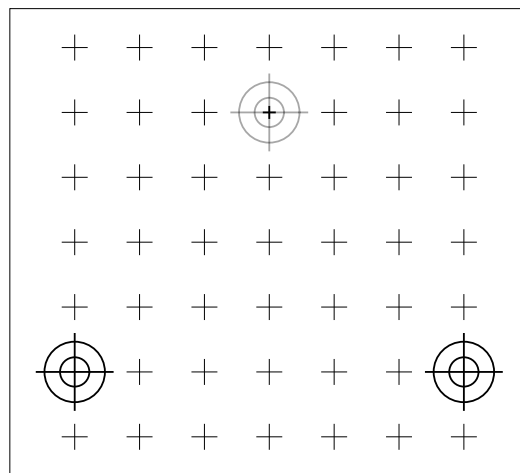


Figure 3 — Example for markers for exceptional circumstances, e.g. on non-vertical elements

### 5 Tags for data read-out

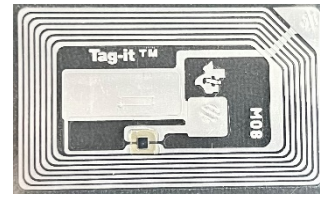
#### 5.1 Functionality

Tags for data-read-out either contain additional information about their marker themselves or provide a link to machine readable further information. The additional information is then stored in the marker database, accessible with a standard HTTP request to the URL, readable by NFC or other machine-reading process.

### 5.1.1 Examples



a) QRcode containing a link to read out data



b) RFID tag giving read-out data

**Figure 4 — Examples of machine-readable tags for data read-out**

The example QRcode in Figure 4a) directs to: <https://example.com/m/1/123> with the following components:

example.com	is the website
m	is the part containing the marker databases
1	is the project/site specific ID
123	is the marker ID

### 5.2 Content

The requirements on the information contained in the tags is described in Table 2.

The first 6 data fields are prescribed. Depending on the projects requirements, different pieces of information may be added. The data is represented as JSON objects (ISO/IEC 21778:2017). Coordinate and accuracy triplets are given as a standard JSON list of three floats where values correspond in the order described in the remarks. I.e. a position of the left target measured at  $x=1$ ,  $y=2$  and  $z=3$  may be represented in the data as  $l_{xyz}=[1.0,2.0,3.0]$ , and is added as any other field. On errors, e.g., requesting invalid data or the server timing out returns a status message stating the cause.

An example file can be found in Annex A.

**Table 2 — Content of tags for data read-out**

Content	Common name	Need	Remarks
version	version	mandatory	Shall be "0.1.0" when using this version of this document.
marker number	marker_nr	mandatory	Corresponds to ID number of markers in the current project (integer)
validity	valid	mandatory	true/false
coordinates of left target in the PCS <sup>a</sup>	$l_{xyz}$	mandatory	Describing the position (x,y,z)

Content	Common name	Need	Remarks
coordinates of right target in PCS <sup>a</sup>	r_xyz	mandatory	Describing the position (x,y,z)
EPSG Code of PCS	epsg	mandatory	Is always "1032"
Date of measurement	measured_date	recommended	yyyy-mm-dd (string)
Accuracy of left target coordinates	l_dx dy dz	recommended	(dx,dy,dz) Usually standard deviation from surveying
Accuracy of right target coordinates	r_dx dy dz	recommended	(dx,dy,dz) Usually standard deviation from surveying
BCF <sup>b</sup> issue guid	issue_id	optional	Corresponds to an issue with additional information.
SRS <sup>c</sup> coordinates of left target	l_srs_xyz	optional	Describing SRS (x,y,z)
SRS coordinates of right target	r_srs_xyz	optional	Describing SRS (x,y,z)
EPSG Code of SRS	srs_epsg	optional	Defining the SRS used
Related fiducial tags <sup>d</sup>	related_tags	optional	List of Strings with identification for tags: {identifier}_{index}, e.g APR_01
marker normal vector	normal	optional	Describing normal (x,y,z)
coordinates of additional target in the PCS <sup>a</sup>	a_xyz	optional	Describing the position (x,y,z)
Accuracy of additional target coordinates	a_dx dy dz	optional	(dx,dy,dz) Usually standard deviation from surveying
Name of the project	Project_name	optional	
Contact Person	Contact_person	optional	Contact information like i.e. name and / or email-address, phone number
NOTE 1: Other variables may be defined in addition to the variables in Table 2 according to individual project needs.			

Content	Common name	Need	Remarks
NOTE 2: If additional targets are required as described in Clause 4.6 and Figure 3, the respective additional variables for its coordinates and accuracy shall be added.			
<p>a Project coordinate system</p> <p>b Defined in 3.6</p> <p>c In the geodetic domain, also the term coordinate reference system (CRS) is used</p> <p>d Described in Clause 6</p>			

### 5.3 Layout and size

No special requirements.

### 5.4 Naming convention

If the tags contain a human-readable number, it shall correspond to the marker ID number. Independent projects shall have different project indices.

### 5.5 Handling and application

Tags for data read-out shall be placed in the proximity of the marker.

### 5.6 How to set up the URL

The valid URLs are linked to a JSON file on the server on a project basis. For the end user, these are read-only. The specific file can be updated or added directly in the project folder on the backend. It is in the folder:

```
{project_folder}/scanner_data/markers.json
```

(See Annex A.5)

Each marker is represented in this file as

```
"marker_id": {"param1": "value1", "param2": "value2"}
```

The parameters and values are those found in the table.

## 6 Fiducial tags

### 6.1 Functionality

Fiducial tags are used for systems that rely on optical methods to process captured data or for deducing position and orientation of machines, such as:

- various (laser) scanning applications
- autonomous vehicles or robots identifying their own position and orientation in space
- Augmented Reality (AR) applications.

Usually black and white patterns of different types are used, that are printed and placed on real world objects. They usually code a non-negative integer in a black and white pattern. The pattern is machine-readable by optical processes, and the coordinates of the associated number read from a lookup table.

The checkerboard patterns used for scanning applications are fiducial tags, that do not contain alphanumeric information.

### 6.1.1 Examples

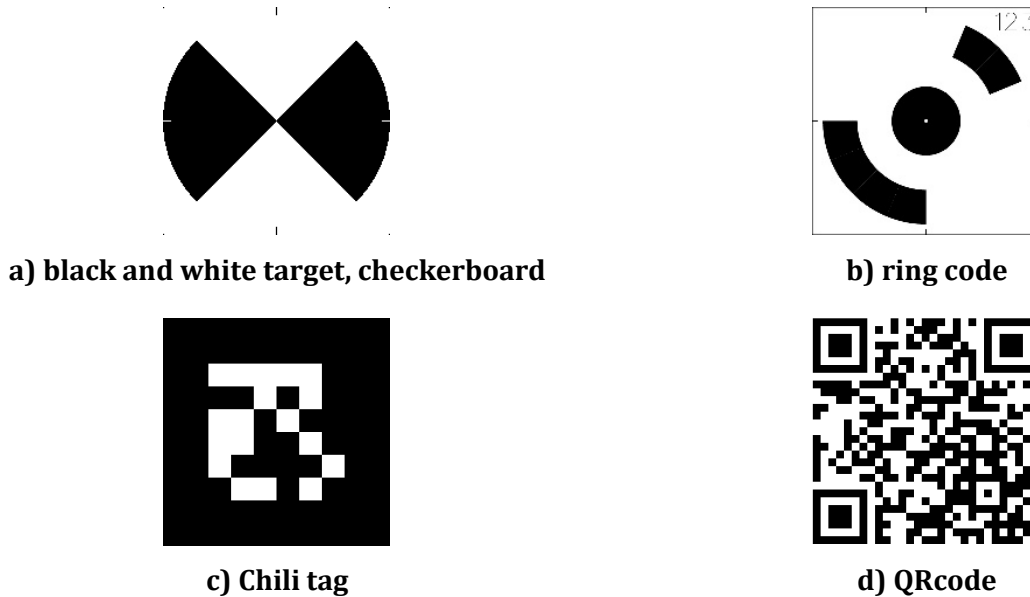


Figure 5 — Examples of fiducial tags

## 6.2 Content

No special requirements. The content, if any, may be determined by the machine application.

## 6.3 Layout and size

No special requirements. The appropriate size may be determined by the machine application.

## 6.4 Naming convention

If the fiducial tags code a number, the use of the same tag number as the marker ID number is strongly recommended.

## 6.5 Handling and application

Tags should be geometrically associated to the targets of the marker. The marker grid is intended to be used for precise positioning. Transformation calculations are in the responsibility of the user.

# 7 Workflow

## 7.1 Introduction

The coordinate frames of the project, surveying and geometric position information are important during planning, the construction and possibly even operation phase of a building.

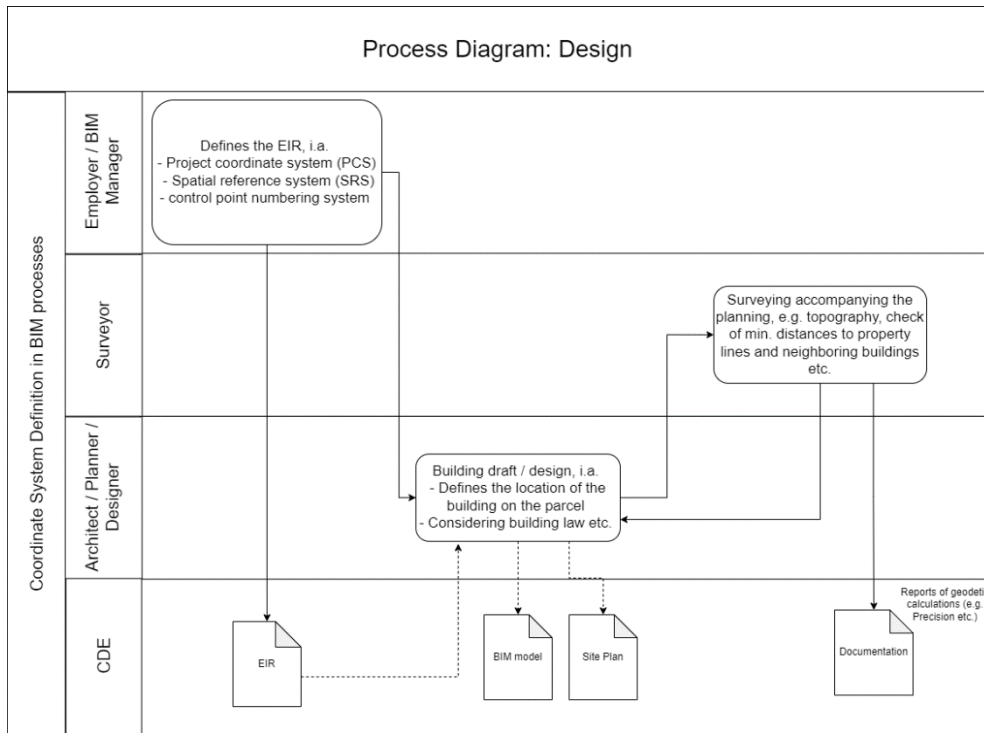
In the following the workflow for setting up this geometric framework of a (BIM-) construction project is outlined and a method for managing the markers within this framework is described.

## 7.2 Workflow scheme

Projects that use BIM, define the employer information requirements (EIR) which contains the project coordinate system (PCS) and spatial reference system (SRS).

For this process there shall be a common control point numbering system defined.

The first process diagram in Figure 6 concerns the design phase, when the project coordinate system and the position of the building on the site are defined.



**Figure 6 — Design Phase**

The second process diagram in Figure 7 addresses the realisation of the coordinate system on the construction site.

Key personnel with respect to markers are the technical manager/surveyor manager and the surveyor, who provide the markers as well as the related geometric information for the digital applications used on site.

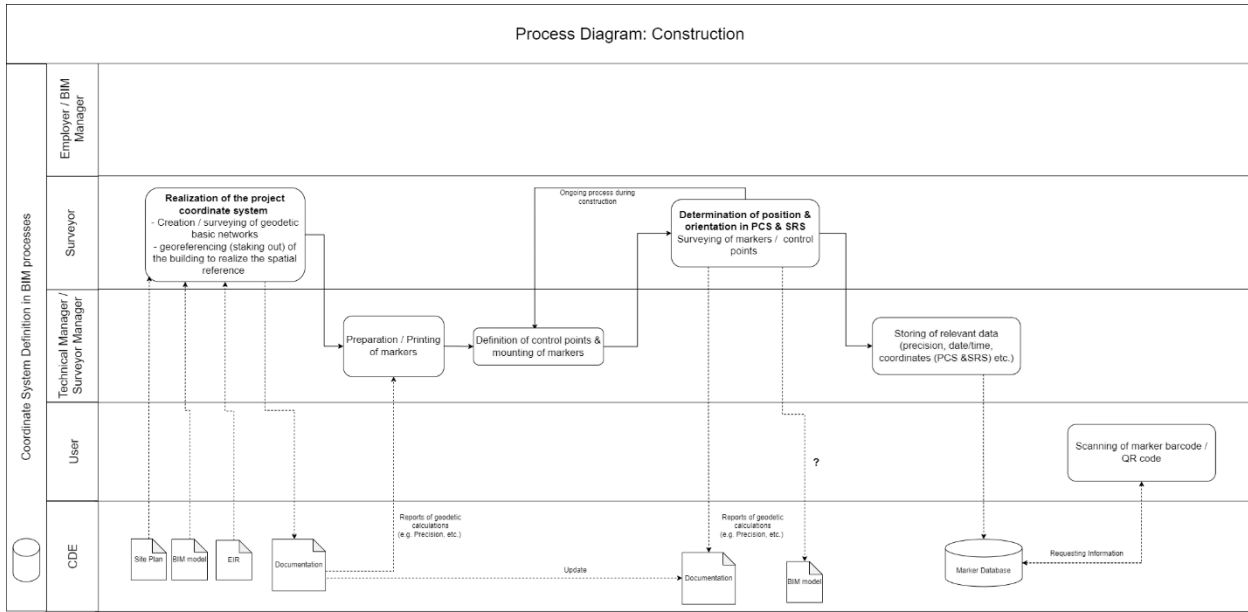


Figure 7 — Construction Phase



## Annex A (informative)

### Example of implementation on European pilot construction sites

#### A.1 Use on construction sites

The layout of markers and their use has been developed during the EU-supported research project **BIMprove** (grant agreement N° 958450) on three pilot construction sites. They are in Norway, Spain and Switzerland and thus allowed an overview on today's practice of the construction industry in Europe.

While the system was developed for use in the planning and construction phase, it will be similarly useful for monitoring of structures and maintenance or renovation.

##### A.1.1 Involved

Systems that were used in the project are listed in table A.1:

**Table A.1 — Examples of digital technologies used**

Application	Device	Purpose	Required tags
Augmented Reality (AR) system	Augmented Reality/Mixed Reality headset	Visualisation of planned versus current state	proprietary tags, customized tags
Autonomous robot	Ground-based wheeled vehicle	mobile laser scanning	April tags
Indoor UAV	Custom made research drone	mobile scanning (optical, infrared, depth)	Chili tags
Outdoor UAV	Commercial drone	mobile scanning (optical, infrared, depth)	Chili tags
Laserscanning	Various commercial scanners	Stationary laser scanning	black and white tags

##### A.1.2 Open data

An introduction to the markers is published together with sample files under:

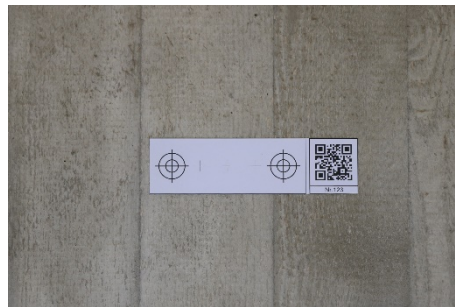
<https://www.bimprove-h2020.eu/marker>.

#### A.2 Markers

##### A.2.1 Placement of markers

Markers are produced in sizes fitting to project needs.

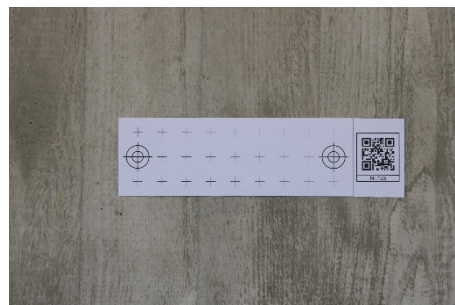
They are put physically onto vertical objects on site or inside the building by the technical manager/surveyor manager of the project. Preferably machine-readable read-out tags are provided and placed in the proximity of the marker.



**a) Example of small marker**



**b) Example of marker with recommended size of 150mm (distance between targets)**



**c) Example of larger marker,**

**Figure A.1 — Prepared markers, placed on structure**

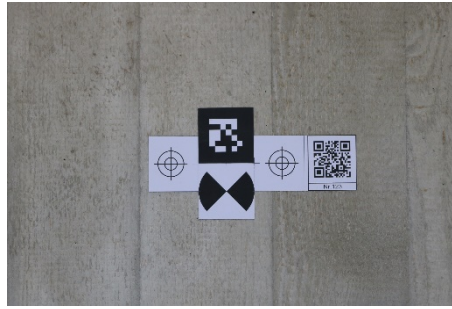
### **A.2.2 Surveying**

The surveyor measures the target positions of each marker and makes the data available in the project coordinate frame.

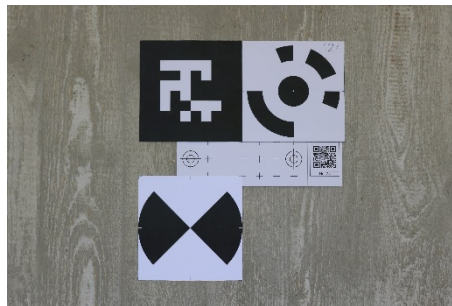
For BIM projects it is recommended to set up a Marker model and store all associated data there.

If read-out tags are provided, the information is transferred there. In this case the information is stored in a project database and send out via Internet by scanning a QRcode.

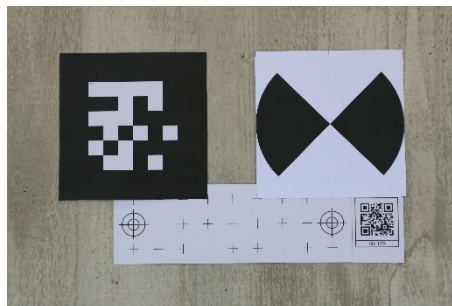
### A.3 Use with different (fiducial) tags



a) Example of small marker



b) Example of marker with recommended size of 150mm (distance between targets)



c) Example of larger marker

Figure A.2 — Markers with different tags for digital applications

### A.4 Read-out data of QRcode

The scope of read-out data is determined by the project needs. Here three examples are presented:

- minimal content
- the proposed standard content
- full set of information as in Table 2.

The functionality can be tested by scanning the printed example QRcodes.

#### A.4.1 Example of minimal read-out data



Figure A.3 —Read-out tag with minimal data; URL: <https://www.bimprove-h2020.eu/m/1/123>

The URL sends a .json file to the scanning device, containing the marker information as described in Table 2. This is then processed by the machine. In the simplest case it can be displayed on a smartphone:

```
{  
  "version": "0.1.0",  
  "marker_nr": 123,  
  "valid": true,  
  "l_xyz": [  
    310.208,  
    201.489,  
    97.363  
  ],  
  "r_xyz": [  
    310.051,  
    201.61,  
    97.364  
  ],  
  "epsg": "1032",  
}
```

#### A.4.2 Example of standard read-out data



Figure A.4 —Read-out tag with standard data; URL: <https://www.bimprove-h2020.eu/m/1/124>

```
{  
  "version": "0.1.0",
```

```

"marker_nr": 124,
"valid": true,
"l_xyz": [
  310.208,
  201.489,
  97.363
],
"r_xyz": [
  310.051,
  201.61,
  97.364
],
"epsg": "1032",
"measured_date": "2020-01-01",
"l_dxdydz": [
  0.001,
  0.001,
  0.001
],
"r_dxdydz": [
  0.001,
  0.001,
  0.001
],
"project_name": "CWA demo project",
"contact_person": "someone@example.com",
}

```

#### A.4.3 Example of large set of read-out data



Figure A.5 —Read-out tag with large set of data; URL: <https://www.bimprove-h2020.eu/m/1/125>

Please note, that in this case the information is password-protected to show, how the information can be protected. (User: CWA; Password: 125)

```

{
  "version": "0.1.0",
  "marker_nr": 125,
  "valid": true,
  "l_xyz": [
    310.208,

```

prCWA XXXX:2023(E)

```
        201.489,  
        97.363  
    ],  
    "r_xyz": [  
        310.051,  
        201.61,  
        97.364  
    ],  
    "epsg": "1032",  
    "measured_date": "2020-01-01",  
    "l_dxdydz": [  
        0.001,  
        0.001,  
        0.001  
    ],  
    "r_dxdydz": [  
        0.001,  
        0.001,  
        0.001  
    ],  
    "project_name": "CWA demo project",  
    "contact_person": "someone@example.com",  
    "issue_id": "f6a6afb7-b4cc-4760-a4b8-7085a9a7d696",  
    "l_srs_xyz": [  
        10.826834,  
        59.910968,  
        102.032  
    ],  
    "r_srs_xyz": [  
        10.82683,  
        59.910968,  
        102.032  
    ],  
    "srs_epsg": "4326",  
    "related_tags": [  
        "APR_00",  
        "CHI_00"  
    ],  
    "normal": [  
        0.707107,  
        0.707107,  
        0.0  
    ],  
    "a_xyz": [  
        310.14,  
        201.51,  
        97.564  
    ],  
    "a_dxdydz": [  
        0.001,  
        0.001,  
        0.001  
    ],  
}
```

## A.5 Example of folder location in project

Marker file of the specific project with the guid 6b07072541a24c1ead1902757473c47b. The full path is based on where the base project folder is.

```
/home/ubuntu/workspace/bimprove/project_data/projects/6b07072541a24c1ead1902757473c47b/scanner_data/markers.json
```

**Annex B**  
(informative)  
**Cybersecurity**

Please note that requirements on cybersecurity are not within the scope of this document. Nevertheless, this topic needs to be addressed. If software is able to read QR codes from images or point clouds, it could open any link contained in any scanned QR code. As a QR code might contain a link to a corrupted website, usual security measures need to be considered.