TECHNICAL REPORT

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Symbol libraries for construction and facilities management

Librairie de symboles pour la gestion de la construction et des aménagements

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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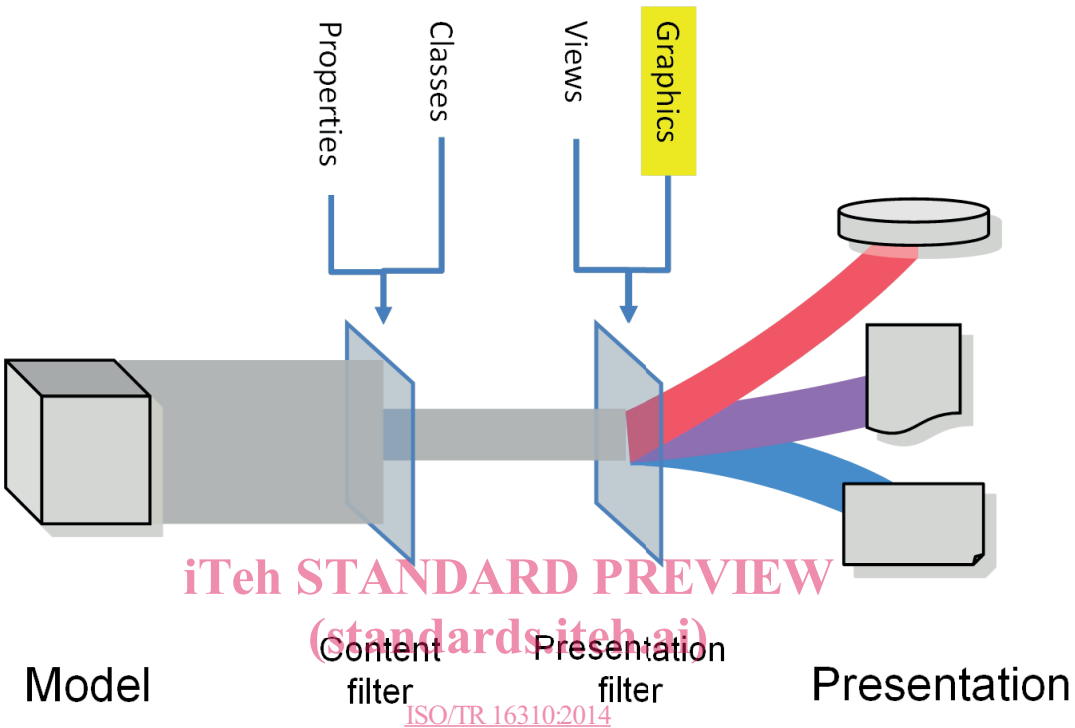
Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword — Supplementary information.

The committee responsible for this document is ISO/TC 10, *Technical product documentation*, Subcommittee SC 8, *Construction documentation*.

Introduction

Drawings, documents, and other presentations are increasingly being derived from models instead of being produced independently. The content, text, and graphics of the presentation are defined by applying rules, filters, to the model.



a) **Content** is selected from the model by using classification or other properties of the objects therein.

b) **Appearance,** using the presentation filter, is defined by selecting views, including formatting of content, and applying graphics. The graphics can be taken directly from the model but is often simplified and/or made more distinct by using **symbols** or simplified representation.

c) **Presentations** in the form of text, drawings, images, or other forms are the result, to be viewed on screen or printed.

Technical documentation relies heavily on graphics, whether it is presented on paper as drawings, or displayed on a computer screen. Also, much of the graphics is usually in the form of symbols or simplified representation. A symbol is a shape or a sign which represents something else, like the “flag” that symbolizes a light switch, while simplified representation resembles the object, and has physical dimensions equal to the object.

Standardized symbols play the role of a uniform (non-lexical) language that is understood in the same way by different readers. The potential benefits of using standardized symbols include savings in producing models and documentation, but above all, they serve to facilitate the efficient use of the documentation, and not least to avoid costly mistakes caused by misinterpretation.

This Technical Report investigates the needs and requirements within the construction and facilities management sector for symbol libraries, in digital form as well as the conventional printed form. Which libraries are needed? And how should they be defined, distributed, and maintained? The conclusions will be used to make decisions on future standardization.

Present standards for construction-related symbols have been created mainly to support uniform appearance on paper drawings produced by different authors.

The need for libraries of agreed symbols has not diminished over the years, but new issues related to the use of symbols have surfaced as practice has shifted from manual drafting to the use of computers

for producing drawings and CAD/BIM models. Also, the roles of national and international standards have changed over the past few years. Overlapping parts of national and international standards have required the withdrawal of national standards without them being fully replaced by international standards. In particular, this applies to Europe, where published EN standards must not in any part be conflicting with national standards. Altogether, there is a need for a new approach to symbol standards.

This Technical Report is the outcome of a proposal for a joint effort of the committees ISO TC 10/SC 8, *Construction Documentation*, and ISO TC 59/SC 13, *Organization of information about construction work*.

In the final section of this Technical Report are recommendations for future standardization work, for sharing and discussion within the standardization community, in particular ISO TC 10/SC 8 and ISO TC 59/SC 13. Also, the work should be coordinated with standards and activities of buildingSmart International. The intended goal is to arrive at a common roadmap. Out of this, concrete standardization efforts can be initiated and carried out.

Symbol libraries for construction and facilities management

1 Scope

This Technical Report intends to specify the requirements and needs for supplying and managing standardized symbolic descriptions of objects that need to be specified in the construction process. Within this context, the term "symbol" is interpreted to cover pure symbolic presentation as well as simplified representation of geometrical shapes of objects.

2 Existing standards

The present situation is that standards are available only for some arbitrary categories of symbols, not covering the everyday needs of those producing and using documentation for buildings and civil works. The following table shows a brief review of ISO and EN standards as well as national standards for some countries. It is not a complete list but rather examples of the present situation.

Standard number	Title
ISO	
ISO 3766	Construction drawings — Simplified representation of concrete reinforcement
ISO 7518	Technical drawings — Construction drawings — Simplified representation of demolition and rebuilding
ISO 5261	Technical drawings — Simplified representation of bars and profile sections
ISO 5845 (all parts)	Technical drawings — Simplified representation of the assembly of parts with fasteners
ISO 6411	Technical drawings — Simplified representation of centre holes
ISO 6410 (all parts)	Technical drawings — Screw threads and threaded parts
ISO 4067-2	Building and civil engineering drawings — Installations — Part 2: Simplified representation of sanitary appliances
ISO 14617 (all parts)	Graphical symbols for diagrams
ISO 1219-1	Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphical symbols for conventional use and data-processing applications
ISO 11091	Construction drawings — Landscape drawing practice
ISO 7519	Technical drawings — Construction drawings — General principles of presentation for general arrangement and assembly drawings
ISO 7437	Construction drawings — General rules for execution of production drawings for prefabricated structural components

Standard number	Title
ISO 2553	Welded, brazed and soldered joints — Symbolic representation on drawings
ISO 6790	Equipment for fire protection and firefighting — Graphical symbols for fire protection plans — Specification
ISO 128-50	Technical drawings — General principles of presentation — Part 50: Basic conventions for representing areas on cuts and sections
EN	
EN 1861	Refrigerating systems and heat pumps — System flow diagrams and piping and instrument diagrams — Layout and symbols
SS - Swedish Standard	
SS 32269:2008	Construction drawings — Representation of fasteners
SS 32268:2008	Construction drawings — Representation— Beams and columns of steel
SS 32267:1994	Construction drawings— Representation — Excavation drawings
SS 32270:1994	Construction drawings — Symbols and designations for fittings
SS 32264:1993	Construction drawings — Representation on drawings for drainage, water services, heating and mechanical ventilation
SS 32260:1986	Construction drawings — Installations — Symbols and designation for heating, ventilation and sanitary installation and for automatic control
SS 32231:1974	Symbols and designations for refrigerating plants
NS - Norwegian Standard	
Not updated:	
NS 2410:1984	Technical drawings — Building drawings — Drawings for structural metal work
NS 3037:1975	Building drawing — Drawings for concrete components
NS 8313:1983	Building and civil engineering drawings — Simplified representation of fittings
NS 8330:1982	Building and civil engineering drawings — Drawings for construction of reinforced concrete
NS 8331:1982	Building and civil engineering drawings — Symbols for concrete reinforcement
NS 8340:1987	Construction drawings — Installations — Graphical symbols for plumbing, heating, ducting and ventilation
NS 8341:1987	Construction drawings — Installations — Simplified representation of sanitary appliances
NS 8342:1987	Construction drawings — Installations — Graphical symbols for automatic control

Standard number	Title
NS 8343:1987	Construction drawings — Installations — Graphical symbols for refrigerating plants
NS-ISO 6790:1986	Equipment for fire protection and fire protection plans — Specifications
BS - British Standard	
BS 8541-1	Library objects for architecture, engineering and construction — Identification and classification — Code of practice
BS 8541-2	Library objects for architecture, engineering and construction — Recommended 2D symbols of building elements for use in building information modelling
BS 8541-3	Library objects for architecture, engineering and construction — Shape and measurement — Code of practice
BS 8541-4	Library objects for architecture, engineering and construction — Attributes for specification and assessment — Code of practice

In the process of producing symbol libraries, each standardization project should include further research about existing standards within its scope.

3 Ongoing standardization related to symbols

3.1 BIM

3.1.1 Current standardization revolves to a great extent around building information modelling (BIM). Coordination with product modelling efforts such as Standard for the Exchange of Product data (STEP) and buildingSmart is naturally of the essence, and should contribute to the presentation facilities of product models.

3.1.2 IFC, Industry Foundation Classes, is a buildingSmart specification for the structure and format for the exchange of building information models and their objects. The current IFC version, IFC 4, has been approved as an International Standard, ISO 16739.

3.1.3 buildingSmart data dictionary (previously IFD), also a buildingSmart initiative, is a publicly accessible database to hold the terminology to use for properties connected to different classes of objects in an object library. The properties are identified in a language-independent way, making it possible to exchange objects across system borders and languages. IFD is work in progress, and so far suggestions for properties within a limited number of object classes exist.

3.1.4 IDM, Information Delivery Manual, specifies a method for defining information sets to be exchanged between systems. The method takes its starting point in a process map for the process to be supported, then further specified into exchange requirements, and finally detailed to describe the functional parts, i.e. the units of information to be exchanged. The general description has been approved as a part of an International Standard, ISO 29481-1, and one more part of the International Standard is being produced, for management communication.

3.1.5 MVD, model view definitions, specifies a subset of IFC standard objects to be used in specific information exchanges, as a technical implementation of the IDM. A number of MVD's are being defined by buildingSmart International, but are not yet broadly adopted in the market.

3.1.6 BIM guidance, ISO/TS 12911, suggests a framework for BIM manuals on the generic level. The framework is intended as a basis for further detailing appropriate on different levels such as the national level, the company level, or the construction project level. Possible connections to symbols are the prescription of symbols and symbol libraries to be used as well as the process of retrieving, exchanging, and storing them.

3.1.7 Product data for building services systems models, an ISO TC 59/SC 13 work item, is to offer a common interface which allows the uniform handling of data relating to building service sectors about technical, commercial, maintenance, service, as well as geometric data, images, video, and text information. The general description has been under development as an International Standard, ISO 16757-1:—. The proposed part 2 and part 5 of ISO 16757 are to, respectively, deal with geometry and product catalogue, to which the symbol library issue will be closely related. An important aspect of the International Standard is that it deals with parametric representation of objects.

3.2 Distribution

3.2.1 Within IEC, the use of databases for symbols and other libraries is a reality for a number of years already. Maintenance teams are responsible for adjusting and developing the libraries in a smoother way than the revision procedure for an International Standard requires. The experience from this should be further investigated.

3.2.2 ISO OBP (Open Browsing Platform) contains a collection of concepts, terms, and symbols. It is fully operational but there are suggestions for developing it. In particular, there is a demand for establishing a structure that allows symbols and terms to carry the requirements of the International Standard. Essentially, the entire International Standard should then be available in the database, not just the representation of separate symbols. Also, the format for symbols needs to be revised to allow for use in CAD/BIM application software.

3.3 Other disciplines

Within ISO TC 10/SC 10, symbols for the process industry are being developed, in particular for use with process diagrams. These International Standards have several objects in common with building services systems, such as pumps, valves, and fans. Main products are ISO 14617 (all parts), ISO 10628 (all parts), ISO 14084-1:— and ISO 14084-2:—, and ISO 15519-1 and ISO 15519-2:—.

4 Objects and symbols

4.1 Representation and presentation

4.1.1 Overview

Any **representation** of a real-world (physical) object consists of a set of data corresponding to it. The same applies to any other (intangible) phenomenon which needs to be represented in a model-based construction process. The data for the object are always a subset of the potential complete description of the object, containing a number of properties that are perceived. In most cases, the properties are a subset adapted to the intended use of the data.

For example, the representation of a tree, in a literary text, can consist of a description of the way it looks, how it moves in the wind, and how the bark feels to the hand. A representation of the same tree, for the use of a landscape architect, can instead contain the name of the species (identifier) as well as some properties that are useful for purchase, planting, and maintenance. Thus, the same phenomenon can be represented by a number of “aspect” objects, such as a floor slab as seen by the architect vs. the structural engineer.

The **presentation** is a view of the object data, intended for a specific purpose. A symbol is a graphical presentation of the object, suited for use on a drawing or a diagram, etc. In addition to line graphics, selected

properties can also be displayed as annotation. Symbolic presentation aims at improving readability of the document for the intended use, by being easily recognizable as opposed to the geometry of the physical object (which can be similar for widely different functions) and by sorting out irrelevant information.

Type and **instance** are two states of the representation. A type object defines the properties but does not contain the actual data for each property. When a type object is instantiated, the object will be populated with individual property data, such as its location, individual identity, and perhaps also colour, size, connections to other objects, etc. The graphics presented as a symbol are specified by the type, but the definitive appearance may be modified when the object is instantiated, by setting properties that affect the graphics.

In conclusion, symbol libraries should contain graphics for presentation, but the presented symbols are also connected to an underlying representation of objects. The symbol illustrates one or more of the properties of a represented object. The presentation is also often adjusted to the individual situation, with respect to the instantiation of a type as well as to the intended use of the document where the symbol appears. In the following subclauses, the types of variations are investigated more in detail.

4.1.2 Presentation views

The presentation of an object is strongly connected with the intentional specification on how to visualize a specific aspect of the object model representing the object. A presentation view will need to be this kind of an intentional way of recognition.

A symbol is a specialized visual model of a product with an intentional view how to communicate the desired aspects of the object to relevant parties. A symbol of an object has a so-called mapping relationship with the original object, which may be a 3D, 2D, or non-dimensional (no geometry) existence. The symbol is considered in itself to be a displayable object for communication and can both be 3-dimensional and 2-dimensional in existence, although 2D symbols are by far the most common.

EXAMPLE 1 North point: 2D symbol for a non-dimensional object.

EXAMPLE 2 3D House or cube: 3D symbol for viewing projection.

EXAMPLE 3 Door: 2D symbols for 3D object.

Symbols must have several essential factors to be identified and inter-operatively communicated in order to cope with these technical requirements. Major factors are

— presentation contents/detail,

— dimension,

— projection method,

— scale, and

— presentation style.

Symbol libraries should cope with these factors from the point of presentation view.

Presentation contents are those which should be delivered to receivers and need to be identified in advance with common understanding between related parties, that is, senders/providers and receivers. There are currently some specifications, e.g. in the U.S.A and Denmark, that define predefined levels of detail or levels of development (LoD) that should be considered in order to specify the relevance of the supplied information with respect to its purpose within a specific period of its lifecycle. How to determine the detail level of presentation is just the same task with this consideration. IDM-like specification rules are quite effective to determine which items will be delivered. IDM, Information delivery manual, has been developed by ISO TC 59/SC 13 and can identify delivering contents through individual processes in a formal and standardized way.

Dimension of the presentation is also a main factor of the presentation view. 2D symbols have long been used in conventional presentation using paper drawings, but the advancing use of ICT makes it quite