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Information exchange between BIM and GIS - Part 3: Linking abstract concepts in BIM and GIS standards (ISO/DIS 23143-3:2026)

Informationsaustausch zwischen BIM und GIS - Teil 3: Verknüpfung abstrakter Konzepte in BIM- und GIS-Standards (ISO/DIS 23143-3:2026)

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91.040.01	Stavbe na splošno	Buildings in general

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Information exchange between BIM and GIS —

Part 3: Linking abstract concepts in BIM and GIS standards

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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.

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 13, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM)*.

A list of all parts in the ISO 23143 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 General

In the built environment, building information modelling (BIM) is widely employed throughout the life cycle of buildings and civil infrastructure as a digital methodology emphasizing information processing at the project level. Geographic information systems (GIS) provide a standards-based framework for the acquisition, modelling, management, analysis, and visualization of geospatial data. The ISO 19100 series of International Standards establishes the conceptual and technical foundations for geographic information, and has been widely applied in fields such as natural resources management, transportation, water conservancy, and urban management.

BIM and GIS represent two distinct paradigms of spatial information modelling. BIM is oriented toward life cycle management of works and structures, emphasizing the parametric definition of building components, assembly relationships, and engineering semantics; GIS is oriented toward the spatiotemporal management of spatial objects, emphasizing location, topology, and geographic semantics. The fundamental differences in architecture and underlying philosophy reflect their respective domain requirements, conceptual paradigms, and historical evolution. These differences shape the challenges of semantic interoperability.

The Industry Foundation Classes (IFC) are the most representative open data schema in the BIM domain. IFC adopts an object-oriented design in which construction elements (e.g. walls, doors) are organized via dedicated relationship entities into hierarchical and associative structures. The ISO 19100 series for GIS likewise adopts an object-oriented approach, representing real-world objects or phenomena as features, using UML as the schema language, and providing flexible mechanisms to describe geometry, attributes, and relationships.

Against the backdrop of the demand for information exchange, although BIM and GIS differ significantly, their intersection can still be identified: the description of the objective world. Regardless of how different their perspectives are, both BIM and GIS strive to embody human perception of the objective world through computer-readable datasets. This kind of perception has an objective consistency (e.g., urban patterns, building shapes, etc.). Without such consistency, the foundation for information exchange would be lost. On this basis, they are often needed to be integrated in large-scale infrastructure projects or city information models.

ISO/TR 23262:2021 identifies interoperability opportunities between BIM and GIS by examining the similarities and differences between BIM and GIS. In that technical report, subclause 7.2 recommends linking abstract concepts in BIM and GIS standards to support data exchange opportunities 1 and 2.

Within both BIM and GIS, abstract concepts (e.g. object, relation) are generalizations that capture common patterns, rules, and structural principles. Based on them, the concrete concepts (e.g. bridge, road) are derived and organized semantically. It is fundamental to recognize abstract concepts and establish linkages between them, not only because they form part of exchanged information, but also to prevent fragmented alignment of concrete concepts.

0.2 Propositions

When identifying and linking abstract concepts from BIM and GIS to guide information exchange, the following basic propositions are taken into account in this document:

— Use case-driven scope. Information exchange between BIM and GIS serves use-case needs; the exchanged information shall be bounded by the intended purposes of use.

— Heterogeneity. BIM and GIS differ in methodology and data models; lossless exchange is generally not achievable, nor is it required.

— Interface over implementation. Exchange should follow an interface-oriented rather than an implementation-oriented approach, focusing on “what” rather than “how.” It is unnecessary to exchange all internal constructional relationships within each data schema. The source system is responsible for generating and maintaining its internal relationships; the target system is responsible for consuming and

using the outcomes of those relationships. The responsibility of the exchange is to convey the semantic results of relationships, not their implementation processes.

— Directionality and mode. Information flows in two directions, i.e., BIM-to-GIS and GIS-to-BIM, which are not equivalent. Distinguish between initial (creation) exchange and maintenance (update) exchange. In creation exchange, the target system may not yet contain source data and may lack the capability to receive it. In maintenance exchange, the same object may be updated repeatedly; therefore, data traceability is critical.

— Semantic alignment. To ensure precise alignment between abstract concepts, it is recommended to define exchange relationships using a shared data dictionary and/or linked semantic models between BIM and GIS (e.g. RDF-based semantic networks). This provides a robust foundation for machine-readable semantic interoperability.

This document does not cover every abstract concept in all BIM and GIS standards; rather, it provides a framework enabling domain experts to establish links between abstract concepts. Additionally, software developers can use the concept link records defined in this document as a reference for implementing BIM–GIS information exchange interfaces.

Information exchange between BIM and GIS —

Part 3:
Linking abstract concepts in BIM and GIS standards

1 Scope

This document establishes a methodology for linking abstract concepts within Building Information Modelling (BIM) and Geographic Information System (GIS) standards and specifies structural mechanisms for organizing their link relationships, aiming to facilitate cross-domain information exchange.

Methodologies for the development of RDF that relate to BIM and GIS are not within the scope of this document.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12006-3:2022 [1], ISO 16739-1:2024 [2], ISO 23387:2025 [3], ISO 19101-1:2014 [4], ISO 19109:2025 [5], ISO/DIS 23143-1, as well as the following apply.

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

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

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

3.1
concept
unit of knowledge created by a unique combination of characteristics

[SOURCE: ISO 1087:2019 [6], 3.2.7, modified — Note 1 to entry and Note 2 to entry have been removed.]

3.2
abstract concept
concept (3.1) representing a generalization of common characteristics and relations

Note 1 to entry: An abstract concept is independent of specific instances or technical implementation.

Note 2 to entry: An abstract concept is typically defined in conceptual models such as classes, feature types, or relationship types.

3.3
link
defined association between two entities

Note 1 to entry: An association can be directional or non-directional.

3.4
information exchange
act of satisfying an information requirement or part thereof

[SOURCE: ISO 7817-1:2024 [7], 3.3, modified — The part of speech "verb" has been removed.]

3.5
data schema
physical implementation of a data model in a specific data management system

Note 1 to entry: A data schema can include implementation details such as data types, classifications, and access controls.

[SOURCE: ISO/IEC 25642:2025 [8], 3.11]

4 Abbreviations

BIM	Building Information Modelling
GIS	Geographic Information System
GFM	General Feature Model
IFC	Industry Foundation Classes

5 Methodology

5.1 Purposes

Information exchange between BIM and GIS drives the needs of the two information systems to be able to interpret the data received from each other. The domain-specific data describe the unique characteristics of concepts within the respective conceptual models of the physical world.

The interpretation of the data are based on the concepts to which the data relate and the schema elements defined for those concepts, so that the data retain the semantics defined in the original domains.

Existing BIM and GIS international standards have defined many abstract concepts independently. The abstract concept linkage provides a shared semantic foundation between BIM and GIS standards, so that concept correspondences can be systematically determined and concrete concepts can be aligned accordingly for information exchange.

The purpose of linking concepts is to enable data flow between BIM and GIS to facilitate information exchange. See Figure 1.

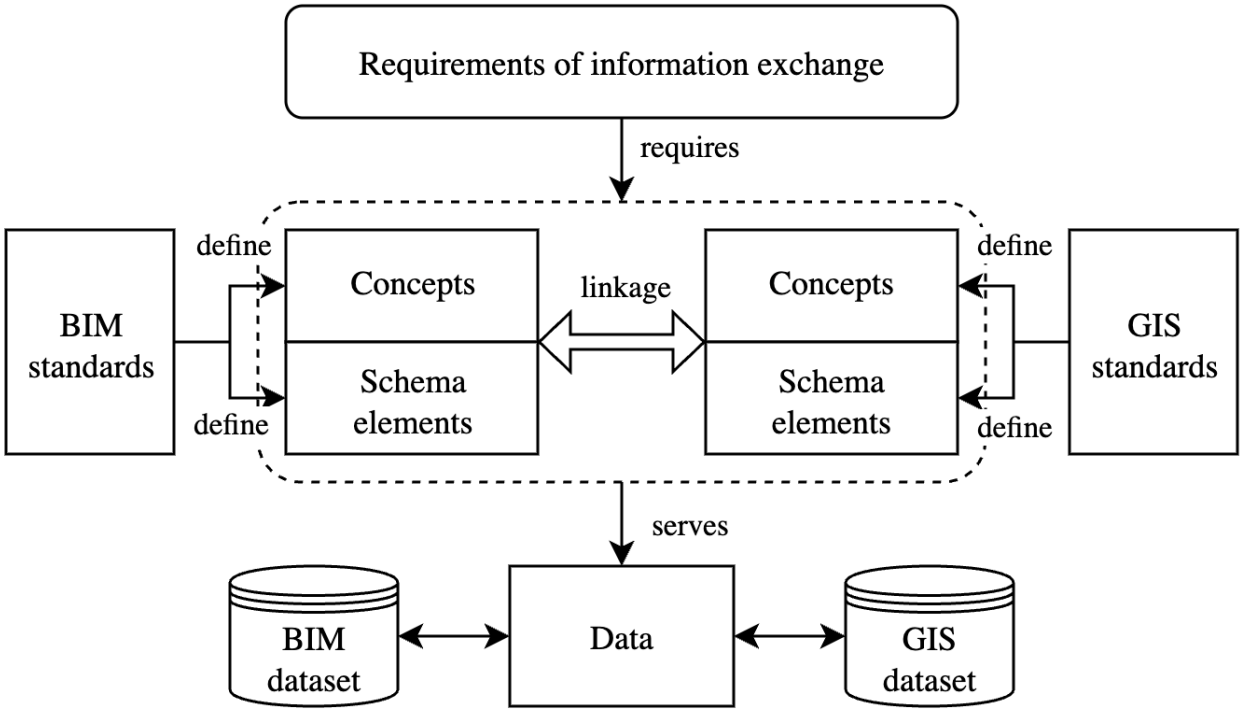

Figure 1 — Purpose of linking concepts for information exchange between BIM and GIS

NOTE Concrete concepts are domain-dependent and represent realizations of abstract concepts at the implementation level.

5.2 Principles

5.2.1 Use-case-driven information exchange

Use case requirements serve as the governing criterion for defining the scope of BIM-GIS information exchange. As the two domains address distinct aspects of the built and natural environments, a clearly defined scope is essential to ensure that concept alignment remains targeted and proportionate. Within this scope, all applicable abstract concepts are identified and linked, to achieve focused and complete information exchange. Concepts outside the scope boundary are excluded to reduce unnecessary complexity without compromising the fitness for purpose of the information exchange.

NOTE See the ISO 29481 series (information delivery manual, for BIM) and ISO 19109:2025 [5] (General feature model and rules for application schema, for GIS) for use-case driven modelling and methodologies.

5.2.2 Semantic-based concept linking

Concept matching shall be based primarily on semantic definitions, including the meaning, scope, and constraints of concepts as defined in their respective source standards. Lexical similarity, such as identical or similar names, shall not constitute sufficient evidence for establishing semantic equivalence. Where lexical similarity contradicts semantic definitions, semantic definitions shall prevail. Additional supporting elements, including semantic relationships, contextual constraints, and classification, shall be considered to verify and validate cross-domain semantic alignment.

5.2.3 Appropriate standard reference

While data items are exchanged between BIM and GIS, the underlying conceptual schemas, data schemas and schema languages shall be identified with reference to appropriate standards. The linkage of abstract

concepts shall be documented with dated references and schema full version identification of schema specifications. Where multiple standards could be referenced, the primary definitional source for the use case shall be selected and recorded, while other sources may be cited informatively.

5.2.4 Domain symmetry

The linkage of abstract concepts shall be established on neutral basis between the BIM and GIS domains. Neither domain shall be regarded as the dominant reference framework into which concepts from the other domain are translated. Each linked schema element shall be identified, interpreted and documented according to the standard in which it is formally defined. Domain symmetry applies to the method of linkage, not to the resulting structures, i.e., differences in scope, granularity, directionality or loss may remain, but they shall be recorded explicitly in the linkage.

5.2.5 Computer interpretability

Concept linkage shall be expressed in a computer-interpretable form to support automated processing, formal validation and reusable deployment across software and databases systems. The representation shall preserve identifiers, source standards, directionality, link type and any declared transformation or loss. This document specifies an ontology-based, machine-interpretable representation of concept links that may be adopted by either BIM or GIS implementations.

5.3 Framework

Both BIM and GIS contain a large number of abstract concepts, yet not all of which are involved in cross-domain exchange; In particular, schema-internal syntactic constructs are designed mainly to build or organize the schema rather than to convey exchange semantics.

To enable interoperability of the information defined by abstract concepts in international BIM and GIS standards, concept links shall be established on the basis of shared domain cognition that concerns only the definitions of exchange-relevant objects and their contextual specifications.

A set of five categories covers the exchange-relevant meaning of an object: basic context, object identification and classification, geometric characteristics, attribute characteristics, and relationship structure.

The whole or part of the meaning for which an abstract concept is responsible shall correspond to one or more of the five categories. On this basis, links between corresponding BIM and GIS abstract concepts can be established, see Figure 2.

NOTE These five categories are further specified in Clause 7.

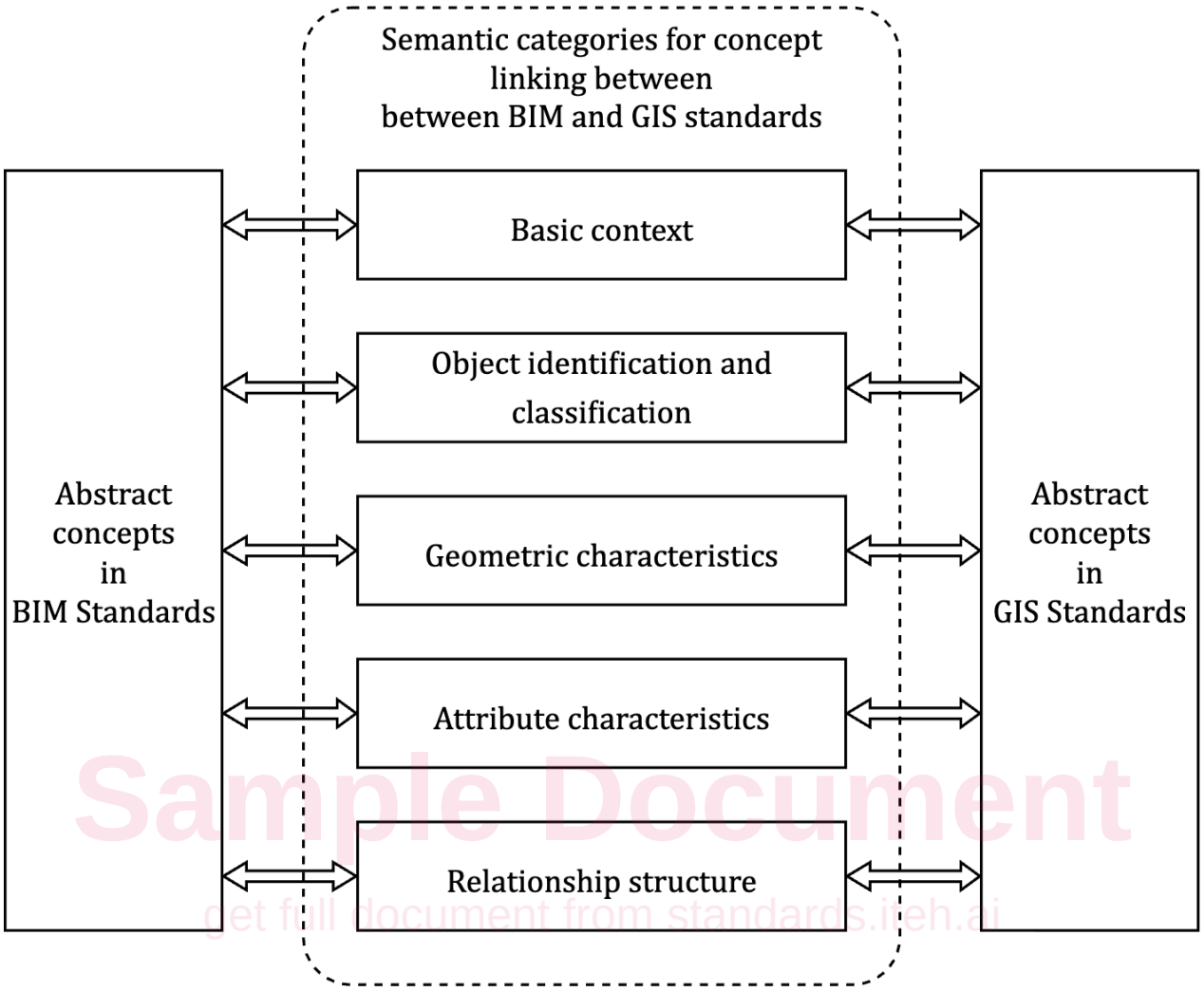

Figure 2 — Framework of linking abstract concepts

5.4 Process for linking abstract concepts

The process for linking abstract concepts (see Figure 3) should be applied to all abstract concepts for defined information exchange.

The process should consist of the following verifiable steps:

— Identify the candidate abstract concepts in BIM and GIS standards within the scope of the requirement.

— Identify which category or categories the abstract concepts correspond to.

— Compare the candidate abstract concepts to determine their semantic correspondence.

— Establish and document formalized representations of concept link.

Where no valid semantic relationship can be established without exceeding the defined scope or distorting original semantics, the result shall be recorded as ‘Not applicable’ for the relevant use case.