Modélisation des INformations INteropérables pour les INfrastructures Durables

## Livrable

# Bridge Data Dictionary
# From conception to bSDD implementation


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## IFC Bridge (UC3)


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# 1. SUMMARY


**Abstract**

This document presents the complete method to create a data dictionary (objects and their properties) dedicated to bridges.

It starts from existing documentation and standards, and go in detail through the methodology, till the transfer to the buildingSMART data dictionary (bSDD).

**Résumé**

Ce document présente la méthode pour créer un dictionnaire de données dédié aux ponts. Ce dictionnaire est composé des objets et leurs propriétés.

Il commence par la sélection de la documentation et des normes existantes, et décrit en détail la méthodologie jusqu'à son transfert dans le dictionnaire de données buildingSMART (bSDD).


# 2. INTRODUCTION

**Document presentation**

**Second phase description**

The second phase of the MINnD project consists in:

- Consolidating the data dictionary.
- Exporting data dictionary to the bSDD.

**Methodology**

This document traces the methodology used:

- from the resource documents,
- the conception of the data dictionary,
- to the transfer.

**Another methodology guide to help other domains**

We wrote another methodology guide entitled 'MINnD Methodology to feed bSDD with a new data dictionary'. This guide helps other domains enter their concepts in the bSDD. These domains can be:

- roads,
- tunnels,
- rails.

# 3. RESOURCE DOCUMENTS

## 3.1. Methodology description

**Steps**

We selected some existing documents in order to have a solid basis to create the Bridge data dictionary. Below are the steps to do so:

| Step | Action | Details |
|---|---|---|
| 1. | We first had to define a structured framework with precise attributes of each concept. | Those attributes must be completed. |
| | | This is the reason why we choose a standard that defines a harmonised reference. |
| 2. | We class bridge concepts in systems to fill the data dictionary. | |
| 3. | We used the classification system of buildingSMART data dictionary to automatically transfer all our bridge concepts to the data dictionary. | |

## 3.2. Reference documents

**Dr. Stuart Chen's data dictionary**

**About the author**

Dr. Stuart Chen is an experienced US researcher and instructor in applications of emerging information technologies to bridge engineering. He is a professor at Buffalo University in the state of New York. He provided us his work on the data dictionary of bridge concepts.

**Data dictionary description**

His dictionary (see table below) gathers different elements of bridges, from the study phase to the construction of a bridge. Each concept attribute belongs to a group and the links between attributes clearly appear.

| | A | B | C | D | E |
|---|---|---|---|---|---|
| 1 | Information Groups | Information Items | Attribute Sets | Attributes | 1.1 bridge concept design |
| 441 | Bridge substructure | Wall pier | Location | Station at wall pier location | |
| 442 | | | | Skew angle at wall pier location | |
| 443 | | | | Elevation at the upper left corner | |
| 444 | | | | Elevation at the upper right corner | |
| 445 | | | Dimensions | Wall pier thickness | |
| 446 | | | | Wall pier depth | |
| 447 | | | | Wall pier width | |
| 448 | | | | Fillet radius | |
| 449 | | | Material | Wall pier material designation | |
| 450 | | | Properties | Drilled shaft name | |
| 451 | | | | Drilled shaft description | |
| 452 | | | | Drilled shaft type | |
| 453 | | | | GUID | |
| 454 | | | Location | Station at drilled shaft location | |
| 455 | | | | Skew angle at drilled shaft location | |
| 456 | | | | Elevation at the top of drilled shaft | |
| 457 | | | | Elevation at the bottom of drilled shaft | |
| 458 | | | | Drilled shaft section | |
| 459 | | | | Drilled shaft diameter | |
| 460 | | | | Drilled shaft width | |

**Extract from Dr. Stuart Chen's data dictionary**

### 3.2 Reference documents | Dr. Stuart Chen's data dictionary

**Content**

**English terms with no attributes**

This document contains exclusively English terms with no attributes.

**1,600 concepts with hierarchical links**

That document is a good starting point because it already contains more than 1,600 concepts with hierarchical links.

**Limits**

However, it deals mainly with US bridges, made of steel. Therefore, it had been improved and completed with concrete bridge concepts, currently carried out in Europe.

**English/French compatibility check**

We check if:

- US terms have a French equivalent.
- US concepts could be applicable to France.

**Other verified references**

In addition to this document, some other references have been verified:

| Checked reference | Delivered by | Reference |
|---|---|---|
| A 'proposed UNIFORMAT II Classification of Bridge Elements' | NIST | [1] |
| 'Bridge Management in Europe' | BRIME | [2] |

## AFNOR's XP P07-150 standard

**About AFNOR**

AFNOR association and its subsidiaries form an international group that aims to serve the general interest and economic development of organisations.

This association provides standardisation and certifications.

**The XP P07-150 standard: the reference document to create our Bridge data dictionary**

**XP P07-150 is a standard…**

The XP P07-150 standard (Afnor, 2014) is an experimental French standard, which will become soon an ISO Standard EN-ISO 23,386. There is no other document of this kind in an international level. Therefore, the XP P07-150 standard is our reference document to create the bridge data dictionary.

**… not a data dictionary**

However, this standard is about to become a European and international standard. It is not a data dictionary. It describes a standardisation method of concepts related to products and methods used in construction industry. This document defines and manages attributes related to each concept of a data dictionary.

### 3.2 Reference documents | AFNOR's XP P07-150 standard

**Concept attributes**

Each concept of the data dictionary of bridge terms has the following attributes:

| Attributes | Details |
|---|---|
| Unique identifier. | A character related to a single concept, which is convenient to precisely identify. |
| English name. | |
| Description in English. | |
| French name. | Or another language. |
| Description in French. | |
| Visual representation. | |
| Creation date. | |
| Country where the concept is used. | |
| Nature of the group. | Domain, class or group of concepts depends on the hierarchy level of the concept. |
| Group of concepts. | Group's name in which the concept is. For a concept at the bottom of the hierarchy level. |
| Relationship between groups. | Group's name in which the concept is (parent) and the names of groups included in it (child), for a concept which is not at the bottom of the hierarchy level. |
| Type. | Kind of value. Integer, real character. |
| Cardinality. | Number of values to describe the concept. |
| | For example: three values are required for coordinates. |
| Physical values. | Length speed, etc. |
| Unit. | |
| Threshold values. | |

**BuildingSMART data dictionary (bSDD)**

**About BuildingSMART**

BuildingSMART, an international organisation in charge of:

- IFC development.
- BIM promotion.

**Working platform**

BuildingSMART provides us the working platform 'bsdd.buildingsmart.org' (BuildingSMART [4]).

**Relevant tool**

Therefore, our working group can create a library of concepts with their attributes in a formal way. The relevance of that tool lies in:

- Its openness and international aspect.
- Its automatic rule checking which prevents miscommunication and data duplication.

**Complement and adaptation**

We choose to complete the data dictionary according to the AFNOR's XP P07-150 (AFNOR, 2014) standard and then to adapt it to the bsDD's shape.

**Strengthening visibility and credibility**

The aim is to create the data dictionary on an international tool in order to strengthen our visibility and credibility.

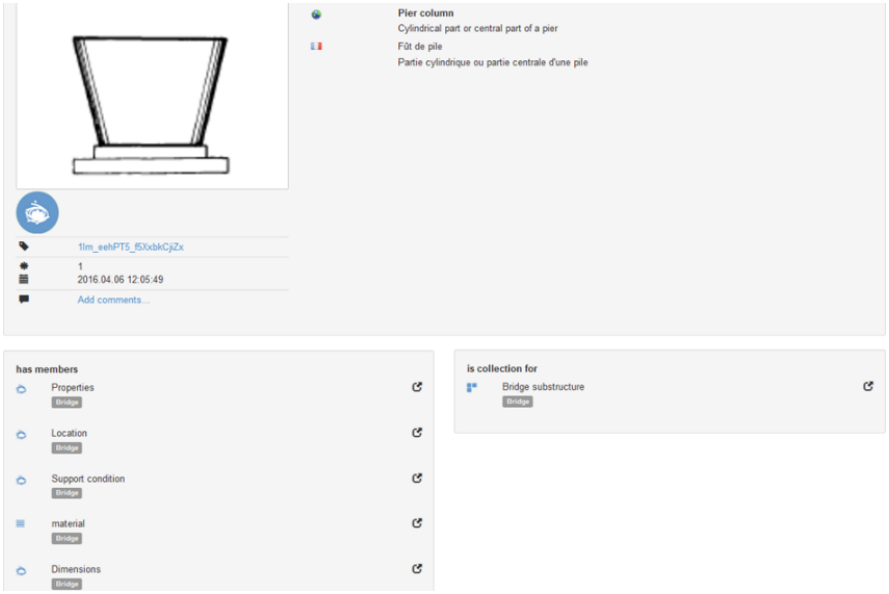
### 3.2 Reference documents | BuildingSMART data dictionary (bSDD)

**Concepts in the bSDD sand box**

Indeed, we need to create some concepts in a bSDD sand box to understand this tool. So far, this platform contains concepts dedicated to the building sector. These concepts were not validated by an international expert panel. The platform does not provide any flow or tracking functions to follow new inputs, changes or requests for changes. Therefore, this platform really needs to be improved, but it is the most recent existing operational tool.

As you can see on the screenshot below, a page shows the concept with its:

- Name.
- Representation.
- Definition.
- Type and hierarchical links to the other concepts.




**Concept in the bSDD**

**Recommendations**

#### Going further in the concept explanation

Some concepts must be more explicit. For instance, the characteristic 'width of a bridge deck' can have different meanings, according to its use:

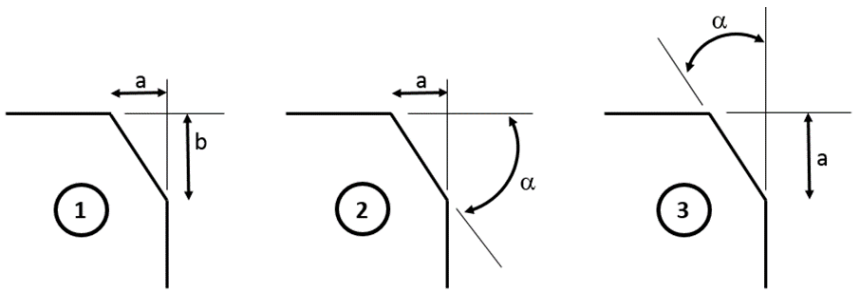
- Operational width.
- Overall width.

#### Accuracy to avoid confusion

Moreover, the diagram must be accurate to avoid any confusion. For instance, the representation of a chamfer could be defined by:

- 2 lengths 'a & b' (See diagram 1 below).
- A length and an angle 'a & α' (See diagram 2 below).

As there is not possibility to add any comments next to a characteristic, the definition is the most suitable. Besides, we have to find a way to clarify on which side the length 'a' is applied (Compare 2 and 3 on diagrams below).



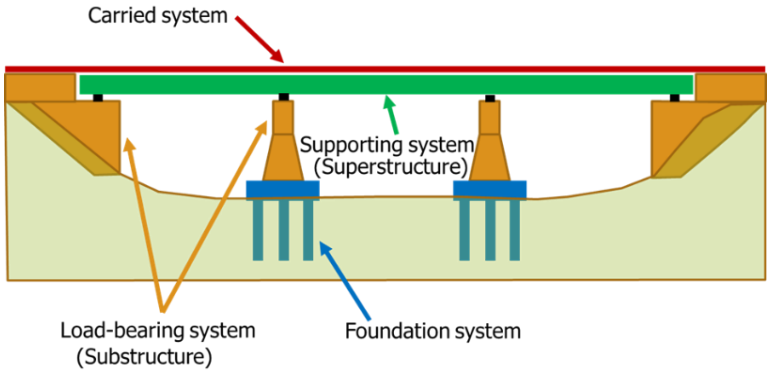

**Several representations of a chamfer**

Links between concepts

### Major systems of a bridge

Nevertheless, in the bSDD, the representation of a concept does not include the links between concepts of the same hierarchical level. We asked ourselves if these links are part of the definition of a concept as they represent the physical links between concepts.

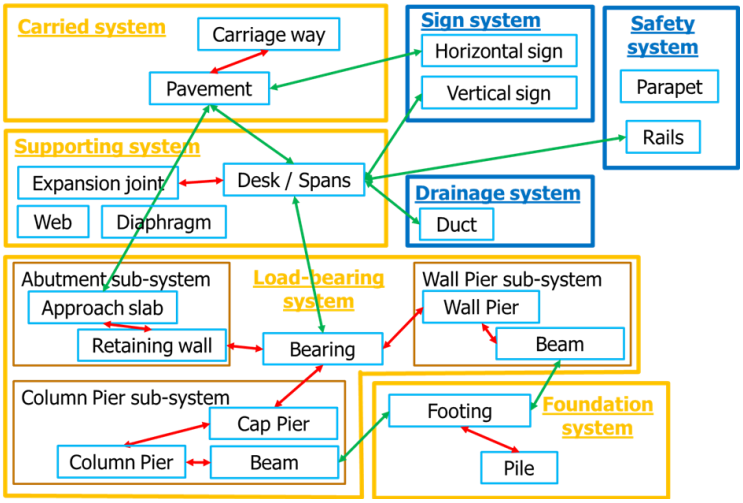
For instance, a bridge gathers several systems as represented on diagram below. But there are obvious links between these systems, which are paramount for a computer to understand the overall behavior of the bridge. When a designer changes the foundation system and moves a pile, the substructure above must move too, and the supporting system (the deck) supported by the moved column.




**Bridge with its major systems**

### Representation of links between concepts proposal

A representation of links between concepts of a same level is proposed below. These systems could be found in other infrastructure fields like roads or railways.




**Example of the concepts of the bridges systems with their links (these links are not hierarchical links)**

Find the legend of representation below.

| | |
|---|---|
| **Green arrow** | Links between systems. |
| **Red arrow** | Links between concepts of the same system. |
| **Blue boxes** | Systems that are not exclusive of the bridge field (sign system, safety system, etc.). |

Conceptual model's role

Links between concepts of a same hierarchical level do not have to be specified in the bSDD. The conceptual model has this role.

3.2 Reference documents

**SETRA English-French lexicon of bridge terms and CHAMOA**

To complete the bridge data dictionary, we used other documents such as an English French lexicon of bridge terms and nomenclature of parts of bridge:

- 'Lexique relatif à la construction des ouvrages d'art' [5].
- 'Observatoire national de la route' [6].

**English French lexicon of bridge terms**

The English French lexicon of bridge terms is a reference document written by the Cerema ITM (previously SETRA). It is a technical lexicon of bridge terms, arranged alphabetically, providing accurate English French and French-English translations. It is often used in the bridge field.

**User guides of CHAMOA**

We also used a document from the Cerema dedicated to bridge structure analysis: the user guides of CHAMOA, a dedicated tool for bridge calculation (Cerema - DTecITM/CTOA/DCSL) [7]. The input data of this structure analysis tool specifies us the semantics expected to define each concept. The Cerema is the centre for studies and expertise on risks, environment, mobility and urban and country planning. It is a public organisation that helps territorial authority to apply their policy.

## 3.3. Visual representation

**Parts of bridge**

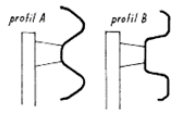
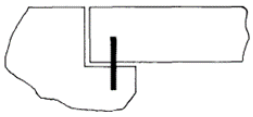
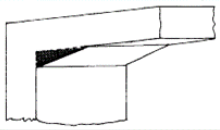
To illustrate the terms, we used another couple of existing documents:

- 'Nomenclature des parties d'ouvrages d'art métalliques' [8].
- 'Nomenclature des parties d'ouvrages d'art en béton armé et précontraint et en maçonnerie' [9].

The nomenclature of the parts of the bridge consists in two documents:

- One is related to reinforced concrete bridges, prestressed concrete bridges and stone bridges.
- One is related to metal bridges. It is a document written by the LCPC and the Cerema ITM.

This nomenclature gathers the kinds of bridges and their parts. See the extract below.

| Nom de la partie d'ouvrage | DEFINITION | Croquis ou photo. |
|---|---|---|
| **GLISSIÈRE** (de sécurité) | DISPOSITIF DESTINÉ À RETENIR SUR LA PLATEFORME UN VÉHICULE (EN GÉNÉRAL LÉGER) EN DÉTRESSE. |   |
| **GORGE** | CREUX DE FORME ALLONGÉE. | |
| **GOUJON** | PIÈCE MÉTALLIQUE CYLINDRIQUE SERVANT D'ASSEMBLAGE OU D'AXE DE ROTATION, FIXÉE PAR SCELLEMENT, FILETAGE OU SOUDURE. |  |
| **GOUSSET** | RENFORCEMENT TRIANGULAIRE DE L'ANGLE DE DEUX PIÈCES PERPENDICULAIRES, OU D'UNE PIÈCE ALLONGÉE. |  |

**Extract from the nomenclature related to reinforced concrete bridges, prestressed concrete bridges and stone bridges**

### 3.3 Visual representation

**Visual representation Aim of this nomenclature**

These documents were written to use a common vocabulary to structural monitoring, because it also provides structural defects. However, they represent an effort to unify, simplify and organize technical vocabulary. Indeed, to avoid ambiguities, the nomenclature provides for each item:

- Its definition.
- A visual representation.

**The case of wooden bridges**

As there are very few bridges made of wood, no specific concepts relative to them appears in the data dictionary. However, the data dictionary will be completed to add them with their relationships. The main subgroup of concepts to add is about the material itself. Few guides exist on wooden bridges, but the CEREMA will provide soon a technical guide dedicated to this kind of bridges which will help to complete the data dictionary.

**A relevant and a reliable approach of the data dictionary**

Our approach of the data dictionary is relevant and reliable thanks to:

- These documents.
- Our exchanges on the bSDD with Håvard Bell of Catenda, a member of buildingSMART.

# 4. SHAPE OF OUR DATA DICTIONARY

## 4.1. Compulsory attributes from the bSDD

**Input data manually**

We are able to choose the right shape of our excel spreadsheet data dictionary by entering the bridge concepts in the bSDD manually.

**Aim of the mirror copy of the dictionary**

Indeed, BuildingSMART created a mirror copy of the dictionary for testing. Users add their own concepts without any consequences to:

- Discover the platform.
- Learn how the platform reacts.

**Three steps to key in a concept**

In order to use the bSDD-test, we entered the concept 'pier column' and its sub-concepts. There are three steps to key in a concept:

- The name of the concept in English and at least in another language.
- The bSDD looks for a duplicate of the concept just entered. If the user thinks it is a new concept, then he can go on to the last step. Otherwise, the user must check if the existing term describes the same concept or not. If not, a context must be added to set apart the two terms.
- The user must choose a concept type among the following ones (see picture below). This concept depends on its nature and its hierarchical level. Besides a description of the concept is required at least in English.


**bSDD concept types and their symbols**

**Creation of the concept**

The description of each concept type is included in the appendix. After that, the concept is created and included in the bSDD.

Thanks to the entry of twenty concepts linked with a 'pier column', we discover the compulsory attributes of any concept which are its:

- English name.
- French name, in our case.
- Type.
- English description.

Once the concept is created, it is possible to add a picture of it.

## 4.2. Hierarchy

**The bridge context**

Another important aspect of the bSDD is the hierarchical links between the concepts. Their definition is closely linked to the context.

That's the reason why we asked for the creation of the 'bridge' context. Indeed, the connection between concepts depends on the context. Once the context bridge is selected, only the links relative to the context 'bridge' appears.

**Aim of the bridge context**

The aim of a specific context is to create specific links to it. It is thus a good choice to create the 'bridge' context to link our concepts between each other. The nature of the link depends on the concept type. The table below shows the available links depending on the nature of the concept:

| | bag | nest | subject | property | measure | value | units | document | classification | actor | activity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| number of relationships | 3 | 3 | 11 | 11 | 10 | 5 | 8 | 7 | 7 | 12 | 10 |
| is part of collection | x | x | x | x | x | | x | x | x | x | x |
| is part of | | | x | x | x | | x | x | x | x | x |
| is documented in | | | x | x | x | x | x | | | x | x |
| is classified as | | | x | x | x | x | x | | | x | x |
| is associated to | | | x | x | | x | | | | | |
| is property of | | | | x | | | | | | | |
| is a value of | | | | | | x | | | | | |
| is a unit of | | | | | | | x | | | | |
| is a type of | | | x | x | x | | x | x | x | x | x |
| is a measure of | | | | | x | | | | | | |
| is a collection for | x | x | | | | | | | | | |
| has values | | | | | x | | | | | | |
| has units | | | | | x | | | | | | |
| has subtypes | | | x | x | x | | x | x | x | x | x |
| has properties | | | x | | | | | x | x | x | x |
| has parts | | | x | x | x | | x | x | x | x | x |
| has members | x | x | | | | | | | | | |
| has measures | | | | x | | | | | | | |
| has documents | | | | | | | | x | | | |
| has collections | | | x | | | | | | | x | x |
| has associations | | | x | x | | x | | | | | |
| classifies | | | | | | | | | x | | |
| acts upon | | | x | | | | | | | x | x |
| next sequence | | | | | | | | | | x | |
| previous sequence | | | | | | | | | | x | |

**Links between the concept type**

**Type's choice**

We choose the type of each concept in the 'bSDD content guideline'. The type of a concept depends on:

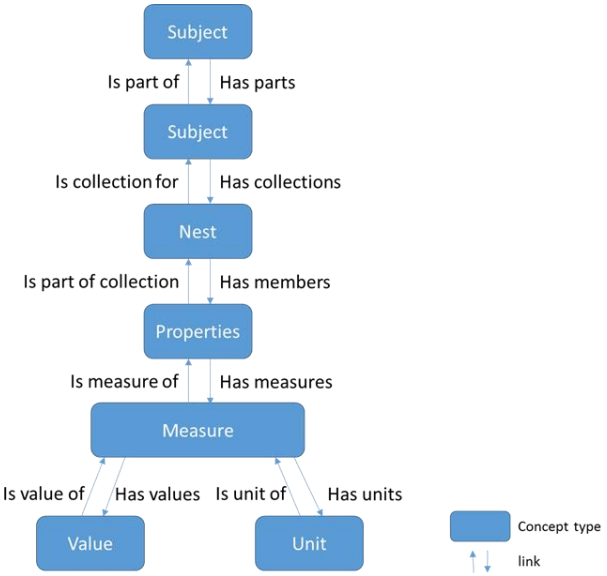
- Its nature.
- Its hierarchy level.

**The four hierarchical levels of the bridge concept**

Our bridge concept has four hierarchical levels, excluding the following concepts:

- The measure.
- The unit.

Consequently, their concept type and the links were defined as follows:




**Concept types and links in the data dictionary spreadsheet**

4.2 Hierarchy

**Hierarchy Concept of the AFNOR's standard essential to the bSDD**

All this test phase was conducted with the buildingSMART experts. They provide us several points of advice.

The concepts of the AFNOR's standard essential to the bSDD are:

| AFNOR's standard essential to the bSDD | |
|---|---|
| Unique identifier | Each concept has a Global Unique IDentifier (GUID). It enables bSDD users to be sure that different concepts do not share the same identifier. |
| Name | Name of the concept, in English and at least one in another language for the bSDD. |
| Description | Character string describing the concept, in English and at least one in another language for the bSDD. |
| Visual representation | Picture of the concept. It can be a photograph or a diagram. |
| Hierarchical link | Indicates the relationships between the concepts. It is the main difference between a dictionary and a data dictionary. This is two attributes actually: the parent group and the child group. |
| Group kind | Indicates the nature of concepts. It can be a subject, a nest or a property (in contrast to group). |
| | A subject is any physical or logical thing. |
| | A nest is a collection with the same type. |
| | A property is any characteristic of a concept or substance. |
| | For example, the table below shows hierarchical linked concepts and their group kind. A concept is the parent of the one under it. |

| Property | Group Kind |
|---|---|
| Bridge substructure | Subject |
| Pier column | Subject |
| Pier column dimensions | Nest |
| Pier column diameter | Property |

**Example of concepts with hierarchical links and their group kind**

## 4.3. Content

**Focus on domain of bridge**

Once we have the shape, we need to determine the right content. The main issue is the accurate definition of the bridges' scope. Indeed, we tried to define all the terms used in the bridge field, including equipment and environment. We had to focus only on the exclusive domain of bridge. The bridge domain must not overlap the related domain like road or rail.

**Domains of the IFC-Infrastructure scope**

The IFC-Infrastructure scope has been split in different domains:

- Alignment.
- Bridge.
- Rail.
- Road.

4.3 Content | Focus on domain of bridge

Developments of the IFC infrastructure architecture

### Developments based on the ISO standard (ISO 16,739)

The diagram below shows the needed developments of the IFC infrastructure architecture. These developments are based on existing IFC4, which is now an ISO standard (ISO 16,739).

The first 'brick' is dedicated to IFC-Alignment. It is the 3D lines on which all linear projects are based on.

Then a data dictionary is developed for each main infrastructure domains.

### In progress domains

Currently, rail, road and bridge are 'in progress' domains, with dedicated international expert panels.

### Future domains

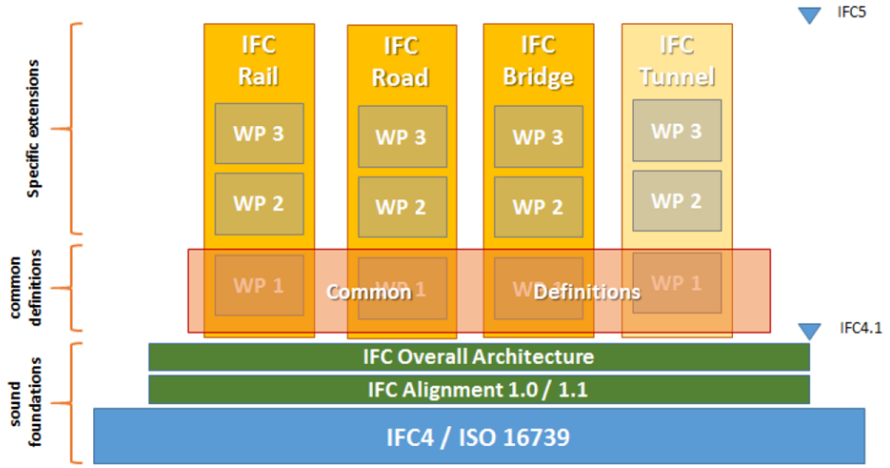
Some other domains will be added soon:

- Tunnels.
- Geology.
- Marine infrastructures.

### Limits of the scope for IFC bridge

The scope for IFC-bridge must stop at the accurate interface with other domains. For instance:

- The ballast and the pavement are out of bridge scope, even if they are often associated to the bridge structure.
- The geology is out of scope, even if we can't size a bridge without knowing the foundation specifications.
- Equipment is out of scope, even if the location of each device must be known to specify their attachment or integration in the structure.




**Scope of IFCs for Infrastructure defined by buildingSMART InfraRoom**

The Bridge data dictionary is exhaustive and exclusive. We must coordinate ourselves with other IFC for Infrastructure leaders to be sure of the scope.

The IFC for infrastructure are based on IFC-Alignment. The latter is essential to set up a bridge and the linear equipment:

- Crash barriers.
- Drainage systems.
- Prestressing elements.
- Etc.

which location is based on a chainage reference, and not on a XYZ coordinate system. We are in a validation process of the first release of IFC-Alignment. This step will govern the global development of IFC for Infrastructure.

# 4.4. Extract of the spreadsheet data dictionary

**Five sheets**

We create the spreadsheet data dictionary with the five following sheets:

- Dictionary.
- Measures.
- Values.
- Units.
- Hierarchical links.

**Concepts**

In our data dictionary spreadsheet:

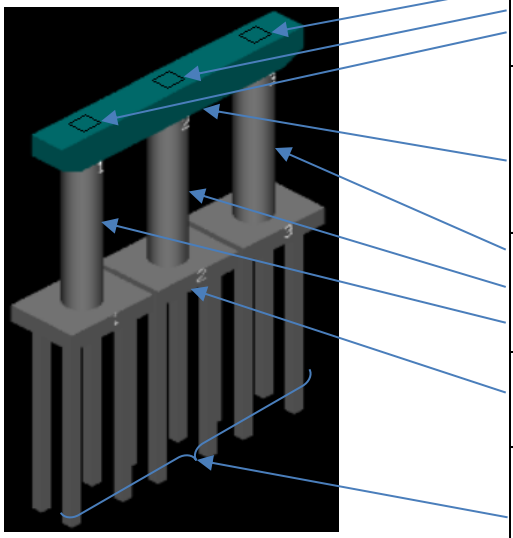
- The concept representing groups is in grey.
- The other one stays uncoloured to easily distinguish the hierarchy between the concepts (see the table below).

| | | | | | | |
|---|---|---|---|---|---|---|
| General information | Gather the general information of fabrication of a bridge | Informations générales | Regroupe l'ensemble des informations générales de | | Active | 2015-03-17T17:36:14+01:00:00 |
| Fabrication type | Type of the fabrication | Type de fabrication | Type de fabrication | | Active | 2015-03-17T17:44:45+01:00:00 |
| Bridge information | Gather the information of a bridge layout | Informations du pont | Regroupe l'ensemble des informations concernant la disposition du pont | | Active | 2015-03-17T17:46:24+01:00:00 |
| Bridge layout | The way the pieces of the bridge are arranged | Disposition du pont | Manière dont les éléments du pont sont disposés | | Active | 2015-03-17T17:49:56+01:00:00 |
| Sloping length between field splices | Distance between two consecutive field splice | Distance selon le profil entre couvre-joints | Distance suivant l'axe de l'ouvrage entre deux couvre-joints consécutifs | | Active | 2015-03-18T11:41:21+01:00:00 |
| Sloping length between cross frames | Longitudinal distance between two consecutive cross frames | Distance entre raidisseurs | Distance longitudinale séparant deux raidisseurs consecutif | | Active | 2015-03-18T11:43:54+01:00:00 |
| Grade at begin abutment | Slope along the bridge axis at begin abutment | pente longitudinale à la culée de début | Pente suivant l'axe de l'ouvrage au niveau de la culée initiale | | Active | 2015-03-18T13:23:46+01:00:00 |
| Grade at end abutment | Slope along the bridge axis at end abutment | pente longitudinale à la culée de fin | Pente suivant l'axe de l'ouvrage au niveau de la culée finale | | Active | 2015-03-18T13:25:21+01:00:00 |
| Grade at pier | Slope along the bridge axis at a pier | Pente au niveau d'une pile | Pente suivant l'axe de l'ouvrage au niveau d'une pile | | Active | 2015-03-18T13:26:48+01:00:00 |

**Bridge data dictionary extract**

**Concepts describing a pier and their subgroups**

The diagram below shows the concepts describing one load-bearing structure of a bridge. The other parts of bridges can also be described with a collection of standardised concepts, gathered in subgroups. This diagram illustrates the needed breakdown describing a common pier. All concepts are defined in the data dictionary with their attributes.



| groups | subgroups |
|---|---|
| Pedestal | Properties |
| | Location |
| | Dimensions |
| | Material |
| Cap beam | Properties |
| | Location |
| | Dimensions |
| | Tapered cap beam |
| | Stepped cap beam |
| | Inverted T cap beam |
| | Material |
| Pier column | Properties |
| | Location |
| | Dimensions |
| | Support condition |
| | Material |
| Footing | Properties |
| | Location |
| | Dimensions |
| | Material |
| Drilled shaft | Properties |
| | Location |
| | Dimensions |
| | Support condition |
| | Material |

**Example of concepts describing a pier and their subgroups**

## 4.5. Data dictionary readability and identification of lacks

**Duplicates content**

**Problem**

The data dictionary shape includes attributes for each concept. This is very significant, but the hierarchy links between concepts is more difficult to see.

**Solution**

To solve this problem, the Excel macro is written to create another Excel spreadsheet, entitled 'hierarchical links'. Each hierarchical level corresponds to one column. It has thus the same shape as Dr. Stuart Chen's data dictionary.

This sheet solves the problem of duplicates. The readable shape of the dictionary preserves the hierarchical link between the concepts. Therefore, duplicates of the original data dictionary can be deleted without any loss of information.

**Identification of the lacks**

**Exceptional bridges**

The bridge data dictionary covers the whole field of bridges. So far, we address the current bridges, and we deal with exceptional bridges, including:

- Prestressing and cable elements.
- Construction tools to carry out the works.

The first added to the data dictionary spreadsheet was the prestressing, the cable elements, and the expansion joint elements.

**Studies to complete the data dictionary**

Then, comparisons with other documents were made to complete the data dictionary. Indeed, another working group studied the classification of big concepts of a civil engineering project in different kinds of IFC. Some of them belongs to the IFC-Bridge scope. These concepts were added to the data dictionary when they were absent.

**The use of CHAMOA and MUR programs to check comprehensiveness**

Understandability of the data dictionary was checked thanks to the input data of civil engineering programs CHAMOA and MUR:

| | |
|---|---|
| **CHAMOA** | This software can dimension usual bridges according to the structural Eurocodes (Cerema - DTecITM/CTOA/DCSL) [7]. |
| **MUR** | This software can dimension retaining walls according to the structural Eurocodes (Cerema - DTecITM/CTOA/DCSL) [10]. |

These two programs are developed by the CEREMA. They use organized input data. These data and their organisation helped to complete our data dictionary.

# 5. TRANSFER TO THE BSDD

**Catenda tool**

**Description**

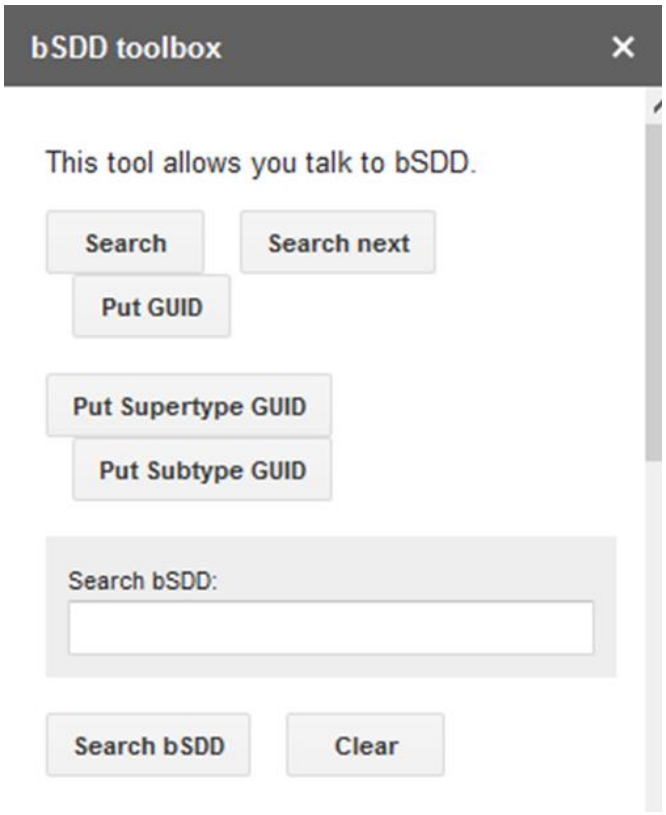
The transfer of the concepts from the data dictionary spreadsheet to the bSDD is done thanks to Catenda.

Catenda set a Google spreadsheet with:

- The same shape than our data dictionary.
- A bSDD module to make the transfer.

**bSDD toolbox**

The screenshot below is the shape of the bSDD toolbox:




**bSDD toolbox**

**Data format checking**

Catenda checks the data format we put in the Google spreadsheet, which represents an additional verification.

**Duplicate content**

During the final transfer Catenda search duplicate content in the bSDD. This module compares the content of the spreadsheet data dictionary with the content of the bSDD to avoid duplicates.

**Inclusion of new concepts**

New concepts may be included in the bSDD later thanks to that module or directly on the bSDD.

**The use of Catenda module**

This module is provided by Catenda and could be used by other working groups to add their concepts in the bSDD.

# 6. METHODOLOGY

**Enter new concepts**

Other working groups create data dictionaries of other domains. Therefore, it is relevant to write a methodology to enter new concepts of new domain in the bSDD. It helps them to be more efficient.

This methodology details the following steps:

| Step | Action |
|---|---|
| 1. | Create identifiers to connect to the bSDD. |
| 2. | Study its working by:<br>• Reading the 'content guidelines' here: (https://docs.google.com/document/d/1YUiR07A27IK0UB8ImYoaoLKCUvh1QFG1FfcvvLOYdP0).<br>• Adding few concepts with their hierarchical links in the bSDD sand box: (http://test.bsdd.buildingsmart.org/). |
| 3. | Create the bSDD Excel spreadsheet by completing:<br>• The 'hierarchical links' sheet.<br>• The 'Values' and 'Units' sheets.<br>• The 'Measures' sheet.<br>• The 'dictionary sheet' thanks to a macro command to import the concepts from the 'hierarchical links' sheet. |
| 4. | Copy paste the previous sheets to the Google sheet data dictionary: (https://docs.google.com/spreadsheets/d/1HdngJfleyNsmYCyMrwCsOqrizP46cRbvstp6Mo6_UoY). |
| 5. | Use the bSDD toolbox to check and avoid duplicates in the bSDD. |
| 6. | Transfer the concepts to the bSDD thanks to the button appearing after logging in. |

**Catenda's approval**

This methodology has been sent to Catenda for approval.

# 7. CONCLUSION

**The data dictionary: an interested concept**

**Groups interested in the data dictionary**

The interest of other groups in the construction sector shows the relevance of the data dictionary. We were contacted several times about the dictionary:

- Working groups on the IFC tunnels and on the IFC roads. They must create data dictionaries with concepts related to the tunnels. These groups wished to adopt our method of classification.
- AEC3, which uses our work to define new IFC classes for civil engineering. AEC3 is an international consulting company in the field of process optimisation in the building industry. For more than ten years, they are specialised in the support of planning and construction processes. They integrate model-based IT solutions - today known as Building Information Modelling (BIM).

**Maintenance of bSDD**

After the final transfer, the maintenance of bSDD concerning the bridge concept is provided by an organisation such as the Cerema. Indeed, Cerema has skills in that domain.

**Catenda module's role**

Thanks to the Catenda's module, the organisation is able to add new entities.

# 8. REFERENCES

[1] Muthiah Kasi nd Robert E. Chapman, 2011, Proposed UNIFORMAT II Classification of Bridge Elements, NIST (U.S. Department of Commerce National Institute of Standards and Technology) Special Publication 1122.

[2] BRIME – Bridge Management in Europe, 2001, Appendix III: Glossary of terms used in bridge engineering, 99p.

[3] AFNOR. (2014, décembre). XP P07-150 : Propriétés des produits et systèmes utilisés en construction – Définition des propriétés, méthodologie de création et de gestion des propriétés dans un référentiel harmonisé.

[4] bSDD_Content_Guidelines, buildingSMART, available on http://bsdd.buildingsmart.org/

[5] SETRA-CTOA/DGO. (août 1997). Lexique relatif à la construction des ouvrages d'art. H. Oudin, R. Tardy, août 1997.

[6] Direction générale des routes (DGR) - Observatoire national de la route (ONR). (2008, juin 1). Dictionnaire de l'entretien routier, VOLUME 5 : Ouvrage d'art. (DGR, Éd.).

[7] Cerema - DTecITM/CTOA/DCSL. CHAMOA. Extract from Les logiciels ouvrages d'art du CTOA: http://www.setra.fr/html/logicielsOA/Ponts_Types/CHAMOA-P/chamoa-p.html

[8] SETRA-LCPC. (1986). Nomenclature des parties d'ouvrages d'art métalliques.

[9] SETRA - LCPC. (1976). Nomenclature des parties d'ouvrages d'art en béton armé et précontraint et en maçonnerie.

[10] Cerema - DTecITM/CTOA/DCSL. MUR : Calcul de murs de soutènement. Extract from Les logiciels ouvrages d'art du CTOA.