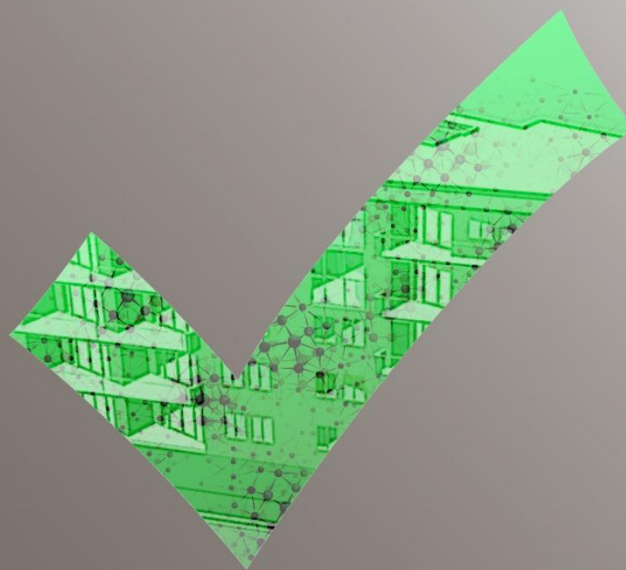




Toward French Semantic Regulation checking based on semantic rules

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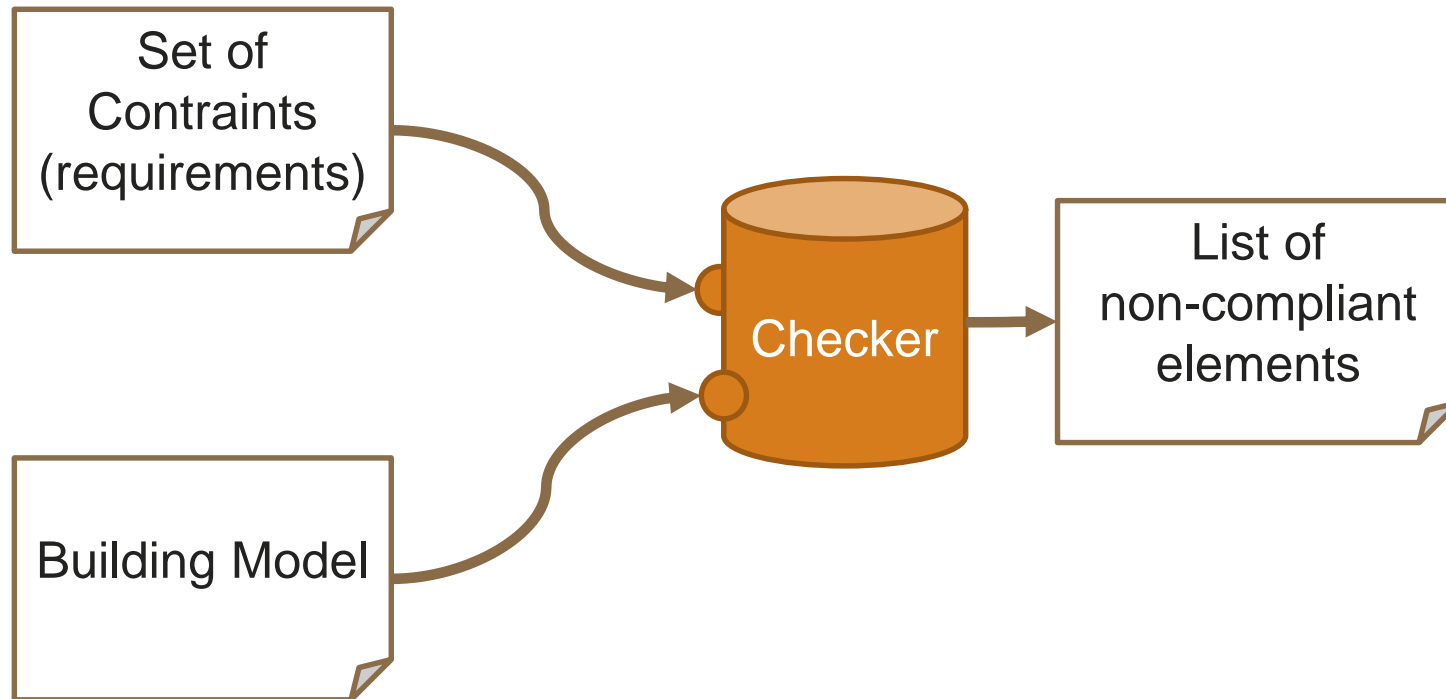
CSTB/TI - Nicolas BUS; Guillaume PICINBONO



**« Digitizing French Building Regulation »
=> Methods and POC**

**Sponsor : French Ministry for Housing
18 Month => July 2018**

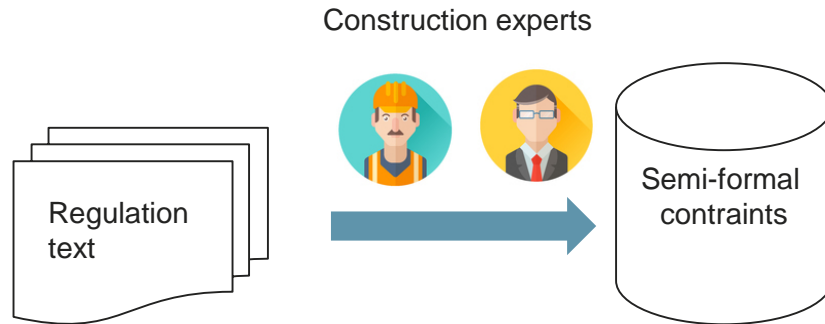
**Involving regulation experts and knowledge engineers
Lead by CSTB**

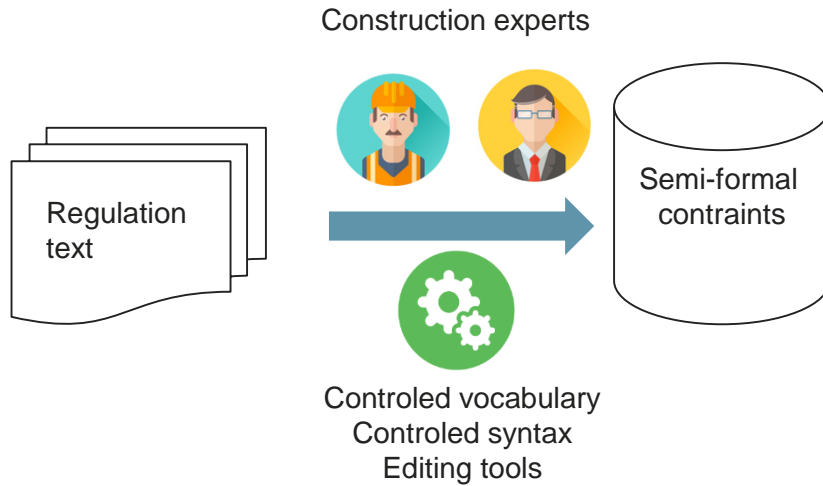


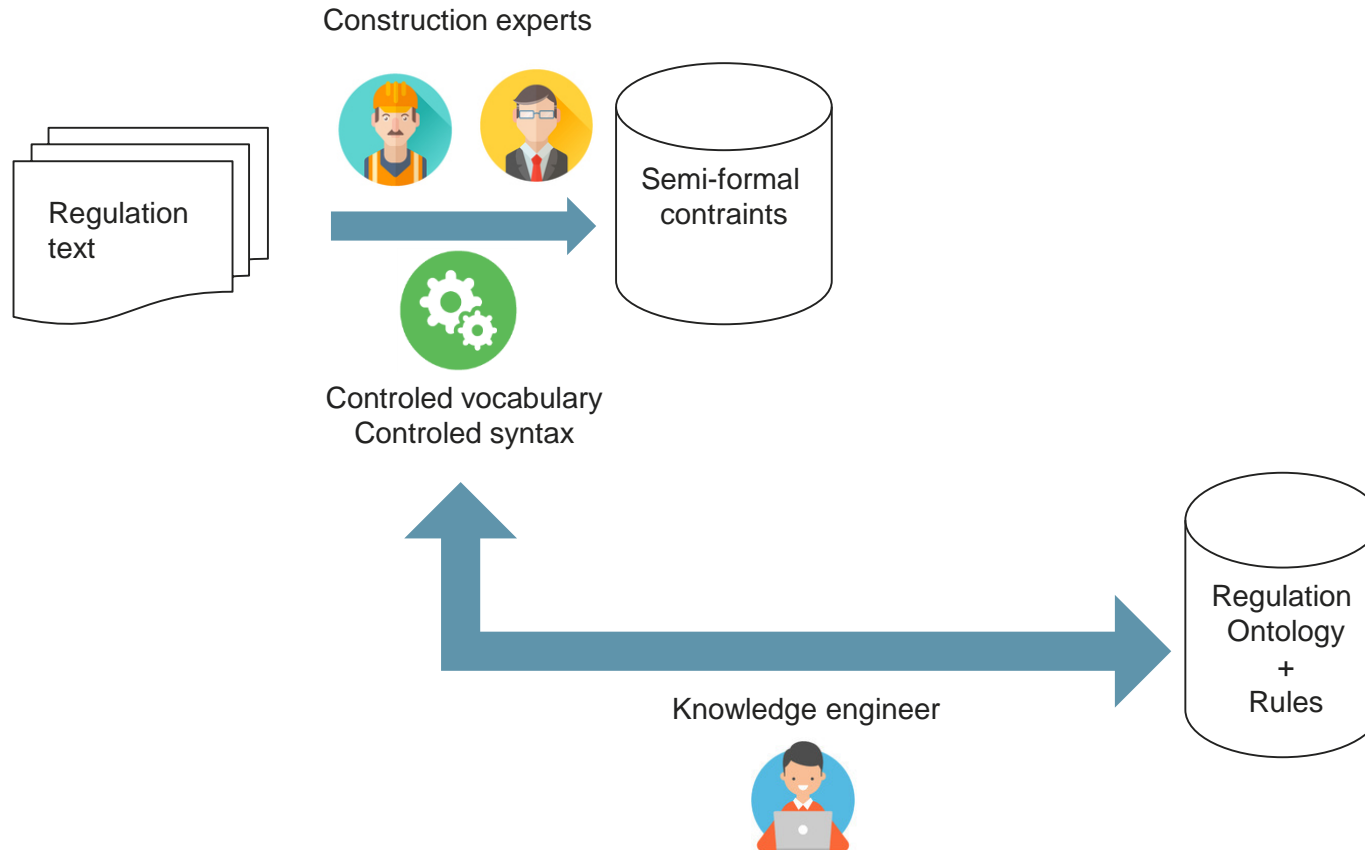
1. Build an **extensible** and **white box** compliance checker
2. Bridge the gap between **human readable** texts and **IFC concepts**

- **Easy to extend** and to add new constraints
- Constraint are **decoupled** from checker implementation
- Constraints and are **auditable**
- Constraints use a **standard** language

- Regulation and BIM use **non-bijective vocabularies**
 - Regulation use a lot of **synonyms**
 - The regulation is **ambiguous**
 - The regulatory text is **not autonomous** (lots of references)
-
- IFC is **verbose** and **low level**
 - IFC geometry is **polymorph** with high level of **detail**







REGULATION TEXT

All elements that takes part to the structure, under the roof, slab must be resistant enough in case of fire (see fire safety standard...).

SEMI-FORMAL CONSTRAINT

IF `structure_element` in `latest_storey` no `fireproof` **THEN_NON_COMPLIANT**

Always begins with « IF »

Use controled vocabulary

Always ends with
« THEN_NON_COMPLIANT »

`element fireproof` ⇔ `element fire_rating > 1h`

Equivalence

French Regulation Ontology

High level concept

Regulation concepts built on other regulation concepts

Alignment

Regulation vocabulary built on IFC concepts

Simplification

Properties, classifications, types, Geometry, topology

IFCOWL

French Regulation Ontology

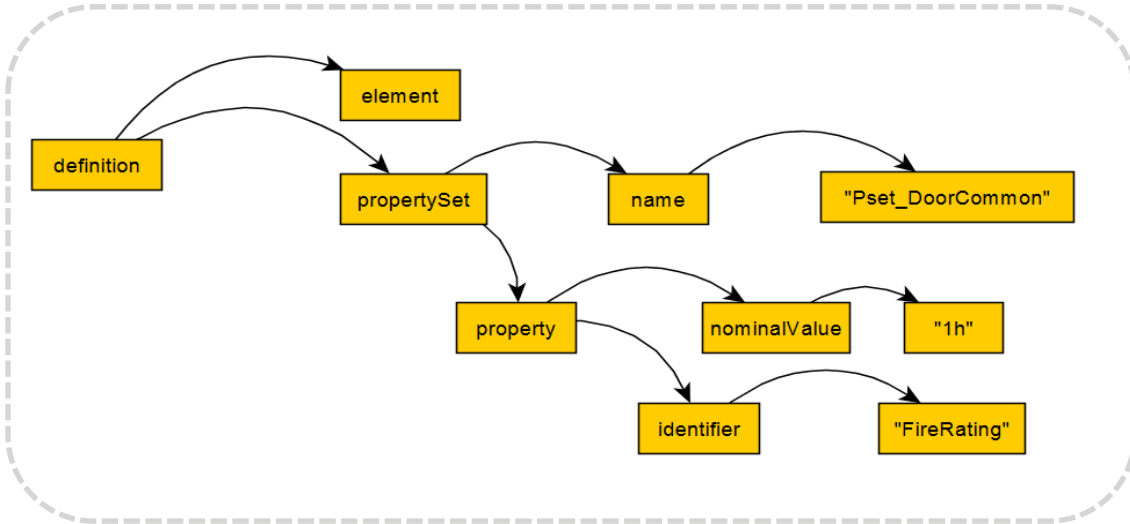
High level concept *:ProtectedSpace*

Alignment *:FireProof*

Simplification *:FireRating*

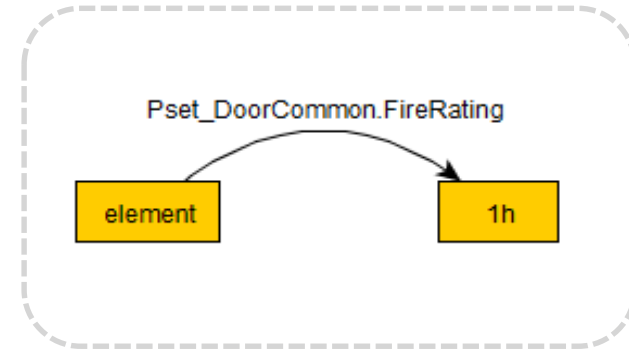
IFCOWL *:RelDefinedByProperties*

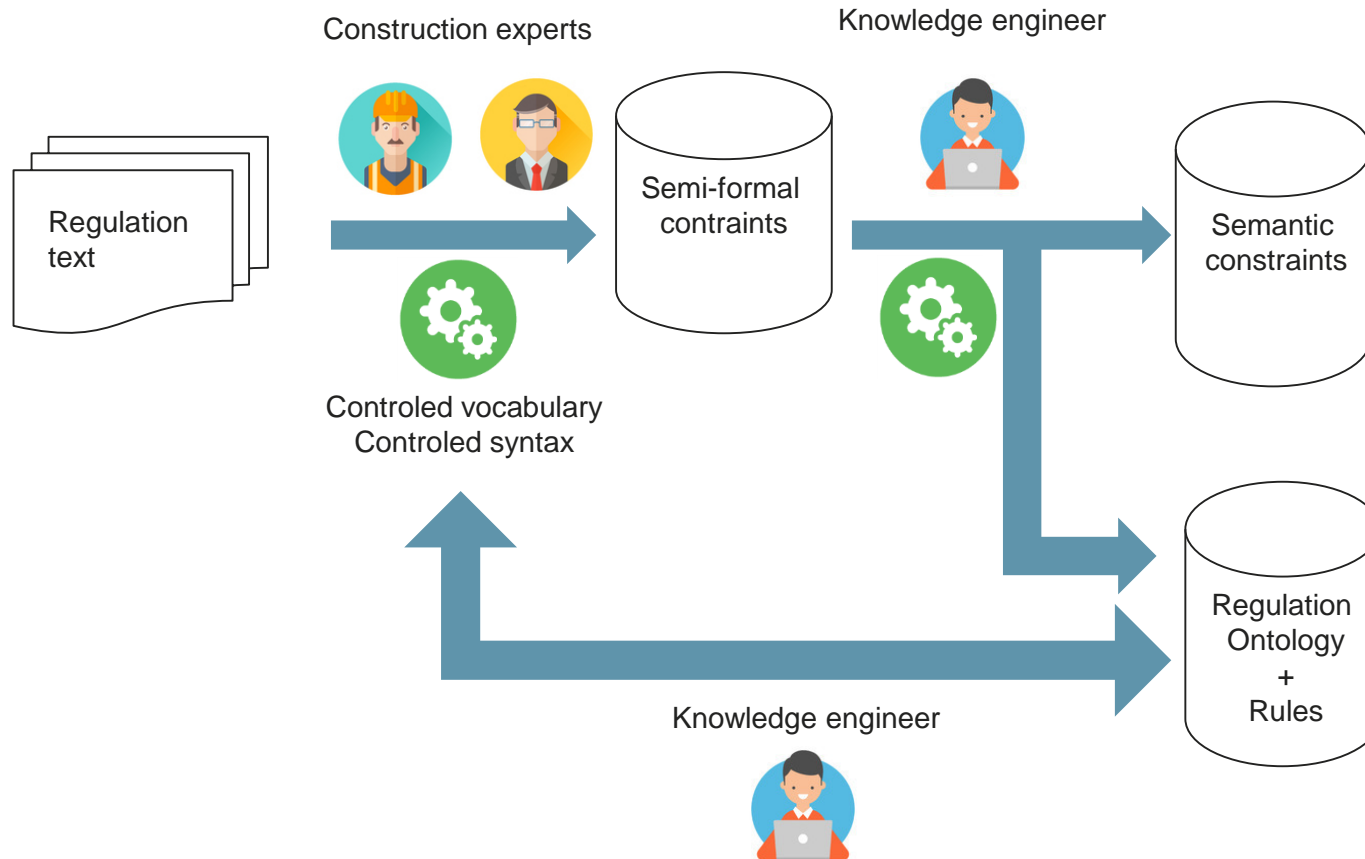
IFC-OWL way to express an object property

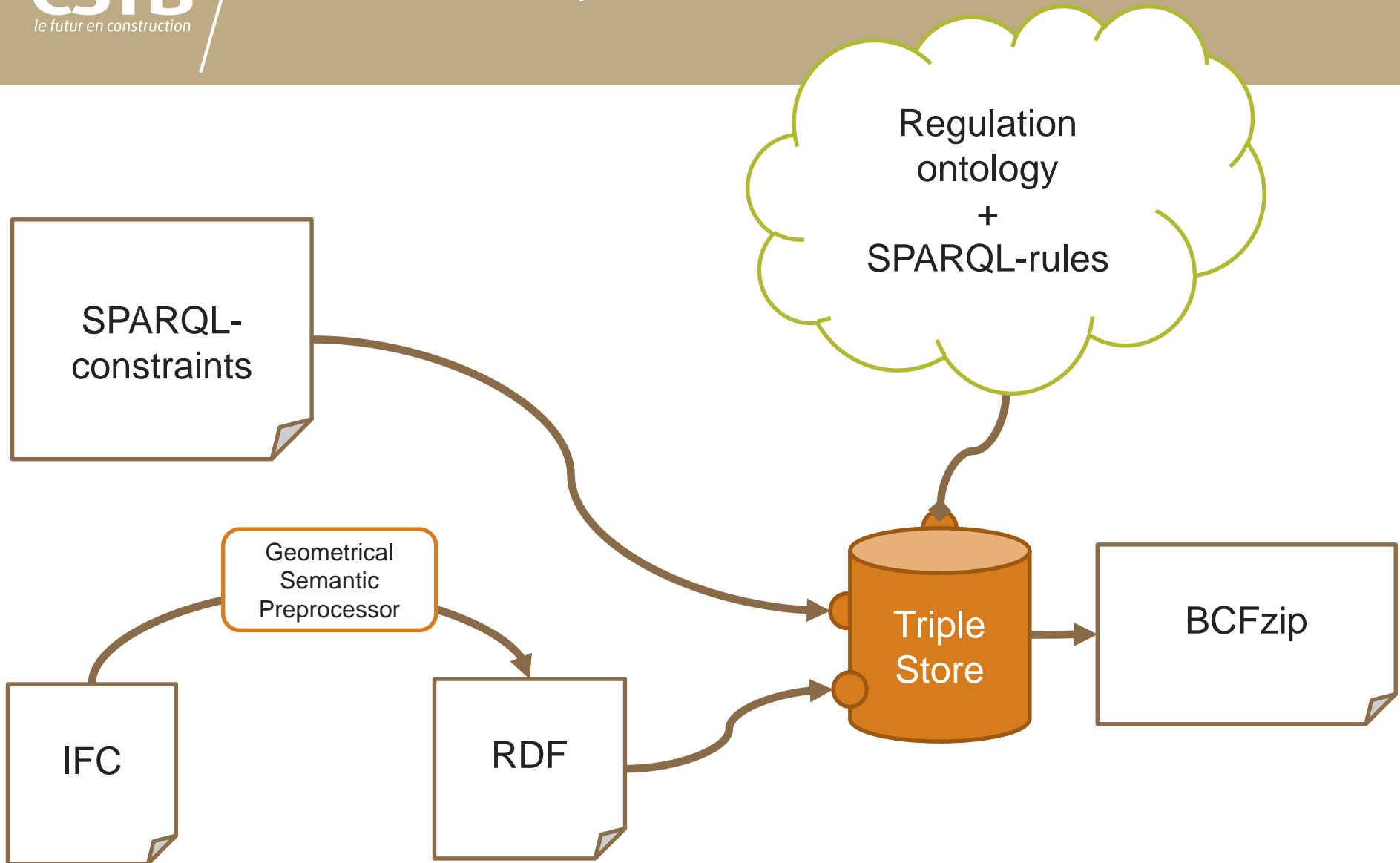


Equivalence

Simplified way







Watching report as
BCF annotations

The screenshot displays a BIM software interface with the following components:

- Modèles Panel:** A table listing files with columns for 'Nom du fichier', 'Type', and 'Version'. The selected file is 'Maquette_Avec_Erreurs.ifc' of type 'IFC2x3' and version 'IFC2x3'.
- Annotations Panel:** Shows the active BCF file 'Maquette_Avec_Erreurs.master.bcf'. It includes a 'Grouper par' dropdown set to 'Aucun', a 'Créer une Annotation' button, and a table of annotations.
- Annotations Table:**

Titre	Commentaires	Date de création
87.3 - Espac...	1	16/10/2017 17:12
87.2 - Espac...	1	16/10/2017 17:12
87.1 - Espac...	1	16/10/2017 17:12
- 3D View:** A 3D model of a building with numerous yellow vertical markers on the roof, representing BCF annotations. A coordinate system (X, Y, Z) is visible at the bottom left.

Improving **geometry level of detail**

Improving **topological inferences**

Improving **rules classification**

Applying constraints corresponding to **building type**

Improving Ontology and rule **maintenance**

Automating Ontology **documentation** including Rules



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Thanks your attention...

CSTB
le futur en construction

Appendices

SEMI-FORMAL CONSTRAINT

IF `structure_element in latest_storey` no `fireproof` THEN NON-COMPLIANT

SPARQL-RULES + ONTOLOGY

```
?e :LoadBearing true
```

```
=>
```

```
?e :StructureElement
```

```
...
```

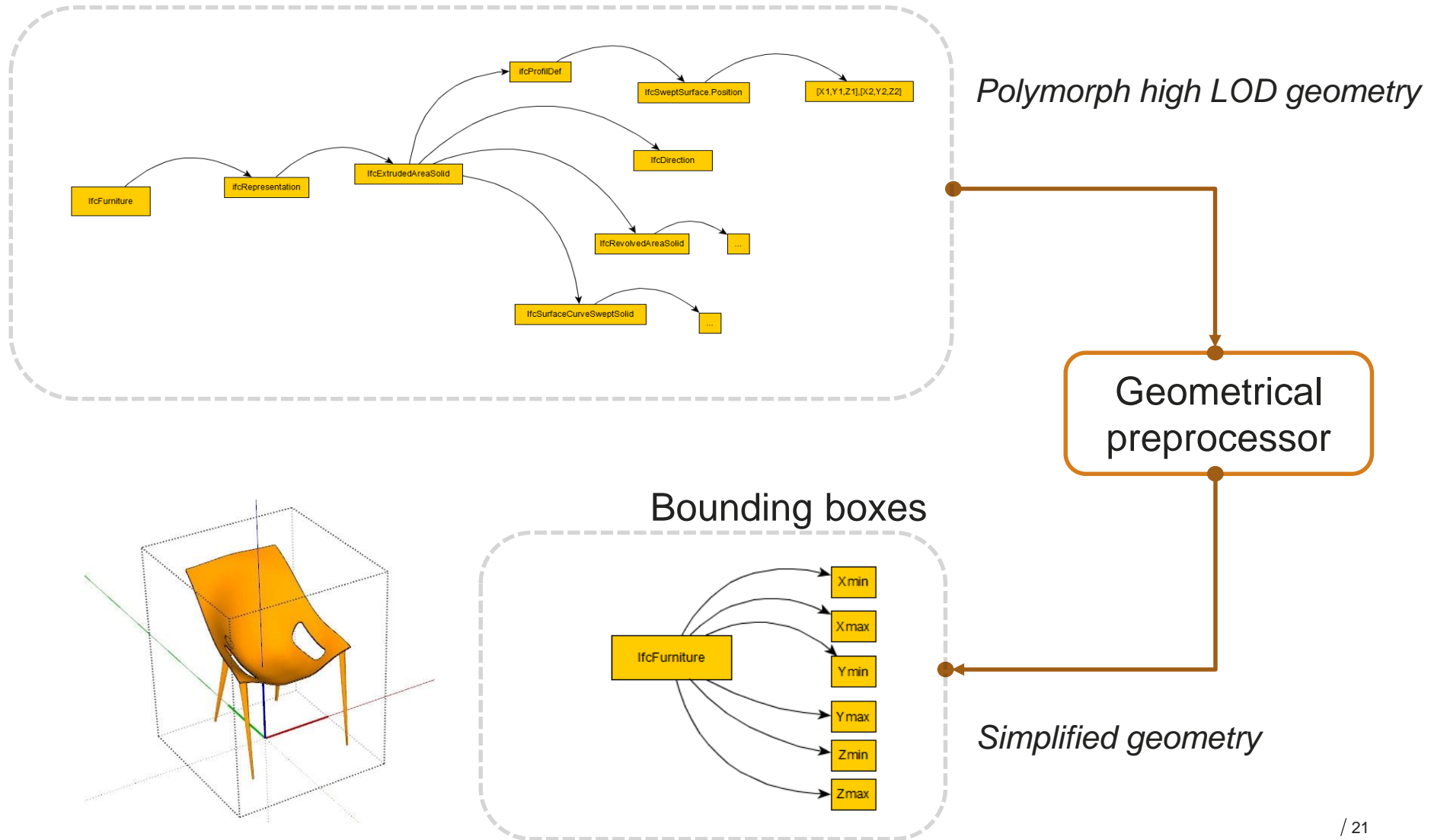
SPARQL CONSTRAINT

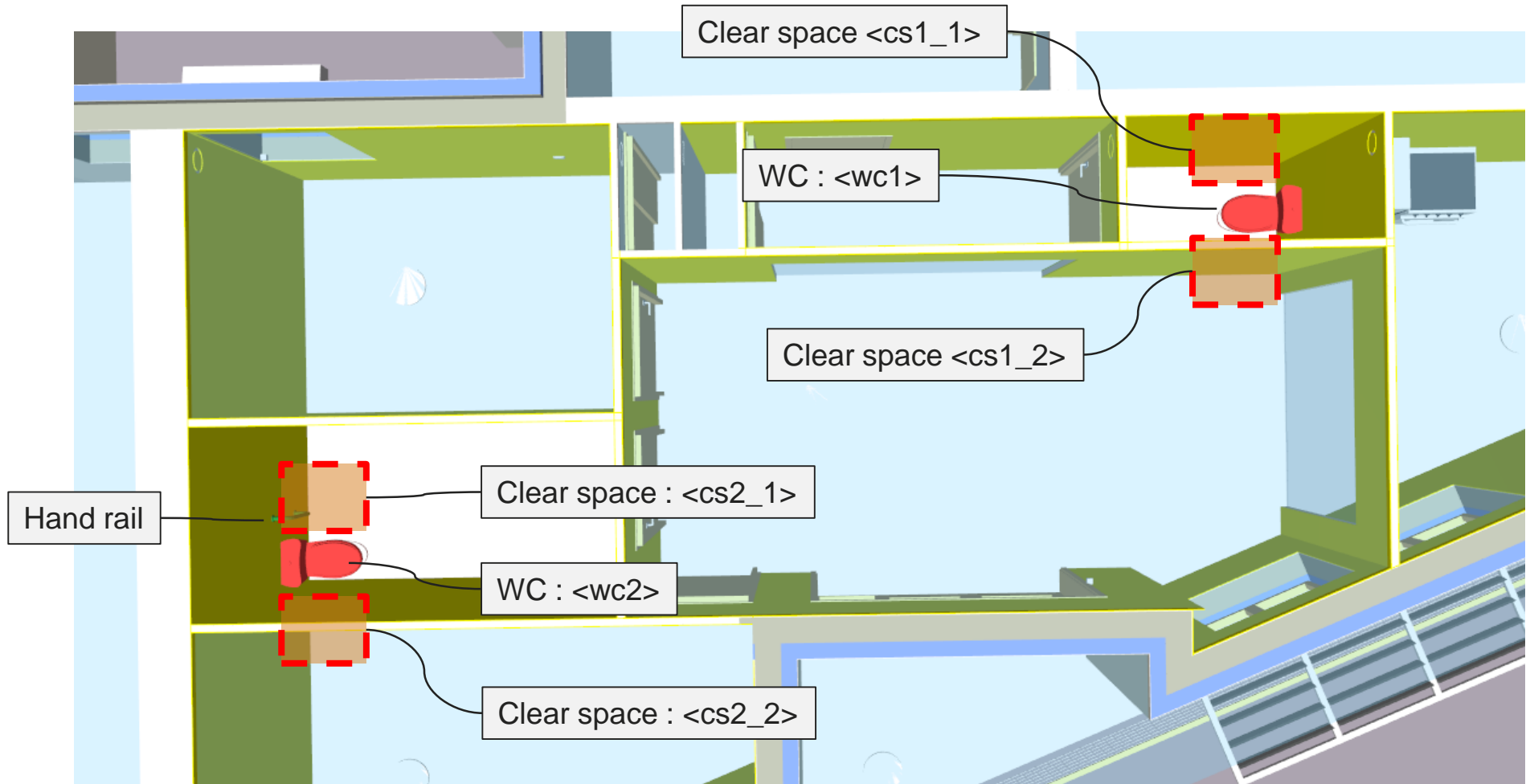
```
SELECT ?e
```

```
?building :LatestStorey ?storey .
```

```
NOT EXISTS (?e a :FireProof)
```

```
?e a :StructureElement; :In ?storey .
```





The screenshot displays the 'Plateforme Numérique Bâtiment' interface. The header includes the platform name and a 'beta' badge. The main area shows a file list under the user 'CM Chez moi'. The file list contains the following entries:

Icon	Filename	Status	Actions	Date	Size
PDF	cerfa_13824-03 (1).pdf		🔍 ⋮ NB	13/04/2018 11:27	736.25 ko
EDF	test.edf			22/03/2018 11:16	21.54 ko
BCF	AIX_ESQ_ARC_ENV.master.bcfzip			03/11/2017 10:51	40.8 ko
IFC	AIX_ESQ_ARC_ENV.ifc	invalide		03/11/2017 10:51	30.19 Mo
BCF	AC9R1-Haus-G-H-Ver2-2x3.master.bcfzip		⋮ 🗑️	03/11/2017 10:49	10.28 ko
IFC	AC9R1-Haus-G-H-Ver2-2x3.ifc	invalide	💬 ⋮ NB	03/11/2017 10:49	4.35 Mo
BCF	test8.master.bcfzip		⋮ FC	23/10/2017 14:40	12.1 ko

A yellow callout box with the text 'IFC file uploaded' has an arrow pointing to the 'AC9R1-Haus-G-H-Ver2-2x3.ifc' file entry, which is marked as 'invalide'.

SEMI-FORMAL CONSTRAINT

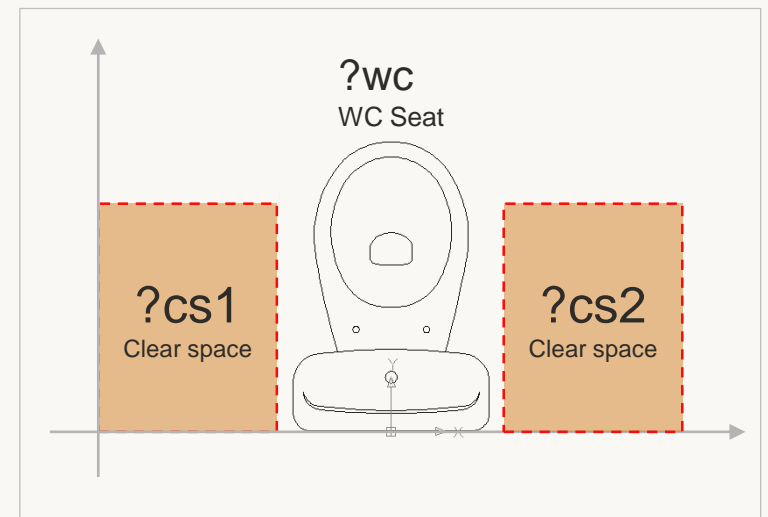
IF no **clear_space** of **width 0.8m**, **depth 1m** beside a **WC_seat** THEN NON-COMPLIANT

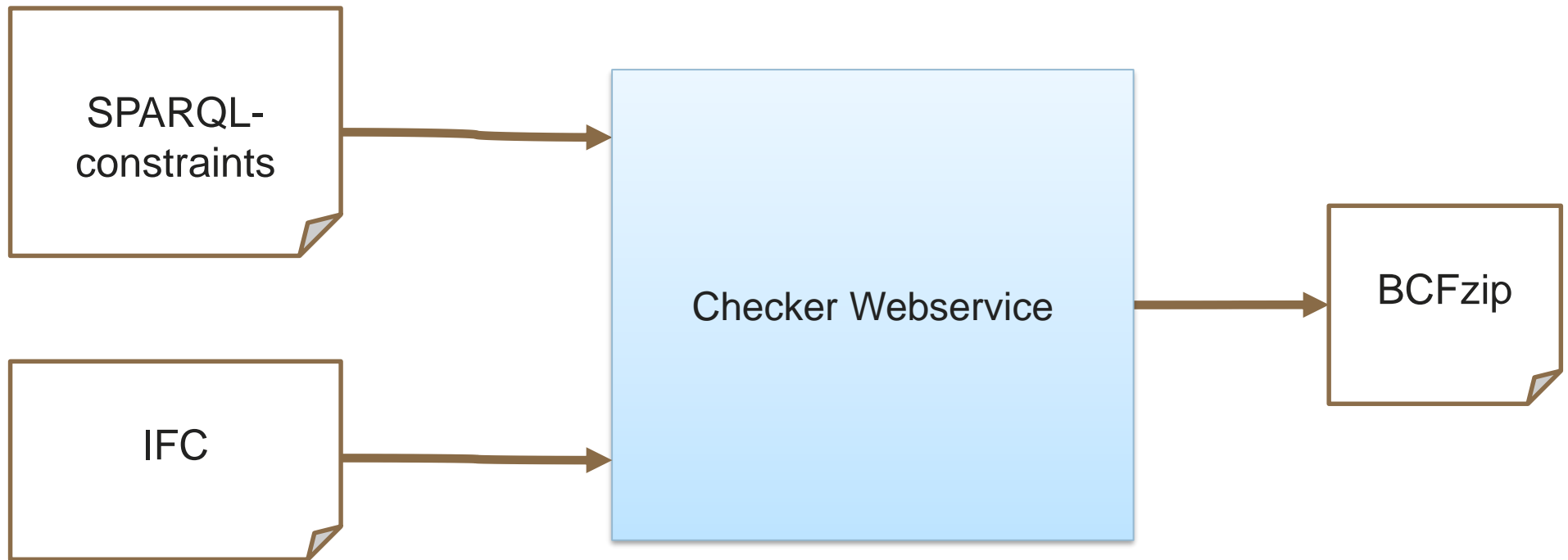
RULE + ONTOLOGY

```
?wc a :WCSeat
=>
?wc :NeedClearSpace ?cs1 ; :NeedClearSpace ?cs2 .
?cs1 :Width 0.8 ; :Depth 1 .
...
?cs1 :X (?WC_X + ?dX) .
?cs1 :Y (?WC_Y) .
```

CONSTRAINT

```
SELECT ?wc
...
?wc a :WC ; ?wc :NeedClearSpace ?cs
?e :Intersects ?cs
...
HAVING COUNT(DISTINCT ?cs)=2
```





The screenshot displays the 'Plateforme Numérique Bâtiment' interface. A yellow callout box with the text 'Executing checker service' has an arrow pointing to the 'Vérifier la maquette' option in a context menu. The context menu is open over a file named 'AIX_ESQ_ARC_ENV.ifc' which is marked as 'invalide'. The file list on the right shows various files with their dates and sizes.

File Name	Date	Size
cer	13/04/2018 11:27	736.25 ko
test.edf	22/03/2018 11:16	21.54 ko
AIX_ESQ_ARC_ENV.master.bcfzip	03/11/2017 10:51	40.8 ko
AIX_ESQ_ARC_ENV.ifc invalide	03/11/2017 10:51	30.19 Mo
AC9R1-Haus-G-H-Ver2-2x3.master.bcfzip	03/11/2017 10:49	10.28 ko
AC9R1-Haus-G-H-Ver2-2x3.ifc invalide	03/11/2017 10:49	4.35 Mo
test8.master.bcfzip	23/10/2017 14:40	12.1 ko

The screenshot displays the 'Assistant de contrôle IFC' (IFC Control Assistant) dialog box. The dialog lists several constraint sets, with 'Règles sur les Réseaux, fluides' (Rules for Networks, fluids) highlighted. A yellow callout box with the text 'Selecting a Constraints set to apply' points to this selection. The background shows a file explorer interface with various files and folders.

Protocole test	Fichier pour tester l'usage de la plateforme DHUP pour une vidéo
wimi_pfptnbdev_io_9445	
wimi_pfptnbdev_io_9449	
Règles sur les Matériaux	
Règles sur les Réseaux, fluides	
Règles sur les Espaces	
PFPTNB - Vérifications Essentielles 2.0	Vérification de présence des informations essentielles : Unités, Phase, Géoréférencement, Arborescence spatiale, Quantités de bases
PFPTNB - Vérifications Essentielles 2.1	Vérification de présence des informations essentielles : Unités, Phase, Géoréférencement, Arborescence spatiale, Quantités de bases
Règles sur les Equipements	
Règles sur les Revêtements	
Règles sur les Menuiseries	

Reading the report

Aut RefLongitude de IfcSite doit être renseigné		Alerte
A4.1 - IfcBuilding dans IfcSite	La structure spatiale de rattachement du ou des bâtiments (IfcBuilding) est le site (IfcSite)	RAS
A4.2 - IfcBuildingStorey dans IfcBuilding	La structure spatiale de rattachement des étages (IfcBuildingStorey) est le bâtiment (IfcBuilding)	RAS
A4.3 - IfcSpace dans IfcBuildingStorey	La structure spatiale de rattachement des espaces (IfcSpace) est l'étage (IfcBuildingStorey)	RAS
B1.1 - Murs - Longueur	La longueur des murs (IfcWall / IfcWalStandardCase) est attendue dans la quantité de base (BaseQuantities) NominalLength.	Alerte
B1.2 - Murs - Hauteur	La hauteur des murs (IfcWall / IfcWalStandardCase) est attendue dans la quantité de base (BaseQuantities) NominalHeight.	Alerte
B1.3 - Murs - Epaisseur	L'épaisseur des murs (IfcWall / IfcWalStandardCase) est attendue dans la quantité de base (BaseQuantities) NominalWidth.	Alerte
B1.4 - Murs - Volume	Le volume des murs (IfcWall / IfcWalStandardCase) est attendu dans la quantité de base (BaseQuantities) NetVolume.	Alerte
B2.1 - Dalles - Surface	La surface des dalles (IfcSlab) est attendue dans la quantité de base (BaseQuantities) NetArea.	Alerte
B2.2 - Dalles - Epaisseur	L'épaisseur des dalles (IfcSlab) est attendue dans la quantité de base (BaseQuantities) NominalWidth.	Alerte
B2.3 - Dalles - Volume	Le volume des dalles (IfcSlab) est attendu dans la quantité de base (BaseQuantities) NetVolume.	Alerte
B3.1 - Poteaux - Longueur	La longueur des poteaux (IfcColumn) est attendue dans la quantité de base (BaseQuantities) NominalLength.	Alerte

Watching report as
BCF annotations

The screenshot displays the KROQI Platform interface. On the left, a sidebar contains a 'Modèles' section with a table listing files, and an 'Annotations' section with a table of BCF annotations. The main area shows a 3D model of a building with numerous yellow vertical markers on its roof, representing BCF annotations. A yellow callout box with the text 'Watching report as BCF annotations' has two arrows pointing to the 'Annotations' sidebar and the 3D model. A mouse cursor is visible in the bottom right of the 3D view area.

Nom du fichier	Type	Version
Maquette_Avec_Erreurs.ifc	IFC 2x3	IFC2x3

Titre	Commentaires	Date de création
87.3 - Espac...	1	16/10/2017 17:12
87.2 - Espac...	1	16/10/2017 17:12
87.1 - Espac...	1	16/10/2017 17:12