Ruben Kruiper
Ioannis Konstas
Alasdair Gray

Farhad Sadeghineko
Richard Watson
Bimal Kumar

Don’t shoehorn, but Link Compliance Checking Data

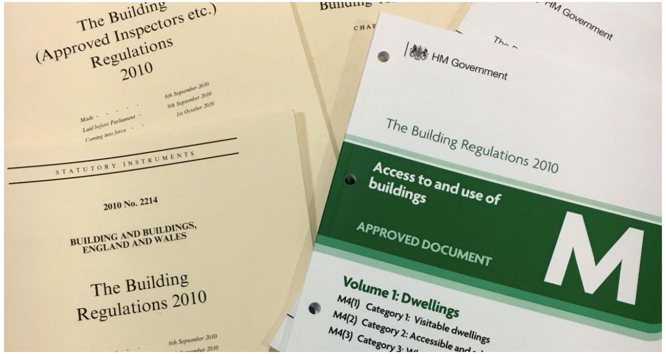
Overview

- Problem space: Automated Compliance Checking (ACC)
  - Subproblem: parsing regulatory texts
  - Subproblem: representing building information
  - Subproblem: formulating rules for ACC
- Solutions in the ACC space benefit from using Linked Data
  - Practical support for current Compliance Checking (CC) process
  - Strategy that relies heavily on Linked Data

Motivations for ACC

- Less human errors, as non-compliance has been linked to (fatal) incidents
  - e.g., Grenfell, and many more
- Additionally, compliance checking is time consuming, complexity, cost, modularity, …

Automated Compliance Checking (ACC)



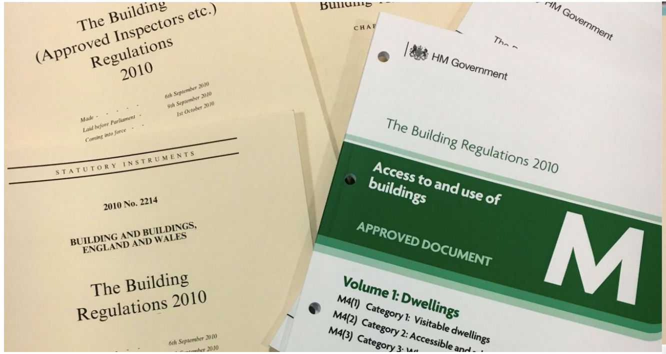
Regulations

- Texts
  - References to tables, figures, sections, documents
- Tables
- Figures
- Formulas
- …

Building (product) information

- IFC, BOT, etc.
- Uniclass, Omniclass, etc
- Classes of:
  - Parts
  - Materials
  - …
- Measurements
- Logistics
- Budgets
- …

Automated Compliance Checking (ACC)



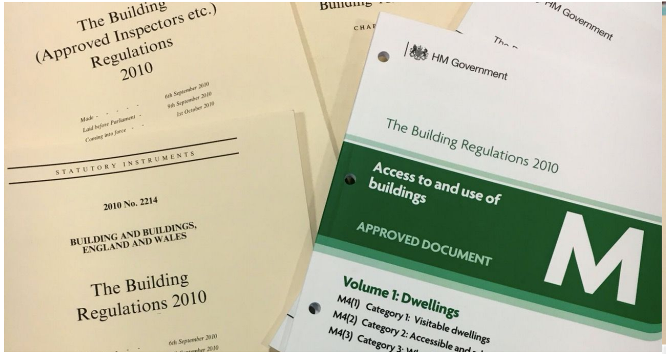
Regulations

- Texts
  - References to tables, figures, sections, documents
- Tables
- Figures
- Formulas
- …

Building (product) information

- IFC, BOT, etc.
- Uniclass, Omniclass, etc
- Classes of:
  - Parts
  - Materials
  - …
- Measurements
- Logistics
- Budgets
- …

Automated Compliance Checking (ACC)



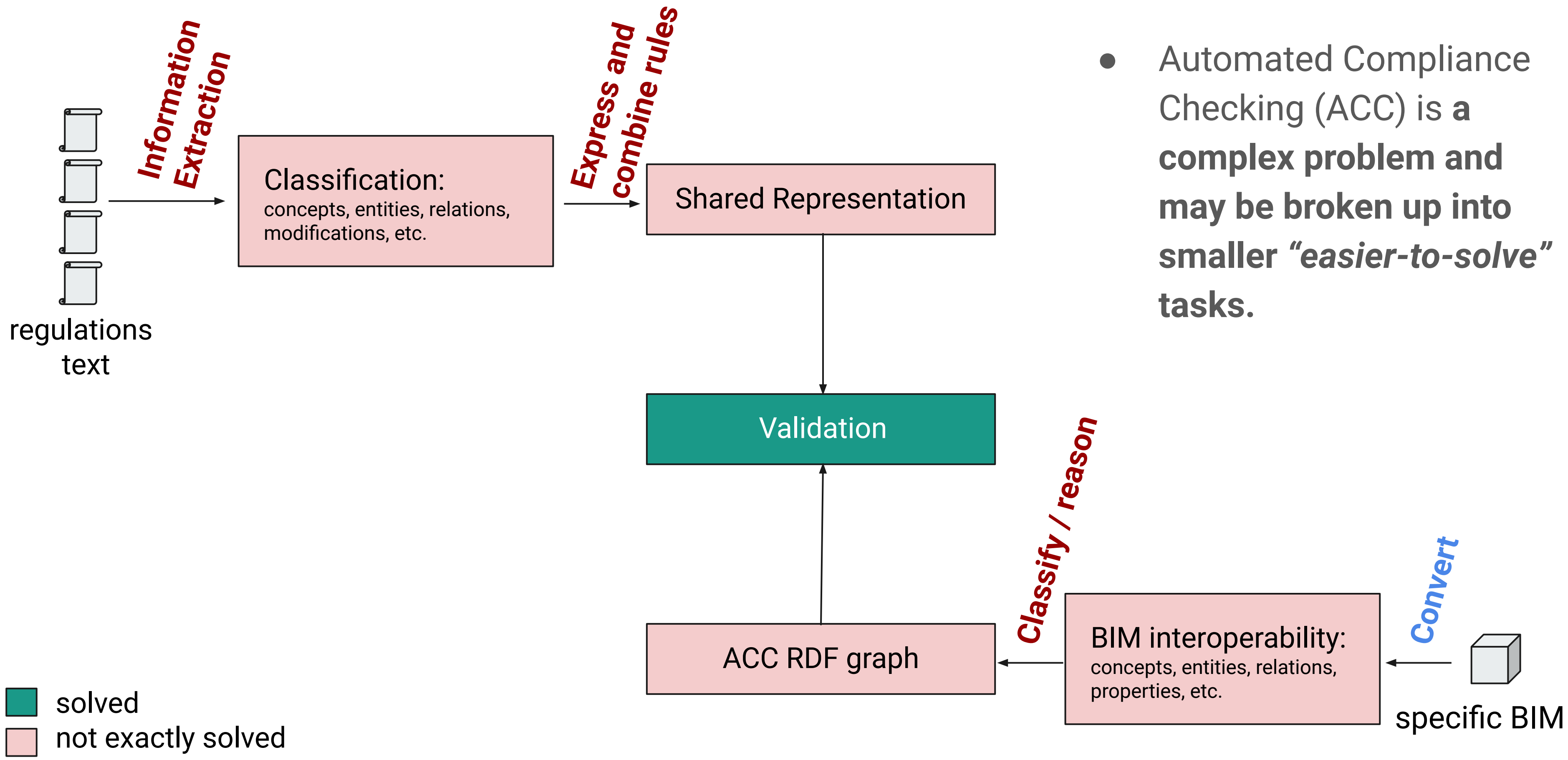
Regulations

- Semantic parsing, e.g., automatically ***derive rules from regulatory texts***

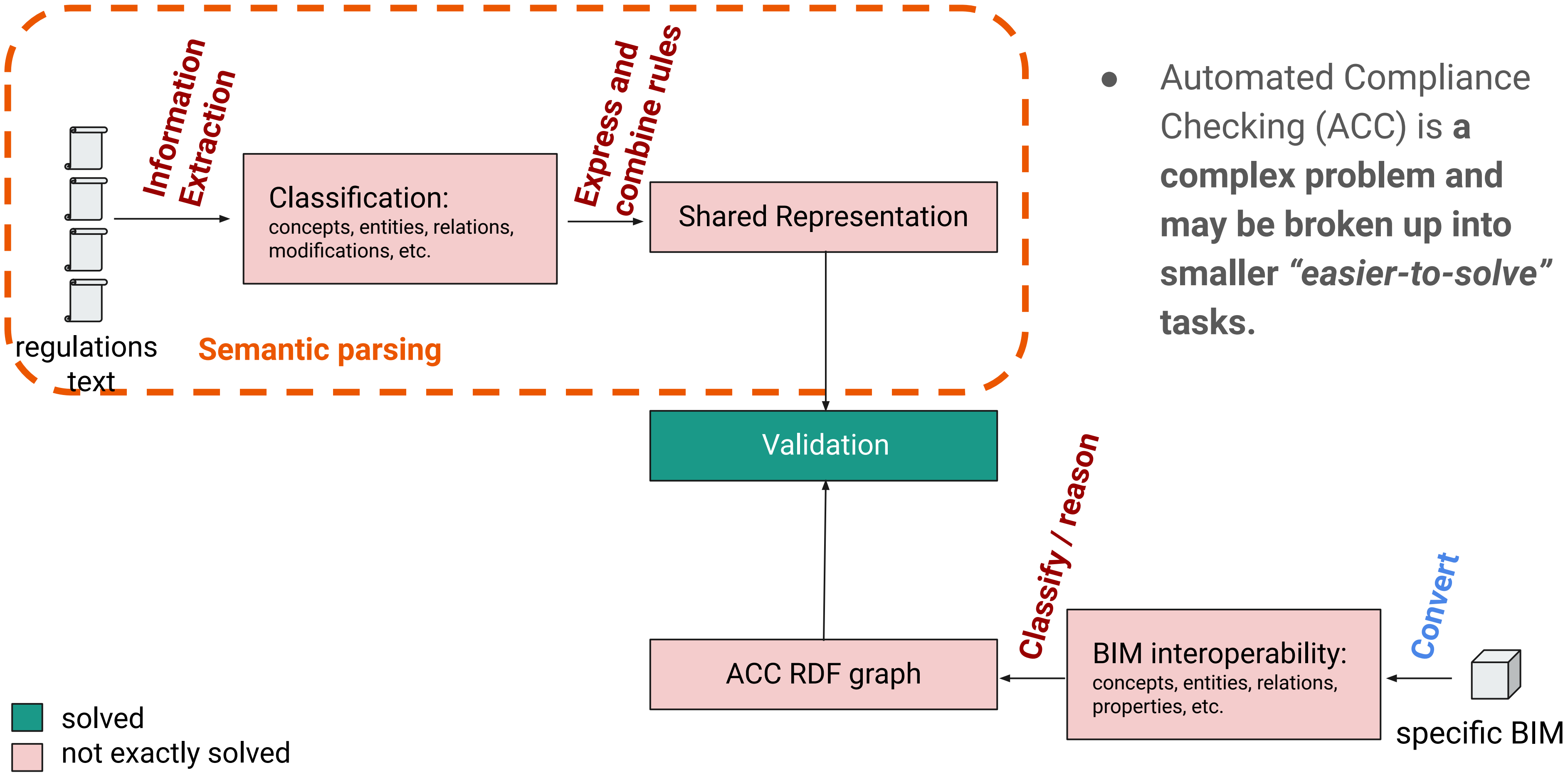
← **existing approaches** →

Building (product) information

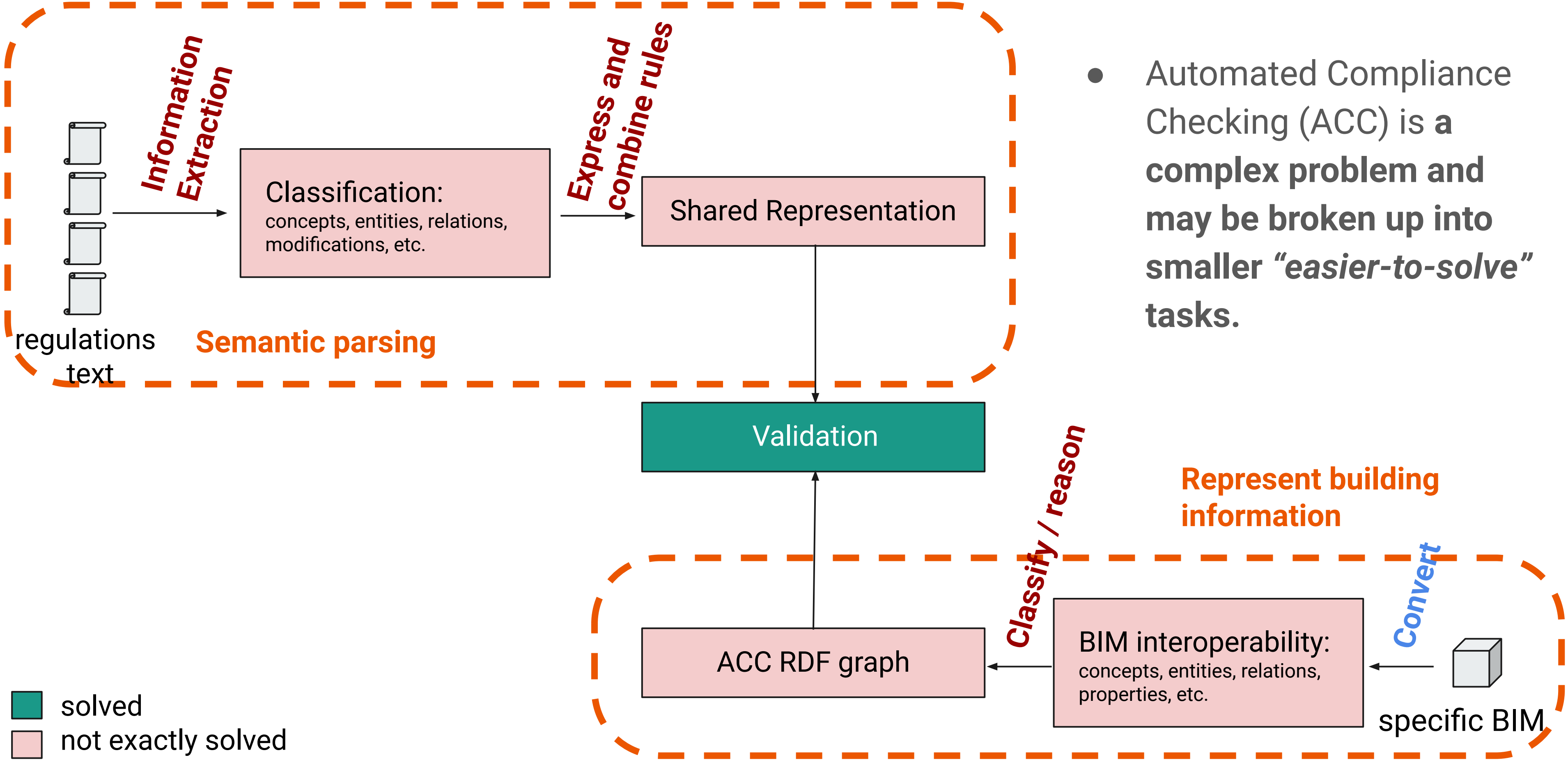
- Automated validation, e.g., compare BIM against manually crafted rules



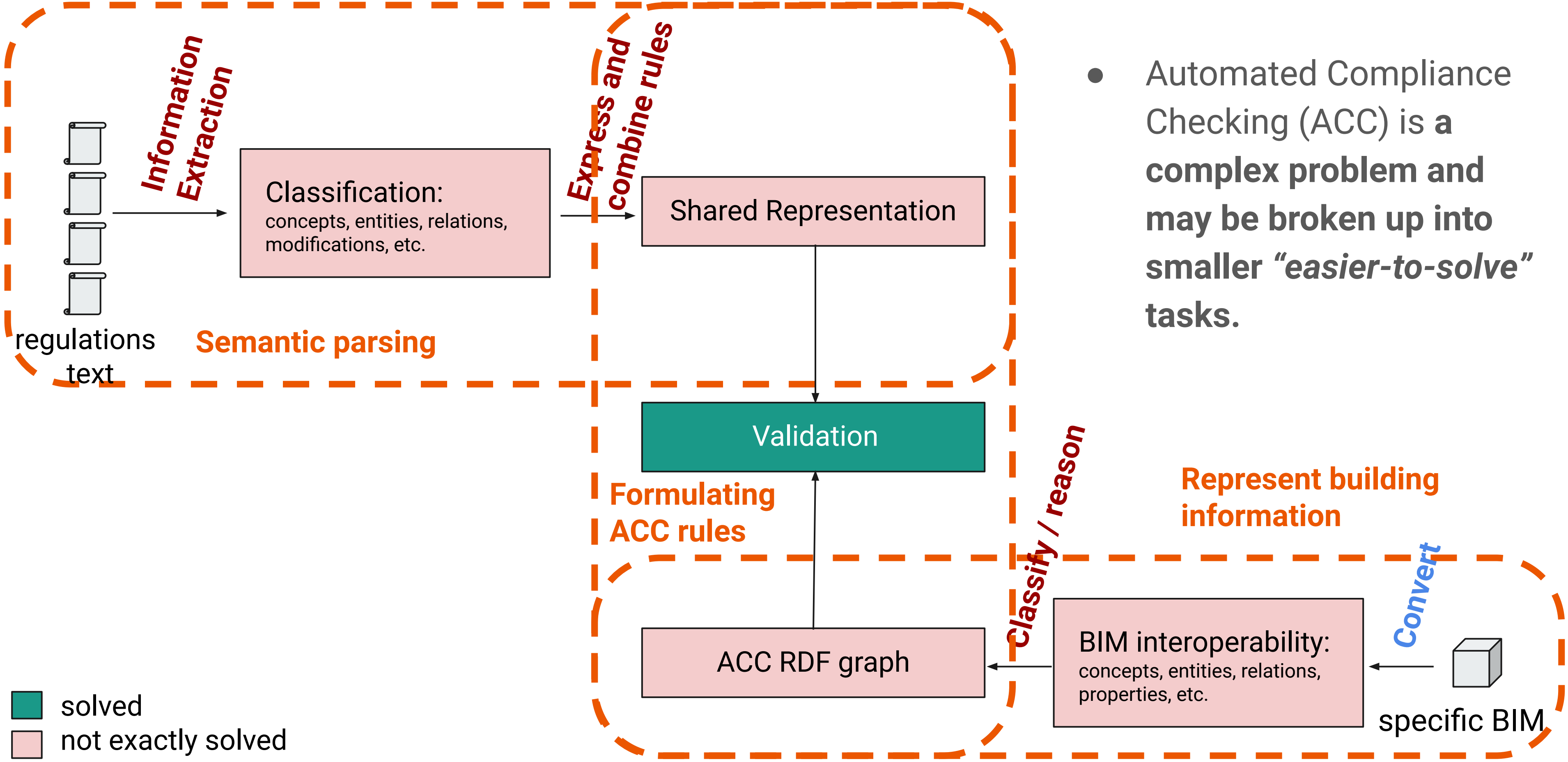
- Automated Compliance Checking (ACC) is **a complex problem and may be broken up into smaller *“easier-to-solve”* tasks.**



- Automated Compliance Checking (ACC) is **a complex problem and may be broken up into smaller *"easier-to-solve"* tasks.**

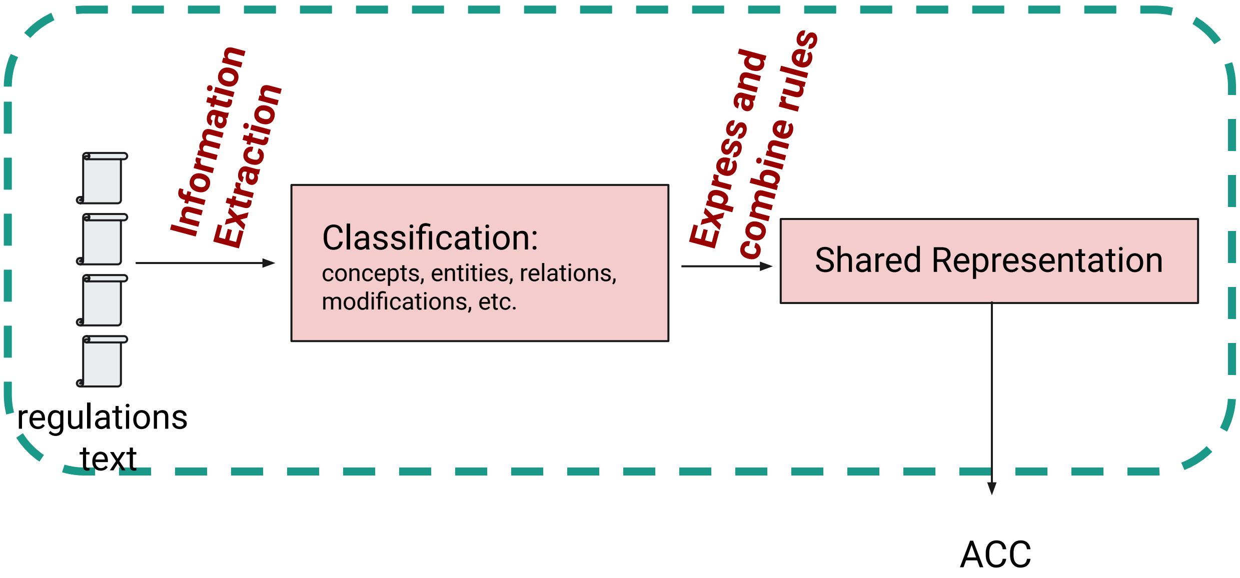


- Automated Compliance Checking (ACC) is **a complex problem and may be broken up into smaller *"easier-to-solve"* tasks.**

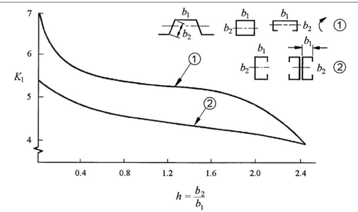


- Automated Compliance Checking (ACC) is **a complex problem and may be broken up into smaller *"easier-to-solve"* tasks.**

1. Semantic parsing of building regulations



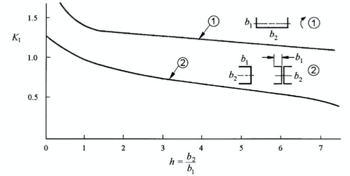
Semantic parsing is the automated conversion of language to rules.



Curve 1 Element connection to webs on both edges $K_1 \approx 7 - \frac{1.8h}{0.15 + h} - 0.091h^3$

Curve 2 Element connected to web on one edge and lip on other edge $K_1 \approx 5.4 - \frac{1.4h}{0.6 + h} - 0.02h^3$

Figure B.2 — *K* factors for stiffened compression elements of beams



Curve 1 Channel flanges as bending elements $K_1 \approx \frac{3.4}{\left(2 + \frac{h}{1 + h}\right)}$

Curve 2 Unstiffened element $K_1 \approx 1.28 - \frac{0.8h}{2 + h} - 0.0025h^2$

Figure B.3 — *K* factors for unstiffened elements of beams

Table 6 – Shortened testing programme, test specimens, type of the test and conditions for ITT

Characteristic	Test method	Type of test	Tested panel thickness	Min. number of ITT specimens	Compliance c
5.2.1.2 Shear strength and modulus	A.3 or A.4	ITT	Maximum	3	G_C and f_{Cv} value
5.2.1.3 Creep coefficient [c]	A.6	ITT	Maximum	1	[Number ≤ orig value]
5.2.1.4 Compressive strength and modulus	A.2	ITT	Maximum	6	E_{Cc} and f_{Cc} value
5.2.1.6 Cross panel tensile strength: (and modulus [b])	A.1	ITT	Maximum	3	E_{Ct} and f_{Ct} value
5.2.1.6 Cross panel tensile strength at elevated temperatures (f_{Ct})	A.1.6	ITT	Maximum	1	E_{Ct} and f_{Ct} value
5.2.1.7 Bending moment capacity (Mu) and wrinkling stress	A.5	ITT	Maximum	1	[Number ≥ original value]

Hygrothermal performance of building components and building elements — Determination of the resistance of external wall systems to driving rain under pulsating air pressure

The European Standard EN 12865:2001 has the status of a British Standard

ICS 91.120.30

10.2.2 Procedure

10.2.2.1 Procedure for ambient temperature only testing t

The leakage rate through the test specimen shall be measurec 25 Pa, or for special purposes at the pressure difference measurement of the leakage rate the pressure difference shall of Q_t established at the end of this period using:

$$Q_{spec} = Q_t^{(20)} - (Q_{app}^{(20)} + Q_{sup/assoc}^{(20)})$$

The length of the gap between the fixed and moving compon door leaf and frame as well as, where appropriate, between the length of the threshold gap shall be measured and recorded.

10.2.2.2 Procedure for ambient together with medium tem classification

For medium temperature tests the average air temperature c raised from ambient temperature to the required stabilisation te min in such a manner that the average air temperature is r Figure 1. The temperature distribution over the face of the door measured by each thermocouple. During the heating up period in the test chamber.

11 Layout

For the layout of approximate ... at an angle

erial across a line of cut ends (A.6)

he panel

Where the cut ends are closer to each other than 5 cm in the longitudinal direction, they shall be treated as one cut end.

Recording and interpretation of test results shall comply with A.16.

The test report shall state the characteristic value (6.2.3) for the shear strength in megapascals (MPa). The span shall be declared in the test report.

A.3.5.2 Shear modulus of the core material (G_C)

For each test specimen, the shear modulus G_C shall be calculated from the slope of the straight part of the load-deflection curve $\left[\frac{\Delta F}{\Delta w}\right]$ as follows (A.7):

Flexural rigidity $$B_S = \frac{E_{F1} \cdot A_{F1} \cdot E_{F2} \cdot A_{F2}}{E_{F1} \cdot A_{F1} + E_{F2} \cdot A_{F2}} e^2$$

Bending deflection $$\Delta w_B = \frac{\Delta F\, L^3}{56{,}34\, B_S}$$

Shear deflection $$\Delta w_S = \Delta w - \Delta w_B$$

Shear modulus $$G_C = \frac{\Delta F\, L}{6\, A_C\, \Delta w_S} \qquad \text{(A.7)}$$

Where

E_{F1} is the E-modulus of the top face;

E_{F2} is the E-modulus of the bottom face;

A_{F1} is the measured area of cross-section of the top face based on measured steel thickness;

A_{F2} is the measured area of cross-section of the bottom face based on measured steel thickness;

e is the measured depth between the centroids of the faces;

Δw is the deflection at mid-span for a load increment ΔF taken from the slope of the linear part of the load-deflection curve;

d_C is the depth of the core material (see D.2.1 where $d_c = D - (t_1 + t_2)$ i.e. the thickness of the two facings);

A_c is the cross sectional area of the core based on measured depth d_c;

L is the span of test specimen at shear failure.

Recording and interpretation of test results shall comply with A.16.

The test report shall state both the mean and characteristic values (6.2.3) of the shear modulus in megapascals

Table 4D — Part 2: Product section DF. Organic zinc-rich paints

Reference	Binder	Main pigment	Volume solids (nominal %)	Main pigment in total pigment (weight % min.)	Dry-film thickness (µm per coat) (minimum advised)	Additional information
DF	Two-pack epoxy	Zinc dust	35	95	50	Quality covered by BS 4652, type 3. Maximum of 75 µm recommended by spray for each layer. An initial prefabrication primer may be only 25 µm

Table 4E — Part 1: Group E systems. Inorganic zinc-rich systems

Reference	Surface preparation	Nominal coating thicknesses, µm			Nominal system thickness, µm
		Primer EP1, EP2	Undercoat KU1, KU2 (see Table 4K)	Finish KF1, KF2 (see Table 4K)	
SE1	Sa2½	75			75
SE2	Sa2½	100			100
SE3	Sa2½	150			150
SE4	Sa2½	75	100	100	275
SE5	Sa2½	75	200	100	375
				HF1, HF2 (see Table 4H)	
SE6	Sa2½	75	100	100	275
SE7	Sa2½	75	200	200	475
				CP7 (see Table 4C)	
SE8	Sa2½	75		25	100

Table 4E — Part 2: Product section EP. Zinc silicate paints

Reference	Binder	Main pigment	Volume solids (nominal %)	Main pigment in total pigment (weight % min.)	Dry-film thickness (µm per coat) (minimum advised)	Additional information (see note c)[a] for application method)
EP1A	Alkali silicate	Zinc dust	40	80	75	Normal spray or pressure pot. Not normally recommended for airless spray (consult manufacturer). High-build
EP2A	Organic silicate	Zinc dust	40	80	50	

[a] Notes to this table are on a pull-out folder following Table 4M. The folder should be extended whilst using any part of Table 4 so that all notes are immediately visible when required.

Table 4F — Part 1: Group F systems. Drying-oil-type paints

Reference	Surface preparation	Nominal coating thicknesses, µm			Nominal system thickness, µm
		Primer FP1 to FP5	Undercoat FU1 to FU4	Finish FF1 to FF4	
SF1	St2	35	35	35	105
SF2	St2	70	25 to 40	25 to 40	120 to 150
SF3	St2	70	50 to 80	50 to 80	170 to 230
SF4	Sa2½	35	—	35	70
SF5	Sa2½	35	25 to 35	25 to 35	85 to 105
SF6	Sa2½	70	35 to 40	25 to 40	130 to 150
SF7	Sa2½	70	70 to 80	25 to 40	165 to 190
SF8	Sa2½	70	70 to 80	50 to 80	190 to 230

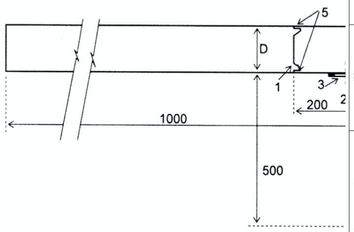
Layout	Colour combination	Meaning/Use	
	Yellow and contrast black	Hazard locations and obstacles where there is the risk of — people bumping, falling or tripping or — loads falling	To warn of potential hazards
	Red and contrast white		To prohibit entry
	Blue and contrast white	To indicate a mandatory instruction	
	Green and contrast white	To indicate a safe condition	

C.1.1.3 Mounting and fixing

C.1.1.3.1 General configuration

C.1.1.3.1.1 General

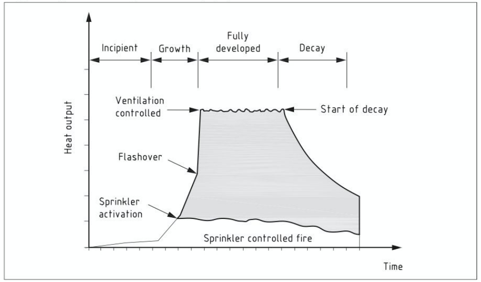
Sandwich panels shall be installed and fixed as described in EN 13823 in the cont and in accordance with C.1.1.3.1 and C.1.1.3.2.



Key

D panel thickness
1 panel joint with factory applied seals
2 screws or pop rivets every 400 mm
3 internal corner flashing
4 screws or pop rivets every 400 mm
5 screws, pop rivets or fixing plate

Figure 10 — *Typical stages in the development and decay of a fire*



7.3.2.2 Growing fire

COMMENTARY ON 7.3.2.2

Where it is possible to establish the item likely to be first ignited, the initial rate of fire growth can be determined from test data. The fire development is defined in terms of the actual heat release rate versus time. However, in most circumstances, only the general nature of the combustible materials is known and the first item to be ignited is indeterminate.

Most fires that do not involve flammable liquids or gases initially grow relatively slowly. As the fire increases in size, the rate of growth accelerates. This can be dependent on many factors including:

a) *nature of combustibles;*

b) *geometric arrangement of the fuel;*

c) *ignitability of the fuel;*

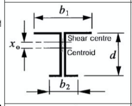
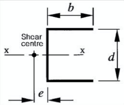
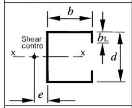
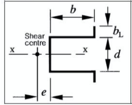
d) *rate of heat release characteristics of the fuel;*

e) *ventilation;*

f) *external heat flux; and*

g) *exposed surface area.*

For design purposes, fires are often assumed to grow proportionately to a growth rate constant multiplied by the square or other exponent of the time. Guidance on the use of characteristic fire

		
	$x_0 = \frac{d^2\left(b_1^3 - b_2^3\right) + db_1b_2(b_1^2 - b_2^2)}{\left(b_1^3 + b_2^3\right)(b_1 + b_2 + 2d)}$	$\frac{b_1^3d^2t}{12\left\{1 + \left(\frac{b_2}{b_1}\right)^3\right\}}$
	$e = \frac{3b^2}{6b + d}$	$\frac{b^3d^2t}{12}\left(\frac{2 + 3\frac{b}{d}}{1 + 6\frac{b}{d}}\right)$
	$e = \frac{d^2bb_Lt}{I_x}\left(\frac{1}{2} + \frac{b}{4b_L} - \frac{2}{3}\frac{b_L^2}{d^2}\right)$	$\frac{b^2t}{6}(4b_L^3 + 3d^2b_L - 6db_L^2 + bd^2) - I_xe^2$
	$e = \frac{d^2bb_Lt}{I_x}\left(\frac{1}{2} + \frac{b}{4b_L} - \frac{2}{3}\frac{b_L^2}{d^2}\right)$	$\frac{b^2t}{6}(4b_L^3 + 3d^2b_L - 6db_L^2 + bd^2) - I_xe^2$

1. Semantic parsing of building regulations

Semantic parsing in ACC is actually quite complicated

- Hundreds of documents, **different formatting and naming conventions** etc.
- Regulations include **references** to figures, tables, other sections and entire other documents.
    - Hence, ACC requires **defeasible logic** and the rules become immensely complex
- **Entails various additional NLP tasks,** e.g., identifying which words belong together (multi-word expressions)

BS 5950-8 1990

4.3.2 Unprotected members

A hot finished rolled or hollow section member which has a load ratio $R \leqslant 0.6$ (see **4.4.2.2** and **4.4.2.3**) may be assumed to have an inherent fire resistance of 30 minutes without any fire protection, provided that it has a section factor H_p/A not exceeding the appropriate maximum value given in Table 4.

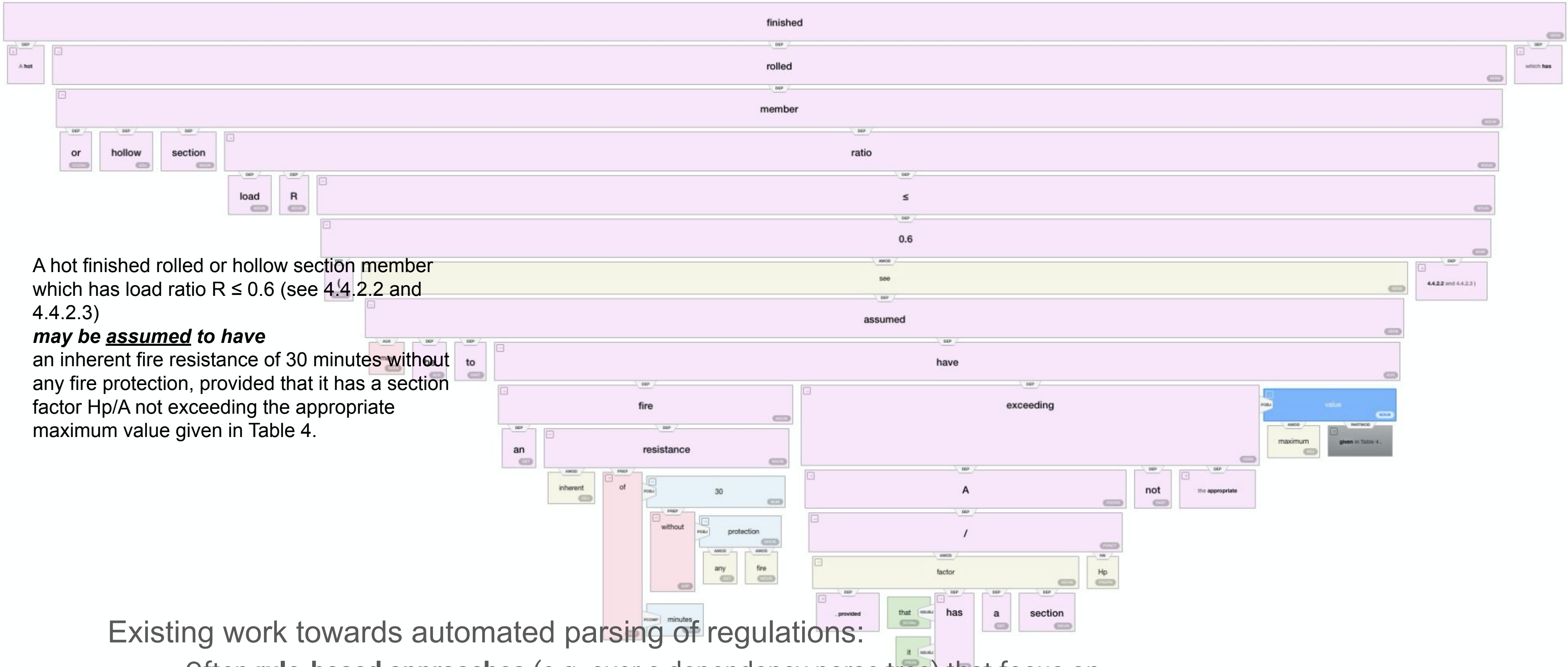
4.3.3 Protected members

4.3.3.1 *Required thickness.* The required thickness of fire protection materials for the required period of fire resistance should be determined from fire tests in accordance with BS 476-20 and BS 476-21.

NOTE Further information on the appraisal of fire test data may be obtained from [2] and [3].

(“Hot finished rolled section member” **OR** “hot finished hollow section member”)

IF: ***has*** (“load ratio” *R)* ***is_equal_or_smaller_than*** (0.6)
has (“fire protection”) ***has_value*** (none)
has (“section factor” *Hp/A*) ***is_equal_or_smaller_than*** (see Table 4…)
THEN: ***has*** (“inherent fire resistance”) ***has_value*** (30 minutes)

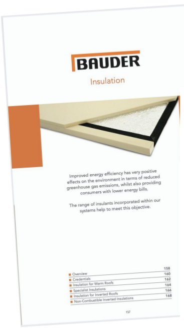


A hot finished rolled or hollow section member which has load ratio R ≤ 0.6 (see 4.4.2.2 and 4.4.2.3)
may be <u>assumed</u> to have
an inherent fire resistance of 30 minutes without any fire protection, provided that it has a section factor Hp/A not exceeding the appropriate maximum value given in Table 4.

Existing work towards automated parsing of regulations:

- Often **rule-based approaches** (e.g. over a dependency parse tree) that focus on
  - a small subset of the regulations, e.g., 1 document on energy regulations
  - a small subset of the types of relations, e.g., only quantitative relations
- **Require further manual parsing**: system only identifies *Named Entities* or only performs *Relation Classification*
- Orthogonally work focuses on **identifying simple coherent clauses from complex sentences**

2. Representing building information



BauderROCK is a non-combustible mineral fibre insulation that achieves Euroclass A1. The flatboards are utilised within warm roofs with exceptional acoustic and fire resistance properties. BauderROCK NC Upstand Insulation is used with inverted roofs alongside the specified Bauder inverted insulation.

Building (product) information comes in various formats.

Often unstructured data, require some form of parsing.

Building Information Models (BIM)

Structured data → what classes exist?

2. Representing building information

A **mapping** is needed between:

1. objects in the BIM model
2. the concepts found in ACC rules (let's assume these can be mapped 1-to-1 with regulatory texts).

example ontology class		*example occurrences in text*
IfcMember.Member	→	"hot finished hollow section member"
	→	"cold-formed member"
	→	"solid timber member"
	→	etc..

2. Representing building information

We need more detail, can we extend the existing ontologies where necessary?

"a formal and explicit specification of a shared conceptualisation"

≈ **formal** language used to capture classification and reasoning logic in machine readable form (often set theory)

≈ **explicit** is about coverage, which concepts and relations, etc., have been defined

≈ **shared** means that all stakeholders agree on the terminology and definitions

≈ **conceptualization,** here, refers to the set of expressions that we'd need to formulate rules

→ interoperability & reasoning

example ontology class		*example occurrences in text*
IfcMember.Member	→	"hot finished hollow section member"
	→	"cold-formed member"
	→	"solid timber member"
	→	etc..

🤔 ***Not so great...***

2. Representing building information

Let's start with "*hot finished hollow section member*"

- Any **IfcMember.Member** with **IfcMaterial** "*steel*", **IfcMaterialProperties** "*hot finished*", and property **IfcRectangleHollowProfileDef**, more?

2. Representing building information

Let's start with "*hot finished hollow section member*"

- Any **IfcMember.Member** with **IfcMaterial** "*steel*", **IfcMaterialProperties** *"hot finished"*, and property **IfcRectangleHollowProfileDef**, more?

But not all necessary classes are easily defined....

- "**In areas where the average daily temperature in January is 25F or less** *or* where **there is a possibility of ice forming along the eaves causing a backup of water,** an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall extend from the lowest edges of all roof surfaces to a point at least 24 inches inside the exterior wall line of the building."

2. Representing building information

Let's start with "*hot finished hollow section member*"

- Any **IfcMember.Member** with **IfcMaterial** "*steel*", **IfcMaterialProperties** "*hot finished*", and property **IfcRectangleHollowProfileDef**, more?

But not all necessary classes are easily defined….

- **"In areas where the average daily temperature in January is 25F or less *or* where there the eaves causing a backup of water,** an ice barrier that consists of at least two layers c or of a self-adhering polymer-modified bitumen sheet shall extend from the lowest edge least 24 inches inside the exterior wall line of the building."

It will be VERY complicated (impossible?) to formally and comprehensively define all classes required for ACC (products, properties, interactions, …) – compounded by the constant change of regulations;

- VERY large amount of classes and properties
- numerous interactions that affect classification
- many diverse stakeholders. leading to a geometrical increase in complexity w.r.t. resolving inevitable terminological and conceptual incompatibilities

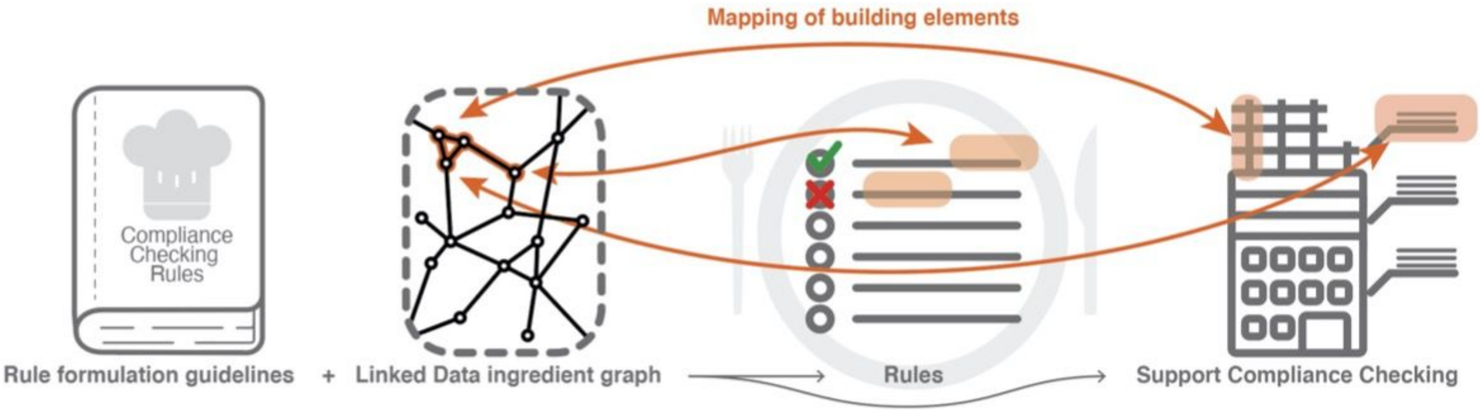
Mapping from (1) the text found in regulations to (2) the classes used in rules, and mapping those to (3) BIM… often involves some serious shoe-horning.

3. Formulating rules for ACC

Result:

- no consensus on which labels/classes may occur in ACC rules
- no standard approach / guidelines to formulating and formatting ACC rules

So how can we expect to achieve something that can interoperate with BIM?

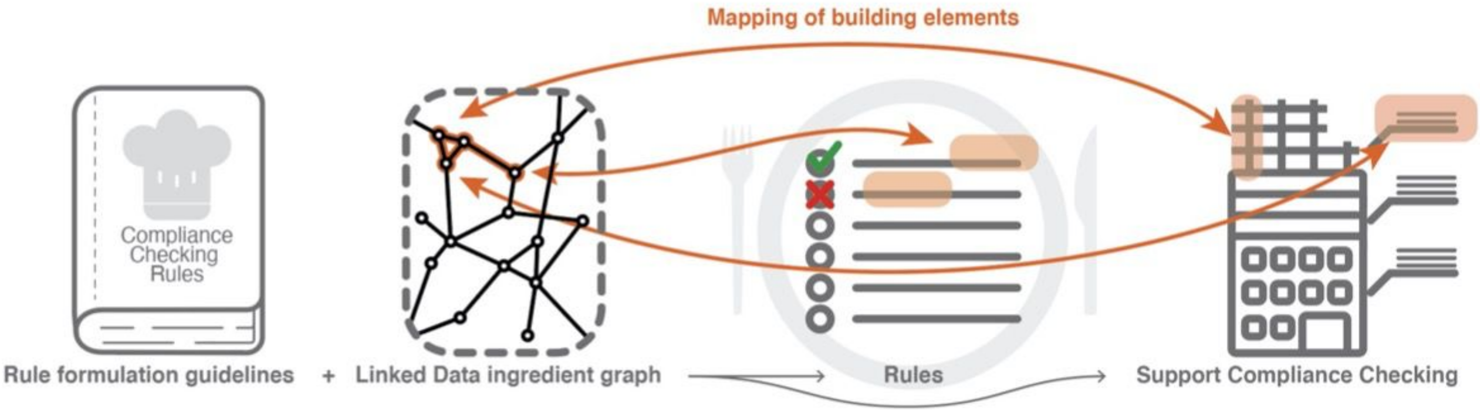


3. Formulating rules for ACC

Result:

- no consensus on which labels/classes may occur in ACC rules
- no standard approach / guidelines to formulating and formatting ACC rules

So how can we expect to achieve something that can interoperate with BIM?



my weak analogy: no recipe, no ingredient list, what are the chances that we make the same dish?

3. Formulating rules for ACC

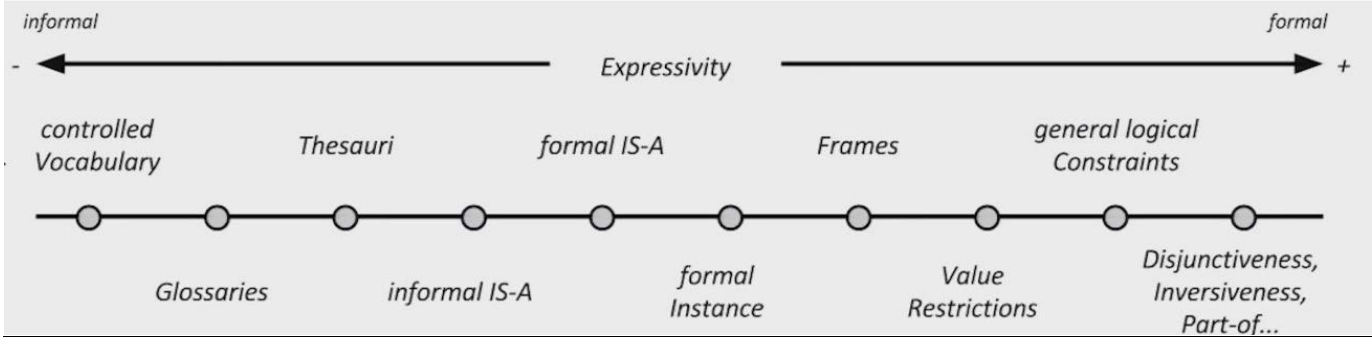


Image:
Harald Sack,
Linked Data Engineering
2016, MOOC OpenHPI

minimum requirement for mapping from text to labels

Ontologies

Controlled vocabulary	A finite list of terms, without specification
Glossary	A finite list of terms that includes informal definitions in natural language
Thesauri	Controlled vocabulary where the concepts are connected via relations (e.g. synonymy, hyponymy, troponymy, antonymy, homonymy, associations)
Taxonomies (Classifi-cation schemes)	**Informal IS-A Hierarchy**: explicit hierarchy of classes, subclass relations are not strict (e.g. index of a library)
	Formal IS-A hierarchy: Explicit hierarchy of classes, subclass relations strict
	Formal instance: explicit class hierarchy, besides strict subclass relations also instance-of relations are allowed.
Object oriented	Frames
	Add Value restrictions
	Add general logic constraints
	Add disjunction, inverse-ness, partOf relations, Cardinality constraints etc.

3. Formulating rules for ACC

A very reasonable suggestion for a controlled vocabulary for ACC is **Uniclass**

- relatively comprehensive
- easier to extend in comparison to more expressive classification systems
- aligned with ISO 12006:2-2015 (in case anyone actually cares)

Still, a decision has to be made w.r.t. mapping between regulation terms and Uniclass.

"hot finished hollow section member" → ***(Pr_20_76_52_16) Carbon steel hot-finished hollow sections***

"hot finished hollow section member" → ***(Pr_20_76_51) Metal sections***
"hot finished hollow section member" → ***(Pr_20_76_51_23) Copper Alloy sections***
"hot finished hollow section member" → ***(Pr_20_76_51_90) Universal beam sections***
"hot finished hollow section member" → ***(Pr_20_76_51_92) Universal column sections***
"hot finished hollow section member" → ***(Pr_20_76_51_98) Wrought iron sections***
"hot finished hollow section member" → ***(Pr_20_76_52) Metal tubes and hollow sections***
"hot finished hollow section member" → ***(TE_10_10_50) Structural members***
"hot finished hollow section member" → ***(Zz_70_80) Sections***

3. Formulating rules for ACC

A very reasonable suggestion for a controlled vocabulary for ACC is **Uniclass**

- relatively comprehensive
- easier to extend in comparison to more expressive classification systems
- aligned with ISO 12006:2-2015 (in case anyone actually cares)

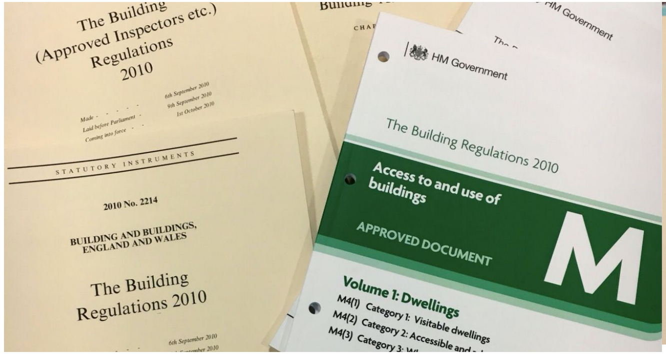
Still, a decision has to be made w.r.t. mapping between regulation terms and Uniclass.

“party wall” → **(Ro_30_30_60) Party wall surveyor**
“party wall” → **(Ac_05_30_60) Party wall notices agreeing**
“party wall” → **(PM_30_10_60) Party wall survey information**
“party wall” → **(PM_70_15_60) Party wall certificate**

Uniclass would still require extension to avoid shoe-horning.

Recap on problem space:
Automated Compliance Checking

ACC solution may not exist



Regulations

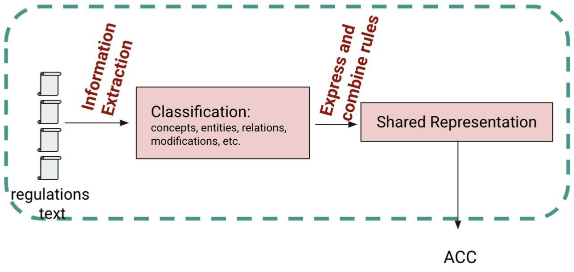
- Parsing is very complicated
- Not clear which classes exist

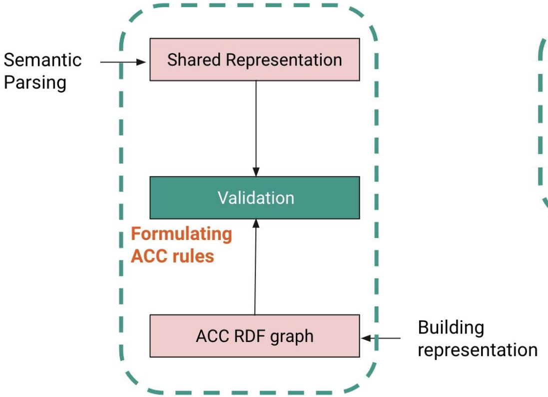
Building (product) information

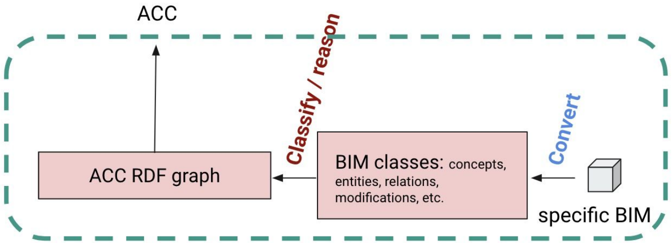
- In cases where semantic enrichment is provided, it usually is not at the right level of granularity for ACC

← Missing strategy, guidance, framework, … →

Incrementally achieve ACC, focus on parts of the puzzle?







If focus is on a subproblem, ***we still need a general strategy to integrate solutions***

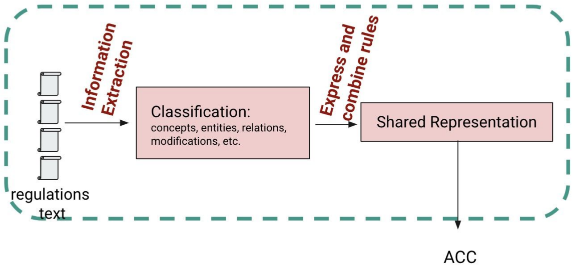
inventory of terms,

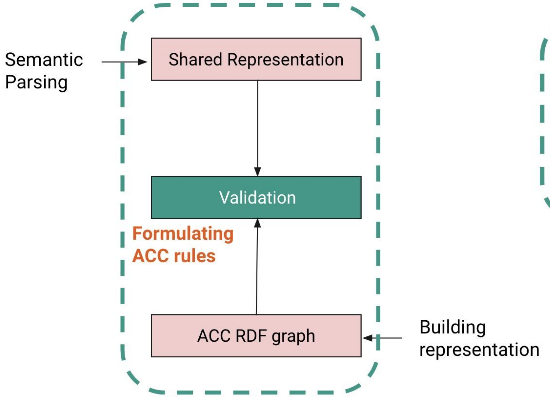
mapping between terms,

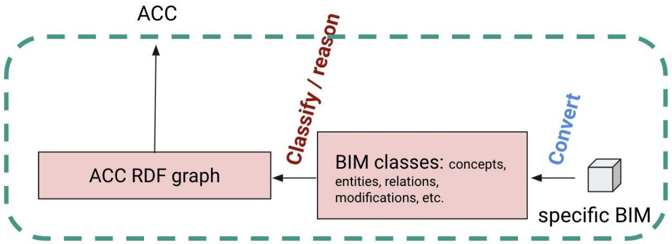
guidance and standards for formulating and integrating ACC rules,

…

Incrementally achieve ACC, focus on parts of the puzzle?







If focus is on a subproblem, ***we still need a general strategy to integrate solutions***

inventory of terms,

mapping between terms,

guidance and standards for formulating and integrating ACC rules,

…

Hmmm… maybe Linked Data should be at the core of such a strategy?

Our position:
Linked Data for Compliance Checking

Our position

ACC should focus on solving feasible and practical problems.

Improve usability of regulations for the built environment

Effective, **efficient** and **easy** use of the regulations to achieve some goal (see ISO)

Our position

ACC should focus on solving feasible and practical problems.
Improve usability of regulations for the built environment

Effective, **efficient** and **easy** use of the regulations to achieve some goal (see ISO)

Example applications (before solving ACC) could be:

- Improve search
- Identify conflicting criteria
- Determine which regulations apply in a geographical area
- Keep track of an audit trail
- etc.

1. Compliance Checking support

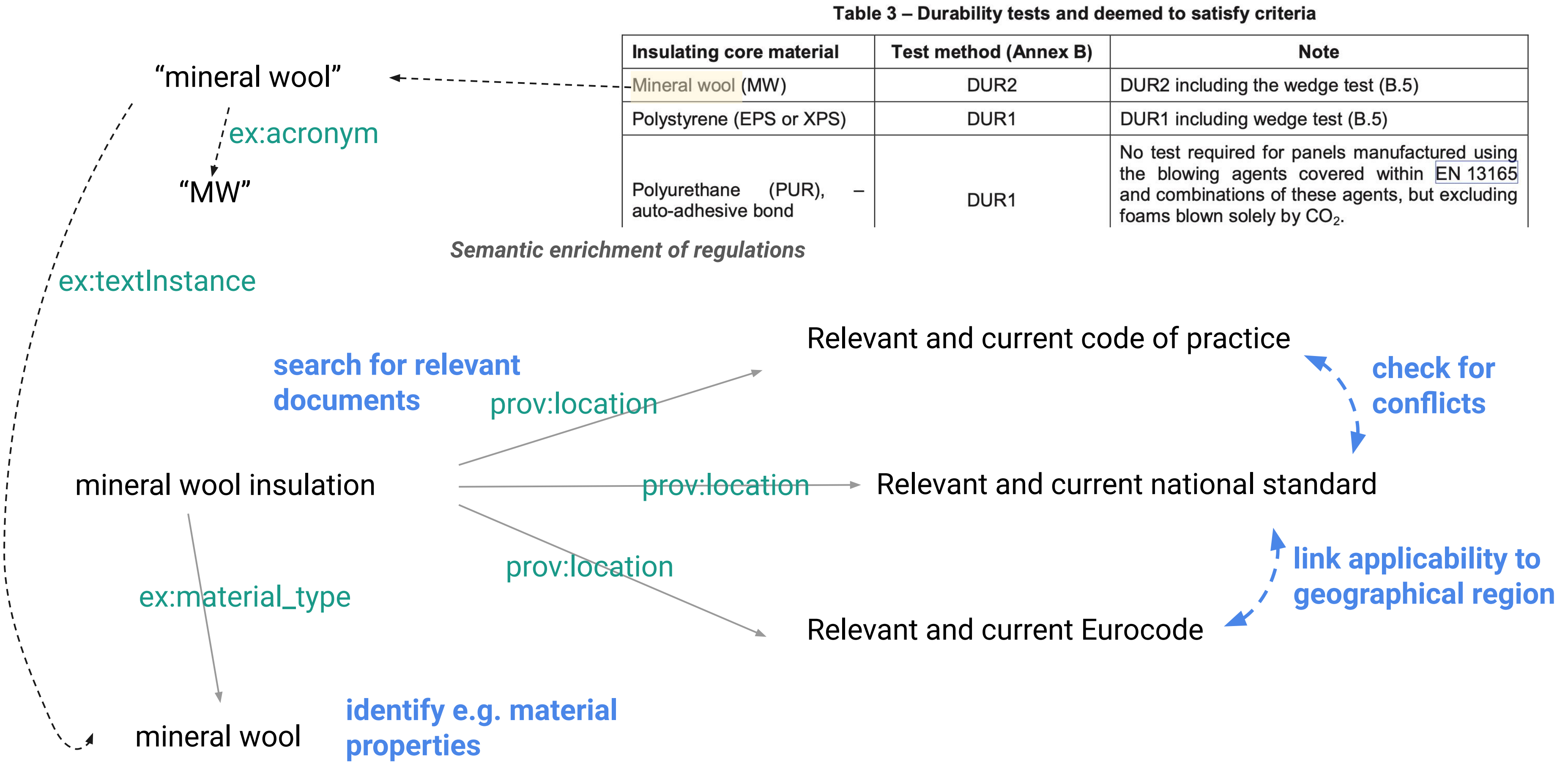


Table 3 – Durability tests and deemed to satisfy criteria

Insulating core material	Test method (Annex B)	Note
Mineral wool (MW)	DUR2	DUR2 including the wedge test (B.5)
Polystyrene (EPS or XPS)	DUR1	DUR1 including wedge test (B.5)
Polyurethane (PUR), – auto-adhesive bond	DUR1	No test required for panels manufactured using the blowing agents covered within EN 13165 and combinations of these agents, but excluding foams blown solely by CO_2.

2. Identify classes to be defined for validation → generate?

- **In areas where the average daily temperature in January is 25F or less** or where there is a possibility of ice forming along the eaves causing a backup of water, an ice barrier that consists of at least two layers of underlayment cemented together or of a self-adhering polymer-modified bitumen sheet shall extend from the lowest edges of all roof surfaces to a point at least 24 inches inside the exterior wall line of the building.

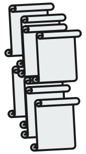
```
:LowestRoofSurfaceEdge @ :RoofEdge AND                                  # IF the BIM subject is the lowest roof surface edge
        NOT  { (  example:locatedIn   example:LowMonthlyTemperatureArea  # And the building is located in a LowMonthlyAvgTemp area
                | example:unknown    xsd:string "there is a possibility of ice forming along the eaves causing a backup of water")
        } OR {
                example:equippedWith [a @:iceBarrier] ;                  # Then it must have an ice barrier
                ( example:distanceIntoExteriorWallInches     xsd:float {MinInclusive 24}     # and the 'distance' should be at least ...
                | example:distanceIntoExteriorWall           xsd:float {MinInclusive 609.6} )
    }

:LowMonthlyTemperatureArea {                                             # Rough idea of a ShEx class
        a                                       gndo:geographicAreaCode ;
        example:averageMonthlyTemperature       xsd:float {MaxInclusive -3.89}.
}

:averageMonthlyTemperature {
        intervals:Month             [xsd:gMonth] ;
        (:averageTemperatureF       xsd:float
        |:averageTemperatureC       %js:{ o = (averageTemperatureF − 32) * 5/9   %})      # convert between F and C

:iceBarrier {
        ( example:equippedWith              example:LayerOfUnderlayment {2,}
        | example:equippedWith              example:SelfAdheringPolymerModifiedBitumenSheet)
}
```

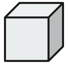
3. Integrate and relate terminology



regulations texts

Use terminology found in regulations

Existing classification labels for

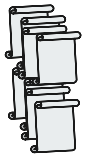


specific BIM

BIM software
BIM interoperability ontologies
Product datasheets
Uniclass, NRM3, etc.
bSDD and other dictionaries
....

“hot finished hollow section member”	ex:textInstance	*(Pr_20_76_52_16) Carbon steel hot-finished hollow sections*
	rdfs:type	*(TE_10_10_50) Structural members*
	skos:broader	*TATA Celsius® hot finished hollow sections*
	prov:location	*BS 5950-8 1990, BS EN 1090-3 2019,* and so on…
	etc.	
	owl:type	anonymous[∀ *IfcMember.Member* ∧ *[IfcMaterial steel etc.*

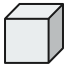
3. Integrate and relate terminology



regulations texts

Use terminology found in regulations

Existing classification labels for



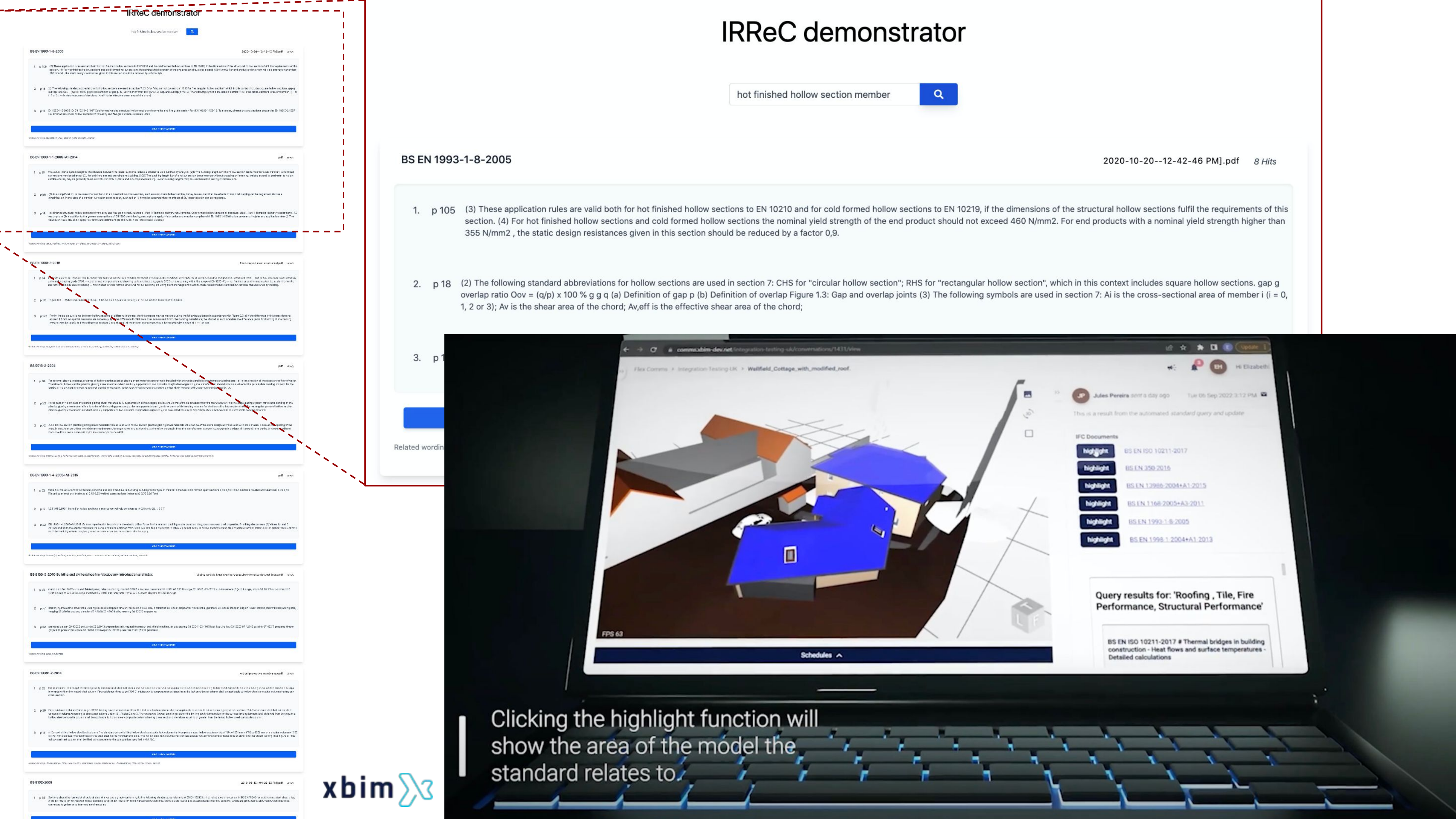
specific BIM

BIM software
BIM interoperability ontologies
Product datasheets
Uniclass, NRM3, etc.
bSDD and other dictionaries
....

"hot finished hollow section member"	ex:textInstance	*(Pr_20_76_52_16) Carbon steel hot-finished hollow sections*
	rdfs:type	*(TE_10_10_50) Structural members*
	skos:broader	*TATA Celsius® hot finished hollow sections*
	prov:location	*BS 5950-8 1990, BS EN 1090-3 2019,* and so on…
	etc.	
	owl:type	anonymous[∀ *IfcMember.Member* ∧ *[IfcMaterial steel etc.*

Example use cases:

- **suggest relevant class labels during design**
- **depending on information captured; suggest appropriate property value ranges**
- **suggest relevant regulations based on label assignment**


IRReC demonstrator
hot finished hollow section member
BS EN 1993-1-8-2005
2020-10-20--12-42-46 PM].pdf
8 Hits
1. p 105 (3) These application rules are valid both for hot finished hollow sections to EN 10210 and for cold formed hollow sections to EN 10219, if the dimensions of the structural hollow sections fulfil the requirements of this section. (4) For hot finished hollow sections and cold formed hollow sections the nominal yield strength of the end product should not exceed 460 N/mm2. For end products with a nominal yield strength higher than 355 N/mm2 , the static design resistances given in this section should be reduced by a factor 0,9.
2. p 18 (2) The following standard abbreviations for hollow sections are used in section 7: CHS for "circular hollow section"; RHS for "rectangular hollow section", which in this context includes square hollow sections. gap g overlap ratio Oov = (q/p) x 100 % g g q (a) Definition of gap p (b) Definition of overlap Figure 1.3: Gap and overlap joints (3) The following symbols are used in section 7: Ai is the cross-sectional area of member i (i = 0, 1, 2 or 3); Av is the shear area of the chord; Av,eff is the effective shear area of the chord;
3. p 1
Related wordin
IFC Documents
highlight
BS EN ISO 10211-2017
BS EN 350-2016
BS EN 13986-2004+A1-2015
BS EN 1168-2005+A3-2011
BS EN 1993-1-8-2005
BS EN 1998-1-2004+A1-2013
Query results for: 'Roofing , Tile, Fire Performance, Structural Performance'
BS EN ISO 10211-2017 # Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations
FPS 63
Schedules
Clicking the highlight function will show the area of the model the standard relates to.
xbim

Working on ACC?
Use Linked Data, thank you!