Réseau Energie et Bâtiments

Denis Bourgeois PhD

directeur **rd**$_2$.ca

ponts thermiques *majeurs*

dépréciation et modélisation énergétique

automatisation et applications

Réseau Energie
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DÉROULEMENT

1. contexte et enjeux
2. *ponts thermiques 101*
3. modélisation et simulation énergétique
4. *Battle royale* : **CNÉB 2017** vs **I.1 CCQ**
5. limites et travaux (en cours)

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CONTEXTE & ENJEUX

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+ descriptif **+ quantitatif**

1970s

- crises énergétiques
- LoCal/Saskatchewan
- ASHRAE 90
- Schöck Isokorb

1990s

- PassivHaus
- encouragements $
- codes d'énergie v2
- ISO 12011/14683

2010s

- DPÉB (UE)
- RP-1365
- … BETBG
- I.1 CCQ
- NECB 2015 > 2017
- 90.1 2019 av

2020s

- CSA Z-5010
- 90.1 2022
- BTAP (CNRC/RNCan)
- OpenStudio-Standards
- encouragements $$
- futurs codes : l'existant
- cotation énergétique
- jumeaux numériques
- rôle des manufacturiers

+ portée limitée **+ englobant**

1970s

- crises énergétiques
- LoCal/Saskatchewan
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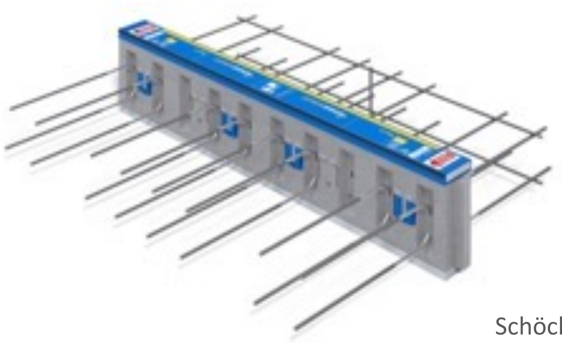
- jumeaux numériques
- rôle des manufacturiers

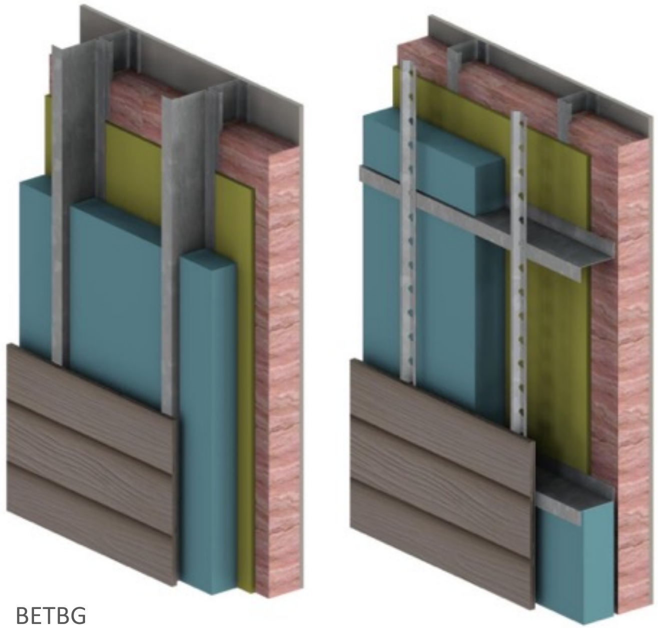
… intègre ponts thermiques **MINEURS**

- **répétitif**, *ex. montants, barres Z, attaches*
- **indépendant** de la géométrie des surfaces
- *R_o (effective ou « clear-field ») = 1 /* U_o

U_o Ψ X



Schöck



BETBG

ponts thermiques **MAJEURS**

- coefficients **linéaires** et **ponctuels**
- très **liés** à la géométrie des surfaces
- *ex. balcons, parapets, colonnes*

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PONTS THERMIQUES 101

Ψ & X … peut être facilement **+50%** du U_t
… +**5** to **15%** en GJ chauffage annuel (Z7)

$$U_t A = U_o A + \sum \Psi L + \sum X$$

khi, propre(s) à chaque **surface**

psi, propre(s) à chaque **surface**

clear-field, propre à chaque **construction**

déprécié, propre à chaque **surface**

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PONTS THERMIQUES 101

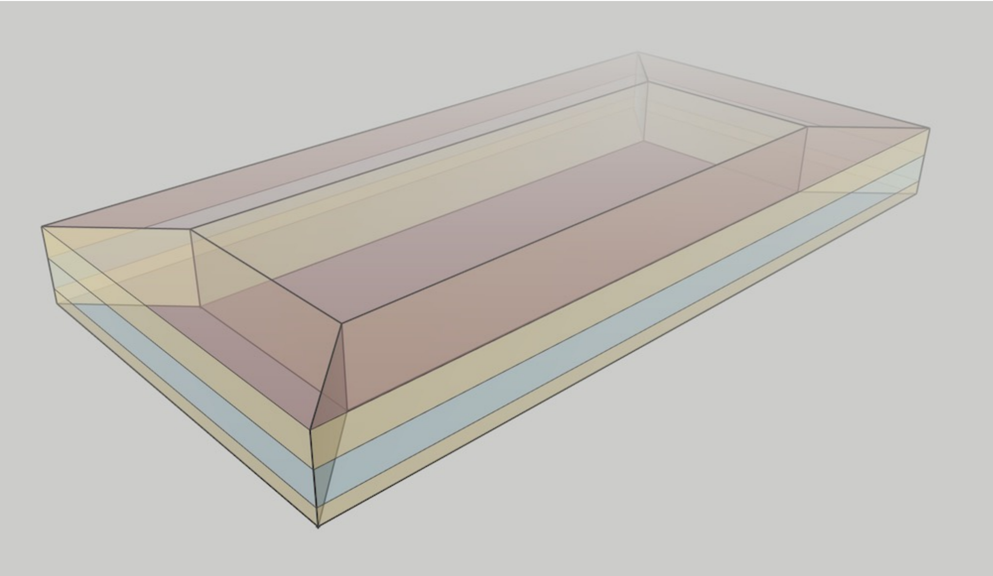
I1 vs CNÉB 2017

$? \; U_t A = U_o A + \Sigma \Psi L + \Sigma X$

CNÉB-QC I1

$? \; U_o A = U_t A - (\Sigma \Psi L - \Sigma X)$

CNÉB 2017



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MODÉLISATION & SIMULATION

… enjeux soulevés

3. RECOMMENDATIONS

In our view, there are two primary paths to implementing modified base building U-values into BC Hydro's New Construction Program. They are described in further detail below.

3.1 Method 1: Simplified Approach - Recommended

The first approach is simple and involves using one of the correlation lines in Figure 6 to equate energy code clear wall U-values to the de-rated U-value to be used in the program. This approach is simple and does not require the use of base building calculations. As the values were derived from archetype buildings with average amounts of interface details, it allows room for projects to improve in effective U-value not only by having better performing interface details, but also by having less of them.

3.2 Method 2: Base Building Calculations Approach – Secondary Recommendation

The second approach would involve base building calculations. The base building would use the same quantity take-offs as the proposed, but the performance values for the linear interface details would be prescribed. The recommended prescribed values would be based on the efficient performance category for all building types except MURBs or 0.12 Btu/h ft F. The downside with this approach is that it does not incent reducing the amount of interface details. A design that has little additional heat loss because it limits the quantity of interface details would not see a significant benefit over the base building, since the base building would also have few interface details. It also does not put a cap on base building heat loss for designs that have excessive articulating architecture (i.e. large quantity of interface details).

Although the analysis above only considered the major interface details, this approach would include all interface details, each with a base building value of 0.12 Btu/h ft F. High rise MURBs would use 0.20 Btu/hr ft F for slabs and glazing, 0.17 Btu/hr ft F for parapets and 0.26 Btu/hr ft F for everything else. Balconies in base building high-rise MURBs shall have the same number of balconies and performance as the proposed, up to 25% of the building perimeter per floor. Point transmittances shall have a base building value of 0.3 Btu/h F for all scenarios.

BC Hydro
Power smart

Accounting for Thermal Bridging at Interface Details

A Methodology for De-Rating Prescriptive Opaque Envelope Requirements in Energy Codes

April 29, 2015

Thermal bridging calculations – to "de-rate" or not? August 2018

Denis Bourgeois, PhD
Iain Macdonald, PhD

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Iain.Macdonald@nrc-cnrc.gc.ca

- Context
- To "de-rate" or not?
- Case study
- Recommendations

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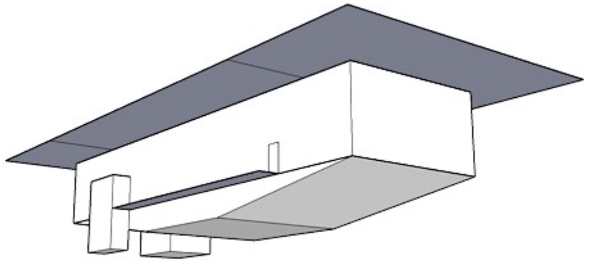
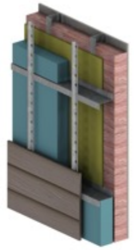
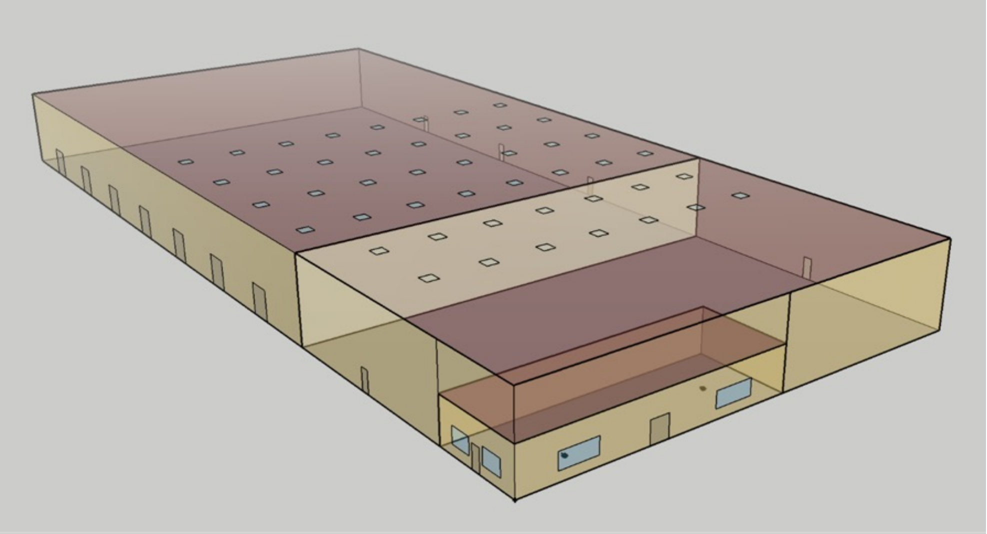
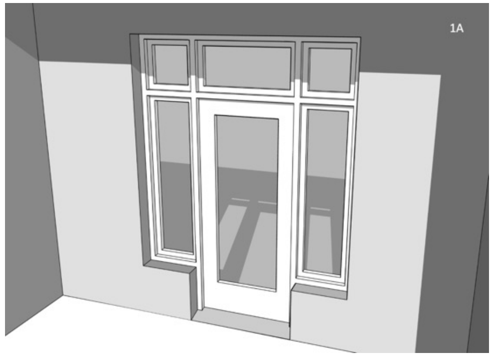
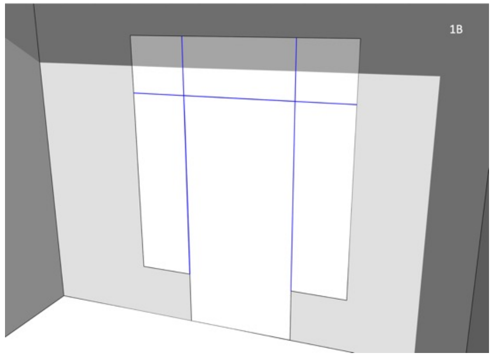
… objectif du webinaire











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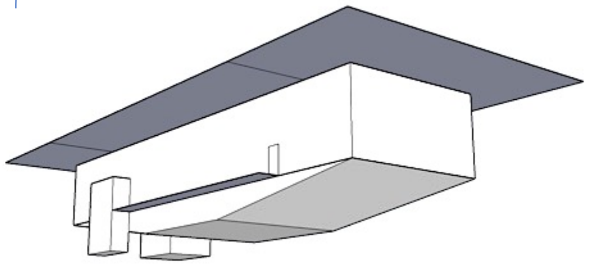
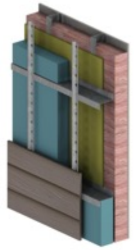
MODÉLISATION & SIMULATION

… +heures +erreurs

1. intrants

relevés **manuels**





U_o Ψ X A L

2. dépréciation

$$U_t A = U_o A + \sum \Psi L + \sum X$$

ex. tableurs

3. extrants

Section 3.3

UA’

BEM

Partie 8

$

optimisation

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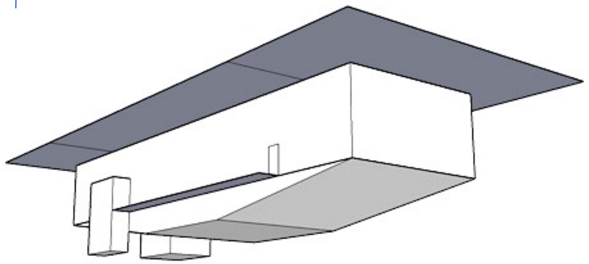
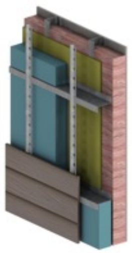
MODÉLISATION & SIMULATION

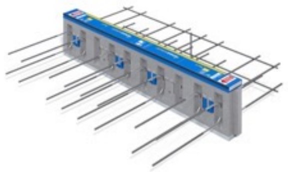
… automatisation ?

1. intrants

relevés ~~manuels~~ automatisés







U_o Ψ X A L

2. dépréciation **automatisée**

$$U_t A = U_o A + \sum \Psi L + \sum X$$

~~ex. tableurs~~

3. extrants, ex. rapports **automatisés**

Section 3.3

UA’

BEM

Partie 8

$

optimisation

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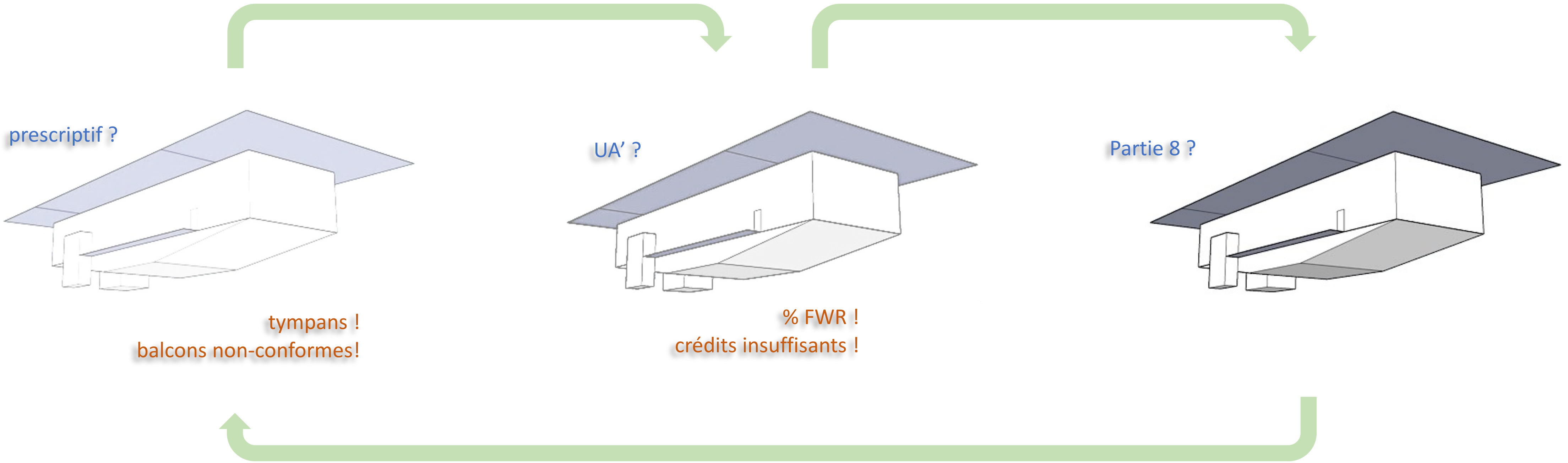
… itérations ?



MODÉLISATION

… impacts chez les professionnels ?

- ~1000 bureaux d'architectes au QC
- @ 10 projets/année/bureau
- @ 4 itérations par projet
- @ 3 heures/itération
- @ 100$/heure

- ~ **12 000 000$/**année au QC ?

- … *habituellement non-facturables*

Réseau Energie et Bâtiments

MODÉLISATION & SIMULATION

rd2.github.io/tbd

rd2

TBD

Thermal Bridging & Derating

Download .zip

Download .tar.gz

A guide to TBD - a Ruby gem and OpenStudio Measure that auto-detects **major** thermal bridges (like balconies, parapets and corners) and then **derates** outside-facing opaque constructions (walls, roofs and exposed floors). The guide is mainly written for architects, echnologists and envelope consultants who are new to energy simulation, and to OpenStudio in particular.

a nutshell ...

ermal bridges are structural elements that interrupt the continuity of insulation in ding envelopes. A curtain wall spandrel back pan may hold in place an R17 (RSi 3.0) of insulation, yet the spandrel's overall R-value may trickle down to R5 (RSi 0.9) - less a third of its nominal value. This drop in spandrel performance is due to its reliance ghly conductive materials (e.g. galvanized steel, aluminium), spandrel ... dth ratio, and how the back pan is held in place ...

Thermal Bridging & Derating

- *gemme* Ruby & *mesure* OpenStudio

Denis Bourgeois rd$_2$.ca

Dan Macumber automaticmagic.com

openstudiocoalition.org

Québec

Canada

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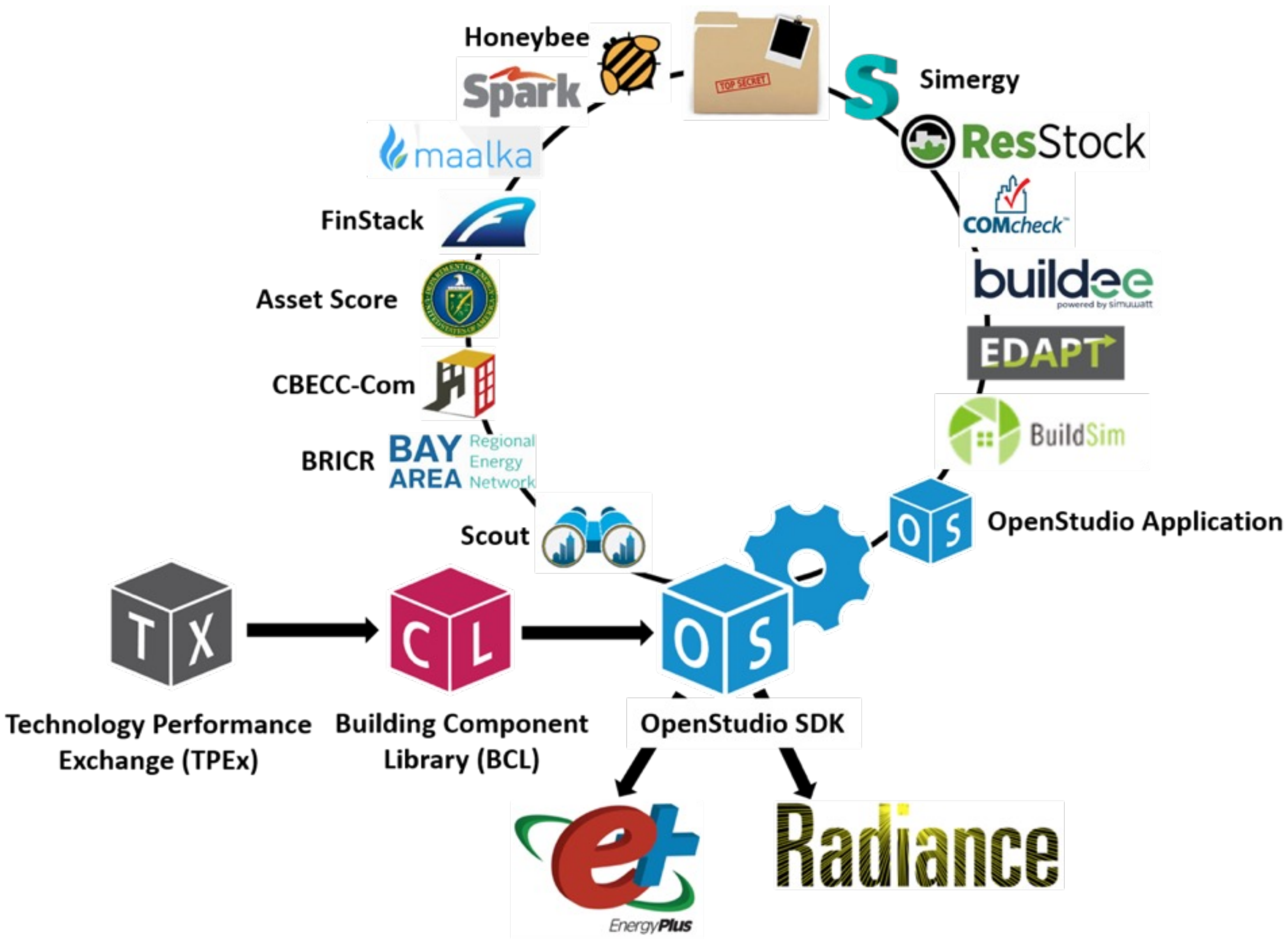

Thermal Bridging & Derating

- *gemme* Ruby & *mesure* OpenStudio
- compatible avec SDK
- licence libre (MIT, BSD-3)
- désormais distribué avec OpenStudio
- partie intégrante de BTAP/OpenStudio-Standards
- partie intégrante de SIMEB+

Québec Canada

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MODÉLISATION & SIMULATION

rd2.github.io/tbd

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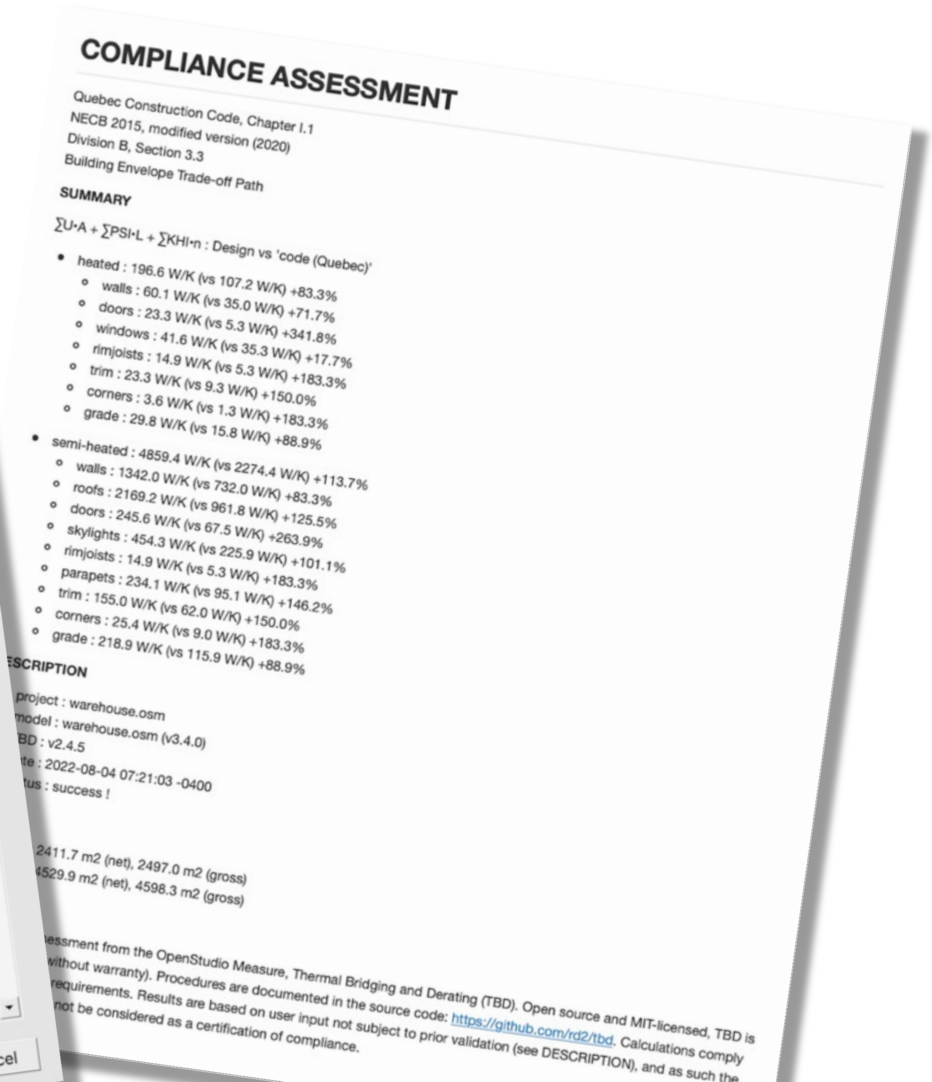

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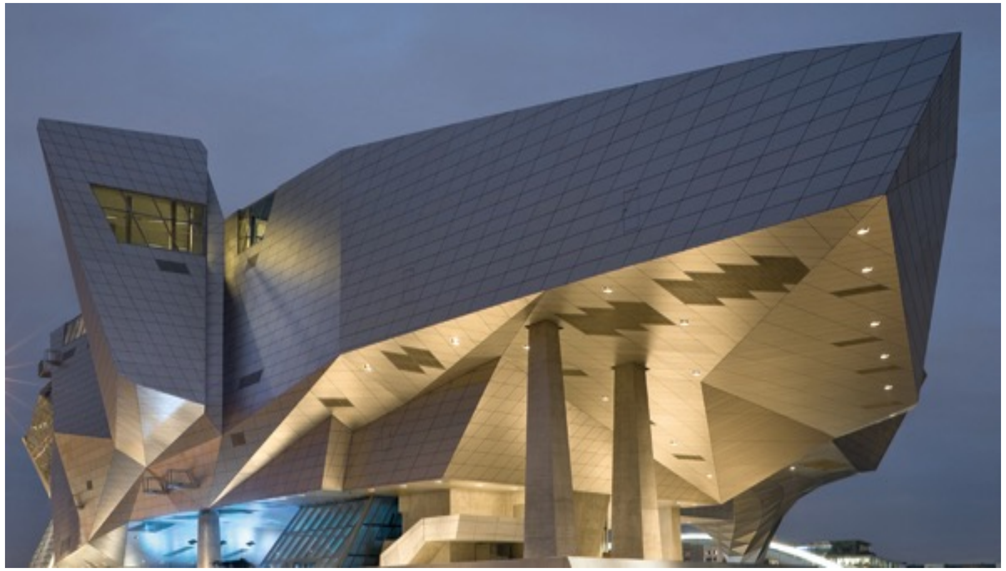
MODÉLISATION & SIMULATION

rd2.github.io/tbd

```json
{
  "schema": "https://github.com/rd2/tbd/blob/master/tbd.schema.json",
  "description": "TBD JSON example - combining building vs space PSI sets",
  "psis": [{
      "id": "OK",
      "rimjoist": 0.7,
      "parapet": 0.7,
      "fenestration": 0.7,
      "corner": 0.7,
      "balcony": 1,
      "party": 0.7,
      "grade": 0.7
    },
    {
      "id": "Awesome",
      "rimjoist": 0.2,
      "parapet": 0.2,
      "fenestration": 0.2,
      "corner": 0.2,
      "balcony": 0.3,
      "party": 0.2,
      "grade": 0.2
    }
  ],
  "building": {
    "psi": "Awesome"
  },
  "spaces": [{
    "id": "ground-floor restaurant",
    "psi": "OK"
  }]
}
```



www.telerama.fr/scenes/musa-c-e-des-confluences,121164.php

TBD JSON I/O

interopérabilité BIM/BEM

… ~OpenStudio *default construction sets*

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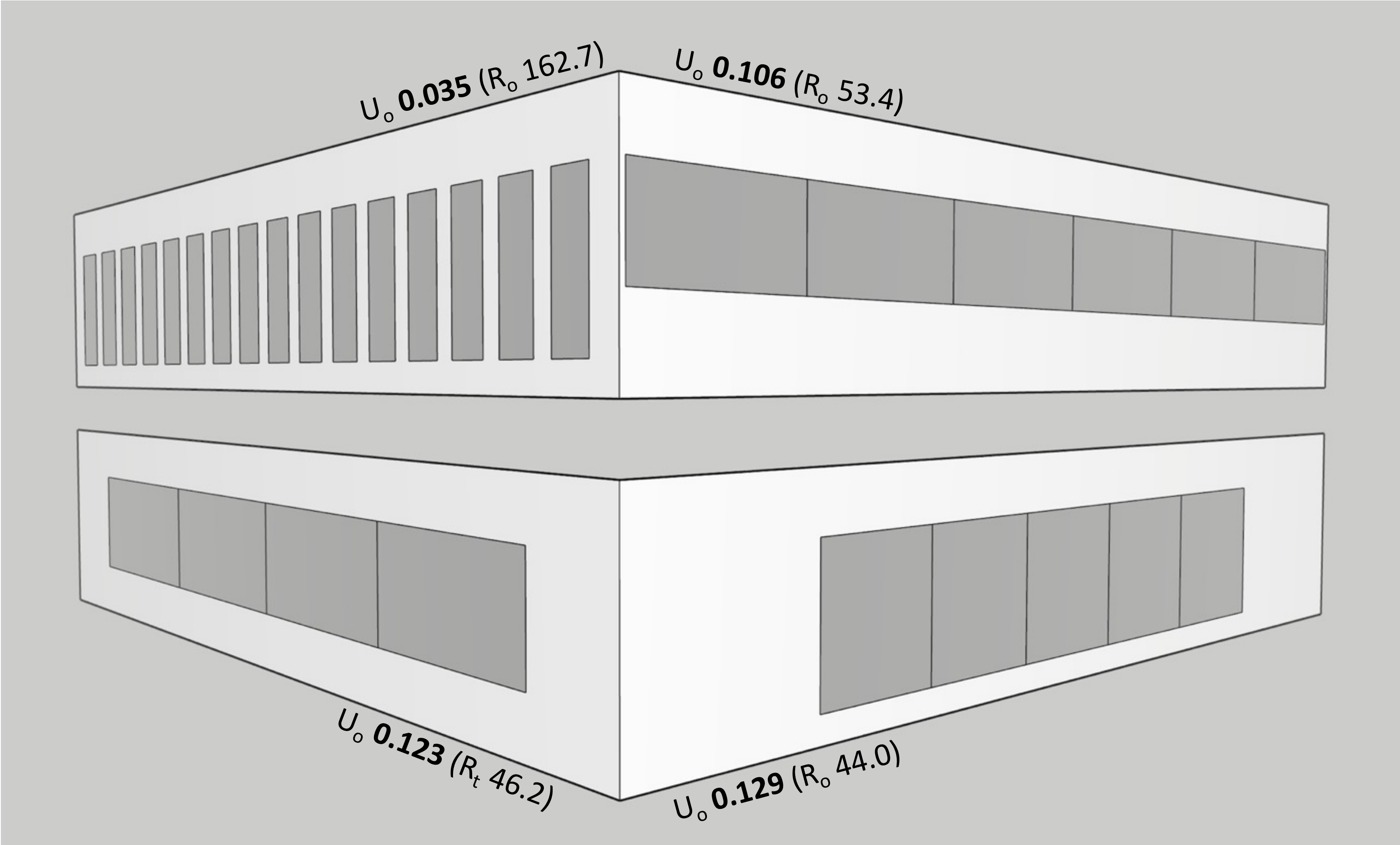
CNÉB 2017 : 5000 DJC

U_t **0.210** (R_t 27)
aire fenêtrée **33%**

fondation Ψ : **0.090**
rive Ψ : **0.017**
coins Ψ : **0.090**
fenêtrage Ψ : **0.078**



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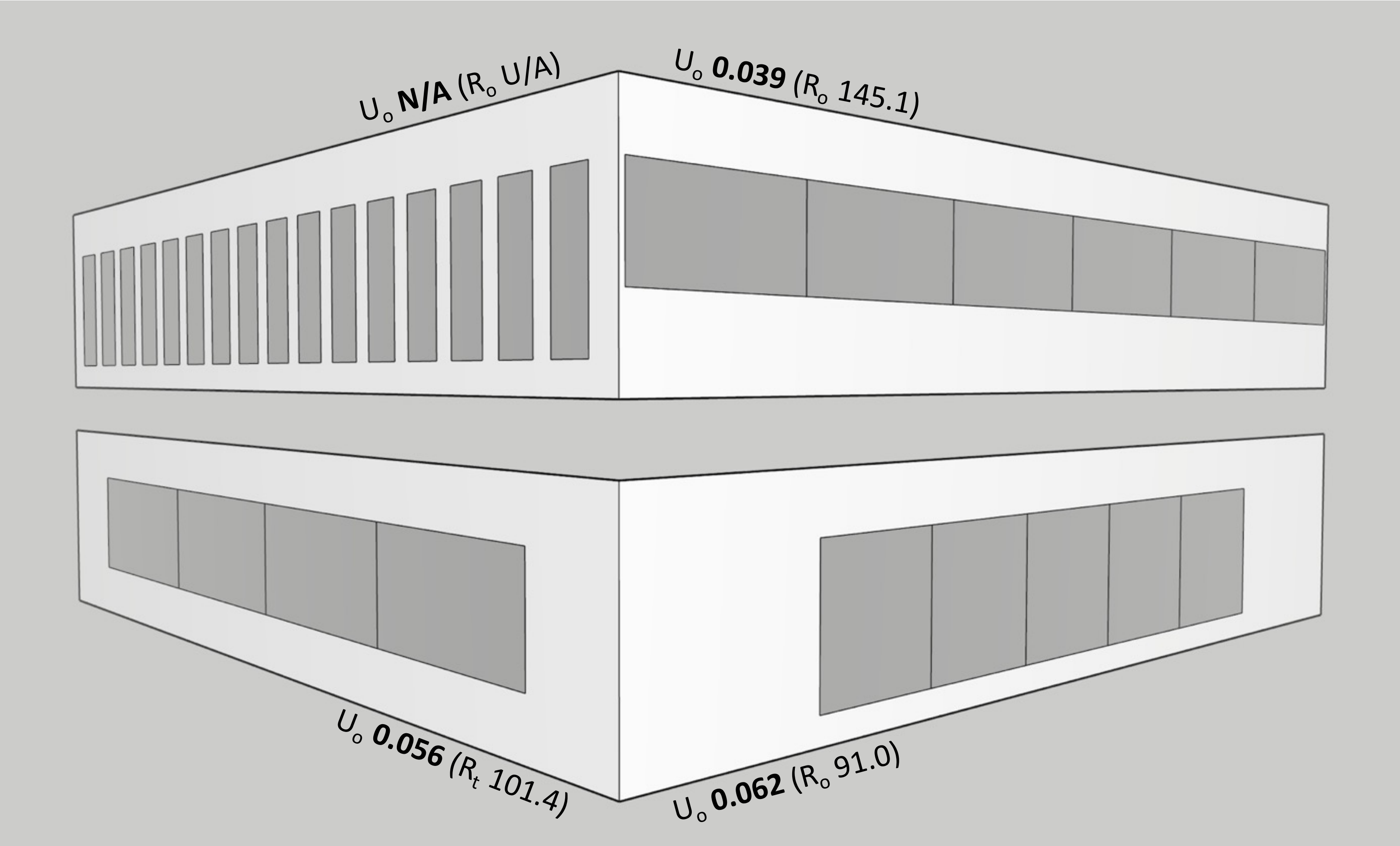
CNÉB 2017 : 5000 DJC

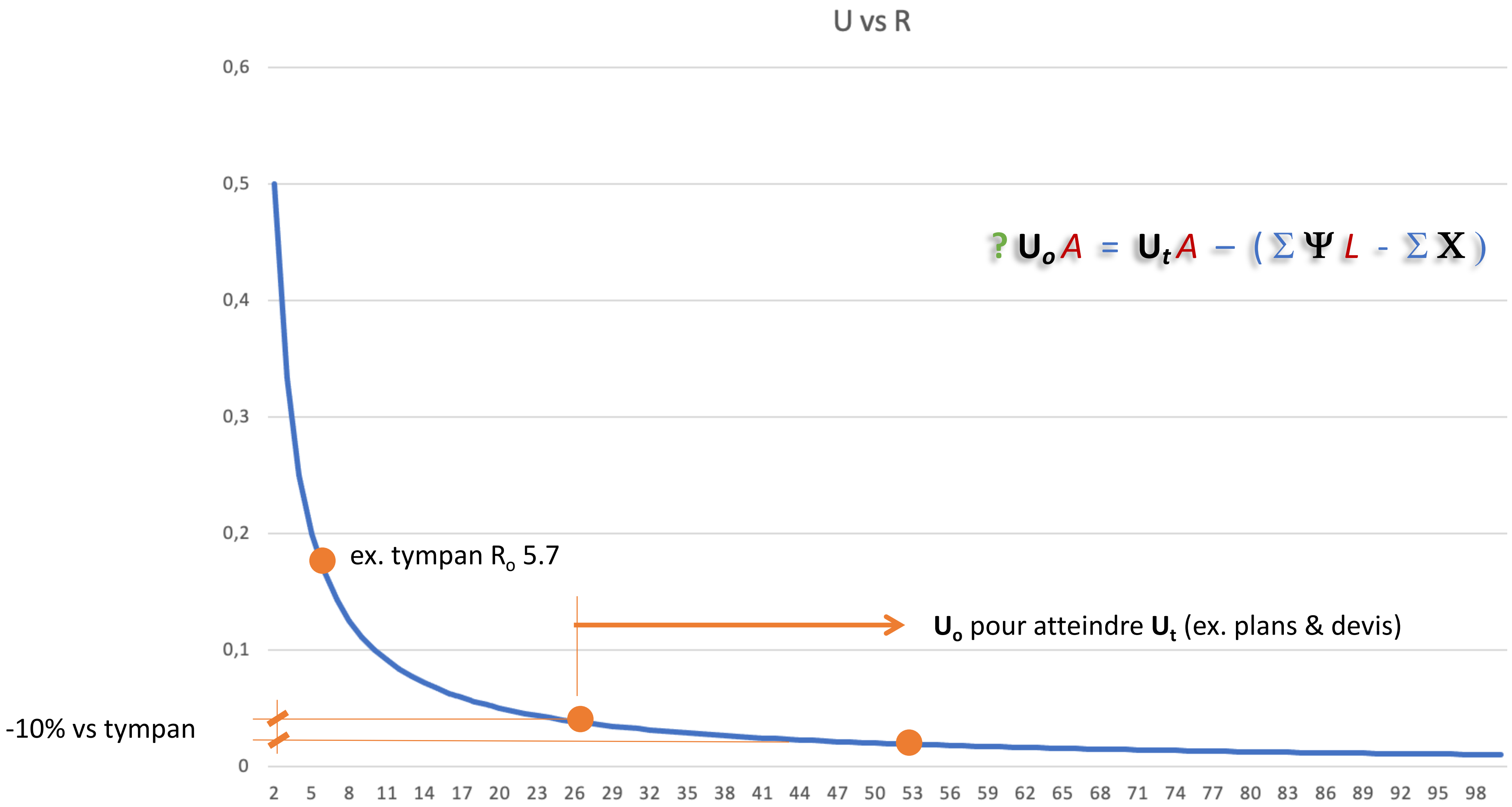
U_t **0.210** (R_t 27)
aire fenêtrée **33%**

fondation Ψ : **0.090**
rive Ψ : **0.200**
coins Ψ : **0.090**
fenêtrage Ψ : **0.078**



Réseau Energie et Bâtiments

CNÉB 2017 : 5000 DJC

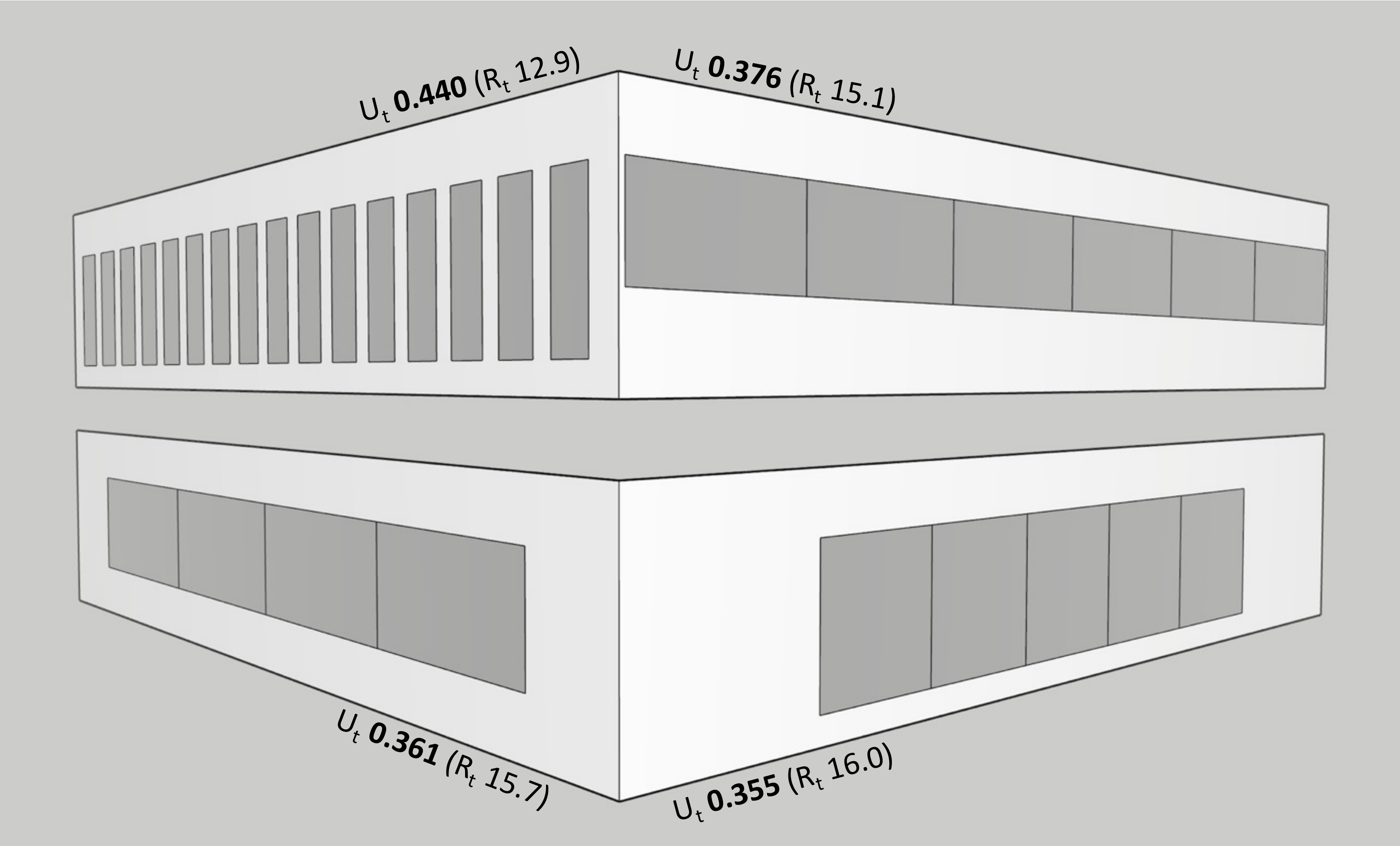


Réseau Energie et Bâtiments

CNÉB-QC I1 : 5000 DJC

U_o **0.278** (R_o 20)
aire fenêtrée **33%**

fondation Ψ : **0.090**
rive Ψ : **0.017**
coins Ψ : **0.090**
fenêtrage Ψ : **0.078**



Réseau Energie et Bâtiments

rd2

CNÉB-QC I1 : 5000 DJC

U_o **0.278** (R_o 20)
aire fenêtrée **33%**

fondation Ψ : **0.090**
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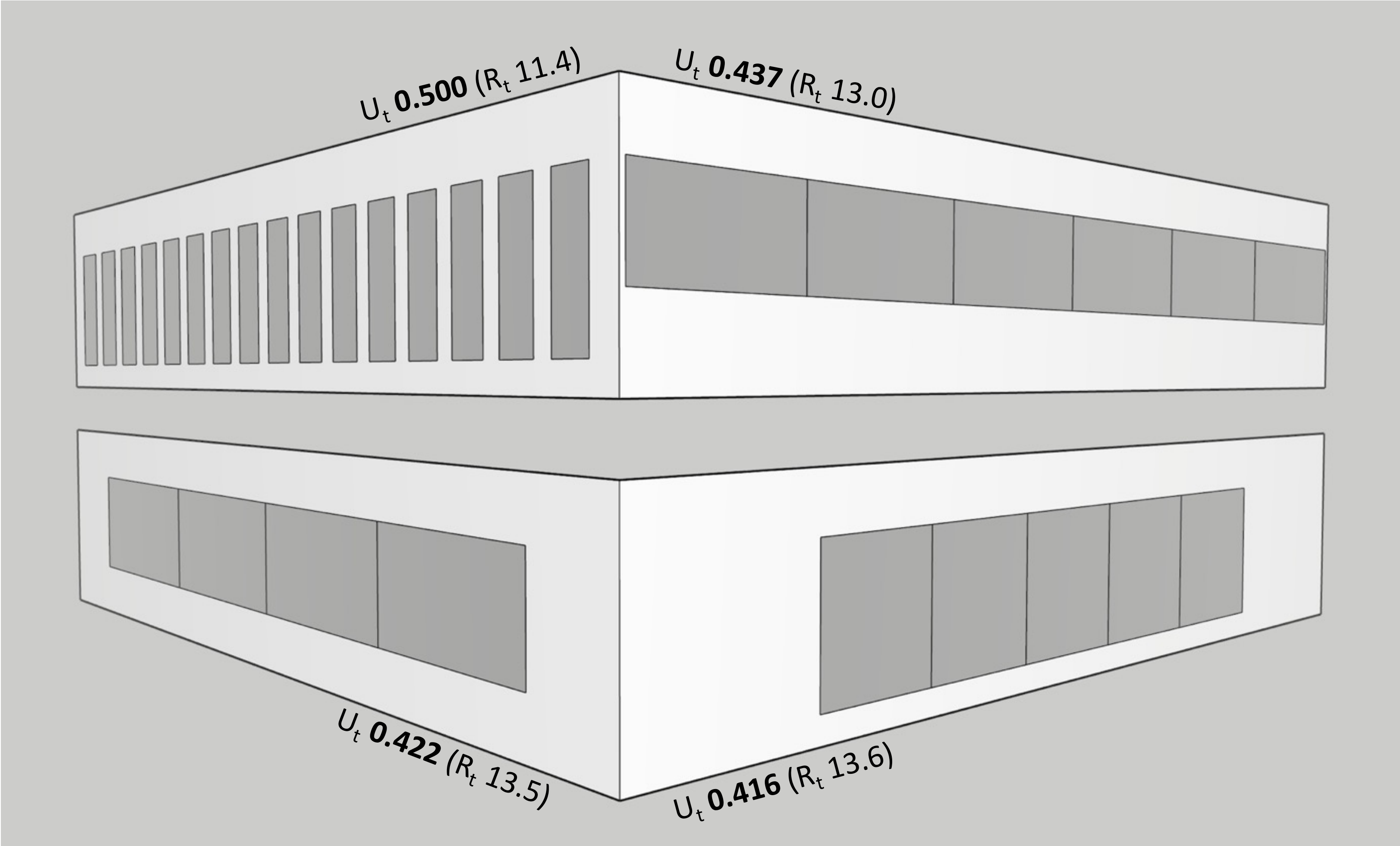
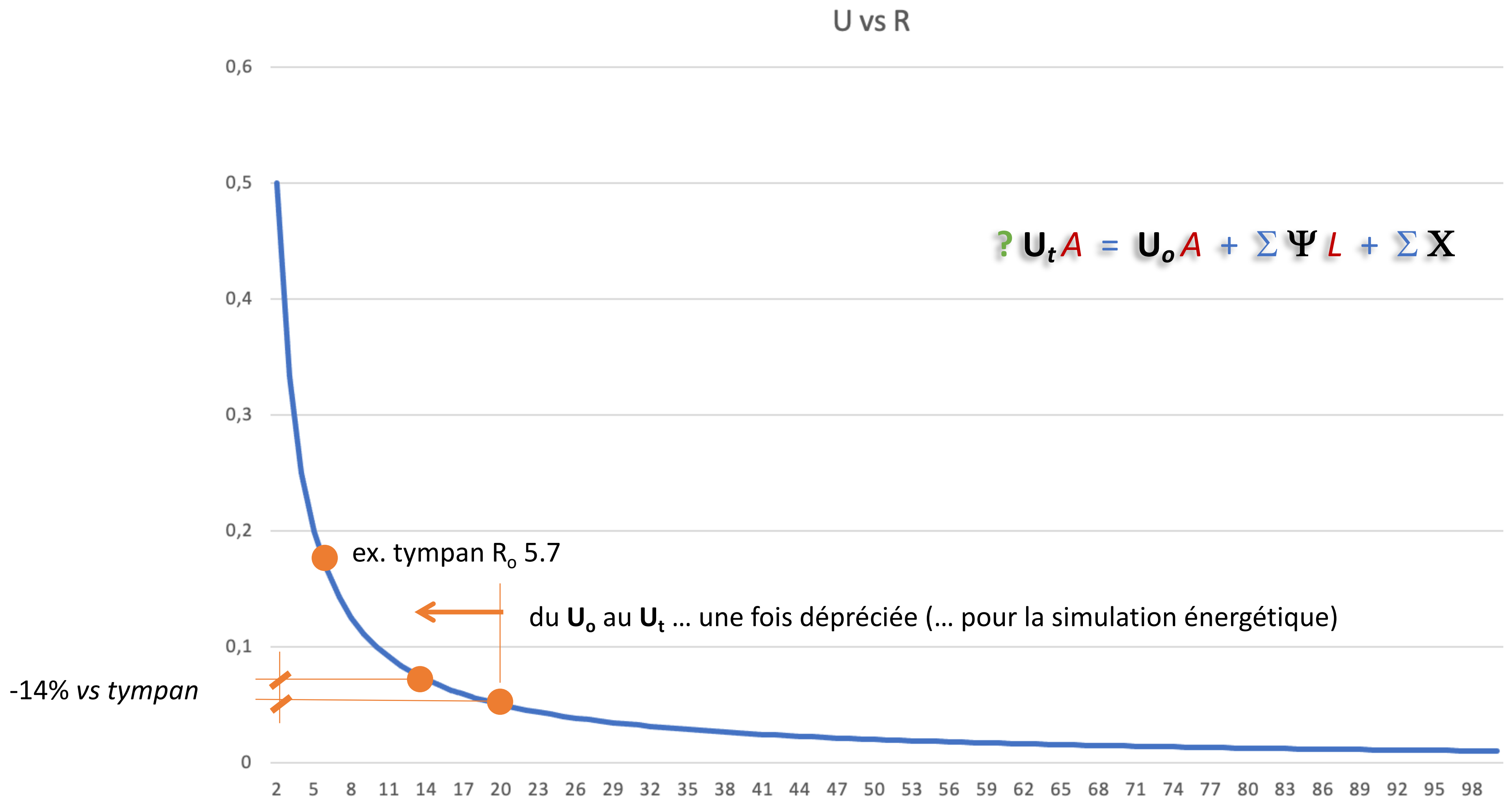


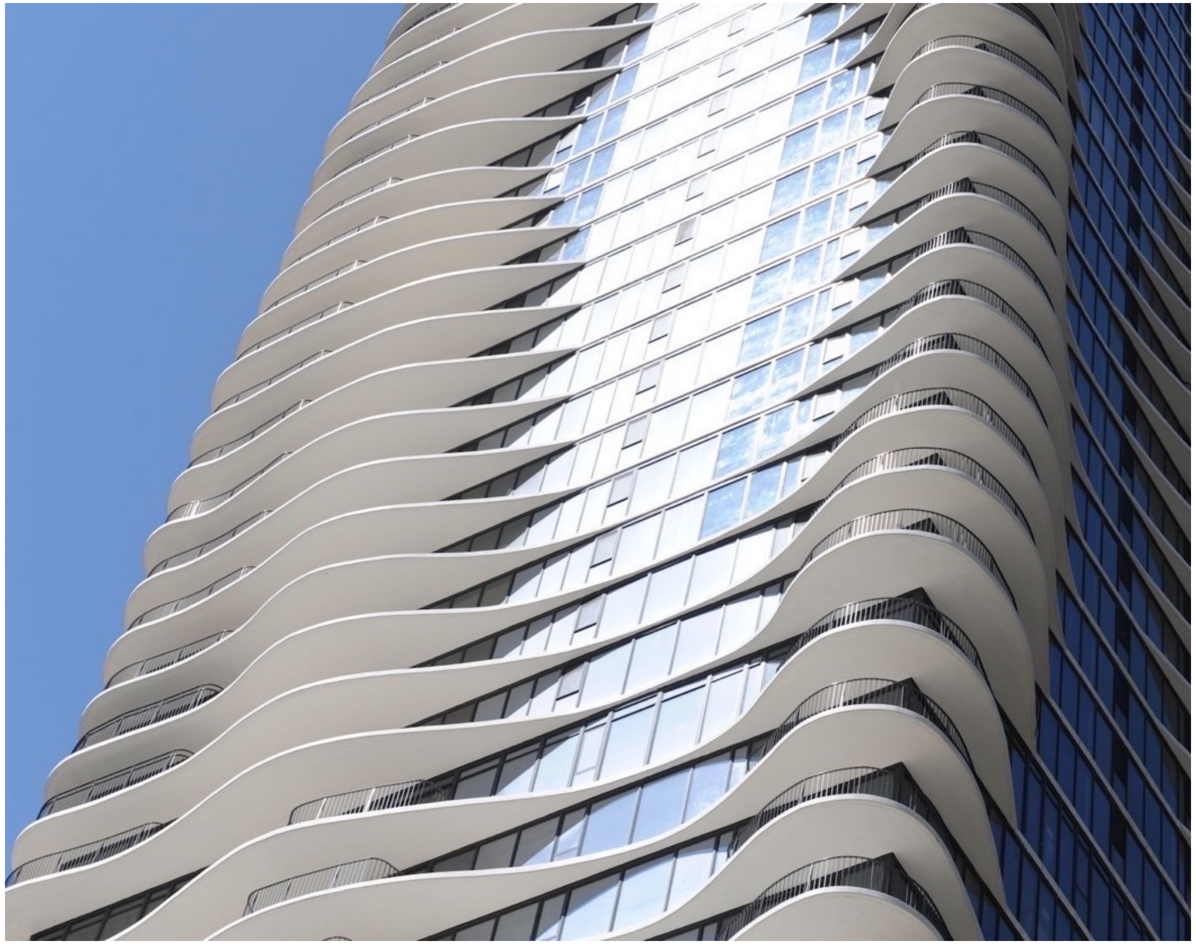
Réseau Energie et Bâtiments

CNÉB-QC I1 : 5000 DJC



LIMITES

fenêtrage



www.architecture.org/learn/resources/buildings-of-chicago/building/aqua

quoi déprécier ?

… OtherEquipment + EMS

Réseau Energie et Bâtiments

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EN COURS …

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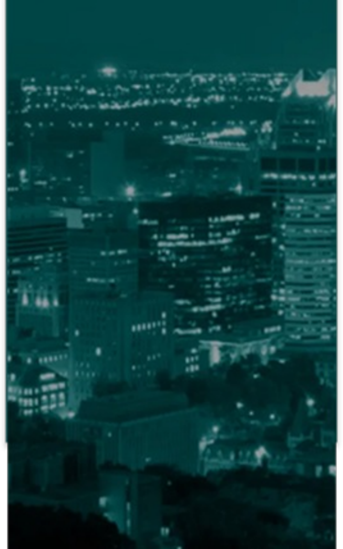
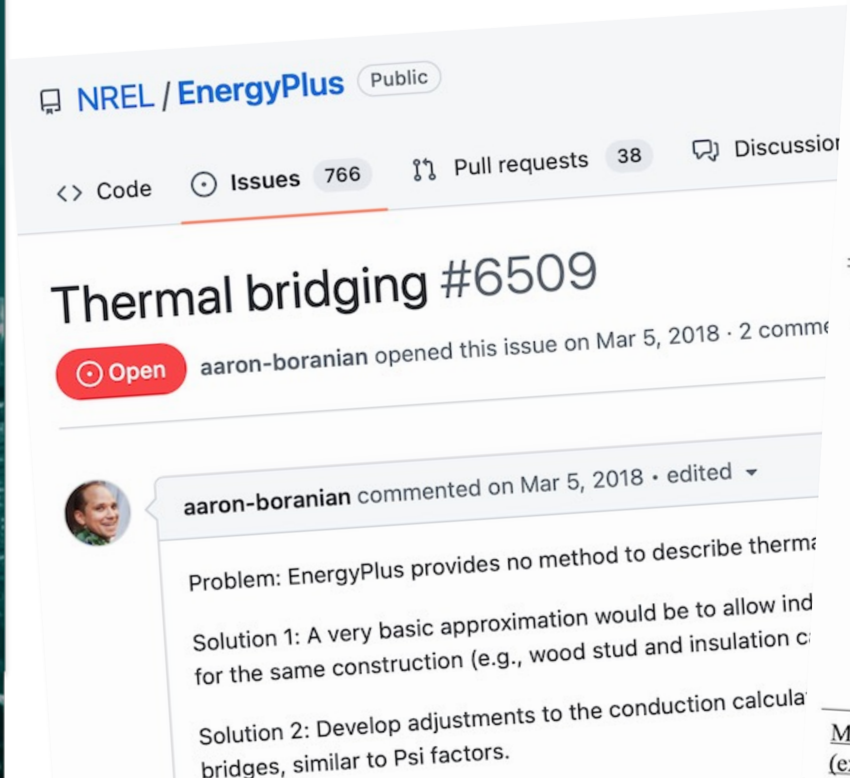
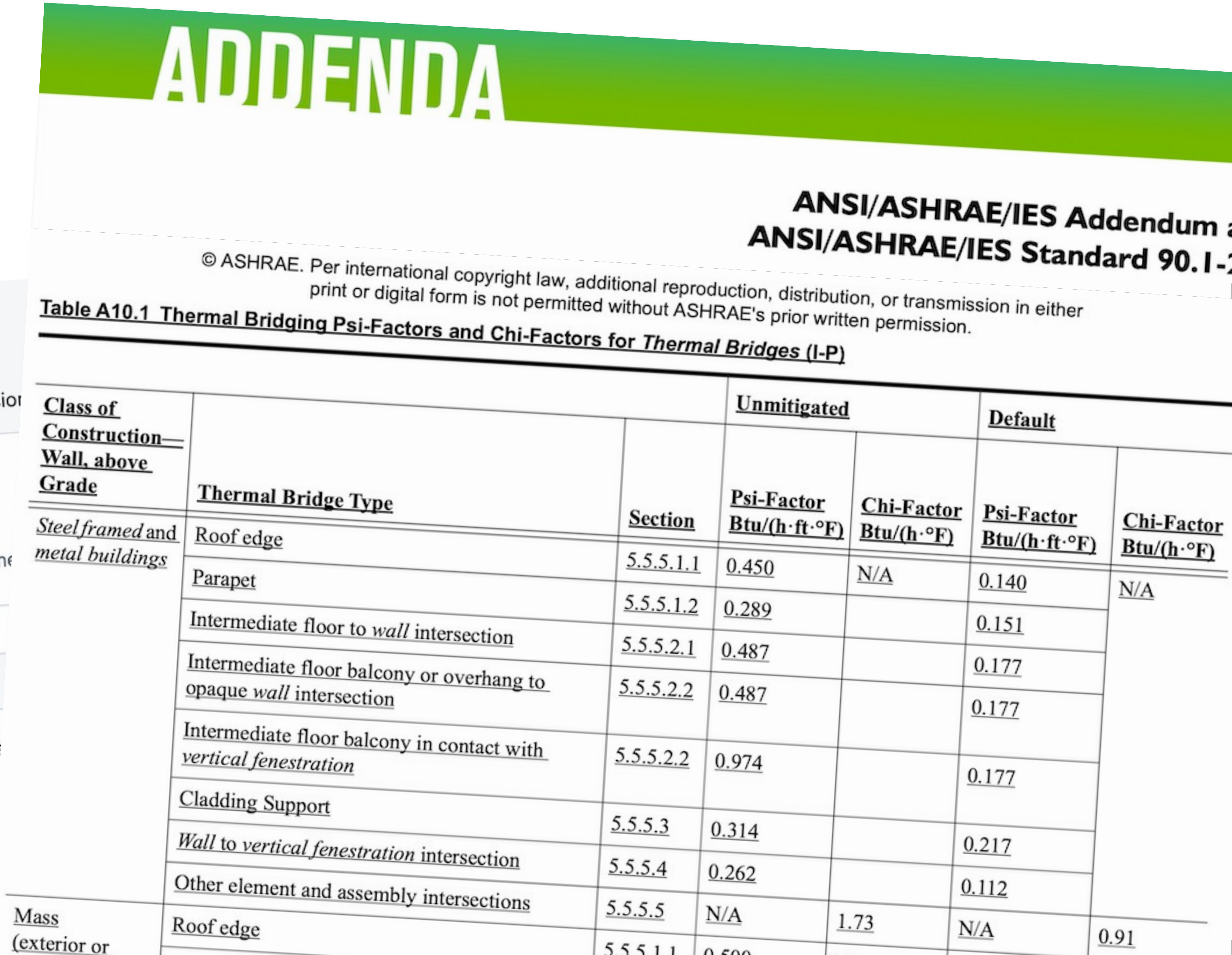
BETBG







ADDENDA

ANSI/ASHRAE/IES Addendum a
ANSI/ASHRAE/IES Standard 90.1-2

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Table A10.1 Thermal Bridging Psi-Factors and Chi-Factors for *Thermal Bridges* (I-P)

Class of Construction—Wall, above Grade	Thermal Bridge Type	Section	Unmitigated		Default	
			Psi-Factor Btu/(h·ft·°F)	Chi-Factor Btu/(h·°F)	Psi-Factor Btu/(h·ft·°F)	Chi-Factor Btu/(h·°F)
Steel framed and *metal buildings*	Roof edge	5.5.5.1.1	0.450	N/A	0.140	N/A
	Parapet	5.5.5.1.2	0.289		0.151	
	Intermediate floor to *wall* intersection	5.5.5.2.1	0.487		0.177	
	Intermediate floor balcony or overhang to opaque *wall* intersection	5.5.5.2.2	0.487		0.177	
	Intermediate floor balcony in contact with *vertical fenestration*	5.5.5.2.2	0.974		0.177	
	Cladding Support	5.5.5.3	0.314		0.217	
	Wall to *vertical fenestration* intersection	5.5.5.4	0.262		0.112	
	Other element and assembly intersections	5.5.5.5	N/A	1.73	N/A	0.91
Mass (exterior or	Roof edge	5.5.5.1.1	0.500			