The importance of a common method and correct calculation of thermal bridges

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Founded by:

SBUF SKANSKA

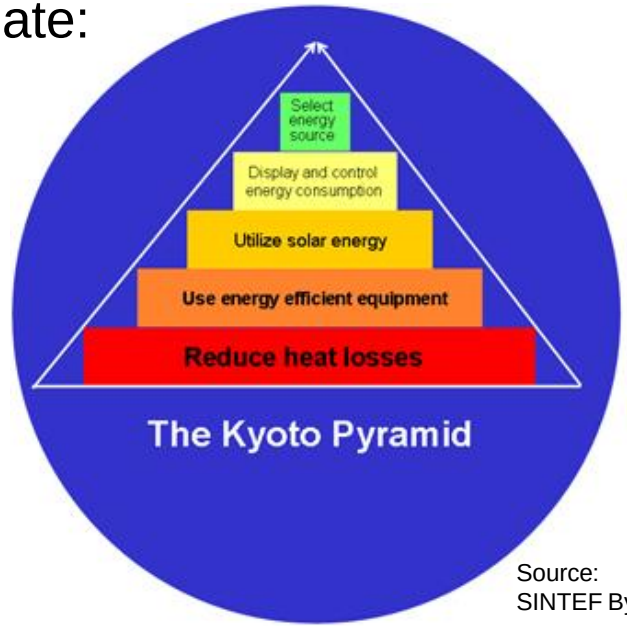
Agenda

- Introduction
- Theoretical background
- State of knowledge
- Example of consequence
- Conclusions

INTRODUCTION

Introduction

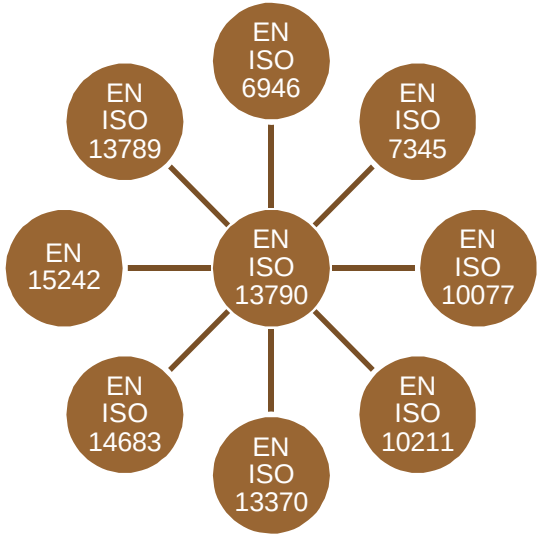
- Recast of the Energy Performance of Buildings Directive, EPBD
  - By the end of 2020 all new buildings shall be “nearly zero-energy buildings”
- Approach to design robust and energy efficient residential building in a Nordic climate:



Source:
SINTEF Byggforsk - Husbanken

Introduction

- EPBD, recast:
  - *The methodology for calculating energy performance should be based not only on the season in which heating is required, but should cover the annual energy performance of a building. That methodology should take into account existing European standards.*



THEORETICAL BACKGROUND

EN 13789 – Heat transfer coefficients

- Transmission heat transfer coefficient:

$$H_T = H_D + H_g + H_U + H_A$$

- Where
  - H_D direct heat transfer coefficient
  - H_g ground heat transfer coefficient
  - H_U heat transfer coefficient, unconditioned spaces
  - H_A heat transfer coefficient to adjacent buildings

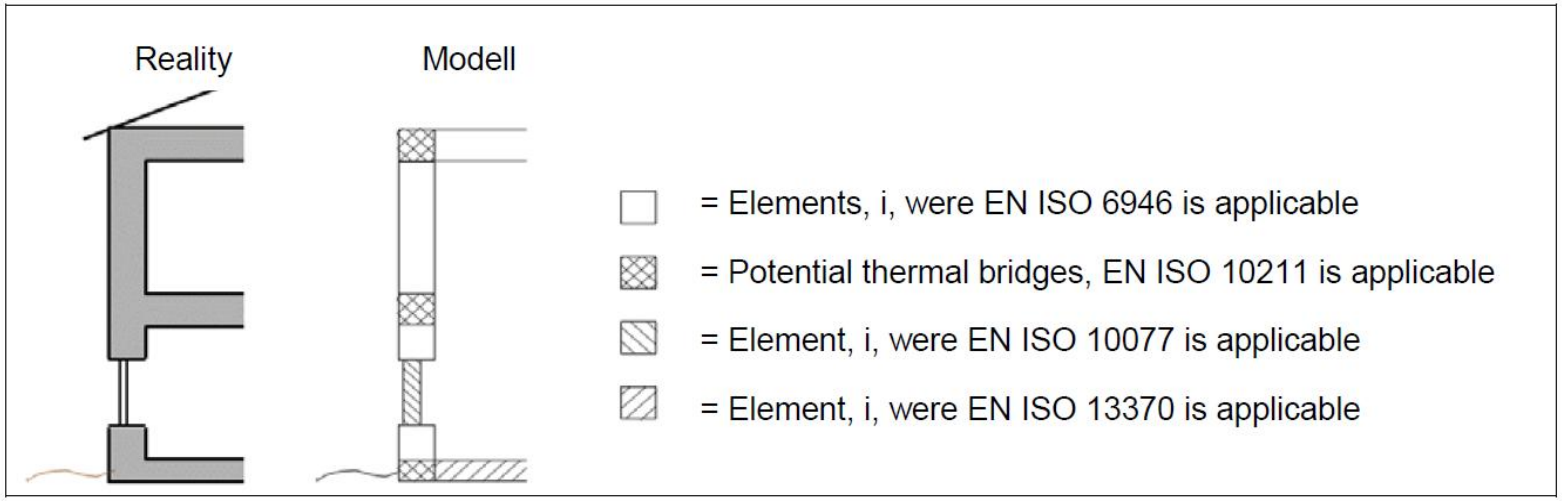
EN 13789 – Heat transfer coefficients

- Direct heat transfer coefficient:
- $$H_D = \sum_i A_i U_i + \sum_k l_k \Psi_k + \sum_j \chi_j$$

  - A_i area of element *i* of the building envelope [m2]
  - U_i thermal transmittance of element *i* [W/m2K]
  - l_k length of linear thermal bridge *k* [m]
  - Ψ_k linear thermal transmittance of thermal bridge *k* [W/mK]
  - χ_j point thermal transmittance of point thermal bridge *j* [W/K]

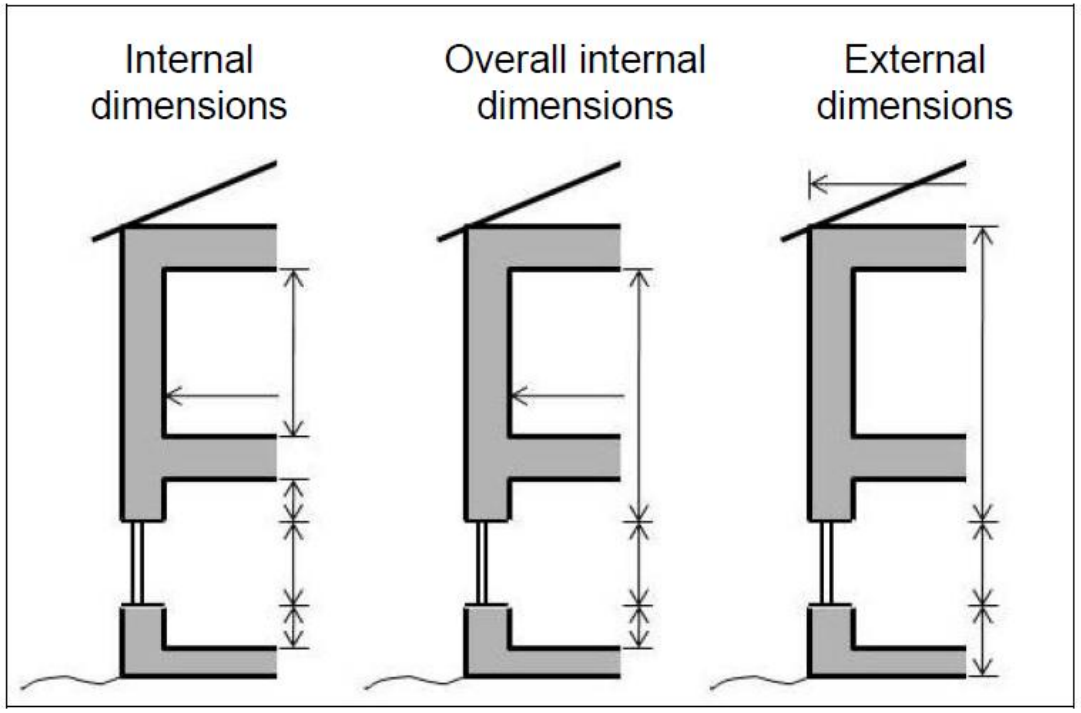
Application of EN ISO 13789

- Clearly divide the building envelopes into different elements:



Application of EN ISO 13789

- EN ISO 13789 allows for measuring of elements according to one of the three methods



EN ISO 10211 – Thermal bridges in constructions

- Linear thermal bridges

$$\Psi = L_{2D} - \sum_{j=1}^{N_j} U_j \cdot l_j$$

- Point thermal bridges

$$\chi = L_{3D} - \sum_{j=1}^{N_j} U_i \cdot A_i - \sum_{j=1}^{N_j} \Psi_j \cdot l_j$$

Important

- The sum of transmission losses through building elements, the term $\Sigma A_i U_i$, will vary depending on the chosen measuring method
- Consequently, the thermal bridges, Ψ_k-values and χ_j-values will vary

- Subscripts to clarify used method for measuring

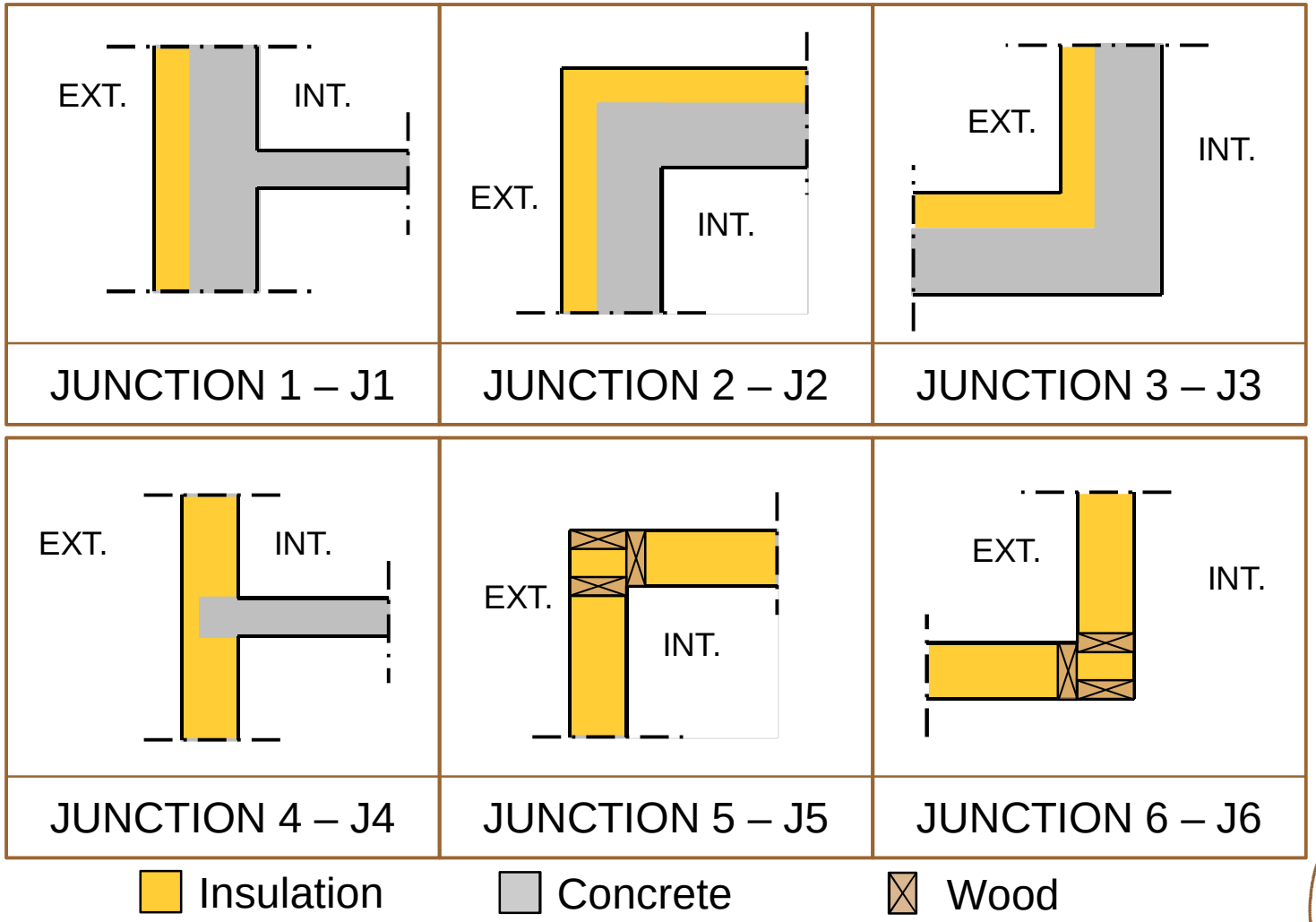
Subscript	Definition
i	Internal
oi	Overall internal
e	External

STATE OF KNOWLEDGE

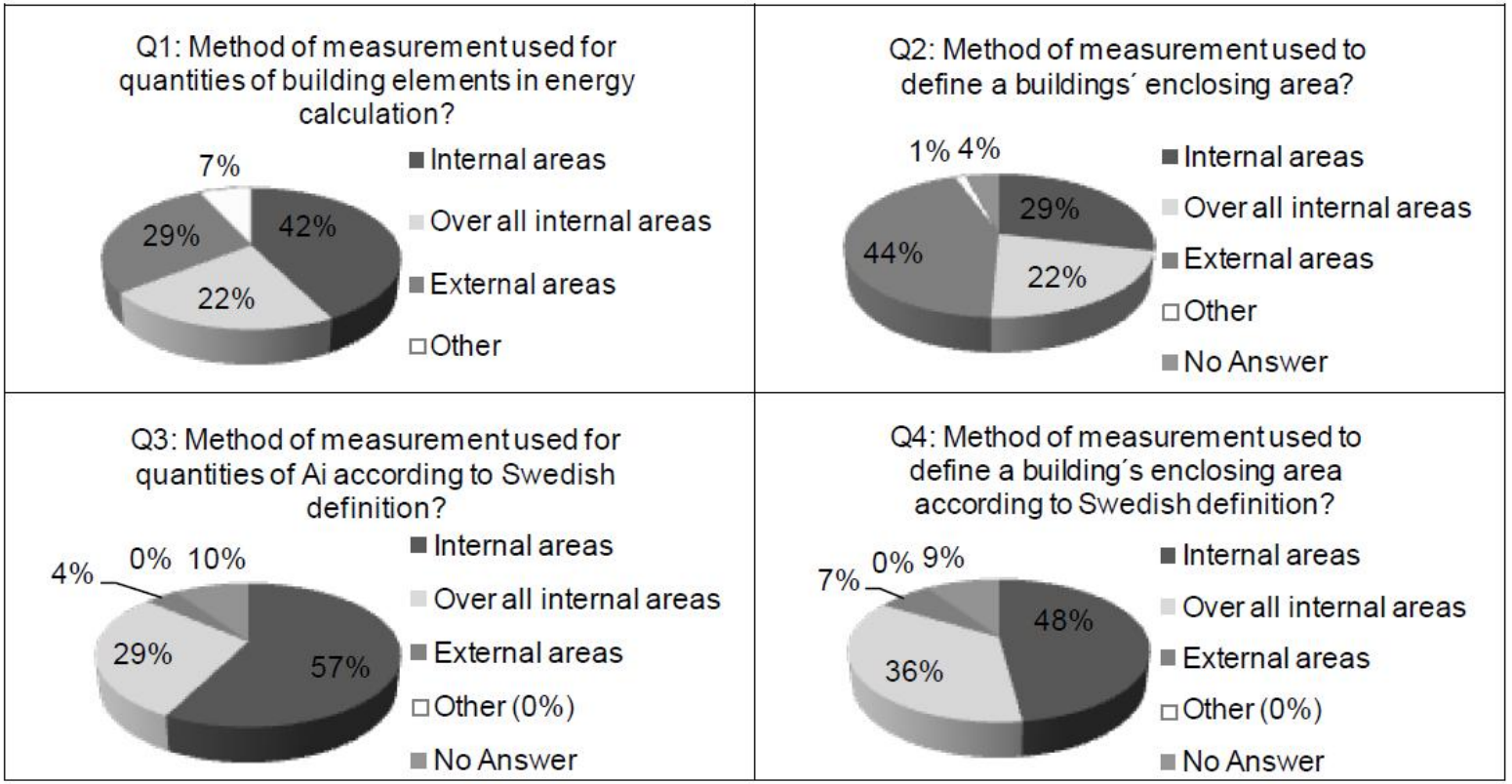
The survey

- Sent to 100 engineers and architects with experience of building projects with focus on energy efficiency
- The survey
  - Four questions about measuring methods used to define thermal transmitting area in energy calculations
  - Six questions, qualitative assessment of different junctions
  - Eight questions about professional background

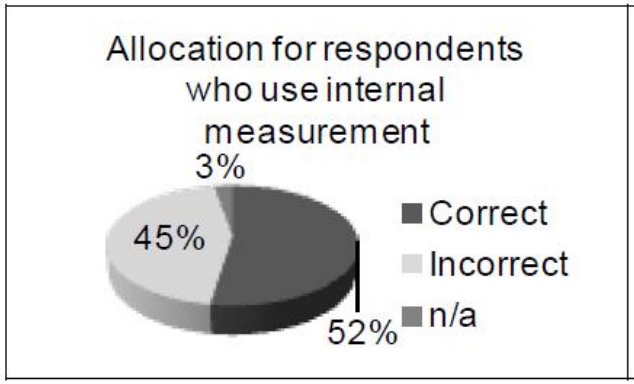
Junctions

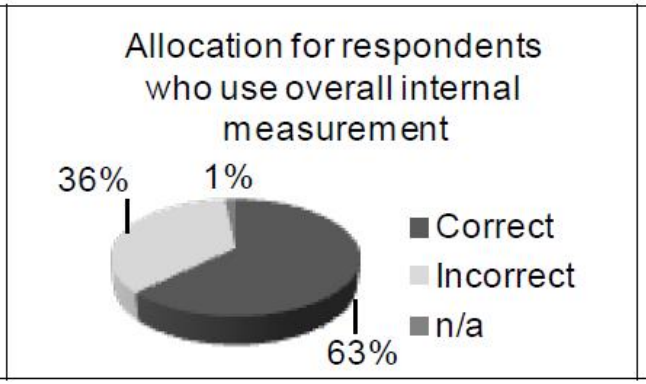

EXT.
INT.
JUNCTION 1 – J1
EXT.
INT.
JUNCTION 2 – J2
EXT.
INT.
JUNCTION 3 – J3
EXT.
INT.
JUNCTION 4 – J4
EXT.
INT.
JUNCTION 5 – J5
EXT.
INT.
JUNCTION 6 – J6
Insulation
Concrete
Wood

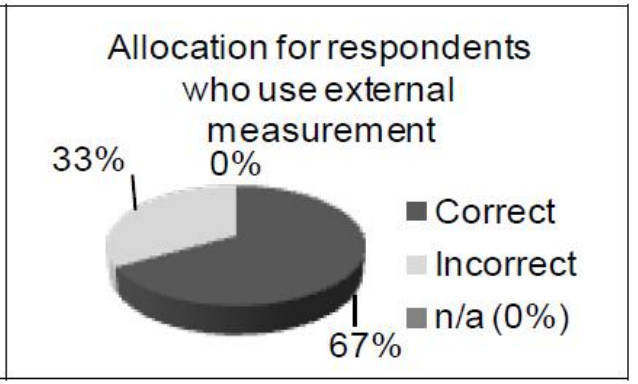
Results

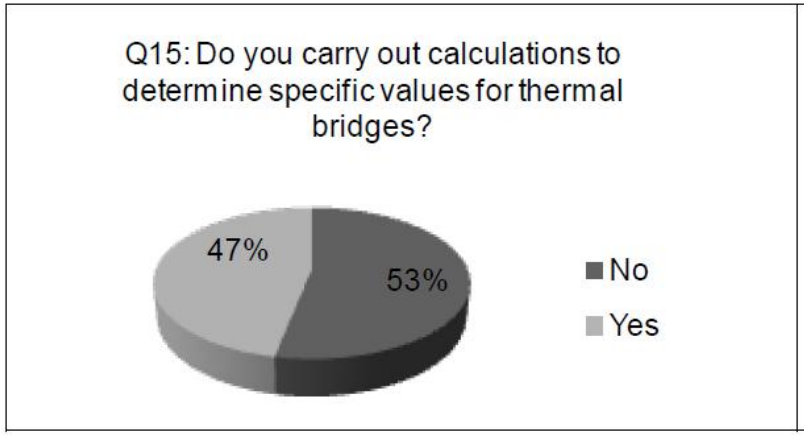

Q1: Method of measurement used for quantities of building elements in energy calculation?
7%
42%
29%
22%
Internal areas
Over all internal areas
External areas
Other
Q2: Method of measurement used to define a buildings´ enclosing area?
1% 4%
29%
44%
22%
Internal areas
Over all internal areas
External areas
Other
No Answer
Q3: Method of measurement used for quantities of Ai according to Swedish definition?
4%
0%
10%
29%
57%
Internal areas
Over all internal areas
External areas
Other (0%)
No Answer
Q4: Method of measurement used to define a building´s enclosing area according to Swedish definition?
7%
0%
9%
48%
36%
Internal areas
Over all internal areas
External areas
Other (0%)
No Answer

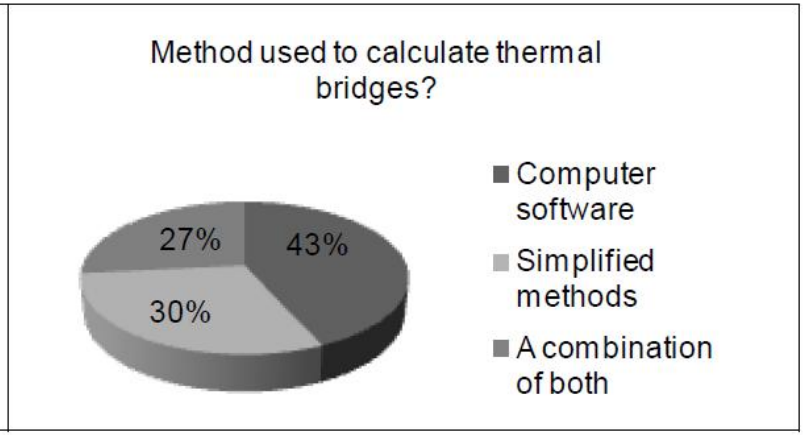
Results


Allocation for respondents who use internal measurement
3%
45%
52%
Correct
Incorrect
n/a


Allocation for respondents who use overall internal measurement
36%
1%
63%
Correct
Incorrect
n/a

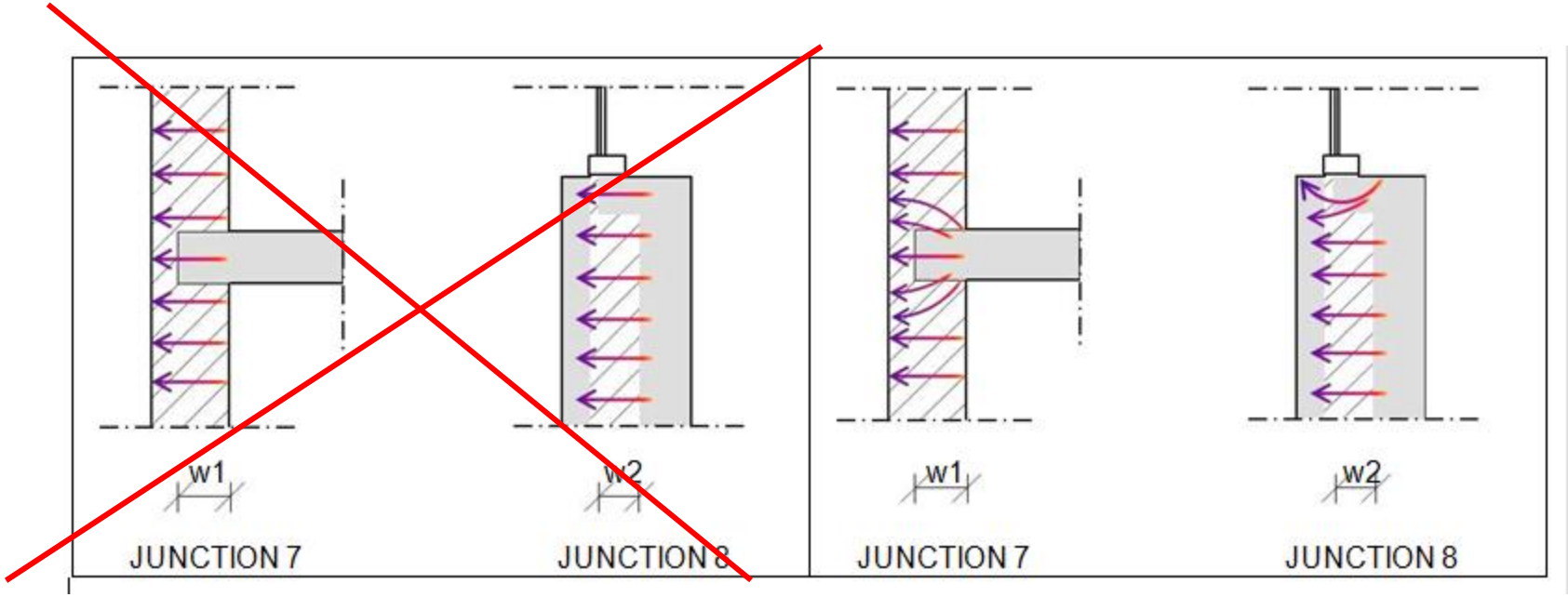

Allocation for respondents who use external measurement
33%
0%
67%
Correct
Incorrect
n/a (0%)


Q15: Do you carry out calculations to determine specific values for thermal bridges?
47%
53%
No
Yes

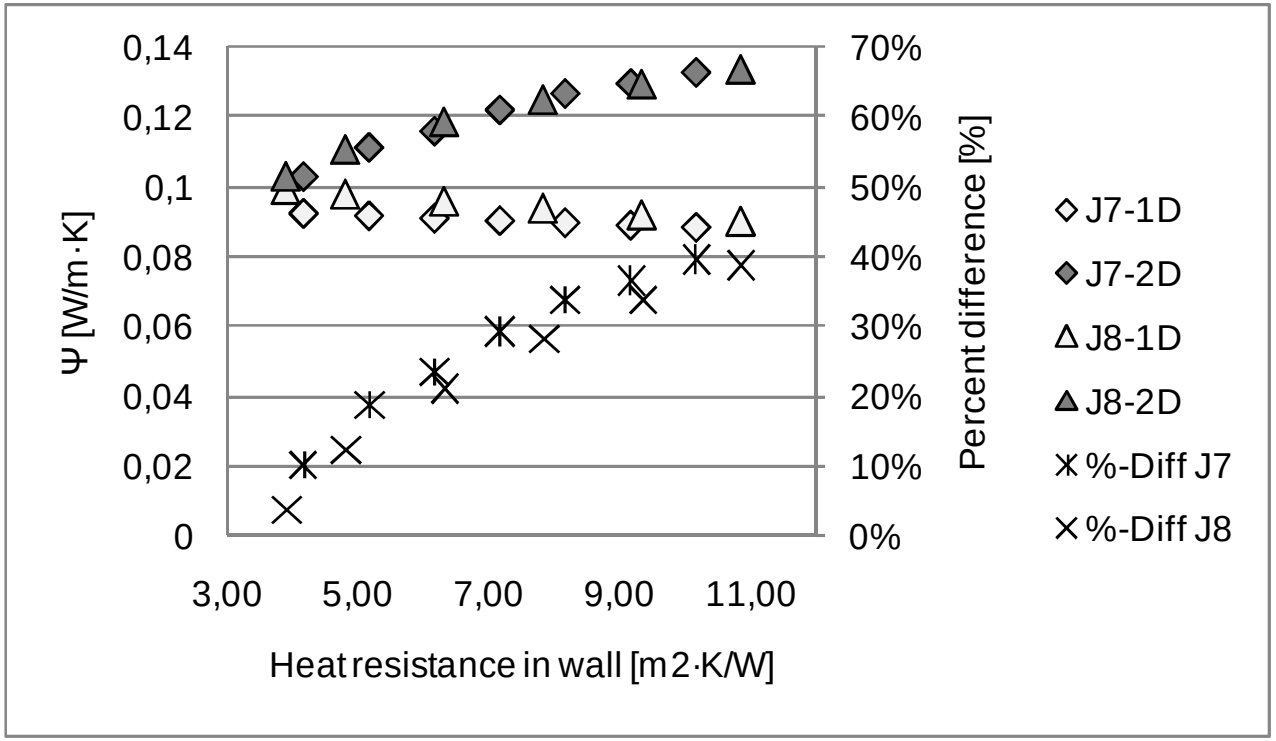

Method used to calculate thermal bridges?
27%
43%
30%
Computer software
Simplified methods
A combination of both

EXAMPLE OF CONSEQUENCE

Heat transfer is not 1D



Heat transfer is not 1D



CONCLUSIONS

Conclusions

- State of knowledge is not satisfying
- Important when we are increasing the use of BIM tools – which may provide quantity take offs for energy simulations
- Subscripts (i, oi, e) should always be used
- It seems as consultants does not always understand that a thermal bridge occur due to difference between internal and external areas

Thank you for the attention!

And thanks to everyone who took the time and answer the questionnaire.