ALDREN WP 2.4 Addressing health and well-being

Application to pilot buildings

ALDREN ALliance for Deep RENovation in buildings

Implementing the European Common Voluntary Certification Scheme, as back-bone along the whole deep renovation process

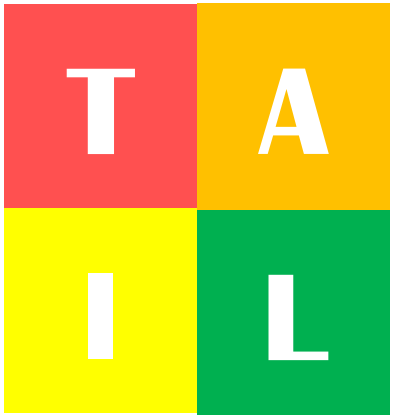
ALDREN Final Event, September, 2020
Corinne Mandin on behalf of the ALDREN T2.4 team

An integrated index: The ALDREN-TAIL index

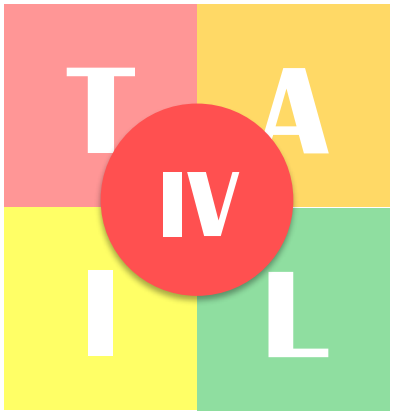
Addressing the **4 major components of IEQ**:

- **T**hermal environment
- **A**coustic environment
- **I**ndoor air quality
- **L**ight – Luminous (visual) environment

Assessed respectively according to the levels of the **12 parameters**



Allowing the assessment of the **overall IEQ**



I II III IV

12 parameters selected to define IEQ components within 4 IEQ components

	IEQ parameter	Measured	Modelled	Visual inspection
T	Indoor temperature (°C)	×	(×)	
A	Noise level (dB(A))	×		
I	CO_2 (ppm)	×	(×)	
	Ventilation rate (L/s)	×	(×)	
	Formaldehyde (µg/m³)	×		
	Benzene (µg/m³)	×		
	$PM_{2.5}$ (µg/m³)	×		
	Radon (Bq/m³)	×		
	Indoor air relative humidity (%)	×	(×)	
	Visible mold (cm²)			×
L	Daylight factor (%)		×	
	Illuminance (lux)	×		

Each of the 12 parameters is assessed according to 4 categories

All the indicators are assessed against 4 categories defined by EN16798 (2019) standard and WHO guidelines, mainly:

- **Category I**: High level of expectation and recommended for spaces occupied by sensitive and fragile people with special requirements like some disabilities, sick, very young children and elderly persons, to increase accessibility
- **Category II**: Normal level of expectation
- **Category III**: Moderate level of expectation
- **Category IV**: Low level of expectation. Poor quality. Unacceptable regarding health

➔ Each indicator is associated to a category at every studied location in the building.

TAIL is determined before and after renovation

Deep energy renovation

TAIL <1 year

Regular operation
3 months < TAIL < 1 year

Same season before and after

Ideally two seasons before and two seasons after

During the on-site measurements, the building shall be **operated and occupied as usual**, to capture typical conditions.

Number of sampling locations

- **A compromise** between the representativeness of the sampling locations regarding the whole building, and the technical and economic feasibility
- **At least 2 rooms – at maximum 10 rooms**
- The sum of the sampling location areas must address **at least 10% of the occupied area**, i.e., office floor area in office buildings and guest room floor area in hotels.

Choice of the sampling locations

- Only offices/workplaces in office buildings and rooms in hotels
  (no lobby or meeting rooms)

- Criteria to chose the sampling locations:
  - The **lowest occupied level and the highest occupied level**
  - **different orientations** (North/South/East/West) meaning different outdoor environment influence (street *versus* garden)
  - **different types of indoor spaces** (materials, ventilation system, occupancy, etc.)
  - **Normally occupied**




Single and open-plan offices in office buildings and the rooms of different sizes in hotels

Duration of sampling

- **One month** for temperature and relative humidity
- **Two months** for radon, if the building is in a radon-prone area
- For the other parameters, **one week:**
  - Monday to Friday in an office building
  - Monday to Monday, Tuesday to Tuesday, etc., in a hotel

Measuring equipment

Temperature measurement

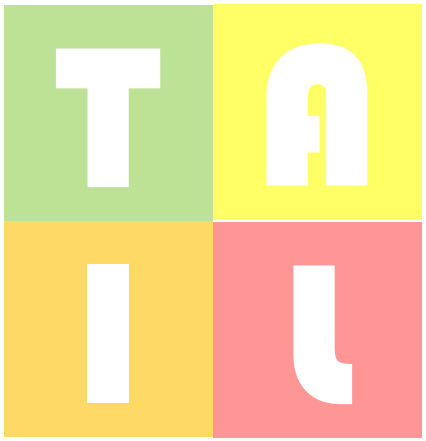
Particles measurement

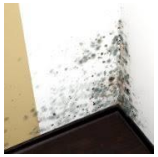
Chemical pollution

CO_2 measurement

Temperature and Relative Humidity measurement

Ventilation rate measurement





Mould observations

Radon dosimeter

Noise measurement

Light measurement

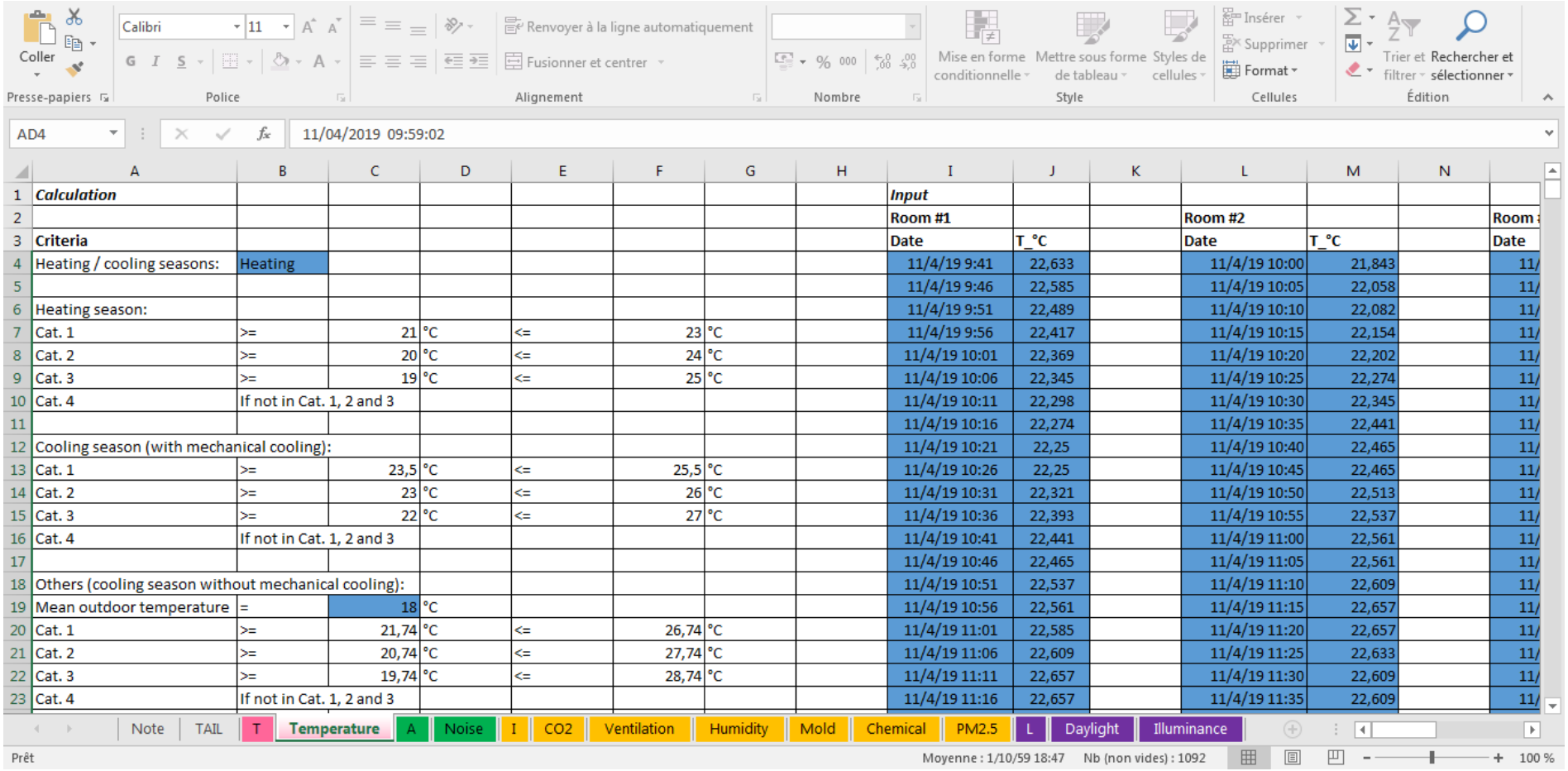
In the **center of the room**

Direct sun

Heating sources

Ventilation channels

TAIL calculation tool

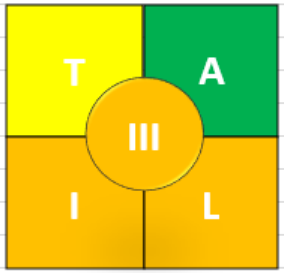


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	***Calculation***								***Input***						
2									**Room #1**			**Room #2**			**Room**
3	**Criteria**								**Date**	**T_°C**		**Date**	**T_°C**		**Date**
4	Heating / cooling seasons:	Heating							11/4/19 9:41	22,633		11/4/19 10:00	21,843		11/
5									11/4/19 9:46	22,585		11/4/19 10:05	22,058		11/
6	Heating season:								11/4/19 9:51	22,489		11/4/19 10:10	22,082		11/
7	Cat. 1	>=	21	°C	<=	23	°C		11/4/19 9:56	22,417		11/4/19 10:15	22,154		11/
8	Cat. 2	>=	20	°C	<=	24	°C		11/4/19 10:01	22,369		11/4/19 10:20	22,202		11/
9	Cat. 3	>=	19	°C	<=	25	°C		11/4/19 10:06	22,345		11/4/19 10:25	22,274		11/
10	Cat. 4	If not in Cat. 1, 2 and 3							11/4/19 10:11	22,298		11/4/19 10:30	22,345		11/
11									11/4/19 10:16	22,274		11/4/19 10:35	22,441		11/
12	Cooling season (with mechanical cooling):								11/4/19 10:21	22,25		11/4/19 10:40	22,465		11/
13	Cat. 1	>=	23,5	°C	<=	25,5	°C		11/4/19 10:26	22,25		11/4/19 10:45	22,465		11/
14	Cat. 2	>=	23	°C	<=	26	°C		11/4/19 10:31	22,321		11/4/19 10:50	22,513		11/
15	Cat. 3	>=	22	°C	<=	27	°C		11/4/19 10:36	22,393		11/4/19 10:55	22,537		11/
16	Cat. 4	If not in Cat. 1, 2 and 3							11/4/19 10:41	22,441		11/4/19 11:00	22,561		11/
17									11/4/19 10:46	22,465		11/4/19 11:05	22,561		11/
18	Others (cooling season without mechanical cooling):								11/4/19 10:51	22,537		11/4/19 11:10	22,609		11/
19	Mean outdoor temperature	=	18	°C					11/4/19 10:56	22,561		11/4/19 11:15	22,657		11/
20	Cat. 1	>=	21,74	°C	<=	26,74	°C		11/4/19 11:01	22,585		11/4/19 11:20	22,657		11/
21	Cat. 2	>=	20,74	°C	<=	27,74	°C		11/4/19 11:06	22,609		11/4/19 11:25	22,633		11/
22	Cat. 3	>=	19,74	°C	<=	28,74	°C		11/4/19 11:11	22,657		11/4/19 11:30	22,609		11/
23	Cat. 4	If not in Cat. 1, 2 and 3							11/4/19 11:16	22,657		11/4/19 11:35	22,609		11/

TAIL calculation tool: output

TAIL Index for Health & Wellbeing

Building location	
Building type	
Date of renovation	



	Category
Thermal environment	2
Acoustic environment	1
Indoor air quality	3
Lighting (visual) environment	3
TAIL	III

Application to 6 office buildings and 5 hotels

Type	TAIL scores before renovation				
	Overall	T	A	I	L
Office	IV	4	4	3	3
Office	IV	4	4	3	3
Office	IV	3	4	2	3
Office	IV	4	4	2	1
Office	IV	2	4	3	4
Office	III	2	1	3	3
Hotel	IV	4	4	4	1
Hotel	IV	3	4	2	1
Hotel	IV	4	4	4	1
Hotel	IV	2	4	4	1
Hotel	IV	1	4	2	1

Lessons learnt from the pilot studies

- Applicability of the method
- Adjustment needed for the rating and applied to the final method
- Differences across the buildings
- Capacity to identify potential for IEQ improvement during renovation operations

Future developments of the rating method and the TAIL index

- Sensitivity analysis of the TAIL index on larger datasets
- Additional parameters underlying TAIL, e.g., inclusion of occupant ratings?
- Extension to other buildings, e.g., schools and dwellings
- Development of a framework for the prediction of TAIL after renovation = PredicTAIL included in the RenoMap
- Monetization of TAIL
- Development of a simple measurement box

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