



Indoor air quality: new construction methods and tools to achieve the foreseen IAQ

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www.built2spec-project.eu



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Project main objective

Reduce the performance gap between the foreseen performance and the as built performance



**Self-Inspection, 3D Modelling,
Management and Quality-Check Tools
for the Construction Worksite**



Portable and easy to use!



Indoor Air Quality (IAQ) figures

Human beings

12 000 L of air per day
85% of the time inside

Indoor air

10 times more polluted than
outdoor air

Bad IAQ in Europe

118 000 deaths per year
1 430 billions euros spent
for diseases and deaths





Improvement of the IAQ

+ 10 % productivity
-35 % sickness leaves



Indoor air Pollutants and sources

Major indoor air pollutants






-  Volatile organic compounds (VOCs) such as formaldehyde
-  Mold
-  Combustion products (NO_x, CO,...)
-  Allergen (pollen, mites,...)







Indoor air Pollutants and sources

Major pollutants sources

Construction elements

-  Building materials
-  Furniture
-  Ventilation system (bring external pollution)
-  Heat generation equipment
-  Etc.

Human activities

-  Cooking
-  Cleaning product
-  Smoking
-  Etc.






Development of a global construction methodology

- 📱 Identification of all critical stages for IAQ
 - 📱 Material reception and storage (humidity)
 - 📱 Ventilation conduct reception and storage (protection)
 - 📱 End of construction (building reception)
 - 📱 Etc.
- 📱 Identification of actions to be taken at each critical stage
 - 📱 Taking pictures
 - 📱 Performing measurements
 - 📱 Other
- 📱 Definition of the workflow for integration to the VCMP






Development of a measurement methodology

Definition of use cases

-  What type of work? (new/rehabilitation)
-  When to perform the measurements?
-  Which measurements?

Interface development for the VCMP

-  Which information will be visible?
-  What design?
-  How it will communicate with the platform (link between the actors of the value chain)?



Development of a measurement methodology

- 📱 Identification of the list of targeted pollutants (21 targeted)
 - 📱 Study of the pollutants guide values of all the EU countries in the project
- 📱 Identification of other parameters to follow (confinement, confort)
- 📱 Definition of indicators
 - 📱 Guideline values (pass or fail)

IAQ Index <div><div></div><div></div><div></div></div>															
Pollution index <div><div></div><div></div><div></div></div>								Confinement index <div><div></div><div></div><div></div></div>				Comfort index <div><div></div><div></div><div></div></div>			
Indoor pollutants <div><div></div><div></div><div></div></div>				Outdoor pollutants <div><div></div><div></div><div></div></div>											
Pollutant	C _{measured} (µg/m ³)	C _{max1} (µg/m ³)	C _{max2} (µg/m ³)	Pollutant	C _{measured} (µg/m ³)	C _{max1} (µg/m ³)	C _{max2} (µg/m ³)	Pollutant	C _{measured} (µg/m ³)	C _{max1} (µg/m ³)	C _{max2} (µg/m ³)	Parameter	Measur ed Value	Slight inconfort range	Incomfor range
<div><div></div><div></div><div></div></div> Formaldehyde				<div><div></div><div></div><div></div></div> Ethylbenzene				<div><div></div><div></div><div></div></div> CO ₂				<div><div></div><div></div><div></div></div> T			
<div><div></div><div></div><div></div></div> Acetaldehyde				<div><div></div><div></div><div></div></div> Toluene								<div><div></div><div></div><div></div></div> RH			
<div><div></div><div></div><div></div></div> 2- butoxyethanol				<div><div></div><div></div><div></div></div> PM 2.5											
<div><div></div><div></div><div></div></div> α-pinene				<div><div></div><div></div><div></div></div> PM 10											
<div><div></div><div></div><div></div></div> Limonene															



Why developing new tools?

- ❏ Passive method (Radiello®, 2 tubes, ISO 16000-4 and ISO 16017-2)
- ❏ 5 days measurement
- ❏ Results: average concentration over 5 days
- ❏ Analysis by specific laboratories



- > Impossible to use this method for a quick control of the IAQ
- > Several days to obtain the result



Why developing new tools?

- 📱 Active method (TENAX® and DNPH, ISO 16000-6 and ISO 16000-3)
- 📱 2 hours measurement
- 📱 Results: average concentration over 2 hours
- 📱 Needs of pumps
- 📱 Analysis by specific laboratories

- > Cannot be performed by non-trained user
- > Time consuming installation
- > Several days to obtain the results





New tool



- Measuring indoor air quality (pollutants concentrations) from the worksite to the exploitation of the building with a **portable and real time analyzer!**

Technology

- Tunable laser source, ONERA licence (The French Aerospace Lab)
- Laser spectroscopy: real time, robust, portable
- Widely tunable: multi-gas, interference management





Pilot test

- 📱 OHL (end user) successfully ran real time IAQ measurements with the X-FLR9 analyser using VCMP on their smartphones
- 📱 Measurements have been conducted in the lobby, cafeteria, bathroom, parking lot, and office space
- 📱 Pilot tests by end users planned in 4 other countries by December 2018










Pilot test

VCMP developed by VRM: Pre-checklist

←

 VCMP - BUILT2SPEC

    Luke

17-0038-008 IAQ Test

DETAILS CATEGORIES SURVEY SCHEDULE ISSUES PROGRESS REPORTS DOCUMENTS COMMENTS FOLDERS

PDF

EXCEL

Pages List

⊖ IAQ Initial Test

Contact Details

Room Air Quality (Indoor)

⊕ Secondary IAQ Test

Room Air Quality (Indoor)

Room name/number

8th floor ohl

Pre-Checklist

Is the room clear of materials or cleaning products (inc paint containers or wood w...

Yes

Notes

Is the room clean (e.g. no rubble or dust linked to the work done in the room)?

Yes

Notes

Is the air entry and air outlet obstructed?

No

Notes

Is there mold trace or a mold odor?

No

Notes

Has the last layer of paint or wood finish been applied more than 48h before the tes...

Yes

Notes

Has someone cooked in the room during the last 48h?

No

Chats



Pilot test

VCMP developed by VRM: Example of results

Perform Measurement

IAQ Index

● Pollution index				● Confinement index				● Comfort index							
● Indoor pollutants			● Outdoor pollutants	● Confinement index			● Comfort index								
Pollutant	C measured (mg/m3)	C max1 (mg/m3)	C max2 (mg/m3)	Pollutant	C measured (mg/m3)	C max1 (mg/m3)	C max2 (mg/m3)	Pollutant	C measured (mg/m3)	C max1 (mg/m3)	C max2 (mg/m3)	Parameter	Measured Value	Slight discomfort range	Discomfort range
● Formaldehyde	52.15	30	100	Ethylbenzene		442000	884000	● CO2	410.0	1000	1400	● T	19.0	19.5 - 20.5 or 24-25	<19.5 or > 25
● Acetaldehyde	137.14	100	1000	Toluene		260	1000					● RH	1%	40%>HR>30% or 65%>HR>60%	< 30% or > 65%
2-butoxyethanol		98000	246000	● PM 2.5	15.0	10	25								
α-pinene		200	2000	● PM 10	11.0	20	50								
Limonene		1000	10000												

CLOSE

Room Air Quality (Indoor)

Secondary IAQ Test

Perform Measurement

IAQ Index

● Pollution index				● Confinement index				● Comfort index							
● Indoor pollutants			● Outdoor pollutants	● Confinement index			● Comfort index								
Pollutant	C measured (mg/m3)	C max1 (mg/m3)	C max2 (mg/m3)	Pollutant	C measured (mg/m3)	C max1 (mg/m3)	C max2 (mg/m3)	Pollutant	C measured (mg/m3)	C max1 (mg/m3)	C max2 (mg/m3)	Parameter	Measured Value	Slight discomfort range	Discomfort range
Formaldehyde	7.5	30	100	Ethylbenzene		200	2000	CO2		1000	1400	T		19.5 - 20.5 or 24-25	<19.5 or > 25
Acetaldehyde	0.25	100	1000	Toluene		260	1000					RH		40%>HR>30% or 65%>HR>60%	< 30% or > 65%
2-butoxyethanol		100	1000	PM 2.5		25	25								
α-pinene		200	2000	PM 10		50	50								
Limonene		1000	10000												

Post-Checklist

Did someone enter the room during the measurement?

No



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