Wood for Zero.

NERO – Cost reduction of new Nearly-Zero Energy Wooden buildings in Northern Climate Conditions

D1.3. Audit and inspection procedures specification

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D1.3.	Audit and inspection procedures specification		
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ABSTRACT:

This procedure allows to assess indoor climate quality in main indoor climate categories such as thermal comfort and indoor air quality having a high degree of interaction with energy performance, and includes a less comprehensive, subjective assessment for lighting and acoustics. The procedure is intended to be used to assess indoor climate in representative rooms of the building in summer and winter conditions. The procedure covers the collection of design documentation, subjective evaluation of indoor environmental condition, measurement of temperature, CO_2, pressure differences, building airtightness, airflow rate, and air velocity.

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1 PU = Public; CO = Confidential, only for members of the Consortium (including the EC services).

2 R = Report; R+O = Report plus Other. Note: all "O" deliverables must be accompanied by a deliverable report.

3 eg DX.Y_name to the deliverable_v0xx. v1 corresponds to the final release submitted to the EC.

4 Person from the lead beneficiary that is responsible for the deliverable.

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6 Typically person(s) with appropriate expertise to assess the deliverable quality.

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Table of Contents

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Audit and inspection procedures specification

This procedure allows to assess indoor climate quality in main indoor climate categories such as thermal comfort and indoor air quality having a high degree of interaction with energy performance, and includes a less comprehensive, subjective assessment for lighting and acoustics. The procedure is intended to be used to assess indoor climate in representative rooms of the building in summer and winter conditions. The procedure does not form a certification system for indoor climate quality, but it may be utilized as a core element if such a certification system will be developed. The procedure includes:

- Design documentation inspection
- Interview with building manager
- One site visit in heating season and another site visit in cooling season
- Monitoring in heating season and cooling season
- Occupant questionnaire in heating and cooling season

1. Collection of design documentation

It is recommended but not mandatory to collect design documentation of the building before the site visit. From the plans and HVAC drawings representative and critical rooms can be decided as well as technical solutions capable to maintain specified indoor climate to be checked. For instance, design airflow rates of ventilation as such or measurement of airflow rate protocols can be used in the assessment of indoor air quality. From terminal device specifications, it is possible to check with manufactures software maximum air velocities. The existence of cooling systems as well as room conditioning units used or not provides information about summer conditions thermal comfort. The same applies for heating system technical solutions. However, if the design documentation is not available, this step can be neglected and can be replaced by more comprehensive interview and site visit.

2. Interview with the building manager

Building manager usually has the best available information about the building performance during operation. It is easy to ask him about the main challenges in building operation and the typical indoor climate related complaints from different rooms or locations. Based on building manager feedbacks, representative and critical rooms for measurements and inspection can be specified. Building manager can show from BMS system how the building operates and which data is monitored. Energy bills data or more specific breakdown is also to be asked from the building manager.

3. Reference room selection

The reference rooms will be selected in such a manner that those can represent the main building functions and give a reasonable picture of a whole building. Typically, 3-5 rooms will be selected. This may include the most critical rooms, i.e. corner rooms with high cooling capacities or rooms with the highest occupancy density. The reference room location requires to be pointed on the building plan. As solar heat gain has significant effect on indoor temperature, rooms from different facades can be a good selection.

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Table 1. Reference room types in different buildings.

Building type	Reference room types
1. Small residential buildings	Living room, bed rooms, children room, etc.
2. Residential block with at least three floors	Living room, bed rooms, children room, etc.
3. Office building	Open plan office space, meeting room, single office room, etc.
4. School building	Class room, assembly hall, common room, walking corridor, etc.
5. Day care center	Play room, sleeping room, assembly hall, dining hall, etc.

4. Temperature and CO2 level

Temperature and CO_2 data will measure or collect from the building management system (BMS). Building with constant air volume (CAV) system does not require any measurement of CO_2 level. Information about ventilation rate is required and measurement details are well explained in section 3.7. Different measurement device are available, which can measure the room temperature, CO_2 level. For instance, Rotronic CL11 device (Figure 1a) will be used. The device has a very good accuracy level. It can measure the indoor temperature, CO_2 concentration with an accuracy of ±0.3 °K and ±30 ppm, respectively. The measurements will take at least one-month duration in heating season and one-month duration in cooling season with 10 minutes time interval.

5. Pressure difference across envelop

Pressure difference across envelop will identify the room pressure state, i.e. over pressurized or under pressurized. Pressure differences across the envelope will measure with 1-minute time interval during the site visits in winter and summer. For instance, Swema3000 device (Figure 1b) will be used, which measures the pressure difference in between -300 to 1500 Pa with an accuracy of ±0.3%.

6. Building airtightness

A blower door machine will use to measure the building leakage rate (Figure 1c) preferably during the winter period's site visit. The measurement setup should follow ISO 9972. All interior doors need to be opened and all exterior doors, and windows are required to be closed. HVAC balancing dampers and registers are not to be adjusted. All mechanical vent should be turned off. Building airtightness will measure at pressure difference of +50Pa and -50Pa. If relevant measurement protocol of standard building leakage test exists, there is no need to repeat this measurement.

In addition, infrared camera will use to find out the air leakages and heat leakages in the walls of a building during heating season. Infrared imaging will together with blower door test to get clearer overview of façade condition at neutral and negative pressure conditions.

7. Airflow rate

Airflow rate will be measured by pressure difference method from supply air duct or device and extract air duct or device from each selected representative room preferably during winter site visit. This is quick and most reliable way to measure the airflow rate. Airflow rate will be calculated by

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pressure difference and system specification. The average of one minutes reading will consider. If it is not possible, a measurement with hood or other methods can be used. If airflow rate measurement's protocols exist, this measurement is not required.

Figure 1. Example device (a) Rotronic CL11 device, (b) Swema3000, (c) Blower door, (d) Smoke

8. Air velocity measurement

The unwanted local cooling of the body are caused by the air movement, which is defined as draught (DR). The air velocity will measure at the point in the occupied zone, where the highest velocity is expected. The air distribution can measure with the smock detector (Figure 1d). The air velocity measurement will take in the same place (typically workplace) at height of 0.1m, 0.6m and 1.1m distance from the floor level. The measurement will proceed with omnidirectional sensor as an average of 3 minutes in selected representative rooms during summer and winter site visits.

9. Subjective evaluation

A simple occupant questionnaire will use to evaluate the occupant satisfaction about indoor climate. Occupant responses will collect during heating and cooling period. The following questions will use in residential and non-residential buildings.

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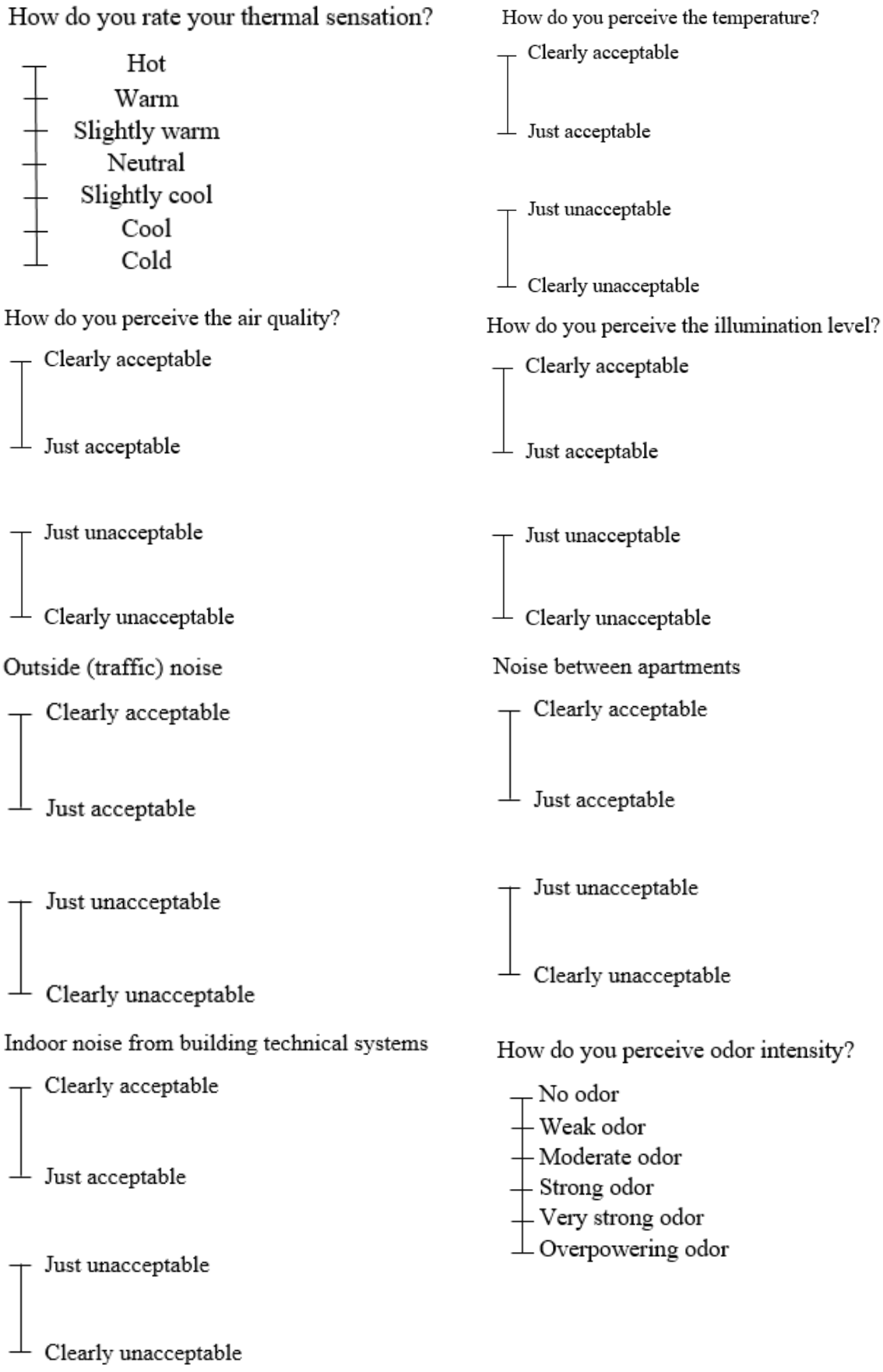

Figure 2. Questionnaires of thermal comfort and indoor air quality in residential building.

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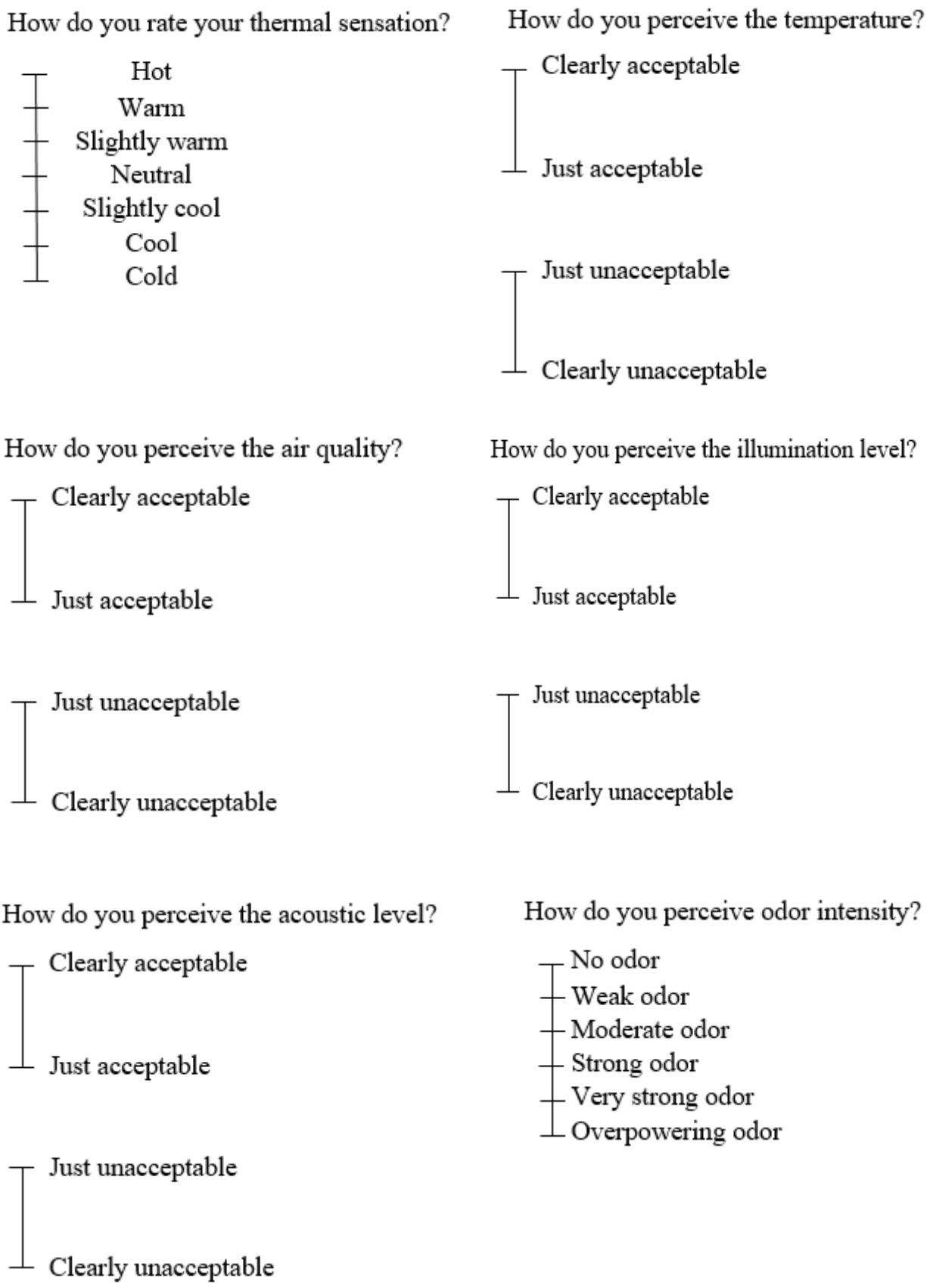

Figure 3. Questionnaires of thermal comfort and indoor air quality in non-residential building.

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