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COMFORT, AS AN ASPECT OF LIFE CYCLE ASSESSMENT (LCA) ANALYSIS TOWARD SUSTAINABLE BUILDINGS

Life Cycle Assessment (LCA) is a standardized, science-based methodology that has been developed to evaluate the environmental impact of buildings, with respect to their processes, their materials and use (energy) throughout the whole life cycle of a building. LCA takes into consideration all the steps that lead from raw material through manufacture, distribution and usage to final disposal. LCA in construction tends to evaluate the environmental impacts throughout the entire life cycle of the building, including upstream and downstream processes associated with the production and disposal. LCA is one of the most promising techniques for an ecological design of buildings. However, in order to appeal to the benefits of LCA, it is important to know how to use LCA properly.

In this paper, the use of LCA in the construction sector has been critically analyzed. The main aspects of LCA have been applied for a case study of a building in Copenhagen, Denmark.

Keywords: LCA analysis, comfort, LCA design, sustainable building, health life-being

1. INTRODUCTION

LCA is a branch of modern Building Engineering, defined as a method that is being increasingly used to evaluate the potential environmental impacts of products and services and their usages. Nowadays, LCA is also being used in building sector, especially where it is a crucial part of assessing buildings environmental sustainability. The life cycle approach focuses on factors related to the completed building to involve the entire life cycle of the building. Life Cycle Assessment (LCA) is included in European standards for sustainable construction, Construction Products Regulation (CPR) and the certification schemes for sustainable buildings at all. An important fact is that Life Cycle Assessment (LCA) is also named as an essential part of the focus area sustainable building in the Danish government's building policy strategy from 2014, which is partly why we have chosen such a current location of our sustainable building, i.e. a location in Copenhagen, Denmark

Life Cycle Assessment (LCA) provides a basic knowledge of the parameters that contribute to resource use and the potential environmental impacts during a building's life cycle for the different players working in assessing the environmentally related part of sustainable building. Incorporating LCA as a tool in the building design stage makes it possible to evaluate the environmental significance of building elements or the different life cycle stages of the building. LCA can thus be used as part of the environmentally friendly design of buildings and in documenting the results.

Life Cycle Assessment (LCA) can also point out the most important aspects of the sustainable development of building sector at all. It is clearly known that the modern Building Engineering aspires to aspects such as comfort of life – living. An aspect which contains everything that can affect on a psychological state of humans who use the building which is a subject of interest. Such an aspect can just offer more sustainable solutions to be achieved by shifting the focus from optimizing the building parts and products' lifetime, to considering their life cycles, either as whole components or as part of the production of new products.

1.1 A BUILDING'S LIFE CYCLE

A life cycle assessment of a building involves typically evaluating its whole life cycle [1]. This means including all stages in the assessment such as: raw material supply, manufacture of construction products, the construction process stage, use stage, demolition, and when the materials are disposed of or recycled.

Therefore, the building's life cycle is divided into five stages that need to be dealt with: The product stage, construction process stage, use stage, the end-of-life stage, and benefits and loads beyond the system boundary.

The first two stages are often the best known, even though acquiring sufficient data for the calculations can be problematic in practice. The following three stages are scenario-based, which means that assumptions have to be made about how the building will be used, maintained, and finally demolished. According to European standard EN 15978:2011, the final stage of building waste recycling must be reported as a separate part of the calculations. These stages offer a quality life cycle towards a sustainable development. The five stages are described as follow:

Table 1. Stages of Building's Life Cycle [1].

1. STAGE: PRODUCT STAGE	
	The product stage concerns the processes which involve the production of construction products used in the building: Raw material supply, transport to the production site as well as the final production of the construction products.
2. STAGE: CONSTRUCTION PROCESS STAGE	
	The construction process stage involves the construction products' journey from production line to the point where they are installed as a part of the finished building: Transport from the manufacturer to the construction site as well as installation in the building.
3. STAGE: USE STAGE	
	The use stage involves the processes related to the construction products' continued performance as part of the building, e.g. maintenance, replacement, repair. Processes related to the building's ongoing operational energy and water use are also included. Most often, the processes will be based upon scenarios, i.e. perceptions about how the processes will take place.

4. STAGE: END OF LIFE STAGE	
	The processes in this stage are also scenario-based. They concern what happens when the building reaches the end of its life, i.e. the building's demolition and the subsequent processes involved in reprocessing or handling the construction products/materials before further use of in other product systems.
5. STAGE: BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY	
	This scenario-based stage contains the calculated gains and drawbacks from reusing and recycling construction products/materials. In accordance with the European standards, contributions from this stage must be considered outside the system boundary and be reported separately.

1.2 WHAT DOES A BUILDING'S LIFE CYCLE LOOK LIKE?

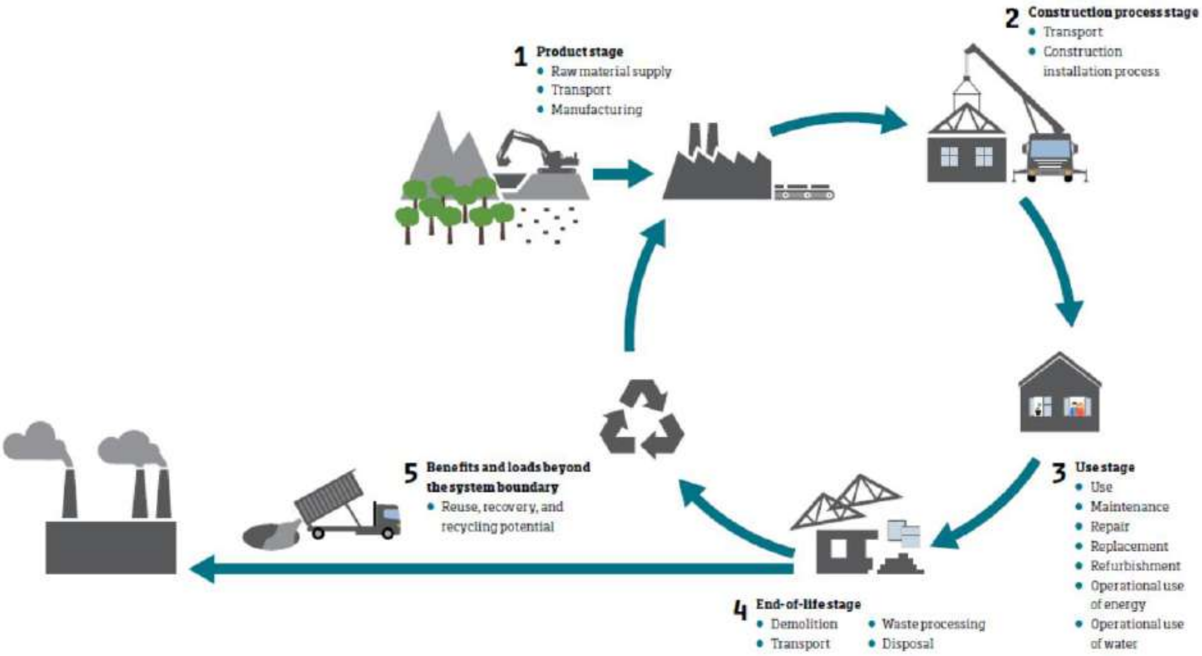

Figure 1. Typical stages of Building's Life Cycle [1].

Figure 1. illustrates the typical life cycle for a building and which stages and processes are involved (Typical stages of a building's life cycle: the product stage, the construction process stage, the use stage, the end of life stage and benefits and loads beyond the system boundary).

An Life Cycle Assessment (LCA) adds up all of the interactions with the environment which take place during the course of the included life cycle stages. The interactions may be in the form of for example, transport emissions or resource consumption from the cultivation of trees.

1.3 A BUILDING'S LIFE CYCLE

Life Cycle Assessment (LCA) involves surveying all of the inputs and outputs linked to the examined system's life cycle. The potential environmental impacts are calculated based on all inputs and outputs, i.e., consumption of resources and emissions associated with the different processes.

1. Global Warming Potential (GWP) – Unit: CO_2 equivalents – Problem: When the concentration of greenhouse gasses in the atmosphere increases, the atmospheric layers near the earth are heated up, resulting in climate change.

2. Depletion Potential of the Stratospheric Ozone Layer (ODP) – Unit: R11 equivalents – Problem: Depleting the stratospheric ozone layer that protects flora and fauna against the sun's harmful UV-A and UV-B radiation.

3. Formation Potential of Tropospheric Ozone Photochemical Oxidants (POCP) – Unit: Ethylene equivalents – Problem: Contributes to UV radiation to ozone formation in the lower atmosphere (summer smog) is damaging to the respiratory system.

4. Acidification Potential (AP) – Unit SO_2 equivalents – Problem: When acidifying substances react with water and fall as 'acid rain, this leads to, among other things, decomposition of root systems and leaching of nutrients from plants.

5. Eutrophication Potential (EP) – Unit: PO_4 equivalents – Problem: An excessive supply of nutrients generated unwanted plant growth in delicate ecosystems, for example, the development of algae which results in the death of fish.

6. Abiotic Depletion Potential for non-fossil Resources (ADPe) – Unit: Sb equivalents – Problem: A high use of abiotic resources can contribute to the depletion of available elements, e.g., depletion of metals and minerals.

7. Abiotic Depletion Potential for Fossil Resources (ADPf) – Unit: MJ – Problem: Heavy consumption of abiotic resources can reduce available fossil energy sources such as oil or coal.

8. Total Use of Primary Energy (PEtot) – Unit: MJ or kWh – Problem: A high use of resources in the primary energy form from fossil and renewable sources can contribute to the depletion of natural resources.

9. Use of Renewable Secondary Fuels (Sec) – Unit: MJ or KWh – Problem: Secondary fuels (e.g., waste) are in principle limited resources, and therefore a high use of secondary fuels can indirectly lead to scarcity of resources.

The aim of the project is to develop Life Cycle Assessment (LCA) of the case study in order to define the impact of sustainability of the designed building. This goal is obtained following different steps as suggested by the reference codes and the steps are summed up in the following scheme:

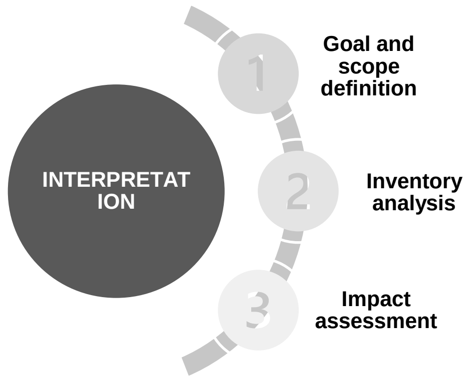

Figure 2. Scheme of Building's Life Cycle for defining the impact of sustainability.

Different assumptions will be shown before calculating the quantities of each material in order to assess the emissions of each single component of the functional unit. The results obtained in terms of production can be used in the Active House Protocol in order to fulfil the third category, which is the "ENVIRONMENT" category, and is composed of data for "Environmental loads", "Freshwater consumption" and "Sustainable construction" of the previously mentioned protocol.

2. GOAL AND SCOPE DEFINITION

Life Cycle Assessment (LCA) is a branch of modern Building Engineering. The most important step according to the codes is to define a goal and scope of the analysis in the Life Cycle Assessment (LCA) framework [2]. It is essential to determine what will be analyzed and why this content will be processed in the Life Cycle Assessment (LCA). The object of the study can be seen through different scenarios, and mainly two of them are considered in this project:

- Cradle to grave: from raw materials to the end of life of the building.
- Cradle to gate: from raw materials to the moment they reach the site and are installed.

This step aims to define the functional unit by answering five main questions of the case study (the residential building):

What? How Much? How long?

Where? How well?

In this case study, the functional unit had the purpose of permanent housing for a family of three members, providing proper comfort (in terms of daylight and energy) in 175 [m^2] during the entirety of a year. The case study is located in Brønshøj, a municipality in Copenhagen, Denmark, with an intended life cycle of 50 years. The house is designed as a wooden structure with CLT technology. It has two bedrooms, a bathroom, a living room with a kitchen, a technical room, and two porches located on the ground floor, and on the second level, which is the mezzanine, it has a small library, bedroom, and a small bedroom toilet. The house has a spectacular view, overlooking the river from its south side. Refer to the functional unit, it is crucial to define the reference flow. According to the Active House Protocol, the reference flow is generally the unit of the area [m^2].

3. DESIGN OF THE BUILDING

3.1 ARCHITECTURAL DESIGN

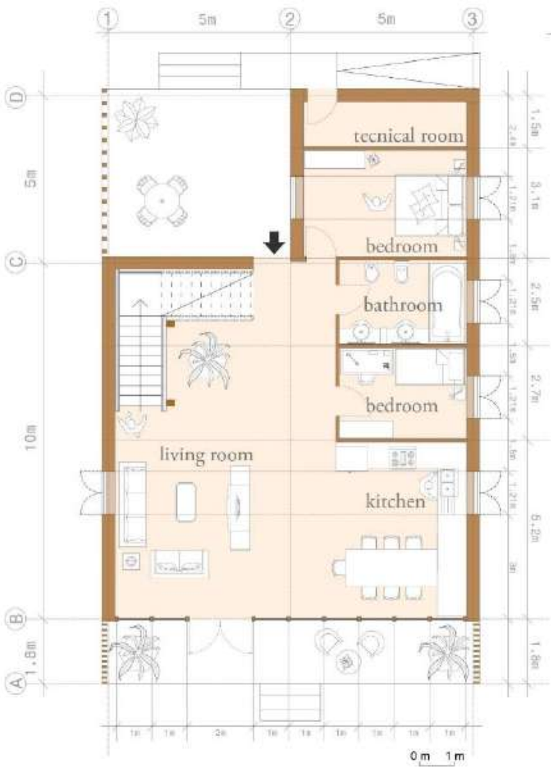

Figure 3. Architectural plan of ground floor.

As can be seen from the Figure 3., there are two entrances, the main entrance from the porch facing North and the South door facing the river. The central part of the ground floor is the opened living room area with the kitchen composing a total of 90 [m^2], one master bedroom with 18 [m^2], one smaller bedroom for the child with 12 [m^2], one main bathroom with 10 [m^2], which altogether are defining the usable space for the ground floor, which is 130 [m^2]. The south porch has 20 [m^2], and the north porch has 25 [m^2].

Figure 4. Architectural plan of mezzanine floor.

As it can be seen from the Figure 4., we have the living room staircase leading up to the opened library with a total area of 28 [m^2], one small toilet with 4.5 [m^2], and a guest bedroom with 12.5 [m^2]. Altogether, they compose a total usable area of 45 [m^2]. The ground floor and the mezzanine level together comprise an entire functional space of 175 [m^2].

3.2 STRUCTURAL DESIGN

For what concerns the structural design, the structure itself is composed of the main ridge beam (30x50cm), seven primary beams (25x40cm), fourteen secondary beams (10x20cm), and external CLT walls amounting to 160.3 [m^2].

Figure 5. Structural Design of the building.

3.3 DESIGN STRATEGIES

There are ten design strategies used:

1. The compact shape of the building decreases heat losses during winter.
2. The porch facing west is used to extend the living area protected from the wind (mainly blowing from west) and from the afternoon sun.
3. Two solar panels facing east are used to heat water for the occupants.
4. Transparent surfaces are mostly facing south to maximize solar gains in winter (maximum sun height is 11 degrees).
5. A shaded porch facing south is used to limit glare and solar gains in summer (maximum sun height is 58 degrees).
6. Transparent surfaces are arranged in such a way to have the best connection with the outdoor and view of the landscape.
7. Transparent surfaces are added to the roof to exploit natural light and ensure better indoor daylight.
8. Openable skylight assures ventilation through stack effect for the exchange of air.
9. Windows are placed on all four sides of the house to exploit cross ventilation.
10. Twenty photovoltaic panels facing east are used to cover 30% of the electricity demand of the building.

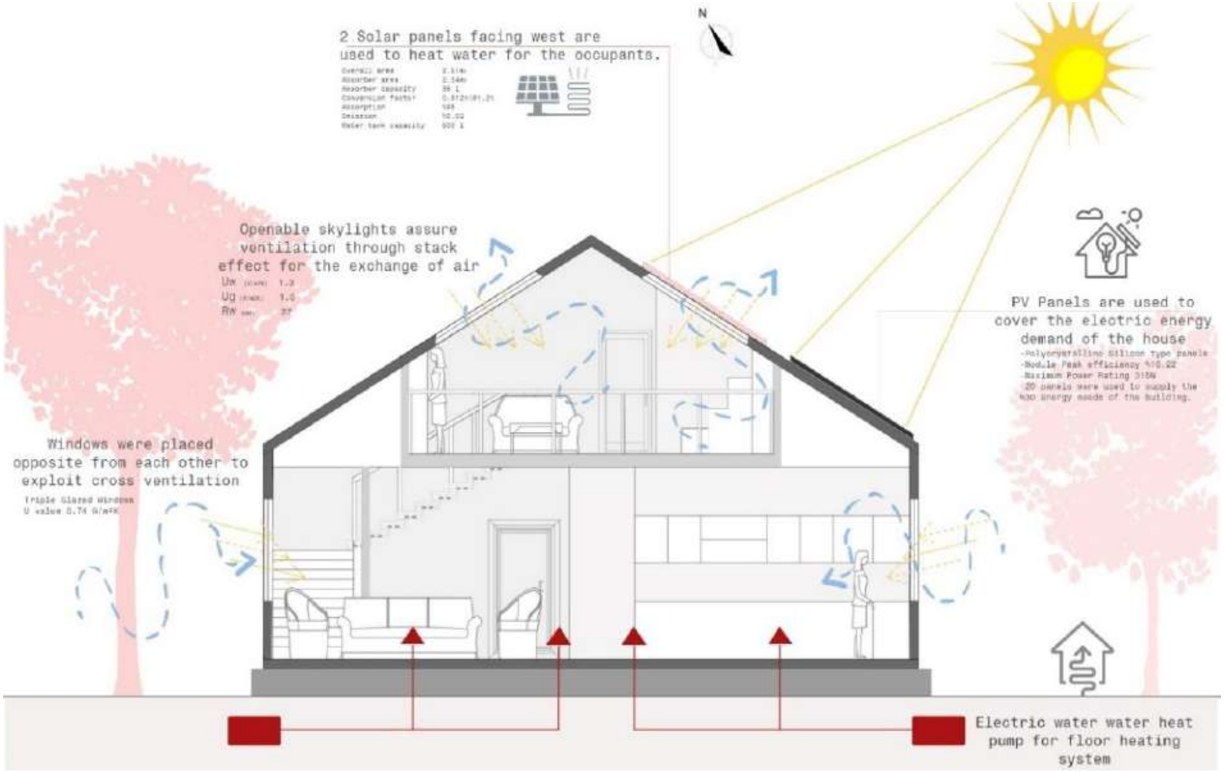

Figure 6. Design strategies applied on the building.

Figure 7. South view of the residential unit (south porch and big curtain wall overlooking the river) towards climatic design.

Figure 8. West view of the residential unit (south porch and big curtain wall overlooking the river) towards climatic design.

3.4 CLIMATIC DESIGN

Temperature: Dry bulb's external temperature ranges between 12°C and 23°C most of the hours. The coldest months are February and December, in which temperatures go below zero, while the hottest month is August, in which it is reached a temperature greater than 27°C.

Sunpath: At West, during the afternoon, external outdoor dry bulb temperature is higher, so there is the need to bring building surfaces away from the western sun. It is better to face most of the glass area to the South for passive solar heating to maximize winter sun exposure, but design overhands to fully shade in summer. The maximum declination angle of the sun is 58° (21st July), and the minimum is 11° (21st December).

Radiation: Radiation is mainly coming from the South. A North diffused radiation has to be exploited. Any passive solar gain is a benefit since the danger of overheating is minimal.

The wind rose: Wind blows mainly from the West and has a moderate velocity. Sunny wind-protected outdoor spaces can extend living areas in cool weather like in Copenhagen.

4. METHODOLOGY

For this project, much software has been used to realize the Life Cycle Assessment (LCA) evaluation [3], [4], [5], [6], [7], [8]. Since the Life Cycle Assessment (LCA) evaluation consists of 3 main categories, each of 3 subcategories, much data needs to be analyzed to achieve a reliable result.

The aspect that is dedicated to Comfort and is subdivided into Daylight, Thermal Environment, and Indoor Air Quality.

For what concerns Daylight, a VELUX daylight visualizer has been used to obtain the required parameters. Three main parameters can be extracted from the software, and they are the Daylight factor (percentage of indoor to outdoor illuminance under CIE overcast sky conditions), the Illuminance (the amount of light that reaches a surface), and Illuminance (the amount of light reflected off a cover).

Dynamic simulations have been done in the software IES-VE (Integrated Environmental solutions) for the Thermal Environment and Indoor Air Quality.

5. WHAT ARE THE RUSULTS? – COMFORT AND ITS SUBDIVIDES

The comfort analysis in the Active House specification [10] promotes solutions for people to live in comfortable buildings in terms of daylight, thermal comfort, and indoor air quality, which is mainly needed because people living in modern societies spend 90% of their time indoors.

For comfort purposes, the shape and orientations of an Active House are optimized to the external climate: in fact, the house is oriented with the big curtain wall placed at South and big skylights to gain the highest amount of solar radiation possible. Furthermore, the West porch has been designed to create an outdoor living area protected from the wind that flows at a speed greater than 19 m/s.

The envelope has been designed with high thermal insulation thickness to insulate the building well since the temperatures are rigid during winter, while openings have been placed in the proper position to exploit cross-natural ventilation and stack effect during the summer months.

5.1 DAYLIGHT

The building has been designed to have natural daylight as the primary light source to reduce the electricity needs for artificial lighting.

High daylight values reached through large transparent surfaces are essential to be achieved (also to guarantee the requirement of being in contact with nature and thus the well-being of the occupants).

The parameter "Daylight Factor" shown in Table 2. has been assessed through the Velux software to evaluate the house's daylight condition: it is defined as the illuminance on a surface expressed as a percentage of the external diffused illuminance.

Table 2. Classes towards "Daylight factor".

CLASS	DAYLIGHT FACTOR
1	DF > 5% on average
2	DF > 3% on average
3	DF > 2% on average
4	DF > 1% on average

Before calculating the daylight factor in our house with all the strategies selected, we also wanted to show how much do our choices affect this parameter: so first of all, we calculated the daylight factor considering the absence of fixed shading systems (placed at South and West), and then we made a comparison with the results obtained with the fixed shading systems applied. Results show that the shading devices perform well, especially in summer, in the living room when the risk of glare is high, but during winter, the level of light is not sufficient in all the houses, this also happens in the rooms with no shading devices applied, and the reason is that the solar radiation is not much at the latitude of Copenhagen.

The daylight factor is assessed room by room: each factor is weighted to give an average daylight factor for each room. The calculation should also consider neighboring buildings, but no other buildings create shades in the site studied. The evaluation includes the living and activity zones (such as living room, workspace, dining room, kitchen, bedroom, or children's room). The room with the lowest daylight factor score sets the overall daylight factor for the building.

Looking at the results, for what the ground floor concerns, it is visible that the living room with the kitchen has the highest average daylight factor due to the presence of the curtain wall (it is essential to underline that only the fixed shading system has been considered, so the need of movable internal curtains is necessary to avoid the risk of glare). The other rooms (bedrooms) have lower daylight since they are exposed only to the East (apart from the master bedroom exposed to both East and West, but a porch shades the West side) and does not have skylights. Results are outstanding due to the strategic position of the skylights, considering the mezzanine: CLASS is between 1 and 2.

The Active House tool measures the class's greater precision, and after inserting the necessary data for every individual room, the output result says that Class 1.4 is reached.

AVERAGE VALUES - DAYLIGHT FACTOR - Ground floor		AREA [m^2]	CLASS
Living room – front part overlooking the south	1.80 [%]	35 [m^2]	1
Living room – the part facing the main entrance	10.80 [%]	55 [m^2]	
Bedroom for children	2.00 [%]	12 [m^2]	3
Bathroom	2.20 [%]	10 [m^2]	3
Master bedroom	2.60 [%]	18 [m^2]	3
DAYLIGHT FACTOR (AREA WEIGHTED)	**5.73 [%]**	**130 [m^2]**	**/**
AVERAGE VALUES - DAYLIGHT FACTOR - Mezzanine floor		**AREA [m^2]**	**CLASS**
Mezzanine area	4.90 [%]	28 [m^2]	2
Bathroom	7.30 [%]	4.50 [m^2]	1
Bedroom	6.00 [%]	12.5 [m^2]	1
DAYLIGHT FACTOR (AREA WEIGHTED)	**5.45 [%]**	**45 [m^2]**	**/**

CONCLUDED RESULT:

DAYLIGHT FACTOR - (AREA-WEIGHTED)	**5.68 [%]**	**175 [m^2]**	**1**

1.1 Daylight

Daylight factor

Room type	Project	Reference
Living room 1	6.3	0
Bedroom 1	2	0
Bathroom 1	2.2	0
Bedroom 2	2.6	0
Living room 2	4.9	0
Bedroom 3	6	0
Bathroom 2	7.3	0

Daylight score:

	Project	Reference
Validated simulation program:	yes	yes
Daylight factor score:	1.4	Out of AH category

Figure 9. Output of Software Daylight Class.

5.2 THERMAL ENVIRONMENT

A thermal environment is vital for comfort in buildings: different local temperatures of the air inside the other areas of the house can cause thermal discomfort, and for this reason, the envelope should be designed well.

The Active House Specifications use the adaptive approach to evaluate the thermal environment. The idea behind the method is that people adapt to the outdoor temperature as it rises and falls. We adapt psychologically by adjusting our activity, clothing level, or opening or closing windows. The adaptive method uses the outdoor running mean temperature (T_m) to vary the comfort limits. Requirements should be met for at least 95% of the hours.

Table 3. Classes towards temperature.

CLASS	HEATING SEASON	COOLING SEASON
1	$T_{i,o} > 21°C$	$T_{i,o} < 25.5°C$
2	$T_{i,o} > 20°C$	$T_{i,o} < 26°C$
3	$T_{i,o} > 19°C$	$T_{i,o} < 27°C$
4	$T_{i,o} > 18°C$	$T_{i,o} < 28°C$

In the building, calculations have been dynamically performed (in summer and winter), considering first the absence of heating or cooling systems, then with systems on to show how much the envelope can affect the indoor temperature.

From the chart, at Figure 10., it is visible that the envelope, without the use of the systems, performs well only with the help of passive strategies. Indoor operative temperatures increase by 8°C concerning the outdoor temperature in winter, and in summer, the indoor operative temperature increases by only 2°C. Heating hours decreased even if there is still a high need for heating while cooling hours increased in the central months of the year. Thanks to the good performances of the envelope, the building will have lower energy demand, and then cooling and heating systems will require low energy consumption, and the plants will have reduced dimensions. Considering the use of heating and cooling systems results obtained are the following, that ar shown in Figure 11.

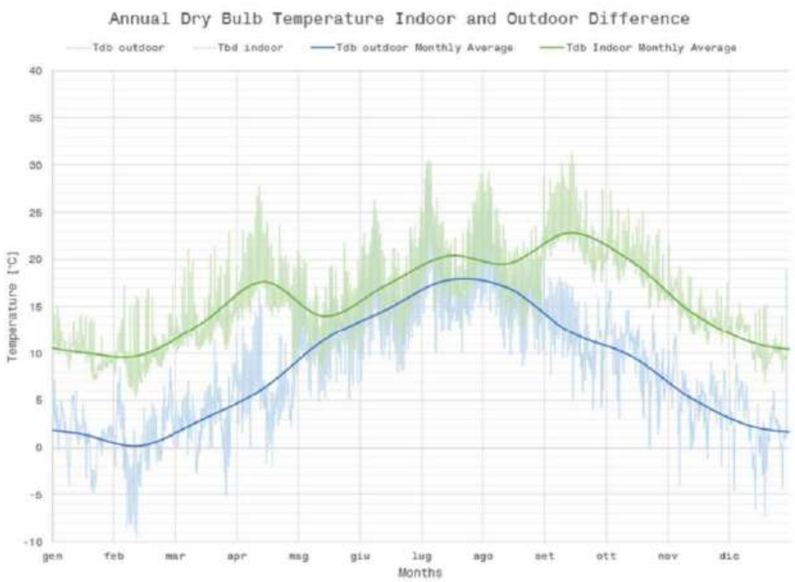

Figure 10. Indoor and Outdoor Temperature Distribution.

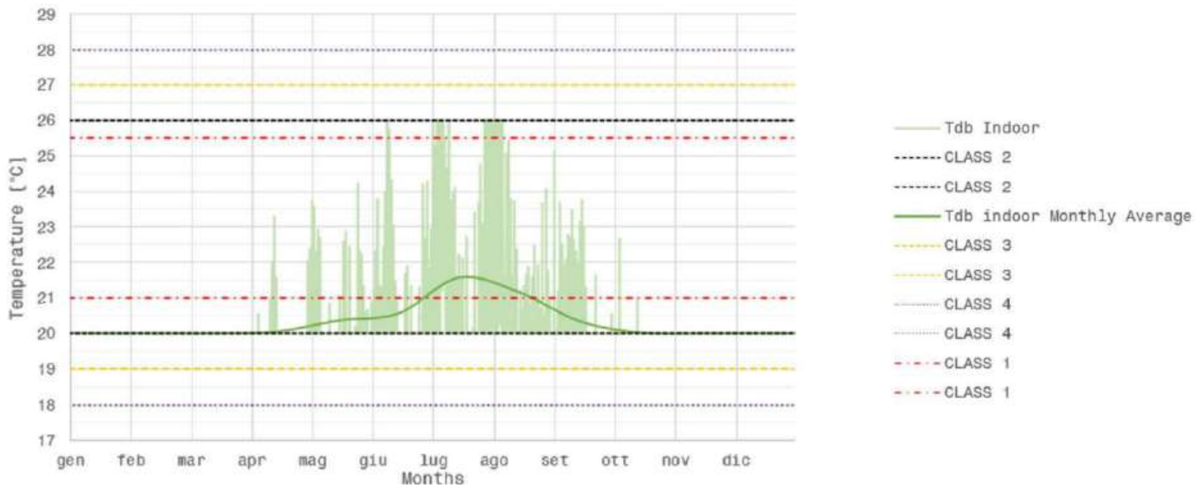

Figure 11. Indoor Temperature Distribution with the use of the HVAC system.

Indoor operative temperature and classes ranges have been plotted hourly in the chart. With a set-point for heating equal to 20°C and a set point for cooling equal to 26°C indoor operative temperature stays between the limits of CLASS 2. It coincides with the lower limit during the whole heating season, while the upper limit is reached only for a short period between July and August.

All the necessary data has been inserted into the Active House Tool, and the following results are obtained:

MINIMUM TEMPERATURE (winter)			OVERHEATING (summer)		
Category	Hours	Percentage	Category	Hours	Percentage
1	114	1.9%	1	2645	95%
2	5976	100%	2	2784	100%
3	5976	100%	3	2784	100%
4	5976	100%	4	2784	100%
Total	5976		Total	2784	

CONCLUDED RESULT:

THERMAL ENVIRONMENT	
MAXIMUM OPERATIVE TEMPERATURE	1
MINIMUM OPERATIVE TEMPERATURE	2

Thermal environment score		
	Project	Reference
Dynamic simulation:	yes	yes
Project stage:	Design (use of standards)	Planning (use of Active House Tool)
Thermal environment category:	Better level	Out of AH category
Thermal environment score:	1.5	Out of AH category

Figure 12. Output of Software Thermal Environment Class.

CLASS 2 is defined in the winter period because 100% of the time, indoor operative temperature is in this range. For the cooling period instead, CLASS 1 is defined because 95% of the time, the indoor operative temperature stays in the scope of the first class, while the remaining 5% falls in the range of the second class.

5.3 AIR QUALITY

The goal of an Active House concerns good air quality inside the house while minimizing the energy used for ventilation: for this reason, natural ventilation should be exploited whenever possible.

Nowadays, people spend most of their time indoors, and good indoor air quality can prevent occupants from getting irritations, asthma, allergy, or even cardiovascular diseases. Also, odor problems are reduced, and this affects the overall well-being of the people inside.

The CO_2 indoor concentration has been classified as a good indicator of indoor pollutants generally related to human activities to evaluate the fresh air supply. For this reason, hourly CO_2 concentrations are determined with a dynamic simulations tool (IES-VE in the case studied), considering standard occupancy rates and the standard CO_2 production per person.

Values obtained are then compared with the outdoor levels of CO_2, and requirements should be met for a minimum of 95% of the occupied time.

Outdoor CO_2 concentration in Copenhagen ranges between 340 ppm and 450 ppm, depending on the hour of the day and the urbanization of the territory. Calculations of the limits according to the classes have been carried out considering both the lower and upper layers. The first chart considers the lower CO_2 concentration level, and the second one the higher concentration level.

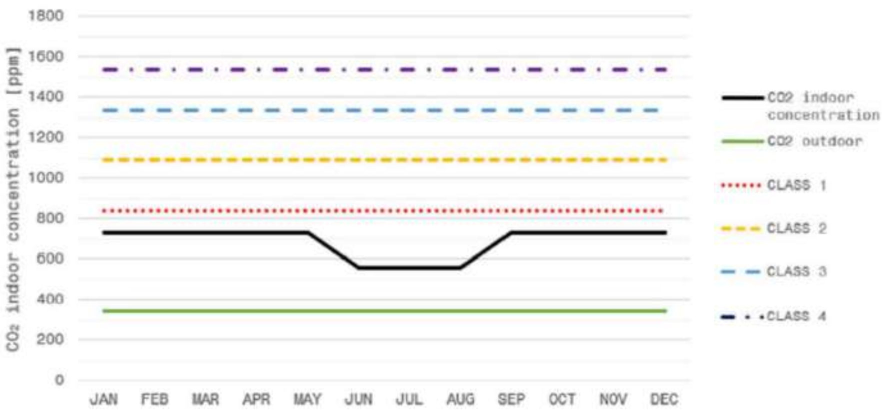

Figure 13. Indoor CO_2 concentration considering the lower limit.

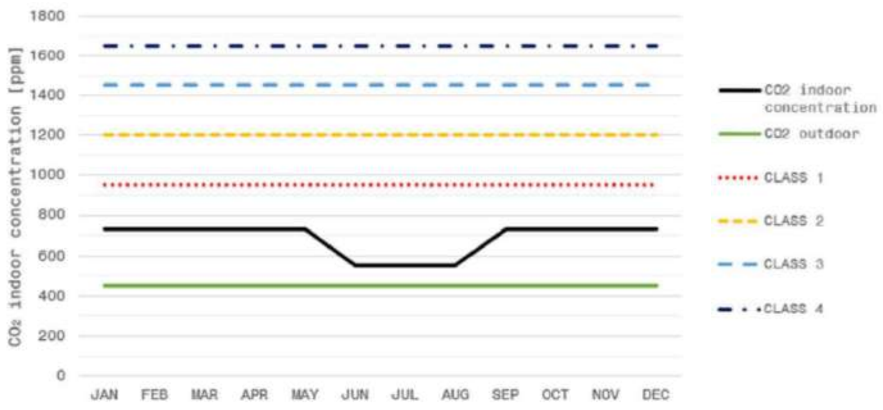

Figure 14. Indoor CO_2 concentration considering the upper limit.

The fresh air supply shall be established according to the limit values for indoor CO_2 concentration in the building occupied for a prolonged period with people as the dominant source. CO_2 concentration classes are calculated starting from the value of outdoor concentration

Table 4. Classes towards CO_2 concentration.

ACTIVE HOUSE PROTOCOL	
CLASS	CO_2 concentration
1	< 500 ppm
2	< 750 ppm
3	< 1000 ppm
4	< 1200 ppm

Results show that CO_2 indoor concentration is 731 ppm during the winter period and 555 ppm during the summer period: this means that in both the situations (upper or lower limit of outdoor CO_2 concentration considered), the difference between indoor and outdoor levels is below 500 ppm and so CLASS 1 is reached for 100% of the hours.The correct exploit of natural ventilation during summer due to the windows' position cross ventilation and the skylights that enable the stack effect causes the reduction of the pollutants inside the ambient.All the necessary data has been inserted into the Active House Tool, and the following results are obtained:

CO_2 concentration (winter)			CO_2 concentration (summer)		
Category	Hours	Percentage	Category	Hours	Percentage
1	5976	100%	1	2784	100%
2	5976	100%	2	2784	100%
3	5976	100%	3	2784	100%
4	5976	100%	4	2784	100%
Total	5976		Total	2784	

CONCLUDED RESULT:

INDOOR AIR QUALITY	
STANDARD FRESH AIR SUPPLY (overall)	1
STANDARD FRESH AIR SUPPLY (summer)	1
STANDARD FRESH AIR SUPPLY (winter)	1

Air quality score		
	Project	Reference
Project stage:	Planning (use of Active House Tool)	Planning (use of Active House Tool)
CO2-concentration above outdoor:	≤ 500 ppm	> 1200 ppm
Indoor air quality score:	1.0	Out of AH category

Figure 15. Output of Software Air Quality Class

In this case, the results given from the software confirm the results obtained manually, and so, during the whole year, CLASS 1 of CO_2 concentration is reached 100% of the time.

6. CONCLUSION

A functional residential unit has been designed by implementing the use of standards, resource guides, simulation software and Active House Design Specifications. Natural Daylight has been exploited by proper positioning of glazing surfaces, Good Thermal Environment has been created by the implemented design strategies and Indoor Air Quality is at a good level according to the Active House Specifications. Two types of simulation tools have been used in order to gain accurate results for the purpose of the Active House approach: VELUX daylight visualizer [12] has been used to the category of Daylight, and IES-VE (Dynamic Simulation Software) has been used for the categories Thermal Environment and Indoor Air Quality. After performing the analysis for the first main category (Comfort) according to the Active House Specifications we can say that the building performs really well in terms of “Comfort”: CLASS of 1.4 has been achieved for “Daylight”, CLASS of 1.5 for “Thermal Environment” and CLASS of 1.0 for “Indoor Air Quality”.

All in all, as a conclusion of the paper we could say that not even for luxury, but also more important for social health of humans, comfort must be treated as an aspect of Life Cycle Assessment (LCA) analysis of the buildings. Comfort undoubtedly offers a health a wide range of benefits which are at first good for the building humas live in, and after that for the general life – being of humans. We also find out that such a Life Cycle Assessment (LCA) analysis could be carried out many aspects touched but the materials which are used, the construction of the building, economical aspects and as we said the most important ones: social – health aspects. For now and further, especially building sector, must develop a different frame of thinking of the building. Not only the construction of the buildings should be discussed, but also from modern topics such a comfort, can make a better building in which everyone it used, can have better tomorrow.

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