Implementing VC technologies in kindergartens

IEA EBC Annex 62 The IEA project on ventilative cooling

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Kindergarten design developed by Natural Works

Location	Lisbon, Portugal
Building Type	Kindergarten
Retrofit (Y/N)	N
Surroundings (Urban / Rural)	Urban
Ventilative Cooling Strategy	SS and DV
Year of Completion	2013
Floor Area (m^2)	680
Shape Coefficient (%)	32
Openable Area to Floor Area Ratio (%)	8
Window to Wall Ratio (%)	18
Sensible Internal Load (W/m^2)	53
STA KPI	-
Climate Zone (KG)	Csa
No. of Days with T_e max > 25	120
Cooling Season Humidity	Low
Heating Degree days (Kd)	215

2 Building Information

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Ground floor

First floor

Parameter	Level of Influence
Initial Costs	
Maintenance Costs	
Energy costs	
Solar Loads	
Internal Loads	
External Noise	
Internal Noise Propagation	
Air Pollution	
Rain Ingress	
Insect prevention	
Burglary prevention	
Privacy	

4 Ventilative Cooling

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5 Control Strategies

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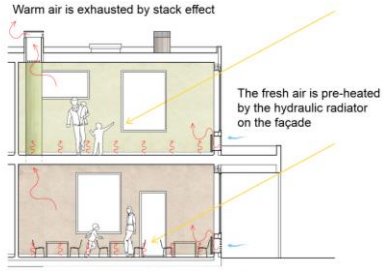
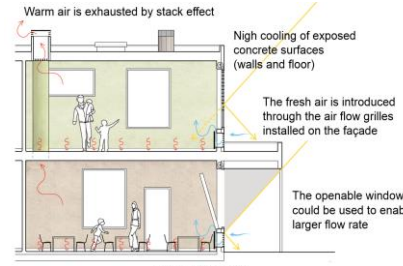


Winter Operation Mode



Summer Operation Mode

Season		Grille 0%= closed, 100% = open	Chimney 0º= closed, 90º = open	Window 0%= closed, 100% = open
Winter/Autumn	Day Night	30% 0%	30º 0º	30% 0%
Spring	Day Night	50% 50%	45º 45º	50% 0%
Summer	Day Night	100% 100%	90º 90º	100% 100%

6 Design Simulation

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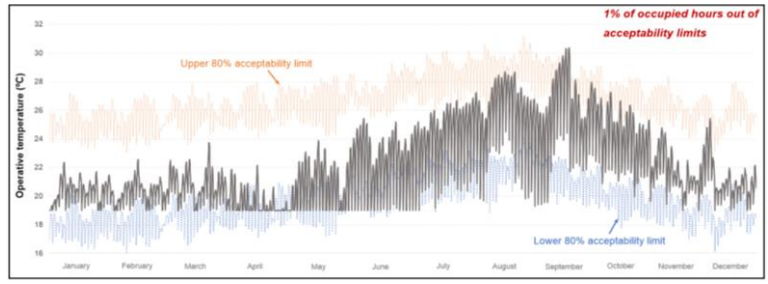

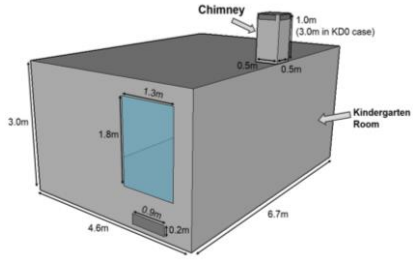

Parameter	Value
T_e , Summer External Temp	30
T_z , Summer Operative Temp	26ºC
Overheating criteria	Adaptive comfort model (80% acceptability limit) for 99% hr_{occ}
Min IAQ air supply rate	7l/s/occupant
Cooling air supply rate	-
Noise Level Rating	-

7 Performance Evaluation

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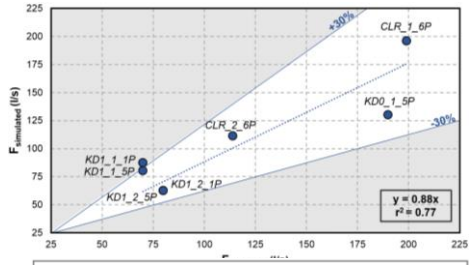
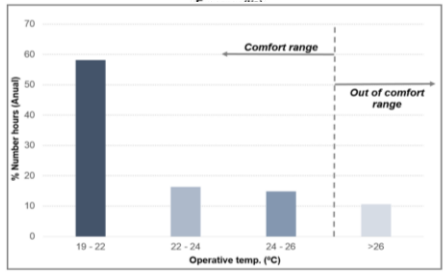
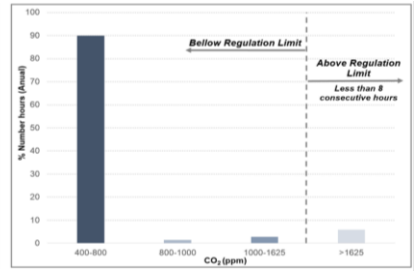


Parameter	Typical year (TMY)
Total Hours > 25°C	12%
Occ Hours > 25°C	16%
Total Hours > 26°C	7%
Occ Hours > 26°C	10%





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Ventilative cooling: Need for fan assistance?						
Outdoor environment		**N**		**M**		**Y**
Hot and dry	Winter	O				
	Summer (low temp. difference)			O[1]		
Dense urban area with low wind speeds (low natural driving force)					O	
Noisy surroundings (high noise insulation needed)				O[2]		
Building heat load level:		**N**		**M**		**Y**
High internal loads > 30 W/m² during occuation	Cold (> 10ºC from comfort zone) (heat recovery needed)	O[3]				
	Temperate (2-10ºC from comfort zone)	O[3]				
	Hot and dry (-2ºC …. +2ºC from comfort zone)				O[1]	
Thermal comfort:		**N**		**M**		**Y**
Normal requirements for 90% of occupancy hours					O[3]	
Building and system:		**N**		**M**		**Y**
High level of exposed building thermal mass		O[4]				

Notes on ratings used above:

1. Although the Lisbon climate is warm in the summer the kindergartens are closed in August. For this reason, we chose "Maybe".
2. This project included eleven kindergartens in different locations in the Lisbon urban area. In two cases, there were noisy surroundings. Cost constraints for all the buildings did not allow for the use of advanced acoustic insulation solutions.
3. The Portuguese building code mentions an indoor temperature range of 19-27°C with no proposed % of time outside this range. EN15251 proposes a requirement of no more than 5% of occupied hours outside this range. The project used these two criteria.
4. The buildings have exposed concrete internal and external walls (with exterior insulation) and exposed concrete floors

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A simple quantitative interpretation of the table "need for fan assistance" can be done by attributing a value to each line (No=1, Maybe=3, Yes=5). In this case, the average value is 2.4: the project may need fan assistance. In fact, it was decided in the project to use chimneys to obtain the required assistance effect.

Ventilative cooling System: Need for supplementary cooling?						
Outdoor environment		**N**		**M**		**Y**
Temperate (2-10ºC from comfort zone)				O		
Dense urban area with low wind speeds (low natural driving force)				O		
Dense urban area with high night temperatures (heat island)			O			
Noisy surroundings				O		
Building heat load level:		**N**		**M**		**Y**
High internal loads > 30 W/m² during occuation	Temperate (2-10ºC from comfort zone)			O		
Thermal comfort:		**N**		**M**		**Y**
Normal requirements for 90% of occupancy hours				O		
Building and system:		**N**		**M**		**Y**
High level of exposed building thermal mass		O				
High space- and use-flexibility			O			

A simple quantitative interpretation of the table "need for supplementary cooling" can be done in the same way as the table before to identify the need for fan assistance. In this case, the average value is 2.1. This value is between "No" and "Maybe". The project uses night cooling and a ventilative cooling system that is assisted by chimneys. A monitoring campaign during the spring and early summer of 2016 showed that adequate thermal comfort can be achieved with 5-10% overheating hours. This is consistent with the results of the quantitative analysis of this table.

10 Performance Evaluation

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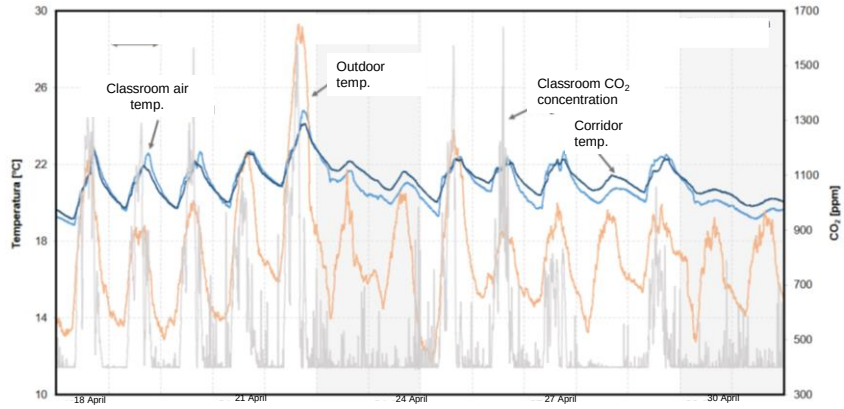

11 Performance Evaluation

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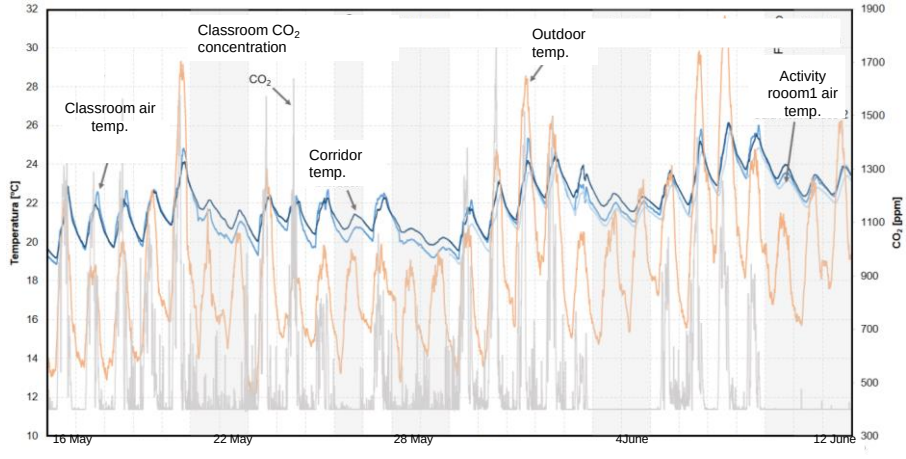

12 Performance Evaluation

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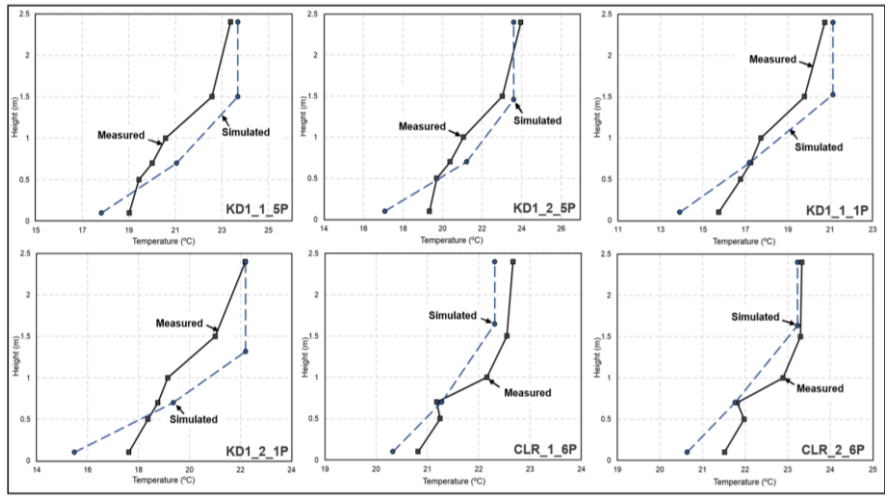

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Thanks!!!!

Check the guide:

International Energy Agency

Ventilative Cooling Design Guide

Energy in Buildings and Communities Programme
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