Designing for Ventilative Cooling: Summary findings from an exploratory practitioner survey and expert interviews with building design professionals in Ireland and the United Kingdom

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Background

- According to the International Energy Agency (IEA)'s report, it is estimated that electricity demand for space cooling could increase by 40% by 2030.
- Contrary to past climatic extremes, the UK and Ireland are now amongst the regions of the world experiencing heat waves.
- A critical review of building design processes carried out in relation to ventilation or cooling decisions in the built environment shows that there is limited information to how ventilative cooling is designed in practice.
- IEA in Buildings and Communities Annex 62 State of the Art Review report (2018) recently defined Ventilative Cooling (VC) as, *'The application of ventilation flow rates to reduce the cooling loads in buildings. VC utilizes the cooling and thermal perception potential of outdoor air. The air driving force can be natural, mechanical or a combination'.* (https://venticool.eu/)

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Objectives

1) Using an exploratory survey and semi-structured interviews, understand the perception of ventilative cooling (VC) from building design practitioners in Ireland and the UK, identify the barriers they face, if any, in designing for VC at various stages of building design.
2) To determine the tools and methods used by practitioners in their respective building design practices in general and to differentiate the usage of tools at different stages of building design for VC decisions.
3) To present potential areas of research into new building regulations, guidance and standards for designing VC.
4) To determine the preparedness of built environment professionals in accounting for extreme climate events in buildings of the future and opportunities for further research.

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Survey Results: Overview

- **Title:** "Perception of ventilative cooling in building design practices"
- **Tool:** Survey Monkey
- **Estimated Completion Time:** 17-35 minutes
- **Target Location:** UK and Ireland
- **Response Count:** 38/71 completed responses
- **Time Run:** March 15th to 30th September 2023
- **Question Types:** A mix of open ended and closed ended questions.

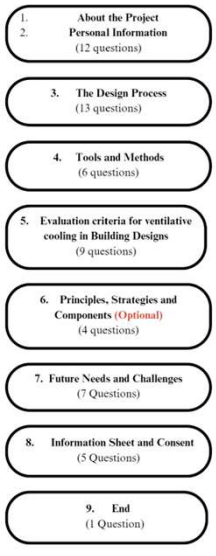

Figure 1: Different sections of the survey

Survey Results: Demographics of Respondents

Table 1: Demographics of Survey Respondents

Demographic	Architect	Engineer	Consultant	Architectural Technician/ Technologist	Researcher with Architectural Background/ Experience	Total (%)
Gender						
Male	13	10	2	2	1	**28(74%)**
Female	7	1	0	0	1	**9 (24%)**
Prefer Not to Say	1	0	0	0	1	**1 (2%)**
Age						
25-34	1	0	0	0	2	**3(7%)**
35-44	5	2	1	1	0	**9(24%)**
45-54	8	7	1	0	0	**16 (42%)**
55-64	6	2	0	1	0	**9 (24%)**
65+	1	0	0	0	0	**1(3%)**
Highest Qualification						
PhD	1	1	1	0	0	**3 (8%)**
Masters or Postgraduate	16	6	1	1	2	**26 (68%)**
Bachelors	3	4	0	0	0	**7 (18%)**
Diploma	0	0	0	1	0	**1 (3%)**
Other	1	0	0	0	0	**1(3%)**

Survey Results: The Design Process

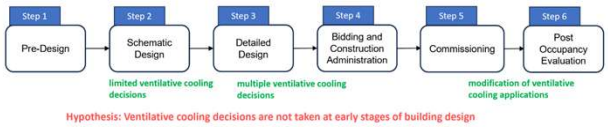

Figure 2: A diagram showing a simplified version of different stages involved in the building design process of practitioners and the hypothesis of the study

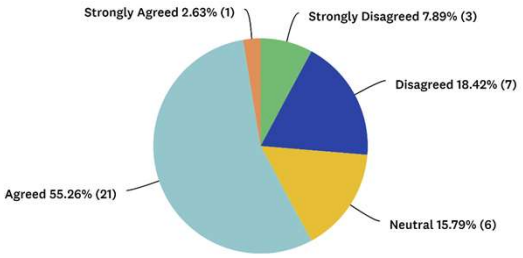

Figure 3: The extent to which respondents agreed or disagreed with the building design process diagram presented to them.

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Survey Results: The Design Process

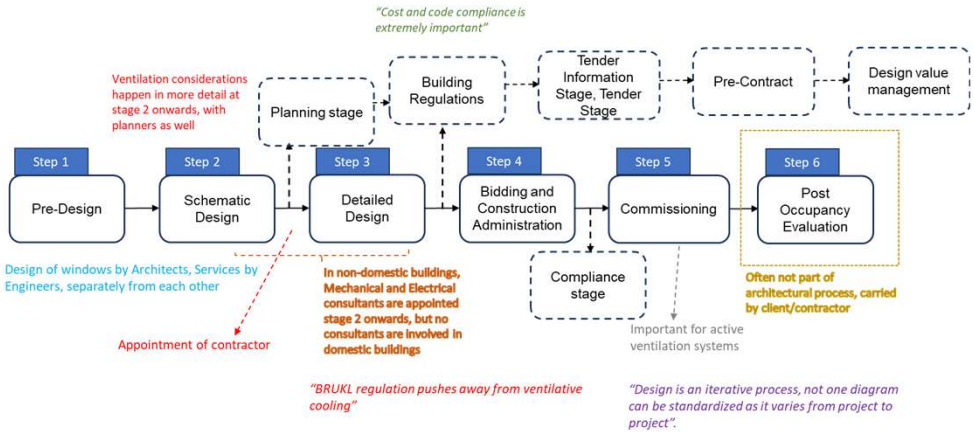

Figure 4: A mind map of comments given by respondents explaining about how design process happens in practice in relation to VC. Comments from respondents are shown in italics and in inverted commas.

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Survey Results: Tools and Methods

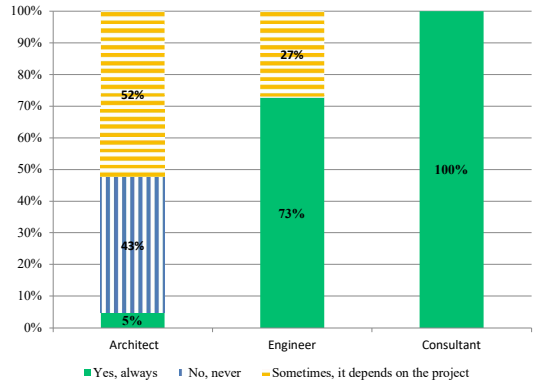

Figure 5 : Results of the question, Do you use any tools or software to make a ventilative cooling decision?

- **73%** of the respondents are satisfied with the VC tools
- Other than the tools, around **53%** of the respondents rely on their **professional experience**, 16% rely on rules of thumb, 5% on personal judgement and 26% hire engineers/consultants to make a VC decision
- Architects are often hesitant to use VC tools at their practices

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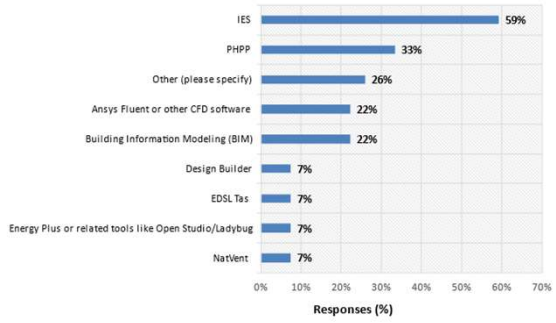
Survey Results: Tools and Methods



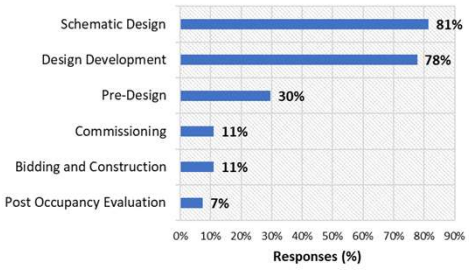


Figure 6: Results of the questions, Please enter the tool(s) or software you use for a ventilative cooling decision and At what stage(s) of your building design process, have you used this/these tools?, from left to right respectively.

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Survey Results: Future Needs and Challenges

Table 2: Responses of Questions related to Future Needs and Challenges of Ventilative cooling in Building Designs in the Survey

Questions	Answer Option 1	Answer Option 2
Do you think that the built environment design professionals are prepared for accounting for extreme future climate events, such as heat waves, while designing buildings today that will be used many years from now?	Yes (21.05%)	No (78.95%)
In your experience does Natural Ventilation work satisfactorily as a cooling solution against future climate change?	Yes (50%)	No (50%)
Can Ventilative Cooling play a role in delivering a carbon neutral built environment?	Yes (92.11%)	No (7.89%)
Do you think ventilative cooling should qualify as a renewable energy source?	Yes (36.84%)	No (63.16%)

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Survey Highlights

- A vast majority of the practitioners are familiar with the term ventilative cooling.
- **IES** and **PHPP** are the most popular VC tools used at detailed stages of building design
- **73%** of the respondents are satisfied with the VC tools, they suggested improvements in current tools
- **Building regulations** of each country and building type are the most important technical requirements that sometimes can overestimate mechanical ventilation requirements in a building.

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Interview Results: Demographics

Sections of the Interview:

1. Design Process
2. Tools, methods and standards employed for ventilative cooling design
3. Resilient Ventilative Cooling
4. Case Study Building

Table 3: Demographics of Interviewees

Practitioner ID	Profession	Age	Gender	Years of Work Experience
1.Engr. UK	Principal Sustainability Consultant	35-44	Male	5 to 10 years
2.Engr.IE	Building Services Engineering Director	45-54	Male	20+
3.Ar.IE	Architect	55-64	Male	20+
4.Engr.IE	Building Services Engineer	45-54	Male	20+
5.Engr.UK	Sustainable Building Services (MEP) Leader	55-64	Female	20+
6.Ar.IE	Architect	55-64	Male	20+
7.Ar.IE	Architect	55-64	Male	20+
8.Ar.UK	Architect	35-44	Male	10 to 20 years
9.Ar.IE	Architect	55-64	Male	10 to 20 years
10.Ar.IE	Architect	45-54	Female	20+

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Interview Results: Methodology

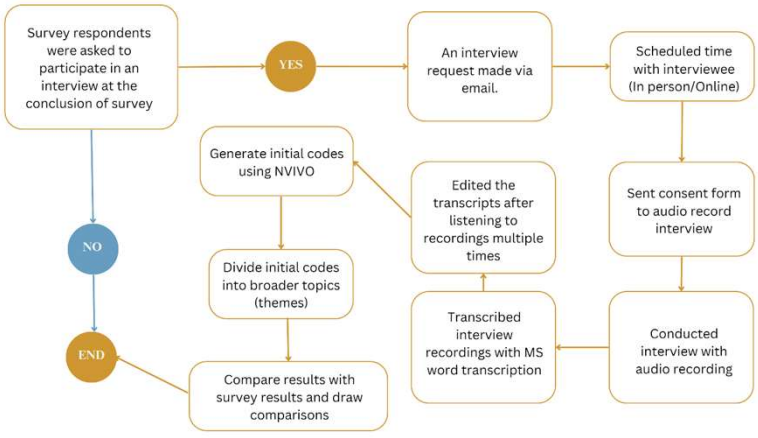

Figure 7: Overall methodology of interview data collection and analysis

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Interview Results: Topics Discussed

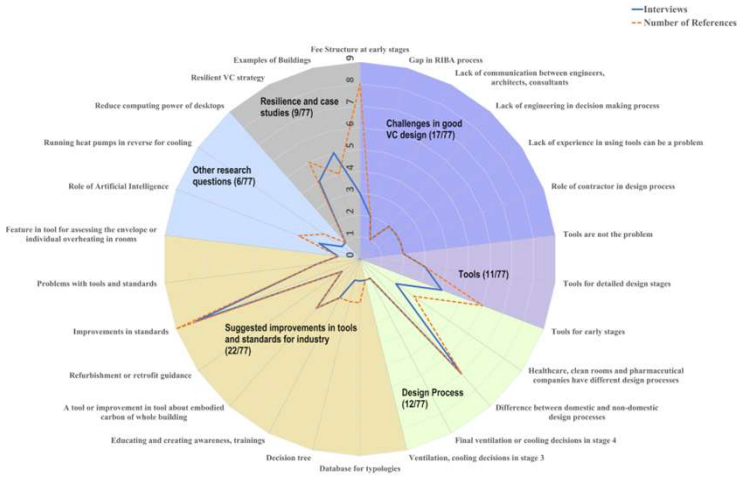

Figure 8: Number of mentions of different topics discussed in interviews. Solid line shows number of interviews, dotted line shows number of mentions. Number of mentions of each topic shown in parentheses in centre

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Interview Results: Tools

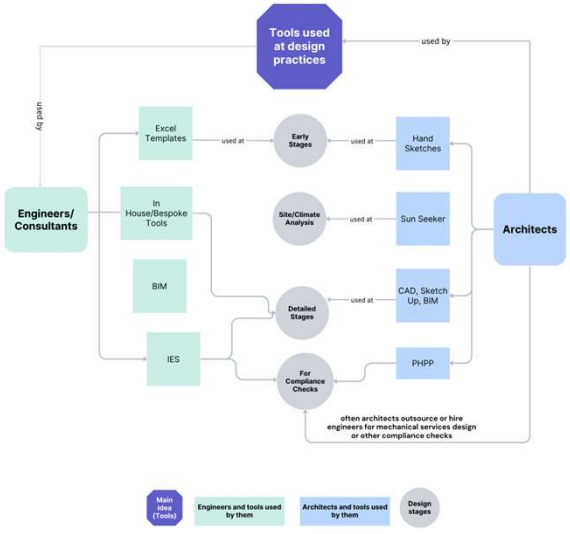

Figure 9: A mind map created by the interviewer after the interviews about how popular tools are used by Architects and Engineers at their respective practices.

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Interview Results: Improvements in standards and other research questions

Table 4: Suggested research directions to improve VC decision making by interviewees

Suggested research questions for improvements in early-stage tools and other technologies	Number of Mentions
Tool for embodied carbon of whole building design	3
Possibility of running a heat pump in reverse for cooling in summer	3
An online real time database with different building archetypes showing examples from history	2
An online decision tree with Yes/No inputs	2
Use of machine learning or artificial intelligence (AI) to make the VC decision making process easy	2
Assessment of the thermal performance of a façade at early stages	1
Identification of overheating in individual rooms at early stages	1
CPD training for experienced practitioners An online application for young people	1
A short design guide with 10 to 15 pages and a lot of diagrams	1
" No amount of ventilative cooling can solve the problem if source of energy consumption is not dealt with" (2.Engr.IE). Computing power of desktop computers is increasing rapidly, further research could look into designing efficient data centres and computers	1

Table 5: Suggested VC standards updates to improve VC decision making by interviewees

Suggested improvements in ventilative cooling standards	Number of Mentions
Separate guidance for new and retrofit buildings	2
"Building services are generally not represented well in the standards" (2.Engr.IE)	2
"Standards are still based on historic conditions, but they are not looking at future conditions". (2.Engr.IE)	2
Standards should include evidence-based information such as surveys etc. about what works well and what does not	2
Sometimes fresh air requirements for human beings versus mechanical systems conflict with each other	2
Building professionals should not be allowed to use default thermal bridging and Y values (heat loss factor) in their calculations taken straight from the standards	1
Many standards used in Ireland are UK standards, different standards should be created for Ireland, e.g. new part O document for Ireland should be drafted **[60]**	1
Standards lack information about ancillary spaces, such as corridors, car parks etc.	1

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Interview Highlights

- The building sector should revise the **fee structure** of building projects to improve collaboration and inclusion of engineers right from the early stages of building design.
- **Site monitoring** and **post occupancy evaluation** are two crucial stages for optimizing building performance, lack of exposure of which can lead to incorrect use of VC strategies and inputs into VC tools.
- VC standards should include more **evidence-based information** such as case studies, surveys and short guidance for use in design practices.
- **Hybrid** ventilation and **stack** ventilation are the two most widely declared resilient VC strategies in the opinion of practitioners.

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Summary

- Building design process is an iterative process and it generally varies from project-to-project
- Current VC Tools can be improved to make them intuitive, time efficient and cost effective particularly for early stages
- Lack of early design stage collaboration, client awareness and project fee structure were key reported challenges in VC design
- Further studies could investigate the topic with a wider population, through a shorter survey and/or collaborative workshops with stakeholders

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Thank You for Listening.

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