

The Change in Architecture with the Impact of Covid-19

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Abstract:

The coronavirus disease 2019 (COVID-19) pandemic is one of the most challenging global events for architecture. It has had profound impacts on architectural processes, priorities, and clients' demands. In response, this study explores the changes in the field of architecture caused by the ongoing pandemic. The research utilizes a mixed-method strategy, encompassing literature analysis, a primary survey (n=109), a case study analysis, and an interview. The results show a substantial tendency towards designing health-focused buildings, where ventilation, sanitation, and flexibility are prioritized. Moreover, the usage of digital technologies and interdisciplinary cooperation is becoming more prevalent. It should be noted that the design techniques developed amid the pandemic will remain relevant in the future, setting new standards in the field.

Keywords: COVID-19, Architectural Design, Ventilation, Adaptability, Sustainability, Health-Centric Design

Introduction

The COVID-19 pandemic has significantly impacted all facets of society, and the architectural profession is no exception. As lockdowns and social distancing measures were implemented, architects faced the urgent need to adapt to a rapidly changing environment. Traditional practices that relied on in-person collaboration shifted almost overnight to digital platforms, fundamentally altering how architects engaged with clients and stakeholders. This unprecedented crisis has also prompted a critical reevaluation of the spaces we inhabit. Health, safety, and well-being emerged as central concerns, driving architects to rethink design principles in favour of creating environments that foster both functionality and comfort.

The demand for flexible, resilient spaces has become increasingly urgent, emphasizing the importance of fresh air, natural light, and communal areas that facilitate safe interactions. This research paper aims to explore the transformative changes within the architectural profession resulting from the COVID-19 pandemic. By examining emerging trends, challenges, and opportunities, the study seeks to provide a comprehensive understanding of how architects are navigating this complex landscape. Ultimately, this exploration aims to highlight the implications of these changes for future architectural practices and the built environment, positioning the profession to effectively respond to the evolving needs of society in a post-pandemic world. The architects are finding themselves at the centre of innovative design solutions, ones that prioritize health and community resilience in a world reshaped by the ongoing pandemic. The evolving challenges of the pandemic have encouraged collaboration between professionals across multiple disciplines.

Methodology

The study uses an exploratory research design utilizing both qualitative and quantitative methods. A thorough review of the literature was performed to uncover emerging trends and research gaps pertaining to architectural practice after the pandemic. Primary data was gathered through a well-designed questionnaire distributed among 109 participants who included architects and students of architecture. Moreover, a case study analysis on the efficiency of ventilation was carried out to learn more about its significance in curbing airborne transmission. An interview with an expert in the field was also conducted for professional perspectives on industry-wide changes.

Literature review

SL No	Topic	Key findings	Research Gap
1	<p>Impact of COVID-19 on architecture profession Abidi, M. Z., & Irshad, Q. (2020). Impact of COVID-19 on Architecture Profession. ResearchGate.</p>	<ul style="list-style-type: none"> • An unhealthy state of the profession • Emergence of new Methods • Continued Demand for Shelter 	<ul style="list-style-type: none"> • Lack of Immediate Solutions • Limited Historical Analysis • Insufficient Focus on Mental Health • Technological Challenges
2	<p>How the COVID-19 pandemic would change the future of architectural design <u>Alhusban, A.A., Alhusban, S.A. and Alhusban, M.A. (2022), "How the COVID 19 pandemic would change the future of architectural design", <i>Journal of Engineering, Design and Technology</i>, Vol. 20 No. 1, pp. 339-357. https://doi.org/10.1108/JEDT-03-2021-0148</u></p>	<ul style="list-style-type: none"> • Pandemic Influence on design • Self-sufficient Homes • Enhanced Home Office requirement • Technological and Health 	<ul style="list-style-type: none"> • Limited scope of research • Lack of Data • Insufficient Exploration of challenges • Generalisation of design • Overemphasis

		Safety requirements	on technology
3	<p>An evaluation of online architectural design studios during COVID-19 outbreak Ceylan, S., Şahin, P., Seçmen, S., Somer, M.E. and Süher, K.H. (2021), "An evaluation of online architectural design studios during COVID-19 outbreak", <i>Archnet-IJAR</i>, Vol. 15 No. 1, pp. 203-218. https://doi.org/10.1108/ARCH-10-2020-0230</p>	<ul style="list-style-type: none"> • Positive impact of digital tools • Effectiveness of independent work • Online work adaptability • Need for continuous improvement 	<ul style="list-style-type: none"> • Limited Scope of Research • Lack of Empirical Data • Insufficient exploration of challenges • Generalisation of design • Short-term focus
4	<p>Transferring COVID-19 challenges into Architecture Innovative Solutions Rania Raouf Sedky, Transferring COVID-19 Challenges into Architecture Innovative Solutions, <i>Architecture Research</i>, Vol. 12 No. 1, 2022, pp. 19-26. doi: 10.5923/j.arch.20221201.03.</p>	<ul style="list-style-type: none"> • Sustainability a Priority • Use of Antimicrobe Materials • Natural Light and Ventilation • Redefined Domestic and Work Spaces, • Modular & Adaptive Designs 	<ul style="list-style-type: none"> • Cost Considerations , Potential for Inequality • Neglecting Community Input • Overemphasis on Technology, • Challenges in Implementation, • Inadequate Research on Hybrid Spaces

<p>5</p>	<p>The COVID-19 Pandemic and the future of working spaces : MARIOTTI, ILARIA (Ed.); Di Marino, Mina (Ed.); Bednář, Pavel (Ed.) (2022) : The COVID-19 Pandemic and the Future of Working Spaces, Regions and Cities, No. 153, ISBN 978-1-000-68453-7, Routledge, London, https://doi.org/10.4324/9781003181163</p>	<ul style="list-style-type: none"> • Home as a workspace, • Impact on privacy and productivity, • Dissatisfaction with WFH Conditions, • Underuse of Third Spaces 	<ul style="list-style-type: none"> • Generalization of Academic Preferences, • Minimal Focus on Long-Term Implications, • Neglect of Mental Health Aspects, • Inadequate Assessment of Campus Spaces
<p>6</p>	<p>Residential architecture in a post-pandemic world: implications of COVID-19 for new construction and for adapting heritage buildings (2021) Spennemann, D. H. R. (2021). Residential architecture in a post-pandemic world: Implications of COVID-19 for new construction and for adapting heritage buildings. In: Journal of Green Building, 16(1), 199–215. doi: 10.3992/jgb.16.1.199. Retrieved from: https://doi.org/10.3992/jgb.16.1.199</p>	<ul style="list-style-type: none"> • Multifunctionality: The need for spaces to adapt to various uses (work, leisure, education). • Health and Safety: Prioritizing ventilation, air filtration, and physical separation to minimize disease transmission. • Mental Well-being: Designing spaces that promote mental health through natural light, views, and biophilic elements. 	<ul style="list-style-type: none"> • Long-term Behavioural Changes: The study primarily focuses on immediate adaptations to the pandemic. • Technological Integration: The role of technology in creating smart and responsive homes should be further investigated. • Cultural and Regional Differences: The impact of the pandemic on residential design may

		<ul style="list-style-type: none"> • Flexibility: Creating adaptable spaces with movable partitions or open floor plans. 	<p>vary across different cultures and regions.</p> <ul style="list-style-type: none"> • Climate Change and Resilience: The intersection of climate change and pandemic resilience should be explored.
7	<p>Transferring COVID-19 Challenges into Architecture Innovative Solutions (2022)</p> <p>Sedky, R. R. (2022). Transferring COVID-19 challenges into architecture innovative solutions. In: Architecture Research, 12(1), 19-26. doi: 10.5923/j.arch.20221201.03. Retrieved from: https://doi.org/10.5923/j.arch.20221201.03</p>	<ul style="list-style-type: none"> • Health and Safety: Prioritizing hygiene, ventilation, and social distancing in design. • Sustainability: Focusing on eco-friendly materials, renewable energy, and minimal environmental impact. • Adaptability and Flexibility: Creating spaces that can be easily adapted to changing needs. • Remote Work and Virtual Collaboration: 	<ul style="list-style-type: none"> • Long-Term Impact on Behavioural Patterns: Further research is needed to understand how long-term behavioural changes, such as increased remote work and virtual collaboration, will shape future architectural needs. • Socioeconomic Disparities: The pandemic has exacerbated existing inequalities.

		<p>Incorporating technology for remote design and collaboration.</p> <ul style="list-style-type: none"> • Mental Health: Designing spaces that promote well-being and reduce stress. 	<p>Research should explore how design can address these disparities and ensure equitable access to healthy and adaptable spaces.</p> <ul style="list-style-type: none"> • Emerging Technologies and Their Impact: The rapid advancement of technologies like AI, VR, and IoT offers new opportunities for architectural design. More research is needed to understand their potential and ethical implications.
8	<p>The Need for Smart Architecture Caused by the Impact of COVID-19 upon Architecture and City: A Systematic Literature Review (2022) Park, S.-J., Lee, K.-T., Im, J.-B., & Kim, J.-H. (2022). The Need for Smart Architecture Caused by the Impact of COVID-19 upon Architecture and City: A Systematic Literature Review. Sustainability, 14(13),</p>	<ul style="list-style-type: none"> • Increased Demand for Smart Architecture: The pandemic has accelerated the need for 	<ul style="list-style-type: none"> • Ethical Implications of Smart Architecture: As smart buildings become more sophisticated, ethical

	<p>7900. doi: 10.3390/su14137900. Retrieved from: https://doi.org/10.3390/su14137900</p>	<p>intelligent buildings.</p> <ul style="list-style-type: none"> • Potential of IoT and Industry 4.0: These technologies can revolutionize the planning, design, and construction of smart buildings. • Machine Learning and Deep Learning: These techniques can optimize building design and improve occupant comfort and energy efficiency. • Advanced Construction Techniques: Technologies like 3D scanning and robotics can enhance construction efficiency and safety. • Embracing New Technologies: Architects must adapt to new technologies to design and construct smart buildings. 	<p>considerations like data privacy, security, and algorithmic bias need to be addressed.</p> <ul style="list-style-type: none"> • Social and Economic Equity: The adoption of smart technologies can exacerbate socioeconomic disparities. Research is needed to ensure equitable access to these technologies and their benefits. • Long-Term Impact on Human Behaviour: The long-term impact of smart buildings on human behaviour and well-being requires further investigation. • Integration of Diverse Technologies: The seamless
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			<p>integration of various technologies, such as IoT, AI, and robotics, presents challenges that need to be addressed.</p>
9	<p>Residential architecture in a post-pandemic world: implications of COVID-19 for new construction and for adapting heritage buildings (2021) Spennemann, D. H. R. (2021). Residential architecture in a post-pandemic world: Implications of COVID-19 for new construction and for adapting heritage buildings. In: Journal of Green Building, 16(1), 199–215. doi: 10.3992/jgb.16.1.199. Retrieved from: https://doi.org/10.3992/jgb.16.1.199</p>	<ul style="list-style-type: none"> • Multifunctionality: The need for spaces to adapt to various uses (work, leisure, education). • Health and Safety: Prioritizing ventilation, air filtration, and physical separation to minimize disease transmission. • Mental Well-being: Designing spaces that promote mental health through natural light, views, and biophilic elements. • Flexibility: Creating adaptable spaces with movable partitions or open floor plans. 	<ul style="list-style-type: none"> • Long-term Behavioural Changes: The study primarily focuses on immediate adaptations to the pandemic. • Technological Integration: The role of technology in creating smart and responsive homes should be further investigated. • Cultural and Regional Differences: The impact of the pandemic on residential design may vary across different cultures and regions. • Climate Change and Resilience: The

			<p>intersection of climate change and pandemic resilience should be explored.</p>
10	<p>5) Architectural design and epidemic prevalence: Insights from Hong Kong's fifth wave (published 2024)</p> <p>Qiao, Q., Sarkar, C., Schuldenfrei, E., & Lai, K. Y. Y. (2024). Architectural design and epidemic prevalence: Insights from Hong Kong's fifth wave. Building and Environment, 256(4), 111516. doi: 10.1016/j.buildenv.2024.111516. Retrieved from: https://doi.org/10.1016/j.buildenv.2024.111516</p>	<ul style="list-style-type: none"> • Building Shape and Transmission: L-shaped buildings were found to have lower transmission rates compared to Y-shaped and X-shaped buildings. • Socioeconomic Factors: Socioeconomic disparities influenced COVID-19 transmission rates, especially in public housing. • Ventilation and Airflow: Good ventilation and airflow are crucial in reducing transmission risks. • Building Design and Public Health: Architectural 	<ul style="list-style-type: none"> • Quantifying the Impact of Specific Design Features: While the study identified correlations between building shape and transmission rates, further research is needed to quantify the exact impact of specific design features, such as window size, orientation, and ventilation systems. • Long-Term Impacts: The long-term impact of the pandemic on architectural design and urban planning

		<p>design can significantly impact public health outcomes.</p>	<p>needs to be explored.</p> <ul style="list-style-type: none"> • Cross-Cultural Comparisons: Comparative studies across different cultural and climatic contexts can provide valuable insights into the universal and culturally specific aspects of architectural design and public health.
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Conclusion and parameters from the research papers

The analysis of the research papers points out some collective research gaps which cannot lead to full understanding and proper implementation of architectural design strategies in the post-pandemic context. Some of the primary limitations are:

There is Less Emphasis on Mental Health: Architectural research has given scant attention to how the pandemic has affected people’s psychological well-being and community life.

Overemphasis on Technology: It puts technology in perspective as a solutions-provider but moves the importance of human centrality and considerations of society into the background.

Narrowness and Short-Term Drift: Most research pays attention first on immediate responses to the pandemic and then the long-term effects of the future crises.

Research Limitations: Studies are often not interdisciplinary, wherein an aspect of architectural design is pursued without considering interconnectivity with several other factors.

Limitations of data: A lack of comprehensive and reliable data available impedes evidence-based design development.

Design Trend Generalizations: There is a tendency to generalize design solutions determined for one place that they shall meet for other communities and individuals.

Neglect of Community Input: It forgets the significance of involving communities in the design process and of having understood the diverse needs and perspectives of communities.

Such gaps would require future research to adopt a more integrated approach that embraces the holistic pattern - "social, psychological, technological". Longitudinal studies, extensive data collection, and

collaborative efforts would lead to new, innovative designs that are both sustainable and evidence based. Hereby, we acknowledge and address the limitations so that more resilient architecture can be designed.

The parameters for the Research paper

This study suggests that architects have significantly adapted their design processes in response to COVID-19, incorporating health, safety, and resilience as key considerations.

The key parameters identified for this study, along with supporting references, are as follows:

P1) Architect's thought and design process for architecture accounting for COVID-19,

Sedky, R. R. (2022). Transferring COVID-19 challenges into architecture innovative solutions. In: *Architecture Research*, 12(1), 19-26. doi: 10.5923/j.arch.20221201.03. Retrieved from: <https://doi.org/10.5923/j.arch.20221201.03>

Pattaranan Takkanon (2020). *Penyesuaian Pembelajaran Sains Building dalam Merespon Pandemi [Adjusting Building Science Learning in Response to the Pandemic]*. Department of Building Innovation, Faculty of Architecture, Kasetsart University.

Spennemann, D. H. R. (2022). Designing for COVID-2x: Reflecting on Future-Proofing Human Habitation for the Inevitable Next Pandemic. *Buildings*, 12(7), 976. <https://doi.org/10.3390/buildings12070976>

P2) Considering a wider perspective demography from collaboration of different fields apart from architecture,

Park, S.-J., Lee, K.-T., Im, J.-B., & Kim, J.-H. (2022). The Need for Smart Architecture Caused by the Impact of COVID-19 upon Architecture and City: A Systematic Literature Review. *Sustainability*, 14(13), 7900. doi: 10.3390/su14137900. Retrieved from: <https://doi.org/10.3390/su14137900>

Wang, S., & Li, A. (2022). Demographic Groups' Differences in Restorative Perception of Urban Public Spaces in COVID-19. *Buildings*, 12(7), 869. <https://doi.org/10.3390/buildings12070869>

Realdania. (2022). *Architecture of the Pandemic: A compendium of COVID-19 responses in the built environment (1st ed.)*. Realdania.

P3) Relevance of the norms set during COVID-19 and their adherence,

Spennemann, D. H. R. (2021). Residential architecture in a post-pandemic world: Implications of COVID-19 for new construction and for adapting heritage buildings. In: *Journal of Green Building*, 16(1), 199–215. doi: 10.3992/jgb.16.1.199. Retrieved from: <https://doi.org/10.3992/jgb.16.1.199>

Mennat-Allah El-Husseiny (2021). Post-Pandemic Home Design Adaptations: Lessons Learnt for Future Theory and Practice. *Civil Engineering and Architecture*, 9(7), 2542 - 2555. DOI: 10.13189/cea.2021.090737.

Khozaei, F., Carbon, C. C., Hosseini Nia, M., & Kim, M. J. (2022). Preferences for Hotels with Biophilic Design Attributes in the Post-COVID-19 Era. *Buildings*, 12(4), 427. <https://doi.org/10.3390/buildings12040427>

P4) Impact and role of Architecture on the deadly effects of COVID-19.

Tolac, S. S., Erkan, I.*, Gokaslan, A., Sahin, A., Kayhan, A. M., Sanlı, M., & Demir, E. T. (2022). Architectural space changes during COVID-19 pandemic. In: *International Journal of Sustainable*

Building Technology and Urban Development, (1), 84-95. doi: 10.22712/susb.20220007. Retrieved from: <https://doi.org/10.22712/susb.20220007>

Qiao, Q., Sarkar, C., Schuldenfrei, E., & Lai, K. Y. Y. (2024). Architectural design and epidemic prevalence: Insights from Hong Kong's fifth wave. *Building and Environment*, 256(4), 111516. doi: 10.1016/j.buildenv.2024.111516. Retrieved from: <https://doi.org/10.1016/j.buildenv.2024.111516>

Coskun H. Post-COVID-19 Era, 15th Minutes City New Urban Model Changing Housing Design and Models. *Arch Case Rep.* 2024; 8(2): 063-074. Available from: <https://dx.doi.org/10.29328/journal.acr.1001098>

Observations

The COVID-19 pandemic has significantly reshaped the field of architecture, necessitating a rethinking of design principles to prioritize health, well-being, and resilience. Here's a deeper dive into the key impacts, supported by cited research: Health and Safety Prioritizing Hygiene and Ventilation: Touchless Design: Implementing touchless fixtures like automatic doors and faucets to minimize contact points (Spennemann, 2022; Raouf Sedky, 2022). Improved Ventilation Systems: Enhancing ventilation systems to improve air quality and reduce the spread of airborne viruses (Spennemann, 2022; Raouf Sedky, 2022). Antimicrobial Materials: Using materials with antimicrobial properties to reduce the growth of bacteria and viruses (Spennemann, 2022; Raouf Sedky, 2022). Flexible and Adaptable Spaces: Modular Design: Designing spaces that can be easily reconfigured to accommodate changing needs, such as transitioning from

- open-plan offices to individual workspaces (Tolac et al., 2022; Raouf Sedky, 2022; Spennemann, 2022).
- Multifunctional Spaces: Creating spaces that can serve multiple purposes, like a living room that can double as a home office (Tolac et al., 2022; Raouf Sedky, 2022; Spennemann, 2022).
- Compartmentalization of Buildings:
- Dividing Large Spaces: Breaking down large, open spaces into smaller, more contained areas to reduce the spread of infection (Spennemann, 2022).
- Creating Buffer Zones: Designing buffer zones between different areas of a building to limit the movement of people and potential contamination (Spennemann, 2022).
- Digital Design Tools: Leveraging digital tools like BIM and cloud-based collaboration platforms to facilitate remote work and design (Raouf Sedky, 2022).
- Virtual Reality and Augmented Reality: Using VR and AR for virtual site visits and design reviews (Raouf Sedky, 2022).
- Natural Light: Maximizing natural light exposure to improve mood and productivity (Khozaei et al., 2022; Stoyanov, 2023; Wang and Li, 2022; Spennemann, 2022).
- Indoor Plants: Incorporating indoor plants to improve air quality and reduce stress (Khozaei et al., 2022; Stoyanov, 2023; Wang and Li, 2022; Spennemann, 2022).
- Views of Nature: Designing spaces with views of natural landscapes to enhance well-being (Khozaei et al., 2022; Stoyanov, 2023; Wang and Li, 2022; Spennemann, 2022).
- Dedicated Workspaces: Creating designated areas for work and study to improve focus and productivity (El-Husseiny, 2021; Stoyanov, 2023).
- Quiet Zones: Designing quiet spaces for relaxation and meditation (El-Husseiny, 2021; Stoyanov, 2023).

- **Prioritizing Outdoor Spaces: Rooftop Gardens:** Incorporating rooftop gardens and terraces to provide outdoor spaces for relaxation and social interaction (Wang and Li, 2022).
 - **Outdoor Workspaces:** Designing outdoor workspaces to encourage fresh air and natural light (Wang and Li, 2022).
 - **Reducing Noise Pollution: Acoustic Treatments:** Using sound-absorbing materials to reduce noise levels and create quieter environments (Wang and Li, 2022).
 - **Spatial Planning:** Strategically planning spaces to minimize noise transmission between different areas (Wang and Li, 2022).
 - **Sustainability and Resilience Sustainable Materials and Practices: Locally Sourced Materials:** Using locally sourced materials to reduce transportation emissions and support local economies (Raouf Sedky, 2022).
 - **Recycled and Renewable Materials:** Incorporating recycled and renewable materials into building design to reduce the environmental impact (Raouf Sedky, 2022).
 - **Energy Efficiency: Energy-Efficient Building Systems:** Implementing energy-efficient HVAC systems and lighting to reduce energy consumption (Raouf Sedky, 2022).
 - **Renewable Energy Sources:** Utilizing renewable energy sources like solar and wind power to reduce reliance on fossil fuels (Raouf Sedky, 2022).
 - **Resilient Infrastructure: Disaster-Resistant Design:** Designing buildings to withstand natural disasters such as earthquakes and hurricanes (Spennemann, 2022)
 - **Redundancy:** Incorporating redundant systems to ensure building operations continue in case of emergencies (Spennemann, 2022).
 - **Water Conservation: Water-Efficient Fixtures:** Using water-efficient fixtures like low-flow toilets and showerheads (Raouf Sedky, 2022).
 - **Water Harvesting Systems:** Implementing rainwater harvesting systems to reduce water consumption (Raouf Sedky, 2022).
 - **Technology Integration Smart Building Technology: IoT Devices:** Using IoT devices to monitor and control building systems, such as lighting, HVAC, and security (Park et al., 2022).
 - **AI and Machine Learning:** Employing AI and machine learning to optimize building performance and energy efficiency (Park et al., 2022).
 - **Digital Design Tools: BIM (Building Information Modeling):** Using BIM to create digital models of buildings, facilitating collaboration and reducing errors (Raouf Sedky, 2022).
 - **Generative Design:** Utilizing generative design algorithms to explore innovative design solutions (Raouf Sedky, 2022).
 - **Remote Monitoring and Control: Remote Access:** Enabling remote access to building systems for monitoring and control (Park et al., 2022).
 - **Predictive Maintenance:** Using data analytics to predict equipment failures and schedule maintenance proactively (Park et al., 2022).
- By incorporating these design principles, architects can create buildings that are not only functional but also promote health, well-being, and sustainability.

Primary data collection

The data was collected through a questionnaire distributed via online forms, and the data collected is consolidated in various charts and graphs. (Total entries-109)

Section 1: Architect’s Thought and Design Process for Architecture Accounting COVID-19 Question 1: How has your design process changed post-COVID-19? (for architects and students of architecture)

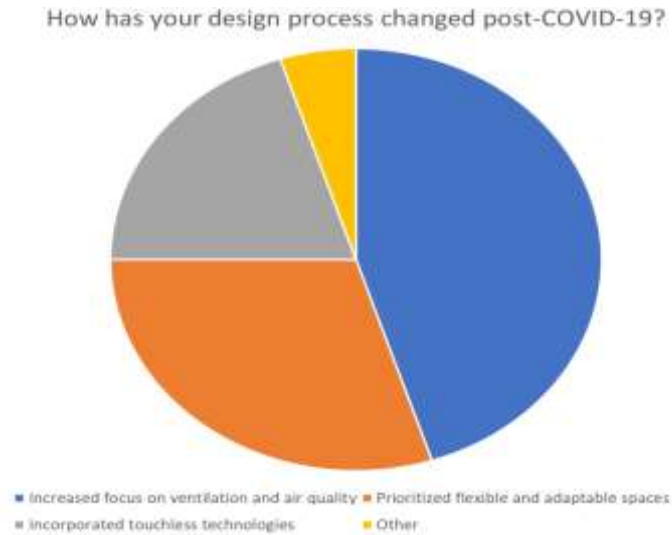


Figure 1: Change in Design Process Post-COVID-19

Interpretation: Most respondents prioritized ventilation and flexible design, indicating a shift toward health-focused architecture.

Question 2: What new considerations (e.g., ventilation, sanitation, flexibility) are now prioritized in your designs?

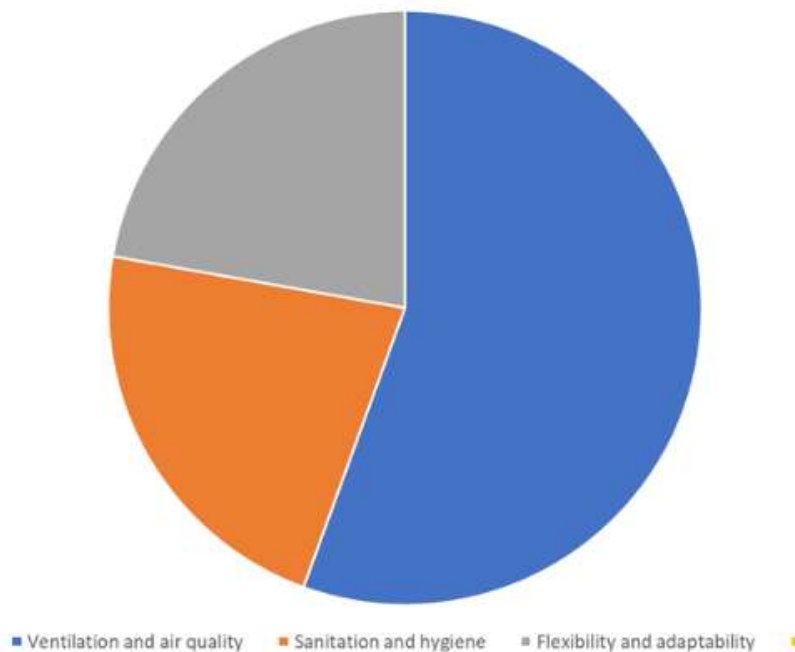


Figure 2: Key Design Considerations

Interpretation: Ventilation is the primary factor, followed by sanitation and adaptability in design.

Section 2: Considering a Wider Perspective Demography from Collaboration of Different Fields Apart from Architecture

Question 1: How important has collaboration with other fields (e.g., public health, engineering, psychology) been in your COVID-19-related projects?

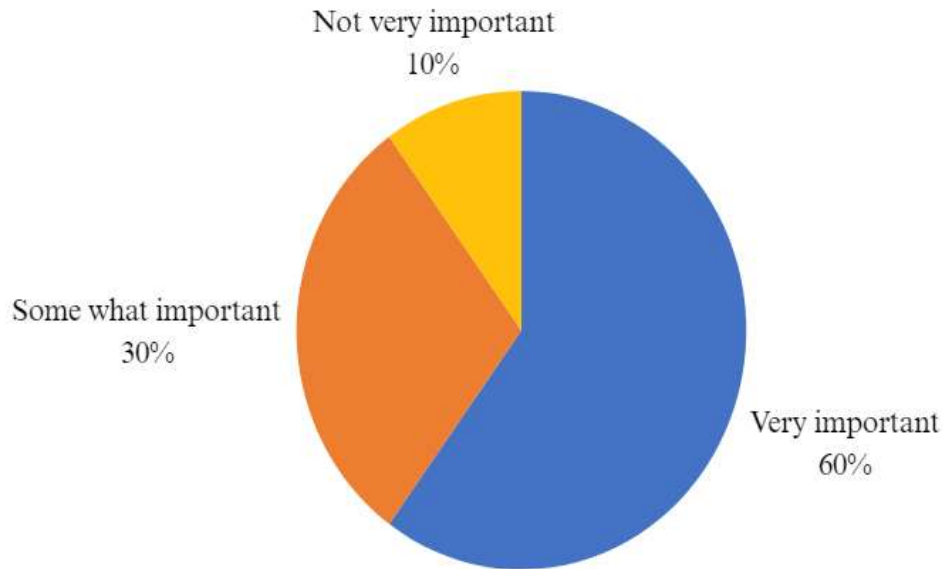


Figure 3: Importance of Interdisciplinary Collaboration

Interpretation: A majority consider collaboration essential, highlighting the need for integrated design approaches.

Question 2: What specific insights or expertise have you gained from these collaborations?

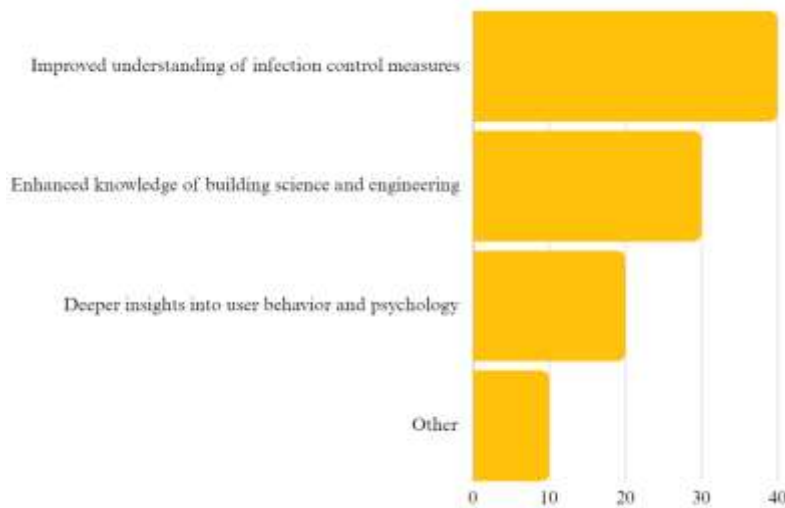


Figure 4: Insights from Collaboration

Interpretation: Key insights include infection control, technical systems, and user behaviour understanding.

Section 3: Relevance of the Norms Set During COVID-19 and Their Adherence

Question 1: Do you think the norms and standards established during the pandemic will have a lasting impact on future building design and construction practices?

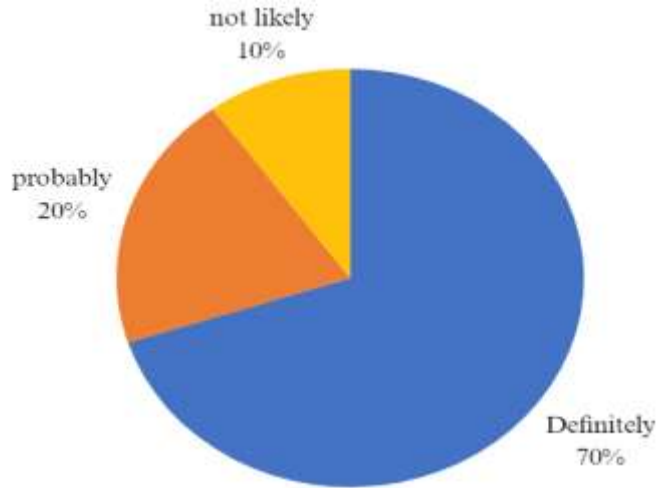


Figure 5: Longevity of Pandemic Design Norms

Interpretation: Most respondents believe these norms will continue in future design practices.

Question 2: Which specific norms or standards do you think will become essential for resilient and sustainable buildings?

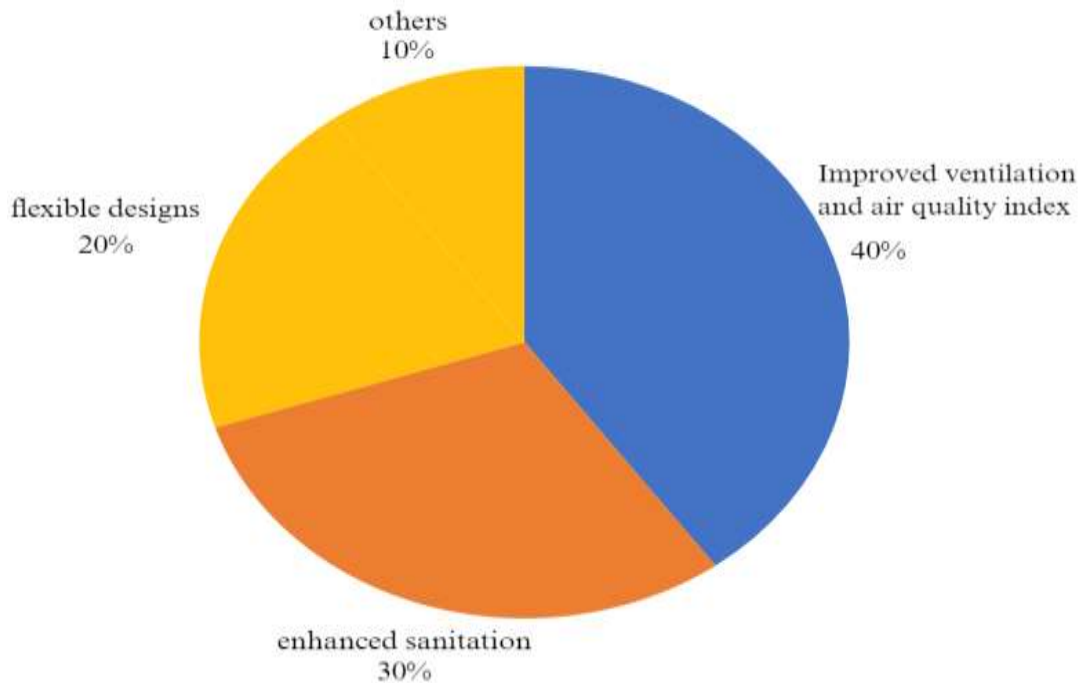


Figure 6: Future Design Standards

Interpretation: Ventilation, sanitation, and flexibility are identified as key future priorities.

Section 4: Impact and Role of Architecture on the Deadly Effects of COVID-19

Question 1: How have building design factors (e.g., ventilation, air filtration, layout) influenced the spread of COVID-19?

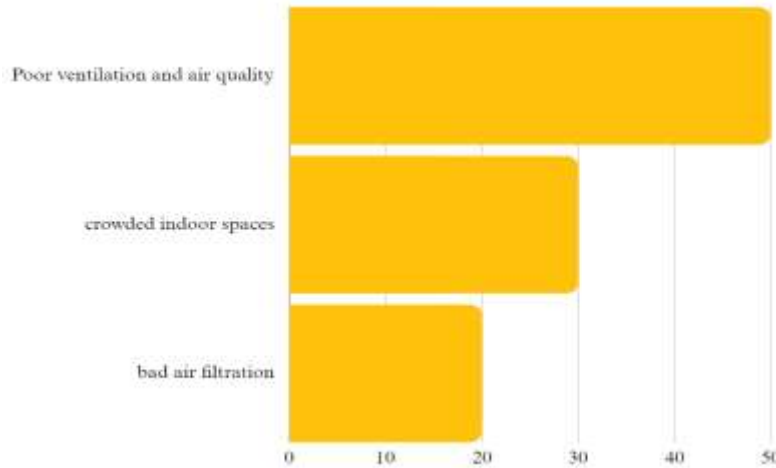


Figure 7: Factors Influencing COVID-19 Transmission

Interpretation: Poor ventilation is the most significant factor affecting virus spread.

Question 2: What lessons can be learned from the pandemic to design buildings that are more resilient to future health crises?

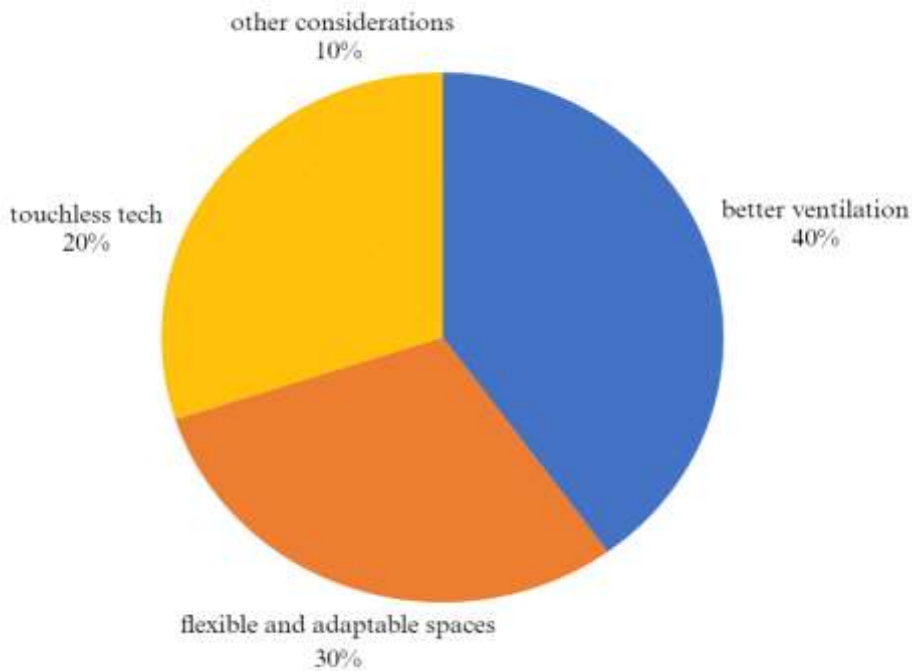


Figure 8: Lessons for Future Design

Interpretation: Improved ventilation and adaptable spaces are the key lessons.

Question 3: What specific architectural features and design strategies do you think are effective in mitigating the spread of COVID-19? (chosen from a wide variety of options, the following came on top)

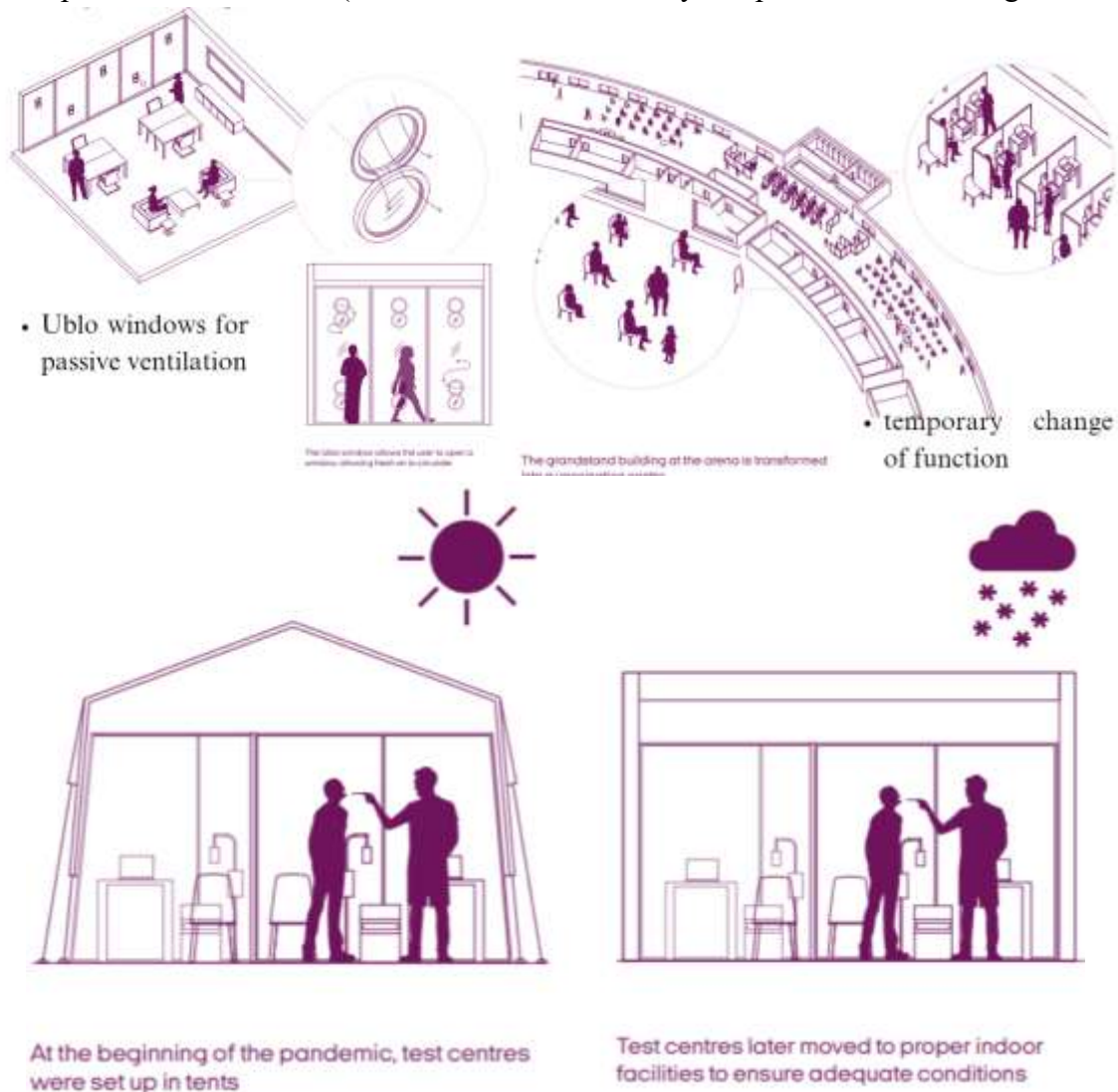


Figure 9: Pandemic-Responsive Architectural Strategies

Interpretation: The images highlight adaptive design strategies focusing on ventilation and flexibility.

Source: Realdania. (2022). *Architecture of the Pandemic: A compendium of COVID-19 responses in the built environment* (1st ed.). Realdania.

Interview with Muzamil Hasham, Founder and lead architect at Design Boulevard, Bengaluru

1. Interviewer: Muzamil, the pandemic was a global shock. How did it change your perspective on architectural design?

Muzamil Hasham: It was a wake-up call, really. Suddenly, the focus shifted from aesthetics to the very fundamentals of human health and safety. We realized that buildings aren't just structures; they're environments that can either protect or endanger us. So, we started designing spaces with improved ventilation, touchless fixtures, and flexible layouts. With regard to ventilation, it showed us how vital natural ventilation is for healthy indoor spaces. We are now focusing more on sustainable designs that use features like open windows and cross-ventilation to improve airflow naturally. It's not just about infection control—these designs are energy-efficient and better for the environment, making buildings safer and

more sustainable for the future.

2. Interviewer: How did architects collaborate with other professionals to address the challenges posed by the pandemic?

Muzamil Hasham: It was a team effort. Architects, engineers, public health experts, and others worked together to find innovative solutions. We learned to think beyond the traditional boundaries of our profession. For example, we delved into the science of airflow and the psychology of space to create environments that promote well-being. We realised the need for optimal designs for high-density, crowded areas to improve ventilation.

3. Interviewer: Do you think the pandemic has permanently changed the way we design buildings?

Muzamil Hasham: Absolutely. The lessons we've learned from this experience will shape the future of architecture. Improved ventilation, flexible spaces, and touchless technology are likely to become standard features. However, we need to be careful not to overengineer our spaces. We still need places that inspire, connect, and uplift the human spirit.

4. Interviewer: How can architecture contribute to a healthier and more resilient future?

Muzamil Hasham: By designing spaces that prioritize human health and well-being. This means creating buildings with plenty of natural light, fresh air, and opportunities for physical activity. We can also design buildings that are adaptable to future challenges, such as climate change and emerging health threats. By thinking long-term and embracing sustainable practices, we can create a more resilient and equitable built environment. Keeping in mind the practical challenges of maintaining consistent airflow can help build a healthier atmosphere.

5. Interviewer: What challenges do you foresee for the future of architecture?

Muzamil Hasham: One of the biggest challenges is the rapid pace of technological change. We need to stay updated with the latest tools and software to remain competitive. Another challenge is balancing aesthetics with functionality and sustainability. We want to create beautiful, functional, and environmentally friendly buildings. It's a delicate balance. It might also be hard to design for climate-specific regions, as it requires more research.

6. Interviewer: How has the pandemic shifted the way clients think about their spaces?

Muzamil Hasham: It's been a real eye-opener for many. Clients are now more mindful about the health and safety implications of their built environments. They're seeking spaces that are not just aesthetically pleasing, but also practical and hygienic. We're seeing a growing demand for well-ventilated spaces, touchless fixtures, and flexible layouts that can adapt to changing needs.

7. Interviewer: AI is a buzzword these days. How do you see it impacting the future of architecture?

Muzamil Hasham: AI is an amazing tool, but it's not here to replace human creativity. Sure, it can crunch huge amounts of data to make buildings more efficient, come up with cool design concepts, or handle routine tasks. But when it comes to the heart of architecture—really understanding people's needs, dreams, and how they live—that's something only humans can truly do and I think we're great at it.

8. Interviewer: Balancing innovation with budget constraints is a common challenge. How do you approach this?

Muzamil Hasham: It's a delicate balancing act. We use parametric design tools to explore multiple design options within a given budget and regulatory framework. By automating certain design processes, we can reduce costs and accelerate the design phase. But ultimately, it's about finding creative solutions that don't compromise on quality.

9. Interviewer: What advice would you give to aspiring architects?

Muzamil Hasham: Stay curious, keep learning, and never stop exploring. The field of architecture is constantly evolving, so it's important to stay updated with the latest trends and technologies. Network with other professionals, seek mentorship, and don't be afraid to take risks. The most rewarding designs often come from pushing boundaries and challenging the status quo.

End of Interview

Keywords of the interview

Health and Safety First: The pandemic has shifted the focus to prioritize health and safety in architectural design.

Technological Advancements: AI, VR, and other technologies are revolutionizing the way architects design and build.

Sustainable and Resilient Design: Architects are emphasizing sustainability and resilience in their projects.

Human-Centered Approach: Designing spaces that prioritize human well-being and comfort.

Interdisciplinary Collaboration: Architects are working closely with engineers, public health experts, and other professionals to create innovative solutions.

Conclusion:

The COVID-19 pandemic has significantly reshaped the field of architecture. Prioritizing health, safety, and well-being, architects are now designing spaces that are not only aesthetically pleasing but also functional and resilient. Key shifts in architectural design post-pandemic include incorporating features like improved ventilation, touchless fixtures, and flexible layouts to minimize the spread of disease; leveraging AI, VR, and other technologies to optimize design and construction processes; creating buildings that are environmentally friendly and can withstand future challenges; prioritizing the needs and experiences of building occupants; and working closely with engineers, public health experts, and other professionals to create innovative and holistic solutions. By adapting to these changes, architects can contribute to a healthier, more sustainable, and resilient future.

Secondary data

Nejatian, A., Sadabad, F. E., Shirazi, F. M., Nejati, S. F., Nakhaee, S., & Mehrpour, O., "How much natural ventilation rate can suppress COVID-19 transmission in occupancy zones," *Journal of Research in Medical Sciences*, vol. 28, p. 84, 2023

Aim:

This study evaluates the effectiveness of natural and mechanical ventilation in reducing the transmission of airborne COVID-19 particles in indoor spaces. It highlights the significant role of natural cross-ventilation as a highly effective strategy compared to single-sided ventilation and mechanical systems.

Key Findings on Ventilation

1. Cross-Ventilation

- **Efficiency:** Reduced viral load in a 100 m² space from 10,000 particles to zero within 15 minutes.
- **Air Flow Rate:** Achieved a ventilation rate of 1325 m³/h.

2. Single-Sided Ventilation

- **Outcome:** Halved the viral load at best.
- **Air Flow Rate:** Approximately 81 m³/h.

3. Mechanical Ventilation

- **Performance:** Less effective in removing viral loads compared to natural ventilation methods.
- **Constraints:** Relies heavily on system capacity and filter efficiency.

4. Critical Ventilation Rates

- Spaces achieving an air change rate (ACH) above six per hour experienced significant reductions in infection risk.
- Cross-ventilation was identified as the most cost-effective and practical solution for achieving high ACH in most scenarios.

5. Ventilation in Specific Settings

- **Classrooms:** Opening all windows reduced viral particle inhalation by up to 80%.
- **Offices and Reception Areas:** Cross-ventilation was vital due to prolonged occupancy.
- **Supermarkets and Malls:** Early shopping hours were recommended due to lower viral load.

6. Practical Guidelines for Ventilation Design

- Cross-ventilation requires placing openings on opposite sides.
- Increasing window size and optimizing opening placement improves ventilation performance.
- A wind speed of 1.5 m/s and openings totaling 0.6 m² per 100 m² of space were sufficient.

Recommendations for Ventilation

1. Adopt Cross-Ventilation Where Possible

- Ensure at least two openings, preferably on opposite sides.
- Optimize opening size and placement.

2. Enhance Air Change Rates (ACH)

- Aim for six or more ACH.
- For single-sided ventilation, ensure maximum opening size and consider using auxiliary fans.

3. Ventilation in High-Risk Areas

- Prioritize cross-ventilation for crowded spaces.
- Combine ventilation with proper spatial arrangements.

4. Ventilation Modelling

- Use empirical equations to calculate expected air exchange.
- Incorporate ventilation assessments in building design.

Research Gaps in Ventilation

1. Climate-Specific Application

- Future research should explore cross-ventilation performance under diverse climatic conditions.

2. Integration with Mechanical Systems

- Limited focus on hybrid systems combining natural and mechanical ventilation.

3. Advanced Ventilation Metrics

- Investigation into advanced parameters, such as turbulence and airflow patterns.

4. Operational Challenges

- Real-world barriers like occupant behaviour, environmental noise, and energy costs.

Emmanuel, U., Osondu, E. D., & Kalu, K. C., "Architectural design strategies for infection prevention and control (IPC) in healthcare facilities: Towards curbing the spread of COVID-19," *Journal of Environmental Health Science and Engineering*, vol. 18, pp. 1699–1707, 2020.

Key Highlights on Ventilation

- **Natural Ventilation in Infection Prevention:**
 - Significance: Ventilation is a critical factor in mitigating airborne infections like COVID-19 in healthcare facilities.
 - Performance: Studies show that natural ventilation, especially with openable windows, provides higher ventilation rates than mechanical systems while being energy efficient.
- **Ventilation Rates and Infection Control:**
 - The CDC recommends an air change rate (ACH) of 12 or more per hour in healthcare facilities.
 - Increasing ACH significantly reduces the risk of infection. For instance, a ventilation rate of 12 ACH can reduce droplet nuclei concentration to 1.8% within 20 minutes, while 24 ACH achieves this in just 10 minutes.
- **Evidence from Isolation Wards:**
 - Hospitals with high percentages of openable windows were found more effective at preventing airborne infections like SARS compared to mechanically ventilated facilities.
- **Design Recommendations for Ventilation:**
 - Ensure adequate cross-ventilation by providing open-ended corridors and integrating courtyards.
 - Use natural ventilation strategies like upper ventilation windows and louvers to enhance airflow in closed areas.
 - When natural ventilation is insufficient, adopt hybrid approaches combining natural and mechanical ventilation.
- **Integration with Structural Design:**
 - Courtyard layouts can establish cohesive ventilation passages, optimizing airflow throughout the building.
 - Avoid closed-end corridors and poorly ventilated spaces, as these increase the risk of airborne transmission.

Guidelines for Implementation:

- **Cross Ventilation:**
 - Design spaces with openings on opposite walls to facilitate natural airflow.
 - Incorporate ventilation channels in hallways and other commonly used areas.
- **Ventilation Monitoring:**
 - Use carbon dioxide tracer-gas techniques to evaluate and optimize airflow patterns.
 - Maintain ACH levels above 12 to ensure effective air exchange.
- **Hybrid Systems:**
 - For regions with limited natural airflow, combine mechanical systems with openable structures to meet ventilation needs.
- **Healthcare Facility Design:**
 - Ensure all patient rooms and wards have operable windows.
 - Use corridors and hallways as secondary airflow pathways with appropriate ventilation openings.

Research Gaps

- **Climate-Specific Adaptation:**
 - Most recommendations assume moderate climatic conditions. There is limited data on ventilation per-

formance in extreme weather.

○ **Long-Term Maintenance:**

- Sustainability of natural ventilation systems and the practical challenges of maintaining consistent airflow need further investigation.

○ **Ventilation in Crowded Settings:**

- More research is needed to determine optimal designs for high-density areas like emergency rooms and waiting areas.

These results obtained from both the primary and secondary sources validate the necessity to shift to resilient and healthy architecture.

Final Insights

COVID-19 has had a significant impact on how architectural practice is conducted because health and safety aspects have been brought to light through the incorporation of new techniques like better ventilation systems and adaptive space planning. This paper has shown the relevance of technological integration and collaboration within different fields in finding solutions to complex problems. There seems to be an ongoing transformation in architecture whereby architects have taken into account the users' needs and how to design buildings that can be adapted to future needs.

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