

# Towards Sustainable Design: Influence of pandemics on Architectural Design and Urban Planning through the ages

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**Abstract:** In the history of the built environment, interior design and urban planning have always responded to epidemics by designing architecture and urban spaces to resist the different viruses and pathogens while preventing their spread. The architectural design strategies used in the past centuries, including Modernism, were a reaction to creating pandemic-free built forms and spaces, thus creating a healthy and sustainable built environment. The Italian piazzas, modernism, minimalism, decentralization of urban cities, urban renewal, etc. were a few of the design outcomes of a pandemic-resistant environment. This research study will help architects understand and evaluate the design strategies used to achieve a healthy, sustainable built environment, thereby adding progressive layers of protection against the virus. Future-built spaces must be designed by taking into account what we've learned from the past and moving in the right direction toward sustainability.

**Keywords:** pandemic, decentralization, low-density housing, sustainable design

## I. INTRODUCTION

The whole world is trying to defend itself against the deadly coronavirus. COVID-19 has a disastrous effect on the health, economy, and societal setup. Coronavirus and its variants have jeopardized all the countries globally and have still not ceased after the protection by two shots of vaccines. This seems to be a recurring hazard, with one variant coming up after another and the series of waves that periodically peak up with a high number of infections.

Communicable diseases have transformed our built environment and urban planning over the past centuries. Many of the practices in architectural and urban design prevalent now have evolved from similar measures taken through the past centuries to safeguard the health, hygiene, and comfort of city dwellers. This research will encourage architects and urban planners to develop innovative ideas and planning theories to protect the built environment from virus attacks, thereby adding more protective layers to the defense system of built forms. This research will also highlight some key zones impacted by the COVID-19 pandemic and list their associated inquiries.

## II. RESPONSE TO EPIDEMICS THROUGH HISTORY

Over the past 500 years, the built form has always responded to the pandemics. Form follows function is the most common

statement in the emergence of Modernism. The function was defined by health, hygiene, sanitation, natural light, ventilation, and access to green areas while referring to the purpose of the building.

### 1. Bubonic Plague



Figure SEQ Figure \\* ARABIC 1- Artek Chair designed by Alvar Aalto

In the 14<sup>th</sup> century, the bubonic plague (Black Death), caused by bacterial infection spread mostly by fleas on rodents and other animals, killed 75-200 million people in Eurasia and North Africa. The Bubonic plague enhanced the urban development of the Renaissance. The city margins were expanded with new suburban development, redevelopment of urban landscapes through civic improvements and public works, overcrowded dense living quarters were dispersed, piazzas and organized public spaces originated, and early quarantine facilities were created. Architects and other experts began to be employed to help with the planning of cities; thus, the Black Death led to the introduction of major changes in European urban cities.

### 2. Cholera pandemic

In the early 1800s, cholera spread through bacterial infection from feces that infected water and food in all countries and killed more than 150,000 people. As this disease resulted from toxic air and water, public parks and advances in sanitation with underground sewer systems were developed in the cities. Architecture and urban planning resulted in better ventilation systems with detached houses, wider streets,

sidewalks, drainage, and sanitary practices. Wide boulevards and public parks came up, and streets were paved to allow easy washing away of waste. Unsanitary and overcrowded neighborhoods and city centers were demolished to replace them with parks and open spaces. Paris's city planning ensured that no citizen was more than a 10-minute walk from the park. In New York, large open green spaces were also planned in the city centers to provide fresh air and light to the densely populated areas (1).

### 3. Tuberculosis epidemic

In the 19<sup>th</sup> century, another epidemic of tuberculosis transformed architecture profoundly. About one in seven people died of tuberculosis, and architects started feeling the responsibility to heal people through design. Tuberculosis modernized architecture inspires architects to renounce ornamentation and bring fresh air, sunlight and connection to nature into the building. Modernism is the amalgamation of Form and Healing Environment. Until the development of antibiotics through the 20<sup>th</sup> century, the therapy for tuberculosis was purely natural and environmental with fresh air, sunlight, rest, and nourishing food. The architectural planning of the Sanatorium (medical facility for long-term illness) had prerequisite design features.

1. Larger expanses of windows for fresh air and sunlight
2. Connection to nature through balconies and terraces for sunbathing
3. Recliner chairs for patients to use on these balconies
4. New technologies developed new materials such as reinforced concrete and steel frame constructions which are more suitable for hygienic buildings.

This global pandemic has manipulated our personal and professional lifestyles, directly influencing the built environment. Consequently, architecture and urbanism after the COVID-19 epidemic will never be the same; measures must be taken to design a healthy, hygienic, and sustainable environment. Cities with high population densities are the most affected during the pandemic. Excessive spatial clustering in urban forms, high-density residential buildings, lack of public green spaces, deterioration of the environment, and sanitation are some of the root causes of the spread of the pandemic. Strategies for urban planning, design proposals for public spaces, approaches to urban housing, and office design must be ensured to reduce social distancing, thereby reducing infection. Diseases spread through unhygienic environments in densely populated areas like slums must be demolished and rehabilitated considering the health of the urban environment. Hotels and serviced apartments should be flexible enough to be transformed into quarantine centers with basic medical treatment and isolation, especially near airports, seaports, and railway stations. Health centers must have multiple spacious courtyards to facilitate airflow and circulation inside the building. Construction technology must also facilitate the prefabrication of building elements and building automation using smart devices.

## III. POST PANDEMIC URBAN PLANNING STRATEGIES

The urban planners and architects must focus on urban improvement and design cities that reduce infection. Dense cities with high population density and overcrowding are the most vulnerable to the risk of infection. Human being lifestyle is designed to adapt to nature, its healing effects – towards sustainability.

### 1. Horizontal expansion of towns and cities

During the pandemic, the human closeness in high populated cities poses a threat of covid infections. Considering social distancing, architects and planners must consider horizontal expansion of towns and cities with more available open green spaces to enhance the air quality for breathing.

### 2. Fewer density cities

During the peak time of pandemic and infection, it was noticed that cities are highly infectious because of their high density and less social distancing, while suburbs and villages are the safest zones. With the shift towards remote and digital transformation, architects and planners must enhance the suburbs and villages with self-sustaining infrastructure and facilities.

### 3. Decentralization

The facilities and services should not be agglomerated together; the commercial facilities, the health facilities, schools, and other services should be distributed across the urban tissue, and the local community center or town center should be enhanced as in the past. The shopping malls would eventually lose their value, and neighborhood markets should be encouraged. A decentralized network of small open green spaces that serves the neighborhood and community is essential for physical and mental health during and even after the pandemic. Decentralization favors the horizontal expansion of cities and towns to maintain sustainable development.

### 4. Greening of cities

The built environment and cities must always be integrated with nature to maintain a healthy lifestyle free of air pollution and harmful infections. Green parks, a connected network of urban green spaces, roadside gardens, and green buildings are important for the sustainable health of cities.

### 5. Urban farming

A self-sufficient community with urban farming has become resilient to the epidemic while protecting the environment. It was one of the stress busters during the pandemic lockdown times. Whether apartments or independent houses, all residential blocks must be integrated with farming vegetables and fruits.

### 6. More walking and cycling

Architects and urban planners must develop communities and urban zones with a network of cycling and walkable streets to discourage sedentary lifestyles, leading to diabetes, obesity, and other non-communicable diseases. As a primary mode of transportation and physical activity, Walking has proved to be both environmentally friendly and beneficial for residents' physical and mental health. The Cities should be made walkable, and bicycling must be enhanced with less use of public transportation. During the pandemic, public mass transportation systems proved to be responsible for spreading the virus. Streets must be redesigned to become wider for safe distancing, uni-directional movement, healthier, safer, greener, and more livable.

## IV. POST PANDEMIC HOUSING

This pandemic brought a greater appreciation for the housing design, its functions, and planning as most people stayed home. People need houses that can effectively provide social isolation, quarantine, and protection from virus infections. High-density housing should be discouraged, while detached houses with a reasonable amount of garden space enhanced social distancing measures, farming food, and the healing effects of sunlight, ventilation, and nature proved ideal during the pandemic. During the pandemic, many people shifted to work from home or remote working methods, continuing even after revoking lockdown measures. Rooms for quarantine, office spaces, and online education classes need to be introduced into the functions of house design. Space programming for housing design must be reconsidered; adaptable design solutions where spaces can be easily transformable to a different function need to be implemented in housing design. Additionally, the observations further reinforced trending models of sustainable design: housing must minimize carbon footprint, provide natural lighting and ventilation, biophilic design integrating with nature, etc.

### 1. Communal activities

Communal activities are important for the physical and mental health of the residents of independent houses or multistoried apartments despite the spread of the virus in such spaces. Hence communal facilities and corridors must be enlarged and widened by reevaluating their dimension and must be designed semi-covered or integrated with green spaces to keep social distancing and protection from the virus.

### 2. Rethink transitional spaces for multistoried housing

In the case of multistoried buildings, public spaces must be connected to the individual homes by creating alternative pathways, thus minimizing crowding in the main lobby. The transit spaces must be well designed with semi-covered green spaces, touchless lifts, and doors to promote the health and safety of residents. Courtyard housing allows good lighting and crosses ventilation.

### 3. Restrictable access space

A containment space with restricted access for home deliveries and a cloakroom should be added to contain the accidental introduction of the virus into the home. This parcel delivery box can be contained on the wall adjacent to the front door or gate.

### 4. Flexibility and adaptability of spaces

Houses became the spaces for almost all activities, including workspaces, online schooling spaces, entertainment spaces, and playing areas, besides the regular sleeping, dining, and living spaces. Hence spaces must be easily transformable and flexible to different functions. Moving walls and furniture, good use of movable furniture vs. built-in furniture, and modularity of building elements must be considered for flexibility in space design.

### 5. Adequate lighting and ventilation

Independent houses or multistoried apartments should never compromise adequate natural lighting and ventilation.

### 6. Space programming and planning

Design for public and private spaces in an individual house must be well segregated. The size of an individual house may increase due to the increased functions like workspace, study space, entertainment, etc. The use of physical distancing and flexibility of spaces must also be considered while programming the area of spaces.

### 7. Green Balconies

Every living space must have access to landscape in outdoor and indoor gardens and terraces with access to nature. Open and semi-open spaces reduce stress because of the increased social interactions and mental fatigue because of the breadth of vision and observation of nature.

## V. POST PANDEMIC OFFICE SPACES

The existing open-plan office spaces could no more be used in the post-pandemic era, and most firms have resorted to remote working or working from home. Although many offices could sustain their working environment remotely, some offices must switch to physical offices. Hence the office buildings will have to rechange their plan and design to work effectively in the coming days.

- a. Low-density offices and low-rise office structures with larger spaces per person.
- b. Multiple entries with security systems.
- c. Reduce the bottlenecks of lifts, staircases, and corridors.
- d. Cubicle office system with natural lighting and ventilation system.
- e. Access to green spaces.
- f. Small clusters of communal facilities.

- g. Smart systems – thermal sensors, HVAC systems with new filters, touch-free digital systems, IT solutions for air quality.
- h. Use ultraviolet germicidal irradiation to disinfect offices at night deeply.

## VI. CONCLUSION

There is no end to the COVID-19 pandemic, but it has helped us predict what post-pandemic architecture and urbanism might look like. In the past, many architectural approaches increased the healthy spaces of our buildings and enhanced sustainability. Based on the current circumstances and emergency measures, we should review our design strategies and planning theories. We could use healthy design and planning strategies more effectively to face pandemics and create a less polluted, more sustainable architecture and urbanism in general. This study does not present answers; it only provides insights into areas where future research will be critically required to extend the scope of research required. Based on the lessons learned from this crisis, this study introduces a vision of the required pandemic free built environment that can be updated to stop the virus from spreading or mitigate its impacts. However, selecting the best antivirus strategy depends on many factors, such as the abilities and capabilities of each community and environment. In this context, the pandemic increased the requirement for policymakers, planners, and architects to think more out of the box, reshape our physical spaces, reset the existing build environment or develop more ideas to face future virus attacks.

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