



The Impacts of Pandemic The Challenges of Sustainable Construction

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Abstract

Sustainable construction can be defined as the way of finding an equilibrium between economic, social, and environmental factors in the design, construction, use, and maintenance of buildings. The main objective of this holistic process that was recently introduced is to maximize the value added by a construction project while minimizing the harm to the surrounding environment and local society. However, it is not yet a common application in the construction industry due to a lack of knowledge and awareness. On another side, pandemics have always shaped societies by reflecting on architecture and urban planning throughout history. Since the world faces a COVID-19 pandemic today and other pressing climate change issues, there is a need for change and re-thinking in order to be able to achieve more sustainable construction. The aim of this paper is to present a comprehensive literature review to identify the key issues and challenges facing sustainable construction and determine how pandemics affect some of these challenges. After that, the paper proposes a model to address some of these challenges with a focus on the 15-Minute City concept. This paper provides academic and industry practitioners with strategies to enhance the utilization of sustainable construction in light of the global epidemics.

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1. Introduction

December 2019 was marked as the beginning of a unique disease outbreak which was called COVID-19 by the World Health Organization (WHO) [14]. The world is now facing unique restrictions and most of the world's population is forced to stay in their homes. Quarantine, social distancing, and self-isolation are the response strategies outlined by WHO to the public to diminish the spread of this global epidemic which not only has curtailed the individuals' desire for social interaction, but also has a contradiction with the system of cities, parks, and subways that are designed [8]. Furthermore, majority of countries closed public places, offices, universities, and schools due to the COVID-19 pandemic and necessitating people to work and study from home [14]. Thus, residential buildings have turned out to be a crucial infrastructure that is vital for supporting these disrupted societies and housing has becoming more than just a living space which eventually increasing buildings' resource consumption such as electricity and water [14].

The construction industry performs a key role in fulfilling the society's needs by adding value to health and economic benefits, including contribution to enhancing the way of living; however, it is a major cause of the reduction of natural resources, high energy consumption, global greenhouse gas emissions, waste generation, and air pollution [4]. These negative impacts have led experts and environmentalists call on for a sustainable way of implementing construction activities. Sustainability has turned out to be a general

term which is attached to activities that happen with an idea of achieving eco-friendliness [3]. The concept of sustainability is to provide solutions to the human activities which are harmful to the environment and that can be attributed to population growth and economic activities. Sustainability needs have risen to be an emphasis point for many communities and countries since the earth's resources are under severe pressure due to exponential growth in population and economic expansion [4]. It has been seen that the world population has grown rapidly from 2.5 billion to 7.9 billion from 1950 to 2022 and this growth has placed further burden on the environment, resulting in enormous air pollution, water pollution and soil pollution [3]. Therefore, proactive measures are required via the implementation of sustainable construction to change or to minimize the negative impacts of construction activities to the environment.

Therefore, changes are required to the current world where we live to become more resilient and sustainable to possible forthcoming disease outbreaks and lockdowns, which introduces challenges to the existing residential buildings for adaptation to a new reality [14]. Also, it is necessary to design the cities and the urban environment in such a way that it delivers a healthy environment for individuals as the interrelation between city elements (such as buildings, streets, public parks, and infrastructure of cities) significantly affects the quality and efficiency of life for individuals in cities [8]. Many questions are raised by designers and planners about how to change the trend in the current design to adapt sustainable design. To ensure that we remain resilient and sustainable, future houses and cities need to minimize environmental impacts and improve the comfort of people under epidemic measures [8].

As part of the study, a comprehensive literature review is presented to identify the key challenges and issues related to sustainable construction, as well as to examine how pandemics may impact some of those. Then, this paper discusses how to overcome some of these challenges with a focus on the 15-Minute City concept, providing academics and industry practitioners with strategies to make sustainable construction more widely utilized as a response to global epidemics.

2. Literature Review

Sustainability has become a popular paradigm in the construction industry because of a rising concern that human activities are causing severe negative impact on the environment [2]. It is being recognized worldwide because it is an essential need for the future [4]. After 1987, the term sustainability gained extensive importance when the Brundtland Report from the United Nations World Commission on Environment and Development described sustainable development as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" [3]. Sustainable construction is a holistic process with an aim of restoring and maintaining harmony between the natural and the built environments and establish settlements that sustain human dignity and help economic equity. It integrates the basic ideas of sustainable development along with environmental obligation, social understanding, and economic profitability objectives to the key participants in the built environment [2]. Since building construction which has huge environmental impact is growing rapidly, more attention is required to the creation of further strategies for the improvement of environmental performance in building design [4]. Therefore, sustainable construction is the way of finding an equilibrium between economic, social, and environmental factors in the design, construction, use and maintenance of buildings [2].

Sustainable Construction is important for management and protection of the environment, and its related challenges are the long-term challenge which need to be tackled by human race [3]. Construction industry that will implement a sustainable construction helps to reduce liability on the ecosystem, develop new markets and foster an eco-friendlier construction process that will assist to sustain future and current generations to achieve a better quality of life [3]. Green buildings facilitate the construction industry to have a positive and practical attitude towards environmental resources by emphasizing on the principles of sustainable site, water efficiency, energy conservation and efficiency, resource-efficient materials, waste minimization and ventilation, including other strategies to minimize environmental impacts and resource consumption [4]. Table 1 shows the seven principles of sustainable construction which were given by the Conseil International du Batiment (CIB) 1994 and are used for decision-making during each phase of the design and construction process [4].

Table 1. The principle of sustainable construction [4].

Item	Description
1	Reduce Resources Consumption
2	Reuse Resources
3	Use Recyclable Resources
4	Protect Nature
5	Eliminate Toxic
6	Apply Life-Cycle Costing
7	Focus on Quality

Many other sources (UNEP Industry and Environment 2003, Carter and Fortune 2007 and others) defined sustainable construction as a method to construct, which encourages the achievement of goals associated with the triple pillars has described below [13]:

- Economic sustainability – increasing profitability by implementing more efficient way to use resources including labour, materials, water, and energy.
- Environmental sustainability – avoiding harmful and potentially permanent effects on the environment by efficient use of natural resources, reducing waste, protecting and where viable improving the environment.
- Social sustainability – responding to the people's needs at any stage of construction process (from commissioning to demolition), providing high customer satisfaction and working diligently with customers.

Construction projects are executed with a poor sustainability nature in most developing countries in recent times and research has demonstrated that sustainability level in most developing countries is low [2]. So, it is required to adapt changes in the thinking, behavior, production, and consumption within the construction industry to achieve sustainability and the construction industry shall modify its construction process from linear to cyclic processes which will increase the usage of recycled, renewed, and reused resources, and thereby reducing the usage of energy and other natural resources [2].

Table 2 shows factors and challenges of sustainable construction identified through literature review along with their sources. To present concise factors, only the challenges that were repeatedly raised in scholarly articles have been selected.

Table 2. Key challenges of sustainable construction identified by literature.

Item	Factors / Challenges	Sources
1	Lack of awareness of the benefits, Level of knowledge and awareness	Salama and Hana (2010), AlSanad et al. (2011), Aghimien et al. (2018), Aigbayboa et al. (2017), Abidin et al. (2003)
2	Higher construction cost	Salama and Hana (2010), Aigbayboa et al. (2017), Miranda and Marulanda (2001), Lowe and Zhou (2003), Ametepey et al. (2015)
3	Short-term budget horizons, Budget constraints	Salama and Hana (2010), Aghimien et al. (2018), Ametepey et al. (2015)
4	Lack of clear federal policy, Lack of rules and legislation from government	Salama and Hana (2010), AlSanad et al. (2011), Abidin et al. (2003), Aghimien et al. (2018), Ametepey et al. (2015)
5	Shortage of knowledge for application and implementation technically	AlSanad et al. (2011), Aghimien et al. (2018), Aigbayboa et al. (2017), Ametepey et al. (2015)
6	Lack of knowledge and alternative building/sustainable materials	Aghimien et al. (2018), Abidin et al. (2003)
7	Lack of demand by clients	Djokoto et al. (2014) Opoku and Ahmed (2014), Pitt et al. (2009)

Salama and Hana (2010) conducted a survey based on 9 key challenges of sustainable construction by distributing to 120 practitioners in United Arab Emirates (mainly client, consultant, project manager, supplier) [13]. The factors were: lack of awareness of the benefits, higher construction cost, short-term budget horizons, length of required payback period, difficulty in quantifying benefits, lack of clear federal policy, documentation and cost of certification, more complex construction, and increased operating costs. AlSanad et al. (2011) conducted a survey and distributed a questionnaire to stakeholders within the Kuwait's

construction industry to identify their level of awareness and knowledge for different stakeholders in Kuwait on the concept of green buildings and sustainability [4]. The collected data represented that the level of knowledge in construction sustainability is in the range from “moderate to good” level which shows that there is good acceptance of the sustainability concept; however, this awareness is not currently well reflected in the design and construction practices actually being applied and the application of sustainability is still measured to be very low due to many factors such as shortage of knowledge for application, lack of awareness at social levels, poor enforcement of legislation, and poor support from the government.

Miranda and Marulanda (2001) studied sustainable construction in developing countries and pointed out that the major challenge is the fact that sustainable construction is being recognized as a concept which would add cost to the project which was formed without critical evaluation of the whole life-cycle benefits of sustainable construction [9]. Also, Aigbavboa et al. (2017) observed similar result while assessing the sustainable construction practices in South Africa and they discovered that the main challenges are the belief of additional cost to building projects, and limited understanding of sustainable construction’s benefits [3]. The idea that sustainable cost more, with no appropriate assessment, creates a significant challenge in the implementation of sustainable construction systems in most developing countries around the world [15]. Aghimien et al. (2018) conducted a survey on sustainable educational buildings in Nigeria and they concluded that the significant challenges are construction related, sustainability awareness and knowledge related, finance related, and government related [2]. Ametepey et al. (2015) found that there are some other important factors in adoption of sustainable construction methods such as cultural change resistance, lack of government commitment, fear of higher investment costs, lack of professional knowledge, and lack of legislation [6]. Abidin et al. (2003) noticed other issues that affect sustainability such as awareness of the sustainability concept, availability of local sustainable materials, knowledge of the benefits of sustainability in construction, knowledge of sustainable design, technical capability, awareness of all related legislation, compliance to building guidelines or requirements when designing and constructing, workmanship during construction, site management and supervision, use of technology to improve project process and construction methods [1]. Therefore, the rate of improvement in the direction of sustainability in construction depends mostly on enhancing awareness, knowledge and understanding of the impacts of people’s actions [4].

Pandemics have always shaped cities throughout history [8]. COVID-19 pandemic which is caused by SARS-CoV-2 has been zoonotic (originating from animals) like SARS and MERS outbreaks and researchers claim that the amount of novel zoonotic diseases is expected to increase in the future [14]. Availability and existing of markets that sell meat and products from wild animals globally, climate change, extensive land usage for agriculture and construction of infrastructure that impacts wildlife habitat are the reasons for the rise of zoonotic diseases by spreading viruses easily [14,16]. Table 3 shows the history of deadliest pandemic from 165 to 2019 which affected not only the health field but also left urban impacts and economic consequences [8].

Table 3. History of deadliest pandemics [8].

Year	Pandemics	Year	Pandemics	Year	Pandemics
165	Antonine Plague	1800	Yellow Fever	1981	HIV / AIDS
541	Plague Justinian	1817	Cholera 6	2002	SARS
735	Small Pox	1855	Third Plague	2009	Sine Flu
1347	Black Death	1889	Russian Flu	2012	MERS
1520	Small Pox	1918	Spanish Flu	2014	Ebola
1600	17th C. Plague	1957	Asian Flu	2019	Covid-19
1700	18th C. Plague	1968	Hong Kong Flu		

The Black Death crisis triggered the need for urban change; so, designers, and urban planners improved the radical urban of the renaissance along with expanding their cities to prevent overcrowding [17,18]. This

pandemic changed the urban design of European societies by launching larger public spaces that gave a better chance for people to connect with nature and decrease isolation [8]. Moreover, the Cholera epidemic which was due to the mixing of clean drinking water with wastewater had a huge impact which helped to improve the urban design field in term of infrastructure design, reducing high population density (greater the population density, greater the risk of infection), managing waste in the streets along with support to have ventilation and daylight in open spaces through which people can move [18,19]. The Victoria embankment along river Thames was constructed in central London and the main sewage system was shifted downriver to safely split wastewater away from clean water supply. Furthermore, Spanish Flu as a deadliest respiratory virus, killed more than 50 million people globally which had a massive impact on deceleration in urban growth and limiting public life for a period to slow the spread of disease by replacing public transportation with walking in uncrowded streets and staying at home [8].

Similarly, COVID-19 which has been the largest global health crisis in decades, affected multiple aspects of our life including economic factors, sustainable development goals, food pathways, education, tourism, urbanization, living spaces, and business [14]. The prominent reason of death in the United States in 2020 was recognized to be the COVID-19 pandemic. It has caused not only the unprecedented number of deaths and hospitalizations but also it has resulted in economic slowdowns, extensive business disturbances, and significant difficulties [5]. According to the United Nations Trade and Development Agency (UNCTAD), the cost of COVID-19 consequences to the global economy in 2020 is around one trillion USD [14, 20]. Also, nationwide economic downturn was the result of COVID-19 pandemic, and the National Bureau of Economic Research (NBER) declared that the U.S. moved into a downturn period in February 2020 which was called the COVID-19 recession [5]. Therefore, the U.S. has suffered record-high unemployment rates due to the economic recession where the rate of unemployment rose from 3.8% in February 2020 to 14.7% in April 2020 [5]. Moreover, people are forced to spend most of their time at home and to work or study from home to prevent viral spread risk during the COVID-19 pandemic, therefore residential building and housing became more than just a living space, as people are staying more at home. This has effects on buildings' resource consumption such as increasing use of electricity and water [14]. Also, COVID-19 had impacts on students' education and their learning capabilities, motivation, and self-discipline due to distant learning during the pandemic. Due to COVID-19, it is expected that future businesses are going to be more digitalized, which will create positive changes including cost-cutting, enhanced business intelligence, and more transparency [14].

3. Problem Identification

According to the available literature review on challenges of sustainable construction, it is noticed that sustainable construction is a skeptical subject for people due to lack of knowledge and awareness (Table 2). Typically, knowledge and awareness are obtained when needed and COVID-19 pandemic which caused by SARS-CoV-2 has triggered this need while COVID-19 is not the first pandemic on this planet and there have been other epidemics that have hit the globe and engulfed millions of people's lives [8].

The globe faces COVID-19 pandemic today which results in a public health crisis, and it is the worst crisis perhaps in more than a century that resulted in the development of many challenges for cities to tackle this pandemic [8]. COVID-19 had brutal impacts on cities socially and economically which lead to increasing inequalities and increasing rate of unemployment worldwide [10]. Also, it has created a great impact on humanity's personal and professional aspects [14]. Due to COVID-19, people are forced to spend most of their time at home to prevent viral spread risk, thus the world needs to adapt quickly to such changes in lifestyle and to transform the perception of the environment in different way, which leads to new urban design and planning [14].

WHO said that "healthy cities and the city planning process are background papers supporting the work of the World Health Organization"; however, the current urban developments have not been very effective in term of urban planning and health [8]. Thus, it is essential to emphasize the importance of re-designing/re-shaping cities and the urban environment in a way that supports a healthy environment for individuals. The interrelation between the elements of city (e.g., buildings, streets, parks, and cities' infrastructure – urban design) radically affects the quality and efficiency of life for individuals in cities [8].



Figure 1. Pillars for achieving sustainability of cities [21].

The social and economic impacts on cities during the COVID-19 pandemic have led to the need for revolutionary re-thinking of cities to adapt to new urban planning mechanism as a way to improve quality of life in cities [10]. When a pandemic spread beyond the country's borders, it is the worst scenario that can happen. When pandemics occur particularly respiratory ones, safety measures highlight the need of isolation and shutting down of public spaces which transforms the image of cities and public spaces into empty environments. Therefore, it necessitates a change in the city's functioning or operation to integrate between community health practices and social thinking transforming urban design for proper functioning of cities during pandemics [8]. Above figure 1 shows the pillars for achieving sustainability of cities [21].

Proposal for Solving the Problem

COVID-19 pandemic created an opportunity to optimize cities by joining the social behaviour at epidemic stage through health viewpoint in planning and design [8]; however social behavior and people's awareness reflect a significant factor in dealing with this epidemic [22].

Based on historical deadliest pandemics along with their impacts on cities, it is essential not only to be reactive but also to be proactive in urban planning and city design in term of resilience and sustainability to address any future threat of pandemics in order to minimize the environmental effects and to sustain and improve the well-being of people under epidemic measures. Paris mayor in her recent campaign has proposed that the city shall be decentralizing and deconstructing policy [8]. This idea can decrease extreme density, and promote walkability concept in each neighbourhood, including homes, jobs, facilities, stores, etc [23]. Therefore, the concept of "15-Minutes City" is a solution for urban planning and city design, as a kind of response to any future pandemic to become more resilient and a sustainable city. The aim is to manage pandemic crisis as well as being functional and a sustainable city.

The "15-Minute City" highlights on accessibility and proximity-based planning where an urban community is designed to accommodate an optimum density that would have access to basic essential needs and services within a 15-min walking or cycling distance [10]. It means residents are able to experience a higher quality of life by traveling less (with 15-min radius) to have their basic essential needs and access required facilities/amenities (e.g. work offices, schools, hospitals, parks, shopping centres, food markets, etc). To sustain a higher and decent quality of life, there are six essential urban social functions which include living, working, commerce, healthcare, education, and entertainment [10]. To attain these functions, the urban life style shall be built in such a way as to comply with components such as proximity, diversity, density, and ubiquity (digitalization) to achieve high value of life. This concept provides more time and opportunities to people to interact with each other (members of the community) and to undertake other social functions, which is very important, but have been lacking as a core function of contemporary urban planning models. The components of "15-Minute City" as sustainable construction is explained in detail [10]:

- **Density:** It is the social sustainability dimension of cities and is paramount to consider the optimal number of people (optimal density) that a given area can comfortably sustain in terms of urban service

delivery and resource consumption. Optimal density allows to effectively plan the available space in such a way that all residents can access their essentials without the need for time and energy consuming automobiles. It also allows to create locally based solutions in areas such as energy generation, food supply and multiple use of available spaces like using school playgrounds as parks after school time.

- Proximity: It is viewed to be both temporal and spatial, and all basic services shall be available and readily accessed by residents in each neighborhood. It helps cities not only in reducing the amount of time lost in traveling but also in reducing the environmental impacts. Ultimately, it allows residents to experience better service through both commercial and public establishments since all essential services are close to each other. Also, basic infrastructure can be used for multiple purpose like using school playgrounds as parks when public is free to access after school hours.
- Diversity: It consists of two parts - (1) the necessity for mixed use neighborhoods which are important in providing a healthy combination of residential, commercial and entertaining components and (2) variety in culture and people. The first part is vital in ensuring that an optimal density and proximity of essential amenities are achieved which guarantees that residents can benefit from essentials within their residential areas without spending much time. The second part, as having a multicultural dimension in a city has positive impacts economically. Locals would enjoy a wide diversity of products such as cultural products and cultural heritage, and this will make it as an attractive urban landscape for visitors and encourage tourism and other related sectors to create new businesses in that area which would result in promoting economic vitality and lead to the creation of increased employment opportunities [24].
- Digitalization: It ensures the actualization of the above three components. Digitalization makes the city smart where factors such as inclusivity, resident participation and real-time delivery of services are encouraged through varying platforms [25, 26]. For example, it is more feasible to use digital tools to ensure that biking practices are improved, by stressing solutions such as bike sharing and the utilization of sensors to ensure the safety and security of cyclists.

Due to COVID-19 health protocols and lockdown measures, which undermined the economic and social dimensions of cities, today's modern urban planning concepts that have created fragmented cities and communities are heavily depended on automobiles [10]. It is not effective to respond to these restrictions because this situation (COVID-19 restrictions vs a heavy reliance on automobiles) had caused bottlenecks in the service delivery to society. Therefore, having more walking and bicycle lanes/streets in the city (re-thinking the transportation system) can be considered to counter the impacts arising from vehicular movement restrictions. Transforming cities from car-driven to more walkable and cyclable provides environmentally friendly alternatives as well as benefit the physical and mental health of citizens [14]. Walking and cycling (micro-mobility) have numerous benefits on social, economic, and environmental levels such as [10]:

- On health and well-being of people by having more time and opportunities to exercise and gain social interactions with health protocol.
- In reducing congestion and pollution (noise, emissions, and others)
- In unlocking numerous potential positive outcomes such as employment, new innovations, creation of urban unique (identity) brands, helping to reduce overheads acquired from fuel costs, road maintenance, and other associated costs.

According to Eltarabily and Elghezanwy (2020), to prevent diseases to public, it is necessary to redesign streets by adding another lane for cyclists and pedestrians which will create healthier and more social-

sustainable cities that affect citizens' behaviour in the time of pandemics. This is a good opportunity for urban planners to rethink streets' design by excluding cars from some streets and providing more spaces for pedestrians and cyclists which will turn the city into green and low carbon streets. Moreover, it is required to consider new standards of using sidewalks such as social distancing while queuing which results in wider sidewalks and paths, providing 1.5m safe distance along with distinguishing the individual's point with a sign on the ground, including more space to accommodate the queue at the public facilities' entrances and providing fixed seats for the elder people [8].

Moreover, having micro-markets to provide essential needs and ensure that locals can access basic commodities within their proximity can help to reduce congestion in supermarkets which will result in reducing the risk of infection and spreading virus [10].

As transportation is a key part of every city and urban environment, health safety strategies are needed in public transportation such as buses, subways, trains, and airplanes to reduce the risk of transmitting infection by touching handles, armrests, and seats. Providing social distancing, frequent purification, undertaking temperature screening, proper cleaning and sanitizing hygiene of employees and passengers are the changes that shall be done for public transportations [8].

Having digital transformations in all daily activities reduce the time wasted in traveling by automobile which will result in reducing emissions that is harmful to the environment. For example, digitalization of businesses makes employees to host online meetings and to work with new portable types of equipment for virtual communication [14]. Also, digitalization can be effective for online shopping, cashless transaction and virtual communications and interactions especially during any pandemic [10]. Moreover, smart cities are safer cities from the public health view since governments can use modern technology and digitalization to track people infected with pandemics which will help in monitoring and collecting infection data [8].

There shall be significant changes in the design of buildings include greener spaces, better air ventilation and intimacy, improved water and wastewater management, introduction of touchless technologies and antimicrobial materials, better solid-waste management, social distancing within the house, and lightweight architecture and flexible building design. The strategies for building construction in cities, shall be modular construction which allows the construction of various building types quickly with lower expenses. The future buildings shall be designed considering the chance for efficient, flexible, and speedy transformation of the building for essential needs (hospitals, medical facilities, etc.). Also, lightweight and flexible structures have benefits due to construction speed and portability. Hygienic building materials that are easy to be sanitized shall be used as a response to pandemic. Design and operation of building shall be changed in such a way to promote self-sufficient strategies and refocus on green space and low-rise buildings with better indoor air quality. Green spaces positively influence people's mental health and allows them to grow food during self-isolation time which is friendly to environment [14].

Urban planners and designers shall design the public places according to human need and to be designed as pandemic-resilient and flexible spaces since the use of public spaces can repurpose for emergency hospitals at the time of pandemics [8].

Homes shall be more than just a living place as COVID-19 suddenly disturbed professional and personal lifestyles globally, so homes shall become more resilient and sustainable for other possible upcoming pandemics. Current urban residents spend a large fraction of their time indoors where they are forced to work from home due to COVID-19. Thus, from the social behaviour aspect, their health is directly affected by housing space which resulted in negative impact of public health, if the designs of homes are poor. Designers shall go back to nature in redesigning the homes and using biophilic design approach to improve quality and performance of homes [8]. Health and safety in houses shall be improved through expanded use of touchless and automotive technologies, selection of finishing materials based on viral survivability, and green spaces expansion. Sustainable technologies shall be used as a response to environmental needs to decrease the consumption of energy and water. Also, it is required to enhance communication technologies to use better remote services and utilize motorized technologies to control better comfort parameters (e.g., air quality, light, temperature, humidity) [14].

Having outdoor parks and green areas is a human need that reduces tension and improves physical, psychological, and mental health. Designers shall create more spaces and practices for individual use in developing green areas such as expanding running tracks and giving priority to small community parks. After all, parks and green zones can inspire more people to safely walk outside their homes and keep safety simultaneously [8].

At the end, it is essential that government create an effective federal policy which can act as the driving force towards implementing the "15-Mintute City" concept including green building. Therefore, all stakeholders (owner, designer, public, etc) would be looking for development of the "15-Mintue City" concept and the adoption of "15-Minute City" in the long-term planning, would result in a higher quality of life.

4. Conclusion

It is clear to everyone that after pandemic crisis, the society will not return as before, and a new norm is established. It is the beginning of changing values, habits, homes, and cities. However, sustainable city is a complex planning and designing problem that merges with technical, environmental, social, and economic aspects, the pandemic crisis triggers the need for developing sustainable and functional cities. Also, with increasing population, it is logical and essential to change the way of thinking in planning and designing cities, to make them healthier and more stable to face any future challenges and crisis. Many research papers introduce the "15-Mintutes City" concept as a solution to pandemic response. The city shall be planned to achieve the best conditions and capabilities for the urban life of its residents and to create environments to attain an enjoyable life, and make the life smoother, comforter, and safer for the residents within it by implementing good technological and sustainable features. If all cities are going to be designed based on four dimensions identified (density, proximity, diversity, and digitalization) within a comprehensive and flexible framework, numerous issues of pandemic crisis can be avoided.

In conclusion, it is emphasized that proximity-based urban planning is key in maintaining quality of life and in delivering the basic urban functions. It is found through study that the three main aspects to have an optimal design for city are being smart, sustainable and comprehensive, considering social design. Therefore, designers, planners, government, and public health officials should cooperate to build healthier cities from now on, as a response to any future pandemic crisis. However, more research is required on enhancing the disease prevention theory through good design of contemporary cities and studying health design strategies.

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