

ADAPTIVE APPROACH TO POST COVID-19 RESIDENTIAL DESIGN

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ABSTRACT

The "new normal" concept that emerged during the COVID-19 pandemic had an impact on changes in behavior, activities, and spatial planning in residential homes. Architects can contribute effectively and actively in thinking about adaptive design ideas and ideas during the Covid-19 pandemic. Architects need to understand more deeply about the Covid-19 pandemic so that they are able to take into account in preparing residential designs in the new normal era. Changes in the new order of life require deep thinking in managing spatial planning for the short and long term in preparing for the pandemic in the future. This paper aims to propose post-covid-19 adaptive design ideas and ideas and to develop a simple and comprehensive set of ideas that are easy to understand and apply to simple residential homes by taking into account the built environment and socio-cultural aspects. The results of this paper are expected to help the government, society, and entrepreneurs in making decisions in preparing for the post-covid-19 new normal era.

Keywords: approach, adaptive, house design and Covid-19

1. INTRODUCTION

The house is one of the basic needs for humans other than clothing and food. The house has a very important function which is not only seen as a means of life, but the house is also a process of human presence in creating a scope for the community and its natural surroundings (Yudohusodo 1991).

The house functions as a healthy place to live for every human being and his family to meet physical and spiritual needs. The house can also act as a place of spread or a place of protection from infectious diseases. The existence of the Covid-19 pandemic has an impact on all changes in human activities that have an impact on residential spatial planning. Pandemic more than just changes in daily activities and ways of life, the Covid-19 pandemic has also changed the structure of people's lives, including in interior planning, space-forming elements, furniture and home air conditioning. This change in way of life has given rise to many thoughts and ideas in the context of preventing the transmission of Covid-19. Changes in house design since the Covid-19

pandemic have prioritized multi-function rooms by collaborating on activities where living, working, socializing, and studying must be done from home. Home design after the Covid-19 pandemic needs to be rethought to be able to adapt to disaster situations in the future. The concept of a residence that prioritizes the interests of health and cleanliness seems to be a necessity for now and in the future. The post-COVID-19 pandemic house design is one that is able to accommodate the adaptation of new habits, with an emphasis on the comfort and health of the occupants. The existence of the Covid-19 pandemic is a good momentum to evaluate the way people live to be healthier in order to anticipate the impact of the epidemic in the future. Architects and interior designers can play an active role in designing homes that are adaptive to preventing the spread of infectious diseases. The approach that can be recommended in designing a house that is adaptive to the spread of infectious diseases is by reviewing some of the requirements that have been set as a healthy house. This paper discusses ideas and approaches to residential houses on limited land in the new normal era by paying attention to the design of the room so that it becomes healthier, safer, and of high quality.

2. RESEARCH METODOLOGY

This research was conducted with a qualitative exploratory method. Qualitative research is research that aims to look at all phenomena that occur in research subjects as a whole, such as people's behavior and perceptions by describing them in the form of words, symbols, and language in special conditions that occur naturally and using scientific methods (Moleong 2012).

Data collection techniques were carried out through primary and secondary data collection. This study aims to provide residential space design solutions on minimal land to maintain and increase the comfort of the space so that it can prepare the room to be safe, comfortable, and healthy. The results of this study will certainly enrich the information, knowledge, and design of researchers and readers in understanding the process of designing residential homes in the face of the Covid-19 virus.

3. RELATED RESEARCH

This research refers to several studies that have been carried out previously, such as the first research conducted by Fuad Rizal in 2021. The research conducted by Fuad Rizal is a Residential Home after the Covid 19 Pandemic with the aim of mapping what things need to be adjusted and prepared to support health protocols during the pandemic and formulate an ideal, conducive and responsive post-Covid-19 residential design adjustment (Rizal 2021). The result of Fuad Rizal's research is that optimizing thermal comfort can be assisted by utilizing a fan, either a ceiling fan or a wall fan. AC can be proposed and used if it is really needed when the fan is not able to produce thermal comfort. The results of Fuad Rizal's research are optimizing thermal comfort, which can be assisted by using a fan, either a ceiling fan or a wall fan. Air conditioners can be proposed and used if absolutely necessary when the fan is not able to produce the desired thermal comfort. The use of air conditioning is recommended at certain times only to help reduce high room temperatures and optimize lighting in the room. This can be increased by utilizing glass doors in the ground floor family room and using artificial lighting if needed. Artificial lighting points have been prepared and can be used if the lighting conditions in the room are not supportive. This research has not provided input and proposals for residential designs after the Covid 19 pandemic.

The other research was carried out by Mohammad Imran in 2021 with the title of the research being Design of Healthy and Responsive Residential Homes to Covid-19. This

research concluded that the implementation of the principles of healthy and responsive residential design is expected to be able to make the house a healthy, clean, comfortable place to live (lighting and ventilation), safe and meet the minimum requirements for the amount of space that can be responsive to Covid-19. The limited conditions that exist in residential homes require modifications to the residential design (design engineering) and also require modification of human behavior (social engineering) as the subject of users and beneficiaries of the dwelling as an adaptation effort and synergistic relationship between humans and houses. This research has not provided input and proposals for residential designs after the Covid 19 pandemic (Imran, Mohammad (STITEK Bina Taruna); As'adiyah 2021).

The third research was conducted by I Putu Udiyana Wasista in 2021 with the title of the research being Projection of Changes in Space Needs and Functions in the Covid-19 Pandemic Crisis. This research discusses several strategic issues and future visions about the possibilities that will occur, in the strategy of changing the use of space functions in the era of the Covid-19 pandemic. The results concluded that the design of the space in the residence will change a lot due to isolation activities in the era of the Covid-19 pandemic. The need for activities for work and recreation will be the main requirement. Such as a space that is tight enough to work to a space such as a balcony to socialize within a limited distance, will be an attractive prospect for space designers. Even colors such as natural colors can be a new prospect for future space design (Wasista 2021). The fourth research was conducted by Fivanda and Adi Ismanto in 2021 with the title Analysis of the Influence of the Concept of Interior Workspaces in Residential Homes after the Covid-19 Pandemic. The purpose of this study is to describe how the effect of workspace design in residential homes on the efficiency and effectiveness of workers in carrying out their roles. The results of the study show that 90% of workers need furniture for work, window ventilation as air conditioning, lighting, and provide natural views. Visualized in the 'less is more' design concept that the implementation of a simple workspace but provides a physical and psychological experience that supports 'work from home' performance. A design concept that prioritizes fulfilling activities on the function and use of furniture as needed (Fivanda (UNTAR) and Ismanto 2021).

The fifth study was conducted by Emmi Nutrisia Dewi, Sri Rahayu, and Risna Puspita Giri with the title Research on Residential Design Studies in an Effort to Create Adaptive Spaces Post-Pandemic in Denpasar City. The purpose of this research is to provide solutions and alternatives for the people of Denpasar City regarding sharing space designs that are able to adapt to post-pandemic conditions (Dewi, Rahayu, and Giri 2021). However, this research has not provided an in-depth design solution from the results of the studies conducted.

4. RESULTS AND DISCUSSION

Adaptive housing for preventing the spread of the COVID-19 virus has actually been accommodated in the concept of a healthy home that always pays attention to local climate elements. The house must meet the aspect of adequate solar lighting and have good air circulation, in addition to adequate green open space facilities. A house that has good air circulation with sufficient sunlight will be able to reduce high air humidity in the tropics so that the house does not feel damp which makes it easier for bacteria and harmful viruses to breed. Green Building Council Indonesia (GBCI) conveyed the importance of regulating air conditioning and utilizing sunlight because respiratory infections can occur through transmission through droplets of various sizes. WHO classifies particle size into respiratory droplets or aerosols (>5-10 μm) and droplet nuclei

(<5 μm). While the size of the COVID-19 virus is 0.06 – 0.14 μm . In other words, the particles of the COVID-19 virus are smaller than PM 2.5 so they are easy to fly further and spread through aerosols. Therefore, the temperature and humidity of the air affect the spread of the virus in the air. The COVID-19 virus survives longer at temperatures below 19° Celsius than at higher temperatures. Viability of the virus will increase in conditions of humidity <40% and >70% (Winata et al. 2021). Low humidity makes airborne particles lighter and can carry the virus farther away.

The American Public Health Association (APHA) issued criteria for healthy homes that must be met ((Apha) 2020); 1) Meet physiological needs (sufficient lighting, ventilation and space), 2) Meet psychological needs (sufficient privacy, healthy communication between families), 3) Meet the requirements for preventing disease transmission (providing clean water, managing feces and household wastewater, free of disease vectors and rats, morning sunlight, protection of food and drinks from pollution, And 4) Meets accident prevention requirements (construction is not easy to collapse, non-flammable and less likely to make occupants slip).

Meanwhile, the Minister of Health of the Republic of Indonesia issued the criteria for residential health through the Decree of the Minister of Health of the Republic of Indonesia No. 829/Menkes/SK/VII/1999 concerning Housing Health Requirements (hereinafter referred to as KepmenKes829/1999) as follows: 1) Building materials, not made of materials that can release substances that are harmful to health, such as: a. Total dust less than 150 mg/m² b. Asbestos less than 0.5 fiber/m³/hour c. Lead (Pb) less than 300 mg/kg material, 2) Air quality with the following details: a. Comfortable air temperature between 18 - 27 degrees Celsius b. Air humidity between 40 – 70%, c. Air exchange 5 times 3 per minute for each occupant, dan 3) Disease vector, no flies and rats.

This decree also states that natural and artificial lighting is needed to make it easier for users to carry out activities at home. Natural lighting in the room can reduce humidity and kill germs. The determinants of the quality of natural lighting that enter the room are 1) The minimum light hole is 1/10 of the floor area of the room; 2) Direct sunlight can enter the room for a minimum of 1 hour every day; 3) Effective light gain is from 08.00 – 16.00; 4) Lower threshold height effective area of openings (windows) between 70 - 80 cm from the floor surface of the room; 5) Placement of the bedroom facing the morning sun so that the room can receive morning sunlight until 10.00 am; 6) If the room faces the afternoon sun, trees should be planted as protection.

To improve the quality of natural daylight in the room, it is also regulated in SNI 03-2396-2001 regarding the procedures for designing natural lighting systems in buildings as follows: 1) If possible, the room should be able to receive light in more than one direction to help level it out. distribution of light and reduce the possible contrast; 2) For optimal natural lighting, it is better if the inner surface of the room uses a bright color; 3) The use of special glass to reduce thermal radiation should not reduce the incoming light.

In addition, air exchange in the room is very necessary in order to get good and healthy air quality as well as provide comfort for users. To obtain natural ventilation, you can use a cross ventilation system with the following conditions: 1) Fixed ventilation area of at least 10% of the floor area of the room; 2) Minimum window area of 1/9 of the floor area; 3) The volume of incoming air is equal to the air that flows out; 4) Incoming air does not come from the toilet or kitchen smoke; 5) Especially for ventilation in the kitchen and bathroom, auxiliary tools such as exhaust are needed, and the ventilation holes are directly connected to the outside.

Besides that, KepmenKes829/1999 also discusses safety and security in the house, one of which is related to structural and construction components in healthy homes such as: 1) foundations and floors with a foundation system that is generally used is a local foundation system made of river stone or concrete. The minimum height of the floor slab is 10 cm from the yard and 25 cm from the road, 2) Walls The materials used are either from the surrounding area and adaptive to local climatic conditions. Generally, the materials used are red bricks and bricks, but it is possible to use other materials such as glass, wood and others. 3) Ceiling / Ceiling Ceiling and ceiling function to limit the upper space (roof) with the space below it as well as a transition space for the reduction of solar heat from the roof. The minimum ceiling height is generally 280 cm, while for bathrooms, toilets and laundry rooms it is at least 240 cm. 4) Roof The roof frame serves to support the roof covering as well as a barrier to disturbances from climatic conditions such as wind, rain and hot sun.

Healthy homes must meet the requirements for sanitation facilities and/or building completeness facilities such as clean/drinking water, management of household feces and wastewater, drainage of rainwater, storage systems and waste disposal. Provision of Clean/Drinking Water The required clean/drinking water ranges from 60–200 liters/day. In addition to drinking, this water is also used for activities such as washing and cooking. and others. Sources of clean water come from springs, artesian wells or clean water supply companies such as public water company (PDAM).

Meanwhile, the management of household wastewater is that every house must have a septic tank and infiltration field to treat household wastewater before it is discharged to urban sewer. Rainwater management for each house must have a network of open drainage channels placed under the roof (gutter) which is then forwarded to environmental drainage and provide infiltration wells. Every house should be able to process its own household waste in the 3R principle (reuse, reduce, recycle). The container provided in every healthy house should be movable, and if not possible, it can be placed outside as a temporary waste tank.

In addition to the criteria for a healthy home above the Covid-19 pandemic, it will change many things, including how to adapt to new habits. Evaluation in house design with an adaptive approach in preventing Covid-19 is a priority in the future. Rooms with good air quality, acoustics, lighting, and optimal levels of thermal comfort, will result in a healthier and adaptive home in the prevention of Covid-19 ((Apha) 2020). Some of the approaches that can be recommended by the author in designing adaptive homes to prevent the spread of the virus in the future are as follows:

a) House Building Orientation

Residential buildings should be oriented in a north-south direction. In addition, a flat building shape (rectangular design) is better than a fat house plan because air will enter and leave faster. The location of a good house is in accordance with the direction of the sun (east-west) so that the sunlight can be evenly distributed from 08.00 - 16.00. The design of the example house extends from north to south with the building attached to the west side fence, leaving room for the yard along the east side fence (See Figure 1).

b) Setting the Building Borders, Building Base Coefficient, and Green Base Coefficient

The application of the building border around the building is absolutely necessary to make it easier for natural air to enter the room properly by applying a minimum on the left/right, front, and rear sides. Setting the building area and land area is 40% of the building area compared to a minimum of 60% of the land area. So that utilizing the yard as a green open space so that natural air can be optimized and the quality of air, soil and water so as to create a balance of environmental sustainability

c) Ventilation System

A healthy house is a house that utilizes natural ventilation so that cross ventilation occurs optimally to reduce the concentration of indoor air pollutants and to enter fresh air and remove pollutants from inside the room. Healthy housing, ideally doesn't to use AC. The effects of natural air and the sun's path on the building can be exploited with a house that is made openly with sufficient distance between the buildings so that air movement is guaranteed. Moving air produces the best refreshment because with this refreshment an evaporation process occurs which lowers the temperature of the human skin (Frick 2007). Droplets containing Covid-19 can spread faster in air-conditioned rooms. The use of air conditioning is not recommended in order to maximize natural air exchange to remove viruses from the room.

It appears in the design of the sample house where the presence of courtyards on the north, south and east sides of the building allows for cross ventilation even though the west side of the building is attached to the boundary fence, design creativity is needed to overcome this situation. The open void is designed continuously from the bottom floor to the top floor so that it gets sufficient ventilation (See Figure 1).

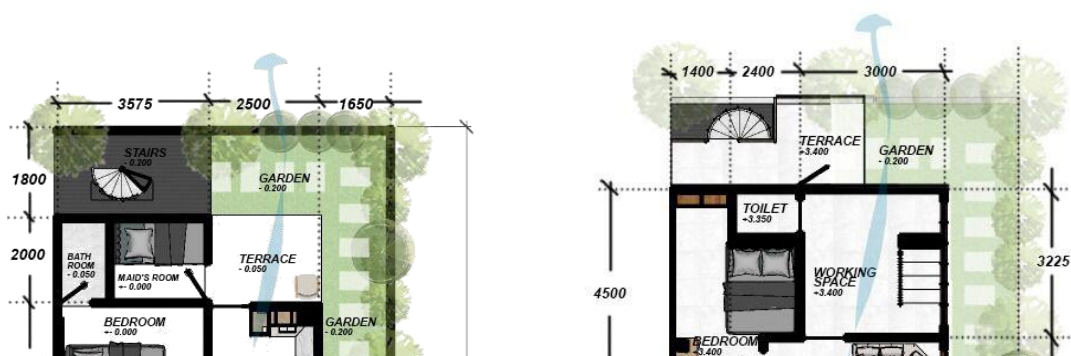


Figure 1. The illustration of the building above has reached the ideal side in terms of natural ventilation.

Designing maximum window openings by not being symmetrical in horizontal lines so that the air blows and rotates around the room so that the room becomes cool. Designing a void in the middle of the land or an intermediate garden can be a solution in maximizing the acquisition of light and fresh air. Utilizing cross ventilation with a fixed ventilation area of at least 10% of the floor area of the room, a minimum window area of 1/9 of the floor area, the volume of air entering is equal to the air flowing out, and ventilation in the kitchen and bathroom required tools such as exhaust, and ventilation holes are directly connected to the outside. Maintaining air quality to stay above the minimum threshold by exchanging the air inside with outside air and providing thermal comfort for the environment community by removing heat from the air temperature

d) Lighting

Ensure the entry of sunlight into the house. Utilizing natural lighting to the maximum but still using lighting standards for indoor learning, creating openings in the form of open areas that can provide maximum lighting while paying attention to comfort in the room, and calculating WWR (wall to window ratio), and paying attention to glare from sunlight. Natural lighting can also be obtained by creating voids and adding plants that are planted vertically on the walls. Although the voids made are not large, they provide a quite pronounced effect in obtaining natural light and air into the room in a house. Redesign of green space, including the change of fresh air that can remove various pollutants,

residents can get direct sunlight for natural lighting and the benefits of intake of provitamin D needs, as well as the benefits of proximity to nature as part of the therapeutic element.

The existence of a courtyard on three sides and an open void has guaranteed the availability of light in this house. The dining room is placed in the middle with the family room as a center for orientation activities in the house with a small yard on the east side with water features and a vertical garden providing sufficient and cool lighting with elements of water and plants. (See Figure 2)



Figure 2. dining room with sufficient lighting with a view of the water feature and vertical garden

Utilization of the roof top as a multipurpose room for sunbathing while exercising and even doing gardening activities. The rooftop is designed to be connected to an open void on the side of the stairs, making it easier to maintain the void area



Figure 3 . Rooftop area to accommodate new activities during the pandemic



Figure 4 . The vertical void relationship opens to the rooftop

e) Exhaust Fan Usage

The use of exhaust fans to accelerate air flow and maximize the exchange of fresh air. Its location must be considered properly so that the incoming air is fresh and clean air. Using the exhaust fan as an additional device to help remove dirty air flows out more quickly. Breaking the concentration of air so that it can be spread, especially in a small room, by making holes or fins on the top and bottom walls to break up the wind to prevent wind tunnels. Utilization of a cyclone ventilator turbine that is set on a building or roof turbine on a building can circulate hot air directly out through the roof. In addition, you can use a roof jalousie, so that air can escape through the roof.

The height of the fence is made lower to maximize airflow for optimal and smooth inside the building. If possible the ceiling is made higher so that more air and light can enter. Modification of the roof and adding a chimney above, the hot air will rise due to the difference in pressure on the ground floor and on the roof. Utilizing cross ventilation with openings on two opposite sides. If possible, consider the application of a closed room laminar air flow. The outlet hole as an inlet partner is absolute in order to achieve cross ventilation in a passive cooling system.

f) Provide a Sanitation Room at the entrance area

There is a sanitation room on the terrace of the house so that guests who come are healthy and clean by washing their hands and hand sanitisers are provided at several points in the room.

g) Open living room and family room design

The terrace can be used as a living room so that receiving guests can be done outdoors with free air and not in direct contact with the family room. Likewise with the family room, there is an effort to have air flow in and out.



Figure 5 The family room and dining room are open and connected directly to the side yard

h) Kitchen space design

In the future kitchen designs are designed with more bulk storage for long term. Kitchen design with more freezer/refrigerator space to store food and drinks when working more from home.

i) Transition Room / Mud room

Mandatory to provide a transition room equipped with a shower, sink, changing room, and a place to store shoes or tools used outside the home on a regular basis. Equipped with a sink type airlock, where the airlock has a more negative pressure than the other rooms. Driveways and spaces where people can clean themselves and the things they bring into their homes are likely to be new desirable features.

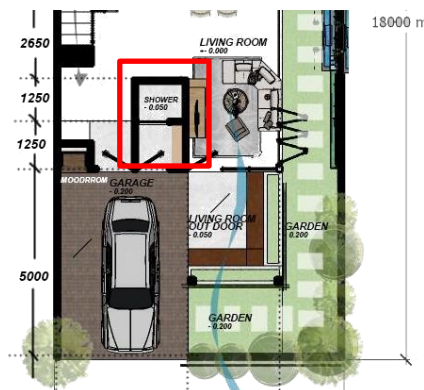


Figure 6. The mudroom is positioned in front as a sanitation area before entering the house

j) Interior Materials

The interior design plays an important role in preventing the spread of the Covid 19 virus. The door can be used as an initial and final screening to reduce the Covid-19 virus by placing touchless hand washing equipped with hand sanitation. The interior must use anti-bacterial materials and materials that are easy to clean, not many pores like aluminum, easy to care for and maintain. Interior design will lead to good health and hygiene, as the choice of white tiles, porcelain fixtures, and stainless steel appliances will become increasingly popular. Builders will endeavor to work with antimicrobial materials, such as copper, kryon and Richlite

k) Landscape Design

The use of trees and shrubs is a natural way to provide protection from the sun as well as to refresh and channel airflow. Rearrange the exterior area of the building by adding natural vegetation around the opening so that the vegetation does not block airflow and cover the opening, as well as choosing plants that cool the air around the opening so that there is a temperature difference on both sides of the room. The addition of plants around the opening is used to reduce the temperature of the surrounding air so that there is a difference in temperature and air pressure on both sides, resulting in cross ventilation. Trees with large size and very shady become an important factor providing fresh air and very effective in reducing temperatures.

Green spaces can also absorb CO₂, add oxygen, lower temperatures with shade and coolness of plants, become water catchments, beautify the environment, and as a medium of education about plants. Future residential of all sizes will be built to prioritize outdoor space. More and more people are interested in growing their own groceries amid a shortage of grocery stores by providing more space for residential gardening. It is necessary to prepare channels and infiltration of rainwater from the roof and hardened yard. However, it must leave at least 30% green open space for plants



Figure 7. Vertical garden in the open void next to the stairs



Figure 8 . Backyard

The yard on three sides of the building is sufficient as a green area to be planted with various types of plants, including vertical gardens and roof top gardens. Plants in addition to freshening the air also calm the atmosphere in the house as in the design you can enjoy from the living room, living room, (Figure 5) stairs (Figure 7) to the back porch (Figure 8).

l) Setting up the gym

As gyms are closed for months, people are becoming exercisers at home. For health reasons, the home gym has become almost as important as the home office. Health is an important focus, being active and sweating is a sign of a healthy body. So making use of the outdoor space or indoor corner available at home will be very important. The open rooftop design can accommodate sports activities and allows it to be accompanied by sunbathing activities in the morning. (See Figure 3)

m) Setting up the workspace

Di masa depan, lebih banyak rumah akan memiliki ruang kantor khusus. Rumah tanpa ruang cadangan yang berfungsi sebagai kantor dapat dirancang fleksibel dan dapat diubah jadi kamar tidur, lemari. menambah fitur seperti teras atap untuk aktifitas saat melakukan kegiatan rapat online dan bekerja. In the future, more homes will have dedicated office space. A house without spare space that functions as an office can be designed flexibly and can be converted into a bedroom, wardrobe. Adding features such as a roof terrace for activities when conducting online meetings and work.

n) Use of Smart Technology

Today the house does not only function as a giver of security and protection to its residents, but there is a significant development of how a house design blends with the latest technology. Technology can play a role in getting a safe, comfortable and practical home such as controlling the amount of energy, especially electricity at home by limiting the use of electronic devices and lights by installing timers automatically and smart home technology can monitor air and water quality to be more efficient, healthy, and of good quality.

o) Waste management

Managing waste is one way that can be done to keep the house clean while protecting nature so that it is not polluted by garbage that comes from the house. The implementation of household waste management is an effort to manage waste from the source through the reduction of landfill waste and handling of waste piles with an emphasis on the application of the 3R principles (reduce, reuse, and recycle). Organic waste such as food scraps and vegetables can be used as compost

5. CONCLUSION

Some conclusions that can be drawn from this paper are as follows:

The rethinking of the residential design approach aims to reduce the chance of the spread of the virus in the home environment as well as maintain and improve the comfort of the room to make it safer and healthier. Evaluation in house design with an adaptive approach in preventing Covid-19 is a priority in the future. Several approaches that can be recommended in designing adaptive homes to prevent the spread of the virus in the

future are to design better housing orientations, adjust building boundaries, regulate ventilation and lighting systems by utilizing exhaust fans, and provide sanitation rooms in the entrance area, structuring the kitchen space by preparing larger storage, providing a transition room / mud room, using anti-bacterial interior materials and materials that are easy to clean, good landscape design, preparing a sports room, preparing a workspace, and managing waste properly.

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