

# The Day After, Batu Agriculture Creative Hub *Agcrea* Adaptive Façade Concept

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## ABSTRACT

The Day after means metaphorical meaning for hope, better architecture design that promotes a new design mindset. The Covid-19 crisis challenged and made us restart the perspective in architectural planning and design towards mitigating epidemic disasters. Design of Batu Agriculture Creative Hub (BACH), a creative and collaborative space for agriculture Start-Up, has considered adaptation strategies for these conditions. Inspired by the smart building strategy, especially the smart envelope for building performance toward resiliency. The smart envelope concept for BACH named *agcrea* (agriculture + creative), an adaptive facade design, transforms a visual representation of the identity of the local character of the Batu city logo. Kinetic moving panels respond to climate dynamics, it open and close follow the sun and wind conditions. Tested with Ecotect, the pattern of movement of the façade panels makes adjustments to the balance of natural light and ventilation to support health and comfort and energy use efficiency in buildings.

**Keywords:** *Batu Agriculture Creative Hub, Health & Comfort, Energy-Efficient, New-Normal Design, Agcrea Adaptive Façade, Ecotect.*

## 1. INTRODUCTION

### 1.1. New Smart Building, Smart Envelope

Taking after the far-reaching acknowledgment of the direness of natural issues and duties related to building movement, the concept of vitality proficiency is translated and borrowed in today's design as a foundational suspicion of plan choices. For that reason, the requirement for a reestablished plan has presently come to the fore, combining the optimization of nearby assets (climatic and fabric) of the inner natural quality with creative technical-constructive strategies. Inside this vast issue, characterizing forms and innovations in understanding and controlling the two-way relationship between building and setting can be used to progress the quality and execution of building envelopes. [14]

The inspiration for the Smart Envelope design was the Al - Bahar Tower by Abdulmajid Karanouh in Abu Dhabi, United Arab Emirates. The Al Bahar Tower is the world's first large-scale commercial project featuring a dynamic smart facade. This building has 25 floors with a height of 150 m. The use of dynamic and intelligent facades can isolate buildings and respond directly to the sun's movement. [1]



**Figure 1.** Al-Bahar Facade

The facade design was deriving from analyzing the movement of the sun in extreme climates. Aedas' design team developed a responsive facade idea using the '*mashrabiya*' form, namely traditional lattices found in traditional Islamic architecture. Two thousand ninety-eight (2098) dynamic panels can be programmed to respond to the sun's movement, protecting the east side of the building in the morning and moving west with the sun throughout the Day [1]. This concept is a simple concept, like the performance of a window curtain.

When viewed from the review literature, the term Smart Building is a building with high-quality space that can actively stimulate users' welfare of life and culture and creativity. Smart Building aims to become an icon in the 21st century that can combine innovative design and technology solutions with high performance in terms of

health (better air quality), comfort, energy efficiency, and environmental resilience. Smart building The smart building components consist of smart shapes, smart envelopes, smart systems, last but not least smart people. [2]

A smart Envelope is a blanket or building facade with advanced performance designed with the best climate and technology solutions in mind, smart construction, which can be windows, facade systems, and management systems. It can produce a design with good security conditions, conducive room conditions, and efficient energy and natural resources. [2]

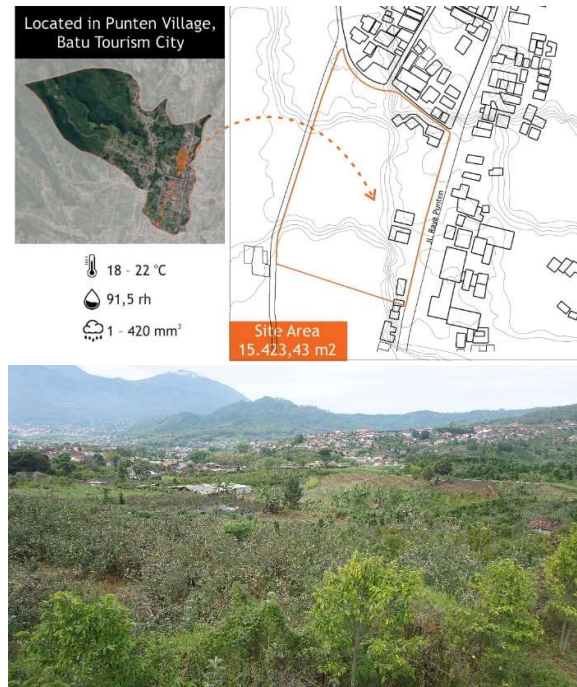
The building blanket is the same as the function of human skin. The Smart Envelope is expecting to be able to fully adapt to dynamic environmental conditions according to the system, user behavior, and energy efficiency automatically. So that it can efficiently control air exchange and ventilation more effectively 40% - 60%. [2]

A smart envelope with adaptive facades using to capture solar energy can help supply electrical energy needs and self-repair. A sensor integration system manages an automation system needed by utilizing a facade or panel to dynamically and responsively respond to environmental conditions. [2]

Smart envelope as a building surface, using a modern cladding system as fragments of a contemporary production mode or as the facade iconography constituents. The cladding panel focuses on this conflict because it both conceals and reveals that it hides its origin; as designed artifice, it represents a more extensive body—the building itself. [3]

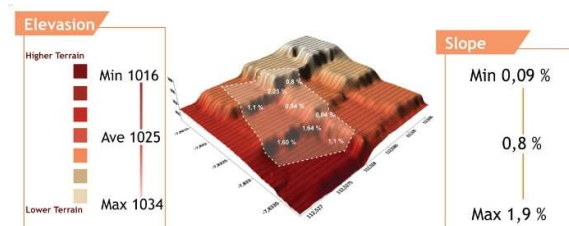
## 1.2. The Context

Besides, the choice of materials used is also a consideration in implementing adaptive facades. Such as transparent to opaque, solid to liquid, waterproof to permeable depending on the environmental problem's needs. The facade formation developed with the local cultural context. So that it can give identity or reflect cultural values and local resources. [1]



**Figure 2.** Site Condition

This inspiration underlies Batu Agro - Creative Hub to apply the smart envelope concept. The proposed location is Punten Village, a productive area of an active plantation and strategic location (Figure 2. Site Condition) [4]. In a percentage of 40.2%, agriculture also takes part in developing the creative industry in Batu City, namely by processing agricultural products in food, beverages, fertilizers, perfume, and medicines. Therefore, the sector as a realm of research, development, and production has the potential to be further developed as one of the identities of Batu City itself. [5] Besides, the design area's topography is contoured land, which supports the cultivation process. The land is present in (Figure 3.Site Topography)



**Figure 3.** Site Topography

Another consideration is the need for a facility that can connect creative industries in one time and one space (Hub), ease initiating innovations, and give birth to a creative atmosphere. This space hope can become a new icon representing the image of Batu City (Creative and Innovative) with the support capacity of the latest Technology.

### 1.3. Toward New-Normal Architecture Design

Meanwhile, we are currently facing a world health problem, where the COVID-19 epidemic has spread rapidly in various parts of the world in a short period. This pandemic affects all life aspects such as social economics, education, health, including architecture [8]. Architecture that supports human life ranges from education, workspace, community housing, etc., slowly but surely responds to these conditions. Architecture idea mindset is restarted, reshaped, and transforming for post-pandemic design ideas [10]. Post-pandemic design ideas, also known as the New-Normal architecture perspective, have to be answering the challenge of a healthy building, promote hygiene, physical, or safe distance measures in mind [10].

On the other hand, the process of creativity in the design aligned in the Qur'an, namely: "Thus, Allah explains to you His verses, so that you think" (Surah Al Baqarah 2: 219) [3]. Where there is the verse's context, first, the moral, ethical values that can apply to the design create an atmosphere of interaction for creators who can compete fairly to connect or Hub. Second, the value of rejection of imitation that reflects and accentuates local cultural values to create a creative and innovative atmosphere. The three values of usefulness and Ijtihad that can be applied using technological facilities are an effort to facilitate the creative process. [5]

This study aims based on issues Confronted with perpetual impacting parameters such as time, climate, capacities, data, human needs, etc. The design ought to be planned with different measurements to confront this boundlessness of powers. Numerous plan methods and innovations which point to reply to the always-changing needs have shown up. The foremost noticeable of these is kinetic design for adaptive facades [11].

## 2. IDEATING & ANALYSIS

Inspired by Al-Bahr smart building envelope, the Batu Agricultural Creative Hub design process starts from the pre-process we named as space planning. Secondly, it is a design decision analysis with the building shape & space analysis based on the environmental response, and last is selection design alternatives that we integrated design [12]. The framework as shown in the (Figure 4. Design process)

### Design Process

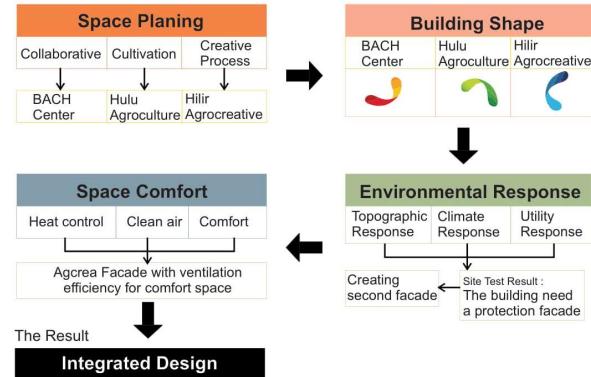


Figure 4. Design Process

### 2.1. Space Planning

We know that Batu Agriculture Creative Hub begins with the space program requirements from the design process. We identified user needs, the program needs, and the building & facilities plan in that process. The main three (3) main programs are the communal space named Batu Agricultural Creative Hub (BACH) Center, which is for administrative activities as an information center, collaborative activity for business in the agricultural sector, and marketing facilities creative agrarian products. Next is *Agro-Kultur*, which means agriculture with plant cultivation activities as an education tool for industry and tourism. The last is *Agro-Kreatif*, which means Agricultural for creative activities such as cultivation product workshop, maker product consultation, and start-up.

### 2.2. Building Shape

One of the foremost imperative characteristics of passive design strategies is to supply consolation condition as much as conceivable interior the building through plan arrangements and based on characteristic assets without utilizing any more extra vitality. So building envelopes which is characterized as rooftops, outside dividers and ground touched floor and outside surfaces of building, has the foremost interaction with the environment and the foremost energy trade with open air. So they have a really pivotal part for giving consolation conditions within the buildings [15].

The next step is a building layout pattern plan for each zone by adopting the Shining Batu Logo's meaning to reflect the local cultural values. This mass arrangement pattern affects the design of the building shape in each area. The red arch interprets as a horizontal relationship between fellow humans with the impression of togetherness or socialism. The building that reflects this has large-scale characteristics with the environment facing forward to impress, embrace, greet, and be magnificent at the Batu Agriculture Creative Hub Center

building. (Figure 5. BACH Center mass & form compositions)

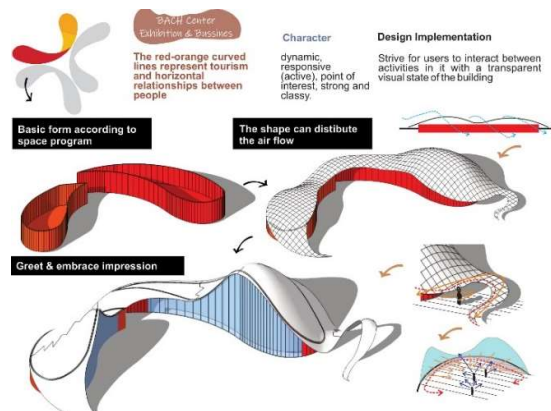


Figure 5. BACH Center mass & form compositions

The green arch defines the relationship between humans, nature, and fellow creatures of God's creation. The characteristics reflect camouflage techniques using green roofs to get a visual impression that is in line with the surrounding nature of Hulu Agro - Kultur. (Figure 6. Hulu Agro - Kultur mass & form compositions)

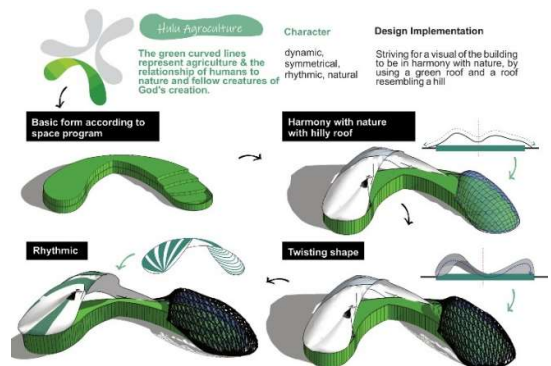


Figure 6. Hulu Agro - Kultur mass & form compositions

The blue arch interprets the relationship between humans and God (vertical) of science. The building that reflects this has the characteristic of using a roof that covers a few openings so that it seems introverted to Hilir Agro - Kreatif. (Figure 7. Hilir Agro -Creative mass & form compositions)

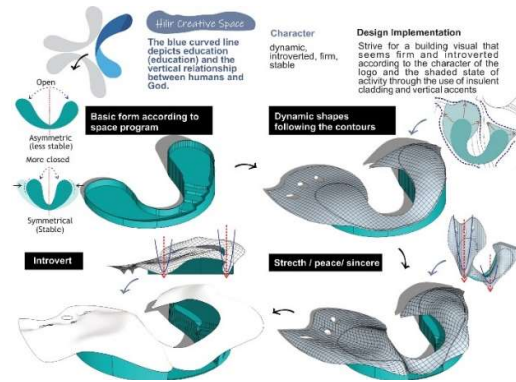


Figure 7. Hilir Agro- Creative facade

## 2.3. Environmental Response

### 2.3.1. Form & Orientation

Then the following phase is study site topography and the microclimate response. Adjustment of the building harmony's basic form with the contours lines and building envelope facilitates wind circulation, sun direction for natural light (Figure 8. Topography and Wind Response), and (Figure 9. Sun and Utilities Response). This process resulted in a change in shape in each building.

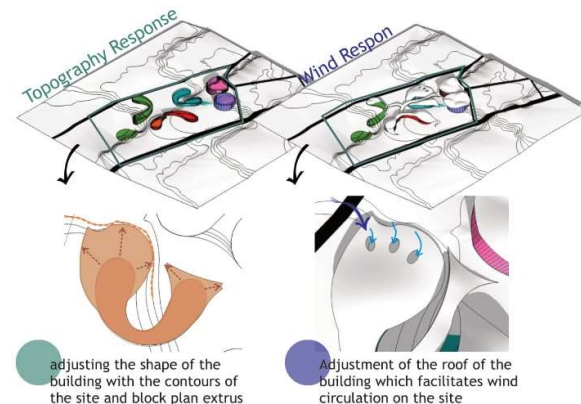
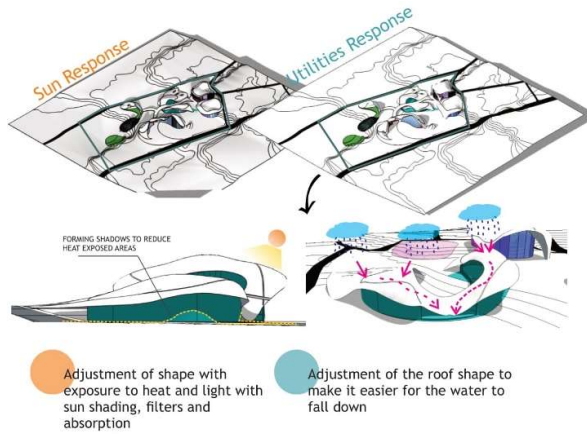


Figure 8. Topography and Wind Response

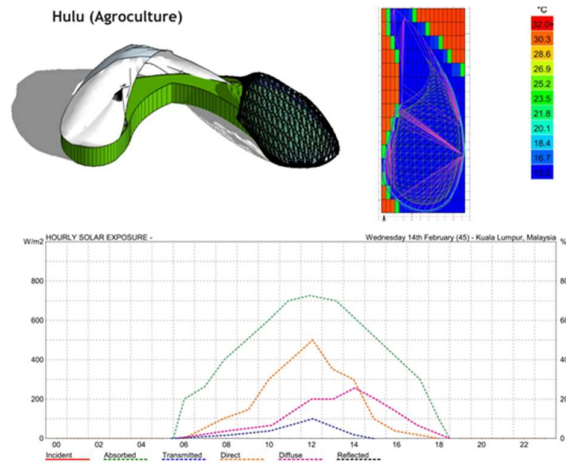




**Figure 9.** Sun and Utilities Response

### 2.3.2. Environmental Analysis

After the environmental conditions respond to the building shape, the building shape can be changed based on adapts to the environment to determine the room's comfort level. The reason is that the design requires space that has stable heat conditions for plant cultivation. So one of the buildings was taken to be tested with Ecotect, whether the room inside was stable. The building teste is Hulu Agro - Kultur, with its building design in the form of a roof frame with window panes. The results see in (Figure 10. Hulu Agro-Kultur thermal test result)

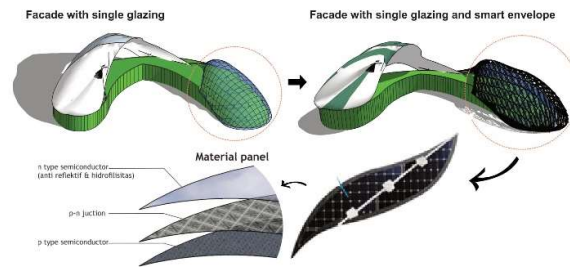


**Figure 10.** Hulu Agro-Kultur thermal test result

Utilizing Ecotect analysis, we can find out the comfort level in the room. The reason is that the design requires space that has stable heat conditions for plant cultivation. The test results from Ecotect show that the average air temperature is in the range of 16.7 to 32 degrees Celsius and direct light means that the light can still transmit by 58%. After examining it, this can happen due to the use of ordinary single glazing material. Therefore, this facade requires a double filter to filter out excess sunlight.

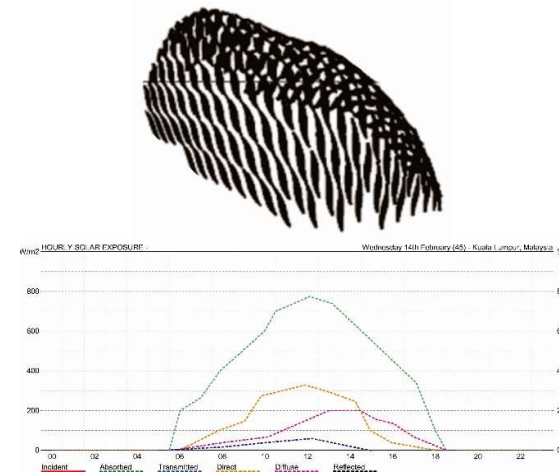
### 2.4. Space Comfort

Responding to the form processing results in response to the area's state, then proceed with a review of space's state. Previously, the site tested using Ecotect. The results stated that the building requires a tool for selecting or controlling the room's heat so that it is stable for plant cultivation activities it shelters. Therefore, the Smart Envelope was designed as a building envelope to overcome these problems.



**Figure 11.** Smart Envelope usage and the panel model

From smart envelope design (Figure 11. Smart Envelope usage and the panel model) The panel using a black chrome material area, a hinge motion tool, so that the panel has 180-degree movement and a sensor against the sun's heat intensity. The panels are then strived to work with movements that can minimize heat in the room, whose working principle is the same as an umbrella. The application of the smart envelope to covering the building was tested for the last time using Ecotect. (Figure 12. Smart Envelope thermal test result)



**Figure 12.** Smart Envelope thermal test result

The graph of the test results above shows that after using the smart envelope, the transmitted light's value reduced by 10% from the panel test in the previous half-open condition.

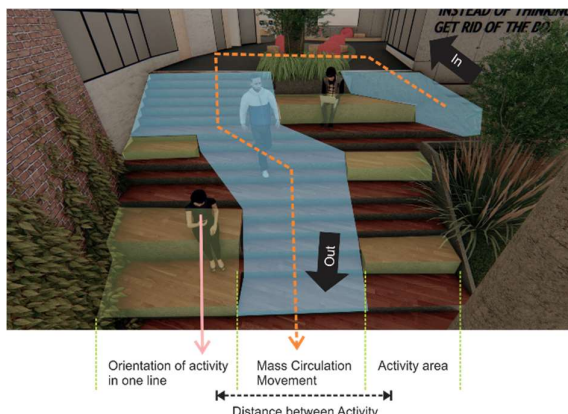
Using a smart envelope for covering the building can minimize exposure to the sun's heat into the room. Continue hot air out of the room and flow the filtered

clean air by moving the panels into the place. The application of this smart envelope is considered efficient in keeping the room air clean and making the room comfortable. On the other hand, the use of black chrome material on the panel can absorb solar thermal energy and convert it into electricity, an alternative electricity source in the Design Area. The façade design if we summarize fit with three the type of intelligent facades, such as; Ventilated façade, Kinetic Façade, and Solar Façade. The Ventilated facade had flexibility and adaptability. The Kinetic façade had interactive and responsive environmental attributes, and last, the Solar façade had a contribution for cooling purposes [13].

### 3. DISCUSSION

Previously, it was clear how we finalize the design issues. It shows from the building's mass structure pattern and the building's shape. The building design applies the values of local creativity raised, namely 'Shining Batu.' it gives each building an identity in distinguishing between activities from one building to another. Of course, during the New Normal period, which strived for minimal physical contact between individuals, relying on the sense of sight / visual was very helpful in doing activities there. Because just looking at the shape of the building that reflects each activity can help users access each building's activities.

Circulation in communal areas with a dense level of user activity design with a one-way channel circulation with different access to and from spaces. The activity and seating area in the communal area also has spacing between other seats, with a circulation ladder being a barrier between the advantages. The seating plan is also oriented in one direction facing. With this spatial pattern, it can minimize contact between individuals for this. (Figure 8)



**Figure 13** Circulation on communal space

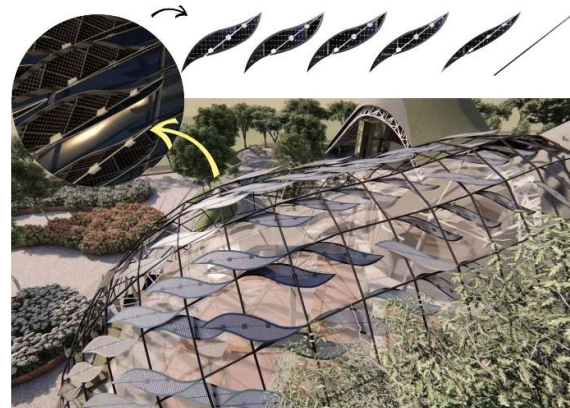
On the other hand, the communal area's furniture design strives to minimize contact interactions with each user. Such as outdoor benches with different orientations

and different seating levels suppressed the possibility of transmission of the virus through droplets. (figure 9)



**Figure 14.** Seating Design

Batu Agriculture Creative Hub Center building has the potency to attract gather & interaction of people. So an efficient air circulation system is needed to remove hot air from shaded activities, forward hot air from outside, and filter and channel clean air into the room. The place has better clean and healthy air quality. The building envelope is an Agcrea Adaptive Façade. (Figure 15. Agcrea Adaptive Façade application on Hulu building)

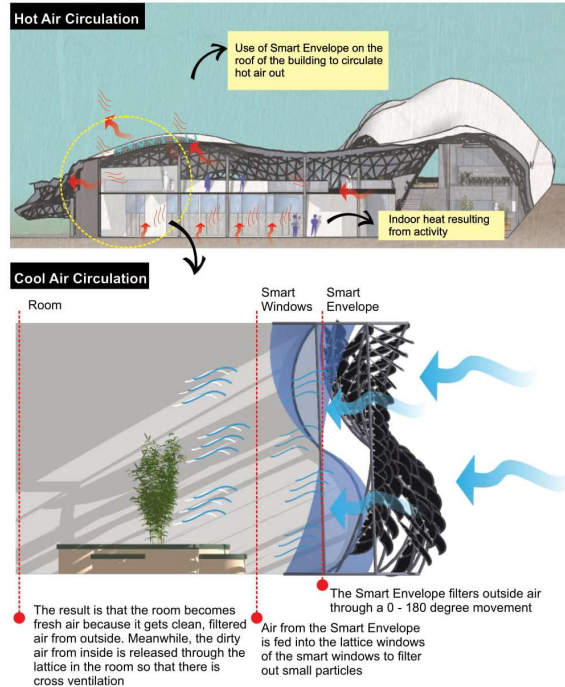


**Figure 15.** Agcrea Adaptive Façade application on Hulu building

Where the horizontal application on the roof of the building can pass hot air from the inside out with openings in each panel (Figure 16. Airflow scheme (top)), its vertical application as a building rooster can select air from outside with a hydrophobic material covering the panel area. The dust and other air pollution particles trap the panel area, and the air can enter and filter it cleanly. (Figure 16. Airflow scheme (bottom))

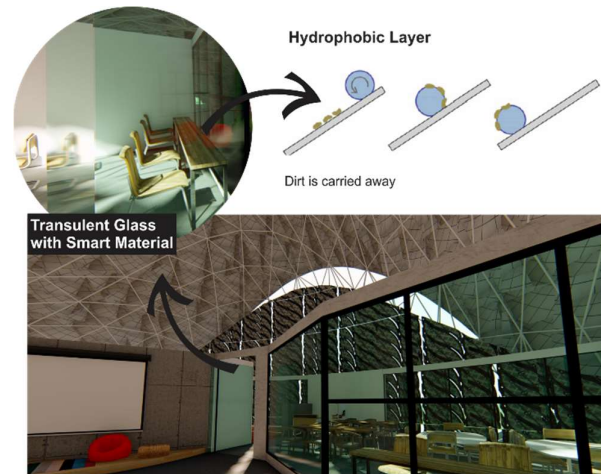


Natural ventilation recommends suppressing the transmission of the virus in the indoor room. The reason is that currently, many rooms use artificial ventilation such as air coolers in closed rooms, which have a high potential for virus transmission because there is no air circulation out.



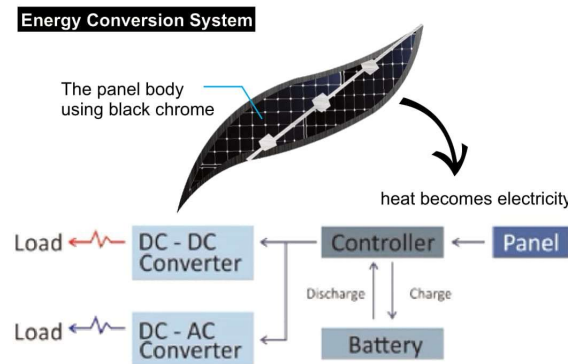
**Figure 16.** Airflow scheme

Batu Agriculture Creative Hub also uses Smart materials that apply to the windows. Double glazing coated with a hydrophobic layer. The hydrophobic coating can clean itself with a drop of water where the layer seeks that the water droplets roll and roll up all the particles attached to the layer's plane so that the presence of particles such as dust, bacteria, and viruses can come along with the falling water. The design advantages are lower maintenance for each room so that it is clean and easy to clean and germs, bacteria, and viruses suppressed.



**Figure 17.** Translucent glass with a hydrophobic layer

With various activities on this site, it also requires a high consumption of electrical energy. Therefore, the Smart Envelope in buildings applies to convert the sun's heat energy into electrical power every Day to utilize activities in the area.



**Figure 18.** Energy Conversion System

Smart envelope uses Solar Panel as the panel's body so that each panel can absorb heat and generate electricity of 570 Kw / h with 2690 panels installed on each building body. Electric power of that size can meet the electricity needs of the area in a day.

#### 4. CONCLUSION

From the results of the discussion, concluded that the design of the Batu Agriculture Creative Hub with the Smart Building - Smart Envelope approach, which integrated with Islamic values in Al - Baqarah (2: 219), could be realized and become a solution for design ideas in the current new-normal. The concept is to maximize creativity in designing spatial and furniture. The big mindset is that the spatial design and furniture minimize interaction between users with accessibility and circulation and user activities orientation. So that in this

design, it is possible to apply physical distancing in this new normal period.

The design of the building envelope in each building is also a solution in the current new-normal adaptation. Where the building envelope can make the state of air circulation in the room smooth because the air is continuously changing (hot air comes out - clean air enters). It happens because the Smart Envelope has a motion system where the panels can filter and channel air. So that natural ventilation in buildings is healthy enough without having to use artificial ventilation. The adaptive facade is an answer to the new-normal today so that the room becomes healthy and comfortable.

On the other hand, Smart Envelope converts heat energy to become electricity. With black chrome panel material, a layer of capturing sunlight and heat energy for renewable energy

Thus, the concept can apply the new-normal period because it considers that users can easily apply health protocols, namely physical distancing, always maintain cleanliness for everyday health and comfort, and the efficiency of using alternative energy.

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