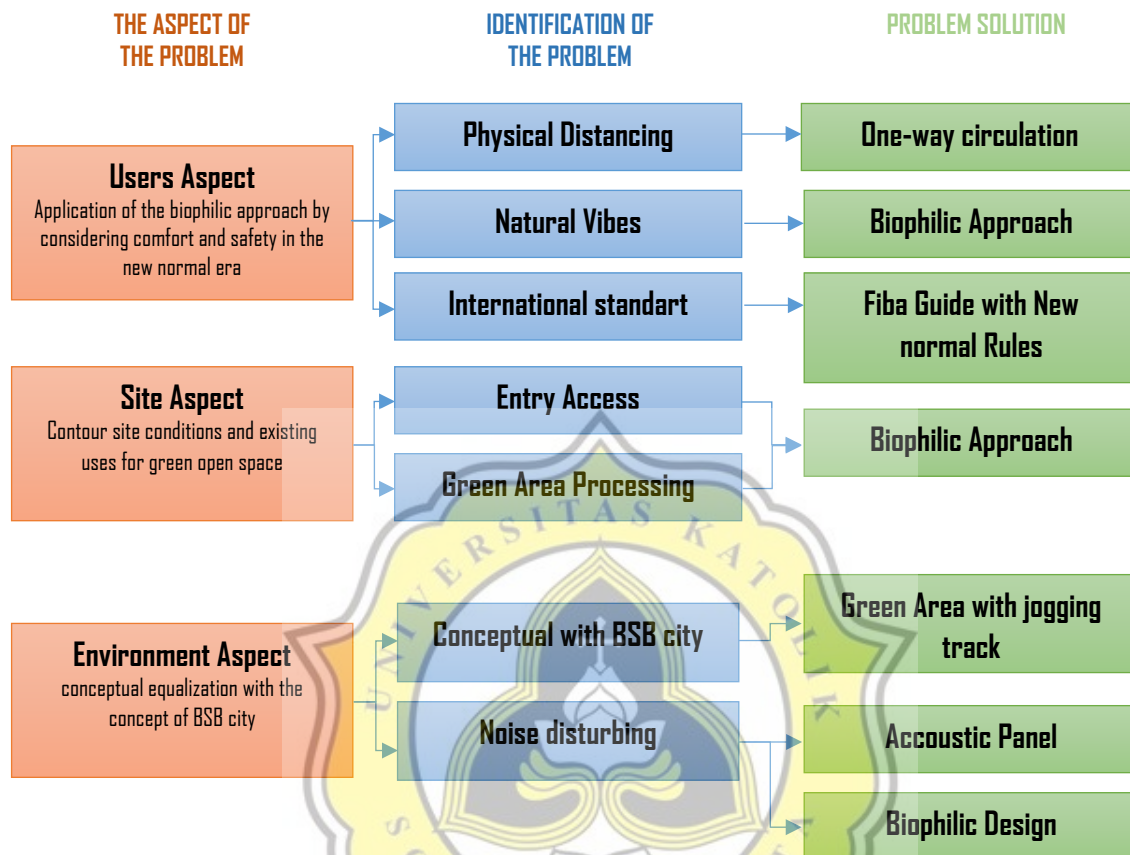


BAB 5. THEORITICAL BASIS

5.1 Problem Scheme



Picture 5.1 Theoretical Basis Graphic
Source : Personal Analysis

Theories that will be used as a foundation to answer the design problems that have been concluded are:

5.2 Biophilic Approach

Biophilic design is a design for humans as biological organisms, who realize that the mind system and body systems are important. Good biophilic design is a design that affects health conditions, socio-cultural norms, and expectations, the frequency and duration of user experience. Most importantly, biophilic design must foster a love of a place. The existence of biophilic design can make the users or athlete in this building can do activities productively.

Answering problems in user aspects for the comfort of athletes in buildings using Biophilic architectural principles

5.2.1 Attributes Of Biophilic Design

According to Chapter 4.1.1, We realize that the existence of nature is very important for all basketball academy users in this new normal era, because this pandemic does not only attack physical health but also mental health. it is the duty of basketball academy planners to create a comfortable atmosphere and can make all athletes and users comfortable to do activities here.

All of these biophilic design qualities are based on a variety of human senses including sight, touch, sound, smell, taste, and movement. The meaning of visual vision so far is the way of people understand and respond to the natural world. When we see plants, animals, water, landscapes, and other natural features, various physical, emotional and cognitive responses are triggered. even to indirect visual contact with nature which i will discuss in more detail later

In the biophilic approach, there are several attributes that can present an atmosphere that can bring users closer to nature, which are:

1. Direct experience with nature

- Light

The experience of natural light is very important for human health and well-being, especially when it is normal like this. allows orientation during the day, night and several seasons in response to the location and cycle of the sun. Awareness of natural light can also facilitate movement and direction, and provide comfort and satisfaction. Beyond simple exposure, natural light can assume forms and forms that are aesthetically appealing through a combination of creative interactions between light and shadow, and the integration of light with spatial properties. Natural light can be brought deep into interior spaces in ways such as glass walls and clerestories, use of reflected colors and materials, and other design strategies. but it is also necessary to think about the selection of interior spaces which require direct and indirect interaction of light. with the direct interaction between humans and natural light, we will realize that the existence of nature is very important especially at times like this (new normal)

- Air

Natural ventilation is important for human comfort and productivity to bring natural air. The experience of natural ventilation in the environment is influenced by several factors such as variations in air flow, temperature, humidity, and air pressure. This condition can be achieved through outside access in simple ways such as windows that can be operated, or with more complex technological and engineering strategies.

- Water

Water is very important for life and positive experiences in the artificial environment can eliminate stress, increase satisfaction, and improve health and performance. Even the majority of humans consist of mineral water. Water can affect various senses of sight, sound, touch, taste, and movement. Various design strategies can satisfy the desire for contact with water including views of bodies of water, fountains, aquariums, built wetlands, and others. Water in an artificial environment will be pleasant when it is clean, moving, and experienced through a variety of senses (though some at an inaudible sound level).

- Plants

Vegetation is an element that may have the most impact on bringing direct natural experience to the artificial environment. The presence of plants can reduce stress, contribute to physical health, increase comfort, and increase performance and productivity. Vegetation in buildings and artificial landscapes must be abundant, ecologically connected, and tend to focus on local species

- Animals

The presence of animal life has been an integral part of human experience throughout human history. But the presence of animals in an artificial environment can be a challenge sometimes. Positive contact with animal life can be achieved through design strategies such as feeders, green roofs, parks, aquariums, bird cages, and the creative use of modern technology. The presence

of animals can live up some artificial environments. If possible, contact with animal life should include diversity of species, and emphasize local species rather than native species.

- Weather

Awareness and response to the weather has become an important thing from people's experience of nature and is very important for human health and survival. Direct contact with the weather in the environment can be both satisfying and stimulating. This can occur through direct exposure to external conditions, as well as by simulating qualities such as weather through manipulating air flow, temperature, barometric pressure, and humidity. The design strategy includes an outside view, self-adjustable windows, decks, balconies, pavilions, gardens and more.

- Natural Landscape and ecosystems

Natural landscapes and ecosystems are divided into many elements. Plants, animals, water, soil, rocks, and geological forms are part of the landscape and ecosystem. People tend to prefer landscapes with processing of green areas, tree spread, open understanding, the presence of water, forest edges, and other characteristics that are characteristic of the arrangement of savanna types that are important in human evolution. However, even ordinary landscapes are preferred by most people rather than artificial landscapes. Functional ecosystems are usually rich in biodiversity and support a variety of ecological services such as hydrological regulation, nutrient cycling, decomposition, and more. Self-supporting ecosystems in the built environment can be achieved through design strategies such as built wetlands, dense forests and grasslands; green roof; water environment simulation; and other facilities. As well as the comparison between authentic and fake, surely most people like something original. Where the original goods have their own purity.

- Fire

One of humanity's greatest achievements is the control of fire which enables the utilization of energy outside of life and impacts from one object to another.

The existence of a fire can provide comfort and anxiety. The satisfying presence of fire in an artificial environment can be achieved through hearth and heart construction, but it is also simulated by the creative use of light, color, movement, and materials from various heat conductances.

2. Indirect experience with nature

- Image of Nature

With artificial images it can also have an impact and can be a bridge between humans and nature. Images and representations of nature in artificial environments (plants, animals, landscapes, water, geological features) can satisfy emotionally and intellectually. These images can be in the form of photographs, paintings, sculptures, murals, videos, monitor simulations, and other representational ways. Single or isolated natural images usually have little impact. Expressions of natural representations must be creative, thematic, and abundant.

- Natural Material

Natural materials can reflect the dynamic nature of organic materials in adaptive responses to stresses and challenges of survival over time. With the exposure of natural materials, it is also sufficient to bring natural vibe to humans or users of a building. Transforming materials from nature often gives rise to positive visuals and touch responses, which are very difficult to imitate. Everyone tends to be curious and want to touch it because they want to feel its texture. Natural buildings can consist of decorative materials including wood, stone, wool, cotton, and leather, used in a variety of products, furniture, fabrics, and other interior and exterior designs.

- Natural Colors

The presence of color is an important means of representing food, water and other resources, and facilitating movement and road search. The effective use of color in artificial environments can be a challenge, given the modern ability to produce artificial colors, especially bright colors. The application of effective biophilic colors as much as possible supports the characteristics of natural

elements. The use of bright colors must be applied carefully, and emphasize the shape of the environment such as flowers, sunsets and sunrises, rainbows, and certain plants and animals.

- Simulating natural light and air

Indoor lighting and treated water are applied on a par with advances in building technology and construction. Artificial light can be made to mimic the spectral and dynamic qualities of natural light. Processed air can also describe the quality of natural ventilation through variations in air flow, temperature, humidity and air pressure.

- Naturalistic shapes and forms

Experience the form and characteristics of the natural world can be very interesting. The natural form does not have to be exactly a "form", but it can also represent something that represents that form. These naturalistic forms vary greatly from patterns such as leaves found in columns, to the shapes of plants in building facades, to animal vaccines woven into cloth and covers. The occurrence of naturalistic forms and forms can transform static space into space that has the dynamic and ambient quality of living systems.

- Evoking nature

Not all depictions of nature must represent the integrity of nature. It could also be the use of elements that represent the principles of the natural world. Natural experiences can be expressed through imaginative and fantastic depictions. this may not be accidentally direct from nature, but it is still interesting from the design principles that are clearly found in the natural world. For example, the "wings" of the Sydney Opera House show the quality of birds; Notre Dame stained glass windows, flowers like roses; meanwhile, the footprints of several cities mimic the vertical heterogeneity of a forest. Not all designs actually occur in nature, but they all take from design principles and the characteristics of the natural world.

- Information richness

The diversity and variability of the natural world is pronounced, has been described as the most information-rich environment people have ever encountered. whether it's natural or built, people tend to respond positively to an information-rich and diverse environment that presents many choices and opportunities.

- Age, change, and the patina of time

Nature will always change, life reflects the dynamic power of growth and aging. People respond to certain things and the associated time patina, expressing the ability of nature to respond adaptively to changing conditions. some changes caused by time must have to be balanced with existing quality in order to become a balanced entity. design strategies such as natural aging ingredients, weathering, sense of time passing, etc

- Natural Geometries

Natural geometry tends to represent the mathematical properties commonly found in nature. there are many elements such as a scale that adjusts hierarchy, artificial geometry, repetitive patterns and more. For example, fractals are geometric shapes that are abundant in the natural world. Other prominent natural geometries include hierarchically arranged scales such as the "Golden Ratio" and "Fibonacci Sequences."

- Biomimicry

The concept of Biomimicry refers to the forms and functions found in nature, especially among species or living things whose nature has been adopted or suggest solutions to human needs and answers. By capturing the characteristics of these non-human traits technologically it can produce direct utilitarian benefits, as well as trigger human admiration for the ingenuity of other lives and the creativity of the natural world.

3. Experience of Space and place

- Prospect and refuge

Prospects refer to a long view of the surrounding arrangements that allow people to understand safety and security. so in this element it refers more to long-term care. These biophilic results can be achieved through design strategies such as outward views, visual connections between interior spaces, and the establishment of safe and protected settings.

- Organized complexity

People like the complexity of natural and human settings, with these choices there are many choices and opportunities. often excessive complexity is often confusing and chaotic. the best choices tend to have quality complexity, but are experienced in an orderly and organized manner. Complex spaces tend to be variable and diverse, whereas organized ones have a connection element.

- Integration of parts to wholes.

This feeling of a whole emerges can often be achieved through successive linkages and succession of space, as well as with clear and visible boundaries. This satisfying spatial integration can be improved by functional or thematic focus.

- Transitional spaces.

Environmental success depends on clearly understood connections between spaces facilitated by clear and visible transitions. Prominent transitional spaces include aisles, thresholds, doors, gates, aisles, thresholds and more.

- Mobility and wayfinding.

The comfort and welfare of people often depend on the space between diverse and often complex spaces. The paths and points of entry and progress must be clear in order to build good mobility and a sense of security, if the circulation path is not clear it often leads to confusion and anxiety.

- Cultural and ecological attachment to place.

Humans evolved as territorial creatures, could control resources, and facilitate movement and mobility. Linkages with places that illustrate this trend can be enhanced by cultural and ecological means. Culturally relevant designs

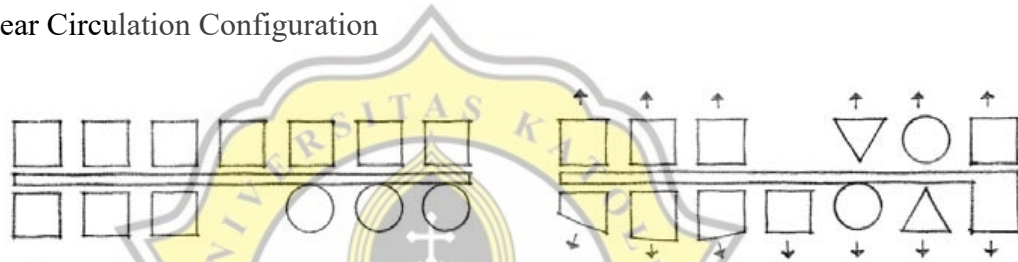
promote connections to places and feelings that settings have different human identities. Ecological connections to the same place can foster emotional attachment to an area because each place has its own characteristics, especially awareness of local landscapes, native flora and fauna, and unique meteorological conditions. Cultural and ecological attachment to places often motivates people to preserve and maintain the natural and human environment.

5.3 Spatial Planning

Here are some of the elements in circulation based on the Form, Space, and Order Architecture Book. (Ching, 2007).

5.3.1 Spatial Organization

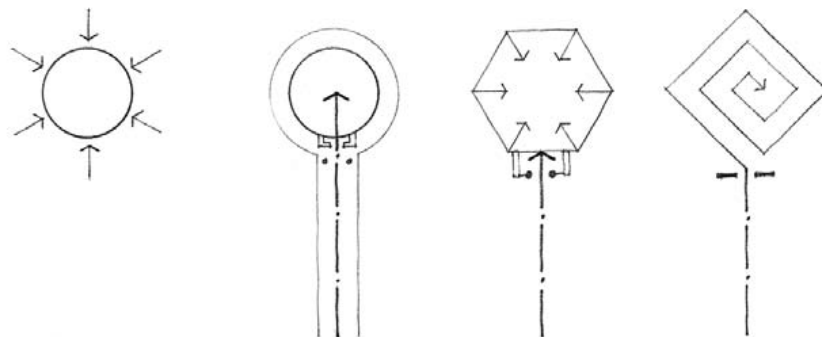
1. Linear Circulation Configuration



Picture 5.2 Linear Configuration
Source : Form, Space, and Order Architecture Book. (Ching, 2007).

Linear organization consists of several spaces. These spaces are related to each other or connected through separate and distinct linear spaces. Linear organization usually consists of repetitions that are the same in size, shape, and function. It can also consist of a single linear space arranged along a series of spaces that differ in size, shape, or function. Each existing space has their respective functions and forms.

2. Centralized Circulation Organization

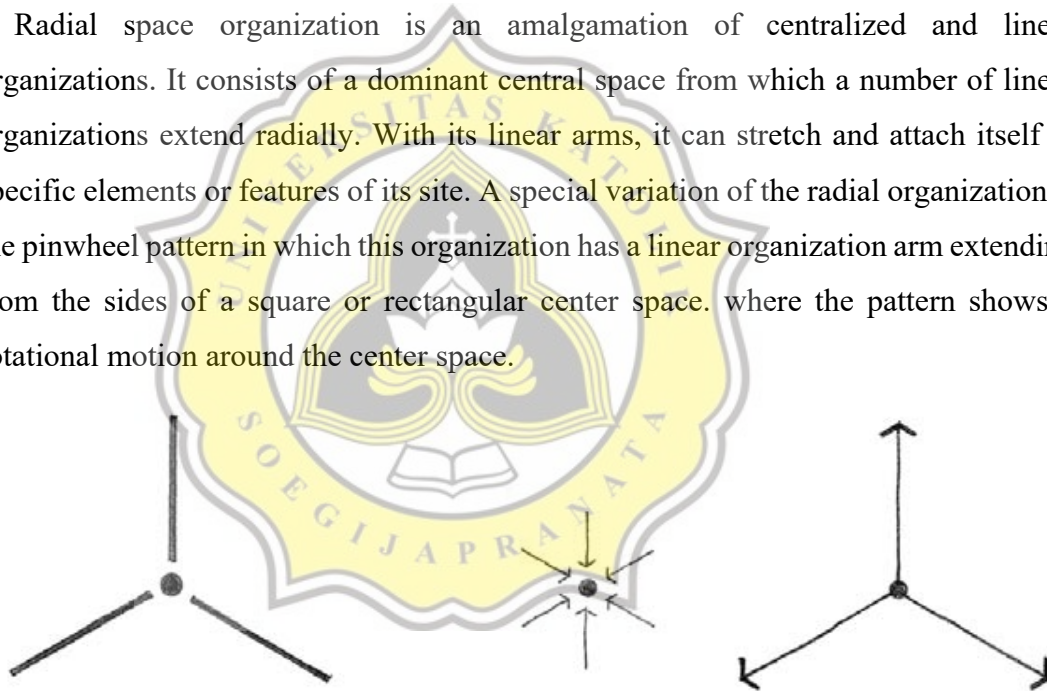


Picture 5.3 Centralized Configuration
Source : Form, Space, and Order Architecture Book. (Ching, 2007).

The central and unifying spaces of the organization are usually regular in shape and large enough to accommodate a number of secondary spaces around them. Due to the centralized form of organization, the conditions of approach and entry must be determined by the site and the articulation of one of the secondary spaces as the entrance or gate. with such a circulation method allows a lot of physical contact between building users because of its centralized concept. Centralized organization whose shape is relatively compact and geometrically ordered can be used to designate points or places outside, be used to end axial conditions, and function as forms of objects in a given field or volume of space

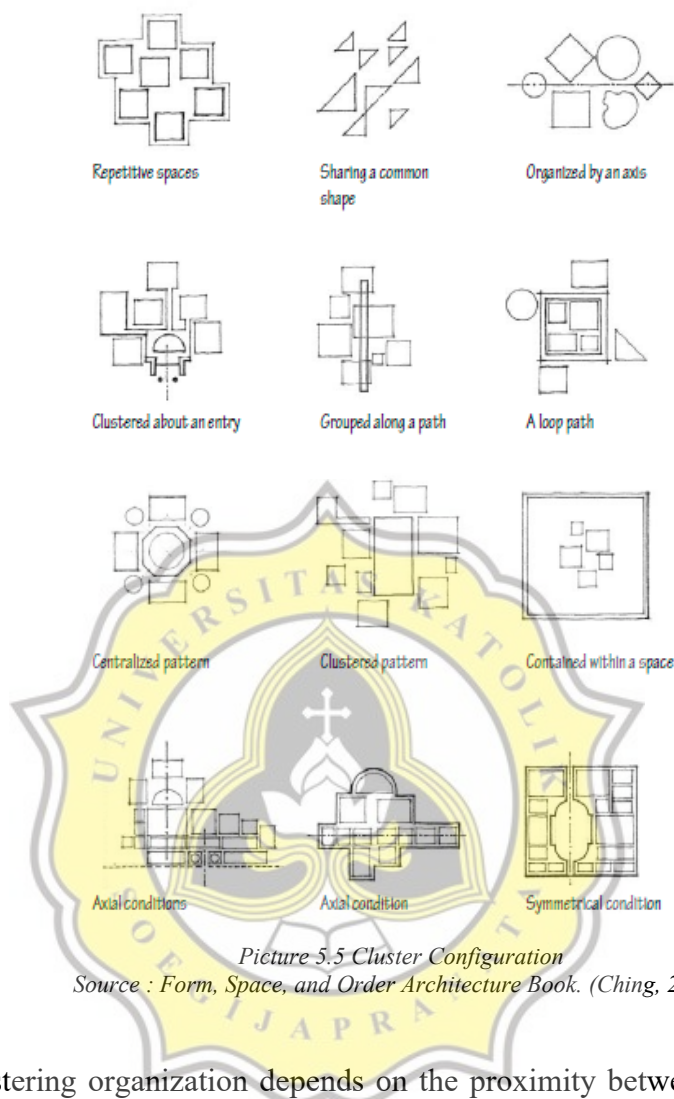
3. Radial Circulation Organization

Radial space organization is an amalgamation of centralized and linear organizations. It consists of a dominant central space from which a number of linear organizations extend radially. With its linear arms, it can stretch and attach itself to specific elements or features of its site. A special variation of the radial organization is the pinwheel pattern in which this organization has a linear organization arm extending from the sides of a square or rectangular center space. where the pattern shows a rotational motion around the center space.



Picture 5.4 Radial Configuration
Source : Form, Space, and Order Architecture Book. (Ching, 2007).

4. Cluster Circulation Organization



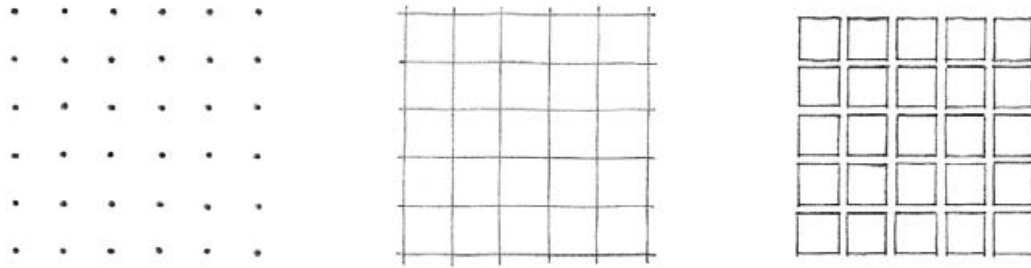
Picture 5.5 Cluster Configuration
Source : *Form, Space, and Order Architecture Book*. (Ching, 2007).

The clustering organization depends on the proximity between spaces. Clustered organizations can also accept in their composition space different sizes, shapes, and functions, but must be related to one another (symmetry or axis). Because the pattern does not originate from a rigid geometric concept, the clustered organizational form is flexible and can easily accept growth and change without affecting its character.

5. Grid Circulation Organization

The grid organization consists of shapes and spaces that have a relationship with each other that are governed by a three-dimensional grid pattern or plane. A grid is made by two, usually perpendicular, series of parallel lines that form a pattern of regular dots at their intersections. And then projected to the third dimension, the lattice

pattern is transformed into a set of repetitive modular space units. for this pattern it tends to be repetitive where all the forms of space are identical in size or shape



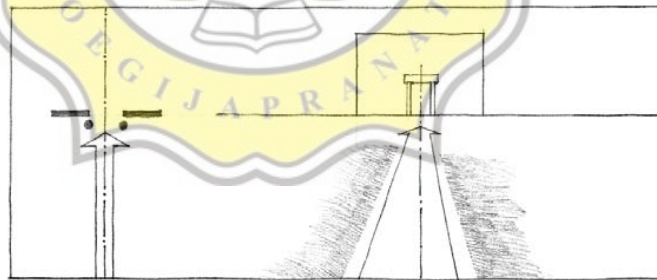
Picture 5.6 Grid Configuration
Source : Form, Space, and Order Architecture Book. (Ching, 2007).

5.3.2 Circulation Element

1. Approach (The Distant View)

Before actually entering the interior of a building, everyone tends to approach the entrance through a path. This is the first phase of the circulation system, where we prepare to see, experience, and use the spaces in a building. The approach to a building and its entrances can vary in duration from a few steps through compressed space to a long, rotating route. For this circulation element is divided by 3 which are

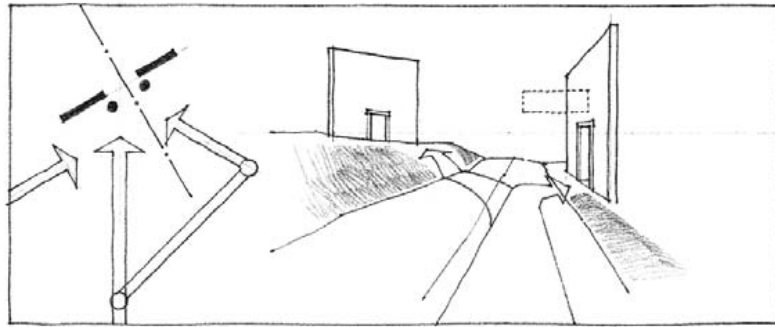
- Frontal



Picture 5.7 Frontal Circulation Element
Source : Form, Space, and Order Architecture Book. (Ching, 2007).

The frontal approach leads directly to the entrance of a building in a straight path.

- Oblique



Picture 5.8 Oblique Configuration

Source : *Form, Space, and Order Architecture Book*. (Ching, 2007).

Increase the effect of perspective on the front facade and form of a building. The path can be redirected one or more times to delay and prolong the sequence of the approach.

- Spiral



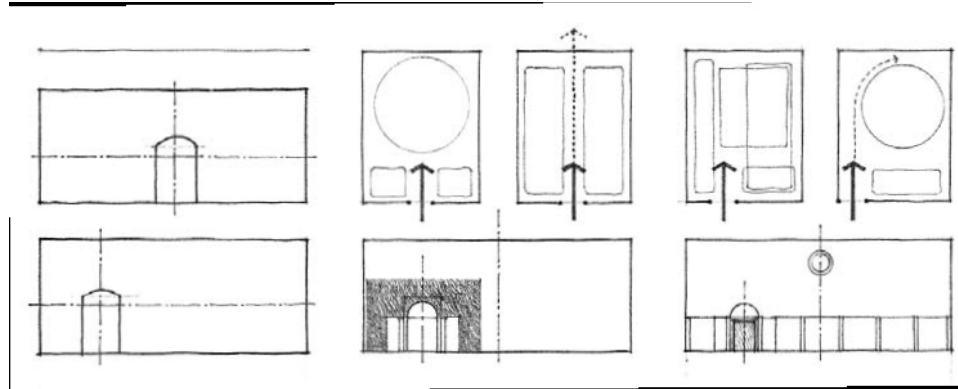
Picture 5.9 Spiral Configuration

Source : *Form, Space, and Order Architecture Book*. (Ching, 2007).

The spiral path is synonymous with extending the order of approach and emphasizing the three-dimensional shape of the building as we move around it.

2. Entrance (From Outside to Inside)

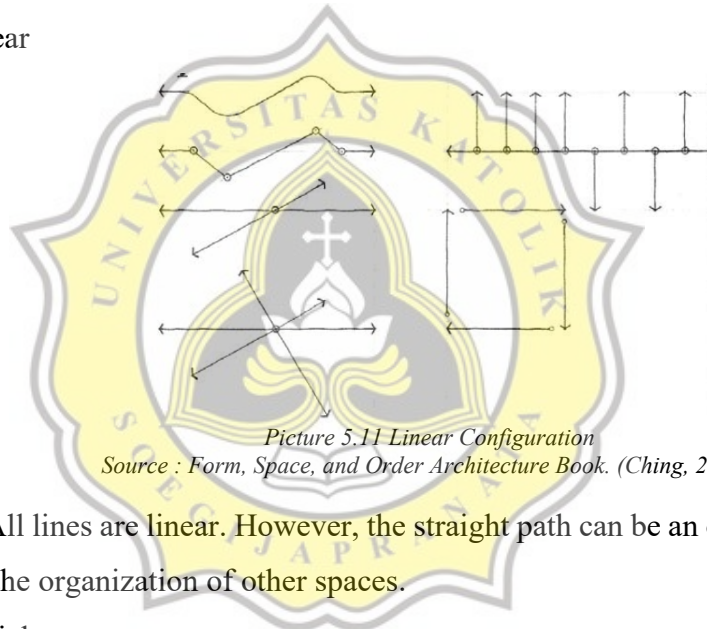
The act of entering can be signified in more subtle ways than punching a hole in a wall. This circulation allows all of the user to see the entrance directly and directly through this access and there is no need to surround the building



Picture 5.10 Entrance Configuration
 Source : Form, Space, and Order Architecture Book. (Ching, 2007).

3. Configuration Path (The Sequence of Space)

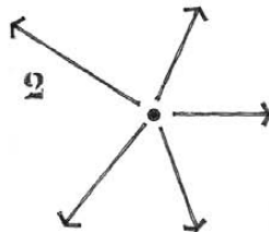
- Linear



Picture 5.11 Linear Configuration
 Source : Form, Space, and Order Architecture Book. (Ching, 2007).

All lines are linear. However, the straight path can be an organizing element for the organization of other spaces.

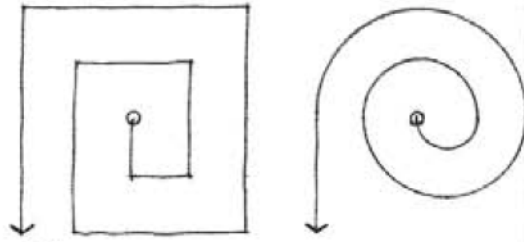
- Radial



Picture 5.12 Radial Configuration
 Source : Form, Space, and Order Architecture Book. (Ching, 2007).

A radial configuration has linear paths terminating at a central, common point.

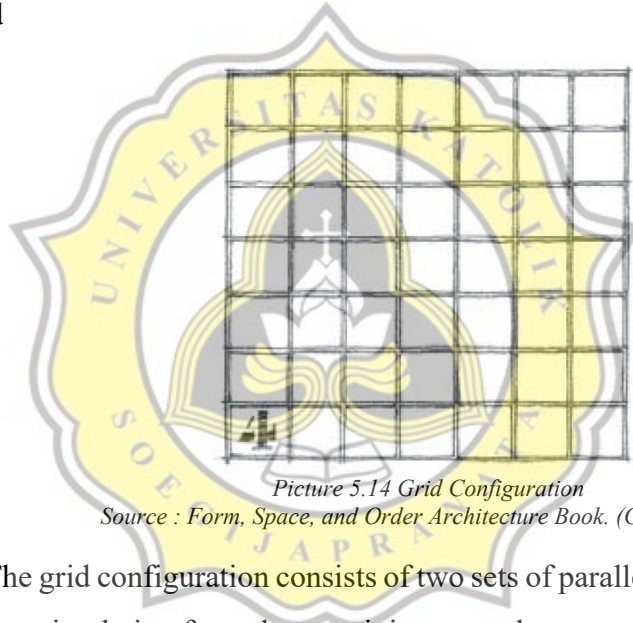
- Spiral



Picture 5.13 Spiral Configuration
Source : *Form, Space, and Order Architecture Book. (Ching, 2007).*

A spiral configuration is a single, continuous path that originates from a central point, revolves around it, and becomes increasingly distant from it.

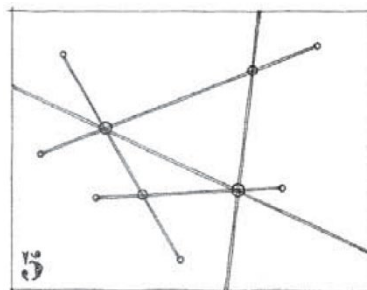
- Grid



Picture 5.14 Grid Configuration
Source : *Form, Space, and Order Architecture Book. (Ching, 2007).*

The grid configuration consists of two sets of parallel paths that intersect and form a circulation from the remaining space between the spaces

- Network

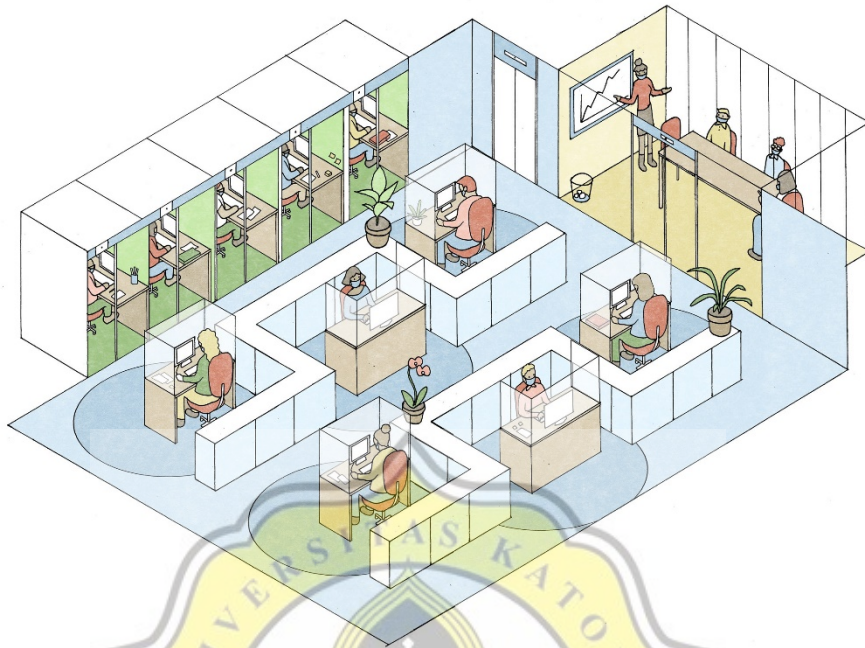


Picture 5.15 Network Configuration
Source : *Form, Space, and Order Architecture Book. (Ching, 2007).*

Configuration consisting of meeting between lines

5.4 New normal Rules

5.4.1 Space For Circulation Of People



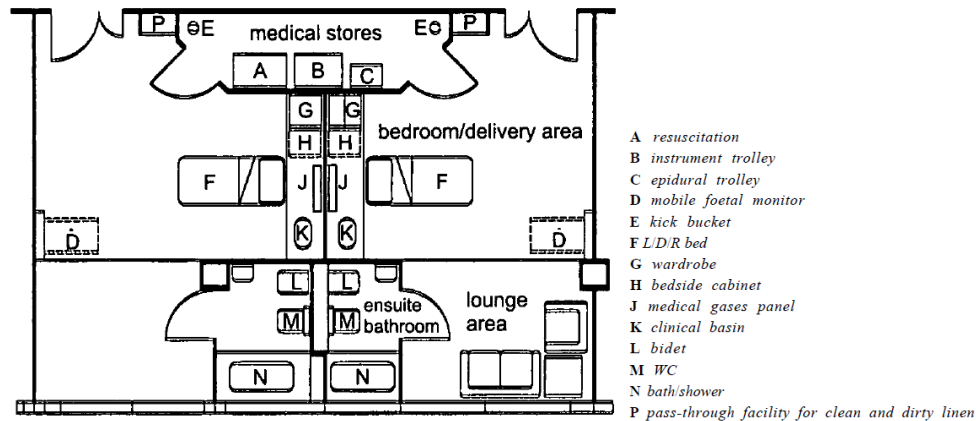
Picture 5.16 Linear Configuration

Source : <https://www.newyorker.com/culture/dept-of-design/how-the-coronavirus-will-reshape-architecture>

Based on chapter 3.1.5, each division of space has a circulation of 60%. for programming ordinary space has a circulation of 30%, but to answer the problems that already exist in the problem formulation of chapter 1 namely "new normal" then the circulation of 30% is doubled to 60%. This application is adjusted to the rules recommended by the health protocol, namely social distancing. But we need to realize, exercise is an important thing too. So by multiplying circulation, they can still apply the rules issued by the government, namely social distancing

5.4.2 Covid-19 Threat

In addition to applying strict rules that must be obeyed for all users, this basketball academy building also provides a place for athletes who experience covid symptoms or who have been exposed to covid virus (positive covid), that is a special room / special room in a dorm for self-isolation.

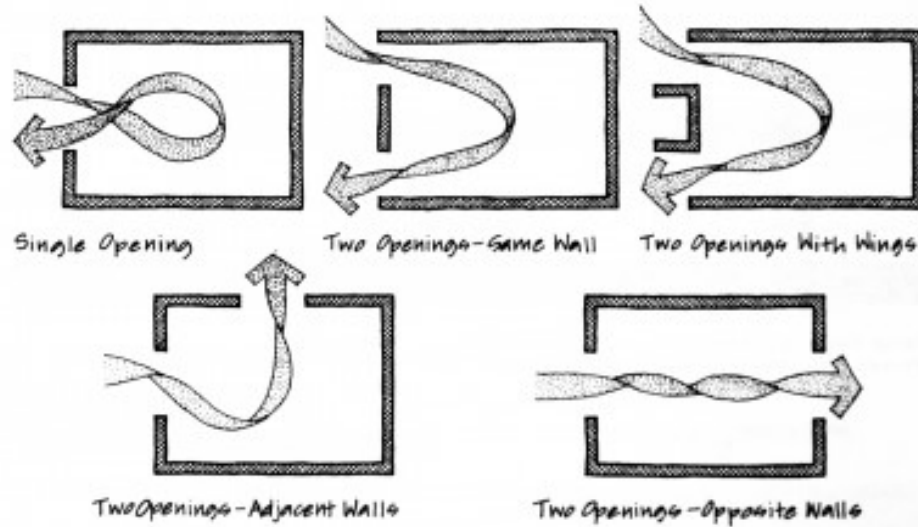


Picture 5.17 self isolation spatial planning
 Source: Metric Handbook

In addition to applying strict rules that must be obeyed for all users, this basketball academy building also provides a place for athletes who experience covid symptoms or who have been exposed to covid virus (positive covid), that is a special room / special room in a dorm for self-isolation

Then besides that also for medical room is divided into 2 namely medical room for handling injuries, and medical room for handling covid.

It is highly recommended that any room has natural ventilation (according to WHO). If possible, use a separate, well-ventilated room when performing aerosol-generating procedures, that is, a negative pressure room with air changes at least 12 times per hour or at least 160 L / s / patient in a naturally ventilated facility. cross ventilation is also very important in maintaining the humidity of a room so that the virus does not always settle in a certain object or room. One way to keep the air quality in a room good is cross ventilation. And for ventilation directions also vary. The following for the direction of the cross ventilation. When placing ventilation openings, we place inlets and outlets to optimize the air passage through the building. Windows or vents placed on opposite sides of the building provide a natural entryway through the structure. This is called cross ventilation. Cross ventilation is generally the most effective form of wind ventilation.



Picture 5.18 The direction of the cross ventilation

Source: <https://indiansustainability.wordpress.com/2015/08/04/importance-of-cross-ventilation/>

This form of air ventilation movement from the openings on one side of the building depends on the tightness of the building envelope - the physical separation between the interior and exterior environments of a structure. The direction and amount of available wind, the potential for airflow through vents, chimneys and other openings and how well wind can move through the building also affect ventilation. When constructing a building, it's important to know which direction the wind is likely to blow if you want to make the best possible use of cross ventilation. The position and size of the vents, windows and doors also influence the effectiveness of this form of ventilation.

5.5 New Normal Rules and Biophilic Approach

Table 5.1 Correlation between New normal and Biophilic approach

NEW NORMAL	ASPECT	BIOPHILIC
Social Distancing	Free space	Green area space
Avoid room humidity that causes the virus to settle on an object	Airflow circulation	Thermal & airflow variability
Isolation room/ medical room	Comfortable and safe place oriented	Visual connection with nature

Source: Personal Analysis

Based on the table above, between the new normal and the biophilic approach has many correlations so that there are several points between them that are related to each other.

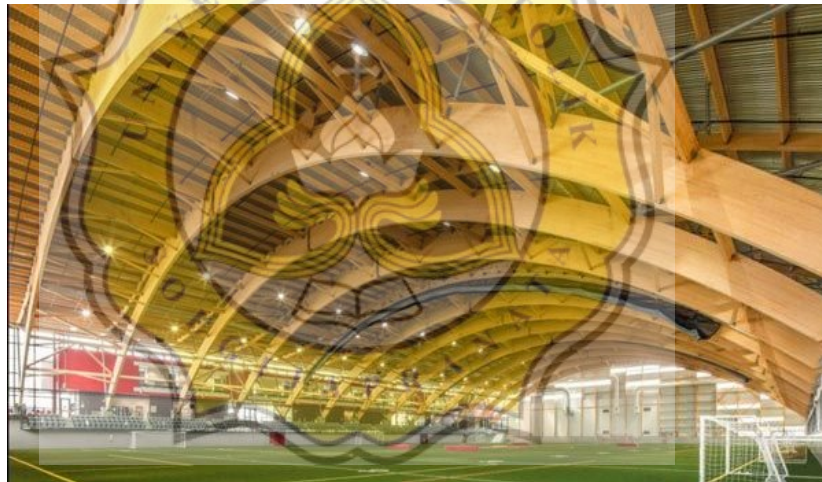
5.6 Building Structure

5.6.1 Glulam Structure

1. The Definition of Glulam

Glued laminated timber (glulam) is a wooden structure made of a number of (two, three, four or more) coating wood or lamina, which is smaller in size, arranged in a direction parallel to the longitudinal axis, attached to one another by an adhesive, so as to form one larger blocks, can be shaped straight or curved lamina blocks.

By laminating a number of smaller pieces of wood, making a structural part that is large, strong, and produced from smaller pieces. This Laminated Timber Glulam is used as a vertical column or horizontal beam, as well as a curved and flexible shape. Glulam is easily produced in a curved form and is available in a variety of wood species and appearance characteristics to meet various end-use requirements. Joints are usually made with plain steel bolts or pegs and steel plates



*Picture 5.19 The application of Glulam Structure
Source : The Practice of Biophilic Design*

2. Benefits and Advantages of Using Glulam

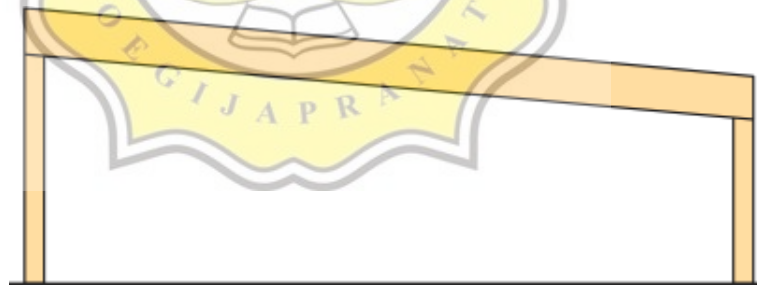
The benefits of using Glulam wood are that it has a fairly good fire resistance, has a low carbon footprint so it is safe for health. Various materials work more or less efficiently. Considering first simple stretch members of the cross-sectional area and length, one can investigate which material produces the lightest part when the tensile force must be carried safely

This glulam technology can increase the strength of inferior wood while increasing its size / dimensions. As is known, wood has limitations in size / dimensions when compared to other structural materials such as steel and concrete. Glulam can transform and utilize small woods into new forms whose strength and dimensions can be adjusted as desired so that they can be used for better structural and furniture purposes. More value than concrete or steel, glulam as a structural material has aesthetic value and that provides comfort. The low weight of a wooden building makes for a relatively simple foundation. For narrow-storey wooden buildings, the risk of slope must be taken into account.

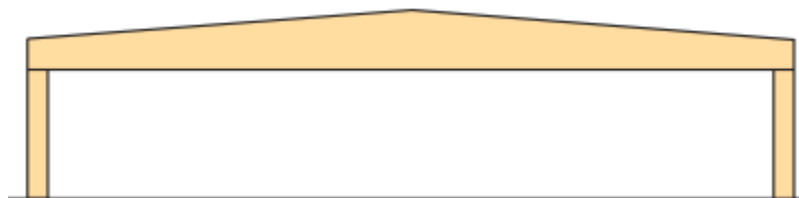
When compared to concrete and steel, glulam can produce a lighter weight structure with a lesser carbon footprint that is much stronger, pound-for-pound. Various structural components can be formed using glulam including parallel beams, sloping beams, curved beams, flying beams, and truss. for the design has almost covered all forms.

3. Size Tolerance

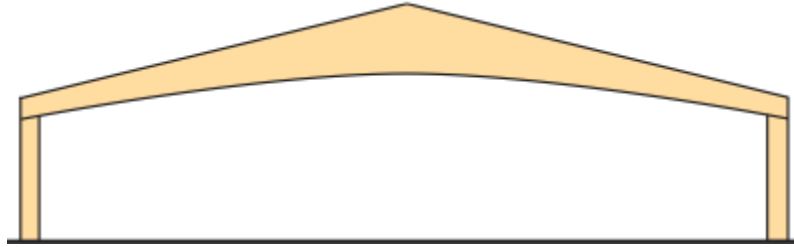
The most common type of glulam element is straight units. Usually made of laminate wood 45 mm thick and used for floor beams, roof beams and columns. For larger spans, supported beam camber may be required to prevent conspicuous deflection. Such blocks can be produced to order. The lamination thickness for curved components is usually 33 mm, but for curved radii less than 7 m, a thinner laminate is required.



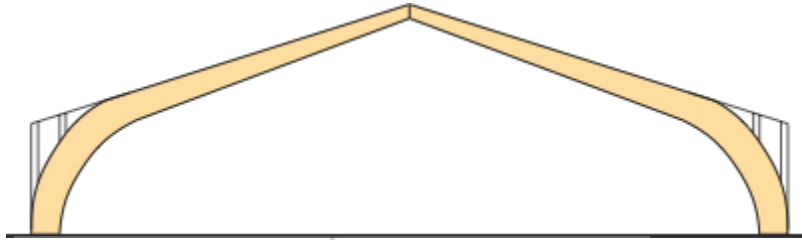
Picture 5.20 Straight beams on columns ≤ 30 m
Source: Modern Timber Construction



Picture 5.21 Double pitched beams on columns 10 – 30 m
Source: Modern Timber Construction



Picture 5.22 Pitched cambered beams on columns 10 – 20 m
Source: Modern Timber Construction



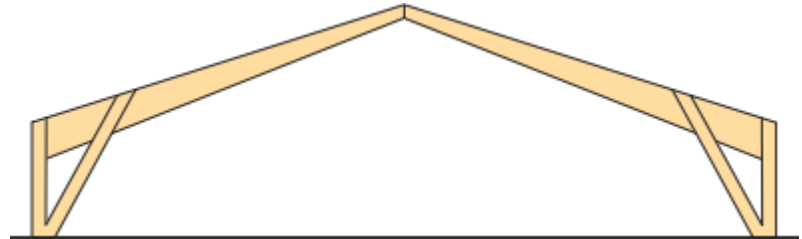
Picture 5.23 Three-pin trusses with tie on columns 15 – 50 m
Source: Modern Timber Construction



Picture 5.24 Three-pin portal frames with curved haunches 15 – 40 m
Source: Modern Timber Construction

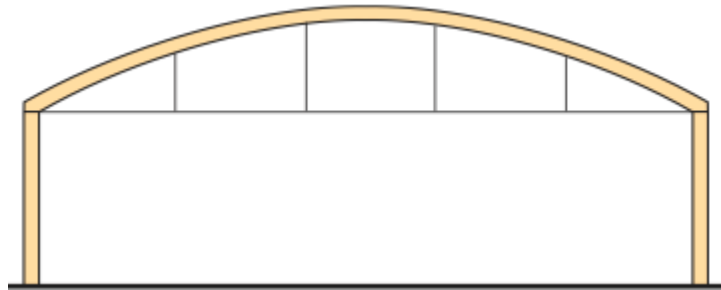


Picture 5.25 Three-pin portal frames with finger jointed haunches 15 – 25 m
Source: Modern Timber Construction

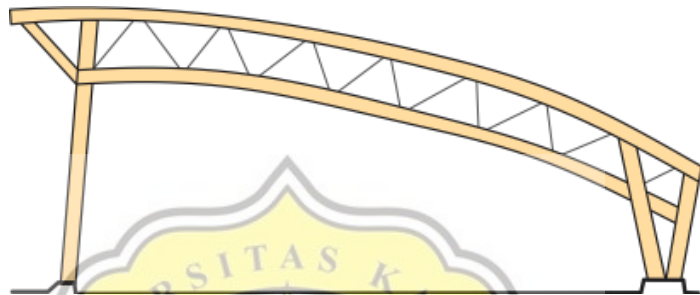


Picture 5.26 Three-pin portal frames of a composite type 15 – 35 m

Source: Modern Timber Construction



Picture 5.27 Three-pin arches on columns 20 – 100 m
Source: Modern Timber Construction

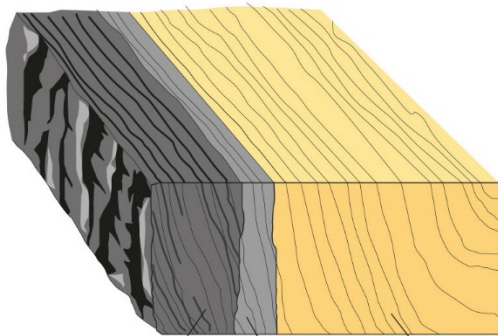


Picture 5.28 Trusses 30 – 85 m
Source: Modern Timber Construction



Picture 5.29 Arch bridge about 25 – 60 m
Source: Modern Timber Construction

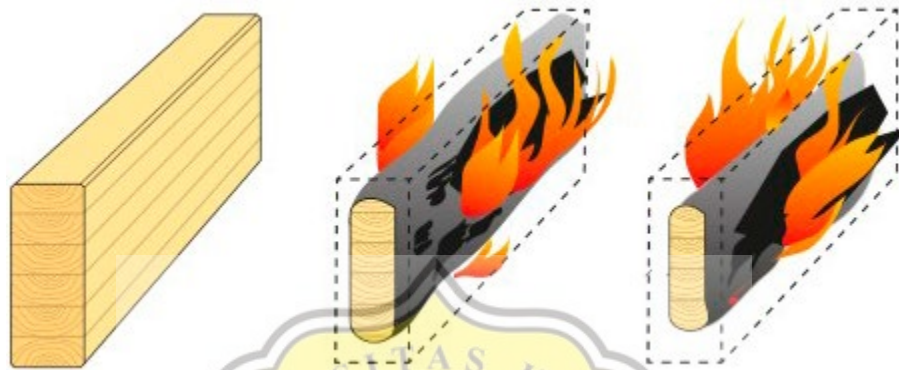
4. Fire Resistance



Carbon Layer Pyrolysis zone Normal wood

Picture 5.30 Arch bridge about 25 – 60 m
Source: Modern Timber Construction

Glulam can maintain the stability of the construction under fire for quite a long time, making it an excellent material for cover structures. Contrary to what many might think, glulam can withstand fire for a long time. A layer of carbon is formed which insulates heat. Laminate wood burns more slowly than many other materials, and it is possible to calculate exactly how wood is affected by fire.



*Picture 5.31 How to glulam works on fire
Source: Modern Timber Construction*

Glulam maintains significant construction stability also in a fire. The figure illustrates cross-laminated wood before the fire (left), after a fire for 30 minutes (center) and after a fire for 60 minutes (right) from all four sides. Beams and other wooden structures made of glulam with large cross-section (strong dimensions) have high fire stability. The surface is first ignited and then the fire penetrates the wood at an almost constant rate - about 0.5 - 1 mm per minute. Slow penetration due to the presence of a carbon layer which forms heat insulation and prevents heat flow from the fire area to the pyrolysis zone. There is also much less smoke when the glulam burns.

5.6.2 GFRC (Glass Fiber Reinforced Concrete)

1. The Definition of GFRC



*Picture 5.32 GFRC Facade
Source: Thebroad.org*

GFRC stands for "Glass Fiber Reinforced Concrete". GFRC consists of a Portland cement based composite with alkali resistant glass fibers randomly scattered throughout the sand / cement matrix. Fibers have a similar purpose to reinforcing steel in reinforced concrete, which is placed primarily in areas of tensile stress. Because glass fibers add flexural, tensile and impact strength, Architectural panels made of GFRC are strong, durable and lightweight.

GFRC panels are often used as exterior facade materials in the construction of various types of buildings such as commercial and institutional buildings. They are available as wall units, window wall units, mullions, and column coverings, as well as for fascia panels, attic roofs, and interior feature panels.

2. Benefits and Advantages of Using GFRC

GFRC material is a material that is light, strong, and durable, and is available in an almost unlimited variety of shapes, colors and textures, GFRC allows Architects to

have the widest range of creative, artistic, and architectural expressions because the material is very flexible and possible for structural elements the most visible.

With up to 80% lighter weight than architectural precast, GFRC panels are light weight and minimize the cost of foundations, foundations and structural frames required to support multi-storey buildings.

GFRC is widely used in building construction and building facades. In overlay applications, GFRC can often be installed directly over old cladding with minimal overlapping loads on existing structures, and minimal disruption to existing tenants and operations. GFRC panels are considered a good material because they can adapt to the replacement of terracotta tiles which deteriorate due to the influence of time and weather.

GFRC is a cement material that is more elastic and denser than precast concrete. The cement to sand ratio for GFRC is 1: 1, compared to 1: 6 for precast concrete. The addition of glass fibers to strengthen the skin results in much higher flexural and impact strength than precast, as well as a lower permeability to water and air. GFRC is a curtain wall exterior cladding (no load); where panels are required to supply structural support to the building (i.e., parking lots), precast panels are a better choice.

