

Designing the Tree Tower With Material Aspect Culture In Tourism Tours Puncak Damar, Jatigede

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Abstract Nature tourism is a travel activity undertaken by a person or group with a special place for recreational purposes, personal development, or business nature attraction by using natural potential, be it natural or cultivated (Achmad Maulidi, 2015). Some examples of nature tourism are: mountain tourism, marine tourism, cave tours, river tours, forest tours and others. The purpose of nature tourism as a means to improve the economic growth of surrounding communities, preserve nature, environment and resources, and as a means to improve the surrounding community. There are several examples of nature tourism in Indonesia, one of which is the Jatigede reservoir located in Sumedang. This reservoir is the second largest reservoir in Indonesia that is able to attract visitors because of the natural beauty and size of the reservoir is very large. Unfortunately the construction of Jatigede dam that has been inaugurated in 2015 still leaves problems and problems for people's lives in the reservoir area. To take advantage of the natural scenery, the designer uses the material aspect to define a durable and robust material standard. The use of material aspects as a need for change support is also one of the important points to build a good and effective product. Knowing the character of the material becomes one of the important things in the design of products and products that will be more appropriate. The product is also a result of the price and value of the proper use and can be accounted for.

Keyword : *Nature tourism, Tree tower, reservoir jatigede, Material*

1. Background

Nature tourism is a travel activity undertaken by a person or a group by visiting a certain place for recreational purposes, personal development, or studying natural attraction by utilizing the potential of natural resources, whether natural or cultivated (Achmad Maulidi, 2015). Some examples of nature tourism are: mountain tourism, marine tourism, cave tours, river tours, forest tours and others. The purpose of nature tourism, among others, as a means to improve the economic growth of the surrounding community, preserve nature, environment and local resources, and as a means to improve the welfare of surrounding communities. There are many areas that can be categorized as nature tourism. One of the tourist attractions we will be discussed in this research is Jatigede nature tourism.

Jatigede is famous for the construction of its reservoir, which was recently inaugurated by President Joko Widodo in 2015. The construction of a hiatus reservoir that lasted for 44 years has drowned 5 sub-districts and 30 villages around 6,783 ha, 1200 ha of forest owned by perhutani and dozens of historical sites (Maya Sari, 2015). Due to the construction of the reservoir, it formed a tourism potential in the area around the reservoir jatigede which has a puddle of 4,983 ha. Looking at the facts that exist, the natural tourism potential of Jatigede reservoir, especially with wide view around the reservoir, can be developed so that it can be a source of livelihood around the reservoir (Adang Jukardi, 2016). Now there are some nature tourism that has been operated by the surrounding community, one of them is Puncak Damar.

Puncak Damar is located at the height of Puncak Damar Paku Alam Village in Darmaraja Subdistrict. The location is right in the forest area of RPH (Resort Polisi Hutan)

Ciboboko, BKPH (Badan Pengankuan Hutan Unit) Cadasngampar, inside the administrative area of Pakualam Village, Darmaraja Subdistrict, Sumedang Regency. According to Ita Liliana (2017) quoted from keliling.com site, Puncak Damar Jatigede Sumedang including a name on the area of nature tourism or tourism attractions. Which has been managed and developed by Perhutani Perhutani KPH (Kesatuan Pemangku Hutan) Sumedang. Because of its location in the highlands, Puncak damar present us a wide view of the area around the Jatigede Reservoir. Tourists who have a visit there can enjoy the beautiful natural scenery of the reservoir freely. In the puncak damar area, tourists can see the scenery from the natural conditions of the mountains, dams, and water gates Jatigede dam. The Puncak Damar also has a pine forest area that scattered at the north of the Puncak damar area. In order to maximize the experience, a facility is needed for a place to see the natural scenery. One of the solution is a tree tower.

The tree tower is a structured building that lies near or between trees and hangs over the ground. According to the definition of the Treehouse Guide (2001), the tree tower is a building built on a tree as a container or around a tree, having a platform (floor / stage / podium) as a safe foothold. The tree tower consists of a structure which is attached around the tree trunk, then on it placed a wooden plank over the structure and stairs for access from below.

In this design, the authors want to create a design of the tree tower with the purposes to develop and exploit the potential of nature as well as the surrounding community as a tourist destination without damaging the natural surroundings. The author hopes that the design of this tree tower can attract tourists to enjoy the scenery, and is expected also with this tourist destinations can build the economic road of the people around.

In this tree tower design, there are several things to note. Starting from the formation of structure, shape and visual, security and comfort, how to treat the material to selecting the material which can be used to create a tree tower. In this case, the author focuses more on the material aspects. Material aspect is a science that learn about the material and its classification. In the design of the Tree Tower, the material aspect holds an important role in the determination of the material to be used in the design. Materials definition according to Deborah D.L Chung (2011), is an aspect that forms the foundation of a technology. Starting from technology related to structural, electronic, thermal, electrochemical, environmental, biomedical and other applications. (Applied Materials Science, 2011) The material consists of several types: metal, polymer, ceramic, natural material, wood, semi conductor, and composite material. However, in the design of this Tree Tower, the materials used are differentiated based on the need for structural and platform sections. With this aspect approach the author can determine the right material based on the classification of the material itself so that it can be a reference for the design of the Tree Tower.

2. Theory

2.1 Tree House

The tree tower is included in the category of the Observation Tower. According to Anggini (2014) The tree tower is a building structure that used to see a scenery from a distance and to create a 360 degree view. The maximum height of this building is 20 meters (65.6 feet) and using the tree as the media to support the building.

Quoted from the site of The Treehouse Guide (2001), there are some things that must be considered in the design of the Tower of the tree, namely:

1. Selection of Trees

There are 4 points in note to choose the right tree. that is:

1) The height of the tree

The higher we are on the tree the more amazing the scenery can be seen directly. However, in order to support security and safety we have to rethink to be there because the effects of strong winds affect the quality of support of the tower of the tree.

Trees can sway swiftly when the weather is windy. In the case of a tree tower, the wind can cause a shock on the tree tower especially when a storm is occurring. A good tree tower construction will not be destroyed if the wind is not fast. tree towers in a blustery area should be at a one-third height from the bottom of the tree, where wind speed is lower and the force effect on the tree is reduced. Conversely, if the area is constant, then by placing a tree tower at half height from the bottom of the tree is good enough.

2) Branch thickness

An important point to note for is the strength of the branch as the support of the tree tower platform. The minimum branch used as support is 4 branches. The branch used depends on the type of Tree tower to be created. For a 1-storey tree tower with no hanging deck, the thickness of each corner is 8 inch (inches). If the tree tower design is more than 1 floor and has a hanging deck then the thickness of the branches is 12 inch or more. If branch conditions do not allow for this, it is advisable to use additional support so that the weights are spread evenly.

3) Building between several trees or branches

If you want to use 2 or more of the branches, tree trunks or trees, we should pay attention to the possibility that happened as the blowing wind caused the shock on the tree tower. This is a problem if using 2 trees because there will be interference from 2 trees that host (host) the tower of the tree. Therefore, the design of the tower as much as possible should be strong and flexible to follow the shape of the tree so that tower trees are made capable of overcoming tension or compression. There are 2 framework options that can be used that have a really strong framework or a flexible and weak framework.

4) Damage to trees

If the tree tower is poorly designed, it will easily damage the tree. It is impossible not to cause any damage at all to the tree. However the tree has developed several techniques to tolerate the damage and make the tree condition remains stable. Things that cause damage to trees include:

- a. Infection
- b. Cut off branches and stems
- c. Nails and screws
- d. Bolt
- e. Growth factor
- f. Fix Support

By knowing any points that make the tree damaged. As a designer we must make sure that the Tree Tower made as far as possible does not hurt the tree too much and also pay attention to the ability of the tree.

2.2 Materials Aspect

Materials according to Deborah D.L Chung in his book "Applied Materials Science" (2001), is an aspect that forms the foundation of a technology. Starting from technology related to structural, electronic, thermal, electrochemical, environmental, biomedical and other applications. Material consists of several types of metal, polymer, ceramic, natural material, wood, semi conductor, and composite material.

According to Michael F. Ashby (2007) Material is "food" in the design. Seuah products are considered successful using materials that work well and can be utilized maximum potential and character.

According to (Palgunadi, Bram, 2008: 261) states in the book 'English-Indonesian Dictionary' by John M.Echols and Hassan Shadily (1995), the term 'material' means: materials, materials, tools. The term 'materialism' means materialism. The term 'materialist' means: materialist. The term 'materialistic' means: materialistic. The term 'materialized' means: materialized. The term 'material' means: equipment, equipment.

Basically, Material is a thing that is available anywhere, anytime, and could be found under any circumstances. Material selection for design is very important. To produce a product in accordance with the designed design, the designer must know the relationship between the material with the structure, properties, and material work. That way the designer is able to determine what kind of material is appropriately used in the design of the product. (Sofyan, Bondan T, 2011)

Materials have several classifications that distinguish the material from each other. According to Bram Palgunadi (2008), there are 9 differentiating material properties. That is:

- a. Material properties in terms of chemical (chemical character).
- b. Material properties in terms of physical and mechanical character (physical & mechanical character).
- c. Material properties in terms of material ability (material ability).
- d. Material properties in terms of shape and nature of the outer surface of the material (surface form & character).
- e. Material properties in terms of shape and nature of the inner materials (inner form & character).
- f. Material properties in terms of material type (material type).
- g. Material properties in terms of material origination, including the origin of the material environment.
- h. Material properties in terms of shape and material profile (material form & profile).
- i. Material properties in terms of the resulting impact (effect).

2.3 Material for Building

1. Wood

Wood material is the most commonly used material because it is easy to produce and cheaper than metal and concrete materials. Wood materials are often used for building construction. Wood materials have several advantages and disadvantages, here is the table comparison.

Table 2.1 Advantages and Disadvantages of wood

Advantages	Disadvantages
Easy to produce	Easy to burn
Easy access	Not every type of wood are last longer
Can isolate the heat	Can shrink and expand, depends on the amount of water content inside the wood.
Durable to chemicals	Easy to get weathering compared with other materials
multifunction	

(Source: Writer, 2018)

Wood material has a kind of trait that distinguishes wood species from each other. There are several classes that distinguish the type of wood. That is by comparing the level of strength, durability, usage rate and specific gravity.

1. Level of Usage

The rate of use of a timber expresses the timber coverage for such construction. There are 5 different levels of wood usage. Levels I and II are used for heavy construction purposes, are not protected and interact directly with moist soils. Examples are Teak, Merbau, and Bangkirai. Level III is used for heavy sheltered construction purposes. Examples are camphor wood, pusa, and others. Level IV is used for lightly shielded construction purposes. Level V is used for temporary work purposes.

2. Specific Weight

What is meant by wood density is the ratio of the weight and volume of wood in the air dry state with the water content of the surrounding wood equilibrium (for Indonesia averaging 14%). Based on the specific gravity, there are several classes from which differentiate the type of wood. (0.60-0.75), Weight (0.75-0.90), Very heavy (> 0.90), Floating (<1), Floating (1), and Drowning (> 1).

3. Level of Durability

Durability is defined as the endurance of wood against the attack of wood destroying factors of the biological class. Natural durability is determined by the extractive substances that are toxic to the destructive factor, so that by itself this natural durability will vary according to the variation in the number and types of extractive substances. This causes natural durability to vary by the same type of wood as well as in the same tree. There are 5 classes of wood durability based on the conditions of use, ie always associated with moist soil and there are termite colonies. The 5 classes are class I, II, III, IV, V. The higher the grade, the lower the durability of the wood. This division applies only to tropical plains and is not subject to the resilience of marine worms.

4. Strength Level

In Indonesia it is rarely tested for tensile strength. To determine the level of strength of our wood base on strong bending, compressive strength and strong wood species. The specific gravity is determined on the moisture content of the wood in the dry air. The requirements for each class according to the gerger den are determined to be classes I, II, III, IV, and V based on the strength

of bending, force strength, and specific gravity. The higher the grade value the weaker the strength of the wood.

Based on the type and class of wood above, it can be concluded that the wood material has certain conditions to be used as construction materials. A wood that can be a construction material should have a good level of use, durable, wood dry, and sturdy.

In Construction, Wood has a certain size standard. Usually widely used for buildings. Each shape and size is known by the name name as follows:

- a. Beams: Have a higher size larger than the width. Examples of commonly used sizes are 6/10 cm, 6/12 cm, 6/15 cm, 8/12 cm, 8/14 cm, 10/10 cm, 12/12 cm.
- b. Board: In the form of thin sheets that are much larger than the thickness. For example the size of 2/20 cm, 3/20 cm, 3/25 cm.
- c. Ram: Ram is a board for making door frame with 3/10 cm or 3/12 cm.
- d. Kaso / usuk: Small beam with the size 4/6 cm and 5/7 cm

The length of each of the above sizes is standardized. The most common is the size of 1 to 3 meters. For the size of 3 to 4 meters is rare, more than 4 meters is usually difficult to find and if there is usually the price per bar enough drain pocket.

In the construction, there are 4 types of wood that is often used. Teak wood is used for heavy construction due to its strong and strong. Kalimantan wood, especially Kamper type, Kruing, Bangkirai, Meranti, Lanan and others suitable for all kinds of construction, especially protected from the influence of heat and water. Glugu Wood (Coconut) is still widely used to make the foundation of the house, especially the tree is really old. Last is Wood Jackfruit, Sawo, Mahogany, and Rasamala are still used to make home construction in the countryside.

2. Metals

Metals Consists of atoms that are dense and have metallic bonding character. Metal materials even dominate in the periodic table. According to Deborah D.L Chung (2001), metals are classified by the majority of commonly recognizable elements. The main class of metal is an iron-based metal commonly used for the manufacture of structures, copper-based metals which are often used for piping, appliances, thermal and electrical conduction, and others. The latter is an aluminum-based metal used for lightweight structures and metal matrix composites.

According to Michael F. Ashby (2007), the metal has a relatively high modulus rate. Most pure metals are soft textured and easily handicapped. The metal can be strengthened with alloy and mechanical treatment and utilizes heat. Some high-strength metal alloys such as spring steel have elasticities as low as 1 percent. However, it is sufficient to ensure the yield of the material before it causes fractures and fractions. Because of this fragile vulnerable metal material most often exposed to corrosion.

3. Concrete

Concrete is a material derived from a mixture of cement, gravel, sand, and water. These four elements are formed by comparison with the quality requirements of the concrete. The quality in question is the strength of the concrete in holding the compressive force until the concrete breaks and breaks. (Santoso, 2017)

As described above, this material has 4 elements that make up a good concrete. That is:

1. Cement

Cement is powdered, and if mixed with water will change shape to paste. Cement paste serves to attach and bind the aggregate to each other. The following is the type of cement in Indonesia. Namely white portland cement, portland pozoland cement (PPC), Ordinary Portland cement (OPC), portland cement mix, cement masonry, and composite portland cement. Of the various types of cement present in Indonesia, each cement provides different results on the concrete.

2. Gravel

Gravel acts as a coarse mixture for concrete. The quality of the concrete depends on strength, extreme weather resistance, does not react to chemistry, cleanliness, gradation of size and shape of gravel.

3. Sand

Sand acts as a fine mixture for concrete. Its function is to close the narrow space created from the pile of gravel. Sand aims to strengthen the concrete mix.

4. Water

Water works to dissolve the cement into a paste and then bind all the mixture of gravel and sand into concrete. The water used should be clean, free of dirt and garbage, and does not contain chemicals in order not to affect the strength of the concrete.

These four elements support each other to create a good quality for the concrete material. Good concrete quality requires an alloy of composition to suit the concrete needs that you want to use. That way, the concrete can be used safely and functioning optimally.

2.4 Materials for Tree House

1. Steel

Steel is a metal alloy with iron (Fe) as the basic element and carbon (C) as its main alloying element. The carbon content in the steel ranges from 0.2% to 2.1% by weight according to its grade. The function of carbon in steel is as a hardening element in the lattice crystal of iron atoms. Carbon steel is a carbon-containing steel 1.7% smaller, while iron has a carbon content greater than 1.7%. Excess steel compared to wood and concrete is this material is made in the factory, which of course has good quality control. (Munir, 2017)

Steel is widely used as material for building construction. Steel is chosen because it has a high strength, long life, and is available in various forms and options. The type of steel used for building construction is steel profiles.

Steel Profile or commonly known as Structural steel is steel made in many shapes and sizes for the needs of construction. According to (Purnosidi, 2018) Profile steel has the types of steel profiles and uses according to their characteristics before being applied. The following are recognized types of steel profiles.

- a. Wide Flange Steel
- b. Hollow Beam Steel
- c. T-Beam Steel
- d. Elbow Steel
- e. Tube Steel
- f. UNP Canal Steel

2. Wood

Indonesia is a very large number of timber producers, both in number and in kind, making it easy to obtain and affordable. Therefore, the use of wood for construction in terms of economic

benefits very profitable. Wood is a material of nature, meaning that this material can be obtained from the wild without having made or processed in the factory. Wood material can be formed various shapes and sizes such as beams, boards, or squares. The most commonly used tree part of the construction is the trunk.

Wood as a construction material has advantages and disadvantages. advantages of wood materials are:

- a. Easy to obtain and relatively inexpensive compared to materials such as steel and concrete.
- b. Easy to do without heavy equipment or special equipment.
- c. The natural shape so that fiber fiber is often exposed as decoration. An example is teak wood.
- d. Can isolate heat. So the house that uses a lot of wood material will feel cool and comfortable.
- e. Electrical Insulation.
- f. Chemical Resistant.
- g. Lightweight, reduce the weight of the building, so as to save the size of the foundation.
- h. Versatile, meaning that this material can be used as a construction, work tool, or as decoration.
- i. Former Wood material can still be used for other purposes.

Here are the advantages of using wood as a construction material. But every advantage there must be a disadvantage as well. Wood material has a disadvantage in its use. that is:

- a. Flammable and inflammable
- b. The strength and durability of wood depends on the type and age of the tree
- c. Rapidly damaged by natural influences. Rain and water cause wood to quickly decay. The heat of the sun causes cracks in the wood.
- d. Can be eaten by termites and beetles
- e. Can shrink or expand depending on the content of water contained.
- f. The strength of wood is not all uniform even though it comes from the same tree. This is caused by defects in trees such as the presence of wooden eyes, the direction of fibers that are not straight or other defects.

Woods have properties that differ from one another depending on the type. A wooden construction has good strength and durability. The following is an example of wood that can be used for building construction materials.

1. Teak Wood.
2. Ulin Wood
3. Bangkirai Wood
4. Merbau Wood

3. Wood Plastic Composite (WPC)

WPC or Wood Plastic Composite is an artificial material derived from a mixture of plastic and wood. According to (Alfari, 2017), WPC is a mixed material that becomes an alternative to today's wood. Increasing wood prices and exploitation of timber use make us start to conserve wood. WPC is made with 50% plastic fiber composition and 50% wood powder. WPC can provide wood-like strength and beauty with durability and advantages as well as the benefits of polymers or plastics.

WPC has 2 types of WPC Hollow and WPC solid. WPC hollow has a hole in the middle. Wood is usually used as a yard fence, terrace floor and also a roof for the gazebo. WPC solid made board, straight and curved. For solid WPC types can be utilized as building materials.

WPC materials have advantages and disadvantages when compared with wood materials. Based on water absorption, WPC only absorbs about 0 - 1.5% moisture content compared with 30% more wood material. Based on its resistance to mold, chemicals, termites and expansion, WPC material can withstand such attacks very well compared to wood materials sufficient to resist such attacks.

3. Empirical Data

3.1 Research Places and Time

The research was conducted in the peak tourism area of Jatigede Reservoir area, in Pakualam Village, Dusun Cisema, Sumedang Regency. On 20 February 2018 with direct observation on location and documentation of the situation around Puncak Damar.

The author also conducted research on the tourism maribaya lodge, Bandung on March 2, 2018 as a study to study the product competitors and conduct interviews to find out the materials they used at their site.

3.2 Observation

In order to make an observations, the authors make direct observations to the Puncak Damar in the area of Jatigede dam. The observations were conducted on February 20, 2018. Here are the results of the observations obtained.

1. The soil type of the peak of resin is the latosol soil.



(Source: Writer, 2018)

2. The view from Damar Peak that presents the area of Jatigede dam and Surian mountain located in the middle of the reservoir.



(Source: Writer, 2018)

3. It has a lot of Pine tree at the forest of Puncak damar



(Source: Writer, 2018)

the author also made observations on the shape of every tree tower that existed in the tour The Lodge Maribaya and Dago Dream Park, Bandung. The observation was conducted on March 2, 2018. Here are the results of observations obtained, namely:

1. The material composition of the tower of trees there is made of mild steel as a structure and wood as the platform floor.
2. Wood material in use of teak wood type. The reason chosen teak is because of its strong and sturdy.
3. Steel used for steel type steel structure of "C".
4. Tree used as a support Tree tower is a pine tree.
5. Connection of wood material using bolts so it can be dismantled if there is a broken part.
6. On the empty part of the steel structure inserted wooden beams to keep giving the natural impression of the Tree Tower.



(Source: Writer, 2018)

3.3 Interview

The author made an interview with the purposes to know the type of material and the reason why the material is chosen in the design of the Tree Tower. On March 2nd, 2018, the writer interviewed one of the employees of the Tree tower at The Lodge Maribaya, Bandung. One officer named San san (20 years old) said that the existing Tree Tower at The lodge maribaya uses teak wood as a platform and steel profile "C" as its structure. From his statement, teak is chosen as a platform because of its strength and robustness. While profile steel is chosen because the formation is sturdy but light enough compared with using concrete. But the constraints that occur in this tree tower is a safety factor that is considered dangerous if exposed to wind. This happens because the condition around The Lodge Maribaya is located on the edge of the hill. Rain also affects the material condition. Continuous rain conditions can cause weathering in wood and corrosion in steel.

4. Analize of Materials Aspect

Design aspect analysis is an advanced stage of the theoretical foundation described in the previous chapter, Chapter 3 contains an analysis of the analysis in a design that is reviewed through the material aspect. In designing a product, design aspect analysis is needed as the advanced stage of a design. At this stage is done data processing based on the source of theoretical basis and data research results.

From the material aspects involved in the design is developed into several categories that are determined based on the data that has been obtained from the analysis of the problem to determine the priority aspect as the main need which becomes the benchmark of a design design dominant

and the level of importance which will later become the needs of the primary aspects secondary, and tertiary aspects. The category of material aspects that have been specified as a material consideration of the product designed, as follows:

Table 4.1 Materials Aspect Category

(Source : writer, 2018)

After knowing what category is needed, the next step is weighted against that category. The weighting aspect as follows:

Tabel 4.2 Scale priority aspects of primary, secondary, and tertiary

Primary (45-30 point)	Secondary (30-25 point)	Tertiary (< 25 point)
Quality of Materials	Jointing System	Aesthetic
Environment		

(Source: Writer, 2018)

4.1 Primary Aspect

The primary aspect is a must and a mandatory component in the design concept to be designed. Primary aspect is the result of weighting that has been done through the count of numbers that are very dominant in the analysis of the problem. For the primary aspect in this design is Material Quality. Because of its high position and priority will affect other aspects of design considerations, these design aspects are absolutely must be gained, understood, and mastered. The connection is very important and can not be ignored at all. Smooth implementation of the design process may depend on the readiness and completeness of this design aspect. Here are the results of the analysis on each design aspect weighting:

4.1.1 Quality of Materials

Material quality is one of the main categories in the design of tree towers. Based on the initial idea in the previous sub-section that has been described. Through the design analysis will be presented what kind of material in accordance with the main issues. In the discussion of material quality, the analyzes presented are divided on the part of the tree tower, ie platform, railing and hand rail, structure and stairs.

1. Platform

The platform in the tree tower serves as a foothold for users. the analyzed material is an outdoor material that can be used as a tree tower platform. Points of analysis that become benchmarks in recommending the material is based on the advantages and disadvantages of material, treatment, maintenance, installation, and the cost of the material.

2. Structure

Structure is an important component in tree towers. The function of the structure is as a frame of the tower that forms a tree tower and holds the load

that visitors give. Therefore, the material used for the structure must take into account the strength, durability, robustness and durability of the material.

No	Materials Aspect	Explanation
1	Quality of Materials	Material quality is one of the benchmarks in material selection. Because the quality of the material will affect the performance of the product. Matters noticed in the quality of materials are measured by the degree of strength of the material structure, the resistance of the material to the load, the mass of the material type, and the durability of the material.
2	Environment	Environment is one aspect that can influence material selection. This is because not all materials can withstand the same weather and environmental conditions. Therefore there is a need for data on the environmental conditions in which the product will be operated.
3	Aesthetic	The aesthetic aspect of a material needs to be taken into consideration to increase the aesthetic value of the product.
4	Jointing System	Jointing is a technique of grafting a material. The jointing technique is performed to form a structure of the product.

3. Railing and Hand rail

Railing or guardrail is a tree tower component that functioned as a safeguard so that users do not fall while on the edge of the platform. While the Hand rail is a handle that is placed on the railing.

4.1.2 Environment

Environmental factors have an influence in material selection. Because the material used will interact directly with the environmental conditions that exist there, the peak of resin, Jatigede. Based on the data obtained in the previous chapter on jatigede natural conditions. Criteria of materials that can be used there must be resistant to hot weather conditions, water resistance and fire resistance. The following is a comparison table of material endurance to weather.

Table 4.3 Materials Durability of Heat, Flame, and Water

Materials	Flammability	Fresh Water	Sunlight (UV)
Wood	D	C	B
WPC	A	A	B
Steel	A	B	A
Stainless	A	A	A

Aluminum	B	A	A
Copper	A	A	A
Titanium	A	A	A

(Sumber : Ashby, 2007)

Based on the above table, it can be concluded that the material in accordance with the peak environment must have resilience to sunlight, fire retardant and water resistant. The result of the material analysis will be the author's analysis to consider the design.

4.2 Secondary Aspect

The secondary aspect is the aspect of the medium-scale priority pendukug based on the needs of the design. The secondary aspect does not significantly affect the design process, but as the supporting aspect of the main needs. The needs of the main aspects will be supported by Jointing material as a secondary category.

3.3.1 Jointing Material

Jointing in the design is positioned as a supporter of the main aspects. Jointing is a technique for connecting materials in a certain way. The jointing method used depends on the type of material. Jointing is required to provide support / support to the material to withstand the load on the product.

4.3 Tertiary Aspect

Tertiary aspect is an aspect with a low priority scale, where the given needs are not very influential in the design. The tertiary aspect is designed after the primary and secondary aspects are met.

1. Aesthetic

Table 4.4 Aesthetic Aspects Affecting On Material Aspects

No.	Aesthetic Aspect	Explanation
1	Texture	A texture on the material can give a good visual impression to the user. Each material has a different texture. Therefore, the designer also needs to pay attention to the texture form in addition to preventing the slippage when the material is wet, can add value to the beauty itself so as to attract visitors.
2	Colour	Colors in the selection of materials can have a psychological impact on users. This is because each color will give a different impression. For example, red gives the impression of passion, yellow gives the impression of broad and light, green or blue gives the atmosphere cool and fresh, and dark gives the impression of narrow, while bright colors like white gives the impression broad. There are also natural colors that give a natural impression. In

		addition, the selection of different colors on each component will show the difference of a function.
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(Source: Writer, 2018)

4.4 Terms of Reference (T.O.R)

Term of Reference is the frame of reference in the design applied to the activities of the workers / executors. In the design of this time T.O.R is one thing that must be considered to make the right design so that the resulting product can work properly. Here is a list of T.O.R needs for the design to be made:

1) Design Considerations

Based on the results of design aspect analysis, some design considerations are as follows:

- a) the material in a design must be adapted to the size of the load, environmental conditions and the weather at the top of the puncak damar.
- b) Material considerations on tree tower structures that meet the size of load requirements.

2) Design Limitations

The design limit on the TOR has an effect on the design process and must be understood by the writer so that the analysis is not widespread and fixed in portion. The design limitations as follows:

- a) Design for tree tower products to be placed in mountain areas affected by wind pressure, soil type and contours, and weather.
- b) The product is designed on the basis of material aspect analysis.

3) Design Needs

The design requirement is adjusted to the result of problem analysis which has been done before research. Needs design as follows:

- a) Selection of materials adapted to environmental conditions.
- b) Materials used are expected to have a good visual to lift the aesthetic value of the product.
- c) Has a strong frame structure.
- d) Have good finishing.

5. Conclusion

In the design of this tree tower, it takes an understanding of material knowledge so that the product can be used safely, comfortably, and durable, taking into account the material aspects. This study focused on the selection of materials that match the needs of the tree tower. By knowing the quality of the material and its interaction with the environment, the researcher is able to select material criteria suitable for use as material of tree tower production. This design aims to meet the wishes of visitors who want to see the vast view of the jatigede dam from the

height, not forgetting as a facility that can be managed by the surrounding community to attract tourists and promote.

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