# Gelam Wood (Melaleuca cajuputi Powell) as a Substructure Construction Material

*by* Kehutanan turnitin

**Submission date:** 21-Jun-2024 02:37PM (UTC+0700)
**Submission ID:** 2406180064
**File name:** gelam_wood...pdf (1.13M)
**Word count:** 3670
**Character count:** 18977

# *Gelam* Wood (*Melaleuca cajuputi* Powell) as a Substructure Construction Material

# *Gelam* Wood (*Melaleuca cajuputi* Powell) as a Substructure Construction Material

**Muhammad Afief Ma'ruf[1,3*], Yudi Firmanul Arifin[2], Mufidah Asy'ari[1], Rusdiansyah[3]**

[1]Doctoral Program of Agricultural Science, Postgraduate Program, University of Lambung Mangkurat, Banjarbaru, Indonesia, [2]Faculty of Forestry, University of Lambung Mangkurat, Banjarbaru, Indonesia. [3]Faculty of Engineering, University of Lambung Mangkurat, Banjarbaru, Indonesia

*)afief.maruf@ulm.ac.id

**Abstract**. *Gelam* wood (*Melaleuca cajuputi* Powell) which is widely used for substructure construction materials in South Kalimantan is classified into strong class II and durable wood class III. This study aims to provide more detailed information regarding what forms of use of *gelam* wood as substructure construction material and why *gelam* wood was chosen for it. This information will later be able to support the preparation of future utilization plans for the use of *gelam* wood considering that currently *gelam* wood is starting to decrease in availability. The method to identified the use of *gelam* wood as a substructure construction material is field survey method combine with other references. *Gelam* wood with a large diameter of 10-12 cm and a length of 4 m is generally used as a construction foundation for 1-storey building with an ultimate bearing capacity of 729,25 kg for single pile foundation. In terms of cost, the foundation with *gelam* wood material is cheaper than the mini-pile concrete foundation for the construction of the same building. The large size of *gelam* wood is also used as sheet pile or retaining wall with an average flexural strength of 100,13 MPa. The small size of *gelam* wood is generally used as wooden scaffolding where the cost of *gelam* wood scaffolding is 26.85% cheaper than iron scaffolding in the rental price, and 15 times the cost of the iron scaffold in the purchase price.

## 1. Background

*Gelam* wood, which belongs to the *Melaleuca* genus of the *Myrtaceae* family, is a plant that grows naturally in the peatlands of South Kalimantan, Central Kalimantan, and other areas. In this case, the species commonly marketed as gelam wood on Kalimantan Island is *Melaleuca cajuputi* Powell [1]. *Gelam* wood as shown in Figure 1 and 2 is capable of growing up to 40 m in height and up to 35 cm in diameter. *Gelam* wood has distinctive characteristics, one of which is able to adapt in different ecosystem environments and adapt to environmental changes that occur, so it is very suitable

to be used as construction material for reclamation or regional development. Besides being used in the form of logs (small diameter logs), *gelam* can also be used in the form of sawn wood.

*Gelam* wood (*Melaleuca cajuputi* Powell) which is widely used for construction materials in South Kalimantan is classified into strong class II and durable wood class III [2]. The chemical composition of gelam wood itself consists of pentosan, cellulose, lignin, and a small amount of subtractive material, with an average density of 0.85. The strength of *gelam* wood itself will increase if it is used in a swamp area that is always submerged, or if it is not exposed to direct sunlight. Until now, the use of *gelam* wood is still very widely carried out in South Kalimantan, especially Banjarmasin City and its surroundings, because the typical type of soil in the area is tidal swamp land which is very suitable for the use of *gelam* wood as foundation construction, especially the foundation of residential buildings. From the results of interviews conducted in related research, information was obtained that for the South Kalimantan area, small *gelam* wood with a diameter of 2 cm to 3 cm is generally used for construction scaffolding, cattle pens, or plant marker poles. Meanwhile, gelam wood with a diameter of up to 10 cm and larger is used as pillars or building foundations for the construction of houses on stilts that require pegs to stilt pillars to resist soil erosion, and as construction material, namely for wooden beams and boards, as well as for making wooden crates in packaging. in freight forwarding, while the remaining wood is used for firewood [3].

The large number of uses of *gelam* wood is due to the large population of *gelam* wood which in the past was abundant and quite easy to find in the peat swamp land of South Kalimantan and other areas. In South Kalimantan itself, the largest producer of *gelam* wood is Barito Kuala District, but it should be noted that the area of the *gelam* forest tends to shrink. This depreciation was mainly caused by several factors such as land conversion into settlements and tidal rice fields. This happens because the product from *gelam* forest is relatively only in the form of *gelam* wood, so it is considered less productive, when compared to products obtained from other forest types such as meranti from mountain forests [4]

**Figure 1**. Gelam Forest in Swamplands

**Figure 2**. *Gelam* wood (*Melaleuca Cajuputi* Powell)

This study tries to provide more detailed information about the use of *gelam* wood as a substructure construction material in South Kalimantan and its surroundings. This is necessary to provide more detailed information regarding what forms of use of *gelam* wood as construction material and why *gelam* wood was chosen for it. This information will later be able to support the preparation of future utilization plans for the use of *gelam* wood considering that currently *gelam* wood is starting to decrease in availability.

## 2. Method

The method to identified the use of *gelam* wood as a substructure construction material is field survey method combine with other references. The area of field survey is Banjarmasin City and Banjar District which *gelam* wood is widely used. The field survey aims to described what kind of form that *gelam* wood is utilize in terms of log diameter and length of *gelam* log. The survey results then compared with other research on the physical and mechanical characteristics of *gelam* wood.

## 3. Results

In general, the Banjarmasin area and its surroundings have a very soft soil structure, because some of the land is inundated by water or influenced by the tides of river water. with a hard soil depth of Banjarmasin City which is at a depth of 28 – 42.4 m [5]. In this case, the use of a suitable foundation for simple buildings is a type of floating foundation with foundation materials that can adapt to the conditions of physical and environmental characteristics of the soft soil. In this case, *gelam* wood is one of the most suitable foundation materials because it is able to adapt to the surrounding conditions [6].

The field survey conducted to obtain what kind of form that *gelam* wood is utilize in terms of log diameter and length of *gelam* log. The result of the field survey is shown in Table 1.

**Table 1.** Log Diameter and Length of gelam log used

| | Type of Building | Location | Log Diameter (cm) | Length (m) |
|---|---|---|---|---|
| **1** | 2-storey house residence | A. Yani Road Km. 11,8, Banjar District | 10-12 | 6 |
| **2** | 1-storey restaurant | A. Yani Road Km. 7,8, Banjar District | 10-12 | 7 |
| **3** | 1-storey house residence | Sunga Bakung Road, Banjar District | 10-12 | 4 |
| **4** | 1-storey house | Sunga Bakung Road, | 10-12 | 4 |

| | | | | |
|---|---|---|---|---|
| | residence | Banjar District | | |
| **5** | 2-storey warehouse | M.T. Haryono Road, Banjarmasin City | 10-15 | 9 |
| **6** | 1-storey house residence | AMD Road, Banjarmasin City | 10-12 | 4 |
| **7** | 1-storey house residence | Sungai Andai Road, Banjarmasin City | 10-12 | 4 |
| **8** | 1-storey house residence | Peradapan Karya Road, Banjarmasin City | 10-12 | 4 |
| **9** | residential fence | Tarakan Road, Banjarmasin City | 10-12 | 3 |
| **10** | scaffolding | Perdagangan Road, Banjarmasin City | 6-8 | 3 |

From the survey results shows in Table 1, for 1-storey house residence the 4 m length gelam wood with diameter 10-12 cm is widely used. For 2-storey building used a 6-9 m gelam wood with 10-15 cm diameter, and for other use such as fence is using a 3 m length gelam wood.

The result from Table 1 shows that *gelam* wood is still widely used, especially for 1-storey house residence, as illustrated in Figure 3. In the city of Banjarmasin and its surroundings, generally the type of piled-*gelam* foundation is used for a 1 (one) floor house made of wood. Recent developments, for concrete buildings using reinforced concrete slab foundations on a pile foundation of cerucuk gelam wood as well. The addition of the *gelam* wood foundation is intended to improve the carrying capacity of the swamp soil [7].

Figure 3. *Gelam* wood foundation for residential houses

Research conducted on residential buildings of the Red Valerian type in the Citra Garden Residence in Banjar District tried to compare the use of a *gelam* wood foundation with a concrete mini pile foundation. The results showed that the bearing capacity of the *gelam* wood foundation was 1368.27 kg with a maximum load received by the pile of 1260.55 kg for the size of the *gelam* wood with a diameter of 10 cm and a length of 6 m. For the same length with a size of 20 cm x 20 cm, the concrete mini pile provides a bearing capacity of 6942.58 kg with a maximum load received by the pile of 6280.03 kg. In this case, the cost needed to make a foundation with *gelam* wood is Rp. 100,079,380,00, while the cost needed to make a mini pile foundation is Rp. 102,837,362.00 [8]. From the results of this study, it can be seen that the cost required for a foundation with *gelam* wood material is still smaller than that of a mini pile concrete foundation for the construction of the same building.

From Table 1 we can also see that 2-storey building is using gelam wood as foundation material. Research conducted on 2 different 3-storey shophouses in Banjarmasin City which experienced structural failure showed that the *gelam* wood foundation used in structural calculations was able to carry the load of the 3-storey shophouse [9] [10]. Another research based on the results of the ANSYS software modeling also shows that *gelam* wood foundation itself is in principle able to withstand the load of high-rise buildings, as long as it is planned properly [11].

When talking about *gelam* wood as a construction material, the bearing capacity of the pile is an important factor in the use of *gelam* wood as a construction material, especially for pile foundations. A laboratory-scale study that combines *gelam* wood pile with woven bamboo in peat swamp soil has given very satisfactory results as an alternative to soil reinforcement. The research was conducted by comparing the bearing capacity of the *gelam* wood pile without bamboo woven reinforcement and with woven bamboo. The results of laboratory tests showed that the maximum soil bearing capacity for the *gelam* wood pile without woven bamboo reinforcement was 39.33 kPa with the variation of the *gelam* wood pile slanted on the left and right sides of the foundation. Reinforcement with *gelam* wood pile combined with 3 layers of woven bamboo itself was able to increase the bearing capacity of the soil up to almost 10 times the condition without woven bamboo reinforcement. This shows that the use of *gelam* wood pile, either with woven bamboo or not, is able to increase the bearing capacity of the foundation on peat soil [12].

In addition to laboratory-scale research, previous studies have also conducted field loading tests to see the ultimate strength of the single pile bearing capacity of the *gelam* wood foundation. The study was conducted in a location which is a soft soil that has a highly water content and is dominated by peat soil using a sample of *gelam* wood foundation piles with a diameter of 12 cm and 14 cm and a length of 3.5 m. The applied load uses a dead load of press brick material by giving the load gradually until the pile settlement reaches 10% of the diameter of the pile. The results showed that the ultimate bearing capacity of *gelam* wood ranged from 567.75 kg to 729.25 kg for 12 cm and 14 cm diameter and 3.5 m length. The results of this study indicate that the *gelam* wood foundation is the right material for soft soil because it is able to transmit the load through the attachment of the pile blanket to the soil [13]

The survey result also shows that *gelam* wood used as foundation for fence, which is to withstand not an axial load, but rather lateral load. The ability of *gelam* wood to withstand lateral forces or horizontal ground movements is closely related to the flexural strength of *gelam* wood itself. Research on the flexural strength of wood using a method based on SNI 03-3959-1995 [14] and ASTM D-198 [15] which compares the flexural strength of *gelam* wood and *sengon* wood shows that the average flexural strength of *gelam* wood is 100.13 MPa and is higher than the average flexural strength. The average of *sengon* wood is 82.62 MPa. In addition, the results of the loading modeling on a simple house structure with the help of the SAP 2000 software show that the flexural stress capacity possessed by *gelam* wood and *sengon* wood is still greater than the flexural stress that must be resisted due to the combination of loading in simple building modeling. This indicates that *gelam* and sengon wood have the potential to be used in simple construction such as simple roof trusses [16].

Besides being used to carry vertical or axial loads such as in building foundations, *gelam* wood is also used as soil reinforcement in resisting soil slides due to lateral forces or horizontal movements of the soil layer, as illustrated in figure 4. Research conducted by regarding the prevention of landslides on road embankments using gelam wood sheet pile walls stated that the effect of strengthening gelam wood sheet pile walls increased soil stability and reduced the occurrence of landslides [17]. The results of this study are in agreement with other studies that use wooden chimneys to increase the shear strength of soft soils where the use of wooden crevices can increase the shear strength of the soil. In this case, the results of the study indicate that the longer the wood recess is used, the strength (shear resistance) of the soil increases [18].

**Figure 4**. Gelam wood as lateral reinforcement

The survey result also shows that gelam wood is also widely used as a supporting material for building construction, namely as wooden scaffolding, as illustrated in Figure 5. Related research compares the budget for the use of scaffolding made of *gelam* wood with scaffolding made of iron. This research was motivated by the availability of *gelam* wood in Banjarmasin which is increasingly scarce, so that alternative materials are needed that are more durable, easy to obtain and can be used repeatedly as scaffolds. One of them in this case is the iron scaffolding. The location for data collection is the construction of the Central Statistics Agency (BPS) South Kalimantan Province on Trikora Road Banjarbaru and a 3-floor shophouse on Benua Anyar Road, Banjarmasin. From the results of the study, it was found that the cost of work for *gelam* wood scaffolding was 26.85% cheaper than iron scaffolding in the rental price. and 15 times the cost of iron scaffolding in the purchase price [19]. However, it should be noted that iron scaffolding can be used over and over again, while gelam wood scaffolding can only be used during one construction work period. In addition to scaffolding, in the city of Banjarmasin itself, *gelam* wood is also used for road pavement foundations, pond foundations, and many other types of construction.

**Figure 5**. Use of gelam wood as a scaffolding

## 4. Conclusion

Based on these previous studies, conclusion of this study can be given as follows:

1. *Gelam* wood with a large diameter of 10-12 cm and a length of 4 m is generally used as a 1-storey house residence foundation with an ultimate bearing capacity of 729.25 kg for 1 pile foundation.
2. In terms of cost, the foundation with *gelam* wood material is still smaller than the mini pile concrete foundation for the construction of the same building.
3. For 2-storey house building, the gelam wood used is a 6-9 m gelam wood with 10-15 cm diameter
4. Large size gelam wood is also used as fence or retaining wall with an average flexural strength of 100.13 MPa of gelam wood.
5. Small-sized *gelam* wood is generally used as wooden scaffolding where the work cost of galam wood scaffolding is 26.85% cheaper than iron scaffolding in the rental price. and 15 times the cost of the iron scaffold in the purchase price.

**References**

[1] Banjarbaru Environmental and Forestry Research and Development Center. 2020. *Komoditas Paludikultur Di Kalimantan*. IPB Press. C.01/06.2020
[2] Ministry of Forestry, 2003. *Budidaya kayu Putih* (*Melaleuca cajuputi*) (silviculture of *kayu putih*). Departemen Kehutanan, Jakarta. 29p.
[3] Arifin, Y. F., Hamidah, S., Arifin, Y. F 2014. The Analysis of Management and Timber Trade System of *Gelam* (*Melaleuca cajuputi*) From Peat Swamp Forest in South Kalimantan. Journal of Wetlands Environmental Management 2, 79 – 83.
[4] Raja, O. 2010. *Hutan Galam atau Kayu Galam* [Online]. Available: http://onanraja.blogspot.com/2010/09/hutan-galam-atau-kayu-galam.html [Accessed 27 Januari 2021 2021].
[5] Ma'ruf, M. A., Rusliansyah, Fitriati, U., & Rachman, A. A. 2019. Digital Mapping of Hard Soil Depth in Banjarmasin City. International Journal of Engineering and Technology, 11, 316–320.
[6] Masitah, M., A.R. Shamsul Bahri, Jamilah M.S. And Salwani Ismail 2014. Histological observation of Gelam (Melaleuca cajuputi Powell) in different ecosystems of Terengganu. Journal of Biology, Agriculture and Healthcare, 4.
[7] Nurfansyah, M. I. S., Prima Widya Wastuti, Ahmad Qurrata Aini, & Nursyarif 2020. *Perkembangan Pondasi Tiang Kayu Pada Rumah Tinggal Di Banjarmasin*. Info-Teknik 21, 199-214.
[8] Rifky, A. 2014. *Studi Perbandingan Pondasi Kayu Galam Dan Mini Pile Pada Bangunan Perumahan Tipe Red Valerian Komplek Citra Garden Banjarmasin*. Jurnal Rekayasa Sipil 2.
[9] Marzuki, A., Alpiannor. *Evaluasi Kegagalan Pondasi Pada Gedung Bertingkat (Studi Kasus: Proyek Pembangunan Ruko 3 Lantai – Banua Anyar Banjarmasin*). Seminar Nasional Geoteknik 2016 PS S1 Teknik Sipil Unlam, 01 Oktober 2016 2016 Banjarmasin. Teknik Sipil Unlam.
[10] Mulyana. 2021. *Studi Daya Dukung Pondasi Kayu Galam Pada Bangunan Ruko Yamaha Di Jalan Ahmad Yani Km.2,5 Kota Banjarmasin*. Diploma, Universitas Islam Kalimantan MAB.
[11] Anggraini, E., Irwandy Muzaidi 2020. *Pemodelan Perilaku Keruntuhan Balok Tinggi Akibat Penurunan Pondasi Di Atas Tanah Lunak Kota Banjarmasin Menggunakan Metode Elemen Hingga 3D*. Jurnal Konstruksia, 11.
[12] Dewi, R., Yulia Hastuti, Yulindasari Sutejo, Maulid M. Iqbal, Muhammad Arfan 2020. Peat Soil Improvement Method Using Woven Bamboo and Cerucuk. International Journal on Advance Science Engineering Information Technology, 10.
[13] Khaliq, A. 2014. *Penentuan Beban Batas Tiang Galam Dengan Loading Test*. Jurnal Poros Teknik, 6.
[14] National Standardization Body. 1995. SNI 03-3959-1995. *Metode Pengujian Kuat Lentur Kayu Di Laboratorium*

[15] American Society For Testing And Materials. 2016. Standard Test Methods of Static Tests of Lumber in Structural Sizes. ASTM D 198 - 15.
[16] Basyaruddin, A. S., Jatmoko Awali 2019. *Potensi Pemanfaatan Kayu Gelam Dan Kayu Sengon Dalam Dunia Konstruksi Berdasarkan Uji Kuat Lentur*. Jurnal Rekayasa Sipil, 13.
[17] Gazali, A. *Analisis Penanggulangan Longsoran Pada Tepi Timbunan Jalan Menggunakan Perkuatan Dinding Turap Galam Di Daerah Rawa Kabupaten Barito Kuala*. Seminar Nasional Tahunan VI Program Studi Magister Teknik Sipil ULM, 26 Oktober 2019 2019 Banjarmasin. Program Studi Magister Teknik Sipil ULM.
[18] Rusdiansyah. *Asumsi Sistem Cerucuk Sebagai Alternatif Solusi Dalam Penanganan Kelongsoran Lereng Jalan Diatas Tanah Lunak*. Seminar Nasional Geoteknik 2016 PS S1 Teknik Sipil Unlam, 1 Oktober 2016 2016 Banjarmasin. Teknik Sipil Unlam.
[19] Rafik, A., Rinova Firman Cahyani 2018. *Analisis Perbandingan Biaya Penggunaan Perancah Kayu Galam Dan Perancah Besi* (Scaffolding). Jurnal Gradasi Teknik Sipil, 2.

# Gelam Wood (Melaleuca cajuputi Powell) as a Substructure Construction Material

ORIGINALITY REPORT

| 17% | 16% | 12% | % |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

MATCH ALL SOURCES (ONLY SELECTED SOURCE PRINTED)

7%

★ elibrary.kdpu.edu.ua

Internet Source

| | | | |
|---|---|---|---|
| Exclude quotes | On | Exclude matches | < 1% |
| Exclude bibliography | On | | |