

Comparison Of Flexural Strength Of Wulung Bamboo Reinforced Concrete Beam As A Substitute For Iron Reinforced

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Article Info	ABSTRACT
Article history: Received Oktober 6, 2026 Revised Oktober 6, 2026 Accepted Oktober 6, 2026 Keywords: Strong flexible, Reinforced bamboo, Reinforcement iron	Concrete bony is one of the material the most popular construction in the civil world and many used in development infrastructure such as buildings, bridges , roads , even House settlement citizens and others. In a number of decade in the era of welcoming Golden Indonesia 2045, the challenges industry construction concrete bony the more complex , so that demands improvement production concrete bony the more high . With development technology concrete bony so the more many ideas and innovations are used For increase quality concrete boned . One of the its innovation that is with using material replacement that is reinforcement bamboo black hair as replacement reinforcement iron . In the study This writer innovate make bamboo black hair as replacement reinforcement iron . Research This aim For know strong flexible beam reinforcement bamboo black hair as substitute . Research This done with compare beam concrete normal with reinforcement bamboo wulung and reinforcement iron . Research This referring to SNI 03- 2834- 2000 concerning Procedures Making Plan Normal Concrete . Based on results study can be concluded that mark strong press concrete normal $F_c' 25$ is 465.9 KN, or 26.36 MPa, strong flexible beam Normal concrete , namely : 27.9 KN or 1.24 MPa, strong flexible concrete reinforcement bamboo namely : 31.4 KN or 1.39 MPa, strong flexible Beam Concrete reinforcement iron namely : 53.85 KN or 2.39 MPa.

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1. INTRODUCTION

Indonesia has set the vision of Golden Indonesia 2045 which aims For make Indonesia a developed and prosperous country in 2045 and at the same time to become an independent country . To reach vision This development infrastructure that strong and sustainable be one of priority main . Concrete bony is one of the material the most popular construction used in development infrastructure such as buildings, bridges , roads , even House settlement citizens and others.

In development infrastructure specifically concrete boned , requires innovation use fulfil need said . One of the material reinforcement potential concrete big For replace steel is bamboo bamboo black hair is is type plant which is very easy to get in Indonesia and has role important in economy especially in rural areas . [1]–[5].

Based on SNI 03-4431-2011 concerning " Strength Test Method" Flexible Normal Concrete with Two point Loading as reference For testing strong flexible Beam concrete reinforced bamboo bamboo black hair Alone own characteristics strong enough flexibility high , so that often used as structural materials especially in construction friendly environment . Based on SNI 8020: 2014 bamboo black hair have types and characteristics as as follows : diameter 100mm, height 15m, thickness walls 10mm to 15mm. [2], [6], [7].

2. METHODS

2.1 Experimental Design

Research was conducted use method experiments in the laboratory , the test objects to be using beam with size 15 cm x 15 cm x 60 cm.. Study This use material plus that is reinforcement bamboo and materials reinforcement iron . And strong press concrete normal cylinder normal Fc'25 with size 15x30 cm. Quantity sample 7 days , 14 days , and 28 days concrete , 3 samples each , Testing this is done For know strong flexible beam concrete to be examined with add reinforcement bamboo.and strong press normal concrete Fc"25.

Table 1. Concrete Beam Test Specimens

No	Test Specimen Sample Concrete (Beam)	7 days	14 days	28 days	Number of Test Objects
1	Strength Test Flexible Size 15 x 60 cm, Normal Concrete	3	3	3	9
2	Strength Test Flexible Size 15 x 60 cm, Reinforced Bamboo Wulung	3	3	3	9
3	Strength Test Flexible Size 15 x 60 cm, Reinforced Iron	3	3	3	9
					18

Table 2. Normal Concrete Cylinder Test Specimens

No	Concrete Test Specimen Samples Normal Cylinder	7 days	14 days	28 days	Number of Test Objects
1	Strength Test press Concrete Size 15 x 30 cm	3	3	3	9
2	Strength Test press Concrete Size 15 x 30 cm	3	3	3	9
3	Strength Test press Concrete Size 15 x 30 cm	3	3	3	9
					18

Source: Research data processing, 2025

2.2 Research Procedure

In the research this stage beginning prepare ingredients like sand , gravel , cement, water and bamboo black hair as reinforcement . Next The test was conducted at the PT. Adhimik RMC laboratory , Sentul Plant, Jl. Raya Babakan Madang , Bogor Regency , West Java . Then do mix design using application Microsoft Excel software, as well as do trial mix process, if the slump test results are in accordance plan so the manufacturing process will continue sample printed test objects use mold beam concrete or Beam measuring 15 x 15 x 60cm and using Mold cylinder size 15 x 30 cm. After the concrete is dismantled from mold for 24 hours then done immediately soaking (curing) until the appointed day so concrete will be tested for strength flexible and for cylinder concrete strength test press . And get results for analysis so that it is obtained conclusion

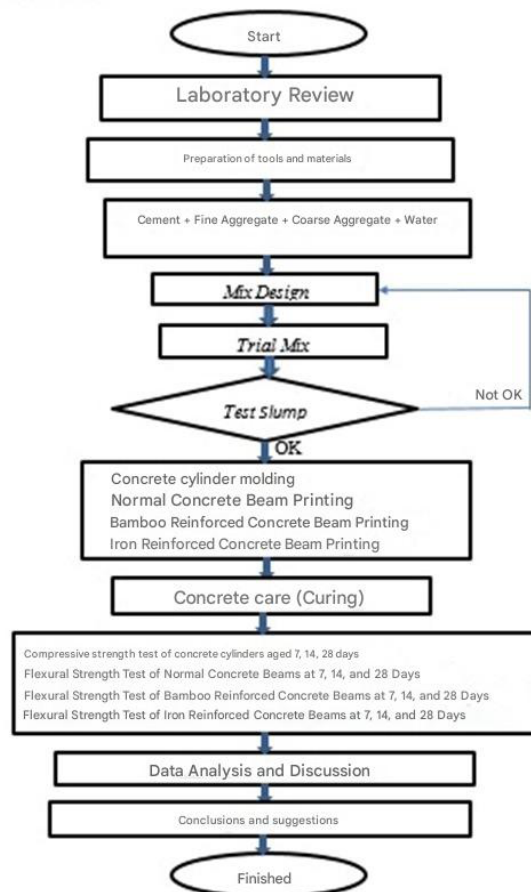


Figure 1. Research Flow
Source: Research documentation 2025

3. RESULTS AND DISCUSSION

Tests conducted in the research This covering inspection aggregate like analysis sieve , weight type , analysis gradation and testing wear and tear Aggregate / crushed stone use Los Angeles engine . Testing slump in the mixture concrete or mix design and testing strong flexible beam concrete and strong press concrete use compression testing machine on samples test object .

3.1 Normal Concrete Mix Design

Mixdesign Quality Normal concrete $f_c' 25$ (Mpa). The provisions normal concrete as following:

1. Planned concrete quality = $f_c' 25$ (MPa)
2. Concrete used in room / non-corrosive
3. Slump Height = 10 ± 2 cm
4. Test Object (beam) = $15 \times 15 \times 60$ cm
5. Cement type = Type 1
6. Item Aggregate Maximum = 40 mm
7. Specific gravity of sand (SSD) = 2.61 grams
8. Heavy Type Aggregate (SSD) = 2.57 grams
9. Water-cement free factor = 0.470
10. Planned concrete = 33.2 Mpa ($f_c'r = f_c' + (1.64 \times S) = 25 + (1.64 \times 7) = 33.2$ Mpa)
11. Free Water Content: Free water content For aggregate No broken sand 175 kg/m^3 ; Free Water Content For aggregate in crushed stone split 205 kg/m^3 ; Free water content = $(2/3 \times 175) + (1/3 \times 205) = 185 \text{ kg/m}^3$

12. Cement water content = $185/0.470 = 393.6 \text{ kg/m}^3$
13. Aggregate Combined presentation aggregate fine = $(30\% + 40\%)/2 = 35\%$
14. Presentation Aggregate rough = $100\% - 35\% = 65\%$
15. Heavy type aggregate combined = $(35\% \times 2.61) + (65\% \times 2.57) = 2.584$

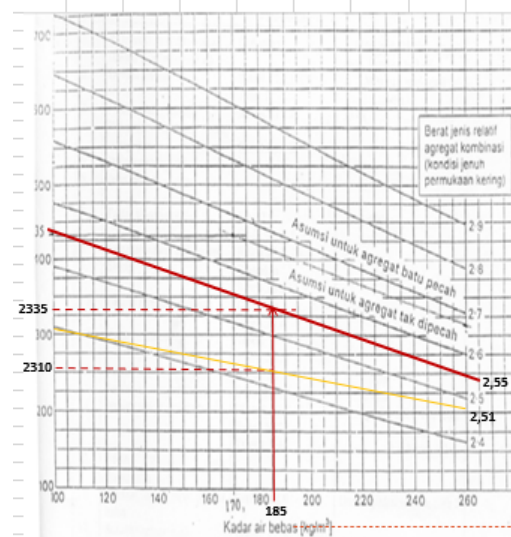


Figure 2. Chart Heavy Content Normal Concrete
Source: SNI 03-2834-2000

Planning normal concrete $f_c'25$

Heavy content concrete = $2335 - 393.6 - 185 = 1,756.4 \text{ Kg/m}^3$

Total Aggregate Fine = $36\% \times 1,756.4 \text{ Kg/m}^3 = 632.304 \text{ Kg/m}^3$

Total Aggregate Coarse = $64\% \times 1,756.4 \text{ Kg/m}^3 = 1,124.1 \text{ m}^3$

From the results calculation furthermore recapitulation planning mixture concrete can be seen in table 4.8 below This :

Table 3. Recapitulation Planning Mixture Normal Concrete

Information	Cement (kg)	Water (kg)	Aggregate Fine (kg)	Aggregate Rough (kg)
Proportion mixture Theoretical	2.09	0.98	3.35	5.96
Every m^3	393.6	185	632.3	1124.1
Every Test mix: 0.0159 m^3	$0.0159 \times 393.6 = 6.26$	$0.0159 \times 185 = 2.94$	$0.0159 \times 632.3 = 10.05$	$0.0159 \times 1124.1 = 17.87$

Source: Research Results 2025

Based on the calculations above , then we get mark proportion mixture manufacturing normal concrete at the following 4.11 level This .

Table 4. Proportion Mixture Normal Concrete

Information	Normal
Cement	6.25
Water	2.94
Aggregate Fine	10.0
Aggregate Rough	17.87

Source: Research Results 2025

From the results the calculation above have been done measure slipperiness or viscosity of the mixture fresh concrete . The slump value that has been carried out can be seen in table 4.12 below This :

Table 5. Slump Value

Sample	Slump value	Unit
Normal Concrete	10	cm
Concrete Variation 1	10	cm
Concrete Variation 2	10	cm
Concrete Variation 3	10	cm

Source: Research Results 2025

3.2 Compressive Strength of Normal Concrete

Based on SNI 1974-2011, it stipulates the procedures for strength testing . press concrete with cylindrical test object For testing strength press concrete . The following results testing strong press Concreting was carried out on test objects aged 7 days , 14 days and 28 days . Testing done with pressure tester concrete , which uses reading on the tool with unit kN and digital display , as shown in table 4.13

Table 6. Recapitulation of Test Results Strong Press Normal Concrete

No	Code Test Object	Age	Slump (cm)	Weight of Test Object	Burden (KN)	Strong Press Concrete (Kg/cm ²)	Average Burden (KN)
1	Fc'25	7	10	12.15	295	205.10	291.9
2	Fc'25	7	10	12.23	288.8	200.79	291.9
3	Fc'25	14	10	12.27	390.8	271.70	391.75
4	Fc'25	14	10	12.27	392.7	273.02	391.75
5	Fc'25	28	10	12.15	480.8	334.27	465.9
6	Fc'25	28	10	12.28	451.0	313.56	465.9

Source: Research Results 2025

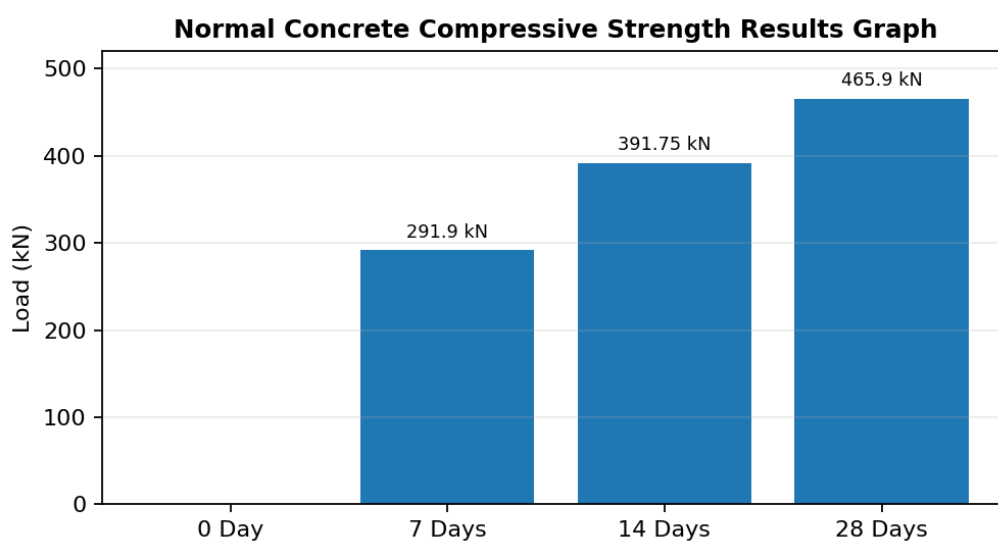


Figure 3. Normal Concrete Compressive Strength Results Graph

Source: Research Data 2025

Testing Strong Flexible Referring to SNI 1974 – 2011 concerning Strength Test Procedures Flexible Concrete with Beam Test Object or Beam , calculation strong flexible concrete use formula :

$$f_s = a\sqrt{f_c}$$

Information -

f_s = Strong Flexible concrete (Mpa)

f_c = Strong press concrete (Mpa)

A = Constant

3.3 Flexural Strength of Concrete Beams

Testing strong flexible concrete carried out on test objects at the ages of 7 days , 14 days and 28 days with use pressure tester concrete (Flexure Testing Machine) With reading on the tool use KN units and digital display . Test results strong flexible beam can be seen in table 4.14 to Table 4.16 and figure 4.8 below This

Table 7. Recapitulation of Test Results Strong Flexible Normal Beam

No	Code Test Object	Age	Slump (cm)	Weight of Test Object	Burden (KN)	Stretch Flexural Strength (Kg/cm ²)	Average Load (KN)
1	K-300	7	10	31.10	19.9	27.06	19.7
2	K-300	7	10	31.16	19.5	26.51	19.7
3	K-300	14	10	31.46	22.1	30.05	22.75
4	K-300	14	10	31.35	23.4	31.81	22.75
5	K-300	28	10	31.54	28.2	38.34	27.9
6	K-300	28	10	31.49	27.6	37.53	27.9

Source: Research Results 2025

Table 8. Recapitulation of Test Results Strong Flexible Beam + Reinforcement Bamboo Wulung

No	Code Test Object	Age	Slump (cm)	Weight of Test Object	Burden (KN)	Stretch Flexural Strength (Kg/cm ²)	Average Load (KN)
1	K-300	7	10	30.82	24.5	27.06	25.5
2	K-300	7	10	31.28	26.5	26.51	25.5
3	K-300	14	10	31.46	27.3	37.12	28.4
4	K-300	14	10	31.35	29.5	40.11	28.4
5	K-300	28	10	31.98	30.2	41.06	31.4
6	K-300	28	10	31.70	32.6	44.32	31.4

Source: Research Results 2025

Table 9. Recapitulation of Test Results Strong Flexible Beam + Reinforcement Iron

No	Code Test Object	Age	Slump (cm)	Weight of Test Object	Burden (KN)	Stretch Flexural Strength (Kg/cm ²)	Average Load (KN)
1	K-300	7	10	33.16	47.1	64.04	47.55
2	K-300	7	10	33.00	48	65.26	47.55

No	Code Test Object	Age	Slump (cm)	Weight of Test Object	Burden (KN)	Stretch Flexural Strength (Kg/cm ²)	Average Load (KN)
3	K-300	14	10	34.14	49.3	67.03	49.7
4	K-300	14	10	33.80	50.1	68.12	49.7
5	K-300	28	10	33.12	53.6	72.88	53.85
6	K-300	28	10	33.23	54.1	73.56	53.85

Source: Research Results 2025

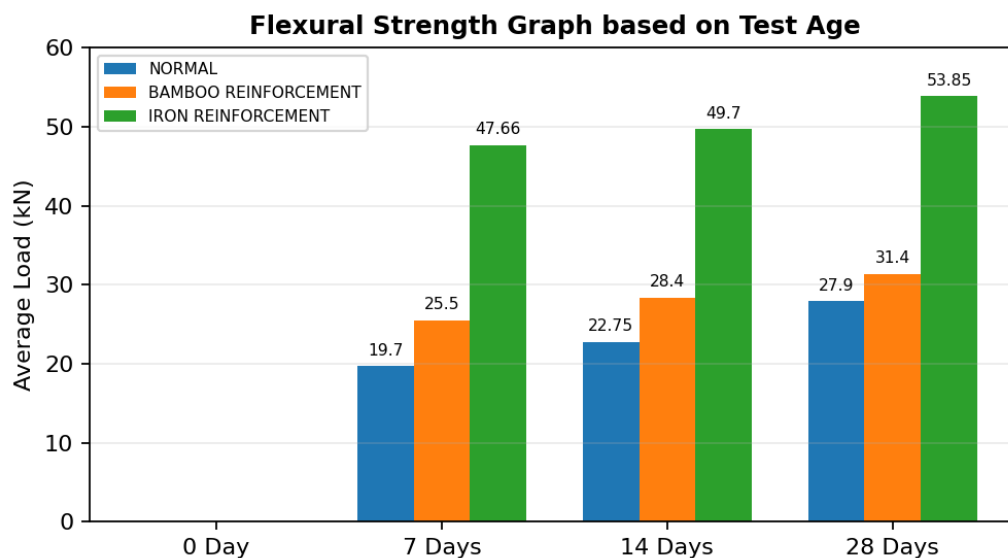


Figure 4. Flexural Strength Graph based on Test Age

Source: Research Data 2025

On the graph combination at each age above , can known strong flexible normal concrete with added concrete reinforcement bamboo black hair and reinforcement iron Keep going experience increase strong flexible beam . [1], [3], [8]–[10].

4. CONCLUSION

Based on results study mark strong flexible beam normal concrete at the age of 28 days of 27.9 KN or 1.24 Mpa , reinforcement bamboo black hair of 31.4 KN or 1.39 MPa, and reinforcement iron of 53.85 KN or 2.39 MPa, and strong press concrete cylinder normal concrete is 465.9 KN or 26.36 MPa, Based on results study can compared to that : mark strong flexible beam concrete reinforcement iron show own strong flexible more tall from reinforcement bamboo wulung . However Good reinforcement iron and reinforcement bamboo black hair both of them No reach minimum strength limit flexible concrete reinforced $f_c'25$ MPa is around 3.1 MPa according to SNI 2847: 2019. and strong press concrete cylinder concrete normal of 26.36, exceeding minimum limit of 25 MPa

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