STUDY OF QUALITY COMPARISON OF LOCAL WOOD BETWEEN LABORATORY TEST RESULTS WITH ANALYSIS OF SNI 2847-2002 AND SNI 7973-2013

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Abstract. Wood is one of Indonesia's natural resources which is a construction element that is easily accessible and available in relatively large quantities. In the construction section, wood is widely used in every function of the building, from preparation to finishing. The research this time aims to determine the strength / quality value of whole wood test results in the laboratory with wood quality based on SNI 2847-2002 and SNI 7973-2013. Types of tests carried out include parallel tensile strength testing, compressive strength parallel to fibers, flexural strength and shear strength. The test objects for each test were 3 pieces with 5 kinds of wood. The wood is Sengon, Bangkirai, Kruwing, Kamper, and Jackfruit from Solo Raya. The results of mechanical testing in the laboratory are compared with the SNI 2847-2002 analysis starting from 14.48% to 87.07%, and with SNI 7973-2013 analysis from 5.30% to 26.39%. From these results provide knowledge that the use of SNI 7973-2013 analysis is closer to the results of mechanical testing in the laboratory than the use of SNI 2847-2002 analysis.

Key words: wood tensile strength, wood compressive strength, wood shear strength, wood flexural strength, test laboratory, SNI 2847-2002 and SNI 7973-2013.

1. Introduction

Indonesia is an agricultural country, where many trees grow in it. With so many trees, it has the potential to use wood from these trees for building structures.

There are many kinds of wood obtained in Indonesia, including wood from teak, mahogany, johar, johar, meranti, Sengon, Bangkirai, Camphor, Kruwing, and jackfruit, so they are called teak, mahogany, johar, johar, meranti wood, Sengon wood, Bangkirai wood, Camphor wood, Kruwing wood, and Jackfruit wood.

Regulations on the use of wood for structural building have undergone changes, starting with the PKKI in 1971 which refers to the name of the tree by using the specific gravity of the wood to determine the strength of the wood, both compressive strength, tensile strength, shear strength and flexural strength. Then go to SNI 2847-2002 wood regulations where the reference for the modulus of bending elasticity is at least 9000 MPa. Now, the most recent wood regulation appears, namely SNI 7973-2013 wood regulations, where the reference changes with the reference modulus of flexural elasticity of at least 5000 MPa.

In order to provide assurance to meet the requirements as structural wood to wood users in the construction of structural buildings, it is necessary to test the wood in the market by means of laboratory tests / direct comparison / comparison by means of analysis based on SNI 2847-2002 and SNI 7973-2013 . The wood materials used are those from the material shop in Surakarta. The things that are compared are flexural strength, tensile strength, compressive strength parallel to the fibers and shear strength. In addition, it is also to determine the density of wood, moisture content and the smallest and largest modulus of elasticity.

2. Method

2.1 Material and equipment

The wood used in this research is wood that is commonly used in the construction of structures, namely teak, mahogany, johar, johar, meranti, sengon, bangkirai, camphor wood, kruwing wood, and jackfruit wood from shops. material in the city of Surakarta. The size is 50 mm x 50 mm x 500 mm, with 3 specimens each and the results are averaged. And the equipment used in this study are as follows: Digital scales, used to weigh the weight of materials. Ovens are used to dry wood in testing moisture content. Rulers and calipers are used to measure the dimensions of wood. Steel clamp tools are used to clamp wood in the tensile strength and shear strength tests. Wood cutting tools are used to cut wood into desired parts. The Universal Testing Machine is used to test the tensile strength, compressive strength, shear strength and flexural strength of wood. Other aids, such as stationery, rulers, research forms, digital cameras and others.

2.2. Research Stages
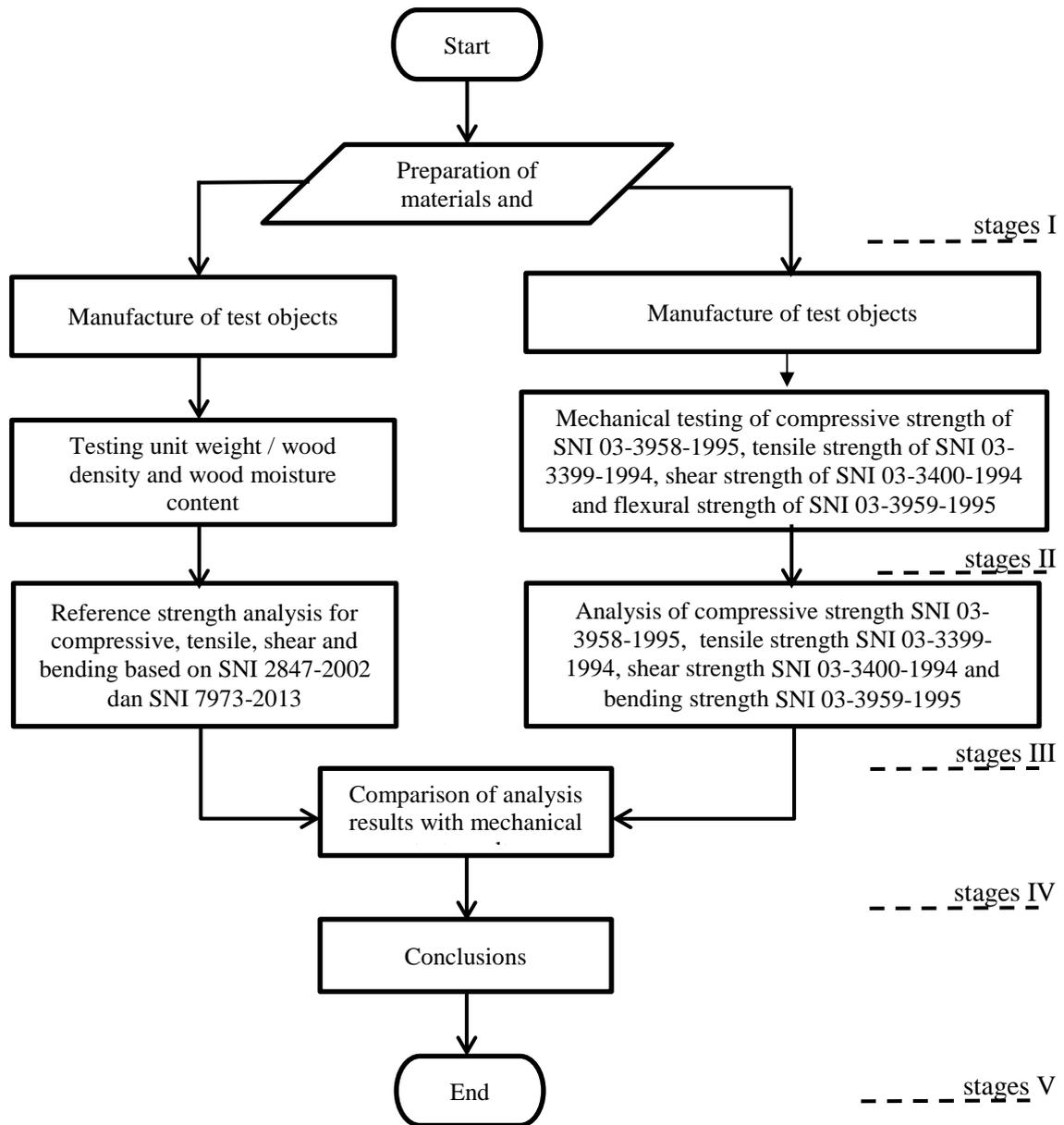The stages of the complete research implementation are as follows:

Figure 1. Flowchart of research stages

3. Results and Discussion

The test results of wood density and moisture content in the laboratory are used to calculate the modulus of elasticity. Furthermore, the value is used as a reference for analysis based on the SNI 2847-2002 and SNI 7973-2013 references to obtain the permit strength / resistance reference for tensile parallel to the fibers, parallel compression of the fibers, bending and shear. The average results of the analysis are compared with the results of the direct test of wood in the laboratory by testing the tensile parallel to the fibers, parallel compression of the fibers, bending and shear. Seen in Figures 1, 2, 3 and 4. The comparison results are shown in tables 2, 3, 4 and 5.

Figure 2. Mechanical testing of tensile wood parallel to fibers in the laboratory

Figure 3. Mechanical testing of wood press parallel to fibers in the laboratory

Figure 4. Mechanical bending of wood in the laboratory

Figure 5. Mechanical shear testing in the laboratory

Table 1. Comparison of the results of the tensile strength test with reference strength based on SNI 2847 2002 and SNI 7973: 2013

Wood type	Tensile strength			Comparison of Wood Test Results in the Lab mechanic test with SNI 2847 2002 (%)	Comparison of Wood Test Results in the Lab mechanic test with SNI 7973-2013 (%)
	Based on SNI 2847 2002 (MPa)	Based on SNI 7973-2013 (MPa)	Based on mechanic test in Laboratorium (MPa)		
Jati	24.12	8.99	168.57	14.31	5.33
Mahoni	18.41	6.72	151.17	12.18	4.45
Johar	27.12	10.11	160.75	16.87	6.29
Akasia	21.12	7.68	120.54	17.52	6.37
Meranti	21.12	7.68	151.9	13.90	5.05
Sengon	16.41	5.89	117.11	14.01	5.03
Bangkirai	32.41	11.88	280.77	11.54	4.23
Kruwing	21.12	7.68	148.46	14.22	5.17
Kamper	24.12	8.99	197.15	12.23	4.56
Nangka	21.12	7.68	117.4	17.99	6.54
Difference average				14.48	5.30

Table 2. Comparison of the results of the compressive strength test with reference strength based on SNI 2847 2002 and SNI 7973: 2013

Wood type	Compressive strength			Comparison of Wood Test Results in the Lab mechanic test with SNI 2847 2002 (%)	Comparison of Wood Test Results in the Lab mechanic test with SNI 7973-2013 (%)
	Based on SNI 2847 2002 (MPa)	Based on SNI 7973-2013 (MPa)	Based on mechanic test in Laboratorium (MPa)		
Jati	27.71	8.99	22.25	124.50	40.39
Mahoni	24.71	6.72	36.20	68.25	18.57
Johar	29.41	10.11	32.59	90.25	31.01
Akasia	26.41	7.68	38.43	68.73	19.98
Meranti	26.41	7.68	22.97	114.96	33.41
Sengon	23.71	5.89	24.43	97.05	24.10
Bangkirai	32.41	11.88	61.48	52.72	19.32

Kruwing	26.41	7.68	42.07	62.78	18.25
Kamper	27.71	8.99	28.65	96.69	31.37
Nangka	26.41	7.68	27.87	94.77	27.54
Difference average				87.07	26.39

Table 3. Comparison of the results of the bending strength test with reference strength based on SNI 2847 2002 and SNI 7973: 2013

Wood type	Bending strength			Comparison of Wood Test Results in the Lab mechanic test with SNI 2847 2002 (%)	Comparison of Wood Test Results in the Lab mechanic test with SNI 7973-2013 (%)
	Based on SNI 2847 2002 (MPa)	Based on SNI 7973-2013 (MPa)	Based on mechanic test in Laboratorium (MPa)		
Jati	25.82	10.16	71.85	35.94	14.14
Mahoni	19.41	7.66	55.95	34.69	13.70
Johar	29.12	11.45	74.55	39.06	15.35
Akasia	22.12	8.75	77.96	28.37	11.22
Meranti	22.12	8.75	51.26	43.14	17.06
Sengon	17.12	6.63	47.14	36.31	14.06
Bangkirai	34.12	13.45	127.23	26.81	10.57
Kruwing	22.12	8.75	76.40	28.95	11.45
Kamper	25.82	10.16	71.57	36.08	14.19
Nangka	22.12	8.75	71.85	30.78	12.17
Difference average				34.01	13.39

Table 4. Comparison of the results of the shear strength test with reference strength based on SNI 2847 2002 and SNI 7973: 2013

Wood type	Shear strength			Comparison of Wood Test Results in the Lab mechanic test with SNI 2847 2002 (%)	Comparison of Wood Test Results in the Lab mechanic test with SNI 7973-2013 (%)
	Based on SNI 2847 2002 (MPa)	Based on SNI 7973-2013 (MPa)	Based on mechanic test in Laboratorium (MPa)		
Jati	4.74	1.19	9.79	48.42	12.19
Mahoni	4.44	0.90	14.89	29.82	6.05
Johar	4.87	1.35	13.06	37.28	10.32
Akasia	4.57	1.02	9.07	50.39	11.27
Meranti	4.57	1.02	9.02	50.69	11.33
Sengon	4.24	0.78	8.77	48.34	8.86
Bangkirai	5.17	1.58	14.12	36.63	11.18
Kruwing	4.57	1.02	12.17	37.57	8.40
Kamper	4.74	1.19	8.51	55.74	14.04
Nangka	4.57	1.02	12.12	37.71	8.43
Difference average				43.26	10.21

Table 5.The average difference between the comparison of wood test results in the lab with SNI 2847-2002 and SNI 7973-2013

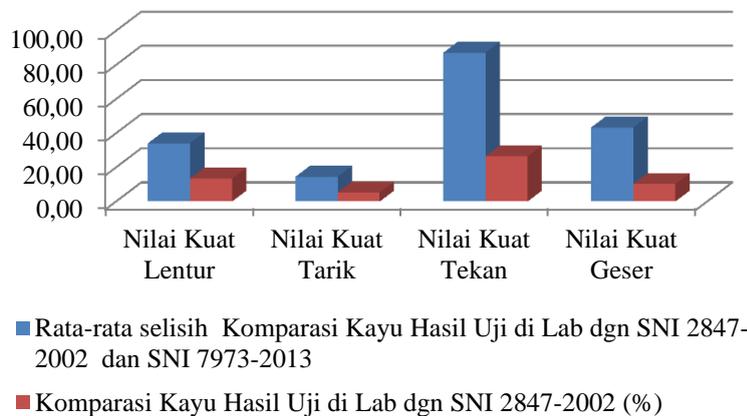| Difference average	Comparison of Wood Mechanical Test Results in the Lab with SNI 2847-2002 (%)	Comparison of Wood Mechanical Test Results in Lab with SNI 7973-2013 (%)
Flexure strength	34.01	13.39
Tensile strength	14.48	5.30
Compressive strength	87.07	26.39
Shear strength	43.26	10.21

Figure 6.The average histogram difference between the comparison of wood from laboratory test results with SNI 2847-2002 and SNI 7973-2013

4. Conclusions

From the results of the research and discussion regarding the comparison of the quality strength / resistance value of wood references based on SNI 2847-2002 and SNI 7973-2013 with the results of direct laboratory testing mechanically with wood test objects in the Surakarta area, it can be concluded as follows:

- There is a large difference in the percentage value between the results of the mechanical strength / resistance testing of the reference wood in the laboratory and the results of the analysis based on SNI 2847-2002 and SNI 7973-2013.
- Comparative results from mechanical testing in the laboratory with SNI 2847-2002 analysis ranging from 14.48% to 87.07%, and with SNI 7973-2013 analysis from 5.30% to 26.39%. From these results provide knowledge that the use of SNI 7973-2013 analysis is closer to the results of mechanical testing in the laboratory than the use of SNI 2847-2002 analysis.
- This study did not look at damage or cracks of specimens.
- For the use of wood in the construction sector, it is necessary to test in the laboratory first in order to obtain the true strength of the wood, so that the strength of the wood structure is close to that of the planned wood.

References

Anonim, 2015, *Keruing*, www.wikipedia.com/keruing

Ardiansyah R., 2010, *Penggunaan Kayu Kampung*, https://ronymedia.wordpress.com/2010/05/19/penggunaan-kayu-kampung/

Asyraaf, 2016, *16 Jenis Kayu Indonesia yang Perlu Kita Ketahui*, https://asyraafahmadi.com/2016/07/08/material-kayu/

Awaludin A, 2005, *Dasar-dasar Perencanaan Sambungan Kayu*, Jurusan Teknik Sipil, Fakultas Teknik, Universitas Gadjah Mada, Yogjakarta.

Badan Penelitian dan Pengembangan Departemen Pekerjaan Umum, 1994, *Metode Pengujian Kuat Geser Kayu di Laboratorium,* SNI 03-3400-1994, Penerbit Dewan Standarisasi Nasional, Jakarta.

Badan Penelitian dan Pengembangan Departemen Pekerjaan Umum, 1994, *Metode Pengujian Kuat Tarik Kayu di Laboratorium,* SNI 03-3399-1994, Penerbit Dewan Standarisasi Nasional, Jakarta.

Badan Penelitian dan Pengembangan Departemen Pekerjaan Umum, 1995, *Metode Pengujian Kuat Lentur Kayu di Laboratorium,* SNI 03-3959-1995, Penerbit Dewan Standarisasi Nasional, Jakarta.

Badan Penelitian dan Pengembangan Departemen Pekerjaan Umum, 1995, *Metode Pengujian Kuat Tekan Kayu di Laboratorium,* SNI 03-3958-1995, Penerbit Dewan Standarisasi Nasional, Jakarta.

Badan Penelitian dan Pengembangan Departemen Pekerjaan Umum, 2002, *Metode Pengujian Berat Jenis Batang Kayu dan Kayu Struktur Bangunan,* SNI 03-6848-2002, Penerbit Dewan Standarisasi Nasional, Jakarta.

Badan Penelitian dan Pengembangan Departemen Pekerjaan Umum, 2013, *Spesifikasi Desain untuk Kontruksi Kayu,* SNI 03-7973-2013, Penerbit Dewan Standarisasi Nasional, Jakarta.

Chauf K.A, 2005, *Karakteristik Mekanik Kayu Kamper sebagi Bahan Konstruksi*, Universitas Tadulako, Palu.

Hunggurami dkk, 2016, *Identifikasi Kuat Acuan Terhadap Jenis Kayu yang Diperdagangkan di Kota Kupang Berdasarkan SNI 7973:2013*, Fakultas Teknik FST Undana, Kupang.

Prasetyo D.D., 2011, *Signifikasi Modulus Elastisitas Kayu Meranti, Mahoni, Bangkirai yang ada di Pasaran dengan SNI 2002*, Fakultas Teknik Universitas Muhammadiyah Surakarta, Surakarta.

Rosyid S.N.P, 2016, *Perbandingan Kekuatan Geser dan Lentur Balok Bambu Laminasi dengan Kayu*, Fakultas Teknik Universitas Muhammadiyah Surakarta, Surakarta.