Flexural Strength Test For Concrete Beam With Mild Steel and Reinforcing Iron

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Abstract. Mild steel in buildings tends to only be used as a roof frame. The phenomenon in the field that lightweight steel roof truss can be combined with mortar mixture. In general this union is found on the walls of the construction of the red stone horses. This phenomenon is captured and applied dynamically, creatively, and innovatively with new idioms. Mild steel can be used as a beam reinforcement. This research is important in order to find alternative reinforcement of beams other than iron and strong beam reinforcement. This study aims to determine the ratio of flexural strength between concrete from mild steel reinforcement and concrete from steel reinforcement. This study uses a concrete flexural strength test and simple test beam method. The test beam is loaded and centered directly. Press testing machine is used as a flexural test device. The machine is equipped with two support beams and one load beam, load construction, and support blocks. Six beams are used as specimens. Test objects are made of different reinforcement. Concrete beams are made from a cross section of 600 mm x 150 mm x 150 mm, used reinforcing iron diameter of 6 mm, and amounting to three (first test object). Concrete beams are made from a cross section of 600 mm x 150 mm x 150 mm, mild steel is used with the profile shape C73.35.10 mm, and there are three pieces (second test object). This study concluded that the test beam was made from a cross section of 600 mm x 150 mm x 150 mm. and mild steel (profile C73.35.10 mm) has twice the maximum flexural strength compared to 600 mm x 150 mm x 150 mm cross section beam and reinforcing iron (6 mm diameter).

1. Introduction
At present, the world of housing construction is developed rapidly through innovation. Innovation is expected to create efficient construction products. At present, housing construction innovation in Indonesia is considered to be immovable [1]. Reinforced concrete structures are planned based on weak reinforced structures (bending collapse). A collapse in the structure occurs due to bending failure. High compressive strength possessed by concrete and high tensile strength is owned by reinforcing steel material [2]. Beams are used to resist bending force [3]. Flexural strength is the tensile strength of indirect concrete. Flexural strength is caused by concrete moments. Maximum flexural strength occurs in fibers under concrete beams. Flexural collapse in reinforced concrete structures occurs in tensile collapse, draw collapse, and compressive collapse [4]. Beams are used to resist bending force. The bending force is caused by the load acting on the floor. The loads are distributed to the supporting columns. The flexural strength of the beam is obtained from beam bending testing. The beam is given two centralized loads with ½ P at the point 1/3 of the span of the pedestal (figure 1) [3]. Roofing material from wood in housing can be used as an alternative, such as mild steel. Mild steel in buildings tends to only be used as a roof frame. The phenomenon in the field
that lightweight steel roof truss material can be combined with mortar mixture on the walls of the construction of horses made of red stone. Thus this phenomenon is captured and then applied dynamically, creatively, and innovatively with a new idiom as a beam reinforcement. This research is important in order to find alternative reinforcement of beams other than iron and strong beam reinforcement. This study aims to determine the ratio of flexural strength between concrete from mild steel reinforcement and concrete from steel reinforcement.

2. Literature Review
Concrete materials are reinforced with mild steel. Mild steel is the main material when bending occurs. The condition of the reinforcing steel is closely related to the magnitude of the flexural strength [4]. The crack condition is caused by three voltages, as follows: The first condition is called flexural cracks; The second condition is called flexural-shear cracks; and the third condition is called the diagonal tension cracks [5]. Flexural capacity and high ductility are owned in square columns. Square columns are created with circle circles. Flexural crack patterns occur in all column crack patterns [6]. Thus, bending patterns occur in all columns.

![Figure 1. Testing of bending 2 centralized loads [2]](image)

At present, the C channel profile is used not only roof beam (gording), but is used as a home structural element such as columns [7]. C channel profiles are used as columns. The C channel profile is cast with fill concrete. This is proven to prevent local buckling. Profile stability is added with mild steel and cast concrete is added in the profile [8, 9]. The C profile filled with concrete can prevent shear failure and crack patterns [10]. C channel profile beam filled with lightweight concrete can increase flexural strength compared to C channel profile beam without lightweight concrete fillers [11]. C channel profiles have stability weaknesses. Therefore, the profile application needs to be given a stiffener and installed in double. Thus, the double C channel filled with cast concrete can prevent local buckling, increase load capacity, increase strength in the column, increase profile stability, and increase flexural strength [12].

3. Research Method
Test method of concrete flexural strength is used simple test beam. The test beam is loaded and centered directly. This method is intended as a reference for carrying out bending tests in the laboratory. This research was conducted on Saturday, August 19, 2017 at the Material and Construction Testing Laboratory, Department of Civil Engineering, Faculty of Engineering, Halu Oleo University. Test equipment is used, as follows: press testing machine (the machine must be equipped with two support beams and one load beam), load block construction, support blocks, and measuring instruments such as rulers, shovel runners, feelers, scales, cameras, stationery, and test results forms are used as flexural testing equipment. Test objects amounted to 6 pieces and made of different reinforcement. Three beams are made of lightweight steel reinforcement material. Three other blocks are made of reinforcing iron material. The test material must meet the provisions of SNI 03-2493-1991 concerning the Making and Maintenance of Concrete Test Objects in the laboratory. Length 600 mm,
width 150 mm, and 150 mm are used in the size of the test beams. All surface areas are required to be flat, free from defects, holes, and curves. Side fields must be perpendicular to the upper plane and lower plane. Flexural strength is calculated by the equation, as follows:

\[
flt = \frac{3PL}{2bd^2}
\]  

Information:

\(flt\) = Flexural strength (Mpa)

\(P\) = Maximum load resulting in test beam collapse (N)

\(L\) = The span length between the two support beams (mm)

\(b\) = The average beam width in the collapsed section (mm)

\(d\) = The average beam height in the collapsed section (mm)

4. Result and Discussion

Test method of concrete flexural strength is used simple test beam. The test beam is loaded and centered directly. Test object is 28 days old. The load when the first crack column when receiving the load (Pmax) is obtained by testing the direct flexural strength. Load data obtained maximum compressive strength and obtained by the compressive force of loading. Six specimens were used in each reinforcement variation. The flexural strength test results are presented in tables (1) and tables (2), as follows:

**Table 1. Condition of test objects**

| Code | Date       | Long (mm) | Cross section | Weight (kg) |
|------|------------|-----------|---------------|-------------|
|      |            |           | Wide (mm)     | High (mm)   |
| KBT1 | 07/30/2017 | 600       | 150,00        | 150,00      | 32,70       |
| KBT2 | 07/30/2017 | 600       | 150,00        | 150,00      | 32,50       |
| KBT3 | 07/30/2017 | 600       | 150,00        | 150,00      | 31,00       |
| KBR1 | 07/30/2017 | 600       | 150,00        | 150,00      | 31,75       |
| KBR2 | 07/30/2017 | 600       | 150,00        | 150,00      | 33,00       |
| KBR3 | 07/30/2017 | 600       | 150,00        | 150,00      | 32,60       |

**Table 2. The results of the average flexural strength of the reinforcing material of beams from reinforcing iron and reinforced beam material of mild steel.**

**Beam Test Specimen**

| Code | b.j. (kg/m³) | Date       | Age (day) | Max. Strength (kN) | Flexural Strength (Mpa) | Average Flexural Strength (Mpa) |
|------|--------------|------------|-----------|--------------------|-------------------------|--------------------------------|
| KBT1 | 2.422        | 08/19/2017 | 28        | 17,50              | 3,889                   | 3,889                          |
| KBT2 | 2.407        | 08/19/2017 | 28        | 20,00              | 4,444                   | 3,889                          |
| KBT3 | 2.296        | 08/19/2017 | 28        | 15,00              | 3,333                   | 3,333                          |
| KBR1 | 2.352        | 08/19/2017 | 28        | 30,00              | 6,667                   | 6,296                          |
| KBR2 | 2.444        | 08/19/2017 | 28        | 25,00              | 5,556                   | 6,296                          |
| KBR3 | 2.415        | 08/19/2017 | 28        | 30,00              | 6,667                   | 6,667                          |
Table 1 above explains that the condition of the test object before being tested is flexible. Table 2 above explained that the results of the maximum flexural strength test of the beam made from a cross section of 600 mm x 150 mm x 150 mm and steel bars with a diameter of 6 mm obtained a mean of 3.889 Mpa. The beam test results are made from a cross section of 600 mm x 150 mm x 150 mm and a mild steel reinforcement with a profile form C73.35.10 mm obtained a mean of 6.296 Mpa.

5. Conclusion
Based on the results of the test that the test beam is made of cross section 600 mm x 150 mm x 150 mm and mild steel in the form of profiles C73.35.10 mm has two times the maximum flexural strength compared to the test beam of the cross section 600 mm x 150 mm x 150 mm, and iron reinforcement with a diameter of 6 mm. This research can be continued to test concrete columns of mild steel with a profile form C73.35.10 mm to the maximum flexural strength.

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