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EXPERIMENTAL STUDY OF INSTALLATION OF NON CENTRIC LIGHT STEEL C PROFILE ON LIGHT STEEL BEAM FRAME

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Abstract

Light steel is one of materials that support the growth of construction technology at this time and it is generally used on roof truss contruction. The profile of light steel is a kind of steel profile which has dimension of thickness that is relatively thin with ratio of wide dimension of each profile element towards its huge thickness. In the assembling and installation, roof truss of light steel which is often encountered, cross section of C profile is connected by attaching body parts of two profiles or connecting wing parts with giving the connecting canal.

This research uses the experimental method by flexural test with two points loading. The light steel which is used in this reserach is light steel of C profile by Ton Dong brand. The size is 75 x 35 x 0,75 mm and the dimensions of beam frame specimen is 180 cm length and 25 cm hight , as many as 3 specimens with non centric profile overview. The research result shows that the average value of flexural strength is 5,25 kN and the average of tensile strenght is 2281,67 N, while the result of experimental test uses UTM (*Universal Testing Machine*), the maximum strength is 5,92 kN and deflection 38,95 mm. The result of SAP 2000 analysis, the maximum deflection is 2,04 mm and 6 kN load.

Keywords : Light steel of C profile, Light steel beam frame, Test of flexural stength.

I. INTRODUCTION

A. Background

Light steel is one of construction materials which is developing and generally used in the construction of roof truss. This material is considered as one of economical solutions, in which this reminds the strength of the material compared to relatively cheap price.

Related to this, this research is to particularize the effect of C profile installation of non centric on beam frame of light steel.

B. Research Objectives

The research objectives of C profile beam frame of steel light include :

1. To know flexural strength of C profile light steel beam frame.
2. How the damage pattern is experienced by non centric light steel C profile beam.
3. To compare the result of experimental test with SAP 2000 analysis.

C. Research Limitation

In writing the report, the research limitations are as follows:

1. The case study researched is the flexural strength of light steel C profile on light steel beam of non centric profile orientation.
2. The test of light steel beam uses two points oading with load point distance 1/3 beam length.
3. The comparison of SAP 2000 analysis with maximum load which is obtained in experimental test.

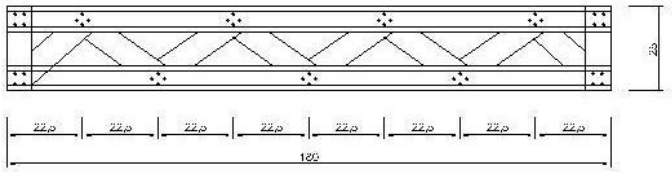
D. Literature Review

The flexural strength analysis of light steel C profile is as a component of roof truss. The research is to know flexural strength value of light steel C profile with span 1 m, height 7,5 cm andthickness 1 mm and 0,75 mm. The Light steel of C profile that was used by Ridwan (2017) was light steel of C profile of PT. Taso and PT. Baja Pratama with span 1 m, height 7,5 cm andthickness 1 mm and 0,75 mm, with bolt connection used specifically for light steel, type SDS andsupport for testing load used UMP 6 mm steel so as not to shift when it was tested, then it was given one point load and two constant point loads slowly and the loads were gradually increased up to maximum load until specimens were having cracked, maximum deflection and broken.

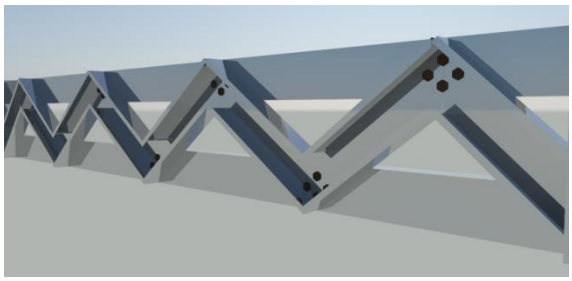
The research was done by Lalu Arya and friends (2019) testing flexural that used C profile of centric light steel on steel beam frame.

II. RESEARCH METHODOLOGY

The specimens used in this research by testing flexural strength of light steel beam of C profile with the length 180 cm x the height 25 cm and light steel dimension of C profile used is 75 x 35 x 0,75 mm, as showed picture 1.

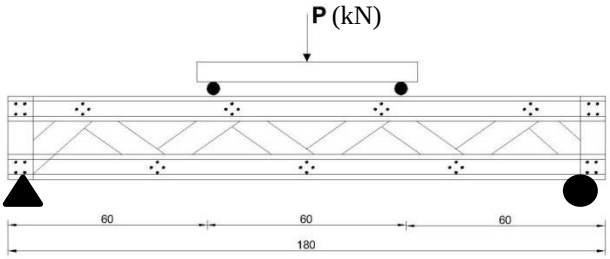


Picture 1. Specimen



Picture 2. Illustration of Connection

Testing of light steel frame beam was done two points loading 1/3 L from end point. Testing the flexural strength of light steel beam uses *Universal Testing Mechine(UTM).* As it is illustrated in the picture 3 below :



Picture 3. Schema of Flexural Strength Test

A. Material

Material used in this research is as follows :

1. Light Steel

   light steel used in this research is C profile with dimension 75 x 35 x 0,75 mm.

2. Screw

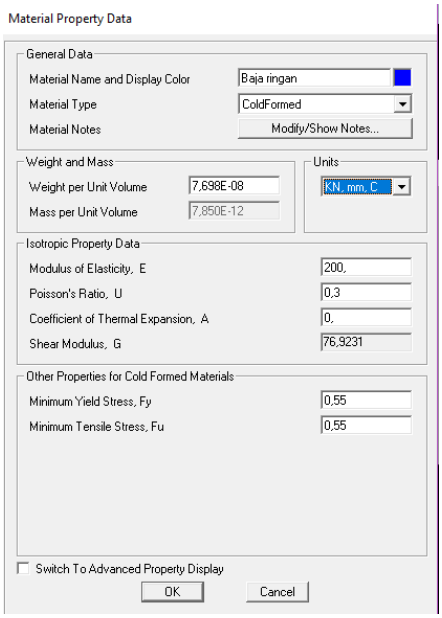
Screw is used to connect light steel of C profile, namely Self Driling Screw (SDS) with diameter specification 12 mm and screw distance used is 2d (24 mm).

The instruments used in this research are :

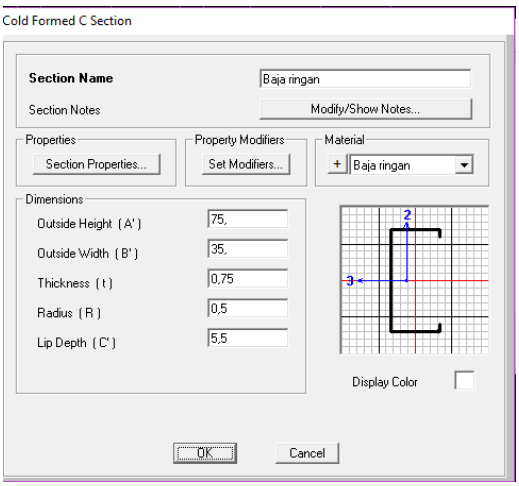
1. Electric drill is used to put up screw.
2. Measuring instrument is used to check the size of research material, especially, in order to have appropriate size as it has been planned.
3. Steel scissors is used to cut light steel.
4. Screw drill bit to tighten or open screw which is installed at the end of screw drill.
5. Instrument of flexural test or Universal Testing Mechine (UTM) is used to test mechanical property, that is flexural strength.

B. Modelling using Software of SAP 2000

Material of property from light steel used is according to the plan with the dimension 75 x 35 x 0,75 mm, with modulus of elasticity (E) 200 kN/mm, minimum yield stress (fy) 0,55 kN/mm and ultimate tensile stress (fu) 0,55 kN/mm for structure modelling in SAP 2000 which is appropriate as picture 4., whereas the materials that is put into the program of SAP 2000 can be seen in the picture as follow :



Picture 4. Data of Property Material of Light Steel



Picture 5. Dimension of Property Material of light Steel.

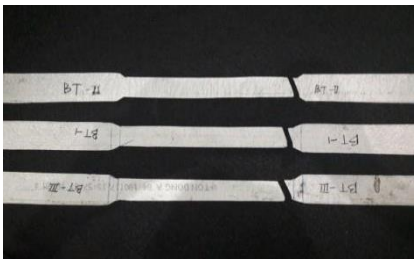
III. RESULT AND DISCUSSION

A. Testing of Light Steel Material

The Tensile test of light steel material is carried out in order to know the value of yield stress and tensile stress of light steel material. From the tensile test of light steel material of C profile, the brand Ton Dong, it is obtained that value of tensile strength is on this table 1 below :

Table 1. Result of Tensile Strength Test

No	specimen	Pmax (N)	Tensile Strength (N/mm)
1	B-1	23,24	1,24
2	B-2	23,24	1,24
3	B-3	21,96	1,17
4	Average	22,81	1,22



Picture 6. The Specimen before and after the Test

From the table and pictures 6 , it is able to be seen that sketch of specimens used and it can be seen after the test, the specimens have broken up at the top after reaching average load as many as 22,81 N with average tensile strength 1,22 N/mm. From the test of tensile that has been done, it can be used as the reference in designing a product. In the tensile test there is the value of maximum tensile strength.

B. Failure of Non Centric C Profile on Light Steel Beam

From the test of flexural strength of light steel C profile, there is a failure or damage on light steel beam of non centric C profile that can be seen on picture 7 :

Picture 7. Failure of B-I Non Centric C Profile Beam

On B-I mode,its failure was at the time the load that was begun with locally bending on the point loading part, then on the screw connection was getting loose and at the time the light steel beam load was having splay, so that point loading was going to drift.

Picture 8. Failure of B-II Non Centric C Profile Beam

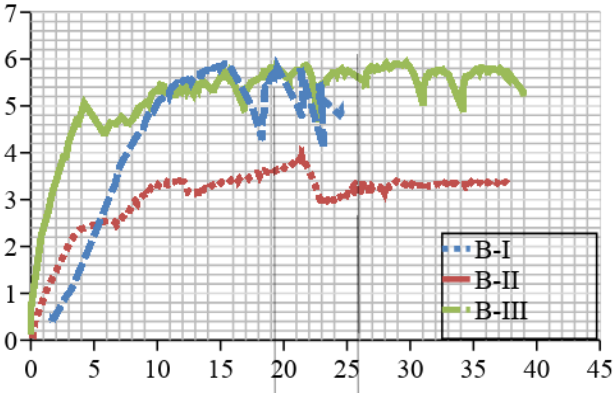
For B-II, the failure occured was the same as B-I mode, its failure was at the time the load that was begun with locally bending on the part of point loading, then on the part of screw connection was getting loose and at the time the light steel beam load was having splay until maximum load.

Picture 9. Failure of B-III Non Centric C Profile Beam

B-III failure Pattern was that at the time the load was having bend at the top and at the bottom of span, then the connection stretched, so that the screw loosened up, then the beam was getting slope at the time of loading until maximum load.

C. Flexural Strength Test of Non Centric C profile Light Steel Beam Frame

From the flexural strength testing data of non centric C profile light steel beam, it can be seen on this following graph :



Picture 10. Flexural Strength of Non Centric C Profile on light Beam

From the graph above, B-I specimen gets lowest load because it is on the loading point which is going to drift, therefore, giving loading on B-I specimen is stopped, it is different from B-II specimen, it gets highest load because loading point has already been strengthened, so that the

loading point is not going to drift and the loading is maximally able to be obtained. Whereas, B-III specimen, its loading obtained is almost the same as B-II specimen only for testing B-III specimen, when giving a load that is not long enough, so that it is not the same as B-I and B-II specimen.

Table 2. Result of Flexural Strength Test of Non Centric C Profile Light Steel Beam Frame

Specimen	P max (kN)	Δ max (mm)	Δ max/Pmax
B-I	3,92	21,38	5,45
B-II	5,92	29,69	5,02
B-III	5,91	15,57	2,63
Average	5,25	22,21	4,23

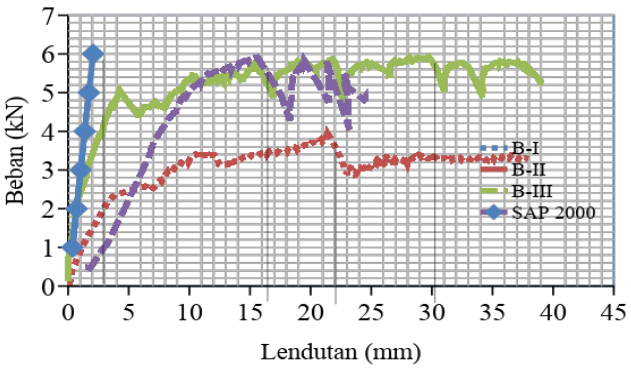
The flexural testing result of C profile light steel beam of B-I specimen reaches the lowest strength as many as 3,92 kN and its deplection 21,38 mm. While beam with the highest strength is B-II specimen with its value as many as 5,92 kN and its deplection 29,69 mm. Whereas B-III beam has strength as many as 5,91 kN with its deplection 15,57 mm. It comes into sight that the three specimens of light steel beam frame are obtained average strength that is able to be detained by the specimen is 5,25 kN with the average deplection 22,21 mm.

D. Flexural Strength Comparison using UTM with SAP 2000

Dimension and configuration used are approriate to the picture of specimen of previous chapter. Based on SAP 2000 analysis, it can be seen on table 3:

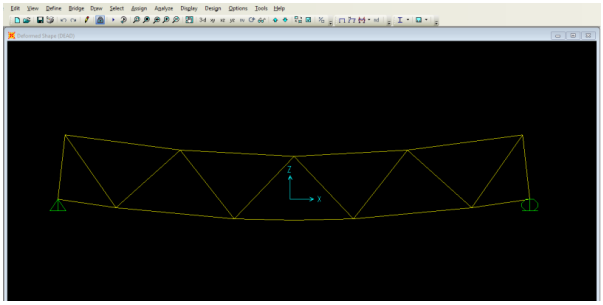
Table 3. The result of SAP 2000 analysis

Loading (kN)	Deplection (mm)
1	0,35
2	0,7
3	1,04
4	1,37
5	1,72
6	2,06



Picure 11. Comparison Result between UTM and SAP 2000

The result of SAP 2000 analysis, the deplection is lower than test using UTM, the deplection resulted with 6 kN loading is only 2,06 mm, while with UTM, it is able to achieve 29,69 mm.



Picture 11. Flexural Strength by SAP 2000

IV. CONCLUSION

Based on the testing result above, thus it is gained the following conclusions :

1. The experimental testing result of flexural strength of non centric C profile light beam is able to hold the average load as many as 5,25 kN.
2. Before reaching maximum strength of light steel beam, it is having broken on loading point part in which it is getting bend then the connection stretches and the beam is having slope.
3. The result of experimental testing uses UTM, the maximum strength 5,92 kN with the deflection 29,69 mm and the result of SAP 2000 analysis, the deflection is as many as 2,04 mm with the load 6 kN.
4. The model in software of SAP 2000 is not be able to be mode of the connection and the number of screws used.

RECOMMENDATION

Based on the research result and conclusion, the researchers give recommendations as follow :

1. It is expected that the further researchers be able to use variation of different connection forms from this research.
2. It is needed to conduct further research about the quality of light steel material which is appropriate to SNI.
3. It is expected when entering property material data in software of SAP 2000 has to be suitable with the quality of lightsteel material according to SNI.
4. It needs to be tried to use other softwares that are close to the original condition with the specimen.

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