FEASIBILITY STUDY OF COLD FORMED STEEL PROFILE ON ROOF OF TYPE 36 HOUSING BUMI FINDARI MAS 2 MAROS REGENCY

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Abstrak

Konstruksi baja ringan merupakan salah satu material yang sering digunakan dalam sebuah konstruksi rangka atap, melihat penggunaan baja ringan tergolong cepat dan praktis. Perumahan Bumi Findaria Mas 2 merupakan salah satu perumahan yang menyediakan rumah subsidi bagi Masyarakat Berpenghasilan Rendah (MBR), yang pada struktur atap rumah tersebut menggunakan baja ringan. Dengan berkembangnya teknologi pada saat ini banyak sekali aplikasi yang memudahkan teknisi dalam menganalisa suatu konstruksi bangunan, salah satu aplikasi yang sering digunakan untuk menganalisa struktur adalah SAP2000. Pada analisa kali ini penulis akan mencoba studi kelayakan stuktur pada rangka atap rumah subsidi tipe 36 di perumahan Bumi Findaria Mas 2 di bawah Ditjen Perumahan Kab. Maros pada program Magang-MBKM yang dijalankan oleh Menteri Pendidikan dan Kebudayaan. Untuk profil yang digunakan pada rangka atap perumahan Bumi Findaria Mas 2 adalah Baja Ringan C75x35x0.65. Dalam analisa rangka atap penulis menghitung rangka atap dengan melihat hasil Interaction Ratios dari hasil analisa SAP2000. Hasil analisa menggunakan profil baja ringan C75x35x0.65 menunjukkan Interaction Ratios lebih dari satu, artinya profil kurang layak untuk digunakan. Setelah mengetahui hasil dari analisa tersebut penulis mencoba menggunakan profil C75x35x1, dan hasil yang didapatkan hasil Interaction Ratios dibawah satu, ini menunjukkan bahwa profil baja tersebut layak untuk digunakan.

***Kata kunci**: Baja Ringan, Rangka Atap, Perumahan, SAP2000, Rasio Interaksi*

Abstract

Cold formed steel construction is one of the materials that is often used in a roof truss construction, considering the use of cold formed steel is relatively fast and practical. Bumi Findaria Mas 2 Residence is one of the housing estates that provides subsidized housing for Low-Income Communities, whose roof structure uses lightsteel. With the development of technology at this time there are many applications that make it easier for technicians to analyze a building construction, one application that is often used to analyze structures is SAP2000. In this analysis, the author will try a feasibility study on the roof truss structure of a subsidized house type 36 in the Bumi Findaria Mas 2 under The Directorate General of Housing Maros Regency in the Internship-MBKM program run by the Minister of Education and Culture. The profile used for the roof truss for the Bumi Findaria Mas 2 housing is cold formed steel C75x35x0.65. In the roof truss analysis the authors calculate the roof truss by looking at the Interaction Ratios results from the SAP2000 analysis. The results of the analysis using C75x35x0.65 cold formed steel profiles show a Interaction Ratios of more than one, meaning that the profile is not suitable for use. After knowing the results of the analysis, the authors tried to use the C75x35x1 profile, and the results obtained by the Interaction Ratios were below one, indicating that the steel profile was feasible to use.

***Keywords**: Lightsteel, Roof Truss, Residence, SAP2000, Interaction Ratios*

1. INTRODUCTION

It is undeniable that the use of cold formed steel today is very much used in the needs of the world construction, one of which is roof truss construction. The roof truss of the house has experienced developments in material technology, namely the creation of lightweight steel roof truss materials as an alternative to wood. The availability of lightweight steel roof truss has been mass-produced with high technology and standardized (Irwansyah N, 2015). Cold formed steel construction itself is a construction that has been widely used today because of the fast development process (Alvian Luthfi, 2021). In addition, cold formed steel has a simple design, is thin, strong, lightweight and can be recycled and has high enough flexibility so that construction is faster and saves time. (Komara I, 2016). From research conducted by Devi Oktarina and Agus Darmawan on "Comparative Analysis of Lightweight Steel Roof Trusses and Timber Roof Trusses from an Analytical View of Structure and Cost Budgeting" it is said that the use of lightweight steel is cheaper than the use of wood in roof construction, this is also the reason why the large use of cold formed steel in the manufacture of roof construction today (Darmawan A, 2015). Cold formed steel itself is cold rolled steel with high quality which is light and thin but its strength is not inferior to conventional steel. (Pangaribuan, 2014)

Roof truss construction is one of the constructions that functions to withstand the weight of the roof construction which is above the truss, which in essence, the roof is the part that protects the building from outside weather. (Rafiq, 2014) . While the roof truss carries its own load and receives the load from the roof and then transmits the load to the building structure such as ringbalk and columns. (Hesna Y, 2009)

During the implementation of the internship the author had the opportunity to check field work related to the suitability of the existing construction in the building. There were several discrepancies found in the construction of the building, such as the reinforcement of sloofs, columns and also ringbalk which at the time of checking referred to Permen No.5/2016 Kementrian PUPR which also used as a reference for the The Directorate general of Housing. One example of non-compliance with Permen No.5/2016 Kementrian PUPR that the author gets is the roof structure used as shown in Figure 1. Where the minimum specifications for using the cold formed steel structure are with a thickness of 0.75 mm.

Figure 1. Truss 0.65x75x6000
(Source : private document)

Seeing this, the authors try to check the feasibility of the cold formed steel profile used. In steel structure work, an application is needed that can support load calculation analysis, to help the checking process the author uses the SAP2000 application which makes planning more effective and efficient. (Mukhlis, 2016)

2. METODOLOGY

To carry out the analysis and design of the cold formed steel truss frame structure, the author uses the Student version of the SAP 2000 computer program. Calculation steps performed namely:

a. Determine the cold formed steel profile along with the specifications and shape of the trusses to be used based on the building plan and roof shape.
b. Identify the load that will work such as: dead load, live load, and wind load.
c. Perform analysis using the SAP200 computer program. From the results of this structural analysis, it will be known whether the truss are able to withstand the load or not.

At the modeling stage the author measures the roof truss in the field and then use the SketchUp application which will later be converted and then imported into SAP2000. The model can be seen in pleminary data.

To carry out structural analysis calculations, the weight of the building above it must first be calculated. The truss are the top structure that must be considered. In addition to the weight of the truss themselves, there are also wind, rain and other loads. The load is also distributed to the lower structure. Before entering the analysis phase, some data is needed, such as material data and loading.

2. 1 Material

The materials used in the planning of cold formed steel type G550 trusses are as follows:

Elastic modulus (E)	=	200,000 N/mm^2
Shear modulus (G)	=	50,000 N/mm^2
Poisson's ratio (U)	=	0.3

Expansion coefficient (A) = 1.17.E-05 ^{0}C
Ultimate Stress min (fu) = 550 N/mm^2
Yielding Stress min (fy) = 550 N/mm^2

The data input in SAP2000 can be seen in figure 2.

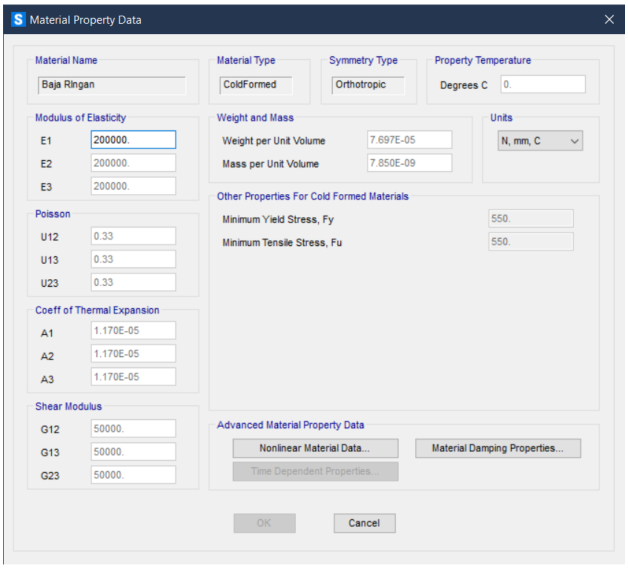

Figure 2. Material Properties
(Aldiansyah et al., 2019)

2. 2 Pleminary Data

The following are the results of modeling carried out in the SketchUp application. The model can be seen in Figure 3..

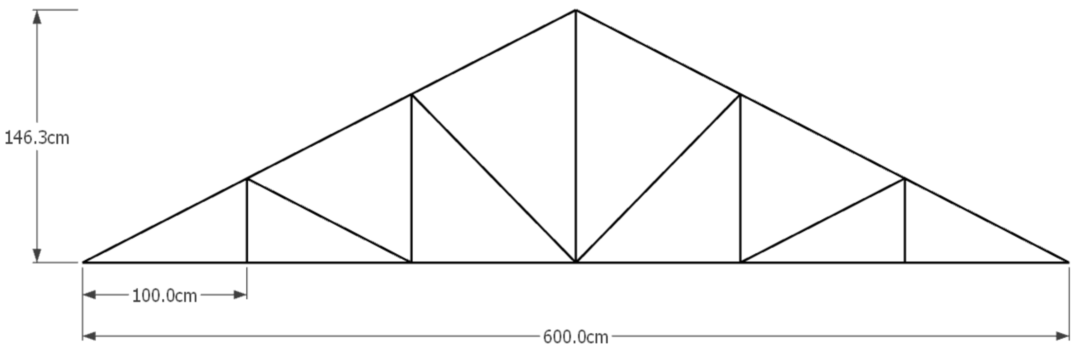

Figure 3. Roof Truss Models

To support the calculation of the structure, supporting data is needed as follows:

The slope of the roof = 26 ^{o}
SG of metal tile = 0.01 t/m^2
Wind Load (Wa) = 0.04 t/m^2
SG of Ceiling = 0.007 t/m^2
(Departemen Pekerjaan Umum, 1987)

Loading

The loading on the planning of conventional steel trusses is as follows:

Dead Load

The dead load on the truss roof which is not calculated automatically on SAP2000, namely SAP2000, namely roof tiles (battens and ribs) plus the weight of the gording, must be calculated manually so that the following results are obtained:

- Upper knot dead load
  SG of metal tile = 0.010 t/m^2
- Lower knot dead load
  SG of Ceiling = 0.007 t/m^2

Live Load

- People Load
  P = 0.1 t/m^2
- Rain Load
  40-0,8α = 40-0,8*26 = 0.1 t/m^2

From the results of loading calculations for people loads and rain loads, people loads are selected as live loads in the combination of loading.

Wind Load

For roof slopes of 26 degrees and closed buildings, the provisions based on PPPURG'87 can be seen in Figure 2 below:

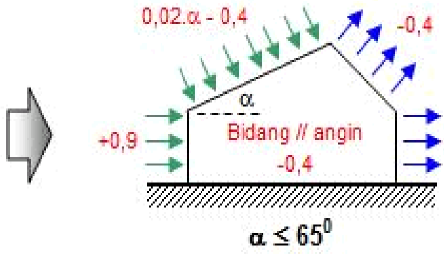

Figure 4. Wind Loading

Pressure Coef (Øt) = 0.02 α x 0.4
= 0.02*26 x 0.4
= 0.12

Tensile Coef = 0.4

Pressure wind load = Coef x Wa
= 0.12 x 0.04
= 0.005 t/m^2

Suction wind load = Coef x Wa
= 0.4 x 0.04
= 0.016 t/m^2

Pressure Wind

Vertical = Wpressure x Cos α
= 0.005 x Cos (26)
= 0.004 t/m^2

Horizontal = Wpressure x Sin α
= 0.005 x Sin 26
= 0.002 t/m^2

Suction Wind

Vertical = Wpressure x Cos α
= 0.016 x Cos (26)
= 0.014 t/m^2

Horizontal = Wpressure x Sin α
= 0.016 x Sin 26
= 0.07 t/m^2

2. 3 Loading Combination

The loading combinations used in roof planning based on SNI-1727-2013 are as follows:

- 1,4D
- 1,2D + 1,6L
- 1,2D + 1,0 W + 1,0 L

(Badan Standar Nasional, 2013)

Explanation :

D is dead loads resulting from the weight of permanent construction, including walls, floors, roofs, ceilings, fixed partitions and fixed service equipment.

L is the live load on the roof caused during maintenance by workers, equipment and materials, or during ordinary use by workers, equipment and materials, or during ordinary use by people and objects.

W is the wind load.

3. RESULT AND DISCUSSION

With the results of the loading above, the load distribution for each bustle can be seen in Table 1.

Table 1 Distribution of the loading of the truss

	Knot		
	Unit	Mid	Edge
Distance between Knot	m	1	0.5
	m	1	0.5
Distance Between truss	m	1.4	1.4
Top dead load	(t)	0.014	0.007
Bottom dead load	(t)	0.01	0.005
Live load	(t)	0.14	0.07
Vertical Pressure wind load	(t)	0.006	0.003
Horizontal Pressure wind load	(t)	0.003	0.002
Vertical suction wind load	(t)	0.02	0.01
Horizontal suction wind load	(t)	0.01	0.005

Explanation :

The calculation for middle knot dead load
(Dead load of top knot) P = 0.01 t/m^2
Distance knot with knot before (a) = 1 m
Distance knot with knot after (b) = 1 m
Distance betwees truss (c) = 1.4 m
Formula to be used :
Dead Load = (a+b)/2*c*P
Dead Load = (1+1/2*1.4*0.01
Dead Load = 0.014 t

From the loading results above, the loading calculation is carried out in the SAP2000 application, by entering the calculated load on the lightweight steel roof truss can be seen in Figure 3,4, and 5.

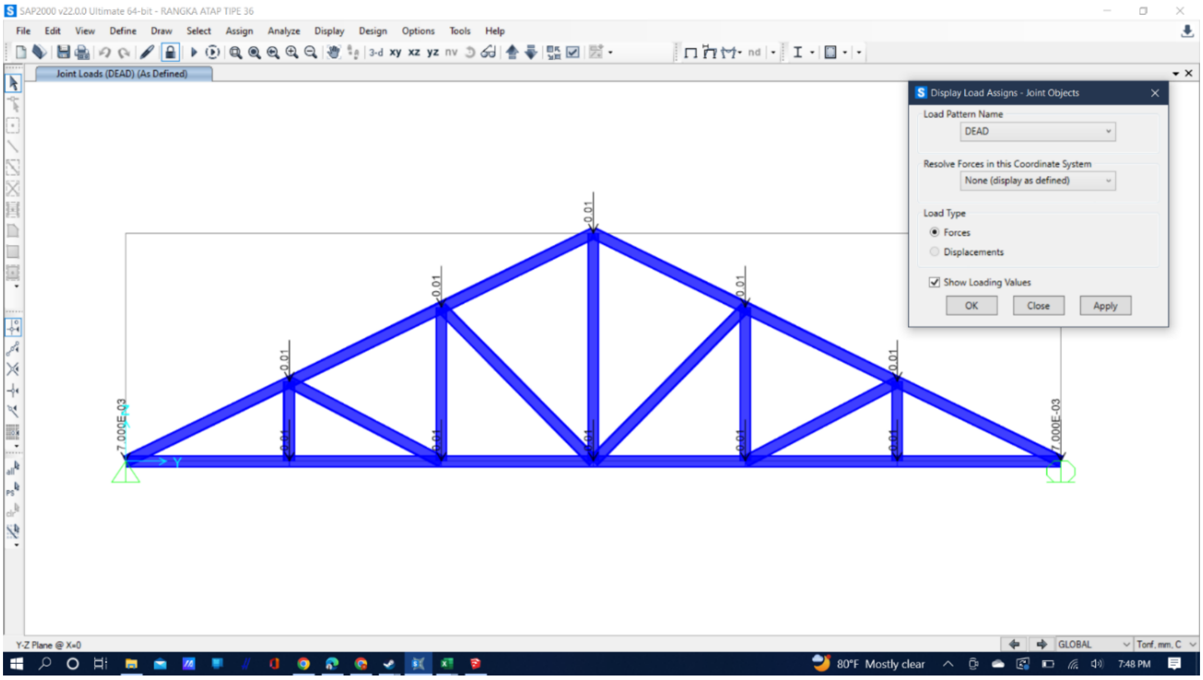

Figure 5. Dead load

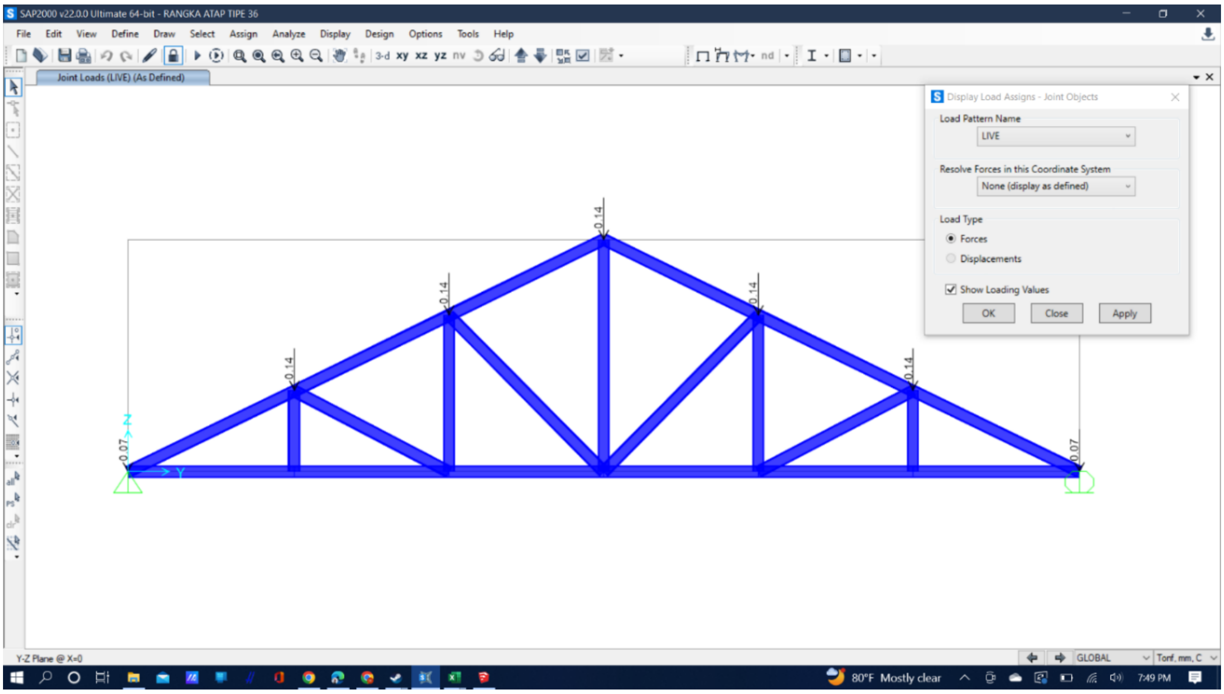

Figure 6. Live load

 ISSN: 2459-9727

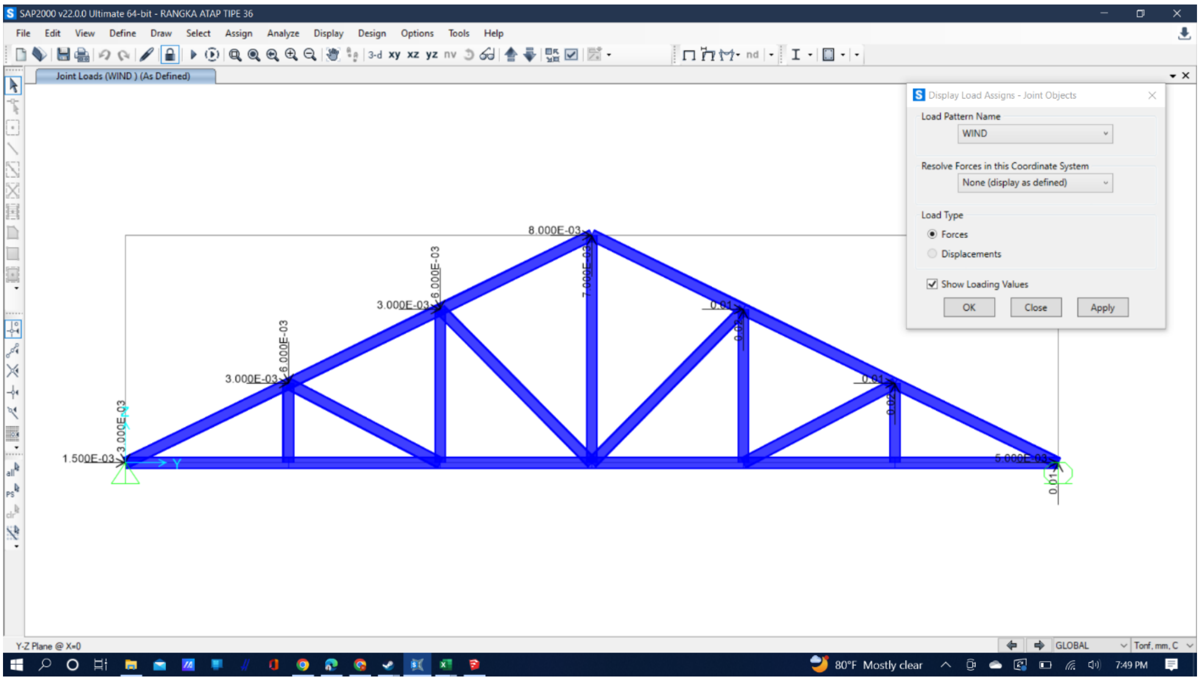

Figure 7. Wind load

From the loading above, a load analysis is carried out on a lightweight steel roof truss. The results of the application analysis obtained the results of a Interaction Ratios above 1 for the C75x35x0.65 cold formed steel profile. The analysis result can be seen in Figure 6.

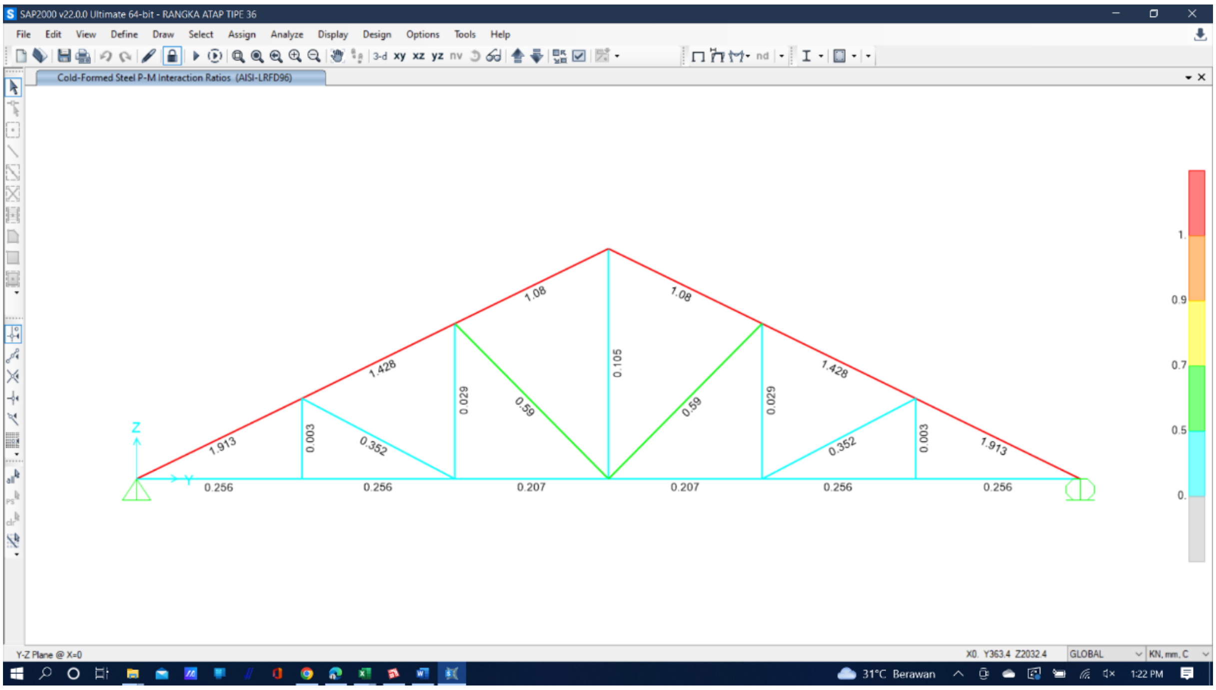

Figure 8. Analysis result SAP2000

The Figure 6 shows that cold formed steel profiles are not recommended for use, because the Interaction Ratios exceeds one. From these results the author tries to do an analysis with different cold formed steel profiles. The profile used for the redesign stage is the C75x35x1 cold formed steel profile. The results of the analysis on the SAP2000 application can be seen in Figure 7.

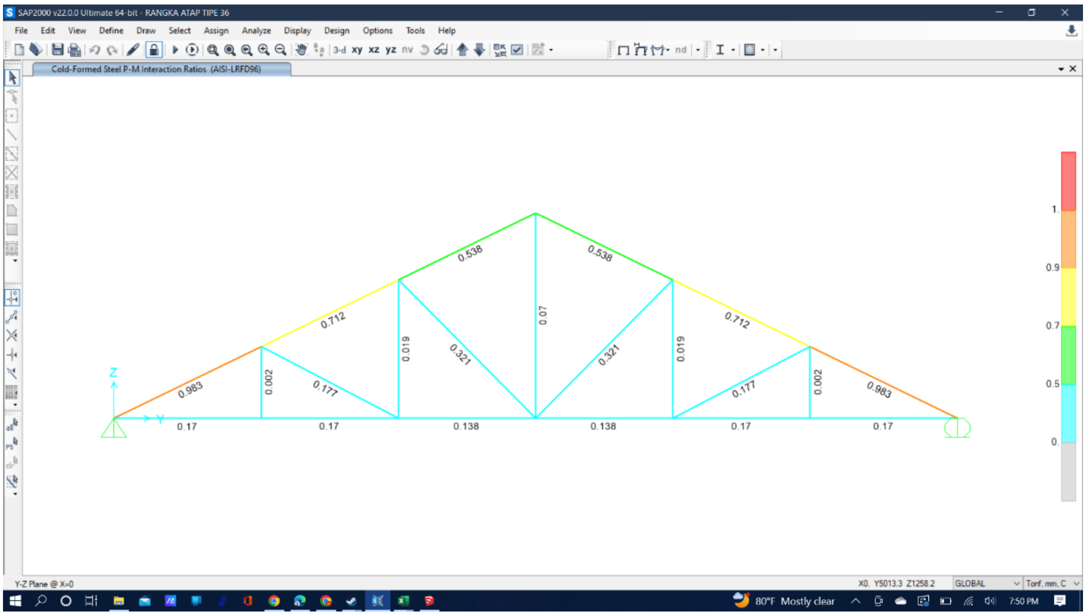

Figure 9. Analysis result SAP2000

The results of the redesign on the steel roof truss show that the Interaction Ratios is below 1, so the C75x35x1 cold formed steel profile is feasible to use.

4. CONCLUSION

From the calculation results above, it can be concluded that the profile used in Bumi Findaria Mas 2 housing is not recommended to use in building construction. The SAP2000 calculation shows the Interaction Ratios on the C75x35x0.65 cold formed steel profile above the number 1. As for the redesigned steel profile or cold formed steel with the C75x35x1 profile, the Interaction Ratios results are below one which means the profile is suitable for use in roof truss construction.

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