COMPARATIVE ANALYSIS OF TOWER BASE TRANSCEIVER STATION (BTS) FOOT 4 BETWEEN BRACING TYPE V WITH BRACING TYPE X

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I. INTRODUCTION
The development of the world of telecommunications is now developing very rapidly in line with the needs of the community for telecommunications technology, namely a network that plays an important role in supporting and facilitating daily activities such as: economic activities, increasing employment and reducing the frequency of traveling (Dynasty and Sulistyarso, 2013). The development is very rapid, especially for wireless communication systems (wireless) and / or moving (mobile) (Kurniawan and Ahyuni, 2019).

The need for 3G and 4G networks usually operates at high frequencies above 2 GHz, in microwave networks in general, shadow areas often occur where the signal cannot reach the user because the building blocks the signal from the nearest tower (Nicholas and Mubarakah, 2014). This can require telecommunications providers to compete to win the hearts of consumers or the public. One of the ways to win the hearts of consumers is the expansion of cellular phone signal coverage and internet signal by building Base Transceiver Station (BTS) (Husnah and Kartini, 2017).

Telecommunication tower is a telecommunication building structure that uses a combination of steel frames as its construction material which functions as a support for telecommunication devices to transmit signals. Base Transceiver Station (BTS) is part of the GSM network element which is directly connected to the Mobile Station (MS) (Husnah and Kartini, 2017). The availability of this service is the first doorstep for customers to access telecommunication connections (Prijono, 2010). The types of BTS towers include the monopole, SST (Self Supporting Tower), and guyed mast types. For low-height BTS towers, monopole and guyed mast types are usually used, while for medium and high-altitudes, SST types are used (Junaidi, 2015).

With the expansion of the range of cellular telephone signals and internet signals, more and more towers are built to fulfill the people's desire for good and stable telephone and internet signals (Galugu, Abadi and Iswandi, 2016). Therefore, it is necessary to plan the development of TowerBase Transceiver Station (BTS) to make comparisons on certain criteria on the TowerBase Transceiver Station (BTS). The criteria compared in this study were between type v bracing and type x bracing in terms of strength and economic aspects.

II. METHOD
The research method used in writing this time is planning the planning data that will be used, then making 3D...
modeling in the autocad application. After the 3D modeling image, what is done is to import the modeling into the SAP 2000 application. After that, perform a structural analysis through the SAP 2000 program by entering the loads that are on the tower such as wind loads and tower live loads. The loads used must comply with existing regulations such as SNI and EIA / TIA. The results of the analysis will come out when the SAP 2000 application is finished. From the results of this analysis, conclusions can be drawn that will result in suggestions for selecting towers that use bracing to be more effective.

The systematic research methodology is used to explain the steps to be used in this research. The flow chart can be seen in the image below.

![Flowchart](image)

### Figure 2.1 Research Methodology Flowchart

**III. DISCUSSION**

**3.1 Planning Data**

Tower Base Transceiver Station (BTS) has the following planning data:

- **Tower Dimensions:**
  - Tower length: 6 m
  - Tower width: 6 m
  - Tower height: 25 m
- **Steel Grade:** BJ37
- **Upper Main Frame:** L 110.100.13
- **Lower Main Frame:** L 150.150.16
- **Diagonal frame:** L 100.100.13

With the placement of the height of the upper main frame and lower main frame as shown below:

**3.2 Calculation of Load**

In the calculation of the load on the tower base transfer station (BTS), there is a load inputted in the SAP 2000 program. The loads inputted in this analysis include live load, antenna load, and wind load.

**3.2.1 Live Load**

The live load input on this tower is 1.11 according to EIA / TIA. This live load is located on the top of the tower frame which presses the 4 joints of the upper frame as shown below.

![Live Load](image)

**Figure 3.2 Tower Live Load**

**3.2.2 Wind Load**

According to SNI 1727-2013, the minimum wind load used in other buildings is 0.77 kN / m², so the load inputted on the tower is 1 kN / m². There are 2 wind loads, namely compressed wind and suction wind. The following is the calculation of compressed wind and suction wind. In this calculation, the area of each segment affects the calculation. The segments are as shown below.
Figure 3.3 Figure of the Area of Each Segment

With the area data for each number in the following table.

Segment Area (m²)

<table>
<thead>
<tr>
<th>Segmen</th>
<th>Luasan (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>2.50</td>
</tr>
<tr>
<td>3</td>
<td>2.58</td>
</tr>
<tr>
<td>4</td>
<td>3.13</td>
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<td>5.63</td>
</tr>
<tr>
<td>9</td>
<td>6.25</td>
</tr>
<tr>
<td>10</td>
<td>6.88</td>
</tr>
</tbody>
</table>

Table 1. Large Table of Area of Each Segment

Calculation of Compressed Wind and Suction Wind Load:
1. Wind Press
   Formula: Wind load x 0.3 x Area of each segment x 0.6
   Example of Calculation in Segment 1:
   Compressive Wind Load = 1 x 0.3 x Segment Area 1 x 0.6
   = 1 x 0.3 x 1.25 x 0.6
   = 0.23 kN / m²

2. Wind Suction
   Formula: Wind load x 0.3 x Area per segment x 0.4
   Example of Calculation in Segment 1:
   Suction Wind Load = 1 x 0.3 x Segment Area 1 x 0.4
   = 1 x 0.3 x 1.25 x 0.4
   = 0.15 kN / m²

The following is a table of compressive and suction loads using Microsoft Excel.

Table 2. Value Table of Compressed Wind and Wind Suction for Each Segment

<table>
<thead>
<tr>
<th>Segmen</th>
<th>Angin Tekan</th>
<th>Angin Hisap</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>9</td>
<td>1.13</td>
<td>0.75</td>
</tr>
<tr>
<td>10</td>
<td>1.24</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Figure 3.4 Wind Load of the Tower

3.3 Analysis of Tower Frame Structure Modeling

Here are the steps for a comparative analysis tower frame structure:
1. Open the AutoCAD program
2. Create a frame structure modeling by differentiating the layers and adjusting the planned frame modeling criteria
3. Save the planned model in .DXF format in AutoCAD
4. Open the SAP 2000 program
5. Import the frame modeling file in .DXF format from AutoCAD to SAP 2000
6. Create a model of the tower frame structure by importing one layer at a time from the modeling file from AutoCAD
7. Input the planned material

8. Input the frame section

9. Live Load Input
10. Wind Load Input
11. Load Combination Input
12. Release frame bracing on the frame model
13. Run the frame modeling
14. Displays the displacement location

15. Showing the displacement on the structure
IV. CONCLUSION
In the BTS tower with xdiagonal type bracing, the self-weight of the tower is 143.44 KN, with the largest displacement located at joint 17 with a displacement of 0.6 millimeters.

In the BTS tower with type v bracing, the self-weight of the tower is 123.686 KN, with the largest displacement located at joint 12 with a displacement of 0.4 millimeters.

From the analysis results obtained in the SAP 2000 program above, it can be concluded that type v bracing is lighter and stronger than type x bracing.

V. ACKNOWLEDGMENTS
This research can be completed properly thanks to the help of various parties. With the completion of this research, we would like to thank friends who have provided input on this research, so that this research can be completed properly.

REFERENCES