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SIMULATION OF AC PACKAGE TRAIN ROOF STRUCTURE STRENGTH USING SOFTWARE

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ABSTRACT
Modification of economic class coach originally is not designed to use package air conditioner. it was changed to use package air conditioner. It will be eliminated a few part of the train roof for air conditioner package holder. For ensure that the package air conditioner's holder is safe, then it was analysed by strength analyses. Make remodeling the train roof and air conditioner holder structure with solidwork 2017. This structure use SS400 which has yield strength of 245 MPa., The mass of package air conditioner are 375 kg. The result of maximum stress is 31,866 MPa. Safety of factor's result is 7,7. And then for the displacement's value is 1173 mm. From this analysis shows that the structural strength of the package air conditioner's holder is still in safe condition.

Keywords**:** coach's roof; package air conditioner; solidwork 2017; stress

INTRODUCTION
Improving service and convenience in the railroad business is an important point to attract and maintain public interest in using rail services. Passenger comfort facilities at the station have also been improved. In terms of ordering tickets, reservations can also be obtained by ordering online to reduce the use of paper on tickets. In addition, facilities such as timeliness in train operations are also getting better.

In addition to service at the station, an increase in service facilities occurs on the train. One of the service changes that occur on trains is air conditioning on economy class trains. Air conditioners used for economy trains while using split ac. Increasingly, the use of air conditioners with spit ac was replaced with ac packages. In changing the use of air conditioning, it will result in the roof frame on economy trains which are designed not to use an AC package, to be changed using an AC package. this will remove part of the roof structure of the train to be replaced with the ac package mount.

To find out the strength of the ac package mount, a strength analysis was carried out on the ac package mount and upper frame using solidwork 2017 software. The method is remodeled into three dimensions in solidwork 2017 software. an economy that has undergone changes using the ac package. The material used in the roof frame structure and ac package mounts uses SS400. After modeling with Solidwork 2017 software, a loading simulation test was carried out with a weight referring to the mass of the ac package of 375 kg.

The purpose of the loading simulation is to get the value of the maximum stress, displacement, and safety factor. From the results of this analysis, it can determine the security conditions on the ac package holder on the roof frame of the train. Besides that, it also gets an overview of the stress distribution and shape changes that occur due to the application of load to the ac package mount. The results of this analysis will determine the level of security resulting from the ac package support.

METHODS

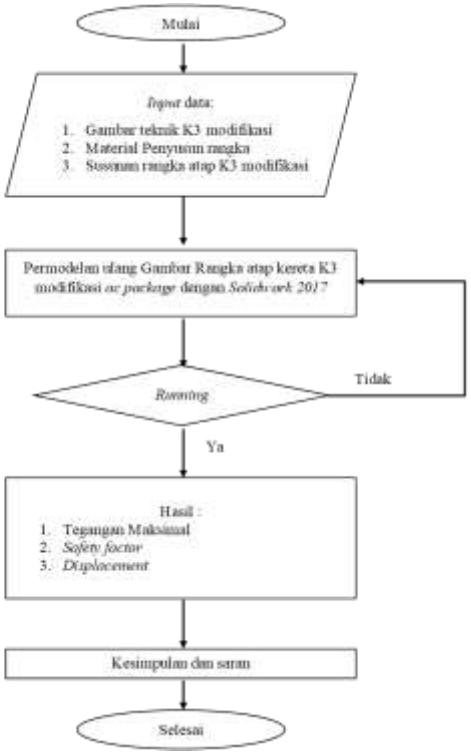

Figure 1. Flowchart

The research was carried out by testing using solidwork 2017 software. The first thing that must be done is to remodel the roof truss of the train with ac package with solidwork 2017. The purpose of the remodeling aims to analyze the stress resulting from a static loading simulation on the ac package holder due to loading generated by the mass of the ac package

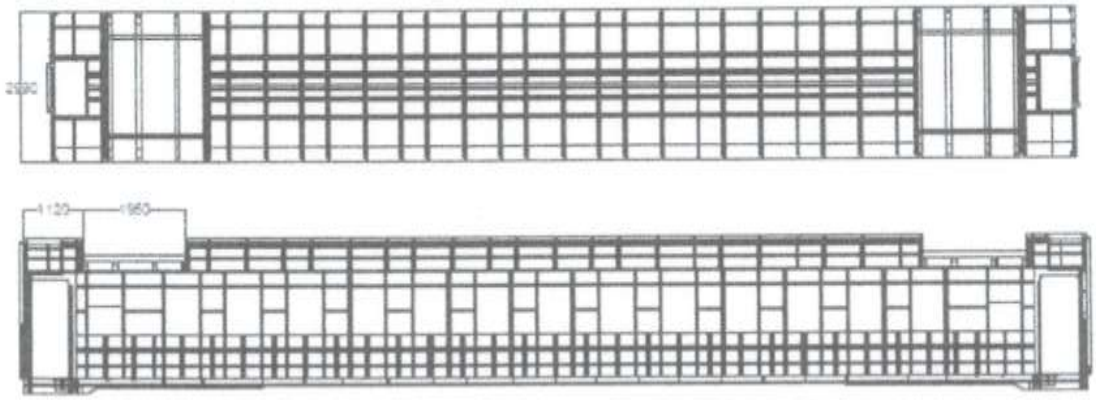

Figure 2. Arrangement of the train frame

Figure 2 above is a train frame arrangement that will be remade into a three-dimensional shape. Modeling in three dimensions only on the roof frame of the train. Place ac package at a distance of 1000 mm from the end of the carriage.

RESULTS

Table 1.

Parameter	Keterangan
Car body length	20000 mm
Car body width	2990 mm
The height of the roof of the train from the head of the rail	3610 mm
Train floor height from the rail head	1000 mm
Empty weight	33 ton
Maximum amount	106

K3 train dimensions

In modeling to a three-dimensional shape, the parts that make up the roof frame are formed first. After the description of each part has been carried out, the next process is to combine the components of each part to the assembly.

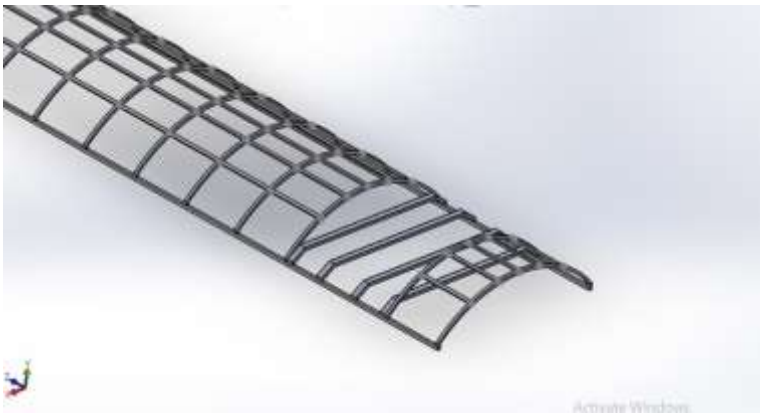

Figure 3. Assembly results

After the assembly process has been carried out, then enter the material data to be used, namely SS400. SS400 material has chemical content including carbon, manganese, phosphorus, silicon and sulfur.

Table 2.
Chemical properties of SS400

Grade	C	Si	Mn	P	S
SS400	0.1986	0.149	0.298	0.0127	0.0045

Data from table 3 states that SS400 material has a yield strength of 245 MPa and an elastic modulus of 2.07 x 105 MPa.

Table 3.
Mechanical properties

Parameter	Unit	Material type
		SS400
Modulus elastisitas	MPa	$2{,}07 \times 10^5$
Poisson's ratio	-	0,3
Massa jenis	Kg/mm^3	7,8e-6
Yield tensile strength	MPa	245
Ultimate tensile strength	MPa	400

After inserting the SS400 material into the frame structure, the next step is to carry out the meshing process. The size of the elements in the meshing is 65.6718 mm with a total of 93,998 nodes produced.

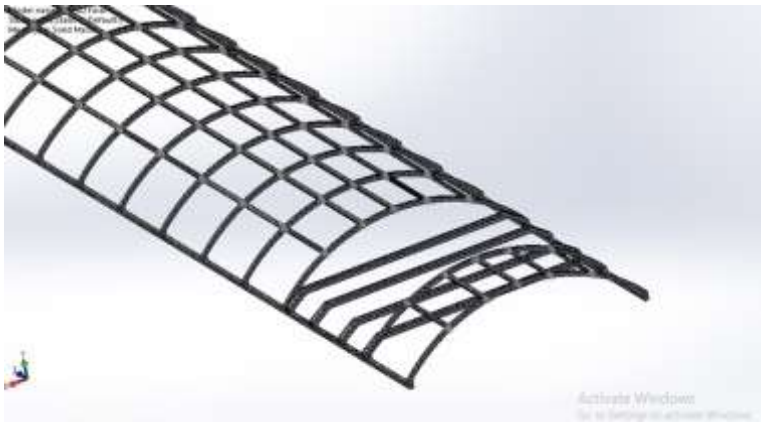

Figure 4. Meshing results

After giving the support to the ac package mount frame, the next step is to apply the force that occurs to the ac mount component. Giving force is adjusted to the mass of ac to be supported. The technical specifications of the ac package have an object mass of 375 kg. So, the amount of weight resulting from the ac is 3750 N.

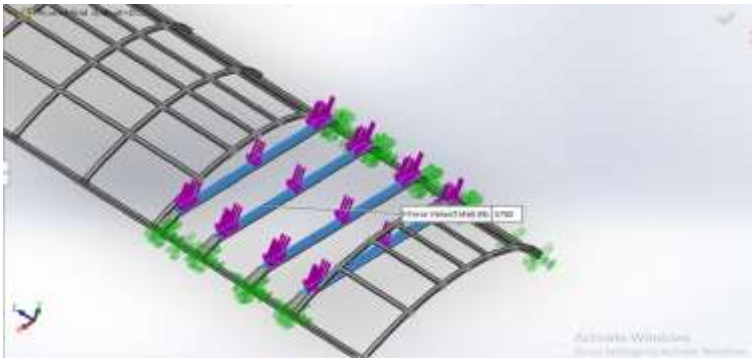

Figure 5. Styling

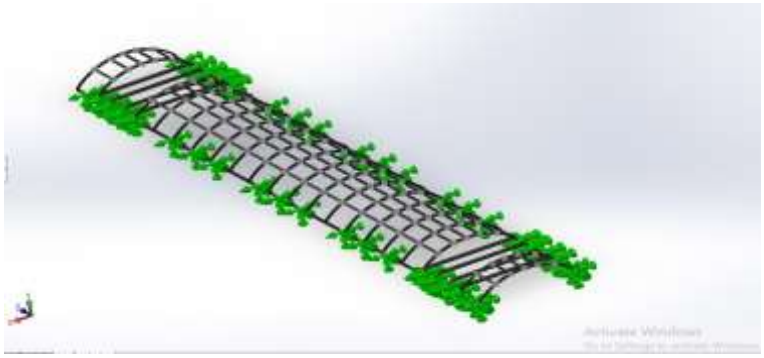

Figure 6. Pedestal giving

The next step after styling, constraints, and meshing is to run the process. The more and more complex the number of geometries and elements produced, the longer the process will run on these differences. In the static analysis on solidwork, the output produced in the test is stress, displacement, and factor of safety

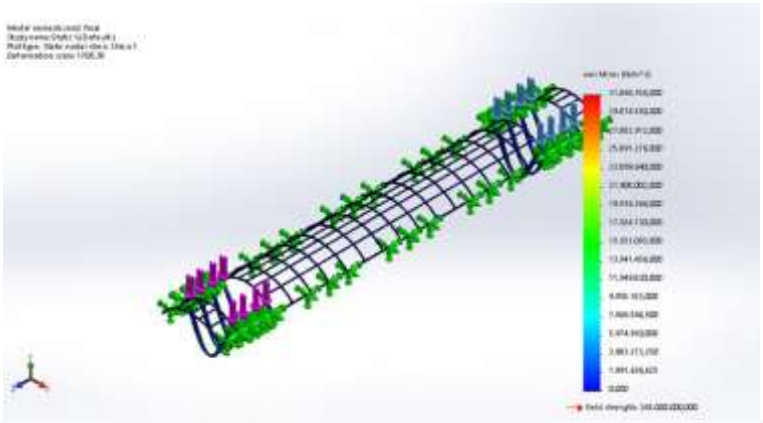

Figure 7. Voltage results

From the results of the analysis in Figure 7, it is stated that the maximum stress generated as a result of the force pressing on the ac package holder is 31.866 MPa. The magnitude of the maximum working stress has no effect on the yield strength value of the SS400 material of 245 MPa. As a result of the force acting causes a change in the shape of the object, namely displacement.

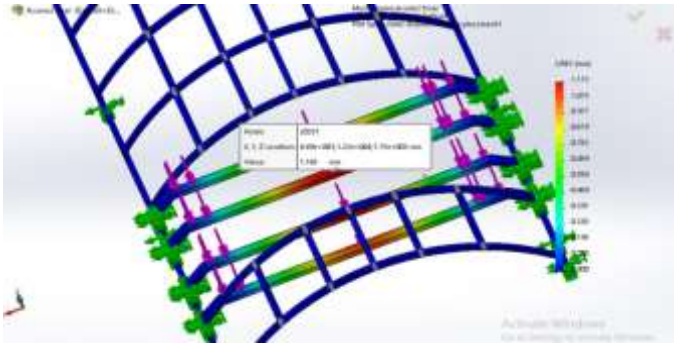

Figure 8. Displacement results

From the results of the analysis that occurs in Figure 8, it shows that the largest displacement that occurs as a result of static loading is shown in red with a displacement value of 1173 mm. In addition, the results obtained in the test are in the form of a safety factor. The result of the safety of factor is the division of the yield strength of the SS400 material with the resulting maximum stress. The safety factor of a design must have a value exceeding 1.5.

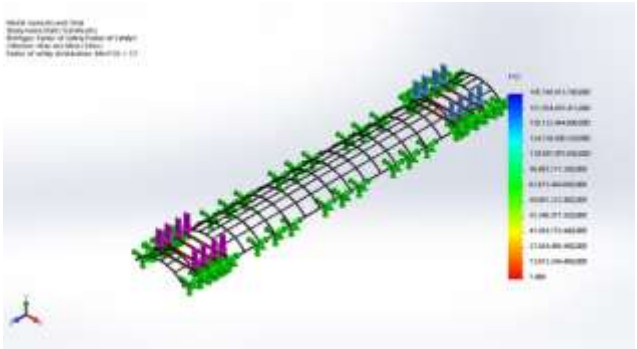

Figure 9. Results of safety of factor

From the results of the analysis in Figure 9, it shows that the resulting safety factor is 7.7. From all the analyzes that have been carried out, it shows that the structure of the roof truss is in a safe condition.

DISCUSSION

From the results of the voltage analysis, a force of 31,866 Mpa was produced, which is smaller than the yiel strength of the material of 245 Mpa. Likewise, the results of the safety of factor analysis resulted in a value of 7.7 where the value was greater than the minimum value of 1.5. From the two analysis results, it shows that the structure of the train roof frame with the addition of AC Package is in safe condition.

CONCLUSION

The results obtained in the process of testing the roof frame structure of the train with the ac package using SS400 material include stress, displacement, and safety of factor. The yield strength of the SS400 material is 245 MPA. The maximum stress analysis results received are 31.866 MPa causing a maximum displacement of 1173 mm. The safety factor value of the structure is 7.7 so that from the results of the structural analysis it is made very safe to withstand the ac package loads received.

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