DAFTAR PUSTAKA

Afrizal, Muhammad, Tri Nopiani Damayanti, Ari Macmuddi Kanosri, S.T. 2015. Rancang Bangun Monitoring Sistem Generator Kereta Api Berbasis Mikrokontroler e proceeding of applied science. Vol. 1 No. 3 Page 20-27

Alliare, Paul E. 1985. *Basics of The Finite Element Method.* C. Brown Publisher. Iowa.

Bagus, Ida Putra Anandya. 2016. Analisis Elemen Hingga pada Proses Bending Pipa Berpenampang Segi Empat dengan Laser. Fakultas Teknologi Industri. Institut Teknologi Industri.Surabaya.

Budynas, Richard G., J. Keith Nisbett. 2014. *Shigley's Mechanical Engineering Design Tenth Edition.* New York: Mc Graw-Hill.

Dapas, Servie O. 2011. Aplikasi Metode Elemen Hingga pada Analisis Struktur Rangka Batang. Vol. 1 No. 2 Page 156-160.

Effendi, Riki. 2014. Optimasi Kekuatan *Horizotal Vessel* Menggunakan Analisis Elemen Hingga. Seminar Nasional Sains dan Teknologi. Fakultas Teknologi. Universitas Muhammadiyah Jakarta. Proceding page 1-7

Endi Sutikno. 2011. Analisis Tegangan Akibat Pembebanan Statis pada Desain Carsbody Tec Railbus dengan Metode Elemen Hingga Jurnal Rekayasa Mesin Vol. 2 No. 1 Page 65-81

Georitno Arief, Marjuki, Alfian Hidayat. 2016. Struktur Belitan Stator dan Rotor Bermagnet Permanen *Fluks* Radial untuk Alternator Fase Tunggal Seminar Nasional Sains dan Teknologi 2016. Proceding page 1-9

Indrakto, Rifky Tatang. 2007. Analisis Pembebanan Statik dengan Variasi Temperature pada Connecting Rod Motor Honda Tipe Grand 100 cc dengan Material Baja AISI 1006, AISI 1040 dan AISI 1070 Menggunakan Software CATIA V5R14 .Tugas akhir. Fakultas Teknik UNS. Semarang.

Isworo, Hajar, Pathur Razi Ansyah. 2018. Metode Elemen Hingga HMKB654, Buku Ajar. Universitas Lambung Mangkurat.

Kementrian Energi dan Sumber Daya Mineral. 2018. Konsumsi Listrik Nasional tahun 2014-2018. Jakarta: Kementrian ESDM

Moaveni, Saeed. 2003. *Finite Element Analysis*: Theory and Application with ANSYS. New Jersey: Pearson Education, Inc.

Nushron, Muhammad Ali Mukhtar, Sagita Rochman. 2017. Analisis Simulasi Proses Ironing untuk Mengetahui Ketinggian Dinding berdasarkan Variasi Reduksi Ketebalan Dinding. Fakultas Teknologi Industri. Universitas PGRI Adi Buana Surabaya.

Rizal, Fahd Pris, Budhi M Suyitno. 2018. Analisis Kekuatan Velg Alluminium Alloy 17 Inc dari Berbagai Desain menggunakan Metode *Finite Element Analysis* (FEA) jurnal Ilmiah Teknobiz. Vol. 9 No. 2 page 33-39

Roslan Abd Rahman, Mohd Nasir Tamin, Ojo Kurdi. 2008. *Stress* Analysis of Heavy Duty Truck Chassis As a Preliminary Data For Its Fatigue Life Prediction Using FEM Jurnal mekanikal. Vol 4 No.26 page76-85.

Shigley, E. Joseph, Mischke, Charles E. and Budynas, Richard G. (2004).Mechanical Engineering Design, McGraww Hill, Singapore.

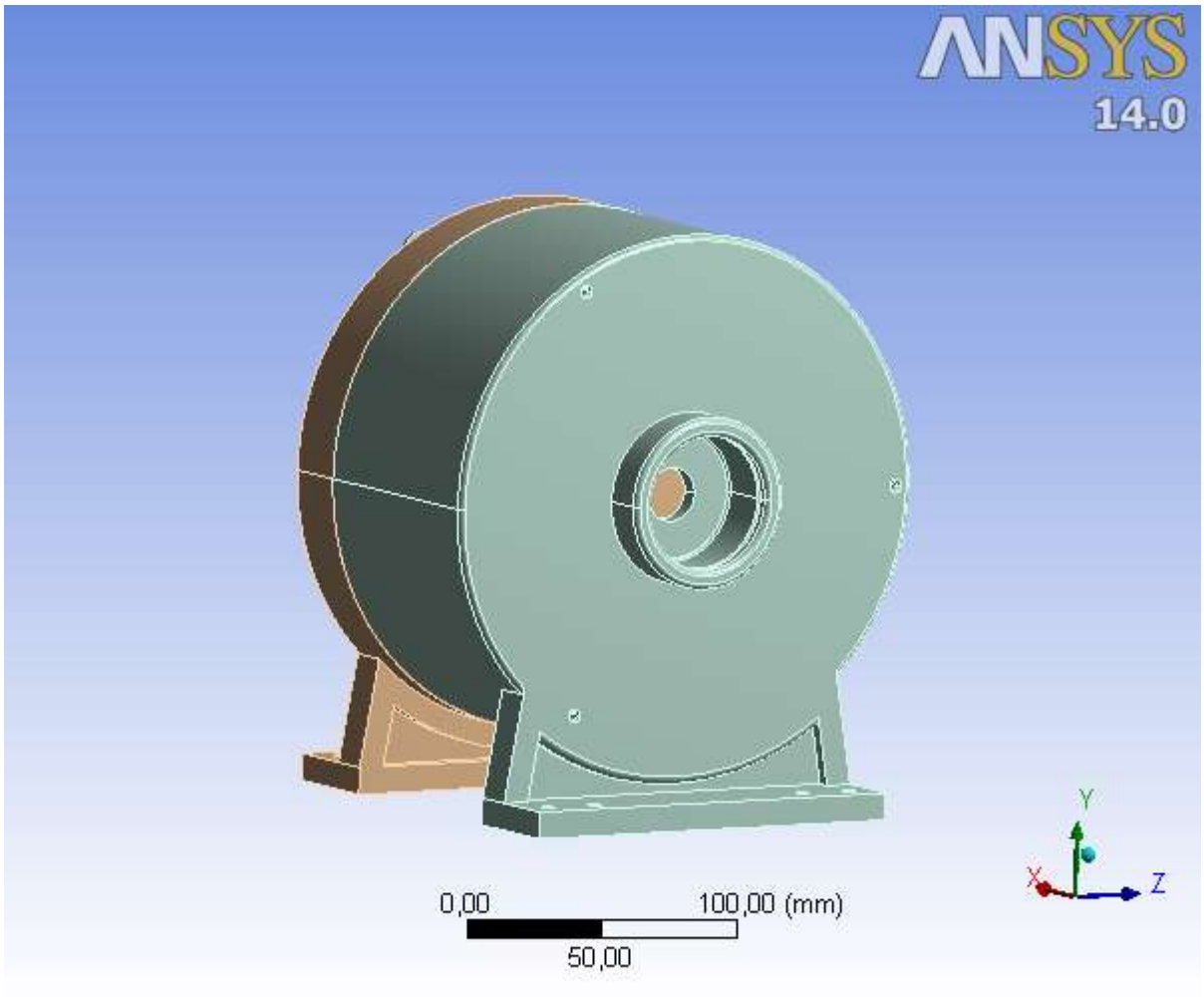
Sonief, Arief. 2005. Diktat Metode Elemen Hingga. Universitas Brawijaya. Malang.

Sugiyono, 2011. Metode Penelitian Kuantitatif, kualitatif dan R&D. Bandung : Afabeta.

Lampiran Uji beban 750 N

Project

First Saved	Sunday, May 10, 2020
Last Saved	Friday, June 5, 2020
Product Version	14.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

- Units
- Model (A4)
  - Geometry
    - Parts
  - Coordinate Systems
  - Connections
    - Contacts
      - Contact Regions
  - Mesh
  - Static Structural (A5)
    - Analysis Settings
    - Loads
    - Solution (A6)
      - Solution Information
      - Results
      - Stress Tool
        - Safety Factor
  - Chart 2
- Material Data
  - Aluminum Alloy

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\SKRIPSI\ANSYS\750 N\750 N_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	

Length X	167, mm
Length Y	217,5 mm
Length Z	195,5 mm
Properties	
Volume	1,1459e+006 mm³
Mass	3,1741 kg
Scale Factor Value	1,
Statistics	
Bodies	5
Active Bodies	5
Nodes	32504
Elements	17495
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\toshiba\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Faces	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Solid*	*Solid*	*Solid*	*Solid*	*Solid*
State	Meshed				
Graphics Properties					
Visible	Yes				
Transparency	1				
Definition					
Suppressed	No				
Stiffness Behavior	Flexible				
Coordinate System	Default Coordinate System				
Reference Temperature	By Environment				
Material					
Assignment	Aluminum Alloy				

Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	77, mm			52, mm	115, mm
Length Y	14, mm			217,5 mm	
Length Z	14, mm			195, mm	
Properties					
Volume	1213,5 mm³			4,3489e+005 mm³	7,0735e+005 mm³
Mass	3,3615e-003 kg			1,2046 kg	1,9593 kg
Centroid X	88,234 mm			95,471 mm	9,4898 mm
Centroid Y	214,77 mm	135,96 mm	57,153 mm	112,64 mm	121,56 mm
Centroid Z	147,96 mm	284,46 mm	147,96 mm	193,46 mm	193,39 mm
Moment of Inertia Ip1	3,977e-002 kg·mm²			7913,5 kg·mm²	14811 kg·mm²
Moment of Inertia Ip2	1,724 kg·mm²	1,7239 kg·mm²	1,724 kg·mm²	3116,3 kg·mm²	7844,5 kg·mm²
Moment of Inertia Ip3	1,724 kg·mm²			4986,6 kg·mm²	10032 kg·mm²
Statistics					
Nodes	421	437	428	11556	19662
Elements	177	191	184	6122	10821
Mesh Metric	None				

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 5
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 6
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	0,84193 mm
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies

TABLE 7
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*	*Contact Region 2*	*Contact Region 3*	*Contact Region 4*	*Contact Region 5*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	3 Faces	2 Faces	3 Faces	2 Faces	3 Faces
Target	4 Faces	2 Faces	5 Faces	2 Faces	3 Faces
Contact Bodies	Solid				
Target Bodies	Solid				
Definition					
Type	Bonded				
Scope Mode	Automatic				
Behavior	Program Controlled				
Suppressed	No				
Advanced					
Formulation	Program Controlled				
Detection Method	Program Controlled				

Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region 6*	*Contact Region 7*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	2 Faces	1 Face
Target	2 Faces	1 Face
Contact Bodies	Solid	
Target Bodies	Solid	
Definition		
Type	Bonded	
Scope Mode	Automatic	
Behavior	Program Controlled	
Suppressed	No	
Advanced		
Formulation	Program Controlled	
Detection Method	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	6,6846e-002 mm
Inflation	
Use Automatic Inflation	None

Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	5
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Advanced	
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	32504
Elements	17495
Mesh Metric	None

Static Structural (A5)

TABLE 10
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 11
Model (A4) > Static Structural (A5) > Analysis Settings

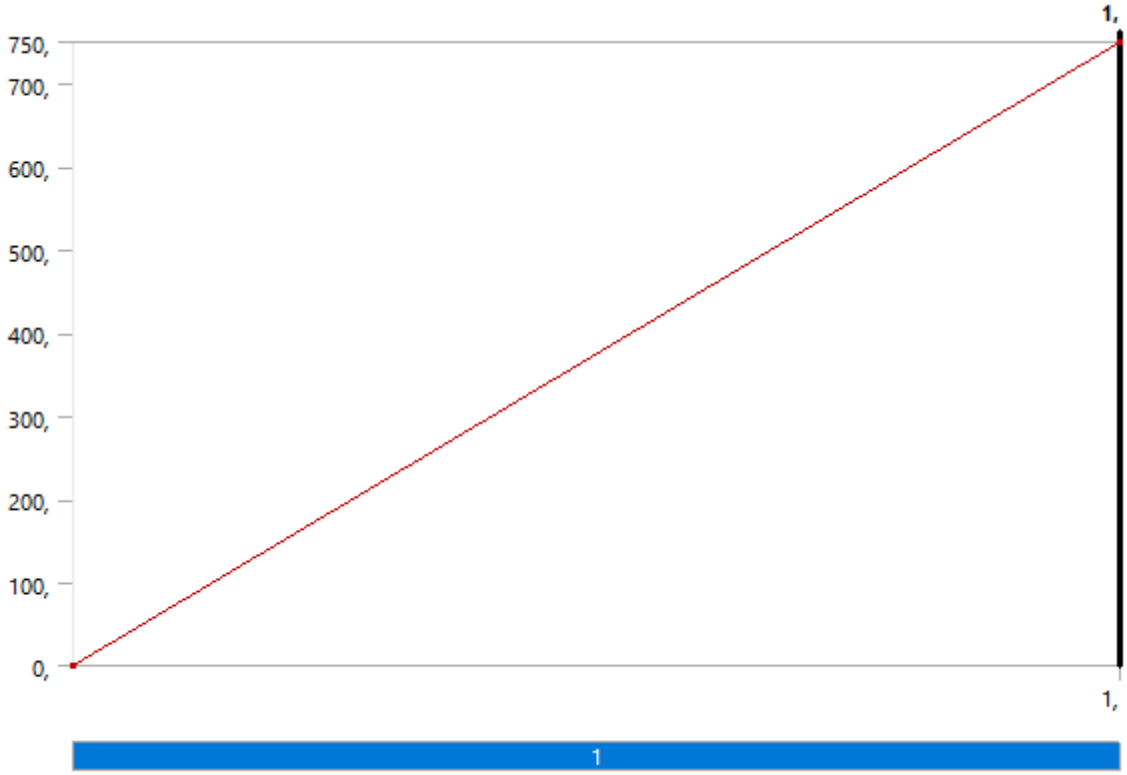
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s

Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Calculate Results At	All Time Points
Max Number of Result Sets	Program Controlled
Analysis Data Management	
Solver Files Directory	E:\SKRIPSI\ANSYS\750 N\750 N_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 12
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	16 Faces	2 Faces
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Vector
Magnitude		750, N (ramped)
Direction		Defined

FIGURE 1
Model (A4) > Static Structural (A5) > Force



Solution (A6)

TABLE 13
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Total Deformation*	*Equivalent Elastic Strain*	*Maximum Shear Elastic Strain*	*Equivalent Total Strain*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Directional Deformation	Total Deformation	Equivalent Elastic Strain	Maximum Shear Elastic Strain	Equivalent Total Strain
Orientation	X Axis				
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Results					
Minimum	-7,1976e-003 mm	0, mm	4,7055e-009 mm/mm	5,4474e-009 mm/mm	4,7055e-009 mm/mm
Maximum	1,2606e-003 mm	8,5669e-003 mm	1,712e-004 mm/mm	2,449e-004 mm/mm	1,712e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				
Integration Point Results					
Display Option			Averaged		

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Elastic Strain 2*	*Maximum Principal Elastic Strain*	*Middle Principal Elastic Strain*	*Minimum Principal Elastic Strain*	*Elastic Strain Intensity*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Equivalent Elastic Strain	Maximum Principal Elastic Strain	Middle Principal Elastic Strain	Minimum Principal Elastic Strain	Elastic Strain Intensity
By	Time				
Display Time	Last				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	4,7055e-009 mm/mm	-4,0026e-007 mm/mm	-1,8307e-005 mm/mm	-1,983e-004 mm/mm	5,4474e-009 mm/mm
Maximum	1,712e-004 mm/mm	1,8787e-004 mm/mm	1,8297e-005 mm/mm	1,0691e-008 mm/mm	2,449e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Elastic Strain*	*Shear Elastic Strain*	*Equivalent Plastic Strain*	*Equivalent Stress*	*Shear Stress*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					

Type	Normal Elastic Strain	Shear Elastic Strain	Equivalent Plastic Strain	Equivalent (von-Mises) Stress	Shear Stress
Orientation	X Axis	XY Plane			XY Plane
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				Global Coordinate System
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-1,5327e-004 mm/mm	-1,6889e-004 mm/mm	0, mm/mm	2,6467e-004 MPa	-4,508 MPa
Maximum	1,4957e-004 mm/mm	2,5269e-005 mm/mm	0, mm/mm	12,061 MPa	0,67447 MPa
Minimum Occurs On	Solid			Solid	
Maximum Occurs On	Solid			Solid	
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Stress*	*Stress Intensity*	*Maximum Principal Stress*	*Middle Principal Stress*	*Minimum Principal Stress*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Normal Stress	Stress Intensity	Maximum Principal Stress	Middle Principal Stress	Minimum Principal Stress
Orientation	X Axis				
By	Time				
Display Time	Last				

Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-16,165 MPa	2,908e-004 MPa	-6,0924 MPa	-8,0445 MPa	-18,341 MPa
Maximum	15,645 MPa	13,073 MPa	17,69 MPa	7,6617 MPa	5,5237 MPa
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Maximum Shear Stress*	*Strain Energy*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Maximum Shear Stress	Strain Energy
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Results		
Minimum	1,454e-004 MPa	1,225e-011 mJ
Maximum	6,5367 MPa	2,1586e-002 mJ
Minimum Occurs On	Solid	
Maximum Occurs On	Solid	
Information		
Time	1, s	
Load Step	1	

Substep	1
Iteration Number	1

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Results	
Minimum	> 10
Minimum Occurs On	Solid
Information	
Time	1, s
Load Step	1
Substep	1
Iteration Number	1

Chart 2

FIGURE 2
Model (A4) > Chart 2

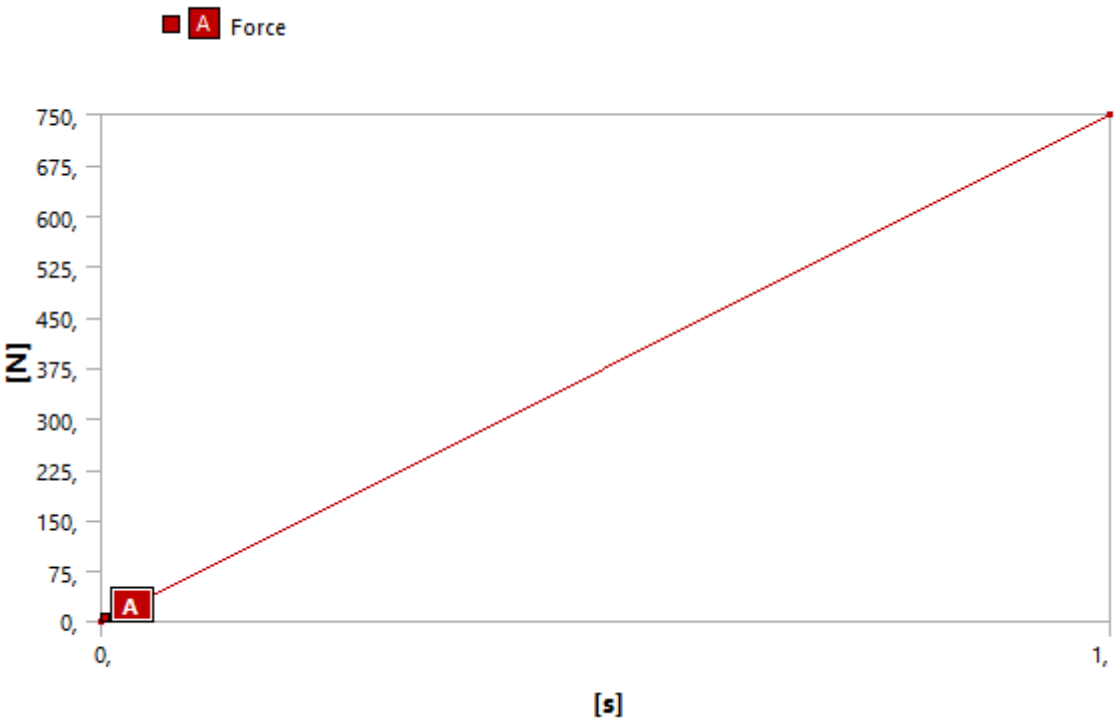


TABLE 22
Model (A4) > Chart 2

Steps	Time [s]	[A] Force [N]
1	0,	0,
	1,	750,

Material Data

Aluminum Alloy

TABLE 23
Aluminum Alloy > Constants

Density	2,77e-006 kg mm^-3
Coefficient of Thermal Expansion	2,3e-005 C^-1
Specific Heat	8,75e+005 mJ kg^-1 C^-1

TABLE 24
Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 25
Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength MPa
280,

TABLE 26
Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength MPa
280,

TABLE 27
Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
310,

TABLE 28
Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22,

TABLE 29
Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity W mm^-1 C^-1	Temperature C
0,114	-100,
0,144	0,
0,165	100,
0,175	200,

TABLE 30
Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress MPa	Cycles	R-Ratio
275,8	1700,	-1,
241,3	5000,	-1,
206,8	34000	-1,
172,4	1,4e+005	-1,
137,9	8,e+005	-1,
117,2	2,4e+006	-1,
89,63	5,5e+007	-1,
82,74	1,e+008	-1,
170,6	50000	-0,5
139,6	3,5e+005	-0,5
108,6	3,7e+006	-0,5
87,91	1,4e+007	-0,5
77,57	5,e+007	-0,5
72,39	1,e+008	-0,5
144,8	50000	0,
120,7	1,9e+005	0,
103,4	1,3e+006	0,
93,08	4,4e+006	0,

86,18	1,2e+007	0,
72,39	1,e+008	0,
74,12	3,e+005	0,5
70,67	1,5e+006	0,5
66,36	1,2e+007	0,5
62,05	1,e+008	0,5

TABLE 31
Aluminum Alloy > Isotropic Resistivity

Resistivity ohm mm	Temperature C
2,43e-005	0,
2,67e-005	20,
3,63e-005	100,

TABLE 32
Aluminum Alloy > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	71000	0,33	69608	26692

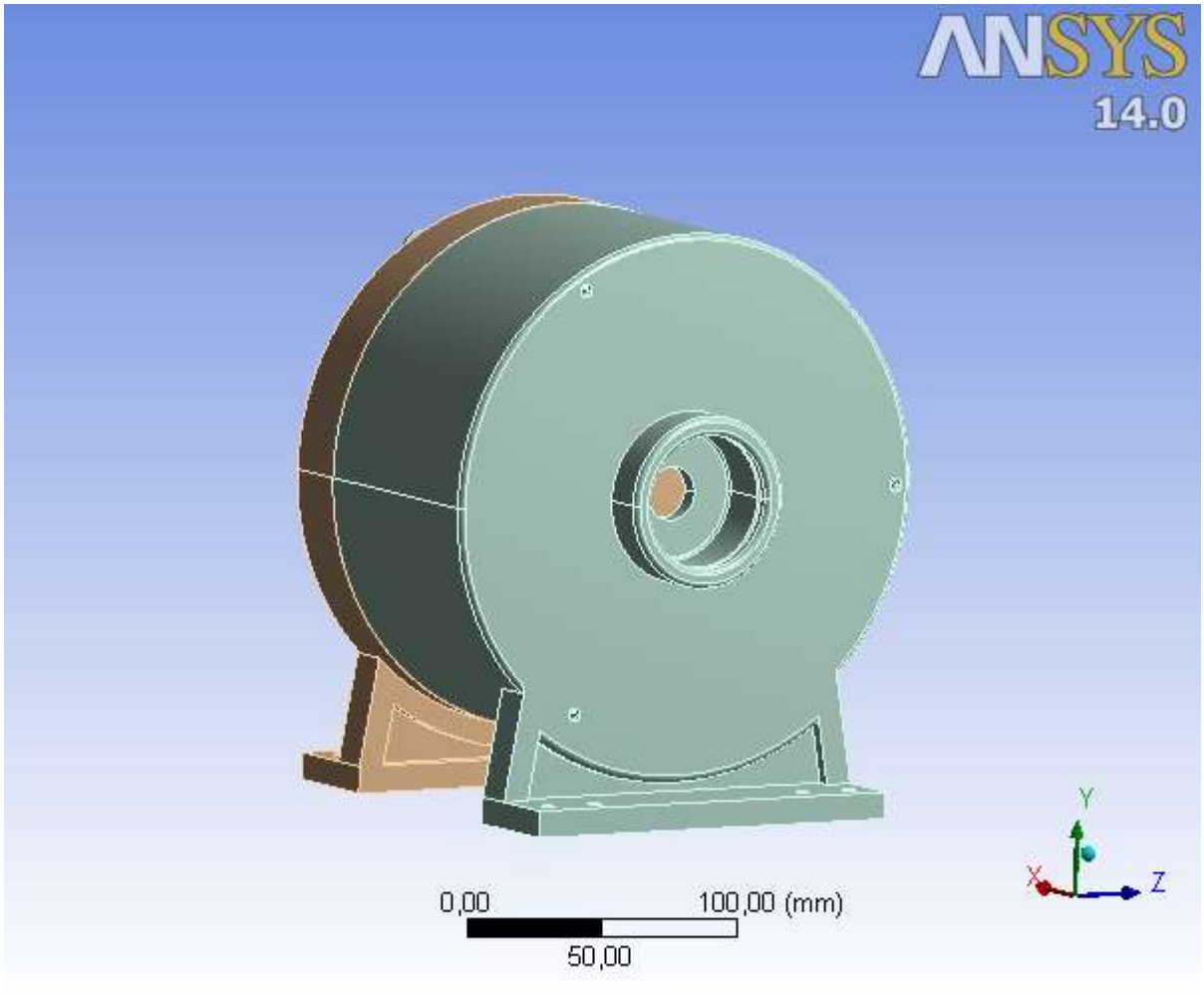
TABLE 33
Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1,

Lampiran Uji beban 1000 N

Project

First Saved	Sunday, May 10, 2020
Last Saved	Friday, June 5, 2020
Product Version	14.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

- Units
- Model (A4)
  - Geometry
    - Parts
  - Coordinate Systems
  - Connections
    - Contacts
      - Contact Regions
  - Mesh
  - Static Structural (A5)
    - Analysis Settings
    - Loads
    - Solution (A6)
      - Solution Information
      - Results
      - Stress Tool
        - Safety Factor
  - Chart 2
- Material Data
  - Aluminum Alloy

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\SKRIPSI\ANSYS\1000 N\1000 N_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	

Length X	167, mm
Length Y	217,5 mm
Length Z	195,5 mm
Properties	
Volume	1,1459e+006 mm^3
Mass	3,1741 kg
Scale Factor Value	1,
Statistics	
Bodies	5
Active Bodies	5
Nodes	32504
Elements	17495
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\toshiba\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Faces	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Solid*	*Solid*	*Solid*	*Solid*	*Solid*
State	Meshed				
Graphics Properties					
Visible	Yes				
Transparency	1				
Definition					
Suppressed	No				
Stiffness Behavior	Flexible				
Coordinate System	Default Coordinate System				
Reference Temperature	By Environment				
Material					
Assignment	Aluminum Alloy				

Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	77, mm			52, mm	115, mm
Length Y	14, mm			217,5 mm	
Length Z	14, mm			195, mm	
Properties					
Volume	1213,5 mm³			4,3489e+005 mm³	7,0735e+005 mm³
Mass	3,3615e-003 kg			1,2046 kg	1,9593 kg
Centroid X	88,234 mm			95,471 mm	9,4898 mm
Centroid Y	214,77 mm	135,96 mm	57,153 mm	112,64 mm	121,56 mm
Centroid Z	147,96 mm	284,46 mm	147,96 mm	193,46 mm	193,39 mm
Moment of Inertia Ip1	3,977e-002 kg·mm²			7913,5 kg·mm²	14811 kg·mm²
Moment of Inertia Ip2	1,724 kg·mm²	1,7239 kg·mm²	1,724 kg·mm²	3116,3 kg·mm²	7844,5 kg·mm²
Moment of Inertia Ip3	1,724 kg·mm²			4986,6 kg·mm²	10032 kg·mm²
Statistics					
Nodes	421	437	428	11556	19662
Elements	177	191	184	6122	10821
Mesh Metric	None				

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 5
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 6
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	0,84193 mm
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies

TABLE 7
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*	*Contact Region 2*	*Contact Region 3*	*Contact Region 4*	*Contact Region 5*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	3 Faces	2 Faces	3 Faces	2 Faces	3 Faces
Target	4 Faces	2 Faces	5 Faces	2 Faces	3 Faces
Contact Bodies	Solid				
Target Bodies	Solid				
Definition					
Type	Bonded				
Scope Mode	Automatic				
Behavior	Program Controlled				
Suppressed	No				
Advanced					
Formulation	Program Controlled				
Detection Method	Program Controlled				

Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region 6*	*Contact Region 7*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	2 Faces	1 Face
Target	2 Faces	1 Face
Contact Bodies	Solid	
Target Bodies	Solid	
Definition		
Type	Bonded	
Scope Mode	Automatic	
Behavior	Program Controlled	
Suppressed	No	
Advanced		
Formulation	Program Controlled	
Detection Method	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	6,6846e-002 mm
Inflation	
Use Automatic Inflation	None

Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	5
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Advanced	
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	32504
Elements	17495
Mesh Metric	None

Static Structural (A5)

TABLE 10
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 11
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s

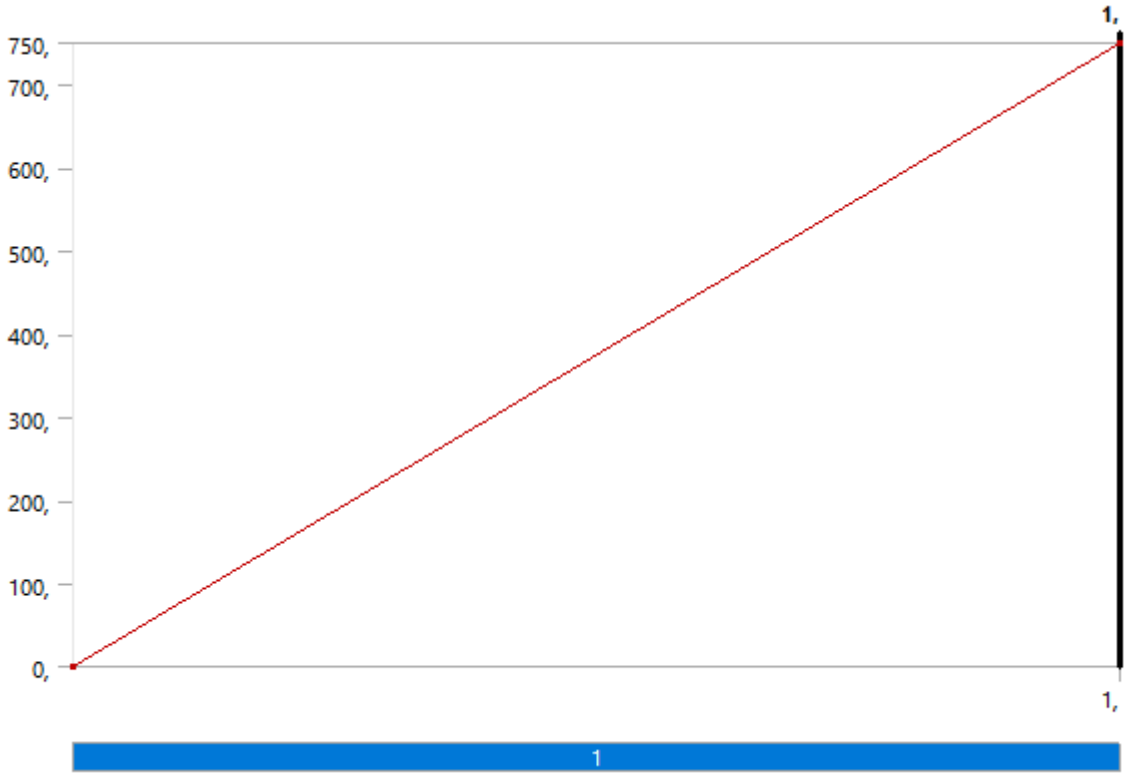
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Calculate Results At	All Time Points
Max Number of Result Sets	Program Controlled
Analysis Data Management	
Solver Files Directory	E:\SKRIPSI\ANSYS\1000 N\1000 N_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 12
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	16 Faces	2 Faces
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Vector
Magnitude		1250, N (ramped)

Direction		Defined

FIGURE 1
Model (A4) > Static Structural (A5) > Force



Solution (A6)

TABLE 13
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2,5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Total Deformation*	*Equivalent Elastic Strain*	*Maximum Shear Elastic Strain*	*Equivalent Total Strain*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Directional Deformation	Total Deformation	Equivalent Elastic Strain	Maximum Shear Elastic Strain	Equivalent Total Strain
Orientation	X Axis				
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Results					
Minimum	-1,1996e-002 mm	0, mm	7,8425e-009 mm/mm	9,079e-009 mm/mm	7,8425e-009 mm/mm
Maximum	2,101e-003 mm	1,4278e-002 mm	2,8534e-004 mm/mm	4,0816e-004 mm/mm	2,8534e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				
Integration Point Results					

Display Option		Averaged

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Elastic Strain 2*	*Maximum Principal Elastic Strain*	*Middle Principal Elastic Strain*	*Minimum Principal Elastic Strain*	*Elastic Strain Intensity*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Equivalent Elastic Strain	Maximum Principal Elastic Strain	Middle Principal Elastic Strain	Minimum Principal Elastic Strain	Elastic Strain Intensity
By	Time				
Display Time	Last				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	7,8425e-009 mm/mm	-6,671e-007 mm/mm	-3,0512e-005 mm/mm	-3,305e-004 mm/mm	9,079e-009 mm/mm
Maximum	2,8534e-004 mm/mm	3,1311e-004 mm/mm	3,0495e-005 mm/mm	1,7819e-008 mm/mm	4,0816e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Elastic Strain*	*Shear Elastic Strain*	*Equivalent Plastic Strain*	*Equivalent Stress*	*Shear Stress*
State	Solved				
Scope					

Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Normal Elastic Strain	Shear Elastic Strain	Equivalent Plastic Strain	Equivalent (von-Mises) Stress	Shear Stress
Orientation	X Axis	XY Plane			XY Plane
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				Global Coordinate System
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-2,5545e-004 mm/mm	-2,8149e-004 mm/mm	0, mm/mm	4,4112e-004 MPa	-7,5134 MPa
Maximum	2,4929e-004 mm/mm	4,2115e-005 mm/mm	0, mm/mm	20,102 MPa	1,1241 MPa
Minimum Occurs On	Solid			Solid	
Maximum Occurs On	Solid			Solid	
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Stress*	*Stress Intensity*	*Maximum Principal Stress*	*Middle Principal Stress*	*Minimum Principal Stress*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					

Type	Normal Stress	Stress Intensity	Maximum Principal Stress	Middle Principal Stress	Minimum Principal Stress
Orientation	X Axis				
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-26,942 MPa	4,8467e-004 MPa	-10,154 MPa	-13,407 MPa	-30,568 MPa
Maximum	26,076 MPa	21,789 MPa	29,483 MPa	12,77 MPa	9,2062 MPa
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Maximum Shear Stress*	*Strain Energy*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Maximum Shear Stress	Strain Energy
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Results		
Minimum	2,4233e-004 MPa	3,4029e-011 mJ

Maximum	10,894 MPa	5,9961e-002 mJ
Minimum Occurs On	Solid	
Maximum Occurs On	Solid	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Results	
Minimum	> 10
Minimum Occurs On	Solid
Information	
Time	1, s
Load Step	1
Substep	1
Iteration Number	1

Chart 2

FIGURE 2
Model (A4) > Chart 2

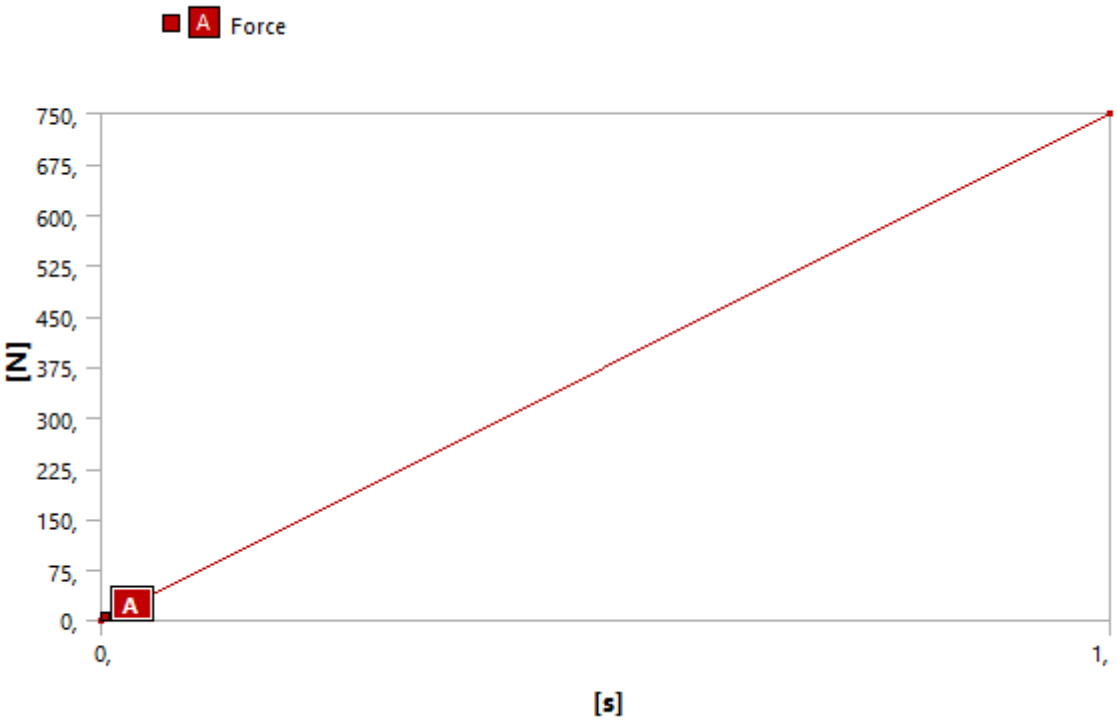


TABLE 22
Model (A4) > Chart 2

Steps	Time [s]	[A] Force [N]
1	0,	0,
	1,	1250,

Material Data

Aluminum Alloy

TABLE 23
Aluminum Alloy > Constants

Density	2,77e-006 kg mm^-3
Coefficient of Thermal Expansion	2,3e-005 C^-1
Specific Heat	8,75e+005 mJ kg^-1 C^-1

TABLE 24
Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 25
Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength MPa
280,

TABLE 26
Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength MPa
280,

TABLE 27
Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
310,

TABLE 28
Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22,

TABLE 29
Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity W mm^-1 C^-1	Temperature C
0,114	-100,
0,144	0,
0,165	100,
0,175	200,

TABLE 30
Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress MPa	Cycles	R-Ratio
275,8	1700,	-1,
241,3	5000,	-1,
206,8	34000	-1,
172,4	1,4e+005	-1,
137,9	8,e+005	-1,
117,2	2,4e+006	-1,
89,63	5,5e+007	-1,
82,74	1,e+008	-1,
170,6	50000	-0,5
139,6	3,5e+005	-0,5
108,6	3,7e+006	-0,5
87,91	1,4e+007	-0,5
77,57	5,e+007	-0,5
72,39	1,e+008	-0,5
144,8	50000	0,
120,7	1,9e+005	0,
103,4	1,3e+006	0,
93,08	4,4e+006	0,

86,18	1,2e+007	0,
72,39	1,e+008	0,
74,12	3,e+005	0,5
70,67	1,5e+006	0,5
66,36	1,2e+007	0,5
62,05	1,e+008	0,5

TABLE 31
Aluminum Alloy > Isotropic Resistivity

Resistivity ohm mm	Temperature C
2,43e-005	0,
2,67e-005	20,
3,63e-005	100,

TABLE 32
Aluminum Alloy > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	71000	0,33	69608	26692

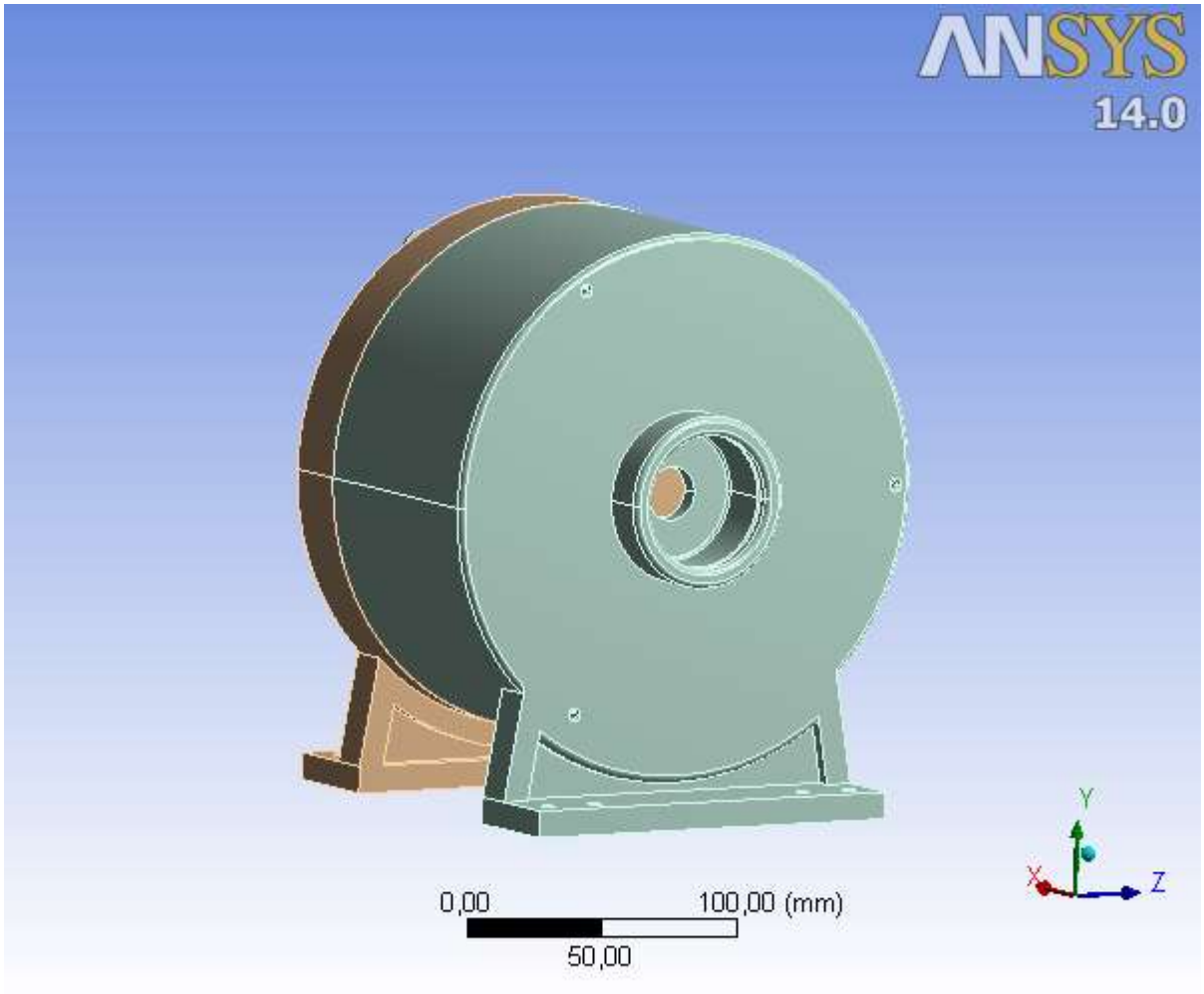
TABLE 33
Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1,

Lampiran Uji beban 1250 N

Project

First Saved	Sunday, May 10, 2020
Last Saved	Friday, June 5, 2020
Product Version	14.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

- Units
- Model (A4)
  - Geometry
    - Parts
  - Coordinate Systems
  - Connections
    - Contacts
      - Contact Regions
  - Mesh
  - Static Structural (A5)
    - Analysis Settings
    - Loads
    - Solution (A6)
      - Solution Information
      - Results
      - Stress Tool
        - Safety Factor
  - Chart 2
- Material Data
  - Aluminum Alloy

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\SKRIPSI\ANSYS\1250 N\1250 n_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	

Length X	167, mm
Length Y	217,5 mm
Length Z	195,5 mm
Properties	
Volume	1,1459e+006 mm^3
Mass	3,1741 kg
Scale Factor Value	1,
Statistics	
Bodies	5
Active Bodies	5
Nodes	32504
Elements	17495
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\toshiba\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Faces	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Solid*	*Solid*	*Solid*	*Solid*	*Solid*
State	Meshed				
Graphics Properties					
Visible	Yes				
Transparency	1				
Definition					
Suppressed	No				
Stiffness Behavior	Flexible				
Coordinate System	Default Coordinate System				
Reference Temperature	By Environment				
Material					
Assignment	Aluminum Alloy				

Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	77, mm			52, mm	115, mm
Length Y	14, mm			217,5 mm	
Length Z	14, mm			195, mm	
Properties					
Volume	1213,5 mm³			4,3489e+005 mm³	7,0735e+005 mm³
Mass	3,3615e-003 kg			1,2046 kg	1,9593 kg
Centroid X	88,234 mm			95,471 mm	9,4898 mm
Centroid Y	214,77 mm	135,96 mm	57,153 mm	112,64 mm	121,56 mm
Centroid Z	147,96 mm	284,46 mm	147,96 mm	193,46 mm	193,39 mm
Moment of Inertia Ip1	3,977e-002 kg·mm²			7913,5 kg·mm²	14811 kg·mm²
Moment of Inertia Ip2	1,724 kg·mm²	1,7239 kg·mm²	1,724 kg·mm²	3116,3 kg·mm²	7844,5 kg·mm²
Moment of Inertia Ip3	1,724 kg·mm²			4986,6 kg·mm²	10032 kg·mm²
Statistics					
Nodes	421	437	428	11556	19662
Elements	177	191	184	6122	10821
Mesh Metric	None				

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 5
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 6
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	0,84193 mm
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies

TABLE 7
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*	*Contact Region 2*	*Contact Region 3*	*Contact Region 4*	*Contact Region 5*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	3 Faces	2 Faces	3 Faces	2 Faces	3 Faces
Target	4 Faces	2 Faces	5 Faces	2 Faces	3 Faces
Contact Bodies	Solid				
Target Bodies	Solid				
Definition					
Type	Bonded				
Scope Mode	Automatic				
Behavior	Program Controlled				
Suppressed	No				
Advanced					
Formulation	Program Controlled				
Detection Method	Program Controlled				

Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region 6*	*Contact Region 7*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	2 Faces	1 Face
Target	2 Faces	1 Face
Contact Bodies	Solid	
Target Bodies	Solid	
Definition		
Type	Bonded	
Scope Mode	Automatic	
Behavior	Program Controlled	
Suppressed	No	
Advanced		
Formulation	Program Controlled	
Detection Method	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	6,6846e-002 mm
Inflation	
Use Automatic Inflation	None

Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	5
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Advanced	
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	32504
Elements	17495
Mesh Metric	None

Static Structural (A5)

TABLE 10
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 11
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s

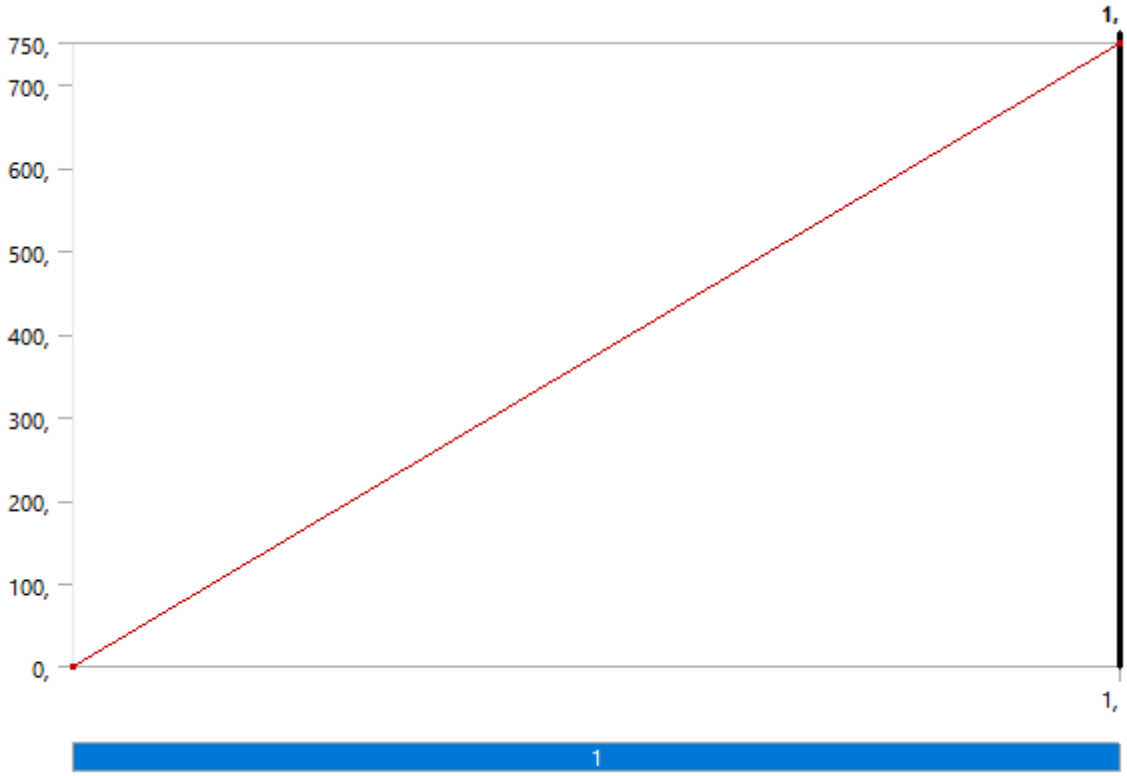
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Calculate Results At	All Time Points
Max Number of Result Sets	Program Controlled
Analysis Data Management	
Solver Files Directory	E:\SKRIPSI\ANSYS\1250 N\1250 n_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 12
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	16 Faces	2 Faces
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Vector
Magnitude		1250, N (ramped)

Direction		Defined

FIGURE 1
Model (A4) > Static Structural (A5) > Force



Solution (A6)

TABLE 13
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2,5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Total Deformation*	*Equivalent Elastic Strain*	*Maximum Shear Elastic Strain*	*Equivalent Total Strain*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Directional Deformation	Total Deformation	Equivalent Elastic Strain	Maximum Shear Elastic Strain	Equivalent Total Strain
Orientation	X Axis				
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Results					
Minimum	-1,1996e-002 mm	0, mm	7,8425e-009 mm/mm	9,079e-009 mm/mm	7,8425e-009 mm/mm
Maximum	2,101e-003 mm	1,4278e-002 mm	2,8534e-004 mm/mm	4,0816e-004 mm/mm	2,8534e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				
Integration Point Results					

Display Option		Averaged

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Elastic Strain 2*	*Maximum Principal Elastic Strain*	*Middle Principal Elastic Strain*	*Minimum Principal Elastic Strain*	*Elastic Strain Intensity*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Equivalent Elastic Strain	Maximum Principal Elastic Strain	Middle Principal Elastic Strain	Minimum Principal Elastic Strain	Elastic Strain Intensity
By	Time				
Display Time	Last				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	7,8425e-009 mm/mm	-6,671e-007 mm/mm	-3,0512e-005 mm/mm	-3,305e-004 mm/mm	9,079e-009 mm/mm
Maximum	2,8534e-004 mm/mm	3,1311e-004 mm/mm	3,0495e-005 mm/mm	1,7819e-008 mm/mm	4,0816e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Elastic Strain*	*Shear Elastic Strain*	*Equivalent Plastic Strain*	*Equivalent Stress*	*Shear Stress*
State	Solved				
Scope					

Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Normal Elastic Strain	Shear Elastic Strain	Equivalent Plastic Strain	Equivalent (von-Mises) Stress	Shear Stress
Orientation	X Axis	XY Plane			XY Plane
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				Global Coordinate System
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-2,5545e-004 mm/mm	-2,8149e-004 mm/mm	0, mm/mm	4,4112e-004 MPa	-7,5134 MPa
Maximum	2,4929e-004 mm/mm	4,2115e-005 mm/mm	0, mm/mm	20,102 MPa	1,1241 MPa
Minimum Occurs On	Solid			Solid	
Maximum Occurs On	Solid			Solid	
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Stress*	*Stress Intensity*	*Maximum Principal Stress*	*Middle Principal Stress*	*Minimum Principal Stress*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					

Type	Normal Stress	Stress Intensity	Maximum Principal Stress	Middle Principal Stress	Minimum Principal Stress
Orientation	X Axis				
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-26,942 MPa	4,8467e-004 MPa	-10,154 MPa	-13,407 MPa	-30,568 MPa
Maximum	26,076 MPa	21,789 MPa	29,483 MPa	12,77 MPa	9,2062 MPa
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Maximum Shear Stress*	*Strain Energy*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Maximum Shear Stress	Strain Energy
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Results		
Minimum	2,4233e-004 MPa	3,4029e-011 mJ

Maximum	10,894 MPa	5,9961e-002 mJ
Minimum Occurs On	Solid	
Maximum Occurs On	Solid	
Information		
Time	1, s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Results	
Minimum	> 10
Minimum Occurs On	Solid
Information	
Time	1, s
Load Step	1
Substep	1
Iteration Number	1

Chart 2

FIGURE 2
Model (A4) > Chart 2

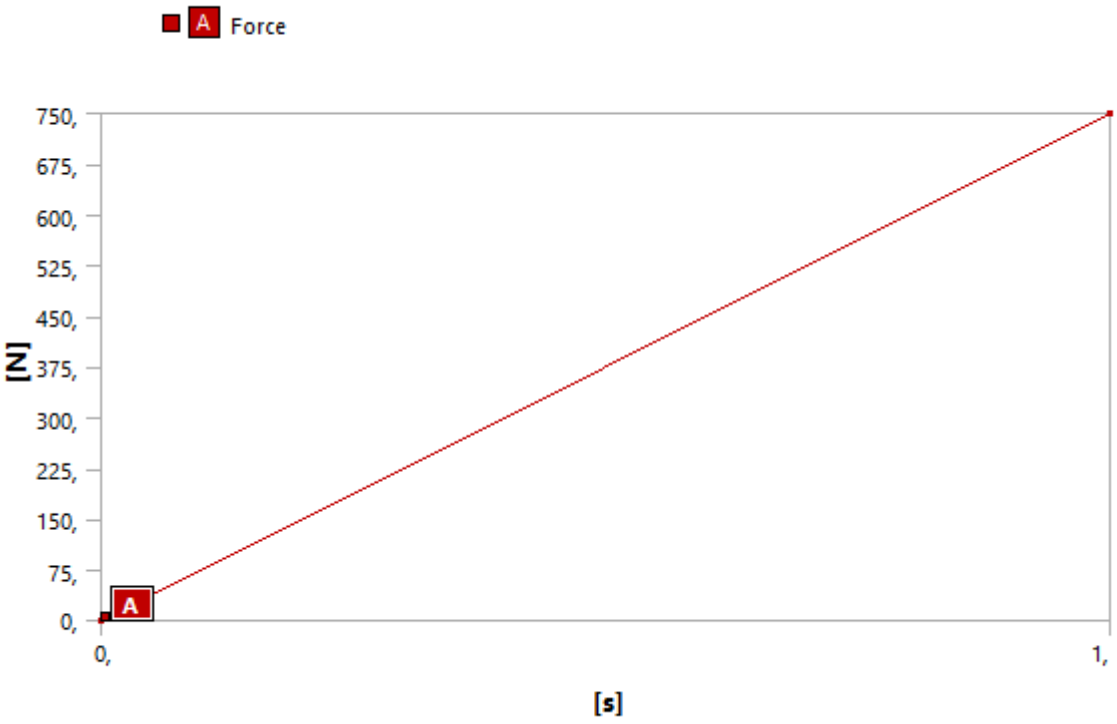


TABLE 22
Model (A4) > Chart 2

Steps	Time [s]	[A] Force [N]
1	0,	0,
	1,	1250,

Material Data

Aluminum Alloy

TABLE 23
Aluminum Alloy > Constants

Density	2,77e-006 kg mm^-3
Coefficient of Thermal Expansion	2,3e-005 C^-1
Specific Heat	8,75e+005 mJ kg^-1 C^-1

TABLE 24
Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 25
Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength MPa

280,

TABLE 26
Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength MPa
280,

TABLE 27
Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
310,

TABLE 28
Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22,

TABLE 29
Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity W mm^-1 C^-1	Temperature C
0,114	-100,
0,144	0,
0,165	100,
0,175	200,

TABLE 30
Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress MPa	Cycles	R-Ratio
275,8	1700,	-1,
241,3	5000,	-1,
206,8	34000	-1,
172,4	1,4e+005	-1,
137,9	8,e+005	-1,
117,2	2,4e+006	-1,
89,63	5,5e+007	-1,
82,74	1,e+008	-1,
170,6	50000	-0,5
139,6	3,5e+005	-0,5
108,6	3,7e+006	-0,5
87,91	1,4e+007	-0,5
77,57	5,e+007	-0,5
72,39	1,e+008	-0,5
144,8	50000	0,
120,7	1,9e+005	0,
103,4	1,3e+006	0,
93,08	4,4e+006	0,
86,18	1,2e+007	0,
72,39	1,e+008	0,
74,12	3,e+005	0,5

70,67	1,5e+006	0,5
66,36	1,2e+007	0,5
62,05	1,e+008	0,5

TABLE 31
Aluminum Alloy > Isotropic Resistivity

Resistivity ohm mm	Temperature C
2,43e-005	0,
2,67e-005	20,
3,63e-005	100,

TABLE 32
Aluminum Alloy > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	71000	0,33	69608	26692

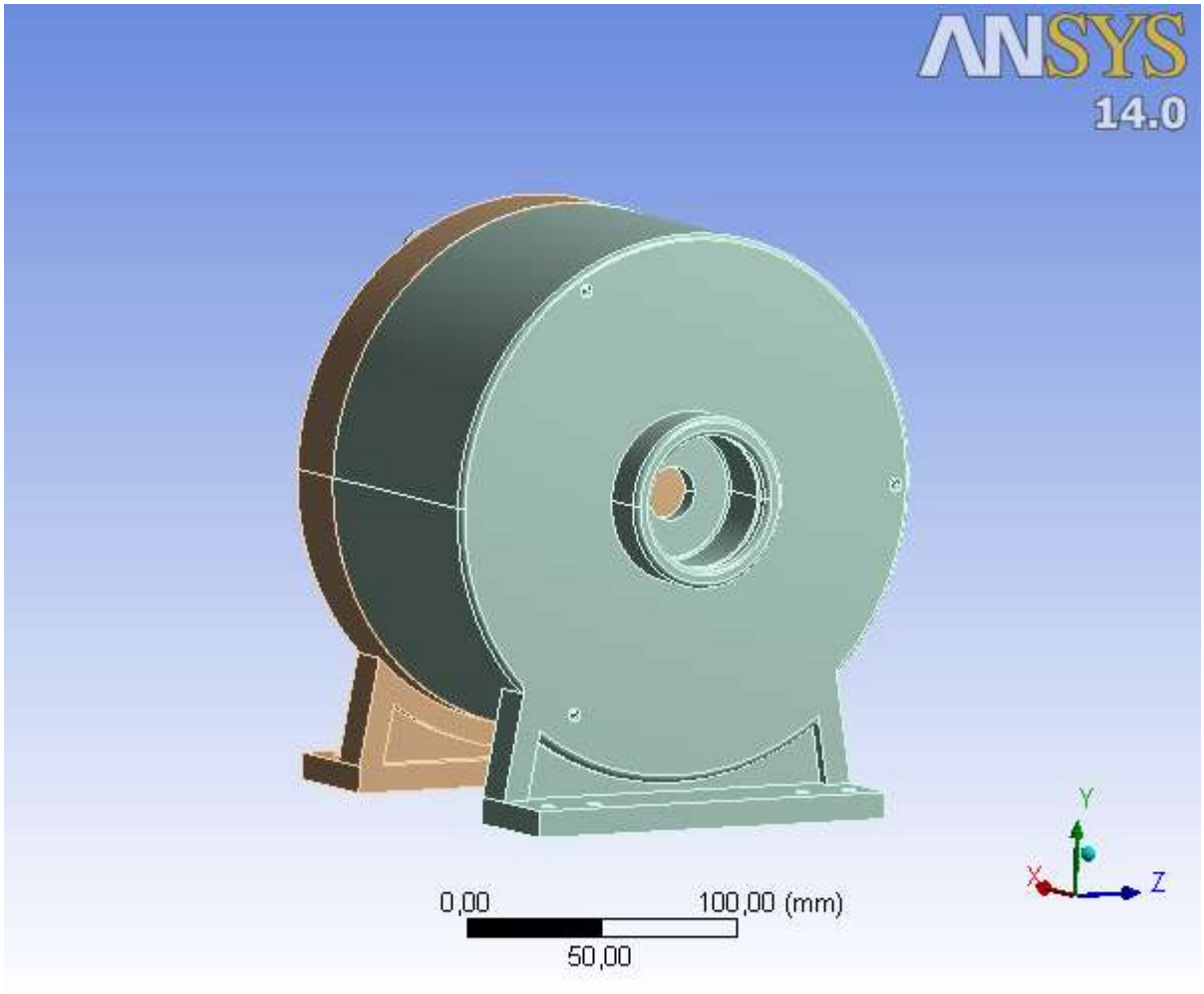
TABLE 33
Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1,

Lampiran Uji beban 1500 N

Project

First Saved	Sunday, May 10, 2020
Last Saved	Friday, June 5, 2020
Product Version	14.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

- Units
- Model (A4)
  - Geometry
    - Parts
  - Coordinate Systems
  - Connections
    - Contacts
      - Contact Regions
  - Mesh
  - Static Structural (A5)
    - Analysis Settings
    - Loads
    - Solution (A6)
      - Solution Information
      - Results
      - Stress Tool
        - Safety Factor
  - Chart 2
- Material Data
  - Aluminum Alloy

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	E:\SKRIPSI\ANSYS\1500 N\1500_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	

Length X	167, mm
Length Y	217,5 mm
Length Z	195,5 mm
Properties	
Volume	1,1459e+006 mm³
Mass	3,1741 kg
Scale Factor Value	1,
Statistics	
Bodies	5
Active Bodies	5
Nodes	32504
Elements	17495
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\toshiba\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Faces	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Solid*	*Solid*	*Solid*	*Solid*	*Solid*
State	Meshed				
Graphics Properties					
Visible	Yes				
Transparency	1				
Definition					
Suppressed	No				
Stiffness Behavior	Flexible				
Coordinate System	Default Coordinate System				
Reference Temperature	By Environment				
Material					
Assignment	Aluminum Alloy				

Nonlinear Effects	Yes				
Thermal Strain Effects	Yes				
Bounding Box					
Length X	77, mm			52, mm	115, mm
Length Y	14, mm			217,5 mm	
Length Z	14, mm			195, mm	
Properties					
Volume	1213,5 mm³			4,3489e+005 mm³	7,0735e+005 mm³
Mass	3,3615e-003 kg			1,2046 kg	1,9593 kg
Centroid X	88,234 mm			95,471 mm	9,4898 mm
Centroid Y	214,77 mm	135,96 mm	57,153 mm	112,64 mm	121,56 mm
Centroid Z	147,96 mm	284,46 mm	147,96 mm	193,46 mm	193,39 mm
Moment of Inertia Ip1	3,977e-002 kg·mm²			7913,5 kg·mm²	14811 kg·mm²
Moment of Inertia Ip2	1,724 kg·mm²	1,7239 kg·mm²	1,724 kg·mm²	3116,3 kg·mm²	7844,5 kg·mm²
Moment of Inertia Ip3	1,724 kg·mm²			4986,6 kg·mm²	10032 kg·mm²
Statistics					
Nodes	421	437	428	11556	19662
Elements	177	191	184	6122	10821
Mesh Metric	None				

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0,
Origin	
Origin X	0, mm
Origin Y	0, mm
Origin Z	0, mm
Directional Vectors	
X Axis Data	[1, 0, 0,]
Y Axis Data	[0, 1, 0,]
Z Axis Data	[0, 0, 1,]

Connections

TABLE 5
Model (A4) > Connections

Object Name	*Connections*
State	Fully Defined
Auto Detection	
Generate Automatic Connection On Refresh	Yes
Transparency	
Enabled	Yes

TABLE 6
Model (A4) > Connections > Contacts

Object Name	*Contacts*
State	Fully Defined
Definition	
Connection Type	Contact
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Auto Detection	
Tolerance Type	Slider
Tolerance Slider	0,
Tolerance Value	0,84193 mm
Use Range	No
Face/Face	Yes
Face/Edge	No
Edge/Edge	No
Priority	Include All
Group By	Bodies
Search Across	Bodies

TABLE 7
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region*	*Contact Region 2*	*Contact Region 3*	*Contact Region 4*	*Contact Region 5*
State	Fully Defined				
Scope					
Scoping Method	Geometry Selection				
Contact	3 Faces	2 Faces	3 Faces	2 Faces	3 Faces
Target	4 Faces	2 Faces	5 Faces	2 Faces	3 Faces
Contact Bodies	Solid				
Target Bodies	Solid				
Definition					
Type	Bonded				
Scope Mode	Automatic				
Behavior	Program Controlled				
Suppressed	No				
Advanced					
Formulation	Program Controlled				
Detection Method	Program Controlled				

Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Program Controlled

TABLE 8
Model (A4) > Connections > Contacts > Contact Regions

Object Name	*Contact Region 6*	*Contact Region 7*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Contact	2 Faces	1 Face
Target	2 Faces	1 Face
Contact Bodies	Solid	
Target Bodies	Solid	
Definition		
Type	Bonded	
Scope Mode	Automatic	
Behavior	Program Controlled	
Suppressed	No	
Advanced		
Formulation	Program Controlled	
Detection Method	Program Controlled	
Normal Stiffness	Program Controlled	
Update Stiffness	Program Controlled	
Pinball Region	Program Controlled	

Mesh

TABLE 9
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	6,6846e-002 mm
Inflation	
Use Automatic Inflation	None

Inflation Option	Smooth Transition
Transition Ratio	0,272
Maximum Layers	5
Growth Rate	1,2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Advanced	
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	32504
Elements	17495
Mesh Metric	None

Static Structural (A5)

TABLE 10
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22, °C
Generate Input Only	No

TABLE 11
Model (A4) > Static Structural (A5) > Analysis Settings

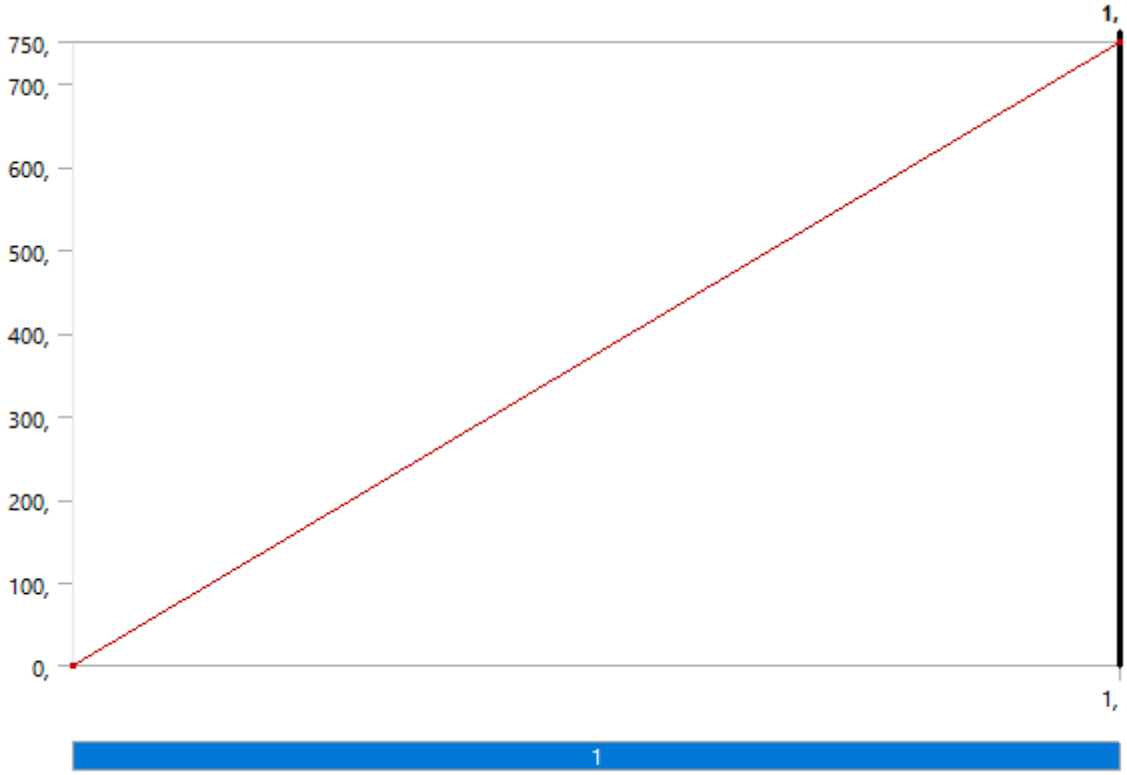
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1,
Current Step Number	1,
Step End Time	1, s

Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Calculate Results At	All Time Points
Max Number of Result Sets	Program Controlled
Analysis Data Management	
Solver Files Directory	E:\SKRIPSI\ANSYS\1500 N\1500_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 12
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	16 Faces	2 Faces
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Vector
Magnitude		1500, N (ramped)
Direction		Defined

FIGURE 1
Model (A4) > Static Structural (A5) > Force



Solution (A6)

TABLE 13
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1,
Refinement Depth	2,
Information	
Status	Done

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2,5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Total Deformation*	*Equivalent Elastic Strain*	*Maximum Shear Elastic Strain*	*Equivalent Total Strain*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Directional Deformation	Total Deformation	Equivalent Elastic Strain	Maximum Shear Elastic Strain	Equivalent Total Strain
Orientation	X Axis				
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Results					
Minimum	-1,4395e-002 mm	0, mm	9,411e-009 mm/mm	1,0895e-008 mm/mm	9,411e-009 mm/mm
Maximum	2,5212e-003 mm	1,7134e-002 mm	3,424e-004 mm/mm	4,8979e-004 mm/mm	3,424e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				
Integration Point Results					
Display Option			Averaged		

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Elastic Strain 2*	*Maximum Principal Elastic Strain*	*Middle Principal Elastic Strain*	*Minimum Principal Elastic Strain*	*Elastic Strain Intensity*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Equivalent Elastic Strain	Maximum Principal Elastic Strain	Middle Principal Elastic Strain	Minimum Principal Elastic Strain	Elastic Strain Intensity
By	Time				
Display Time	Last				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	9,411e-009 mm/mm	-8,0052e-007 mm/mm	-3,6614e-005 mm/mm	-3,966e-004 mm/mm	1,0895e-008 mm/mm
Maximum	3,424e-004 mm/mm	3,7574e-004 mm/mm	3,6594e-005 mm/mm	2,1383e-008 mm/mm	4,8979e-004 mm/mm
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Elastic Strain*	*Shear Elastic Strain*	*Equivalent Plastic Strain*	*Equivalent Stress*	*Shear Stress*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				

Definition					
Type	Normal Elastic Strain	Shear Elastic Strain	Equivalent Plastic Strain	Equivalent (von-Mises) Stress	Shear Stress
Orientation	X Axis	XY Plane			XY Plane
By	Time				
Display Time	Last				
Coordinate System	Global Coordinate System				Global Coordinate System
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-3,0654e-004 mm/mm	-3,3778e-004 mm/mm	0, mm/mm	5,2935e-004 MPa	-9,016 MPa
Maximum	2,9914e-004 mm/mm	5,0537e-005 mm/mm	0, mm/mm	24,122 MPa	1,3489 MPa
Minimum Occurs On	Solid			Solid	
Maximum Occurs On	Solid			Solid	
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Normal Stress*	*Stress Intensity*	*Maximum Principal Stress*	*Middle Principal Stress*	*Minimum Principal Stress*
State	Solved				
Scope					
Scoping Method	Geometry Selection				
Geometry	All Bodies				
Definition					
Type	Normal Stress	Stress Intensity	Maximum Principal Stress	Middle Principal Stress	Minimum Principal Stress
Orientation	X Axis				
By	Time				

Display Time	Last				
Coordinate System	Global Coordinate System				
Calculate Time History	Yes				
Identifier					
Suppressed	No				
Integration Point Results					
Display Option	Averaged				
Results					
Minimum	-32,331 MPa	5,816e-004 MPa	-12,185 MPa	-16,089 MPa	-36,682 MPa
Maximum	31,291 MPa	26,147 MPa	35,38 MPa	15,323 MPa	11,047 MPa
Minimum Occurs On	Solid				
Maximum Occurs On	Solid				
Information					
Time	1, s				
Load Step	1				
Substep	1				
Iteration Number	1				

TABLE 19
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Maximum Shear Stress*	*Strain Energy*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Maximum Shear Stress	Strain Energy
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Results		
Minimum	2,908e-004 MPa	4,9001e-011 mJ
Maximum	13,073 MPa	8,6344e-002 mJ
Minimum Occurs On	Solid	
Maximum Occurs On	Solid	
Information		
Time	1, s	

Load Step	1
Substep	1
Iteration Number	1

TABLE 20
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 21
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Results	
Minimum	> 10
Minimum Occurs On	Solid
Information	
Time	1, s
Load Step	1
Substep	1
Iteration Number	1

Chart 2

FIGURE 2
Model (A4) > Chart 2

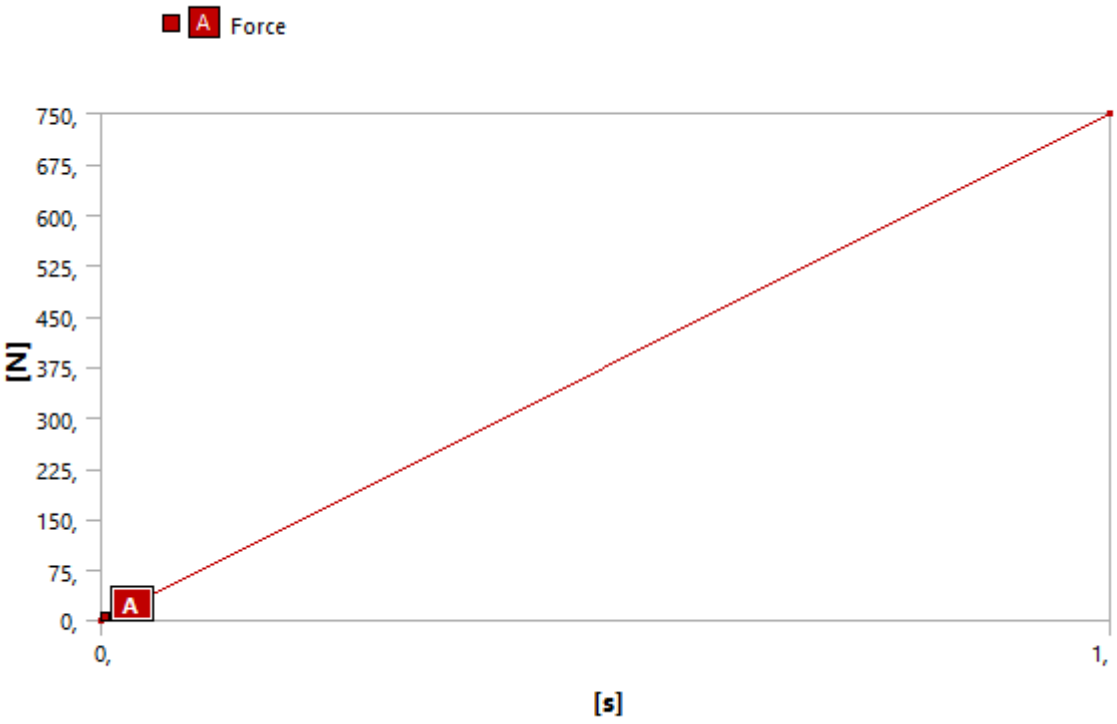


TABLE 22
Model (A4) > Chart 2

Steps	Time [s]	[A] Force [N]
1	0,	0,
	1,	1500,

Material Data

Aluminum Alloy

TABLE 23
Aluminum Alloy > Constants

Density	2,77e-006 kg mm^-3
Coefficient of Thermal Expansion	2,3e-005 C^-1
Specific Heat	8,75e+005 mJ kg^-1 C^-1

TABLE 24
Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength MPa
0,

TABLE 25
Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength MPa

280,

TABLE 26
Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength MPa
280,

TABLE 27
Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength MPa
310,

TABLE 28
Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
22,

TABLE 29
Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity W mm^-1 C^-1	Temperature C
0,114	-100,
0,144	0,
0,165	100,
0,175	200,

TABLE 30
Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress MPa	Cycles	R-Ratio
275,8	1700,	-1,
241,3	5000,	-1,
206,8	34000	-1,
172,4	1,4e+005	-1,
137,9	8,e+005	-1,
117,2	2,4e+006	-1,
89,63	5,5e+007	-1,
82,74	1,e+008	-1,
170,6	50000	-0,5
139,6	3,5e+005	-0,5
108,6	3,7e+006	-0,5
87,91	1,4e+007	-0,5
77,57	5,e+007	-0,5
72,39	1,e+008	-0,5
144,8	50000	0,
120,7	1,9e+005	0,
103,4	1,3e+006	0,
93,08	4,4e+006	0,
86,18	1,2e+007	0,
72,39	1,e+008	0,
74,12	3,e+005	0,5

70,67	1,5e+006	0,5
66,36	1,2e+007	0,5
62,05	1,e+008	0,5

TABLE 31
Aluminum Alloy > Isotropic Resistivity

Resistivity ohm mm	Temperature C
2,43e-005	0,
2,67e-005	20,
3,63e-005	100,

TABLE 32
Aluminum Alloy > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	71000	0,33	69608	26692

TABLE 33
Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1,

Lampiran Uji Beda T Test

UJI BEDA T TEST

VON MISSES

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	manual	.05	4	.015	.007
	simulasi	.00	4	.000	.000

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	manual & simulasi	4	1.000	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	manual - simulasi	.051	.015	.007	.028	.074	6.971	3	.06

DEFORMASI

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	manual	.00	4	.000	.000
	simulasi	.01	4	.004	.002

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	manual & simulasi	4	1.000	.000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	manual - simulasi	.013	.004	.002	.019	.007	6.971	3	.06

Hasil Equivalent Strain

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean

Pair 1	manual	.00	4	.000	.000
	simulasi	.00	4	.000	.000

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	manual & simulasi	4	.939	.061

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	manual - simulasi	.000	.000	.000	.000	.000	3.054	3	.055

UNIVERSITAS PGRI ADI BUANA SURABAYA
FAKULTAS TEKNOLOGI INDUSTRI

Program Studi : Teknik Industri – Teknik Elektro

KAMPUS II: Jl. Dukuh Menanggal XII/4 ☎ (031) 8281181 Surabaya 60234

BERITA ACARA BIMBINGAN TUGAS AKHIR

Form Prop-03

Nama	: Edi Nasrulloh	Foto 3x4
NIM	: 163700023	
Program Studi	: Teknik Industri	
Pembimbing	: M. Nushron Ali Mukhtar, S.T., M.T.	
Periode Bimbingan	: Gasal/Genap*) Tahun 20… / 20….	
Judul Proposal Tugas Akhir	"Analisis Desain *Stator* Generator *Type* Magnet Permanen *Fluks Axial* Menggunakan Metode *Finite Element Analysis* (FEA)"	

KEGIATAN KONSULTASI / BIMBINGAN

No	Tanggal	Materi pembimbingan	Keterangan	Paraf
1	20 / 04 / 20	Pengumpulan Bahan	Revisi	
2	27 / 04 / 20	Analisis Simulasi	Revisi + ACC	
3	4 / 05 / 20	Analisa Data (perhitungan)	Revisi + ACC	
4	12 / 05 / 20	Data ukuran + ACC	ACC	
5	19 / 05 / 20	Penyajian Data.	ACC	
6	28 / 05 / 20	Pembahasan hasil simulasi Ansys	Revisi	
7	4 / 06 / 20	Bab IV + ACC	ACC	
8	10 / 06 / 20	Kesimpulan & Saran	Revisi + ACC	
9	11 / 06 / 20	Bab I, BII, BIII. ACC	ACC	

Dinyatakan selesai tanggal ....11.... Juni ..... **2020.**

Surabaya, 11 Juni 2020

Mengetahui, Ketua Program Studi,	Pembimbing,	Mahasiswa,
Yunia Dwie Nurcahyanie , S.T., M.T.	M. Nushron Ali Muhtar, S.T., M.T.	Edi Nasrulloh

UNIVERSITAS PGRI ADI BUANA SURABAYA
FAKULTAS TEKNOLOGI INDUSTRI
Program Studi : Teknik Industri – Teknik Elektro
KAMPUS II: Jl. Dukuh Menanggal XII/4 ☎ (031) 8281181

FORM REVISI TUGAS AKHIR

Nama Mahasiswa : Edi Nasrullah
NIM : 1637000023
Fakultas / Progdi : Teknik Industri
Judul Tugas Akhir : Analisis Desain Stator Generator Type magnet permanen Fluks Axial menggunakan metode finite Element Analysis

Ujian Tanggal : 30 - Juni - 2020

No Bab.	Tanggal	Materi Konsultasi	Keterangan Catatan	Tanda Tangan Penguji
I		Rumusan Masalah	Acc	
II				
III				
IV				
V				

Disetujui Dosen Penguji
Pada Tanggal, 06/07/2020

Penguji I,

(Prihono)

Penguji II,

(Yohanes Utomo, ST, MT)

1. a. Penyelesaian Revisi paling lambat 2 minggu dari pelaksanaan Ujian Tugas Akhir.
   b. Pengetikan, penjilidan, penandatangani Tugas Akhir dan mengumpulkan Tugas Akhir paling lambat 2 minggu dari revisi.
2. Apabila sampai batas waktu tersebut (point 1,a dan b) mahasiswa belum menyelesaikan revisi dan tanda tangan, maka **Ujian dinyatakan Gugur**.
3. a. Foto copy Form Revisi diserahkan ke Program Studi.
   b. Tugas Akhir yang sudah direvisi diserahkan ke Fakultas 3 (Tiga) eksemplar untuk dijilid.

UNIVERSITAS PGRI ADI BUANA SURABAYA
FAKULTAS TEKNOLOGI INDUSTRI
Program Studi : Teknik Industri – Teknik Elektro
KAMPUS II: Jl. Dukuh Menanggal XII/4 ☎ (031) 8281181 Surabaya 60234

BERITA ACARA UJIAN TUGAS AKHIR

Pada

Hari, tanggal : Selasa, 30 Juni 2020
Jam : 08.00 - selesai
Tempat : Gedung FTK. Teknik

Telah dilaksanakan Ujian Tugas Akhir:

Nama Mahasiswa : Edi Nasrullah
Program Studi : Teknik Industri
Judul Tugas Akhir : Analisis Desain stator Generator Type magnet permanen fluks Axial menggunakan metode finite element Analysis
Bidang Keahlian :
Tanda Tangan : .....

Saran-saran perbaikan :
1 tgl. Hari tempat

Tim Penguji

Nama	(Tanda tangan)
1. Prihono	
2. Yitno Utomo. ST. MT	

*) Jangka waktu perbaikan Tugas Akhir **dua minggu setelah ujian.**
Apabila waktu tersebut tidak dipenuhi, maka nilai Ujian Tugas Akhir **dianggap batal dan mahasiswa yang bersangkutan diwajibkan mengulang Ujian lisan.**