



*Scientific and Technical Center of Alfa-Tranzit Co., Ltd  
Year of foundation 2000, December*

*The main areas of work:*

*Development of methods for designing dynamic structures of rotating machinery*

*Development of rotor balancing techniques based on the results of mathematical modeling*

*Development of commercial software DYNAMICS R4, Dyn FE for the general dynamics study of the of rotating machinery*

*Development of commercial software for the design of bearing assemblies – bearings, hydraulic dampers, etc.*

*Training users to work in the software*

*Design of experimental installations for determining the dynamic characteristics of components and parts of the GTE*

*Software development for vibration diagnostics and forecasting systems of the engines technical condition*

*Performing research and R&D on orders from enterprises*

# PD -14 in DYNAMICS R4



Software interface showing simulation parameters and results. The left sidebar lists analysis types: Natural frequencies, Critical speeds, Natural frequency map, Unbalance response, Orbit (unbalance response), Transient response, Mean value, Fast Fourier Transform, Waterfall diagram, and Orbit (Transient response).

Des	Value	Designation
R_freq	83100 1/min	Frequency range
ort_warning	1e-006	Orthogonality warning threshold
save	yes	Use saved results

986.0 (16.4 Hz, )
1310.3 (21.8 Hz, )
1541.6 (25.7 Hz, )
1560.8 (26.0 Hz, )
2174.2 (36.2 Hz, )
2701.5 (45.0 Hz, )
2939.4 (49.0 Hz, )
2946.5 (49.1 Hz, )
3906.0 (65.1 Hz, )
4036.2 (67.3 Hz, )
4284.8 (71.4 Hz, )
4687.2 (78.1 Hz, )
4932.0 (82.2 Hz, )
5095.6 (84.9 Hz, )
5397.2 (90.0 Hz, )
5475.0 (91.3 Hz, )
5564.4 (92.7 Hz, )
5685.3 (94.8 Hz, )
5811.2 (96.9 Hz, )
6080.5 (101.3 Hz, )
6134.0 (102.2 Hz, )
6427.6 (107.1 Hz, )
7023.8 (117.1 Hz, )
7324.4 (122.1 Hz, )
7630.7 (127.2 Hz, )
7812.1 (130.2 Hz, )
8316.6 (138.6 Hz, )
8723.8 (145.4 Hz, )
9314.8 (155.2 Hz, )
9463.6 (157.7 Hz, )
9494.7 (158.2 Hz, )
9755.0 (162.6 Hz, )

RotX RotY

Elements list:

- System elements
  - Assembly
  - Submodel
  - FE structure
  - Superelement
  - Shaft
- Gross motion elements
- Subsystem elements
  - Kinematic joint
  - Beam
  - Beam Bimetal
  - Shell
  - Shell with flange
  - Disk
  - Mass
  - Mass pedestal
  - Generalized element
  - Coupling
    - Trunnion coupling
    - Shaft stepping
- Links
  - Link
  - Rigid link
  - Elastic nonsymmetric link
  - Generalized gear set
  - Gear set
  - Squirrel Cage
  - Connection point
  - Links FB
  - Offset Half Journal Bearing
- Loads
  - Unbalance load
  - Axial force
  - Blade loss
  - Dynamic load
  - Torque load
  - Nonlinear elements
    - User link
    - Non-linear support
    - Plain Journal Bearing support
    - Ball Bearing support



# PD-35 in DYNAMICS R4



РВД	1191.6	19.9
Опоры	1543.7	25.7
Variables	1555.6	25.9
Materials	1650.8	27.5
Groups	1722.1	28.7
РВД	1775.5	29.6
УВД N=3 КВД	2023.5	33.7
УВД N=4 КВД	2224.0	37.1
УВД N=5 ТВД	2509.4	41.8
Корпус Ш/п КВД	3441.3	57.4
Корпус Р/п КВД	3835.7	63.9
Корпус Р/п ТВД	4044.3	67.4
РВД	4324.8	72.1
Variables	4517.5	75.3
Materials	4889.6	81.5
Algorithms	4919.6	82.0
Basis	5264.6	87.7
Natural frequencies	5392.9	89.9
Критические скорости РВД	5393.2	89.9
Критические скорости РВД	5656.9	94.3
Natural frequency map	5940.2	99.0
Natural frequency map	6101.4	101.7
Unbalance response	6941.5	115.7
Orbit (unbalance response)	7125.7	118.8
Transient response	7155.2	119.3
Mean value	7393.4	123.2
Fast Fourier Transform	8544.5	142.4
Waterfall diagram	8778.6	146.3
Orbit (Transient response)	8900.3	148.3
Parameter analysis	8954.2	149.2
	9166.7	152.8
	9445.0	157.4
	9638.3	160.6
	9794.1	163.2
	9897.4	165.0

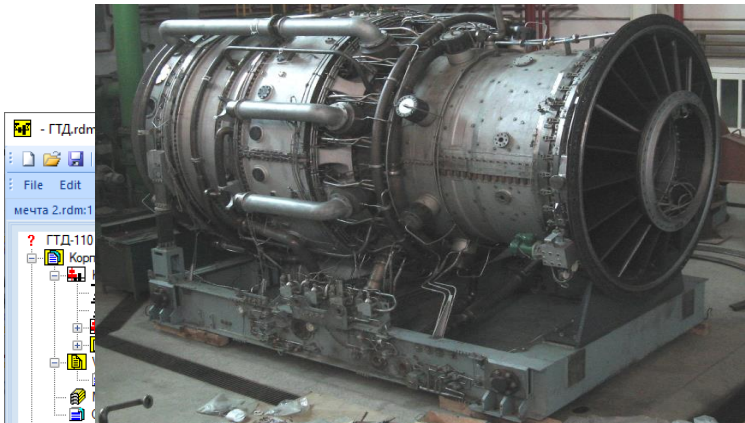








# GTE-110 in DYNAMICS R4



File Edit  
мечта 2.rdm:1

ГТД-110

- Копр
- Ротор
- Ротор
- Variables
- Materials
  - ЭП-609Ш
  - 18Х2Н4МА
  - ЭП-609Ш 0 плотность
- Groups
  - [ ] Дисбалансы Вариант
  - [ ] Дисбалансы Вариант
  - [ ] Дисбалансы Вариант
  - [ ] Эксплуатационный д
  - [ ] Жесткие болты 1
- Materials
- Groups
- Algorithms
- Basis
  - Natural frequencies
  - Natural frequencies t\_pr=2
  - Natural frequencies t\_pr=2
  - Natural frequencies t\_pr=3
  - Natural frequencies t\_pr=2
  - Natural frequencies t\_pr=4
  - Natural frequencies t\_pr=0
  - Natural frequencies t\_pr=6
  - Critical speeds
  - Natural frequency map
  - Unbalance response
  - Orbit (unbalance respo
  - Transient response
  - Mean value

0.0	0.0	0.00
0.0	0.0	0.00
349.2	5.8	3.93
590.4	9.8	0.00
654.0	10.9	4.10
1284.1	21.4	0.94
1381.2	23.0	0.85
1758.9	29.3	0.75
2238.4	37.3	1.51
3052.8	50.9	1.21
4115.6	68.6	0.69
4337.4	72.3	1.06
5216.8	86.9	0.77
5726.9	95.4	0.67
5987.9	99.8	0.12
6187.1	103.1	0.20
6568.4	109.5	-0.00
7428.3	123.8	0.00
7807.8	130.1	0.37
8125.9	135.4	0.10
8173.2	136.2	0.19
8521.3	142.0	0.26
8855.8	147.6	0.00
9106.6	151.8	0.00
9454.8	157.6	-0.00
10047.3	167.5	0.00
10211.6	170.2	0.02

The variable defines time parameter for computing of dynamical system

For Help, press F1

Log

```

6207.007450 22.027400
6568.381951 -0.000000
7428.316189 0.000000
7807.798125 29.161854
8125.860032 8.208120
8173.194276 15.493787
8521.274203 22.082873
8855.805086 0.000000
9106.629873 0.000000
9454.842636 -0.000000
10047.305240 0.000000
10211.619896 2.096349
10269.366300 11.562283
10509.670184 0.000000
10823.935506 0.924145
10982.039937 35.736957
11277.548970 2.494002
11721.891755 32.769503
12133.328439 0.000000
12406.833724 31.197507
13456.059450 5.530240
13592.682656 19.485073
14263.330281 11.469704
14596.499327 -0.000000
15228.729488 39.101183
15792.845183 10.158884
16419.447160 7.442427
16481.214985 -0.000000
16636.867086 1.107100
16770.536701 10.262191
17113.451424 0.000001
17547.065772 7.569443
18177.989253 0.000000
18197.113802 10.935397
18577.124405 -0.000000
19743.833126 17.933051
20560.733138 0.000000
21645.720480 -0.000000
21975.261347 6.185592
    
```

RotX RotY





# GTE-25PA in DYNAMICS R4



The screenshot displays the DYNAMICS R4 software interface. The main window shows a 3D model of the engine with various components highlighted in different colors. A 'Log' window is open on the right, showing the following text:

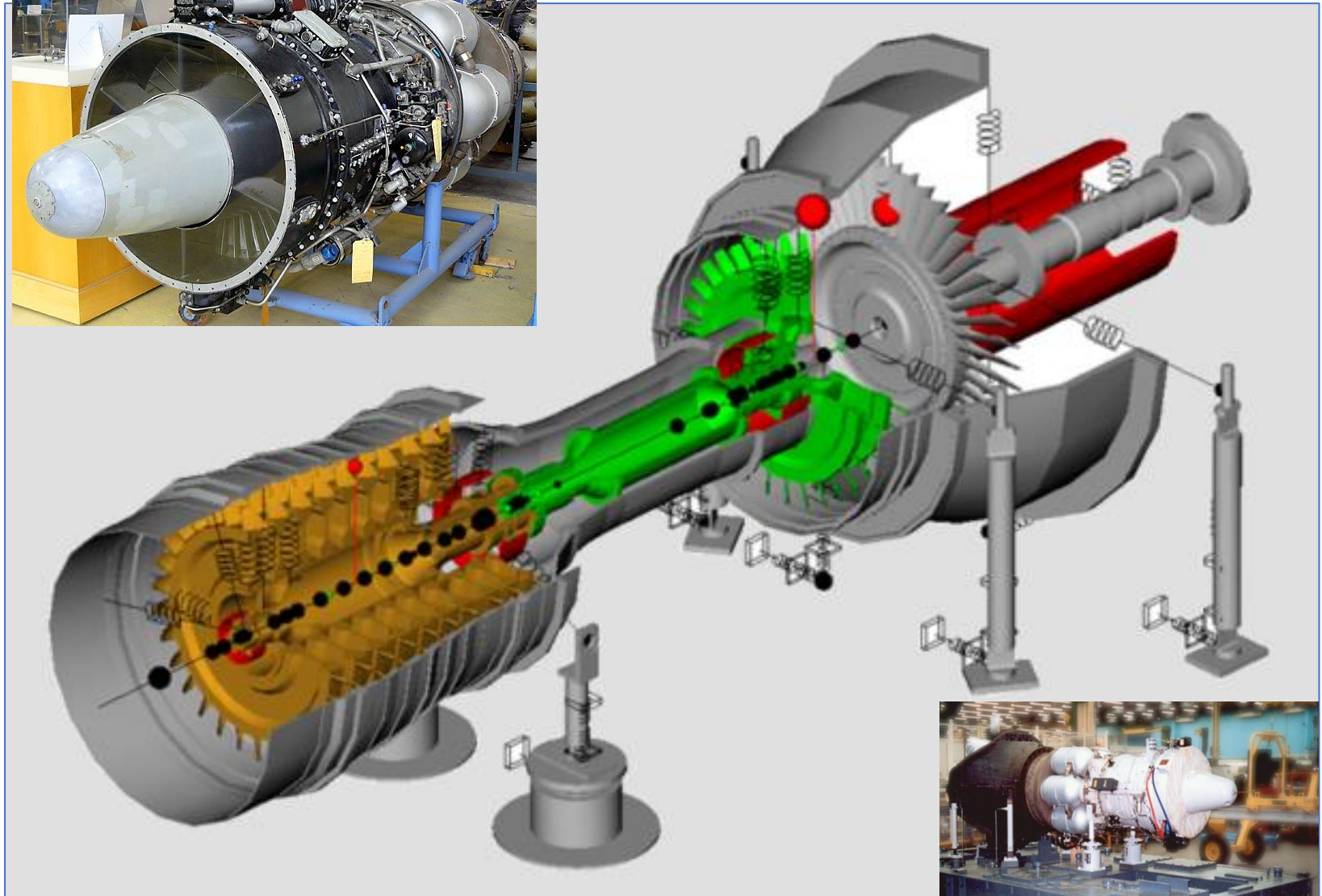
```

A:\Инжиниринг\ОАО Авиа...
Loading data...
OK
Update object results for p
Calculation of basis
A:\Инжиниринг\ОАО Авиа...
begin of SOE integrator i
enter calculateSystemMa
/exit calculateSystemMa
enter calculateSystemCo
reduce mtrA from 774 to
Zero roots amount: 7
/end of SOE integrator in
enter calculateEigenvalue
3960/3960
/mem alloc in calculateEige
System matrix M is not
3960/3930
/prepare +mem alloc in calc
enter calculateSymmGene
calculateSymmGeneralizedEig
0 0.000000
1 0.000000
2 0.000000
3 0.000000
4 0.000000
5 0.000000
6 0.000000
7 1011.549536
8 1011.549585
9 1549.900970
    
```

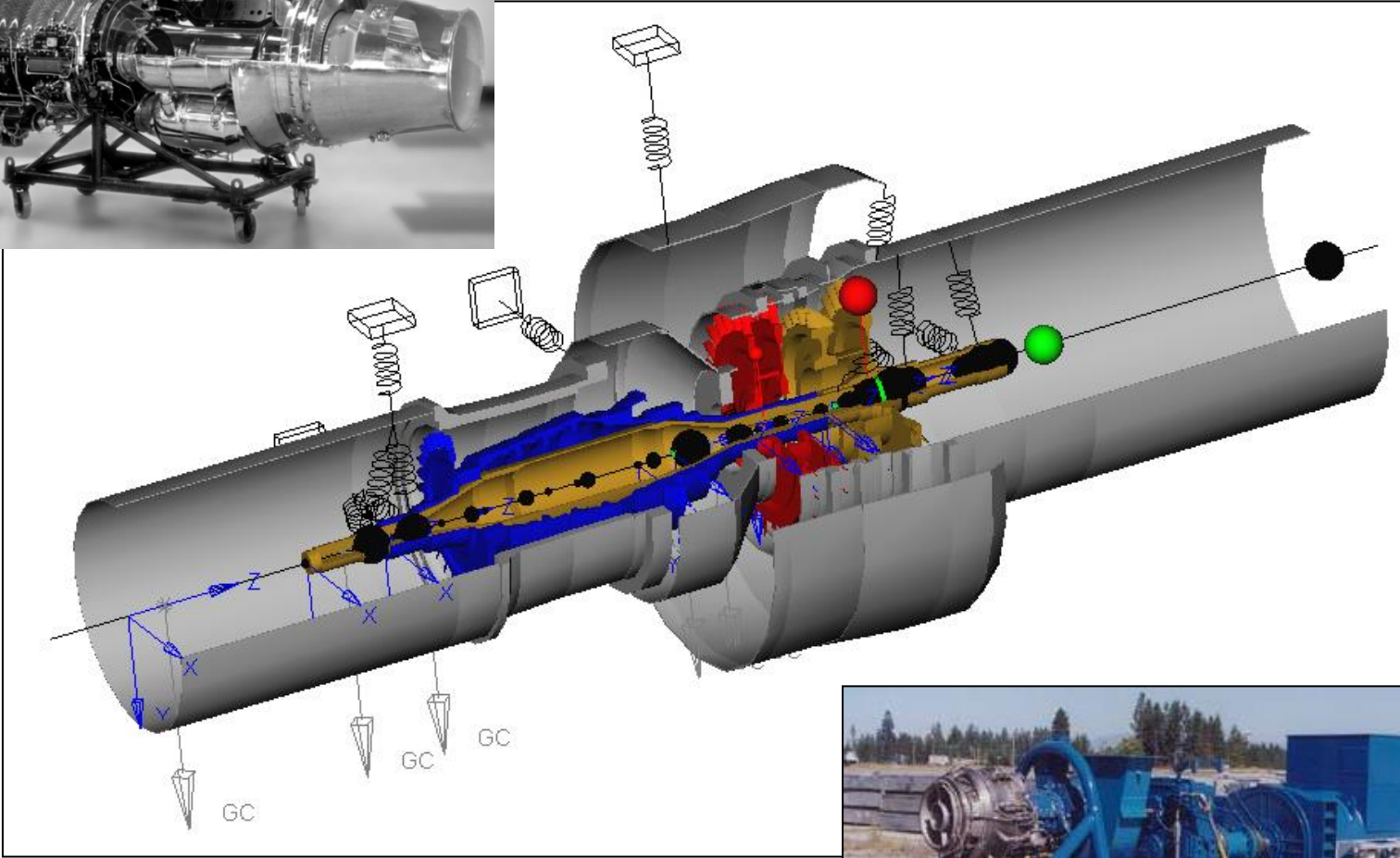
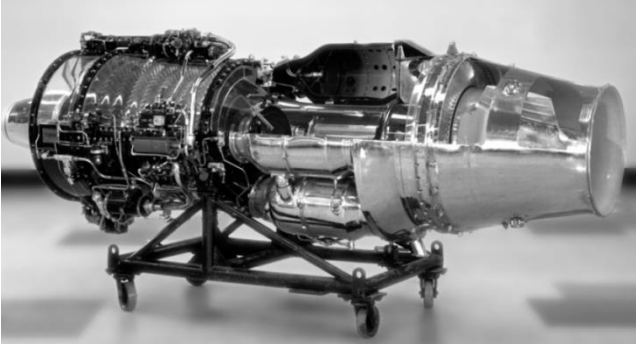
Group	Value 1	Value 2
Vnn	0.0	0.0
Vsn	0.0	0.0
КОРПУСА	0.0	0.0
Ротор ВД	0.0	0.0
Ротор СТ	0.0	0.0
Ротор НД	0.0	0.0
Variables	0.0	0.0
Materials	0.0	0.0
Groups		
[-] ДБ КНД Диск 0 ст	1011.5	16.9
[-] ДБ ТНД	1011.5	16.9
[-] ДБ Вал ТНД	1549.9	25.8
[-] ДБ КВД	2157.8	36.0
[-] ДБ ТВД	2158.0	36.0
[-] ДБ Ц.Т. КНД	2158.0	36.0
[-] ДБ Вал ТНД В1 и В3	2358.5	39.3
[-] ДБ ТНД пл. И и пл. Е	2358.6	39.3
И	2774.2	46.2
Е	2774.2	46.2
[+] ДБ Ц.Т. СТ	3398.8	56.6
[-] ДБ КВД пл. Д(0) и пл. Б(12)	3399.1	56.7
[-] ДБ Вал ТНД распр	3765.7	62.8
Algorithms		
Basis		
Критические скорости В	3765.7	62.8
Критические скорости Н	4423.9	73.7
Критические скорости С	4424.0	73.7
Natural frequency map	5074.4	84.6
Unbalance response	5074.6	84.6
	5219.6	87.0
	5221.3	87.0
	5430.5	90.5



# Orenda Marc 14 (Canada) in DYNAMICS R4



T-53 (Canada) in DYNAMICS R4



# St B-5 in DYNAMICS R4



System

- Ротор
- Втулка 2
- Шлицевое крепление с
- Диск
- Втулка
- Вал
- Диск
- Редуктор
  - \* Солнце-Сателлит 2
  - \* Солнце-Сателлит 3
  - \* Коронная-Сателлит 2
  - \* Коронная-Сателлит 3
  - Коронная шестерня
  - Ротор водила 1
  - Солнце
  - Сателлит 1
  - Сателлит 2
  - Сателлит 3
  - Шлицевая втулка
  - Ось сателлита 1
  - Ось сателлита 2
  - Ось сателлита 3
  - Втулка водила
  - \* Солнце-Сателлит 1
  - Ротор водила 2
  - Шлицевое соединение
  - Ось сателлита 1 слева
  - Ось сателлита 2 слева
  - Ось сателлита 3 слева
  - Ось сателлита 1 справа
  - Ось сателлита 2 справа
  - Ось сателлита 3 справа
  - \* Коронная-Сателлит 1
  - Втулка водила
  - Статор
  - Подшипники
    - ш/л 1 (основной ротор)
    - ш/л 2 (основной ротор)
    - ш/л 3 (ротор водила)
    - ш/л 4 (ротор водила)
    - ш/л 6-1 (сателлит 1 сле
    - ш/л 6-2 (сателлит 2 сле
    - ш/л 6-3 (сателлит 3 сле
    - ш/л 6-1 (сателлит 1 сле

Freq [rpm]	Freq [Hz]
10593.0	176.6
10593.0	176.6
15577.5	259.6
25991.6	433.2
25991.6	433.2
33292.1	554.9
33292.2	554.9
35649.6	594.2
35649.7	594.2
40086.0	668.1
40086.2	668.1
44413.5	740.2
44413.8	740.2
59305.2	988.4
80315.1	1338.6
80316.3	1338.6
91855.0	1530.9
91857.7	1531.0
107090.7	1784.8

Elements

- Disk
- Mass
- Mass pedestal
- Generalized element
- Coupling
- Trunnion coupling
- Shaft stepping
- Links
  - Link
  - Rigid link
  - Elastic nonsymmetric link
  - Generalized gear set
  - Gear set
  - Squirrel Cage
  - Elastic Ring
  - Connection point



# Power turbine NK-38ST in DYNAMICS R4



- Жесткая связь 6
- Жесткая связь 7
- Опора 2
- Опора РСТ
- Корпус СТ
- Опора 1
- Опора РСТ
- Фикст.коничка 1e3
- Опора СТ по отчету АПТ
- Корпус
- Корпус
- Подшипники СТ
  - 6 р/н РСТ
  - 7 р/н РСТ
  - 8 ш/н РСТ
- Variables
- Materials
- Groups
- Algorithms
  - Basis
    - Natural frequencies
    - Critical speeds
    - Natural frequency map
    - Unbalance response
    - Orbit (unbalance response)
    - Unbalance response
    - Orbit (unbalance response)

33774.5	562.9
37159.3	619.3
39263.5	654.4
39263.5	654.4
40032.0	667.2
40032.0	667.2
41790.9	696.5
41790.9	696.5
45153.2	752.6

- System elemen
- Assembly
- Submodel
- FE structure
- Supereleme
- Shaft
- Gross motion e
- Subsystem ele
- Kinematic j
- Beam
- Beam Bime
- Beam MKD
- Shell
- Shell with f
- Disk
- Mass
- Mass pede
- Generalizec
- Coupling
- Trunnio
- Shaft st
- Links
  - Link
  - Rigid link
  - Elastic non
  - Generalizec



File Edit View Tools Window Help

BASIS Link INNER 1

- Impellers
  - Compressor Wheel
  - Turbine Wheel
- Inter shafts connections
- Thrust Collar
- Shaft
- INNER Film 1 Floating Ring Bearing clr 1-3
- BASIS Link INNER 2
- INNER Film 2 Floating Ring Bearing clr 1-3
- Variables
- Materials
- Groups
- Algorithms
  - Basis
    - Natural frequencies
    - Critical speeds
    - Natural frequency map
    - Transient response
    - Load Transient response results
      - Mean value
      - Fast Fourier Transform
      - Waterfall diagram
      - Orbit (1e4 rpm)
      - Orbit (2e4 rpm)
      - Orbit (4e4 rpm)
      - Orbit (6e4 rpm)
      - Orbit (8e4 rpm)

Freeze

Bing Case System

- Angular contact ball bearing
- Active Magnetic Bearing su
- Damper support
- Clearance
- Dry bush
- Unbalanced Magnetic Pull
- Annular seal
- Seismic excitation
- Group
- Variables
- Algorithms
  - Data post processing
    - Mean value
    - Fast Fourier Transform
    - Waterfall diagram
    - Orbit (unbalance response)

The element is represented by link between rotor and stator subsystems. It models two well-known cases of plain journal bearing: the "short" bearing and the "long" bearing. Different kinds of fluid film

Des	Case		Designation
x	0	mm	x coordinate
y	0	mm	y coordinate
z	0	mm	z coordinate
eps_x	0	deg	Rotation about x axis
eps_y	0	deg	Rotation about y axis
eps_z	0	deg	Rotation about z axis
link scope	local		Defines of scope for link co

Coordinate [z2] in direction Z indicates the position of right side of element

For Help, press F1
CAP
NUM SCRL