COMMUNICATION SKILLS 2
ASSIGNMENT 1:
ANALYSIS OF TRAIN WHEEL

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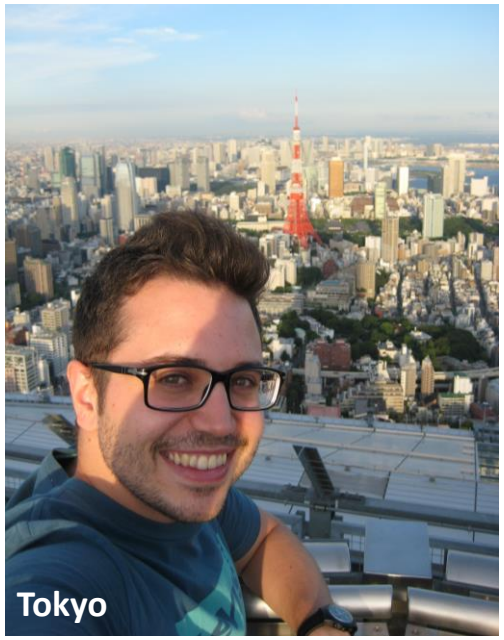
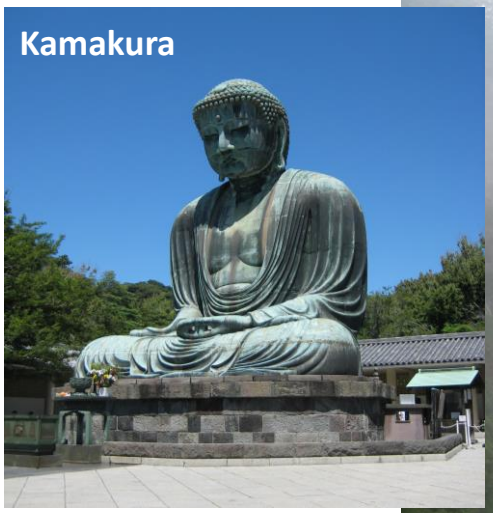




INTRODUCTION

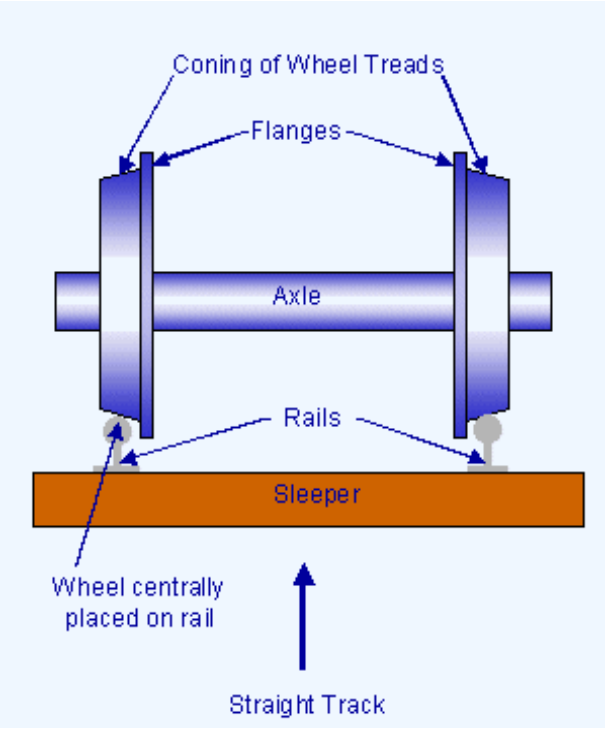
- Introduction
- Problem definition
- Methodology
- Results and discussion
- Conclusions
- Future works

INTRODUCTION

Wheel-rail contact:

- Consequences:
  - Friction
  - Vibrations

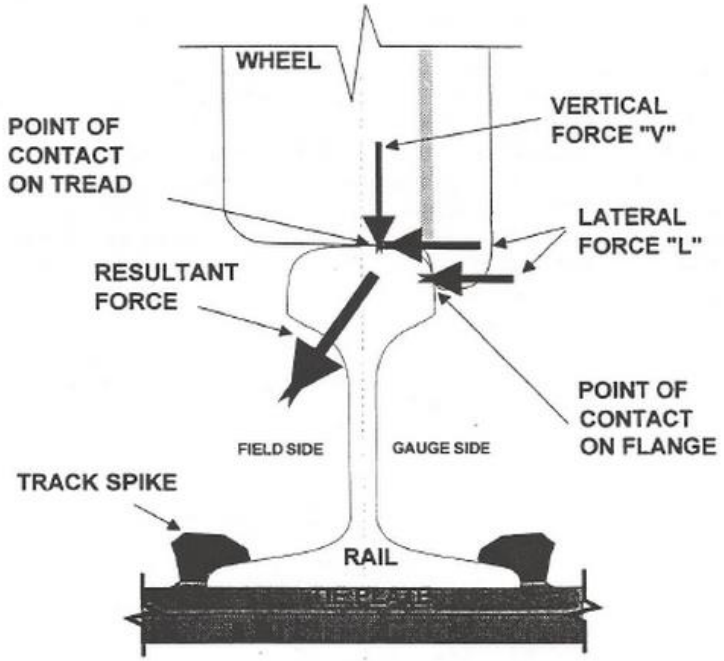
- Flanges: lateral displacements



INTRODUCTION

Noises produced:

- *Flanging*:
  - Intermittent
  - Wide range of frequencies
- *Squeal*:
  - Very annoying noise
  - Lateral displacements
  - Cause: take curves



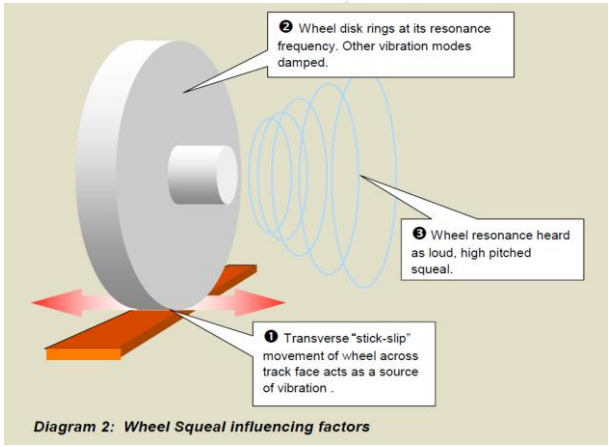
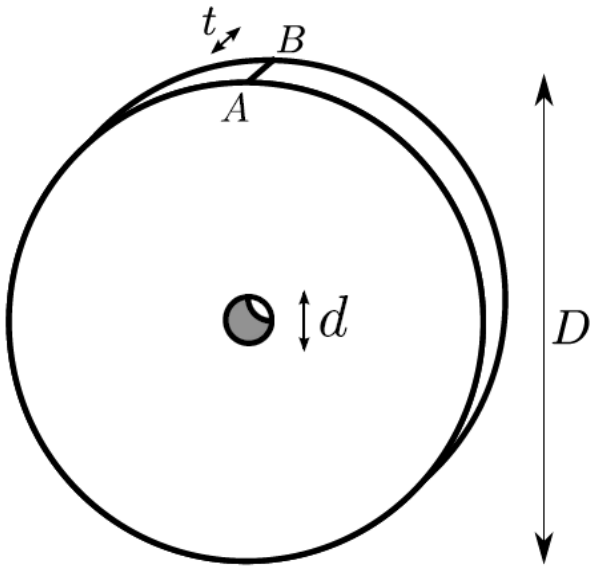


Diagram 2: Wheel Squeal influencing factors

PROBLEM DEFINITION

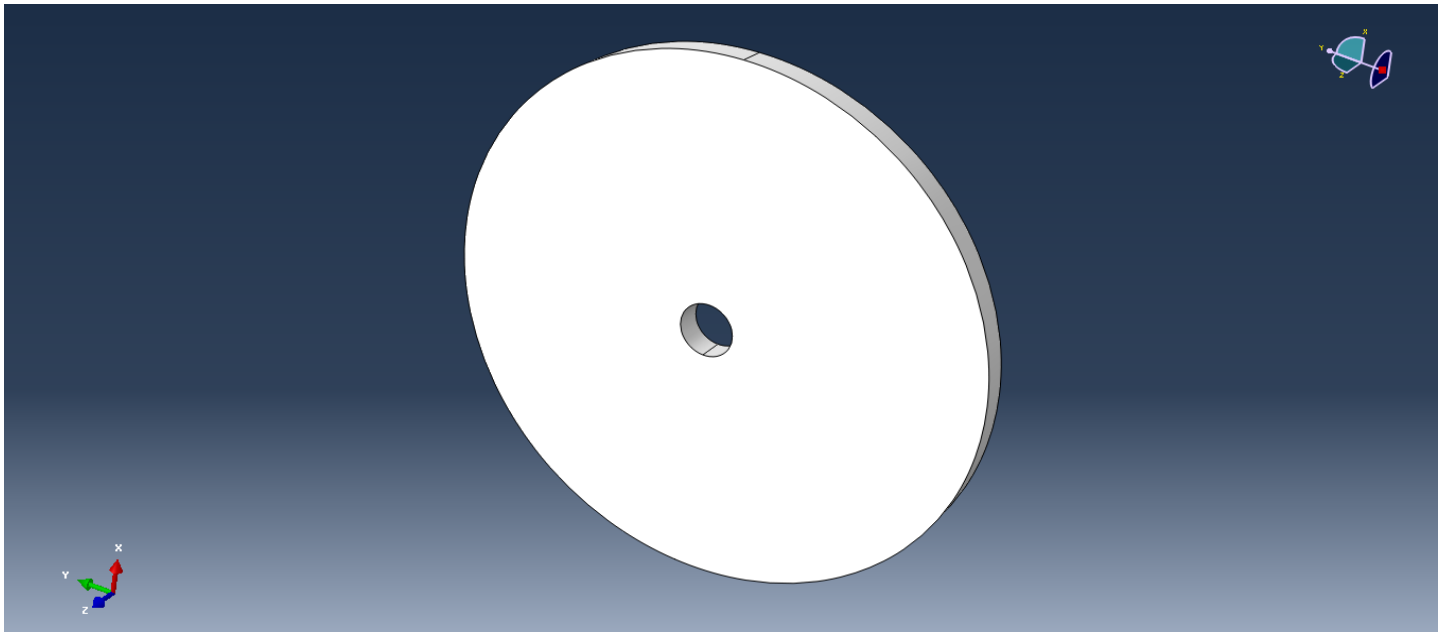
Wheel geometry:



Width	t	[m]	0.05
Internal diameter	d	[m]	0.10
External diameter	D	[m]	1.00
Density	ρ	[Kg/m^3]	7800
Yong Modulus	E	[Pa]	$210E9$
Poisson Ratio	ν	[-]	0.25

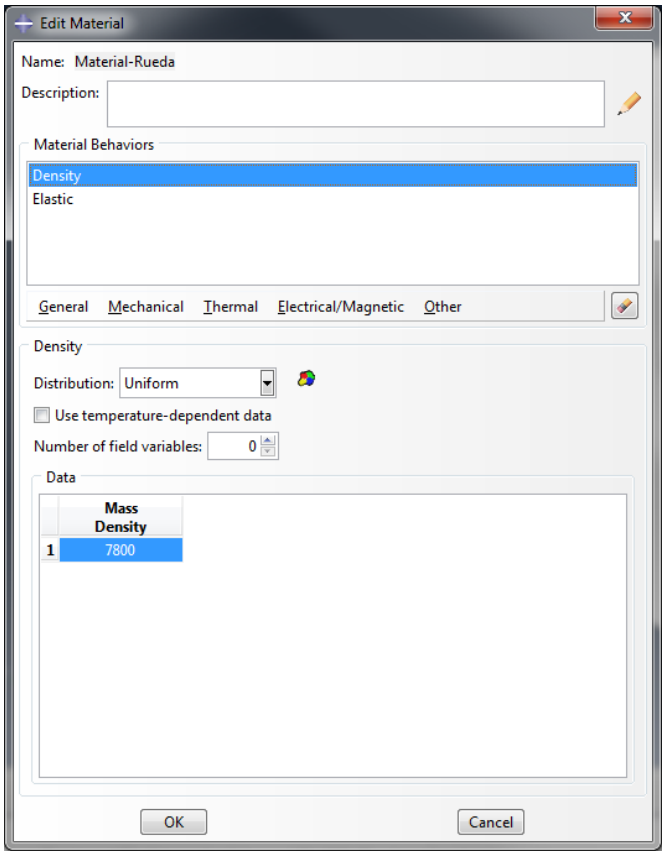
STEPS: Software ABAQUS

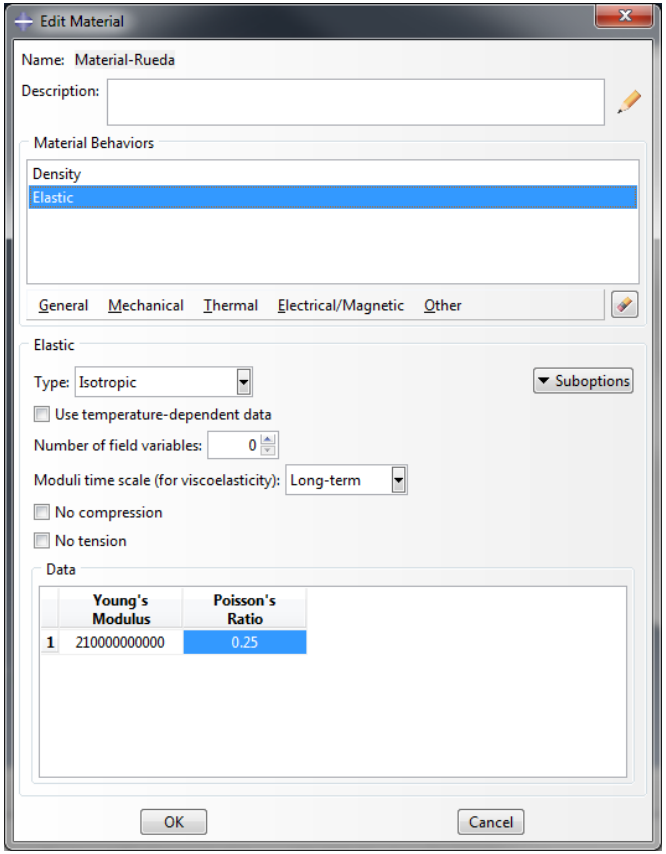
- **PART:** import geometry



METHODOLOGY

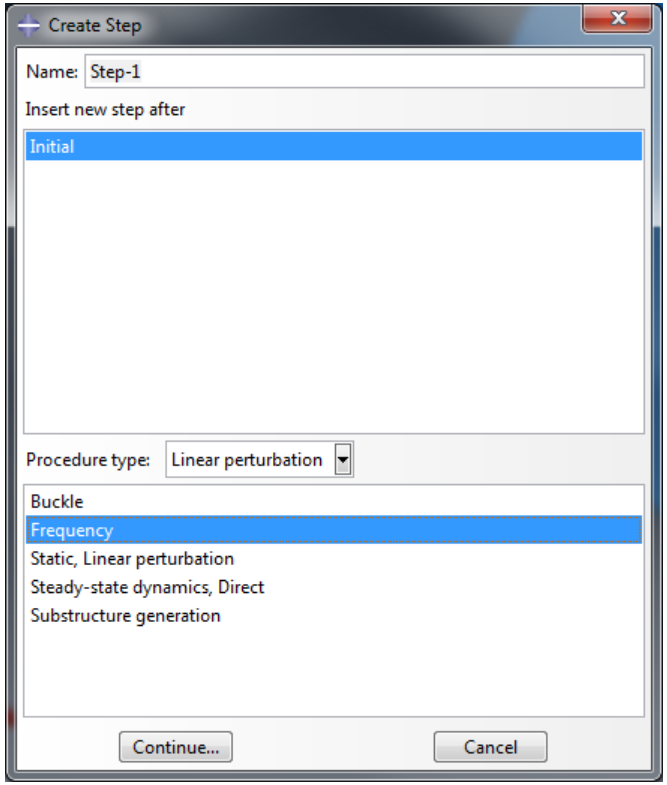
- **PROPERTY**: create material and assign
- **ASSEMBLY**: create an *instance*

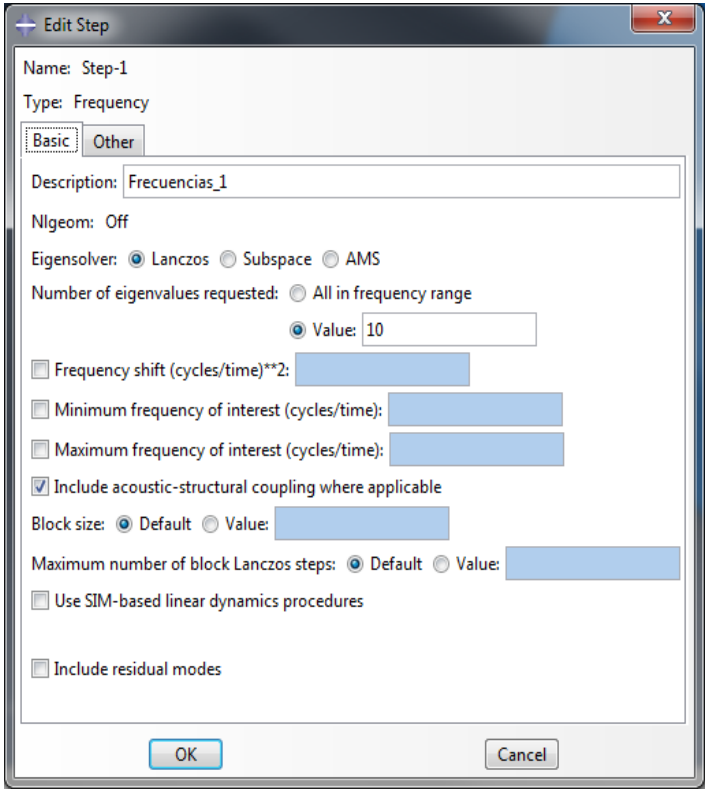




METHODOLOGY

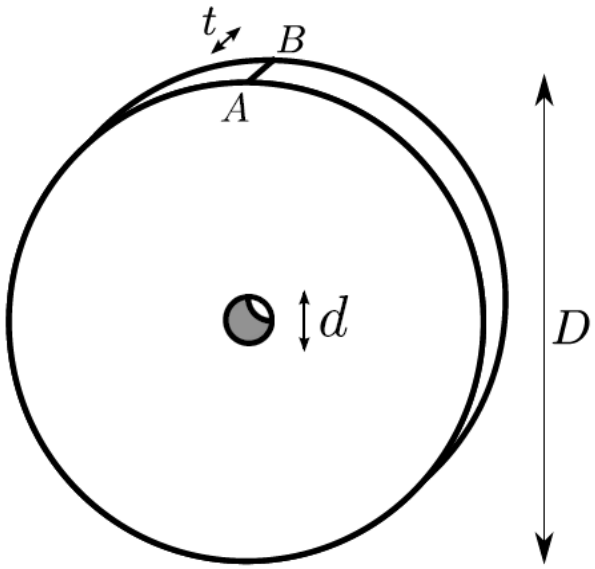
- **STEP**:
  - Only one step
  - Number of natural frequencies=10

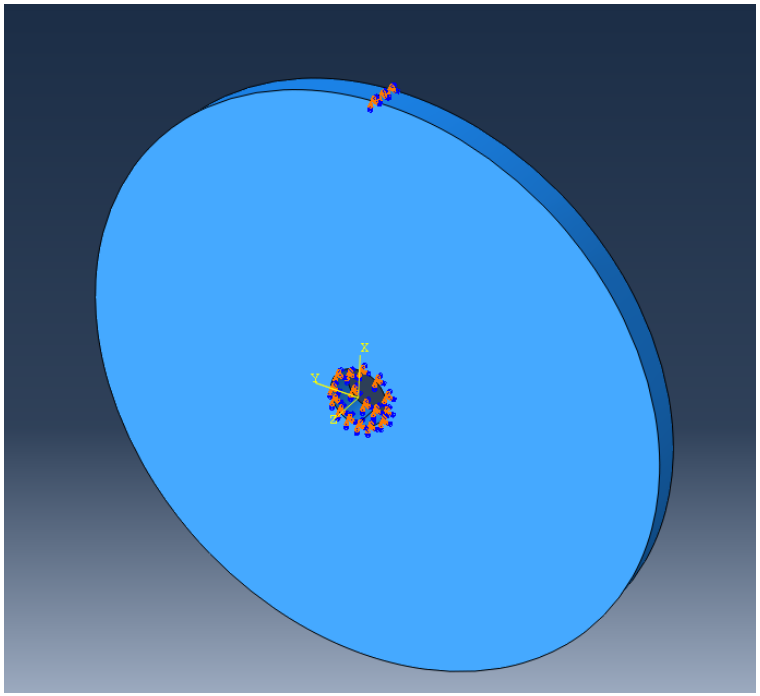




METHODOLOGY

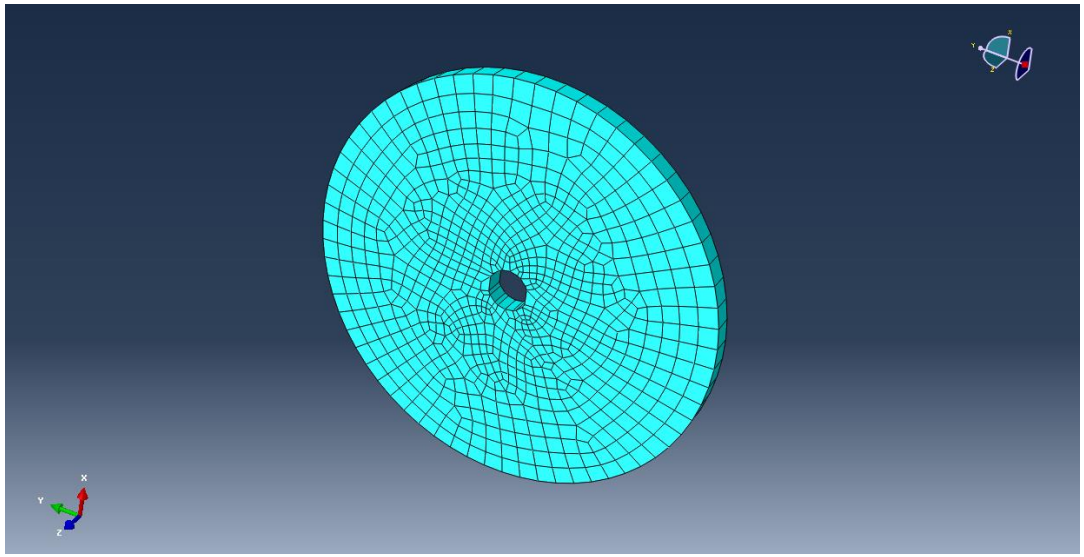
- **LOAD**: boundary conditions
  - Restrict displacements and rotations





METHODOLOGY

- **MESH**:
  - Hexaedral elements
  - Global size: 0.05m
- **JOB**:
  - Submit → Results

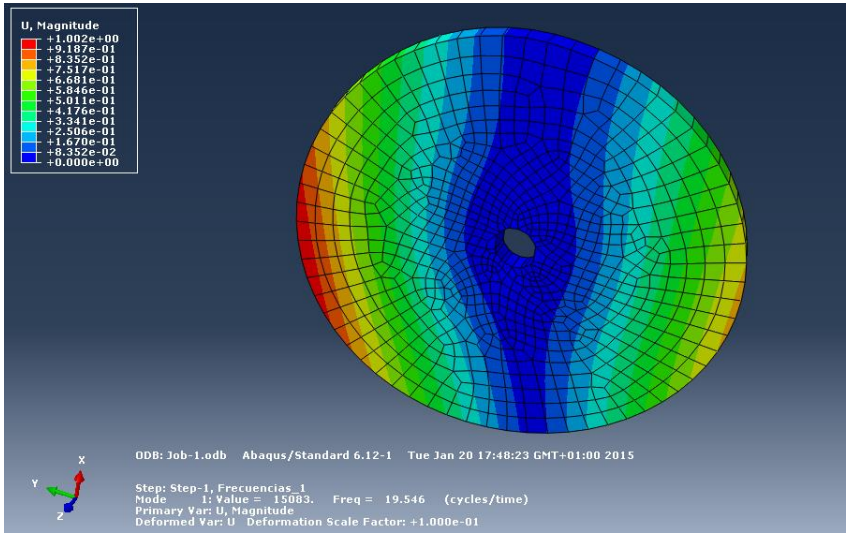


RESULTS AND DISCUSSION

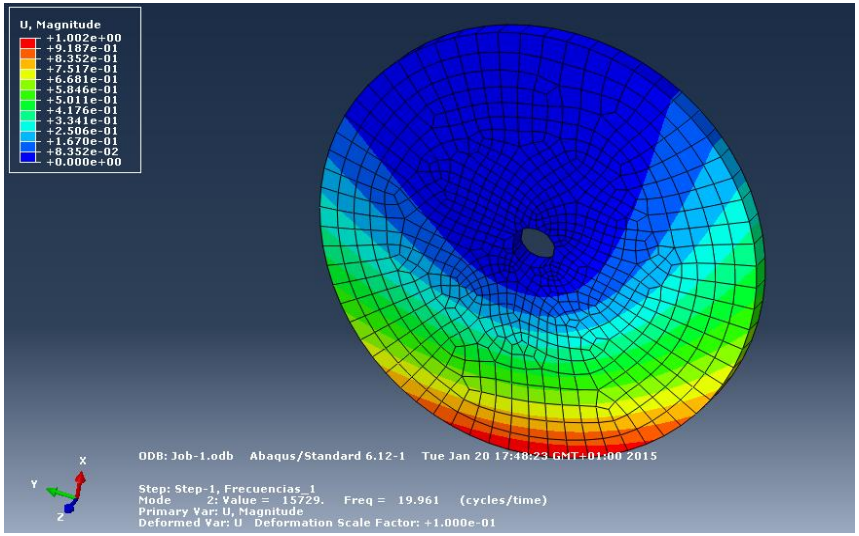
- **Natural frequencies**:

Modo	Frecuencia [Hz]	Modo	Frecuencia [Hz]
1	19.546	6	77.131
2	19.961	7	102.28
3	28.010	8	123.38
4	37.568	9	129.00
5	59.266	10	135.47

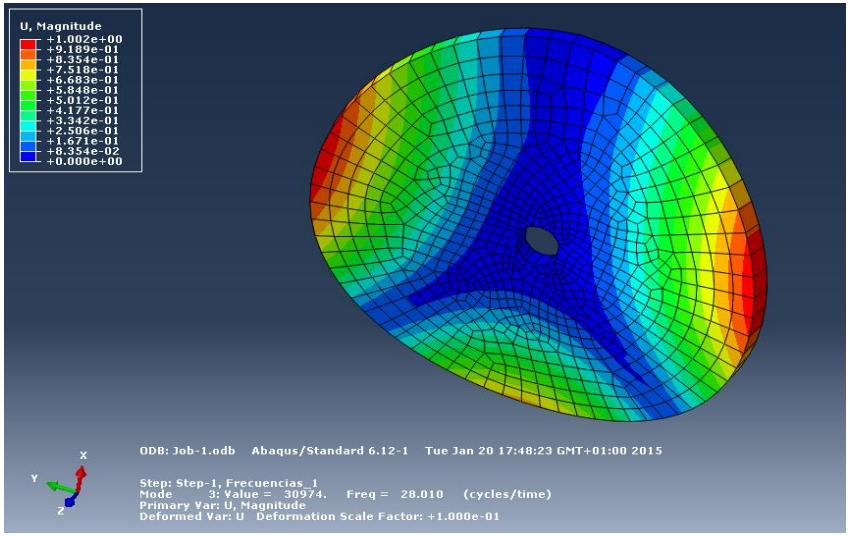
RESULTS AND DISCUSSION



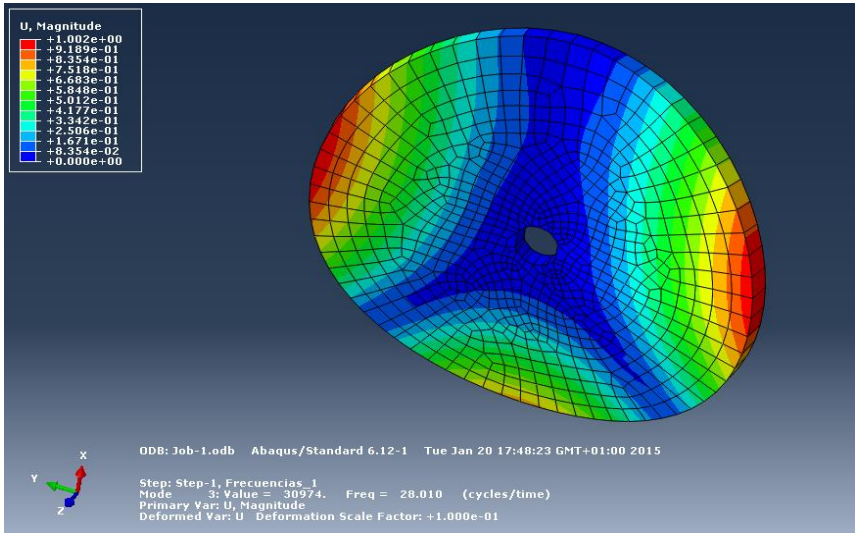
Modo 1



Modo 2



Modo 3



Modo 4

RESULTS AND DISCUSSION

- Rotation frequency:
  - Max. Train speed: 350 km/h

$$f_{rotation} = \frac{97.222}{\pi} = 30.9467\ [Hz]$$

Mode	Frecuency [Hz]	Speed [km/h]
1	19.546	221.06
2	19.961	225.75
3	**28.010**	**316.78**
4	37.568	424.88

RESULTS AND DISCUSSION

- **Frecuency of the sleepers**:
  - Distance between sleepers: 0.6m
  - Max. speed: 350 km/h

$$f_{sleepers} = \frac{97.222}{0.6} = 162.0370\ [Hz]$$

  - Critical speeds:

Mode	Frecuency[Hz]	Speed [km/h]	Mode	Frecuency[Hz]	Speed [km/h]
1	19.546	42,21936	6	77.131	166,603
2	19.961	43,11576	7	102.28	220,9248
3	28.010	60,5016	8	123.38	266,5008
4	37.568	81,14688	9	129.00	278,64
5	59.266	128,0146	10	135.47	292,6152

RESULTS AND DISCUSSION

- **Other causes that produce *squeal***:

- Wheel diameter
- Bend radius of the rail
- Correct alignment of the wheels
- Ambient factors

CONCLUSIONS

- Important wheel deformations
- Risk: rotation frequency (mode 3)
- No risk: sleepers frequency
- Too simplified analysis

FUTURE WORKS

- More complex wheel geometry
- Other rotation-sleepers frequencies
- Wheel diameter changing
- Study wheel defects

Thank you for your attention