TÉCNICO LISBOA

Dynamic absorber

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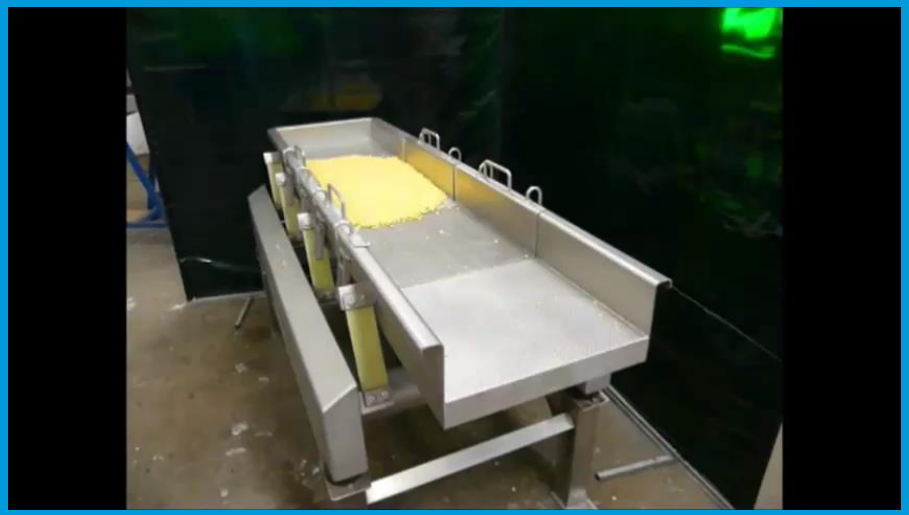
https://www.youtube.com/watch?v=WjePA0a8e_c

Objectives

- Why we need/what to isolate/attenuate vibrations?

It is not always the case!

Vibrating tables



Rim polishing

Why we need/what to isolate/attenuate vibrations?

- Structural;
- Dynamic stability;
- Lifetime;
- Comfort;
- ...

Structural

http://www.pbs.org/wgbh/nova/next/tech/rubber-bearings-seismic-protection/

https://vibrationdata.wordpress.com/

http://www.pardo.net/bike/pic/fail-001/FAIL-151.html

https://www.fos4x.de/en/applications-optimization-of-wind-turbines/

Dynamic stability

https://www.youtube.com/watch?v=kX9dIxAyu0I

https://www.youtube.com/watch?v=iTFZNrTYp3k

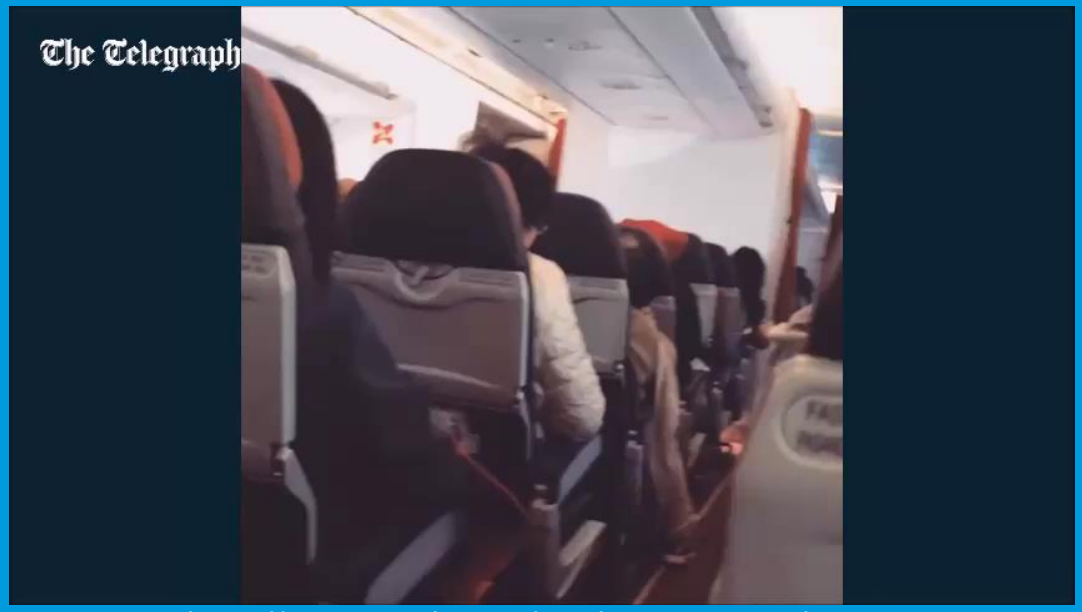
https://www.youtube.com/watch?v=lXyG68_caV4

https://www.youtube.com/watch?v=CqEccgR0q-o

Lifetime and comfort

https://www.youtube.com/watch?v=fWQwtBhlR_0

https://www.youtube.com/watch?v=hALQ-jqPV-Y



https://www.youtube.com/watch?v=YAGPyKNZhHw

Methods to "attenuate" vibrations

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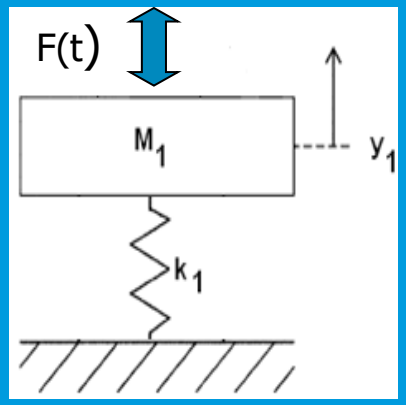
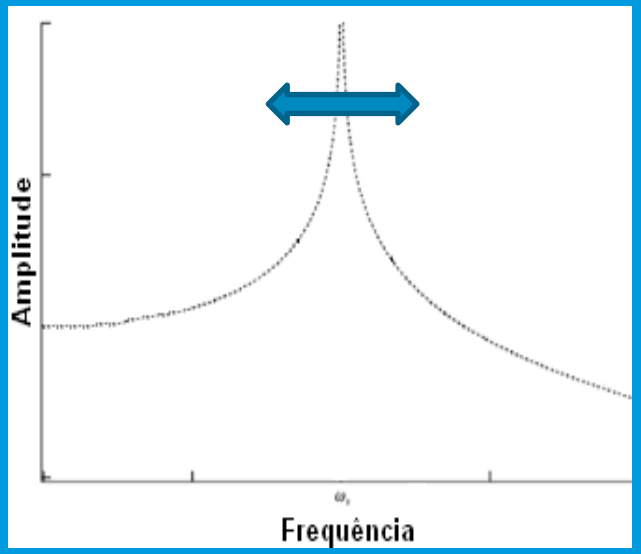
Isolator





https://www.youtube.com/watch?v=rnhDpuq6Fgo

Methods to "attenuate" vibrations

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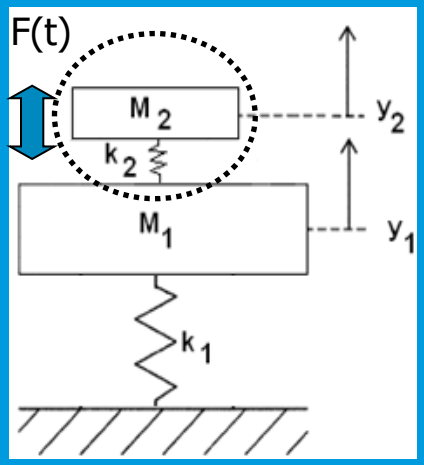
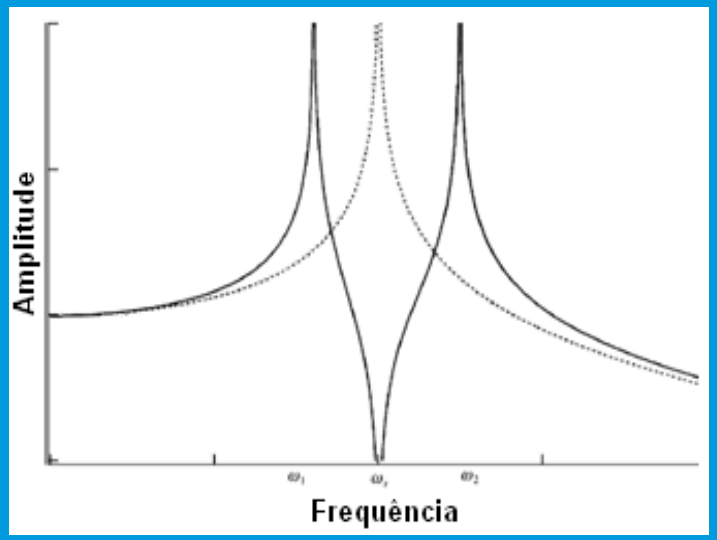
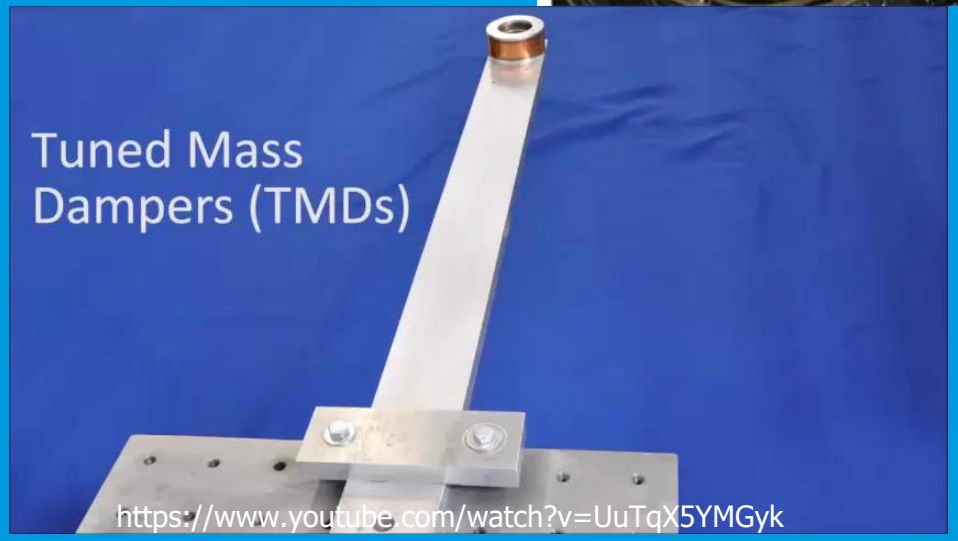
Absorber

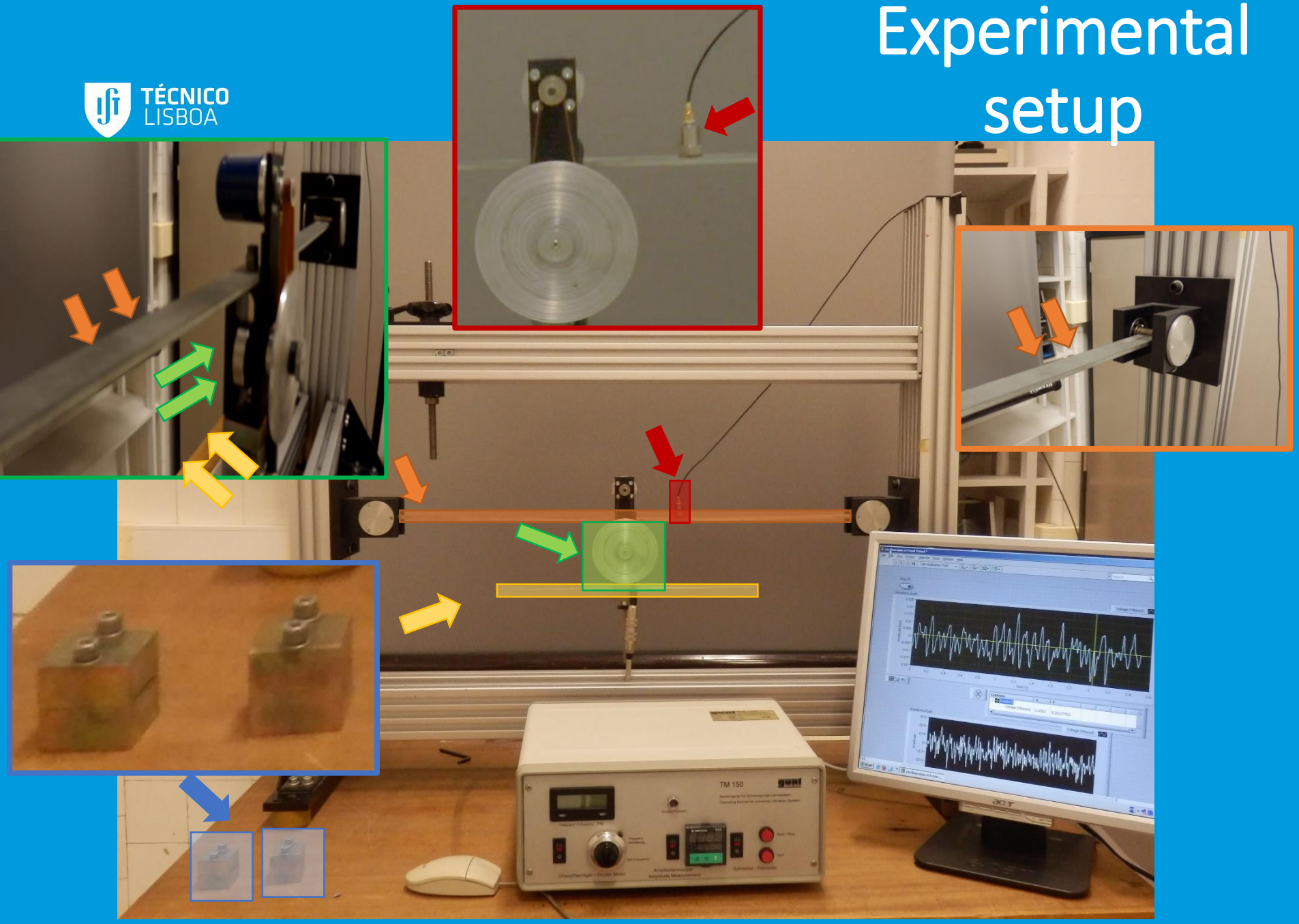




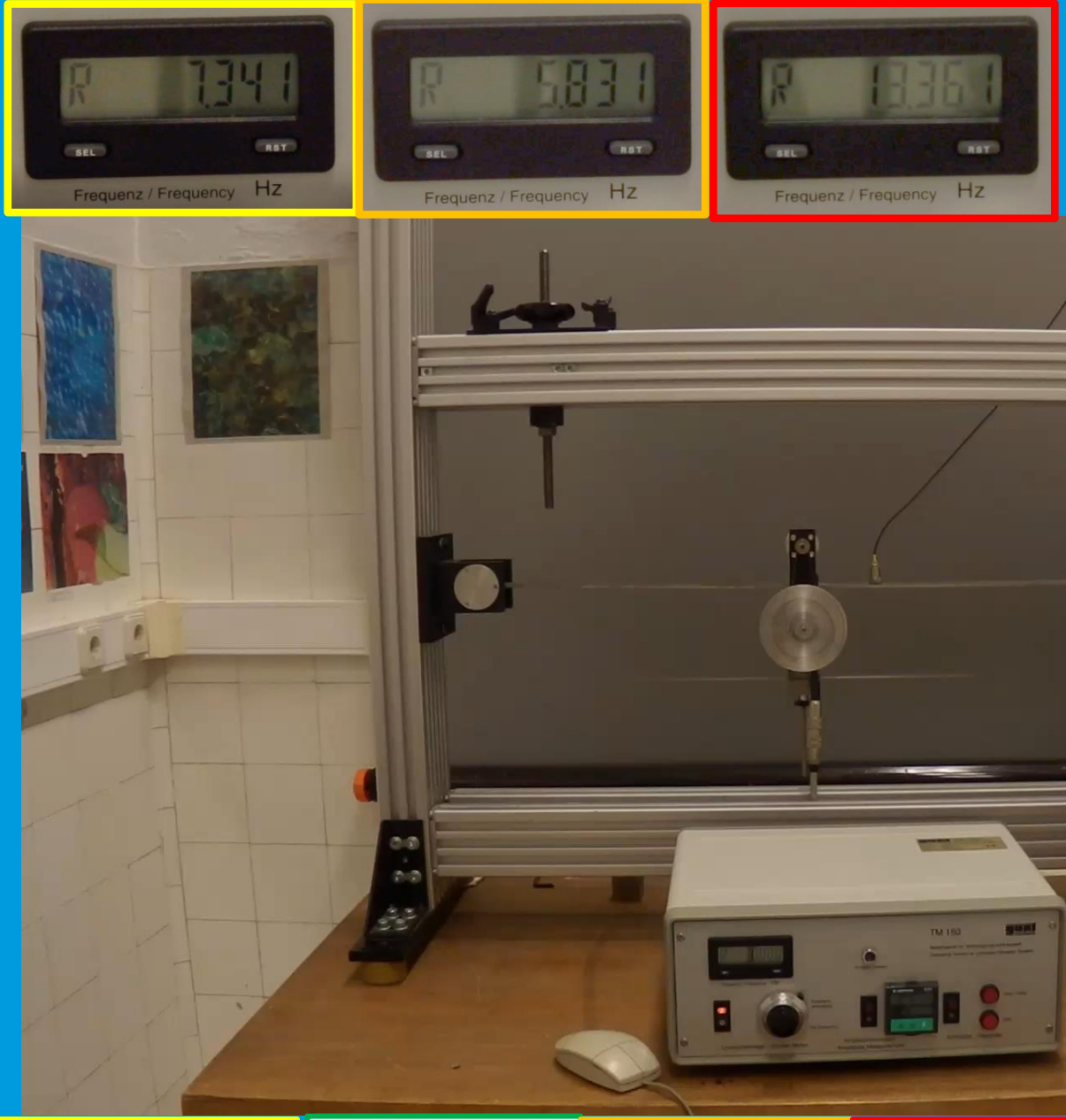


Experimental Test Dynamic absorber (Laboratory)

Experimental setup



Experimental setup

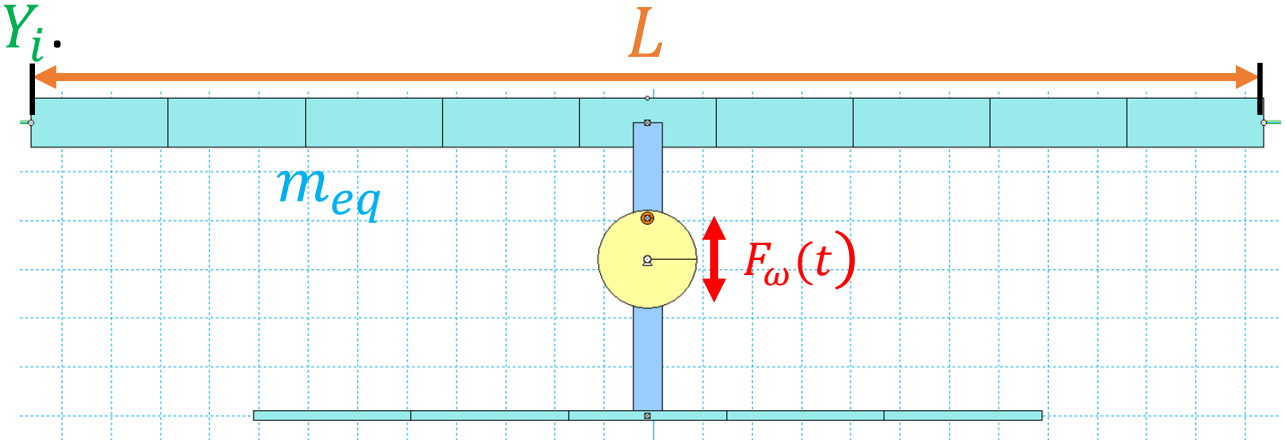


Without absorber	With absorber	With absorber	With absorber
$f_n = 7.34\ Hz$	$f = 7.34\ Hz$	$f_1 = 5.83\ Hz$	$f_2 = 13.36\ Hz$
$Y_i = 3\ mV$	$Y_f = 0.15\ mV$	$Y_1 = 0.8\ mV$	$Y_2 = 6\ mV$

Experimental Test
Dynamic absorber
(Simulation)

Simulation of case I (without absorber)

- Objectives: Knowing the parameters: m_{eq}, L e f_n (defined for each group), one obtains the time frequency response of the system under forced vibrations and estimate the values of k_{eq}, E and Y_i.



Known parameters

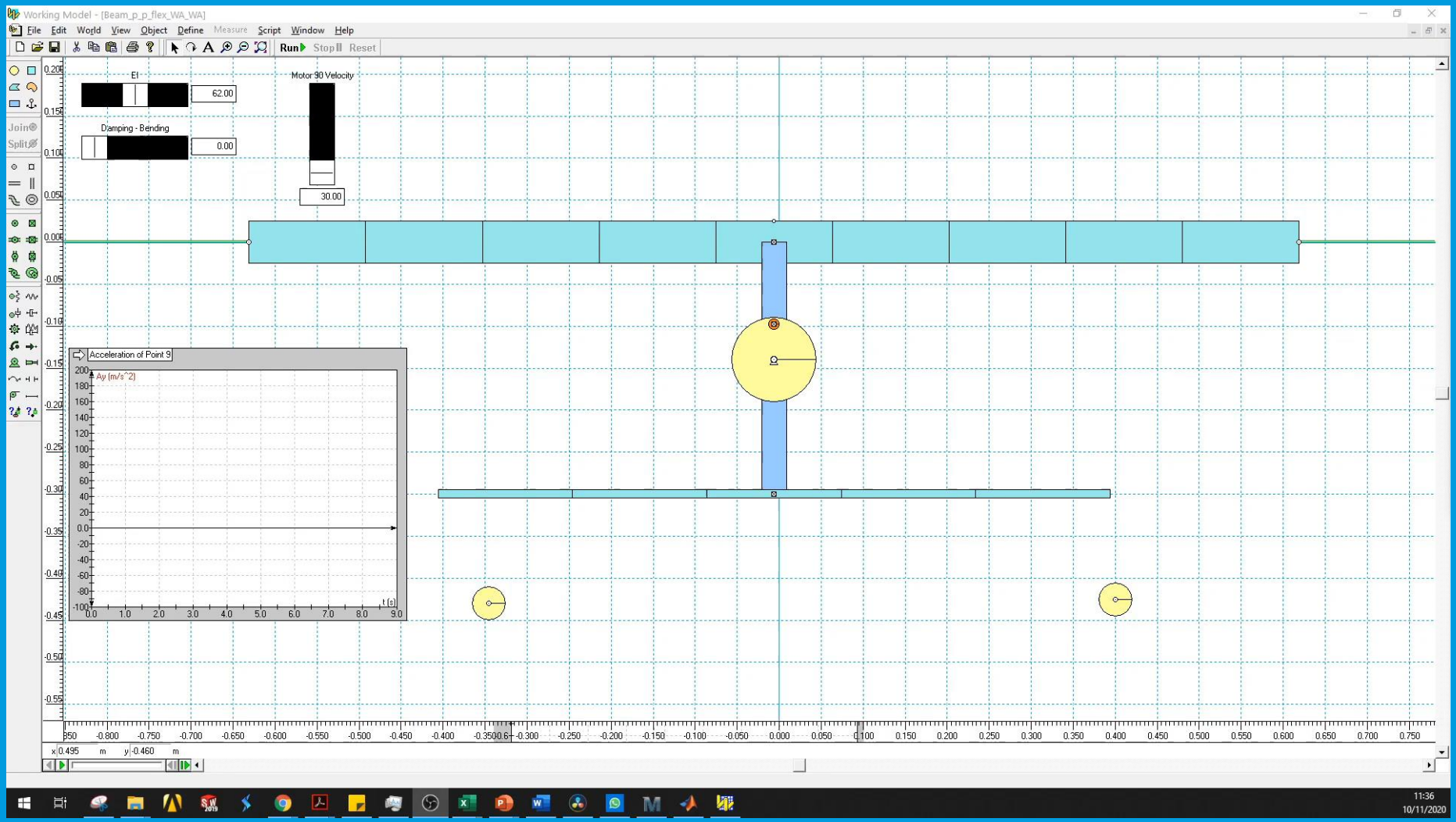
m_{eq} – Equivalent mass of the main system;
L – Length of the beam;
f_n – 1st natural frequency of the system.

Parameters to be determined

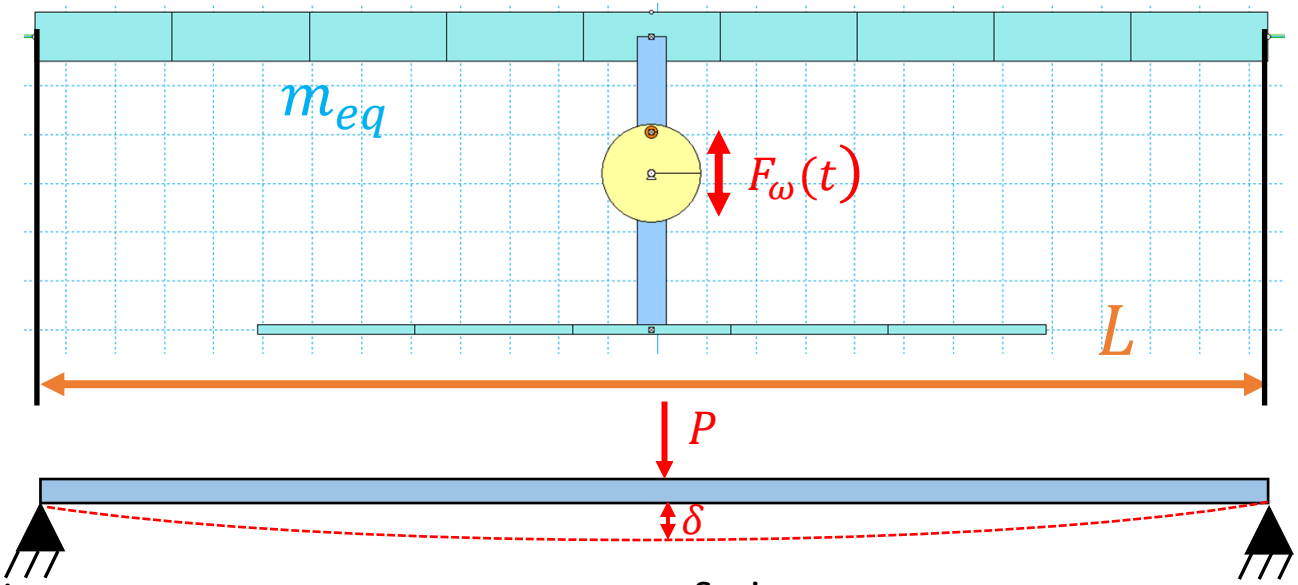
k_{eq} – Equivalent stiffness of the main system;
E – Modulus of elasticity of the main system's beam;
Y_i – Vibration amplitude at the exciting frequency.

Simulation of case I (without absorber)

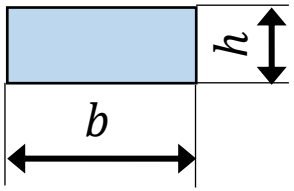
Without absorber
$f_n = 40\ rad/s$
$Y_i = 180\ \mathrm{m/s^2}$



Simulation of case I (without absorber)



Cross-section



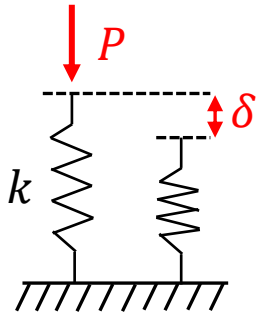
$b = 25\ mm$

$h = 4\ mm$

$$\delta = \frac{P\,L^3}{48\,E\,I}$$

$$I = \frac{1}{12}bh^3$$

Spring



$$\delta = \frac{P}{k}$$

k_{eq}

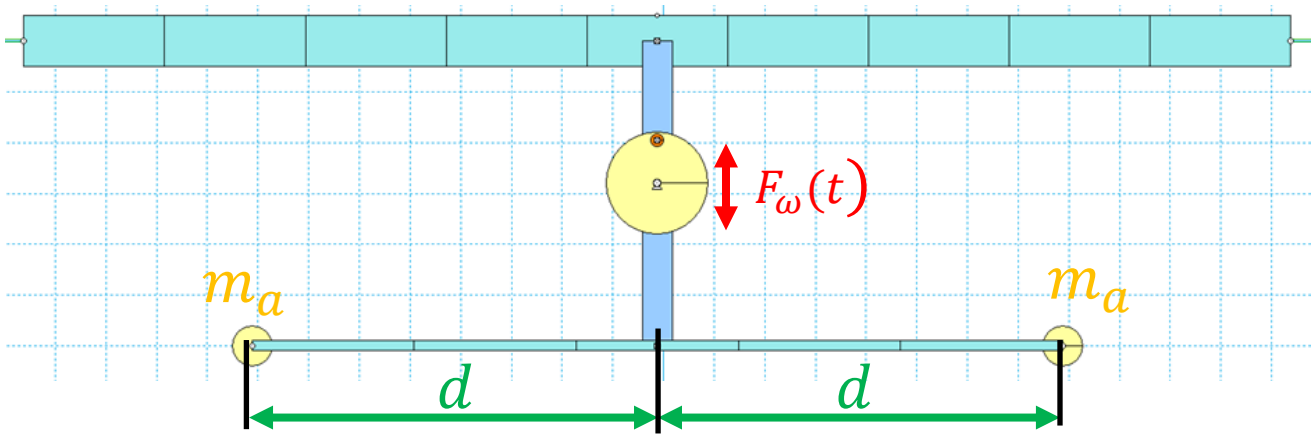
E

Plot

Y_i

Simulation of case II (with absorber)

- Objectives: Knowing the parameters: m_a e $f_{p_{abs}}$ (defined for each group, one obtains the time frequency response of the system under forced vibrations and estimate the values of d, Y_f e η_{abs}.



Known parameters

m_a – Mass of the absorber (each);

$f_{p_{abs}}$ – Excitation frequency at which is intended to suppress vibrations.

Parameters to be determined

d – Distance of the mass;

Y_f –Amplitude of vibration at the excitation frequency;

η_{abs} – Efficiency of the absorber.

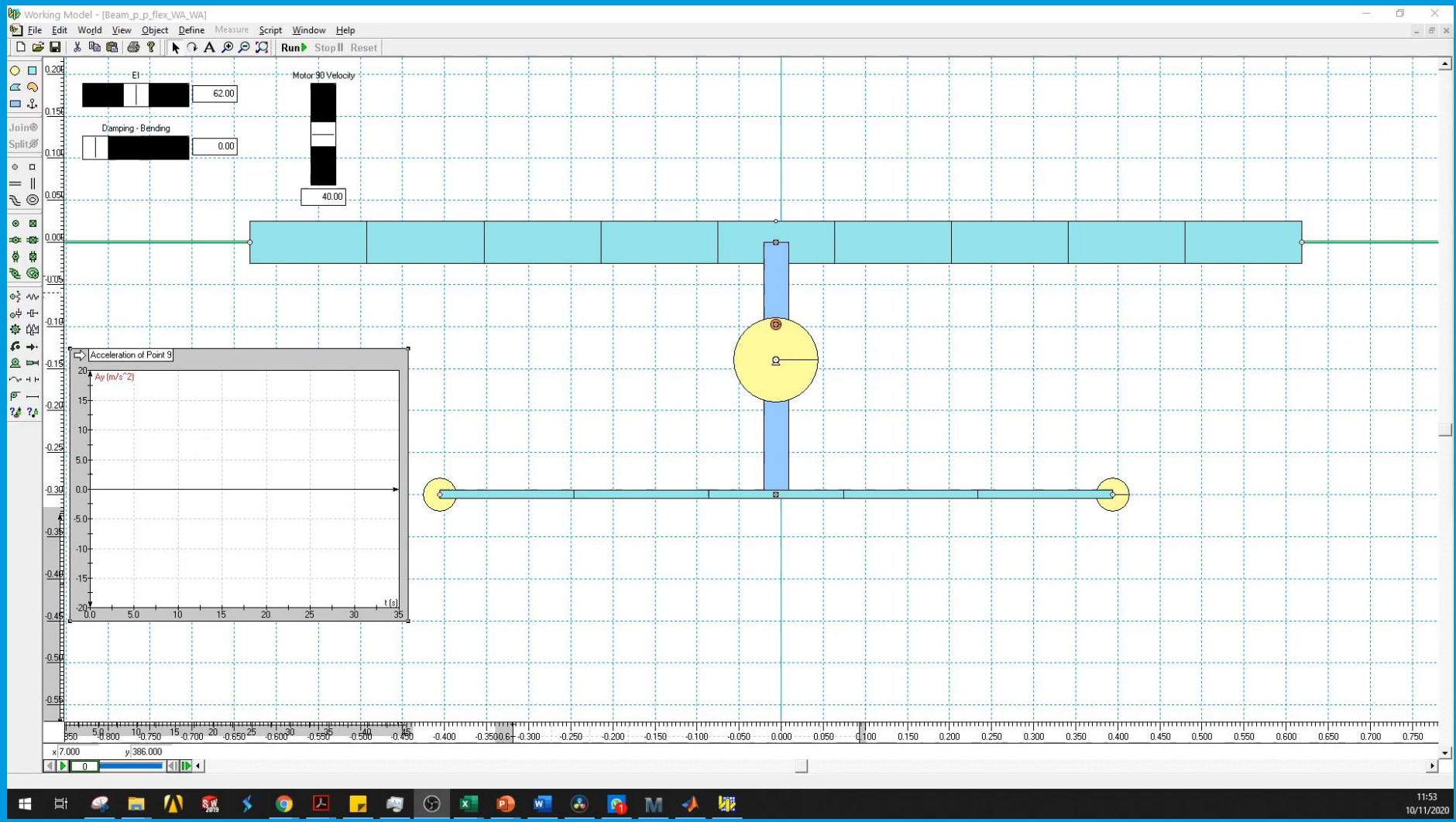
With absorber

$f_{p_{abs}} = 40\ rad/s$

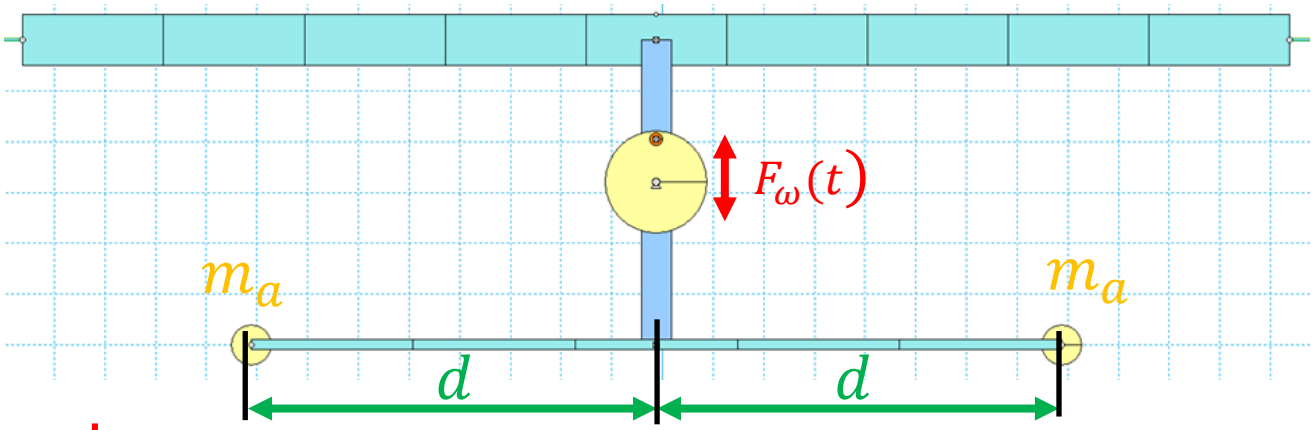
$Y_f = 5\ m/s^2$

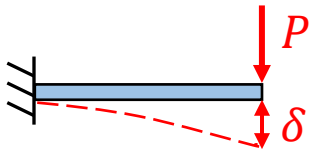
$\eta_{abs} = 97.2\%$

Simulation of case II (with absorber)



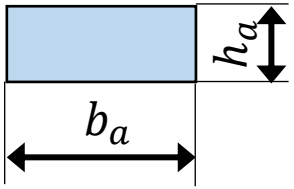
Simulation of case II (with absorber)





$$\delta = \frac{P\,d^3}{3\,E\,I}$$

Cross-section

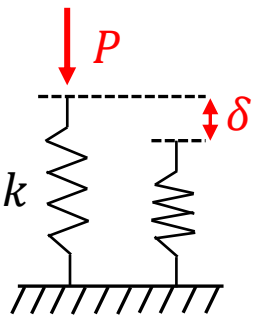


$$I = \frac{1}{12} b_a h_a^3$$

$b_a = 20\ mm$

$h_a = 1.5\ mm$

Spring



$$\delta = \frac{P}{k}$$

d

Plot

Y_f

Estimate η_{abs}

Experiment procedures

1) To each group are assigned the following parameters m_{eq}, L , f_n, m_a and $f_{p_{abs}}$;

2) The teacher conducts the simulation of test I and returns to the group the corresponding files that contains the data referring to the time response without the absorber;

3) The teacher conducts the simulation of test II and returns to the group the corresponding files that contains the data referring to the time response with the absorber;

4) Each group downloads a file where it must be registered the values of all requested parameters (the file can be printed and later scanned in *pdf format or digitally filled);

5) The group must submit the file described in 4).

Dynamic absorber

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