Vortex Induced Vibrations (VIV)

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Summaery 2021

Vortex Induced Vibrations (VIV)

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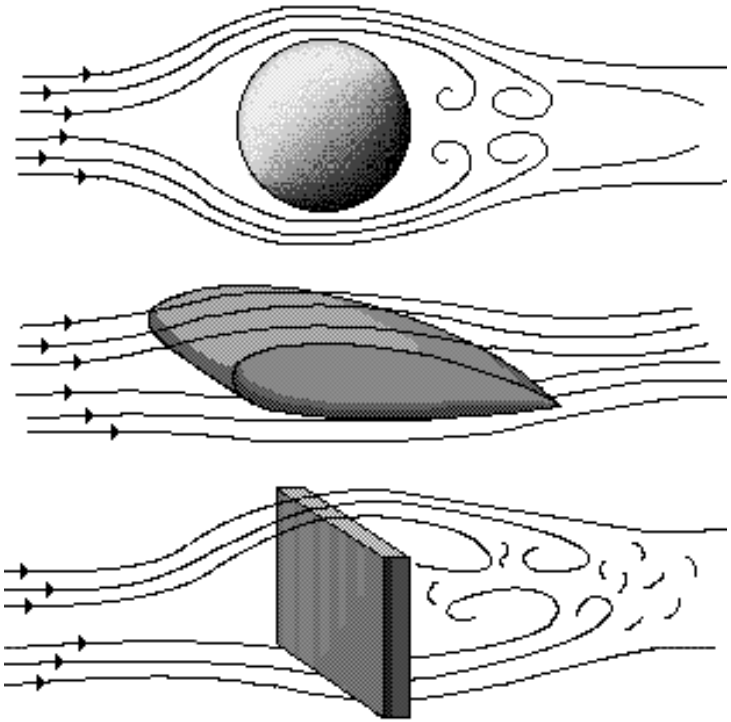
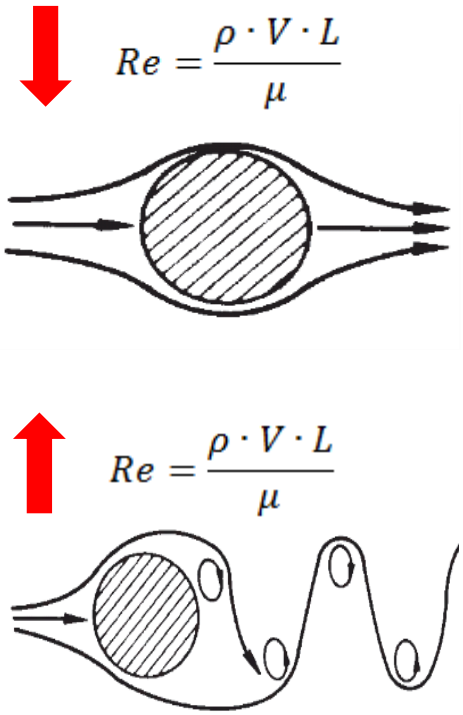
- Vibration of a body forced by periodically generated vortex.
- Commonly in bridges, transmission lines, offshore structures, pipelines…





Natural Frequency

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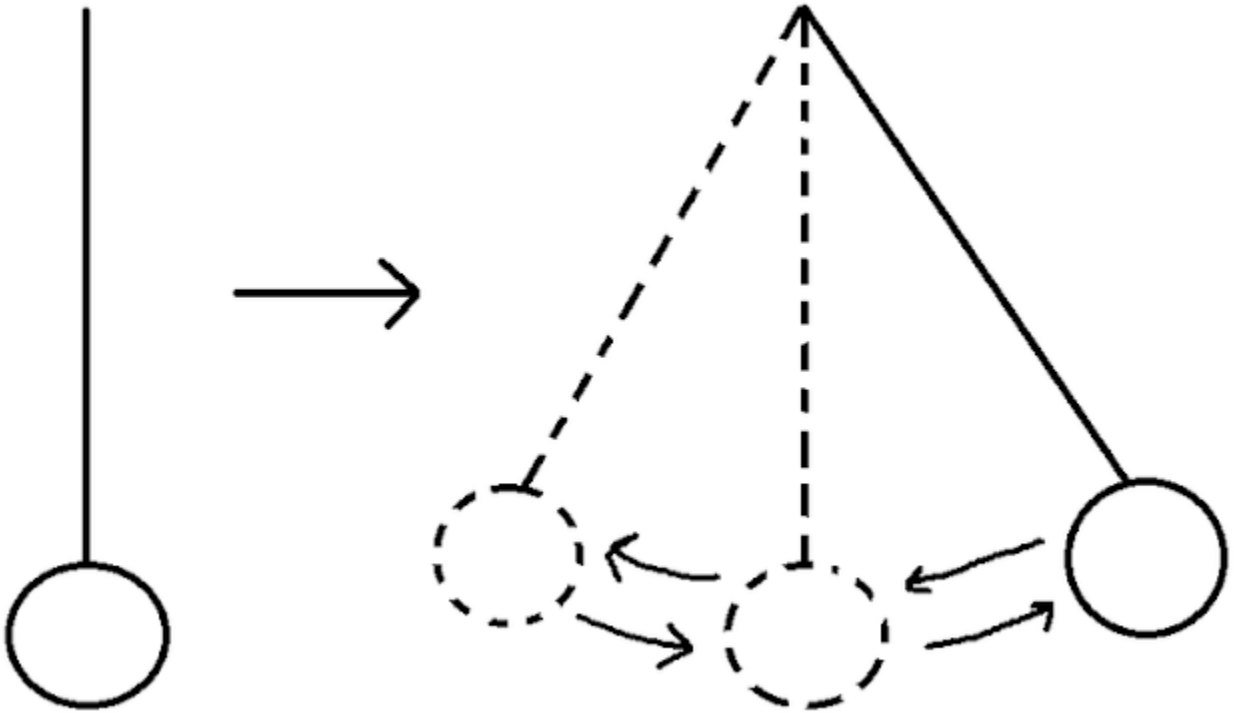
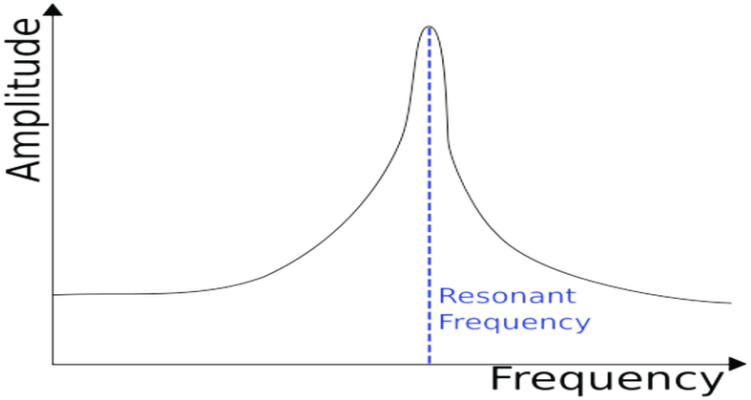


Resonance



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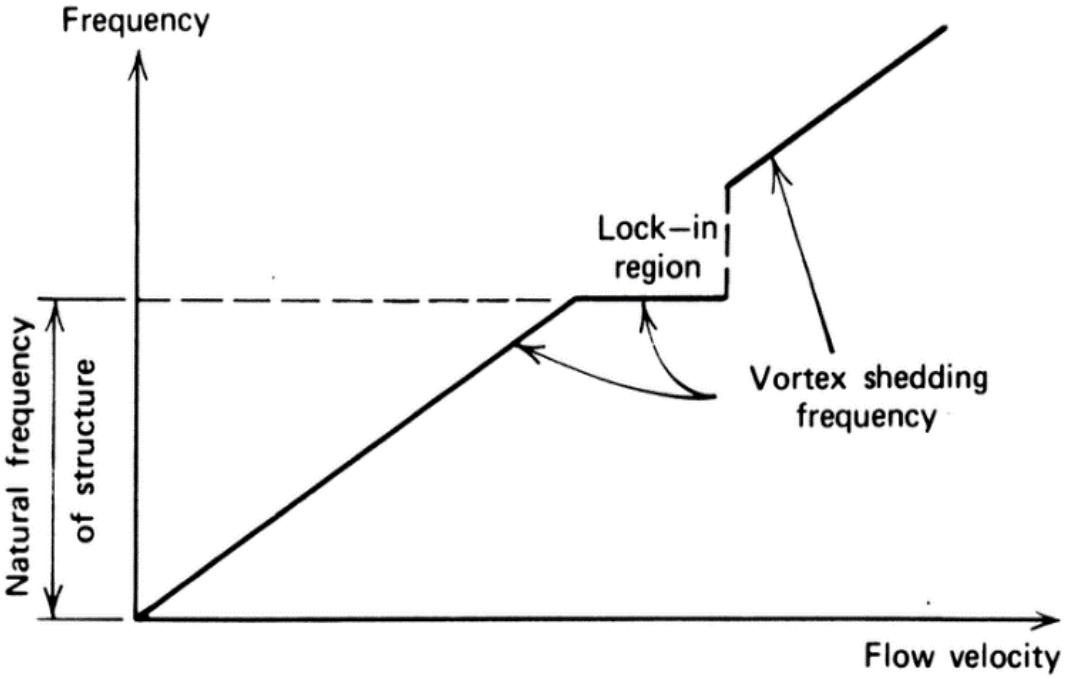
Vortex Induced Vibrations (VIV)

- **Lock-in Region**



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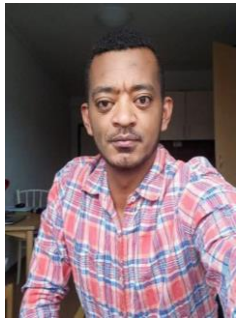
Vortex Induced Vibrations (VIV)

- **Small-scale example**



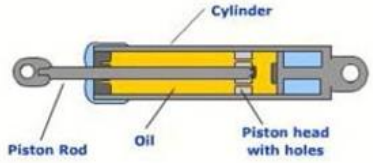
Yigezu Mikiyas

Damping

- Damping is a reduction in the amplitude as a result of energy being drained from the system to overcome friction or other resistive force .

Type of dampers

• Viscous Dampers

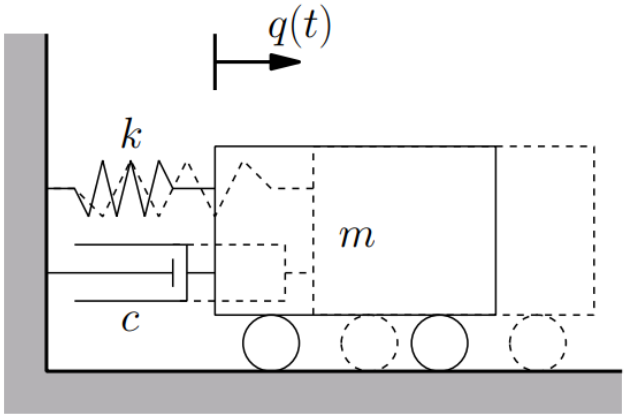


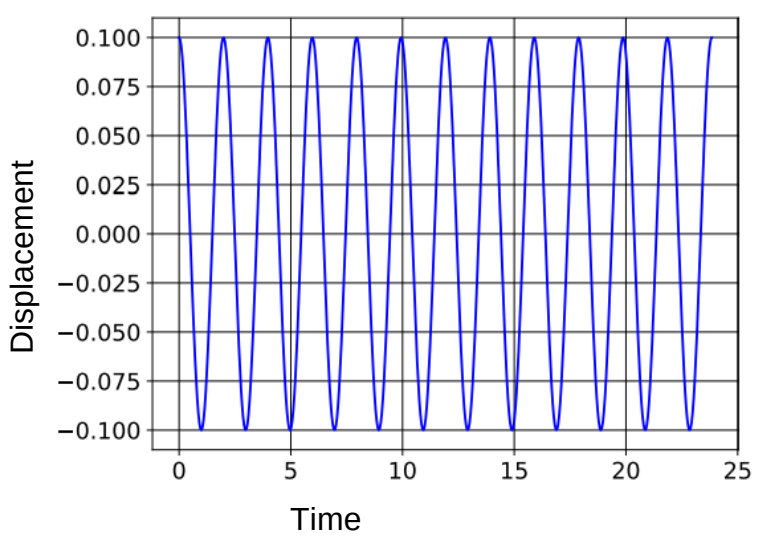
•Friction Dampers

• Viscoelastic Dampers

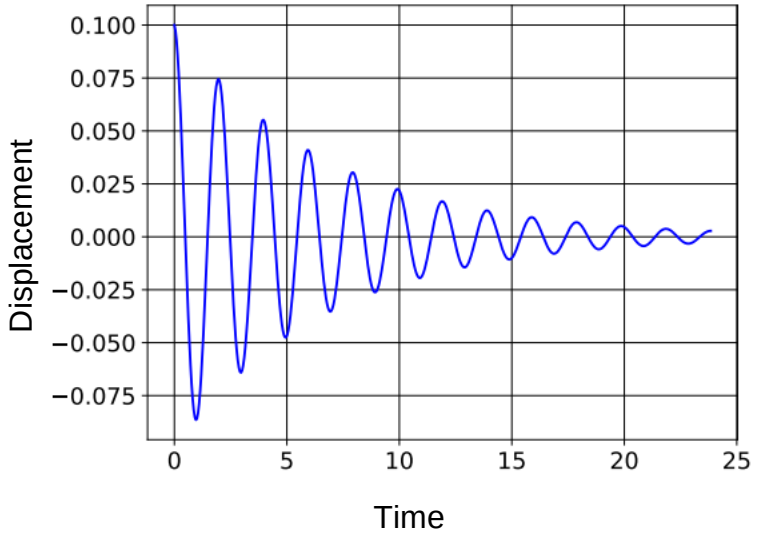
•Tuned Mass Damper (TMD)

Vortex Induced Vibrations (VIV)





No Damping



Damping

Vortex Induced Vibrations (VIV)

Case Study: Alconétar Bridge

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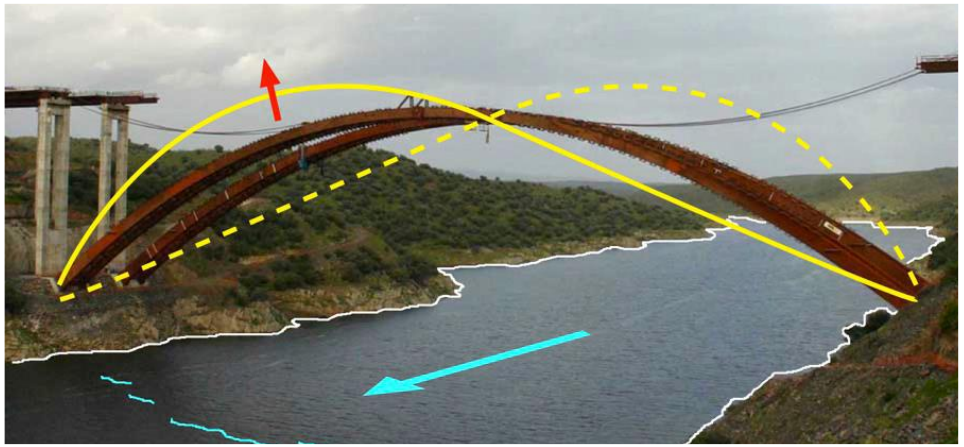

Alconétar Simulation and Analysis

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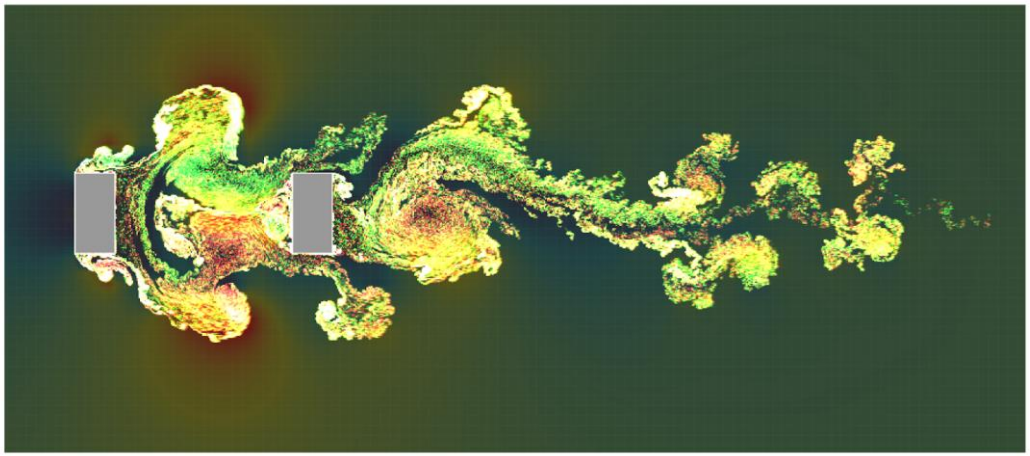
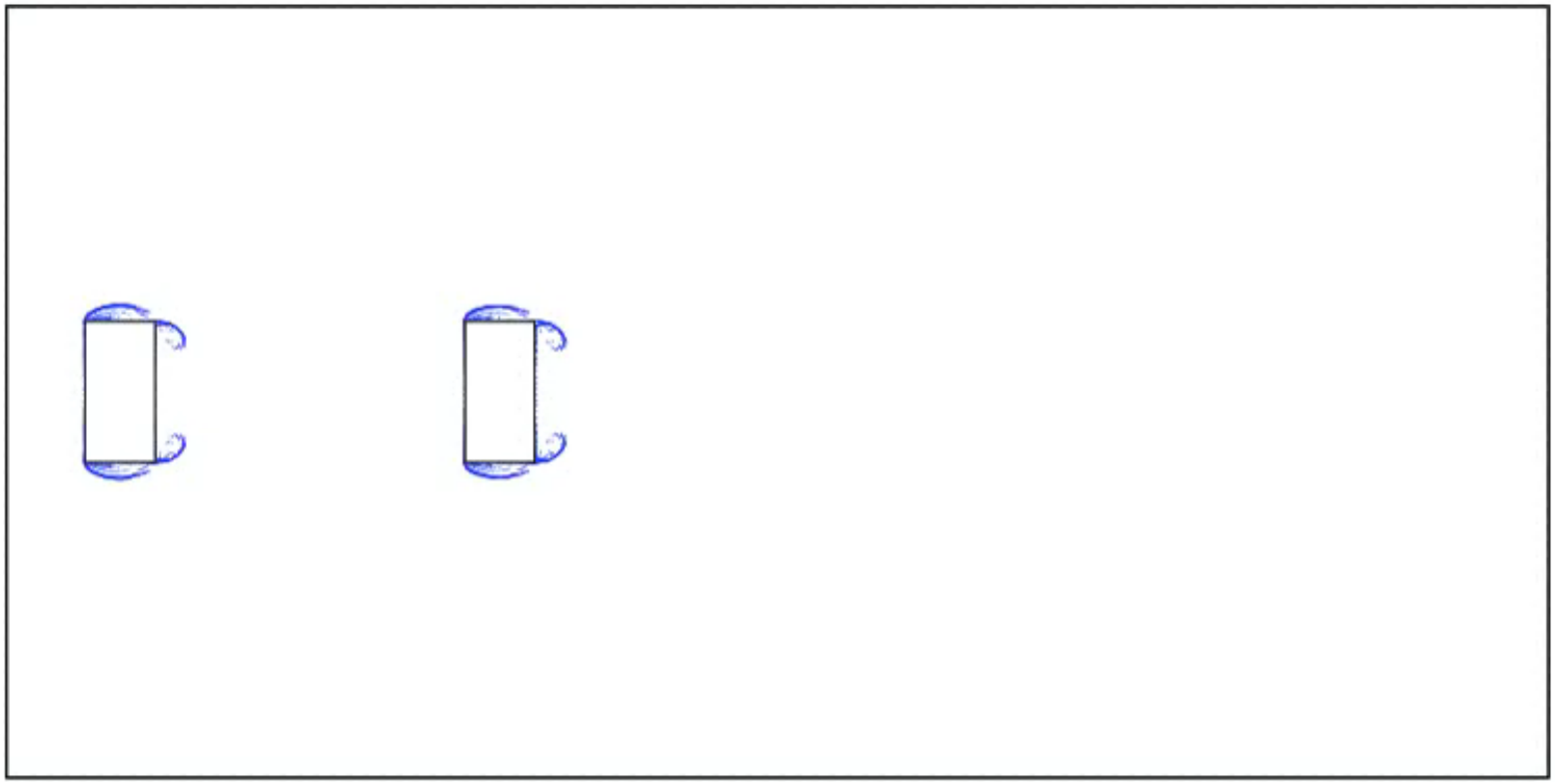
Ucrit = 13,08 m/s



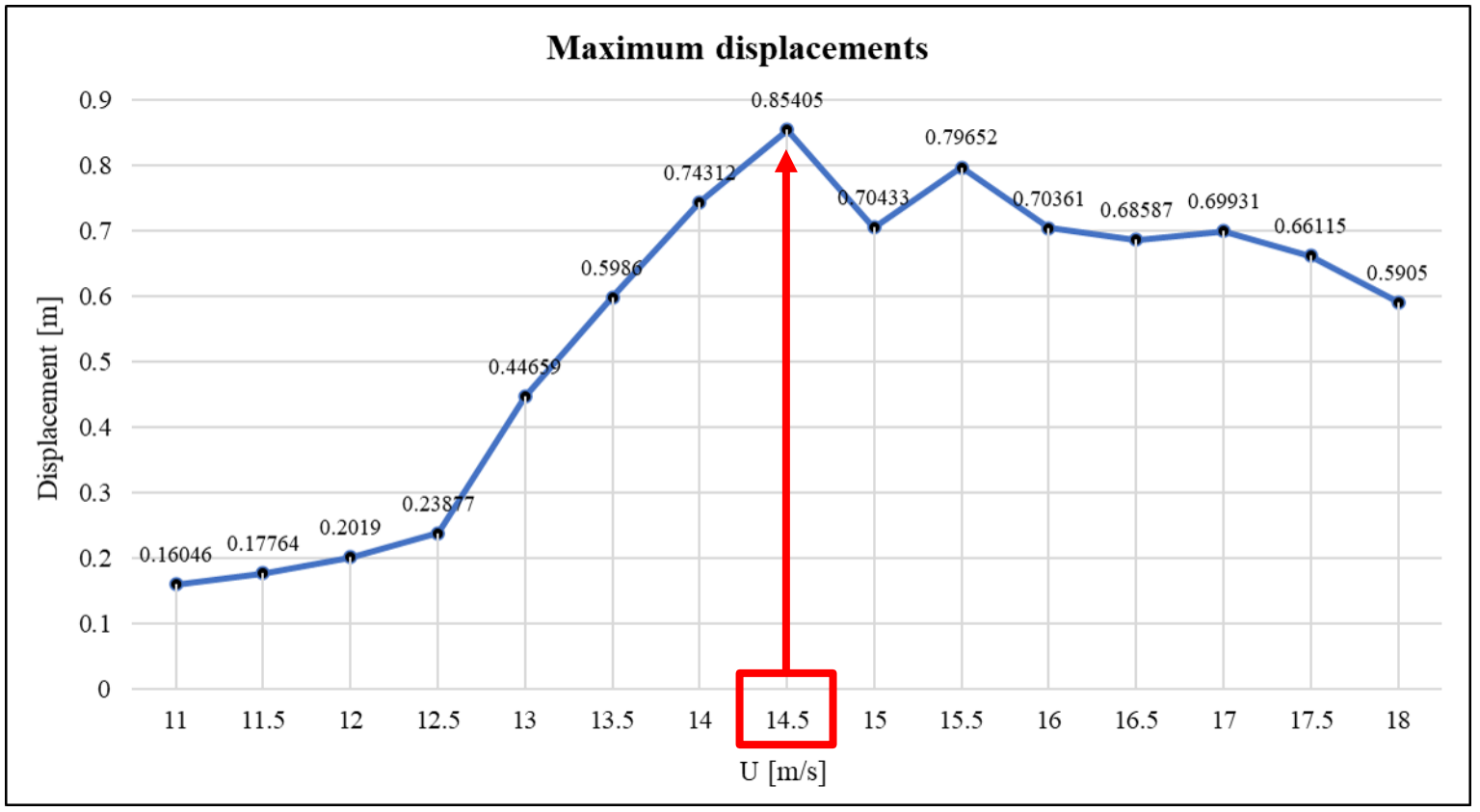
Alconétar Dynamic Analysis

Marjorie Pons Piñeyro



Alconétar Dynamic Analysis

Marjorie Pons Piñeyro



Tuned mass dampers (TMD)

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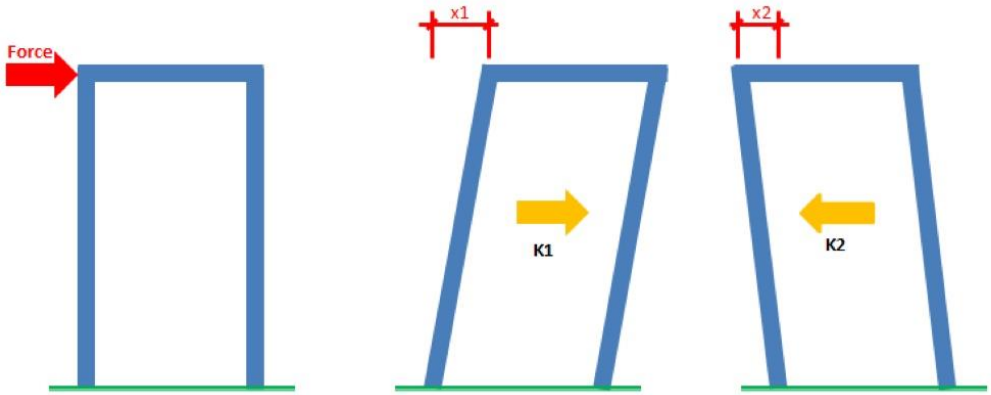
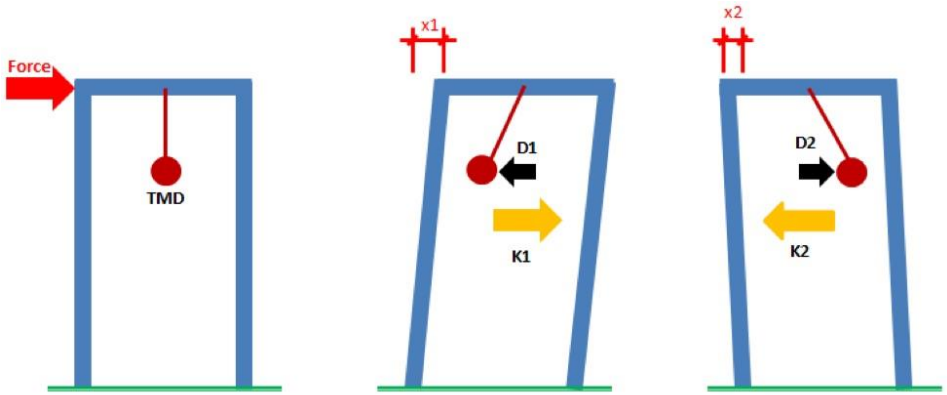


Schematic A - Building Without TMD



Schematic B - Building With TMD

Tuned mass dampers (TMD)

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Tuned mass dampers (TMD)

Renan da Cunha

TMD – Alconétar bridge

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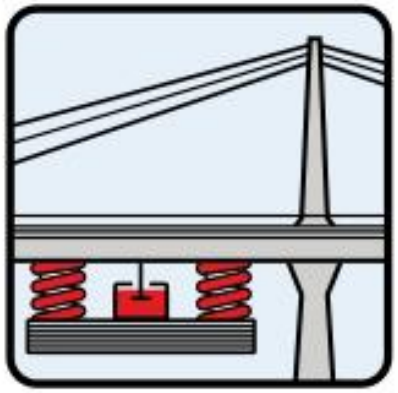
- Range of analysis: 12m/s to 18m/s



TMD – Alconétar bridge

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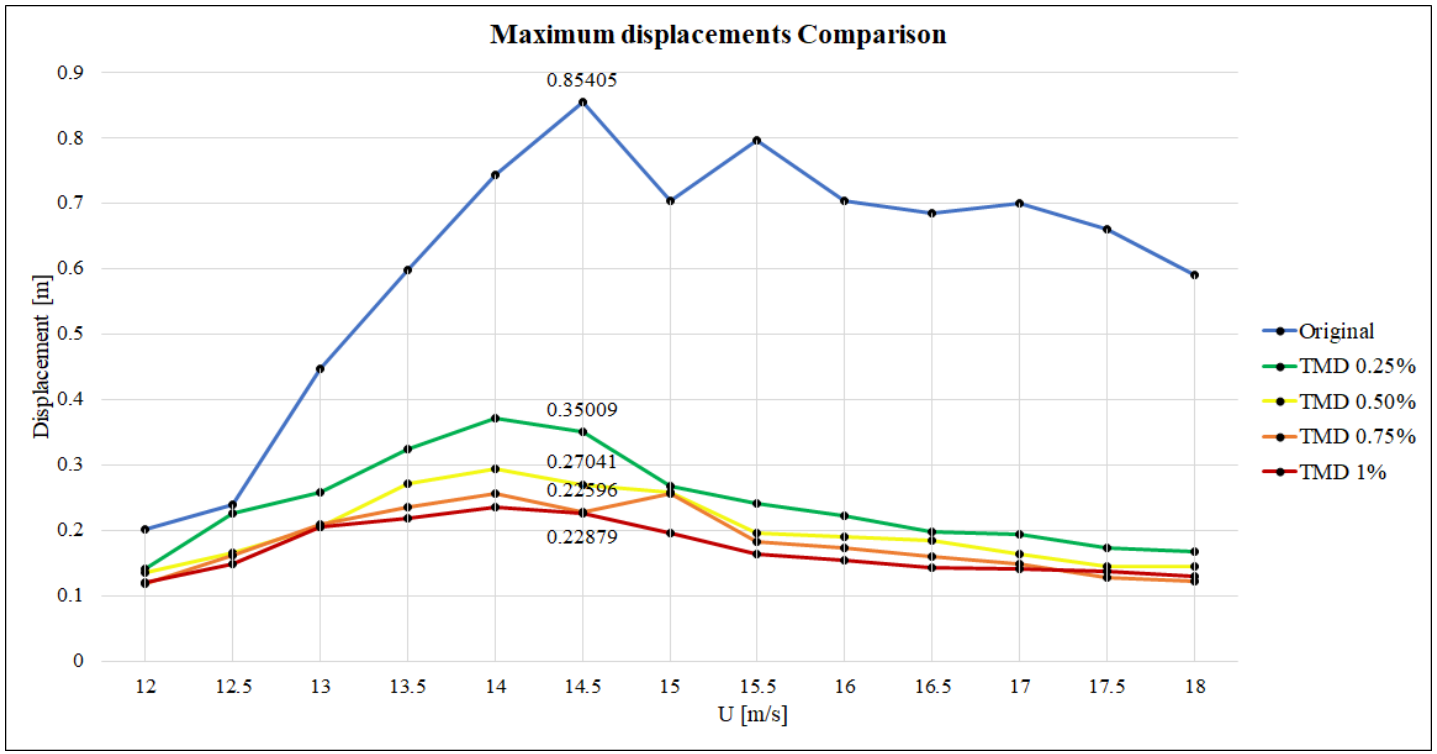
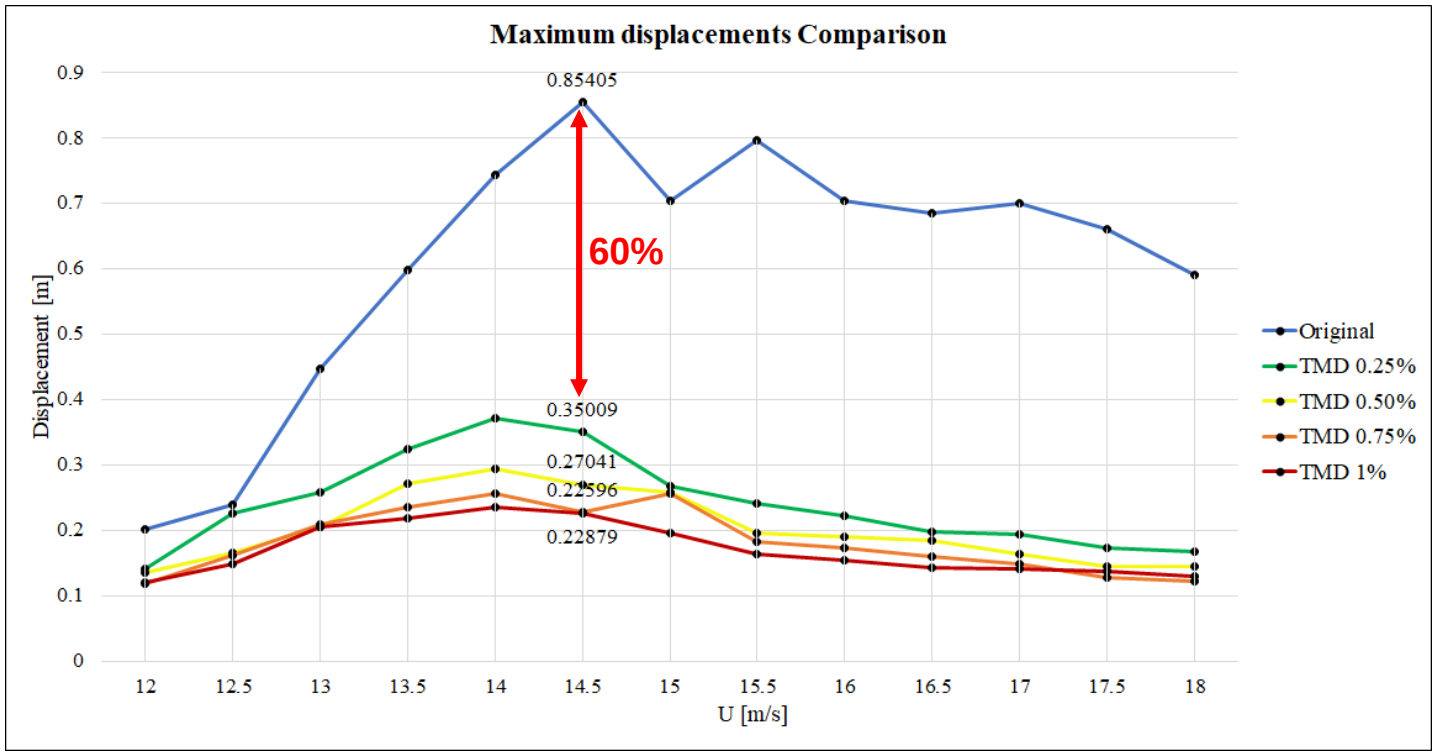
- Displacements Original bridge x Bridge with TMD



TMD – Alconétar bridge

Renan da Cunha

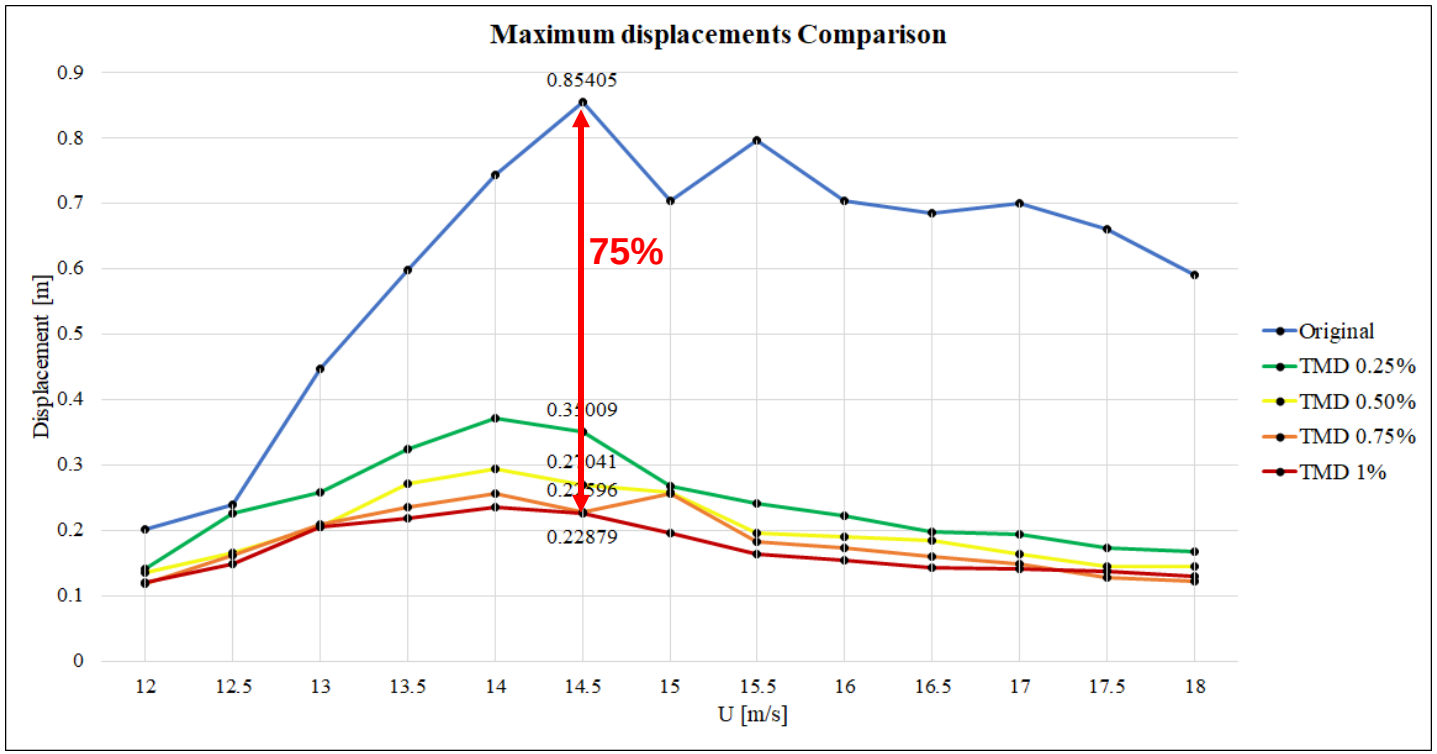
- Displacements Original bridge x Bridge with TMD



TMD – Alconétar bridge

Renan da Cunha

- Displacements Original bridge x Bridge with TMD



Eurocode max. displacement

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$$\frac{y_{F,max}}{b} = \frac{1}{St^2} \cdot \frac{1}{Sc} \cdot K \cdot K_W \cdot c_{lat}$$

St	is the Strouhal number given in Table E.1
Sc	is the Scruton number given in E.1.3.3
K_W	is the effective correlation length factor given in E.1.5.2.4
K	is the mode shape factor given in E.1.5.2.5
c_{lat}	is the lateral force coefficient given in Table E.2

Eurocode max. displacement

Renan da Cunha

$$\frac{y_{F,max}}{b} = \frac{1}{St^2} \cdot \frac{1}{Sc} \cdot K \cdot K_W \cdot c_{lat}$$ **= 0,48m**

St	is the Strouhal number given in Table E.1
Sc	is the Scruton number given in E.1.3.3
K_W	is the effective correlation length factor given in E.1.5.2.4
K	is the mode shape factor given in E.1.5.2.5
c_{lat}	is the lateral force coefficient given in Table E.2

Eurocode max. displacement

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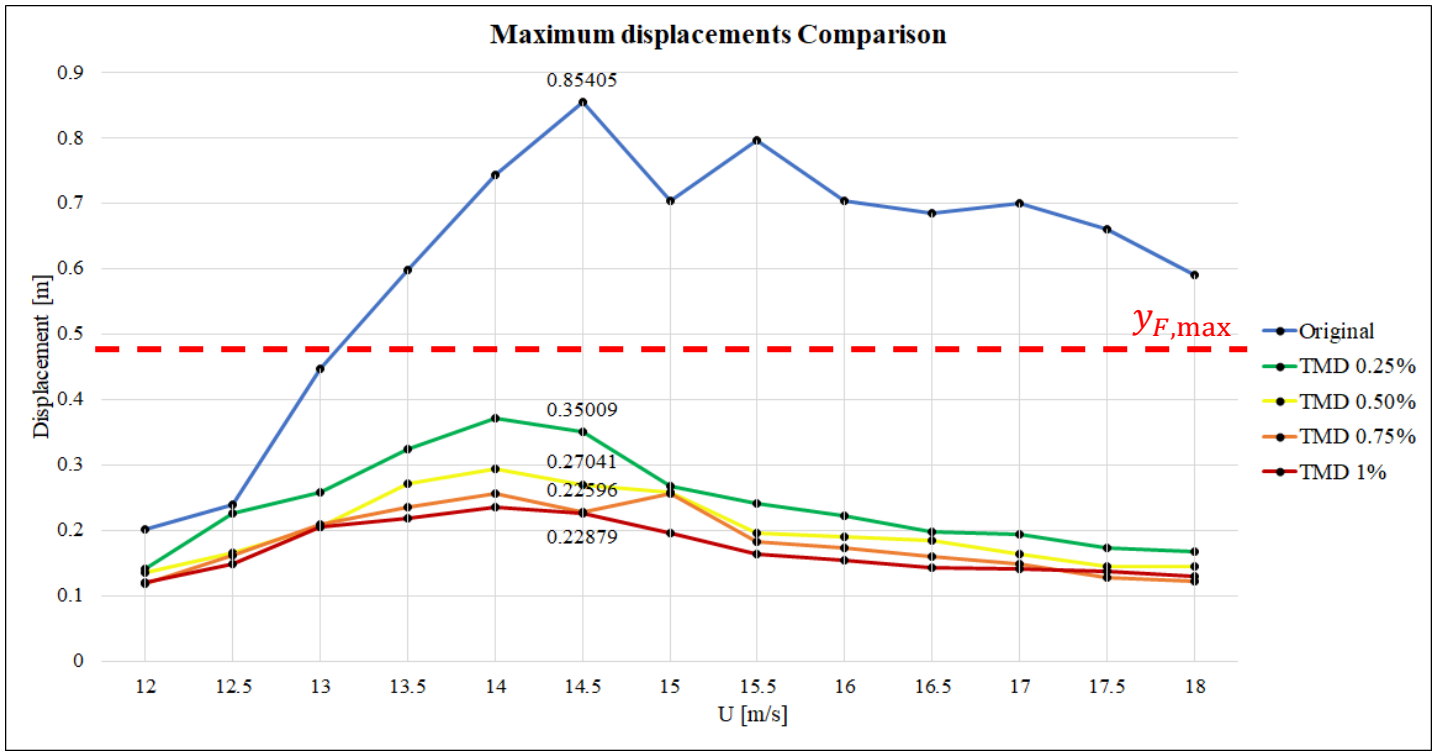
- Choosing the TMD



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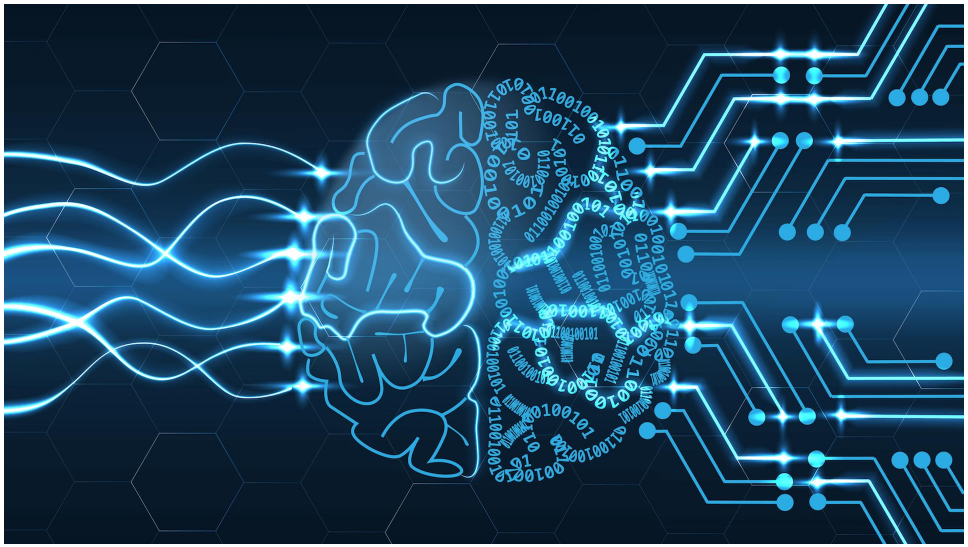
AI model

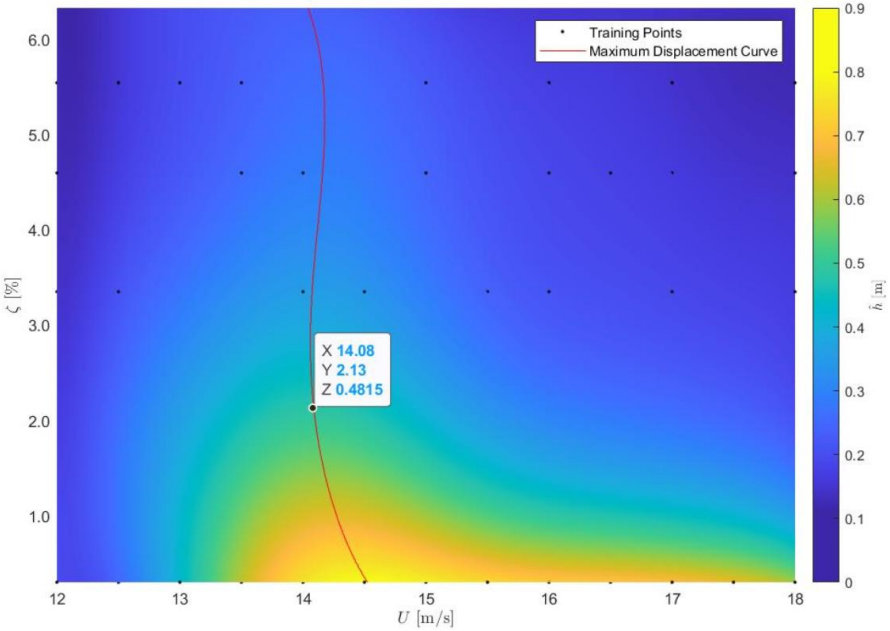
- **Artificial Intelligence**

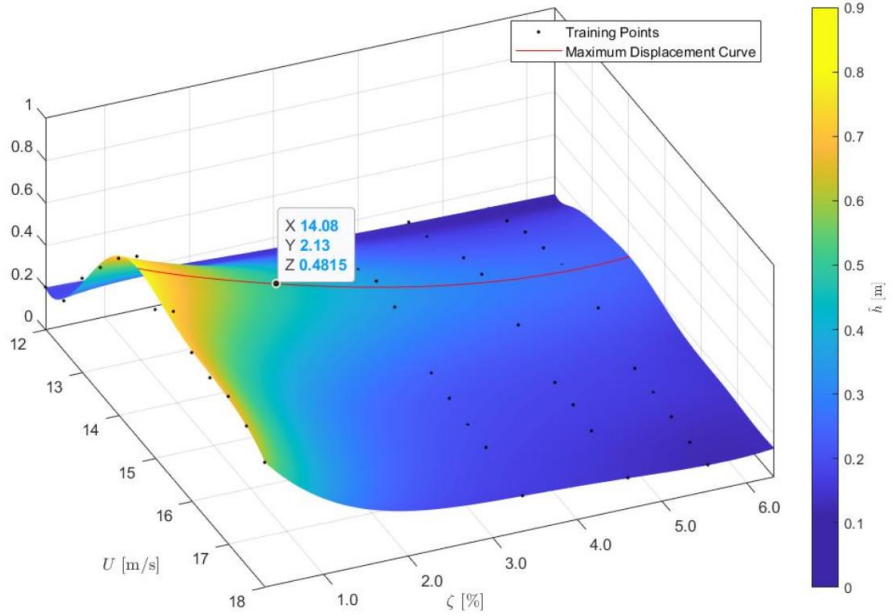
Goal: What is the required damping that respects code limitations?



AI model

- **Inputs:** Damping values and wind speeds.
- **Outputs:** Displacements.





Further solutions

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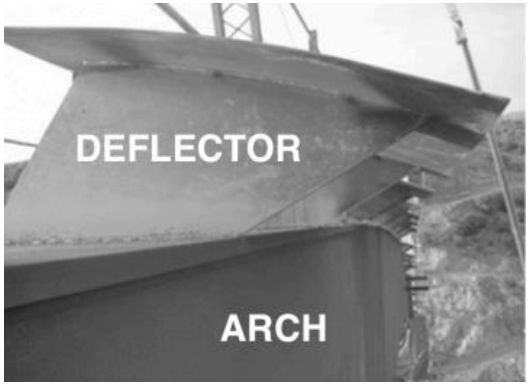

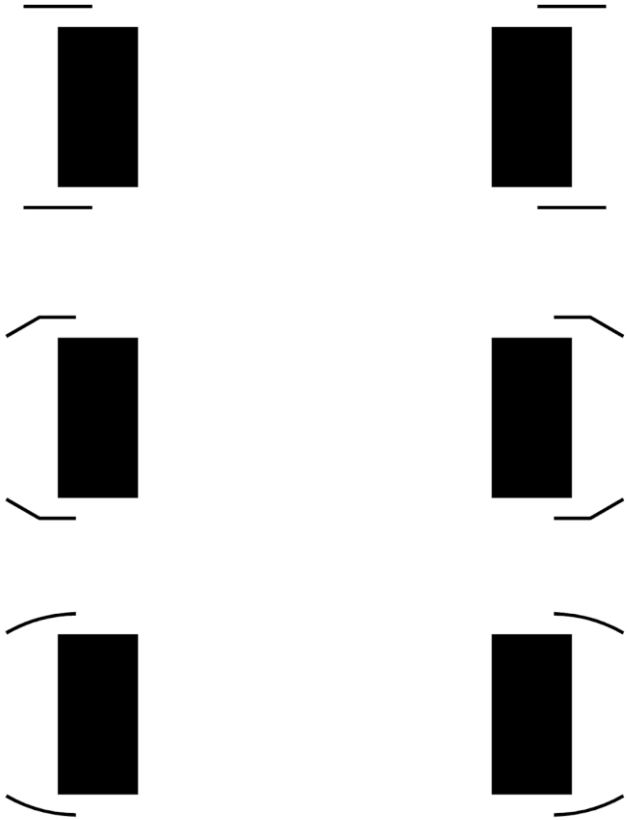

Further solutions - Deflectors

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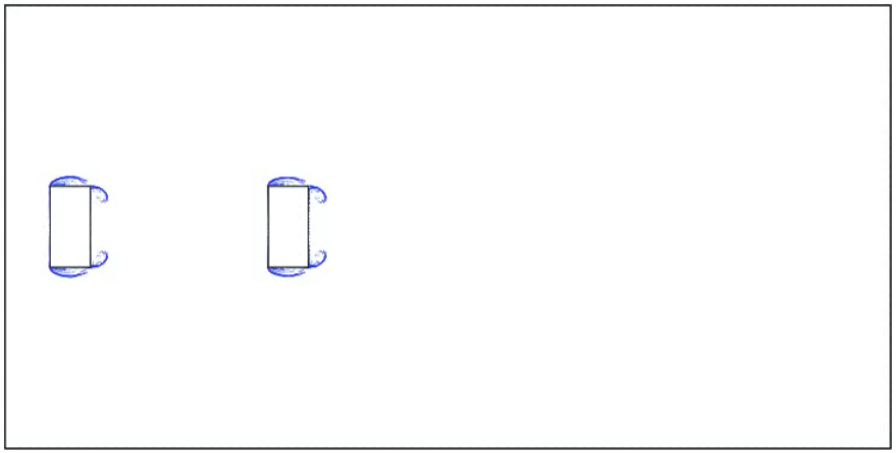
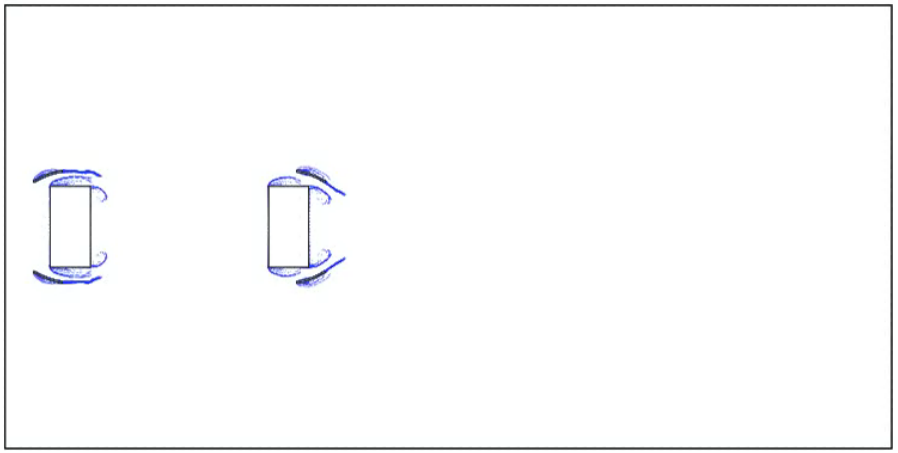


BEFORE



AFTER

Thank you!!!

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