Construction

E-book

Vibration Isolation Acousticork

Why is damping important for construction?

AMORIM
CORK COMPOSITES

Damping and vibration isolation

Damping is essential for vibration control in construction. With a high loss factor, cork is an excellent damping material, increasing safety and comfort in buildings and infrastructures.

What is damping?

Damping is the dissipation of vibration energy in solid mediums and structures over time and distance. Similar to the absorption of sound in air, damping occurs whenever there is any type of friction that diminishes movement and disperses the energy.

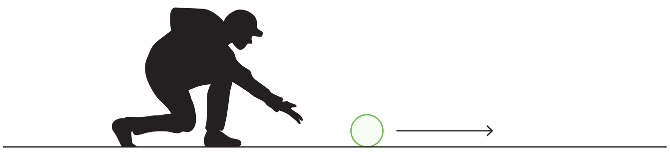
Each material's damping capacity is referred to as its loss factor, and this represents the ratio between dissipated energy and the energy remaining in the system during each cycle.

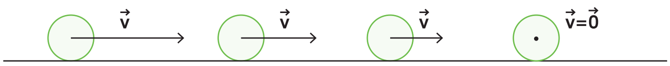
In construction, damping is essential for limiting vibrations and ensuring safety and comfort in buildings and infrastructures.

Examples of damping

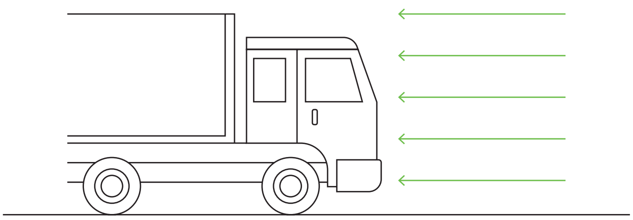
Some simple examples provide a better understanding of the concept of damping:

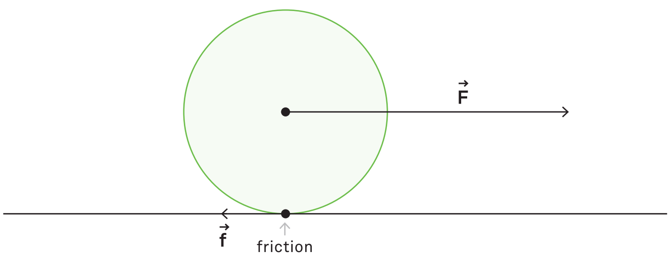
Imagine rolling a ball on the floor with a certain amount of initial force. If there is nothing opposing this movement, the ball would roll indefinitely without stopping. However, the ball does finally stop because there is a force called friction between the ground and the ball, that counters the ball's movement, making it lose speed and eventually stop.





Friction, also called attrition, is an example of a dynamic damping system.





Another example is the resistance faced by a car. The resistance is the result of the rolling friction of its tyres and the air resistance.

Damping effect in liquid environments is called viscous damping.

Why is damping important?

Damping is a way to limit vibrations and is essential for protecting the system as a whole.

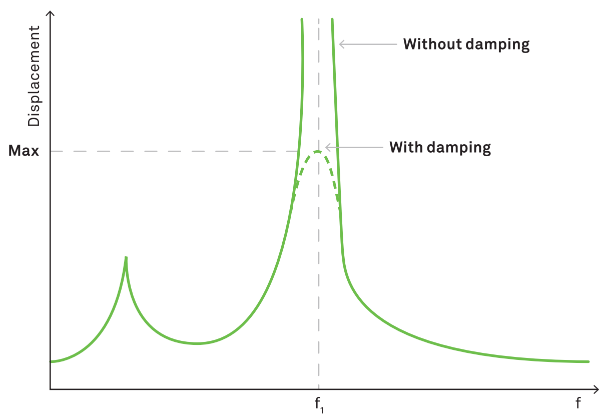
This is what happens with the spring hinges of a door or drawer, where damping prevents major impact when they are opened/closed, preserving them and protecting the system. On a large scale, bridge deck damping systems have the same purpose.

Supposing there is a dynamic energy affecting a building or a structure at a certain frequency which is similar (or close) to the natural frequency of this structure, what could happen? In theory the overlapping frequencies of exciting force (disturbing frequency) and natural frequency lead to increasing amplitudes of the vibration, which is called the resonance effect. This resonance effect in real life may cause the collapse of the entire integrity of the structure.

To avoid situations of resonance effect, various solutions have been studied, two main measures are part of the vibration isolation concept:

- changing the structure's natural frequency, altering the load and its distribution, ensuring a sufficient gap between the natural frequency of the structure (f_0) and the exciting disturbing frequency (f_n). Typical incoming dynamic forces which can lead to disturbing frequencies are dynamic loads or wind effects;
- adding damping characteristics ensures that even under resonance circumstances, the stability of the structure. It contributes to the loss of energy when in resonance.

Transmission function



Vibration control

It is often thought that vibration control can be achieved "just by adding some rubber" to the system, to isolate the structure. However, introducing a resilient component without taking the system's characteristics into consideration (surrounding atmosphere, temperature, material's rigidity, load of, and on, the structure, contact area, material transmissibility, material form factor, excitation frequency, etc.) can even have the opposite effect and increase displacements.

Transmissibility: mass, rigidity and damping

An insulation system's performance is determined by its transmissibility, i.e. by the ratio between the energy introduced to the system and the energy leaving the system. Vibration control material is selected considering the placement of the system's disrupting frequency in the insulation area. Additionally, the insulation system's damping volume will determine the system's peak transmissibility level (f_n). As damping increases, the peak value decreases.

The dynamic response and the transmissibility of a structure are essentially determined by their mass and rigidity properties, responsible for the energy remaining in the system, and by the damping, which determines energy loss in the system.

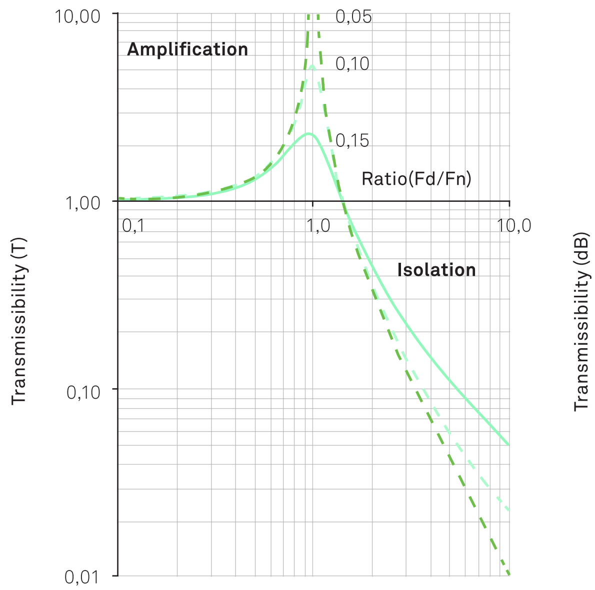
Of these three characteristics, damping is the least understood and the most difficult to predict and measure. Mass and rigidity are easier to understand and measure as they can be determined using static measurements.

Many vibration problems can be addressed using a simple physical model, known as the spring-mass system. If the mass is disturbed from the equilibrium position by a brief external force, it will have a natural frequency of f_0. The range of this vibration disappears over time, based on the spring damping function, described as the mechanical loss factor (η).

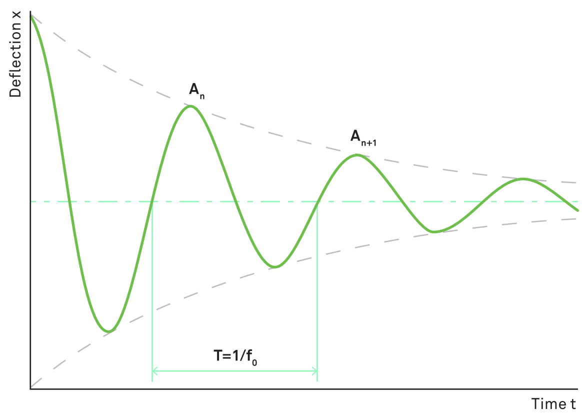
Damping can be measured by:

→ vibration range reduction in the resonance phase;
→ temporal variation in free vibrations;
→ spatial reduction of forced vibrations.

Degree of transmission



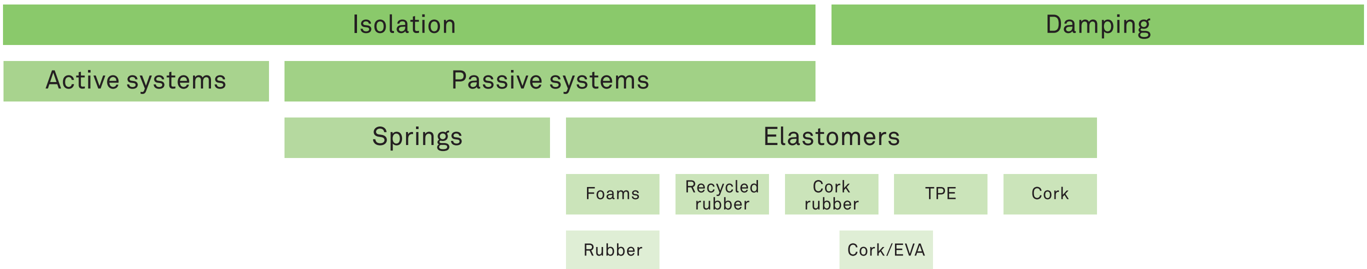
Fading behavior of a free vibration displacement x



Cork as a damping material

Due to its closed, cellular structure, filled with air, cork has a higher loss factor than rubber, which is essential for damping and consequent energy dissipation.

Our specific polymer formulations and the addition of cork, with its unique compressibility and recovery features, enhance the material's high loss factor.



The Acousticork Vibration Isolation range from Amorim Cork Composites offers solutions with an excellent compromise between damping and insulation.

Acousticork range mechanical loss factor (η)

Material	Loss Factor (DIN 53513)*
Acousticork VC1001	0.15
Acousticork VC1002	0.13
Acousticork VC1003	0.16
Acousticork VC1004	0.16
Acousticork VC1005	0.10
Acousticork VC1006	0.14

* Temperature, frequency and load dependent

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AMORIM CORK COMPOSITES
Rua de Meladas, 260 - P.O. Box 1
4536-902 Mozelos - VFR
Portugal
T. +351 22 747 5300
F. +351 22 747 5301
E. acc@amorim.com

www.amorimcorkcomposites.com