



ROAD SAFETY BARRIERS: STANDARDS, TECHNOLOGY, AND APPLICATIONS

MACCAFERRI

 **TUBOSIDER**



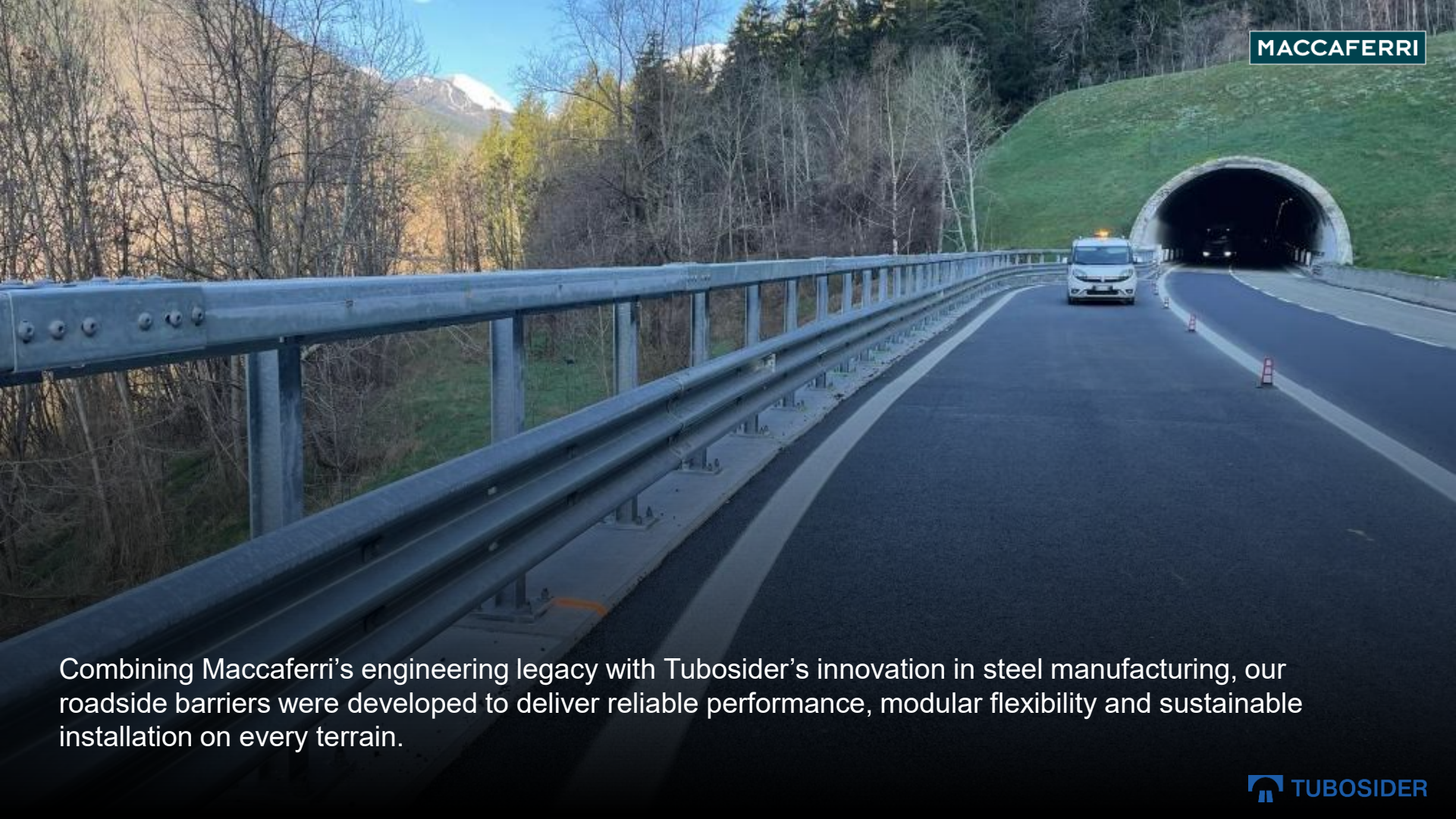
- 5' Introduction
- 15' Normative Frameworks
- 15' Our Portfolio
- 5' Conclusions

Live Q&A

Speakers: *Anisur Rahman – Business Developer DT Business Unit at Maccaferri*
Riccardo Gambarino– Technical Director at Tubosider



As infrastructure projects evolve, there is a growing need for roadside safety solutions that are faster to install, adaptable to variable terrains, and cost-efficient.

A photograph of a two-lane asphalt highway in a mountainous region. On the left side of the road, there is a long, continuous roadside barrier made of galvanized steel beams and posts. The road curves to the right and leads into a dark tunnel entrance. A white car is driving away from the camera towards the tunnel. The surrounding landscape includes bare trees on the left and a grassy embankment on the right. In the background, snow-capped mountains are visible under a clear blue sky.

Combining Maccaferri's engineering legacy with Tubosider's innovation in steel manufacturing, our roadside barriers were developed to deliver reliable performance, modular flexibility and sustainable installation on every terrain.



With **over 140 years** of engineering heritage, Maccaferri brings **global expertise** in geotechnical and infrastructure solutions.

Tubosider, part of the **ASTM Group**, brings **more than 60 years of experience** in safety systems and steel structures. Renowned for its know-how in road safety barriers, Tubosider is a trusted name in infrastructure engineering.

Together, they combine deep technical expertise and innovative design to deliver high-performance, certified road safety solutions. This partnership brings strength, reliability, and engineering precision to the development of restraint systems that meet the highest standards of safety and durability.

ROAD SAFETY BARRIERS

MACCAFERRI

Designed for Safer Roads

Road restraint systems are **passive safety solutions** engineered to absorb impact energy and help prevent vehicles from veering off the road. Their purpose is to limit the consequences of an accident, making everyday travel safer for all road users.

According to European data, a **well-designed** and **properly installed** system can reduce the severity of side-impact crashes by up to **70%**—a significant improvement in road safety.

To ensure their effectiveness, these systems must be installed and maintained in line with the **manufacturer's specifications**. This requires close cooperation among all stakeholders, including designers, contractors, and project owners.

Effective solutions, built for real-world safety.



To place a safety barrier on the market, the manufacturer must comply with two key regulatory frameworks:

- **European Legislation:** CEN Standards – **EN 1317** series
- **National Requirements:** Country-specific regulations and application rules

The EN 1317 standards define **harmonized procedures** for testing and assessing the **performance of road restraint systems**, but they intentionally do not specify how or where these products should be used on the road network.

That responsibility lies with **each individual country**, which defines its own technical requirements and application criteria based on local road safety policies and infrastructure needs.



European Legislation: CEN Standards – EN 1317 series

EN 1317 is a European standard that defines the performance requirements and testing methods for road restraint systems, such as safety barriers, terminals, and crash cushions.



It includes:

Classification of performance levels (e.g. containment level, working width, impact severity)

Crash test procedures to evaluate how systems behave under real vehicle impacts

CE marking requirements, including:

- Full-scale crash testing (ITT)
- Factory Production Control (FPC)
- Certification by a Notified Body (CPR)
- Declaration of Performance (DoP)

CE marking requirements

- **Full-scale crash testing (ITT – Initial Type Testing):** Verification of the barrier's performance through **complete crash tests**, simulating real accident conditions to assess containment, redirection, and severity levels. It's the fundamental proof of the product's compliance with harmonized standards.
- **Factory Production Control (FPC):** A permanent internal control system implemented by the manufacturer to ensure that every unit produced maintains the same performance as the tested prototype. It includes material checks, process monitoring, and traceability.
- **Certification by a Notified Body (CPR – Construction Products Regulation):** An independent third-party assessment performed by a designated Notified Body, which verifies both the crash test results and the effectiveness of the Factory Production Control in compliance with the EU Construction Products Regulation.
- **Declaration of Performance (DoP):** A formal document issued by the manufacturer, stating the product's declared performance based on test results and certification. It ensures transparency and allows the product to be legally placed on the EU market with the CE mark.



Local Legislation

The EN 1317 standards define **harmonized procedures** for testing and assessing the **performance of road restraint systems**, but they intentionally do not specify how or where these products should be used on the road network.

That responsibility lies with **each individual country**, which defines its own technical requirements and application criteria based on local road safety policies and infrastructure needs.

With **our technical support**, we help customers choose the most suitable barrier solution for their specific conditions. Our portfolio includes **several systems designed to meet the requirements of international clients**, covering all containment levels and installation scenarios.



Key Performance Parameters & Certification

Manufacturers must declare the barrier's ability to:

- Contain and **redirect vehicles**
- **Minimize injury risks** for light vehicle occupants
- Ensure long-term **durability**

These characteristics are verified through **crash tests**, mandatory for all road safety barriers, which assess:

- **Impact severity** (for light vehicles)
- **Containment and redirection** (for light and heavy vehicles)



Containment Levels of Road Restraint Systems

Containment level defines the barrier's ability to **contain and redirect different type of vehicles of different masses**, speeds and impact angles during a crash.

It is a fundamental performance criterion assessed during **full-scale crash testing**.

Common Containment Levels (according to EN 1317-2) are:

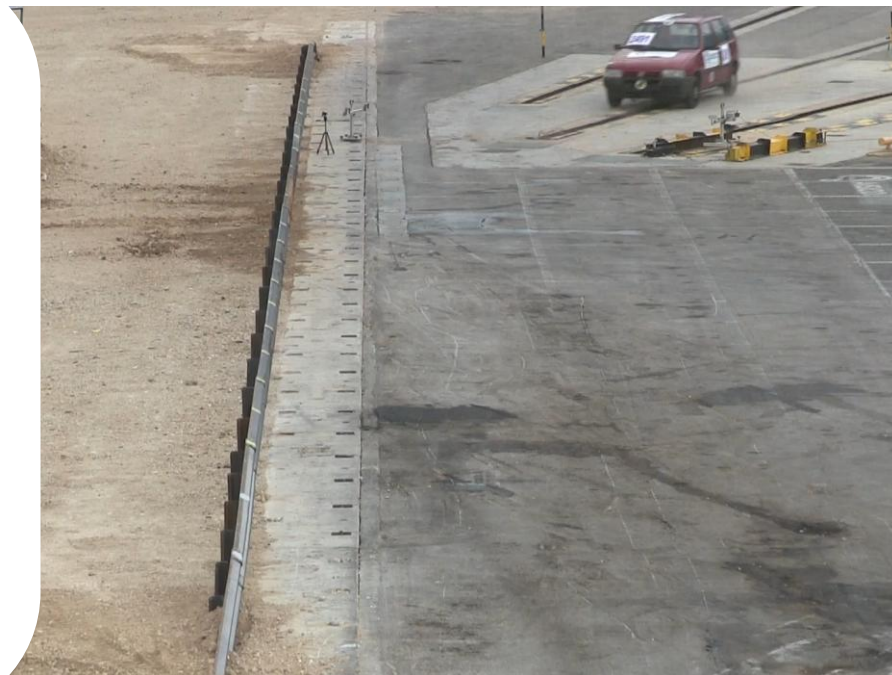
N1 / N2 – Normal containment (cars and small vehicles)

H1 / H2 / H3 – High containment (including medium to heavy vehicles)

H4a / H4b – Very high containment (heavy trucks)

Each level corresponds to specific test vehicles, impact speeds, angles, and give measured performance outcomes.

A higher containment level **does not always mean better**, but rather **suitability for the specific road environment** (e.g., urban roads, highways, bridges, tunnels).



Crash Test Metrics

Crash testing **defines** critical deformation and safety metrics:

Working Width (W): Lateral distance of the front of the barrier from pre-impact position to maximum barrier displacement

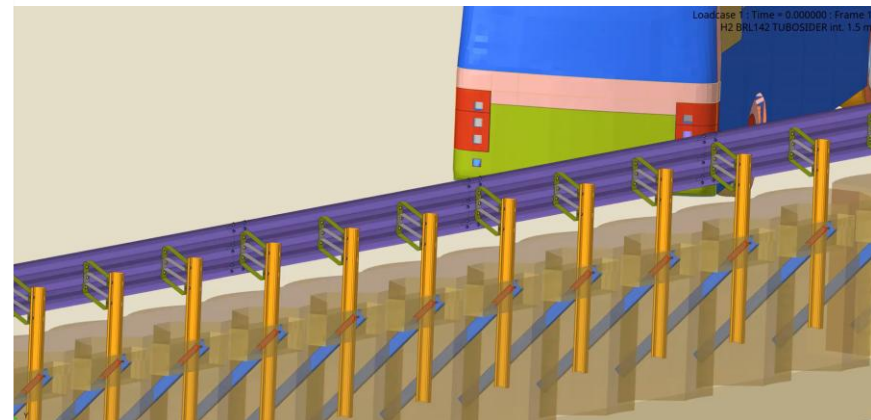
Dynamic Deflection (D): Maximum lateral movement of the front of the barrier during impact

Vehicle Intrusion (Vi): Maximum dynamic position of the vehicle during the impact

ASI (Acceleration Severity Index): Measures impact severity on occupants

Wn, Dn, Vin: Standardized indices used for comparison and classification

These parameters do not represent the real performance of the barrier on the roads, which will practically never be those recorded in the test field, but they provide the values necessary for comparing the different restraint systems.



CE marking requirements

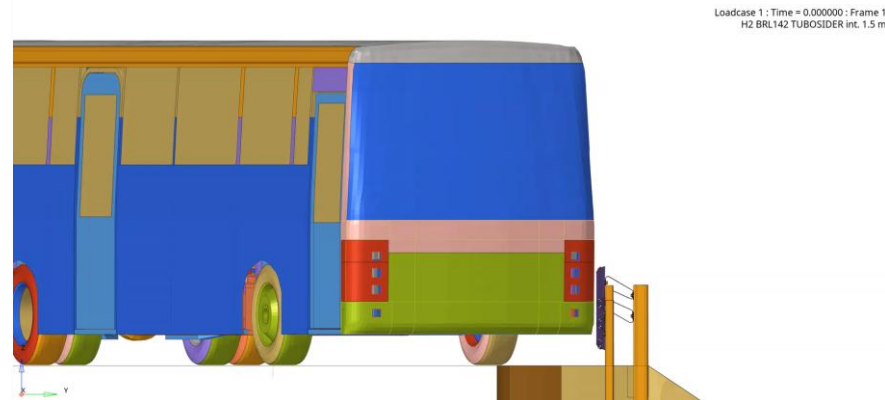
- **Full-scale crash testing (ITT – Initial Type Testing):** Verification of the barrier's performance through complete crash tests, simulating real accident conditions to assess containment, redirection, and severity levels. It's the fundamental proof of the product's compliance with harmonized standards.
- **Factory Production Control (FPC):** A **permanent internal control system** implemented by the manufacturer to ensure that every unit produced maintains the same performance as the tested prototype. It includes material checks, process monitoring, and traceability.
- **Certification by a Notified Body (CPR – Construction Products Regulation):** An **independent third-party assessment** performed by a designated Notified Body, which verifies both the crash test results and the effectiveness of the Factory Production Control in compliance with the **EU Construction Products Regulation**.
- **Declaration of Performance (DoP):** A **formal document issued by the manufacturer**, stating the product's declared performance based on test results and certification. It ensures transparency and allows the product to be legally placed on the EU market with the **CE mark**.



- Our production cycle includes **strict quality checks at every stage**
- Finished systems undergo **field tests** in line with all applicable standards
- Tests are carried out by **internationally accredited bodies**

With **over 500 crash tests** conducted, our systems are validated under a wide range of conditions.

This commitment ensures **high standards of safety, compliance, and durability**.





500+



140+



500k+



OUR BARRIERS

MACCAFERRI

What sets us apart



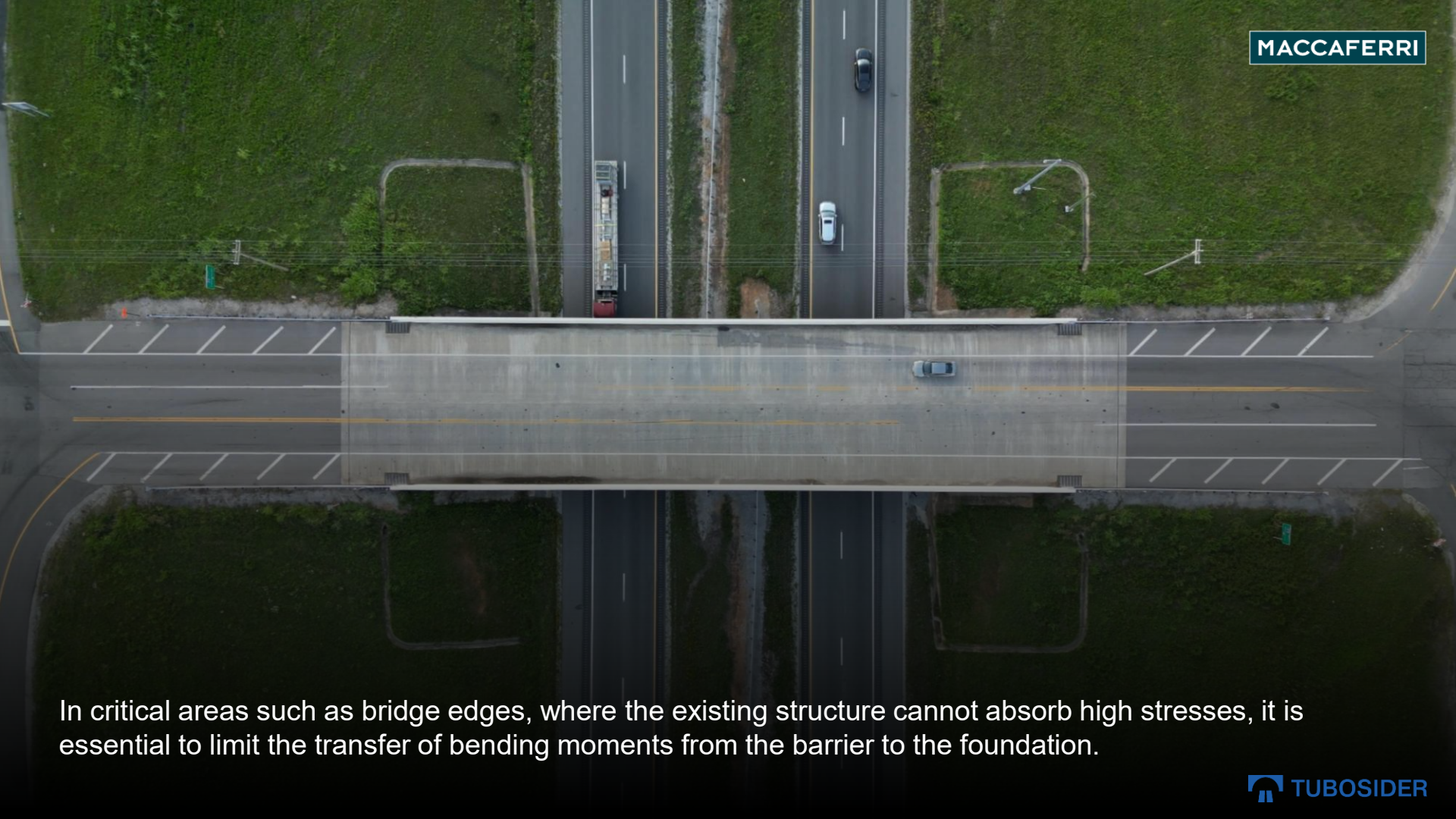
We have a full portfolio with over 140 CE marked barriers for every need

Among our complete portfolio some of our most unique features are:

Lo.S.T.

A.To.S

**Barriers on slope
embankments**

An aerial photograph showing a concrete bridge spanning a multi-lane highway. The bridge has a light-colored concrete deck and a metal barrier along its edges. Several vehicles are visible on the highway: a white car on the bridge, a white car on the right lane, a dark car on the right lane, and a semi-truck on the left lane. The highway is flanked by green grassy areas with some utility poles and wires. The image is used to illustrate the concept of limiting bending moment transfer from the bridge barrier to the foundation in critical areas.

In critical areas such as bridge edges, where the existing structure cannot absorb high stresses, it is essential to limit the transfer of bending moments from the barrier to the foundation.



For this reason, **Maccaferri and Tubosider developed Lo.S.T.**—a parapet system specifically engineered to minimize stress transmission, while ensuring certified performance and maximum safety.

Low Stress Transfer Vehicle Parapet

Lo.S.T. is a parapet system equipped with a high-performance anchoring mechanism, engineered to transfer very low shear and bending moment forces to the foundation with precision:

- **Moment:** 14 kNm
- **Shear:** 69 kN

These values were determined through full-scale crash tests and validated via computational mechanical analysis.



Controlled Energy Dissipation Mechanism

The uniqueness of the system lies in its **ability to regulate the progressive collapse of the posts**, thereby **absorbing energy without directly transmitting it** to the anchoring dowels and foundation.

The mechanism relies on two key components:

- A specially **designed base plate**, which allows for controlled rotation of the post in both transverse and longitudinal directions;
- A **energy dissipation system** (so-called fuse) which opposes and slows the rotation of the base plate.

This gradual base plate deformation, triggered by the fuse system, results in **significant energy dissipation**, greatly reducing stress on the dowels and the foundation. As a result, the foundation can be designed for lower load levels than those specified by EN 1991-2 for horizontal forces transmitted by restraint systems.



Certified Performance and Versatility



The **Lo.S.T.** barrier has undergone Initial Type Testing (ITT) crash tests in accordance with the EN 1317 standard, achieving the following performance classifications:

Containment Level: H2

Impact Severity Level: B

Working Width Class: W4

Vehicle Intrusion Class: VI4

A version with a high containment class H4 is also being tested, intended for bridges and viaducts with high levels of heavy traffic.

Lo.S.T. and its anchoring system are protected by patent. The anchoring solution can be customized to suit a wide variety of parapet and foundation configurations, offering flexibility alongside high safety performance.

OUR BARRIERS

MACCAFERRI

What sets us apart



We have a full portfolio with over 140 CE marked barriers for every need

Among our complete portfolio some of our most unique features are:

Lo.S.T.

**Barriers on slope
embankments**

A.To.S

A photograph showing a metal safety barrier installed on a steep, grassy embankment. The barrier is made of grey metal posts and rails. The embankment is covered in green grass and some yellow wildflowers. In the background, a valley with a dirt road and some buildings is visible. The sky is clear and blue.

Safety barriers are usually crash-tested on flat, compacted ground, but in reality, they're often installed on narrow, weak embankments. These conditions can prevent the correct formation of the plastic hinge, leading to unpredictable performance compared to certified tests.



Maccaferri and Tubosider developed CE certified barriers systems that ensure reliable performance even on weak and geometrically limited embankments.

The Challenge of Installing Safety Barriers on Embankments

Real-world vs. Test Site Conditions

Unlike standardized crash tests typically performed on flat, compacted terrain, actual road environments often involve **narrow, low-consistency embankments**, which significantly affect the performance of safety barriers.

Key Issues Identified:

Geometry: Test setups use ideal flat terrain behind the barrier. In reality, barriers are frequently installed on embankments that are geometrically limited and inconsistent.

Soil Consistency: In soft or inconsistent soils, the plastic hinge (a key deformation mechanism) **may not form**, compromising the barrier's performance. On stiffer soils, the plastic hinge forms at a specific depth, closely matching crash test conditions.



BARRIERS ON SLOPE EMBANKMENTS

MACCAFERRI

The Challenge of Installing Safety Barriers on Embankments

Design Challenge:

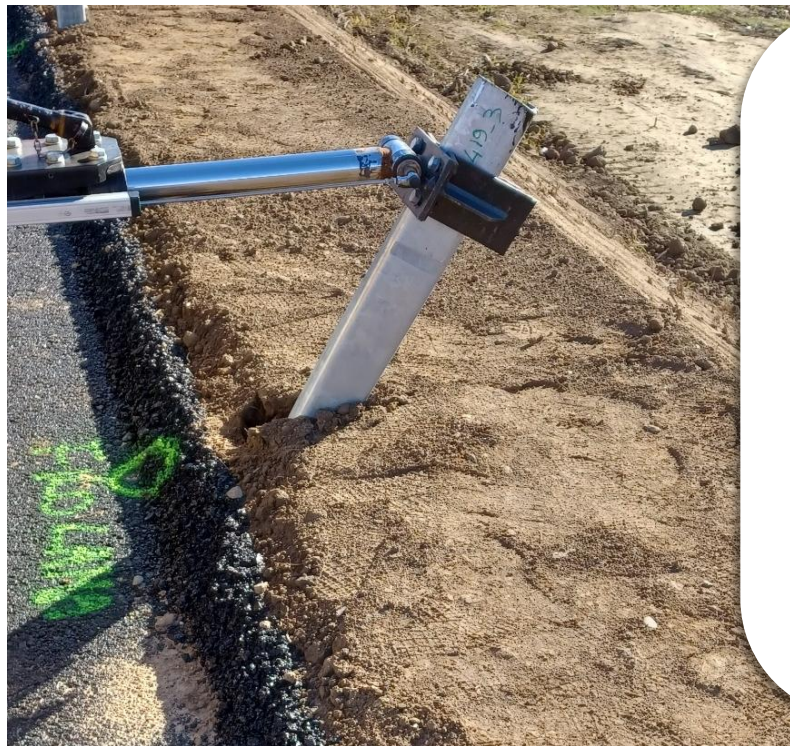
How can designers ensure the **barrier system behaves in real conditions** as it does in certified crash tests?

Our Approach:

To address this complex issue, **Maccaferri and Tubosider** joined forces to develop a solution tailored to these real-world conditions. This includes an innovative range of **barrier systems and complementary stabilization elements** specifically designed for use on weak or geometrically constrained embankments.



Available Design Strategies



Ground Reinforcement (Rehabilitation):

- Rebuilding the support terrain to replicate test field conditions.
- Drawbacks: Often requires long construction times, high costs, and causes major traffic disruption.

Use of Devices Tested on Poor Embankments:

- Some safety systems have been tested specifically on narrow, weak embankments.
- Limitation: Their performance is often lower and more variable than that of standard devices tested on flat, compacted terrain.

Enhanced Anchoring Systems (e.g., ATOS Anchors):

- The most effective solution is the use of auxiliary anchors that restore or compensate for the lack of bearing capacity in poor soils.
- These components help replicate the mechanical behavior observed in standard crash tests, without needing to modify the terrain.

OUR BARRIERS

MACCAFERRI

What sets us apart



We have a full portfolio with over 140 CE marked barriers for every need

Among our complete portfolio some of our most unique features are:

Lo.S.T.

**Barriers on slope
embankments**

A.To.S



Devices installed alongside road or railway infrastructure are often positioned on **weak or unstable soils**. This condition can compromise their **performance**, especially in the case of **safety or integrated barriers**, and may also require extensive and costly foundation works, as commonly seen with gantries and vertical signage.



For this reason, the A.To.S. system was developed—to **ensure to road safety systems reliable performance** even on weak soils, while **minimizing the need for heavy and costly foundation works**.

Anchorage Tool for Soils

A.To.S. is a system specifically developed to support **barrier posts and vertical structures** installed on **weak or low-consistency soils**, while still achieving the same performance levels as installations on high-strength subgrades.

It works by **transferring the stresses**—caused by horizontal crash loads—from poor soils **to adjacent areas with better mechanical characteristics**, such as road pavement layers.

This enhances the structural response and **reduces reliance on traditional vertical anchorage**, leading to **lower rehabilitation/reconstruction of the embankment and installation costs**.





150+
1000+
20+

FEM Analysis

Dynamic Test

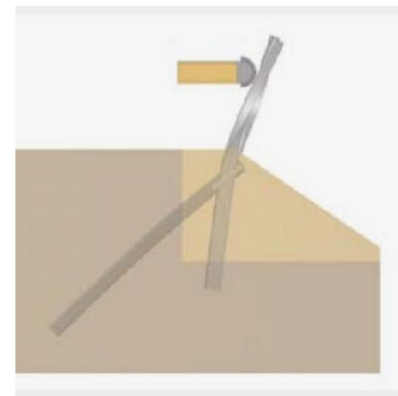
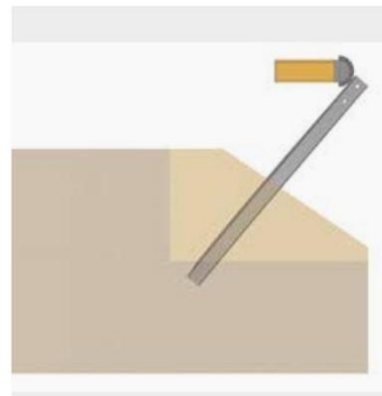
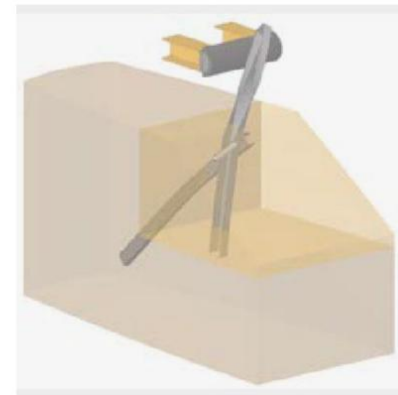
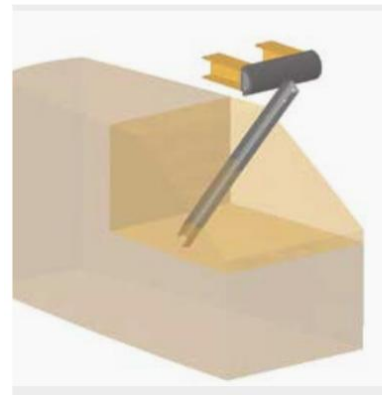
Crash Test

Versatile Applications and Cost Efficiency

The A.To.S. system is adaptable to a wide range of roadside and railway infrastructure, including:

- **Road Safety Barriers**
- **Integrated barriers**
- **Vertical signage**

Its adoption allows for the restoration of optimal performance conditions, even on compromised soils, while also avoiding expensive and invasive foundation works.



Key advantages:

A.To.S. stands out for several key advantages that demonstrate its effectiveness, practicality, and cost-efficiency in safety barrier applications. These advantages include:

- ❏ Ensures the **proper functioning of safety** and integrated barriers installed on weak or low-consistency soils.
- ❏ **Optimizes foundation design** for structures subject to horizontal loads, reducing the need for oversized or invasive solutions.
- ❏ **No disassembly required**: can be applied without removing any components of the existing devices.
- ❏ **Cost-effective solution** with low production and installation costs, requiring minimal site occupation.
- ❏ **No maintenance or replacement needed**, even after modest impacts on the supported devices.
- ❏ **No interference** with existing road pavement or underground utilities.
- ❏ **Proven performance**, validated through a comprehensive testing program, ensuring long-term functionality and reliability.

OUR BARRIERS

MACCAFERRI

What sets us apart



We have a full portfolio with over 140 CE marked barriers for every need

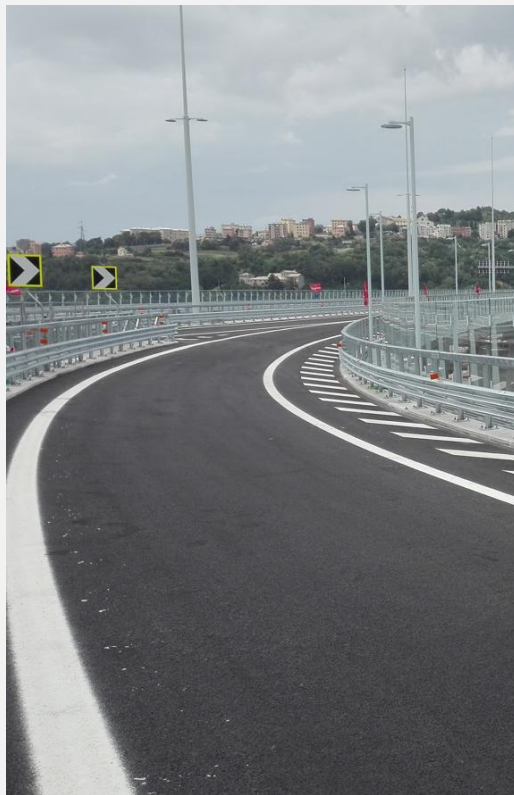
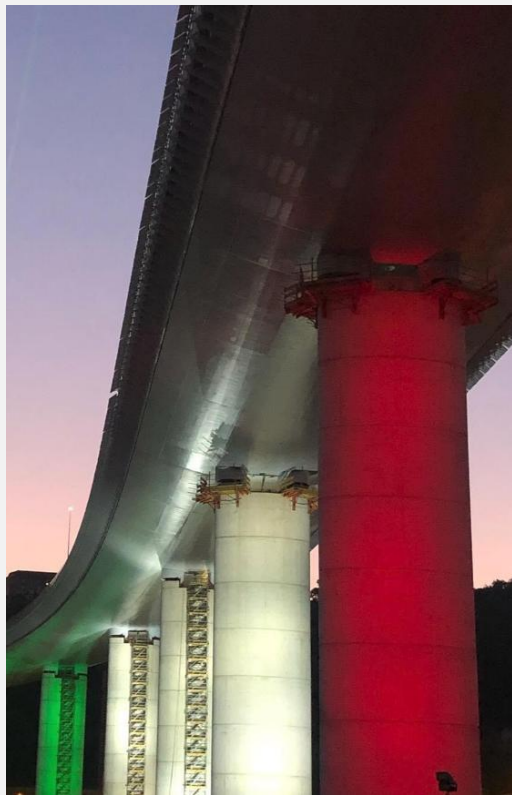
Our Success Stories



Customer: TUNISIE AUTOROUTES

Country: Tunisia

Site : AUTOROUTE GABES – Medenine – ras jedir



Customer: ASPI AUTOSTRADE PER L'ITALIA
Country: Italy
Site : Genova – San Giorgio Bridge



Customer: Itinera S.A. Tortona Sucursala Bucuresti

Country: Romania

Site : Varianta de ocolire a municipiului satu mare



Customer: M6 del epitesi kft / bilfinger berger civil
hungary kft / porr epitesi kft

Country: Hungary

Site : M6 Dunanjvaros – Skekszard Highway

CERTIFICATION

Beyond our CE mark

MACCAFERRI

Tubosider's goal is to deliver **high-quality, long-lasting, and cost-effective products**.

The company's Quality Assurance System has been certified according to **EN ISO 9001:2015** since 1994, reflecting its long-standing commitment to excellence.

In recent years, Tubosider has also achieved several additional certifications, further confirming its dedication to continuous improvement and industry standards.



Beyond our CE mark

A corporate Ethical Policy brings transparency, respect and accountability to our operations and interactions with clients.

Our products are certified in accordance with internationally recognised standards and we are members of key industry organisations.

The Environmental Product Declaration (EPD) certificate quantifies our environmental impact allowing us to perform accurate LCA



Tubosider is a recognized leader in R&D for road safety systems, with a dedicated division that collaborates with **top global experts** and **prestigious universities**. Every day, we drive **innovation** to improve safety for road users and ensure **infrastructure reliability**.

With a **dual mission**—enhancing the performance of existing products and developing **cutting-edge solutions**—we continuously set new benchmarks aligned with the latest **international standards** of quality and safety.





Do you need technical assistance?

Our engineers are always here to support you in designing and selecting the most suitable solutions for every type of project.

Q&A

Thank you

Officine Maccaferri S.p.A.

T: +39 051 6436 000

E: info.hq@maccaferri.com

maccaferri.com

 [Maccaferri](#)

 [MaccaferriWorld](#)

 [MaccaferriWorld](#)

 [MaccaferriWorld](#)

 [Maccaferriworld](#)