VERTICAL WALLS IN URBAN INFRASTRUCTURE

Date 14 June, 2022

MACCAFERRI

WEBINAR AGENDA

5’ *Introduction*

20’ *MacRes System: applications and solution features*

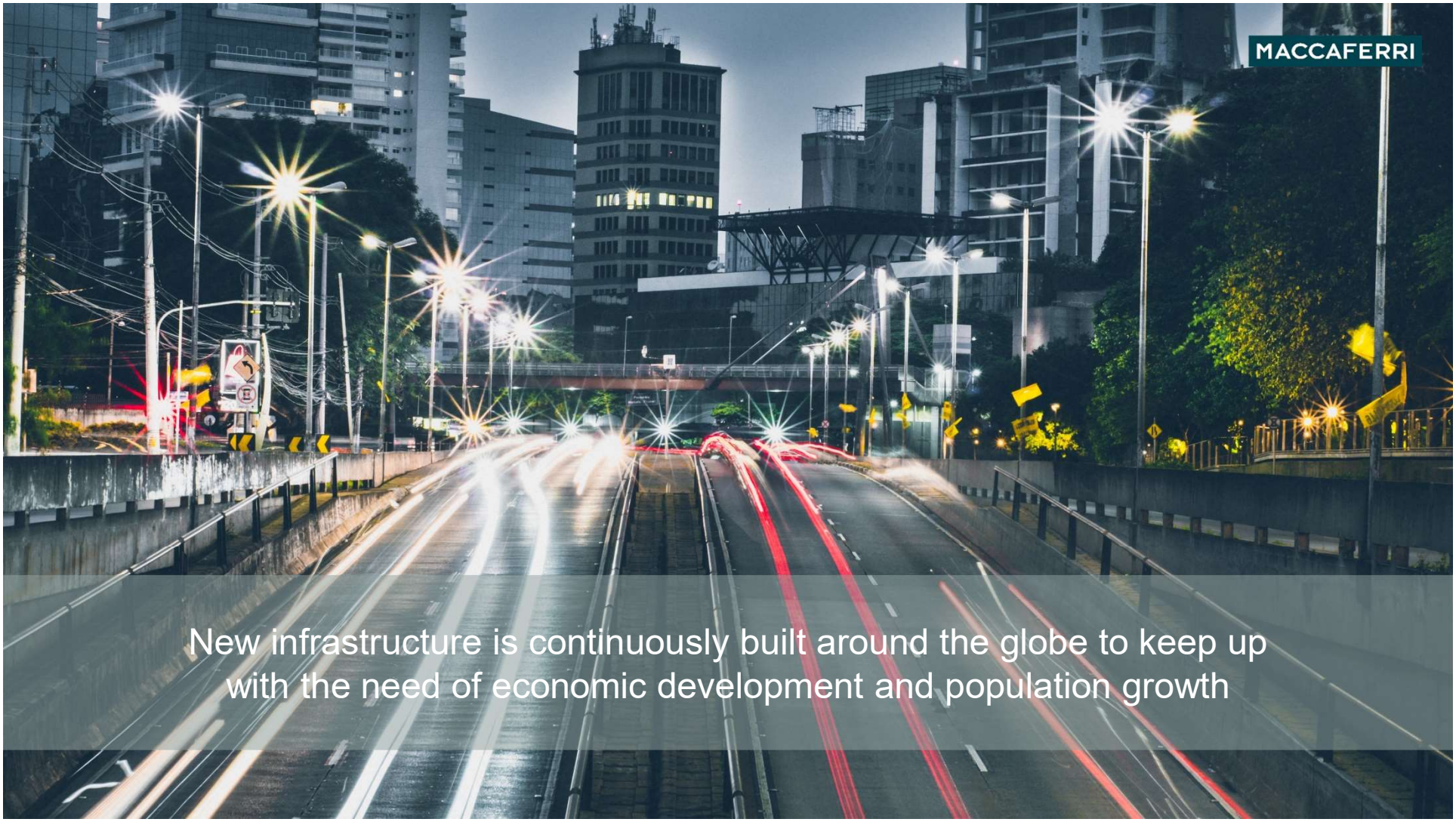
15’ *Design method and installation process*

Live Q&A Session

Speaker

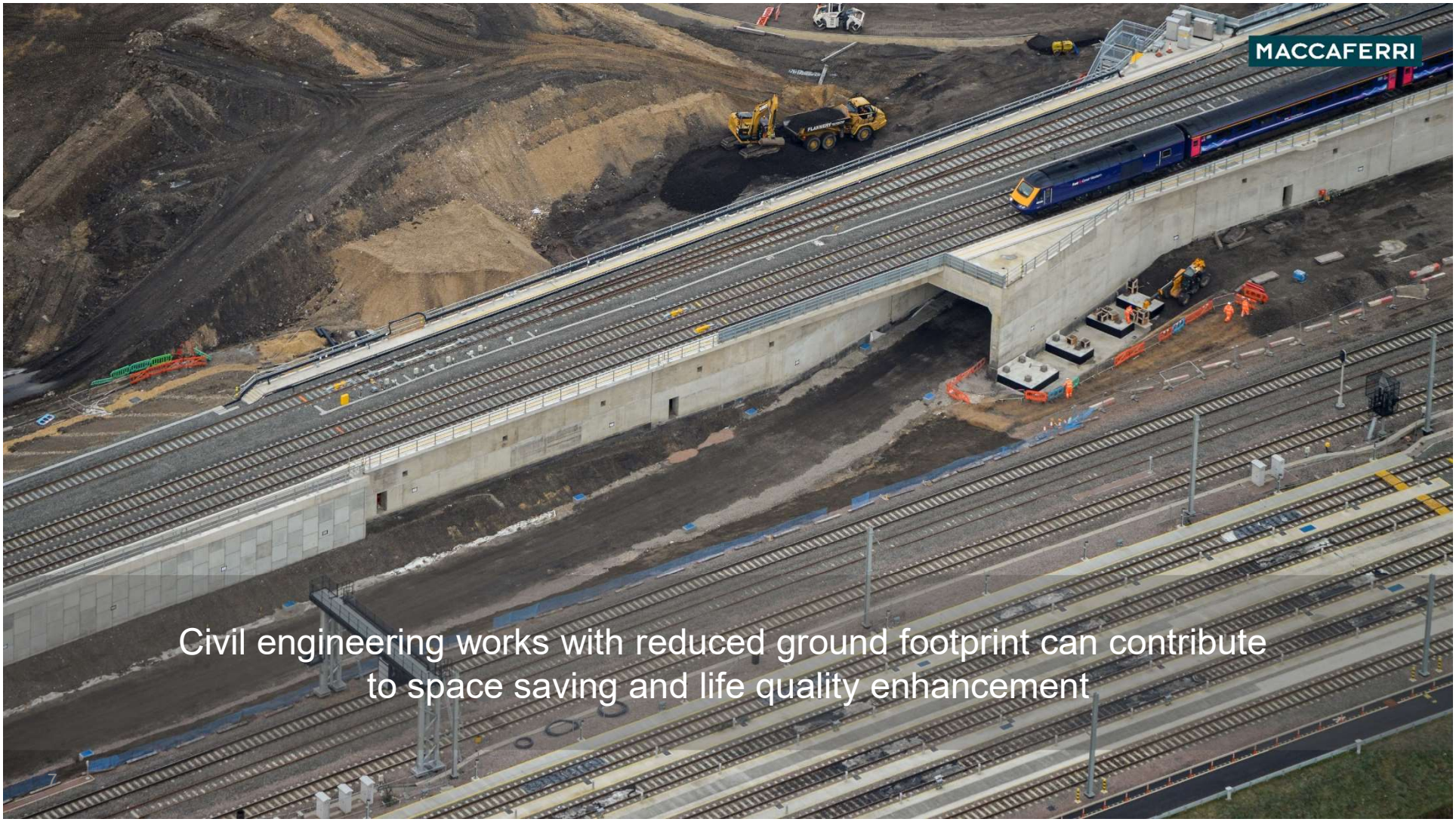
G. Lugli − Group Business Development GSY Unit


MACCAFERRI
Over the last few decades, the world has been urbanizing rapidly


MACCAFERRI
New infrastructure is continuously built around the globe to keep up with the need of economic development and population growth


MACCAFERRI
In the urban environment, space is a key resource
that is becoming more and more limited

This is the reason why the demand for vertical structures has been dramatically increasing over the past few years



Civil engineering works with reduced ground footprint can contribute to space saving and life quality enhancement

WHO WE ARE

Maccaferri at a glance

Sales in **100+** countries

Revenues ~ **500** M€

3,000+ employees

23 factories

60+ subsidiaries

RETAINING WALLS

We have a long-standing history and technical experience in the research, design and development of **retaining wall solutions**.

- MASS GRAVITY WALL
- REINFORCED FILL STRUCTURES
  - Vertical rock faced
  - Inclined rock faced
  - Vegetated Faced
  - Vertical Concrete Panels

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  - Vertical Concrete Facing with blocks for segmental walls

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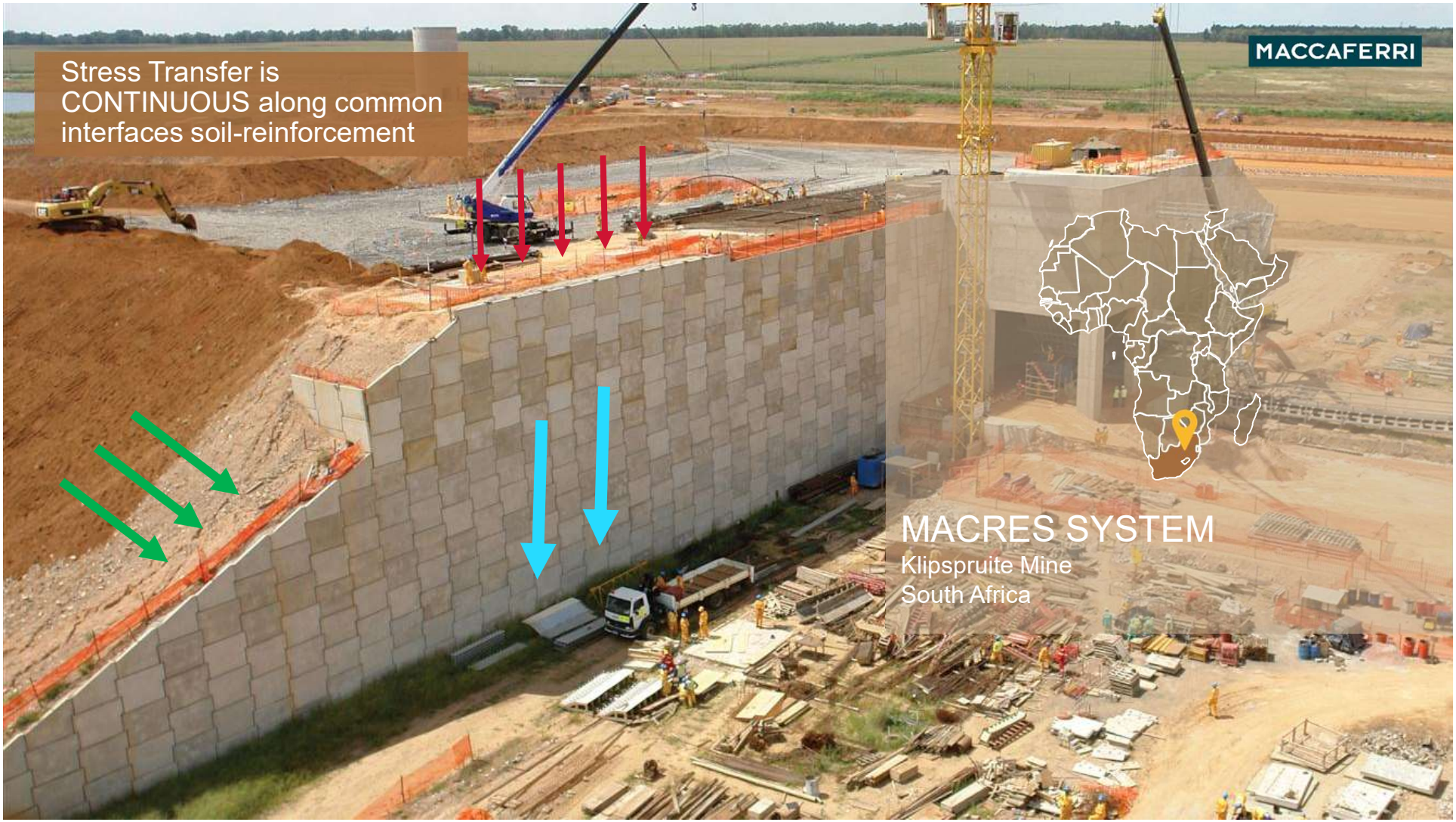
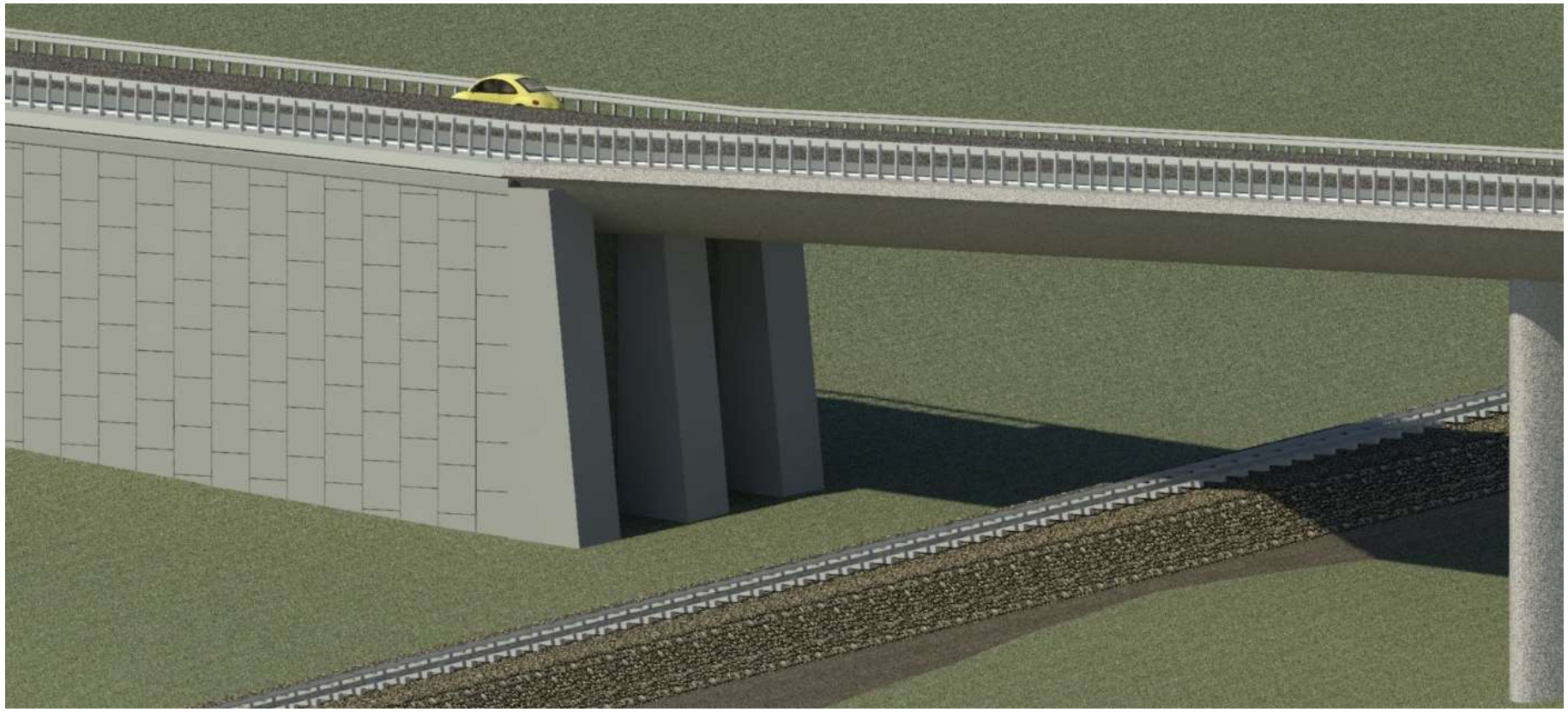
APPLICATIONS


MACCAFERRI
MACRES SYSTEM
South Ring Road
Sofia, Bulgaria


Stress Transfer is
CONTINUOUS along common
interfaces soil-reinforcement
MACCAFERRI
MACRES SYSTEM
Klipspruite Mine
South Africa

INFRASTRUCTURE IN LIMITED SPACE

MACCAFERRI

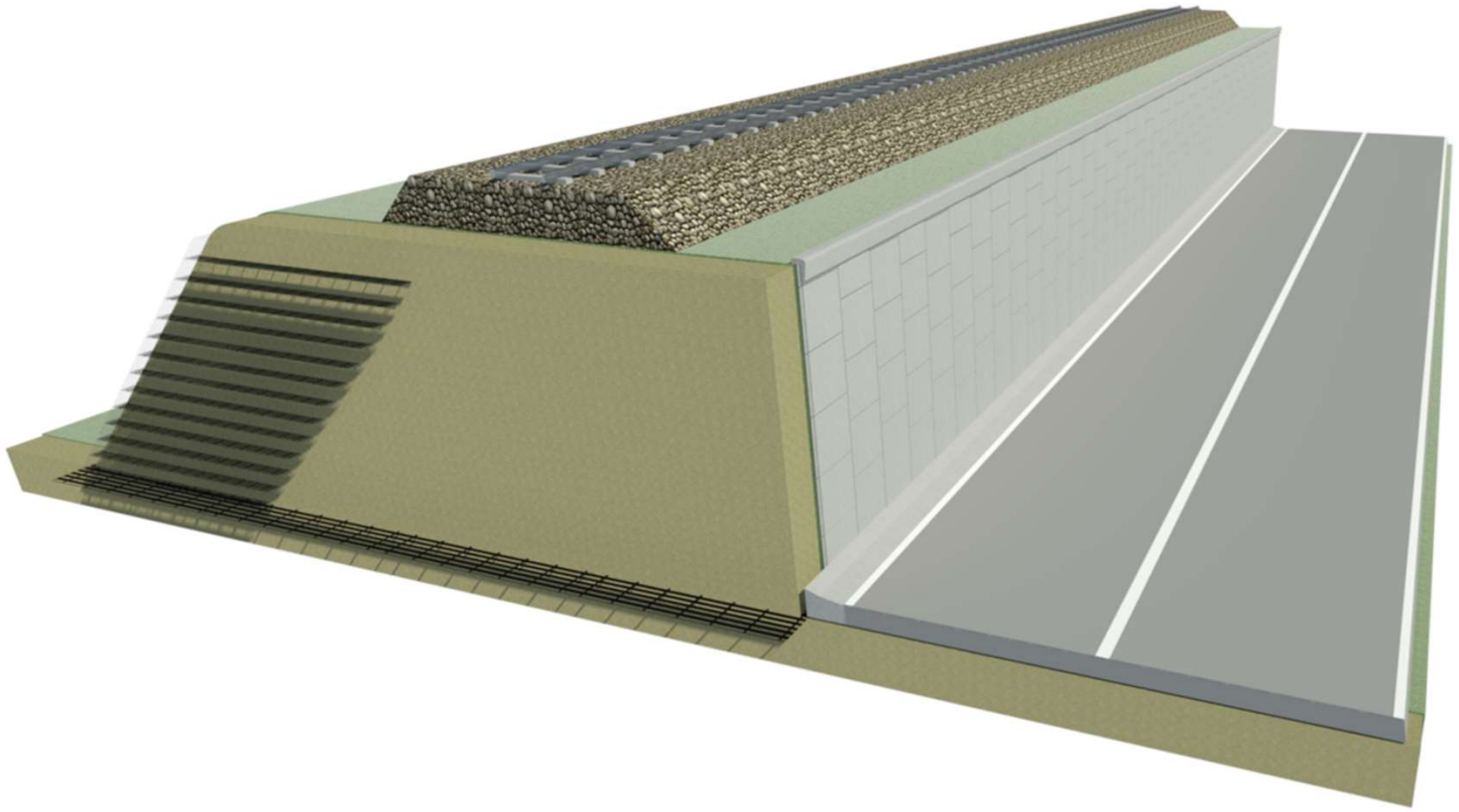



MACCAFERRI
MACRES SYSTEM
D1 Dubna Skala
Slovakia


MACCAFERRI
MACRES SYSTEM
D3 Svrcinovec
Skalite, Slovakia

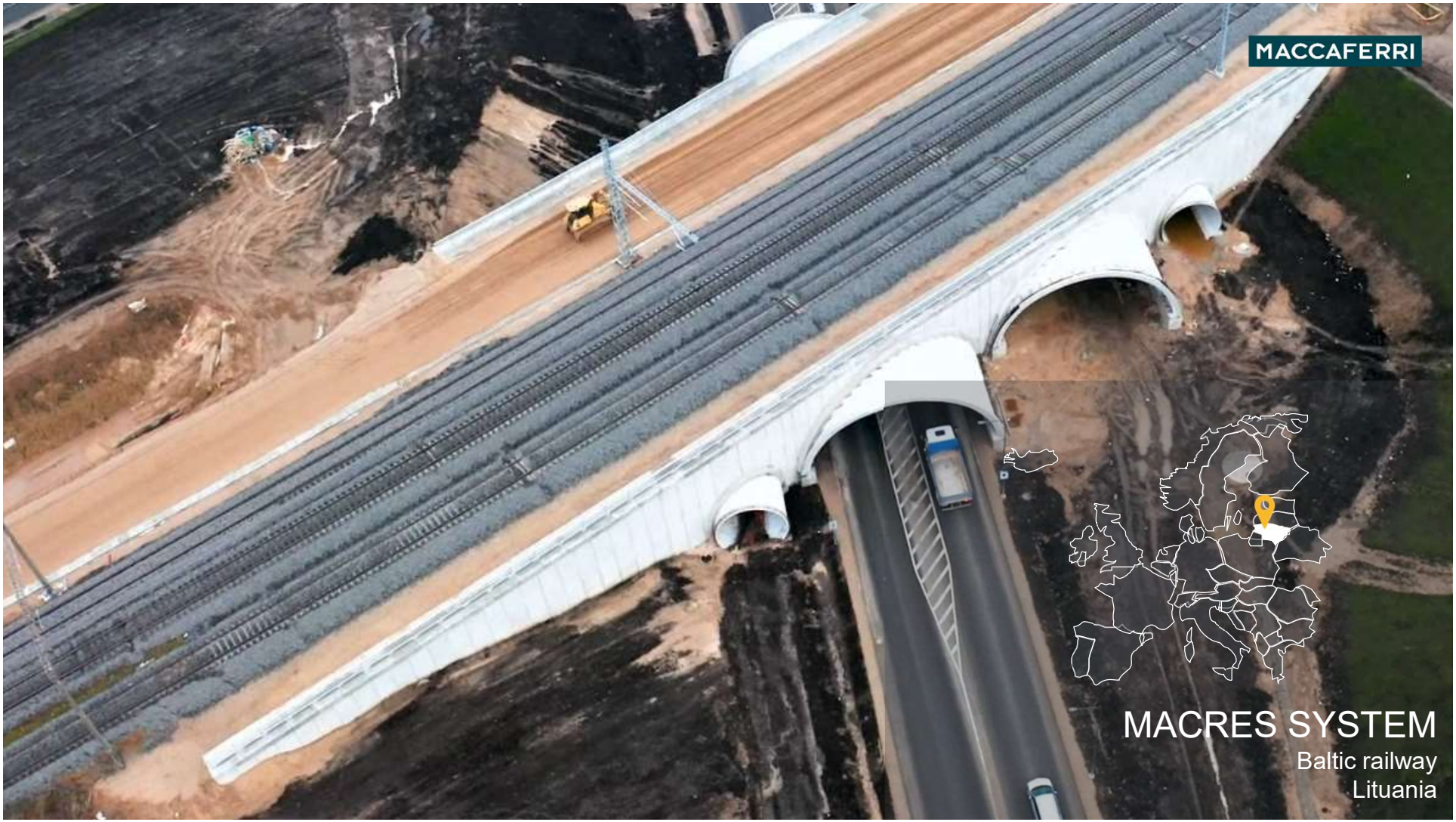
RAILWAY RELATED STRUCTURES

MACCAFERRI




MACCAFERRI
MACRES SYSTEM
Arluno, Italy

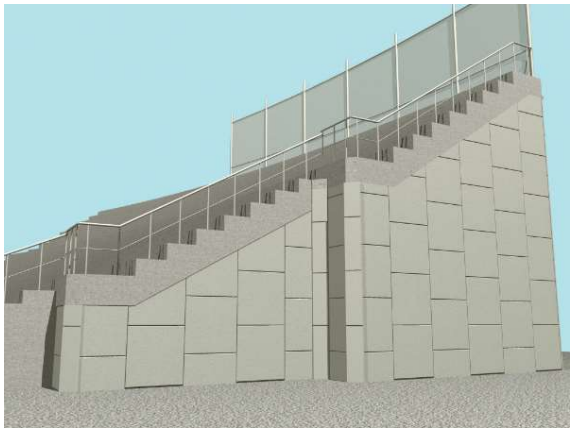

MACCAFERRI
MACRES SYSTEM
Supporting railway
Reading, UK

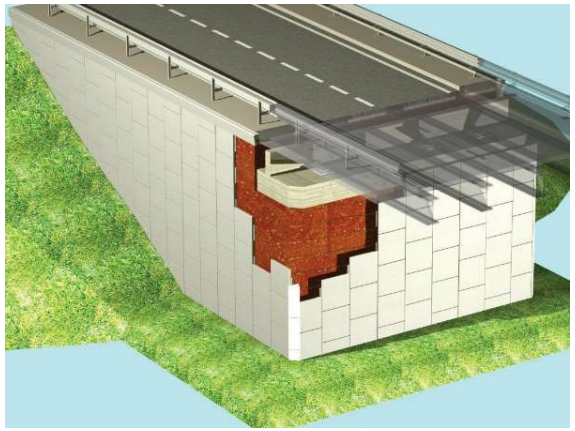

MACCAFERRI
MACRES SYSTEM
Baltic railway
Lituania

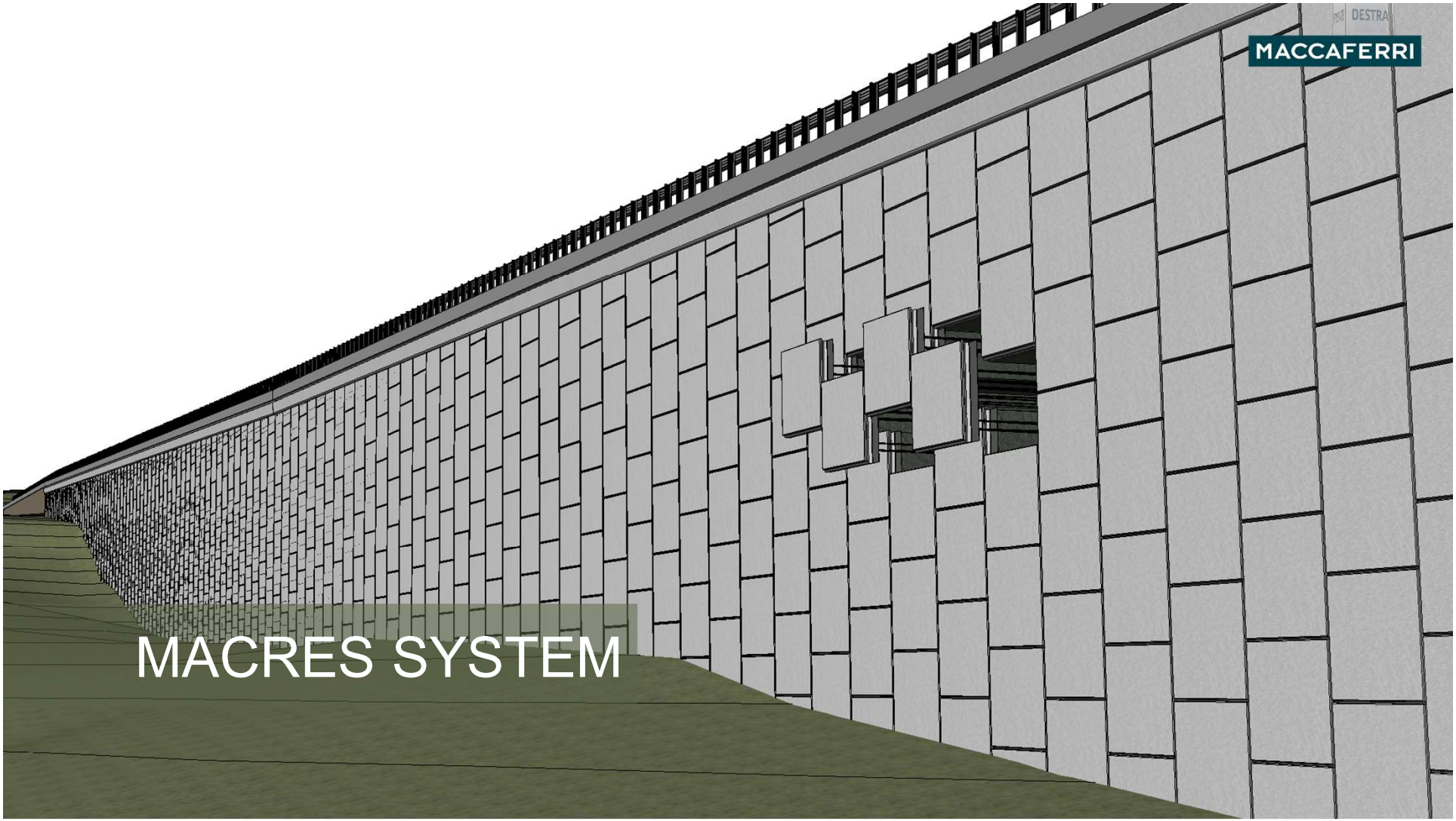
OTHER TYPICAL APPLICATIONS

MACCAFERRI

Other MacRes typical applications include:
culvert walls, tunnel portals and approaches, flood walls, waterfront structures, retaining walls for mining sector, etc.



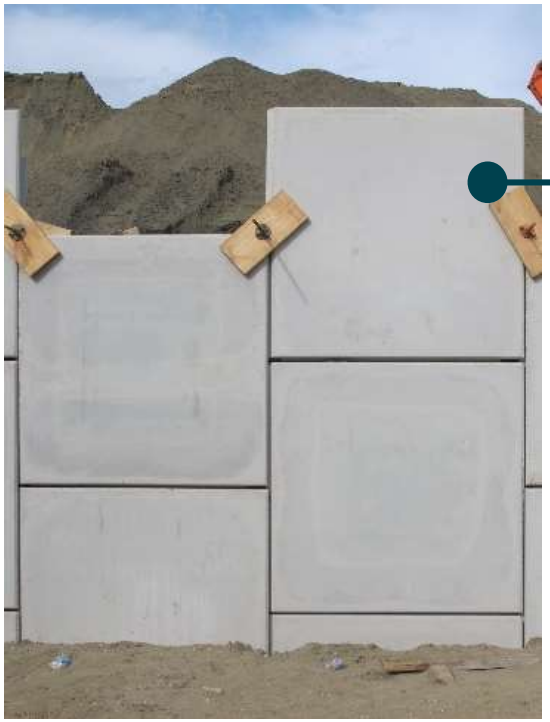




MACRES SYSTEM

MACRES SYSTEM

Behind the wall



CONCRETE PANEL

Concrete type ***depends on project specifications,*** but minimum requirements are:

- Class XF1 and XC4 (according to EN 206 or equivalent, resistant to rainwater and de-icing salts)
- Minimum compressive strength Rck at 28 days, >37 Mpa
- Geometric tolerances and finishing shall meet EN13369
- Minimum panel thickness is 14cm

MACRES SYSTEM

Behind the wall

CONCRETE PANEL (VARIANTS)

Several panels' geometries are available to meet finished elevation requirements

Corner elements are needed when bend ray is less than the one allowable by panels

The **top-course panel** can be capped with a precast coping to expedite the installation.

Panels can be also customized according to clients needs and on-site obstructions

MACRES SYSTEM

Behind the wall

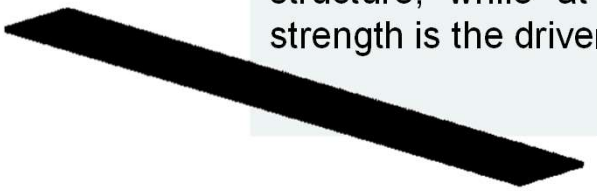
PARAWEB POLYMERIC STRIPS

Paraweb PET strips with LLDPE coating

Several strip types available to optimize the design – Paraweb M & 2

What is the difference?
Same materials but different thickness and width.

Why wider strips are needed?
Because the pullout is the critical failure mode for the first top layers of the MSE structure, while at the bottom, the tensile strength is the driven force.



MACRES SYSTEM

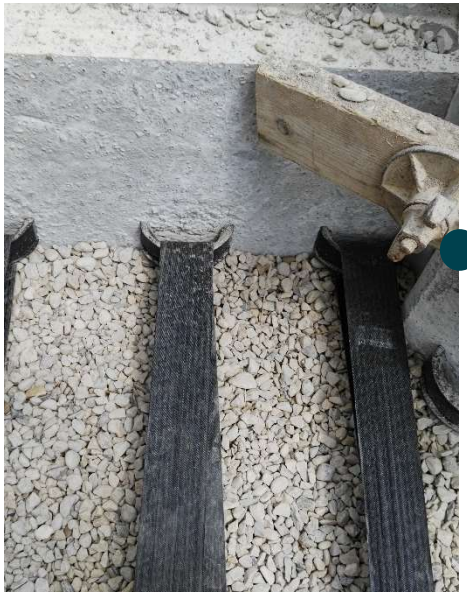
Behind the wall

GEOTEXTILE

- Geotextile strips shall cover the horizontal and vertical joints between panels
- The Nonwoven Geotextile shall meet the requirements for filtration applications as per national Standards and may vary according to the project specific requirements
- The purpose of the geotextile strip is to prevent the migration of fines from the reinforced wall fill
- Alternatively, GDC can be used allowing free drainage of the backfill.

MACRES SYSTEM

Behind the wall

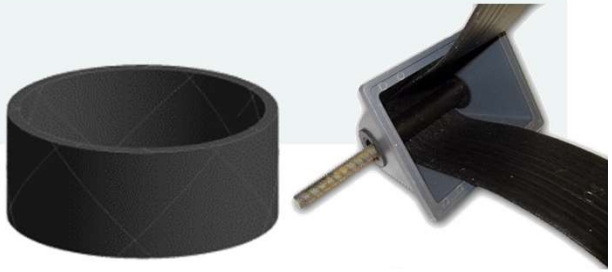


MACLOOP / MACBOX

MacLoop: loop made of paraweb strips, protected by a polymeric saddle for ease of installation.

MacBox: the insert is secured by a steel rebar embedded in the panel and protected by a polymeric sleeve

The strength of both connections has been determined through independent connection/pullout testing program

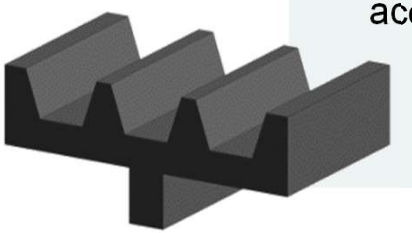


MACRES SYSTEM

Behind the wall

EPDM PAD

- Bearing pads are preformed EPDM rubber pads typically 2 cm thick
- Thickness, dimensions and stiffness is supported by laboratory testing and by design computations
- The purpose of the pad is to avoid concrete to concrete contact and to accommodate panels settlements




MACCAFERRI
MACRES SYSTEM
Anthwerp, Belgium
PARAWEB

PARAWEB

MACCAFERRI

Geostrip reinforcement

- Paraweb™ PET strips with LLDPE coating
- Rough surface which develops excellent friction
- Resistant to corrosion
- Several strip types available to optimize the design
- Durability tested up to 120 years
- Easy to be treated on site and ease of shipment
- International Certifications and Worldwide Experience
- Flexible and adaptable installation

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Corrosion of the wall reinforcement can ultimately lead to **failure of the structure**

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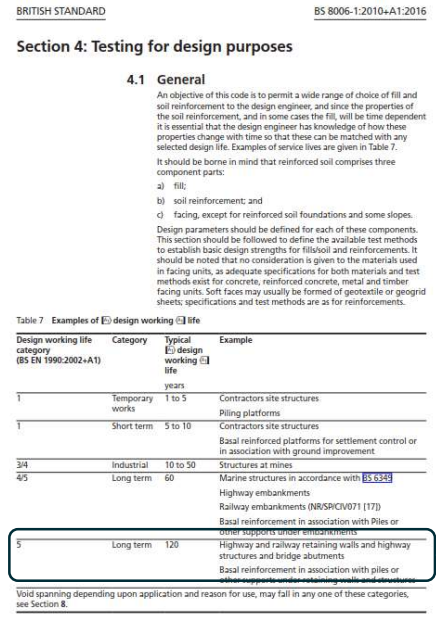

BRITISH STANDARD BS 8006-1:2010+A1:2016

Section 4: Testing for design purposes

4.1 General

An objective of this code is to permit a wide range of choice of fill and soil reinforcement to the design engineer, and since the properties of the soil reinforcement, and in some cases the fill, will be time dependent it is essential that the design engineer has knowledge of how these properties change with time so that these can be matched with any selected design life. Examples of service lives are given in Table 7.

It should be borne in mind that reinforced soil comprises three component parts:

a) fill;

b) soil reinforcement; and

c) facing, except for reinforced soil foundations and some slopes.

Design parameters should be defined for each of these components. This section should be followed to define the available test methods to establish basic design strengths for fills/soil and reinforcements. It should be noted that no consideration is given to the materials used in facing units, as adequate specifications for both materials and test methods exist for concrete, reinforced concrete, metal and timber facing units. Soft faces may usually be formed of geotextile or geogrid sheets; specifications and test methods are as for reinforcements.

Table 7 Examples of design working life

Design working life category (BS EN 1990:2002+A1)	Category	Typical design working life (years)	Example
1	Temporary works	1 to 5	Contractors site structures
			Piling platforms
1	Short term	5 to 10	Contractors site structures
			Basal reinforced platforms for settlement control or in association with ground improvement
3/4	Industrial	10 to 50	Structures at mines
4/5	Long term	60	Marine structures in accordance with BS 6349
			Highway embankments
			Railway embankments (NR/SP/CIV/071 [17])
			Basal reinforcement in association with Piles or other supports under embankments
5	Long term	120	Highway and railway retaining walls and highway structures and bridge abutments
			Basal reinforcement in association with piles or other supports under retaining walls and structures

Void spanning depending upon application and reason for use, may fall in any one of these categories, see Section 8.

Tested according to ISO/TR 20432 Guidelines for the determination of the long-term strength of geosynthetics for soil reinforcement.

Design life up to 120 years, as per BS 8006 requirements

5	Long term	120	Highway and railway retaining walls and highway structures and bridge abutments Basal reinforcement in association with piles or other supports under retaining walls and structures

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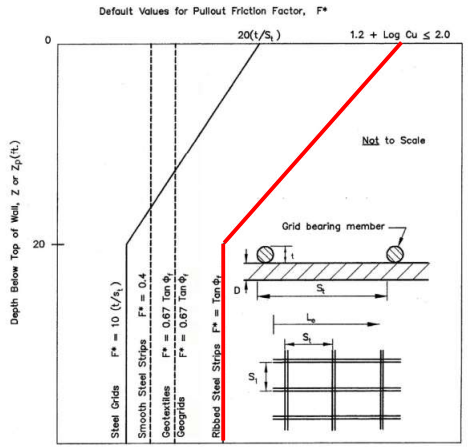

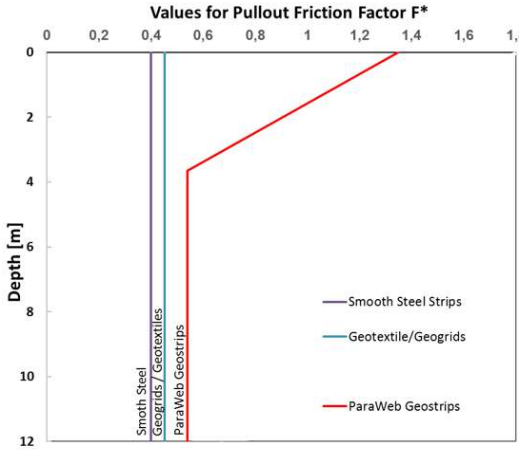

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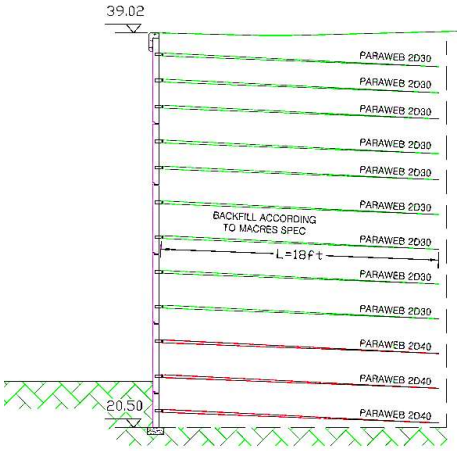

PARAWEB® 2
GEOSYNTHETICS REINFORCEMENT STRIPS

Description
ParaWeb® strips are p
sheath. The strips are

PA							
MECHANICAL PROPER							
Ultimate Tensile Strength							
Strain at UTS (EN ISO 1							

PARAWEB® M
GEOSYNTHETICS REINFORCEMENT STRIPS

Description
ParaWeb® strips are planar structures consisting of a core of high tenacity polyester yarn tendons encased in a polyethylene sheath. The strips are suitable for reinforcement applications in combination with concrete wall facing panels.

PARAWEB ME		27	36	45	54	63	
MECHANICAL PROPERTIES							
Ultimate Tensile Strength (EN ISO 10319)	kN	27.4	36.2	45.2	54.3	63.3	1
Strain at UTS (EN ISO 10319)	%			9.5			

PARAWEB

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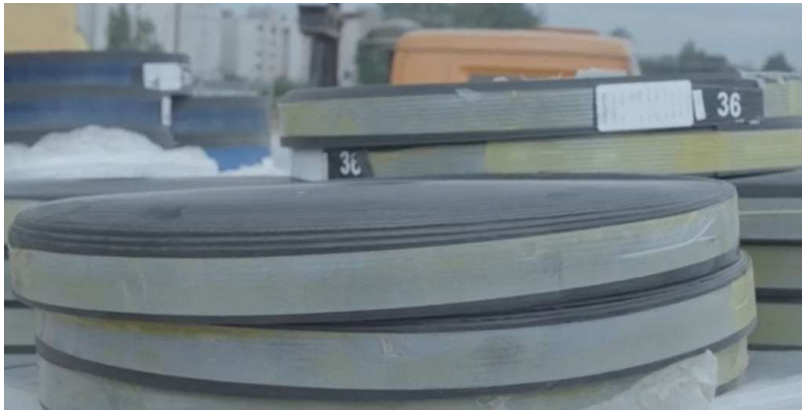

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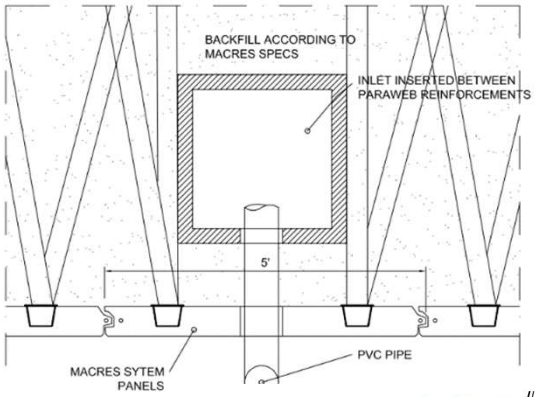
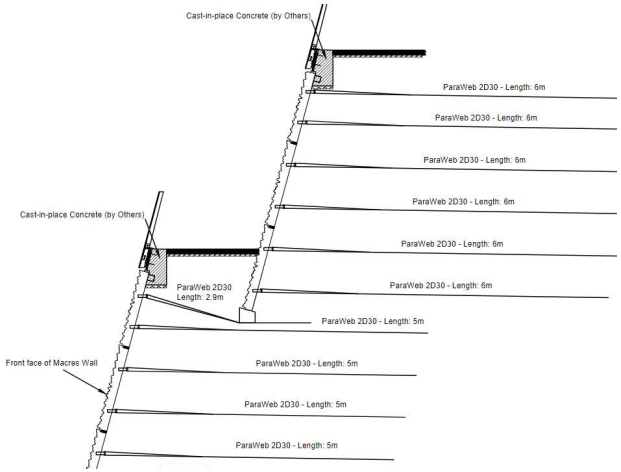
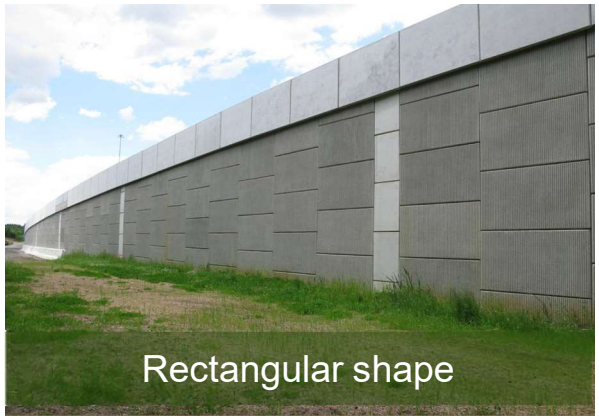
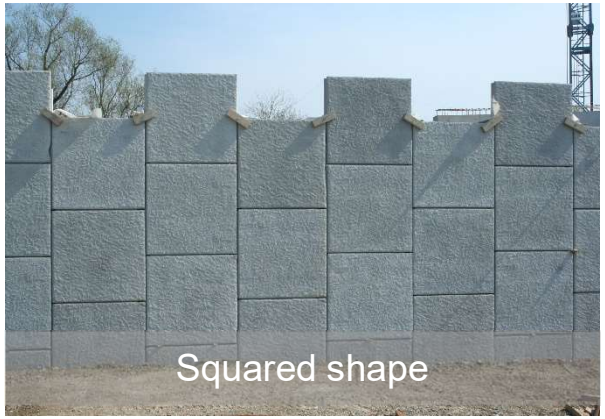




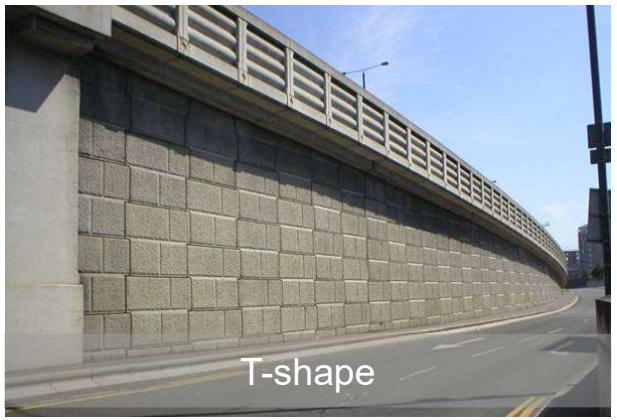
SHAPE TYPES


Rectangular shape


Squared shape

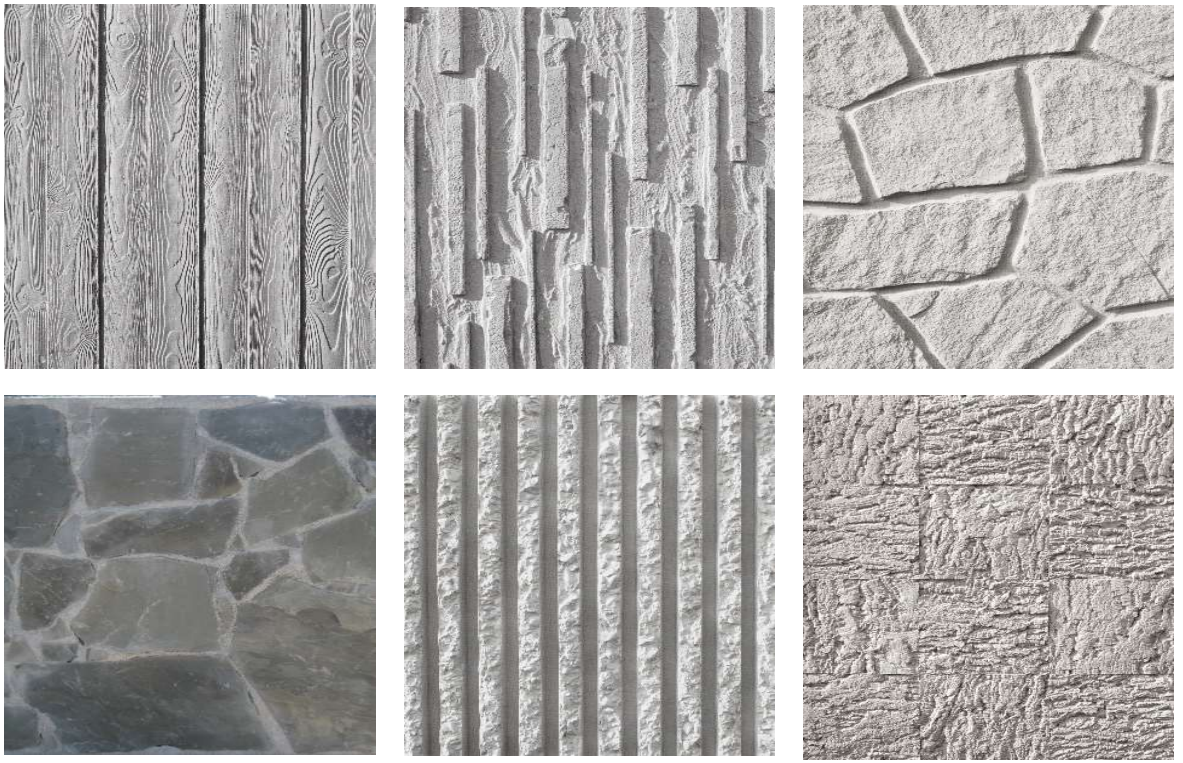

Cross-shape


T-shape


T-shape

FINISHING TYPES

- Concrete surface finish can vary upon client request and project specifications
- Molds are designed to allow for installation of polymeric formliners or real stones placed at the bottom of the mold
- Also, concrete colour and texture upon request



FINISHING TYPES

MACCAFERRI

Brug van den Azijn

FINISHING TYPES

Painted vertical wall in France

DESIGN METHOD

DESIGN METHOD: WHAT DO WE NEED TO KNOW?

MACCAFERRI

- Ground
- Aesthetic
- Groundwater
- Durability and maintenance
- Construction requirements
- Row
- Environmental concerns
- Boundary Conditions

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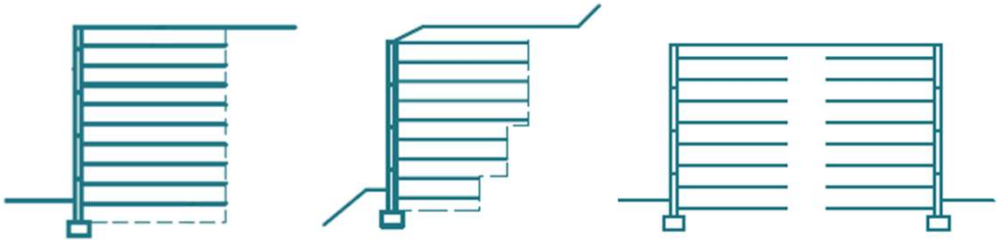
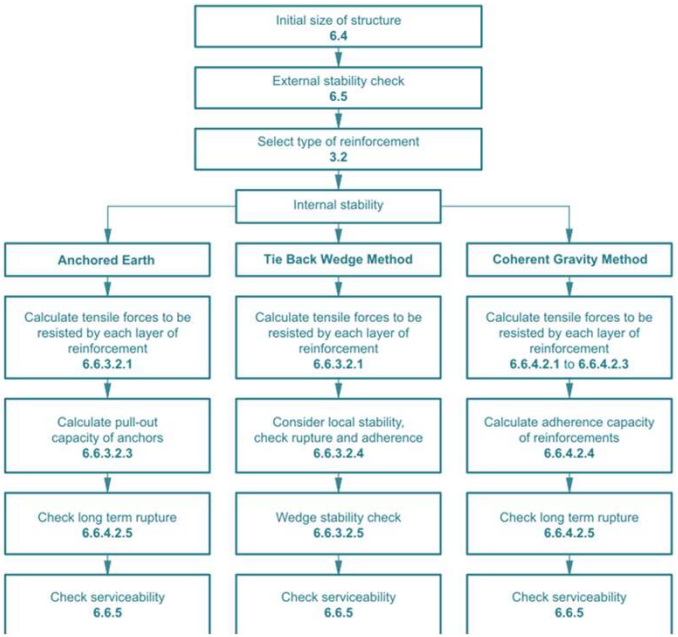


simple trapezoidal back to back



DESIGN METHOD

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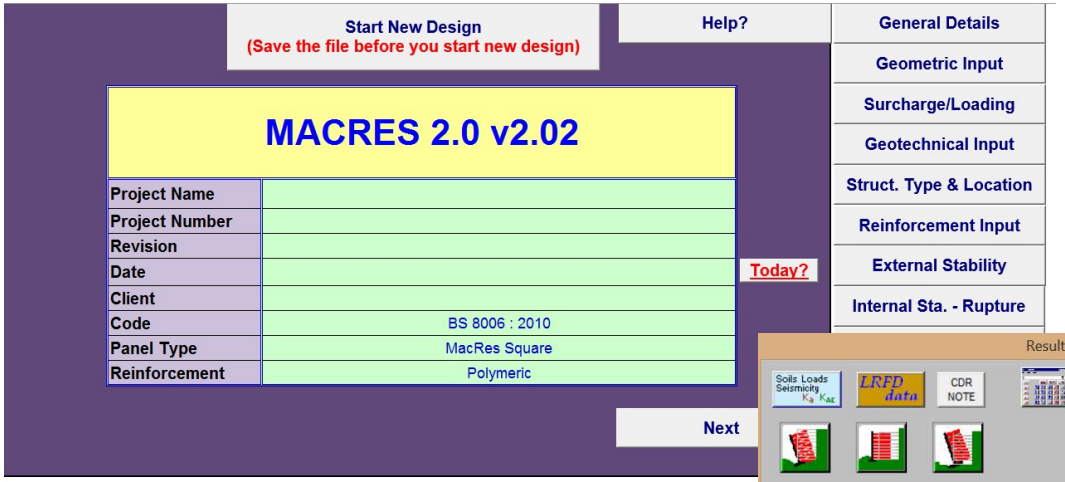
The design load is sustained by the long-term design strength LTDS (Tal = Td) of the reinforcement, which is calculated considering the appropriate RFs for creep, installation damage and durability

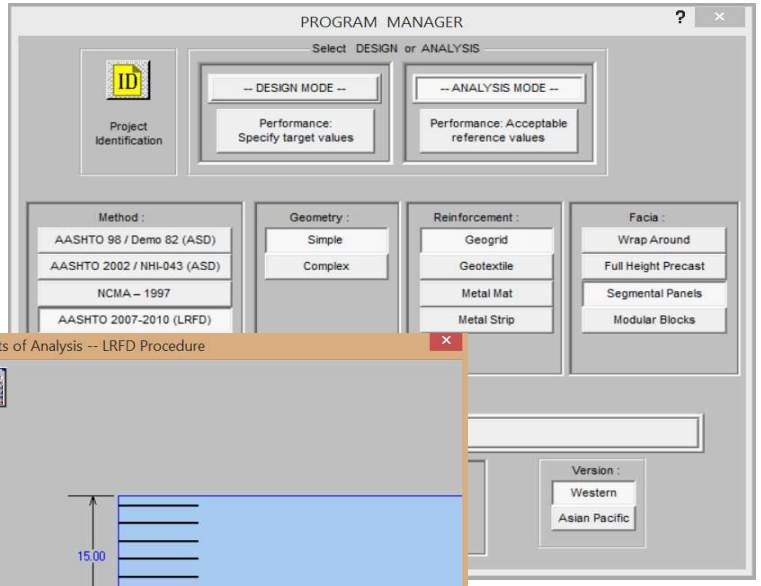
$$T_{al} = T_{ult} / (RF_{cr} \times RF_{id} \times RF_{d})$$

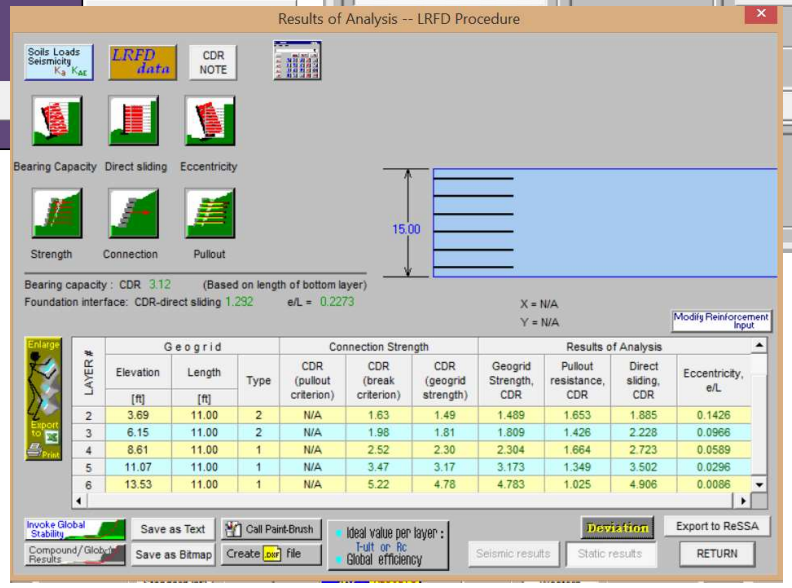
DESIGN SOFTWARE

MACCAFERRI



DESIGN – MacRes v 2.0

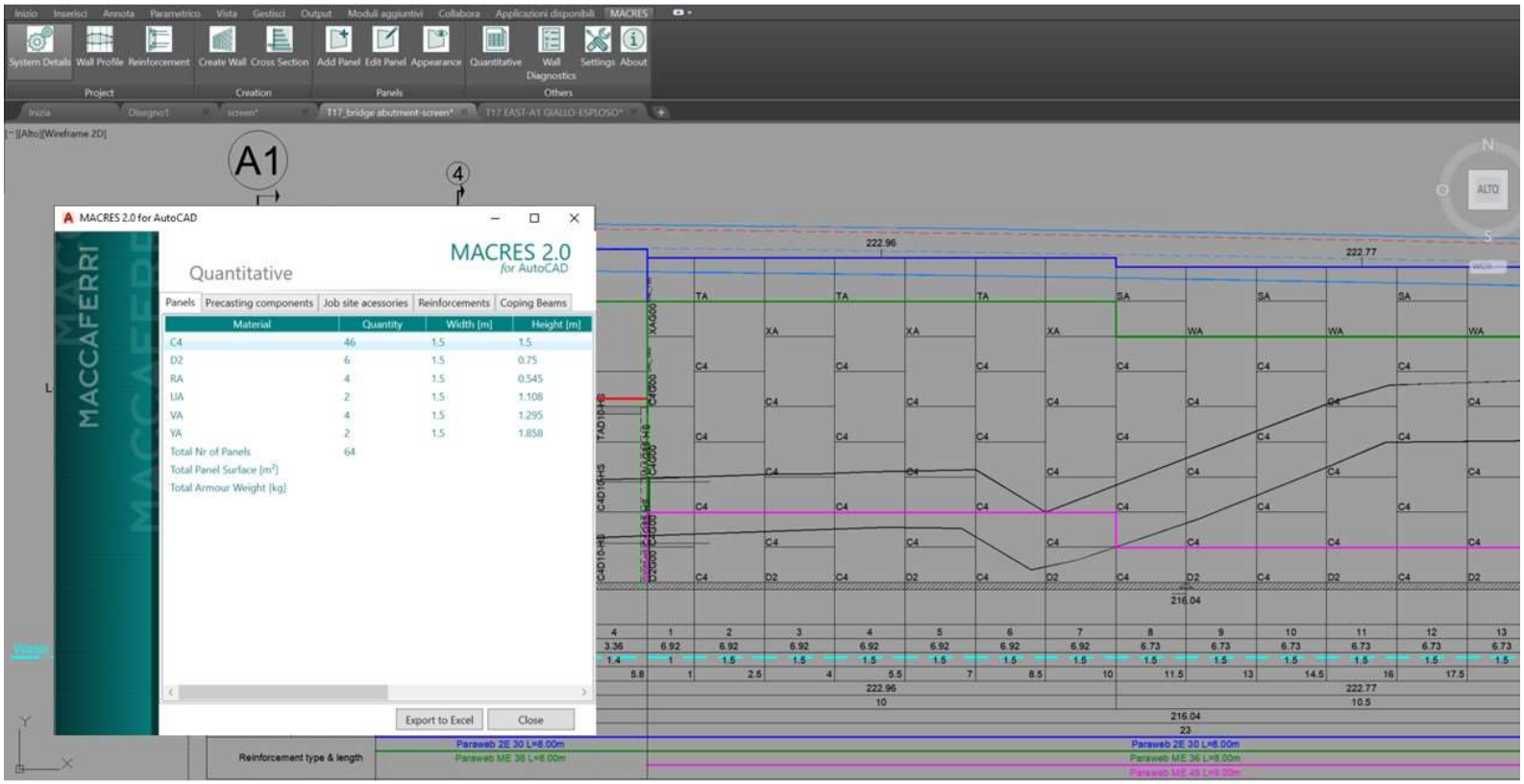




MSEW

GRAPHIC SOFTWARE

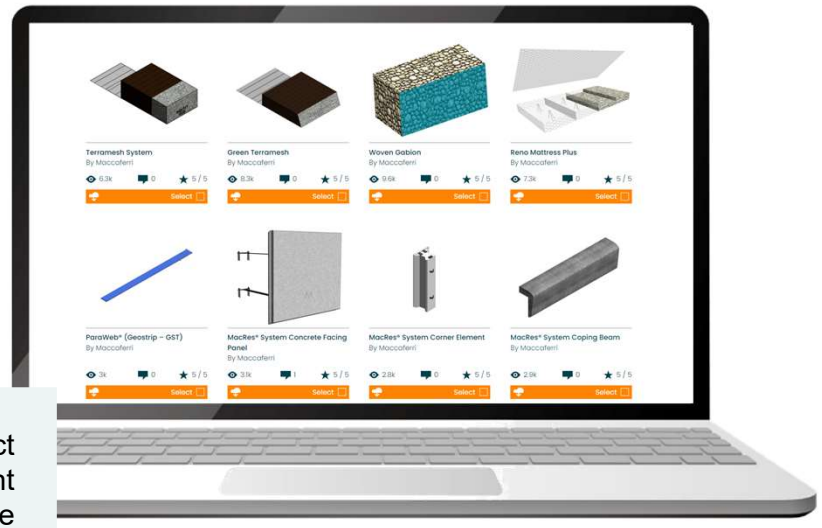
MacRes for Autocad



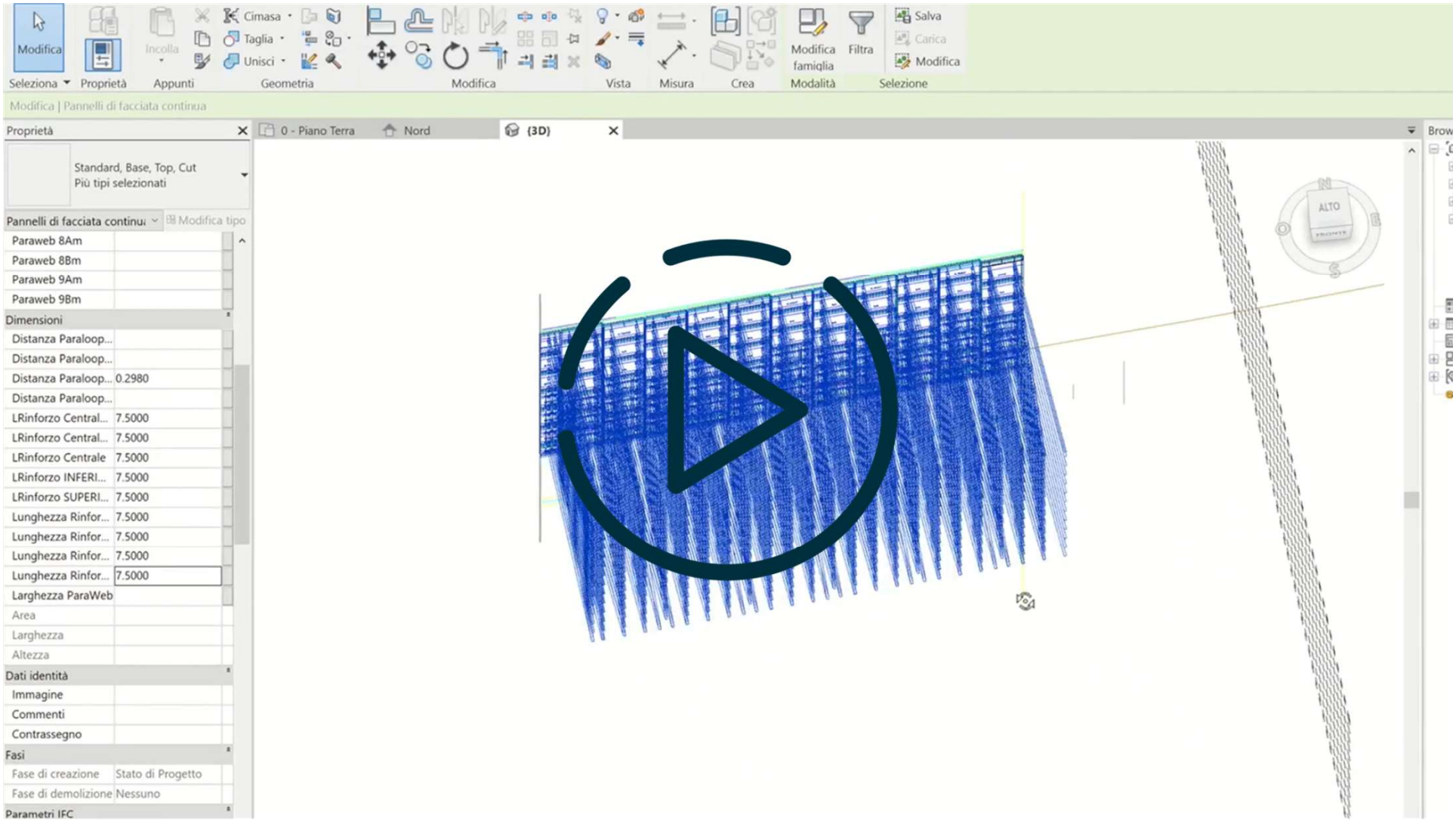
DIGITALIZATION PROCESS

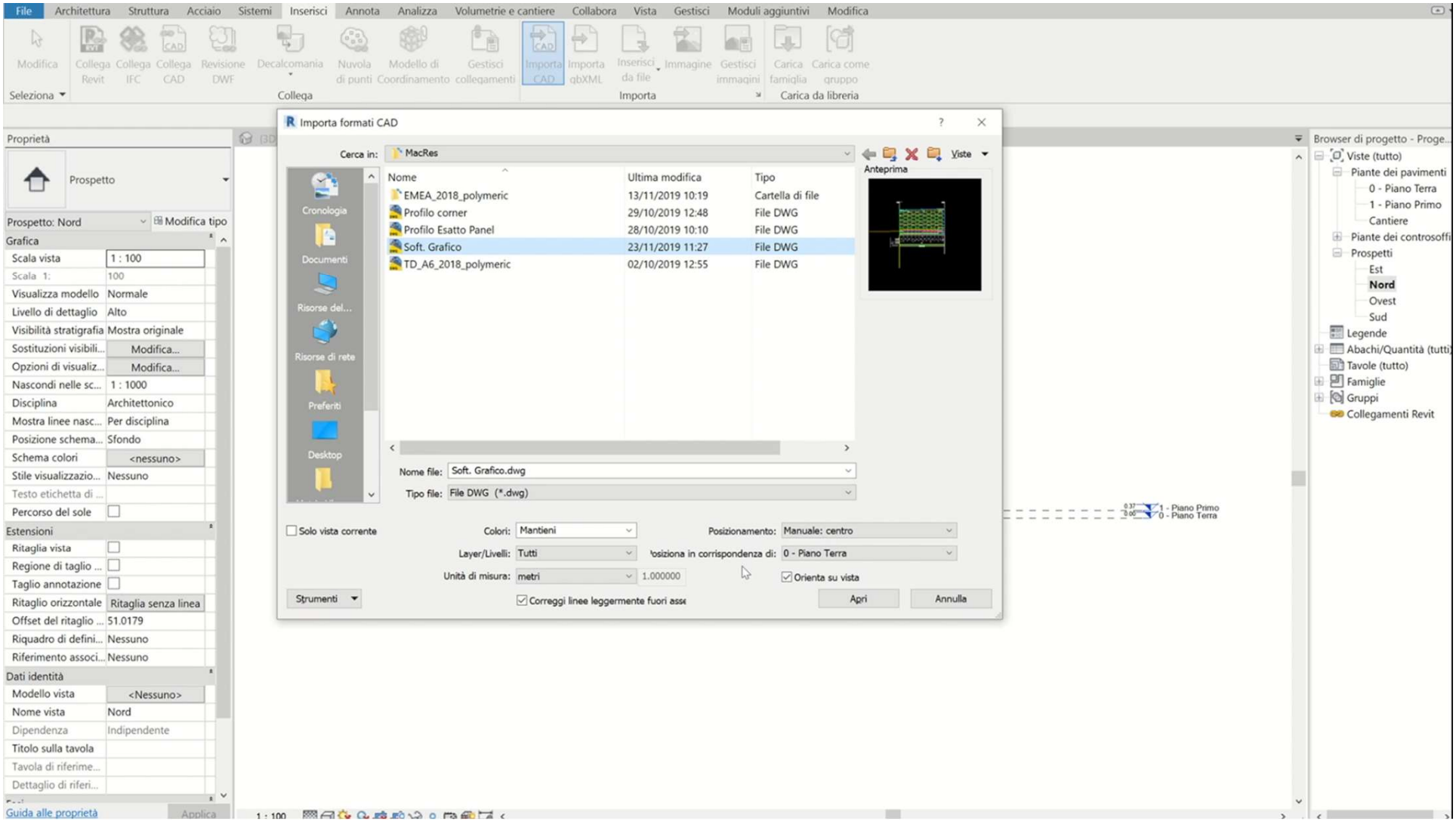
BIM Library available

Scan here
and discover our BIM library
or visit
maccaferri.com/bim



Our products are also available as BIM. Our BIM Object have been validated by the British Board Agreement (BBA) as being a true and fair representation of the physical product/system. BIM system **reduces design time and cost** and facilitates cooperation between project stakeholders


Modifica
Seleziona
Proprietà
Incolla
Appunti
Cimasa
Taglia
Unisci
Geometria
Modifica
Vista
Misura
Crea
Modifica famiglia
Filtra
Modalità
Salva
Carica
Modifica
Selezione
Modifica | Pannelli di facciata continua
Proprietà
Standard, Base, Top, Cut
Più tipi selezionati
Pannelli di facciata continua
Modifica tipo
Paraweb 8Am
Paraweb 8Bm
Paraweb 9Am
Paraweb 9Bm
Dimensioni
Distanza Paraloop...
Distanza Paraloop...
Distanza Paraloop... 0.2980
Distanza Paraloop...
LRinforzo Central... 7.5000
LRinforzo Central... 7.5000
LRinforzo Centrale 7.5000
LRinforzo INFERI... 7.5000
LRinforzo SUPERI... 7.5000
Lunghezza Rinfor... 7.5000
Lunghezza Rinfor... 7.5000
Lunghezza Rinfor... 7.5000
Lunghezza Rinfor... 7.5000
Larghezza ParaWeb
Area
Larghezza
Altezza
Dati identità
Immagine
Commenti
Contrassegno
Fasi
Fase di creazione Stato di Progetto
Fase di demolizione Nessuno
Parametri IFC
0 - Piano Terra
Nord
{3D}
ALTO


File
Architettura
Struttura
Acciaio
Sistemi
Inserisci
Annota
Analizza
Volumetrie e cantiere
Collabora
Vista
Gestisci
Moduli aggiuntivi
Modifica
Modifica
Collega Revit
Collega IFC
Collega CAD
Revisione DWF
Decalcomania
Nuvola di punti
Modello di Coordinamento
Gestisci collegamenti
Importa CAD
Importa gbXML
Inserisci da file
Immagine
Gestisci immagini
Carica famiglia
Carica come gruppo
Seleziona
Collega
Importa
Carica da libreria
Proprietà
Prospetto
Prospetto: Nord
Modifica tipo
Grafica
Scala vista 1 : 100
Scala 1: 100
Visualizza modello Normale
Livello di dettaglio Alto
Visibilità stratigrafia Mostra originale
Sostituzioni visibili... Modifica...
Opzioni di visualiz... Modifica...
Nascondi nelle sc... 1 : 1000
Disciplina Architettonico
Mostra linee nasc... Per disciplina
Posizione schema... Sfondo
Schema colori <nessuno>
Stile visualizzazio... Nessuno
Testo etichetta di ...
Percorso del sole
Estensioni
Ritaglia vista
Regione di taglio ...
Taglio annotazione
Ritaglio orizzontale Ritaglia senza linea
Offset del ritaglio ... 51.0179
Riquadro di defini... Nessuno
Riferimento associ... Nessuno
Dati identità
Modello vista <Nessuno>
Nome vista Nord
Dipendenza Indipendente
Titolo sulla tavola
Tavola di riferime...
Dettaglio di riferi...
Guida alle proprietà
Applica
Importa formati CAD
Cerca in: MacRes
Viste
Anteprima
Cronologia
Documenti
Risorse del...
Risorse di rete
Preferiti
Desktop
Nome
Ultima modifica
Tipo
EMEA_2018_polymeric 13/11/2019 10:19 Cartella di file
Profilo corner 29/10/2019 12:48 File DWG
Profilo Esatto Panel 28/10/2019 10:10 File DWG
Soft. Grafico 23/11/2019 11:27 File DWG
TD_A6_2018_polymeric 02/10/2019 12:55 File DWG
Nome file: Soft. Grafico.dwg
Tipo file: File DWG (*.dwg)
Solo vista corrente
Colori: Mantieni
Posizionamento: Manuale: centro
Layer/Livelli: Tutti
Posiziona in corrispondenza di: 0 - Piano Terra
Unità di misura: metri
1.000000
Orienta su vista
Strumenti
Correggi linee leggermente fuori asse
Apri
Annulla
1 - Piano Primo
0 - Piano Terra
Browser di progetto - Proge...
Viste (tutto)
Piante dei pavimenti
0 - Piano Terra
1 - Piano Primo
Cantiere
Piante dei controsoffi
Prospetti
Est
Nord
Ovest
Sud
Legende
Abachi/Quantità (tutti)
Tavole (tutto)
Famiglie
Gruppi
Collegamenti Revit
1 : 100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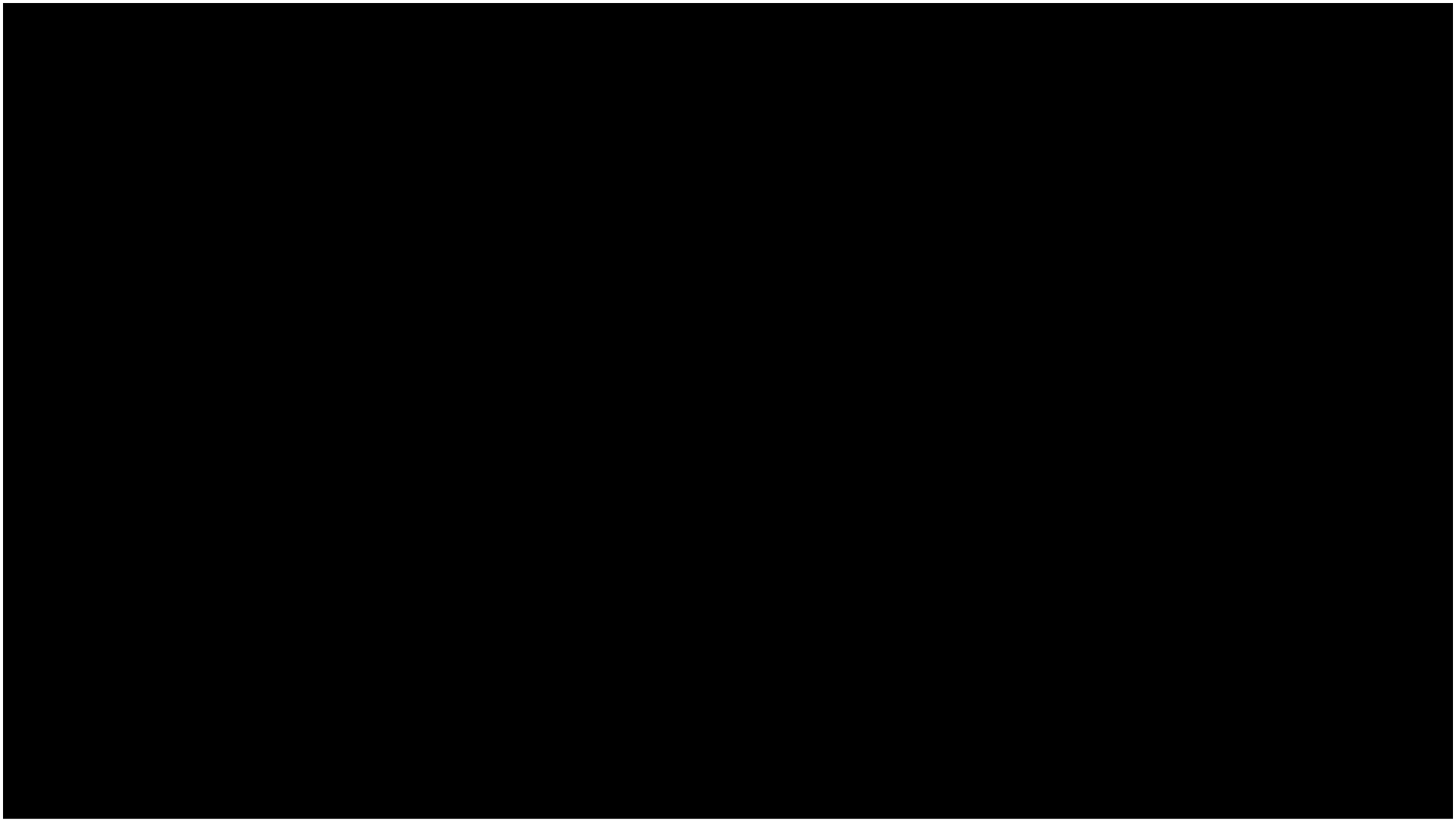
INSTALLATION



MACCAFERRI

LIVE Q&A

Chat box