MACCAFERRI

Introduction to Geohazard Standard Specification for Simple Drapery

MACCAFERRI

Up to now, there is no standard specification for geohazard solutions in North America. Often projects specifications are referring to a unique product or the wrong ASTM designation or Federal Specification.

Also some specification refers to European specifications not available in USA.

MACCAFERRI

Why a standard specification is required?

MACCAFERRI

Better Sourcing for Products

Easier for the designers, contractors and owners to compare different products for the same application.

MACCAFERRI

More projects in Geohazard Industry

Federal Highway Administration 23 CFR 635.411, "Material or product selection".

"Federal funds shall not participate, directly or indirectly, in payment for any premium or royalty on any patented or proprietary material, specification, or process specifically set forth in the plans and specifications for a project"

MACCAFERRI

Better Quality Control

As an Example: High strength fastners with minimum tensile strength as per ASTM A975-11 for Hexagonal double twisted steel wire mesh connection

MACCAFERRI

Rockfall Barrier

EOTA

European Organisation for Technical Approvals

ETAG 027 GUIDELINE FOR EUROPEAN TECHNICAL APPROVAL OF FALLING ROCK PROTECTION KITS - 2008

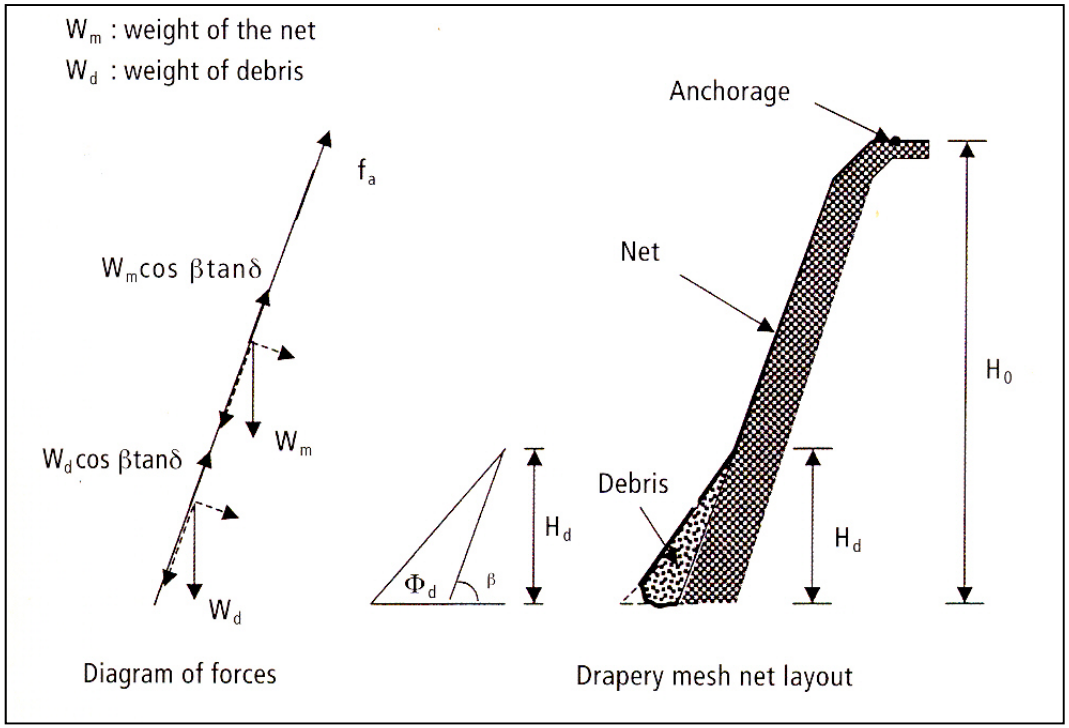
MACCAFERRI

Drapery Systems

MACCAFERRI

Simple Drapery

The design methodology is based on the analysis of the total weight acting on geohazard fabric. The geohazard fabrics works mainly on tensile strength.

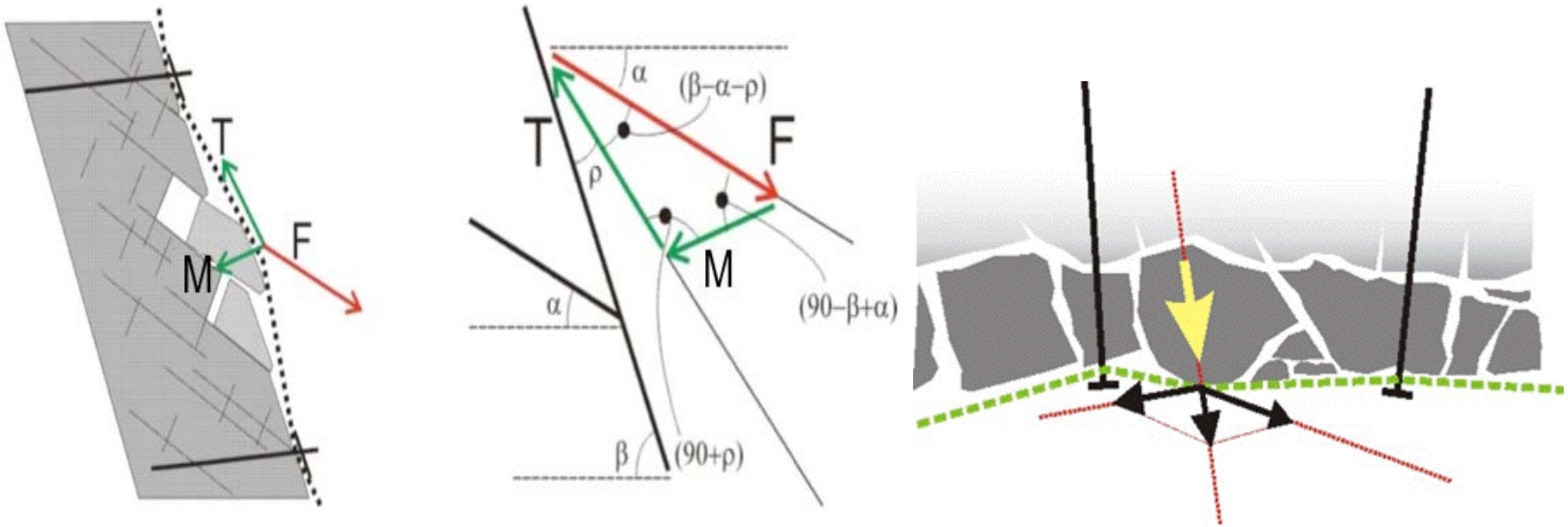


MACCAFERRI

Simple Drapery

MACCAFERRI

Secured Drapery



Equilibrium Design Theory
F= Forces developed by the block sliding
T= Mesh tensile resistance from secured by the upper anchors
M= Punch resistance from the mesh under the block sliding

MACCAFERRI

Secured Drapery

MACCAFERRI

Existing Standards for Geohazard Drapery System.

MACCAFERRI

European Standardization UNI (Italy)

-Weight

-Deformability to the concentrated load (PUNCHING TEST)

-Strength and deformability to the longitudinal tensile force (TENSILE TEST)

MACCAFERRI

ISO Standard (draft)

ISO/CD 17746
Steel wire rope net panels and rolls- Definitions and spe cifications

ISO/CD 17745
Steel wire ring net panels - Definitions and specifications

MACCAFERRI

North America

ASTM A975 Standard Specification for Double–Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)

MACCAFERRI

USA - Working Groups for Developing New Standards

- Association Geohazard Professional
  * Standard Specification Committee

- ASTM (American Society for Testing and Materials)
  * D18.25.06 Geohazard Protection Systems

The long term goal is to develop standard specifications for all the geohazard solutions in collaboration with different agencies like ASTM.

Latest Development

MACCAFERRI

Definitions

Rockfall, n. In geohazard mitigation; The gravity induced downward motion of detached rock involving free falling, bouncing, rolling, and/or sliding.

Geohazard Fabric, n. In geohazard mitigation; A material made typically from steel wire and/or wire rope, interwoven in such a manner to create a continuous interlaced flexible structure usually used in rockfall, slope stabilization, avalanche and/or debris flow applications.

Wire Net: n. In geohazard mitigation; A geohazard fabric consisting of multiple steel wire rope or strands forming a uniform grid pattern.

Wire Mesh, n. In geohazard mitigation; A geohazard fabric consisting of single steel wires forming a uniform grid pattern.

MACCAFERRI

Definitions

Ring Net, n. In geohazard mitigation; A geohazard fabric consisting of interlocking steel rings connected to multiple adjoining rings.

Secured Drapery System: In geohazard mitigation; A drapery system means a system made up by the association of net, anchors and other structural elements which have the purpose to prevent the detachment and/or the movement of rocks.

Simple drapery system: In geohazard mitigation; A system made with geohazard fabric, anchored at the top and could be eventually at the toe, with the goal of containing the stones in motion.

MACCAFERRI

Geohazard Fabric Testing

- Unit Weight
- Mesh Opening
- Corrosion Protection
- Punch Test
- Tensile Strength

MACCAFERRI

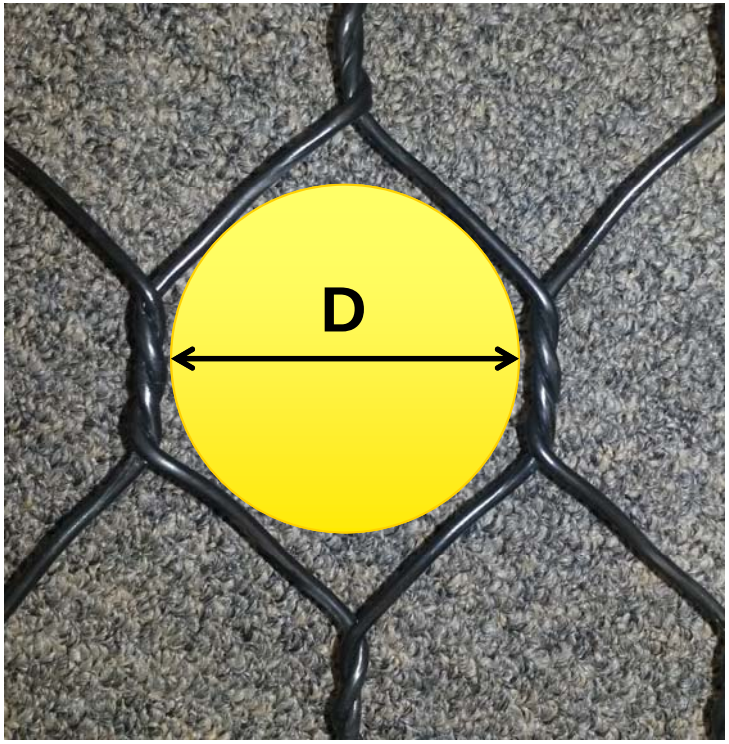
UNIT WEIGHT

The laboratory sample should be free from imperfections or other areas not representative of the material sampled prior to installation. The number of test specimens shall be a minimum of five, cut so that they are representative of the entire roll width and with a combined total minimum area of 10 m2 (100.76 ft2). Each test specimen shall be equal in area not less than 1 m x 1 m (3.28 ft x 3.28 ft). Each sample shall be cut to make sure to have full mesh openings.

MACCAFERRI

MESH OPENING

The laboratory sample should be free from imperfections or other areas not representative of the material sampled prior to installation. The minimum mesh opening dimension shall be measured from the diameter of the largest circle that will pass through the mesh opening. It shall be from a standard production roll and with a minimum average of 5.



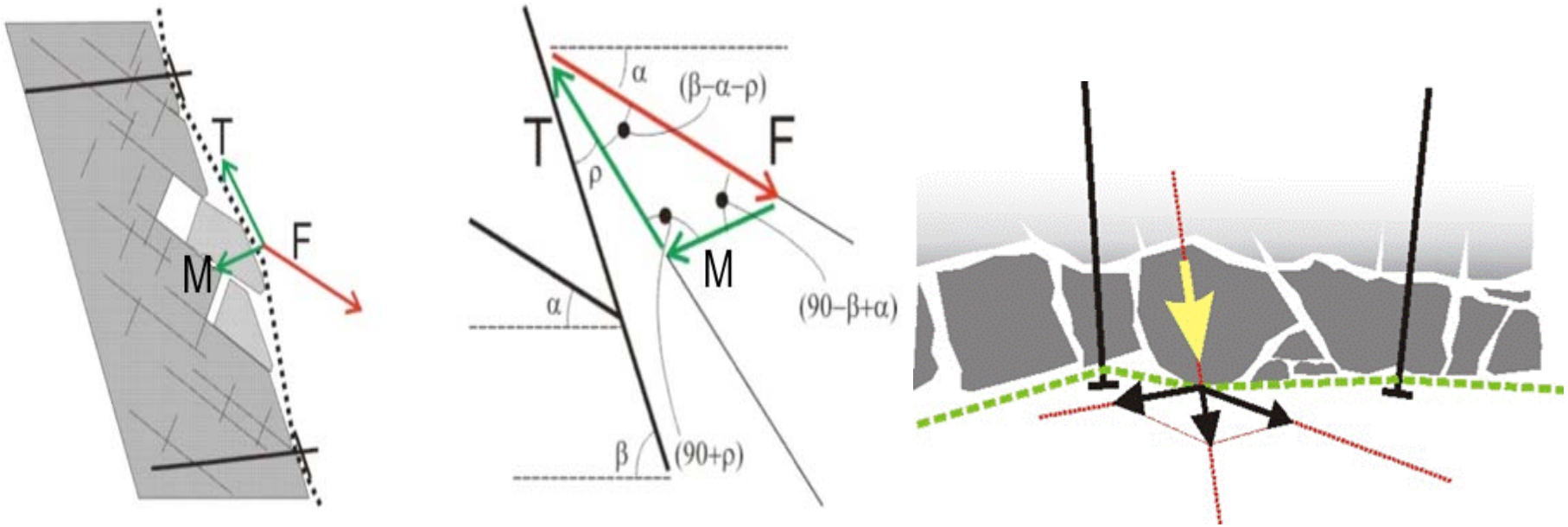
MACCAFERRI

Available Standard:

European UNI & ASTM A975

MACCAFERRI

SECURED DRAPERY - PUNCH TEST



Equilibrium Design Theory
F= Forces developed by the block sliding
T= Mesh tensile resistance from secured by the upper anchors
M= Punch resistance from the mesh under the block sliding

MACCAFERRI

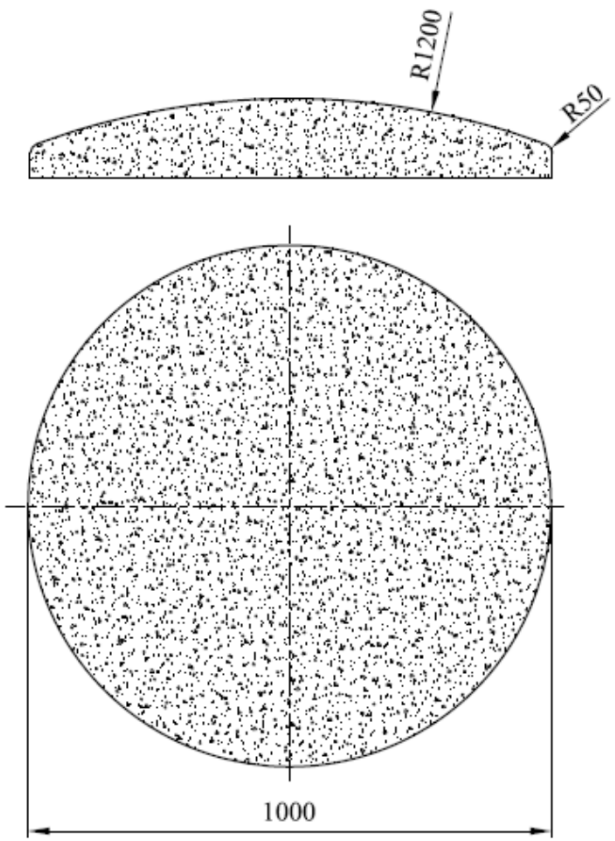
PUNCH TEST UNI

The geometrical characteristics of the press are (ref. Figure):

- radius of curvature 1,200 mm

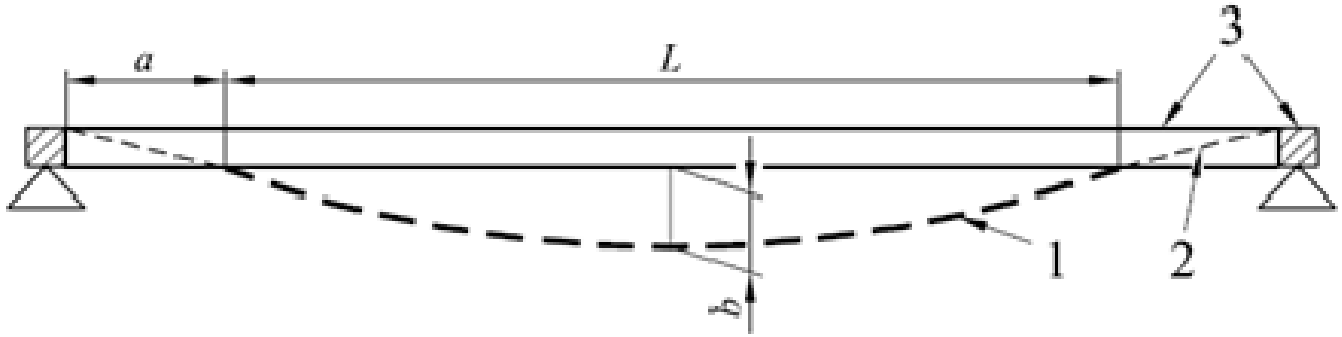
- maximum diameter of the sample projected on a plane 1,000 mm

- radius of curvature at the side 50 mm



MACCAFERRI

PUNCH TEST UNI



Legend

a Constraining Area < 0.15* *L*
b < 0.2* *L* [m]
L = 3.0 ± 0.2 * 3.0 [m]
1 Mesh test piece
2 Tensioning devices
3 Rigid frame

The following measurements must be taken continuously during the test:
- force exercised by the press;
- movement of the press relative to the reference plane.

MACCAFERRI

DETAILED REPORT

-General description

-Nominal dimensions of specimen

-Instrumentations

-Detailed description of boundary conditions

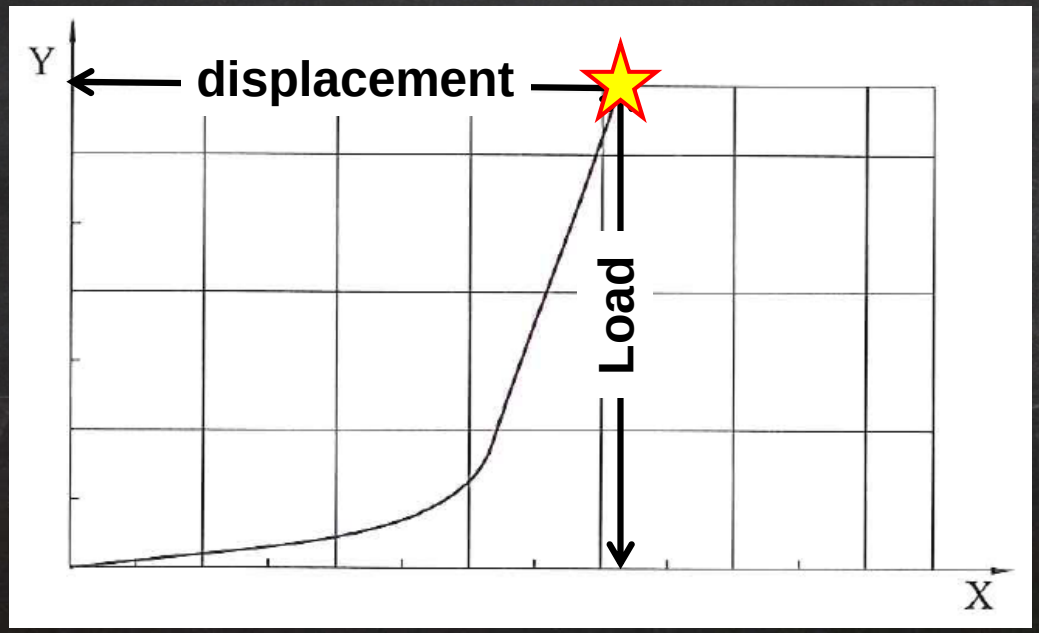
-Deflection value

-Description of failure mode

-Maximum load

-Load-Displacement relationship

-Photographic documentation

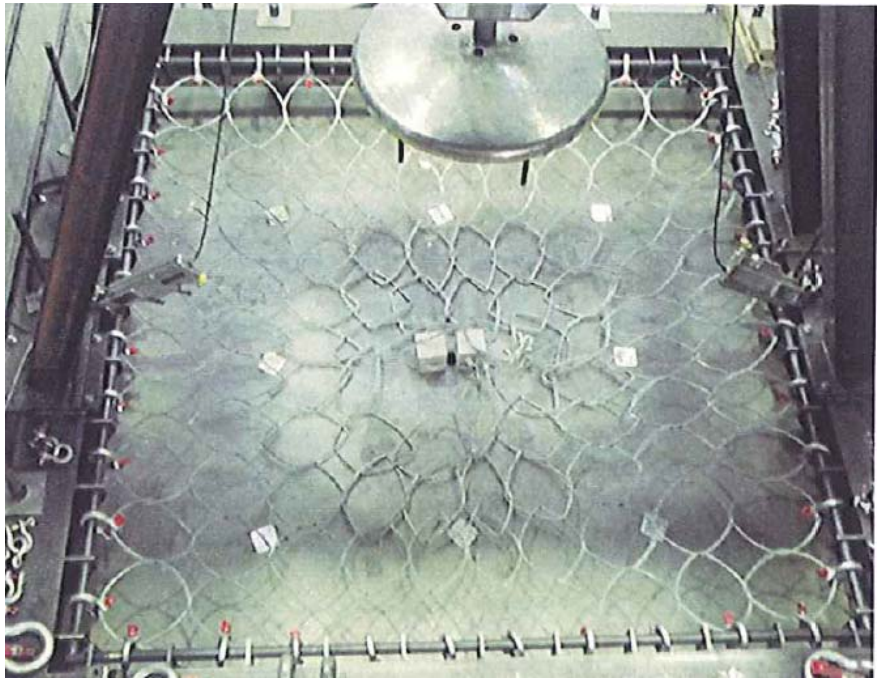


MACCAFERRI

University of Venice (Punch Test)

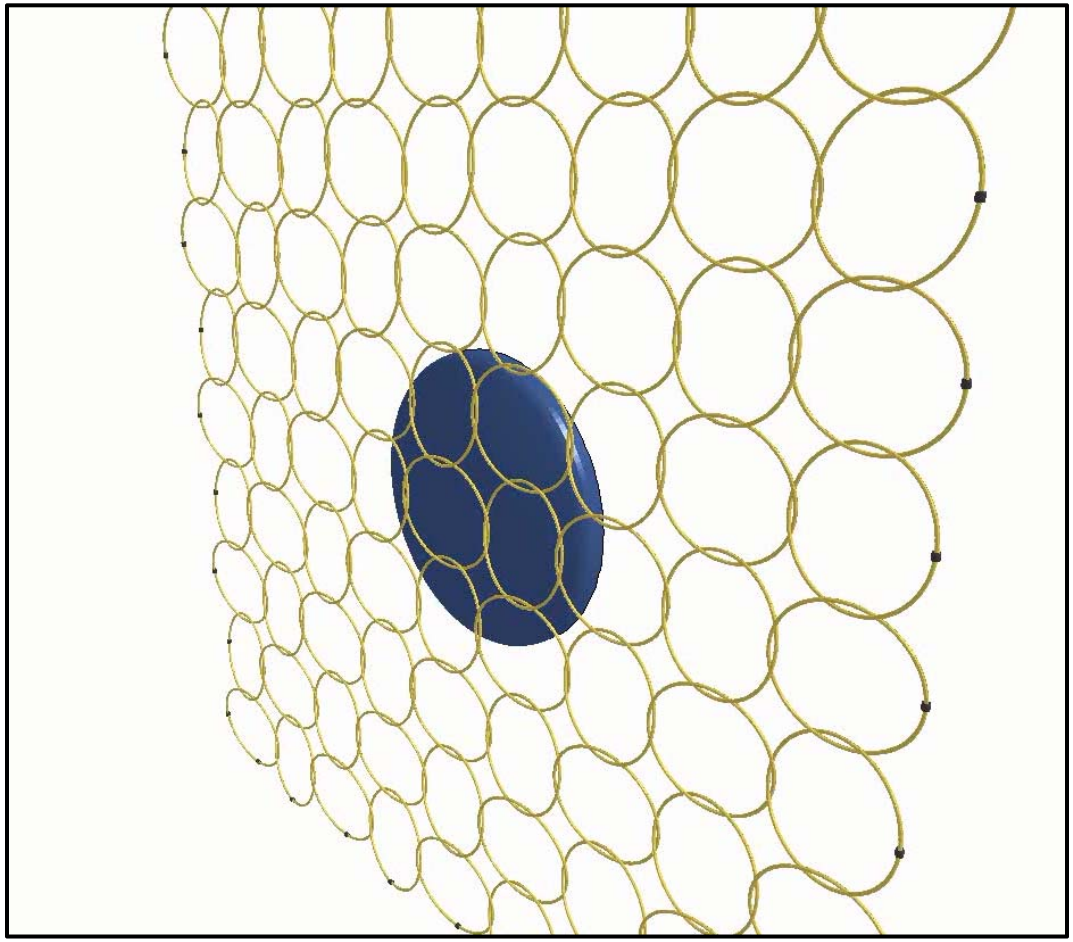
MACCAFERRI

PUNCH TEST UNI - Ring Net



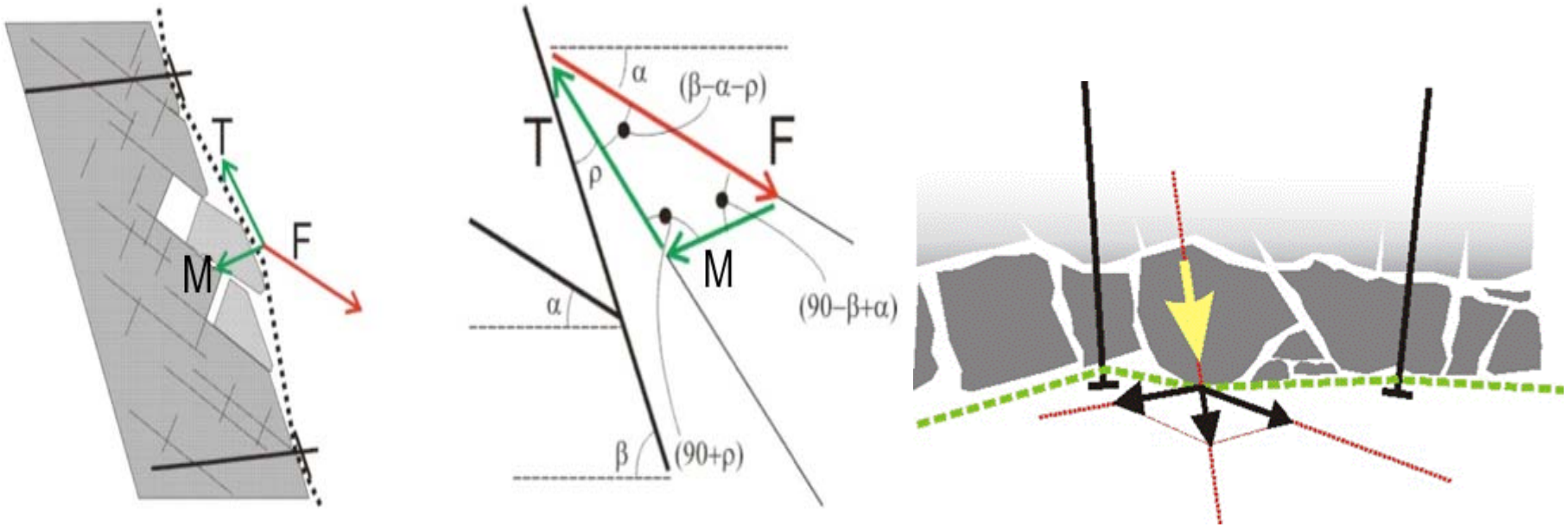
MACCAFERRI

PUNCH TEST UNI



MACCAFERRI

SECURED DRAPERY - PUNCH TEST



Equilibrium Design Theory
F= Forces developed by the block sliding
T= Mesh tensile resistance from secured by the upper anchors
M= Punch resistance from the mesh under the block sliding

MACCAFERRI

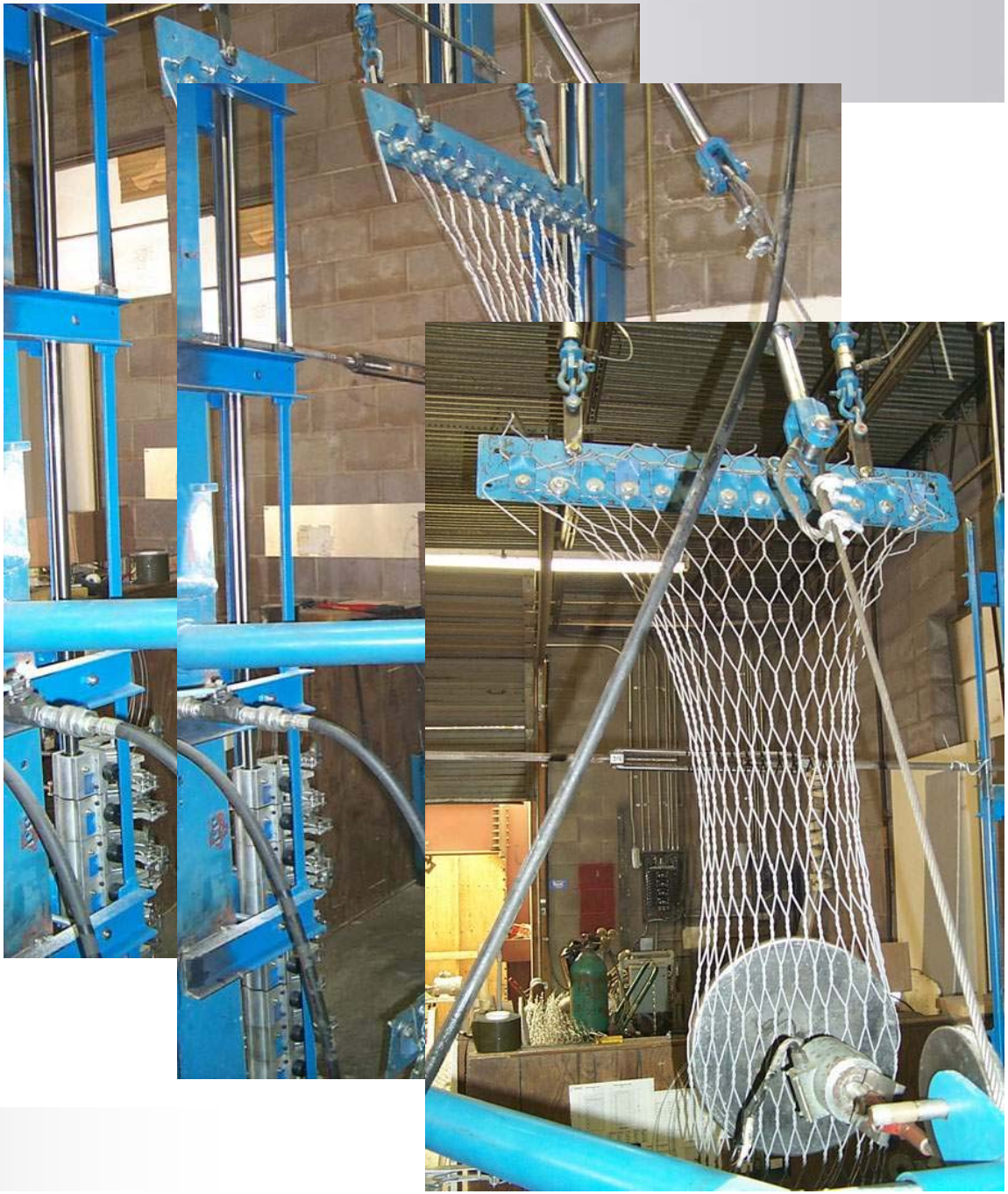
PUNCH TEST – ASTM A975 for DT MESH

Pre-Tensioned Punch Test

- An uncut section of1.82 m (6 ft) in length) and not less than 0.91 m(3 ft)
- clamps shall be centered along the width and the excess width will be allowed to fall free on each side of the clamped section.
- tension sufficient to cause 10 % elongation of the sample section between the clamps.
- Punch device 960 cm2(1 ft2) applied to the approximate center of the sample

MACCAFERRI

PUNCH TEST



MACCAFERRI

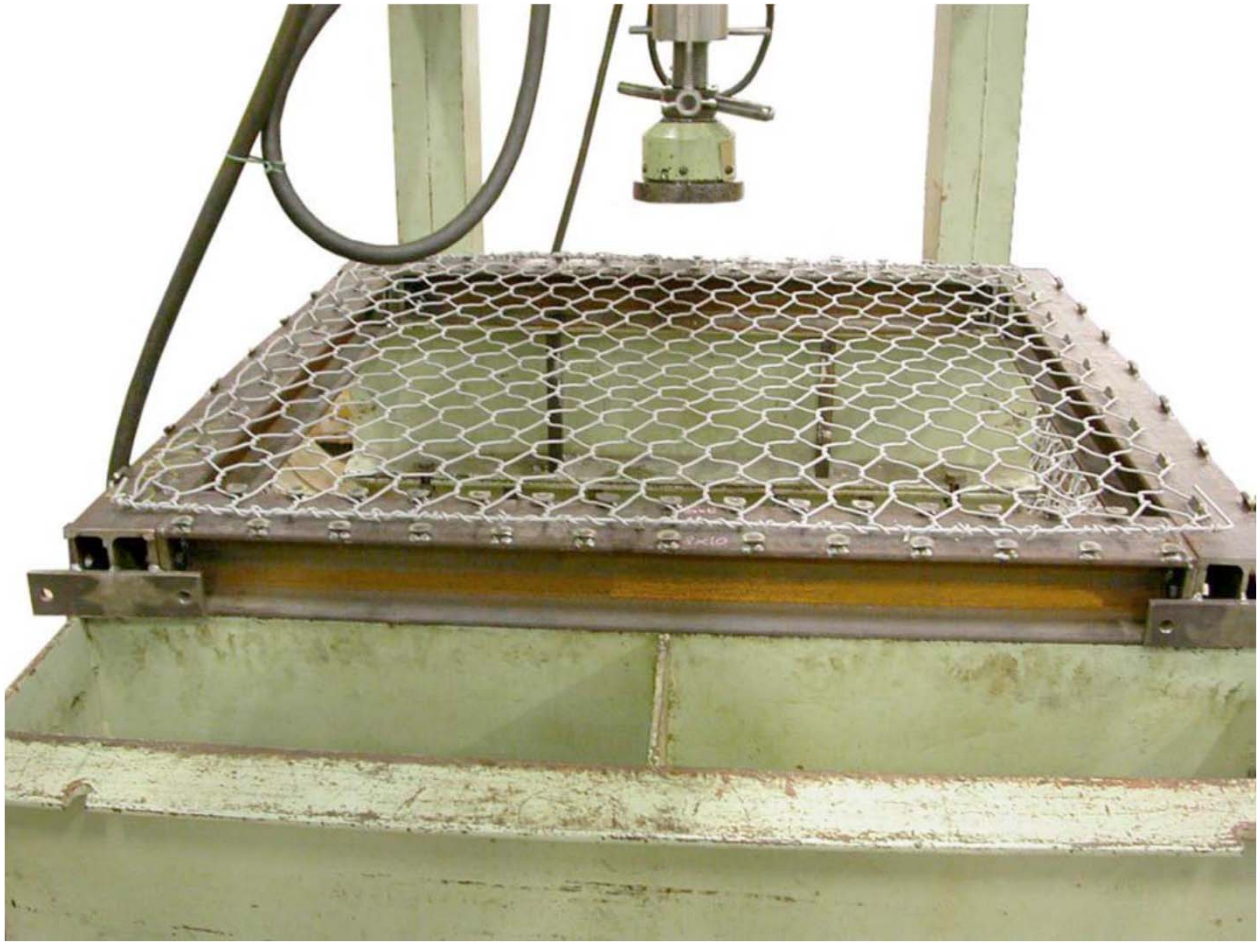
PUNCH TEST – ASTM A975 for DT MESH

Secured Punch Test—

- An uncut section of 1.24 m(4.1 ft) in length and not less than 0.9 m (3 ft) in width including all selvedge
- sides and the ends securely clamped at every mesh opening to a rigid frame
- load of 960 cm2(1 ft2) applied to the approximate center of the sample section between the clamps and in a direction perpendicular to the direction of the tension force.

MACCAFERRI

PUNCH TEST – ASTM A975



MACCAFERRI

PUNCH TEST – ASTM A975 FOR DT MESH

- The sample shall withstand, without rupture of any strand or opening of any mesh fastening, an actual load applied by means of a circular ram at a rate as indicated in equaling or exceeding the values shown in Table 2.
- The ram head used in the test shall be circular with a 350-mm (13.8-in.) diameter and have its edges beveled or rounded to prevent cutting of the wire strands.

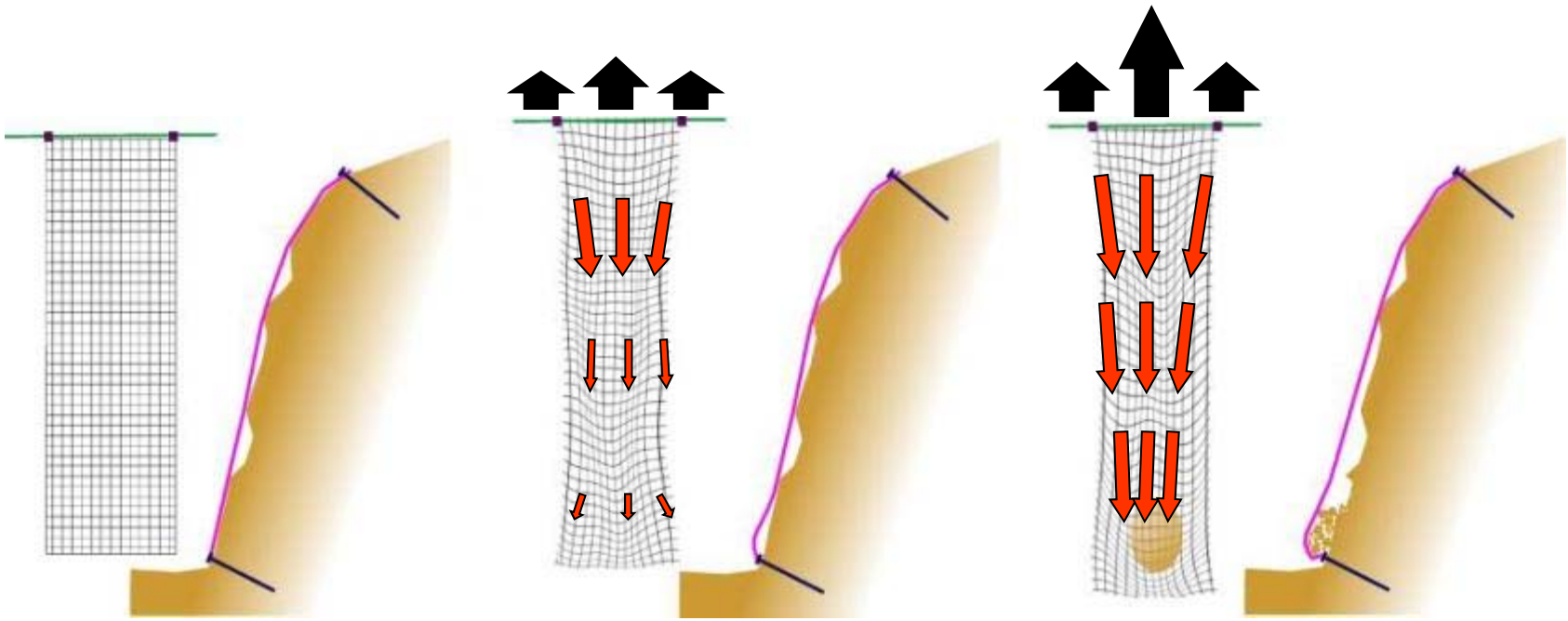
MACCAFERRI

Available Standard for Tensile Strength:

European UNI
ASTM A975
ISO

MACCAFERRI

SIMPLE DRAPERY - TENSILE STRENGTH



1 – Theoretical case

2 – Mesh weight

3 – weight of the debris

Forces acting on the mesh

Reaction of the mesh

MACCAFERRI

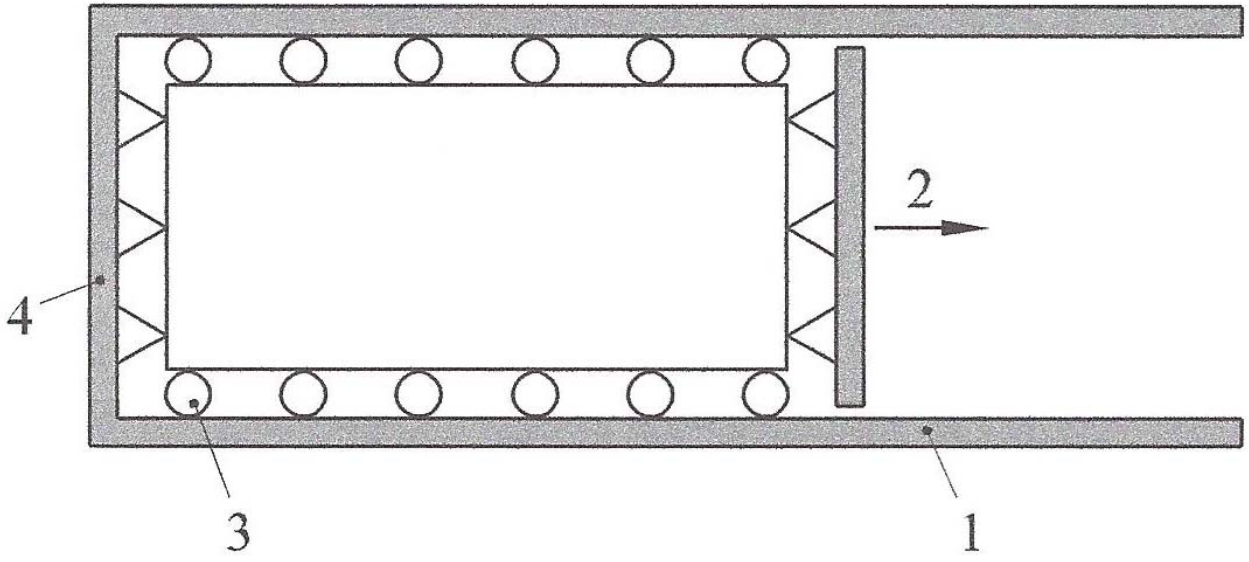
TENSILE STRENGTH UNI

1- Fixed Frame

2- Moving Beam

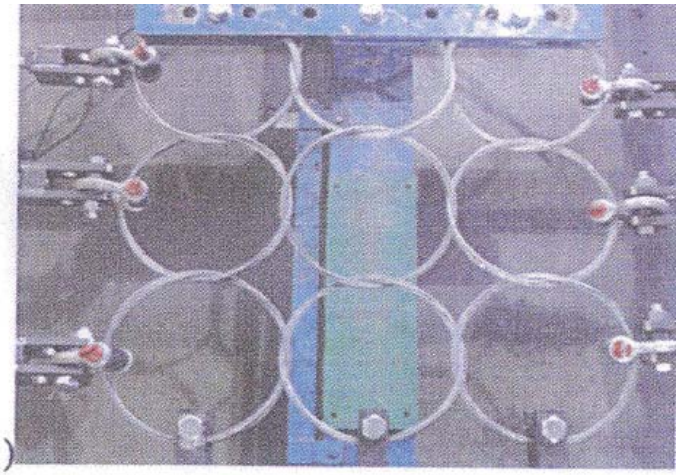
3- Free Lateral Constrain

4- Side Beam

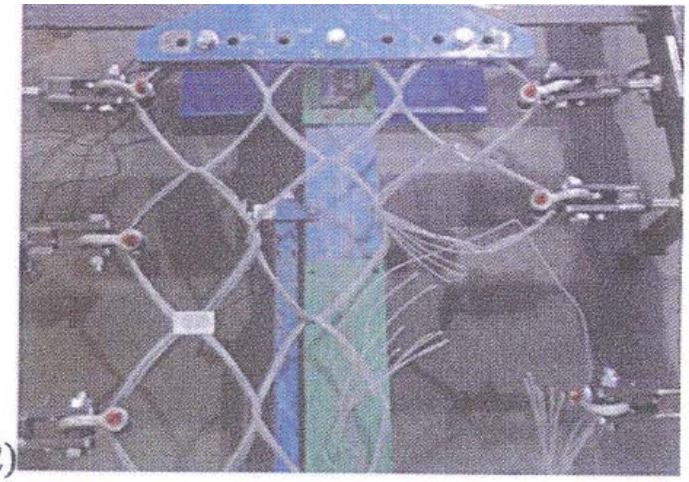


MACCAFERRI

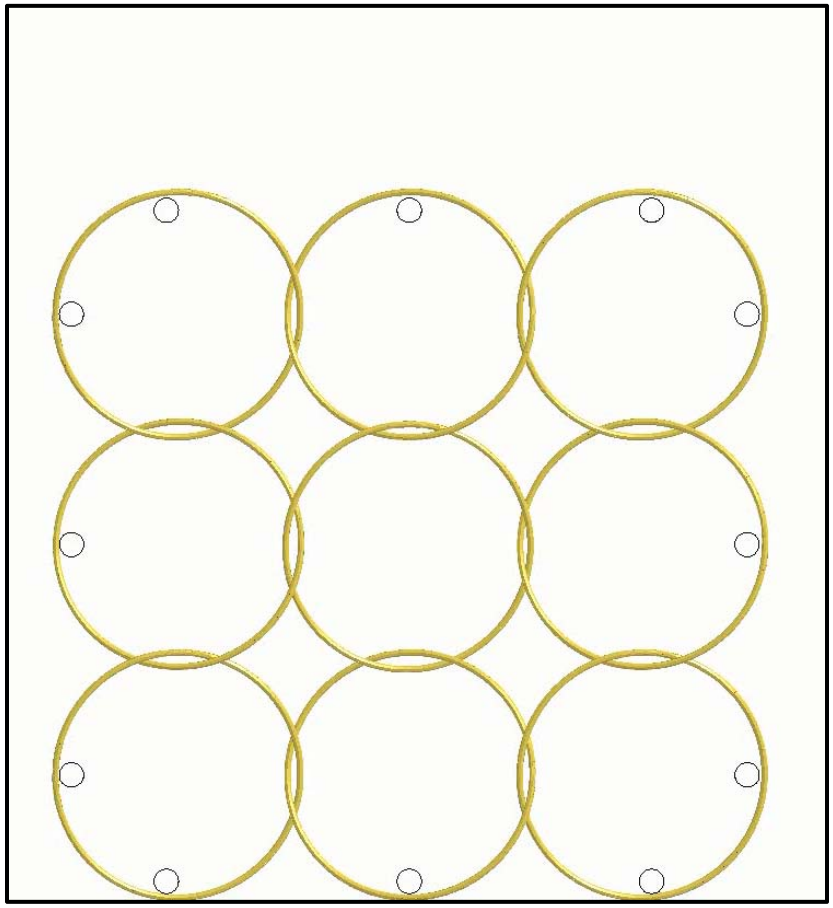
TENSILE STRENGTH UNI



(1)

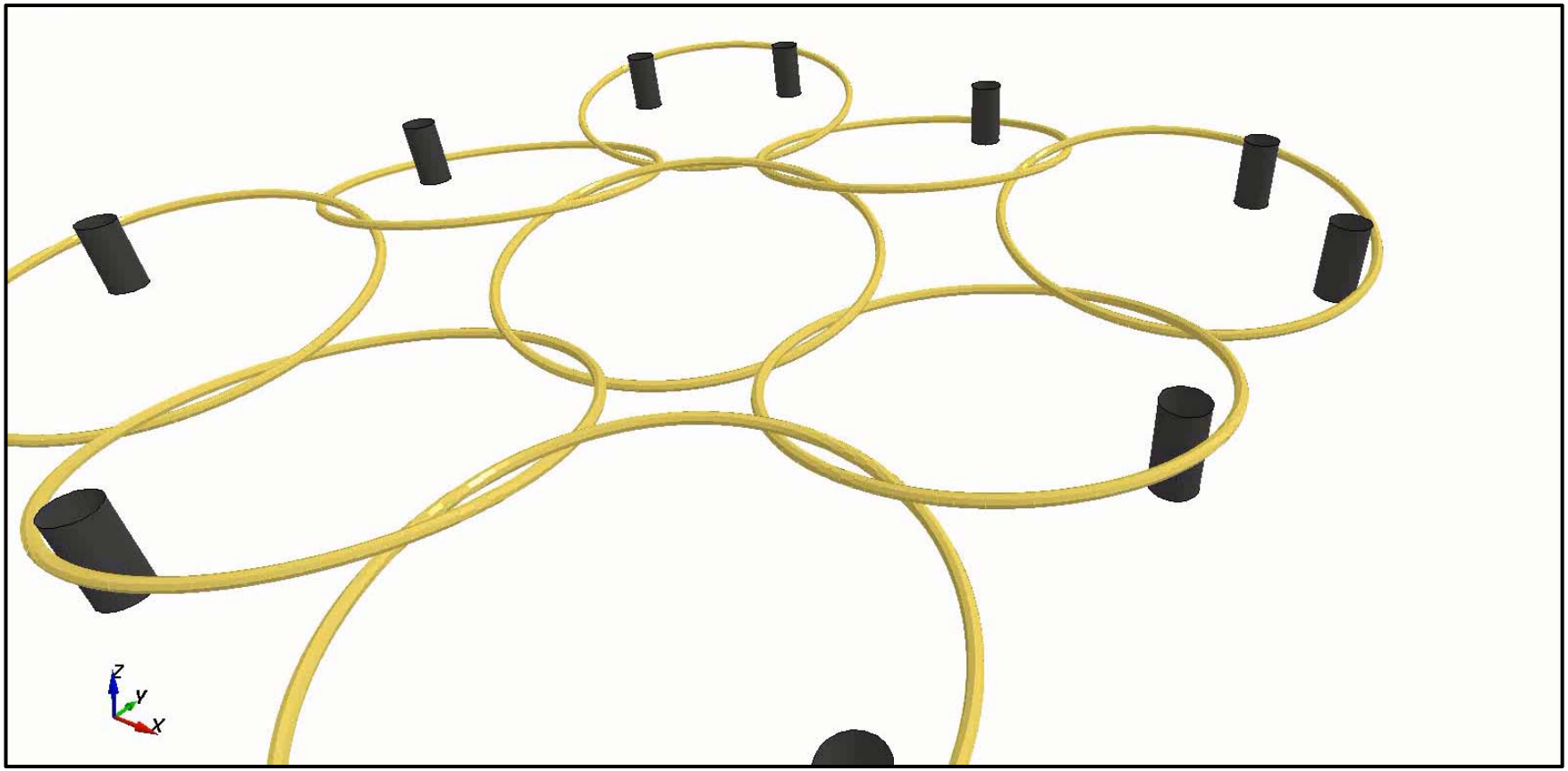


(2)



MACCAFERRI

TENSILE STRENGTH



MACCAFERRI

TENSILE STRENGTH UNI

MACCAFERRI

Tensile strength - HEA Panel 300 mm with 8 mm Wire Rope

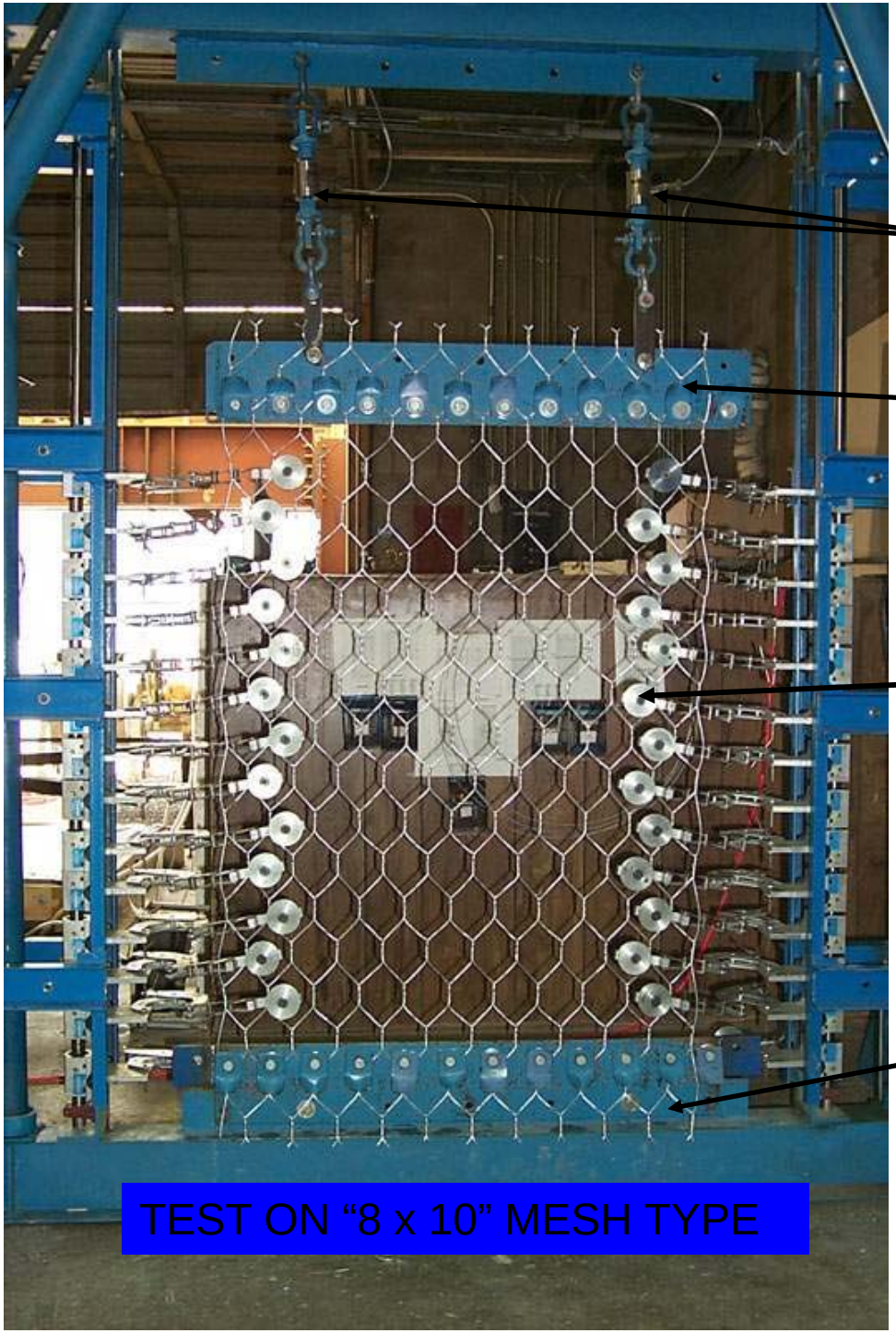
Average Load (kN/m)	**211.7**	
Average Displacement (mm/m)		79

MACCAFERRI

TENSILE STRENGTH – ASTM A975 DT MESH

Tensile Strength Test

- The width of a specimen shall not be less than seven repetitions of a mesh pattern, nor shall the length be less than fourteen repetitions.
- sides and the ends securely clamped at every mesh opening to a frame
- The apparatus shall grip the wire in such a manner as to allow the wire failures to occur at least one mesh pattern away from the gripping points. If a failure occurs in a wire leading directly to a gripping point that specimen shall be rejected, and not included among the tests reported.



Tensile strength parallel to the pull direction

Pulling apparatus (jacks)

Clamping equipment. The mesh is hooked along the “V” points.

Roller clamps
They are used to provide a lateral restraint during the tensioning. The also allow for a free adjustment of the mesh as elongation occurs along the pull direction.

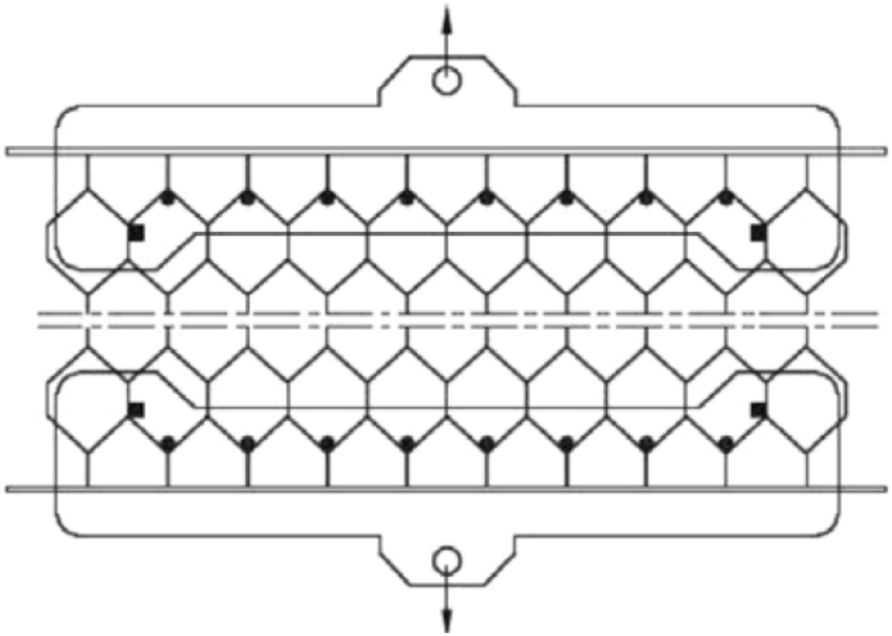
Base clamping plate. It is bolted to the to the base of the apparatus

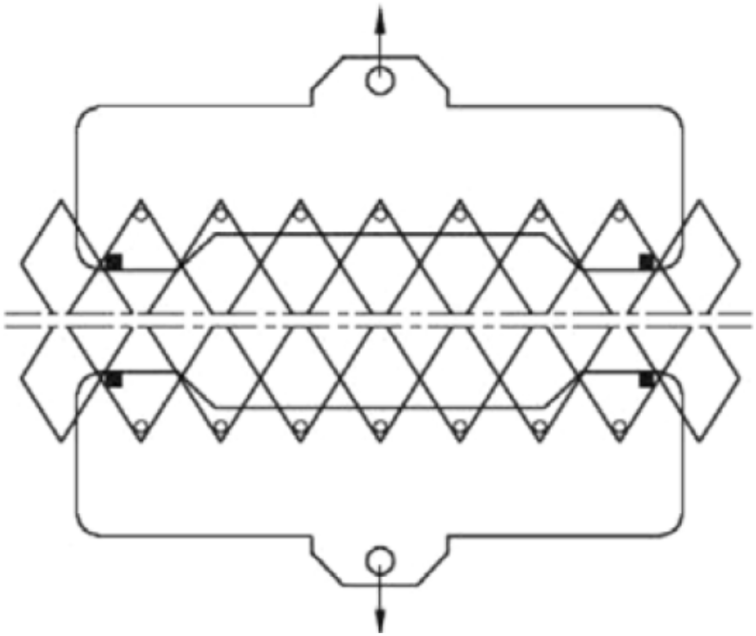
Test under run. Tension is being applied

Failure is reached as one or more wires break

MACCAFERRI

ISO/EN TENSILE STRENGTH





MACCAFERRI

ISO/EN TENSILE STRENGTH

MACCAFERRI

TENSILE STRENGTH TEST REPORT

- full description of sample (construction materials and relative strengths, construction characteristics, geometrical characteristics, technical details, etc.);
- identification of the test method used;
- nominal dimensions of test piece;
- detailed description of the test piece constraining condition, complete with photographic documentation;
- detailed description of the failure mode;
- actual tensile strength and maximum elongation;
- average tensile strength and maximum elongation;
- load - displacement diagram;
- photographic documentation of the test piece before and after the tests;
- description of instrumentation used and temperature during test.

MACCAFERRI

ASTM INTERNATIONAL
Standards Worldwide

http://www.astm.org/

THE ASSOCIATION OF GEOHAZARD PROFESSIONALS

http://www.geohazardassociation.org/