SISGEO LATINOAMERICA

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— CLEVER SOLUTIONS FOR DAM SAFETY AND MONITORING

Gianfranco Iannaccone

INDEX

- *Why dam monitoring?*
- *TEL-310* ***submergible*** *pendulum*
- *MEXID* ***miniaturized*** *MPBX*
- *BH* ***profile*** *inclinometers*
- *DEX-S automatic* ***extenso-inclinometers***
- *OMNIAlog* ***network*** *data acquisition system*

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WHY DAM MONITORING?

The most common causes of failure of operating dams are:

- poor construction materials
- geological instability
- landslide into reservoir
- poor maintenance
- human, computer or design error
- internal erosion (earth-fill dams)
- earthquakes

→ **Inadequate monitoring system**

Vajont Dam, Italy

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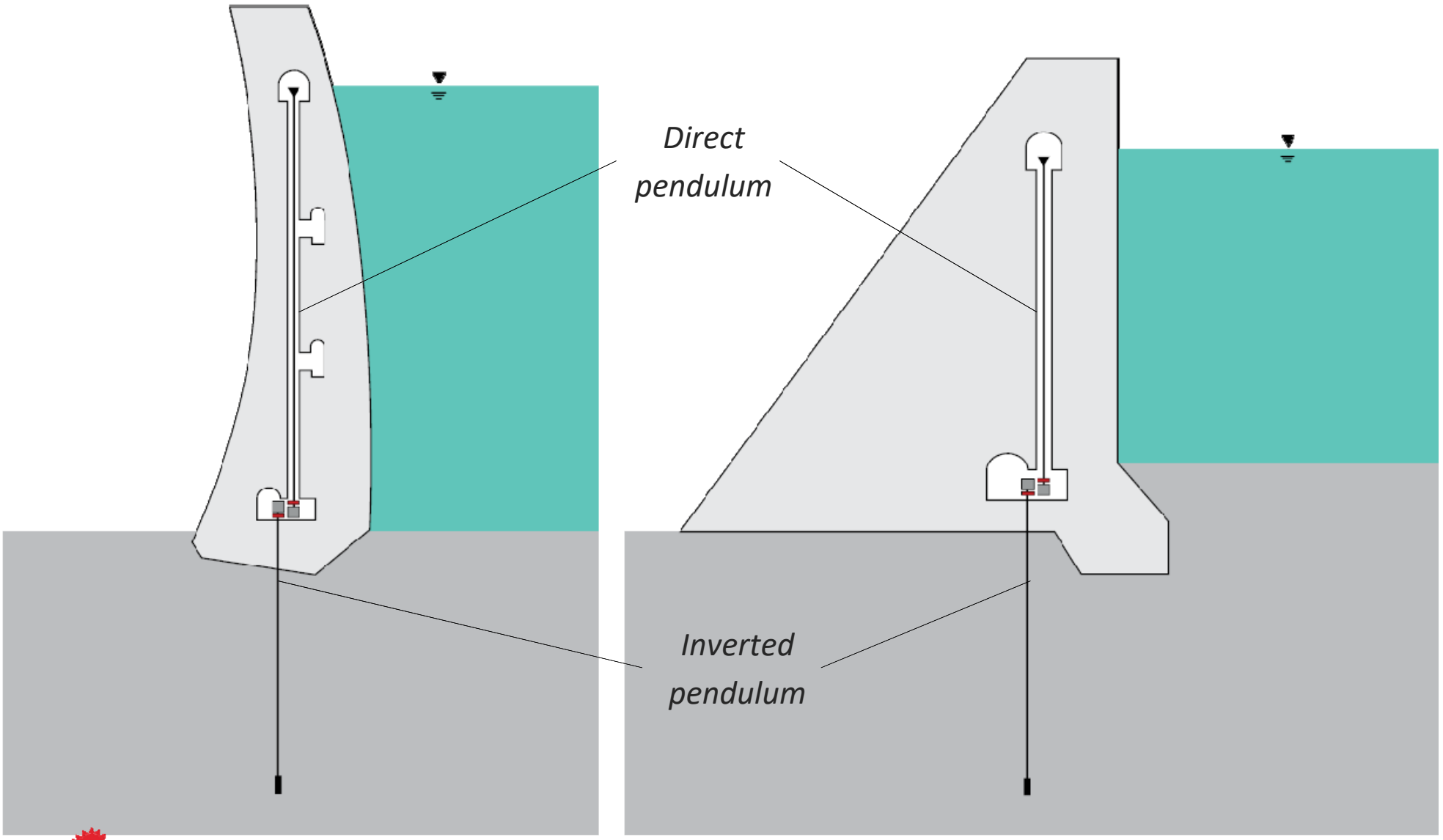
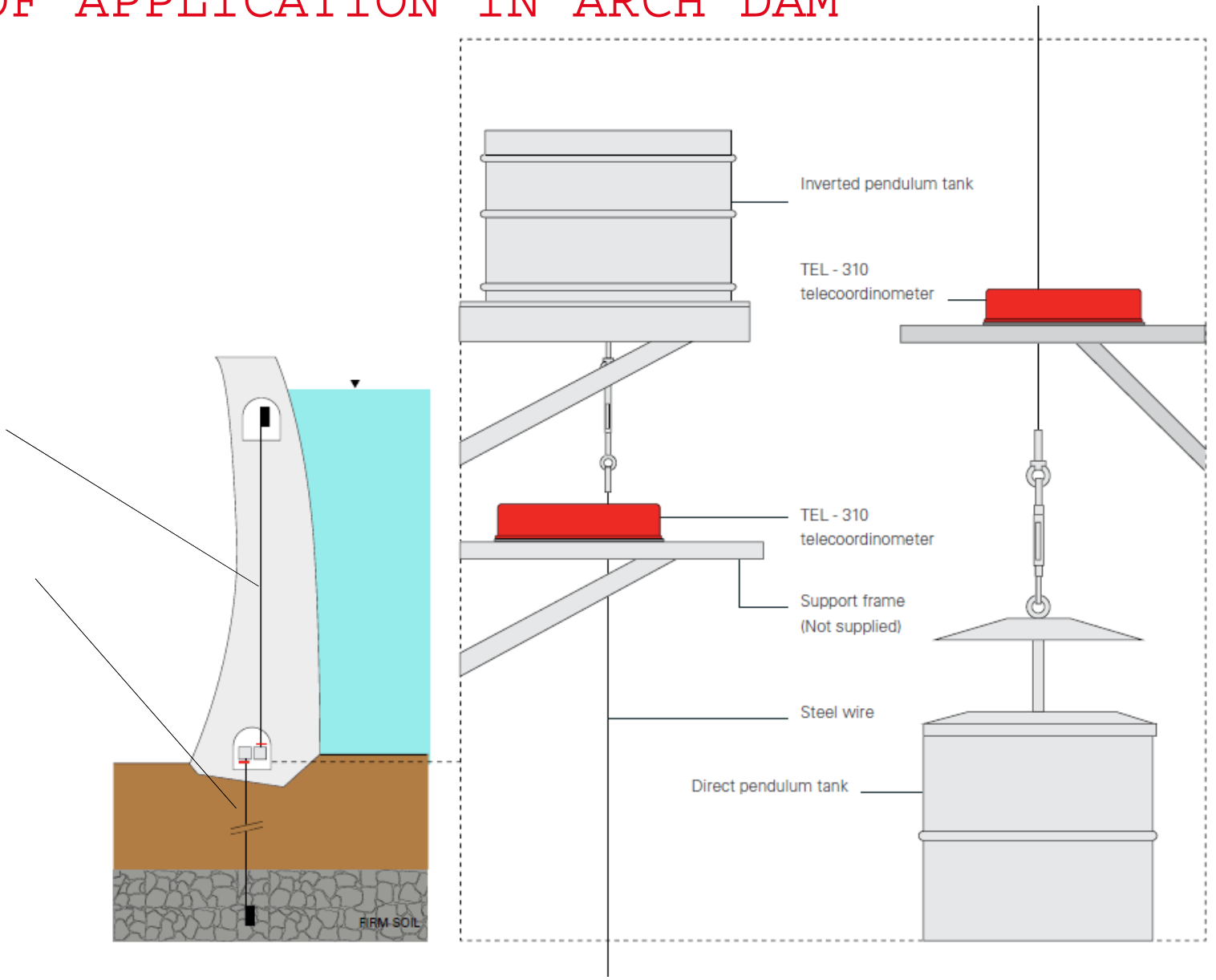
PENDULUMS:
APPLICATIONS IN ARCH AND GRAVITY DAMS



TEL-310 SUBMERGIBLE TELEPENDULUM:
EXAMPLE OF APPLICATION IN ARCH DAM

Direct pendulum

Inverted pendulum



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TEL-310 SUBMERGIBLE TELEPENDULUM

WHAT HAPPEN IN CASE OF FLOODING INTO THE GALLERIES??

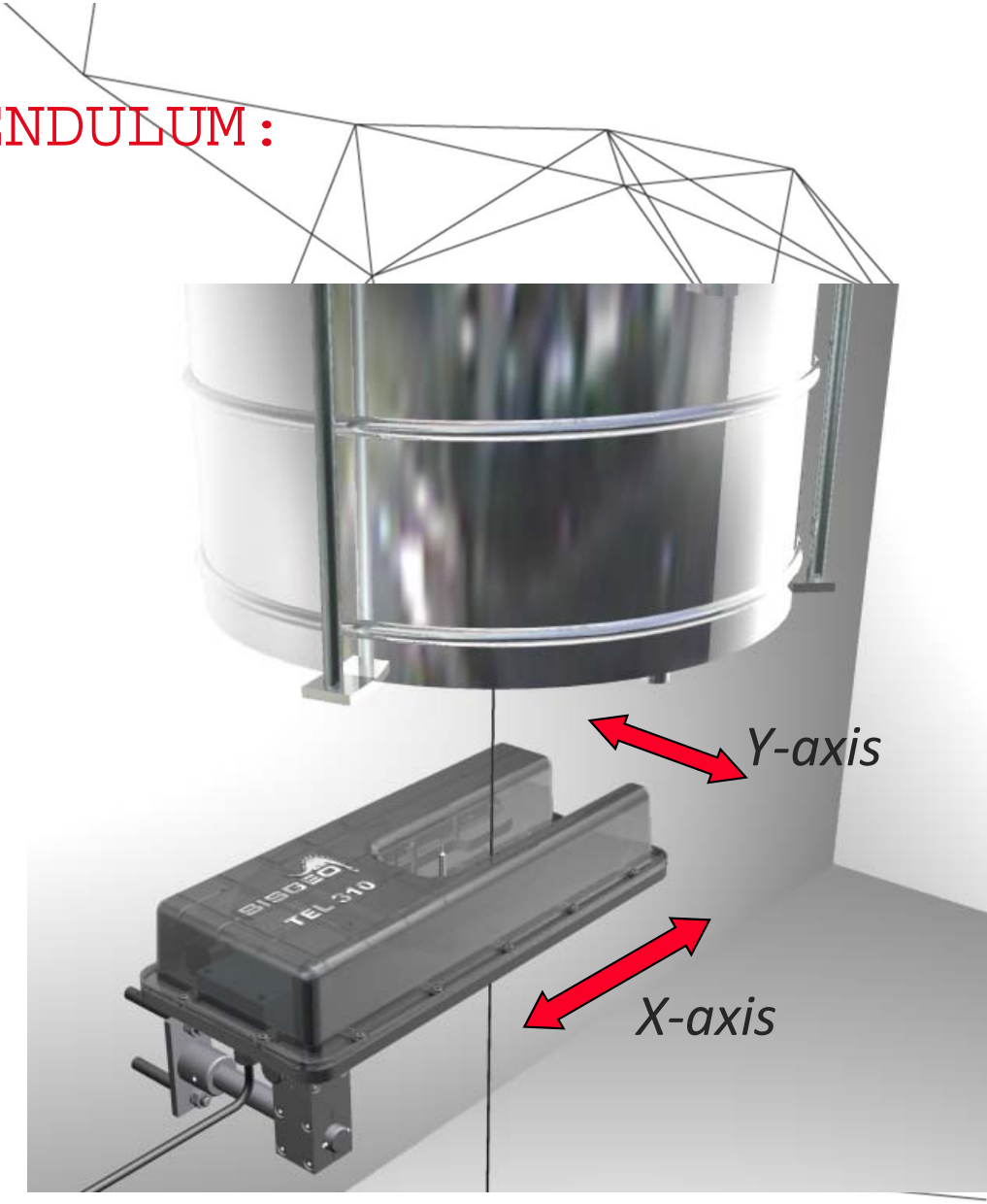
Telependulums and all their components will be submerged by water / mud

SISGEO TEL-310 telependulum is the ONLY ONE in the market with IP68 protection (waterproof).

After flooding just clean the optical unit and run!

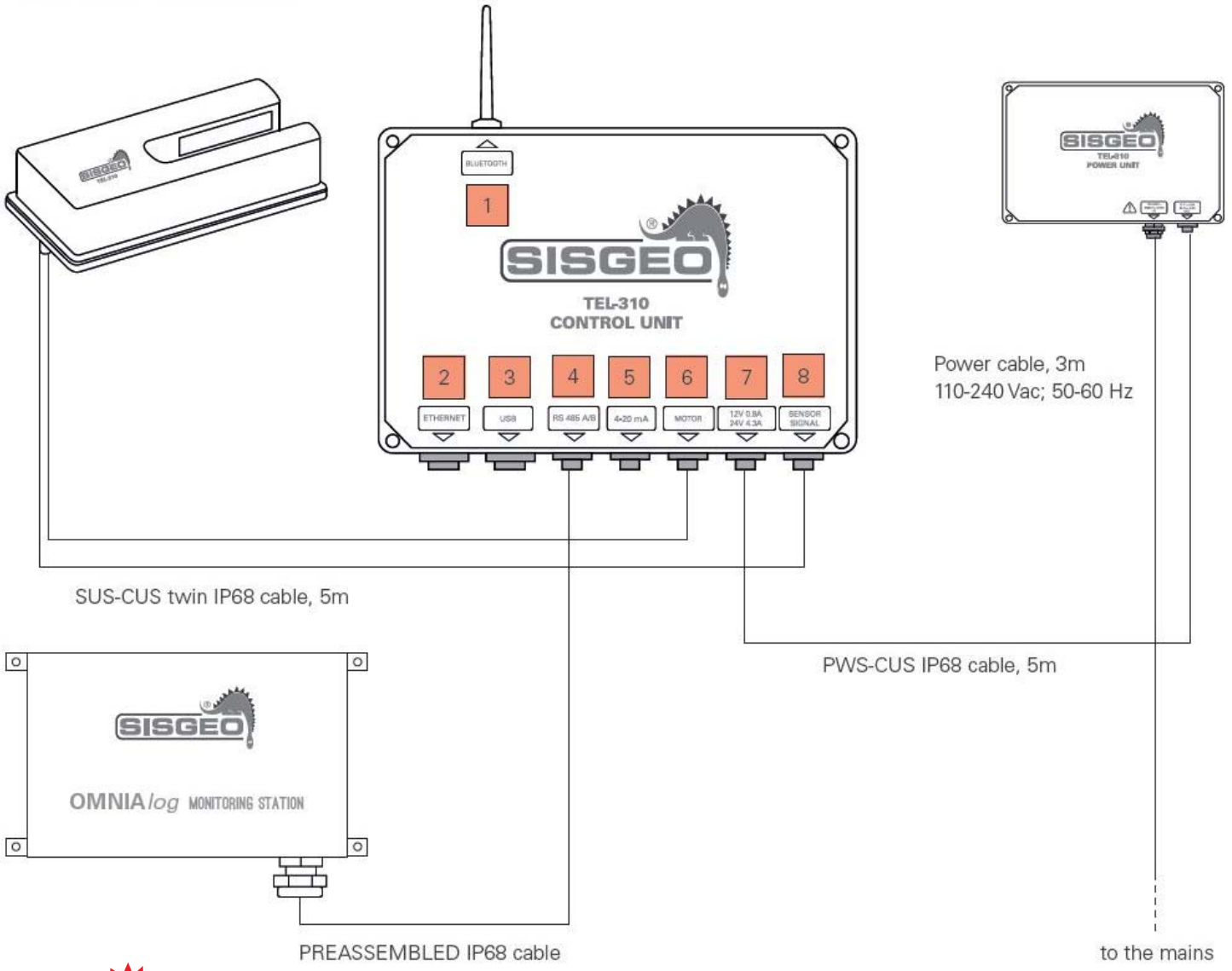
TEL-310 SUBMERGIBLE TELEPENDULUM: MAIN FEATURES

- *Wide measuring range: 60x145mm;*
- *Waterproof components IP68 until 50kPa (5m water head);*
- *Remote auto-diagnostic through "log file";*
- *High level built-in software for data elaboration and validation.*



Datasheet: http://www.sisgeo.com/uploads/schede/schede/TEL310_EN_01_telependulum_telecoordinometer.pdf

TEL-310: WIRING SCHEME



ALL the components *(boxes, connectors, cables) are* ***waterproof IP68 up to 50 kPa***

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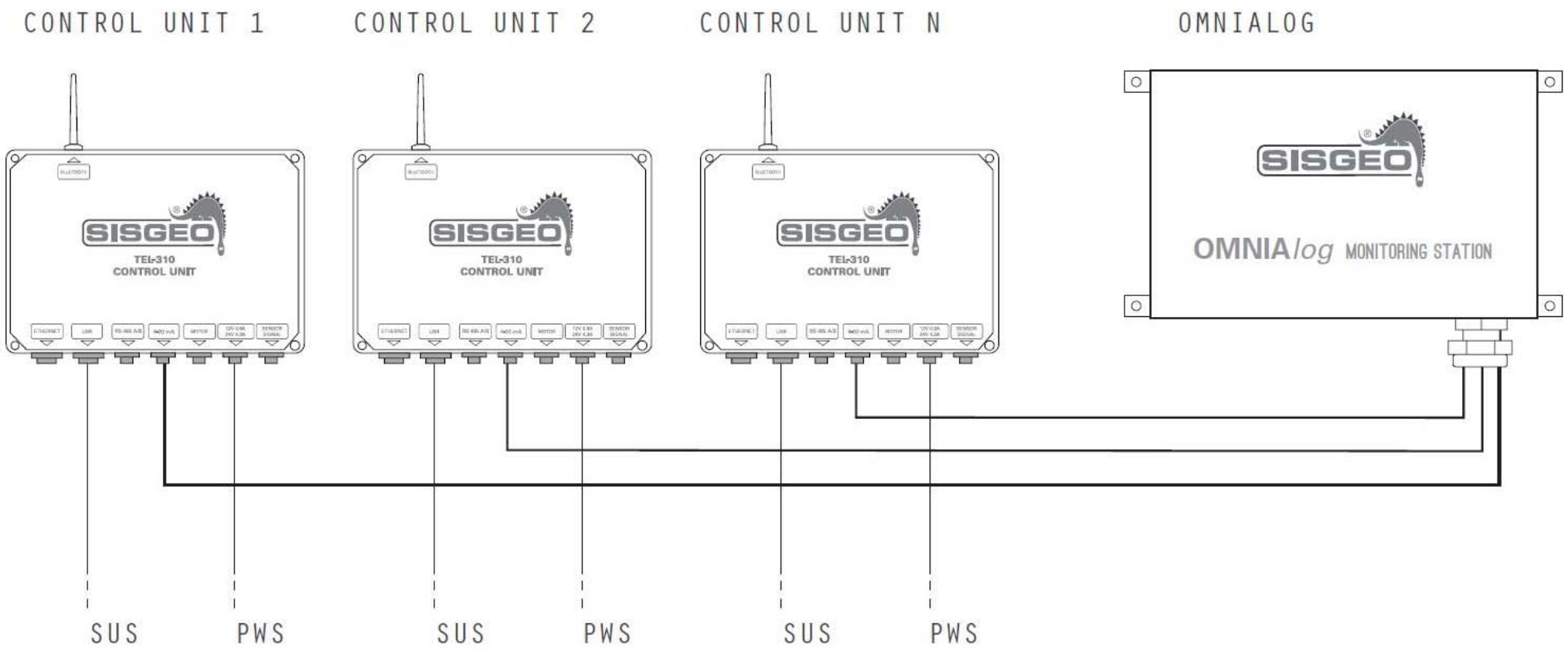
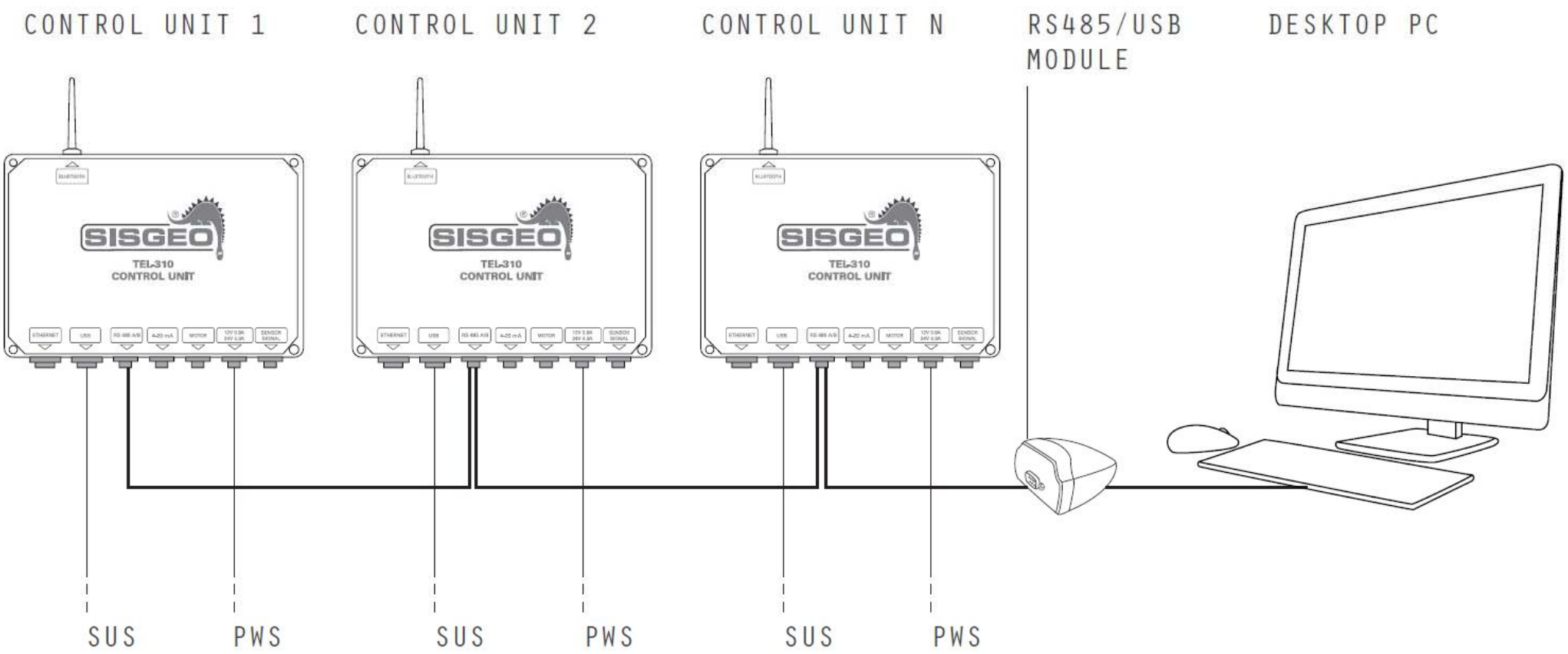
TEL-310: LOGGER ANALOGUE NETWORK



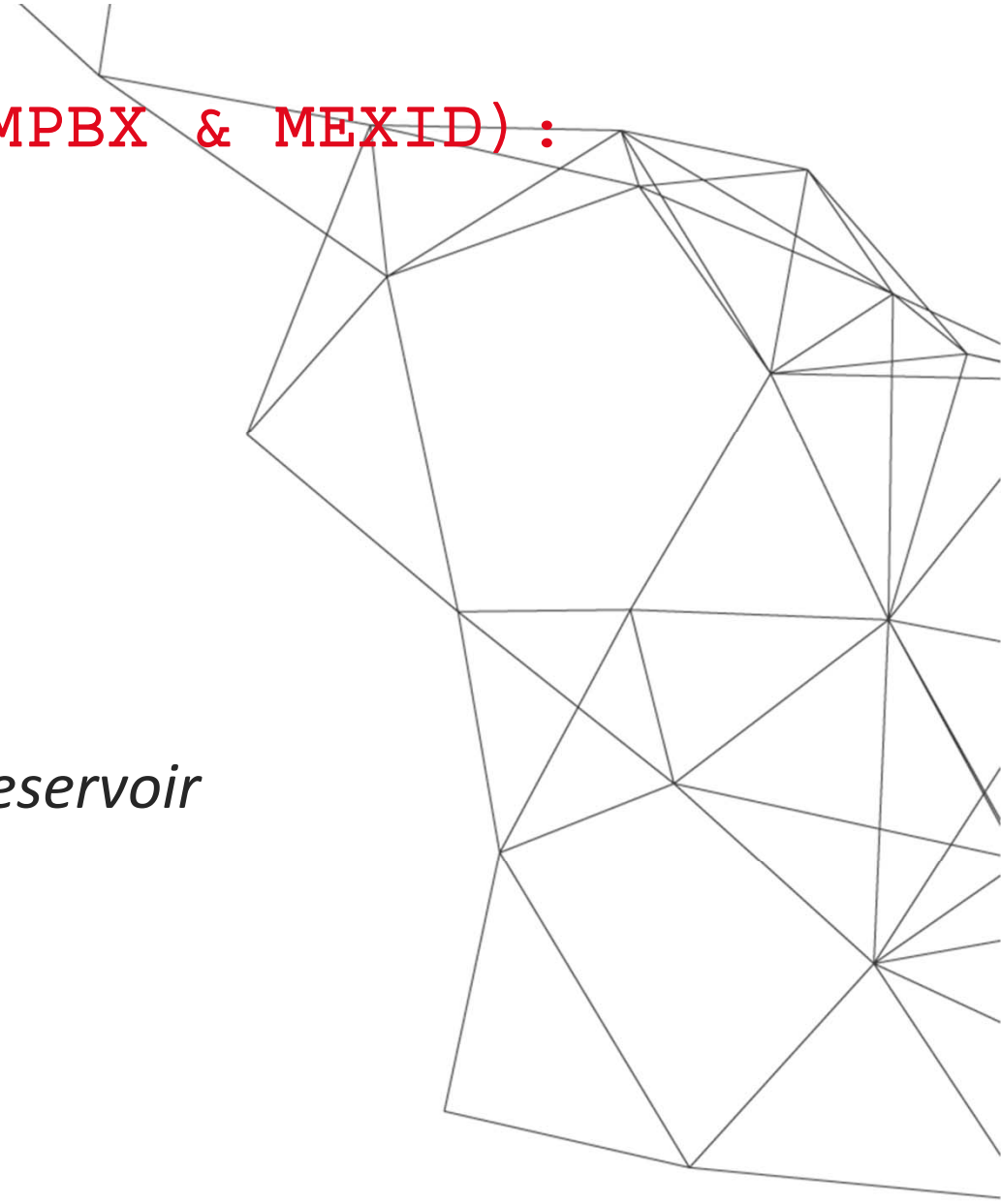
TEL-310: RS485-PC DIGITAL NETWORK



BOREHOLE EXTENSOMETERS (MPBX & MEXID): APPLICATION AND AIM

MPBX and MEXID can be installed in:

- *dam foundations*
- *dam abutments*
- *rockfall / topple landslide over the reservoir*



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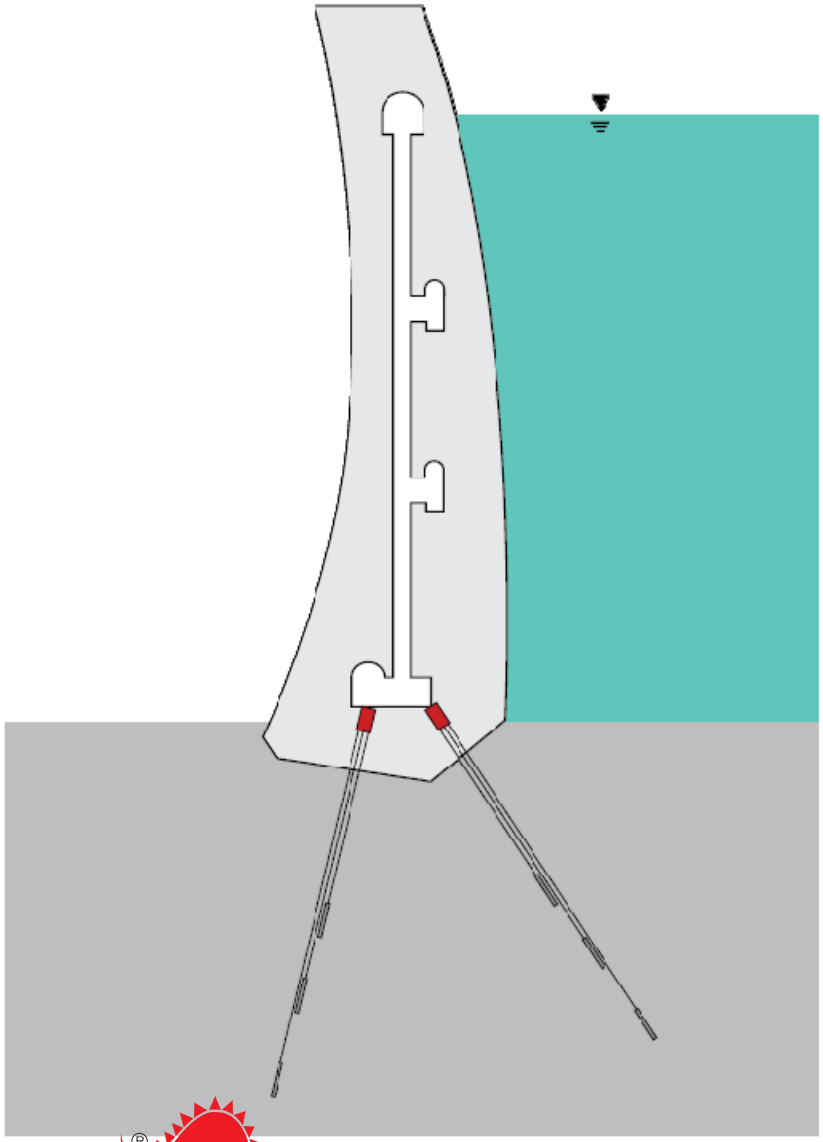
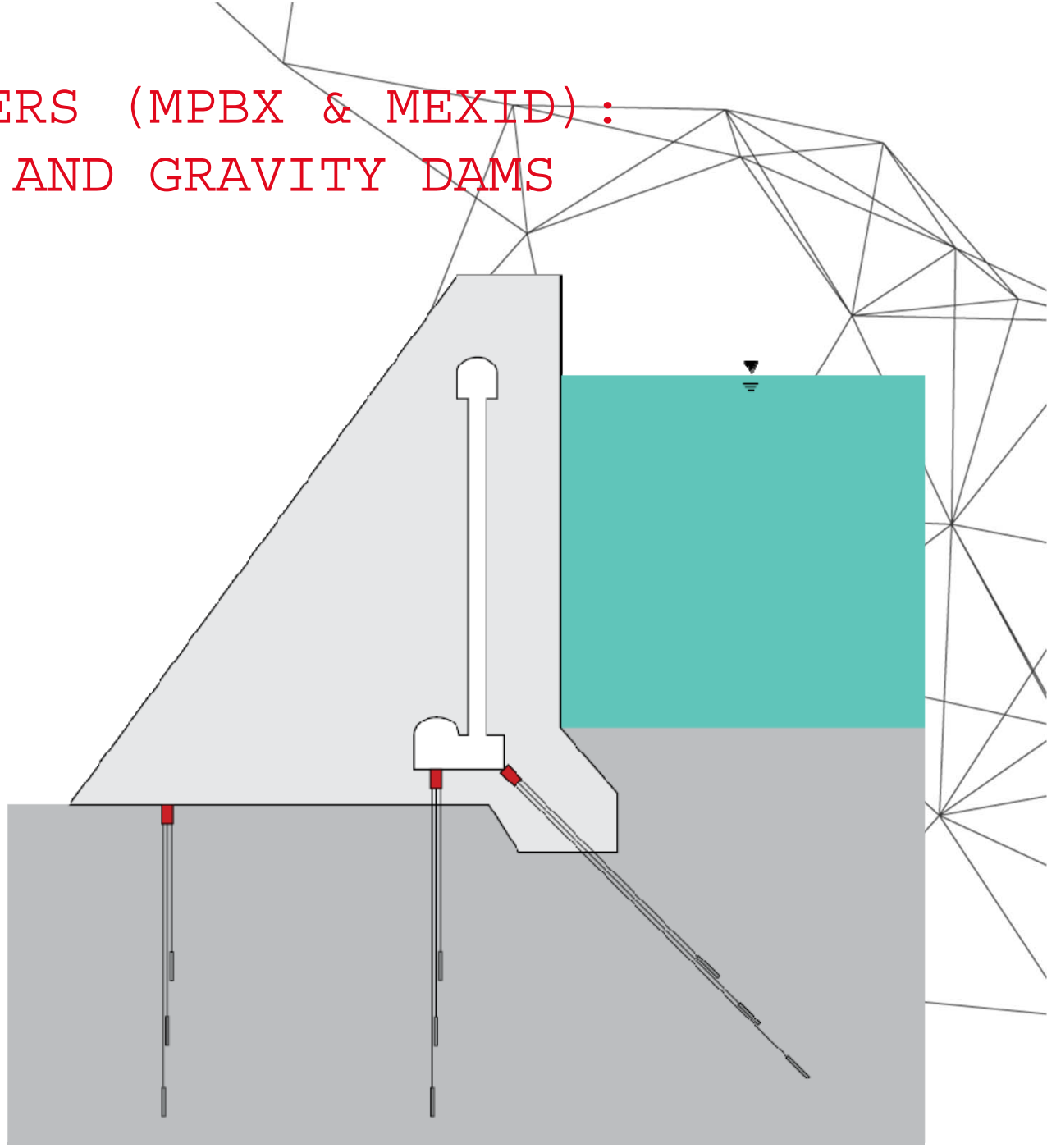
BOREHOLE EXTENSOMETERS (MPBX & MEXID): APPLICATION IN ARCH AND GRAVITY DAMS





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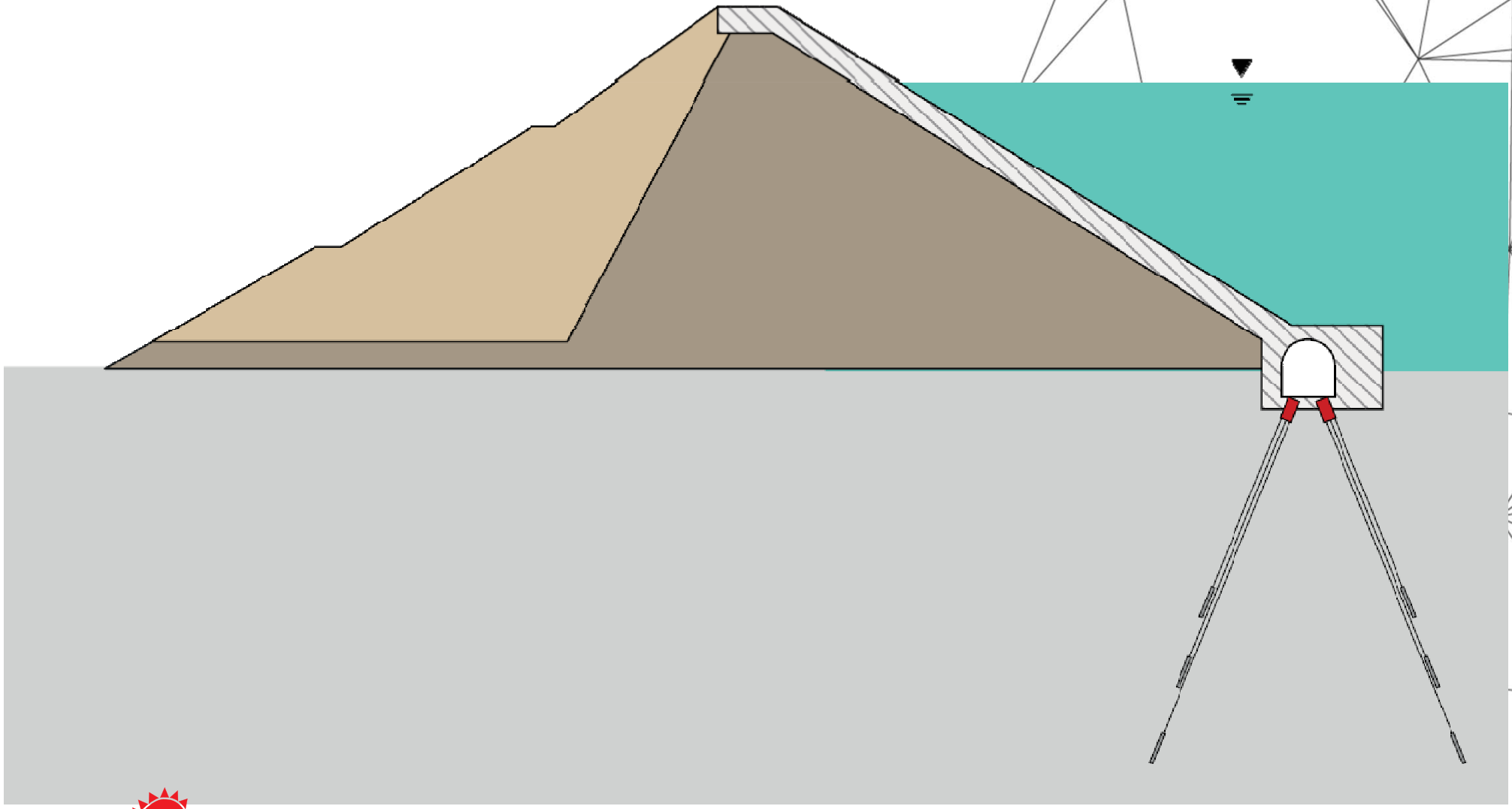
BOREHOLE EXTENSOMETERS (MPBX & MEXID): APPLICATION IN EMBANKMENT DAM



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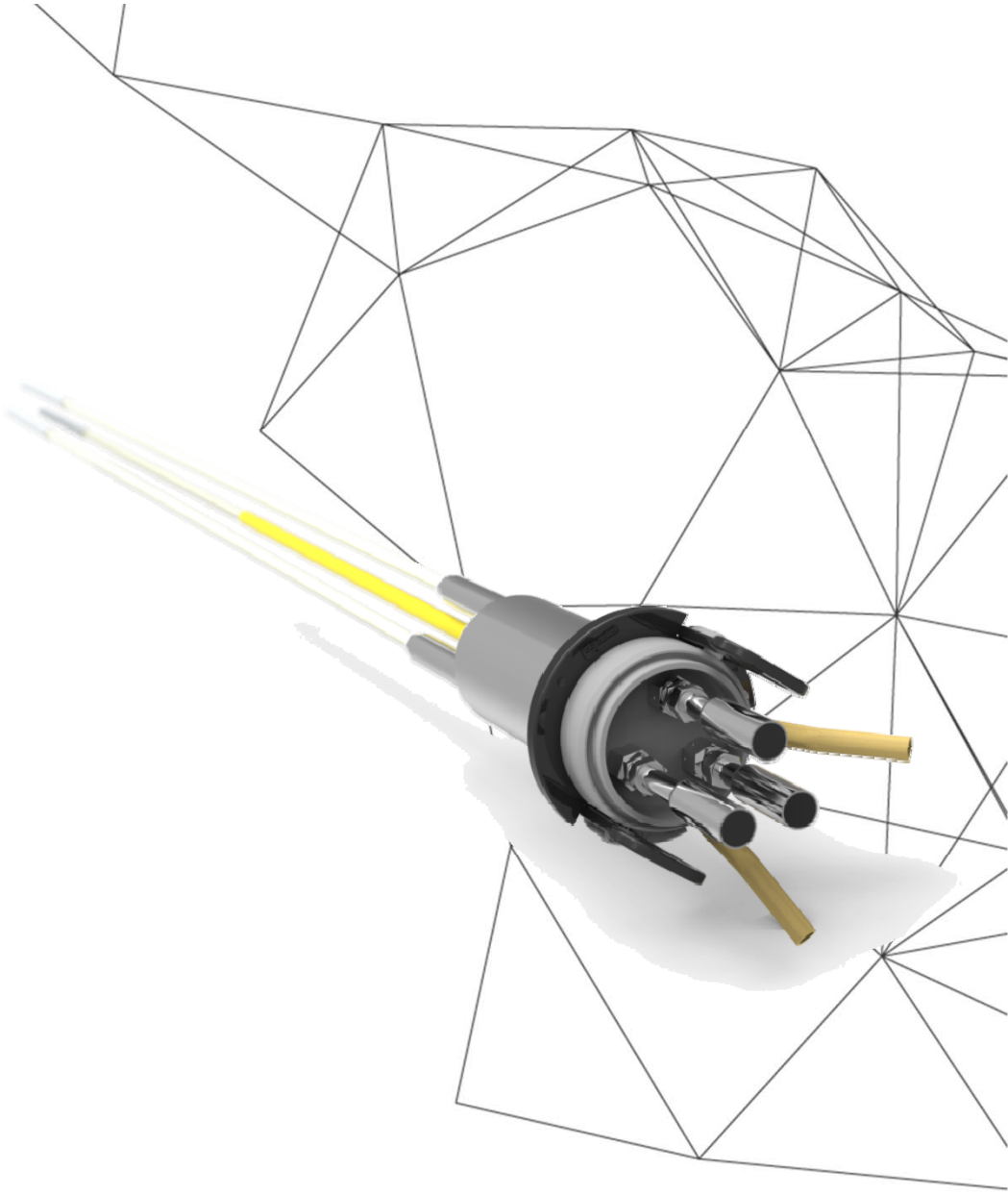
BOREHOLE EXTENSOMETERS: WHY MEXID?

Sometimes to drill the borehole for MPBX become a problem or impossible:

Required drill hole:
Ø 101 mm (4"),
Ø140 mm (5.5”) first meter



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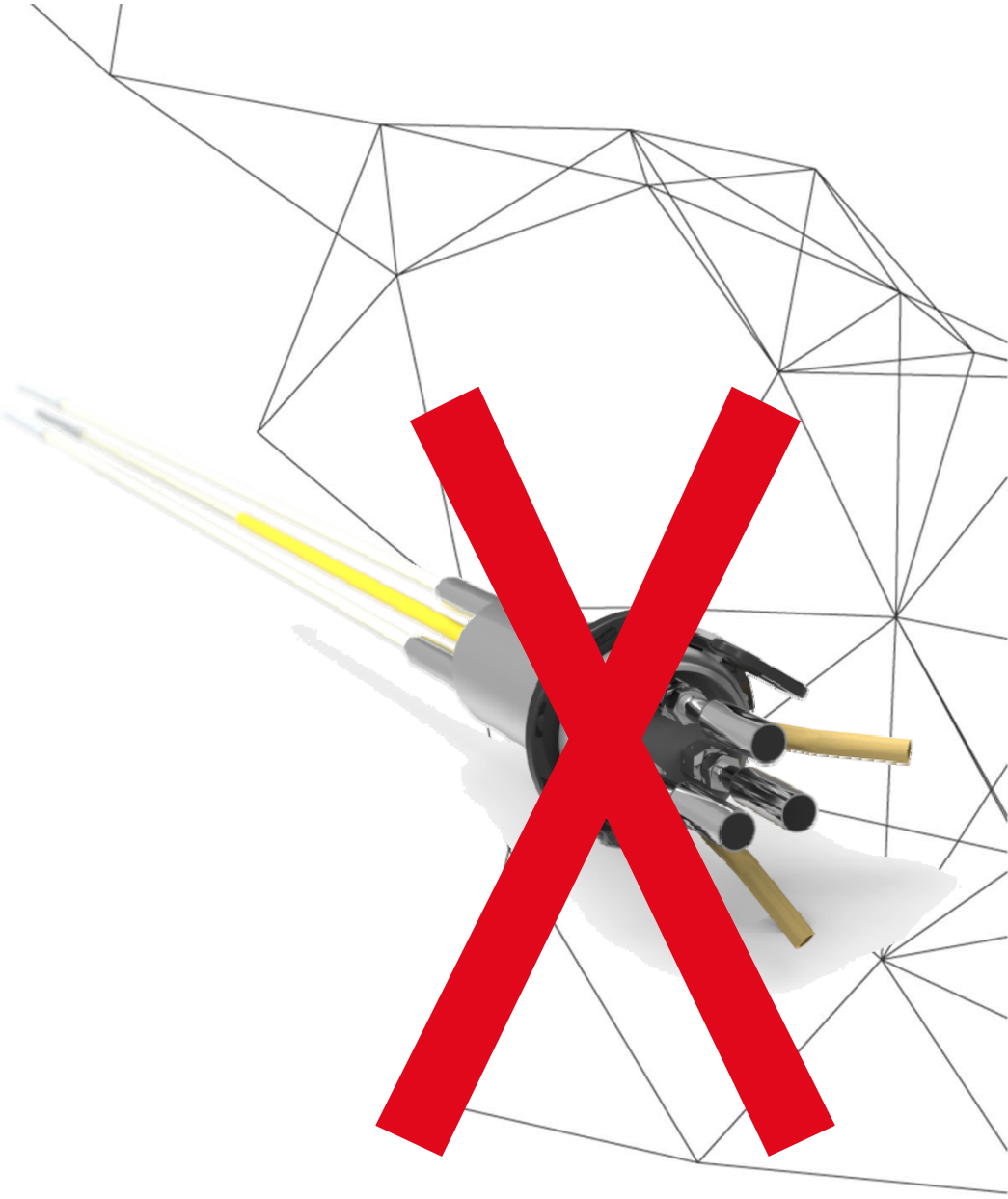
BOREHOLE EXTENSOMETERS: MEXID SOLUTION

Sometimes to drill the borehole for MPBX become a problem or impossible:

Required drill hole:
Ø 101 mm (4"),
Ø140 mm (5.5”) first meter

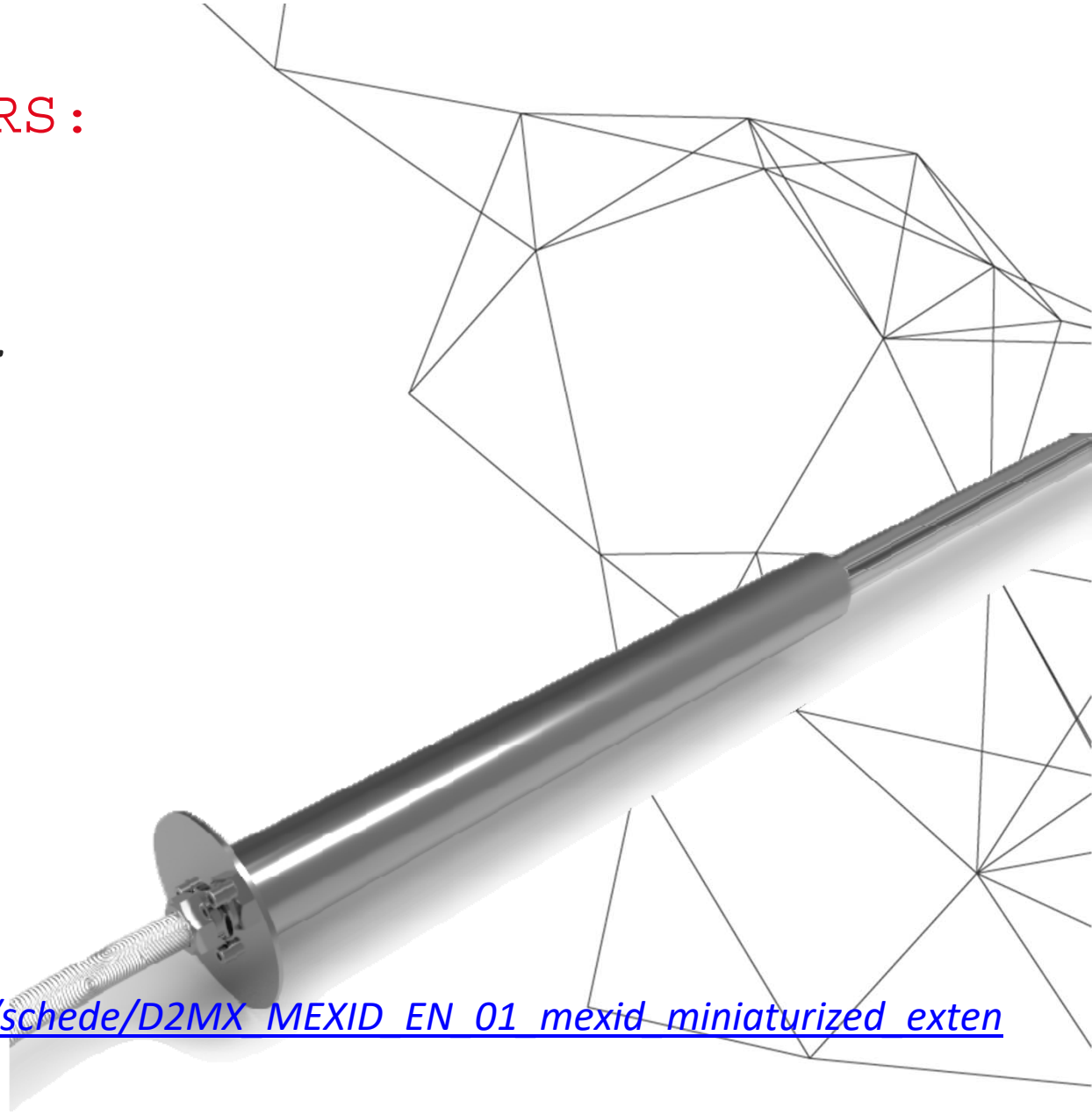
i.e.: DAM REHABILITATION



BOREHOLE EXTENSOMETERS: MEXID SOLUTION

Required drill hole for MEXID:
Ø 50 mm (2"),
Ø 75 mm (3") first meter

Portable and small drilling machine can be utilized

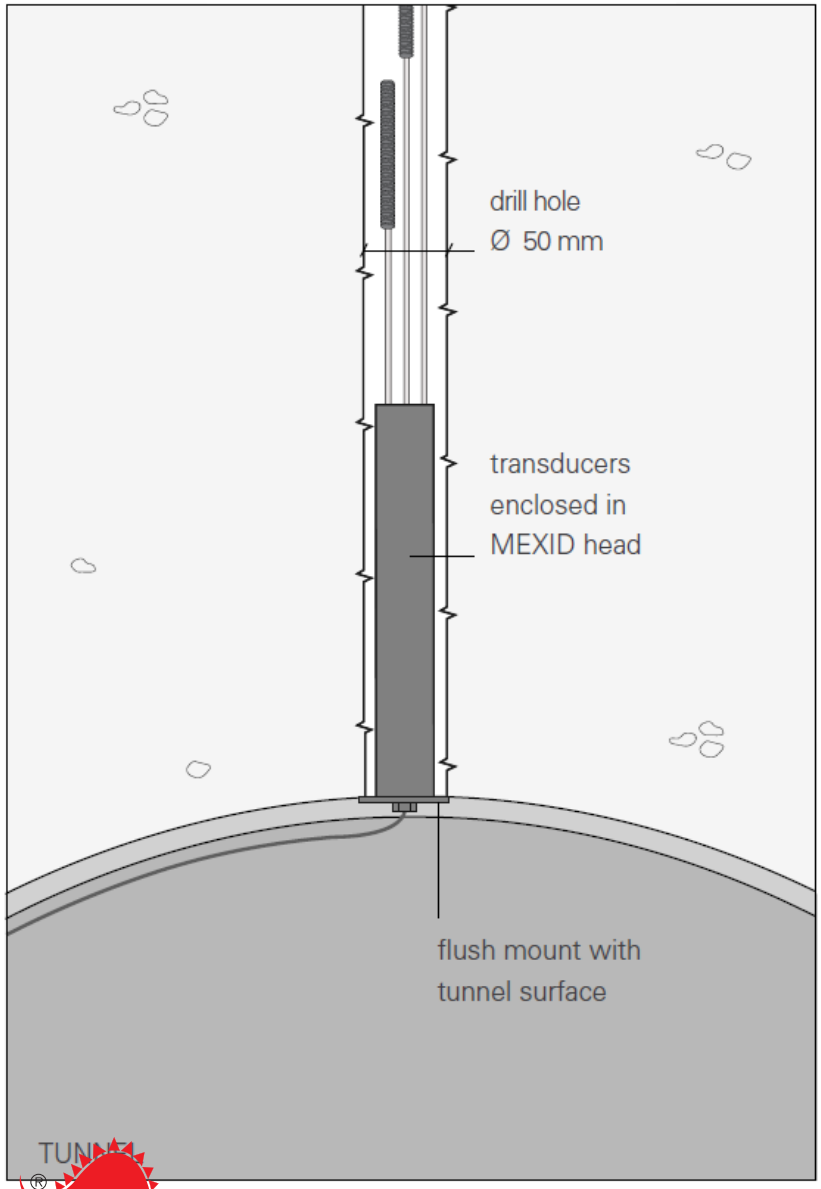


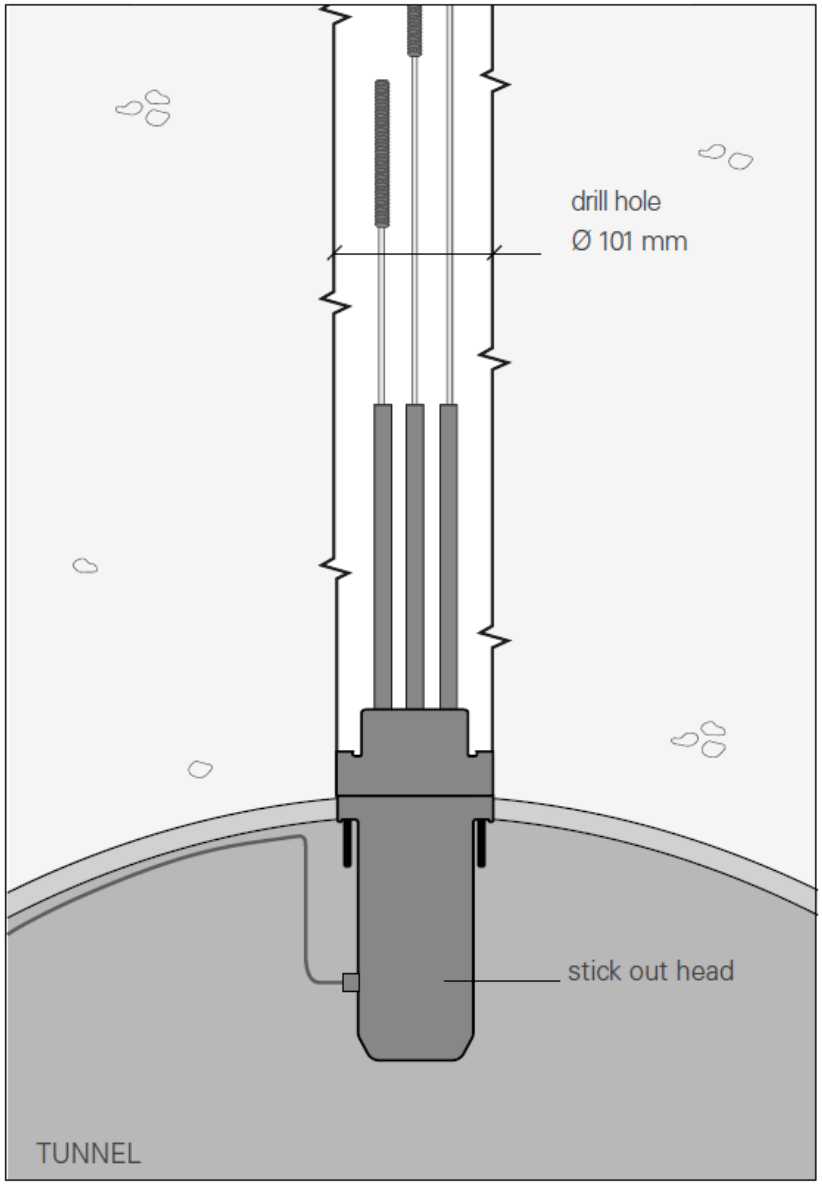
Datasheet:
http://www.sisgeo.com/uploads/schede/schede/D2MX_MEXID_EN_01_mexid_miniaturized_extensometer.pdf

ENGURI DAM - Georgia

ENGURI DAM – Georgia – 2° highest arch dam in the World

MEXID Vs MPBX





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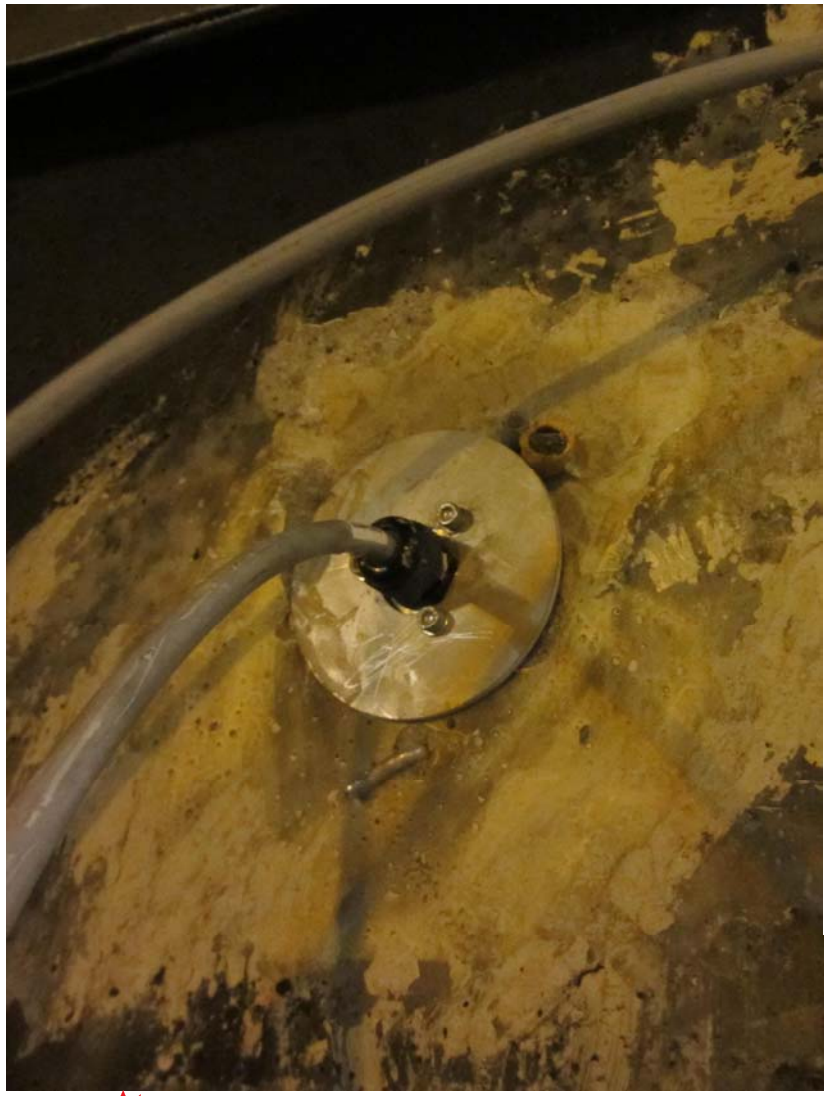
MEXID Vs MPBX



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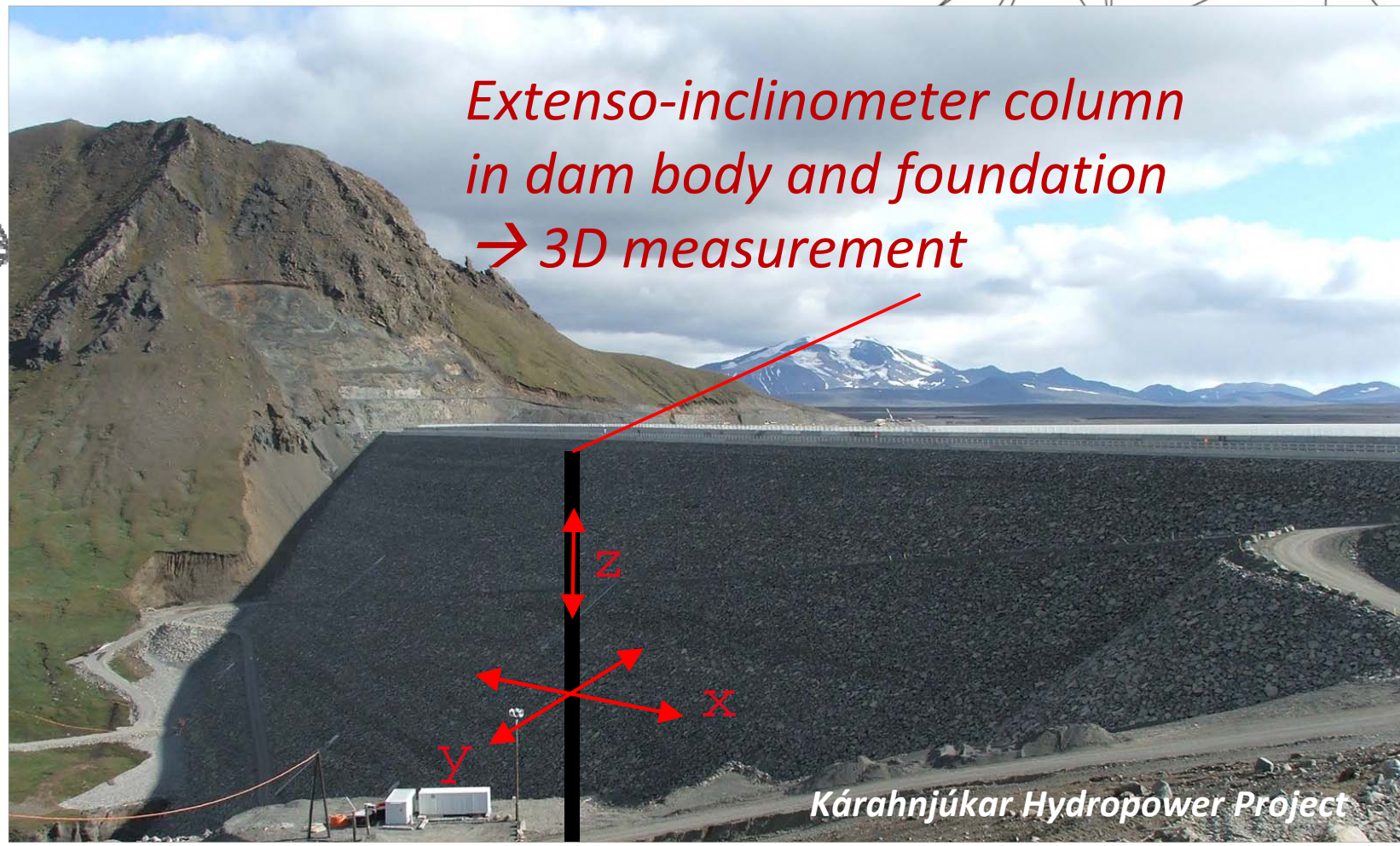
DEX-S 3-D EXTENSO-INCLINOMETERS



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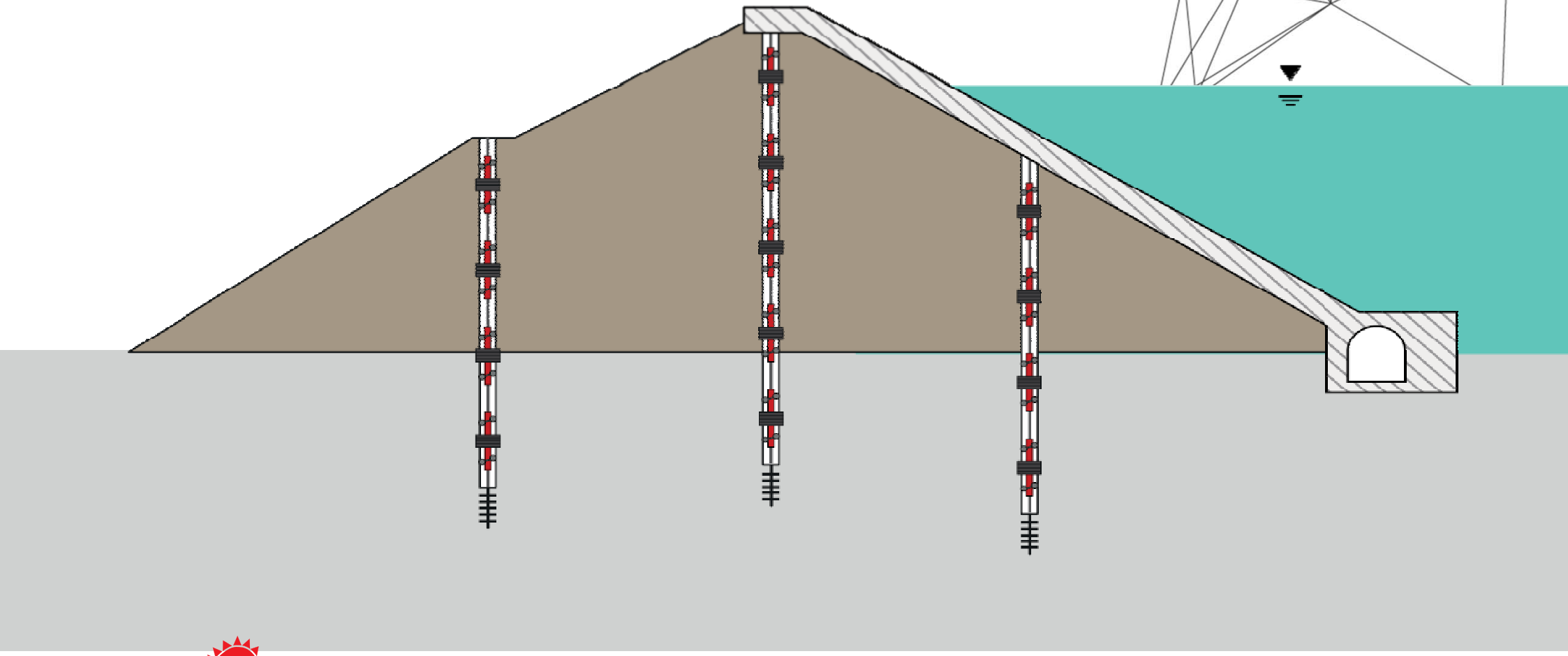
DEX-S 3-D EXTENSO-INCLINOMETERS: APPLICATION IN MEMBRANE EMBANKMENT DAMS



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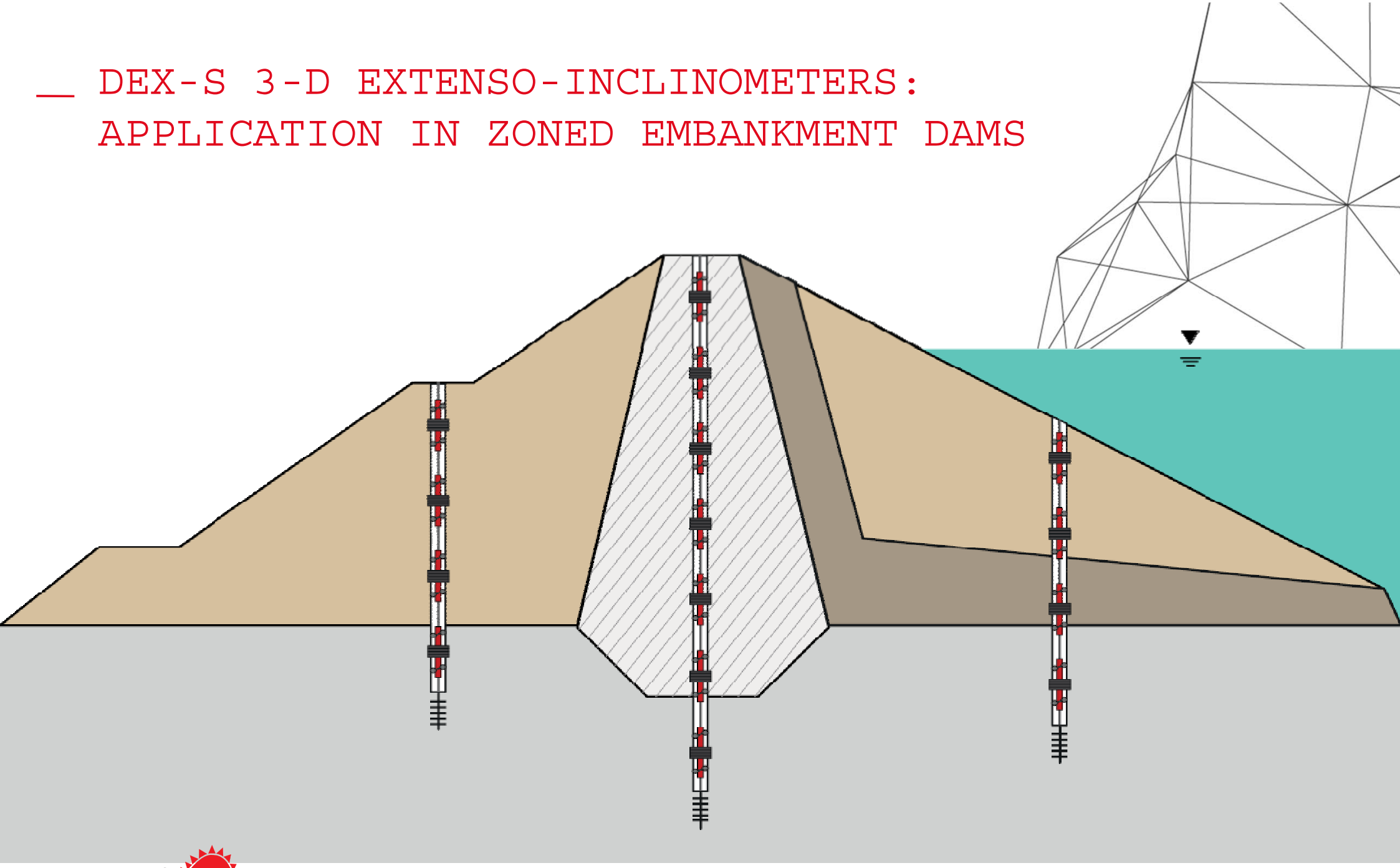
DEX-S 3-D EXTENSO-INCLINOMETERS: APPLICATION IN ZONED EMBANKMENT DAMS



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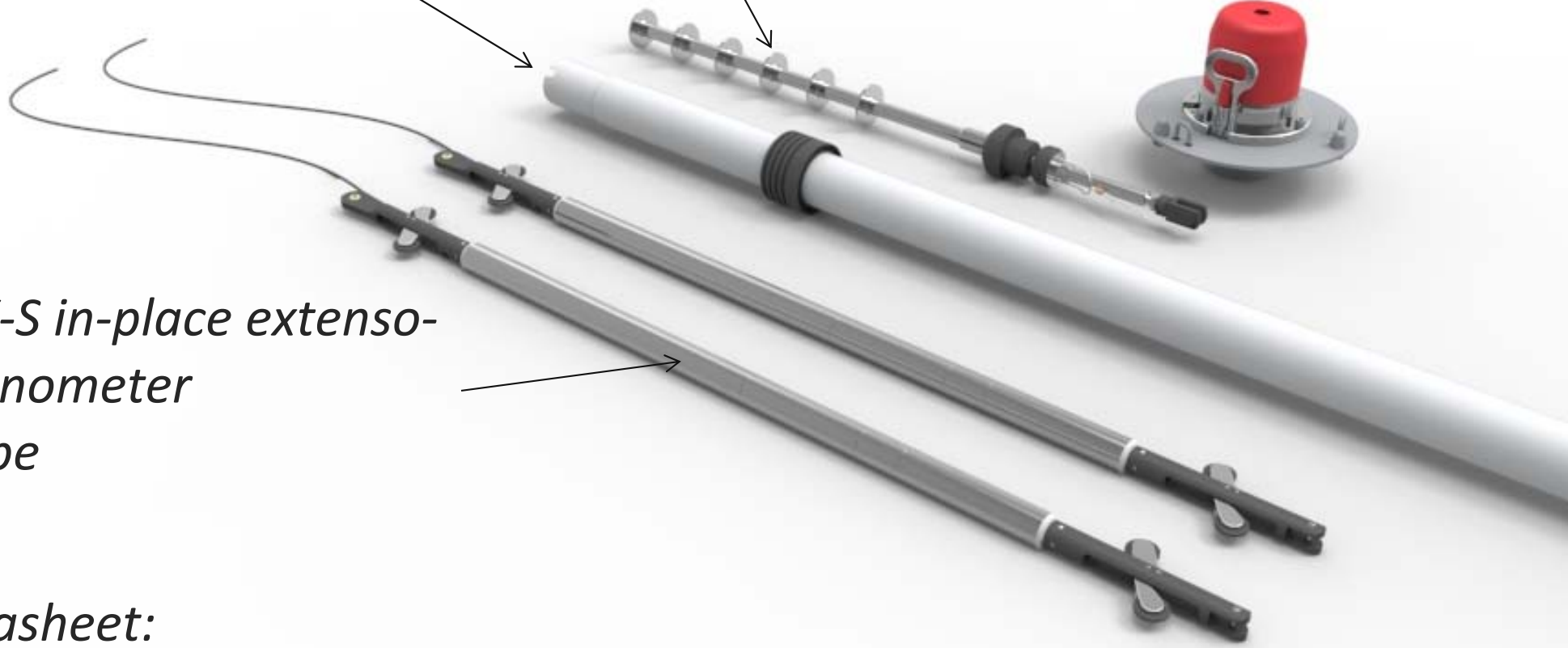
CLEVER SOLUTIONS FOR DAM SAFETY AND MONITORING

DEX-S: MAIN COMPONENTS

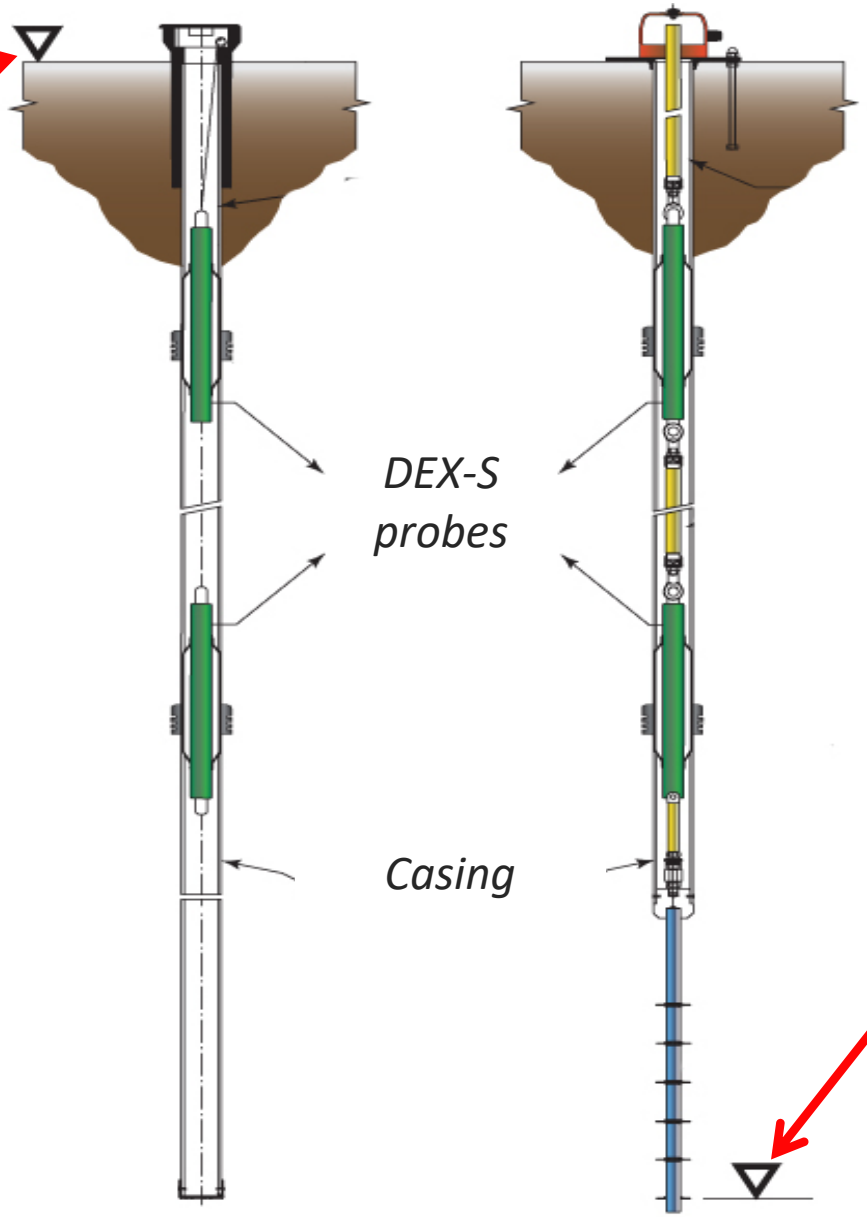


Datasheet:

http://www.sisgeo.com/uploads/schede/schede/dex_en.pdf

DEX-S: INSTALLATION METHODS

DEX-S chain with upper reference (hanging from the top)



DEX-S chain with lower reference (stiff chain connected to the bottom anchor)

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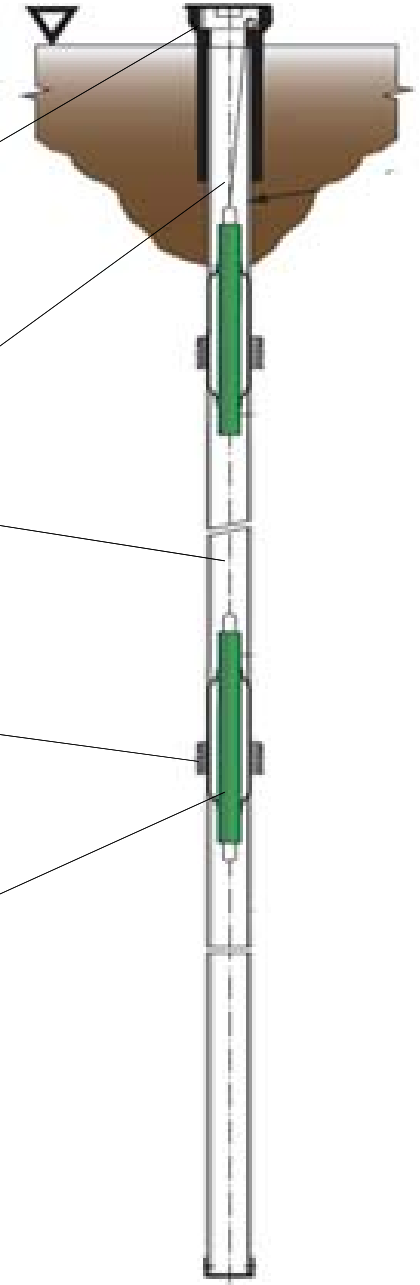
DEX-S INSTALLATION: SUSPENDED FROM THE TOP

Top cap

Suspending steel cable

Magnet ring

DEX or DEX-S probe



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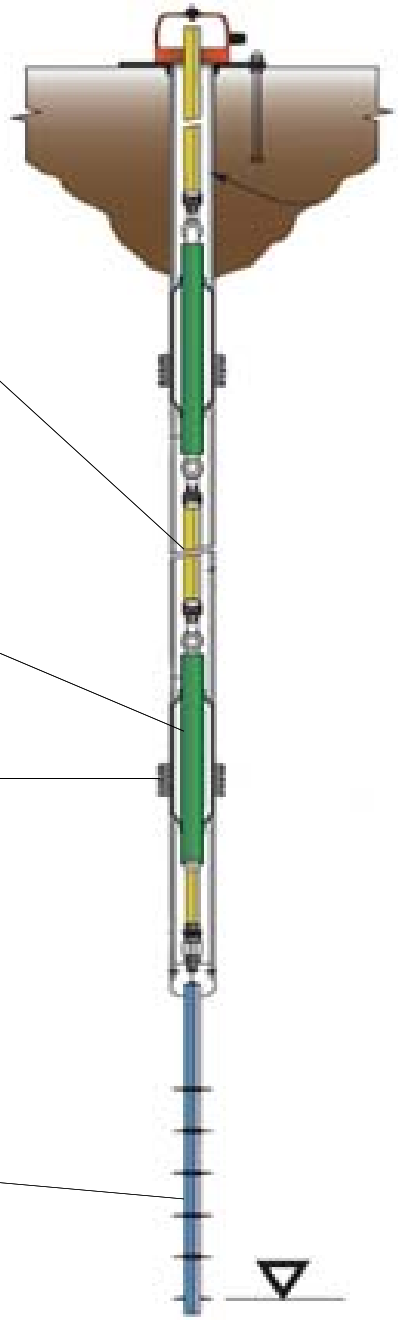
DEX-S INSTALLATION: BOTTOM ANCHOR

Steel placing rod

DEX or DEX-S probe

Magnet ring

Bottom anchor reference



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BH PROFILE INCLINOMETERS: APPLICATION AND AIM

BH Profile inclinometers can be installed in:

- *dam body*
- *dam upstream face*
- *dam abutments*

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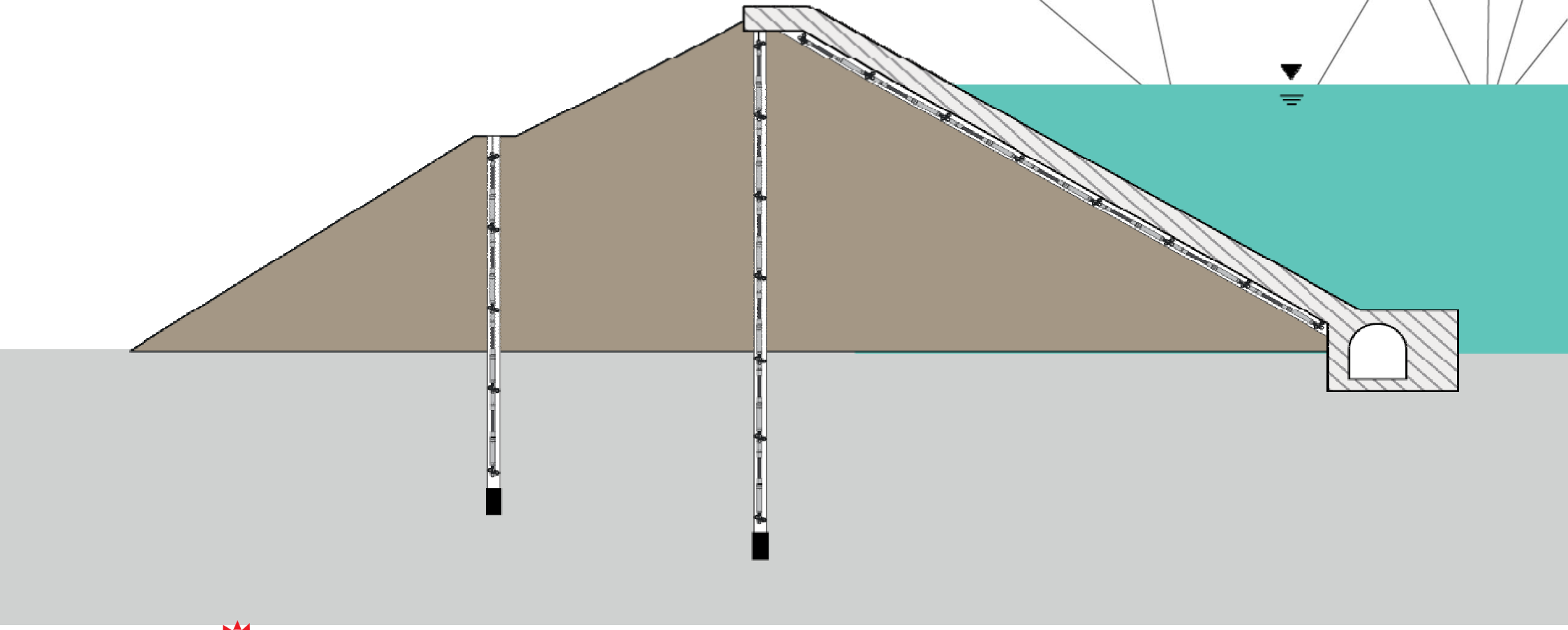
BH PROFILE INCLINOMETERS: APPLICATION IN MEMBRANE EMBANKMENT DAMS



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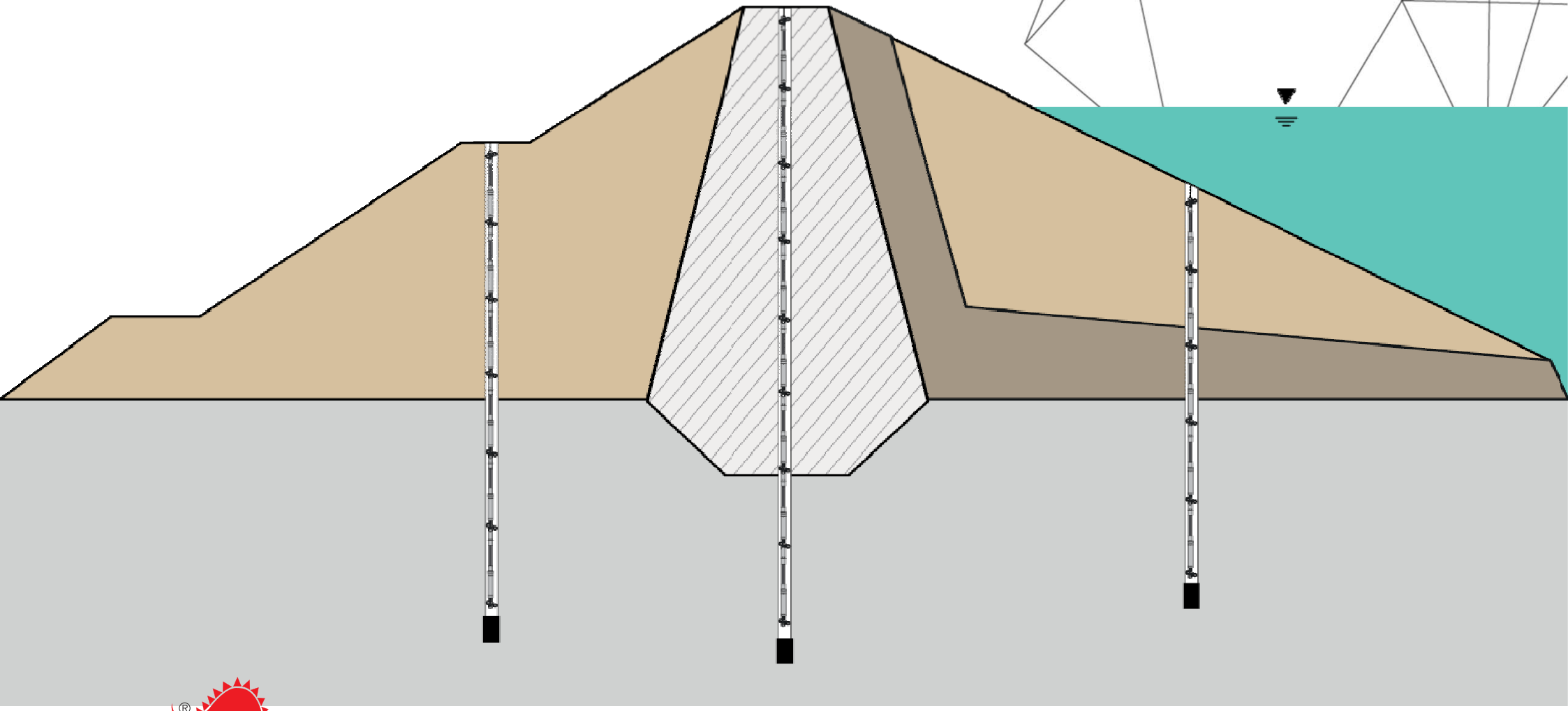
CLEVER SOLUTIONS FOR DAM SAFETY AND MONITORING

BH PROFILE INCLINOMETERS: APPLICATION IN ZONED EMBANKMENT DAMS



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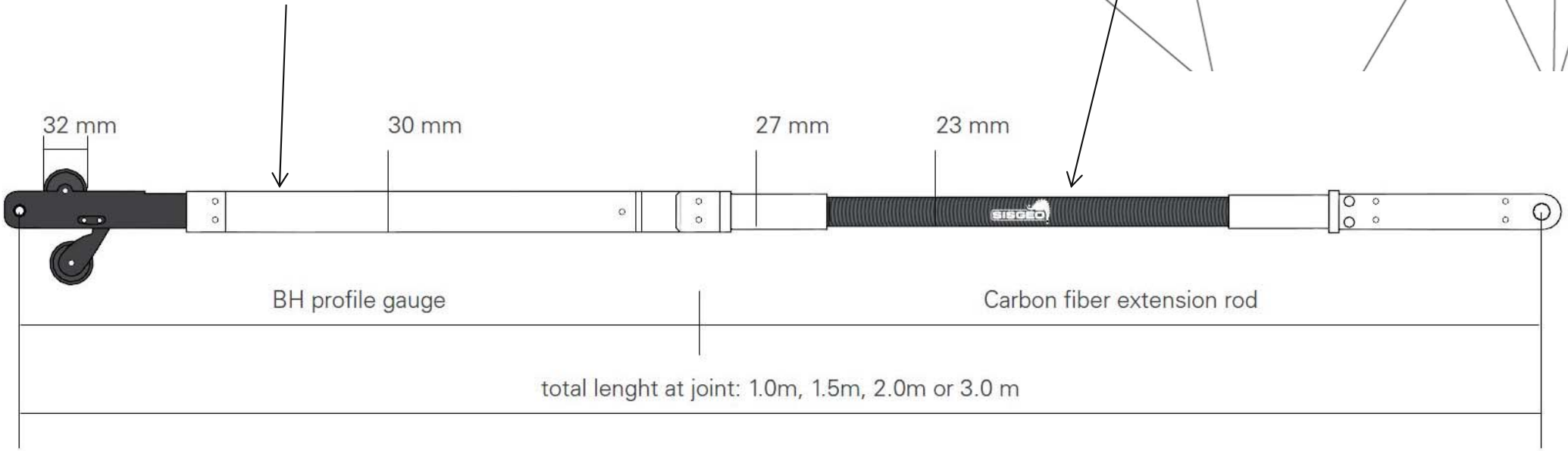
CLEVER SOLUTIONS FOR DAM SAFETY AND MONITORING

BH PROFILE INCLINOMETERS: COMPONENTS

Inclinometer sensor (digital MEMS)

Carbon fiber extension rod



Datasheet:

http://www.sisgeo.com/uploads/schede/schede/S430_EN-00_BH_profile_inclinometer.pdf

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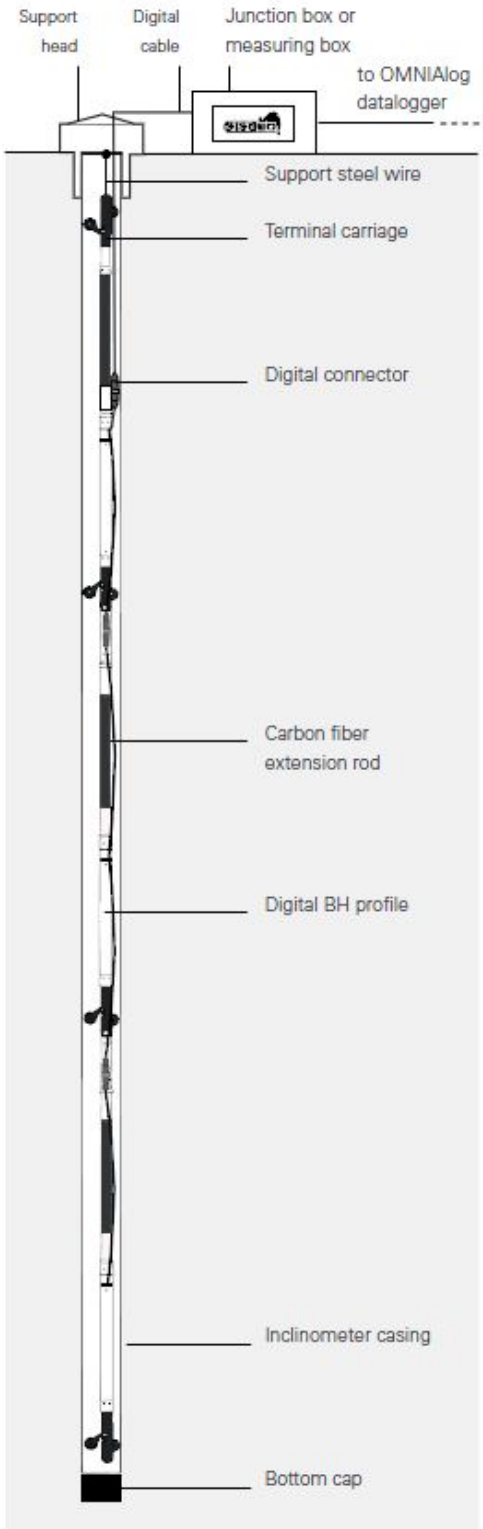

BH PROFILE INCLINOMETERS: CONTINUOUS BOREHOLE PROFILING

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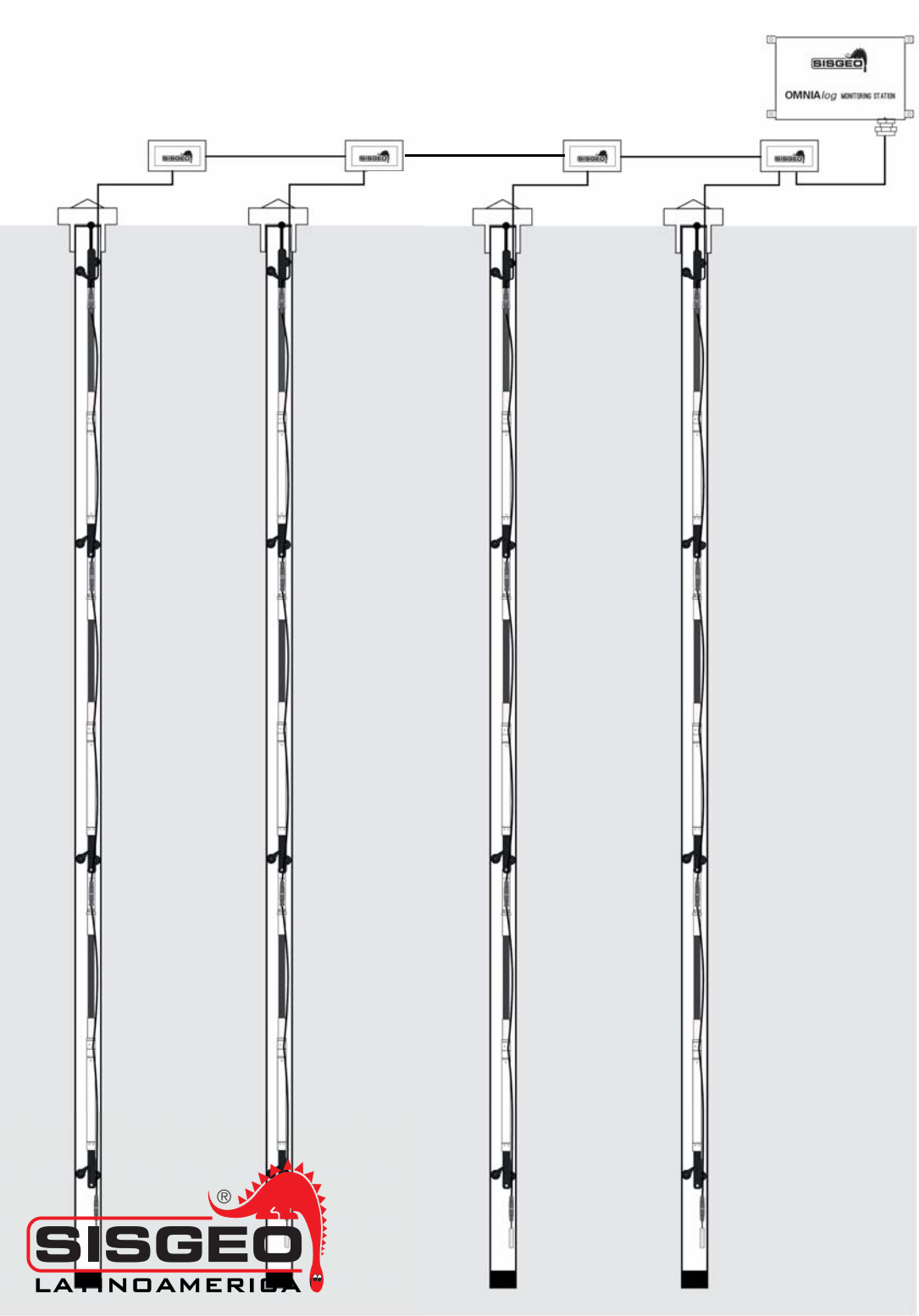
CLEVER SOLUTIONS FOR DAM SAFETY AND MONITORING



BH PROFILE INCLINOMETERS: DATALOGGER CONNECTION

Connection of up to 250 BH Profile inclinometers to datalogger with ***only one single signal cable*** *(RS485 technology)*

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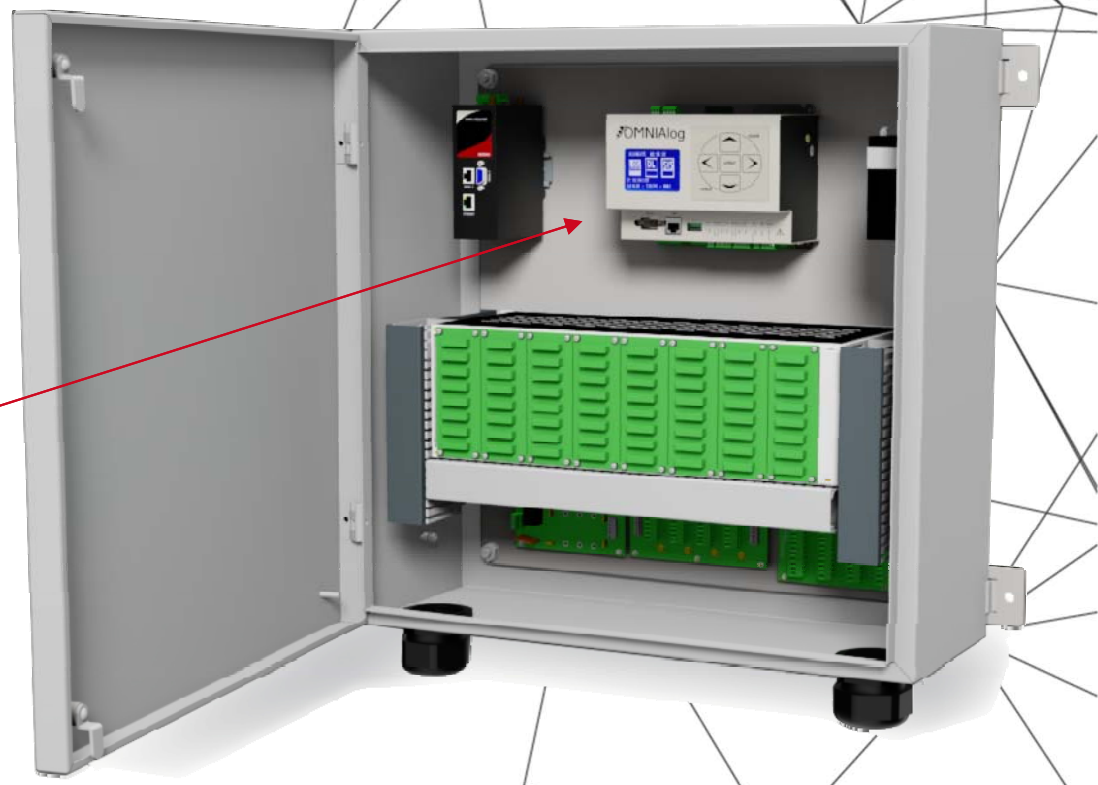
OMNIALOG DATALOGGER AND DATA ACQUISITION SYSTEMS



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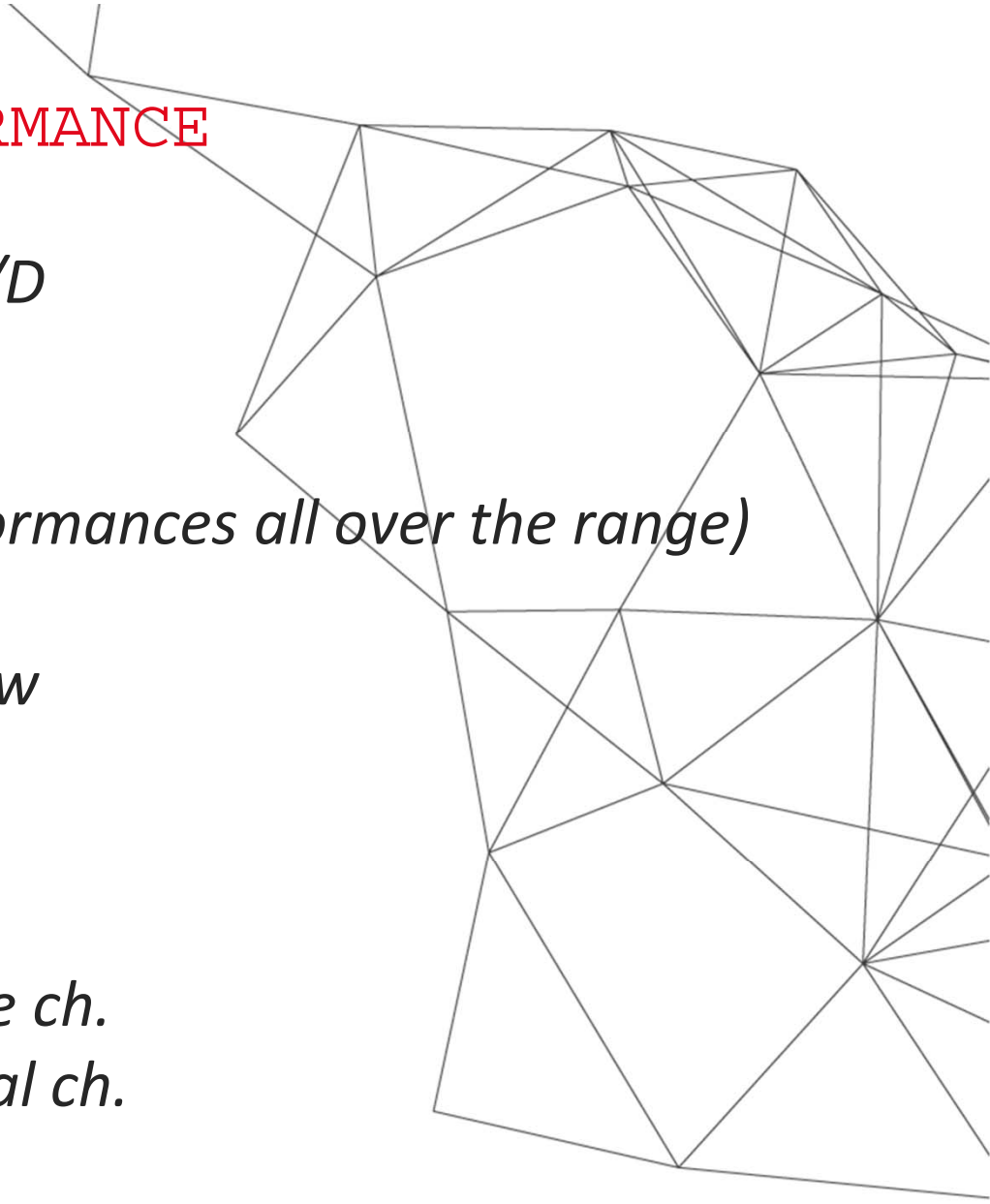
CLEVER SOLUTIONS FOR DAM SAFETY AND MONITORING

OMNIALOG DATALOGGER

- *Display*
- *Keyboard*
- *Standard LAN port*
- *USB port*
- *On-board channels*
- *Alarm output*

OMNIALOG DATALOGGER PERFORMANCE



ACCURACY	*0.01% FS, 24-bit A/D*
TEMP. RANGE	*-30° .. +70°*
	(constant performances all over the range)
SAMPLING RATE	*high.. medium.. Low*
ON BOARD CHANN.	*8 (differential)*
TOTAL CHANNELS	*up to 391 analogue ch.*
	up to 254 digital ch.

Datasheet:

http://www.sisgeo.com/uploads/schede/schede/OMNIALOG_EN_01_-_OMNIAlog_Datalogger.pdf

OMNIALOG DATA ACQUISITION SYSTEMS

- *Stainless steel cabinet*
- *Multiplexer expansion boards*
- *Communication interface*
- *Digital instrument input*
- *External multiplexer input*
- *Back up battery*

Datasheet:

http://www.sisgeo.com/uploads/schede/schede/OMNIA_DAS_EN_00_data_acquisition_system.pdf

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OMNIALOG DAS - THETA DAM, KENYA

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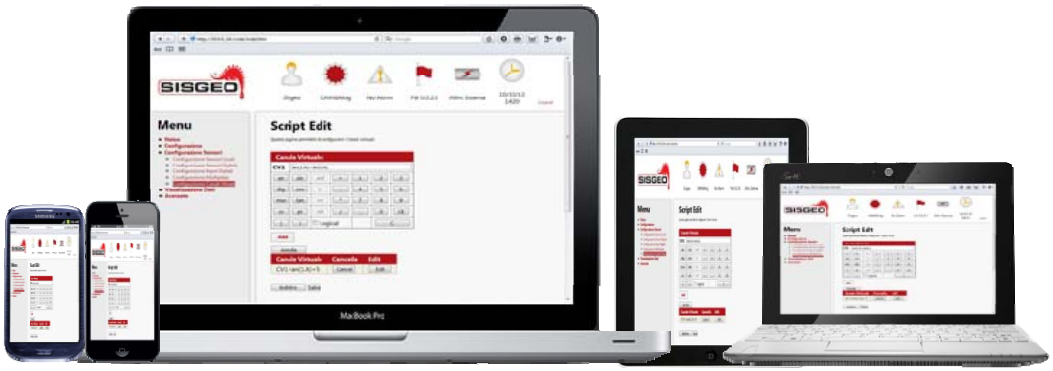
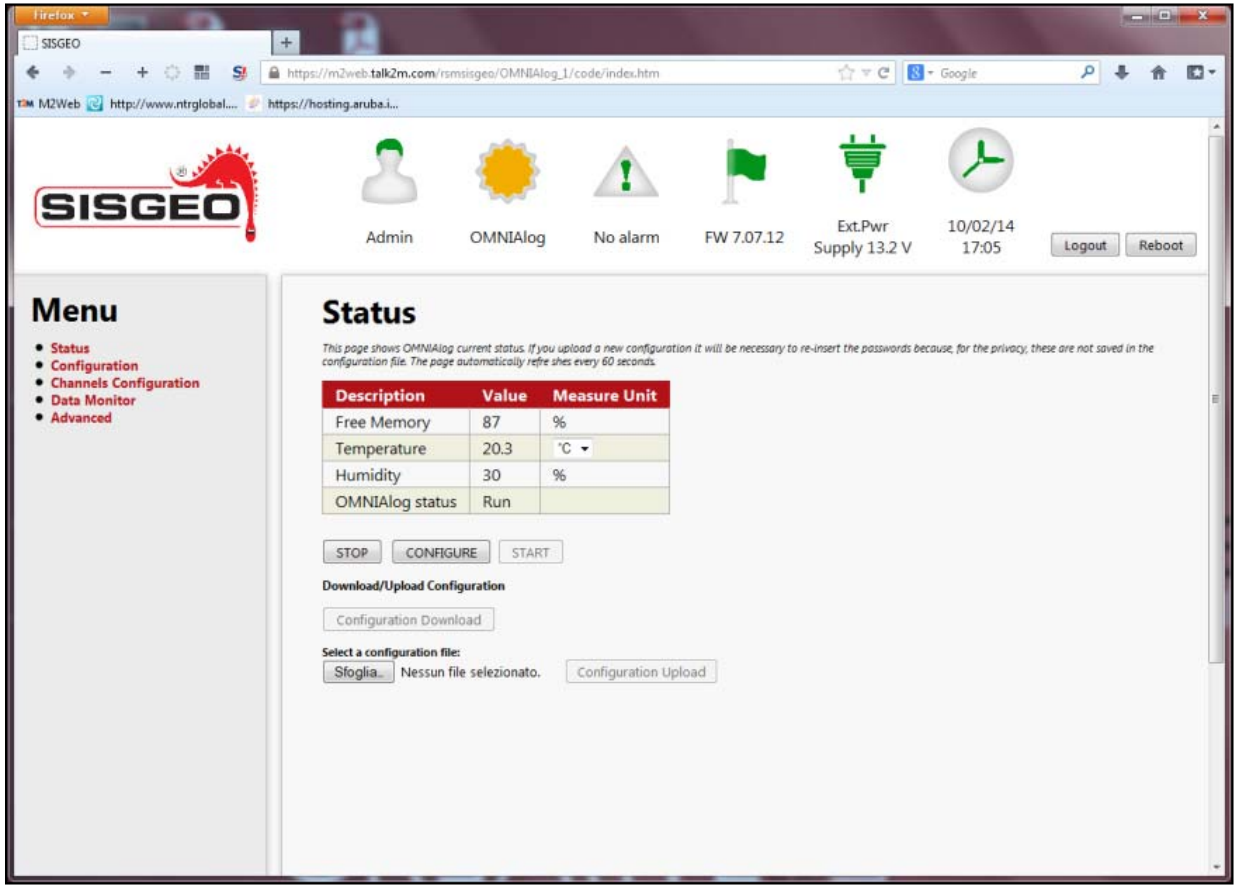
__ OMNIALOG SYSTEMS: NO SOFTWARE NEEDED

- Independent OS platform
- No software installation is required



HTML

OMNIALOG SYSTEMS: WEB SERVER ON BOARD



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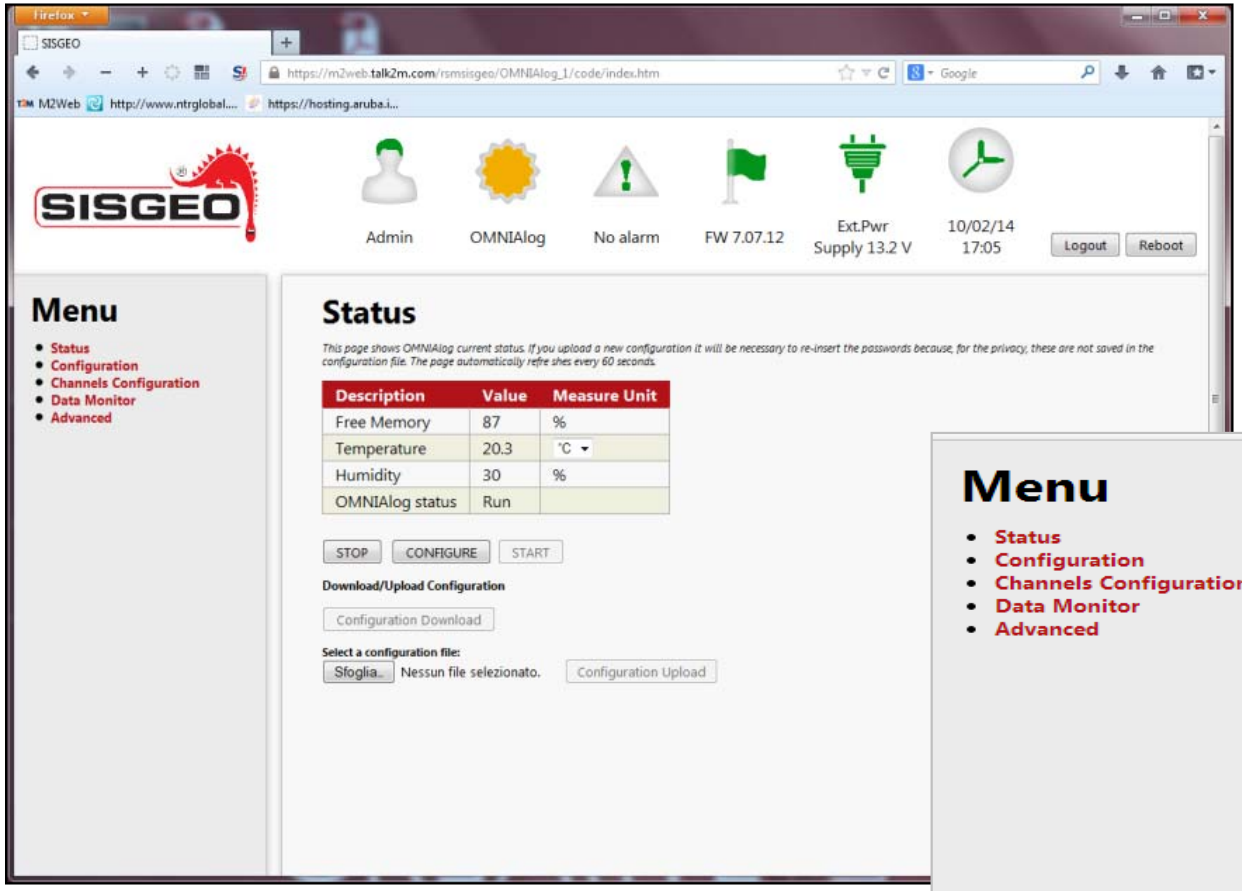
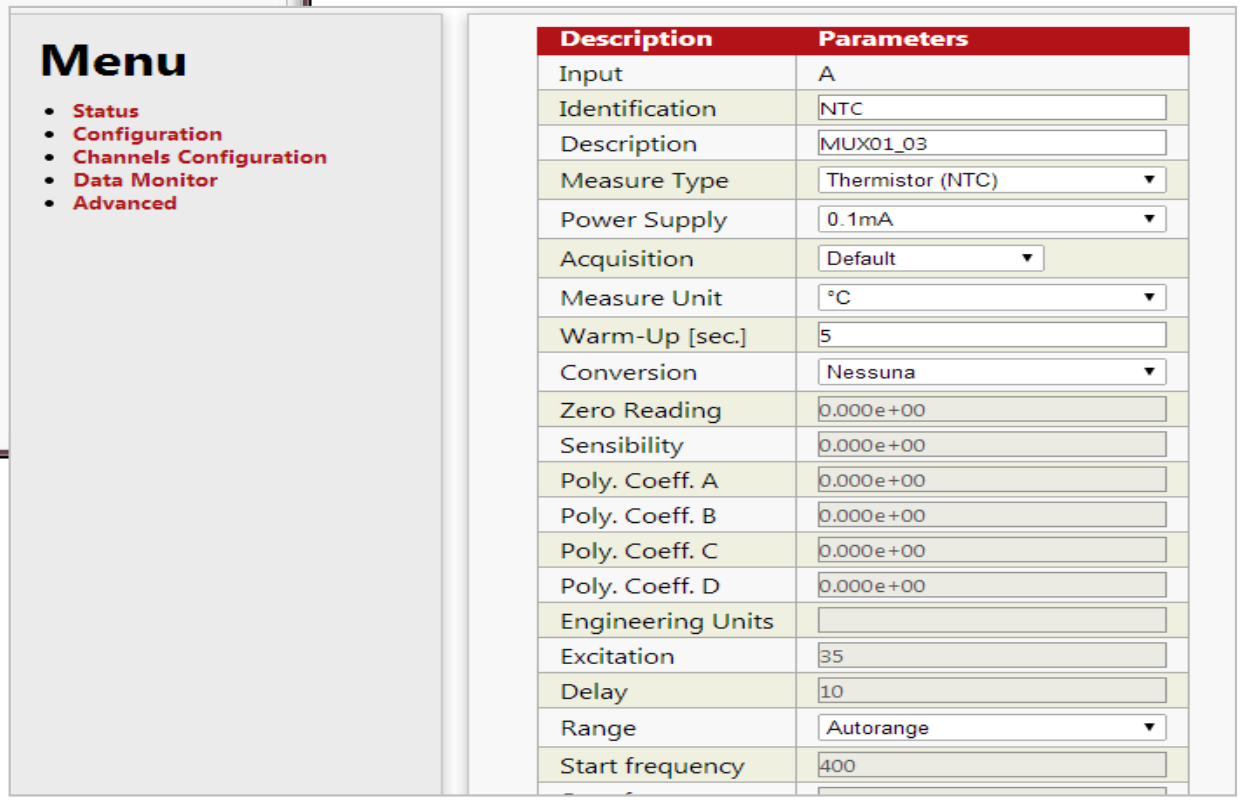
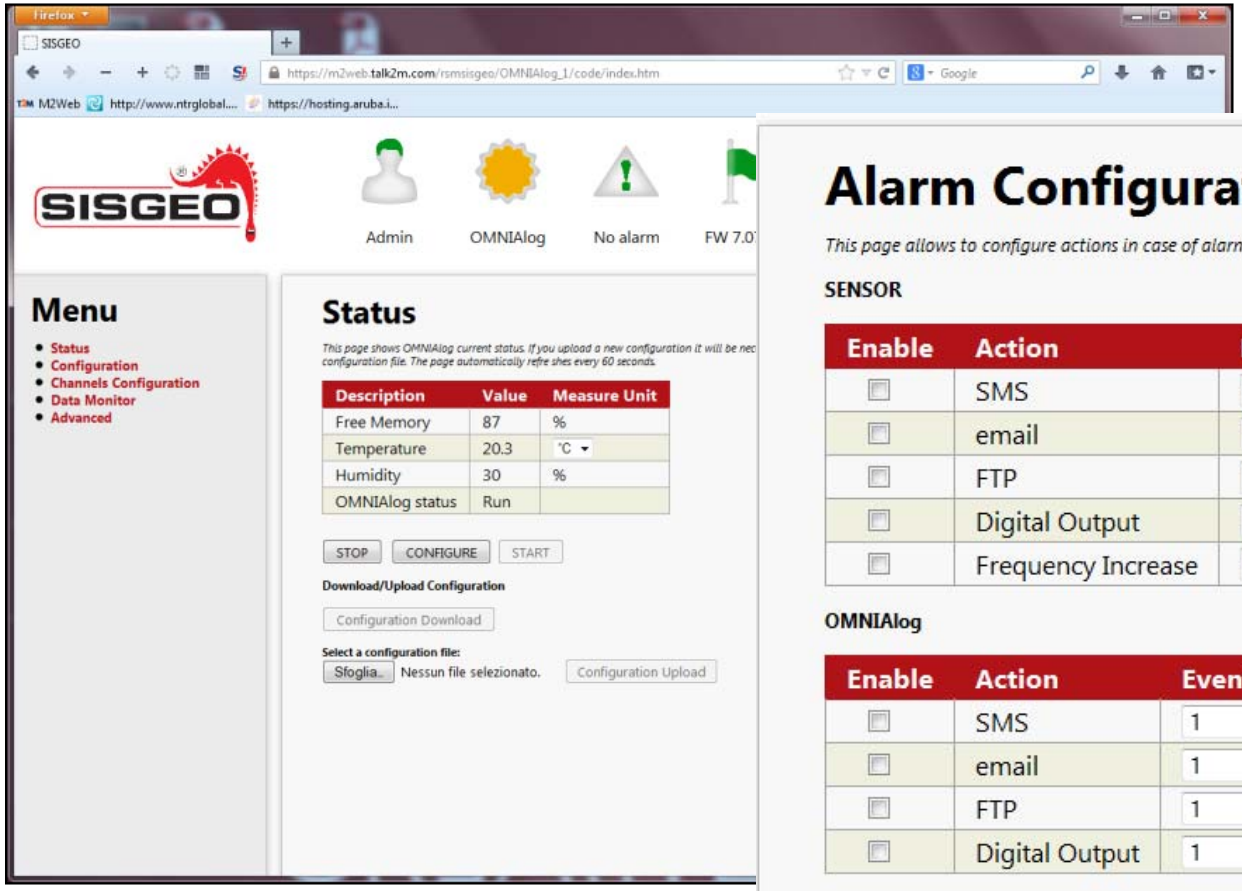
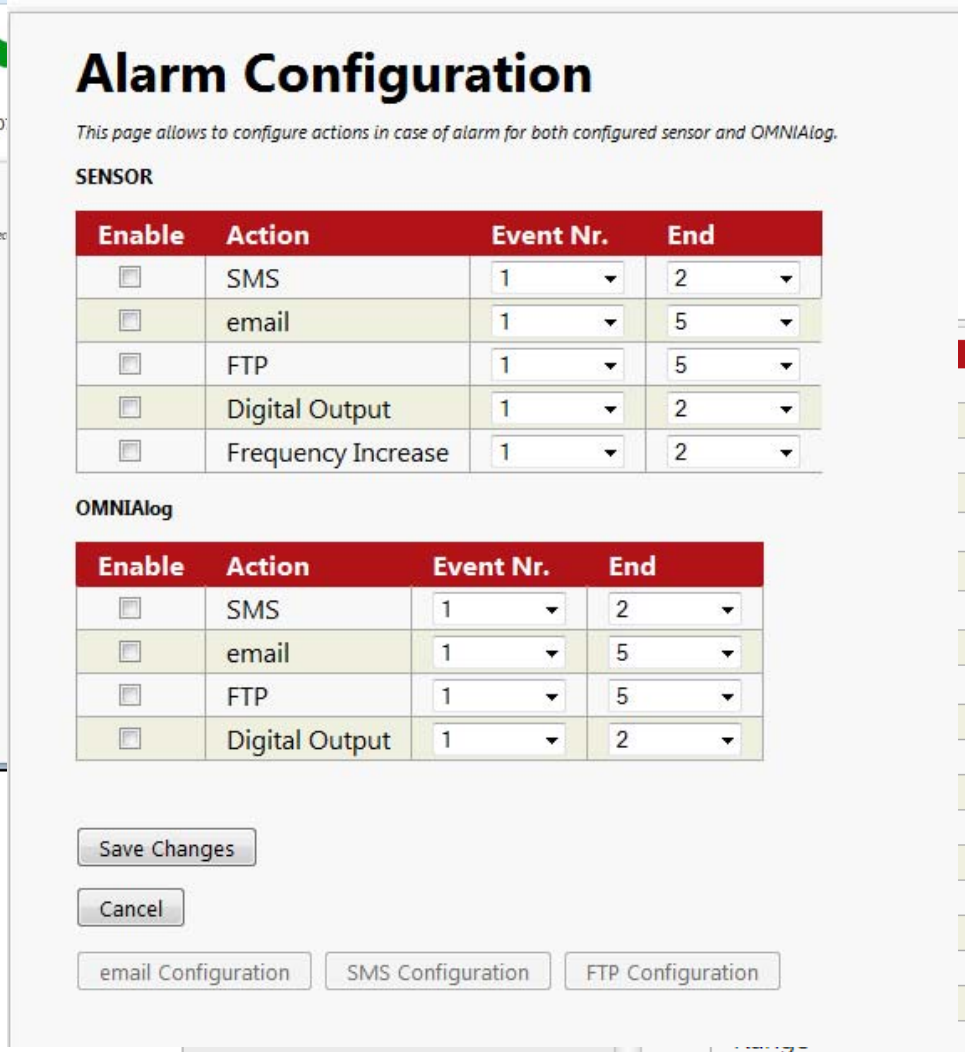
OMNIALOG SYSTEMS: WEB SERVER ON BOARD





OMNIALOG SYSTEMS: WEB SERVER ON BOARD

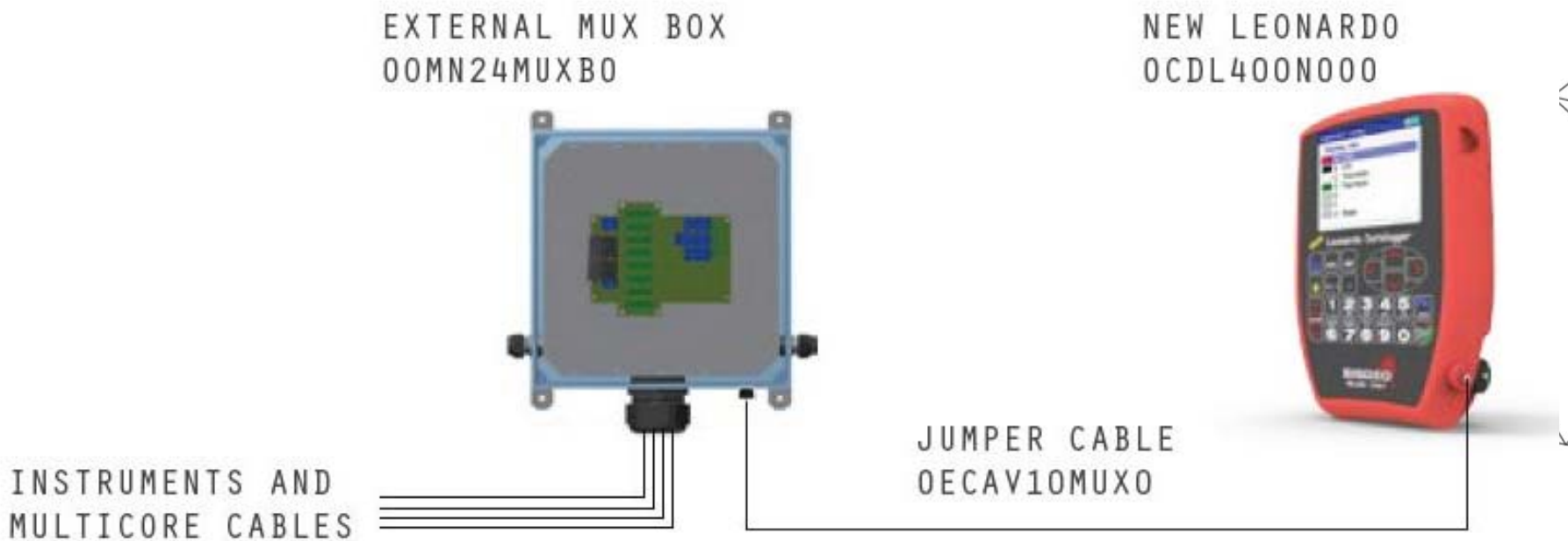




OMNIALOG DAS: EXTERNAL MULTIPLEXERS

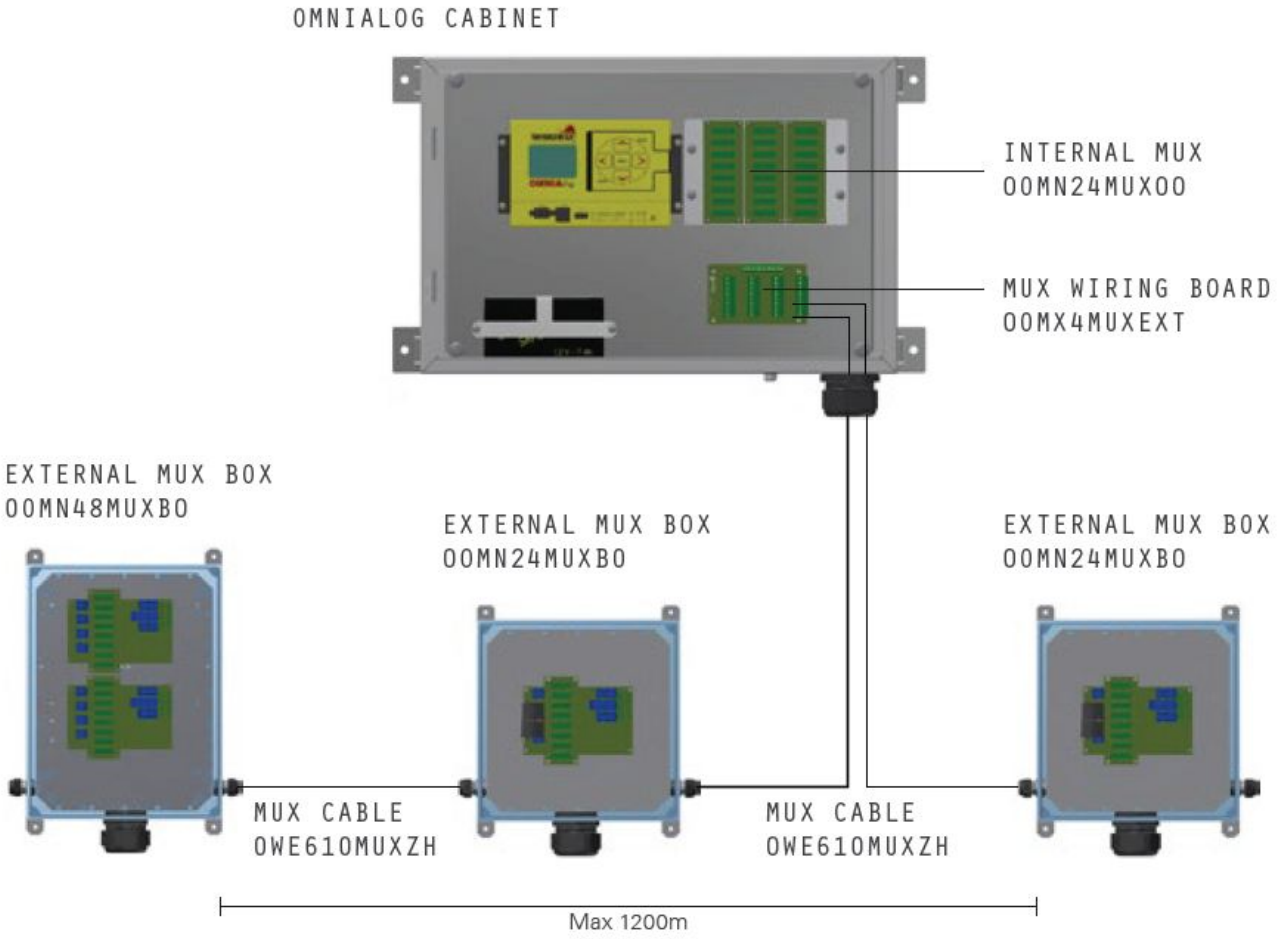
FASE 1:

Instruments are wired to the external mux working as **temporary stand-alone junction boxes**. New Leonardo portable readout can read and store data of all the connected instruments simply clicking a button.



OMNIALOG DAS: EXTERNAL MULTIPLEXERS

FASE 2:
Multiplexer boxes are connected to OMNIAlog cabinet in order to **automatically manage all the instruments** wired to the MUX boxes.



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GIANFRANCO IANNACCONE

Gerente Latinoamérica

g.iannaccone@latinoamerica.sisgeo.com

Móvil Col: +57 318-2001544

Móvil Ita: +39 346-1365229

Tel: +57 1 6368710