



OBSERVATION AND AUSCULTATION OF THE STATE OF CONSERVATION OF ANCHORAGES IN ROAD GEOTECHNICAL STRUCTURES IN THE ASCENDI NETWORK

Jorge Dias

jdias@ascendi.pt

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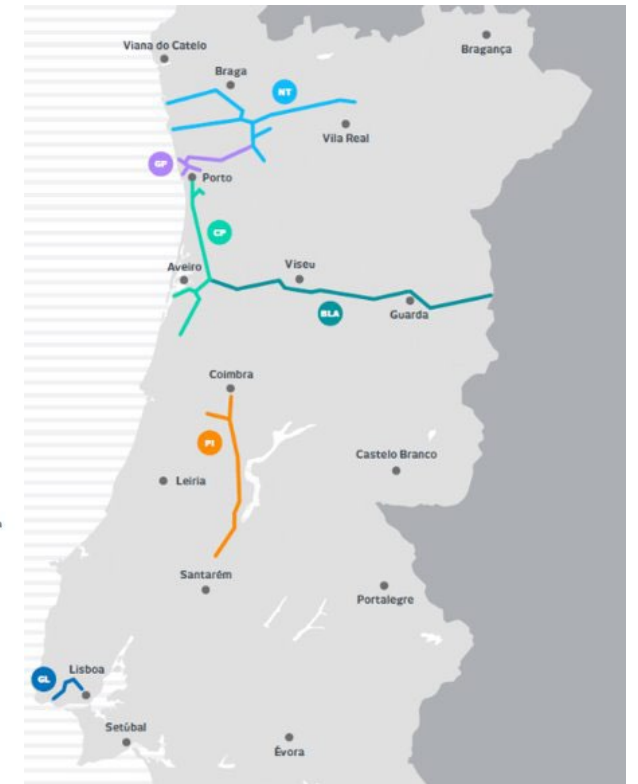
/ 01 Ascendi Key Figures #1 Overview

/ Ascendi, a leader in the road infrastructure market, **manages infrastructure assets** and provides **toll collection** and **operation & maintenance** services.

/ With more than 20 years of consolidated experience, Ascendi is recognized by its **innovative capacity** and **operational efficiency**.

6 Motorway Concessions

630 Km in operation



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/ 01 Ascendi Key Figures #2 Business Areas

Asset
Management



/ Control of **6** Concessions

/ **\$3.6 Billion** Global investment in the 6 concessions CapEx

Operation &
Maintenance



/ Road **Operation and Maintenance**

/ **Intelligent Transport Systems (ITS)**

/ **Maintenance Management**

Toll
Collection



/ **2** traditional toll operations

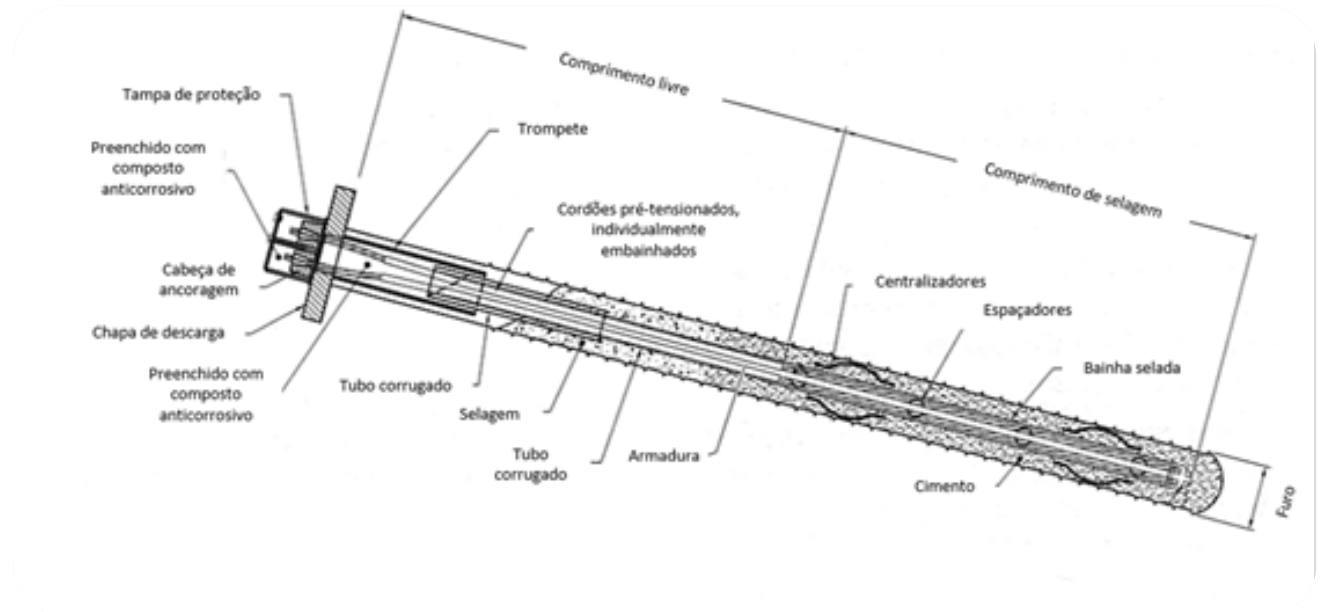
/ **7** electronic toll operations

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/ 02 Observation and Auscultation of Anchors in Geotechnical Structures in the Operation Phase

/ The Observation and Auscultation of Anchorages includes:

- Inventory database;
- Catalog of subcomponents and pathologies;
- Visual Inspection;
- Load cell reading campaigns;
- Tests Applicable to Anchorages.



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/ 02 Observation and Auscultation of Anchors in Geotechnical Structures in the Operation Phase

#1 Definition of Subcomponent









Subcomponent	Weight
Protective metal box	5%
Anchor head	25%
Discharge plate	15%
Adjacent structure	20%
Load cell	35%



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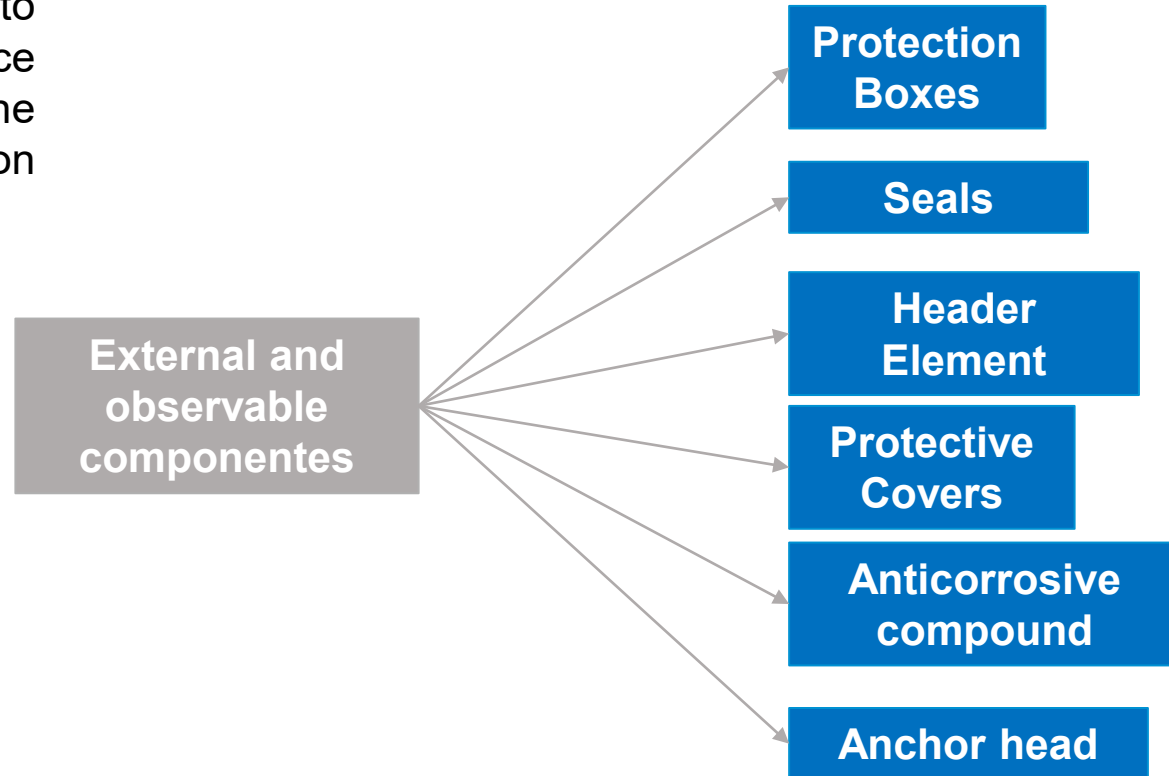
#2 Cataloguing of Pathologies

Pathology	E.C	E.M	Description	Examples
Damaged glass	Não	Sim	The protective box glass is damaged/broken.	
Non-existent glass	Não	Sim	Non-existent protective case glass	
Protection box - Presence of vegetation	Não	Sim	Presence of vegetation inside the protective box or on its periphery.	
Protection box - Corrosion	Não	Sim	Protective case with corrosion or corrosion stains.	
Protection box - Non-existent pressure gauge	Sim	Sim	Non-existent manometer.	
Deterioration of the header element	Sim	Sim	Deterioration of concrete elements	

/ 02 Observation and Auscultation of Anchors in Geotechnical Structures in the Operation Phase

#3 Visual Inspection

/ The main objective of the visual inspection is to verify the state of conservation and maintenance of the external and observable components of the anchorage, as well as the state of protection against corrosion, which include:



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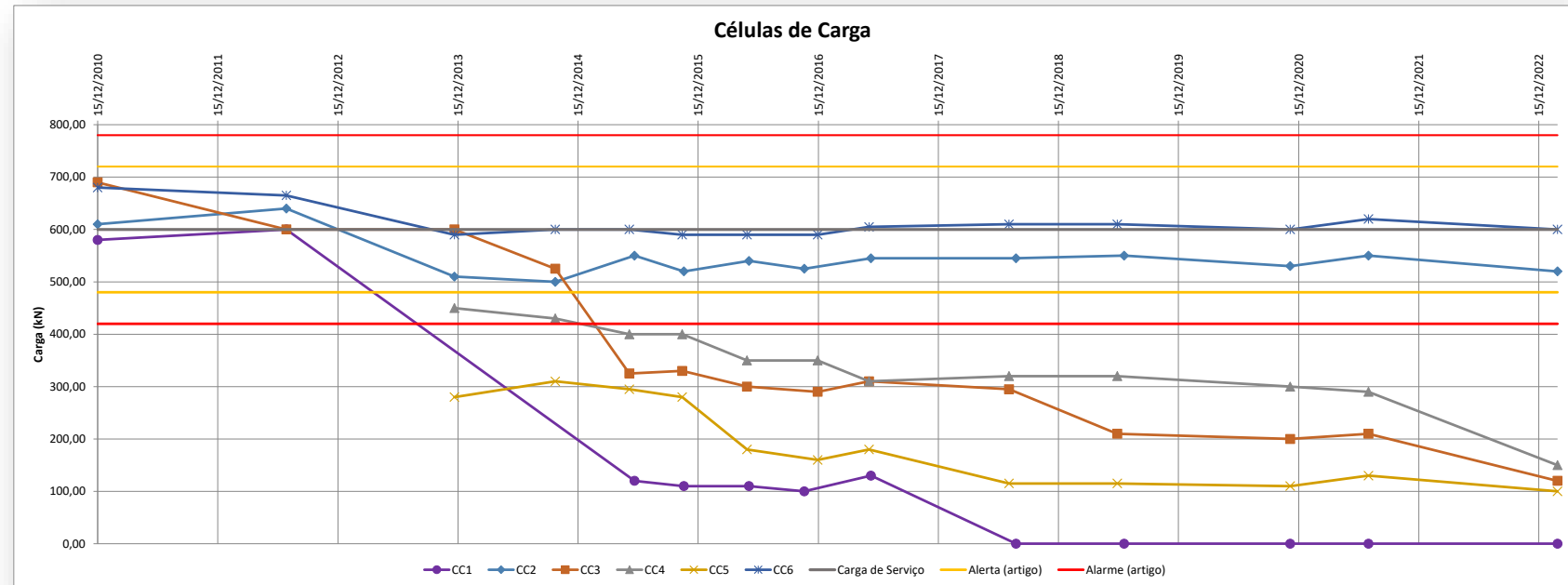
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#4 Load cell reading campaigns

Criteria for load cell

Level	Load cell
1 (Stable)	$\Delta P < \pm 20\%$
2 (Alert)	$\pm 30\% > \Delta P > \pm 20\%$
3 (Alarm)	$\Delta P > \pm 30\%$

ΔP - variation of the final ground anchor load [%].

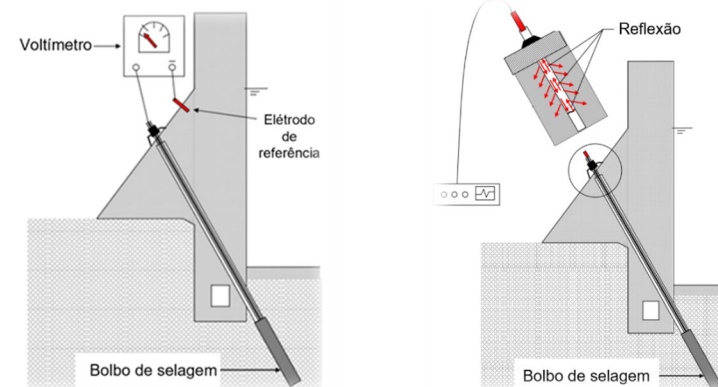


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#5 Test Applicable to Anchorages

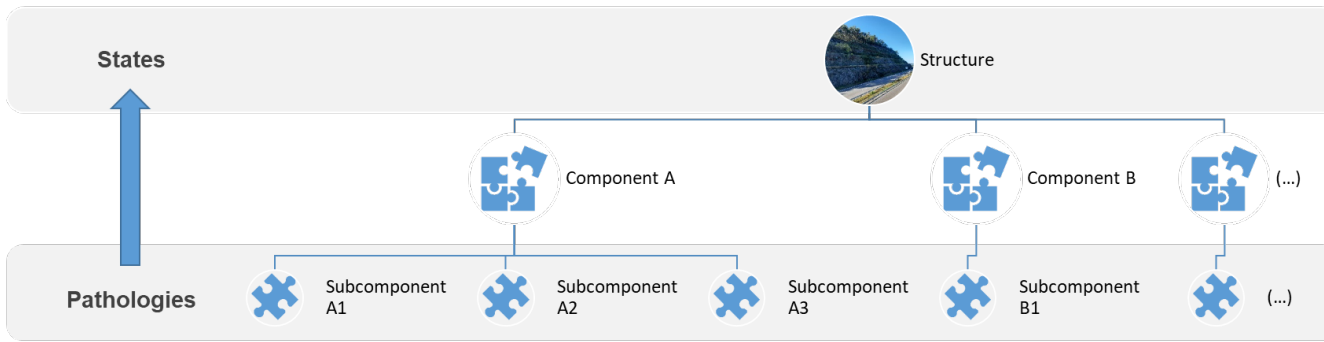
Non-destructive testing	Destructive testing
Simple Inspection Method	Preliminary rehearsal
Endoscopy	Carotage
Traction Check Test	Deactivation and excavation of the sealing bulb
Half-cell Corrosion Potential	
Impact method	
Ultrasonic method	



* This issue has been widely discussed, given that there is a high risk of the anchorage breaking.

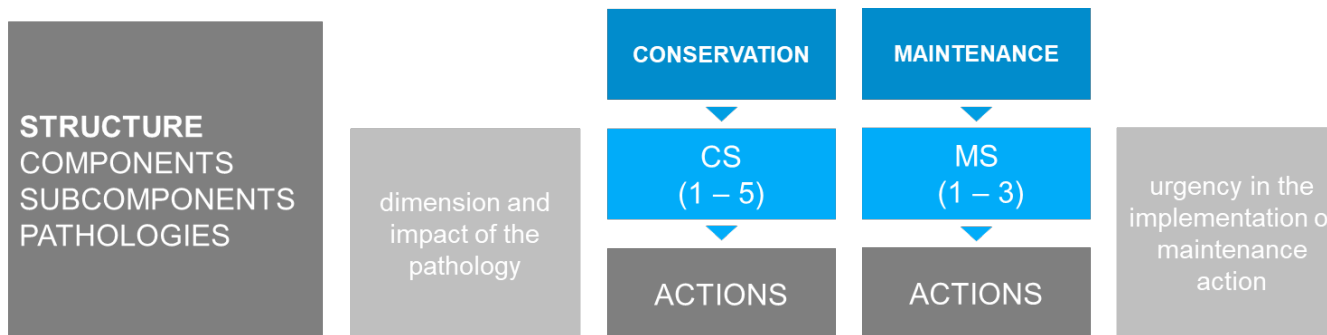
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/ 03 Attribution of Maintenance and Conservation States to Anchorages – Ascendi Method



$$CS_{slope} = \frac{\sum_{i=1}^n \mu_i \cdot CS_i}{\sum_{i=1}^n \mu_i}$$

CONSERVATION STATE	
1	VERY GOOD
2	GOOD
3	MEDIUM
4	BAD
5	VERY BAD



$$MS_{slope} = \max (MS_{Component})$$

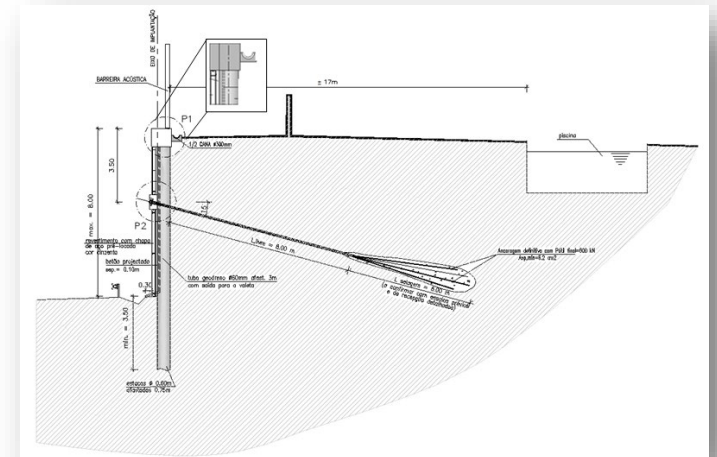
MAINTENANCE STATE	
1	GOOD
2	MEDIUM
3	BAD

/04. Case Study – Application of the Methodology developed by Ascendi

/04.1. Anchored Wall - PK 000+299 - A4, Grande Porto Concession

Main characteristics:

- Maximum height= 8m;
- Length = 73m;
- Pile curtain 0,60m in diameter, spaced 0,75m;
- Anchored beam, with 45 anchors, spaced 1.50 m apart and load 600 KN (project);
- 6 Load cells.



/04. Case Study – Application of the Methodology developed by Ascendi

/04.2. Performed

/ To assess the Maintenance and Conservation Status of Anchors, the following activities were carried out:

- Visual Inspection;
- Endoscopic test;
- Electrical Resistance Test;
- Load Cell Reading.



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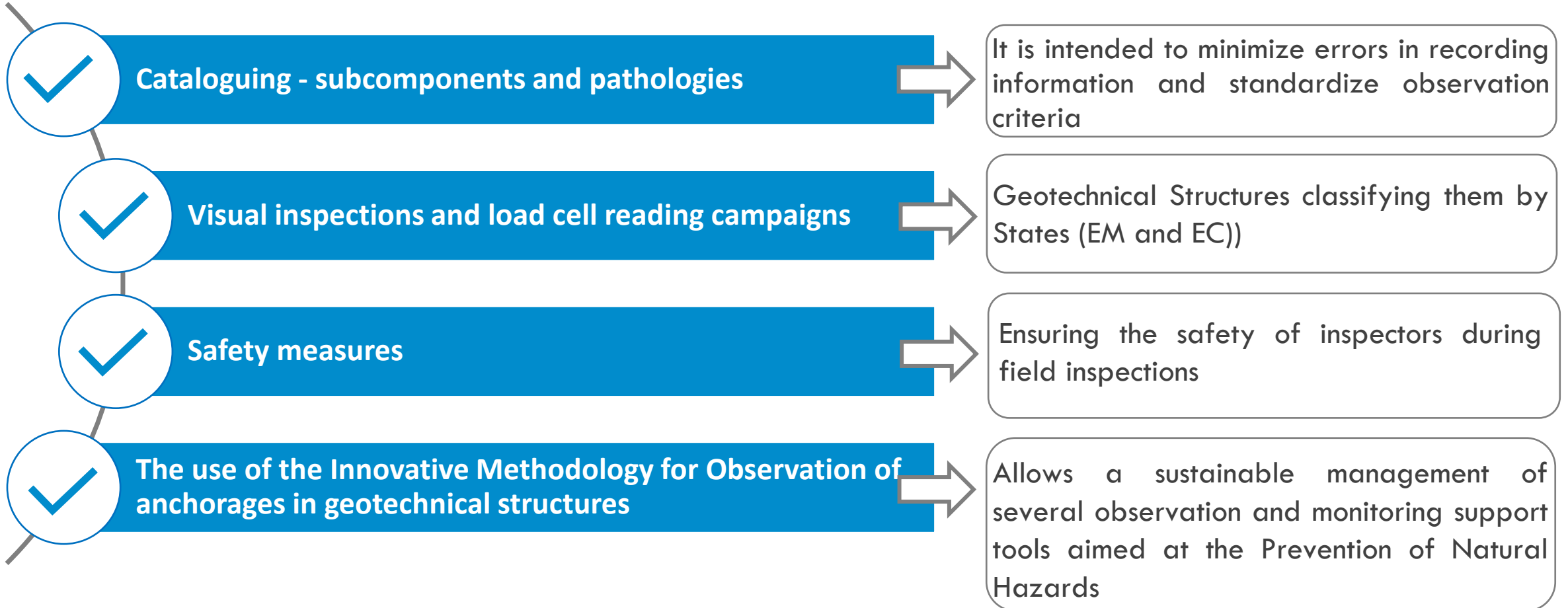
/04. Case Study – Application of the Methodology developed by Ascendi

/04.3. Synthesis Table of Pathologies by Anchorage subcomponent – CC5

Load Cell	Subcomponent	Pathology	E.C.	E.M.	Description
Load cell 5	Discharge plate	Surface corrosion	Good	Medium	-
	Anchor head	In accordance	-	-	-
	Protection box	In accordance	-	-	-
	Adjacent structure	In accordance	-	-	-
	Load cell	Excess load	Very bad	-	Value read: 873 KN
Anchorage Conservation and Maintenance States			Bad	Medium	

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/05. Conclusions



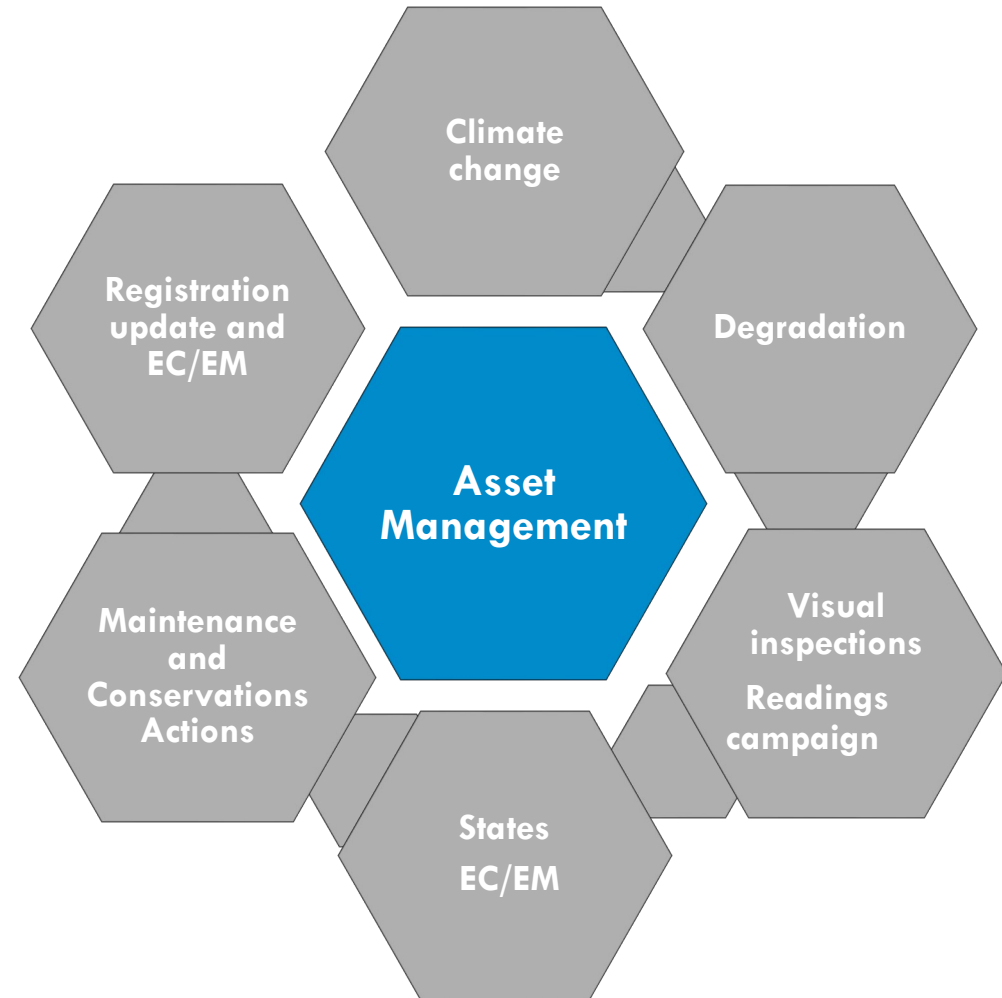
/05. Future Challenges

/ Pillars:

- ❖ Sustainability;
- ❖ Resilience;
- ❖ Safety.

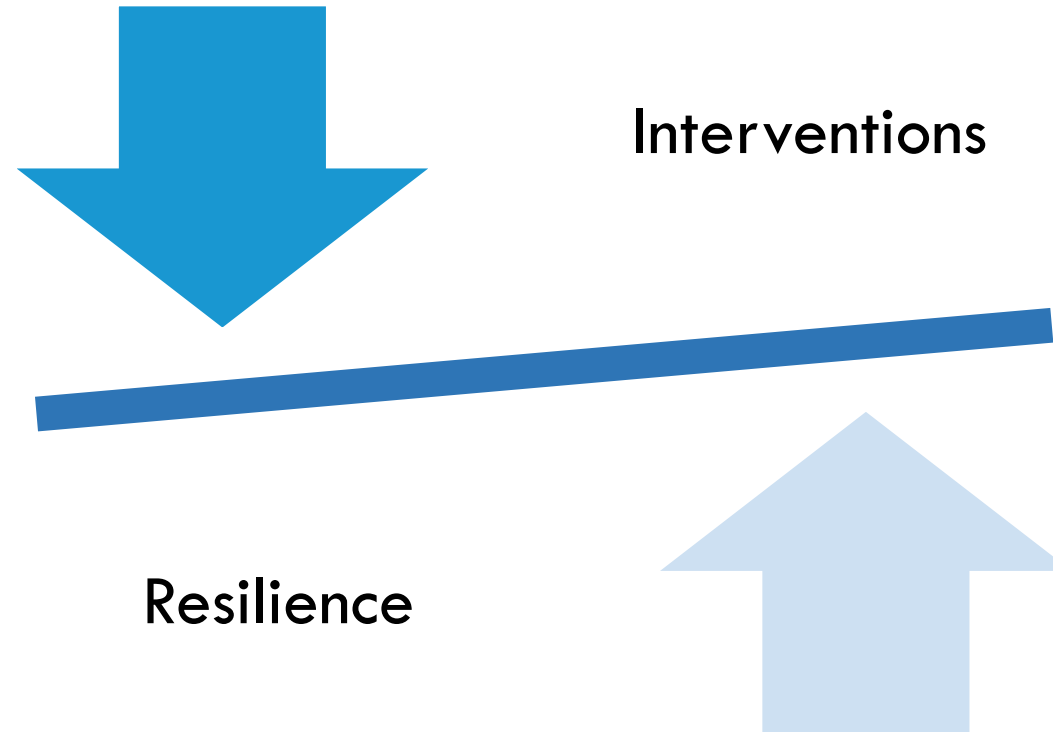
Future developments:

- ✓ Adjustment and improvement of the methodology;
- ✓ Integration of instrumentation equipment's in the calculation of Conservation and Maintenance States.



/05. Future Challenges

/ climate change / Carbon footprint



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/05. Future Challenges – Reduction of carbon footprint

OBSERVATION AND MONITORIZATION

Visual inspections;
Regarding campaingns;
Alert and alarme criteria.

MAINTENANCE

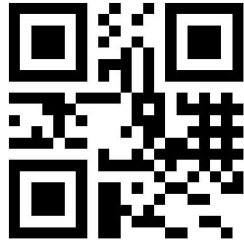
Cleanning (Drainage System);
Minor repairs;
Vegetation Management.

RESILIENCE

Best solutions;
Best approche;
Asset Management.

THANK YOU FOR YOUR ATTENTION

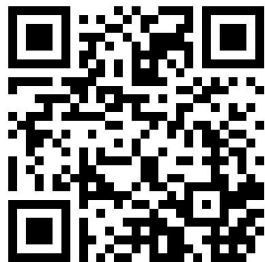
Jorge Dias
jdias@ascendi.pt



Ascendi



Digital Operation



THANK YOU

Jorge Dias

jdias@ascendi.pt



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