

LIM LOGGING

Case study

Optical imaging and geophysical logging in the context of a “health check” on a vital structure



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Context

A number of dams were studied in the Burgundy region of France with respect to their ability to withstand exceptional flood events.

The study included drilling cored boreholes downwards from the crest of the dams and into the bedrock on which they repose.

LIM Logging equipment was used in these boreholes to provide high quality image data and calibrated geophysical logs to aid in the assessment of these critical structures.



Field operation

With no particular access constraints, it was possible to position the logging vehicle in the immediate vicinity of the boreholes.

Both ends of the dam were cordoned off to prevent any unauthorised public access during the operation. This for general safety reasons but particularly with respect to the use of a radioactive source during the operation.

A total of four boreholes were logged during the operation using OPTV52 and PDGC50 probes.



OPTV38 / OPTV52 Probes



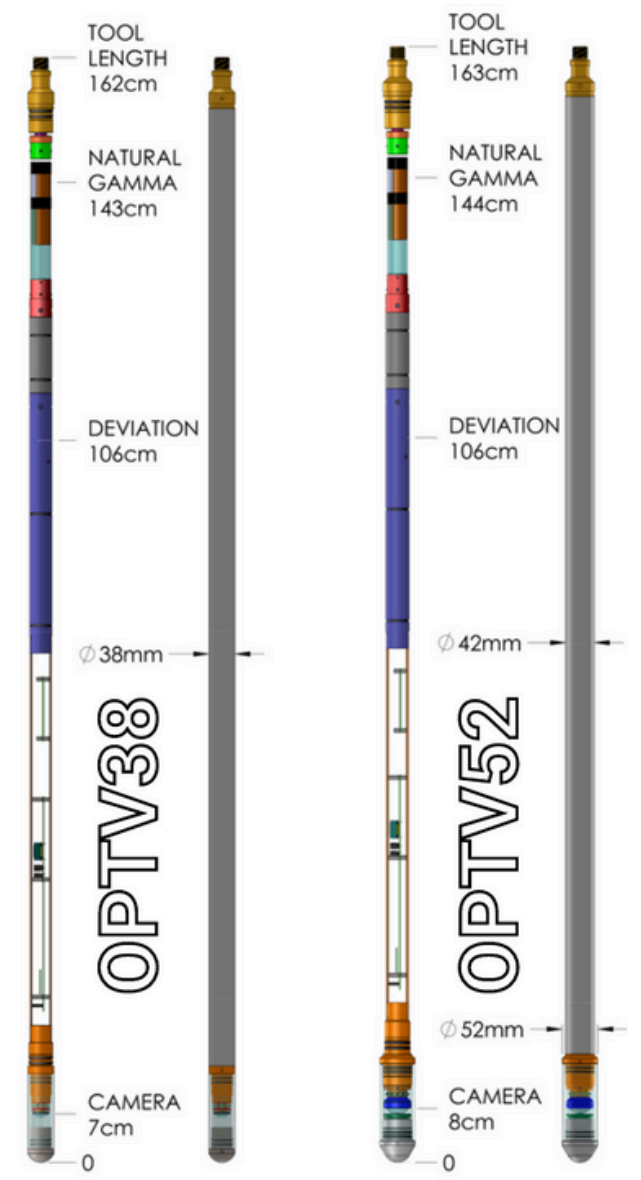
Key features:

- CMOS camera offering up to 1440 px per image line
- powerful onboard DSP allowing frame rates of up to 60 images per second (= 3.6 m/min logging speed for 1 mm vertical resolution)
- white LED lighting for natural colour rendition
- three-axis orientation sensor (triple accelerometers/magnetometers) for probe orientation from vertical down to vertical up



OPTV38 / OPTV52 Probes

	OPTV38	OPTV52
Diameter:	38 mm	52 mm
Length:	1 620 mm	1 630 mm
Weight:	6 kg	7 kg
Max temp/pressure:	70°C / 100 bar	
Orientation precision:	+/- 0.5° inclination, +/- 1° azimuth	



PDGC50 Probe



Key features:

- short (15 cm), medium (30 cm) and long spaced (48 cm) directionally-focussed density detectors
- additional detection of low-energy (typically photo-electric effect) gamma rays on the medium spaced detector
- side-walling caliper arm (for 50 to 450 mm borehole diameter as standard)
- natural gamma detector



PDGC50 Probe



Diameter:	50 mm
Length:	2 500 mm
Weight:	20 kg
Max temp/pressure:	70°C / 200 bar
Operating conditions:	60 - 450 mm diameter open borehole fluid-filled or dry borehole
Radioactive source:	Cs-137, recommended activity 3.7 GBq / 100 mCi

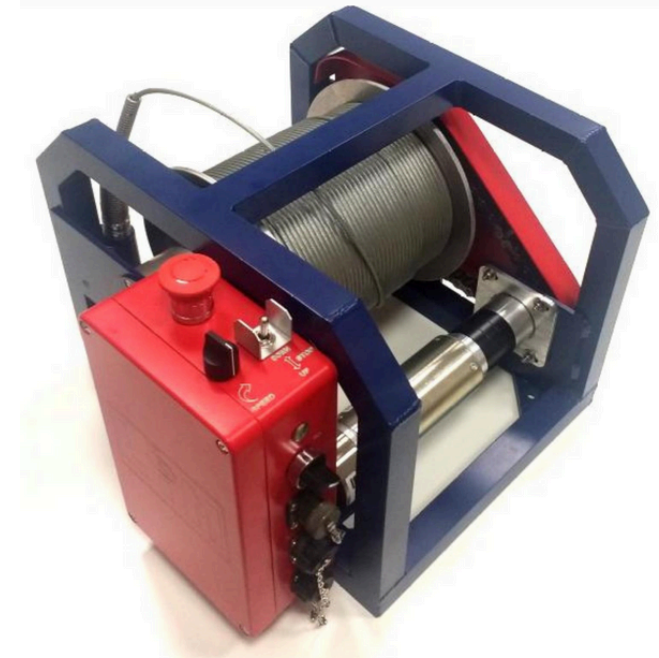


Surface Equipment



Data acquisition:

- the probes are deployed on an electric logging winch (such as the 150 m capacity model opposite)
- LIM Logging probes can auto-switch according to the type of cable in use (monocable or four-conductor)
- depth information and probe data are processed and formatted by the compact but powerful EMINDLOGGER data acquisition module for transmission to a PC or laptop via USB

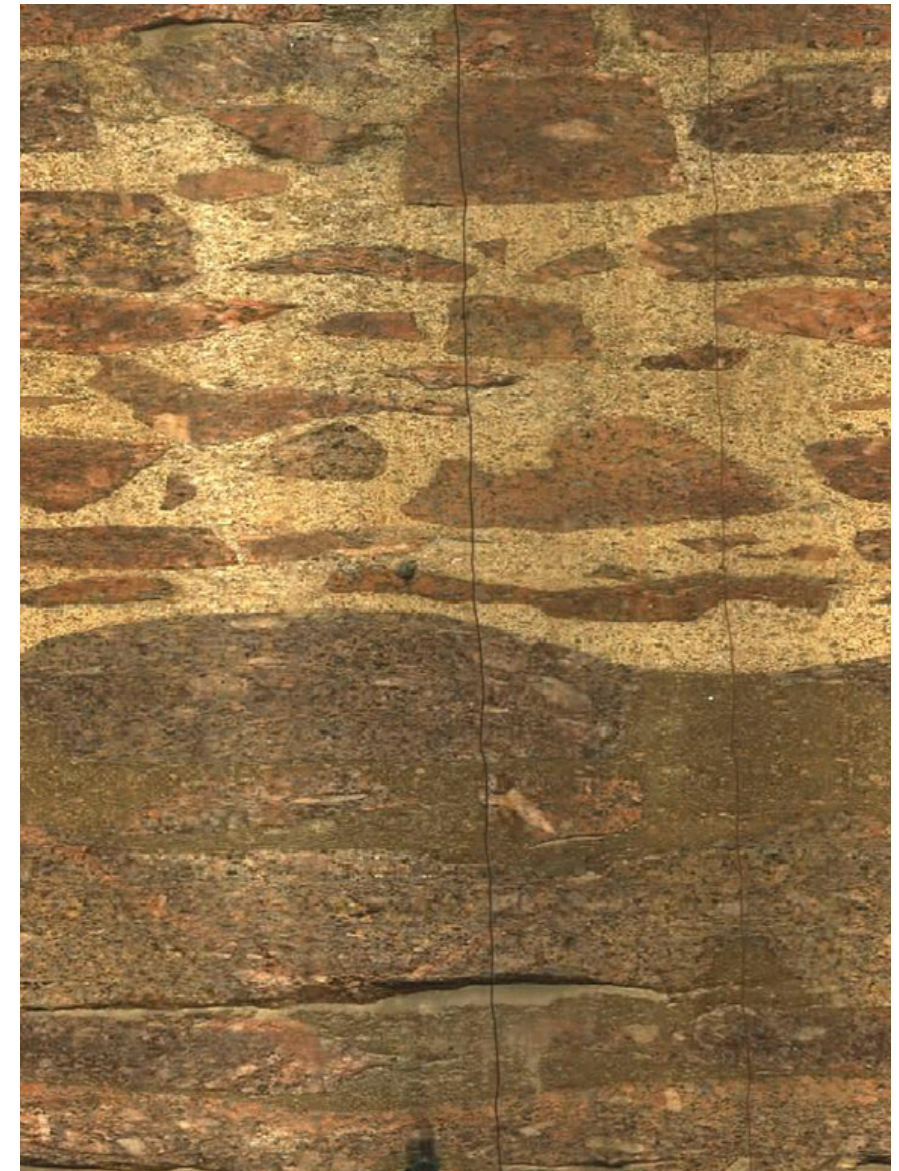


Preliminary Results



OPTV52:

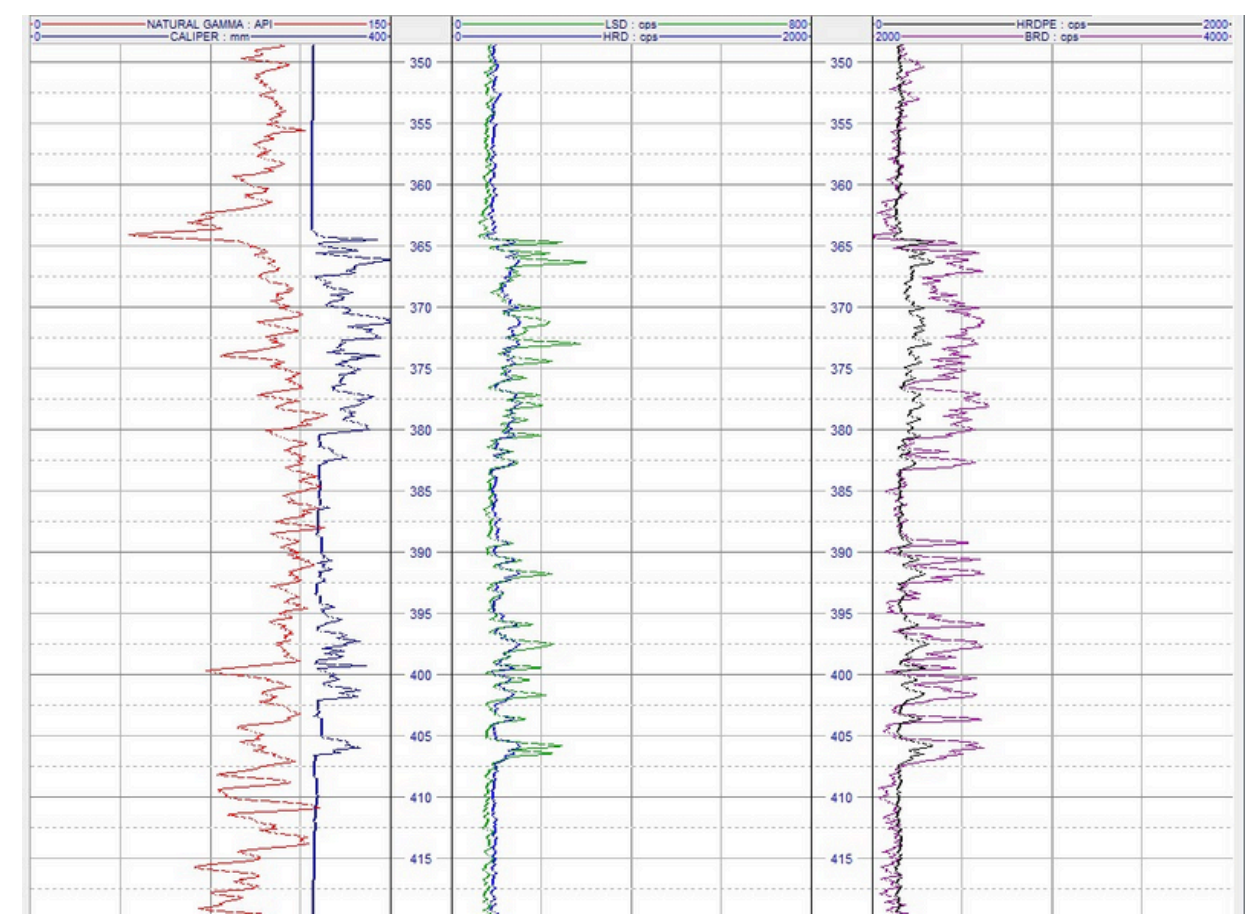
- orientated image of the borehole wall referenced to either Magnetic North (optional correction for local magnetic declination) or the borehole “high-side” in the case of an inclined borehole
- inclination and azimuth of the borehole
- opposite: OPTV image extract showing the masonry/bedrock contact in one of the boreholes studied



Preliminary Results

PDGC50:

- density detector responses in counts-per-second at three different depths of investigation (LSD Long Spacing / HRD High Resolution + Photo Electric / BRD Bed Resolution)
- borehole diameter
- natural gamma radioactivity

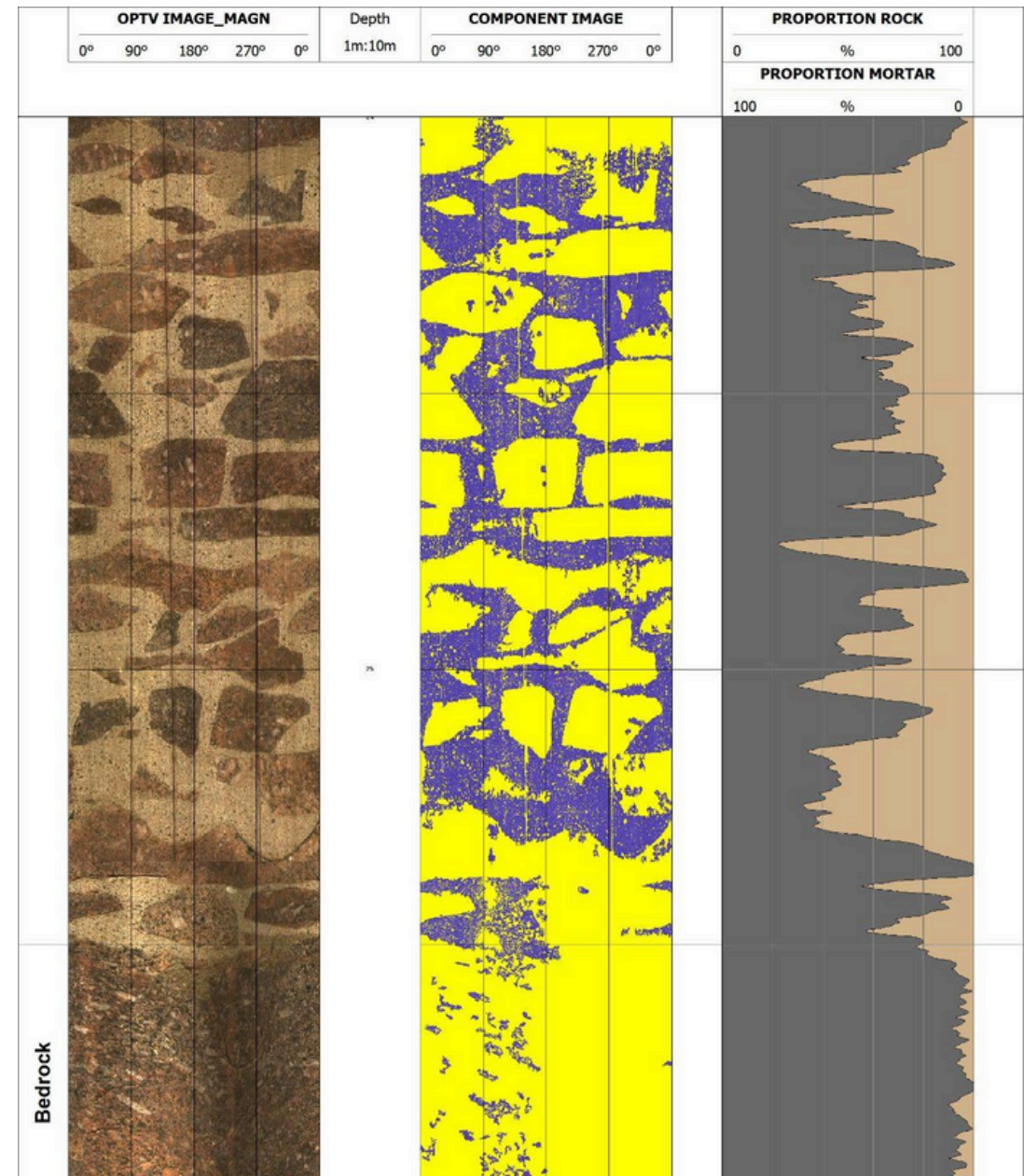


Post-processing



Image data:

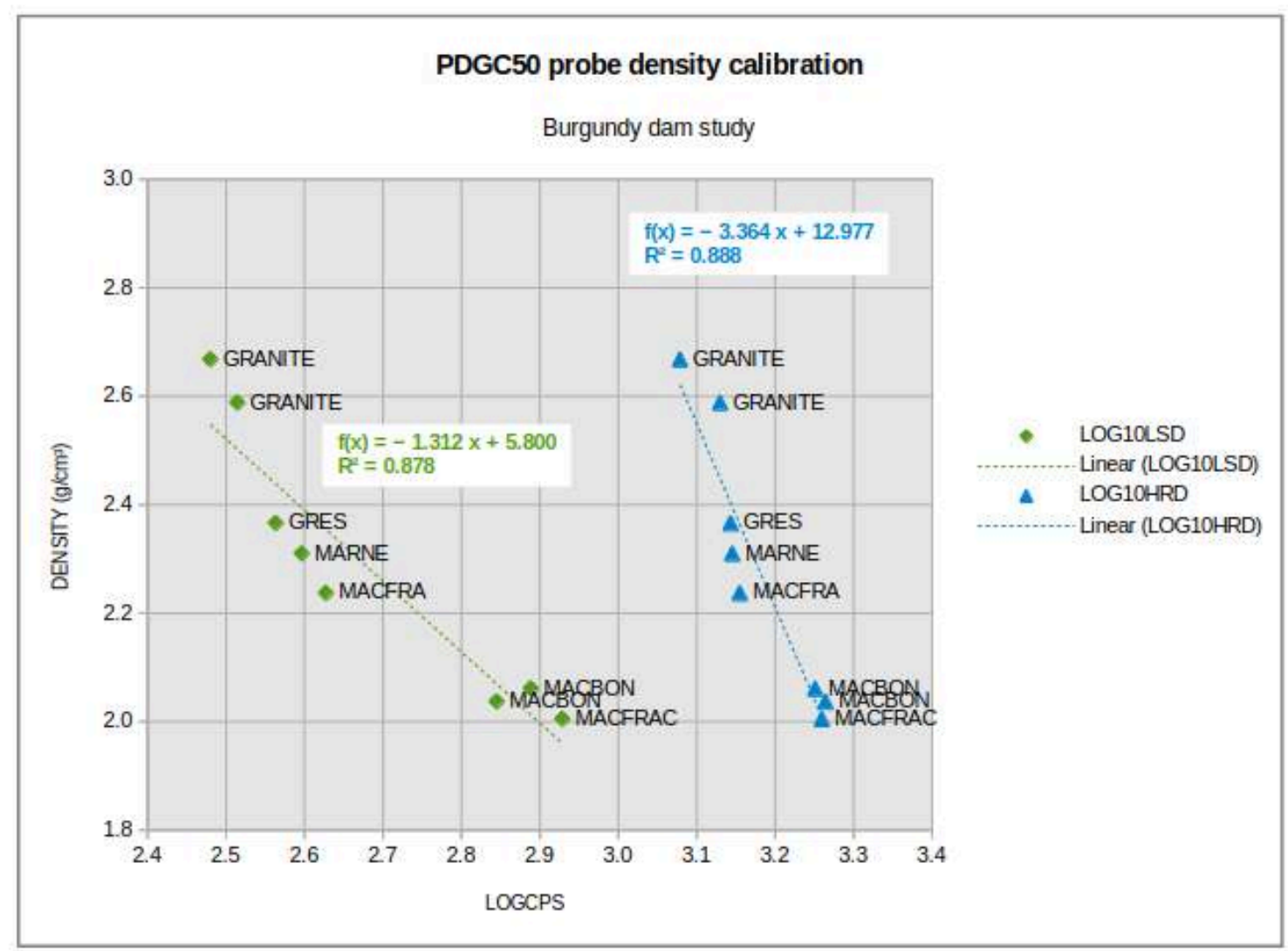
- picking and analysis of fractures potentially affecting the integrity of the structure
- RGB value-based analysis of the image data in order to quantify the relative proportions of rock and mortar in the masonry



Post-processing

Geophysical data:

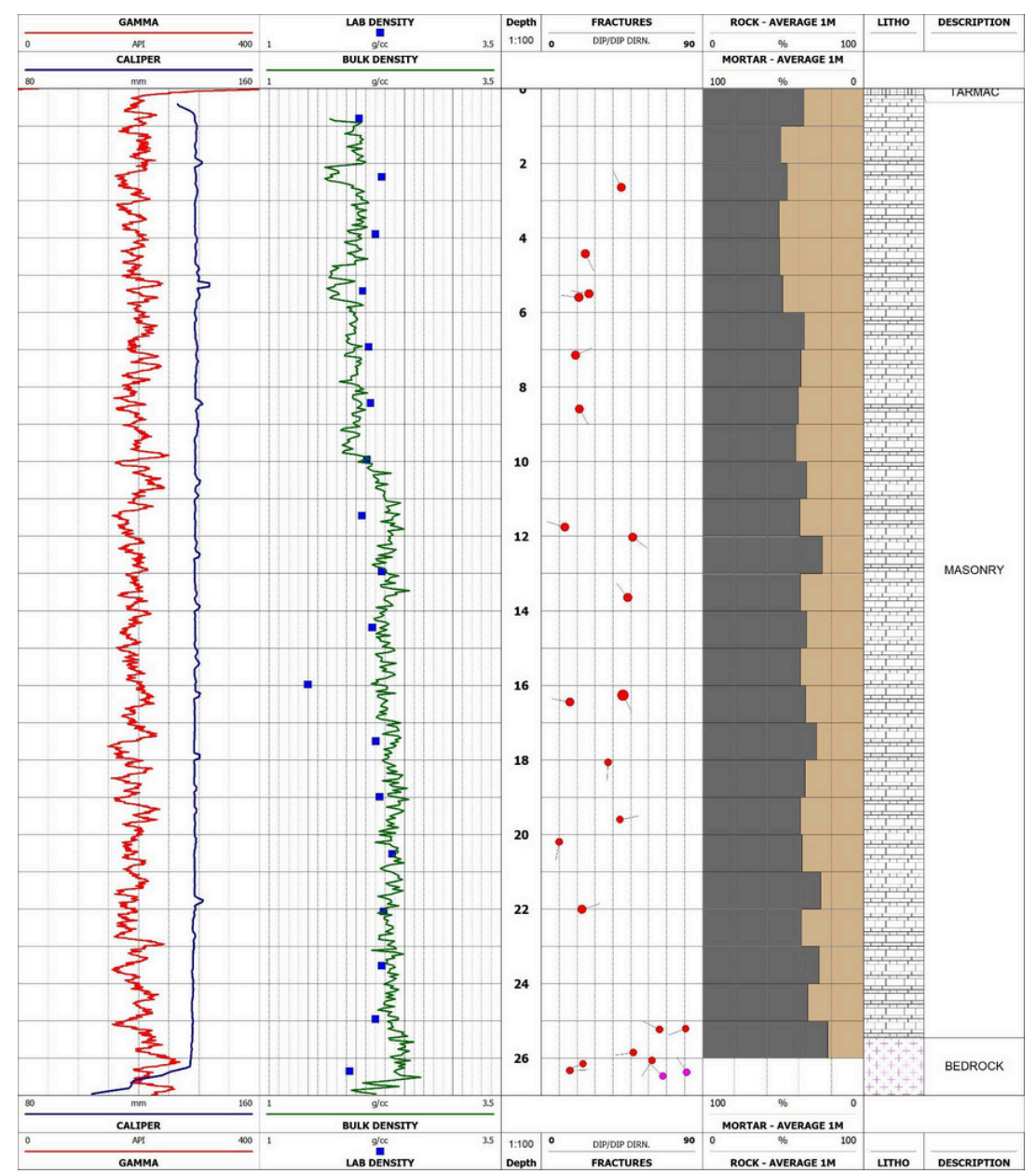
- density calibration integrating lab test results from core samples



Final results

Composite log presenting the key information:

- geophysical parameters
- fracture data (relative importance and direction)
- masonry component proportions averaged over 1 m intervals
- Following the study it was decided to proceed with precautionary renovation works.





**Thank you for attending
It was a “dam” good project!**

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