

Timber assessment of the Japanese Gateway

ROYAL BOTANICAL GARDENS, KEW.

INTRODUCTION

Following instructions from Sarah Mitchell-Dolby of Acanthus Clews Architects, I visited The Gardens on 24.10.23. The objective of the survey is to determine condition of those sections of the support posts of Japanese Gateway in contact with the ground.

A microdrill was used to test the integrity of the timber at various points where deterioration was visible or suspected – with a view assessing magnitude and extent of damage. This instrument drills a 2.5mm drill bit into the timber at a constant pressure. Resistance to the drill is a product of material density. One of the principal factors controlling timber density is fungal decay and wood borer damage. The resistance is presented as a graph, interpretation of which can indicate concealed decay. The drill positions are referenced in the observations (prefixed by 'MD') and appended to the end of the report.

JAPANESE GATEWAY

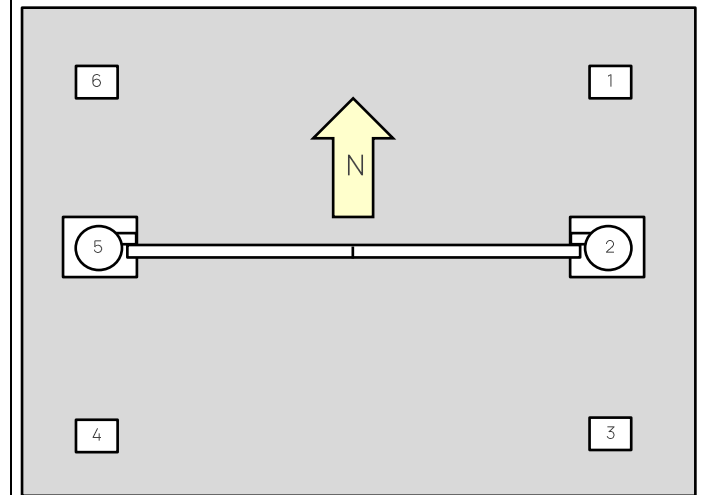
As previously reported, the bases of the posts are all concealed by decorated copper plates which are tacked to the timber.

In many places the copper plates are not continuous, or the tacks have fallen out, making limited access to the timber possible with the microdrill.



The elements of the gateway are numbered as shown opposite.

Note the gates open to the S. As such the vertical stop bars are on the N side of the doors – the pivot hinges on the S.



Construction and calibration of the instrument.

In all cases the posts were drilled at the lowest points where the copper plate would allow – see below for numbered drill positions. Initially the square and round section posts were drilled up from their bases to determine construction and to calibrate the machine – where known good material was being drilled.

Post 6 – MD 8.

The trace shows *'this'* post consists of separate outer cover plates of 60mm section, with what is assumed to be a single central post of 170mm section.



Posts 5 and 2 – MDs 9 and 10.

Both round posts were drilled at different orientations (N-S and E – W). Both showed 80 – 85mm outer section – then space. The probe normally auto retracts after 100mm of space, as the probe oscillates and then deflects producing anomalous readings. However, in the case of graph 9, the probe continued through nearly 200mm of space, indicating the round posts are almost certainly hollow.



Post 1

Some deterioration of the outer surface of the cover plate. This post is drilled at its corner (as opposed to though one of its faces). It is not clear whether the outer cover plate is thicker than that of post 6, or whether a section of some other element has been picked up. There is a cavity 130 – 180mm which doesn't appear to be a decay trace.

More sound material was then encountered until 340mm – when a hard material (probably a metal fixing) was encountered.

Even though the post was drilled at an angle, the trace indicates a possibility that the corner posts ((1, 3, 4 and 6) might not be of a similar construction.



Post 2

The plate had become detached as shown.

There is some very superficial deterioration of the timber surfaces.

MD below the metal band showed the post remains hollow at its base where it bears onto the plinth.



Post 2 – vertical stop.

First photo showing N side which appears sound.

The timber was drilled from the S side where there is some deterioration of the bar at its base. MD showed sound material for 75mm, a small gap, then hard material – almost certainly a metal fixing.

The base of the door interfacing with the pivot hinge is sound – although the metal is corroding – see post 5.



Post 3

Possibly some deterioration of the outer plate – although the probe might have deflected below it, but sound material centrally.



Post 4

Showing sound trace through cover plates and central section.



Post 5

There is some deterioration of the base of the vertical stop bar which was drilled. MD showed a similar trace to 14, with the probe hitting hard material at 120mm. The plate was in tact around the post base, so MD 9 (used for calibration) is as low as the drill can go.

The pivot hinge has rusted and there is probably very localised decay to the timber around socket in the hinge stile for the pivot hinge, which has resulted on the door collapsing on the pivot hinge – pushing out what is probably the socket cover fillet in the process.

Whatever the sequence of events, the door requires a localised repair in this corner – and remounting.



Post 6

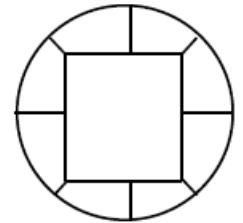
MD showing sound cover plate and central post (which has a central seasoning fissure at 170mm). The probe then couldn't progress after 265mm, due to the density and strength of the timber – possibly encountering a knot.



DISCUSSION & RECOMMENDATIONS

Drilling positions were dependent on the gaps in the plates – which varied from post to post. As such, the same angle of drill entry was not possible in every case. As such, it is not possible to say with certainty whether the construction of the posts (1, 3, 4 and 6) is the same. All seem to have outer cover plates around a central post (possibly made up of more than one element). In some cases, when drilling at the base of the posts, it is possible the probe deflected under the base of the cover plates, which finish just above that point where the plates chamfer in to the 'waist'.

Posts 2 and 5 probably have a section similar to the diagram opposite, with a metal band around the base, just above the plinth.



It was not possible to determine nature and condition of the plinths, which were all covered in the plates, without any gaps to make drilling possible.

Based on the drilling that was possible, and the fact that copper is a nature biocide, it seems unlikely there will be any significant structural decay to any of the post bases.

As mentioned above, the most significant defect is the deterioration of the lower pivot hinges of both doors – although the W door is the worst effected, where the lower pivot hinge arrangement has collapsed.

Tim Floyd – November 2023

MICRO DRILL

The micro drill drills a 2mm diameter needle into the timber, measuring both the torque generated by the drill motor to turn the drill bit – known as 'drill' (dark green shaded curve on the graph) and-more importantly- the resistance being experienced by the motor responsible for sliding the whole mechanism forward at a pre-set rate – known as 'feed' (light green shaded curve).

The torque generated in the drill and the resistance experienced by the feed mechanism are generally correlative. However wet timber - or the existence of other materials such as resin which may have been used in past repair - can affect the drill to a greater or lesser extent than the feed.

Peaks in the graphs represent torque/resistance being experienced by the drill/feed. The Y axis is magnitude of resistance/torque, with 100(%) representing that value where the motor can no longer move the feed mechanism at its pre-set feed speed (which would require a reduction in the feed speed).

The machine has 5 pre-set feed speeds that can be used – dependent on the nature of the timber. For example, dense medieval oak generally requires a low feed speed of 25 - 100cm/min, softwood requires 100 – 150cm/min. The faster feed speeds of 175 and 250cm/min are more applicable to living trees (another application for this equipment). Adhering to these criteria means that any reading over around 30% amplitude (on the Y-axis) represents dense and sound timber – especially when lower feed speeds are used.

Information regarding the individual drilling points is presented on the graphs which are included at the end of the report – either as comments (bottom right) or in the status panel (top left) which shows details such as feed speed and orientation of the drill – shown as 'Tilt' and measured in degrees from horizontal (a drilling straight down from above would be indicated by -90° , straight up would be indicated by $+90^{\circ}$, straight in horizontally would show as a tilt of 0°).

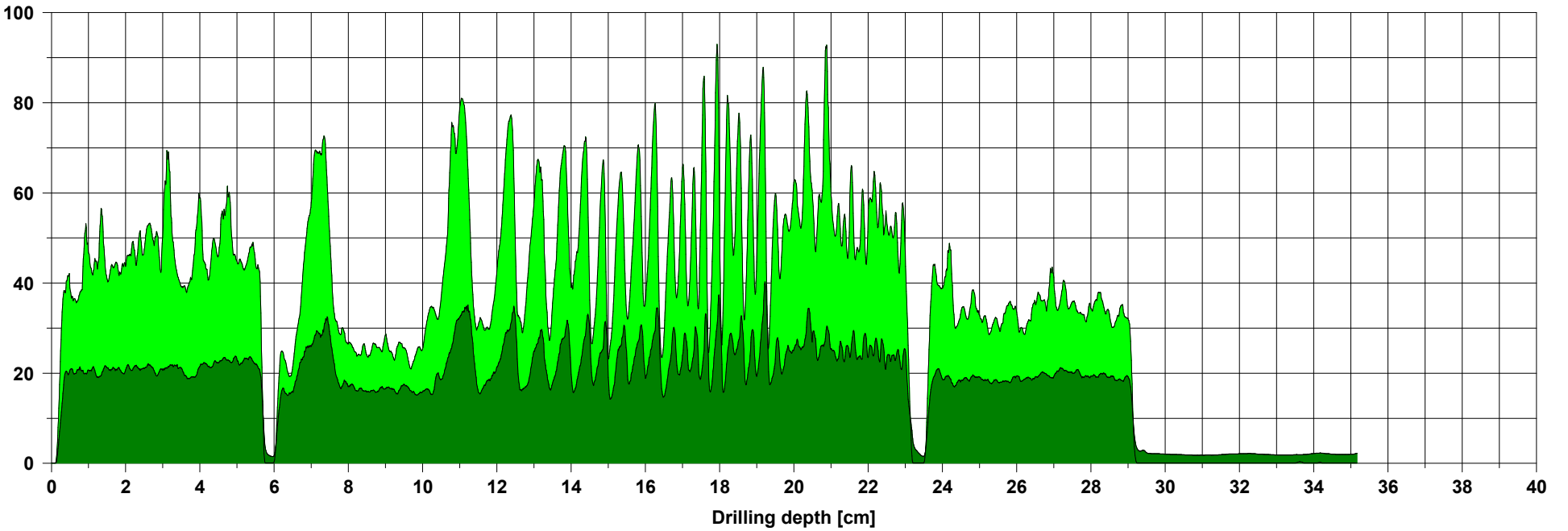
Those graphs – generally the first 1 or 2, described in the comments as 'calibration' are important, as they represent a trace through timber known to be sound – and as such form a baseline for interpretation of subsequent graphs.

Close centred peaks and troughs in the graph represent the early wood late wood boundaries (growth rings) – with early rapid spring growth resulting in softer material, producing a trough, and the later summer growth being slower, producing a narrower and denser growth phase marked by a peak in the graph.

Measuring / object data

Measurement no.:	8	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 35,17 cm	Tilt	: -2°	Direction:	
Date	: 24.10.2023	Offset	: 72 / 276	Species	:
Time	: 10:57:33	Avg. curve	: off / off	Location	:
Feed	: 100 cm/min			Name	:

Amplitude [%]



Assessment

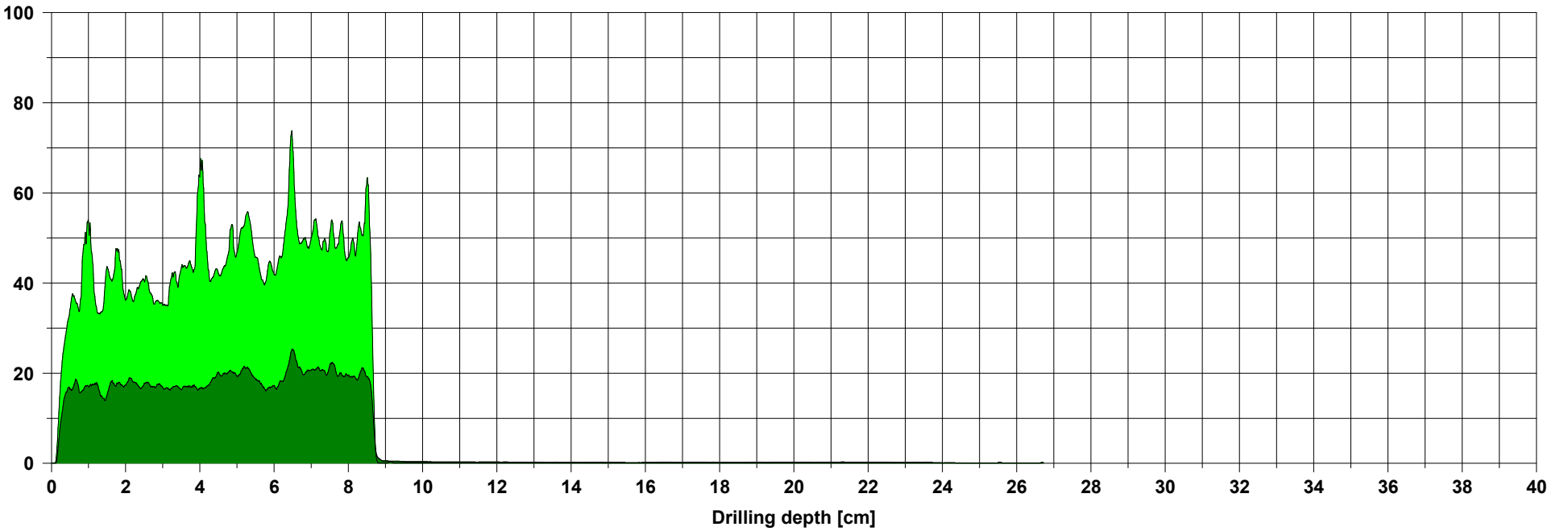
Comment

Cal sq post 6

Measuring / object data

Measurement no.:	9	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 26,72 cm	Tilt	: -5°	Direction:	
Date	: 24.10.2023	Offset	: 73 / 274	Species	:
Time	: 11:02:13	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

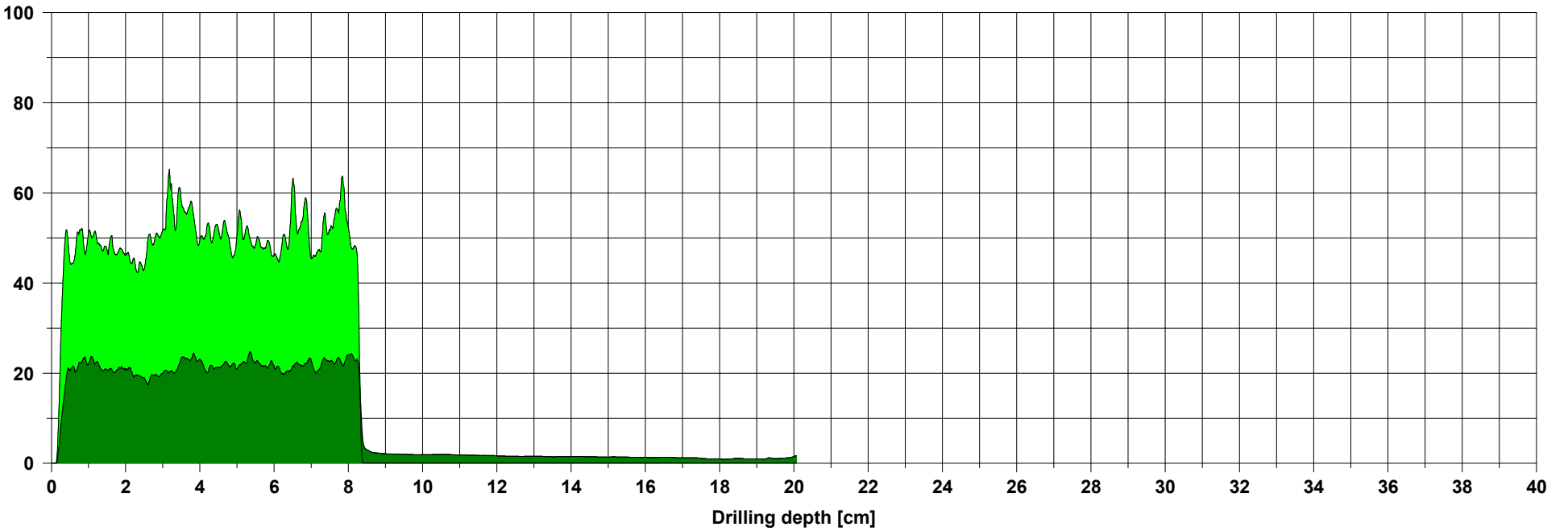
Comment

Cal round post 5

Measuring / object data

Measurement no.:	10	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 20,07 cm	Tilt	: -2°	Direction:	
Date	: 24.10.2023	Offset	: 72 / 270	Species	:
Time	: 11:03:50	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

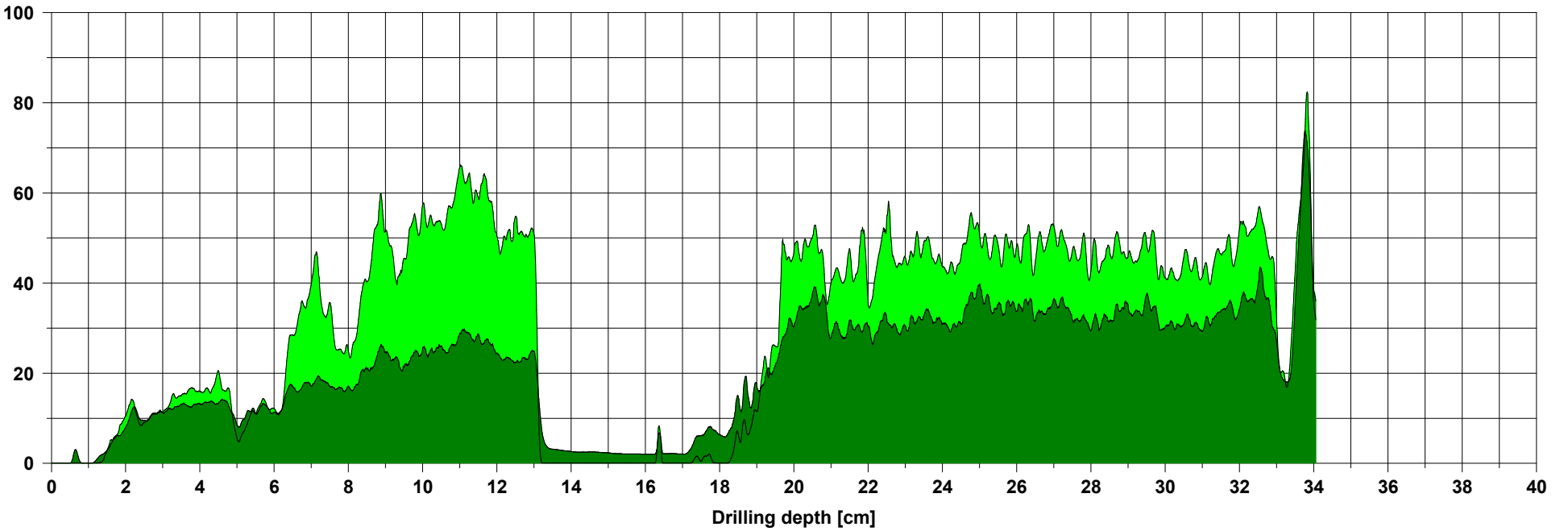
Comment

Cal round post 2

Measuring / object data

Measurement no.:	12	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 34,06 cm	Tilt	: -2°	Direction:	
Date	: 24.10.2023	Offset	: 70 / 274	Species	:
Time	: 11:32:36	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

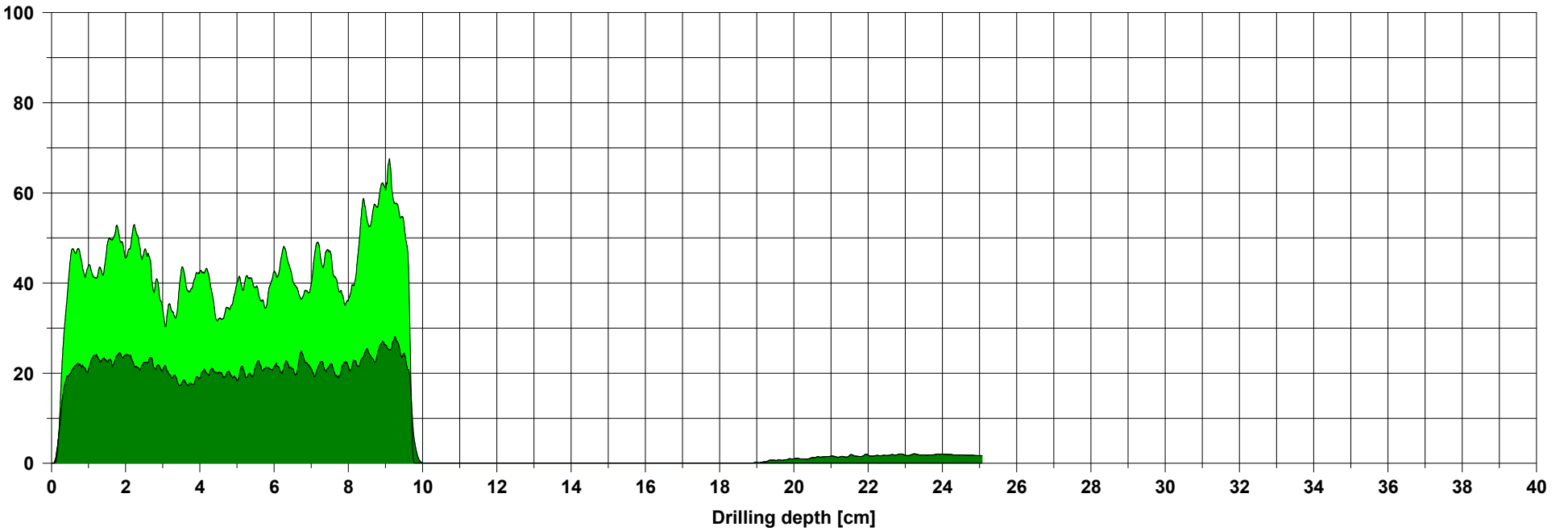
Comment

Post 1

Measuring / object data

Measurement no.:	13	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 25,07 cm	Tilt	: -8°	Direction:	
Date	: 24.10.2023	Offset	: 73 / 270	Species	:
Time	: 11:40:00	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min			Name	:

Amplitude [%]



Assessment

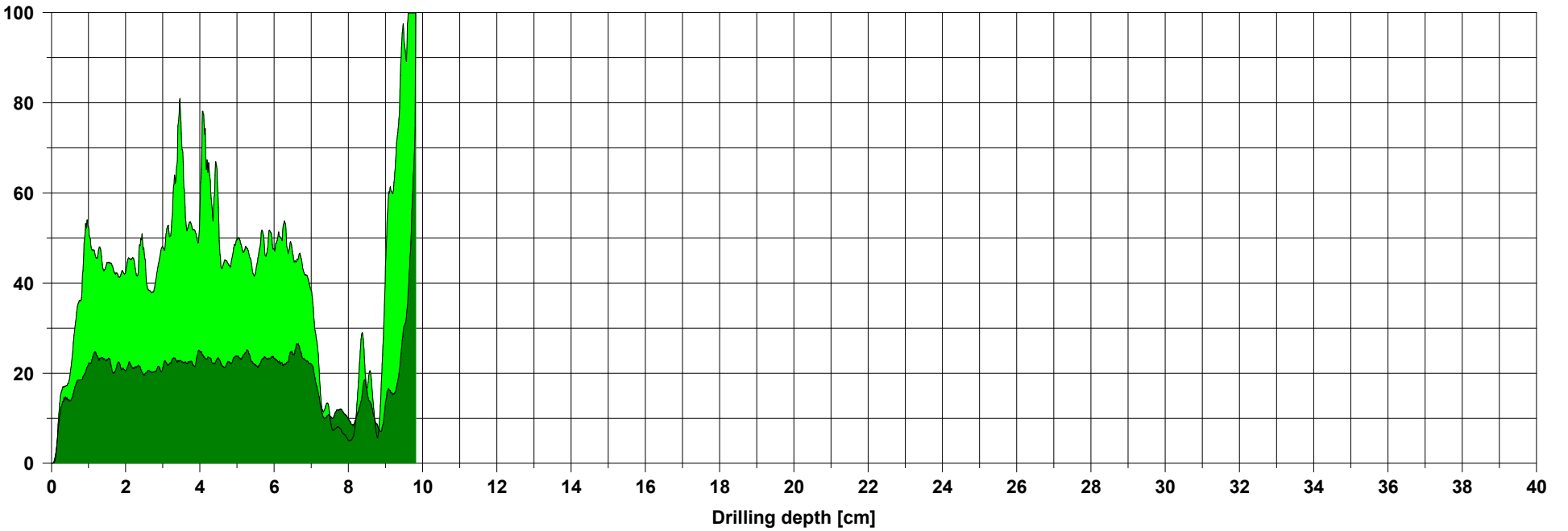
Comment

Post 2

Measuring / object data

Measurement no.:	14	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 9,81 cm	Tilt	: -1°	Direction:	
Date	: 24.10.2023	Offset	: 73 / 275	Species	:
Time	: 11:49:11	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

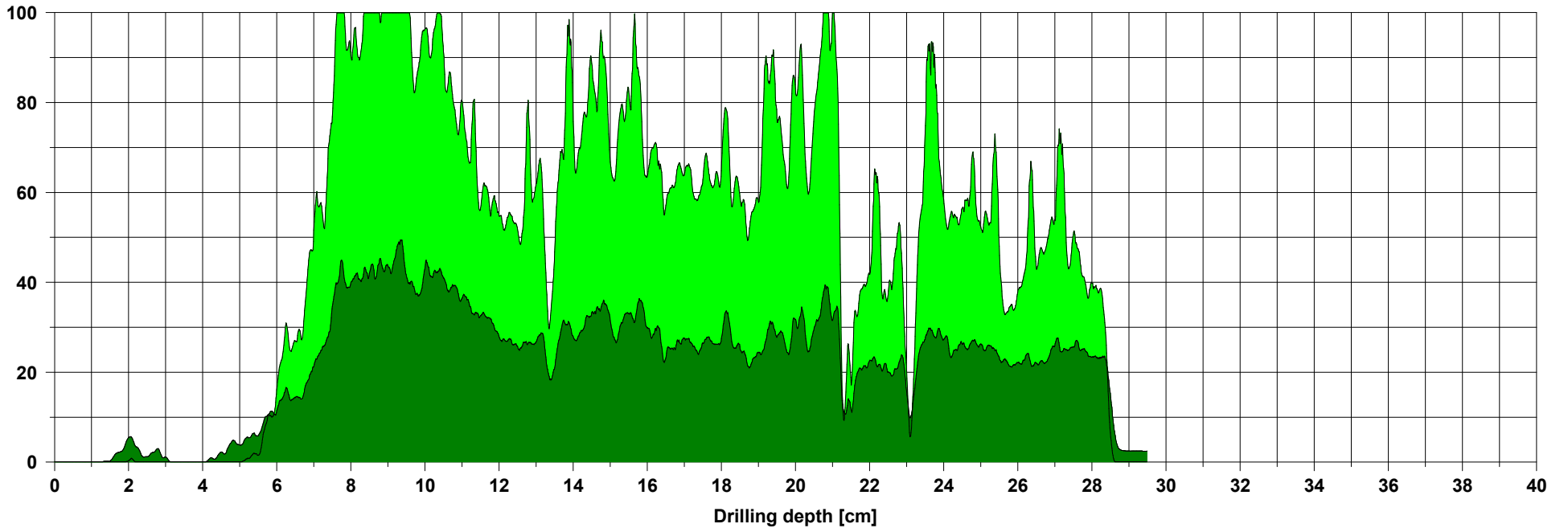
Comment

Post 2 - base of vertical stop bar

Measuring / object data

Measurement no.:	15	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 29,49 cm	Tilt	: +8°	Direction:	
Date	: 24.10.2023	Offset	: 72 / 272	Species	:
Time	: 12:01:09	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

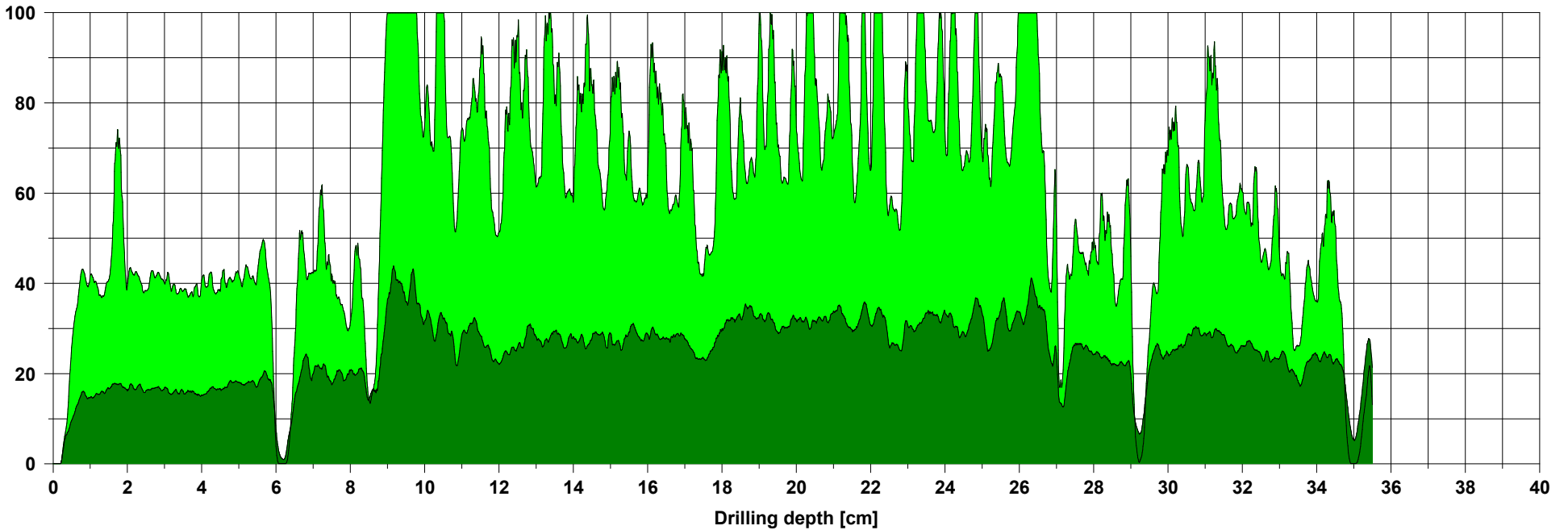
Comment

Post 3

Measuring / object data

Measurement no.:	16	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 35,50 cm	Tilt	: -2°	Direction:	
Date	: 24.10.2023	Offset	: 70 / 273	Species	:
Time	: 12:07:02	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min			Name	:

Amplitude [%]



Assessment

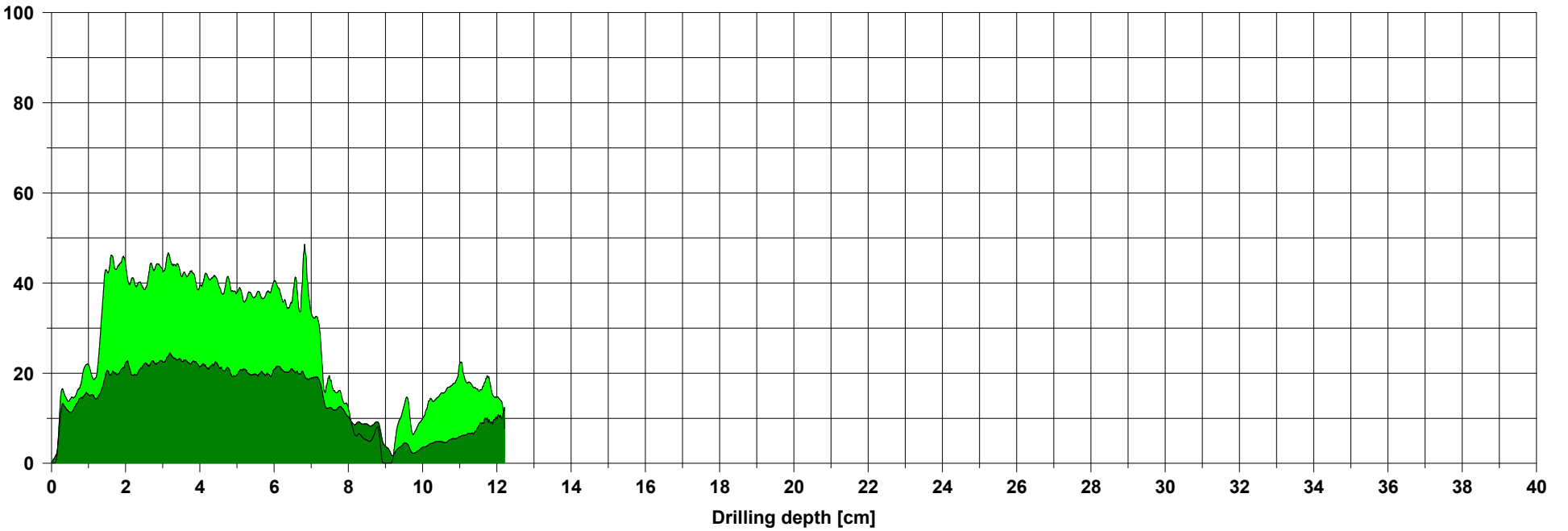
Comment

Post 4

Measuring / object data

Measurement no.:	17	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 12,21 cm	Tilt	: -2°	Direction:	
Date	: 24.10.2023	Offset	: 70 / 270	Species	:
Time	: 12:15:02	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

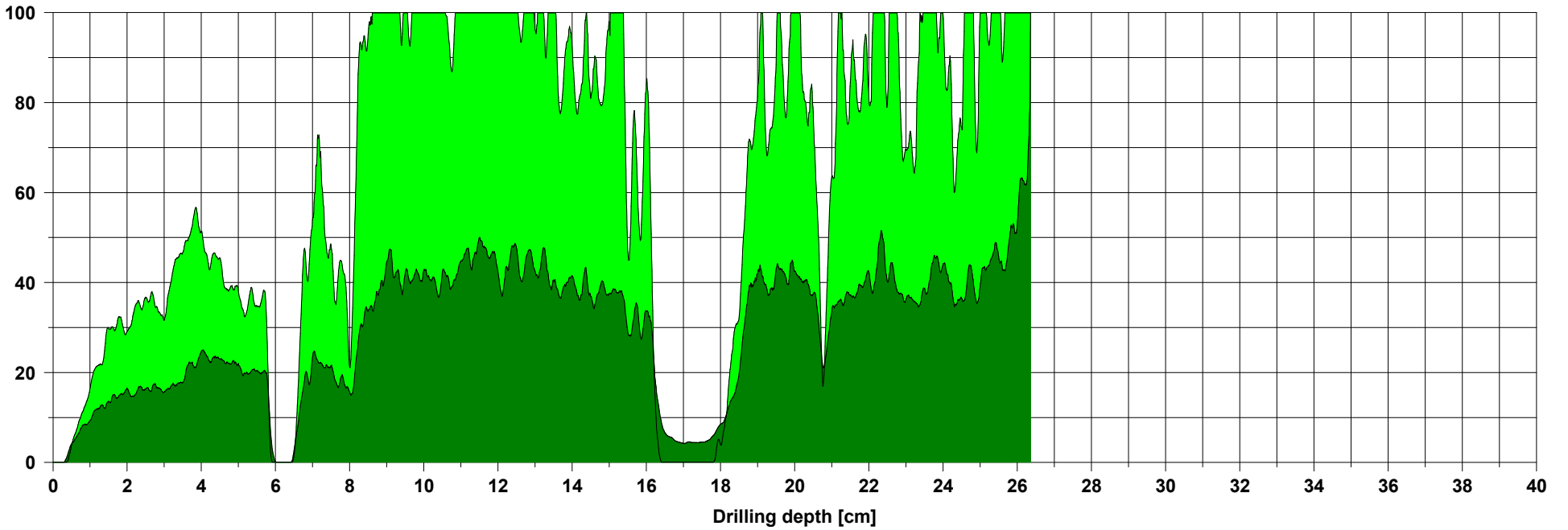
Comment

Post 5. Base of vertical stop bar

Measuring / object data

Measurement no.:	18	Speed	: 2500 r/min	Diameter:	
ID number	: Japanese Gateway	Needle state:	---	Level	:
Drilling depth	: 26,36 cm	Tilt	: -3°	Direction:	
Date	: 24.10.2023	Offset	: 73 / 277	Species	:
Time	: 11:29:36	Avg. curve	: off / off	Location:	
Feed	: 100 cm/min	Name	:		

Amplitude [%]



Assessment

Comment

post 6