Appendix

Resistograph micro-drilling to Estimate Wood Density

Contract Number:	04/HY/2010
Date of Works:	31/10/2012
Tree Location:	Bonham Road (11SW-A/R577_0)
Tree ID:	T2 LCSD CW/14
	T4 hyd_hk_11sw_a_r577_0_wt4
	T5 hyd_hk_11sw_a_r577_0_wt5
Species Name:	*Ficus microcarpa*
Detection instruments:	Resistograph (IML 400)
Prepared by:	Lau Yin Pong (ITS)

Scope

As per instructions provided by Highways Department (HyD), 20 locations were assigned to carry out Resistograph reading on LCSD CW/14, hyd_hk_11sw_a_r577_0_wt4 and hyd_hk_11sw_a_r577_0_wt5 to gain internal graphical readings of specific locations.

T2-P0

Location of detection on LCSD CW/14 (10 Resistographs):

T4-P0

Location of detection on hyd_hk_11sw_a_r577_0_wt4 (5 Resistographs):

T5-P0

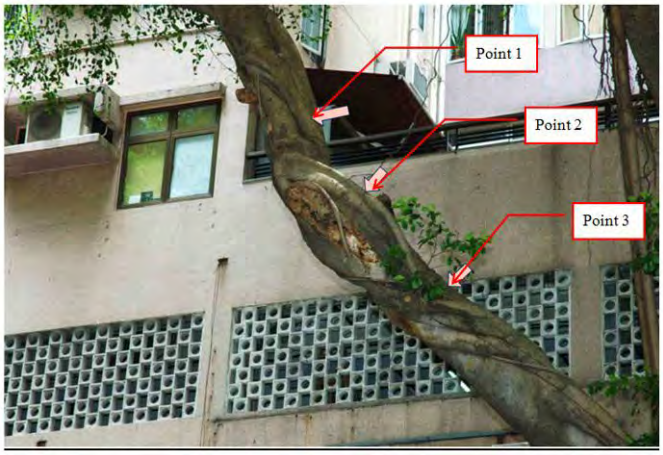
Location of detection on hyd_hk_11sw_a_r577_0_wt5 (5 Resistographs):

T2-P1

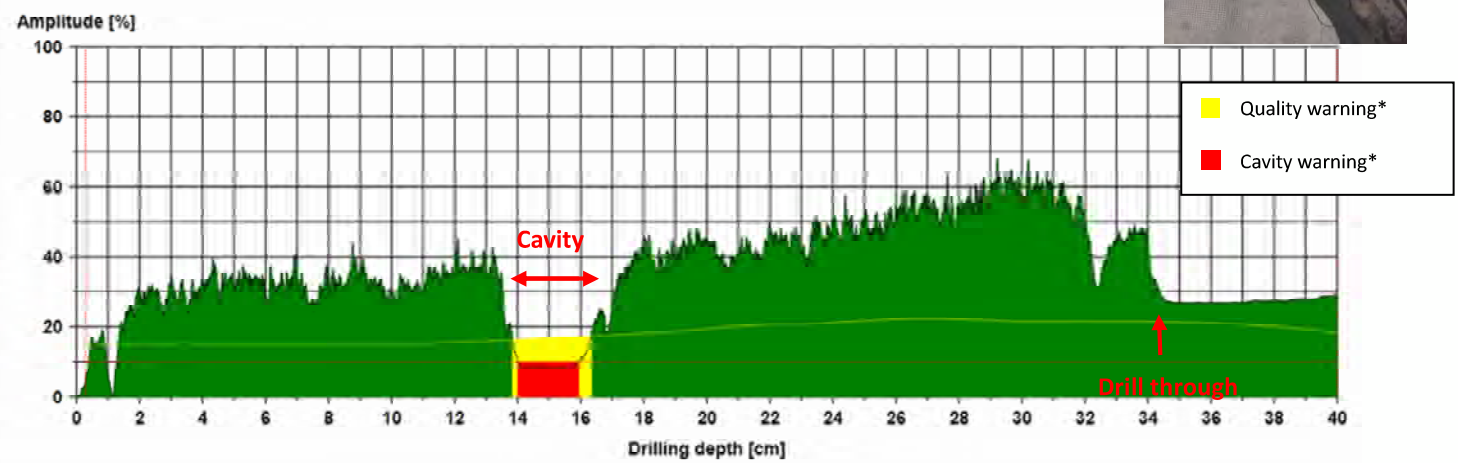
Resistograph Readings:

LCSD CW/14 Point 1:

Assigned location:



Work Photo:



LCSD CW14 Point 1 was set on the South-eastern trunk where exposed dead wood was observed. Strong partial aerial root fusions were observed on trunk surface.

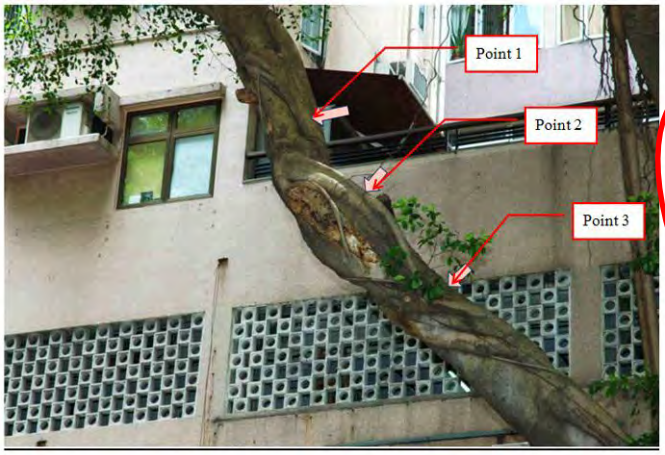
A small central cavity was noted between 13cm & 17cm. This could be correlated with the dead wood partly exposed on south-eastern face of trunk. The drill bit then entered the solid sound wood from 18cm to 34cm. It then drilled through the trunk at 35cm. (The circumference of the stem where the reading was taken was 1200mm.) This Resistograph reading reflects a normal density of wood on aerial roots on both side of trunk. This implies a good formation of reaction wood enclosed decayed old wood and re-strengthened the trunk.

* Quality warning: Warning given by IML 400 when value goes lower than Quality curve
Cavity warning: Warning given by IML 400 when value goes lower than Cavity curve

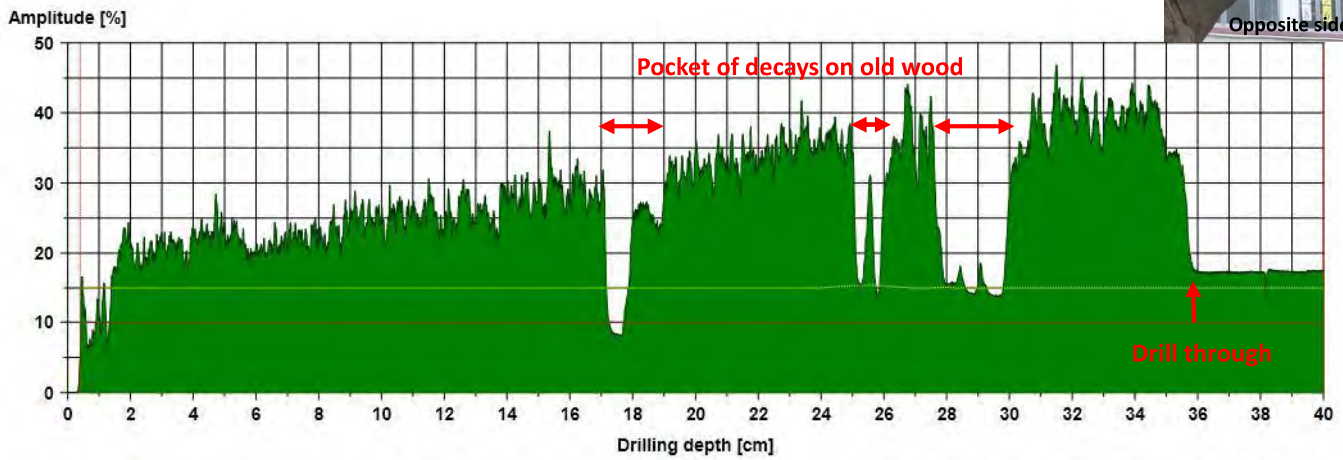
T2-P2

LCSD CW/14 Point 2:

Assigned location:



Work Photo:



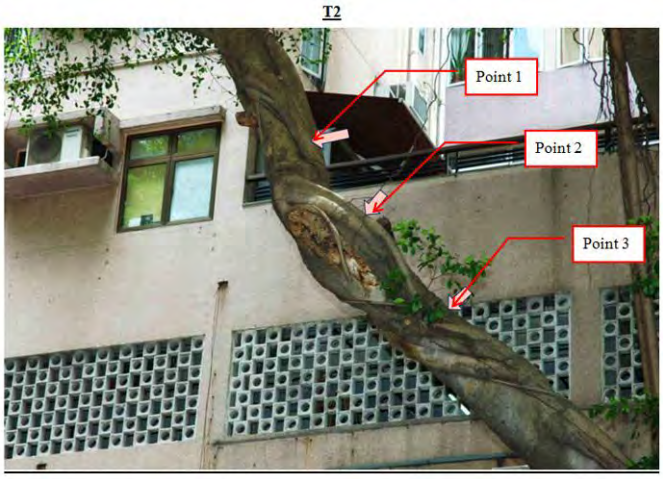
Point 2 was set on a south-eastern limb where exposed dead wood was observed. Partially fused aerial roots were observed around the old wood to strengthen the area. The reading was taken behind the protruded aerial roots to avoid abnormal reading due to aerial root fusion.

Troughs were identified on LCSD CW/14 Point 2 between 17cm & 18cm. It could be possibly a pocket of decay existed on old wood. Aerial root formed strong reaction wood on both sides of the old wood to compensate lost strength. Sound wood is observed from 2cm to 17cm, which contribute to at least 30% of trunk girth. The bit drilled through the trunk at 36cm. (The circumference of the stem where the reading was taken was 1500mm.)

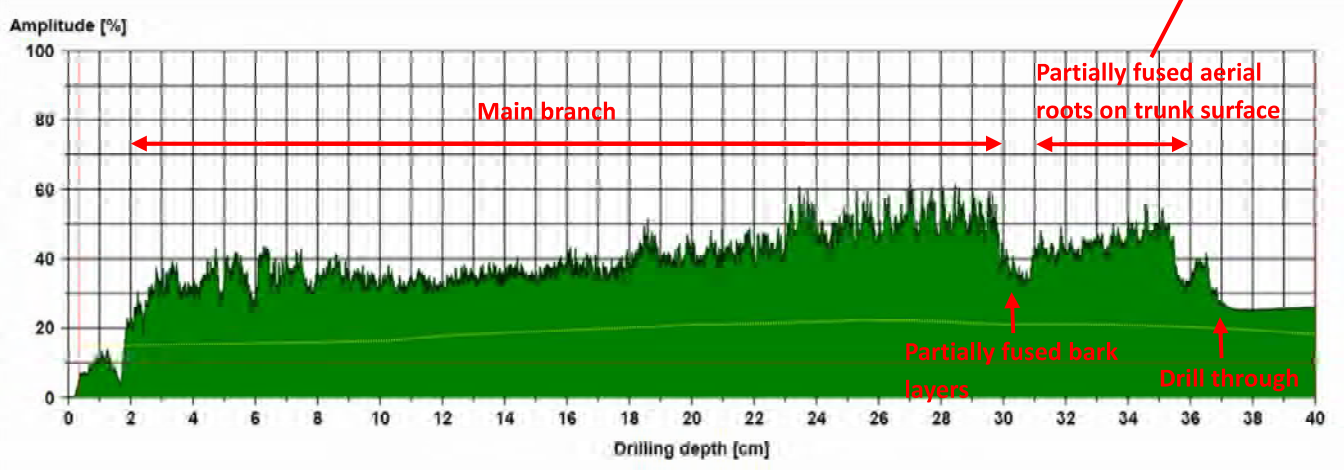
T2-P3

LCSD CW/14 Point 3:

Assigned location:



Work Photo:



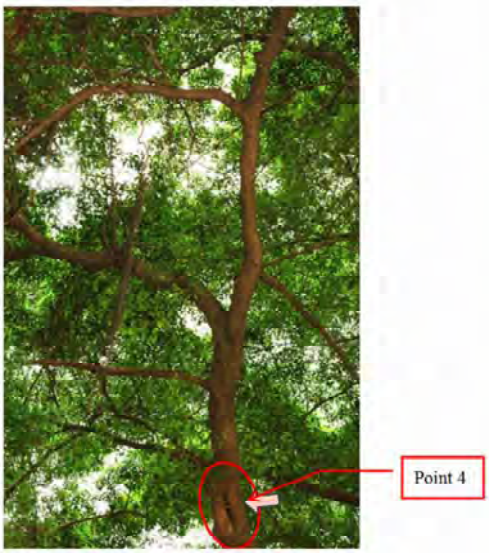
Point 3 was set below Point 2 where exposed dead wood was not observed. Partially fused aerial roots were observed on trunk surface.

This Resistograph reading reflects a normal density of wood on the trunk. The bit drilled through the trunk at 37cm. (The circumference of the stem where the reading was taken was 1430mm.) A drop of the reading was noted at 30cm when it entered the bark layer, followed by a slow climb from 31cm to 35cm. This pattern was related with a change of wood density between the trunk and partially fused aerial roots on lower trunk surface. The slow ascending curve between 31cm to 35cm indicated a normal wood density on also the partially fused aerial root.

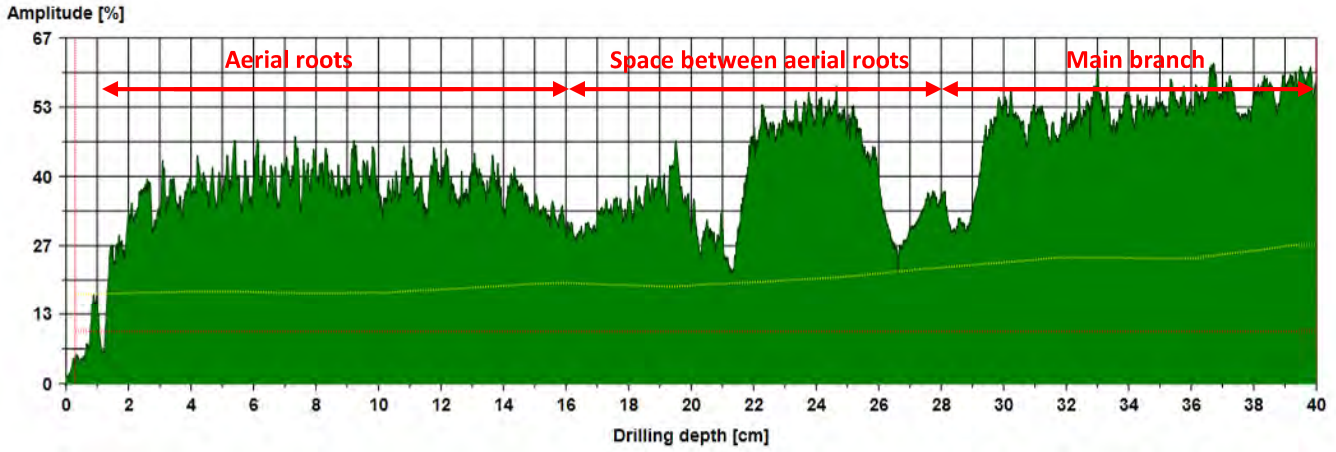
T2-P4

LCSD CW/14 Point 4:

Assigned location:



Work Photo:



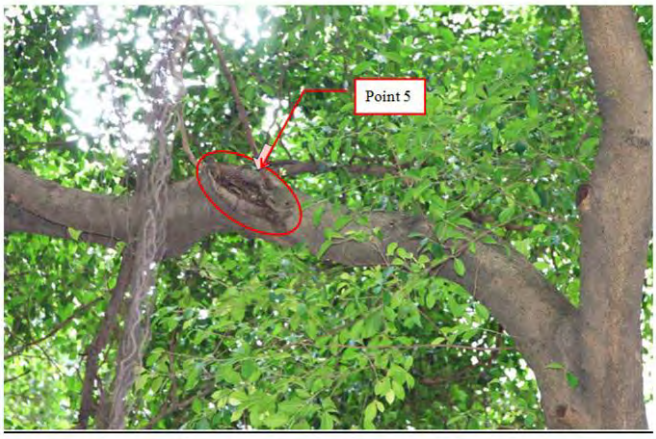
Point 4 was set on a branch on top of SE crown. An aerial root partially fused with the main branch in the location. The reading was taken as an opposite position due to site restriction.

Sound structure of aerial root was indicated the curve between 2cm & 14cm. Between 14cm & 29cm, vigorous fluctuations were observed when the drill bit passed through space between aerial roots. Smaller aerial roots and epicormics affected the drill bit and caused fluctuations. The drill bit entered the main branch again at 29cm. Normal density of wood was reflected by the slowly ascending curve between 29cm & 40cm.

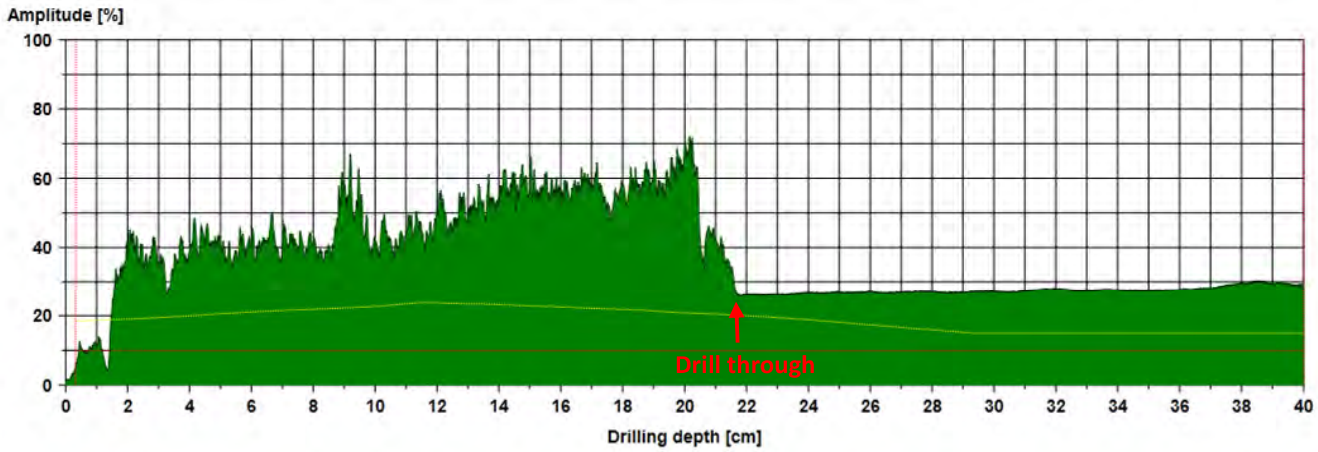
T2-P5

LCSD CW/14 Point 5:

Assigned location:



Work Photo:



Point 5 was set on a branch on SE crown with an open cavity. The reading was taken as an opposite position due to site restriction.

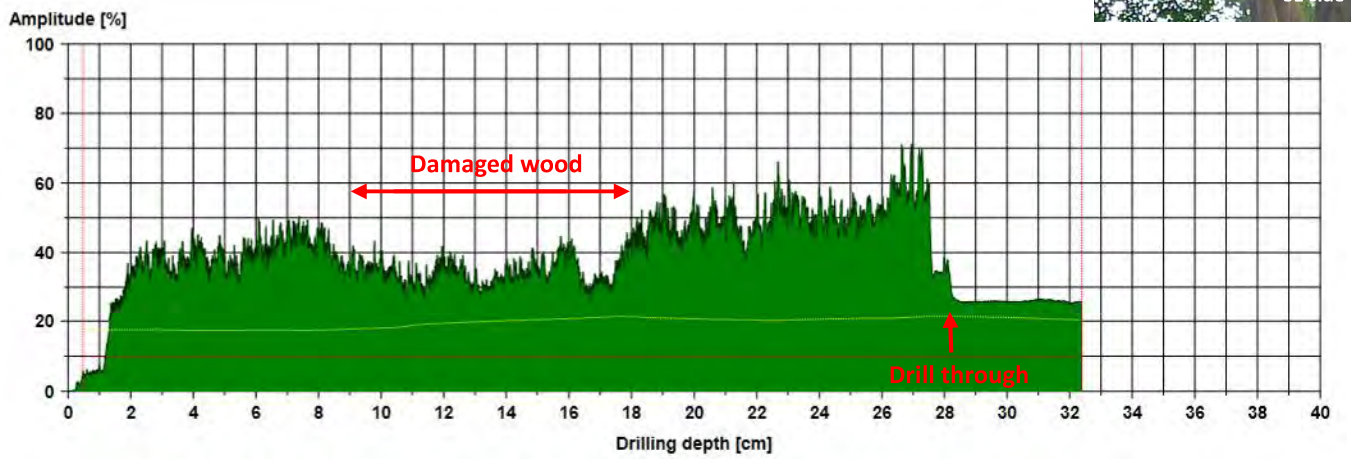
This Resistograph reading reflects a normal density of wood on the trunk. No significant drop of wood density behind open cavity was recorded. The bit drilled through the trunk at 21cm. (The circumference of the elliptical stem where the reading was taken was 660mm.) Based on the result, it was likely that the decay was fenced off by wall 4 from spreading inside. Good wound wood formation was observed to close the cavity.

T2-P6

LCSD CW/14 Point 6:

Assigned location:

Work Photo:



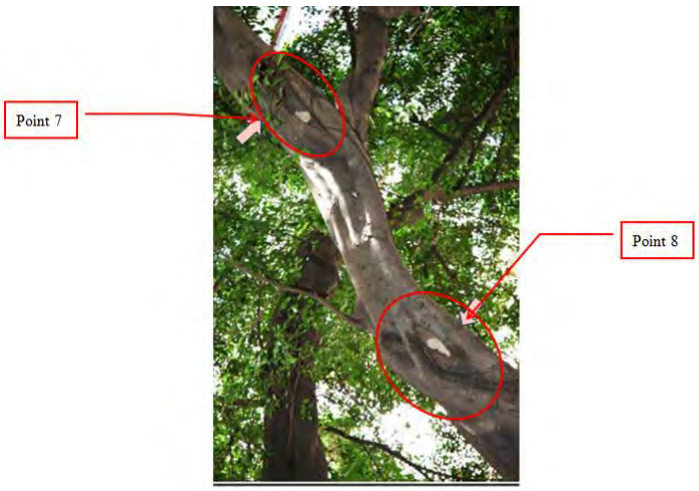
Point 6 was set on a branch on SE crown. A jagged wound of previous branch failure and insect nest were observed near the position. Partially fused aerial roots were observed on surface.

The bit drilled through the trunk at 28cm. (The circumference of the elliptical stem where the reading was taken was 1150mm.) Damaged wood was recorded between 9cm & 18cm. Luckily, thick sound wood (between 2cm & 9cm, 18cm & 27cm) was observed on both side of branch. Risk of failure was not high based on this result (>50% wall thickness). On the other hands, there were aerial roots laid (where they were not included into this Resistograph record) on this branch to strengthen the old wood. Risk is expected to be further lowered.

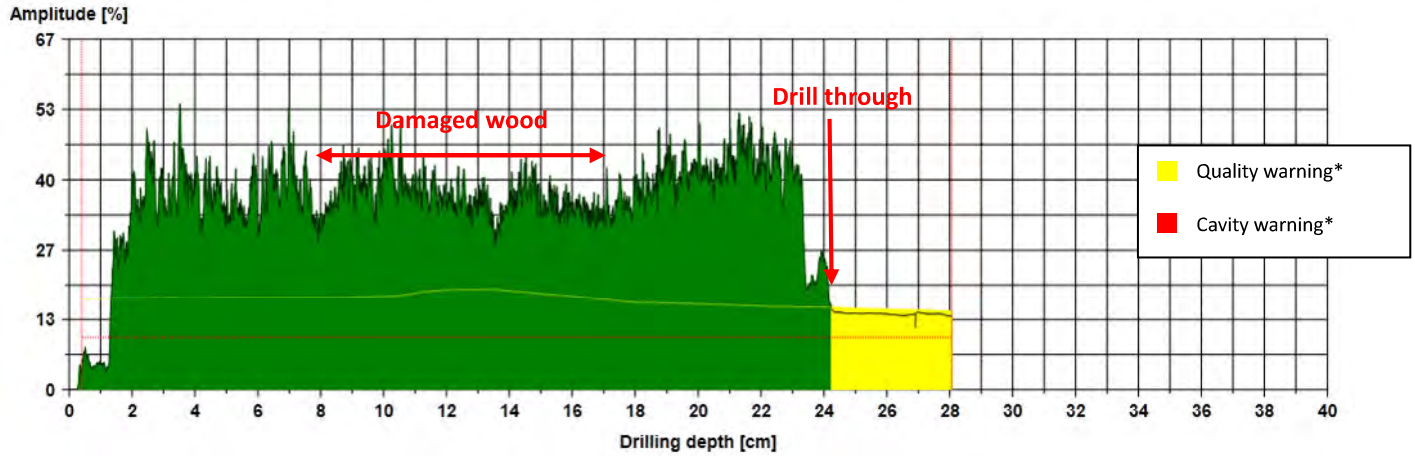
T2-P7

LCSD CW/14 Point 7:

Assigned location:



Work Photo:



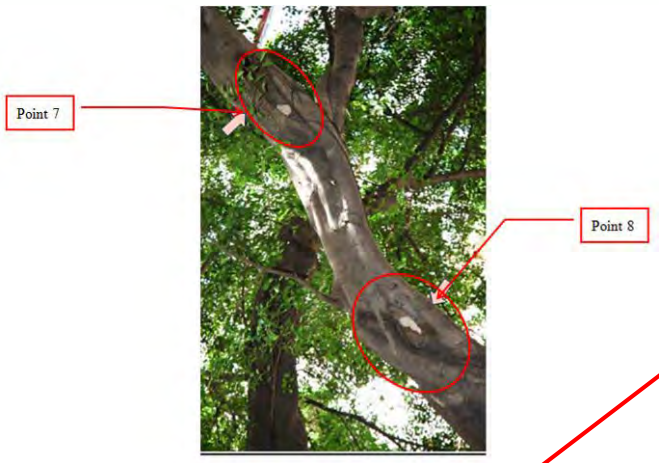
Point 7 was set on the same location opposite to Point 6. A jagged wound of previous branch failure and insect nest were observed near the position. Partially fused aerial roots were observed on surface. The bit drilled through the trunk at 24cm. (The circumference of the elliptical stem where the reading was taken was 1150mm.) Wood with suspected decay was recorded between 8cm & 17cm. Luckily, thick sound wood (between 1cm & 8cm, 17m & 23cm) was observed on both side of branch. On the other hands, there were strong aerial roots laid (where they were not included into this Resistograph record) on top of this branch to strengthen the old wood. Risk is expected to be low.

* Quality warning: Warning given by IML 400 when value goes lower than Quality curve
Cavity warning: Warning given by IML 400 when value goes lower than Cavity curve

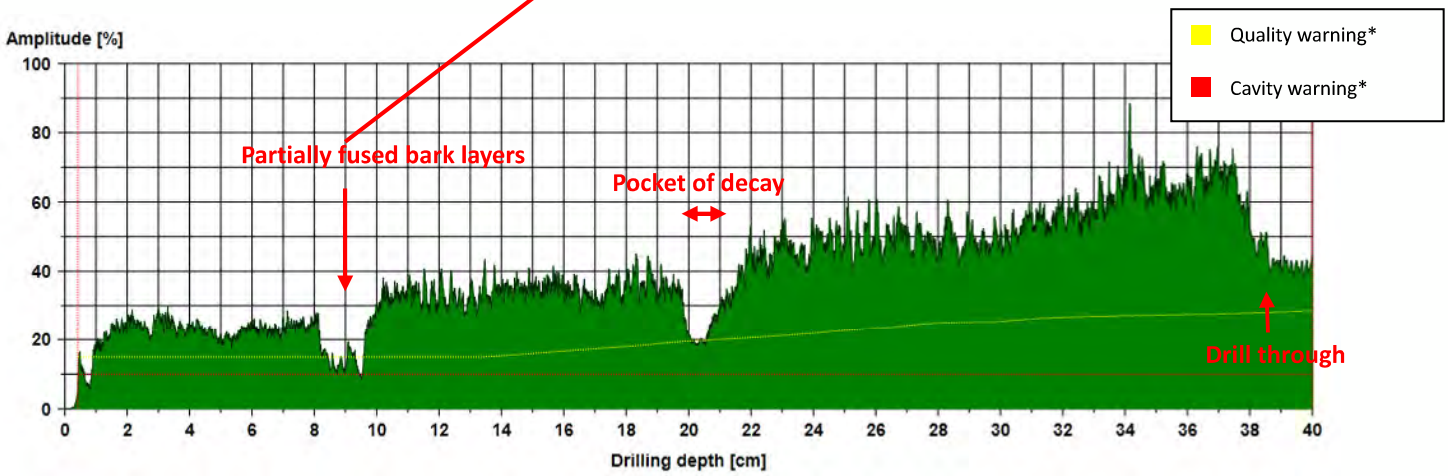
T2-P8

LCSD CW/14 Point 8:

Assigned location:



Work Photo:



Point 8 was set on a branch on SE side of crown below Point 7. Insect nest was observed on trunk surface. Partially fused aerial roots were observed on surface.

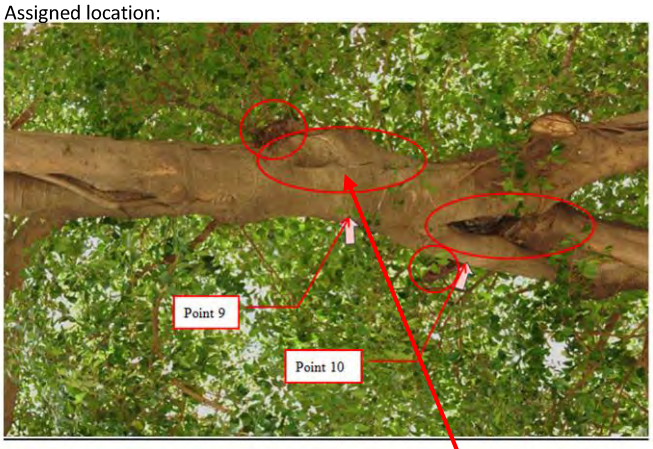
The bit drilled through the trunk at 37cm. (The circumference of the elliptical stem where the reading was taken was 1200mm.) Troughs were recorded between 8cm & 10cm and 20cm & 22cm. Troughs recorded between 8cm & 10cm was likely due to the presence of partially fused bark layers; while another was likely to be a small pocket of internal decay. With normal wood density observed between 1cm & 8cm (aerial root), 10cm & 20cm and 22cm & 38cm, the risk of failure was expected to be low.

* Quality warning: Warning given by IML 400 susceptible of a potential damaged wood
Cavity warning: Warning given by IML 400 susceptible of a potential cavity

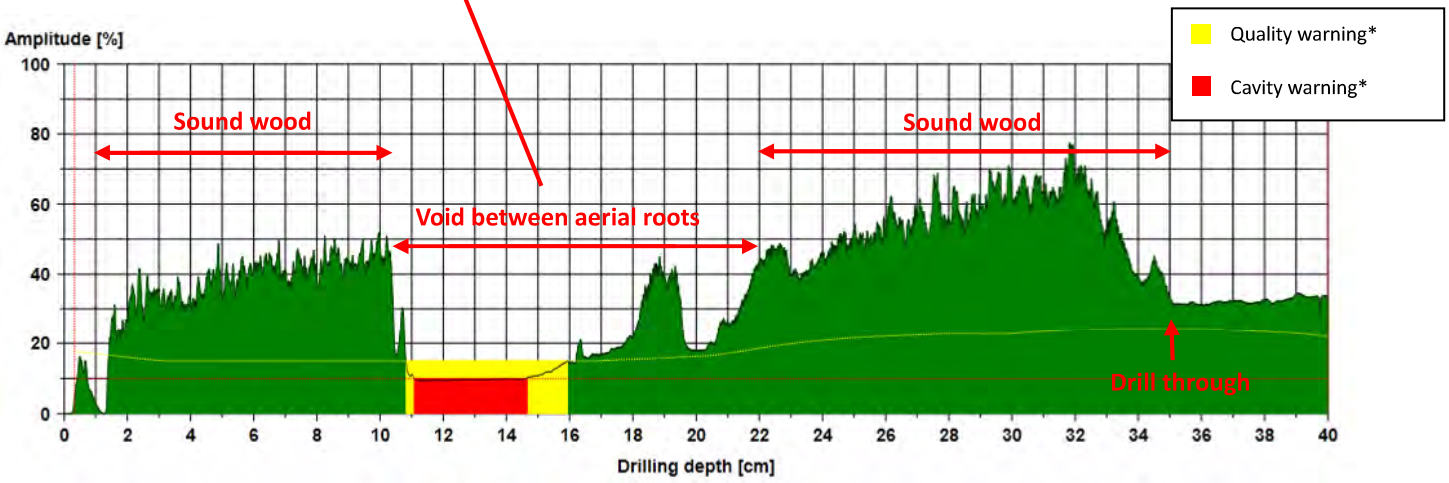
T2-P9

LCSD CW/14 Point 9:

Assigned location:



Work Photo:



Point 9 was set on a branch on NE side of crown. A pruning wound was observed close to the location. Also strong aerial root fusions were observed on surface.

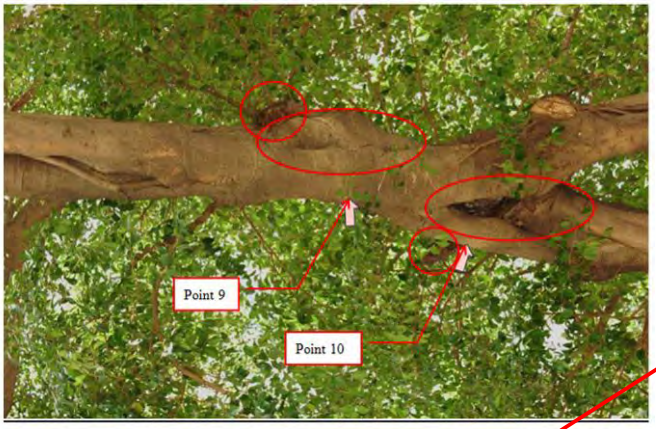
The bit drilled through the trunk at 35cm. Large area of reduced resistance was recorded between 10cm & 22cm. Without significant cavity or observable signs of decay, this area of low resistance is due to the presence of space between main branch and aerial roots. Complicated fused structures between main branch and aerial roots made Resistograph readings more difficult to be interpreted. However large proportion of sound wood was observed on both side of structure making it more likely to be stable.

* Quality warning: Warning given by IML 400 when value goes lower than Quality curve
Cavity warning: Warning given by IML 400 when value goes lower than Cavity curve

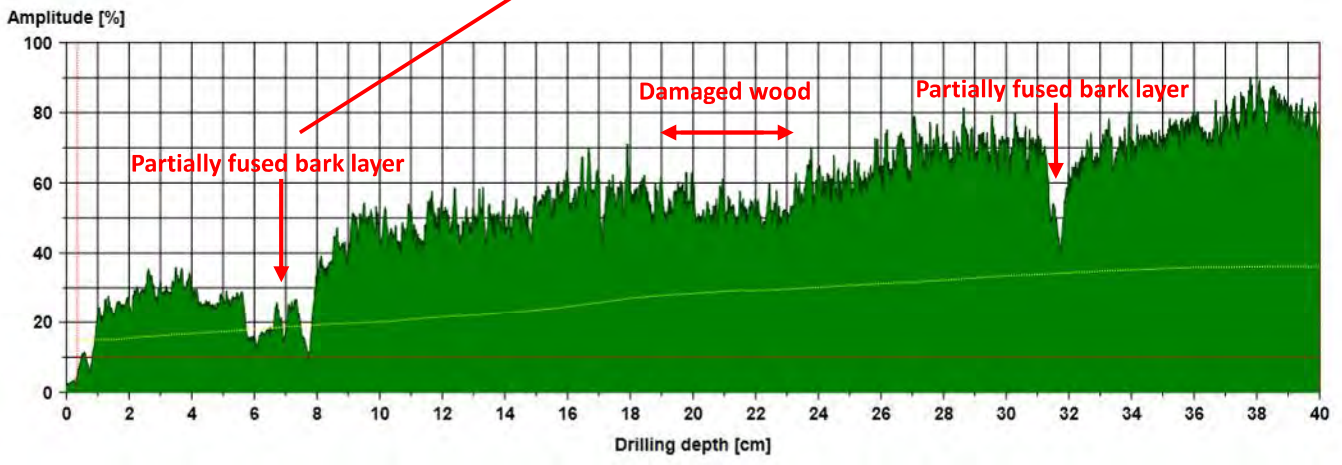
T2-P10

LCSD CW/14 Point 10:

Assigned location:



Work Photo:



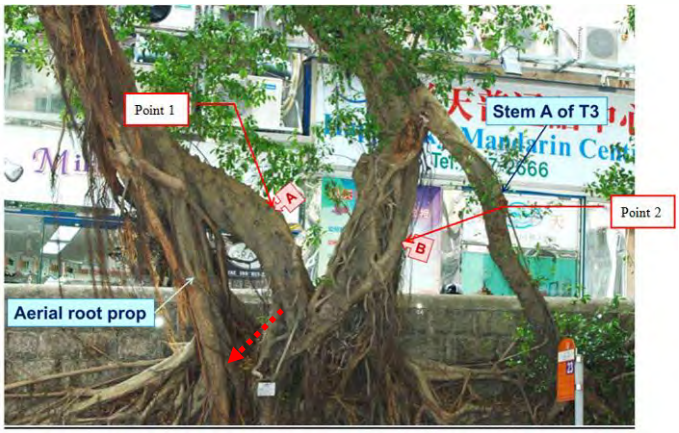
Point 10 was set on a branch union on NE side of crown. A few wounds of previous branch failure were observed around the region. Also strong aerial root fusions were observed on surface.

Troughs were recorded between 5cm & 8cm and 31cm & 32cm. These troughs recorded between 5cm & 8cm was likely due to the presence of a partially fused bark layer. Small flat area was observed between 19cm & 23cm, it is suspected to be decay spread from nearby wounds. Normal wood density was observed generally between 8cm & 19cm, 24cm & 30cm and 33cm & 40cm. This branch was believed to be sound based on the above result.

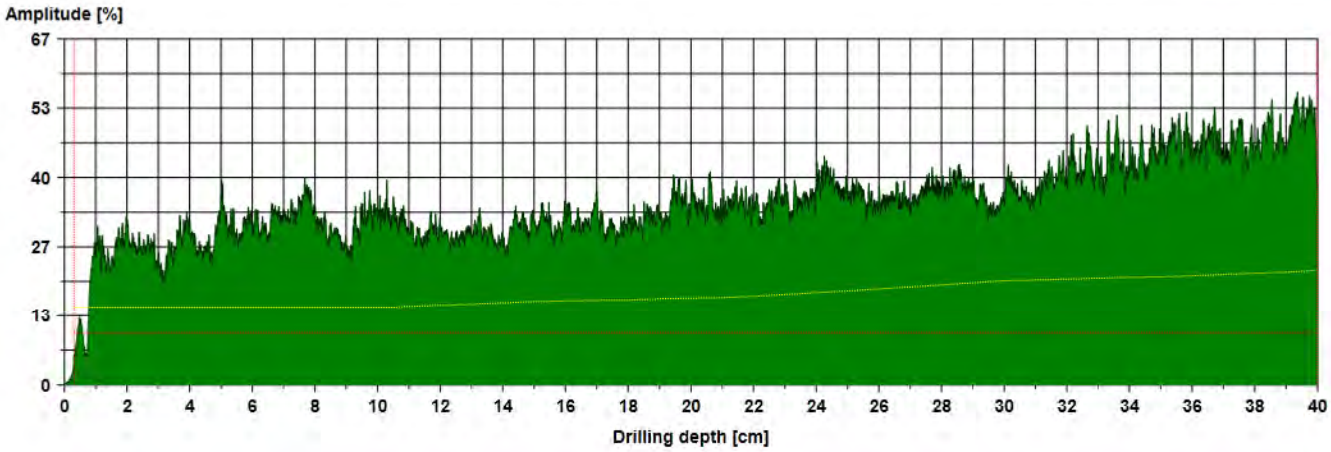
T4-P1

hyd_hk_11sw_a_r577_0_wt4 Point 1:

Assigned location:



Work Photo:



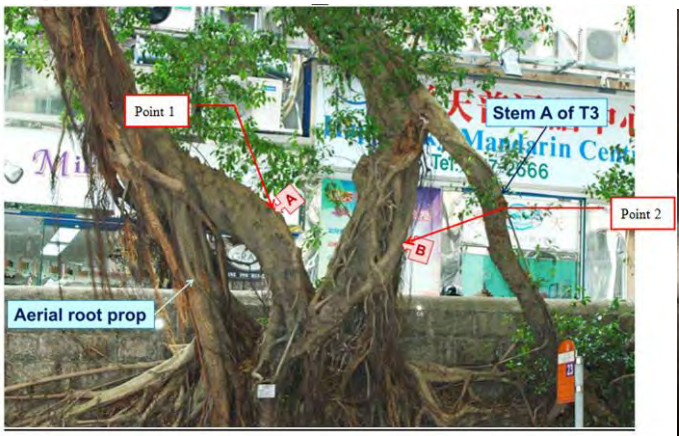
Point 1 was set on a bended trunk of hyd_hk_11sw_a_r577_0_wt4. A clean surface without any fused aerial roots was observed.

Point 1 shows a general normal density of wood. No particular concern is raised.

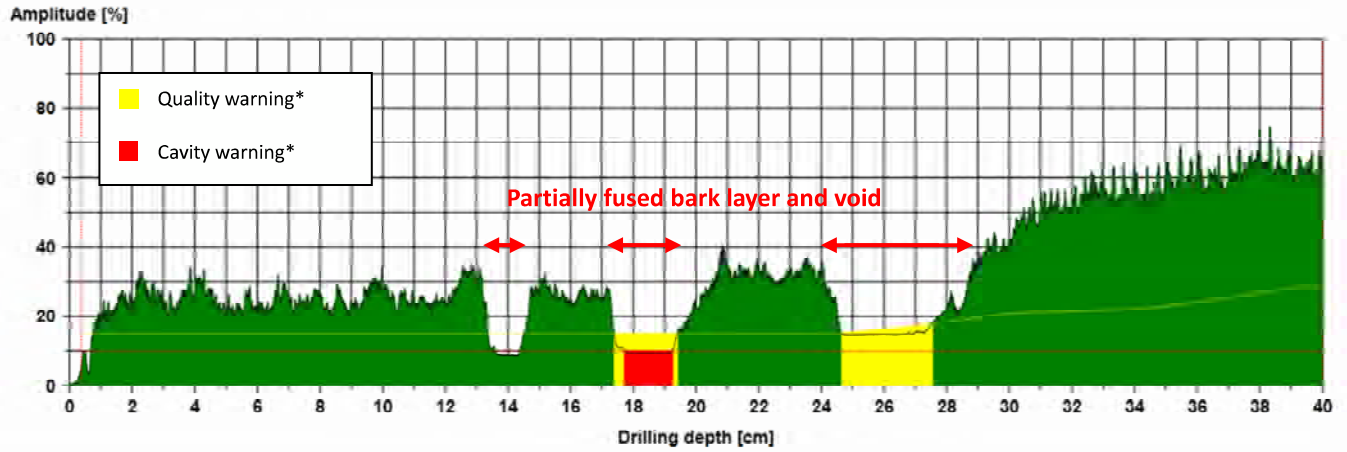
T4-P2

hyd_hk_11sw_a_r577_0_wt4 Point 2:

Assigned location:



Work Photo:



Point 2 was set on the second trunk of hyd_hk_11sw_a_r577_0_wt4. Multiple partly fused aerial roots can be found on the trunk surface.

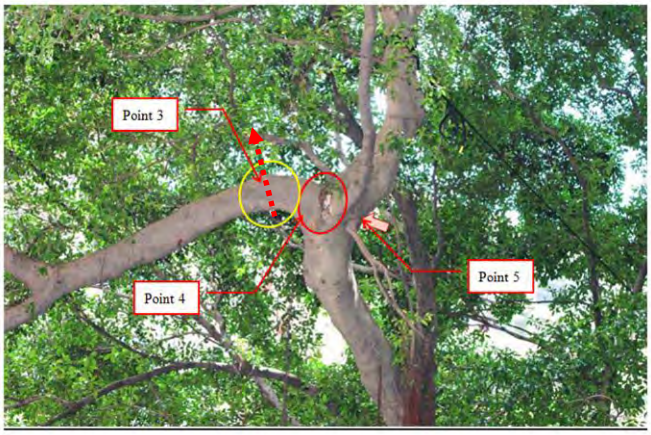
Areas of reduced resistance were recorded between 10cm & 22cm, 17cm & 20cm and 24cm & 29cm. This tree part was made up of multiple fused aerial roots. Small gaps of different width were observed under different degree of fusion. Without significant cavity or observable signs of decay, this area of low resistance is due to the presence of space between aerial roots or partially fused bark layers. These partially fused structures made Resistograph readings more difficult for direct interpretation. However large proportion of sound wood was observed on both side of structure making it more likely to be stable.

* Quality warning: Warning given by IML 400 when value goes lower than Quality curve
Cavity warning: Warning given by IML 400 when value goes lower than Cavity curve

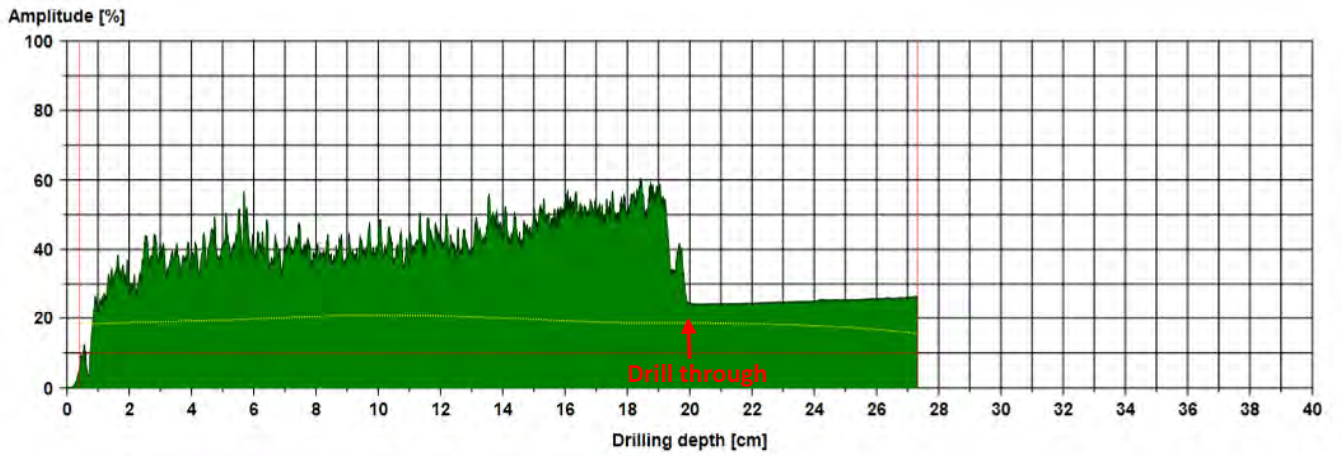
T4-P3

hyd_hk_11sw_a_r577_0_wt4 Point 3:

Assigned location:



Work Photo:



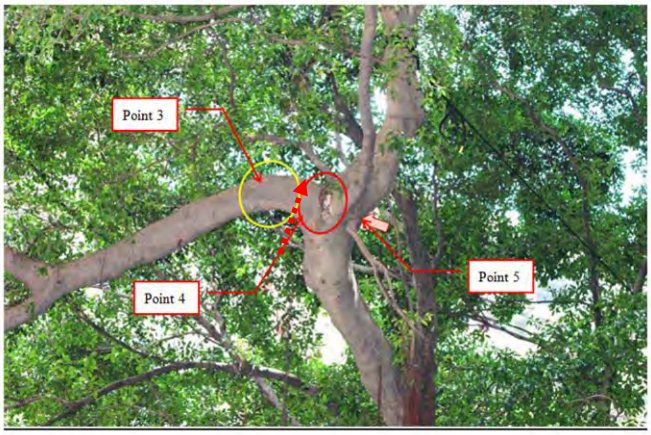
Point 3 was set on a branch close to a wound from previous branch failure.

The reading was taken as an opposite position due to site restriction. The bit drilled through the trunk at 20cm. (The circumference of the elliptical stem where the reading was taken was 630mm.) The curve shows a general normal density of wood. No particular concern is raised. There was no decay spread from the nearby wound.

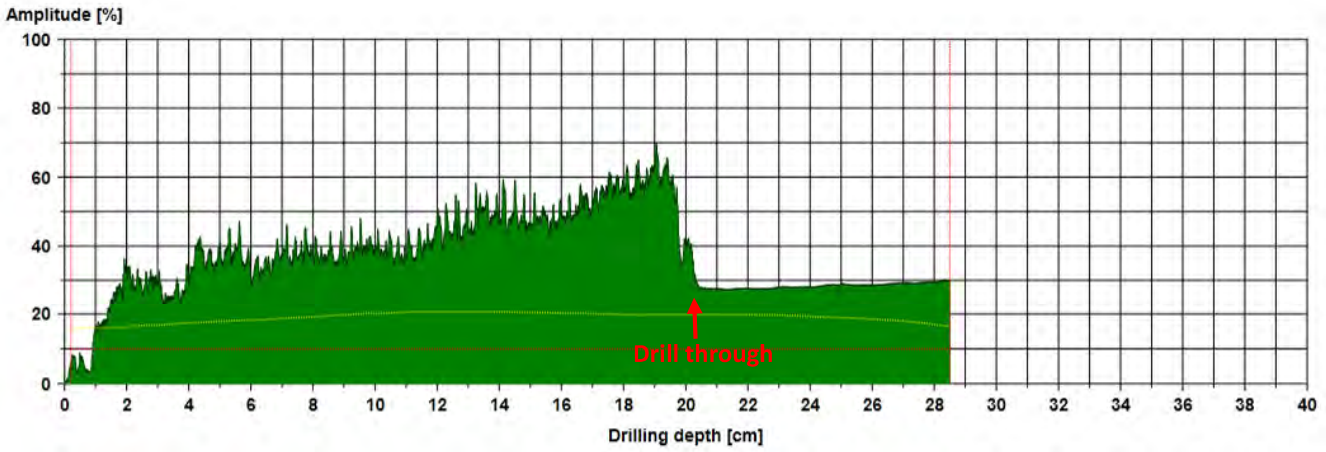
T4-P4

hyd_hk_11sw_a_r577_0_wt4 Point 4:

Assigned location:



Work Photo:



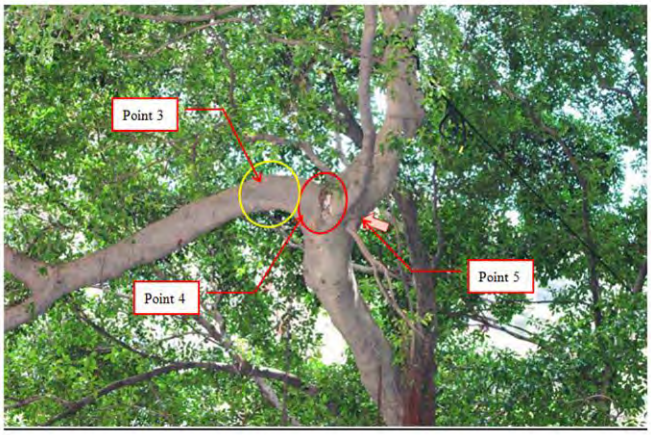
Point 4 was set on a branch union close to a wound from previous branch failure.

The bit drilled through the trunk at 20cm. (The circumference of the elliptical stem where the reading was taken was 700mm.) The curve shows a general normal density of wood. No particular concern is raised. There was no decay spread from the nearby wound. Branch attachment was believed to be intact.

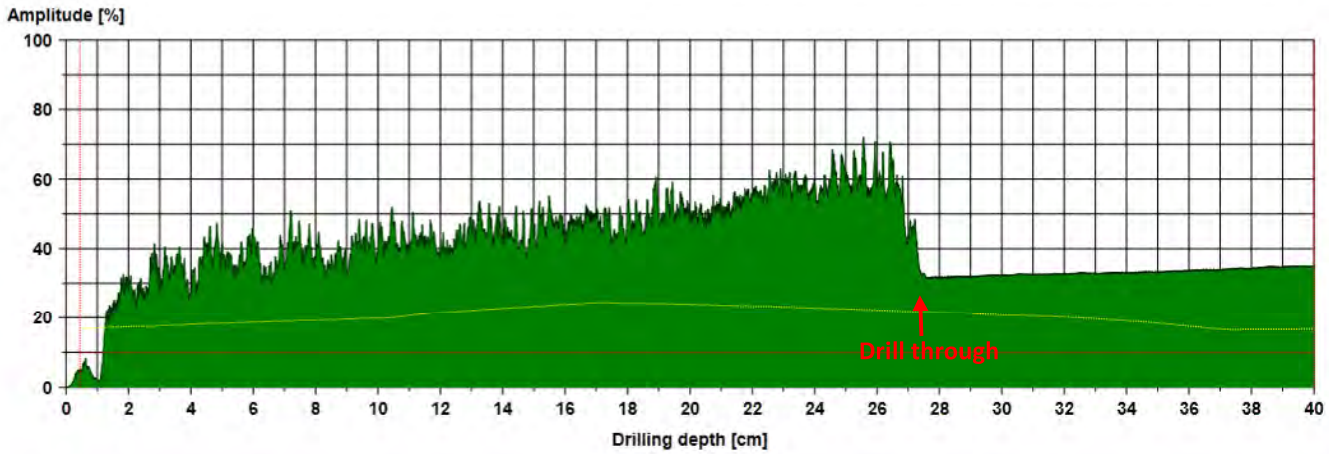
T4-P5

hyd_hk_11sw_a_r577_0_wt4 Point 5:

Assigned location:



Work Photo:



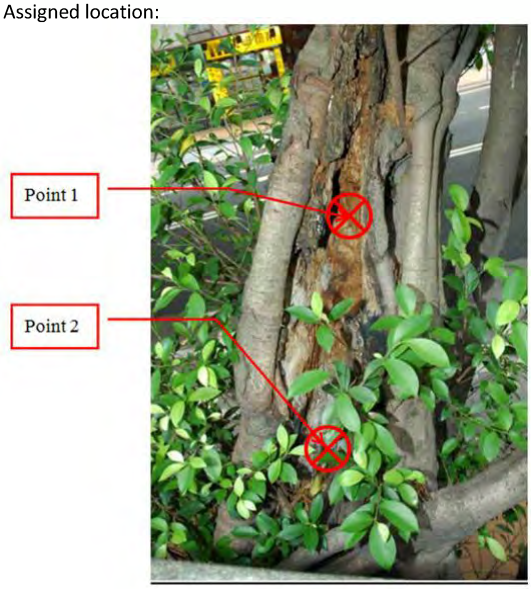
Point 5 was set on a branch union close to a wound from previous branch failure.

The curve shows a general normal density of wood. No particular concern is raised. The bit drilled through the trunk at 27cm. (The circumference of the elliptical stem where the reading was taken was 1000mm.) There was no decay spread from the nearby wound. Branch attachment was believed to be intact.

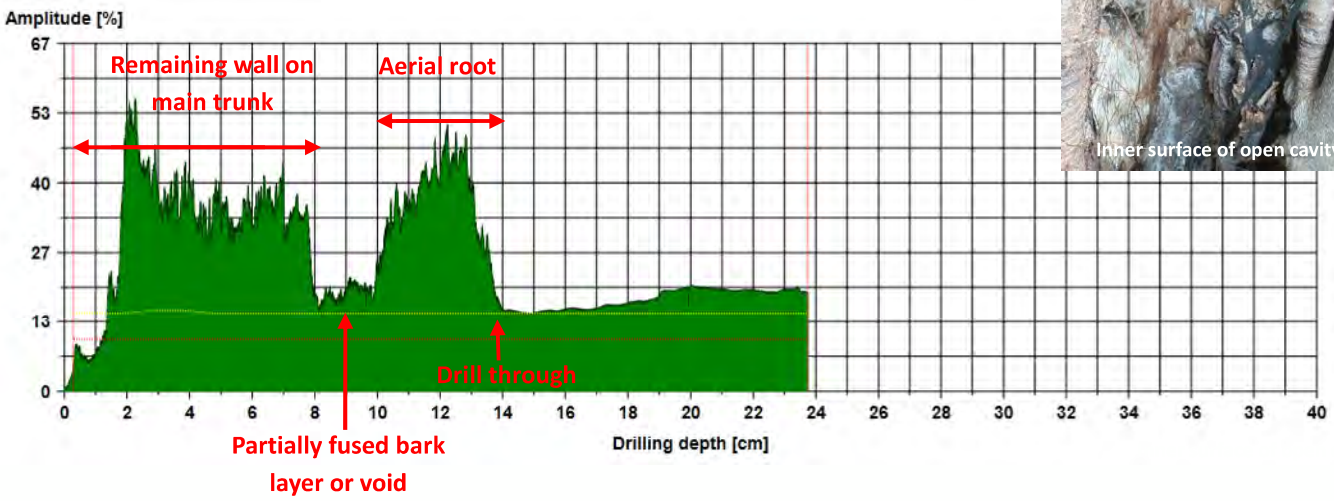
T5-P1

hyd_hk_11sw_a_r577_0_wt5 Point 1:

Assigned location:



Work Photo:

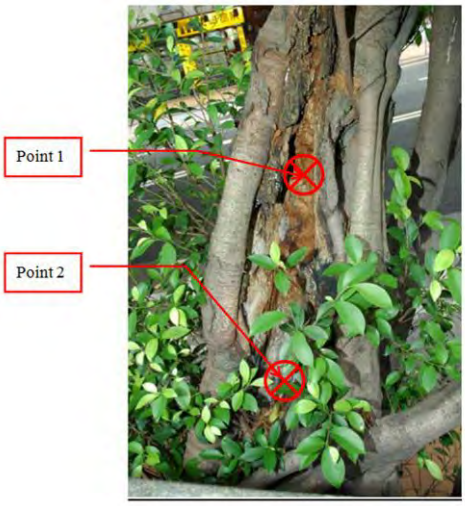


Point 1 was set at the inner surface of the upper open cavity. The drill bit passed through the remaining wall of main trunk at 8cm. A drop of resistance observed between 8cm & 10cm was likely to be made up of void space and bark layer of aerial roots. The drill bit entered the aerial root again at 10cm and drilled through the whole structure at 14cm. The residual thickness was less than 8cm. (The circumference of the whole trunk where the reading was taken was 1180mm.) Yet this residual thickness was not the only factor to conclude the trunk stability. Additional supports from the aerial root system should be evaluated.

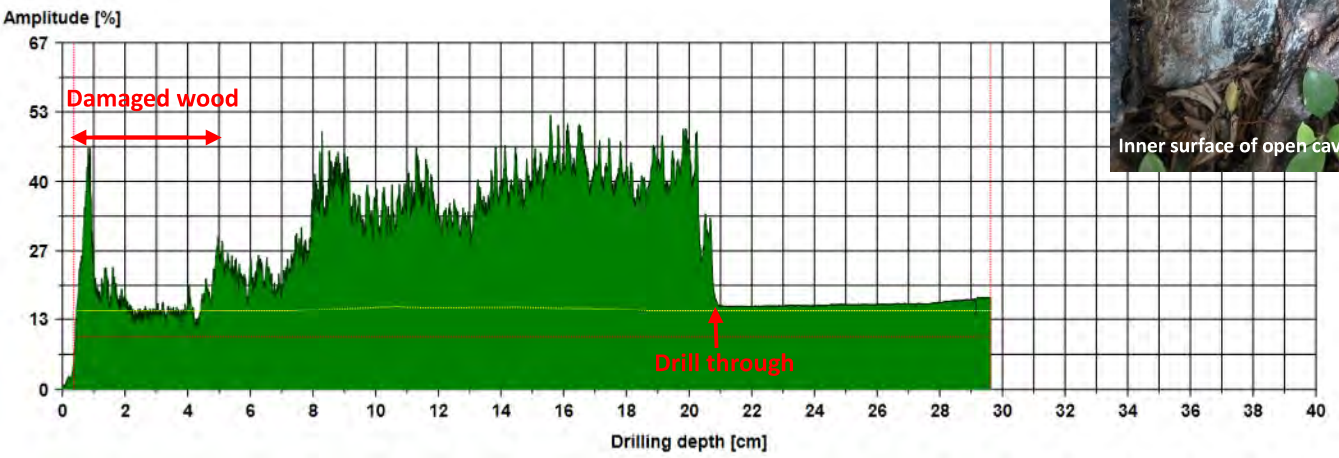
T5-P2

hyd_hk_11sw_a_r577_0_wt5 Point 2:

Assigned location:



Work Photo:



Another point, Point 2, was set much lower than Point 1, near the bottom of the open cavity. This was also the root collar region of hyd_hk_11sw_a_r577_0_wt5.

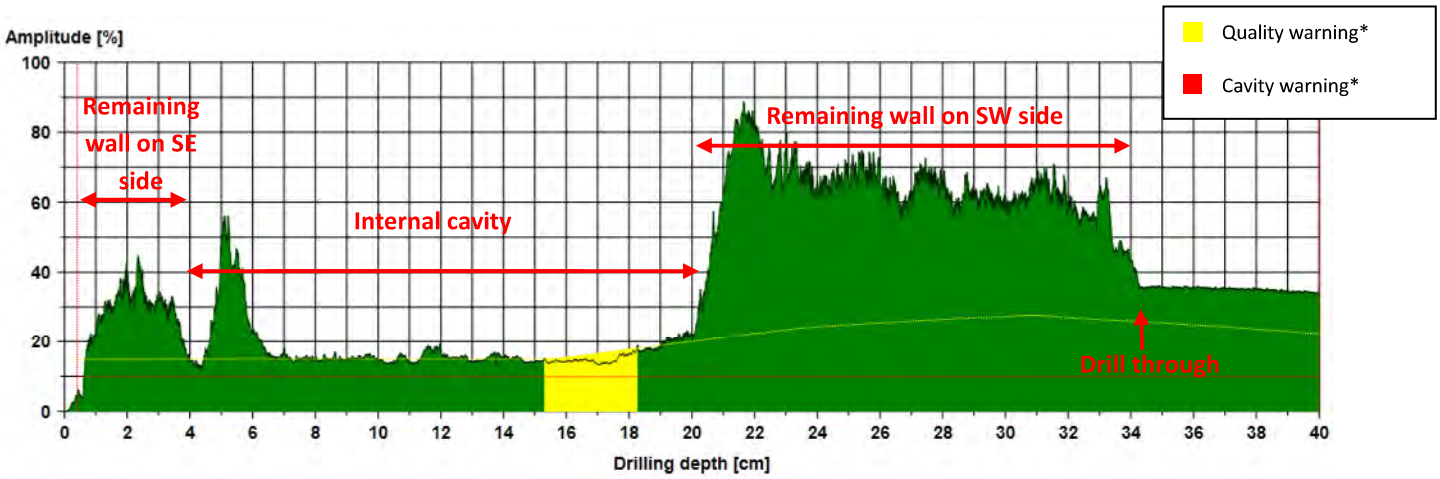
An area of lower resistance was observed between 1cm & 5cm. It was the decayed inner surface of the open cavity. The curve climbs slowly until 21cm where the drill bit passed through the remaining wall of main trunk. The residual thickness of sound wood was about 13-14cm. (The circumference of the whole trunk where the reading was taken was 1350mm.)

T5-P3

hyd_hk_11sw_a_r577_0_wt5 Point 3:

Assigned location:

Work Photo:



Point 3 was set above the open cavity to gain internal reading of the influence on main trunk above this cavity.

Large area of low resistance was recorded between 4cm & 21cm, indicative of an internal cavity. The residual wall thickness on SE side (LHS of curve) was as thin as 3cm. The bit drilled through the trunk at 34cm. (The circumference of the stem where the reading was taken was 1100mm.) Yet this residual thickness was not the only factor to conclude the trunk stability. Additional supports from the aerial root system should also be evaluated as a whole.

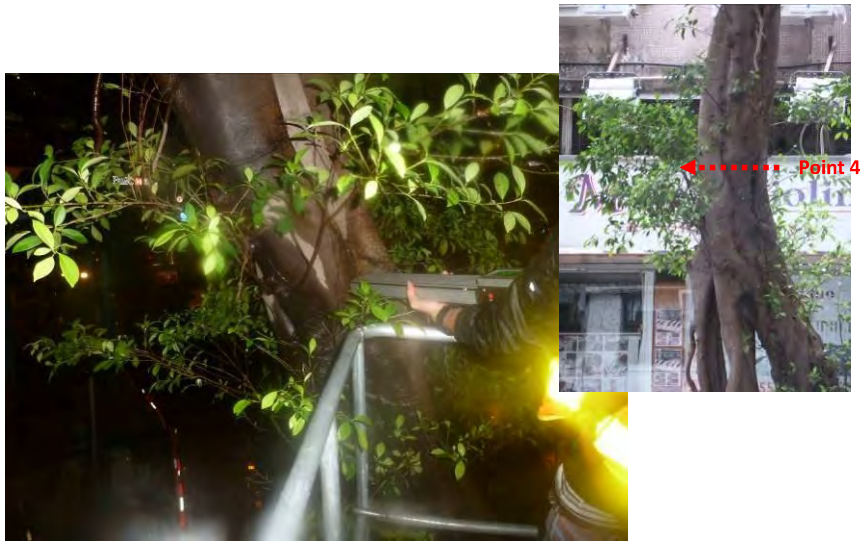
* Quality warning: Warning given by IML 400 when value goes lower than Quality curve
Cavity warning: Warning given by IML 400 when value goes lower than Cavity curve

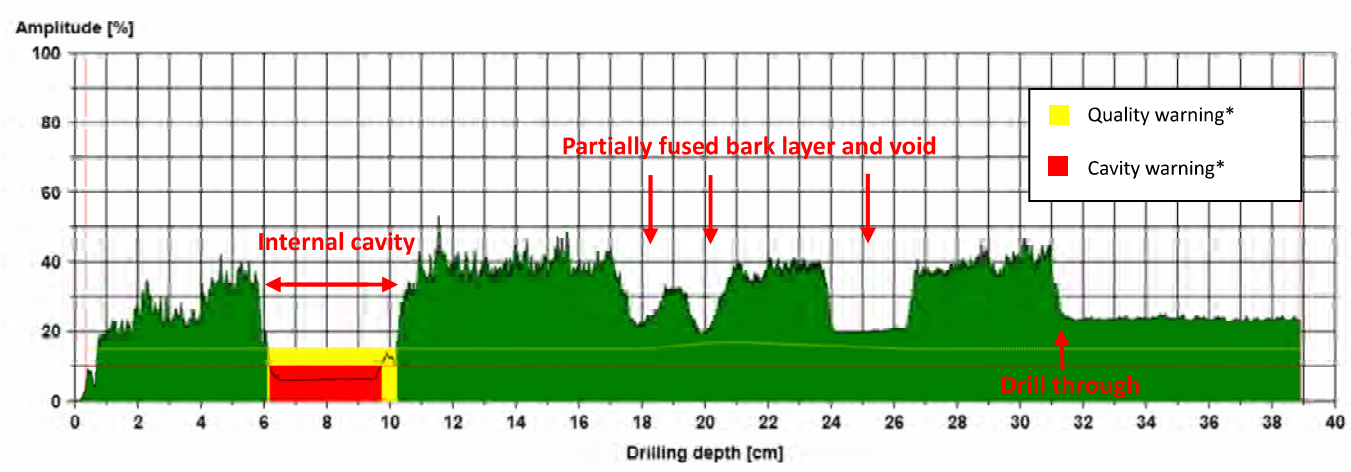
T5-P4

hyd_hk_11sw_a_r577_0_wt5 Point 4:

Assigned location:

Work Photo:





Another point, Point 4, was set around 30cm above Point 3 in an opposite direction. In this area the main trunk was fused with multiple aerial roots to form a complex.

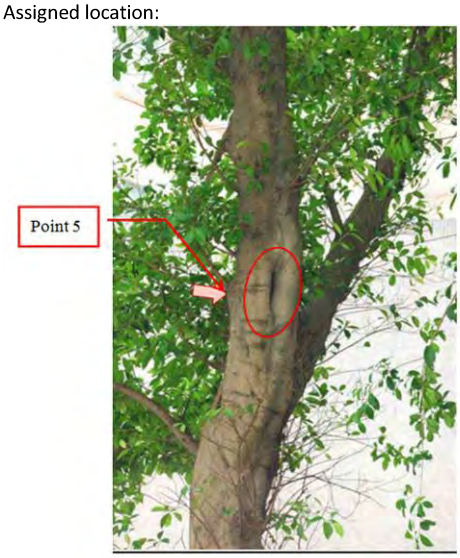
Area of low resistance was recorded between 6cm & 11cm. Internal cavity was suspected in this area Troughs recorded at 18cm, 20cm and 24cm to 27cm were likely to be partially fused bark layers and voids formed between main trunk and aerial roots. The bit drilled through the trunk at 31cm. (The circumference of the elliptical stem where the reading was taken was 1300mm.)

* Quality warning: Warning given by IML 400 when value goes lower than Quality curve
Cavity warning: Warning given by IML 400 when value goes lower than Cavity curve

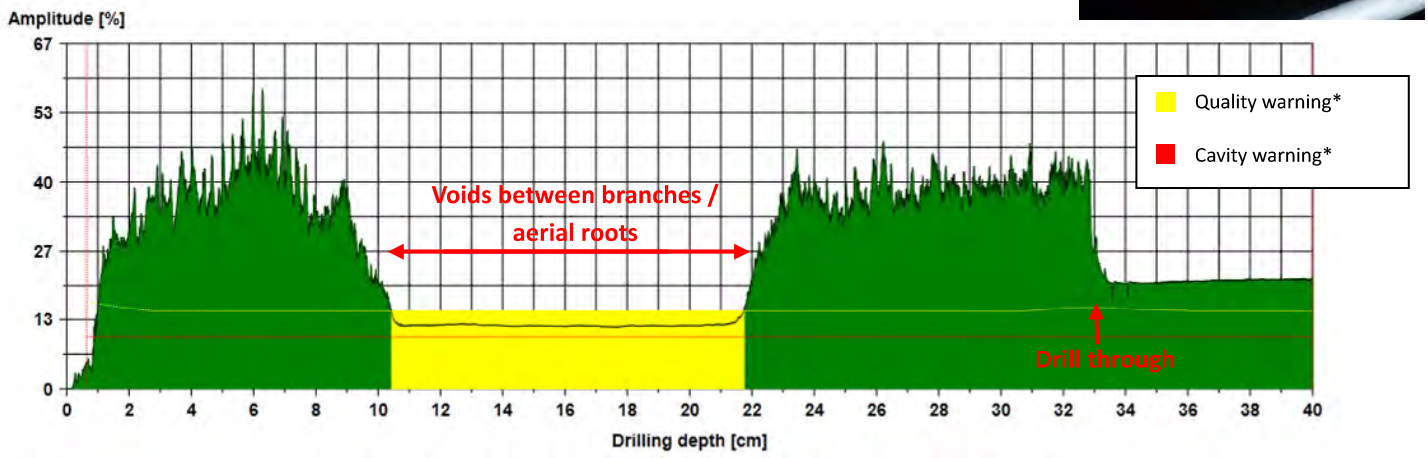
T5-P5

hyd_hk_11sw_a_r577_0_wt5 Point 5:

Assigned location:



Work Photo:



Point 4, was set on the upper part of hyd_hk_11sw_a_r577_0_wt5 where a few branches/aerial roots joined to form a trunk. Voids were visible from both side of trunk.

The bit drilled through the trunk at 33cm. (The circumference of the complex where the reading was taken was 960mm.) Normal wood densities were observed between 1cm & 10cm and 22cm & 33cm.

* Quality warning: Warning given by IML 400 susceptible of a potential damaged wood
Cavity warning: Warning given by IML 400 susceptible of a potential cavity