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Determine the Thickness of Pavement Layers Variety Using GPR Technique in Some Sites at University of Kufa, Najaf, Iraq

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Abstract : In this study, the thickness of layers of asphalt pavement and concrete was measured with some of the sites at the University of Kufa using a Ground Penetration Radar (GPR)device. After radar pulse analysis that registered in the surveyed area study found that a clearly differentiated in the thicknesses from one location to another.
Keywords : GPR, radexplorer software, bandpass filters, University of Kufa, ground vision, amplitude correction.

Introduction:

Ground Penetrating Radar (GPR) is a non-destructive geophysical surveying technique that is nowadays applied to structure assessment. It has a methodology in the emission of high-frequency electromagnetic pulses that transmitted. The changes in the electromagnetic properties of the medium are discontinuities, which are identified by the reflection of the energy. As a consequence, it provides the technique images, where the depth of the cut is determined by the two-way travel time of the reflected waves on the scans A. The projection on the surface is defined by the coordinates of the position of the receiver antenna in the scans A, As well as the knowledge of the depth and position of layers of asphalt and concrete pavement. Hence, the method has been widely used in this field during the last decades[1].The study area is located at the University of Kufa, in the holy Najaf city, Iraq with coordinates of (N 3201.375) and (E 4422.344), at an altitude of 33 m above sea level.

Radar survey of the study area

The survey in some of the sites at the University of Kufa using a Ground Penetration Radar (GPR) is measured. The data are obtained through the system, Ground Penetration Radar (GPR) software, collect the data, such as ground vision, and adjusted operating settings. These softwares apply some filters (main processing) on obtaining data [2]. GPR is used for survey after adjusting parameters setting as shown in Table (1).

Table 1.Operating settings(GPR) applied field work

Antenna 250MHz	Parameter Setting
Short	Max. Window Time
83	Speed (cm/ns)
189.6	Window Time (ns)
0.05	Point Interval (m)
2548.62	Coding Frequency
5.22	Depth (m)

Interpret data resulting from radar scanning device (GPR) through a program Rad Explorer Software in the RAMAC system is designed to process radar survey data and interpreted within the framework of a unified system. There are many factors that affect the accuracy of treatment such as soil type and surface signals and noise[3]. To get a processing accurate data must take action on that data if the good actions such as removing noise or unwanted signals [4, 5].

Processing and interpretation of profile No. (11)

The field survey site by a device (GPR) to profile a number (11) in the internal department's garage at the University of Kufa of 32˚ 01.795 'N and E 44˚ 22. 520' is examined. The antenna used with a frequency of 250 MHz. Where the depth of penetration was approximately 5.20 m and path length 45 m and direction from west to east at a height of 28 m above sea level. Note at the beginning profile paved street area, which follows this region, the concrete pavement are found and this shows clearly the difference in the reflections of electromagnetic waves in the two regions and this pre-treatment as shown in Fig. 1.

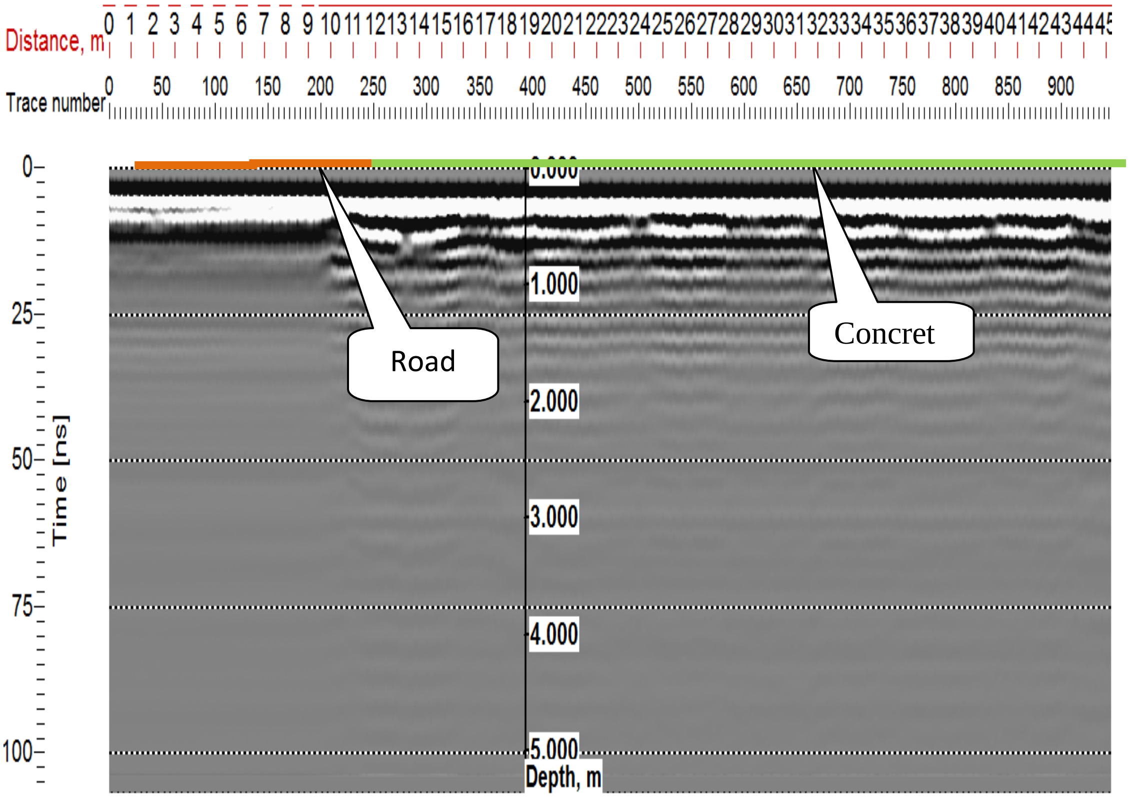

Fig. 1 Profile GPR No. 11 before the treatment

When processing the same profile by Time-Zero filter notes the zero point of the ejections wave. Which represents the red dotted line and had a choice of (First Break= 2.6 ns) as well as the penetration depth of about (5.20m)as shown in Fig. 2.

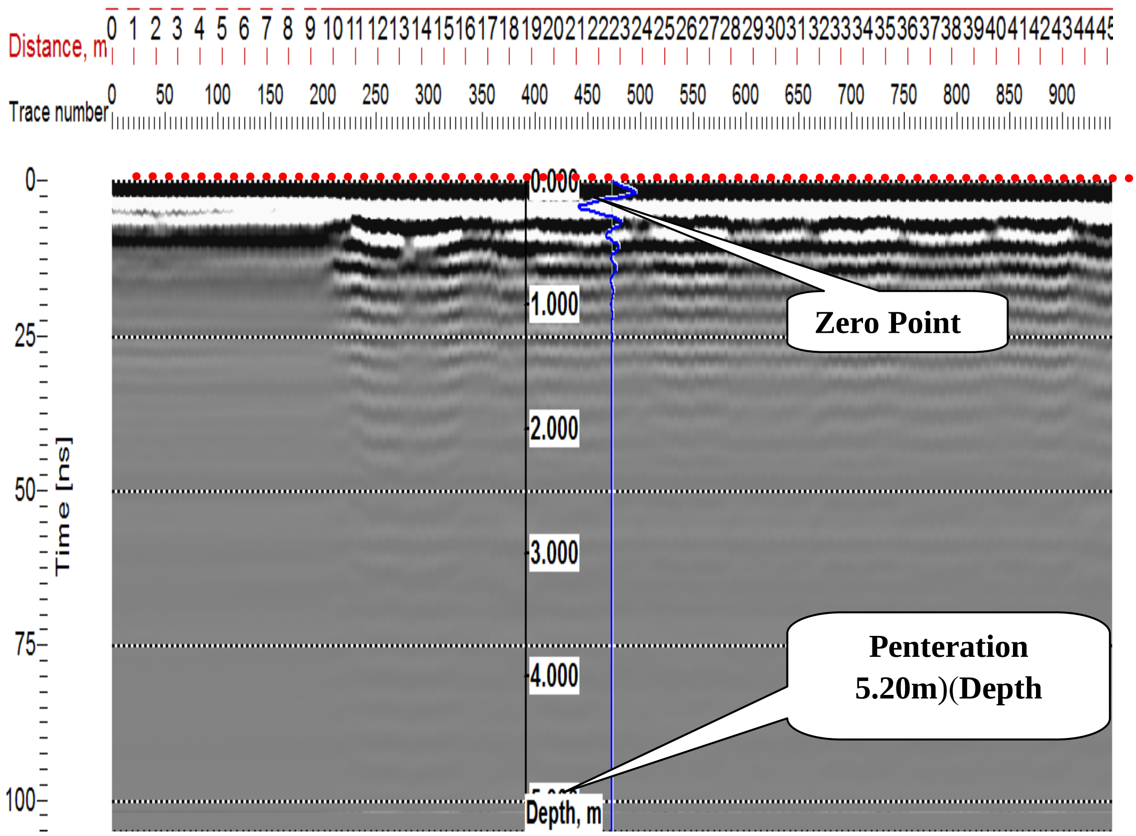

Fig. 2 Profile GPR No. 11 after the treatment by Time-Zero filter

When applying an Amplitude Correction filter to profile No. 11 observe the emergence of abnormalities clearly in the beginning of the profile, as shown in Fig. 3, caused by a metal fence trap located near the device at the beginning of the path as shown in Fig. 4, since one of the goals of research knowledge of the factors affecting the work of the device (GPR).

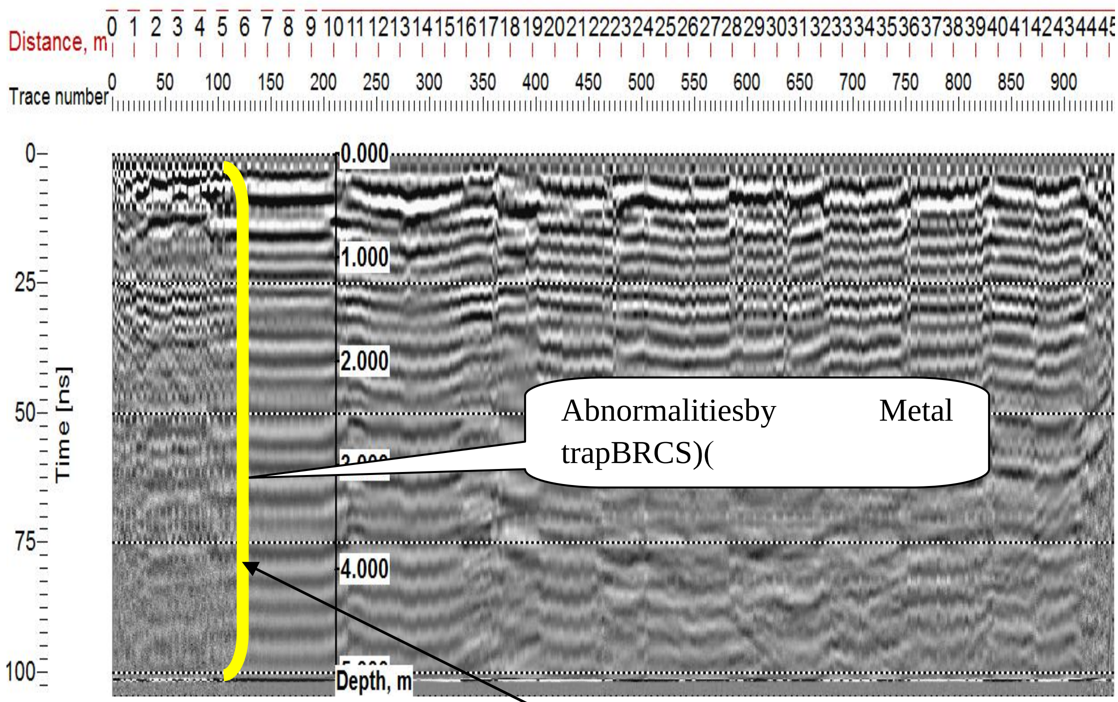

Fig. 3 Profile GPR No. 11 after the treatment by Amplitude Correction filter

Fig. 4 Metal trap which causes abnormalities in Profile GPR No. 11

Table 1 shows the application of the Band - Pass filter and observe frequencies unwanted remove the picture looks clearly and choose the button (run) note that asphalt thickness estimated at approximately (0.35 m), which represents ten meters width of the road.

Table 1 Information about Band-Pass filter

Low Cut	83 MHz
Low Pass	297 MHz
High Pass	604 MHz
High Cut	800 MHz

While the adjustment layer and concrete thickness estimated at approximately 0.75 m, which represents ground garage interior department at the University of Kufaas shown in Fig. 5.

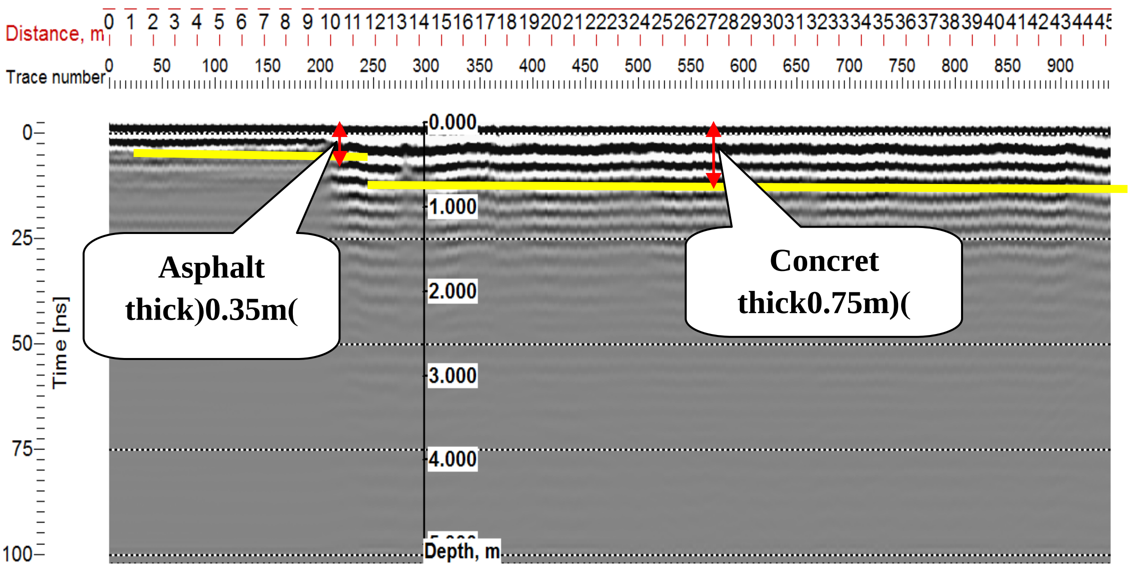

Fig. 5 Profile GPR No. 11 after the treatment by Band-Pass filter

Processing and interpretation of profile No. (16)

The field survey site is examined by a device (GPR) to profile a no. 16 in the garden in front of pharmacy college at the University of Kufa of 32˚ 01.795 'N and E 44˚ 22. 520'.Where the total length of the track of 30m and direction from east to west at an altitude of 32.75 m above sea level with the coordinates of the region are N 32˚ 01.375 ' and E44˚ 22. 306'. Antenna transmitter has been used as a frequency of 250 MHz, where the depth of penetration was approximately of 5.25 m.Fig. 6 showed the profile no. 16 before the treatment. The propagation of the radar signals into earth layers depends on the electromagnetic properties of soils and rocks, which are dielectric permittivity and electrical conductivity (σ) [6-9].

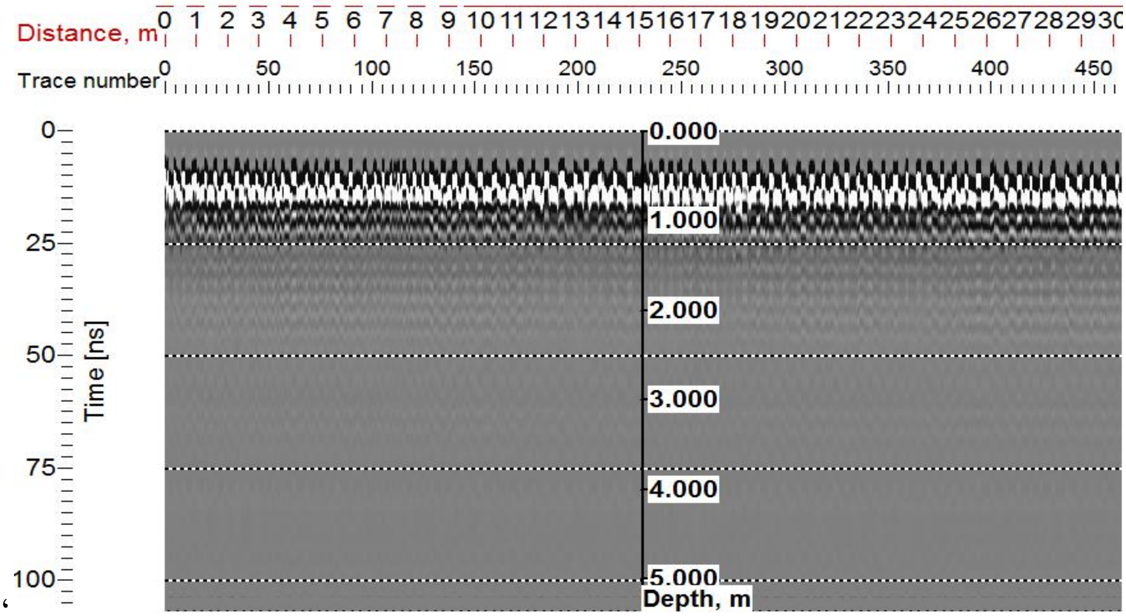

Fig. 6 Profile GPR No. 16 before the treatment

When applied Time-Zero filter and at first Break= 6.1, will note the red dotted line guided to zero point of wave emission for determining the depth of object inside earth with high accuracy. It was found that the depth of penetration, bringing in less about (5.05m) after it was about 5.25m before the treatment, the garden ground opposite of the Faculty of Pharmacy is considered a mix of clay and soil, as shown in Fig. 7.

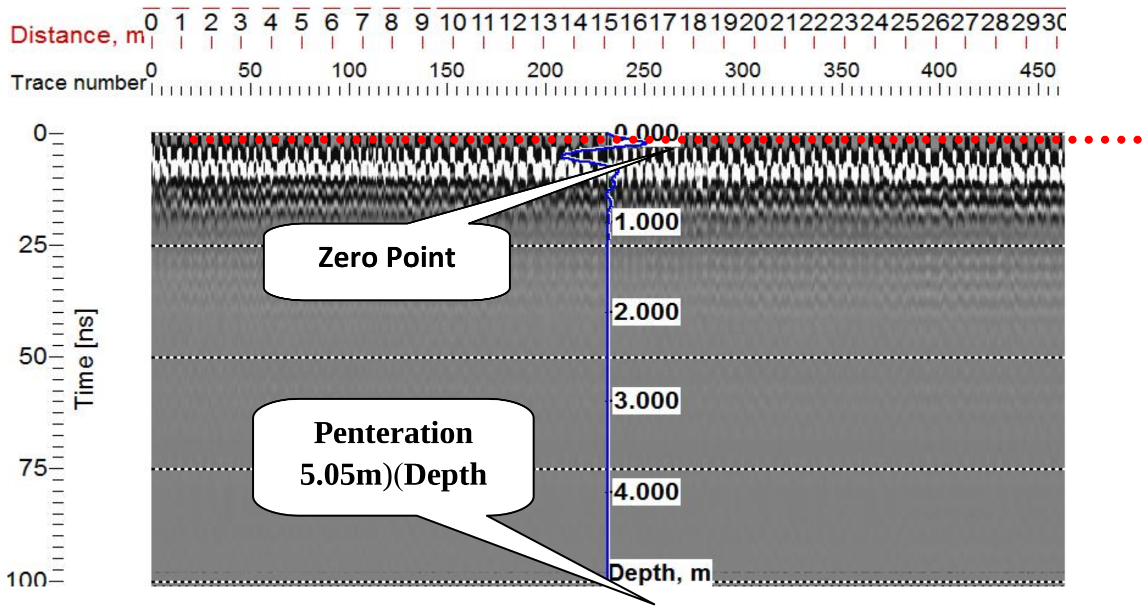

Fig. 7 Profile GPR No. 16 after the treatment by Time-Zero filter

When applied DC- Removal filter at profile GPR No. 16 and at first Break= 6.1, will note the red dotted line guided to zero point of wave emission for determining the depth of the object inside earth with high accuracy. Where it removes displacements resulting from the lack of perfection action electronics, after choosing end time=107. Fig. 8 shows the reflections of the surface layer, which it differs in the reflections of other surface layers.

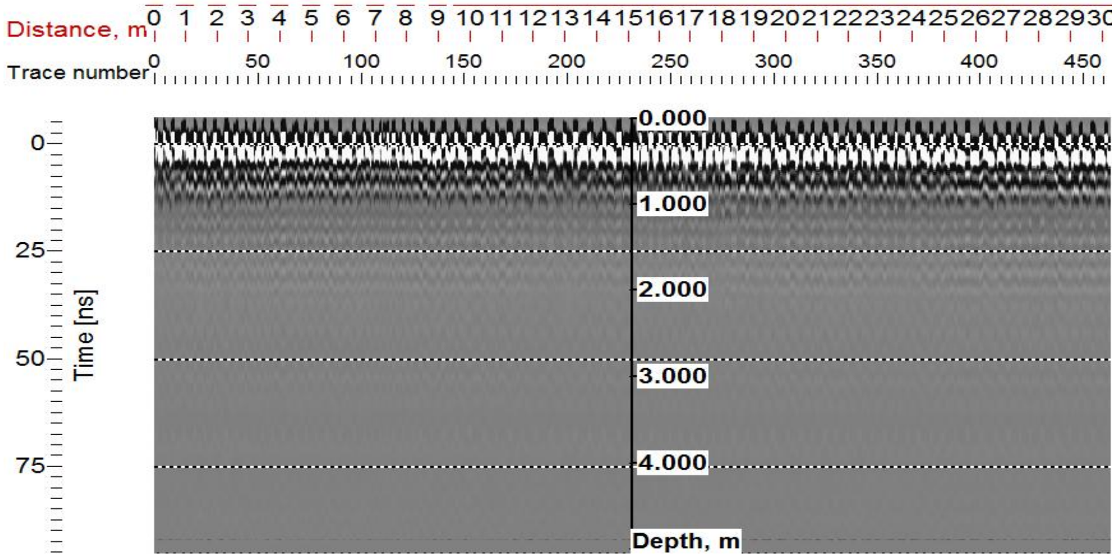

Fig. 8 Profile GPR No. 16 after the treatment by DC-Remova filter

When applying Amplitude Correction filter and identify thickness and colored layers, it find that surface layer in yellow shows soil mixture at a depth of 0.5 m, the layer underneath painted brown (first class) at a depth of 1.5m,andGray layer is the (second layer) different electrical characteristics of the first layeras shown in Fig. 9.

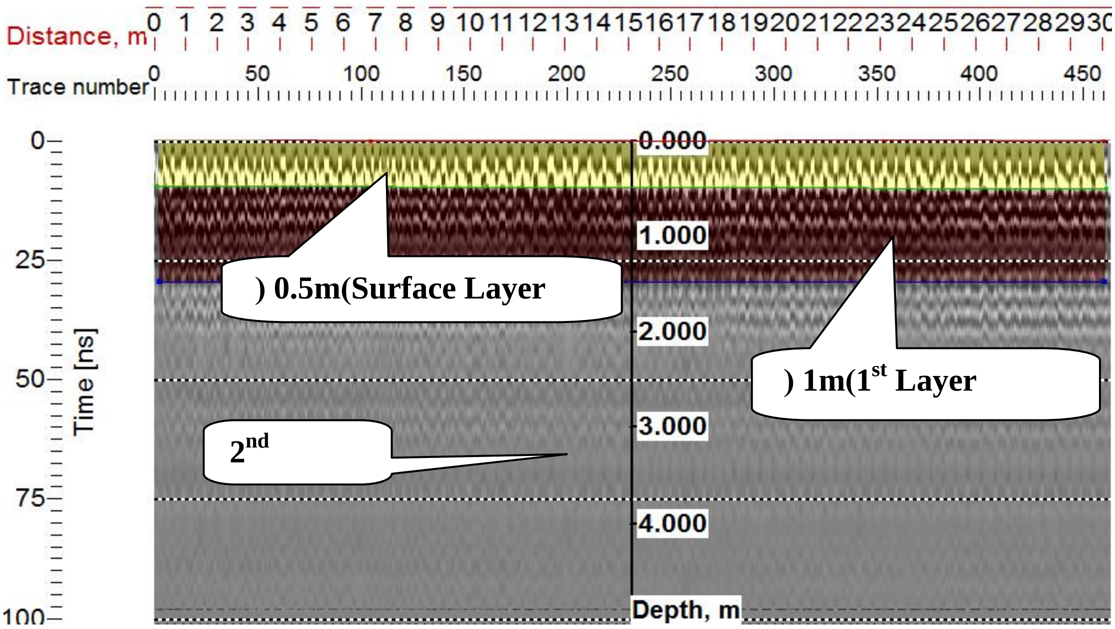

Fig. 9 Profile GPR No. 16 after the treatment by Amplitude Correction filter

Conclusions

In this study, noted that the efficiency of the Ground Penetrating Radar device (GPR) to determine the thickness of each of the layers of asphalt pavement and concrete in the interior department's garage of the University of Kufa site. Different reflections of electromagnetic waves from the different surfaces of the ground garage of interior departments are noted. As well as garden ground of College of Pharmacy, and there is a clear difference in the radar sections of these sites surveyed. The emergence of abnormalities clearly in beginning of the profile no. 11 as a result of the presence of the metal polytheism fence (BRCS).Reflections of the waves affected by these objects near metal materials during the survey.

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