

Ground Penetrating Radar (GPR)

Introduction

Ground Penetrating Radar (GPR) is recent technology. The application GPR in this region is limited due to lack of knowledge in this technology. Somehow in this market GPR is commercially available as cable detector and shallow depth utility detector but that will not professionally solve construction industries demands. GST made web based search to find the appropriate technology that are used for utility mapping and found GPR is widely applied in this context. The application of GPR covers wide spectrum that includes utility mapping, site investigation studies, engineering evaluation studies for construction industries, shallow geological mapping, groundwater table studies etc. The following proposal will enumerate more details about the GPR technology, applications, technical and financial comparisons of the GPR instrument that are commercially available in the market.

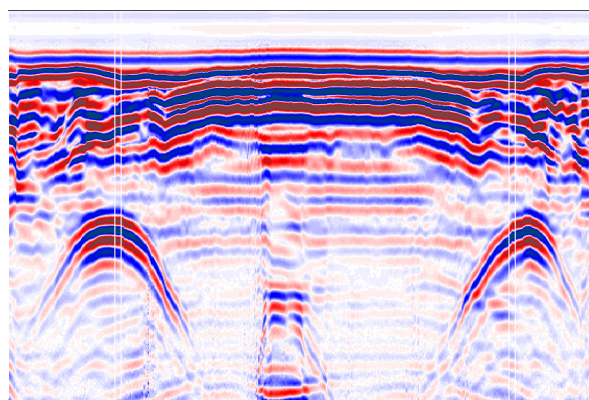
Ground Penetrating Radar

Ground Penetrating Radar, also known as GPR, Georadar, Subsurface Interface Radar, Geoprobng Radar, is a totally non-destructive technique to produce a cross section profile of subsurface without any drilling, trenching or ground disturbances. Ground penetrating radar (GPR) profiles are used for evaluating the location and depth of buried objects and to investigate the presence and continuity of natural subsurface conditions and features.



Basic Principle:

The GPR operates by transmitting electromagnetic impulses into the ground through transmitter antenna. The transmitted energy is reflected from various buried objects or distinct contacts between different earth materials, across which there is a contrast in dielectric constant. The antenna then receives the reflected waves and displays them in real time on screen. Data is also saved in appropriate memory for later processing and interpretation.



Ground penetrating radar waves can reach depths upto 60 meters in low conductivity materials such as dry sand or granite. Clays, shale and other high conductivity materials may attenuate or absorb GPR signals, greatly decreasing the depth of penetration.

The depths of penetrating are also determined by the GPR antenna used. Antennas with low frequency obtain reflections from deeper depths but have low resolution. These low frequency antennas are used for investigating the geology of a site, such as for locating sinkholes or fractures, and to locate large, deep buried objects.

Antennas with higher frequencies (300 to 2000 MHz) obtain reflections from shallow depths (0 to 10 meters) and have a high resolution. These high frequency antennas are used to investigate surface soils and to locate small or large shallow buried objects, pipes, cables and rebar in concrete.

GPR can detect objects of any material, metallic or non-metallic.

Application Areas:

- ❑ Geological and hydro-geological investigations including mapping of bedrock topography, water levels, solution features, glacial structures, soils and aggregates.
- ❑ Engineering investigations to evaluate dams, sea walls, tunnels, pavements, roadbeds, railway embankments, piles, bridge decks, river scour, buildings and monuments.
- ❑ Location and evaluation of buried structures including utilities, foundations, reinforcing bars, cavities, tombs, archaeological artifacts, and animal burrows.
- ❑ Site investigations: location of buried engineering structures and underground storage tanks.
- ❑ Subsurface mapping for cables, pipes and other buried structures prior to trench-less operations.

Advantages:

- ❑ Rapid ground coverage- Antenna towed either by hand or from a vehicle.
- ❑ High-resolution coverage of the survey area, detecting even small objects.
- ❑ On-site interpretation possible due to instant graphic display.

Limitations:

- ❑ Data acquisition may be slow over difficult terrain.
- ❑ Depth of penetration is limited in materials with high electrical conductivities, clays.

- ❑ Energy may be reflected and recorded from aboveground features, walls, canopies, unless antennae are well shielded.
- ❑ Artifacts in the near surface (reinforcing bars, boulders, components of made ground) may scatter the transmitted energy and complicate the received signal and/or reduce depth of penetration.

A table below shows relationship between resolution, "blind" zone and sounding depth with reference to the antenna used. It is assumed that sounding is made in a soil whose relative dielectric permittivity is equal to 4 and specific attenuation is 1 to 2 dB/m. Depth of investigation is understood to be detection depth of a flat boundary with reflectance equal to 1. Note that these data are rather approximate and are strongly dependent on parameters of the environment sounded.

	Antenna						
Parameter	2 GHz	900 MHz	500 MHz	300 MHz	150 MHz	75 MHz	38 MHz
Resolution, m	0.06-0.1	0.2	0.5	1.0	1.0	2.0	4.0
"Blind" zone, m	0.08	0.1-0.2	0.25-0.5	0.5-1.0	1.0	2.0	4.0
Depth, m	1.5-2	3-5	7-10	10-15	7-10	10-15	15-30