Fugro Engineering Services Limited

GROUND INVESTIGATION SERVICES FOR AIRPORTS

Two Cone Penetration Testing Trucks at work at Heathrow Airport

Introduction

The majority of ground investigations for airport projects have to be carried out during airside possessions at night. The duration of these possessions is often limited, which dictates that the maximum amount of information needs to be obtained within a fixed period of time.

Fugro Limited offer a range of geotechnical and geophysical investigation services which due to their rapid speed of operation are ideally suited to the airport environment. Very often these geotechnical and geophysical techniques are complementary to each other and are combined into a comprehensive ground investigation.

Geotechnical Investigations

Fugro Limited have for many years offered specialist geotechnical tools for ground investigation mainly using insitu testing techniques and, more recently, high quality rapid sampling systems. The techniques of most value on airport projects are :

- Soil characterisation using Static Cone Penetration Testing (CPT) (including piezocone and seismic cone
- Installation of push-in gas and water monitoring wells
- Mostap sampling (using CPT equipment)
- In-situ penetration vane testing
- Geoprobe soil, water and gas sampler.

Static Cone Penetration Testing (SCPT)

Most of Fugro's geotechnical investigation techniques have been developed around static cone penetration testing.

The basic principle involves pushing an electrically instrumented probe (the cone penetrometer) hydraulically into the ground at a standard and constant rate of penetration.

Technical details of the friction cone are presented overleaf.

In addition to the cone and friction readings, pore water pressure measurements can be made with the piezocone and shear velocity (and hence shear modulus) with the seismic cone.

The electric cone is a very accurate and rapid soil stratification tool. Given unrestricted access, up to 150m of testing can be carried out per day on site.

For airport applications, lower production rates are generally achieved due to the restricted working time available, particularly when working under airside possessions. However the technique still far out performs conventional percussive boring and window sampling techniques, enabling possession utilisation to be maximised.

Most of Fugro's site personnel have experience of working in the airport environment.

Fugro have working experience of the ground conditions at the following civilian airports :

Blackpool	Heathrow
Birmingham	Inverness
Dundee	Luton
Edinburgh	Prestwick
Gatwick	Stansted
Glasgow	Wick

In addition work has also been carried out at most of the RAF and USAF stations throughout the UK.

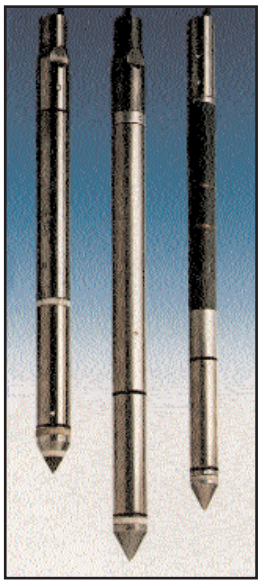
The Fugro Group is an international organisation with around seven thousand staff in over fifty countries.
Our major disciplines are Geotechnics, Environmental Services and Survey.

CPT TECHNICAL DATA

Dimensions of the Cone Penetrometer Truck

Length	3.7m
Width	1.8m
Height	2.6m when travelling 3.95m when operating

Thrust Capacity
18 tonnes



Rate of Penetration

Average	2cm per second
Range:	1.8-2.2cm per second

Maximum Penetration
Depends on soil conditions, but 40m of rods normally available.

Performance Rates
Typically 100 to 150m during one working day.

Other units including low ground pressure crawlers and detached penetrometer equipment are also available.

GEOPHYSICAL TECHNIQUES

Various geophysical techniques can be deployed for ground investigation purposes in conjunction with the geotechnical techniques listed overleaf. The most commonly used techniques within airports are :

- Ground Penetrating Radar
- Micro-gravity
- Seismic refraction
- Resistivity imaging
- Electromagnetic imaging

TYPICAL APPLICATIONS

The techniques described here are particularly applicable to a variety of airport projects such as :

- Aircraft hangers
- Pedestrian piers
- Foundation design
- Pavement assessments- taxiways, aprons & runways
- Tunnels
- Ground contamination assessments

CASE HISTORY FROM HEATHROW AIRPORT

To allow access from the Heathrow Central Terminal Area to the remote Western Apron Stands,it is proposed to drive two access road tunnels under existing taxiways and hard-standing areas. Of crucial importance to the design of the tunnels is knowing accurately the interface between the Terrace Gravels and the underlying London Clay.

Mott MacDonald acting on behalf of the client **British Airports Authority** commissioned Fugro to perform a combined geotechnical and geophysical investigation to accurately contour this interface along the line of both tunnels.

A two phase approach was adopted. Static Cone Penetration Testing (CPT's) was used first to physically probe the ground at 5m centres to accurately determine this interface at each test position. This was followed by a geophysical survey.

Ground probing radar, resistivity, electromagnetic and seismic refraction techniques were trialed. This was followed by an extended ground probing radar survey to assess conditions beneath the concrete hard standing areas.

A total of 400 CPT's and 14,000m of radar survey lines were performed over a 6 week period during restricted night time possessions and clearly demonstrated the value of these rapid investigation techniques where detailed soil information is required in as short a time as possible.

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