STRATASCAN

Geophysical Survey Report

East Portlemouth Church, Devon

For

Friends of East Portlemouth Church

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LIST OF FIGURES

1   SUMMARY OF RESULTS

A ground probing radar survey was carried out at St Winwalloe Parish Church, East Portlemouth, Devon.

The results have identified features across the site which may relate to structural remains and buried features. Within the central part of the church strong anomalies have been identified which are probably caused by buried walls possibly from the earliest phases of construction. Anomalies have also been detected which may be associated with deep features, although further investigation would be required to clarify this.

2   INTRODUCTION

2.1   Background synopsis

Stratascan were commissioned to undertake a geophysical survey of East Portlemouth Church, Devon. This survey forms part of a historical investigation being undertaken by Friends of East Portlemouth Church.

2.2   Site location

The site is located at East Portlemouth Church, Nr Salcombe, Devon at OS NGR ref. SX 748 383.

2.3   Description of site

The site is located in and around the immediate exterior of East Portlemouth Church. The church is in current use and appears well maintained. Site photographs can be found in Figure 3.

The underlying geology is gneiss, mica schists (British Geological Survey South Sheet, Fourth Edition Solid, 2001). The overlying soils are of the Carstens soil association which are typical paleo-argillic brown earths (Soil Survey of England and Wales, Sheet 5 South West England).

2.4   Site history and archaeological potential (Saint Winwalloe Church, 2006)

Much of the current church was built in the 12th century and is first referred to during 1268. The church is dedicated to St Winwalloe, sometimes referred to as St Onolaus which is the Latin version.

Evidence for a previous church on the site comes from the shape of the churchyard which is ovoid. This is the typical shape prior to the Norman Conquest, after which churchyards are characteristically square or rectangular. The dedication to a Celtic saint suggests that the date of a previous church may be around 600AD after the death of Winwalloe but before the Celts were driven out of the area by the Saxons. A second suggestion is during the 10th century and the reign of King Athelstan.

There is potential to identify anomalies that relate to a former church and also responses relating to features of the current building.

2.5   Survey objectives

The objective of the survey was to locate any anomalies that may be of archaeological origin and relate to the possible former church on the site.

2.6   Survey methods

Ground Probing Radar (GPR) was used to survey the site due to the hard nature of the floor surface.

More information regarding this technique is included in the Methodology section below.

3   METHODOLOGY

3.1   Date of fieldwork

The fieldwork was carried out on a single day, 13th November 2006 when the weather was wet.

3.2   Grid locations

The location of the survey grids has been plotted in Figure 3. Note that the interior and exterior surveys are based on different grids and as such have differing coordinates.

3.3   Description of techniques and equipment configurations

Two of the main advantages of radar are its ability to give information of depth as well as work through a variety of surfaces, even in cluttered environments and which normally prevent other geophysical techniques being used.

A short pulse of energy is emitted into the ground and echoes are returned from the interfaces between different materials in the ground. The amplitude of these returns depends on the change in velocity of the radar wave as it crosses these interfaces. A measure of these velocities is given by the dielectric constant of that material. The travel times are recorded for each return on the radargram and an approximate conversion made to depth by calculating or assuming an average dielectric constant (see below).

Drier materials such as sand, gravel and rocks, i.e. materials which are less conductive (or more resistant), will permit the survey of deeper sections than wetter materials such as clays which are more conductive (or less resistant). Penetration can be increased by using longer wavelengths (lower frequencies) but at the expense of resolution (see 3.4.2 below).

As the antennae emit a "cone" shaped pulse of energy an offset target showing a perpendicular face to the radar wave will be "seen" before the antenna passes over it. A resultant characteristic *diffraction* pattern is thus built up in the shape of a hyperbola. A classic target generating such a diffraction is a pipeline when the antenna is travelling across the line of the pipe. However it should be pointed out that if the interface between the target and its surrounds does not result in a marked change in velocity then only a weak hyperbola will be seen, if at all.

The Ground Probing Impulse Radar used was an MF system manufactured by Ingegneria Dei Sistemi (IDS).

The radar surveys were carried out with a 400MHz antenna. This mid-range frequency offers a good combination of depth of penetration and resolution.

3.4   Sampling interval, depth of scan, resolution and data capture

3.4.1 *Sampling interval*

Radar scans were carried out along traverses 0.5m apart on an orthogonal grid within the church and 1m apart on a parallel grid outside as shown in Figure 3. Data was collected at 40 scans/metre. A measuring wheel was used to put markers into the recorded radargram at 1m centres.

3.4.2 *Depth of scan and resolution*

The average velocity of the radar pulse is calculated to be 0.1m/ns which is typical for the type of sub-soils on the site. With a range setting of 60ns this equates to a maximum depth of scan of 3m respectively but it must be remembered that this figure could vary by ± 10% or more. A further point worth making is that very shallow features are lost in the strong surface response experienced with this technique.

Under ideal circumstances the minimum size of a vertical feature seen by a 200MHz (relatively low frequency) antenna in a damp soil would be 0.1m (i.e. this antenna has a wavelength in damp soil of about 0.4m and the vertical resolution is one quarter of this wavelength). It is interesting to compare this with the 400MHz antenna, which has a wavelength in the same material of 0.2m giving a theoretical resolution of 0.05m. A 900MHz antenna would give 0.09m and 0.02m respectively.

3.4.3 *Data capture*

Data is displayed on a monitor as well as being recorded onto an internal hard disk. The data is later downloaded into a computer for processing.

3.5   Processing, presentation of results and interpretation

3.5.1 Processing

The radar plots included in this report have been produced from the recorded data using
IDSGRED software. The data has been filtered to remove background noise.

3.5.2 Presentation of results and interpretation

Manual abstraction
Each radargram has been studied and those anomalies thought to be significant were
noted and classified as detailed below. Inevitably some simplification has been made to
classify the diversity of responses found in radargrams.

i.   Strong and weak discrete reflector.
        These may be a mix of different types of reflectors but their limits can be clearly
        defined. Their inclusion as a separate category has been considered justified in order to
        emphasise anomalous returns which may be from archaeological targets and would not
        otherwise be highlighted in the analysis.

ii.   Complex reflectors.
        These would generally indicate a confused or complex structure to the subsurface. An
        occurrence of such returns, particularly where the natural soils or rocks are
        homogeneous, would suggest artificial disturbances. These are subdivided into both
        strong and weak giving an indication of the extent of change of velocity across the
        interface, which in turn may be associated with a marked change in material or moisture
        content.

iii.   Point diffractions.
        These may be formed by a discrete object such as a stone or a linear feature such as a
        small diameter pipeline being crossed by the radar traverse (see also the second
        sentence in 4. below).

iv.   Convex reflectors and broad crested diffractions.
        A convex reflector can be formed by a convex shaped buried interface such as a vault or
        very large diameter pipeline or culvert. A broad crested diffraction as opposed to a point
        diffraction can be formed by (for example) a large diameter pipe or a narrow wall
        generating a hybrid of a point diffraction and convex reflector where the central section
        is a reflection off the top of the target and the edges/sides forming diffractions.

v.   Planar returns.
        These may be formed by a floor or some other interface parallel with the surface. These
        are subdivided into both strong and weak giving an indication of the extent of change of
        velocity across the interface which in turn may be associated with a marked change in
   material or moisture content.

4   RESULTS

The data gathered from the site show a large number of anomalies. These have been interpreted and categorised into four sections:

- Discrete and complex responses probably associated with buried walls
- Weak discrete anomalies – possible buried structure
- Broad crested anomalies possibly relating to vault style features
- Responses which may be caused by current flooring

Exterior
Radar data was gathered over a 1m parallel grid running in transects offset from the church walls. Several areas of discrete response have been identified. It is possible that these represent buried structures, although the exact nature these may take is not clear. For example they may be caused by wall remains, grave cuts or ditch features. Around the perimeter of the church several other responses forming linear anomalies are observed (see example Radargram 1). Discrete responses, such as these, forming linear features are indicative of buried structural walls or foundations. Of all of these types of anomaly the two occurring in the west of the church oriented north-south about either side of the Tower are perhaps the most noteworthy as they are consistently observed in adjacent radar transects and almost align with each other across the tower. It is possible that these are caused by a continuous linear feature.

Discrete response – possible buried structure


Horizon at 1.0m

Horizon at 1.6m
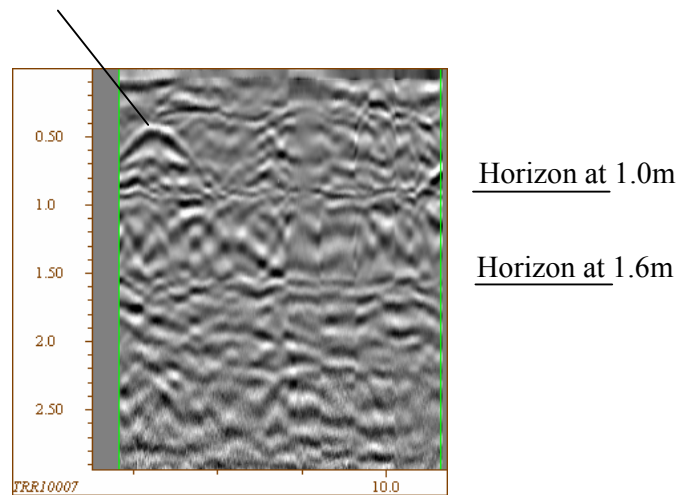
Example Radargram 1. Traverse 19N – West side of porch showing a discrete response which may be associated with a structural feature.

Two horizons have been identified within the data (Example Radargram 1), an upper level at 1m and a lower level at 1.6m. Based on information given by the local grave digger it is likely that the lower horizon at 1.6m represents the conformity between the soil and bedrock while the upper level may merely be caused by a slight variation in soil characteristics. This indicates that anomalies below the 1.6m level may be natural in origin.

Interior
Within the church, similar to the exterior, a number of discrete responses are identified which may be related to buried features. Along with these several stronger responses are also observed (Example Radargram 2).

Strong response – probable buried wall

Deep broad crested response
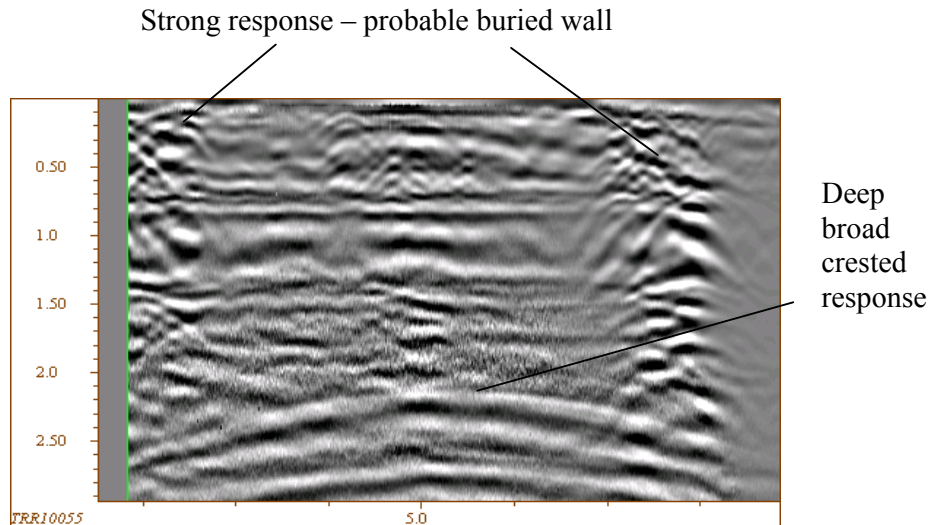
Example Radargram 2. Transect 9E – central Nave area. Showing strong complex and discrete responses which may be caused by buried walls. Also visible is a deep broad crested response.

These strong responses are approximately 1m wide and are likely to represent significant structural features such as walls. Responses of this type are only noted within the interior of the church and mainly in the central parts, with one isolated anomaly in the porch. It therefore seems possible that because these are located in the centre of the church they may relate to the earliest phases of construction and may even be associated with the suspected former building on the site. Also shown in Example Radargram 2 is a deep convex response at around 2m depth. In total four areas of these anomalies are observed. Under normal circumstances such responses would be widespread across a site and attributed to a natural pedological or geological effect, and in fact they are beneath the previously interpreted 1.6m level to bedrock. However they are not widespread throughout this site and are only observed within the interior of the church suggesting that they are anthropogenic in origin. Considering their location within the church it is possible that they are related to buried structures beneath the church which may have been cut into the underlying rock. The complex response seen on the right hand side of Example Radargram 2 appears to extend down to the broad crested anomaly suggesting that the two types of response are associated with the same structure. It does remain ambiguous exactly what the broad crested responses are caused by and further investigation would be required to clarify their origin.

Within the Tower an 'L' shaped anomaly is identified with a relatively shallow depth suggesting it is caused by a near surface features possibly associated with the current flooring. Areas within the Porch, Chancel and Nave may also be of this origin.

5   CONCLUSION

The results show there to be evidence of buried structural features at the site. Around the exterior responses have been identified which may relate to buried structures, while other areas may be caused by linear features. Within the central part of the church areas of broad crested anomalies and discrete responses are observed which may relate to the earliest phases of construction or even the suspected former building on the site. The origin of the broad crested responses remains ambiguous and would require further investigation to clarify.

6   REFERENCES

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Soil Survey of England and Wales, 1983. *Soils of England and Wales, Sheet 5 South West England*.