FORENSIC INVESTIGATION OF SUBSIDENCE TO DWELLING
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ABSTRACT
Investigation of house subsidence is always fraught with difficulty, because one doesn’t ever know the full information of the foundation soils, the method of construction or the quality of construction. This report illustrates the importance of undertaking a desktop study and obtaining the origins of the soils to confirm the bore hole logging in order to obtain a correct diagnosis of the likely cause of subsidence.

1 BACKGROUND
The owner of a house noted severe cracking in his house following the construction of a road in front of the house. The owner complained to the contractor who passed the claim on to their insurer. The insurer engaged a suitably experienced geotechnical (Geotechnical engineer #1) to write a report to identify the cause of cracking.

The geotechnical engineer engaged an experienced soil testing company (Soil tester #1) to conduct soil testing around the dwelling.

The diagnosis by Geotechnical Engineer #1 was that cracking of the house finishes resulted from the house being founded on clay soils which had cracked as a result of the recent drought conditions in the Gold Coast region.

The owner had been in possession of the house for about twenty years and was convinced that the cracks only appeared after the construction of the road in front of their dwelling, which involved the use of a compaction roller.

2 DWELLING TYPE
The house is a single storey masonry veneer dwelling with a concrete tile roof and on grade concrete floor slab constructed in the early 1980s, prior to the advent of the first Australian Standard 2870-1986, Residential Slabs and Footings. Damage to masonry walls and concrete floors was significant (with reference to Table A1 and A2 AS2870-1986).

3 DROUGHT
The Gold Coast had experienced drought in the mid 2000s and the local Hinze Dam reached critical low levels in early 2004. July 2006 was a record dry month.

4 BORELOGS FROM SOIL TESTER #1
The general soil profile recorded using a 100 mm diameter power drilling rig was residual clay soils to at least a depth of 2.5 m depth. Shrink/swell laboratory testing indicated that the clays soils had significant shrink swell potential.

5 CONCLUSION BY GEOTECHNICAL ENGINEER #1
Based on the results of the soil testing, Geotechnical Engineer #1 reported that the clay foundation soils were susceptible to drying shrinkage from the recent drought, causing settlement of the dwelling resulting in cracked finishes. The conclusion was that the cracking was not caused by the road making process in front of the owner’s house.

6 ENGAGEMENT OF GEOTECHNICAL ENGINEER #2
The owner engaged wanted a second opinion. Another geotechnical engineer (Geotechnical Engineer #2), considered that the initial investigation was extensive and seemingly thorough. Therefore it was mentioned to the owner that proceeding with another investigation that may produce similar results. Upon insistence from the owner that cracking occurred after the road making process, the commission was accepted based on the following considerations.
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a) It was noted that a power drilling rig had been used for soil testing. Forensic testing using a power drilling machine is not recommended because detection of soil layer interfaces can be missed and soil structure can be destroyed. Thus the soil profile may have not been recorded accurately.

b) If the soil foundation was fill, vibration from a compaction roller could initiate further settlement resulting in cracking of finishes and structural elements.

c) Other houses in the street had also cracked.

The commission included a new soil testing programme using hand augers (Soil tester #2) conducted in late 2007.

7 RESULTS OF SOIL TESTER #2

The results of the soil testing programme (Soil tester #2) resulted in a general soil profile of brown clayey fill to depths of 1.2 m and 2.2 m—see Table 1. The fill comprised of SILTY SAND and SANDY CLAY in different layers.

Table 1: DEPTH OF FILLING

<table>
<thead>
<tr>
<th>Test Location #BH1</th>
<th>Test location #BH2</th>
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<tbody>
<tr>
<td>2.2 m</td>
<td>1.2 m</td>
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The Fill was above a layer of black alluvial clay with root fibres, over grey alluvial clay with rounded river gravel (20-30 mm). The bore hole locations are shown on Figure 1.

8 DESKTOP STUDY BY GEOTECHNICAL ENGINEER #2

A desk top study, including observation of geological maps (BEENLEIGH 1:100,000), soils maps (Moreton Region Land Resource Areas map 1:250,000) and Google earth aerial photography, revealed that the development had been constructed on the Nerang River flood plain and that the origin of natural soil type in the area was alluvium.

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Figure 1: Site plan shows location of investigation holes.
9 CONCLUSION BY GEOTECHNICAL ENGINEER #2

- Based on the results of Soil tester #2, the house block had been filled with sandy and clayey filling overlying alluvial soils to form a flat building block.
- As the bore logs by Soil tester #1 did not mention ‘alluvial’ the material logging might be incorrect.
- It was considered that vibration from a compaction roller nearby could initiate compaction and settlement in the filling. Clay filling could settle if the clays had desiccated as a result of the drought.
- Settlement could result in cracking of the masonry and concrete structural components and finishes to the house.
- It was not discounted that the house may have experienced some settlement cracking as a result of some drying shrinkage of the clay soils, even before the construction of the road.
- It was concluded that cracking of masonry and concrete structural components and finishes arising from settlement of the fill foundation soils as a result of use of compaction equipment nearby was plausible and very likely.

10 CONCLUSION

Lessons learnt:

a) Don’t assume bore hole logging by others is correct.

b) Listen to the report of eye witnesses.

c) Forensic soils investigation should be conducted using hand augers wherever practical, or other means that provide a method of identifying soil structure and origin.

d) Bore hole logging must accurate or wrong conclusions will result.

e) It is important to check origins of soils using a desk top study (e.g. geological maps).

In this case the error in the bore logs of Soil tester #1 may have been avoided if bore hole logging had been accurate and results checked against available maps such as geological, soils and aerial photographs (Google earth) which would have indicated that the likely natural soil type was of alluvial origin.