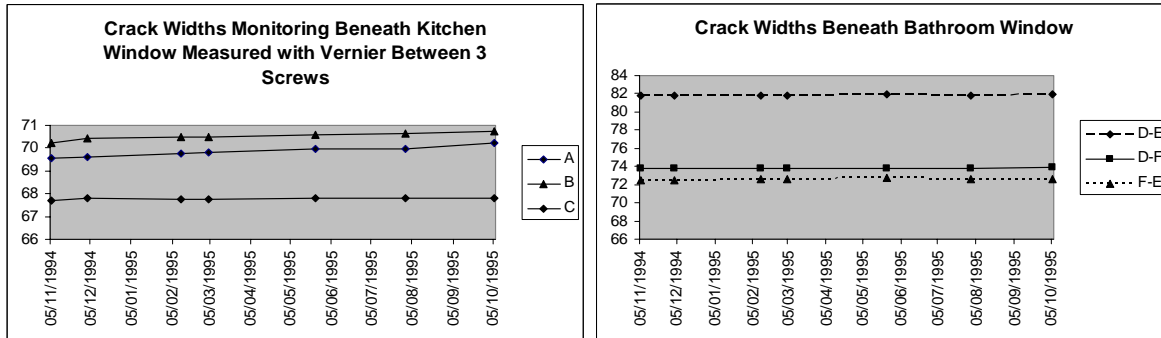
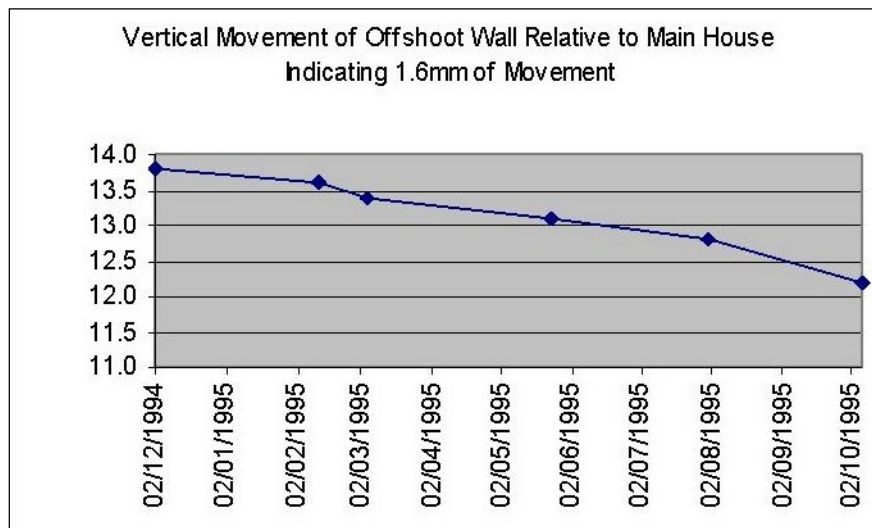


## CASE STUDY 1 - SIMPLE VERTICAL CRACK

This illustrates a relatively straightforward situation where there was an almost vertical crack through the corner of a window. It was thought that movement might be associated with a Viking defensive ditch that passed somewhere through the house. Three pins were set up on the crack at two locations. As indicated below, results were not clear as the crack was opening horizontally without any significant vertical shear movement.



Movement Gauges were subsequently installed on the wings either side of the crack. A third gauge was located on a third wall.



The Movement Gauges gave the necessary details of the relative movements within weeks.

The movement in this case had the characteristics of steady settlement. Excavations found a broken drain at one corner that was weakening the soft clay beneath the foundations.

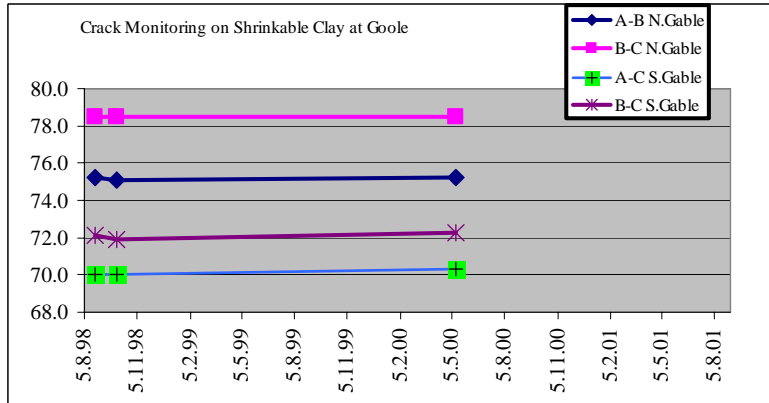
### Comment on Case Study 1

Experience subsequently gained with Movement Gauges on other buildings has confirmed that cracking often takes place at some distance from where the actual settlement is taking place. This explains why readings of vertical shear movements at cracks is often disappointing. As illustrated in other Case Studies, the position and movement of cracks is often associated more with the structure of the wall than the form of the movement in the foundations.

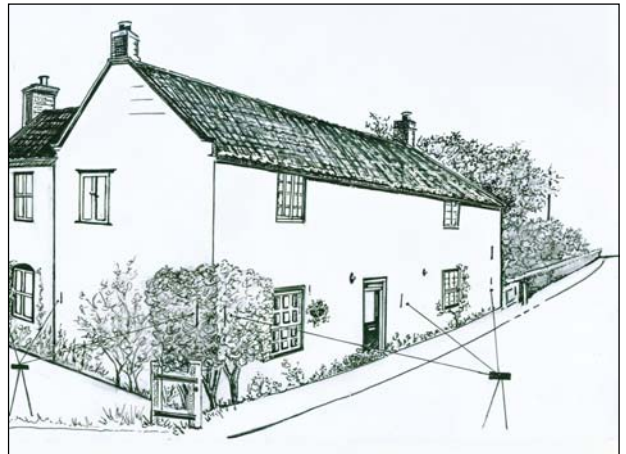
## CASE STUDY 2 - HOUSE ON SHRINKABLE CLAYS

A building approximately 300 years old had obvious signs of major settlement. The householder's bed needed a brick at one end to level it up! Levelling of the bedding courses

indicated that the ends of the building had settled by around 300mm relative to the central door and hallway. Yet there were few major cracks, and in the course of the monitoring, little movement was picked up at one crack and zero at another.



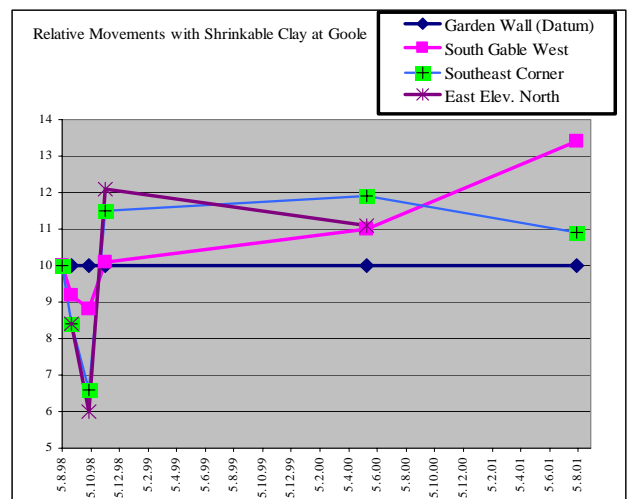
Movement gauges were set up on the south gable wall, and another series were set up along the east front of the house. The two adjacent gauges at the south east side were considered to be a "change point". The actual height difference between the gable and front movement gauges was never measured as it is only the changes in level that are significant. Two gauges at different heights or on different elevations can be considered to be moving together if set on adjacent stones in contact.



The results from Movement Gauges picked up major relative movements within the month of August, some of which was regained over the eleven subsequent months. This still left significant long-term net movement which needed to be prevented.

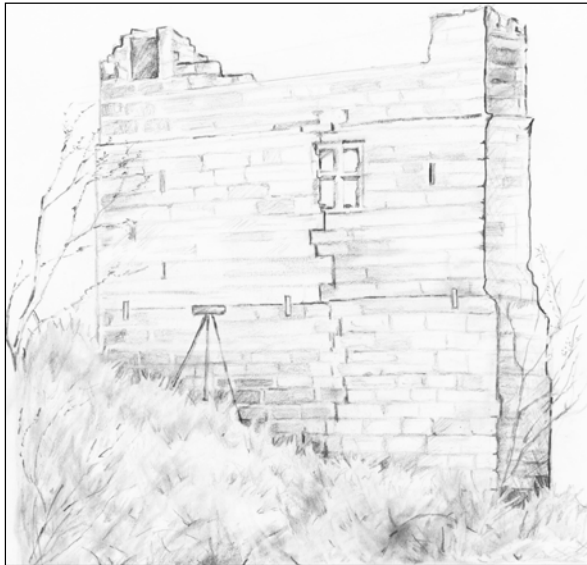
### Comments on Case Study 2

The results from the Movement Gauges indicate that buildings constructed with lime mortar are capable of accommodating large relative movements without undue cracking. It was the small net movement over a calendar year that was causing damage, rather than the much larger seasonal movements.



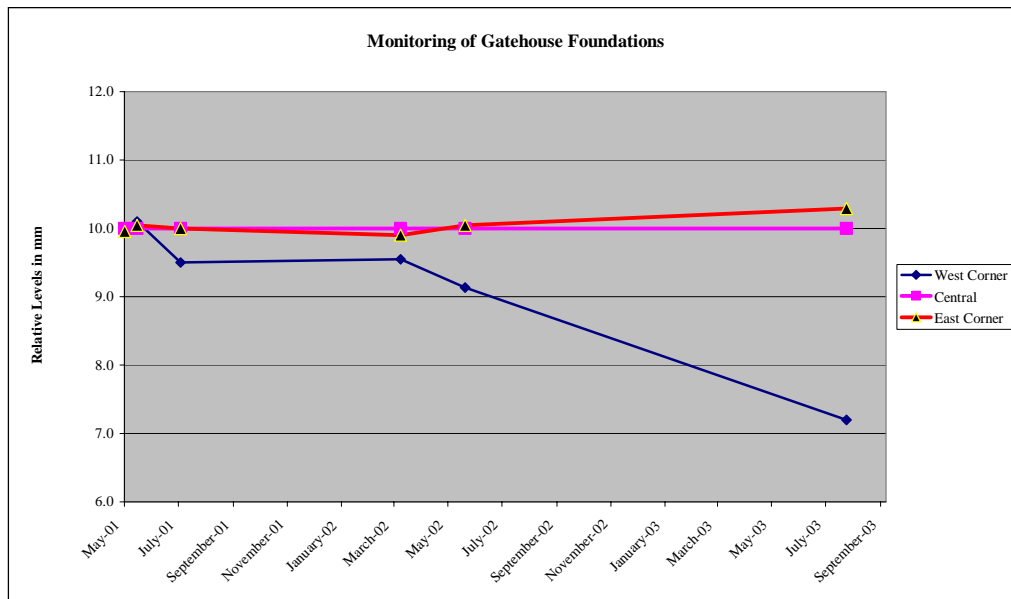
## CASE STUDY 3 – MOVING CASTLE

A Medieval Gatehouse to a Norman Motte and Bailey Castle was exhibiting cracking on the north and south elevations. It was initially suspected that the east side of the Gatehouse was sliding into the Moat.



Monitoring cracks from ladders was considered too expensive. Movement Gauges on the north wall were expected to show settlement of the bottom east corner relative to the central and west corner at the top of the moat. With this technique there is rarely an absolute datum

The results quickly indicated that the hypothesis that the gatehouse was falling into the moat was very wrong. It was the corner at the top of the bank that was settling relative to the centre and bottom corner. There was no movement across the crack, and the crack was positioned remote from the actual movement.



### Comments on Case Study 3

After just the second set of readings, the more logical explanation for the movement became apparent. The corner constructed on the Norman Motte piled up by Saxon serfs was settling. The corner constructed in the moat would be on better founding strata.

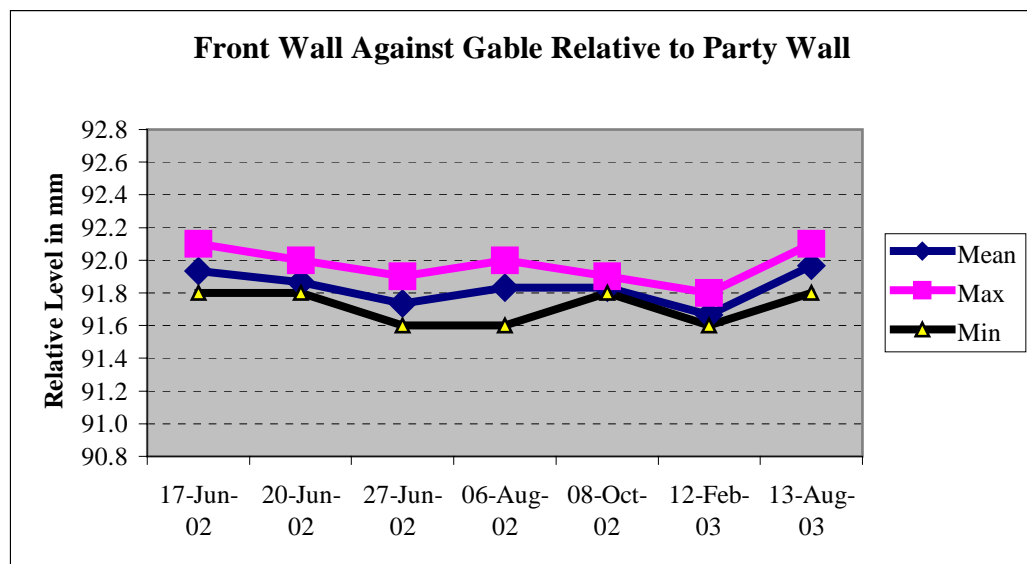
The position of the cracks gave no indication of where or how the foundations were moving. Cracks appear to relate much more to the wall structure than foundation movements.

## CASE STUDY 4 – INSURANCE CLAIM AFTER PARTY WALL WORKS

Extensive cracking in a building with a history of foundation problems was proved to be unrelated to the foundations. Irrefutable data allowed the insurers to cancel planned underpinning.

This rather more mundane example involved cracking in a semi-detached Edwardian brick house. A mega-store had been constructed against a gable wall which had involved improvements in the foundations to the gable wall of the residential building. Significant cracking was taking place within the ceilings to both floors of the house along with external cracking to the windows. This house and other houses in the area had signs of previous movement and it was learnt that they are founded on soft clay. It was initially thought that the partial foundation improvements were causing differential movement in the foundations.

Eight Movement Gauges were fixed around the inside of the house on the external, internal and party walls. As the front and back rooms had been knocked through, it was possible to monitor all positions without the need for any change points.



Typical results from one of the eight positions are indicated in the graphs. From the graphs the following was deduced:

1. As the Y-axis for various sets of readings has a scale of only 0.2 mm, the results, even within the first six weeks, were indicating that there were no significant differential movements. The client was informed.
2. Reading errors from inaccuracies in the early versions of the movement gauges and from movement in the automatic level sat on the timber ground floors were of the same order as any actual movement. The extreme and mean readings were therefore plotted.
3. After taking measurements for over a year, the results still indicated no significant differential movement between any of the walls relative to the original party wall.

As cracking was continuing, it was clear that damage must be related high-level distress such as thermal expansion of the superstore. Planned underpinning would not help.