4 ANCHOR FORCES

4.1 INTRODUCTION

The object of these tests was to investigate the forces that anchors receive during a typical day's access work. Although the tests were of limited scope, they gave a valuable insight into the loads involved. While these tests are labelled 'anchor forces', they also represent the forces that pass into the user's harness.

Work was carried out at Firbank Viaduct, Sedbergh, Cumbria. A portable load cell was installed on the working rope where it held the full weight of the technician. A level 3 IRATA technician then performed a variety of operations and a laptop computer was used to continuously record the forces. The operations and peak forces were as follows.

4.2 ABSEILING

From the anchor point the technician abseiled approximately 10 metres at a speed of 1 metre per second. The average force was 0.75 kN, the weight of the operative. Slight jerks meant the force varied from 0.65 kN to 0.90 kN.

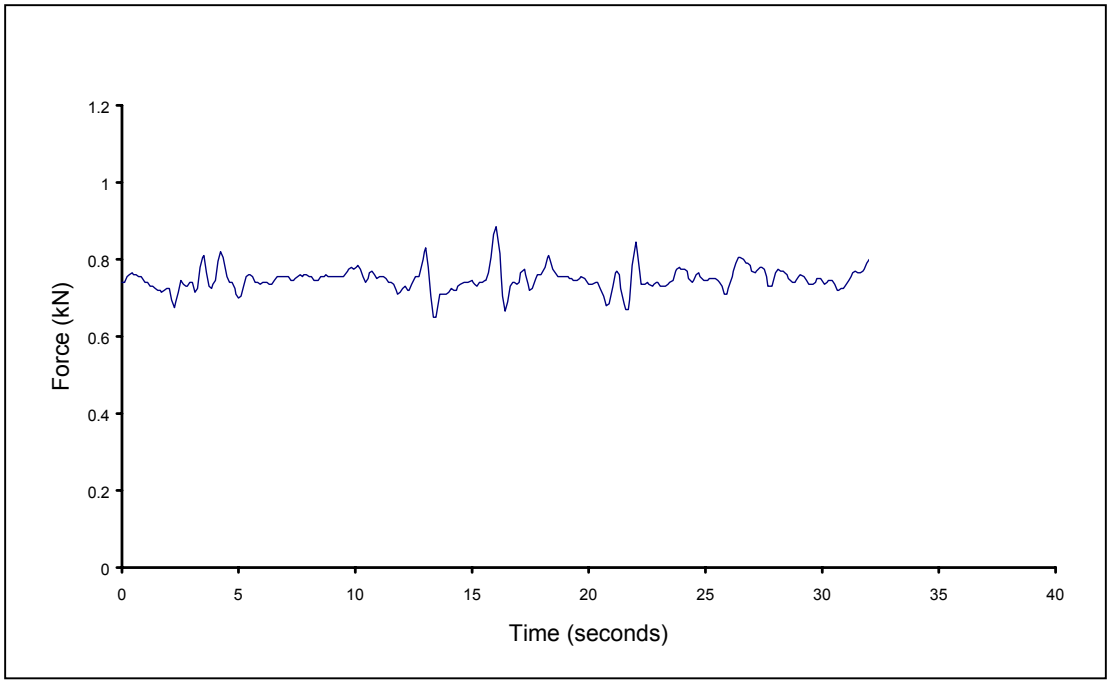

Figure 14
Graph showing forces generated when abseiling

4.3 ASCENDING

The technician ascended back to the anchor point using the normal technique of hand and chest ascenders. Again, the average force was 0.75 kN, but the maximum and minimum forces covered a greater range: from 0.35 kN to 1.05 kN.

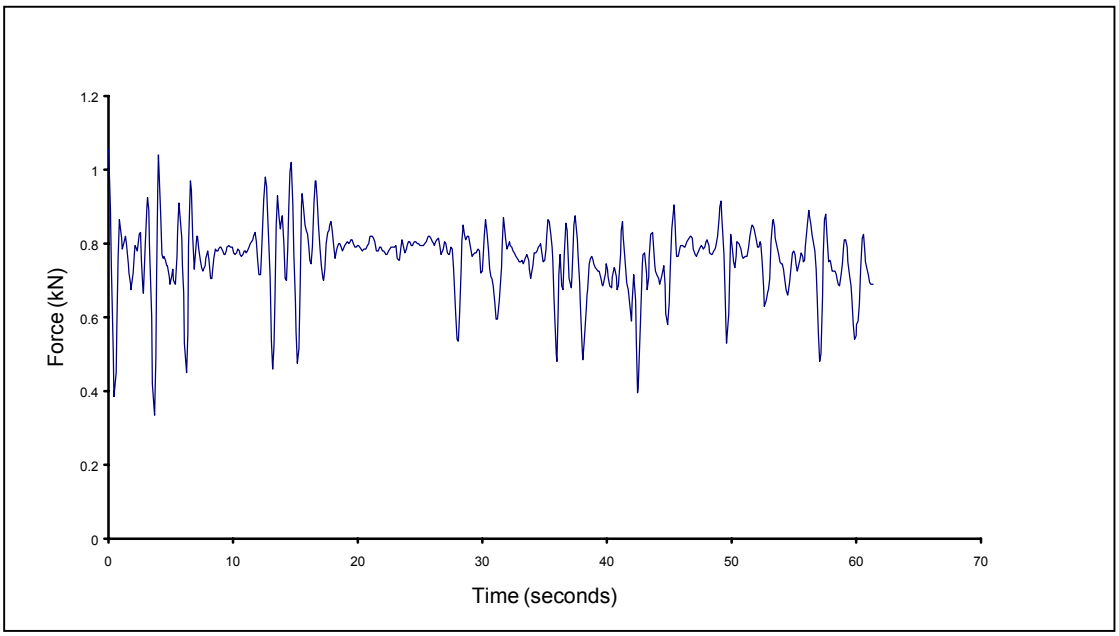

Figure 15
Graph showing forces generated when ascending

The sequence of climbing is - put weight onto footloop and stand up, sit down to transfer the weight onto the chest jammer and finally bend leg whilst moving the hand ascender up the rope. The peaks and troughs coincide with these movements which were then repeated.

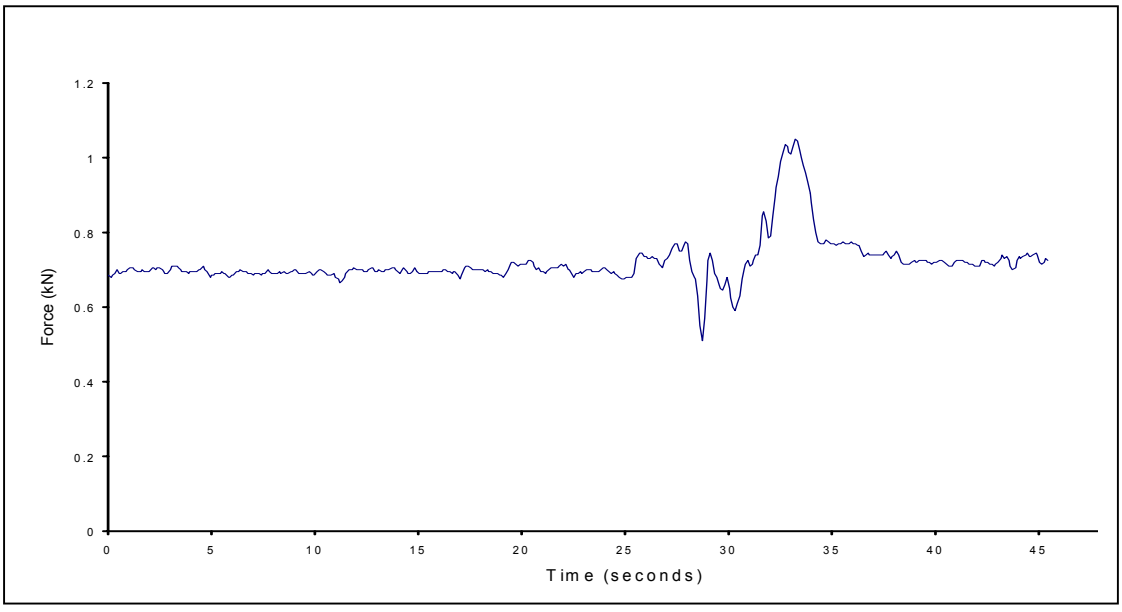

Figure 16
Graph showing forces generated when changing from ascent to descent

4.4 WORK POSITIONING

A combination of hand ascender and descender were used to ascend the rope: a not unusual work positioning technique. Forces were similar to those produced by normal ascent but slightly wider ranging: from 0.30 kN to 1.10 kN.

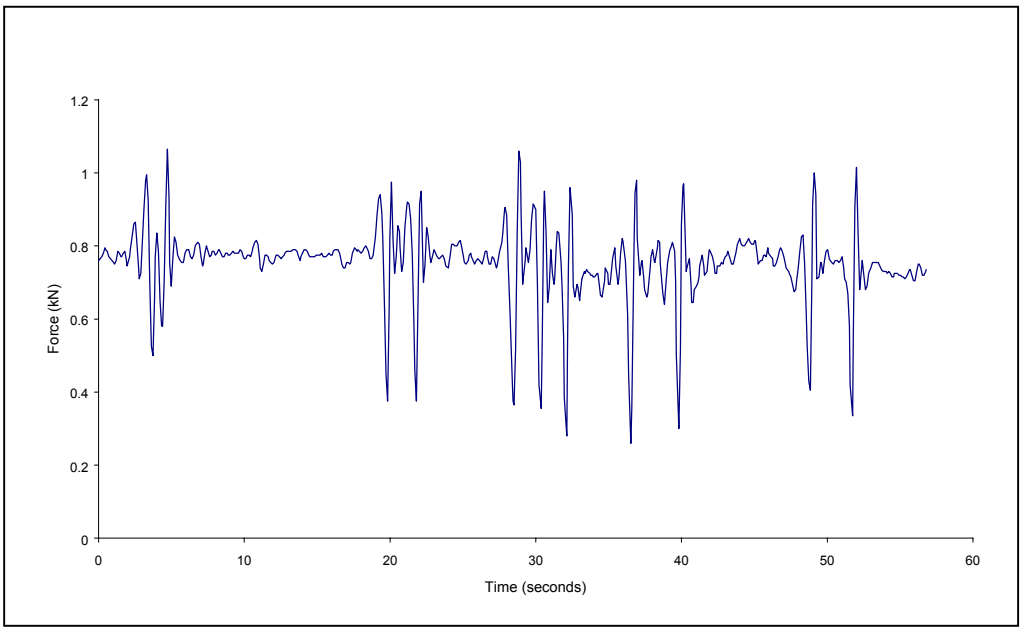

Figure 17
Graph showing forces generated when ascending using a combination of ascender and descender

The sequence of climbing was the same as in Figure 15, Ascending, except that a hand ascender was not used. In this case the footloop was attached to a descender and to move this upwards the slack rope was pulled through the descender.

4.5 WORKING

The technician remained at one point on the rope, around 5 m below the anchor, and performed a variety of simple work operations. Again, average forces were 0.75 kN, with values ranging from 0.45 kN to 1.00 kN.

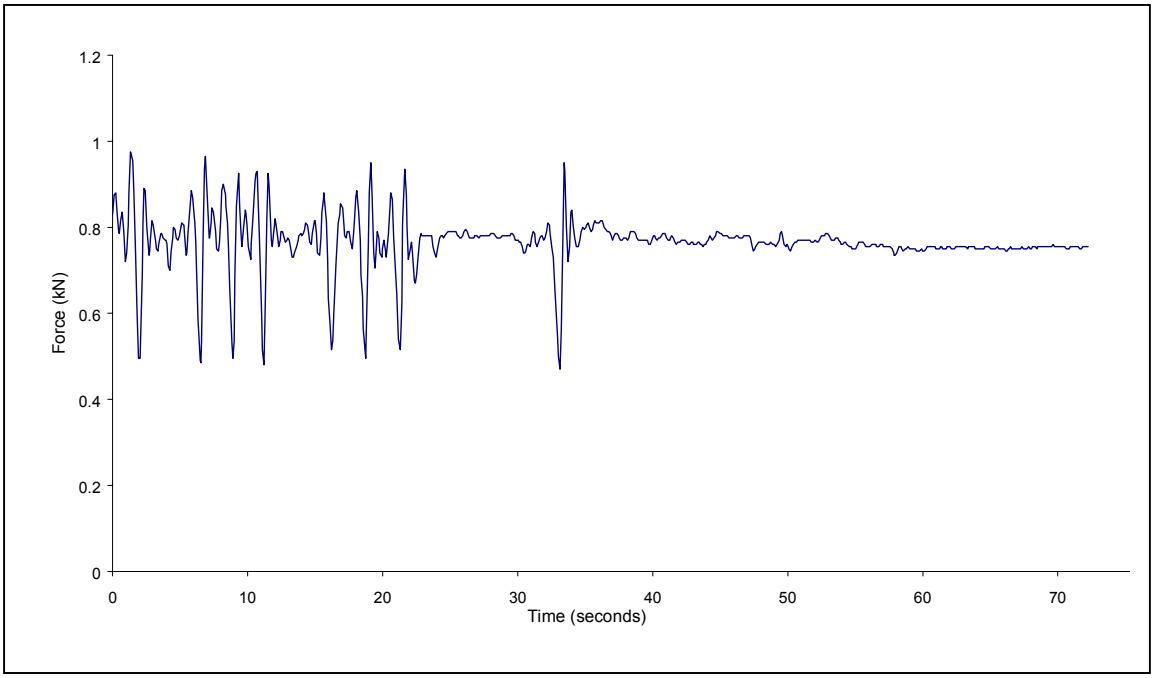

Figure 18
Graph showing forces generated whilst working at a single point

4.6 RIGGING

The technician remained stationary in one position, around 5 m below the anchor, while carrying out a variety of rigging procedures such as tying knots and placing strops and slings around the structure. The forces varied very little, from 0.72 kN to 0.78 kN.

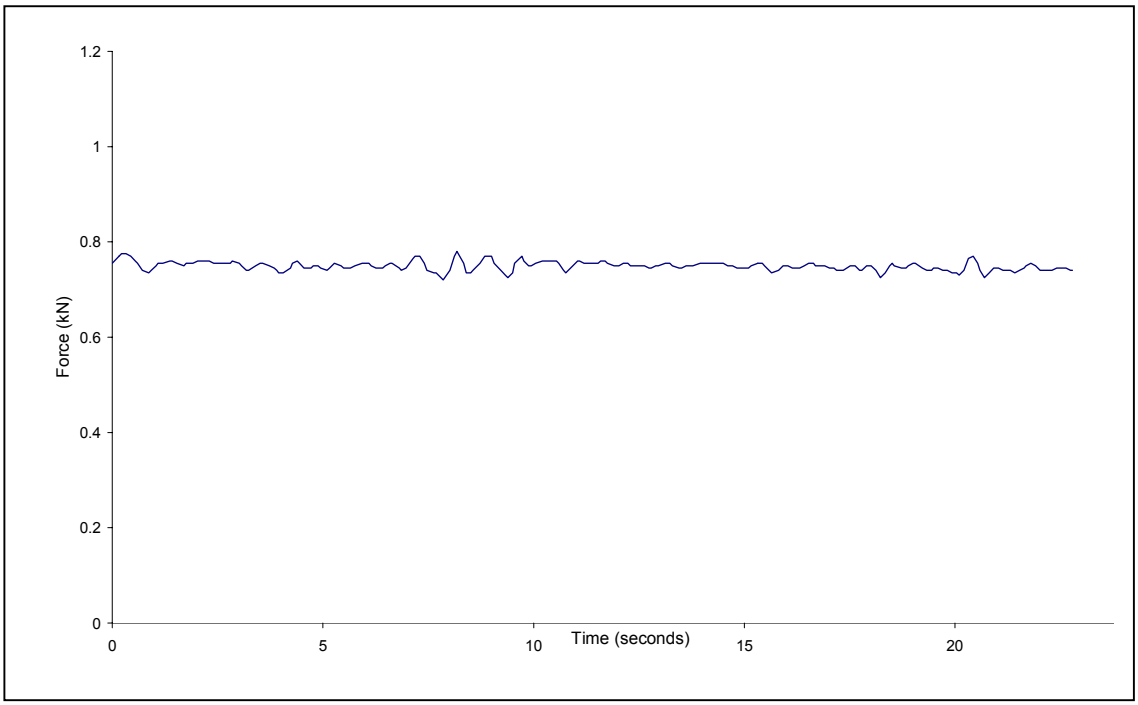

Figure 19
Graph showing forces generated when tying knots in one place (operative stationary on rope)

4.7 ASCENDING/DESCENDING RAPIDLY

Attempts were made to generate higher forces by carrying out conceivable poor practices, such as abseiling jerkily and ascending as fast as possible. Higher forces and correspondingly low forces representing bounces were seen, ranging from 0.35 kN to 1.60 kN.

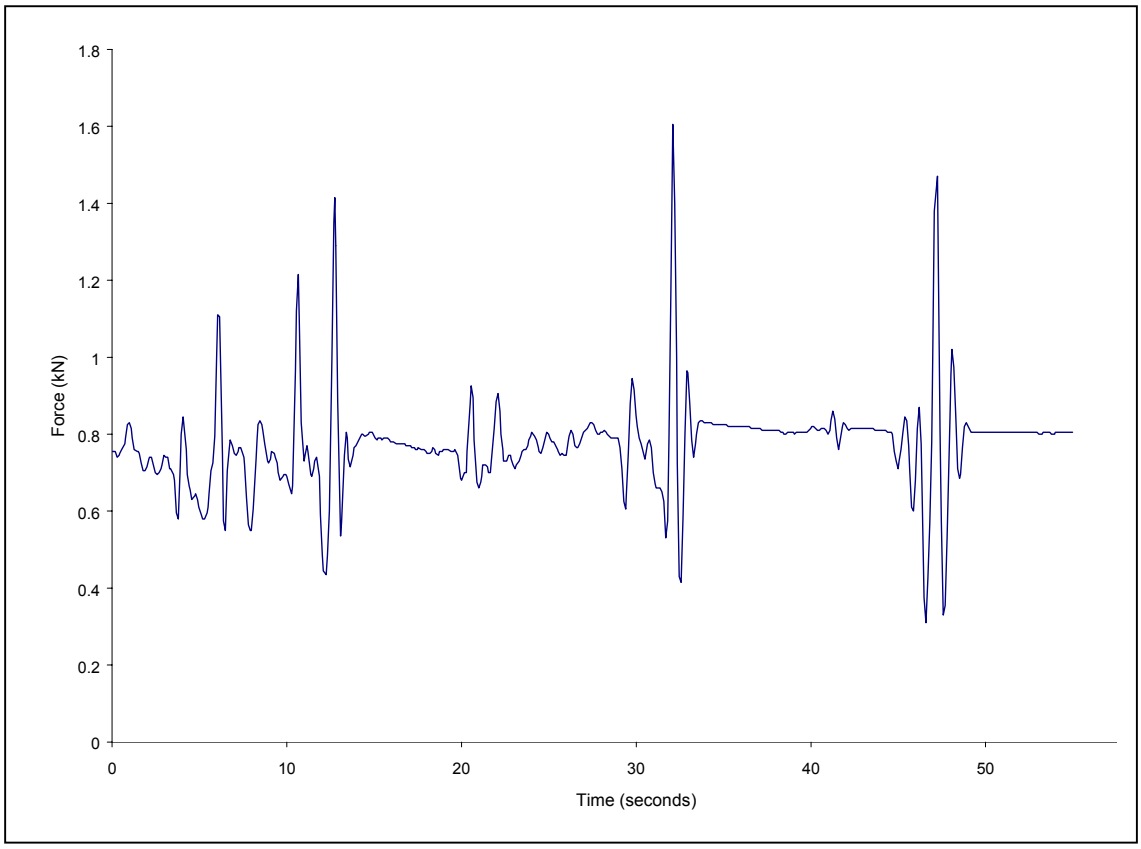

Figure 20
Graph showing forces generated when ascending and descending rapidly

4.8 SUMMARY

In normal operations loads on anchors should not exceed 150% of the gross weight of the operative, i.e. the weight of the operative and his/her equipment. It is possible to increase peak forces to 200% of the gross weight of the operative by moving abruptly or braking. Rescue procedures, where static loading may be doubled, should always be carried out as smoothly as possible.

The further down the rope from the anchor the operations were carried out, the more rope was available to stretch and absorb peaks and troughs in the loading, thus reducing force fluctuations.