FIGURE 7

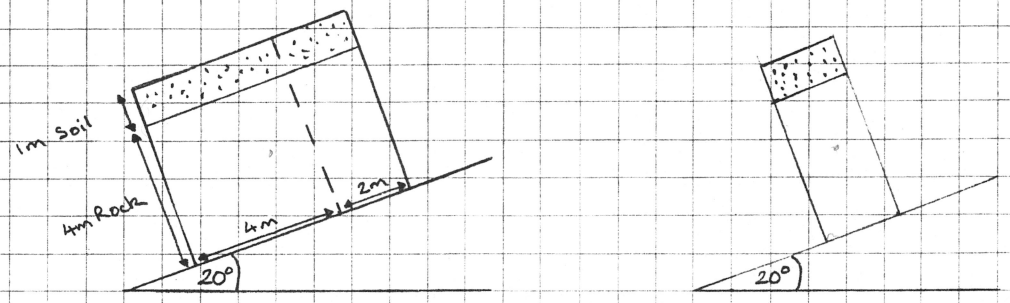
Fig. 7 Eastern part of slope after failure

FIGURE 8

Stresses For Testing

Stresses are calculated from the geometry of a failed block in the eastern flank of the landslip.

From photographs taken by FUGRO before and after failure, the geometry may be approximated as follows:

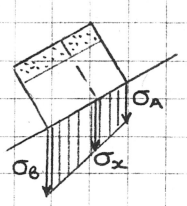


Prior to failure — Post failure

Take $\gamma = 20\ kN/m^2$. Height, $h = 5m$; Breadth, $b = 1m$; $\beta = 20°$, $\tan\beta = 0.364$

Then from Hencher (1977)-

Prior to failure



Length, $l = 6m$

$\frac{l}{3h} = 0.4$

$\therefore \tan\beta < \frac{l}{3h}$ (case 1, Hencher 77)

Stress at leading edge:

$$\sigma_B = \frac{30 \times 20}{6 \times 1 \times \cos 20}\left(1 + \frac{3 \times 5}{6}\tan 20\right)$$

$$= 203\ kN/m^2$$

Stress at rear edge:

$$\sigma_A = \frac{30 \times 20}{6 \times 1 \times \cos 20}\left(1 - \frac{3 \times 5}{6}\tan 20\right)$$

$$= 9.6\ kN/m^2$$

Stress at leading edge of rear block

$$\sigma_x = \frac{203 - 9.6}{3} + 9.6$$

$$= 74\ kN/m^2$$

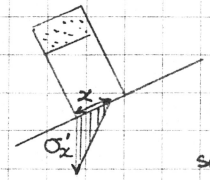
If soil were only 0.5m thick then

$\sigma_B = 174\ kN/m^2$

$\sigma_A = 17.3\ kN/m^2$

$\sigma_x = 69.5\ kN/m^2$

Post failure



Only rear block left on plane (assume it slid separately from leading block)

Length, $l = 2m$, $\frac{l}{3h} = 0.13$

$\therefore \tan\beta > \frac{l}{3h}$ (case 3, Hencher 77)

Then

$$\sigma_x' = \frac{4 \times 10 \times 20}{3 \times 1 \times \cos 20\,(2 - 5.\tan 20)}$$

$$= 1575\ kN/m^2$$

Note: $x = \frac{3}{2}(l - h\tan\beta) = 0.27m$ (close to toppling)

If soil were only 0.5m thick then

$$\sigma_x' = \frac{4 \times 9 \times 20}{3 \times 1 \times \cos 20\,(2 - 4.5\tan 20)}$$

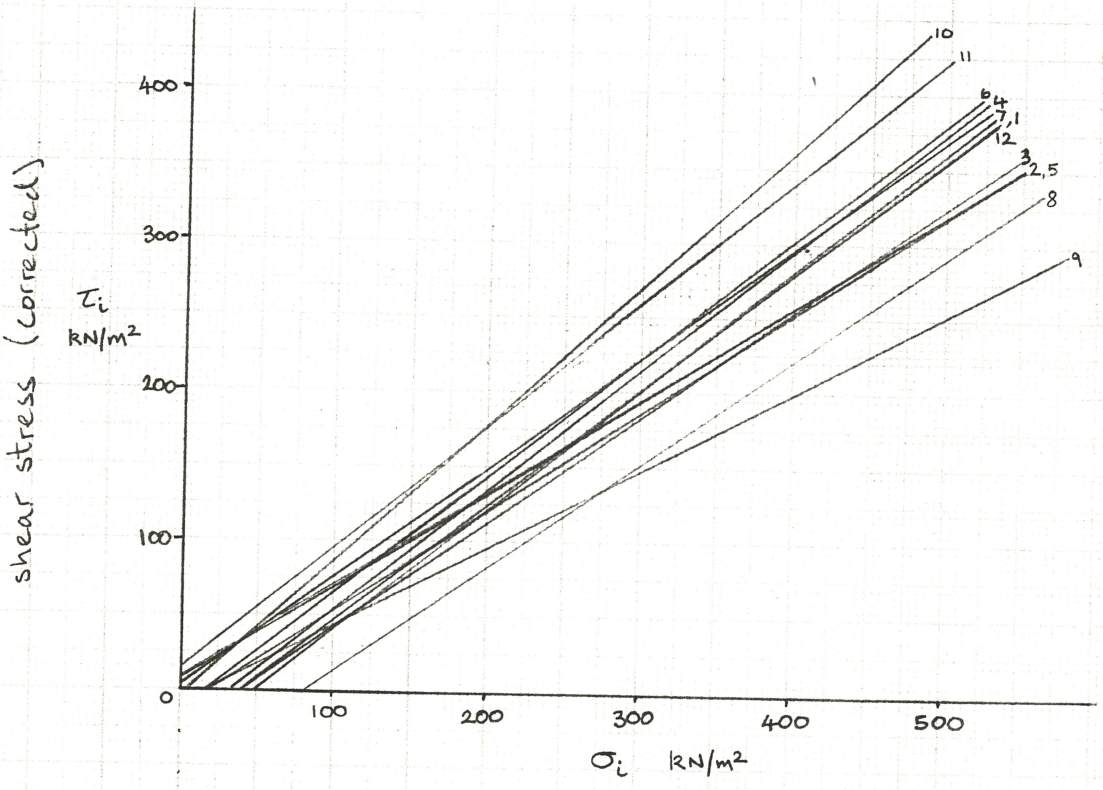
$$= 705\ kN/m^2$$

and $x = 0.54m$

$\therefore$ Stress range for testing $0 - 1500\ kN/m^2$, concentrating on $0 - 700\ kN/m^2$.

FIGURE 9

Best fit lines - corrected data. All tests



YIP KAN STREET ROCK SLOPE FAILURE

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FIGURE 10

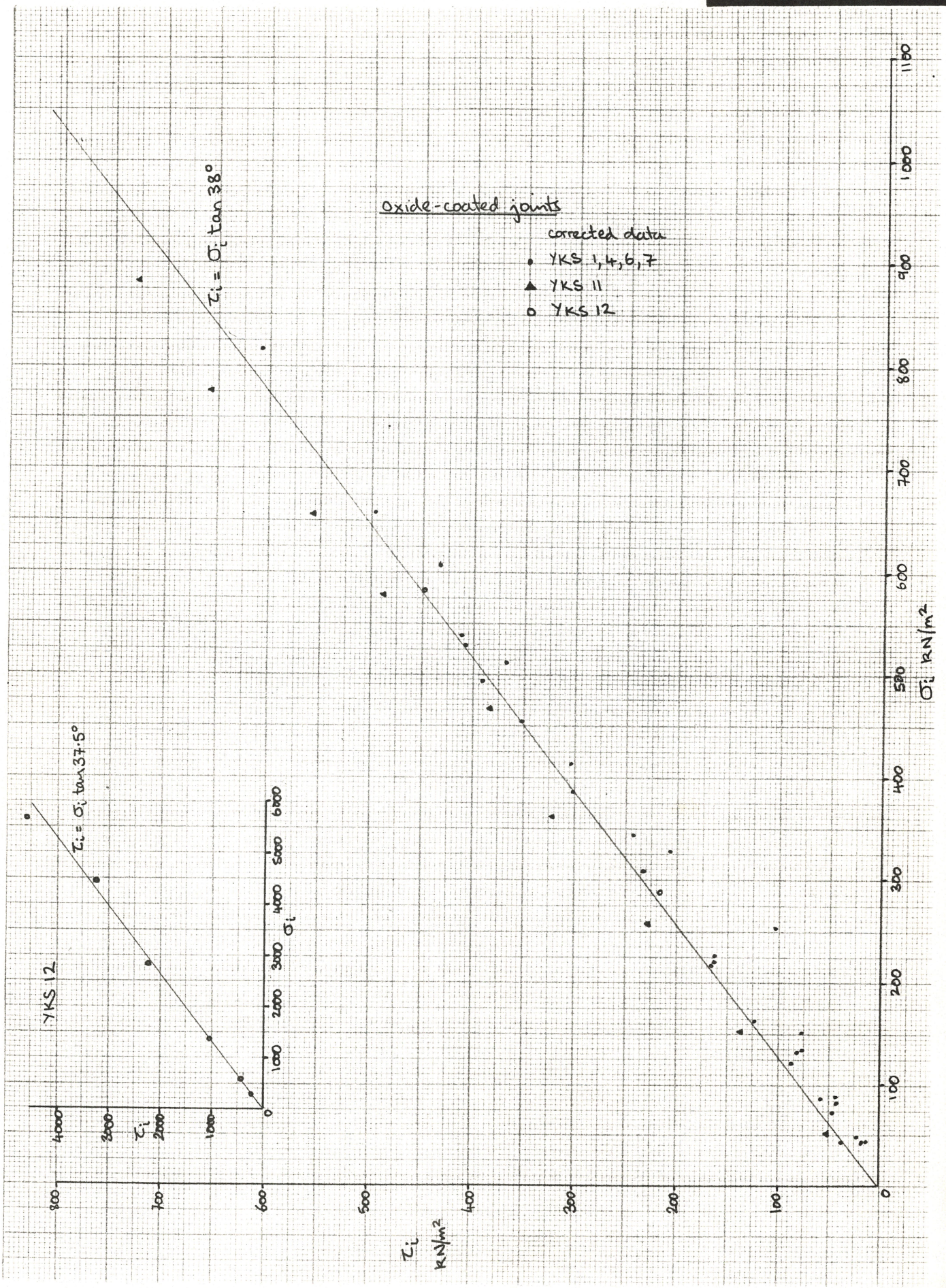

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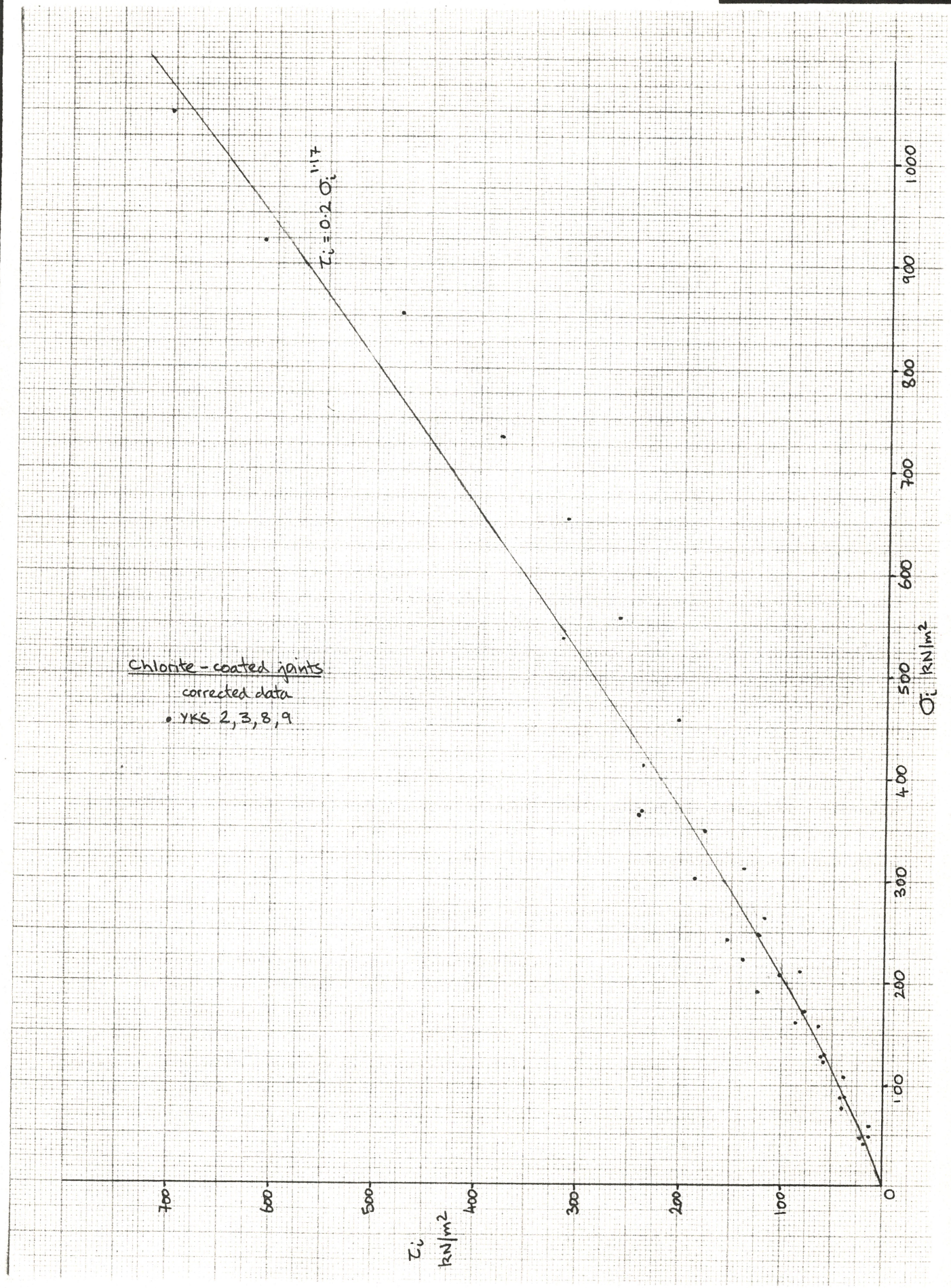
FIGURE 11



YIP KAN STREET ROCK SLOPE FAILURE

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TABLE 1

Summary of Direct Shear Tests Results - YIP KAN STREET ABERDEEN

• All tests carried out under water

Test No.	Surfaces	Failure details	Plotting Points kN/m²		Linear Regression, Power Curve
			σ_i	τ_i	
YKS 1	Brown oxides ~ planar	Fine flour, striations	48.1 89.3 151.6 254.2 344.9 454.4 539.8	21.9 44.9 77.5 104.4 244.2 350.8 410.1	Linear r^2 = 0.96 c = - 42 ϕ = 39.4° Power r^2 = 0.97 a = 0.18 b = 1.21
YKS 2	Green-chlorite, undulating	Fine flour, striations	40.54 76.1 122.2 160.9 223.4 300.3	18.8 40.0 59.0 85.3 139.7 185.9	Linear r^2 = 0.99 c = - 13.1 ϕ = 33.3° Power r^2 = 0.99 a = 0.27 b = 1.14
YKS 3	Grey-green chlorite, undulating	Fine flour, striations 2nd run 3rd run	49.8 89.8 127.4 172.5 191.0 243.6 366.3 364.2	13.5 37.9 61.8 76.9 124.2 129.9 239.3 240.1	Linear r^2 = 0.97 c = - 27.5 ϕ = 35.2° Power r^2 = 0.99 a = 0.06 b = 1.40
YKS 4	Brown-grey ~ planar	Flaking of oxides, rock flour and debris	44.8 81.7 134.8 218.1 327.2 412.0 493.0	14.6 43.1 75.6 166.0 206.0 303.0 390.0	Linear r^2 = 0.99 c = - 26.5 ϕ = 39° Power r^2 = 0.99 a = 0.12 b = 1.32
YKS 5	Brown-grey oxides, fairly rough	Flour, striations, some cracking at rear of specimen	78.4 132.3 184.6 220.8 310.9 385.8 477.5	44.2 82.2 130.7 168.5 208.8 235.0 299.4	Linear r^2 = 0.98 c = 9.28 ϕ = 31.7° Power r^2 = 0.98 a = 0.52 b = 1.04

TABLE 1 (contd)

Summary of Direct Shear Tests Results - YIP KAN STREET ABERDEEN

Test No.	Surfaces	Failure details	Plotting Points kN/m²		Linear Regression, Power Curve
			σ_i	τ_i	
YKS 6	Brown-grey oxides, rough, undulating	Flaking of oxides fine flour, striations, some cracking at rear of specimen	41.1 78.8 130.6 529.1 225.2	18.9 47.0 81.9 406.2 162.4	Linear r^2 = 1.00 c = - 17.2 ϕ = 38.6 Power r^2 = 1.00 a = 0.24 b = 1.19
YKS 7	Brown iron oxides	Rock flour, striations, some flaking	44.2 85.6 121.8 164.6 220.3 308.7 385.3 512.5 605.8 657.8 232.2 818.6	38.6 58.6 89.5 123.0 162.0 234.8 301.3 368.5 431.7 495.9 171.4 606.5	Linear r^2 = 1.00 c = 1.9 ϕ = 36.3° Power r^2 = 1.00 a = 0.85 b = 0.98
YKS 8	Green chlorite - thick, smooth, undulating	Smeared chlorite. Minor rock flour	59.8 109.8 158.4 211.1 264.4 311.7 411.4 537.0 731.5 922.7 1047.6	10.3 39.9 63.6 81.3 118.4 138.2 235.7 316.7 376.5 612.9 702.6	Linear r^2 = 0.98 c = - 55.1 ϕ = 34.7° Power r = 0.99 a = 0.05 b = 1.39
YKS 9	Thin covering of chlorite on high areas. Undulating	Failure mostly in chlorite - fine, green compacted flour	47.9 88.3 130.0 171.0 208.6 248.0 349.1 455.5 556.7 653.9 853.0	23.3 41.3 58.9 79.5 100.3 123.5 176.2 201.3 262.5 313.5 475.9	Linear r^2 = 0.98 c = -11.7 ϕ = 27.8° Power r^2 = 1.00 a = 0.42 b = 1.02

TABLE 1 (contd)

Summary of Direct Shear Tests Results - YIP KAN STREET ABERDEEN

Test No.	Surfaces	Failure Details	Plotting Points kN/m^2		Linear Regression, Power Curve
			σ_i	τ_i	
YKS 10	Matching joint. Rough green tinge	Fine rock flour (white)	42.7 100.3 188.6 244.5 318.4 450.4 615.7 649.0	60.6 127.4 146.6 202.5 251.1 351.1 503.9 696.7	Linear r^2 = 0.93 c = -5.9 ϕ = 42.5° Power r^2 = 0.95 a = 2.51 b = 0.82
YKS 11	Undulating, brown oxides	Fine rock flour, striations	881.8 775.3 656.7 577.1 465.5 361.3 257.1 153.1 51.0	726.3 655.5 556.2 486.8 384.6 320.7 228.4 137.6 52.1	Linear r^2 = 1.00 c = 14.8 ϕ = 39.3° Power r^2 = 1.00 a = 1.31 b = 0.93
YKS 12	Undulating, brown oxides	Compacted rock flour, striations. Fracture of lower specimen at high stresses	287.0 581.0 1365.0 2816.0 4445.0 5663.0	216.0 448.0 1020.0 2209.0 3215.0 4575.0	Linear r^2 = 0.99 c = -33.3 ϕ = 38.1° Power r^2 = 1.00 a = 0.72 b = 1.01