

- 1) K_{Ic} for steel is $50 \text{ MPa} \sqrt{m}$
 For a plate experiencing a stress of 400 MPa How large can a crack get before it becomes unstable?
 1 m
 50 mm
 5 mm

$$K_1 = 400 \sqrt{\pi \cdot 0.005} = 50.132 \text{ MPa} \sqrt{m} > 50 \text{ MPa} \sqrt{m}$$

The 5mm crack is unstable

- 2 A detail of “D” type experiences vibration stress under an engine of amplitude 25MPa (range of 50 MPa).
 The engine runs at 100 rpm. What is the expected life span of the detail?

Detail D can take 1.4×10^7 cycles for a stress range of 50 MPa. At 100 cycles per minute that's 140,000 minutes, which is 97.2 days (just over 3 months)

- 3 You have yield strength test data on some steel plate. The mean of the values is 400 MPa. The COV is 5%. What should you report as the strength (certified strength) of the steel?

Mean is 400. Std.dev = $.05 \times 400 = 20$ MPa. 95% of all values are above 1.645 standard deviations below the mean. So 95% of values are above $(400 - 1.645 \times 20 = 367.1)$. Best to report that the strength is 360 MPa. Most samples will have better than 5% pass rate.

- 4 You plan to operate an offshore structure for 40 years. What are the chances of the structure experiencing the 100 yr. storm (or more) (assuming constant climate)

$$\begin{aligned} \text{Pr}(\text{no storm}) \text{ in 1 year} &= .99 \\ \text{Pr}(\text{no storm}) \text{ in 2 years} &= .99 \times .99 \\ \text{Pr}(\text{no storm}) \text{ in 40 year} &= .99^{40} \end{aligned}$$

$$\text{Pr}(\text{at least 1 storm}) \text{ in 40 year} = 1 - .99^{40} = 33.1\%$$

- 5 There is a game at a Fair Grounds. The rules are as follows:
 It costs \$1 per turn
 On Turn 1 you flip 1 coin. If you get a head, you win \$100
 On turn 2 you flip 2 coins. If you get 2 heads, you win \$100
 On turn 3 you flip 3 coins. If you get 3 heads, you win \$100

If you win you stop – the game's over. You've won \$100
 But you must play until you win!!

Would you play?

What is the expected value of your net winnings?

ANS: 71% of players win and leave the game, costing the game owner \$100 (expected winnings per player is \$71 – less playing costs). But 29% of players become trapped as losers facing terrible odds, and must keep playing and paying the game owner an unlimited amount of money. See next page.

Most of the winners would probably return to play again and so the entrapment rate would be even higher than 29%.

