Seam bowling

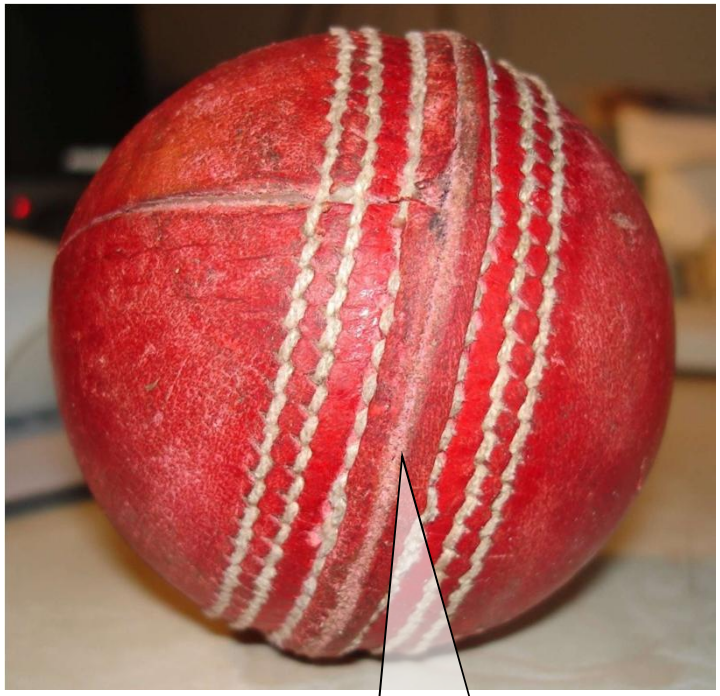
- Types of contact forces that can act on the ball
- The non-spherical shape of the ball caused by the seam can lead to the ball deflecting laterally after it bounces
- The ball landing so the normal force from the surface of the wicket does not act through the centre of mass of the ball will cause the ball to deflect laterally

Types of contact forces that can act on the ball

- The contact forces are those which occur when the ball bounces on the wicket, these are:
  - Frictional forces – due to the relative difference in velocities of the surface of the ball in contact with the wicket and the wicket itself
  - Shape of ball – the non-spherical shape of the ball gives rise to possibly lateral components in the forces on the ball
  - Inelastic impact – loss of energy during impact (internal forces)
- The condition of both the wicket and the ball at point of contact has an effect on the bounce of the ball
  - Uniformity of wicket at point of contact
  - Amount of ‘give’ at point of contact in both the ball and the wicket – affects the resultant vertical force
  - Amount of ‘skid’ at point of contact in both the ball and the wicket – affects the horizontal / frictional force

The non-spherical shape of the ball caused by the seam can lead to the ball deflecting laterally after it bounces

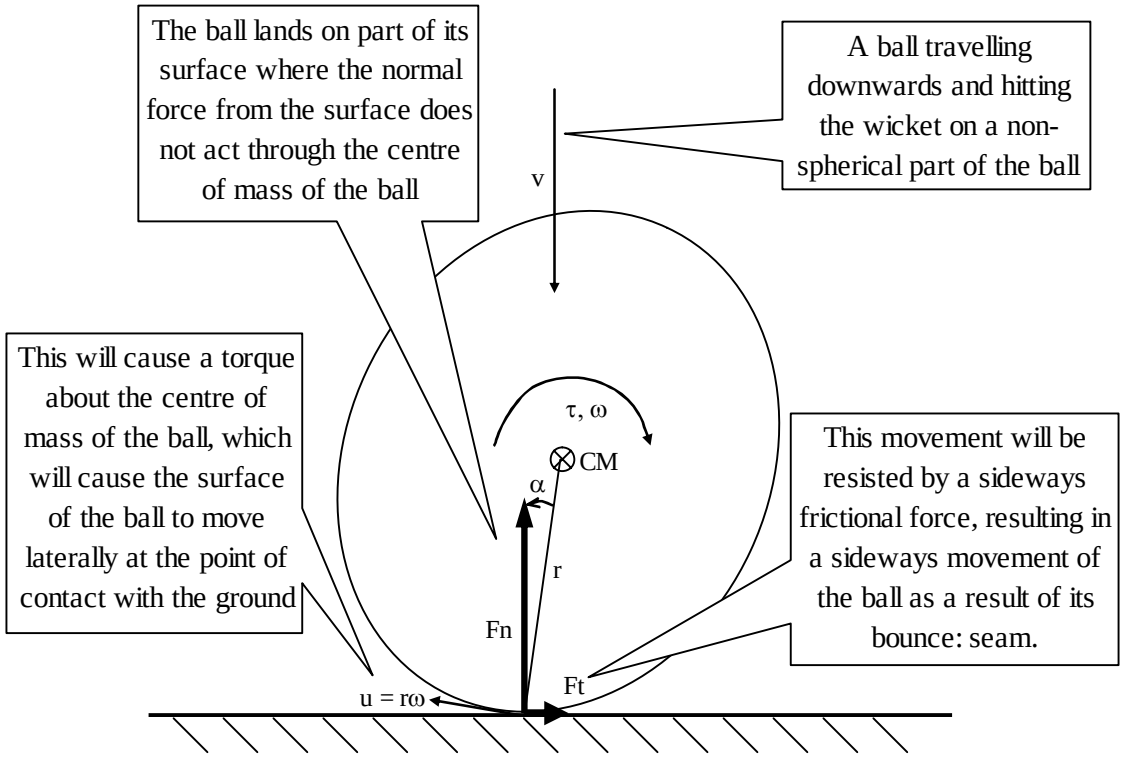
Kookaburra Regulation 4-piece ball



- Bowlers (and batsmen) are aware that the ball does not always bounce straight when it hits the wicket
  - this may be due to imperfections in the surface of the wicket
  - or to the shape of the ball
- Bowlers attempt to get the ball to land near its seam as there the ball is at its most non-spherical
- A worn 4-piece ball seen here is resting on its seam on a flat surface which causes it to be tilted about 15^{o} from vertical – if the ball hits the wicket at less of an angle than this then the protruding seam will cause lateral movement off the wicket
- For a new ball, the seam may protrude even more than shown in this picture, see the wear on the apex of the seam

The ball landing so the normal force from the surface of the wicket does not act through the centre of mass of the ball will cause the ball to deflect laterally

Model of the influence of seam on the bounce



- If the resulting normal force (Fn) from bouncing on a non-spherical part of the ball does not act through the centre of mass of the ball, a torque (τ) around the centre of mass (CM) is created
- This torque causes the surface of the ball to want to move sideways ($r\omega$) at its point of contact which is resisted by a tangential frictional force (Ft) from the wicket
- If we assume that the tangential friction force prevents any rotation of the ball (no slip), then analysis of the dynamics gives the post-bounce velocity in the lateral direction as $\tan(\alpha)*\Delta\upsilon_y$
  - where α is the angle between the normal force and the line from the point of contact to the centre of mass of the ball
  - $\Delta\upsilon_y$ is the change in vertical velocity of the ball during its impact with the ground
- For a ball bowled at 140kph with a seam angle of 10^o, produces a lateral velocity of about 2m/s, or a deviation of about 20cm after the bounce and before the ball reaches the bat.
- The 'harder' the ball hits the wicket, the larger the normal force and the more torque will be generated and if the non-slip assumption still holds, the greater the lateral movement