Worked Example – Graphical (Mohr Circle) Solution
2D Stress Analysis

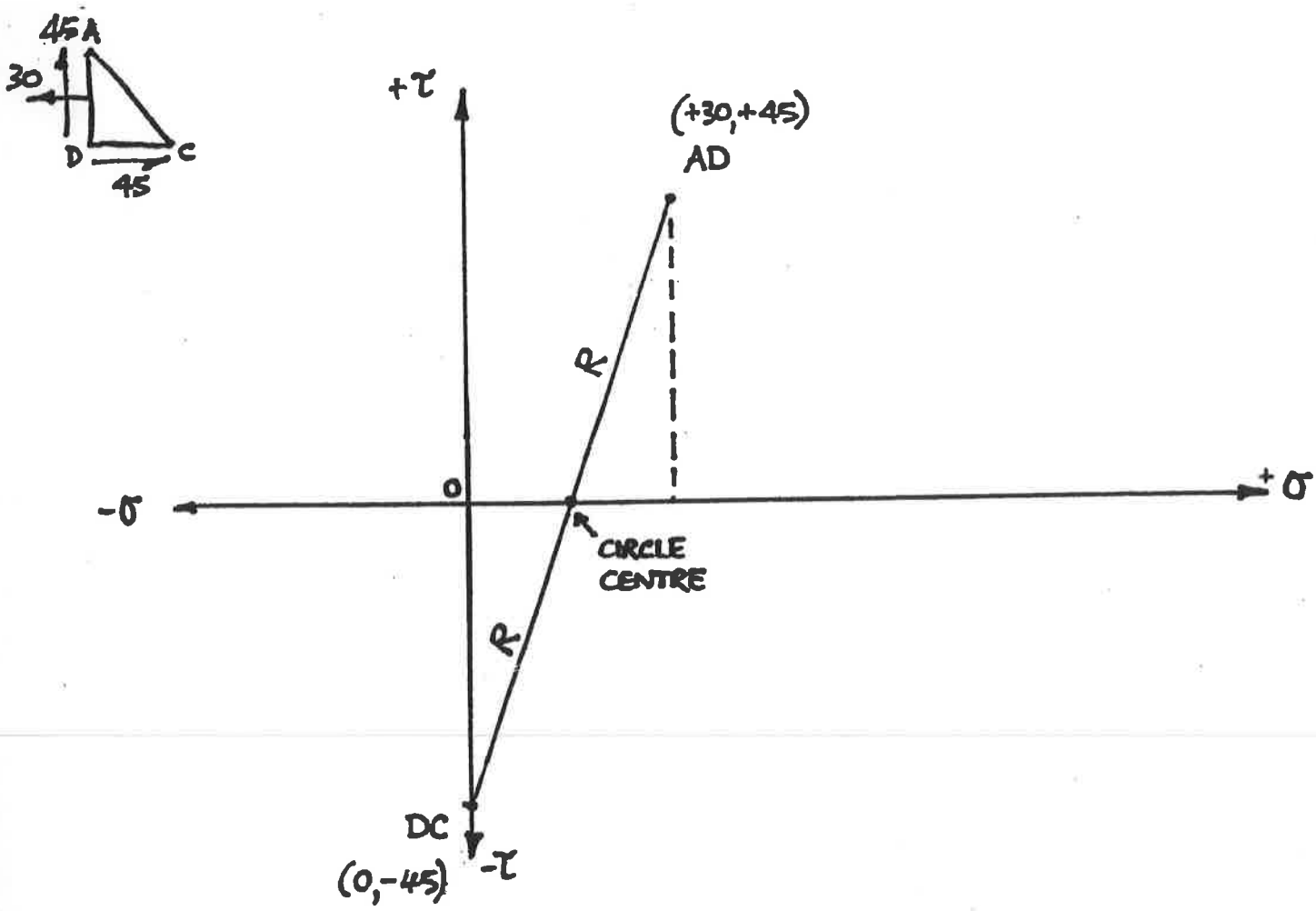
Referring to the previous worked example, draw the Mohr Circle of Stress and obtain the principal stresses, the maximum shear stress, the angle of the principal plane and the stresses acting on the 45° plane within the material element.

Solution
Following the method of construction shown in the notes:

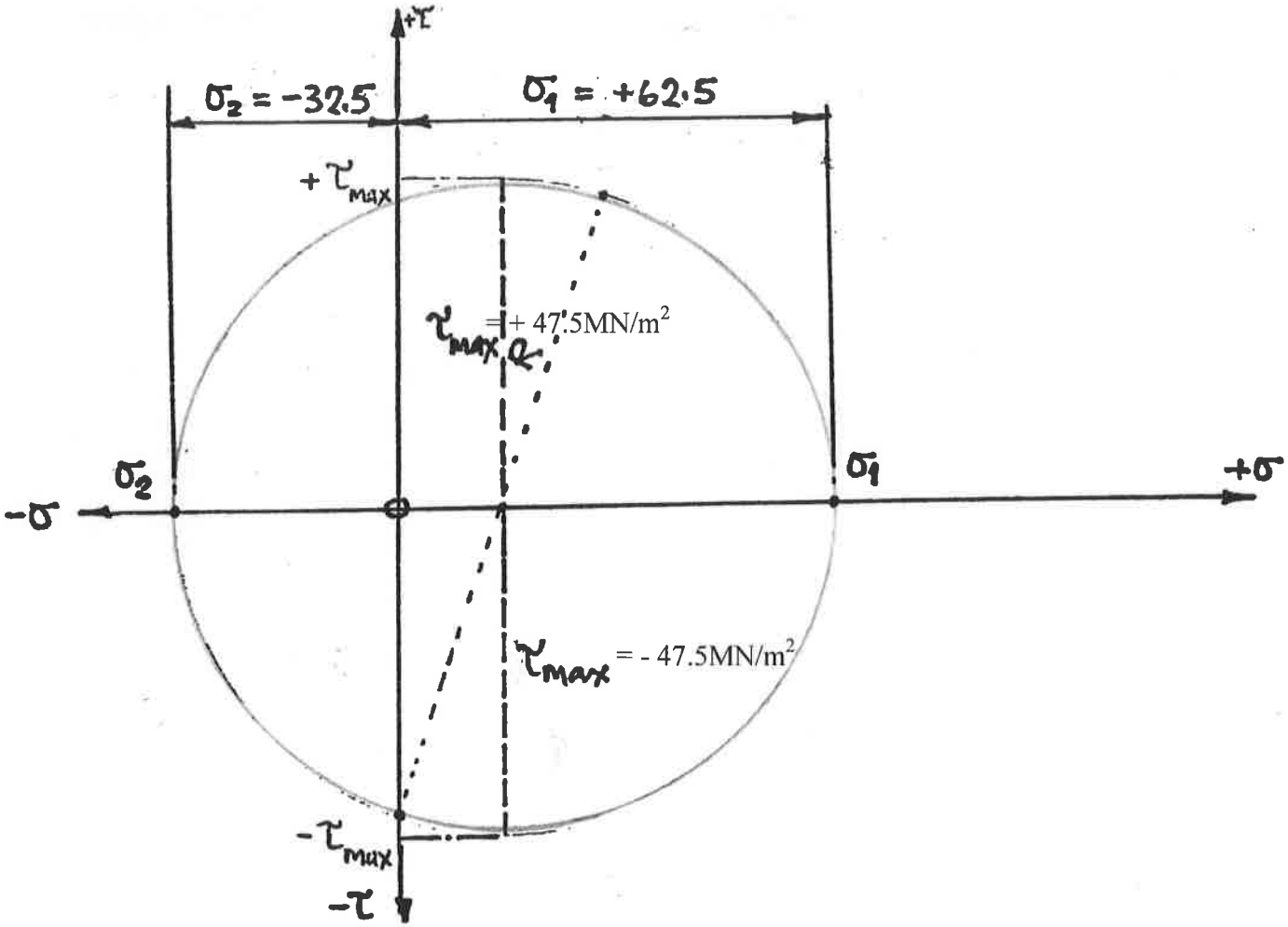
1. Position the origin and draw axes for σ (x-axis) and τ (y-axis). [Scale – 10mm:10MN/m^2]

2. Using the two right angles planes, plot the corresponding 'points' which represent them.

3. Join AD and DC to obtain the centre of the circle.

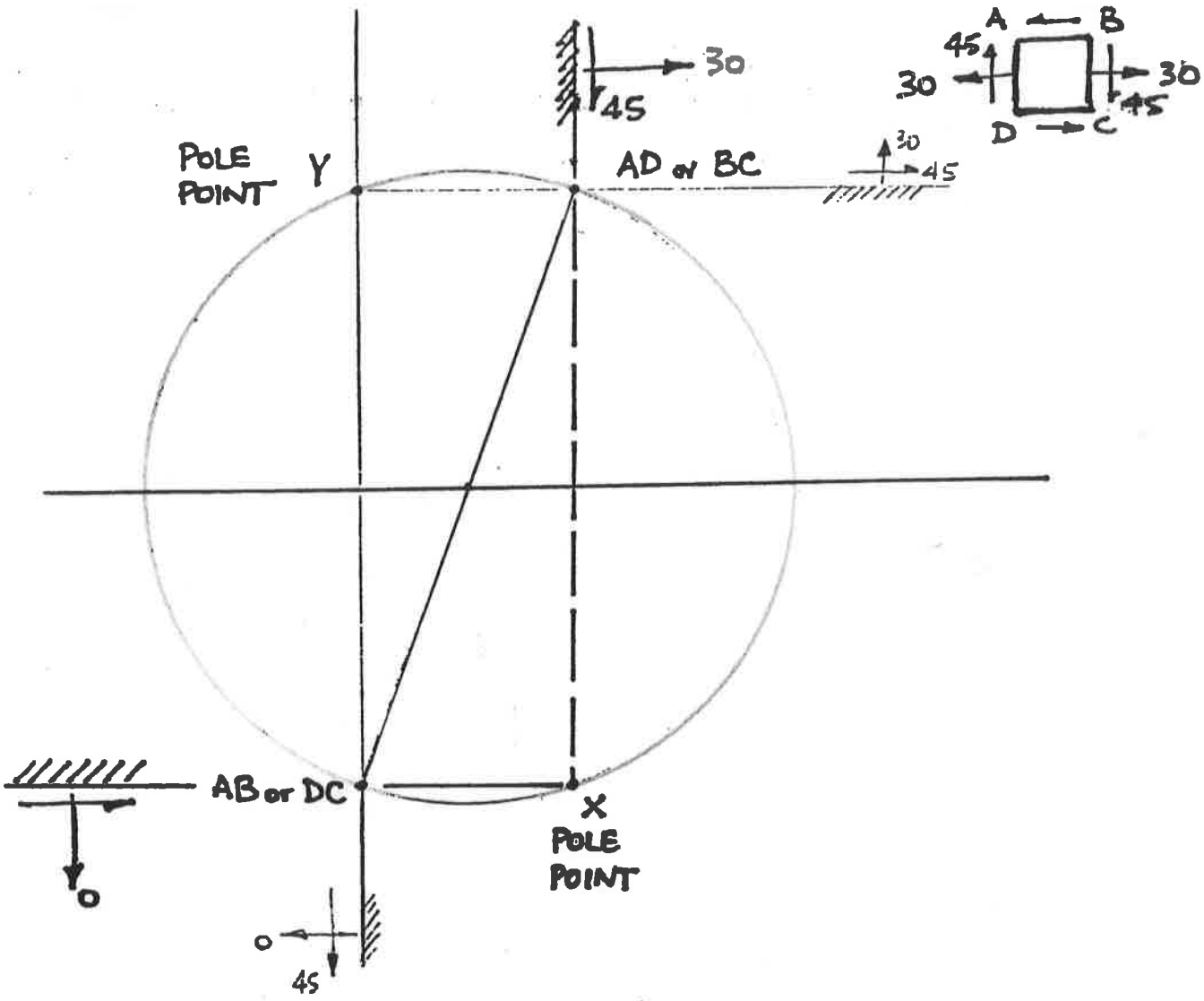


4. Using the distance from the centre to either AD or DC (i.e., radius R), draw the Mohr Circle.



5. The max. principal stress (σ_1) can then be obtained as +62.5MN/m^2, with the minor principal stress (σ_2) -32.5MN/m^2. The max. shear stress τ_{max} is found to be ±47.5MN/m^2.

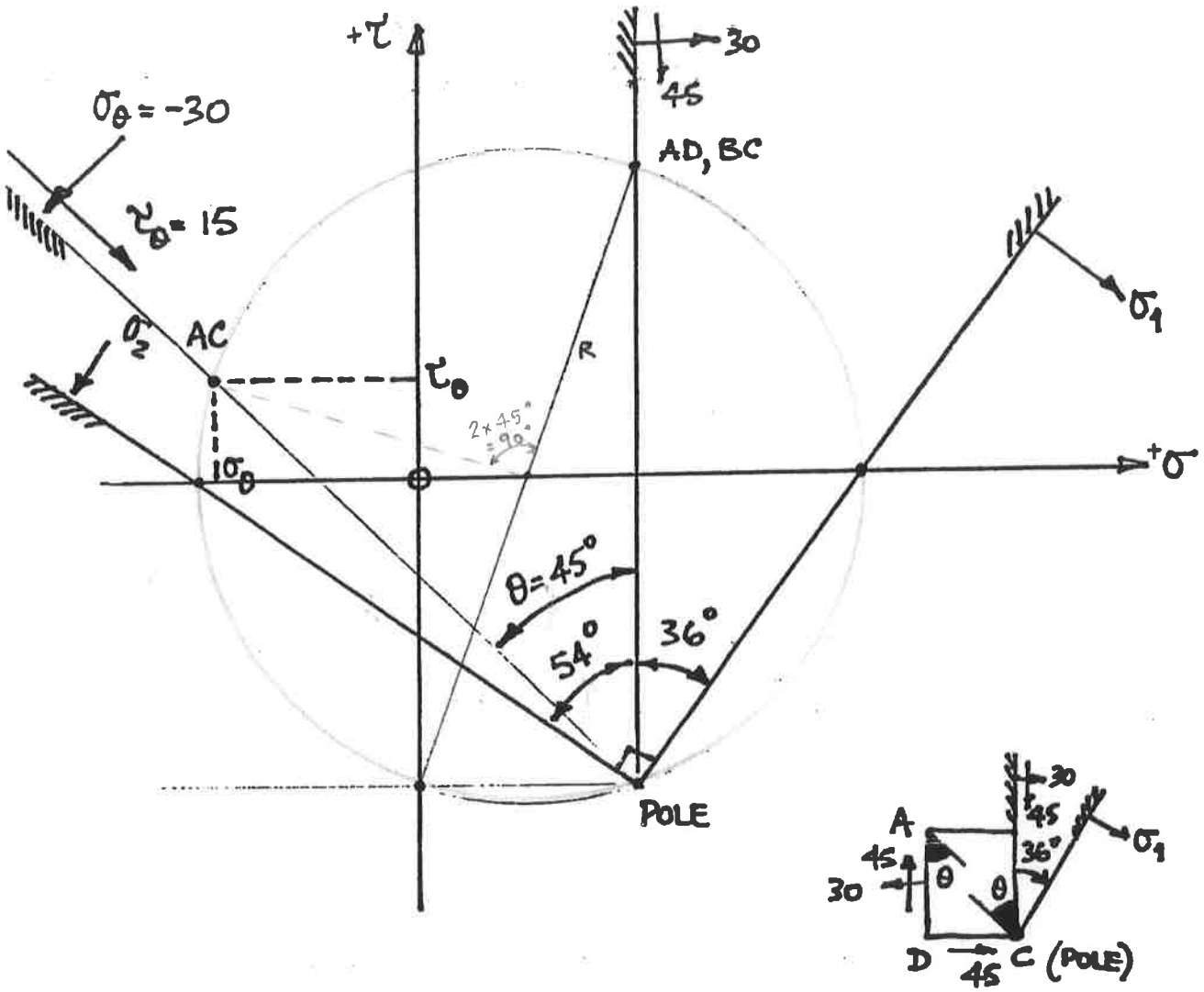
6. In order to establish the angles of the planes carrying σ_1, σ_2 and τ_{max} relative to one of the given planes AD, DC etc., the Pole Point is selected. This is **not** one of the points AD, DC but another point obtained by considering a ''mirror reflection' about the σ axis (x-axis).



7. There are two pole point possibilities, i.e., 'X' or 'Y' as shown.

8. It is useful to select the one which best resembles the original material element. In this case, pole point 'X' could be taken as equivalent to corner C without having to rotate angles.

9. Draw a line from pole point 'X' to σ_1, σ_2 and τ_{max} positions on the circle and hence measure the angles.



10. The stresses acting on the plane AC @ $\theta = 45^{\circ}$ are obtained by measuring of $\theta = 45^{\circ}$ as shown above and the appropriate scales used to obtain σ_θ, τ_θ, or, rotate line R (2 x 45°) counterclockwise.

The solution using the Mohr Circle is achieved by drawing **one**, not several circles!