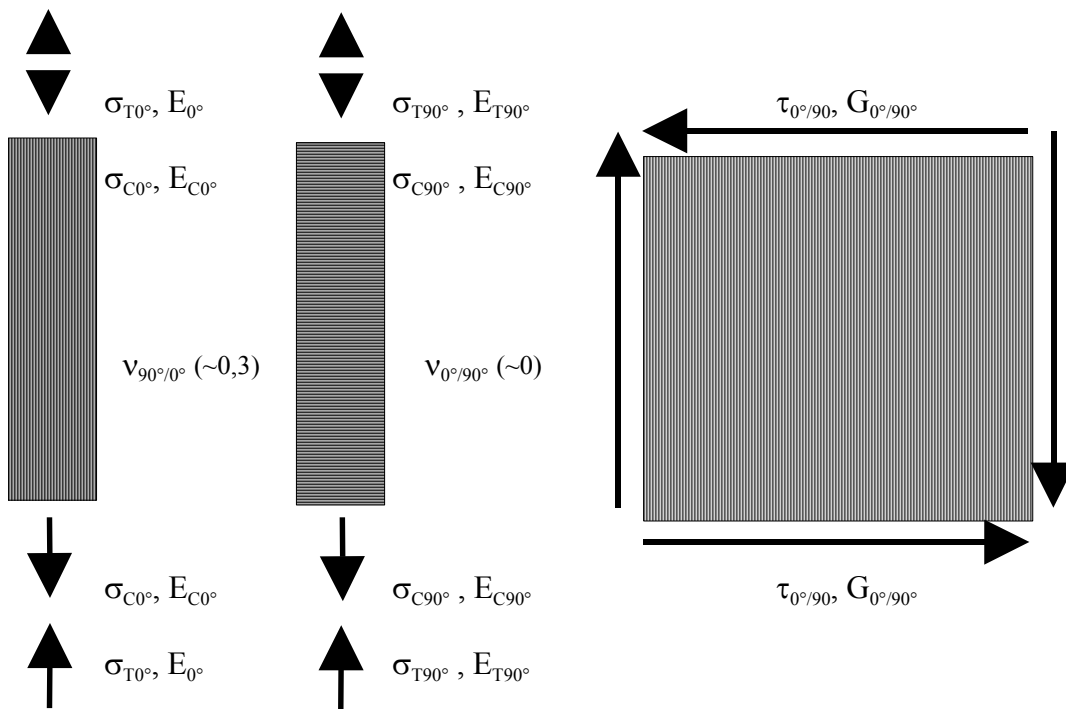


## Prediction of laminate properties

Client: Ahlström

FiReCo AS has performed a prediction of various laminate properties for some different laminate lay-ups with Ahlström reinforcements. The laminates to be used were defined by Ahlström, along with test data for various laminates. Most data were from tensile testing. In plane compression and shear data have been established by conservative estimation and experience with similar materials.

All combination of materials have been theoretically assessed by using laminated plate theory and the Tsai Wu strength criterion, along with an in-house FiReCo routine for prediction of ultimate laminate failure.



*Laminate in plane characterisation and testing*

# Marine Commercial



To characterise a laminate with one fibre direction, 9 different material parameters are needed:

1) Tensile strength ( $\sigma_{T0^\circ}$ ), 2) compression strength ( $\sigma_{C0^\circ}$ ) and 3) Youngs-modulus ( $E_{0^\circ}$ ) in the fibre direction  
4) Tensile strength ( $\sigma_{T90^\circ}$ ), 5) compression strength ( $\sigma_{C90^\circ}$ ) and 6) Youngs-modulus ( $E_{90^\circ}$ ) perpendicular ( $90^\circ$ ) to the fibre direction), as well as 7) Poisson ratio ( $\nu_{90^\circ/0^\circ}$ ), for constraint in perpendicular direction due to strain in the fibre direction. In addition, 8) in-plane shear strength ( $\tau_{0^\circ/90}$ ) and 9) shear modulus ( $G_{0^\circ/90^\circ}$ ) for the laminate. Explanation of the different properties may be seen from the figure above.