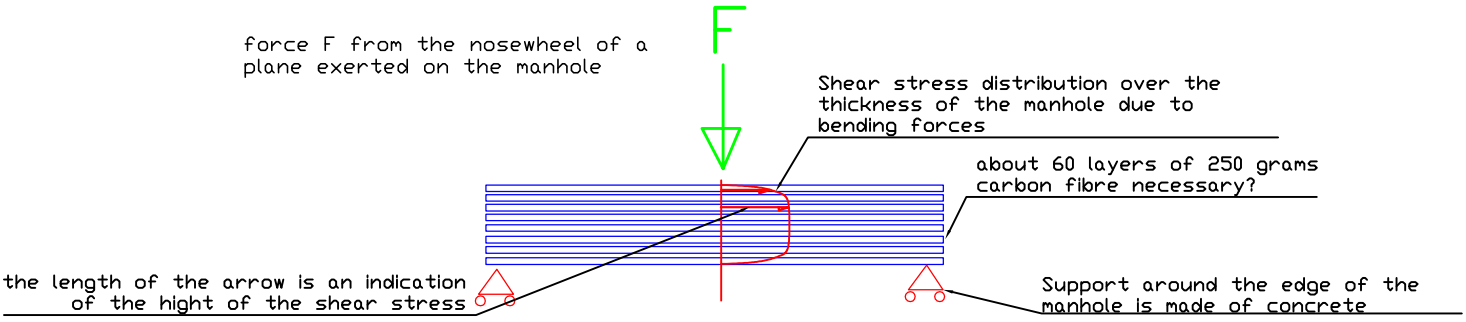
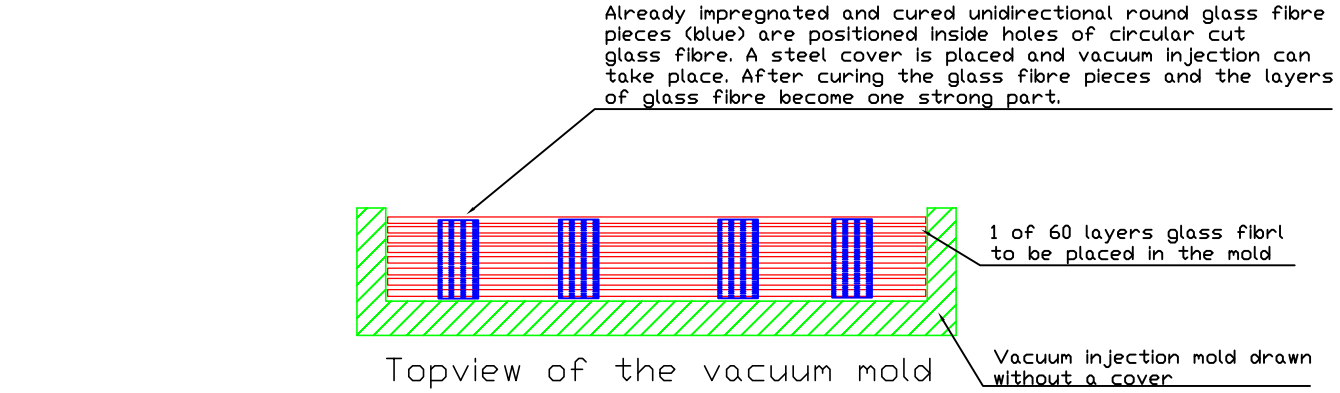
Optimisation of a carbon fibre manhole cover on which an aeroplane should be able to land

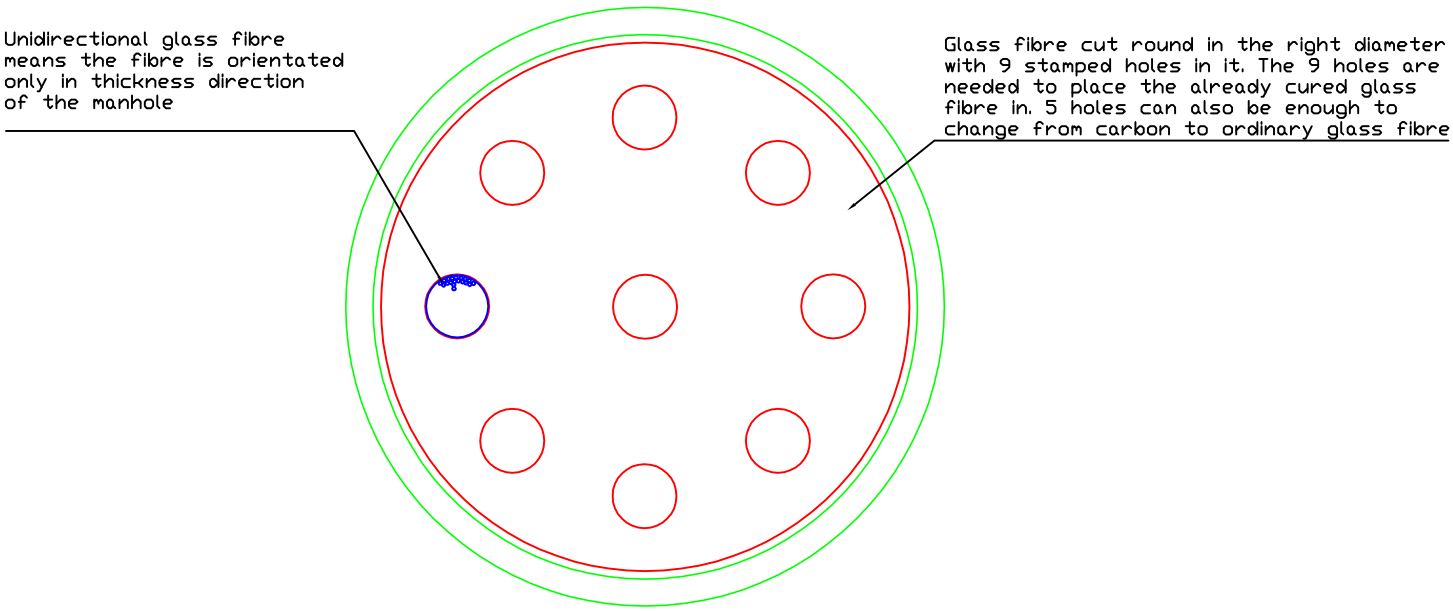


When the nose wheel of an aeroplane touches the manhole, bending stresses occur in the manhole. Due to these bending stresses shear stresses will arise through the thickness of the manhole. The shear stresses change in thickness direction. So shear stresses are carried by the resin because there are no fibres in thickness direction. Some fibres are good to handle shear stresses. The resin is very weak in this point of view. In this design the resin must carry shear stresses although resin is not good in it. To overcome this problem a redesign is needed. Just by using a bar made of unidirectional fibres, shear forces can be carried by the fibers. underneath you see this new design. No shear forces have to be carried by the resin anymore. Due to extra strength the expencive carbon fibres can be changed to the much cheaper glass fibres. Both strength, reliability and durabilty have been improved and production costs are lowered by at least 20%.

Cross sectional drawing of the fibre layers placed in a vacuum mold



Topview of the vacuum mold



Just by using some inserts (unidirectional already cured glass fibre) the resin does not need to carry shear stresses. the resin is only good in letting forces go into the fibre. just by adding some cheap inserts (for sale as standard product so very cheap), the 60 layers of expensive carbon fibre can be replaced with cheap glass fibre. the only extra thing to be done is stamping holes in the layers of glass fibre