

Q41

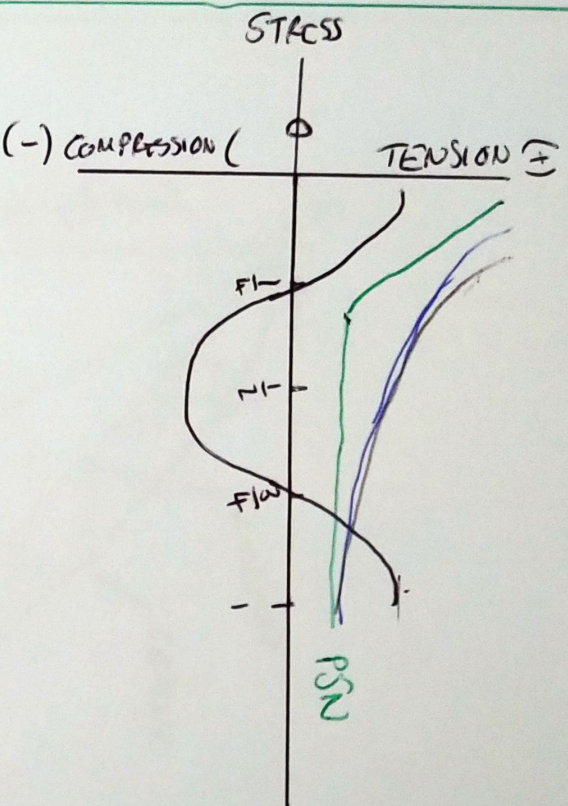
FEA can be used to reduce the number of prototypes used by building virtual prototypes instead, FEA allows simulation of the behaviour of components to visualize how they behave. FEA uses the finite element analysis to solve mathematical equations that calculate the details such as stress & strain experienced. These calculations allow engineers to visualize the behaviour under given loads. The tool also allows the opportunity to experiment with design to minimise materials use, and identify and modify design according to these findings, such as weak spots or areas of tension. These design flaws were traditionally found during prototypes stage, and would then require further prototypes to witness the results of modification.

~~Also~~ A components performance can be iterated after simulations until design specifications are met. Then physical prototypes can be used to fine tune the design.

1b FEA is a very useful tool and reduces the need for number of physical prototypes required during testing, however, as FEA makes some assumptions in its calculations so some computed results are approximation. ~~Physical~~ Some physical prototypes will still be required to validate the approximate solutions provided by FEA

1c Physical prototypes are used to provide correlation between ~~one~~ ~~over~~ FEA and the final design. The correlation of the information provides confidence that the FEA ~~has~~ is correct but is also normally part of the sign off for the final design.

4b



4a

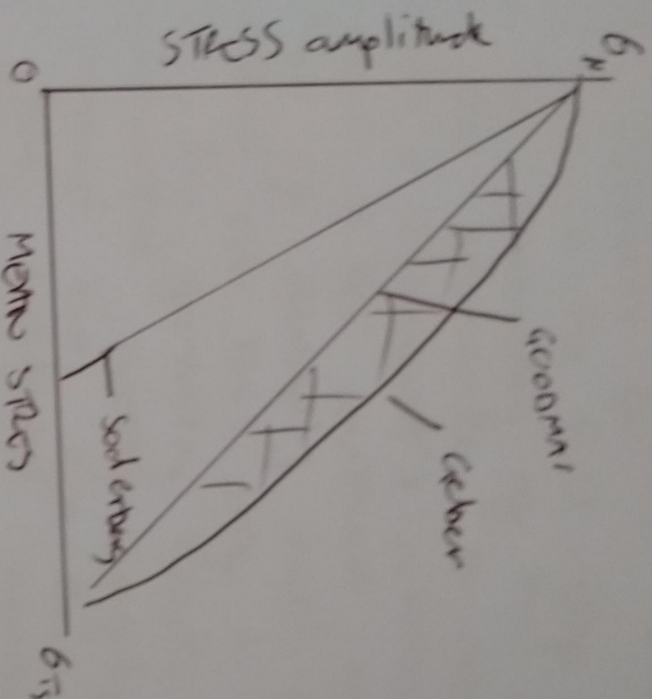
The Wöhler machine has an offset cam that causes the load to stroke up and down, when it is stretched the load is under tension stress, when the load climbs the spring compresses resulting in compressive stress (each rotation is one cycle which is the  $(N)$ )

4c

PSN - curve

The PSN curve demonstrates fatigue where the measurement samples intersect will identify the point of failure this may be at periods of high stress or extended life

4d



4e

Soderberg focuses on the yield strength of the material which gives additional safety margin and is popular and widely used. Goodman considers both the mean stress and the alternating stress amplitude, however Gerber increases the margin further. Most stress test will fall in the grey area between Goodman and Gerber.

Q2  
a

The steps that should be taken prior to FEA is the approx S.M.P.E stands for

Split, this is the first step, this is where the geometry of the component is split into elements to create the nodes the nodes & elements allow the mathematical estimates to be carried out. The selection of density and element type is important at this step. 1.

Interpret, the geometry needs to be inputted & approximated, every complex geometries will extend the run time of the model. Material the material needs to be selected and its information inputted

Physical Property - the physical properties of the model need to be inputted such as element size thickness  
Loading this is where the boundary conditions are inputted, these conditions will come from the initial brief.

Evaluate once the model has been solved the model/analysis is past interpret the data, it is important to understand what has contributed to the output and how it can be altered. Also where the approximations are causing issues

Q2

b

The processing stage is where the computer is carrying out the calculation the information inputted in the pre-processing stage. The processing stage is where the computer takes all the boundary conditions, material data & geometries and uses matrix algebra to solve the equations, ~~and identify~~

Q2

c)

Post processing stage is interpreting the results. In this stage it is important to identify any issues such as excessive stresses, incorrect sizes, this stage is where you carry out your updates, before going round the loop again. (simple) ~~it is~~ ~~input~~ FEA calculations are based on assumptions, so the evaluation should consider where assumptions could be causing issues. ~~I and tighten the~~ occasionally you may realise you need to add additional data, such as displacement at selected points.