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Gavin Clarkson 1809104

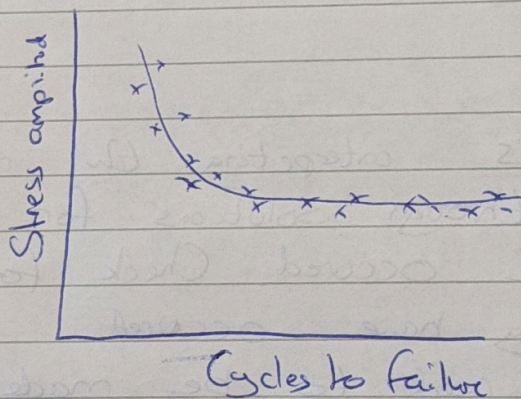
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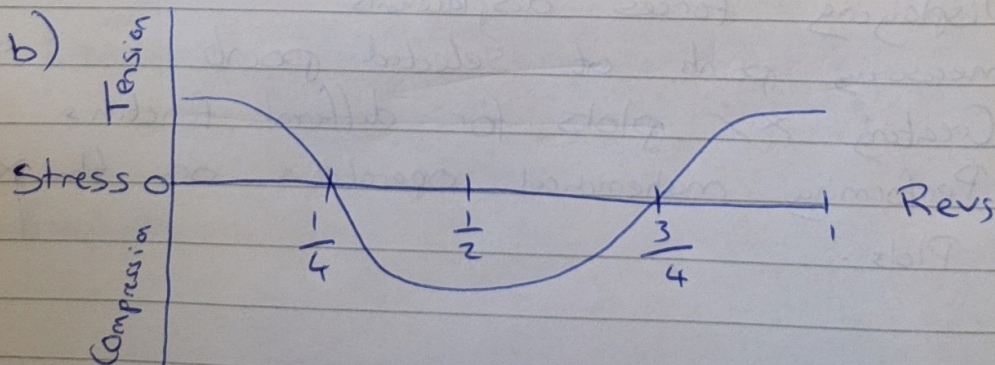
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Question 4

- A) This test would produce one point on a sh curve ~~this would be repeated~~ with varying stress amplitudes ~~and time~~ and plotted. With a line of best fit overlaid on it. This would be related to the probability of failure.



This test puts the top surface into tension + the bottom into compression.



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b) The processing stage describes the computer carrying out the calculations and solving the equations generated from the pre-processing steps.

c) Post processing is interpreting the results generated. You would check through solutions for any problem that may have occurred. Check for any warnings/errors that may have occurred. The checks would need to be made to make sure the model complies with any standards. Post processing can be used to check displacement or stress at ~~the~~ certain points. It can be used for

- Displaying forces displacements
- measuring points at selected points
- Creating XY plots for different functions
- Performing mathematical operations on the XY Plots.

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Question 2

Pre-Processing means ^{Preparing} ~~getting~~ the model before analysis can be taken
a) SIMPLE could be used during the pre-processing stage. SIMPLE stands for Splitting - Split a complex problem in to smaller elements so assumptions can be made between elements

Interpret - To interpret the geometry. To obtain a satisfactory result in a reasonable time. i.e. if a small complex detail could add complexity to the analysis but not have a big effect on the outcome could be ignored.

Material - After product has been modeled + meshed material needs to be selected. This ~~also~~ would determine what solver is used.

Physical Property - these need to be added if 1D or 2D elements are used. Second moment of area, polar second moment of area could be ^{imported} ~~used~~ for 1D. For 2D thickness of elements need to be considered.

Loading - ~~In what direction~~ How the product is loaded. How is it constrained, where forces are applied, how much force

Evaluate - Once the model has been solved. The results need to be ~~analysed~~ analysed. Have any of the previous steps influenced the results. Is information given still accurate

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Question 1

a) FEA can demonstrate the outcome of a product before it is manufactured. It can be used to understand the effect of forces, impacts, shocks, temperatures, vibration, friction, durability, stiffness and weight on the product.

By modeling a product in 3d and submitting it to the above conditions, FEA shows how they react to these conditions and it can highlight weak points or areas of concern or points where savings could be made.

~~By doing this instead of~~
Creating Prototypes (physical) can be expensive and/or time consuming. These prototypes ~~still~~ have to be subjected to various conditions to simulate what they have been manufactured for. A 3d model, once created, can be reused in testing over and over again with minimum time between tests.

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b) physical prototypes can still be useful as FEA uses ^{Limited} ~~different~~ types of element analysis - most commonly Von mises. But different theories are more suitable to different materials/products. FEA could only be as accurate as the mesh size chosen when modelling. Physical prototypes can be used to sign-off the final product design.

c) By using physical tests + FEA in tandem confidence can be grown by verifying ~~these~~ results in both.

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$$\text{Goodman} = \sigma_a = \sigma_N \left[1 - \left(\frac{\sigma_m}{\sigma_{TS}} \right) \right]$$

$$\text{Geber} = \sigma_a = \sigma_N \left[1 - \left(\frac{\sigma_m}{\sigma_{TS}} \right)^2 \right]$$

$$\text{Soderberg} = \sigma_a = \sigma_N \left[1 - \left(\frac{\sigma_m}{\sigma_Y} \right) \right]$$

~~These~~ re

Results from these equations are plotted in graph ①.

Most results fall in the shaded region between Goodman + Geber curves.

Soderberg gives a margin of safety.

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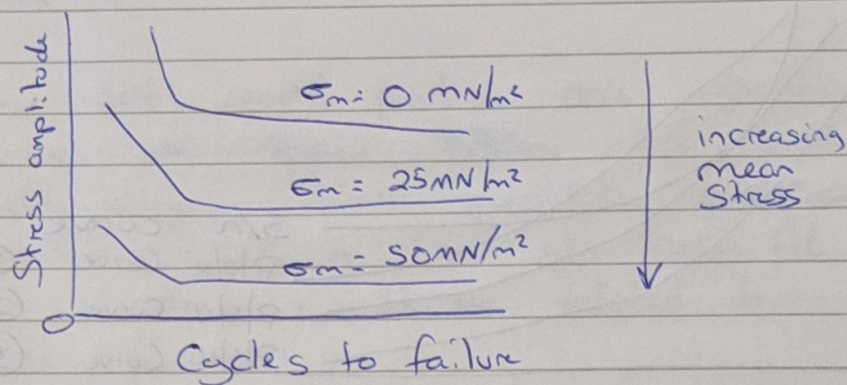
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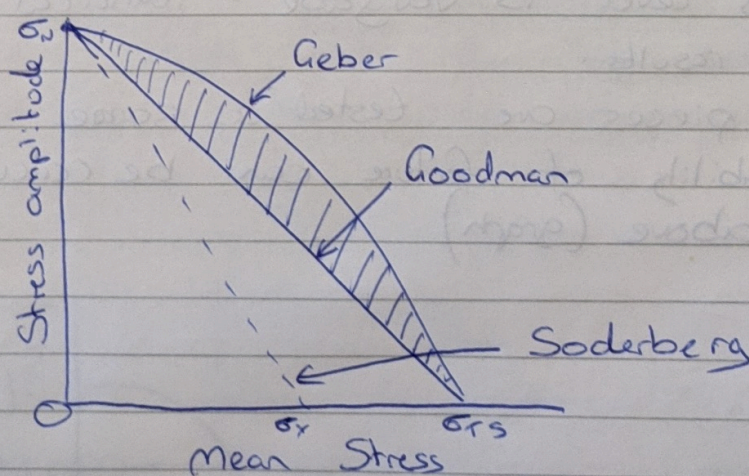
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d)



e)



graph ①

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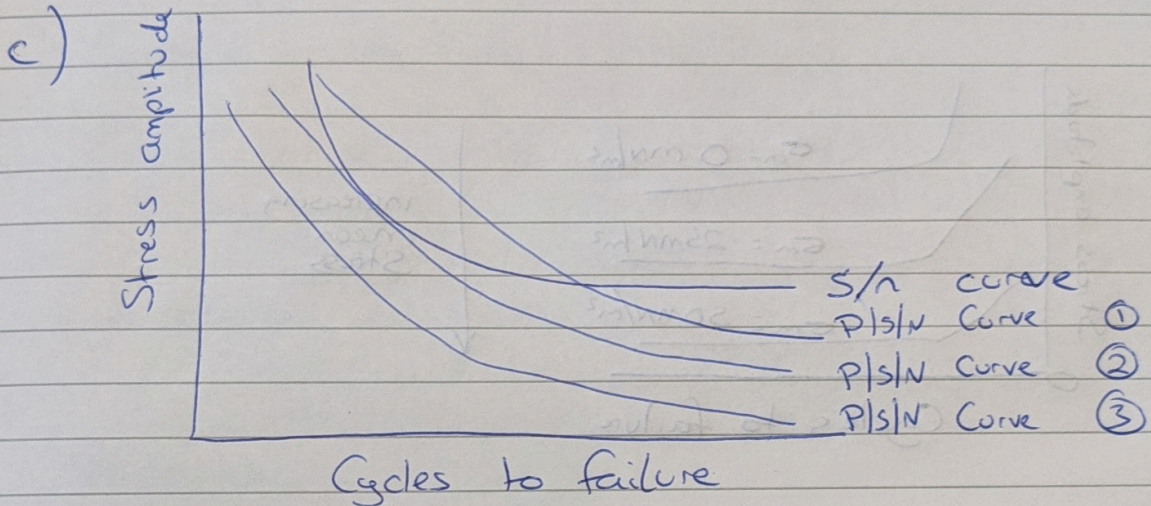
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- ① 90% Chance of failure
- ② 50% chance of failure
- ③ 10% Chance of failure

Fatigue life of a component determined at particular stress level is variable - identical specimens give different results.

Several test pieces are tested at same stress so the probability of failure can be calculated. as seen above (graph)