Peter Temple Advanced Stress analysis + FEA 5/02/2
~~M6~~ M6X00420 14:00

1)A. The use of FEA can be used to reduce the number of physical prototypes needed in product development as instead of building physical prototypes, Virtual prototypes can be built and tested use the FEA Software. You can build and test your model on the Software until you feel the need to Vaildate your design. The FEA tool can be used to basically Road test your design and see how it reacts to different Scenarios and ~~Con~~ Conditions which would otherwise have to be ~~d~~ done by producing physical Prototypes which takes time and money. It Allows for a much quicker and less expensive design process and an overall more robust and reliable product due to the higher ~~an~~ amount of analysis ~~th~~ that has been carried out on it that may not of bein able to have been done on a physical prototype.

B). The use of FEA in Some industries is not good enough as legislation or laws may State this needs to happen as well as ~~a~~ the designer or customer may want it done to gain Confidence ~~of the~~ in FEA design and to Validate it. Car Manufacturing for example ~~legislat~~ legislation may State that physical prototyping must happen before a design is passed off as Safe.

Peter Temple

Advanced Stress Analysis + FEA
M6X00420

05/02/21
14:00

c). Correlations are needed between the FEA and test as the FEA will only give values to how it has been modelled. If there is inaccuracies in the FEA model this then could create differences in the way it behaves e.g. such as how edges are meshed together may vary from a physical protolype. So running the test can give validation to the FEA. This can be done by comparing displacement between the test and the FEA using equipment such as D.T.I's, Photo elastic techniques, load cells and physical measurement. This then will allow the person to compare the results and see how accurate the FEA analysis was. If OK may then allow more designs to be made without the need for physical prototypes saving cost and reducing environmental impacts of the design process. FEA only give approximate results to the information it has been given. It is only as accurate as the information it has.

Peter Temple Advanced Stress Analysis + FEA 05/02/21
M6X00420 14:00

2). The pre-proccessing Stage describes preparing the FE Model before analysis can be carried out this can be covered by the S.I.M.P.L.E. Acronym.
S - Split - you need to split the geometry down into finite elements e.g. nodes So that Mathimatical Assumptions can be made between the elements/nodes The distance between the nodes is small enough then an accurate assumption can be made.

I - Interpet - To be able Obtain a reasonable result in reasonable amount of time the geometry has to be approximated. The small details that add complexity but would not influence the analysis of the design ~~in term~~ should be simplified, so the part can be idealised.

M - Material - Once the part has been simplified and meshed then the material information needs to be added. This then decided what solver needs to be used for example linear or non linear. This material information needs to be accurate to assure correct results.

P - Physical Property - is 1D or 2D elements are used the physical property information needs to be added to the model. For 1D second moment of area or area and orentation for example. If a 2D element is used then the thickness needs to be considerd. This can cause poor colleralition in testing if not accurate or correct or the material used is of varying thicknesses.

2 Cont

L - Loading - once this info has been added ~~the~~ to the FE model the Solver will be able to calculate the Stiffness Matrix for the Structure. From this a Set of Simultaneous equations can be obtained. To Solve this the boundary Conditions Such as loadings and directions of loadings need to be Known This part is the ~~[illegible]~~ other part where poor Correlation can occur with testing as forces and boundary Conditions may not be as is in real life.

~~[illegible]~~ T

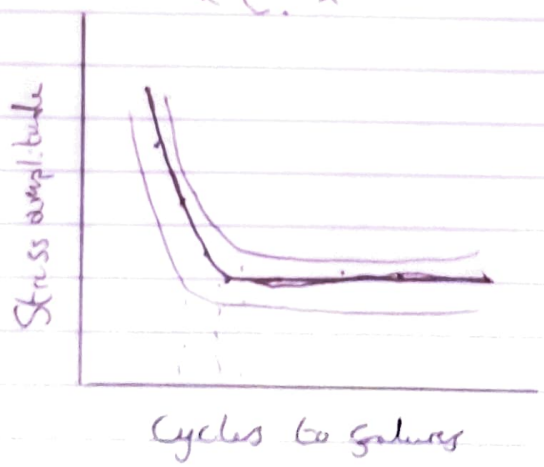
2b). The processing Stage describes the Computer carrying out the Calculations using matrix algebra, in order to Solve the equations generated from the Stiffness Matrix and the boundary Conditions.

2C. The 'E' Step in the Simple Acronym for Post processing.
E - Evaluate - once the model has been Solved it is then ready for the results to be analysed. The Computer only gives approximate results So the user would have to check that all the information inputted in the FE Model is as accurate as possible before accepting the results.

Peter Temple Advanced Stress analysis + FEA 05/02/21
M6X00420 14 00

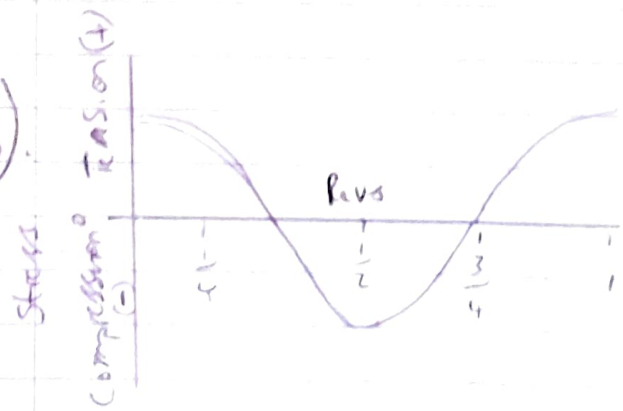
4) A). The Wohler Machine demonstrates fatigue failures when subject to alternating stresses. It uses a motor to rotate a circular ~~cantilever~~ cantilever, with a load at its free end. The specimens have a special design that creates a point of maximum stress at their mid point rather at their ends. This machine captures the stress and amount of cycles. An S/N curve plots the magnitude of an alternating stress verses the number of cycles to failure for a given material. The wohler machine stops once failure occurs and not when failure is near allowing accurate data for an S/N curve as multiple test can be carried out with varying stress amplitudes and a line of best fit could then be added on top of these points.

C) * C. *



4D. - As the mean stress of a specimen is increased then the fatigue life is reduced

B)



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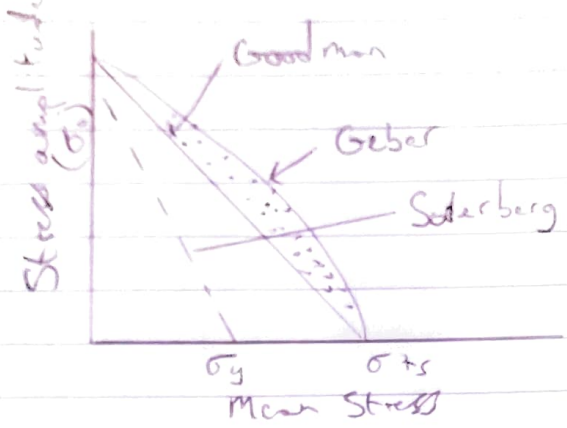
Peter Temple

Advanced Stress Analysis + FEA
MGX00420

05/02/21
14 00

4D)
4E).



The experimental data test results fall in the dotted region between Goodman + Gerber Curves. Soderberg gives a good margin of safety so is often used.