

Name - Joanthan Jones

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Subject - ADVANCED STRESS ANALYSIS & FEA

- 1 a THE NEED FOR ^{THE NUMBER OF} PHYSICAL PROTOTYPES CAN BE REDUCED AS ~~THE~~ VIRTUAL PROTOTYPES CAN BE CONSTRUCTED AND TESTED INSTEAD OF PHYSICAL PROTOTYPES DURING THE PRODUCT DEVELOPEMENT STAGES, SPECIFICALLY DURING THE CONCEPT PHASE.

HOWEVER, THERE MAY STILL BE A NEED FOR PHYSICAL PROTOTYPES TO PROVE OUT OR VERIFY THE RESULTS OF DATA FROM VIRTUAL PROTOTYPE TEST TO APPROVE FINAL DESIGN, THE VIRTUAL RESULTS SHOULD MIRROR "REAL WORLD" SCENARIO.

- b DURING THE CONCEPTUAL STAGE OF THE DESIGN, FEA INFLUENCES PRODUCT DEVELOPEMENT BUDGETS AS THERE IS NO NEED INCUR UNNECESSARY COSTS ASSOCIATED TO THE PRODUCTION OF 3D CAD WITHIN A CAD PACKAGE, THIS ALLOWS BOTH THE DESIGNER AND THE CUSTOMER TO UNDERSTAND FINAL COST AND PERFORMANCE OF EACH DESIGN AT THE CONCEPT PHASE THIS HELPS TO INFLUENCE THEIR DECISION TO DEVELOPE FURTHER, OR NOT,

FEA DATA FROM THE CONCEPTUAL STAGE, BASED ON ITS ORIGINAL GEOMETRY CAN BE UTILISED DURING THE DESIGN AND PRODUCTION STAGES.

- c THE PERFORMANCE OF A COMPONENT CAN BE ASSESSED USING FEA TO ENSURE IT COMPLIES TO DESIGN SPECIFICATION. THE DATA CAN BE USED AS VERIFICATION OF THIS COMPLIANCE

DURING THE DESIGN PHASE OPTIMISATION TECHNIQUES TO ENSURE THAT NO CRITICAL CHARACTERISTICS ARE MISSED DURING THE DESIGN PHASE E.G. ^{REQUIRED} LOAD PATH ARE IN PLACE, BOUNDARY CONDITIONS, OR CONSTRAINTS.

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2 a WHEN CARRYING OUT THE PRE PROCESSING STAGE (DEFINING HOW) THE FOLLOWING STEPS WOULD BE CARRIED OUT:

- i) SPLIT - THIS IS WHERE THE PART GEOMETRY IS SPLIT DOWN INTO FINITE ELEMENTS, THIS ALLOWS SEPERATE MATHEMATICAL ASSUMPTIONS TO BE MADE BETWEEN EACH ELEMENT/NODE. THE SMALLER THE DISTANCE BETWEEN THE NODES, THE CLOSER THE APPROXIMATION. THIS IS CALLED MESHING
- ii) INTERPRET - TO ACHIEVE A REASONABLE RESULT IN A REASONABLE TIMESCALE, THE GEOMETRY NEEDS TO BE APPROXIMATED, ANY COMPLEXITIES NEED TO BE CONSIDERED FOR SIMPLIFICATION OR IF THEY CAN BE REMOVED FROM THE DESIGN ENTIRELY AS THESE WOULD HAVE AN ADVERSE IMPACT TO THE ANALYSIS TIMELINE. THIS IS SIMPLIFYING.
- iii) MATERIAL - THE MATERIAL, SHOULD THEN BE DEFINED ~~ONCE~~ THE PART HAS BEEN MESHED AND SIMPLIFIED AS THE MATERIAL CHARACTERISTICS IN THE FE MODEL WOULD DETERMINE THE TYPE OF SOLVER USED (LINEAR OR NON LINEAR). INCORRECT CHOICE COULD EQUATE TO POOR CORRELATION IN RESULTS.
- iv) PHYSICAL PROPERTIES - THE PHYSICAL PROPERTY DATA NEEDS TO BE ADDED TO THE MODEL, E.G IN 1D ELEMENTS, AREA, ~~OR~~ ORIENTATION, MOMENTS OF AREA AND IN 2D ELEMENTS, PART THICKNESS SHOULD BE CONSIDERED AND DEFINED. AGAIN, POOR DEFINITION COULD LEAD TO POOR CORRELATION DURING TESTING OR VERIFICATION STAGES.
- v) LOADING - USING THE ~~STRESS~~ DATA FROM THE STEPS ABOVE THE FE MODEL CAN BE CREATED TO CALCULATE THE STIFFNESS MATRIX FOR THE PART. USING THE EQUATIONS AND BOUNDARY CONDITIONS THE MODEL CAN BE SOLVED
- vi) EVALUATE - THE MODEL RESULTS ARE THEN ~~REALISED~~ AND EVALUATED TO ENSURE THAT SUITABLE INPUTS WERE DEFINED TO ENSURE ADEQUATE OUTPUTS.

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2 b) THE PROCESSING STAGE IS WHERE THE COMPUTER CARRIES OUT THE CALCULATIONS USING THE DEFINED CONDITIONS AND EQUATIONS

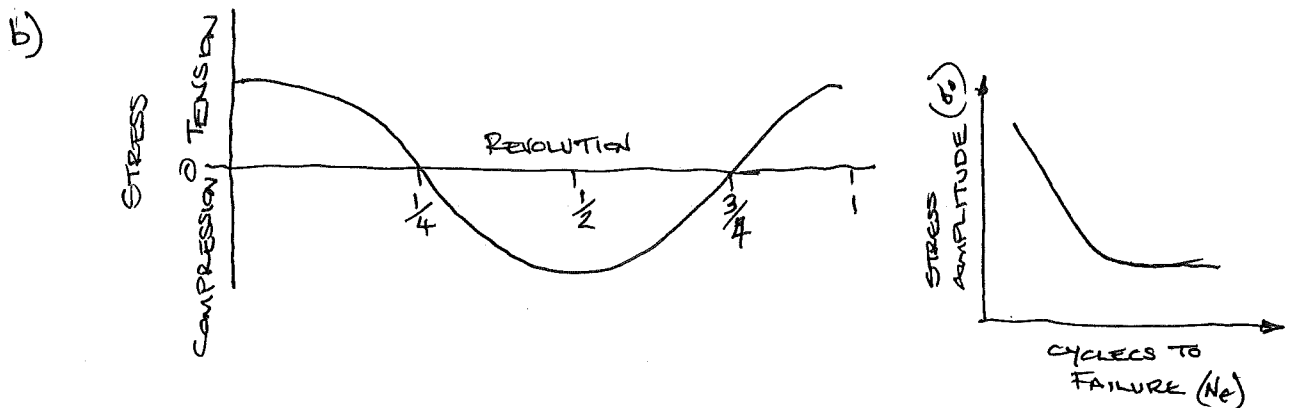
c) DURING POST PROCESSING THE EVALUATION AND ANALYSIS OF ~~FEA~~ MODEL RESULT DATA IS CONDUCTED TO ENSURE THE DESIGN MEET SPECIFICATION PARAMETERS STATED BY CUSTOMERS.

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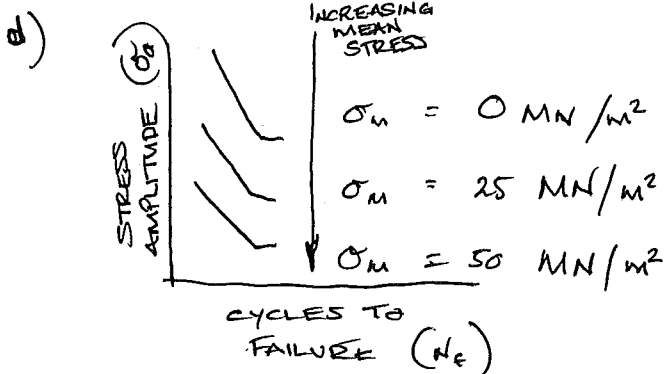
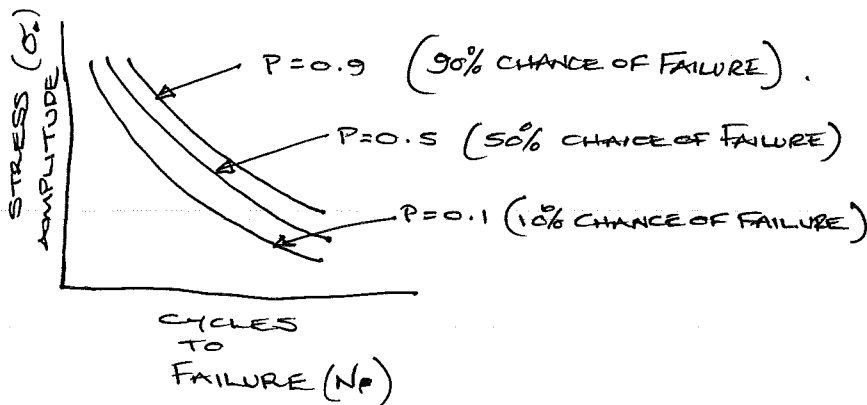
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- 4 a) AN S/N CURVE CAN BE GENERATED BY OBTAINING ROTATIONAL BENDING AND MEAN STRESS DATA. - ~~IN~~ THIS CASE, THIS CAN BE TAKEN FROM FATIGUE TESTING THE WOHLER MACHINE THROUGH ONE ROTATION.



- c) THE FATIGUE LIFE OF THE PART IS DETERMINED BASED ON A PARTICULAR STRESS LEVEL. MULTIPLE TEST PIECES ARE RUN AT THE SAME STRESS CONDITIONS TO CALCULATE THE PROBABILITY OF FAILURE



AS MEAN STRESS IS INCREASED, ~~THE~~ FATIGUE LIFE IS REDUCED

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e)

MOST OF THE RESULTS WILL FALL BETWEEN GOODMAN AND GERBER, HOWEVER SODERBERG IS MOST USED AS IT GIVES AN INCREASED MARGIN OF SAFETY

