



**MAKING
METAL
WORK**

Fix Forever, Not Forever Fixing

MAKING METAL WORK

Understanding design and repair concepts is essential to maximising safety and minimising running costs of plant and equipment. Making Metal Work is a 3 day training course focused on structural failures and repairs, including the following topics:



Risk and Factors of Safety

Concept of loading vs design strength and how both of these can determine whether a structure is safe or not: the load can increase for various reasons and the strength/structural capacity can decrease over time or instantaneously. Separation of these curves is the factor of safety.



Loads and Load Path

Importance of understanding how load is carried in a component or structure, the type of loading and the resulting stresses. Basic stress calculations, moments and force equilibrium.



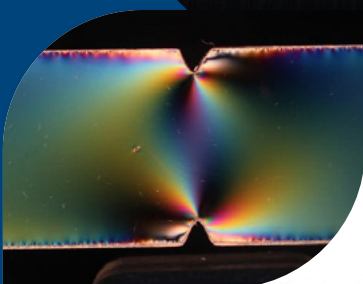
Material Properties

Stress-strain curve, elastic modulus, stiffness, toughness and effect on critical crack length. Triangle of integrity. Heat treatment, quench and tempering and transformation to different microstructures.



Types of Applied Loads

Static and dynamic loads. Point loads and uniformly distributed loads. Moments causing bending and torsion.



Stress Flow and Concentrations

Stress flow and stress concentrations. Demonstrated with use of a polariscope. Effect of holes, weld toe geometry, sharp notches, partial penetration in welds, neutral axis.



Failure Mechanisms

Why components fail including: cyclic loading leading to fatigue, buckling, overloading and hydrogen cracking.



Improving the Life of Welds

Techniques for improving weld fatigue life dealing with stress range, geometry and treatment of the weld toe.



Important Welding Parameters

Details on weld consumable classification and the number of parameters that can be varied. Value of preheat and calculation of the carbon equivalent. PWHT and the effects of residual stress in failures. Introduction to AS 1554 and discussion on GP, SP and FP welds.



Fracture Morphology

Identification of failures: characteristics of fracture surfaces – brittle, ductile, fatigue, torsion, bending (rotating and alternating) tensile, etc. Physical samples will be available for inspection and discussion.



Non Destructive Testing

Description of various NDT methods available and the advantages and disadvantages. Experience with their efficacy in various case studies is described.



Failure Case Studies

Numerous case studies are discussed through the course to illustrate all the aspects of structural failure and repairs. These are taken from personal experience as well as a few well documented classic cases in the public domain.

99% of previous participants rated the Making Metal Work course as above average or excellent.

COURSE MATERIALS

Numerous models are used to illustrate the concepts described, including:

- Polariscope for visualisation of stress concentration
- Bolting model for how preload affects cyclic loading
- Buckling jig to demonstrate various end constraints
- Models for neutral axis, bending, shear and torsion
- Model to illustrate shear centre and the correct placement of reinforcement
- Fractured components are used to show different failure modes

Assessments are done after each section of work with a combination of multiple choice and calculation type questions. These are worked through with the class in a tutorial style before moving to the next section.

Each participant is provided with a 2nd Edition copy of the book "Metal Where It Matters" as well as copies of the slides used in the classes.

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"Making Metal Work was very well presented with many technical subjects explained and questions responded to in highly knowledgeable and easy to understand way. I've learned a lot in the last 3 days."

"I thoroughly enjoyed the course. It was valuable and very relevant to my field of work."

"The course content was very clear, with excellent practical case studies."

"The examples of failure and constant flow of props and demonstrations with gadgets were extremely valuable."

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