

WELDING AND BUCKLING EFFECTS IN THIN STEEL PLATES

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Abstract

Two problems are considered in this dissertation:

- i. the effect of web buckling on the behaviour of hybrid plate girders, and
- ii. the residual stresses induced in steel structures fabricated by welding.

Part I describes an experimental investigation into the behaviour and strength of hybrid girders having high yield strength steel flanges and mild steel webs. The project set out to consider whether the limits specified by current British Standards for webs in mild steel girders could be used for hybrids and whether the design philosophy of these standards could be applied to hybrids. The webs of the test specimens were either unstiffened or transversely stiffened and were designed to the limits permitted by current standards. They were subjected to a wide range of loading conditions to study the effect of moment-shear interaction. The results are compared with predictions of available theories.

Part II describes an experimental and theoretical investigation into the residual stresses caused by welding. The wide ranging experimental programme of Chapter 6 first considers the relationship between the heat input to a weld and the shrinkage force and then studies the effect of various welding (intermittent welding and multi-pass welding) and of specimen geometry.

A study of the welding residual stresses to be expected in the Rising Sector Gates of the Thames Barrier structure is described in Chapter 7. The stresses were measured on a full-scale specimen.

A numerical method for determining welding residual stresses in free plates is developed in Chapter 8. The problem is treated as one of two-dimensional

elastoplastic thermal stress analysis. A finite difference approximation is used to solve the governing differential equation of the problem and plasticity is allowed for using the method of successive elastic solutions. The relationship between the welding parameters and the shrinkage force is obtained theoretically and the effect of coincident two-pass welding is examined.