LIST OF FIGURES

Fig. 1.1 Flow chart showing the plan and sequence of investigation.
Fig. 1.2 Weld bead geometry.

Fig. 2.1 WRC -1992 Diagram.
Fig. 2.2 Espy constitution diagram.

Fig. 3.1 Welding manipulator.
Fig 3.2 Power source.

Fig 4.1 Experimental set up of automatic FCAW cladding system.

Fig 5.1 Cross-sections of the cladded specimen.
Fig 5.2 Cross-sections of the specimen cladded for conformity test.
Fig 5.3 Scatter diagram for penetration model.
Fig 5.4 Scatter diagram for reinforcement model.
Fig 5.5 Scatter diagram for bead width model.
Fig 5.6 Scatter diagram for dilution model.
Fig 5.7 Scatter diagram for heat input model.
Fig 5.8 Scatter diagram for ferrite content.
Fig 5.9 Direct effect of voltage on bead dimensions heat input, ferrite content.
Fig 5.10 Direct effect of voltage on bead dimensions.
Fig 5.11 Direct effect of voltage on bead dimensions (AR, ISF).
Fig 5.12 Direct effect of wire feed rate on bead dimensions heat input, ferrite content.
Fig 5.13 Direct effect of wire feed rate on bead dimensions.
Fig 5.14 Direct effect of wire feed rate on bead dimensions (AR, ISF).
Fig 5.15 Direct effect of welding speed on bead dimensions heat input, ferrite content.
Fig 5.16 Direct effect of welding speed on bead dimensions.
Fig 5.17 Direct effect of welding speed on bead dimensions (AR, ISF).
Fig 5.18 Direct effect of nozzle to plate distance on bead dimensions heat input, ferrite content.
Fig 5.19 Direct effect of nozzle to plate distance on bead dimensions.
Fig 5.20 Direct effect of nozzle to plate distance on bead dimensions (AR, ISF).
Fig 5.21 Direct effect of electrode angle on bead dimensions heat input, ferrite content.
Fig 5.22 Direct effect of electrode angle on bead dimensions.
Fig 5.23 Direct effect of electrode angle on bead dimensions (AR, ISF).
Fig 5.24 Interaction effect of V and N on P.
Fig 5.25 Interaction effect of V and N on P (Response surface)
Fig 5.26 Interaction effect of V and A on P
Fig 5.27 Interaction effect of V and S on R
Fig 5.28 Interaction effect of F and N on R
Fig 5.29 Interaction effect of F and N on R (Response surface)
Fig 5.30 Interaction effect of V and S on W
Fig 5.31 Interaction effect of V and S on W (Response surface)
Fig 5.32 Interaction effect of V and F on W
Fig 5.33 Interaction effect of F and S on D
Fig 5.34 Interaction effect of F and S on D (Response surface)
Fig 5.35 Interaction effect of V and S on AR
Fig 5.36  Interaction effect of F and N on AR
Fig 5.37  Interaction effect of V and A on AP
Fig 5.38  Interaction effect of F and S on AP
Fig 5.39  Interaction effect of V and S on LP
Fig 5.40  Interaction effect of V and S on ESF
Fig 5.41  Interaction effect of F and N on ESF
Fig 5.42  Interaction effect of V and S on ISF.
Fig 5.43  Interaction effect of F and S on HI.
Fig 5.44  Interaction effect of F and S on HI (Response surface).
Fig 5.45  Interaction effect of V and A on ISF.
Fig 5.46  Interaction effect of V and F on FE.
Fig 5.47  Interaction effect of S and N on FE.
Fig 5.48  Interaction effect of S and N on FE (Response surface).
Fig 5.49  Effect of heat input on ESF, R and P.
Fig 5.50  Effect of heat input on ISF, W and D.
Fig 5.51  Effect of heat input on AR and AP.
Fig 5.52  Effect of voltage on P for constant HI.
Fig 5.53  Effect of voltage on R for constant HI.
Fig 5.54  Effect of voltage on W for constant HI.
Fig 5.55  Effect of voltage on D for constant HI.
Fig 5.56  Effect of wire feed rate on P for constant HI.
Fig 5.57  Effect of wire feed rate on R for constant HI.
Fig 5.58  Effect of wire feed rate on W for constant HI.
Fig 5.59  Effect of wire feed rate on D for constant HI.
Fig 5.60  Effect of welding speed on P for constant HI.
Fig 5.61  Effect of welding speed on R for constant HI.
Fig 5.62  Effect of welding speed on W for constant HI.

Fig 6.1  Cross-section of single and double layer specimens cladded at optimum dilution conditions
Fig 6.2  Sensitivity of P on R and W - Direct effect
Fig 6.3  Sensitivity of P on D and AR - Direct effect
Fig 6.4  Sensitivity of W on P and R - Direct effect
Fig 6.5  Sensitivity of W on AR - Direct effect
Fig 6.6  Sensitivity of AR on R - Direct effect
Fig 6.7  Sensitivity of AR on P and W - Direct effect
Fig 6.8  Sensitivity of P and D on R – Interaction effect
Fig 6.9  Sensitivity of P and D on AR – Interaction effect

Fig 7.1  Microhardness testing machine with photographic attachment
Fig 7.2  Distribution of microhardness in single layer (low heat input)
Fig 7.3  Distribution of microhardness in single layer (medium heat input)
Fig 7.4  Distribution of microhardness in single layer (high heat input)
Fig 7.5  Distribution of microhardness in optimized single layer FO 1L (transverse)
Fig 7.6  Distribution of microhardness in optimized single layer FO 1L (longitudinal)
Fig 7.7  Distribution of microhardness in optimized double layer FO 2L
Fig 7.8  The Microstructure of low heat input specimen-F22 At X 400
Fig 7.9  The solidification structure of low heat input specimen-F22 at X 400
Fig 7.10 Photomicrograph showing the solidification structure of medium heat input specimen-F9 at X 100
Fig 7.11 The solidification structure of high heat input specimen-F4 at X 400
Fig 7.12 The solidification structure of high heat input specimen above the fusion line - F4 at X 400
Fig 7.13 The solidification structure of single layer optimized specimen - FO 1L at X 100
Fig 7.14 The microstructure of single layer optimized specimen at the top surface of the cladding- FO 1L at X 100
Fig 7.15 The microstructure at the junction of first layer and second layer of the optimized specimen (FO 2L) at X 100
Fig 7.16 The solidification structure of double layer optimized specimen (FO 2L) at X100
Fig 7.17 Shear block to test clad plate
Fig 7.18 Universal testing machine and shear block with specimen
Fig 7.19 Sheared specimen and shear block
Fig 7.20 Guided bend test specimen cladded with optimum dilution
Fig 7.21 Experimental set up of corrosion testing
Fig 7.22 Double loop EPR curve for high heat input specimen- F4
Fig 7.23 Double loop EPR curve for medium heat input specimen- F9
Fig 7.24 Double loop EPR curve for low heat input specimen- F13
Fig 7.25 Double loop EPR curve for optimized single layer - FO 1L
Fig 7.26 Double loop EPR curve for optimized double layer - FO 2L
Fig 7.27 Cyclic polarization curve for pitting corrosion for high heat input-F4
Fig 7.28 Cyclic polarization curve for pitting corrosion for medium heat input-F9
Fig 7.29 Cyclic polarization curve for pitting corrosion for low heat input-F13
Fig 7.30 Cyclic polarization curve for pitting corrosion for optimized single layer - FO 1L
Fig 7.31 Cyclic polarization curve for pitting corrosion for optimized double layer - FO 2L
Fig 7.32 Effect of heat input on pitting potential (on bar chart)
Fig 7.33 Effect of heat input on pitting potential (on log scale)
Fig 7.34 Effect of heat input on area of hysteresis loop (on bar chart)
Fig 7.35 Effect of heat input on hysteresis loop (on log scale)
Fig 7.36 Effect of heat input on protection potential (on bar chart)