

# CONTENTS

|  | <i>Page</i> |                                      | <i>Page</i> |
|--|-------------|--------------------------------------|-------------|
| List of figures                          | iv          | 5.3 Recommended Design Model—        |             |
| List of tables                           | v           | Summary of Checks                    | 39          |
| Preface                                  | vii         | 5.4 Configuration A—Sections         |             |
| About the author                         | viii        | > 500 mm deep                        | 40          |
| About the contributing author and editor | viii        | 5.5 Configuration B—Sections         |             |
| Acknowledgements                         | ix          | < 500 mm deep                        | 42          |
| <br>                                     |             | <br>                                 |             |
| 1 CONCEPT OF DESIGN GUIDES.....          | 1           | 6 ANGLE CLEAT CONNECTION.....        | 46          |
| 1.1 Background                           | 1           | 6.1 Description of connection        | 46          |
| 1.2 Preliminary considerations           | 2           | 6.2 Typical detailing of connection— |             |
| 1.3 Included connections                 | 3           | Double angle cleats                  | 47          |
| <br>                                     |             | 6.3 Recommended design model—        |             |
| 2 GEOMETRICAL DETAILS.....               | 4           | Double angle cleats—                 |             |
| 2.1 Standard parameters                  | 4           | Summary of checks                    | 48          |
| 2.2 Connection components adopted        | 5           | 6.4 Configuration A—Double angle     |             |
| 2.3 Bolting layout                       | 7           | cleat single line of bolts to        |             |
| 2.4 Gauge lines                          | 9           | supported member—                    |             |
| 2.5 Web coping                           | 12          | Design capacity tables               | 49          |
| 2.6 Flange coping                        | 15          | 6.5 Configuration B—Double angle     |             |
| <br>                                     |             | cleat double line of bolts to        |             |
| 3 DESIGN BASIS.....                      | 17          | supported member—                    |             |
| 3.1 Design models                        | 17          | Design capacity tables               | 54          |
| 3.2 Minimum design actions on            |             | 6.6 Typical detailing of connection— |             |
| connections                              | 18          | Single angle cleat                   | 59          |
| 3.3 Coped sections                       | 22          | 6.7 Recommended design model—        |             |
| <br>                                     |             | Single angle cleat—                  |             |
| 4 WEB SIDE PLATE CONNECTION.....         | 25          | Summary of design checks             | 60          |
| 4.1 Description of connection            | 25          | 6.8 Configuration C—Single angle     |             |
| 4.2 Typical detailing of connection      | 26          | cleat single line of bolts to        |             |
| 4.3 Recommended Design Model—            |             | supported member—                    |             |
| Summary of Checks                        | 27          | Design capacity tables               | 61          |
| 4.4 Configuration A—Single line          |             | 6.9 Configuration D—Single angle     |             |
| of bolts—Design capacity tables          | 28          | cleat double line of bolts to        |             |
| 4.5 Configuration B—Single line          |             | supported member                     | 64          |
| of bolts—Design capacity tables          | 31          | <br>                                 |             |
| 4.6 Configuration C—Double line of       |             | 7 REFERENCES.....                    | 65          |
| bolts—Design capacity tables             | 34          | <br>                                 |             |
| <br>                                     |             | APPENDIX                             |             |
| 5 FLEXIBLE END PLATE CONNECTION ...      | 37          | A ASI Design Guide 1, Part 1         |             |
| 5.1 Description of connection            | 37          | comment form                         | 66          |
| 5.2 Typical detailing of connection      | 38          |                                      |             |



## LIST OF FIGURES

|           |  | <i>Page</i> |           |  | <i>Page</i> |
|-----------|--|-------------|-----------|--|-------------|
| Figure 1  | Selected connections .....   | 3           | Figure 21 | Typical flexible end plate connections .....   | 37          |
| Figure 2  | 90 × 8 or 10 flat bar or plate component.....  | 5           | Figure 22 | Uncoped and single web coped beam (end plate located towards top of beam) .....            | 38          |
| Figure 3  | 180 × 10 flat bar or plate component.....  | 5           | Figure 23 | Uncoped and single web coped beam (end plate located towards bottom of beam) .....         | 38          |
| Figure 4  | 200 or 150 × 10 flat bar or plate component.....   | 6           | Figure 24 | Double web coped beam (end plate depth matches remaining depth of web) .....               | 38          |
| Figure 5  | 100 × 100 × 8 EA angle component.....  | 6           | Figure 25 | Geometry configuration A—sections > 500 mm deep .....                                      | 40          |
| Figure 6  | 150 × 100 × 10 UA angle component.....   | 6           | Figure 26 | Geometry configuration B—member < 500 mm deep .....  | 42          |
| Figure 7  | Supported member end preparations .....  | 8           | Figure 27 | Typical single and double angle cleat connections.....                                     | 46          |
| Figure 8  | Single web cope .....  | 13          | Figure 28 | Alternative 'A'—Single line of bolts to beam web .....                                     | 47          |
| Figure 9  | Double web cope.....   | 13          | Figure 29 | Alternative 'B'—Double line of bolts to beam web .....                                     | 47          |
| Figure 10 | Hole at re-entrant corner .....  | 13          | Figure 30 | double line of bolts to supporting member .....  | 47          |
| Figure 11 | Flange cope.....   | 15          | Figure 31 | Geometry configuration A—Double angle cleat single line of bolts to supported member ..... | 49          |
| Figure 12 | Bolt clearance for flange cope .....   | 15          | Figure 32 | Geometry configuration B—Double angle cleat double line of bolts to supported member ..... | 54          |
| Figure 13 | Single web coped (SWC) sections .....  | 22          | Figure 33 | Alternative 'C'—Single line of bolts to beam web .....                                     | 59          |
| Figure 14 | Double web coped (DWC) sections .....  | 22          | Figure 34 | Alternative 'D'—Double line of bolts to beam web .....                                     | 59          |
| Figure 15 | Typical web side plate connections .....   | 25          | Figure 35 | Single line of bolts to supporting member .....  | 59          |
| Figure 16 | Single line of bolts to beam web, beam-to-column or beam-to-beam connections uncoped, single and double (not shown) web coped beams..... | 26          | Figure 36 | Geometry configuration C—Single angle cleat single line of bolts to supported member ..... | 61          |
| Figure 17 | Double line of bolts to beam web, beam-to-column or beam-to-beam connections uncoped, single (not shown) and double web coped beams..... | 26          | Figure 37 | Geometry configuration D—Single angle cleat double line of bolts to supported member ..... | 64          |
| Figure 18 | Geometry configuration A—Single line of bolts .....  | 28          |           |  |             |
| Figure 19 | Geometry configuration B—Single line of bolts .....  | 31          |           |  |             |
| Figure 20 | Geometry configuration C—Double line of bolts .....  | 34          |           |  |             |



## LIST OF TABLES

|           | <i>Page</i>  | <i>Page</i> |  |
|-----------|--|-------------|--|
| Table 1   | Connection components adopted ... 5  | Table 18    | Web side plate design capacity table—Configuration B, single line of bolts/10 mm component/8 mm FW's, Member $\geq 300$ mm deep .....32                      |
| Table 2   | Additional details of components .... 5  | Table 19    | Web side plate design capacity table—Configuration B, single line of bolts/10 mm component/8 mm FW's, Member $\leq 250$ mm deep .....33                      |
| Table 3   | Values of $n_{max}$ ..... 7  | Table 20    | Web side plate design capacity table—Configuration C, double line of bolts/10 mm component/8 mm FW's, Member $\geq 300$ mm deep .....35                      |
| Table 4   | Gauge lines for universal sections.. 9   | Table 21    | Web side plate design capacity table—Configuration C, double line of bolts/10 mm component/8 mm FW's, Member $\leq 250$ mm deep .....36                      |
| Table 5   | Gauge lines for welded section flanges..... 10   | Table 22    | Flexible end plate design capacity table—Configuration A—Member $> 500$ mm deep .....41  |
| Table 6   | Gauge lines for welded section webs ..... 10   | Table 23    | Flexible end plate design capacity table—Configuration B—Member $> 350$ mm but $< 500$ mm deep.....43  |
| Table 7   | Gauge lines for parallel flange channels ..... 11  | Table 24    | Flexible end plate design capacity table—Configuration B— Member $> 250$ mm but $< 350$ mm deep.....44   |
| Table 8   | Web copes—Beam-to-beam connections universal sections as supported members..... 14   | Table 25    | Flexible end plate design capacity table—Configuration B— Member 200 mm deep .....45   |
| Table 9   | Web copes—Beam-to-beam connections channels as supported members..... 14   | Table 26    | Angle cleat design capacity table—Configuration A Double angle cleat single line of bolts to supported member— Member $> 500$ mm deep .....50                |
| Table 10  | Double flange copes—Beam-to-column web universal sections ..... 16   | Table 27    | Angle cleat design capacity table—Configuration A Double angle cleat single line of bolts to supported member— Member $> 350$ mm but $< 500$ mm deep .....51 |
| Table 11  | Universal beams—Grade 300 Design section moment and web capacities ..... 20  | Table 28    | Angle cleat design capacity table—Configuration A Double angle cleat single line of bolts to supported member— Member $> 250$ mm but $< 350$ mm deep .....52 |
| Table 12  | Welded beams—Grade 300 Design section moment and web capacities ..... 21   | Table 29    | Angle cleat design capacity table—Configuration A Double angle cleat single line of bolts to supported member— Member 200 mm deep .....53                    |
| Table 13  | Parallel flange channels—Grade 300 Design section moment and web capacities ..... 21   |             |  |
| Table 14A | Single web coped universal beams—Grade 300 cope depth $d_c = 65$ mm Design section moment and shear capacities ..... 23                |             |  |
| Table 14B | Single web coped parallel flange channels—Grade 300 cope depth $d_c = 65$ mm Design section moment and shear capacities..... 23        |             |  |
| Table 15A | Double web coped universal beams—Grade 300 Design section moment and shear capacities ..... 24   |             |  |
| Table 15B | Double web coped parallel flange channels—Grade 300 Design section moment and shear capacities ..... 24                                |             |  |
| Table 16  | Web side plate design capacity table—Configuration A, single line of bolts/8 mm component/6 mm FW's, Member $\geq 300$ mm deep..... 29 |             |  |
| Table 17  | Web side plate design capacity table—Configuration A, single line of bolts/8 mm component/6 mm FW's, Member $\leq 250$ mm deep..... 30 |             |  |



|          | <i>Page</i>   |    | <i>Page</i>   |   |    |
|----------|---|----|---|---|----|
| Table 30 | Angle cleat design capacity<br>table—Configuration B<br>Double angle cleat double line of<br>bolts to supported member—<br>Member > 500 mm deep.....                  | 55 |   |   |    |
| Table 31 | Angle cleat design capacity<br>table—Configuration B<br>Double angle cleat double line of<br>bolts to supported member—<br>Member > 350 mm but < 500 mm<br>deep ..... | 56 |   |   |    |
| Table 32 | Angle cleat design capacity<br>table—Configuration B<br>Double angle cleat double line of<br>bolts to supported member—<br>Member > 250 mm but < 350 mm<br>deep ..... | 57 |   |   |    |
|          |   |    | Table 33  |   |    |
|          |   |    | Angle cleat design capacity<br>table—Configuration B<br>Double angle cleat double line of<br>bolts to supported member—<br>Member 200 mm deep ..... | 58  |    |
|          |   |    | Table 34  | Angle cleat design capacity<br>table—Configuration C<br>Single angle cleat single line of bolts<br>to supported member—<br>Member > 300 mm deep ..... | 62 |
|          |   |    | Table 35  | Angle cleat design capacity<br>table—Configuration C<br>Single angle cleat single line of<br>bolts to supported member—<br>Member < 300 mm deep ..... | 63 |

