

Table of contents provided by Syndetics

- **Preface** (p. xiii)
- **Authors** (p. xv)
- **Chapter 1 Principle of the Strut-and-Tie Model** (p. 1)
- **1.2.3 Basic Assumptions** (p. 2)
- **1.2.6 Upper-Bound Theorem** (p. 6)
- **1.3.1 Introduction** (p. 10)
- **1.3.3 Strut-and-Tie Modeling** (p. 11)
- **1.3.4 Elements of STM** (p. 13)
- **1.4 D-Regions versus B-Regions** (p. 16)
- **1.4.4 Defining the Boundaries of D-Regions** (p. 17)
- **1.1 Introduction** (p. 1)
- **1.2.4 Tresca Yield Criterion** (p. 3)
- **1.4.2 B-Regions** (p. 17)
- **1.2 Limit Theorems of Perfect Plasticity** (p. 1)
- **1.2.2 Why Limit Analysis** (p. 1)
- **1.2.5 Lower-Bound Theorem** (p. 4)
- **1.4.1 Introduction** (p. 16)
- **1.2.1 Introduction** (p. 1)
- **1.3 The Strut-and-Tie Model - A Lower Bound Solution** (p. 10)
- **1.3.2 Concept** (p. 11)
- **1.4.3 D-Regions** (p. 17)
- **1.5 Historical Sketch** (p. 19)
- **1.5.1 The Development of the Truss Model for B-Regions Design** (p. 19)
- **1.5.2 The Start of the Strut-and-Tie Model for D-Regions Design** (p. 21)
- **1.5.3 STM for a Unified and Consistent Design** (p. 23)
- **References** (p. 24)
- **Chapter 2 Developing a Strut-and-Tie Model** (p. 27)
- **2.1 Introduction** (p. 27)
- **2.2 The Load Path Method** (p. 28)
- **2.3 Elastic Stress Analysis** (p. 30)
- **2.4 Model Optimization** (p. 31)
- **2.5 Basic Discontinuous Stress Fields** (p. 34)
- **2.5.1 Why** (p. 34)
- **2.5.2 Region D 1** (p. 34)
- **2.5.3 Region D 2** (p. 35)
- **2.5.4 Region D 3** (p. 37)
- **2.5.5 Region D 4** (p. 37)
- **2.5.6 Regions D 5 and D 6** (p. 38)
- **2.5.7 Region D 7** (p. 38)
- **2.5.8 Regions D 8** (p. 39)
- **2.5.9 Regions D 9 and D 10** (p. 39)
- **2.6 Examples of Discontinuous Stress Fields** (p. 41)
- **2.6.1 Local Pressure** (p. 41)
- **2.6.2 Beam with Dapped End** (p. 42)

- **2.6.4 Deep Wall-Like Column with Recess** (p. 43)
- **2.7 Modeling of B-Regions with Web Reinforcement** (p. 46)
- **2.7.1 B-Region with Vertical Web Reinforcement** (p. 46)
- **2.6.3 Beam with Recess** (p. 43)
- **2.6.5 Walls with Openings** (p. 44)
- **2.6.6 Deep Beam with Eccentric Large Opening** (p. 45)
- **2.7.2 B-Region with Inclined Web Reinforcement** (p. 49)
- **2.8 2D and 3D Modeling** (p. 49)
- **References** (p. 52)
- **Chapter 3 Failure Criteria** (p. 53)
- **3.1 Introduction** (p. 53)
- **3.2 Concrete Struts** (p. 54)
- **3.2.1 Behavior and Strength** (p. 54)
- **3.2.2 ACI 318-14 Effectiveness Factor for Struts** (p. 58)
- **3.3 Nodal Zones** (p. 59)
- **3.3.1 Geometry and Strength** (p. 59)
- **3.3.2 ACI 318-14 Effectiveness Factor for Nodal Zones** (p. 62)
- **3.4 Reinforced Ties** (p. 63)
- **3.5 Anchorage of Reinforcement** (p. 64)
- **3.5.1 Bond Action of Straight Bars** (p. 64)
- **3.5.2 Anchorage Length** (p. 65)
- **3.5.3 Lap Joints** (p. 66)
- **3.5.4 Curved Reinforcement** (p. 68)
- **References** (p. 69)
- **Chapter 4 Illustrative Design Examples** (p. 71)
- **4.1 Introduction** (p. 71)
- **4.2 Deep Beam under Concentrated Load** (p. 71)
- **4.3 Symmetrically Loaded Deep Beam with Variable Depth** (p. 76)
- **4.4 Unsymmetrically Loaded Deep Beam with Variable Depth** (p. 84)
- **4.5 Beam with Dapped End** (p. 84)
- **4.6 Beam with a Recess** (p. 86)
- **4.7 Local Pressure** (p. 87)
- **4.7.1 Concentric Local Pressure** (p. 87)
- **4.7.2 Eccentric Local Pressure** (p. 88)
- **4.8 Deep Beam with Large Opening** (p. 88)
- **4.9 High Wall with Two Large Openings** (p. 90)
- **4.10 Example on Strength Assessment of a Continuous Deep Beam with Large Openings** (p. 93)
- **References** (p. 100)
- **Chapter 5 Deep Beams** (p. 101)
- **5.1 Introduction** (p. 101)
- **5.2 Modeling** (p. 101)
- **5.2.1 Simply Supported Deep Beams** (p. 101)
- **5.2.2 Continuous Deep Beams** (p. 102)
- **5.3.1 Example 5.1: Type I Model for Strength Assessment of Beam under Two Point Loads** (p. 103)

- **5.3.2 Example 5.2: Design of a Wall-Type Column** (p. 107)
- **5.3.3 Application of a Type II Arch-Action Model** (p. 108)
- **5.3.4 Example 5.3: A Type II Arch-Action Model for Strength Assessment of a High Strength Concrete Deep Beam** (p. 110)
- **5.3.5 Application of the Type II Fan-Action Model** (p. 114)
- **5.4.1 Example 5.4: Design of a Top and Bottom Loaded Deep Beam** (p. 115)
- **5.4.2 Deep Beam with a Ledge** (p. 117)
- **5.5 Deep Beams with Indirect Supports** (p. 118)
- **5.6 Applications to Continuous Deep Beams** (p. 121)
- **5.6.2 Type I Model for a Bottom Loaded Beam** (p. 127)
- **5.7 Brackets and Corbels** (p. 128)
 - **5.7.1 Modes of Failure** (p. 128)
 - **5.7.2 Strut-and-Tie Modeling** (p. 130)
 - **5.7.3 Nodes Detailing for Safety** (p. 130)
 - **5.7.4 Step-by-step Design Procedure** (p. 133)
 - **5.7.5 Transverse Reinforcement of Struts** (p. 135)
- **5.3 Applications to Simply Supported Deep Beams** (p. 103)
- **5.4 Bottom Loaded Deep Beams** (p. 115)
 - **5.6.1 Example 5.5: Strength Assessment of Top Loaded Beam Using Type I Model** (p. 121)
 - **5.7.6 Example 5.6: Strength Assessment of Double Corbel** (p. 136)
- **References** (p. 137)
- **6.1 Introduction** (p. 139)
 - **6.2.1 Small Openings** (p. 139)
 - **6.2.2 Strut-and-Tie Modeling of Beams with Small Openings** (p. 142)
- **6.3 Shallow Beams with Large Openings** (p. 143)
 - **6.3.1 Large Openings** (p. 143)
 - **6.3.2 Modeling** (p. 146)
- **6.4.1 Modeling** (p. 150)
 - **6.4.2 Example on Strength Assessment of a Deep Beam with a Large Opening** (p. 152)
 - **6.4.3 Example on Design of a Deep Beam with Eccentric Large Openings** (p. 154)
- **6.5 Continuous Deep Beams with Web Openings** (p. 155)
 - **6.5.1 Example on a Continuous Deep Beam with a Small Opening** (p. 155)
 - **6.5.2 Modeling of Continuous Deep Beams with Large openings** (p. 156)
- **References** (p. 157)
- **Chapter 6 Openings in Shallow and Deep Beams** (p. 139)
 - **6.2 Shallow Beams with Small Openings** (p. 139)
 - **6.4 Simply Supported Deep Beams with Web Openings** (p. 150)
- **Chapter 7 Beam-Column Connections** (p. 159)
 - **7.1 Introduction** (p. 159)
 - **7.2 Knee Corner Joints under Opening Moments** (p. 159)
 - **7.2.1 Joint Behavior** (p. 159)
 - **7.2.2 Role of Detailing** (p. 160)
 - **7.2.3 Strut-and-Tie Modeling** (p. 161)
 - **7.2.4 Example 7.1: Strength Assessment of an Opening Corner** (p. 162)

- **7.3 Knee Corner Joints under Closing Moments** (p. 164)
- **7.3.1 Joint Behavior** (p. 164)
- **7.3.2 Role of Detailing** (p. 165)
- **7.3.3 Strut-and-Tie Modeling** (p. 166)
- **7.3.4 Example 7.2: Strength Assessment of a Closing Corner** (p. 166)
- **7.4 Obtuse Corner Joints** (p. 168)
- **7.5 Wide Beam Supported on a Narrow Column and Vice Versa** (p. 170)
- **7.6 Exterior Beam-Column Connections** (p. 170)
- **7.6.1 Joint Behavior** (p. 170)
- **7.6.2 Role of Detailing** (p. 173)
- **7.6.3 Strut-and-Tie Modeling** (p. 174)
- **7.6.4 Example 7.3: Strength Assessment of an Exterior Joint** (p. 175)
- **7.7 Tee Beam-Column Connections** (p. 177)
- **7.7.1 Joint Behavior** (p. 177)
- **7.7.2 Role of Detailing** (p. 177)
- **7.7.3 Strut-and-Tie Modeling** (p. 178)
- **7.8 Interior Beam-Column Connections** (p. 179)
- **7.8.1 Joint Behavior** (p. 179)
- **7.8.2 Bond Condition and Confinement** (p. 180)
- **7.8.3 Strut-and-Tie Modeling** (p. 180)
- **7.8.4 Example 7.4: Strength Assessment of an Interior Joint** (p. 180)
- **References** (p. 183)
- **Chapter 8 Pile Caps** (p. 185)
- **8.1 Introduction** (p. 185)
- **8.2 Distribution of Pile Loads** (p. 185)
- **8.3 2D (Indirect) Modeling of Pile Caps** (p. 187)
- **8.3.1 Design Example 8.1** (p. 187)
- **8.4 Geometry of 3D STMs** (p. 195)
- **8.4.2 Simplification of Nodal Zone Geometry** (p. 195)
- **8.5 Strength of Struts in Pile Caps** (p. 197)
- **8.5.1 Effect of Inactive Concrete on Bearing Struts** (p. 197)
- **8.5.2 Bearing Strength of Struts Confined by Inactive Concrete** (p. 198)
- **8.6 Strength of Nodal Zones in Pile Caps** (p. 201)
- **8.6.1 Strength of the Nodal Zone underneath the Column** (p. 201)
- **8.6.2 Strength of the Nodal Zone above the Piles** (p. 203)
- **8.3.2 Design Example 8.2** (p. 190)
- **8.4.1 Challenges** (p. 195)
- **8.4.3 Limits of Strut Angle** (p. 197)
- **8.7 Example 8.3: Strength Assessment of Pile Cap Supported by 4 Piles via 3D Modeling** (p. 203)
- **8.8 Example 8.4: Strength Assessment of Pile Cap Supported by 6 Piles via 3D Modeling** (p. 213)
- **References** (p. 223)
- **Index** (p. 225)