Part I  Engineering Design Integrity Overview

1  Design Integrity Methodology ................................ 3
   1.1 Designing for Integrity ...................................... 4
       1.1.1 Development and Scope of Design Integrity Theory .... 12
       1.1.2 Designing for Reliability, Availability, Maintainability
            and Safety ............................................ 14
   1.2 Artificial Intelligence in Design ............................. 21
       1.2.1 Development of Models and AIB Methodology ........... 22
       1.2.2 Artificial Intelligence in Engineering Design .......... 25

2  Design Integrity and Automation ................................ 33
   2.1 Industry Perception and Related Research .................. 34
       2.1.1 Industry Perception .................................... 34
       2.1.2 Related Research ................................... 35
   2.2 Intelligent Design Systems ................................. 37
       2.2.1 The Future of Intelligent Design Systems .......... 37
       2.2.2 Design Automation and Evaluation Design Automation ... 38

Part II  Engineering Design Integrity Application

3  Reliability and Performance in Engineering Design .......... 43
   3.1 Introduction ............................................. 43
   3.2 Theoretical Overview of Reliability and Performance
        in Engineering Design .................................... 45
       3.2.1 Theoretical Overview of Reliability and Performance
            Prediction in Conceptual Design ....................... 60
       3.2.2 Theoretical Overview of Reliability Assessment
            in Preliminary Design .................................. 72
       3.2.3 Theoretical Overview of Reliability Evaluation
            in Detail Design ....................................... 90
### 3.3 Analytic Development of Reliability and Performance in Engineering Design

- **3.3.1 Analytic Development of Reliability and Performance Prediction in Conceptual Design** ........................................... 107  
- **3.3.2 Analytic Development of Reliability Assessment in Preliminary Design** .................................................... 133  
- **3.3.3 Analytic Development of Reliability Evaluation in Detail Design** .......................................................... 190  

### 3.4 Application Modelling of Reliability and Performance in Engineering Design

- **3.4.1 The RAMSA Analysis Application Model** ................. 242  
- **3.4.2 Evaluation of Modelling Results** ........................................... 271  
- **3.4.3 Application Modelling Outcome** ....................................... 285  

### 3.5 Review Exercises and References

```
3.4.1 The RAMSA Analysis Application Model
3.4.2 Evaluation of Modelling Results
3.4.3 Application Modelling Outcome
```

### 4 Availability and Maintainability in Engineering Design

- **4.1 Introduction** ....................................................... 296  
- **4.2 Theoretical Overview of Availability and Maintainability in Engineering Design** .......................................................... 302  
  - **4.2.1 Theoretical Overview of Availability and Maintainability Prediction in Conceptual Design** ....................... 308  
  - **4.2.2 Theoretical Overview of Availability and Maintainability Assessment in Preliminary Design** ...................... 349  
  - **4.2.3 Theoretical Overview of Availability and Maintainability Evaluation in Detail Design** ............................ 385  
- **4.3 Analytic Development of Availability and Maintainability in Engineering Design** ......................................................... 415  
  - **4.3.1 Analytic Development of Availability and Maintainability Prediction in Conceptual Design** ............................... 416  
  - **4.3.2 Analytic Development of Availability and Maintainability Assessment in Preliminary Design** ...................... 436  
  - **4.3.3 Analytic Development of Availability and Maintainability Evaluation in Detail Design** ............................ 456  
- **4.4 Application Modelling of Availability and Maintainability in Engineering Design** ......................................................... 486  
  - **4.4.1 Process Equipment Models (PEMs)** ............................. 486  
  - **4.4.2 Evaluation of Modelling Results** .................................... 500  
  - **4.4.3 Application Modelling Outcome** .................................. 518  
- **4.5 Review Exercises and References** ........................................ 520
5 Safety and Risk in Engineering Design ........................................... 529
  5.1 Introduction .............................................................................. 530
  5.2 Theoretical Overview of Safety and Risk in Engineering Design ........................................... 537
    5.2.1 Forward Search Techniques for Safety in Engineering Design ........................................... 541
    5.2.2 Theoretical Overview of Safety and Risk Prediction in Conceptual Design ........................................... 588
    5.2.3 Theoretical Overview of Safety and Risk Assessment in Preliminary Design ........................................... 607
    5.2.4 Theoretical Overview of Safety and Risk Evaluation in Detail Design ........................................... 627
  5.3 Analytic Development of Safety and Risk in Engineering Design ........................................... 676
    5.3.1 Analytic Development of Safety and Risk Prediction in Conceptual Design ........................................... 678
    5.3.2 Analytic Development of Safety and Risk Assessment in Preliminary Design ........................................... 687
    5.3.3 Analytic Development of Safety and Risk Evaluation in Detail Design ........................................... 702
  5.4 Application Modelling of Safety and Risk in Engineering Design ........................................... 725
    5.4.1 Artificial Intelligence-Based (AIB) Blackboard Model ........................................... 726
    5.4.2 Evaluation of Modelling Results ........................................... 776
    5.4.3 Application Modelling Outcome ........................................... 790
  5.5 Review Exercises and References ........................................... 791

A Design Engineer’s Scope of Work ........................................... 799

B Bibliography of Selected Literature ........................................... 807

Index ............................................................. 811
Handbook of Reliability, Availability, Maintainability and Safety in Engineering Design
Stapelberg, R.F.
2009, XXIV, 827 p. 281 illus., Hardcover