Table of Contents

Certificate ii

Acknowledgement iv

List of Tables v

List of Figures ..... **vi**

Abstract vii

Chapter 1 Introduction 1

1.1 Sleepers 1

1.2 Functions of sleepers 1

1.3 Requirement of an ideal sleeper 1

1.4 Sleeper desity and spacing of sleepers 2

1.5 Number of sleeper per kilometer 3

Chapter 2 Literature Review 5

2.1 General 5

2.2 Sleeper Deterioration 5

2.2.1 Timber Sleepers 6

2.2.2 Concrete Sleepers 6

2.3 Maintenance of railway track 7

Chapter-3 Comparison of different types of sleepers **8**

3.1 Different types of sleepers 5

3.2 Wooden sleepers 8

3.2.1 Advantage and Disadvantage of wooden sleepers 8

3.3 Steel Through Sleeper 10

3.3.1 Advantage and Disadvantage 10

3.4 Cast Iron sleepers 13

3.4.1 Advantage and Disadvantage 13

3.4.2 Cast Iron Pot sleepers 14

3.4.3 C.S.T.-9 sleeper 14

3.4.4 C.S.T.-9 sleeper for M.G……..16

3.4.5 C.S.T.-10 sleepers……16

3.4.6 C.S.T.-11 sleepers……16

3.4.7 C.S.T.-12 sleepers ……17

3.4.8 C.S.T.-13 sleepers……..17

3.4.9 Cast iron sleepers with bitumen macadam filling……17

3.5 Concrete Sleepers……18

3.5.1 Evolution and History of Development of concrete sleepers……18

3.5.2 Different concepts of Development……..19

3.5.3 Need for development of concrete sleepers in India……19

3.5.4 Advantage and Disadvantage of concrete sleepers……20

3.5.5 Design considerations……21

3.5.6 Loading conditions adopted by Indian Railway for Design of concrete sleepers

3.5.6.1 B.G. sleepers……21

3.5.6.2 M.G. Sleepers……22

3.5.7 Types of concrete sleepers…….....23

3.5.8 Mono block prestressed concrete sleepers with pandrol clips……24

3.5.8.1 PCS-12 sleepers and PCS-14 sleeper……...24

3.5.8.2 Mono block Post-tension type of concrete sleepers for B.G……26

3.5.8.3 Reinforced cement concrete two block sleepers for use with IRN 202 ..26

3.5.8.4 Mono Block PRC sleeper for M.G.(PCS-17)……..27

3.5.8.5 Two Block RCC Sleepers for B.G. yards……...27

3.5.8.6 Two block concrete sleepers……28

3.5.9 Pre-Stressed concrete sleepers for turn outs……29

3.5.9.1 Salient features of PRC sleepers for turn outs……29

3.5.9.2 Making of PRC sleepers……33

3.5.10 Laying the concrete sleepers……..33

3.5.10.1 Compaction……34

3.5.11 Manufacture of concrete sleeper……34

3.5.12 Handling of concrete sleepers……39

3.5.13 Permitted location for laying of concrete sleepers……39

3.5.14 Laying of concrete sleepers……40

3.5.15 Maintenance of concrete sleepers ……40

3.5.16 Action in case of rerailment……..42

3.5.17 Mono Block Sleeper versus Two Block Concrete sleeper……42

3.5.18 Scope and planning of concrete sleeper on Indian Railway……45

3.5.19 Economies in use of concrete sleepers……46

3.5.20 Development of type of concrete sleepers……..47

Chapter-4 Methodology of Research……..48

4.1 Failure of Railway concrete sleeper during service life……48

4.2 Detected Defects……...49

4.3 Deterioration during production and coupling……50

4.4 Defects during transportation & installation……51

4.5 Defects during operation and maintenance……..52

4.6 Deterioration of defects during operation……55

4.7 Sleeper Defects Reduction Methods……..56

Chapter-5 Concrete Sleeper Quality Control ……59

5.1 Concrete Sleeper Plants on Indian Railway……59

5.2 Map showing location of concrete sleeper plant……..60

5.3 Specification and Drawing…….....60

5.4 System of Quality Control……...60

5.5 Role of RDSO……..61

5.6 Initial Development of Plant……61

5.7 Production Inspection…….....61

5.8 Raw Material……62

5.9 Manufacturing Process……..63

5.10 Weigh Batcher……64

5.11 Manufacturing Process……65

5.12 Steam Curing……..67

5.13 Product Inspection……..68

5.14 Typical Quality Assurance Plan…….69

5.15 Statistical Analysis…….74

Chapter-6 Track Renewal……77

6.1 Necessity of Mechanised Relaying……77

6.2 Description of P.Q.R.S Equipment……77

6.3 Relaying with Pre-fabricated Panel……82

6.4 Semi Mechanical Relaying System (SMRS)……..86

6.5 Track Renewal on European Railway System……87

6.6 Track Renewal method based on use of DONELLI Portal cranes……..88

6.7 Track renewal method based on use of "Plasser High Speed Relaying Train…90

6.8 Track Renewal Train (TRT) for Indian Railway……..91

Chapter-7 Results and Discussion…….97

Chapter-8 Conclusion and Recommendation……..98

References……...101