

1. Introduction.....	1
1.1. Background	1
1.2. Research objectives	4
1.3. Methodology	5
1.4. Dissertation structure	6
2. A review of multi-criteria assessment techniques applied to sustainable infrastructures design	8
2.1. Introduction.....	9
2.2. Materials and Methods	11
2.2.1. Research question	11
2.2.2. Data sampling strategy.....	11
2.3. Results and Discussion.....	12
2.3.1. General overview of the retrieved data	12
2.3.1. Impact assessment and selection of indicators.....	15
2.3.2. Treatment of qualitative data	24
2.3.1. Normalisation of the indicators.....	25
2.3.2. Weighting techniques.....	27
2.3.3. Aggregation of indicators	28
2.3.1. Sensitivity analysis	31
2.3.2. Dealing with the experts' subjectivity	32
2.4. Conclusions.....	33
3. Life Cycle Cost Assessment of preventive strategies applied to prestressed concrete bridges exposed to chlorides.....	36
3.1. Introduction.....	37
3.2. Materials and Methods	38
3.2.1. Case Study Description.....	38
3.2.2. Durability performance of the preventive measures	40
3.2.3. Life Cycle Cost Analysis (LCCA).....	44
3.2.4. Social Life Cycle Assessment (SLCA).....	45
3.3. Results and Discussion.....	48
3.4. Conclusions and future lines of research.....	54
4. Life cycle impact assessment of corrosion preventive designs applied to prestressed concrete bridge decks	55
4.1. Introduction.....	56
4.2. Materials and methods	58
4.2.1. Preventive designs and problem definition	58
4.2.2. Service life predictions	62
4.2.3. Life cycle assessment (LCA).....	65
4.3. Results of the life cycle assessment	71
4.3.1. Environmental impact assessment	71
4.3.2. Element contribution to the overall impacts	77
4.3.3. Uncertainty analysis.....	78

4.3.4.	Design-oriented approach versus maintenance-oriented approach.....	80
4.4.	Discussion	82
4.5.	Concluding remarks	83
5.	Reliability-based maintenance optimization of corrosion preventive designs under a life cycle perspective	84
5.1.	Introduction.....	85
5.2.	Materials and methods	86
5.2.1.	Goal and scope definition	87
5.2.2.	Inventory analysis.....	91
5.2.3.	Life cycle impact assessment.....	96
5.3.	Reliability-based maintenance optimization	96
5.3.1.	Service life prediction.....	96
5.3.2.	Maintenance optimization problem	98
5.4.	Results and discussion.....	99
5.4.1.	Assessment results under economically optimized maintenance.....	99
5.4.2.	Assessment results under environmentally optimized maintenance ..	101
5.4.3.	Analysis of the Pareto Front	104
5.4.4.	Uncertainty analysis of the results	105
5.5.	Conclusions.....	106
6.	Social life cycle assessment of concrete bridge decks exposed to aggressive environments	108
6.1.	Introduction.....	109
6.2.	Social performance evaluation of deck designs	111
6.3.	Social Life Cycle Assessment.....	112
6.3.1.	Definition of goal and scope	113
6.3.2.	Inventory.....	115
6.3.3.	Impact assessment.....	119
6.3.4.	Results and interpretation	127
6.4.	Conclusions.....	133
7.	Sustainability assessment of concrete bridge deck designs in coastal environments using neutrosophic criteria weights	135
7.1.	Introduction.....	136
7.2.	Materials and methods	139
7.2.1.	Preliminaries on Neutrosophic sets.....	139
7.2.2.	Neutrosophic extension of the analytical hierarchy process	140
7.3.	Sustainability assessment of bridge preventive designs.....	146
7.3.1.	Reliability-based maintenance	147
7.3.2.	Life cycle assessment.....	150
7.4.	Results and discussion.....	157
7.4.1.	Neutrosophic Group AHP results	157
7.4.2.	LCCA results	161
7.4.3.	LCA results.....	162

7.4.4.	SLCA results	163
7.4.5.	Sustainability results	164
7.5.	Conclusions	166
8.	Discussion of the results	168
8.1.	Research Question Q1	168
8.2.	Research Question Q2	174
8.3.	Research Question Q3	176
8.4.	Research Question Q4	178
9.	Conclusions and future work	181
9.1.	General conclusions	181
9.1.1.	Main conclusions	181
9.1.2.	Methodological conclusions	183
9.2.	Specific conclusions	184
9.3.	Future lines of research	185
10.	References	186