

---

## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Modularity in civil engineering . . . . .	1
1.2	Structural optimization methods . . . . .	3
1.3	Design optimization of modular structures . . . . .	4
1.4	Objectives of the thesis . . . . .	5
1.5	Achievements of the thesis . . . . .	5
1.6	Scope and outline . . . . .	6
<b>2</b>	<b>Design optimization of modular structures</b>	
	<b>A review</b>	<b>9</b>
2.1	Topology optimization with module periodicity . . . . .	9
2.2	Current limitations . . . . .	20
2.3	Objectives of the thesis: contributions and challenges . . . . .	24
2.4	Conclusions . . . . .	29
<b>3</b>	<b>Module rotation and dynamic grouping</b>	
	<b>Parameterization</b>	<b>33</b>
3.1	Module rotation as a topology variation . . . . .	33
3.2	Dynamic grouping . . . . .	48
3.3	Unified parameterization . . . . .	50
3.4	Conclusions . . . . .	50
<b>4</b>	<b>Stability considerations</b>	<b>53</b>
4.1	Global stability . . . . .	53
4.2	Local buckling of hollow elements . . . . .	63
4.3	Unification: global stability and local buckling . . . . .	64
4.4	Numerical validation . . . . .	66
4.5	Conclusions . . . . .	72
<b>5</b>	<b>Unification: formulations and algorithms</b>	<b>75</b>
5.1	Mixed-variable reformulations . . . . .	75
5.2	Optimization strategy . . . . .	79
5.3	Conclusion . . . . .	91
<b>6</b>	<b>Design applications</b>	<b>93</b>
6.1	Benchmark examples . . . . .	93
6.2	Real-life case studies . . . . .	108
<b>7</b>	<b>Conclusions</b>	<b>129</b>