

## CONTENTS

<b>PREFACE</b>	iii
<b>SYMOLOGY</b>	v
<b>1. INTRODUCTION</b>	1
<b>2. SHEAR CONNECTORS IN COMPOSITE CONSTRUCTION</b>	3
2.1 Usual types of Shear Connectors	3
2.2 Economic issues of Perfobond and T-Perfobond connectors	9
2.3 Other applications for perforated shear connectors	10
<b>3. EXPERIMENTAL TESTS</b>	13
3.1 Push out tests – general	13
3.2 Tests on Perfobond connectors by Vianna <i>et al</i> (2009 and 2013)	15
3.2.1 First set of tests (Vianna <i>et al</i> , 2009); general	15
3.2.2 Test layout and instrumentation	16
3.2.3 Results analysis	17
3.2.4 Second set of tests (Vianna <i>et al</i> , 2013); general	19
3.2.5 Stress history	21
3.2.6 Influence of the holes and of the reinforcement bars	25
3.2.7 Influence of the concrete resistance	28

## CONTENTS

3.2.8 Failure mode analysis	29
<b>3.3 Tests on Perfobond connectors by Cândido-Martins <i>et al</i> (2010)</b>	<b>29</b>
3.3.1 Mechanical and geometrical properties of the push-out specimens (third series)	29
3.3.2 General results and force-slip curves	31
3.3.3 Influence of the number of holes in the connector	33
3.3.4 Effect of steel reinforcing bars in the holes	34
3.3.5 Effect of two connectors placed side by side	35
3.3.6 Failure mode analysis	36
<b>3.4 Tests on Perfobond connectors and lightweight concrete by Valente <i>et al</i> (2004, 2009)</b>	<b>37</b>
3.4.1 Objectives	37
3.4.2 Test specimens	37
3.4.3 Test results	41
3.4.4 Comparison with tests performed on standard concrete	45
3.4.4.1 Influence of concrete bearing in front of the connector edge	45
3.4.4.2 Influence of concrete dowels passing inside the connectors' openings	45
3.4.4.3 Influence of the transversal reinforcement used inside the Perfobond holes	47
3.4.4.4 Influence of the welded wire mesh	48
3.4.4.5 Summary	49
<b>3.5 Tests on T-Perfobond connectors by Vianna (2009) and Vianna <i>et al</i> (2009 and 2008a)</b>	<b>50</b>
3.5.1 Tests from the fourth series (Vianna <i>et al</i> , 2009)	50
3.5.2 Perfobond and T-Perfobond connectors comparisons	53

3.5.3 Tests from the fifth series (Vianna <i>et al</i> , 2008a)	54
3.5.4 Resistance and deformation	55
3.5.5 Comparative assessment of the behaviour of different T-Perfobond geometries	56
3.5.6 Influence of steel reinforcement bars	59
3.5.7 Influence of the concrete compressive strength	59
3.6 Tests on Perforated connectors by Costa-Neves <i>et al</i> (2013)	61
3.6.1 Geometries and instrumentation	61
3.6.2 General results	63
3.6.3 Perfobond connectors	64
3.6.3.1 Force-deformation curves	64
3.6.3.2 Influence of the reinforcement bars	66
3.6.3.3 Stress history	66
3.6.4 Summary	66
3.6.5 T-Perfobond connectors	68
3.6.5.1 Force-deformation curves	68
3.6.5.2 Influence of the reinforcement bars	69
3.6.5.3 Stress history	69
3.6.6 I-Perfobond connectors	70
3.6.6.1 Force-deformation curves	70
3.6.6.2 Influence of the reinforcement bars	71
3.6.6.3 Stress history	71
3.6.7 Double T-Perfobond connectors	72
3.6.7.1 Force-deformation curves	72

3.6.7.2 Stress history	73
3.6.8 Failure modes	74
3.6.9 Influence of the connector geometry	74
<b>4. ANALYTICAL MODELS</b>	77
4.1 Introduction	77
4.2 Perfobond connectors	77
4.3 T-shaped connectors	81
4.4 Clothoid and puzzle shaped connectors	81
<b>5. COMPARISON OF EXPERIMENTAL AND ANALYTICAL RESULTS</b>	85
5.1 Perfobond connectors	85
5.1.1 Results from the first tests series (Vianna <i>et al</i> , 2009)	85
5.1.2 Results from the second series of tests (Vianna <i>et al</i> , 2013)	86
5.1.3 Detailed analysis of each analytical formulation	89
5.1.4 Results from the third series of tests by Cândido-Martins <i>et al</i> (2010)	91
5.1.5 Results from the sixth series of tests by Costa-Neves <i>et al</i> (2013)	96
5.2 T-Perfobond connectors	97
5.3 I-Perfobond connectors	100
5.4 Double T-Perfobond connectors	101
<b>6. NEEDED DEVELOPMENTS</b>	103
<b>REFERENCES</b>	105