

# TABLE OF CONTENTS



UNIVERSIDAD NACIONAL DE ENTRE RÍOS  
FACULTAD DE INGENIERÍA  
CENTRO DE MEDIOS  
BIBLIOTECA

ABSTRACT	IX
ABRIS	X
LIST OF SYMBOLS	XI
<b>1. Introduction</b>	<b>1</b>
1.1. State of the art	4
1.2. Motivation and objectives	6
1.3. Thesis outline	8
References	8
<b>2. Characterizing cellular solids: morphology and mechanics</b>	<b>13</b>
2.1. Structural properties	13
2.1.1. Trabecular bone	13
2.1.2. Synthetic foams	17
2.2. Mechanical properties	18
2.2.1. Elasticity	19
2.2.2. Elasticity & Morphology	21
2.2.3. Strength	22
References	24
<b>3. Multiaxial failure criterion: theory and testing setup</b>	<b>27</b>
3.1. Strength criteria	27
3.1.1. Hill criterion	27
3.1.2. Hoffman criterion	28
3.1.3. Tsai-Wu criterion	28
3.1.4. Fabric dependent failure criteria	29
3.2. Custom triaxial cell	34
3.3. Validation of the custom cell	36
References	37

4421

<b>4.</b>	<b>Synthetic foams: a preliminary study</b>	<b>39</b>
4.1.	Materials and methods	39
4.1.1.	Mechanical testing in the standard triaxial system	41
4.1.2.	Mechanical testing in the custom triaxial cell	42
4.1.3.	Data analysis	43
4.2.	Results	45
4.2.1.	Elastic properties	45
4.2.2.	Failure properties	46
4.2.3.	Strain-rate dependence	48
4.2.4.	Multiaxial data	49
4.3.	Discussion	51
4.3.1.	Size effect and boundary conditions	53
4.3.2.	Mechanical properties and density relationships	54
4.3.3.	Anisotropy of polyurethane foam	55
4.3.4.	Multiaxial analysis and yield surfaces	56
	References	58
<b>5.</b>	<b>Human trabecular bone: materials and methods</b>	<b>61</b>
5.1.	Materials	62
5.1.1.	Bone sample withdrawal protocol	62
5.1.2.	Bone sample evaluation and allotment	63
5.2.	Methods	64
5.2.1.	Testing protocol	64
5.2.2.	Data analysis	69
	References	73
<b>6.</b>	<b>Human trabecular bone: results and discussion</b>	<b>75</b>
6.1.	Results	75
6.1.1.	Morphology and tissue properties	75
6.1.2.	Mechanical behaviour	79
6.2.	Discussion	84
6.2.1.	Shape, architecture and composition of trabecular bone samples	85

---

6.2.2. Mechanical response of trabecular bone samples	86
References	96
<b>7. Conclusions</b>	<b>99</b>
7.1. Summary	99
7.2. Perspectives	103
References	104
<b>APPENDIX DETAIL</b>	<b>105</b>
<b>APPENDIX A</b>	<b>107</b>
<b>APPENDIX B</b>	<b>111</b>
<b>APPENDIX C</b>	<b>123</b>
<b>ACKNOWLEDGMENTS</b>	<b>131</b>
<b>CURRICULUM VITAE</b>	<b>133</b>