

## APPENDIX – A

### Mechanical Properties of Human Compact Bone[78]

Properties	Parallel Distribution	Normal Distribution
Tensile Strength (MPa)	124 – 174	49
Compression Strength (MPa)	170-193	133
Bending Strength (MPa)	160	
Shear Strength (MPa)	54	
Young's Modulus	17.0 – 18.9	11.5
Work of Fracture (J/m <sup>2</sup> )	6006 (Low Strain) 98 (High Strain)	
Ultimate Tensile Strain	0.014 – 0.031	0.007
Ultimate Compressive Strain	0.0185 – 0.026	0.028
Yield Tensile Strain	0.007	0.004
Yield Compressive Strain	0.010	0.011

### Callus

4 Weeks – Elastic Modulus	80N/mm <sup>2</sup>
8 Weeks – Elastic Modulus	700 – 2800 Nmm <sup>2</sup>
12 Weeks – Elastic Modulus	5000 – 20000 N/mm <sup>2</sup>

### Bone as a Material

Bone Type	Load Type	Elastic Modulus 10 <sup>6</sup> N/m <sup>2</sup>	Ultimate Stress 10 <sup>6</sup> N/m <sup>2</sup>
Cortical	Tension	11.4 – 19.1	107 – 146
	Compression	15.1 – 19.7	156 – 212
	Shear	-	73 – 82
Cancellous	Tension	≈0.2 – 5	≈3 – 20
	Compression	0.1 - 3	1.5 - 50
	Shear	-	6.60 ± 1.66
Tibia	Torsion along long axis 101 ± 35Nm		

## Standard Units

### Force:

Newton = 0.1 Kilogram = 0.22 Pounds Force = 0.1 Kilo pound (Kp)

### Pressure or Stress:

Force/Area = Newton/Metre<sup>2</sup> (N/m<sup>2</sup>) = 1 Pascal (Pa)

Pascal:

1N/m<sup>2</sup> = 1 \* 10<sup>4</sup> pounds/inches<sup>2</sup> (psi)

10<sup>3</sup>N/m<sup>2</sup> = 1 Kilo Pascal (KPa)

10<sup>6</sup>N/m<sup>2</sup> = 1 Mega Pascal (MPa)

10<sup>9</sup>N/m<sup>2</sup> = 1 Giga Pascal (GPa)

### Moment:

Force \* moment arm distance Newton-Meter (Nm)

### Axial Stiffness:

Force/Deformation (N/mm)