

# Project: Post & Beam

## Contents

### A Post & Beam Perspective i

#### CHAPTER ONE

### The Plan 1

- 1.1 Methodology 1
- 1.2 Parts and Terminology 2
- 1.3 Project Drawing Views 3
  - 1.3 Plan Views 4
  - 1.3 Elevation Views 4
  - 1.3 Sectional / Detail Views 5

#### CHAPTER TWO

### Joinery Design 6

- 2.1 Full Tenon and Mortise 6
- 2.2 Peg Tenon and Mortise 7
- 2.3 Kneebrace - Tenon and Mortise 7
- 2.4 Shouldered Half-lap 8
- 2.5 Shouldered Corner Dovetail 8
- 2.6 Shouldered / Housed Dovetail 9
- 2.7 Butted and Splined Splice 10
- 2.8 Splayed Wedged Scarf 11
- 2.9 Bladed Scarf 11

#### CHAPTER THREE

### Shop Drawings 12

- 3.1 Plan Grid 12
  - 3.1 Post Labeling 13
  - 3.1 Beam Labeling 14
- 3.2 Posts 15
- 3.3 Single - Shouldered Kneebraces 16
- 3.4 Gable Wall Beams 17
- 3.5 Sidewall Beams 18
- 3.6 Tie Beam 19
- 3.7 Ridge Beam 20
- 3.8 Spread Sheet 20

#### CHAPTER FOUR

### Timber Joinery 22

- 4.1 Material Preparation 22
  - 4.1 Centerline Layout 24
  - 4.1 Squaring Line 25

# Project: Post & Beam

## Contents

<b>4.2 Mid and Corner Post Tenons</b>	<b>26</b>
4.2 King Post Tenons	28
<b>4.3 Gable Plate Beams</b>	<b>29</b>
4.3 Splayed Wedged Scarf	30
4.3 Splayed Wedged Scarf Template	30
4.3 Splayed Wedged Scarf: Layout	33
4.3 Splayed Wedged Scarf: Cutting	34
4.3 Fitting the Scarf / Layout of Additional Joinery Waypoints	35
4.3 Gable Beam Post Mortises	36
4.3 Fitting Posts to Beams	37
4.3 Gable Beam Shouldered Half-Lap	39
4.3 Fitting Shouldered Half-Lap	40
<b>4.4 Kneebrace Math</b>	<b>41</b>
4.4 Determining the Kneebrace Hypotenuse / Overall Length	42
4.4 36" Kneebrace Layout	42
4.4 Single - Shoulder Kneebrace Tenon	43
4.4 Quarter Point Layout - Cutting a Curve	45
4.4 36" Kneebrace Mortise	46
4.4 Fitting Kneebraces to the Post and Beam	47
<b>4.5 Sidewall Plate Beams</b>	<b>48</b>
4.5 Centerline Layout on Bowed Timbers	49
4.5 Butted Splice with Spline Connection	50
4.5 Fitting Spline Connections	51
4.5 Post and Kneebrace Mortises	52
4.5 Shouldered Half-Lap	52
4.5 Shouldered Dovetail (Female)	53
<b>4.6 Tie Beam</b>	<b>55</b>
4.6 Shouldered Dovetail (Male)	56
4.6 Fitting Shouldered Dovetail	58
4.6 Bladed Scarf	58
<b>4.7 Ridge Beam Joinery</b>	<b>60</b>
<b>4.8 Pegging Template Design</b>	<b>61</b>
4.8 Post Pegging Template	62
4.8 Kneebrace Pegging Template	63
4.8 Spline Pegging Template	64
4.8 Drawboring Tenons	65
<b>4.9 Second Floor Frame (optional)</b>	<b>66</b>
4.9 Shouldered Corner Dovetail	67
<b>4.10 Floor Joist Layout</b>	<b>68</b>
4.10 Housed 2" Lap	69
4.10 Joist Housing	70
4.10 Housed Dovetail	71
4.10 Tusk Mortise and Tenon	72
<b>4.11 Timber Finishing and Packaging</b>	<b>73</b>
4.11 Edging	73
4.11 Planing	73
4.11 Finish	74
4.11 Packaging	74
<b>4.12 Project P&amp;B Frame Assembly</b>	<b>75</b>

# Project: Post & Beam

## Contents

### CHAPTER FIVE

## **Raftered Roof Framing 77**

<b>5.1 Common Rafter Length</b>	77
5.1 Pythagorean Theorem	78
5.1 Rafter Square Tables	79
5.1 The Constant Method	79
5.1 Rafter Stepping-Off (Imperial)	80
<b>5.2 Rafter Stepping-Off (Metric)</b>	81
<b>5.3 Gable End Framing</b>	83

### CHAPTER SIX

## **Infill Wall System 85**

<b>6.1 E.P.S. Panel Fabrication</b>	86
<b>6.2 Frame and Panel Construction</b>	87
<b>6.3 Acrylic Stucco Basecoat</b>	89
<b>6.4 Infill Panel Installation/Finish</b>	90
<b>6.5 Timber Post &amp; Beam Design</b>	91

### PROJECT PHOTOS

## **Post & Beam 93**

## **Hammer Bents 97**

# Project: Hammer Bents

## Contents

### A Bents Perspective 103

#### CHAPTER ONE

### The Plan 109

1.1 Methodology	109
1.2 Parts and Terminology	110
1.3 Project Drawing Views	111
1.3 Elevation Views	111
1.3 Plan Views	113

#### CHAPTER TWO

### Joinery Design 114

2.1 45° Blind Tenon/Mortise with Sloped Shoulder	115
2.2 Wedged Thru Tenon/Mortise with Sloped Shoulder	115
2.3 Wedged Thru Tenon/Mortise with Housing	116
2.4 Shouldered Thru Open Tenon/Mortise	117
2.5 Double - Shouldered Housed Kneebrace	117
2.6 Single - Shouldered Kneebrace	118
2.7 Collar Tie	118
2.8 Housing and Spline Connection	118
2.9 Housed 2" Lap	119

#### CHAPTER THREE

### Shop Drawings 120

3.1 Centerline Lofted Layout	120
3.2 Virtual Sizing of Timbers	122
3.3 Principal Posts	123
3.3 45° Sloped Shouldered Tenon	123
3.3 Thru Mortise with 1" Housing	124
3.3 36" Kneebrace Housed Mortise	124
3.3 Thru Mortise with 1" Housing	124
3.3 48" Kneebrace Mortise	125
3.4 Hammer Girts	125
3.4 Housed Thru Wedged Tenon	126
3.4 36" Kneebrace Housed Mortise	126

# Project: Hammer Bents

## Contents

3.4 Sloped Shouldered Thru Wedged Tenon	126
<b>3.5 Hammer Posts</b>	<b>127</b>
3.5 45° sloped Shouldered Tenon	127
3.5 Sloped Shouldered Thru Mortise	127
3.5 36" Kneebrace Housed Mortise	127
3.5 Sloped Shouldered Thru Mortise (Reversed)	128
<b>3.6 Anchor Beams</b>	<b>128</b>
3.6 Sloped Shouldered Thru Wedged Tenon	128
3.6 Kneebrace Housed Mortise	129
<b>3.7 Principal Rafters</b>	<b>129</b>
3.7 Shouldered Thru Open Mortise/Tenon	129
3.7 45° Sloped Shouldered Mortise	129
3.7 45° Plumb Cut	130
3.7 Housed 2" Lap	130
<b>3.8 Connecting Girts</b>	<b>130</b>
3.8 Housing with Spline Mortise	130
3.8 Housed Thru Wedged Tenon	131
3.8 48" Kneebrace Mortise	131
<b>3.9 48" Kneebrace Single - Shouldered Tenon</b>	<b>131</b>
<b>3.10 36" Kneebrace Double - Shouldered Tenon</b>	<b>132</b>
3.10 Dovetail Collar Tie	132
<b>3.11 Purlins</b>	<b>133</b>
3.11 Housed 2" Lap	133
<b>3.12 Project Spreadsheet</b>	<b>133</b>

## CHAPTER FOUR

### Timber Joinery 138

<b>4.1 Centerline and Virtual Layout</b>	<b>138</b>
<b>4.2 Squaring Line</b>	<b>139</b>
<b>4.3 Straight-edge Guides and Templates</b>	<b>140</b>
<b>4.4 Principal Posts</b>	<b>142</b>
4.4 45° Sloped Shouldered Tenon	142
4.4 Thru Mortises	144
4.4 Housings	145
<b>4.5 Mitered Fat</b>	<b>146</b>
<b>4.6 48" Kneebraces Single - Shoulder Tenon</b>	<b>148</b>
4.6 48" Kneebrace Mortise	149
<b>4.7 36" Kneebrace Double - Shouldered Tenon</b>	<b>150</b>
4.7 36" Kneebrace Housed Mortise	152
4.7 Quarter Point Layout	153
<b>4.8 Hammer Girts</b>	<b>154</b>
4.8 Housed Thru Wedged Tenon	155
4.8 Cutting Long Tenons	156
<b>4.9 Hammer Posts</b>	<b>158</b>
4.9 45° Sloped Shoulder Tenon	159
4.9 Sloped Shoulder Thru Mortise	159

# Project: Hammer Bents

## Contents

4.9 36" Kneebrace Housed Mortise	160
<b>4.10 Anchor Beam</b>	<b>160</b>
4.10 Sloped Shoulder Through Tenon	160
4.10 36" Kneebraces Housed Mortise	161
<b>4.11 Principal Rafters</b>	<b>162</b>
4.11 Shouldered Thru Open Tenon/Mortise	163
4.11 45° Sloped Shouldered Mortise	163
4.11 Housed 2" Lap	164
<b>4.12 Collar Tie Dovetail Half-Lap</b>	<b>165</b>
<b>4.13 Purlins</b>	<b>165</b>
4.13 Housed 2" Lap	166
<b>4.14 Connecting Girts</b>	<b>167</b>
4.14 Housing and Spline Connection	168
4.14 Housed Thru Wedged Tenon	168
4.14 48" Kneebrace Mortise	168
<b>4.15 Pre-Drilling the Mortises</b>	<b>169</b>
<b>4.16 Hammer Bent Test Fitting</b>	<b>170</b>
4.16 Drawboring Tenons	172
<b>4.17 Frame Finishing and Packaging</b>	<b>173</b>

## CHAPTER FIVE

### **Project Frame Raising 174**

<b>5.1 Board Footage Measure</b>	<b>174</b>
<b>5.2 Volume and Weight</b>	<b>174</b>
<b>5.3 Vertical Center of Gravity</b>	<b>175</b>
<b>5.4 Lifting Tackle Loads</b>	<b>175</b>
5.4 Vertical Lifting Force	176
5.4 Horizontal Force	176
5.4 Tackle Force	176
5.4 Guy Force	176
5.4 Gin Pole Compression	177
5.4 Manpower	177
<b>5.5 Anchoring Posts to Foundation</b>	<b>177</b>
<b>5.6 Timber Frame Raising</b>	<b>178</b>

## CHAPTER SIX

### **Wall / Roof System 181**

<b>6.1 Structural Insulated Panels (S.I.P.)</b>	<b>181</b>
<b>6.2 Timber Hammer Bents Design</b>	<b>182</b>
<b>6.3 Post &amp; Beam with Hammer Bents Design</b>	<b>182</b>

# Appendix

## Contents

### APPENDIX I

## Timber Frame Tools 184

<b>I.1 Layout Tools</b>	184
<b>I.2 Lifting and Hold-down Tools</b>	185
<b>I.3 Hand Tools</b>	186
<i>I.3 Grinding and Sharpening</i>	187
<b>I.4 Power Tools</b>	188
<i>I.4 Power Tool Safety</i>	189
<i>I.4 Personal Safety</i>	189
<i>I.4 Tool Use and Care</i>	190

### APPENDIX II

## Wood 191

<b>II.1 Wood Structure</b>	191
<i>II.1 Wood Seasoning</i>	192
<b>II.2 Drying Timbers</b>	193
<i>II.2 Shrinkage Effect</i>	194
<b>II.3 Timber Grades</b>	195
<i>II.3 Wood Defects</i>	196
<b>II.4 Wood Degradation</b>	197
<b>II.5 Wood Treatments</b>	198
<b>II.6 Wood Repair</b>	199
<b>II.7 Wood Finishes</b>	200

### APPENDIX III

## Structural Beam Loading and Sizing 203

<b>III.1 Defining Loads</b>	205
<b>III.2 Calculating Beam Size</b>	205
<i>III.2 Determining Floor Girder Size</i>	205
<i>III.2 Determining Roof Ridge and Purlin Beam Sizes</i>	206

### APPENDIX IV

## Structural Concepts 207

<b>IV.1 Loads Defined</b>	207
---------------------------	-----

# Appendix

## Contents

<i>IV.1</i> Dead Loads	207
<i>IV.1</i> Live Loads	208
<i>IV.1</i> Wind Loading	208
<i>IV.1</i> Snow Loads	208
<i>IV.1</i> Earthquake	209
<b>IV.2 Load Distribution</b>	<b>209</b>
<b>IV.3 Forces in Equilibrium</b>	<b>210</b>
<i>IV.3</i> Sectioning Technique	210
<i>IV.3</i> Resultants and Components	211
<b>IV.4 Strength of Materials</b>	<b>211</b>
<i>IV.4</i> Strain	213
<i>IV.4</i> Deformation	213
<b>IV.5 Structural Properties of Wood</b>	<b>214</b>
<i>IV.5</i> Allowable Stresses	214
<b>IV.6 Connections</b>	<b>215</b>
<b>IV.7 Hammer Bent Analysis</b>	<b>215</b>