# LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE NO.</th>
<th>TITLE</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Pull-push forces on joints</td>
<td>2</td>
</tr>
<tr>
<td>1.2</td>
<td>Types of joint in moment resisting frame</td>
<td>7</td>
</tr>
<tr>
<td>1.3</td>
<td>Beam-Column Joints</td>
<td>7</td>
</tr>
<tr>
<td>1.4</td>
<td>Three joints in a framed structure</td>
<td>8</td>
</tr>
<tr>
<td>3.1</td>
<td>Elevation of the building</td>
<td>21</td>
</tr>
<tr>
<td>3.2</td>
<td>Plan of the building</td>
<td>21</td>
</tr>
<tr>
<td>3.3</td>
<td>3D Frame of the building</td>
<td>22</td>
</tr>
<tr>
<td>3.4</td>
<td>Bending Moment profile for the reinforced concrete building</td>
<td>23</td>
</tr>
<tr>
<td>3.5</td>
<td>Bending Moment Diagram</td>
<td>24</td>
</tr>
<tr>
<td>3.6</td>
<td>Shear Force Diagram</td>
<td>25</td>
</tr>
<tr>
<td>3.7</td>
<td>Reinforcement details of EBCJ</td>
<td>27</td>
</tr>
<tr>
<td>3.8</td>
<td>Bending Moment Diagram</td>
<td>28</td>
</tr>
<tr>
<td>3.9</td>
<td>Shear force Diagram</td>
<td>28</td>
</tr>
<tr>
<td>3.10</td>
<td>Reinforcement details of IBCJ</td>
<td>30</td>
</tr>
<tr>
<td>3.11</td>
<td>3D view of IBCJ</td>
<td>31</td>
</tr>
<tr>
<td>3.12</td>
<td>Reinforcement details of CBCJ</td>
<td>33</td>
</tr>
<tr>
<td>3.13</td>
<td>3D view of CBCJ</td>
<td>34</td>
</tr>
<tr>
<td>3.14</td>
<td>Reinforcement details of EBCJS</td>
<td>37</td>
</tr>
<tr>
<td>3.15</td>
<td>Reinforcement Details of IBCJS</td>
<td>37</td>
</tr>
<tr>
<td>3.16</td>
<td>3D view of the IBCJS</td>
<td>38</td>
</tr>
<tr>
<td>3.17</td>
<td>Reinforcement details of CBCJS</td>
<td>38</td>
</tr>
<tr>
<td>3.18</td>
<td>3D view of a CBCJS</td>
<td>39</td>
</tr>
<tr>
<td>4.1</td>
<td>Casting of EBCJ specimen</td>
<td>42</td>
</tr>
<tr>
<td>4.2</td>
<td>Casting of EBCJS specimen</td>
<td>42</td>
</tr>
</tbody>
</table>
4.3 Curing of EBCJ specimen
4.4 Curing of EBCJS specimen
4.5 Casting of IBCJ specimen
4.6 Casting of IBCJS specimen
4.7 Curing of IBCJ specimen
4.8 Curing of IBCJS specimen
4.9 Casting of CBCJ specimen
4.10 Casting of CBCJS specimen
4.11 Curing of CBCJ specimen
4.12 Curing of CBCJS specimen
4.13 Test setup of EBCJ specimen
4.14 Test setup of EBCJS specimen
4.15 Test setup of IBCJ specimen
4.16 Test setup of IBCJS specimen
4.17 Test setup of CBCJ specimen
4.18 Test setup of CBCJS specimen
5.1 Load - Deflection curve of EBCJ
5.2 Load - Deflection curve of EBCJS
5.3 Deflected profiles of EBCJ and EBCJS
5.4 Failure Pattern of EBCJ
5.5 Failure Pattern of EBCJS
5.6 Failure pattern of top face of slab
5.7 Loading sequence diagram of IBCJ
5.8a Load vs. Deflection curve of a North beam of IBCJ
5.8b Load vs. Deflection curve of a South Beam of IBCJ
5.8c Load vs. Deflection curve of a East Beam of IBCJ
5.8d Load vs. Deflection curve of a West Beam of IBCJ 64
5.9 Loading Sequence Diagram of IBCJS 68
5.10a Load vs. Deflection curve of North Beam of IBCJS 69
5.10b Load vs. Deflection curve of South Beam of IBCJS 69
5.10c Load vs. Deflection curve of East Beam of IBCJS 70
5.10d Load vs. Deflection curve of West Beam of IBCJS 70
5.11a Energy Dissipation curve of a North Beam of IBCJ 72
5.11b Energy Dissipation curve of a South Beam of IBCJ 72
5.11c Energy Dissipation curve of a East Beam of IBCJ 72
5.11d Energy Dissipation curve of a West Beam of IBCJ 73
5.12 Combined Energy dissipation curves for beams of IBCJ 73
5.13a Energy Dissipation curve of North Beam of IBCJS 75
5.13b Energy Dissipation curve of South Beam of IBCJS 75
5.13c Energy Dissipation curve of East Beam of IBCJS 76
5.13d Energy Dissipation curve of West Beam of IBCJS 76
5.14 Combined Energy dissipation curves for beams of IBCJS

5.15a Ductility Factor curve of North beam of IBCJ

5.15b Ductility Factor curve of South beam of IBCJ

5.15c Ductility Factor curve of East beam of IBCJ

5.15d Ductility Factor curve of West beam of IBCJ

5.16 Combined Ductility Factor for beams of IBCJ

5.17a Ductility Factor curve of North beam of IBCJS

5.17b Ductility Factor curve of South beam of IBCJS

5.17c Ductility Factor curve of East beam of IBCJS

5.17d Ductility Factor curve of West beam of IBCJS

5.18 Combined Ductility Factor for beams of IBCJS

5.19a Stiffness Degradation of North beam of IBCJ

5.19b Stiffness Degradation of South beam of IBCJ

5.19c Stiffness Degradation of East beam of IBCJ

5.19d Stiffness Degradation of West beam of IBCJ

5.20 Combined Stiffness Degradation curves of beams of IBCJ

5.21a Stiffness Degradation curve of North Beam of IBCJS

5.21b Stiffness Degradation curve of South Beam of IBCJS
5.21c Stiffness Degradation curve of East Beam of IBCJS 90
5.21d Stiffness Degradation curve of West Beam of IBCJS 91
5.22 Combined Stiffness Degradation curves for beams of IBCJS 91
5.23 Failure pattern of IBCJ 92
5.24 Failure pattern of IBCJ (Source: Bum-Sik Leel 2012) 93
5.25 Crack pattern of bottom side of IBCJS 94
5.26 Load Sequence of CBCJ specimen 96
5.27a Load vs. Deflection of North Beam of CBCJ 97
5.27b Load vs. Deflection of East Beam of CBCJ 97
5.28 Load Sequence diagram of CBCJS 101
5.29a Load vs. Deflection of North Beam of CBCJS 101
5.29b Load vs. Deflection of East Beam of CBCJS 102
5.30a Energy Dissipation curve of North Beam of CBCJ 103
5.30b Energy Dissipation curve of East Beam of CBCJ 103
5.31 Combined Energy Dissipation curves for beams of CBCJ 104
5.32a Energy Dissipation curve of North Beam of CBCJS 105
5.32b Energy Dissipation curve of East Beam of CBCJS 106
5.33 Combined Energy Dissipation of beams of CBCJS 106
5.34a Ductility Factor of North beam of CBCJ 107
5.34b Ductility Factor of East beam of CBCJ 108
5.35 Combined Ductility Factor for beams of CBCJ 108
5.36a Ductility Factor of North beam of CBCJS 110
5.36b Ductility Factor of East beam of CBCJS 110
5.37 Combined Ductility Factor for beams of CBCJS 111
5.38a Stiffness Degradation of North Beam of CBCJ 113
5.38b Stiffness Degradation of East Beam of CBCJ 113
5.39 Combined stiffness degradation for beams of CBCJ 114
5.40a Stiffness Degradation of North Beam of CBCJS 115
5.40b Stiffness Degradation of East Beam of CBCJS 116
5.41 Combined stiffness degradation for beams of CBCJS 116
5.42 Failure pattern of CBCJ 117
5.43 Crack pattern (Source: Sangjoon Park et al. 2013) 118
5.44 Failure pattern of CBCJS 119
5.45 Crack pattern (Sangjoon Park et al. 2013) 119
6.1 Concrete part 123
6.2 Reinforcement part 123
6.3 Assembly and interaction of parts 124
6.4 Meshing 124
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5a</td>
<td>Deflection at 2 kN Loading – 4.42 mm- EBCJ</td>
</tr>
<tr>
<td>6.5b</td>
<td>Deflection at 4 kN Loading – 9.44 mm- EBCJ</td>
</tr>
<tr>
<td>6.5c</td>
<td>Deflection at 6 kN Loading – 15.58 mm- EBCJ</td>
</tr>
<tr>
<td>6.5d</td>
<td>Deflection at 8 kN Loading – 30.33 mm- EBCJ</td>
</tr>
<tr>
<td>6.5e</td>
<td>Deflection at 9 kN Loading – 50.26 mm- EBCJ</td>
</tr>
<tr>
<td>6.6</td>
<td>Load vs. Deflection curves of EBCJ (Analytical and Experimental work)</td>
</tr>
<tr>
<td>6.7a</td>
<td>Deflection at 5 kN Loading - 1.05mm - EBCJS</td>
</tr>
<tr>
<td>6.7b</td>
<td>Deflection at 10 kN Loading - 3.05mm- EBCJS</td>
</tr>
<tr>
<td>6.7c</td>
<td>Deflection at 15 kN Loading - 3.45mm- EBCJS</td>
</tr>
<tr>
<td>6.7d</td>
<td>Deflection at 20 kN Loading - 4.65mm- EBCJS</td>
</tr>
<tr>
<td>6.7e</td>
<td>Deflection at 25 kN Loading - 5.05mm- EBCJS</td>
</tr>
<tr>
<td>6.7f</td>
<td>Deflection at 30 kN Loading - 5.45mm- EBCJS</td>
</tr>
<tr>
<td>6.7g</td>
<td>Deflection at 35 kN Loading - 6.24mm- EBCJS</td>
</tr>
<tr>
<td>6.7h</td>
<td>Deflection at 40 kN Loading - 9.44mm- EBCJS</td>
</tr>
</tbody>
</table>
6.7i Deflection at 45 kN Loading - 14.22mm- EBCJS
6.7j Deflection at 50 kN Loading - 22.22mm- EBCJS
6.8 Load and Deflection curve of EBCJS - Analytical and Experimental work
6.9a Deflection at 5kN Loading – 2.20 mm -IBCJ
6.9b Deflection at 10kN Loading – 5.84 mm -IBCJ
6.9c Deflection at 15kN Loading – 9.58 mm -IBCJ
6.9d Deflection at 20kN Loading – 17.76 mm -IBCJ
6.10 Stress Diagram of IBCJ specimen
6.11 Strain Diagram of IBCJ specimen
6.12 Load vs. Deflection curves of IBCJ (Analytical and Experimental work)
6.13a Deflection at 5kN Loading - 1.47mm-IBCJS
6.13b Deflection at 10kN Loading – 5.78mm-IBCJS
6.13c Deflection at 15kN Loading – 7.68mm-IBCJS
6.13d Deflection at 20kN Loading – 11.35mm-IBCJS
6.13e Deflection at 25kN Loading – 14.56mm-IBCJS
6.13f Deflection at 30kN Loading – 18.67mm-IBCJS
6.13g Deflection at 35kN Loading – 21.92mm-IBCJS
6.13h Deflection at 40kN Loading – 25.87mm - IBCJS 142
6.13i Deflection at 45kN Loading – 28.65mm - IBCJS 142
6.13j Deflection at 50kN Loading – 34.90mm - IBCJS 142
6.13k Deflection at 55kN Loading – 38.80mm - IBCJS 143
6.14 Stress diagram of IBCJS 143
6.15 Strain diagram of IBCJS 144
6.16 Load vs. Deflection curves of North Beams of IBCJS (Analytical and Experimental work) 145
6.17a Deflection at 5kN Loading – 4.06mm - CBCJ 146
6.17b Deflection at 10kN Loading – 12.55mm - CBCJ 147
6.17c Deflection at 14kN Loading – 18.63mm - CBCJ 147
6.18 Load vs. Deflection curve of CBCJ (Analytical and Experimental work) 148
6.19a Deflection at 5kN Loading - 1.56mm - CBCJS 149
6.19b Deflection at 10kN Loading – 3.34mm - CBCJS 150
6.19c Deflection at 15kN Loading – 5.56mm - CBCJS 150
6.19d Deflection at 20kN Loading – 8.16mm – CBCJS 150
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.19e</td>
<td>Deflection at 25kN Loading – 12.25mm - CBCJS</td>
<td>151</td>
</tr>
<tr>
<td>6.19f</td>
<td>Deflection at 30kN Loading – 16.55mm - CBCJS</td>
<td>151</td>
</tr>
<tr>
<td>6.19g</td>
<td>Deflection at 35kN Loading – 20.40mm - CBCJS</td>
<td>151</td>
</tr>
<tr>
<td>6.19h</td>
<td>Deflection at 40kN Loading – 23.33mm - CBCJS</td>
<td>152</td>
</tr>
<tr>
<td>6.19i</td>
<td>Deflection at 45kN Loading – 27.14mm - CBCJS</td>
<td>152</td>
</tr>
<tr>
<td>6.20</td>
<td>Deflected profile of North beam of CBCJS (Analytical and Experimental work)</td>
<td>153</td>
</tr>
</tbody>
</table>