Outlines

• Specimen Design
• Construction
• Test Setup
• Instrumentation Scheme
  – Interior
  – Exterior
• Material Property
• Test Result
Specimen Design
Scope of Beam-Column Joint Specimen

Side View

Plane View
Cross Section of Members

\[ \rho_s = 2.53\% \]

**Column**
- Longitudinal Rebar: 8-D19
- Stirrups: D10@12 cm
- Crossties: D10@24 cm
- Stirrups: 90° Hook, Staggered
- Crossties: 135° and 90° Hooks, Staggered
- Cover: 2 cm

**Beam**
- Longitudinal Rebar: 10-D19
- Stirrups: D10@15 cm
- Stirrups: 135° and 90° Hooks, Staggered
- Cover: 2 cm
Beam-Column Joint A

Plane View

Side View

Front View

Section A-A

Section D-D

Section C-C

Section B-B
Specimen Construction
Specimen Construction

- Rebar Installation Completed
- Formwork Assembly Completed
- Concrete Pouring Completed
Test Setup
Test Setup Sketch

Loading Direction

Front View

Side View

Load cell

Beam

Bottom View

Base

Column

190

35 27 20

37.5 22 ± 3

20

2.5

12

20

42

20

50

5.6

5.6

31.8

65.6

5080

15

17

13

29

80

29

15

2

10

30

65

260

40

110

65

540
Instrumentation Scheme

- Interior
- Exterior
Strain Gauge
(Beam-Column Joint A)

Total 46
Longitudinal: 32
Transverse: 14

Section B-B
- Longitudinal: 32
  - Stain Gage A: 6
  - Stain Gage B: 6
- Ties: 6
  - Stain Gage C: 6
  - Stain Gage D: 6
Total 24

Section C-C
- Longitudinal: 22
  - Stain Gage A: 4
  - Stain Gage B: 4
  - Stain Gage C: 4
  - Stain Gage D: 4
  - Stain Gage E: 4
- Hoop: 2
  - Stain Gage F: 2
Total 22
Strain Gauge
(Beam-Column Joint B)

Total 46
Longitudinal: 32
Transverse: 14

Bottom View
Strain Gauge A, D

Top View
Strain Gauge B, D

Side View
Strain Gauge C

Section B-B
Longitudinal
Stain Gage A: 6
Stain Gage B: 6
Hoop
Stain Gage C: 6
Tie
Stain Gage D: 6
Total 24

Section C-C
Longitudinal
Stain Gage A: 4
Stain Gage B: 4
Stain Gage C: 4
Stain Gage D: 4
Stain Gage E: 4
Total 22

Hoop
Stain Gage F: 2
Exterior (Beam-Column Joint A/B)

Loading Direction

NDI Makers (45 Maker)
Material Property
## Compression Strength of Concrete

<table>
<thead>
<tr>
<th>Specimen</th>
<th>$f'_c$ (MPa)</th>
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</thead>
<tbody>
<tr>
<td>Specimen 1</td>
<td>24.87</td>
</tr>
<tr>
<td>Specimen 2</td>
<td>24.86</td>
</tr>
<tr>
<td>Specimen 3</td>
<td>24.47</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>24.73</strong></td>
</tr>
</tbody>
</table>
Stress-Strain Curve of Concrete
Test Result

• **Beam-Column Joint A**
• **Beam-Column Joint B**
Loading Protocol

2 Cycles Applied at Each Displacement Level

Drift Ratio (%)

Load Cycle

Loading Direction

NAR Labs
National Applied Research Laboratories
Hysteretic Loop (Beam-Column Joint A)

Max Load: 100.40 kN @2.0%

Max Load: -100.67 kN @2.0%
Crack Pattern (Beam-Column Joint A)

Start

$V_{max} = 100.40 \text{ kN}$
(Drift Ratio = 2%)

Final
(Drift Ratio = 5%)
Hysteretic Loop (Beam-Column Joint B)

Max Load: 157.60 kN @3.0%

Max Load: -157.41 kN @3.0%
Crack Pattern (Beam-Column Joint B)

Start

\[ V_{\text{max}} = 157.60 \text{ kN} \]
(Drift Ratio = 3%)

Final
(Drift Ratio = 7%)
Comparison of Hysteretic Loop

- **Beam-Column Joint A** vs. **Beam-Column Joint B**

Max Load: **100.40 kN @2.0%**
Max Load: **157.60 kN @3.0%**

Max Load: **-100.67 kN @2.0%**
Max Load: **-157.41 kN @3.0%**
Analytical Result

• Beam-Column Joint A
• Beam-Column Joint B
NDI Maker Position
Calculation of $\gamma_{avg}$

$$\frac{\Delta - \bar{\Delta}}{2} \times \frac{d}{bh}$$

where $b \approx 200 \text{ mm}$, $h \approx 200 \text{ mm}$,

d is calculated by NDI embedded program
Comparison of Shear Deformation

- **Beam-Column Joint A vs. Beam-Column Joint B**
Lateral Force vs. Shear Deformation
(Beam-Column Joint A)
Lateral Force vs. Shear Deformation
(Beam-Column Joint B)
Thanks for your kind attentions