EARTHQUAKE EXPERIENCE OF TURKISH PRECAST INDUSTRY

TURKISH PRECAST BUILDINGS COMMITTEE
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Istanbul Technical University

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Bologna-ITALY
BRIEF HISTORY OF TURKISH PRECAST INDUSTRY

- First experiences in RC precast construction goes back 1960s.
- 90% of the industrial buildings were constructed by using RC precast technology in 1990s.
- Western European type frame structures (gravity frames) were constructed commonly.
- During the last two decades, awareness about EQ behavior are increased.
- Moment resisting connections, diaphragm action, drift restriction etc.
Earthquake Damages Recorded in Last 30 Years (Members of TPA)

<table>
<thead>
<tr>
<th>TURKISH EQs</th>
<th>Year</th>
<th>M_w</th>
<th>PGA</th>
<th>Total Building</th>
<th>Collapsed and Heavy Damaged</th>
<th>Minor/Moderate Damages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adana / Ceyhan</td>
<td>1998</td>
<td>5.9</td>
<td>0.22 g</td>
<td>114</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Körfez / Kocaeli</td>
<td>1999</td>
<td>7.4</td>
<td>0.32 g</td>
<td>481</td>
<td>17</td>
<td>14</td>
</tr>
<tr>
<td>Bingol</td>
<td>2003</td>
<td>6.1</td>
<td>0.55 g</td>
<td>39</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Van</td>
<td>2011</td>
<td>7.2</td>
<td>0.25 g</td>
<td>66</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>700</td>
<td>17</td>
<td>21</td>
</tr>
</tbody>
</table>

App. 3%
Single Story Frame Structures – Industrial Buildings
Single Story Frame Structures – Industrial Bldgs.
Single Story Frame Structures – Industrial Bldgs.
1999 Kocaeli EQ.

Photo: Prof. Dr. Şevket ÖZDEN
Single Story Frame Structures – Industrial Bldgs.
1999 Kocaeli EQ.

Single Story Frame Structures – Gymnasium
2011 Van EQ.

Single Story Frame Structures – Industrial Bldgs.
2011 Van EQ.

Single Story Frame Structures – Industrial Bldgs.
Hammering Effect Flexible vs. Rigid Adjacent Buildings
EARTHQUAKE EXPERIENCE OF TURKISH PRECAST INDUSTRY

2011 Van EQ.

Single Story Frame Structures – Industrial Bldgs.
Multi-Story Frame Structures – Residential Bldgs.
2004 Bingol EQ.

**Photo:** Hakan ATAKÖY

**Multi-Story Frame Structures – Residential Bldgs.**
1999 Kocaeli EQ.

Student Hostel
Avcılar-Istanbul
2011 Van EQ.

*Multi-Story Frame Structures – Gymnasiums*
Residential Houses For Immigrants – Kocaeli - 1990

Multi-Story Panel Structures – Residential Housing
1999 Kocaeli EQ.

Conventional RC vs. Precast RC Buildings
Construction of Post-tensioning Precast RC Building
2011 Van
RESEARCH ACTIVITIES
FULL SCALE COLUMN TESTS

ISTANBUL TECHNICAL UNIVERSITY
ALTERNATIVE CONNECTION DETAILS

17.5 cm  55 cm  17.5 cm

17.5 cm  55 cm  17.5 cm

5 cm  50 cm  5 cm

50 cm  150 cm  150 cm
FULL SCALE COLUMN TESTS
## MOMENT RESISTING BEAM-COLUMN CONNECTION TESTS
SAFECAST 2009- 2012

<table>
<thead>
<tr>
<th>Industrial Type</th>
<th>ITMNM</th>
<th>ITMPM</th>
<th>ITC-1</th>
<th>ITC-2</th>
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</thead>
<tbody>
<tr>
<td>Residential Type</td>
<td>RTMNM</td>
<td>RTMPM</td>
<td>RTC-1</td>
<td>RTC-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IT</th>
<th>M</th>
<th>PM</th>
<th>IT</th>
<th>RT</th>
<th>C</th>
<th>NM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Type</td>
<td>Monotonic</td>
<td>Positive Moment</td>
<td>Residential Type</td>
<td>Cyclic</td>
<td>Negative Moment</td>
<td></td>
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</tbody>
</table>

27.10.2016
MOMENT RESISTING BEAM-COLUMN CONNECTION TESTS
SAFECAST 2009- 2012

INDUSTRIAL TYPE BEAM-COLUMN CONNECTION
MOMENT RESISTING BEAM-COLUMN CONNECTION TESTS
SAFECAST 2009- 2012

RESIDENTIAL TYPE BEAM-
COLUMN CONNECTION
MOMENT RESISTING BEAM-COLUMN CONNECTION TESTS
SAFECAST 2009- 2012
MOMENT RESISTING BEAM-COLUMN CONNECTION TESTS
SAFECAST 2009-2012
INNOVATIVE CONNECTION DEVICES FOR CLADDINGS
SAFECLADDING 2012-2015

ENERGY DISSIPATIVE STEEL CUSHIONS

Force (kN) vs. Displacement (mm) graph with N=23 kN
INNOVATIVE CONNECTION DEVICES FOR CLADDINGS
SAFECLADDING 2012- 2015
INNOVATIVE CONNECTION DETAILS FOR CLADDINGS SAFECOLLADDING 2012- 2015
INNOVATIVE CONNECTION DETAILS FOR CLADDINGS
SAFEC
LADDING 2012- 2015
Retrofitting of the Pinned Beam to Column Connections of RC Precast Frames by Lead Extrusion Dampers
Ph.D. Thesis of Dr. Cihan Soydan
Retrofitting of the Pinned Beam to Column Connections of RC Precast Frames by Lead Extrusion Dampers
Ph.D. Thesis of Dr. Cihan SOYDAN

Dönme (rad)
Zaman (sn)
Yalın Sönümleyicili
ERZ1.25

Dönme (rad)
Zaman (sn)
Yalın Sönümleyicili
ERZ1.40

Yalın
Sönümleyicili
ERZ1.25
ERZ1.25
ERZ0.25
ERZ1.25

ERZ1.40
ERZ1.40
ERZ1.25
ERZ1.25
ERZ0.25
ERZ1.40
Retrofitting of the Pinned Beam to Column Connections of RC Precast Frames by Lead Extrusion Dampers

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Thanks for your interest..

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