PRELIMINARY REPORT (AS OF JUNE 30, 1978) ON
THE JAPAN EARTHQUAKE OF JUNE 12, 1978 AND ITS EFFECTS

by John A. Blume, acting as EIC

The Earthquake (USGS data by telephone, Chris Rojahn)

June 12, 1978 08:14:27.0 GMT

38.29°N 141.99°E

Depth: 48 km (free solution)

$M_s$ 7.5

Approximate Epicentral Distances

To Sendai - 100 km
To Fukushima Power Plant - 116 km

Tsunami Effects

Small

Maximum Intensity

5.5 on JMA scale

Strong Motion Records (tentative data; sources Yanev and Yoshimi)

20 or more SMAC recordings plus several more at the nuclear power plant.

Some tentative peak accelerations:

Sendai horizontal - 0.25g
Yoshahara horizontal - 0.32g
On bridge piers at Sendai - 0.5 to 0.6g
Sendai area building, ground floor - 0.25g
9th floor - 1.0g

Ground level, Fukushima power plant - 0.10 to 0.12g
At some intermediate height, Fukushima power plant - 0.20g

Soil Problems, Sendai and coastal area (various sources)

Liquefaction
Landslides

$15$ to $20$ million damage to dikes (Yanev)

Many roads closed
Bridge piers tilted and/or settled; several bridges out of service
Sendai area structures and plants (source, Yanev and some other)

Population: 550,000 plus
3 oil tanks failed, spilling contents (70' diameter)
Concrete plant severely damaged
Large refinery - nominal damages (except oil tanks)
Power plant (oil burning); down 8 days; main damage to boilers
6 or 7 bridges (50' to 300' span) damaged; 1 collapse(?); repairs underway
An 8 story university building with non-deformed rebars; damage severe; but Yanev estimates total loss
Butane plant had tank or pipe rupture, followed by fire and destruction
Silos damaged
Harbor structure damage

Tall buildings: No collapses but many cracks including shear walls; being used, generally; rough estimate of number of buildings exposed:
1,000+ of 10 stories or so
'dozens' of 20 stories or so
20+ of 25 to 30 story
Most of modern design, many steel frames from 2 to 30 stories
Many buildings instrumented
General building performance: very good

Small residential buildings: (Borcherdt):
$70,000,000 damage; 25,000+ damaged; 4,000+ damaged 50% or more

Fukushima Nuclear Power Plant (source, Yanev)

Plant kept operating; apparently no damage or problems. Automatic shutdown (scram) did not operate (may have been set above motion level of 0.10g to 12g recorded at ground level).
Early reports on casualties (subject to change)
Killed 21
Injured 400
COMPARISONS BASED ON PRELIMINARY DATA

by John A. Blume

<table>
<thead>
<tr>
<th></th>
<th>June 1978 Sendai</th>
<th>June 1978 Salonica</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak ground motion</td>
<td>0.25g</td>
<td>0.13g</td>
</tr>
<tr>
<td>Population</td>
<td>550,000</td>
<td>720,000</td>
</tr>
<tr>
<td>Killed</td>
<td>21</td>
<td>50</td>
</tr>
<tr>
<td>(40 in 1 building)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Injured</td>
<td>400</td>
<td>100</td>
</tr>
</tbody>
</table>

There were more deaths at Salonica than at Sendai even though the peak ground acceleration at Salonica was only about half as great. The populations are generally similar. This indicates some of the advantages of earthquake-resistant design, codes, procedures, and research.

It can be speculated in advance of detailed study that the collapsed 8-story building at Salonica could have had at least one natural period at about 0.5 sec which is also the reported dominant period for the Salonica ground motion. Thus, the dynamic amplification could have been considerable. This structure should be analyzed in detail.
Expectancy of Maximum Acceleration of Earthquakes in 75 Years (Gals)

Figure A

Expectancy of Maximum Acceleration of Earthquakes in 100 Years (Gals)

Figure B

From a 1965 Report