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Earthquake Response Analysis of No.6 Blast Furnace of Chiba Works

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Synopsis :

Earthquake measurements have been taken since 1977 in order to investigate the dynamic behavior of No.6 blast furnace and its surrounding soft ground at Chiba Works. Two severe earthquakes of the so-called "directly under" type, hit the Kanto districts on September 24 and 25, 1980, registering Richter magnitudes of 6.0 and 6.1, respectively. Their epicenters were located near Chiba Works, and maximum response acceleration at the super-and sub-structures of No.6 blast furnace and its surrounding soft ground is the largest of all the earthquakes ever observed. In this report, the results of earthquake observations are discussed in comparison with those of theoretical approaches, namely, analytical simulations using lumped mass idealization. The following conclusions may be drawn from the observation and analysis of actual earthquakes. (1) Judging from the response spectrum, the structure is more liable to resonate with the so-called "long-distance" type earthquake than with the "directly under" type, and yet in the latter type earthquake, the structure is strongly affected by the vertical motion of the earthquake. Further study in this aspect is required to be expedited. (2) Story shear coefficient at the sub-structure calculated from response acceleration of actual earthquakes approximate to the design values, but those at the

super-structure exceed them. (3) It is predicted that if earthquakes occur that have substratum acceleration a little less than eleven times that in the biggest "directly under" type earthquake (June 12, 1978), or twice that in the biggest "long-distance" type (Sept. 24, 1980), the story shear coefficient at the tip story will exceed the design value.

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千葉第6高炉の地震応答解析
 Earthquake Response Analysis of No. 6 Blast Furnace of Chiba Works

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Works, and maximum response acceleration at the super- and sub-structures of No. 6 blast furnace and its surrounding soft ground is the largest of all the earthquakes ever observed.

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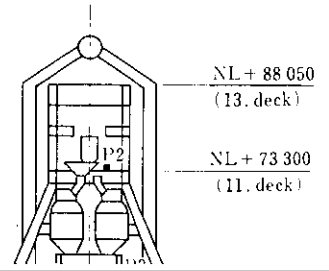
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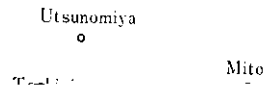
造物の、耐震工学からみた特質を明らかにするとともに、耐震設計上の資料たらしめようとしたものである。

2. 地震観測地点および解析フロー

地震応答解析においては、入力波として、エル



度を始動装置が感知すると、データレコーダーを
作動させ、始動時刻を印字させる。遅延装置は地
震動の初期部分の記録を見逃さないよう、遅延時
間3 sのものを備えている。前述した経路により、



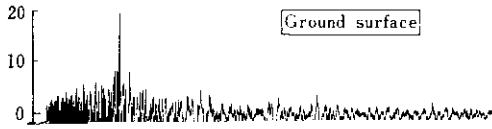
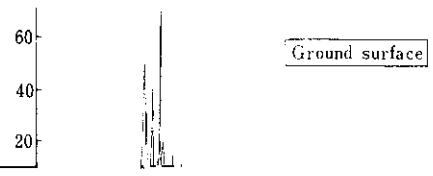


Table 2 Maximum acceleration of observed earthquakes (Ground)

Location	Component	Response Max. Acc. (Gal)
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は、前述したように、震央距離が極めて近く、震源深さが浅いという、極めてまれな例であり、類似地震観測データもほとんどないため、上述の現象の一般化として評価できない。アルジェリアのエルアスナムやメキシコ等で最近伝えられる直下型



視できないことを、この地震は教訓として与えてくれた。このことから、全川地震動記録は貴重



てよく、本地盤は全般的に極めて軟弱な地盤であることがわかる。これは地盤改良工事を行ったときのPS検層結果²⁾から得られたS波速度と、ほぼ同傾向である。

4.3 加速度記録による応答スペクトル

遠距離型地震および直下型地震のもつ特性を構造物の応答の面から調べるために、観測によって得られた加速度記録の地表面加速度水平成分(N-S)を用いて、1自由度系の加速度および速度応答スペクトルを、次式により求めた。

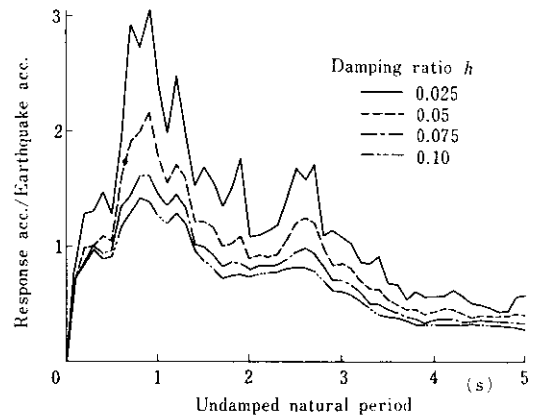


Fig. 19 Acceleration response spectra (Jan. 19, 1979)

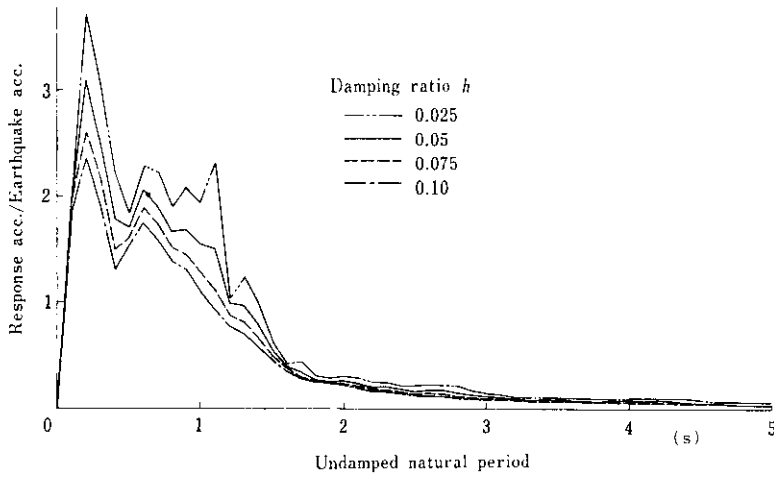


Fig. 14 Acceleration response spectra (Sept. 25, 1980)

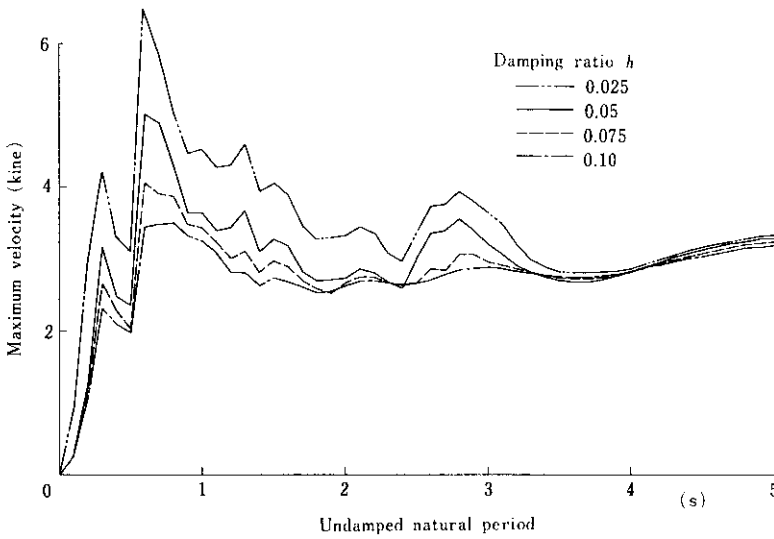


Fig. 13については比較的長周期の構造物に、Fig. 15については短周期の構造物に大きな影響を与えている。しかしながら、構造物の固有周期が1s以上では速度応答スペクトルがほぼ一定値を示すと

程度の短周期構造物で地動加速度の3倍以上の最大加速度が生じる可能性のあることを示しており、固有周期が1.5s以上の構造物に対しては大きな影響をもたないことを意味している。このよう

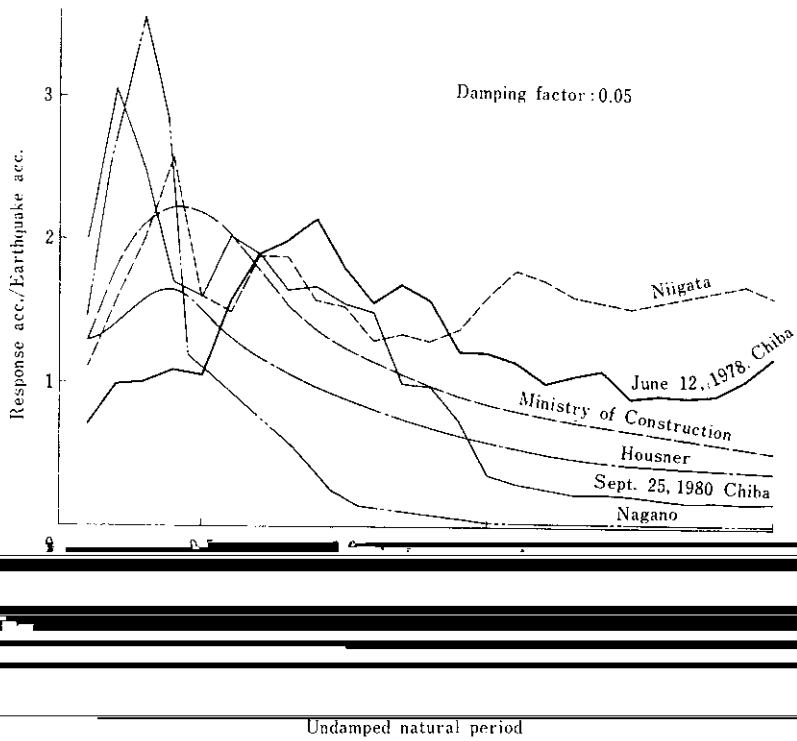
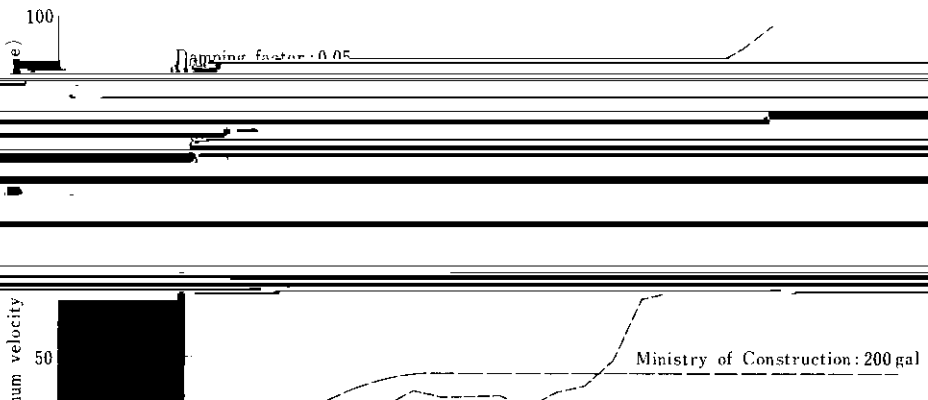
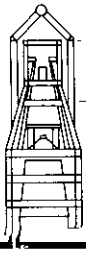
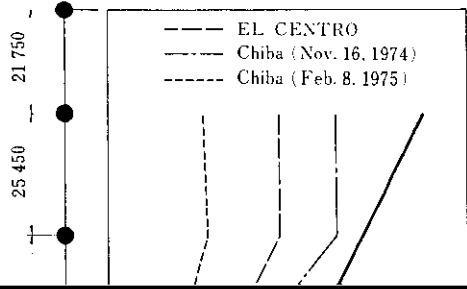


Fig. 16 Comparison of acceleration response spectra with past data





No.	Weight(t)
7	480.4
6	1 509.6
5	10 014.6
4	41 399.7
3	20 264.2
2	21 645.9
1	12 731.8



による解析結果のうち、上部構造物に作用する水
せん断力係数に比較して、上部工のそれが急激に増

Fig. 19に示した。小規模地震結果と同様であるが、其般層の入り加

離型地震および直下型地震に着目し、軟弱地盤層の動的変形特性を把握するとともに、高炉という

伝播速度は、ほぼ妥当な値を示す。

(4) 応答スペクトルから、高炉上部工および基礎

との共振の固有周期が一致すれば、直下型地