EARTHQUAKE COUNTERMEASURES OF SHIZUOKA PREFECTURE :

___ PRIMARILY ABOUT BUILDINGS ___

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SUMMARY

This report begins by summarizing the circumstances under which the Earthquake Countermeasures Section was established by Shizuoka Prefectural Government for the first time in the nation. The various projects with this section are also shown in Chapter 1.

Chapter 2 describes seismic evaluations, primarily of reinforced concrete buildings. The reinforcement of buildings based upon the results of the above evaluation is also mentioned.

Chapter 3 refers to the panic of residents after the prediction of an aftershock announced by the Governor of Shizuoka Pref. on the occasion of the January 1978 "Izu-Oshima Earthquake" and the lessons from this experience.

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1. THE ESTABLISHMENT OF AN EARTHQUAKE COUNTERMEASURES SECTION

Many large earthquakes occur on the Pacific side of Japan. The area off the coast of Tokai has had large earthquakes at intervals of between 100 and 200 years (see " Fig.1 ").

The recorded large scale earthquakes in 1498, 1605, 1707, 1854, and 1944 which all measured around Magnitude 8 badly damaged the area (see " Fig.2 "). As for"The Tonankai Earthquake" in 1944, The Sea of Enshu was its seismic center. This encouraged the idea that a crustal strain in the area had been released.

However, recent seismological studies have indicated that Suruga Bay has been accumulating a crustal strain. This means that a large scale earthquake has not occurred in and around Shizuoka Prefecture (Suruga Bay) for more than 125 years since the earthquake in 1854. This fact foreshadows the imminent occurence of a large scale earthquake.

As land subsidence is one of the reliable proofs for earthquake prediction, a closer observation system than any other area is provided in our prefecture. Changes of land height and horizontal strain are being surveyed. Land subsidences of more than 40 cm during the years 1900 to 1973 and 3 cm during the past two years, have been recorded in Shizuoka City (at the mouth of the Abe Riv.) and the Cape Omaezaki respectively (see " Fig.3 ").

A shortening of about 90 cm in distance between Matsuzaki, Izu Peninsula and the Cape Omaezaki in about 90 years, from 1884 through 1977, has also been noted (see " Fig. 4 "). In addition, a seismic gap is apparent in Suruga Bay which has had no major earthquake for many years (see " Fig. 5 ").

Consequently the Tokai Large Scale Earthquake Theory in which Suruga Bay is regarded to be a seismic center has been presented and has become people's concern. This motivated the Shizuoka Prefectural Government to establish the Earthquake Countermeasures Section in 1977.

The projects being carried out by this section are about 120 in number including such matters as :
Information, Traffic and Transport Control, Evacuation, Medical Care, Food Supply, and Building Safety.

2. EARTHQUAKE COUNTERMEASURES FOR BUILDINGS

We have set up evaluation standards for earthquake resistance and reinforcement of existing buildings for wooden houses, reinforced concrete buildings and steel structures respectively. The details of seismic evaluation of the reinforced concrete buildings are stated below.

The evaluation standard which Shizuoka Prefecture has adopted in 1977 is based upon the National Standard and Guideline. This unique evaluation standard has been developed by Shizuoka Prefectural Government considering twofold factors : first, the distance of buildings from the epicenter of an expected earthquake, and second, the geological and soil condition of the building sites. Furthermore, a system of computer analysis to aid building evaluation was developed under the direction of Prof. Umemura at Tokyo University.

In this evaluation standard, the potential disaster area is divided into five concentric zones denoted at distances of 40, 50, 60, and 70 kilometers (see " Fig.6 "): and into four different groups depending on the geological and soil condition of the building sites. A comparison of the building strength (I_S) with the seismic evaluation value which is required from the combination of the above two factors at the building site (E_S) determines the safety level of the buildings.

The importance of the buildings judged from their roles (C_I) and the topographical conditions of the building sites (C_ϕ) are used in considering the final seismic evaluation value (E_T). (Thus $E_T = E_S \times C_I \times C_\phi$)

In the case of $I_S \geq E_T$, we can recognize the evaluated buildings as the earthquake-resistant type. Out of 1,400 reinforced-concrete buildings of Shizuoka Prefectural Government, 500 buildings were chosen as important facilities in view of earthquake emergency. We planned to evaluate them according to the above mentioned method under a five-year plan. Forty four buildings in 1977, one hundred forty four buildings in 1978, and two hundred forty buildings in 1979 have already been evaluated. The remaining buildings will be evaluated in 1980.

The first two years of this evaluation plan were considered experimental. Instructions on seismic evaluation method have been given to the municipal officials, architects, and contractors since 1979,so that every building should be inspected by them.

Table 1 below, shows results after evaluating one hundred eighty buildings in past two years.

Table 1

Levels	Evaluations	Factors ($E_T=E_S$)	the Number of buildings	Percentages
A	of the earthquake resistance	$I_S \geqq E_T$	17	9 %
B	need a check-up in detail	$I_S \geqq 0.7E_T$	21	12 %
C	need reinforcement	$0.3E_T < I_S < 0.7E_T$	93	51 %
D	need urgent reinforcement	$0.3E_T < I_S < 0.7E_T$	39	22 %
E	need rebuilding	$0.3E_T \geqq I_S$	10	6 %
Total			180	100 %

Buildings of C & D Levels have nearly equivalent evaluations, but the buildings placed in Level D are those which appear less sturdy and which pose a greater danger to human life in view of their lesser ductility and eccentricity.

In 1971 the "Building Code" in Japan was revised and the countermeasures of shearing stress on building column were enforced. The relationship between the suggested evaluation level and the age of above one hundred and eighty buildings is presented in percentages as follows in Table 2.

Table 2

Bld. age \ Levels	A	B	C	D	E	%
Built before in 1960	6	0	56	13	25	100 %
Built in 1961-1965	5	7	60	21	7	100 %
Built in 1966-1970	5	5	56	31	3	100 %
Built in and after 1971	22	31	36	11	0	100 %

Two out of thirty nine D Level buildings have been designated as examples of reinforcement work. They are currently being repaired according to designs of reinforcement. As for all new constructions in Shizuoka Prefecture, we have been recommending that they should be undertaken only after seismic evaluation.

In June 1978, the National Government enacted the "Large Scale Earthquake Countermeasures Act". In August 1979, one hundred seventy municipalities in six prefectures (Shizuoka Pref. being the most central area) were designated as "Intensive Earthquake Disaster Prevention Countermeasure Areas" in view of the potential Great Tokai Earthquake.

In these circumstances the prefectural government has determined to subsidize half of the expenses for the inspection of reinforced concrete public buildings such as schools, hospitals, and social welfare facilities, and three quarters of the expenses for the inspection of reinforced concrete private buildings. Furthermore, as a result of seismic check-ups, it has become clear that a large amount of reinforcement cost is needed. Therefore, the prefectural government has asked the National Government for financial support in reinforcement and rebuilding.

In parallel with the official seismic evaluation of principal buildings mentioned above, we have been also directing the residents of Shizuoka Prefecture to know the seismic resistance of their own houses.

3. THE PANIC AMONG RESIDENTS AFTER THE ANNOUNCEMENT OF THE POSSIBILITY OF THE IMMINENT AFTERSHOCK

After the January 1978"Earthquake in the IZu-Oshima Area", which measured Magnitude 7, the Governor of Shizuoka Pref. announced the possibility of the imminent aftershock, Unexpectedly this announcement threw the residents into a panic.

To our regret, this confusion occurred because of sudden and improper information and explanation without the communication between the officials and residents.

From this experience, we have learned the importance of the content of an announcement and its transmittance.

We have been taking efforts to keep the residents more fully informed on the earthquake and emergency procedures by the press and community information services.

At the same time, we have strongly asked the National Government to provide appropriate earthquake predictions.

In conclusion we should like to express our gratitude to those concerned for providing this opportunity for us to tell about the Shizuoka Prefectural Earthquake Countermeasures.

Fig. 1 A ROUGH MAP OF JAPAN

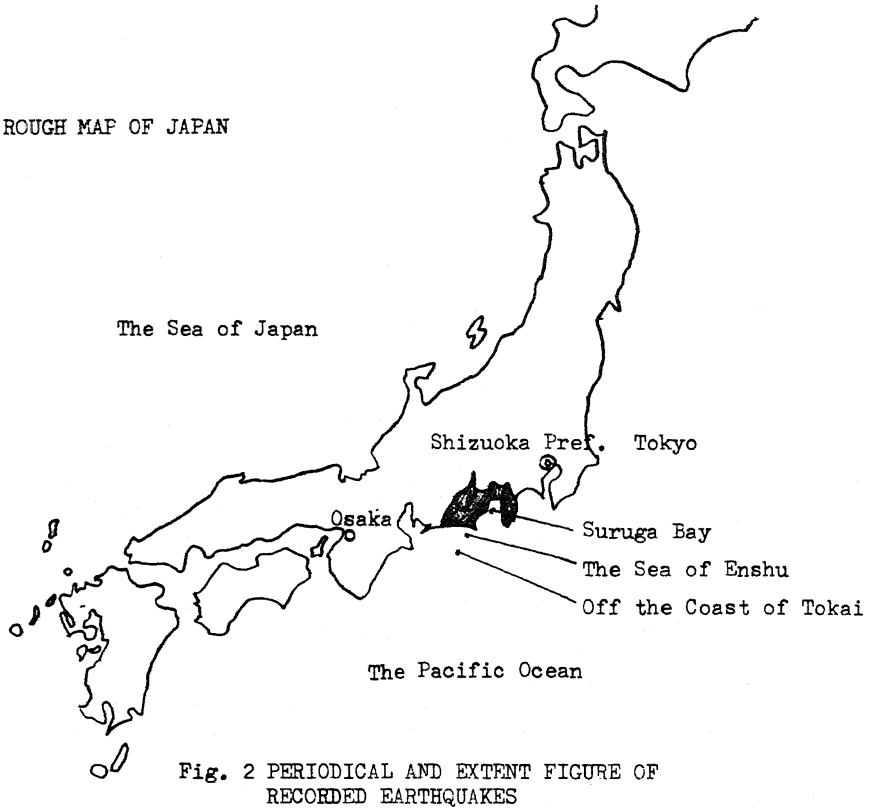

Fig. 2 PERIODICAL AND EXTENT FIGURE OF RECORDED EARTHQUAKES

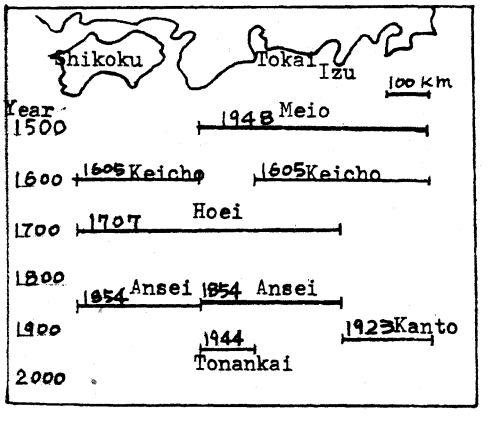

Fig. 3 AN OBSERVATION NETWORK OF A WATER LEVEL & A FLUCTUATION IN 70 YEARS OF THE AREA

*Year 1973- 1900
Unit : cm
Base : Numazu City

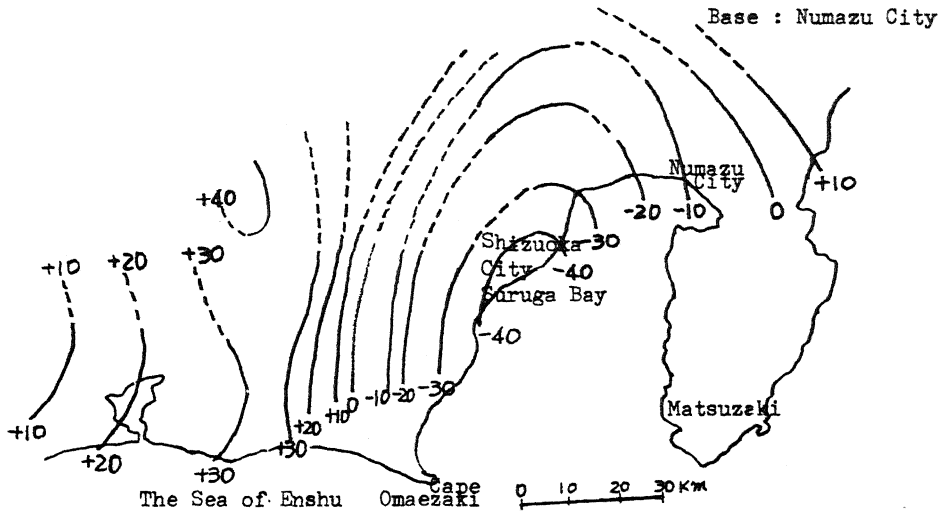

Fig. 4 A HORIZONTAL STRAIN IN & AROUND SURUGA BAY (SURVEYED BY GEOGRAPHICAL SURVEY INSTITUTION)

*Year 1977-1884
Unit : cm

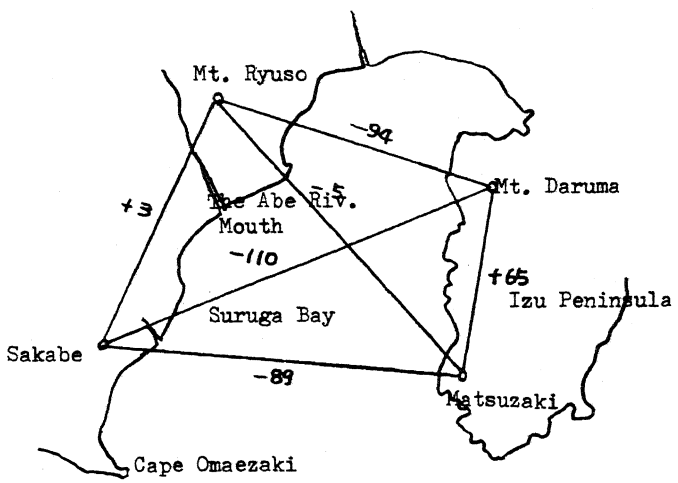

Fig. 5 DISTRIBUTION OF EPICENTERS IN & AROUND SURUGA BAY *Year 1926-1972

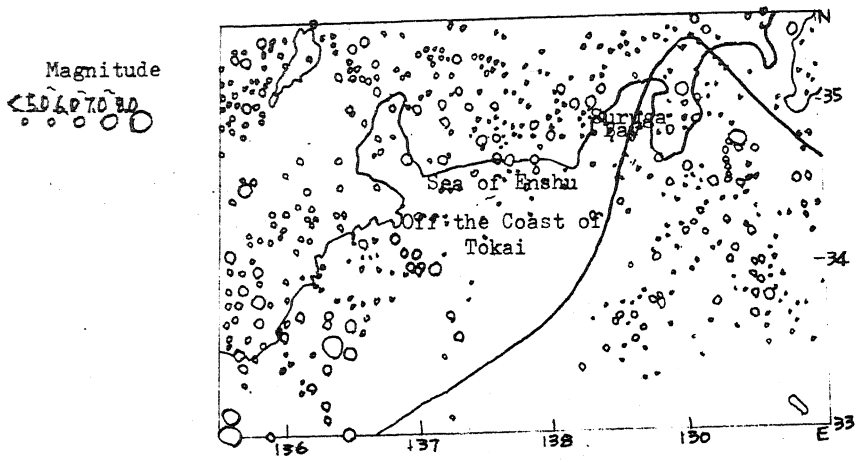

Fig. 6 ZONES BY DISTANCE FROM THE EXPECTED EPICENTER