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# The Distributions of Damaged Houses and Strong Winds by Typhoons

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## 1. Introduction

Recently, two violent typhoons hit the western part of Japan. One is the typhoon 5915 (Vera) which struck Kii Peninsula on September 25, 1959 and crossed through the central part of Japan, causing severe damage and it was named "Isewan Typhoon". The other is the typhoon 6117 (Nancy) which struck the south-eastern part of Shikoku and passed over Honshu. Its path, scale and intensity resembled those of the "Muroto Typhoon" which hit Kinki District in 1934, and hence this typhoon was called "Muroto Typhoon II". The minimum atmospheric pressures of these typhoons were about 930 mb at the coast of Japan, and these rank among the strongest storms.

Both of these storms caused severe casualties and damages. The loss of life was estimated as 5041 in Isewan Typhoon and as 207 in Muroto Typhoon II, and the damaged homes amounted approximately to 568,000 and 980,000 respectively. Although some damage was caused by tides or floods, a great many small structures and steel towers were destroyed directly by strong winds.

To obtain data for wind resistant design of structures, the local distributions of damaged houses by these typhoons, were investigated. There is a detailed account of damages to houses made by each city, town or village. From this accunt we made inquiries about the percentage of comletely destroyed houses. Most of the destroyed houses were wooden structures.

## 2. Distributions of the damage caused by the typhoons

(1) *Isewan Typhoon* (*September* 26, 1959 *Typhoon*)

Fig. 1 shows the distribution of ten minute maximum wind speeds and Fig. 2, the distribution of the percentages of completely destroyed houses by Isewan Typhoon. The dotted lines in the figures indicate the path of the typhoon center.

The severely damaged areas were located about 20 to 60 km east of the path and the area of severest damage was observed near the sea. Although some damage at the coast was caused by flood, the wind was also strongest in this area. The districts at the distance of 30 to 40 km from the coast suffered considerable damage when they were plain countries, and even the inland about several hundred kilo-meters from the sea was affected.

(2) *Second Muroto Typhoon* (*September* 16, 1961 *Typhoon*)

Fig. 3 shows the distribution of ten minute maximum wind speeds and Fig. 4, the distribution of the percentages of cmpletely destroyed houses by Muroto Typhoon II.

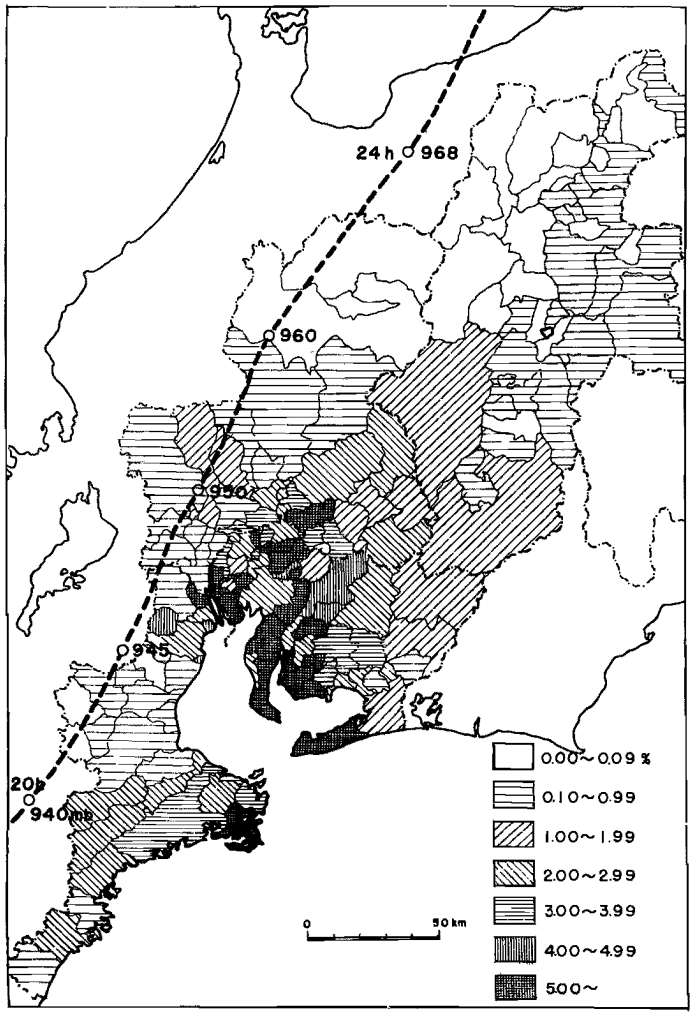


Fig. 2. Local distribution of the percentages of completely destroyed houses by Isewan Typhoon.

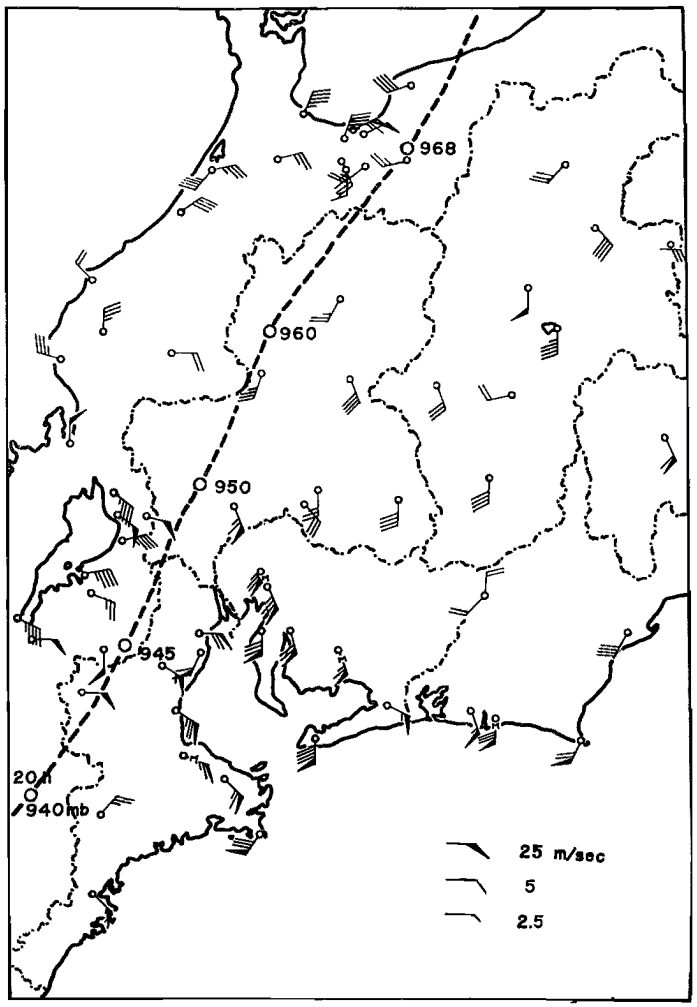


Fig. 1. Local distribution of maximum wind speeds by Isewan Typhoon.

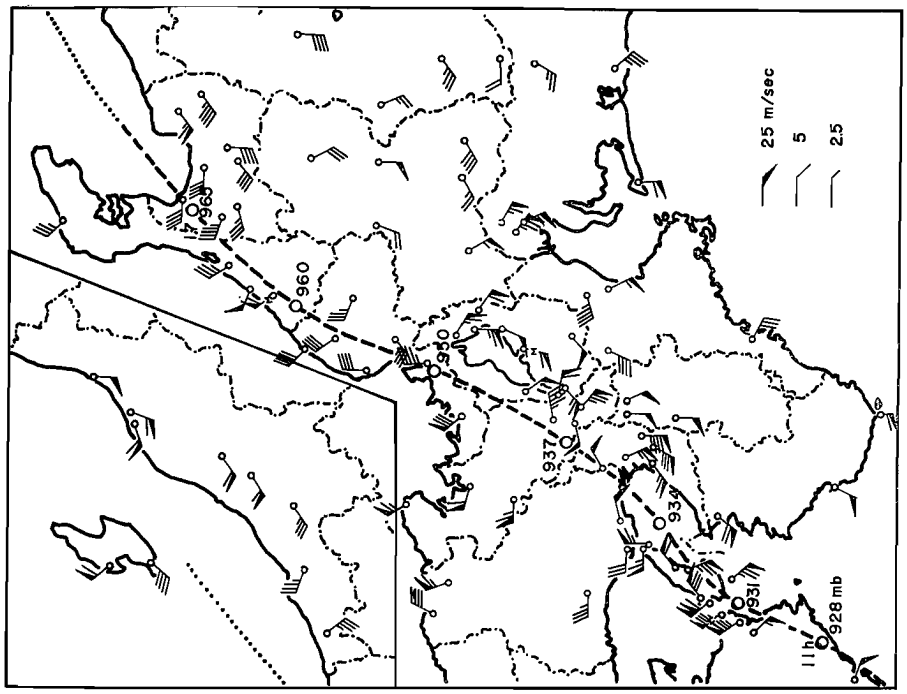


Fig. 3. Local distribution of maximum wind speeds by Muroto Typhoon II.

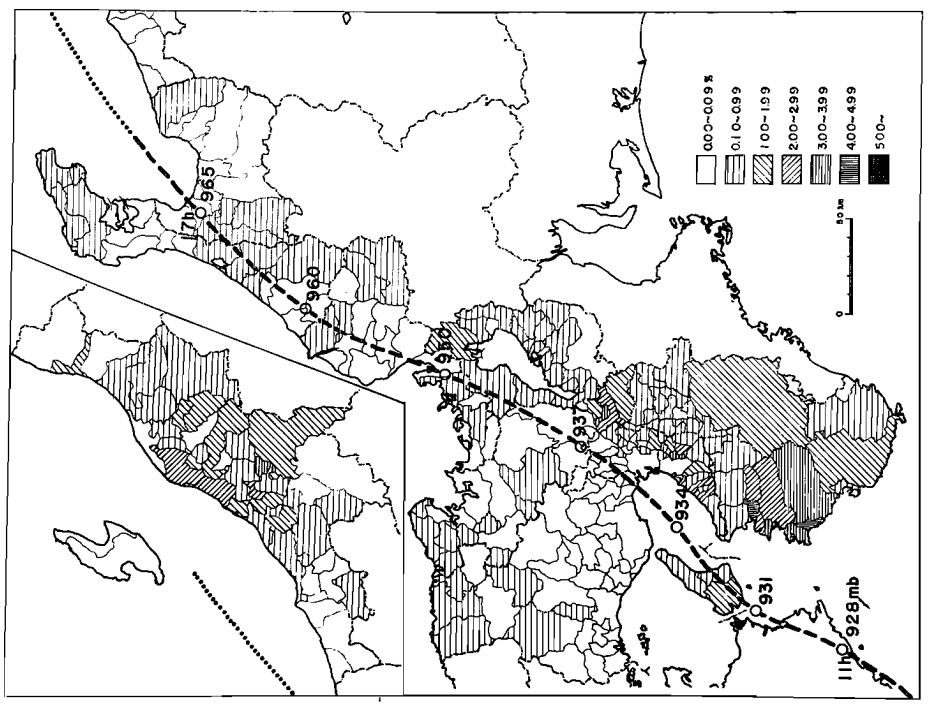


Fig. 4. Local distribution of the percentages of completely destroyed houses by Muroto Typhoon II.

The severest damaged area was also in the east side of the path of typhoon but the percentage of destroyed houses in each district was smaller than the percentage by Isewan Typhoon, in spite of the fact that the maximum wind speeds are almost the same in both typhoons. The reason for this is presumed that the province struck by Muroto Typhoon II was attacked often by strong wind in the past.

The typhoon appears to have been once dissipated over the land after it struck the coast and recovered again over Lake Biwa and the Japan Sea, so the areas near to those two areas were also damaged.

### 3. The relation between the rate of damage and the maximum wind speed

Fig. 5 and 6 show the percentage of destroyed houses in relation to the maximum wind speeds and the maximum peak gusts in each district by Isewan Typhoon. The relation between the rates of damages and the wind speeds is more distinct in Fig. 6. We can see from this that strong wind duration was not so destructive to structures, but maximum peak gust was quite damaging.

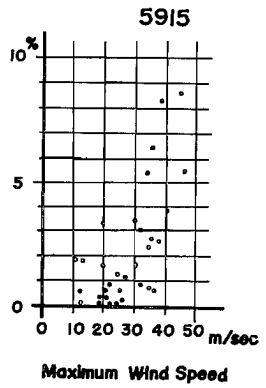


Fig. 5. Relation between the percentages of completely destroyed houses and maximum wind speeds by Isewan Typhoon.

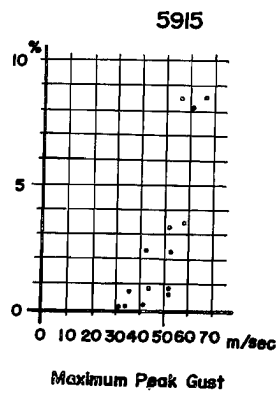


Fig. 6. Relation between the percentages of completely destroyed houses and maximum peak gusts by Isewan Typhoon.

It is interesting to note from Fig. 6 that no wooden house was completely destroyed by the wind speed less than 30 m/sec, but beyond this speed, the wind became suddenly destructive. The average value of the percentage of destroyed houses at the maximum gust speed of 50 m/sec, is only 3% and at maximum gust speed of 60 m/sec, it amounts to 8%.

### 4. Conclusion

The rate of damage introduced in this paper is not so accurate a statistic because it contains certain ambiguous factors. For instance, the structure of wooden houses varies from region to region and there may be some errors in official statistics. Moreover the method or instrument of wind measurement is different in each station.

Nevertheless, there is some correspondence between the rate of damage and

the maximum wind speed in local distributions. We tried to find the topographical interference for wind speed or damage, but this problem was so complicated that the final result could not be obtained.

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