

# Evacuation Behavior and Evacuation Sites in Miyako after the 2011 Great East Japan Earthquake

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## SUMMARY:

The great east Japan earthquake hit eastern Japan at 2:46 p.m., March 11. Then came a giant tsunami, which swept away people, cars, houses and communities in Iwate, Miyagi and Fukushima prefecture. Time span between earthquake and tsunami reaching was about 30 minutes in Iwate prefecture, so almost people had an sufficient time for evacuation. We made Miyako city intended area, we has conducted a survey on evacuation behavior from Tsunami. The survey included 96 survivors. Survey by interviewing evacuees was conducted at some shelters in June. In this paper, it is reported that how survivors evacuated from the view of a evacuation distance and time, in addition an evacuation site. Third part of survivors evacuated in under 200m. 77% of survivors evacuated within five minutes. Half of an evacuation site was outdoor including community facilities and shrine. Then altitude, square measure and capacity of evacuation site was surveyed.

*Keywords: Tsunami, Evacuation sites, Evacuation behavior, Questionnaire survey*

## 1. INTRODUCTION

The number of deaths, there were 4,667 in Iwate Prefecture. On the other hand, some refugees who survived it to prompt and appropriate evacuation.

Interview survey was conducted on tsunami evacuation behavior in the Miyako city, Iwate Prefecture. Refugees of 96 people have answered the evacuation process. To record in detail the behavior at the time of the tsunami evacuation. This record can contribute to the reconstruction plan of the affected areas of disaster prevention measures and to future earthquakes.

In the present study was carried out a detailed study of tsunami evacuation site. This study is intended for tsunami shelter were actually people were evacuated in the Miyako city. Assume the evacuation of vulnerable people, to analyze the characteristics of the tsunami evacuation routes and sites locations. The purpose of this study is to gain insights that contribute to the evacuation plan of vulnerable people.

## 2. METHOD

Based on the results of interviews about tsunami evacuation, tsunami evacuation site to organize the many victims were evacuated in Miyako city. From interviews, in addition to evacuation, evacuation routes have also revealed. In this study, we surveyed the evacuation routes and shelter. Such as altitude, to investigate the current status of evacuation routes, area and form it at the local tsunami evacuation site.

Miyako city is divided into six districts of Taro Tsugaruishi · Omoe · Sakiyama, Miyako Hanawa. In this study, we surveyed were victims, especially in three districts of Taro Miyako Tsugaruishi. Taro Taro is an old town district, which merged with Miyako city in 2005. Taro is the old town district has received a large tsunami in the past. Is an advanced district doing the "Declaration of the city of tsunami disaster prevention."

### 3. RESULTS AND DISCUSSION

#### 3.1 Casualty and Tsunami Evacuation

As intended to grasp the characteristics of the damage in Miyako, Table 1 shows the ratio of the number of houses collapsed and the number dead or missing. Miyako, despite the large number of houses damaged, the lowest ratio of the number of dead or missing. Although this is also considered factors such as terrain, many residents in Miyako makes a proper evacuation, that is partly spared.

**Table 3.1.** The number of houses collapsed and casualty (coastal area of Iwate)

	Death a	Missing b	Houses Collapsed c	(a+b)/c
Rikuzentakata	1,554	298	3,341	0.55
Ofunato	339	88	3,629	0.12
Kamaishi	884	169	3,641	0.29
Otsuchi	802	505	3,717	0.35
Yamada	604	165	3,167	0.24
Miyako	420	114	4,675	0.11
Total	4,603	1,339	22,170	0.27

Summarizes the Miyako shelter had been specified before the earthquake is shown in Table 2. The most common is a shrine where evacuation was followed by public facilities. It is said that the shrine is also a lot of people were evacuated in the earthquake of the past and this time, it is understood that shrine have a major role as a refuge. In addition, the district Taro, shelter had been distinguished and the second evacuation shelter first. The first shelter where over 28, the second shelter 16 locations had been specified. First evacuated to a shelter, such as the familiar square first, from the situation had settled down and evacuation plan to evacuate to the second location, such as schools and community centers.

**Table 3.2.** Evacuation sites had been specified in Miyako

	School	Shrine	Public(indoor)	Public(outdoor)	Office	Medical	Dwelling	Others	Total
Hanawa	1	0	2	0	0	0	0	1	4
Miyako	2	16	10	17	1	2	1	6	55
Sakiyama	1	2	1	0	0	1	0	2	6
Omoe	0	5	3	2	0	0	0	5	15
Tsugaruishi	1	3	2	3	0	0	0	5	14
Taro	1	5	8	4	1	0	6	5	30
Total	6	31	26	26	2	3	7	24	115
	52.00%	27.00%	22.60%	22.60%	1.70%	2.00%	6.10%	20.90%	100.00%

Results of the survey interview, the details of evacuation behavior has been revealed. For shelter, the shelter is 46.7% of most outdoor, indoor shelter was then 35.9%. Evacuation distance was less than 200m 33.3% 20.0%,201-500m is next. In addition, with respect to evacuation time, 77.3 percent had completed less than five minutes to evacuate. Evacuation means walking accounted for nearly half of the total. Was about 30% of people driving a car that then fled. Principle has been banned by the

guidance of regional disaster prevention plan, evacuation of by car there is a risk of congestion and accidents. However, according to a survey by the Cabinet Office, that he had received a number of survivors were evacuated by car in this earthquake, such as in the case of the elderly was a distant hill, or if, the use of the car.

### 3.2 Characteristics of each district

In November 2011, conducted a study on tsunami evacuation route leading to the location and there in Miyako. The district was surveyed and the main shelter in three places Tsugaruishi district, district Taro, Miyako district, multiple victims actually were evacuated in each district. List of survey results are shown in Table 3.3.

#### ■ Tsugaruishi

Tsugaruishi elementary school, high school industrial Miyako is not a hill of what is specified in the shelter, the first floor of the school building and schoolyard is flooded in this earthquake. On the back of the elementary school because there is a mountain Tsugaruishi, there were many people there were evacuated to secondary. For evacuation route is located in a location that can be evacuated within a 5-10 minute walk from both residential flat.

Akamae elementary school seems to be flooded but did not because there was a hill, the path leading up to it has become a steep, rapid evacuation of the like cover on foot of the elderly is difficult. Temporary housing to ground is currently under construction.

#### ■ Taro

Human damage was less when compared to past disasters in this earthquake, but most buildings have been washed away. Taro in the district, the lesson of the earthquake in the past, road maintenance in a lattice shape the book as a baseline number of evacuation road parallel to the road, leading to the hill to intersect the baseline, such as the angle of intersection is a corner cut have been devised.

Considered were able to evacuate in a straight line from where most of the housing for it. Also have been scattered around the mountain refuge Akanuma, secondary evacuation is possible in about 5 to 10 minutes walk has been developed for evacuation routes leading to the mountain refuge Akanuma from which one (Figure 3.1.). Evacuation routes to the mountain Akanuma has become the type of evacuation route features a stair slope, it is possible to light car.



Figure 3.1. Evacuation Routes in Taro

#### ■ Miyako

Fisheries Museum of Science and Jodogahama hotel is located in located in the easternmost Jodogahama Honshu, located at high altitudes. There were many persons who evacuated from the city for housing in the car away, through a somewhat steep. Parking There are three units, approximately 56 parking is possible in accordance with 1.2 parking. Is currently third in the parking lot, temporary housing have been built. From the residential area facing the bay to the mountain road that can have multiple evacuation Usugisan on foot, many residents were evacuated to the parking lot the other hand.

Kumano Shrine near Kuwagasaki elementary schools and is spread over the fish market and residential areas. Characteristic of evacuation routes, it can not be much improvement there is a flat partition, to evacuate in a straight line to where it was found difficult evacuation. Kuwagasaki elementary school because the flooded part, were also secondary victims were evacuated across the road to Kumano Shrine. Kumano Shrine is flooded up to about one-third of the stairs of the approach, with about 100m length is also wider approach further, without flooding, many became victims of the space can be evacuated safely.

**Table 3.3.** Detail of evacuation sites

District	Evacuation site	Area	Flood-disaster situation	Evacuation route	Outlook to the sea
Tsugaruishi	Tsugaruishi elementary school	11,648m <sup>2</sup>	Inundation up to the height of the knee	Gentle slope	N
	Industrial high school Miyako	57,200m <sup>2</sup>	Inundation Rubble on the ground Traces of tsunami height of 2m at the outer wall of the school	Flat Straight line Wider roads	N
	Akamae elementary school	6,995m <sup>2</sup>	Without flooding The current temporary housing have been built	Narrow winding road	Y
Taro	Dewa shrine		Without flooding Stairs (up to the collapse of the stage 44 stage 38) collapse	Stairs with handrail Slope is steep (34 °, 134m)	Y
	Taro first elementary school	15,025m <sup>2</sup>	Many people were evacuated to the mountains for Akanuma tsunami have been pouring into the ground	Flat	N
	Taro community center	1,276m <sup>2</sup>	Evacuees were evacuated to the mountains for the first floor was flooded Akanuma	Flat Straight line Gentle slope	N
	Mt. Akanuma		Without flooding There were many persons who have been evacuated as evacuation shelter next two	There are several escape routes Hold down the stroller, wheelchair evacuation accepted because it features a slope and stairs	N
	General office Taro	6,478m <sup>2</sup>	Without flooding Is partially destroyed railing of the stairs near the entrance	linear flat Also possible for secondary evacuation shelter also close in the other distance	Y
	Joun temple	6,000m <sup>2</sup>	Without flooding	Slope Height of 6.5m from the road 270m distance to the embankment	Y
Miyako	Kuwagasaki elementary school	8,986m <sup>2</sup>	The water came up a little ground	Gentle slope Is not linear but flat	Y
	Kumano shrine		Without flooding Inferred tsunami has come close to the stage 48 from stage 15 in the circumstances of the railing of the stairs at the entrance.	Is difficult to understand rather than a linear way but flat Stage height 5.2m width 3m 48 24 ° tilt: Stairs	Y
	Fisheries Museum of Science		Without flooding	There was a distance from the residential area in steep A large number of refugees in the car	N
	Jodogahama Park Hotel			In both the second parking lot, parking 1st FULL (54cars × 2 = 108cars)	N

#### 4. CONCLUSIONS

In this study, we conducted a survey of evacuation and site in the Miyako is one of the earthquake affected areas in eastern Japan. As site for evacuees had actually, a detailed investigation was carried out on site. Results of the investigation, the details of evacuation routes and site became clear. There was also a relatively quick evacuation was carried out by the road construction and installation of stairs and slopes with a handrail. In order to shorten the evacuation time, the development of

evacuation routes that are intended to be all situations is essential.

In the area of the coastal district of Miyakowan parcel evacuation route was complicated by non-uniform. Seems to be that way for the road distracting, and caused difficulties when non-residents try to escape in a car. On the other hand, tourist facility located on a hill that offers a large parking lot, was able to accept refugees in the car smoothly.

Tsugaruishi district is a flat terrain, high ground is small. Therefore, many of the designated evacuation site was flooded part, did not fulfill the function as a site.

On the other hand, in the district Taro has been developed to advanced evacuation routes, evacuation was possible in the shortest distance to a hill or site. Evacuation site next to two can be quickly when the next one site was flooded because it was also been secured site and evacuation route in between the primary and secondary evacuation site also.

Conclude from this three districts, it is important to the development of evacuation routes and site depending on the circumstances of terrain. And site evacuees were evacuated, comparative analysis of site did not evacuate refugees has become an issue in the future.