

Basic concepts related to the development of tsunami evacuation facilities

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Chapter 1 Introduction

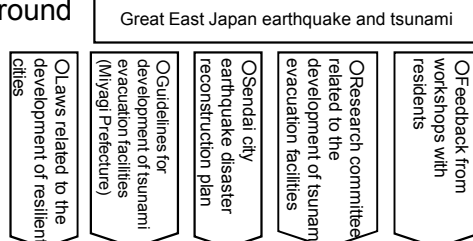
1.1 Motivation

To summarize and organized the items to be considered on the development of appropriate tsunami evacuation facilities, in light of the Sendai city earthquake disaster reconstruction plan and the actual conditions of the affected areas, towards the reconstruction of the eastern part of Sendai city damaged by the East Japan tsunami disaster.

1.2 Orientation



1.3 Background



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1.4 Planning period

As the planning period, from the fiscal year 2013 it is aimed to conduct as soon as possible the survey, design and construction towards the development of tsunami evacuation facilities.

Chapter 2 Setting conditions for facility development

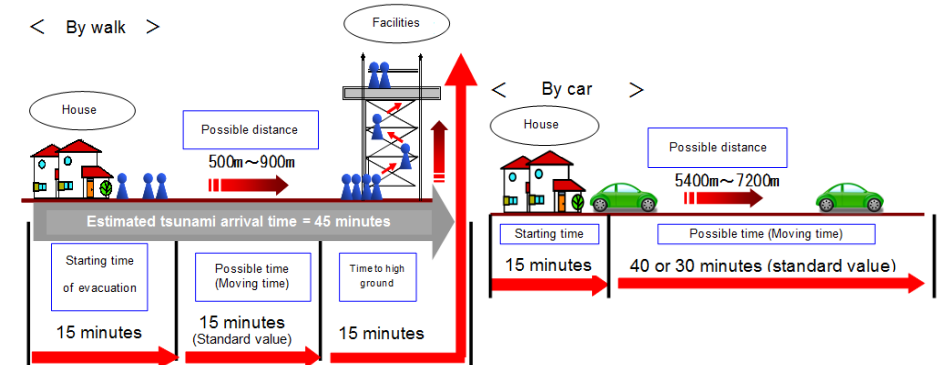
2.1 Concept of the target area

Target area: Eastern part of the Sendai Tobu expressway
※Areas outside the target area will also be considered if necessary.

Estimated tsunami arrival time: Set to 45 minutes

2.2 Concept of evacuation by walk and car

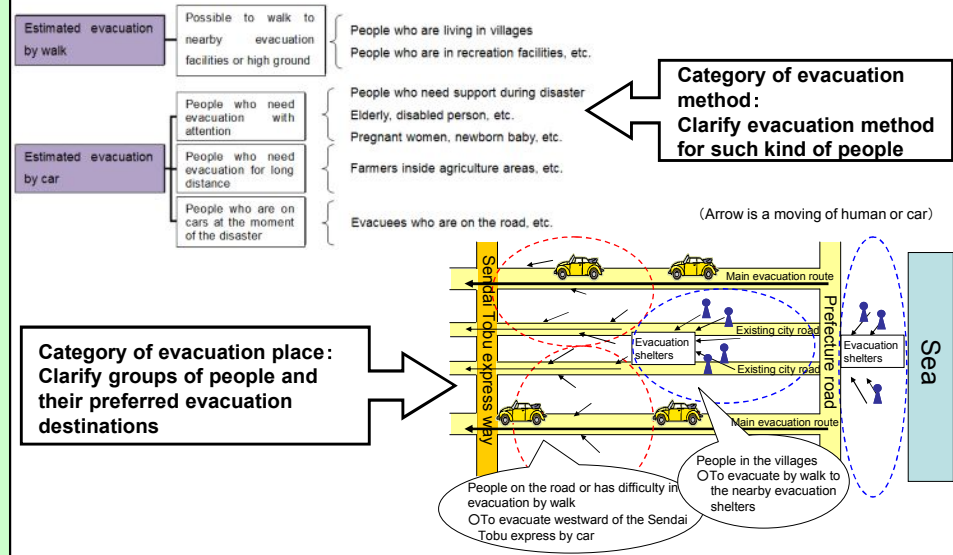
- Assumes the evacuation follows pedestrian general rules (Including bicycles)
- Assumes car evacuation considering evacuees on it



2.3 Concept of population estimation

Population is assumed referring to occupation at major properties before the disaster (villages ※, parks, etc.) and considering ongoing reconstruction and relocation projects.
※ Except for disaster hazard zones

2.4 Concept of evacuation behavior



Chapter 3 Items related to facility requirements

3.1 Facility requirements

Concept for size and capacity:

- ① To be set based on evacuation distance and method, and the assumed population evacuation behavior
- ② To ensure about 1 m² area per evacuee
- ③ In consideration of the above assumptions, the size & capacity is set.

Concept for height and number of story:

- ① Number of stories of the evacuation building is set based on the local inundation depth and building function
- ② Ensuring that tsunami will not overtop the height of evacuation tower and high ground



Concept for structure:

- ① Tsunami evacuation building: Reinforced concrete, steel frame is also considered depending on the actual situation of the area
- ② Tsunami evacuation tower: Steel frame
- ③ High ground: Presents less resistance to tsunami direction according to shape

Concept for facility:

Consideration of ① Moving to high place ② Emergency case ③ Safety ④ Others

Consideration for persons who need support:

- ① Moving to high place
- ② Emergency case
- ③ Response toward user-friendly planning regulations (facility maintenance manual) of Sendai city

Usage in normal condition:

- ① Depending on the region's actual situation and existing facilities, usage in normal condition is should be considered
- ② For the safety in normal time, some measures such as intrusion preventing are to be considered

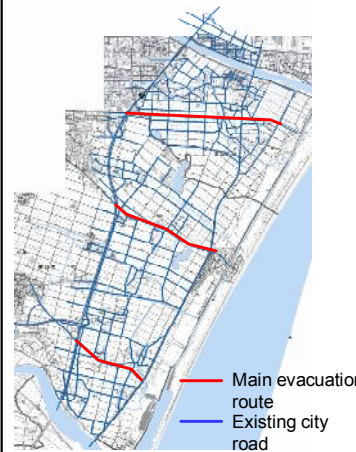
Concept for maintenance:

- ① Tsunami evacuation building: Maintenance of facilities (Electricity, water and etc.) are important.
- ② Tsunami evacuation tower: Maintenance cost can be reduced by devising the facilities.

3.2 Concept of the evacuation route

Flow of consideration of road network during evacuation

① Setting of road network



Use of the three main evacuation routes and other existing city roads is assumed.

Implementation of necessary countermeasures depending on the traffic condition during evacuation is assumed.

② Estimation of traffic volume

Car traffic volume is set based on the possible evacuation behavior, tsunami evacuation facilities and appropriate sharing of roles of the estimated population.

③ Conditions during evacuation

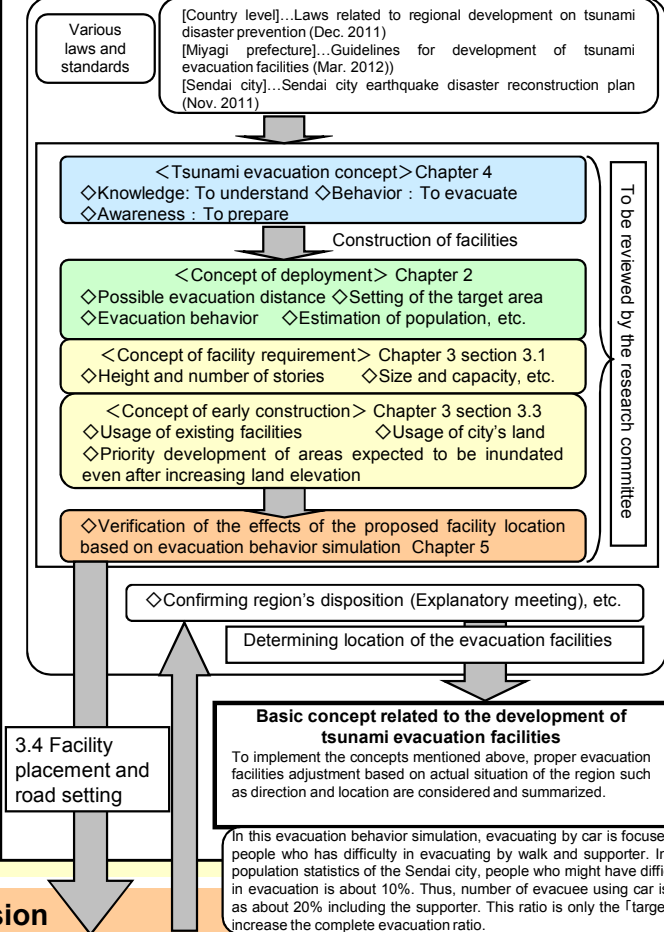
Item	In the car during the earthquake occurrence	Not in the car during the earthquake occurrence
Start time of evacuation	After 5 minutes	After 15 minutes
Possible time of evacuation	40 minutes	30 minutes
Evacuation speed	Regulation speed	
Evacuation exit point	West of Tobu expressway	

Evacuation behavior simulation

Consideration of extraction of problems and countermeasures

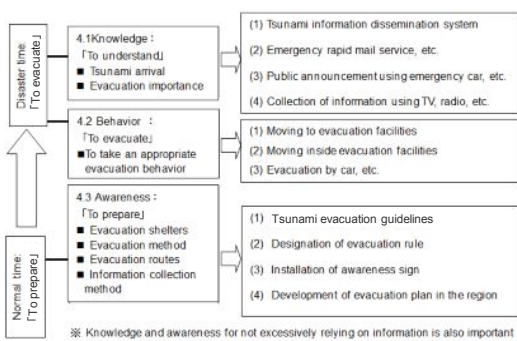
3.3 Concept of facility development

Flow of ideas for facility development

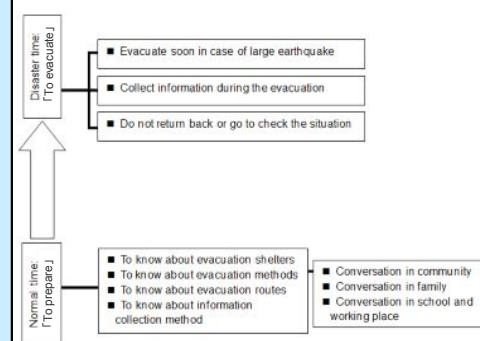


Chapter 4 Items related to knowledge and awareness

「System chart for information dissemination side」



「System chart for information receiver side」

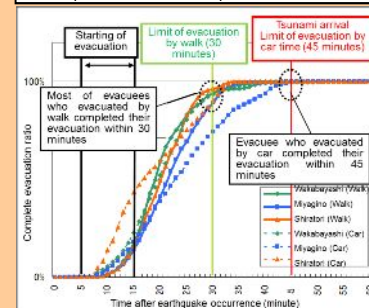


Chapter 5 Conclusion

Verification is performed using evacuation shelter location and evacuation behavior simulation mentioned in chapter 2 and 3

<Main simulation setting>

- Maximum number of evacuee is set (Basic resident register at 11th March 2011, estimated population after reconstruction, traffic census).
- Evacuation method of villagers is set as 80% by walk and 20% by car (Only people who need to evacuate by car is set as minimum).
- According to traffic condition at the evacuation time, implementation of the countermeasure such as road width and structure is assumed.
- People who are at coastal park areas located eastward of the prefecture road are not considered in the simulation.



<Verification results>

- Under the traffic conditions stated above, everyone who evacuates by car complete their evacuation within 45 minutes after the earthquake occurrence.
- For the case of evacuation by walk, most people complete their evacuation within 30 minutes although it takes time in some regions.
- In order to have everyone completing their evacuation, both soft measure such as developing evacuation plan in the area and performing evacuation drill and hard measure such as securing necessary road width or strengthen road structure against earthquake shake are important.