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Study on Installation of Speed Humps as Traffic Safety Measures on Residential Roads in Bangkok

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Introduction

- The total road length in Thailand is about 700,000 km, of which about 100,000 km are national highways and trunk roads.
  It has actively implemented traffic safety measures.
- However, on the **residential roads**, safety measures are **insufficient**.

- On residential roads, speed control is an effective traffic safety measure, and speed humps are widely used as one of the speed control devices.
- Humps are a mix of engineered designs and voluntarily installed by residents, and their locations, shapes, and conditions are not managed.
- Because their shapes and designs are not uniform, and maintenance is poor, their intended traffic safety effects may not be fully realized.

This study aims to conduct a wide-area survey of speed humps on residential roads in Bangkok to identify their locations, maintenance conditions, and challenges.
In addition, the speed-reducing effects will be analyzed using probe data, and installation guidelines will be proposed.

Literature Review

Research on installation as an accident measure

1) London: Setting 20 mph (32 km/h) zones reduced fatalities and injuries by 42% (Grundy et al., 2009).

Research on installation as a speed reduction effect

1) Thailand: Speed-reducing effect limited to 20–30 m before-after humps (Satiennam et al., 2014; Sanya et al., 2011; Phornthep et al., 2021).
2) U.S.: Multiple installations is necessary for overall speed control (Hallmark et al., 2002).
3) Korea: Crashes near humps showed less severe injuries; humps should be placed near crosswalks (Yeo et al., 2020).

Research on structural differences

1) Greater height results in a stronger speed reduction (India / Gupta, 2012; Malaysia / Abdul Rahman, 2012; Serbia / Antić, 2012).
2) Bow-shaped humps provide stronger speed reduction; trapezoidal humps are excellent for ride comfort (Kamada et al., 2014).

Literature Review - Summary

- Speed humps are effective traffic safety measures on residential roads.
- When installing, it is important to consider differences in speed-reducing effects according to their structure and placement.

- Measurement of vehicle speed has mainly been used on video cameras and speed guns.
  →Speed profiles are limited to changes only near the humps.
- Few studies have analyzed the wide-area effects of speed hump installation and proposed placement strategies.
- In developed countries, installation is based on guidelines, while in Thailand, it is similar to a translation of the Australian manual, and its appropriateness is unclear.

The positioning of this study

To propose installation guidelines adapted to Thailand's traffic environment, contributing to traffic safety on residential roads.

Flow of research

Survey on speed hump installation conditions

- Identify locations and conditions of speed hump installation
- Identify locations of traffic accidents

Analysis of speed-reducing effects of speed humps

- Select research target roads where safety measures are strongly required
- Analyze the effects of speed humps using speed profiles

Proposal of installation guidelines

- Propose new guidelines for installation
- Apply and evaluate the proposed guidelines in model districts

Survey on speed hump installation conditions

- A wide-area survey was conducted to identify where, how many, and under what conditions speed humps are installed on residential roads.
- The survey used Google Street View (latest images available at the time of survey).

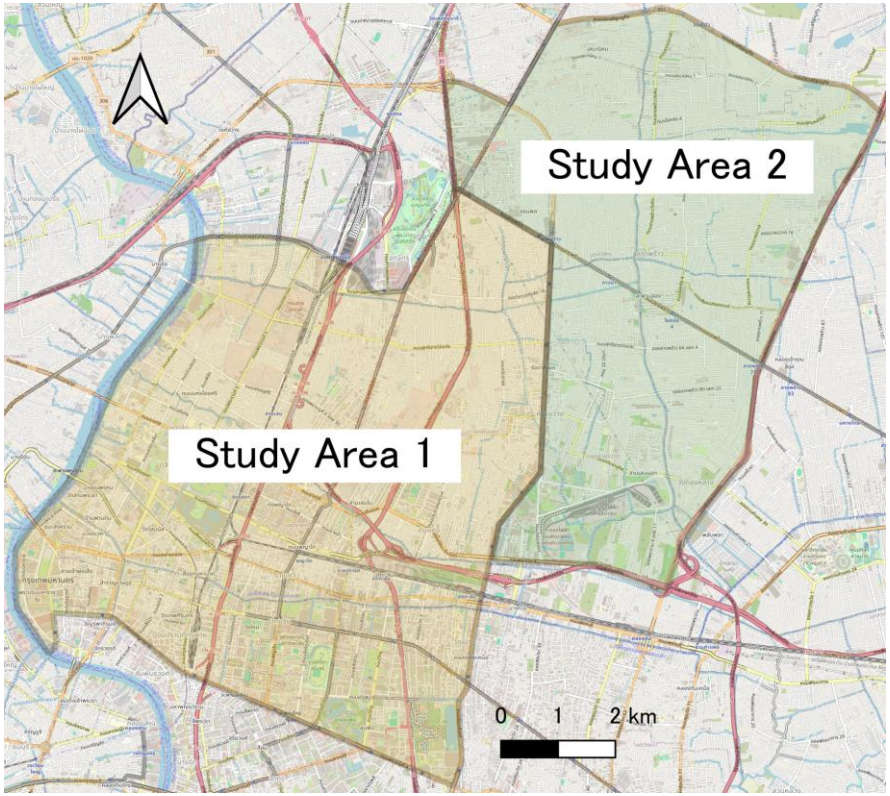


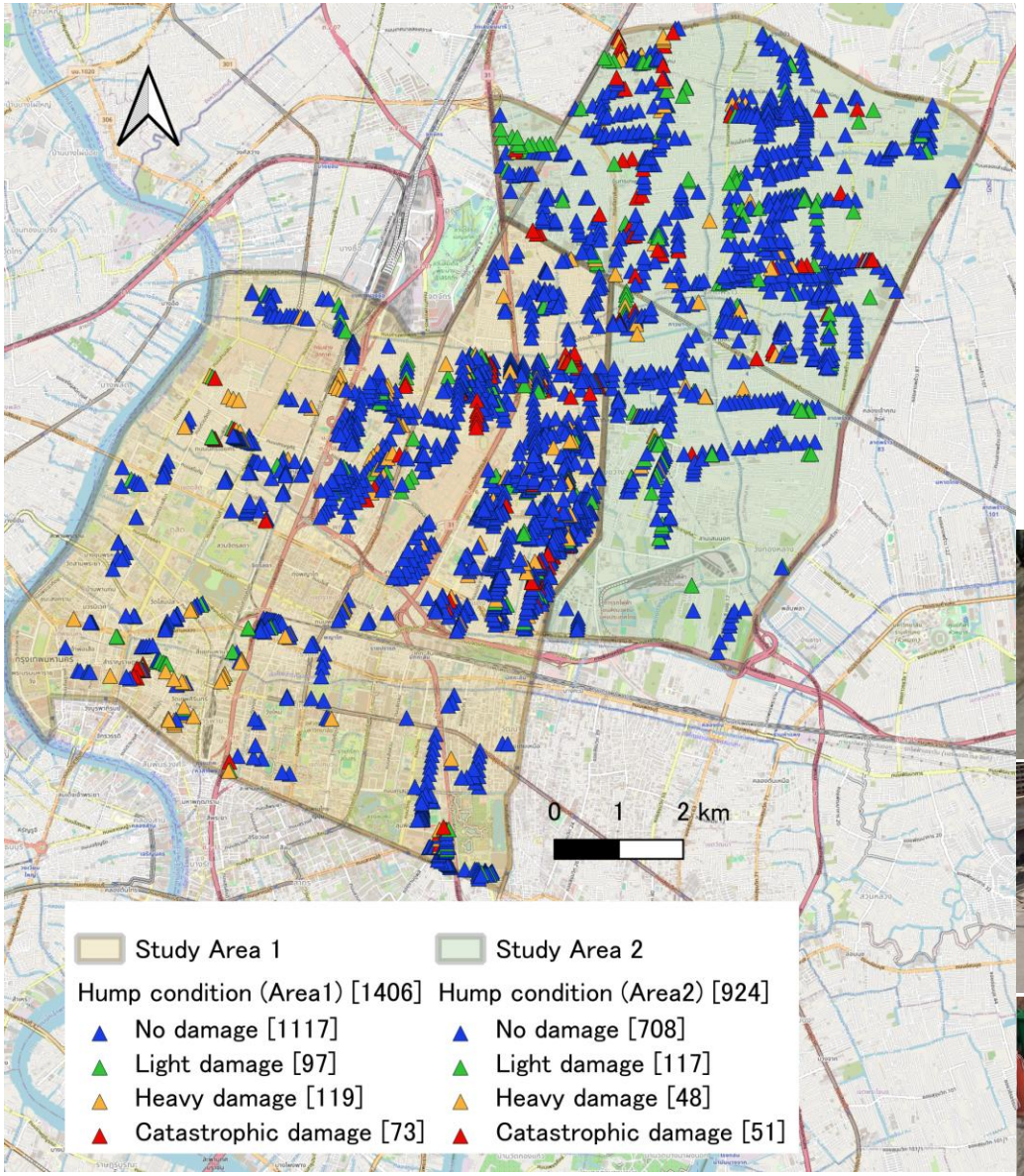
Fig. Study area

【Survey items】

- Signs and markings
  Confirmed the warning signs or road markings indicating speed humps.
- Damage conditions
  Classified the level of damage into four categories:
  No damage / Light / Medium / Severe

Note:
Based on visual judgment by the surveyor

Survey on speed hump installation conditions



- ✓ A total of 2,414 speed humps were identified in the study areas.
- ✓ 514 locations (≈20%) showed various levels of damage.
- ✓ Many humps with the same design were installed linearly,

Installation is uneven by area.
→Strategic area-based installation is necessary.

Light damage:
~30% missing

Medium damage:
~50% missing

Severe damage:
>50% missing

Selection of roads requiring traffic safety measures

- Analyze past accidents on residential roads and probe data.
- For each link, the 85th percentile speed and probe density were calculated and visualized.

  → Identification of road characteristics at accident locations.

$$Q = \frac{n}{30days \cdot 24hours} \cdot \frac{1}{l}$$

Where:

Q : Probe density（plot/km・hour）
l : Link length（km）
n : Number of probe data points within a 10 m buffer of the road centerline

【Data sources used in this study】

Longdo Traffic accident data

Provider	Metamedia Technology
Period	Jan 1, 2018 – Dec 31, 2023
Contents	Latitude, longitude, date, accident summary

iTIC probe data (Taxi)

Provider	The Intelligent Traffic Information Center
Period	Sep 1, 2019 – Sep 30, 2019
Contents	Latitude, longitude, date, speed, direction

Selection of roads requiring traffic safety measures

- Relationship between accident locations and **driving speed**

✓ More than half of the accidents occurred on roads with speeds of 30 km/h or less.

→Possible factors: high traffic density, short vehicle spacing, narrow roads, and poor visibility due to parked vehicles.

- Relationship between accident locations and **probe density**

✓ More than 80% of accidents occurred on roads with a probe density of 0.34 plot/km·h or higher (≥ 1 plot / 3 hours), = Heavy traffic volume.

→ Many of these roads are likely used as **"through-roads"** that pass through residential areas and connect main roads.

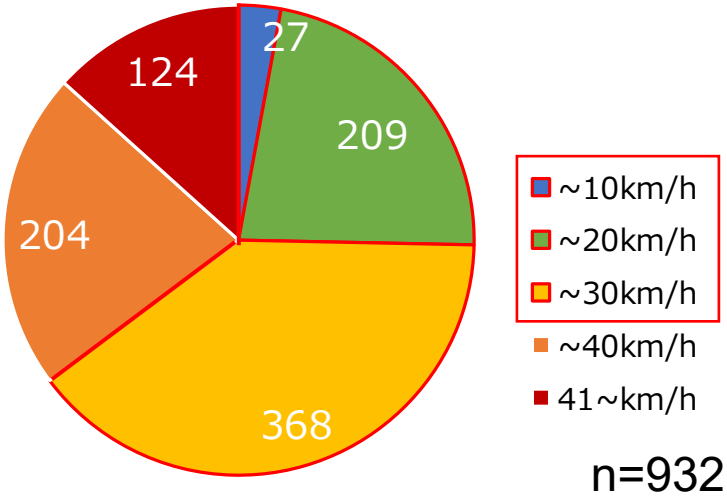


Fig. Accident locations and driving speed

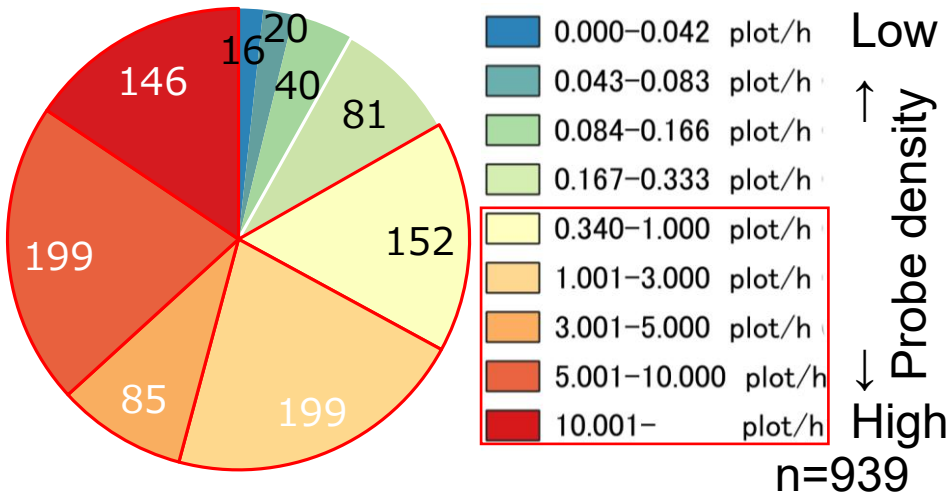


Fig. Accident locations and probe density

A total of 39 **"through-roads"** were selected as research target roads.

Analysis of speed-reducing effects of speed humps

- Each target road was divided into two sections as shown in the figure.
- Speed profiles were created to evaluate the effects of speed hump installation.
- Desired speed is likely influenced by road width.
  →Free speed section: The relationship between road width and spacing between humps was also analyzed.

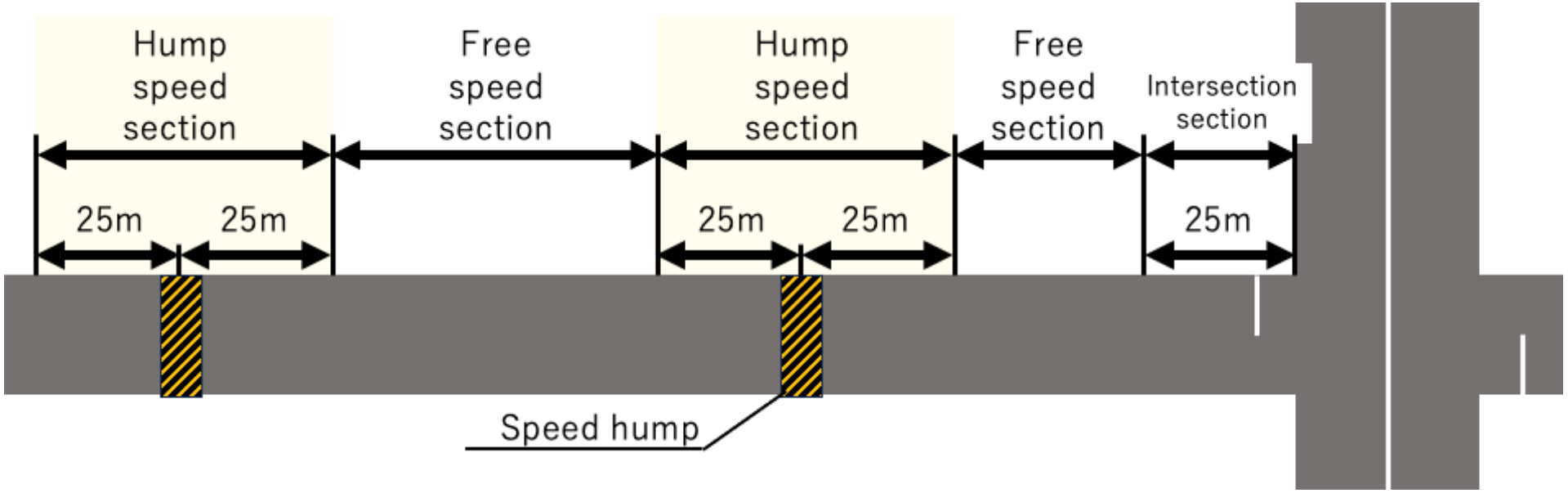


Fig. Dividing the Analysis Section

Analysis of speed-reducing effects of speed humps

- The figure shows an example of a speed profile.
- Visualized the tendency of deceleration near humps and acceleration recovery using probe data.

✓ Hump speed sections: All 11 sections were suppressed below 30 km/h.

✓ Free speed sections: In 9 out of 11 sections, speeds exceeded 30 km/h.

→Statistical evaluations were conducted for all 39 target roads.

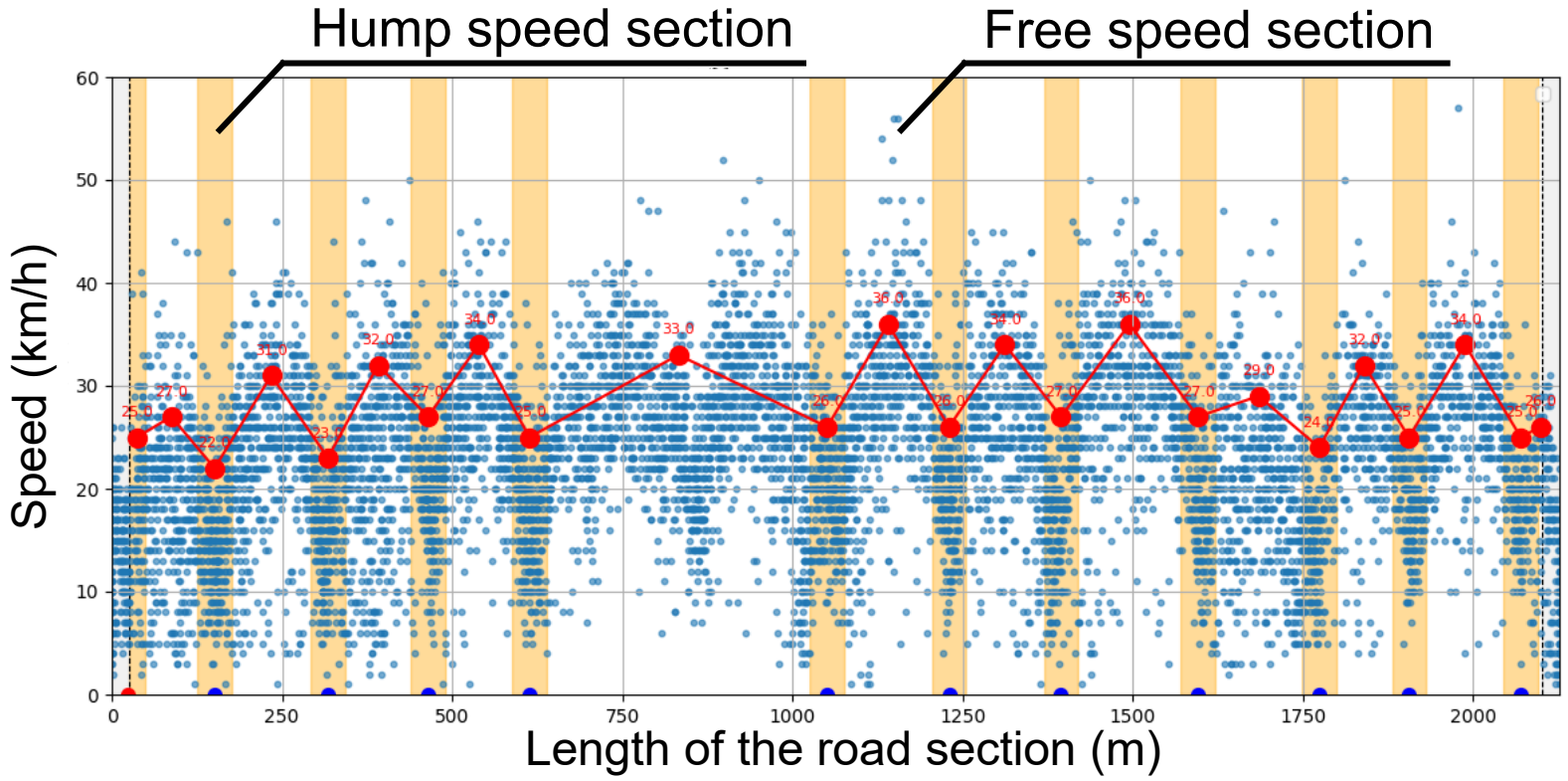


Fig. Speed profile（Soi Lat Phrao 80 Yaek 22）

Analysis of speed-reducing effects of speed humps

- **Hump speed sections**

✓ Out of 189 sections, 179 sections were suppressed below 30 km/h.

✓ In the remaining 10 sections, speeds slightly exceeded 30 km/h.

→Need to improve (e.g., increase the height, install a road sign, repair damage)

- **Free speed sections**

✓ 138 sections were identified and divided into two groups according to road width.

T-test results showed 6.0 m as the threshold (minimum SD and p-value).

→If narrow roads: Current manual recommendation of **80–120 m spacing** is effective.

→If wider roads: Speed recovers quickly, so multiple hump installations are less effective than narrow. Extra installation at hazardous spots is more effective.

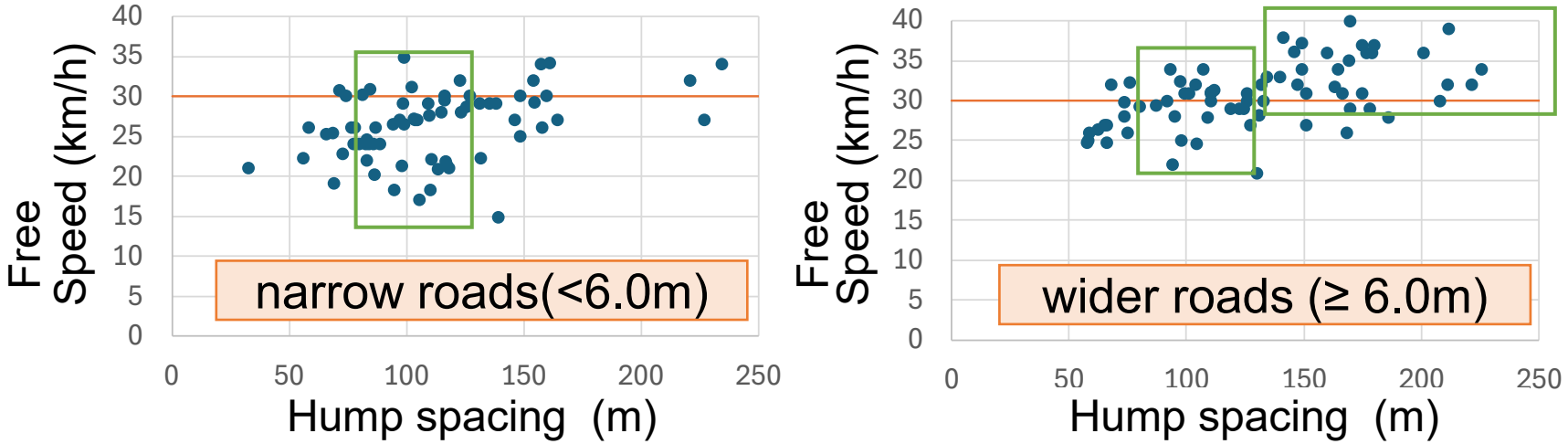


Fig. Relationship between hump spacing and free speed

Proposed Guideline for Speed Hump Installation

- Based on the analysis results, new guidelines for speed hump installation are proposed, summarized below.

Step 1. Determining the Target Zone

- Decide on broader areas (not individual Soi/Thanon)
- Areas surrounded by major roads or with direct access to them

Step 2. Assessment of Current Conditions

- Investigate:
  - Traffic volume (probe density) & speed*
  - Speed humps (location, condition)
  - Accident occurrence status

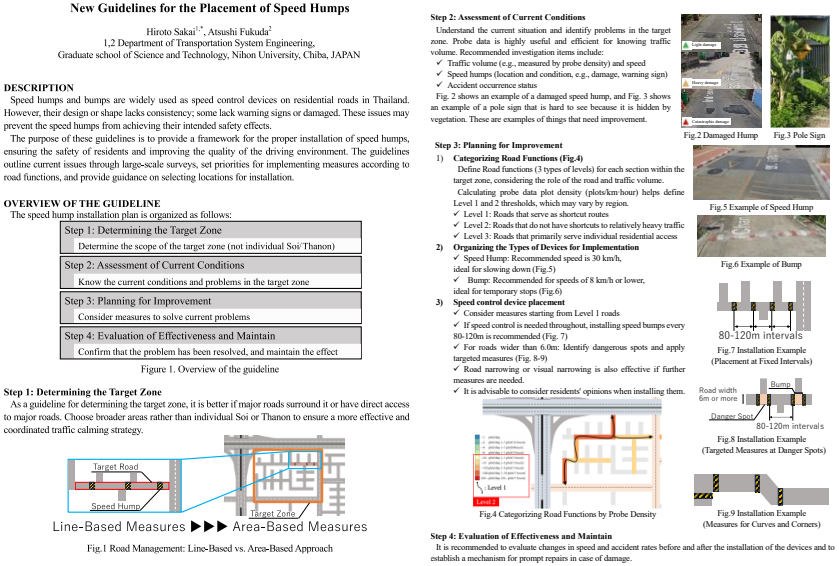
*Probe data is highly useful and efficient

Step 3. Planning for Improvement

- Classify roads into Levels 1–3 for priority setting:
  - Level 1: Residential roads connecting main roads
  - Level 2: High-traffic or frequent accidents on roads
  - Level 3: Dead-end roads with minimal traffic
- Identify hotspots (e.g., intersections, apartment entrances)
- Decide on new speed control devices or removal of ineffective ones
- Consider the difference in free speed according to the road width
- Interview residents for additional information

Step 4. Evaluation of Effectiveness and Maintain

- Investigate:
  - Changes in driving speed
  - Change in the number of accidents
- Establish a scheme to ensure any damage is repaired immediately



New Guidelines for the Placement of Speed Humps

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DESCRIPTION

Speed humps and bumps are widely used as speed control devices on residential roads in Thailand. However, their design or shape lacks consistency; some lack warning signs or damaged. These issues may prevent the speed humps from achieving their intended safety effects.

The purpose of these guidelines is to provide a framework for the proper installation of speed humps, ensuring the safety of residents and improving the quality of the driving environment. The guidelines outline current issues through large-scale surveys, set priorities for implementing measures according to road functions, and provide guidance on selecting locations for installation.

OVERVIEW OF THE GUIDELINE

The speed hump installation plan is organized as follows:

Step 1: Determining the Target Zone
Determine the scope of the target zone (not individual Soi/Thanon)
Step 2: Assessment of Current Conditions
Know the current conditions and problems in the target zone
Step 3: Planning for Improvement
Consider measures to solve current problems
Step 4: Evaluation of Effectiveness and Maintain
Confirm that the problem has been resolved, and maintain the effect

Figure 1. Overview of the guideline

Step 1: Determining the Target Zone

As a guideline for determining the target zone, it is better if major roads surround it or have direct access to major roads. Choose broader areas rather than individual Soi or Thanon to ensure a more effective and coordinated traffic calming strategy.

Fig.1 Road Management: Line-Based vs. Area-Based Approach

Step 2: Assessment of Current Conditions

Understand the current situation and identify problems in the target zone. Probe data is highly useful and efficient for knowing traffic volume. Recommended investigation items include:

- ✓ Traffic volume (e.g., measured by probe density) and speed
- ✓ Speed humps (location and condition, e.g., damage, warning sign)
- ✓ Accident occurrence status

Fig. 2 shows an example of a damaged speed hump, and Fig. 3 shows an example of a pole sign that is hard to see because it is hidden by vegetation. These are examples of things that need improvement.

Fig.2 Damaged Hump Fig.3 Pole Sign

Step 3: Planning for Improvement

1) **Categorizing Road Functions (Fig.4)**
   Define Road functions (3 types of levels) for each section within the target zone, considering the role of the road and traffic volume.
   Calculating probe data plot density (plots/km·hour) helps define Level 1 and 2 thresholds, which may vary by region.
   - ✓ Level 1: Roads that serve as shortcut routes
   - ✓ Level 2: Roads that do not have shortcuts to relatively heavy traffic
   - ✓ Level 3: Roads that primarily serve individual residential access
2) **Organizing the Types of Devices for Implementation**
   - ✓ Speed Hump: Recommended speed is 30 km/h, ideal for slowing down (Fig.5)
   - ✓ Bump: Recommended for speeds of 8 km/h or lower, ideal for temporary stops (Fig.6)
3) **Speed control device placement**
   - ✓ Consider measures starting from Level 1 roads
   - ✓ If speed control is needed throughout, installing speed bumps every 80-120m is recommended (Fig. 7)
   - ✓ For roads wider than 6.0m: Identify dangerous spots and apply targeted measures (Fig. 8-9)
   - ✓ Road narrowing or visual narrowing is also effective if further measures are needed.
   - ✓ It is advisable to consider residents' opinions when installing them.

Fig.5 Example of Speed Hump

Fig.6 Example of Bump

Fig.7 Installation Example (Placement at Fixed Intervals)

Fig.8 Installation Example (Targeted Measures at Danger Spots)

Fig.4 Categorizing Road Functions by Probe Density

Fig.9 Installation Example (Measures for Curves and Corners)

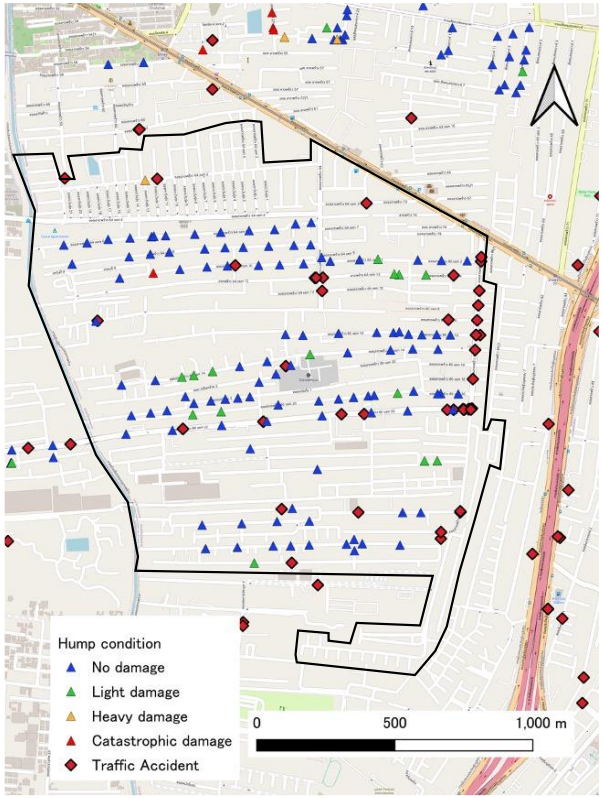
Step 4: Evaluation of Effectiveness and Maintain

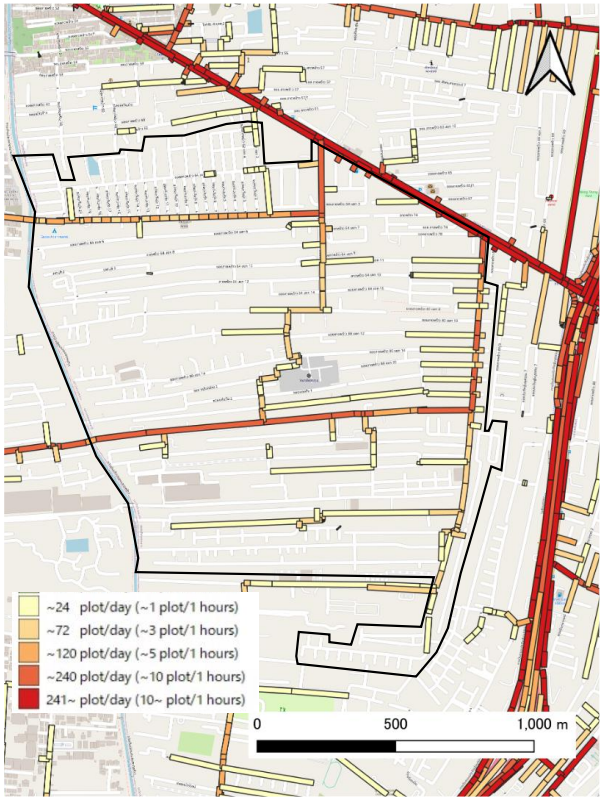
It is recommended to evaluate changes in speed and accident rates before and after the installation of the devices and to establish a mechanism for prompt repairs in case of damage.

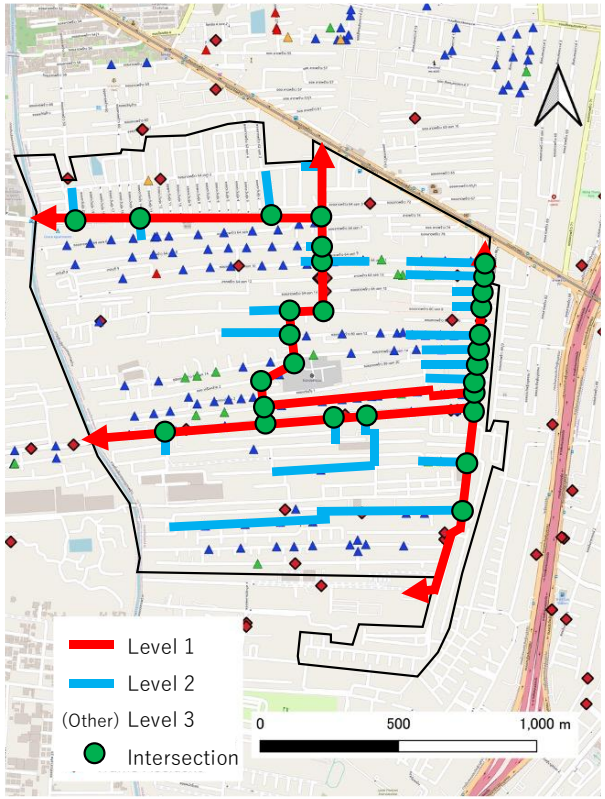
Fig. proposed guideline

Evaluation of the Proposed Guideline

As a model case, a block around Wat Samakkee Tham Temple in Wang Thonglang District was selected, and the following results of applying the proposed guidelines.







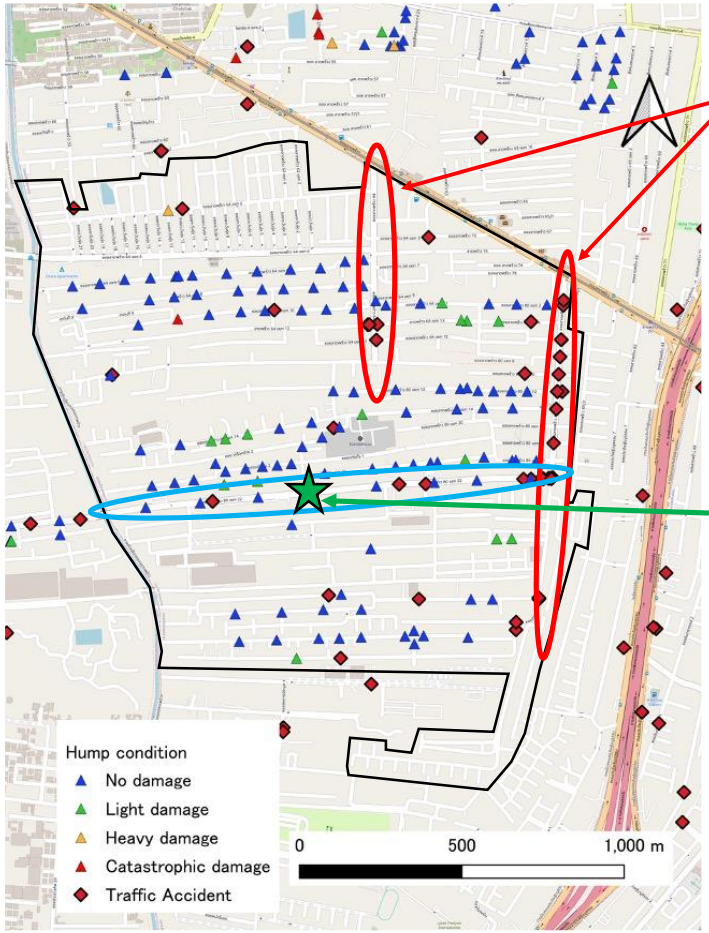
Step 1.
Selection of target area

Step 2-1
Survey of current conditions
- Hump installation status
- Accident locations

Step 2-2
- Probe density
  Show (≥0.34 plot/km·h) only

Step 3
Planning of installation
- Classification of road levels
- Hazardous spots

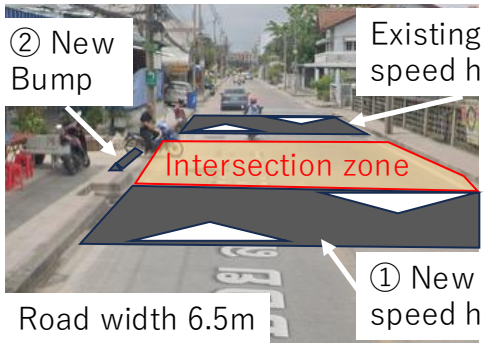
Evaluation of the Proposed Guideline



Road width 5.1m

Road width 5.3m

Level 1 road (frequent accidents) ▶ Install 80-120m intervals.



Road width 6.5m

Intersection of Level 1 and Level 2 roads (location of accident)
▶ Proposal for adding humps (①) or installing bumps (②).

Installation proposal

Narrow roads, without speed humps, with frequent accidents
→ Propose new speed humps installation at 80–120 m intervals.

Improvement proposal

Wide roads, hazardous intersections, with frequent accidents
→ ①Propose a new speed hump installation to pass slow speeds
→ ②Propose a new bump installation to prevent jumping out

Conclusion & Future Work

- 2,414 speed humps were identified on residential roads in the study area,
  → About 20% were damaged
  → Linear installation was observed, but area-based planning was not considered.

- 189 speed humps (speed) were analyzed **using probe data**.
  → 179 humps were confirmed to reduce speed below 30 km/h.

- Proposed area-based speed hump installation guidelines.
  →Evaluated in a model district and showed a specific improvement plan.

〈Future work〉

✓If acceleration data can be collected, analyze sudden braking points.
✓Implementing a pilot project and making the guidelines more practical.
✓Probe density is not identical to actual traffic volume; however, if consistency is secured, it can be applied to traffic assignment.

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Thank you for your attention