Québec 2010
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XIII INTERNATIONAL WINTER ROAD CONGRESS

QUÉBEC, FEBRUARY 8 TO 11, 2010

SUSTAINABLE WINTER SERVICE FOR ROAD USERS

EFFORTS TO IMPROVE THE VISUAL EMVIRONMENT ON EXPRESSWAYS THAT PASS THROUGH AREAS OF SNOWSTORM AND DRIFTING SNOW

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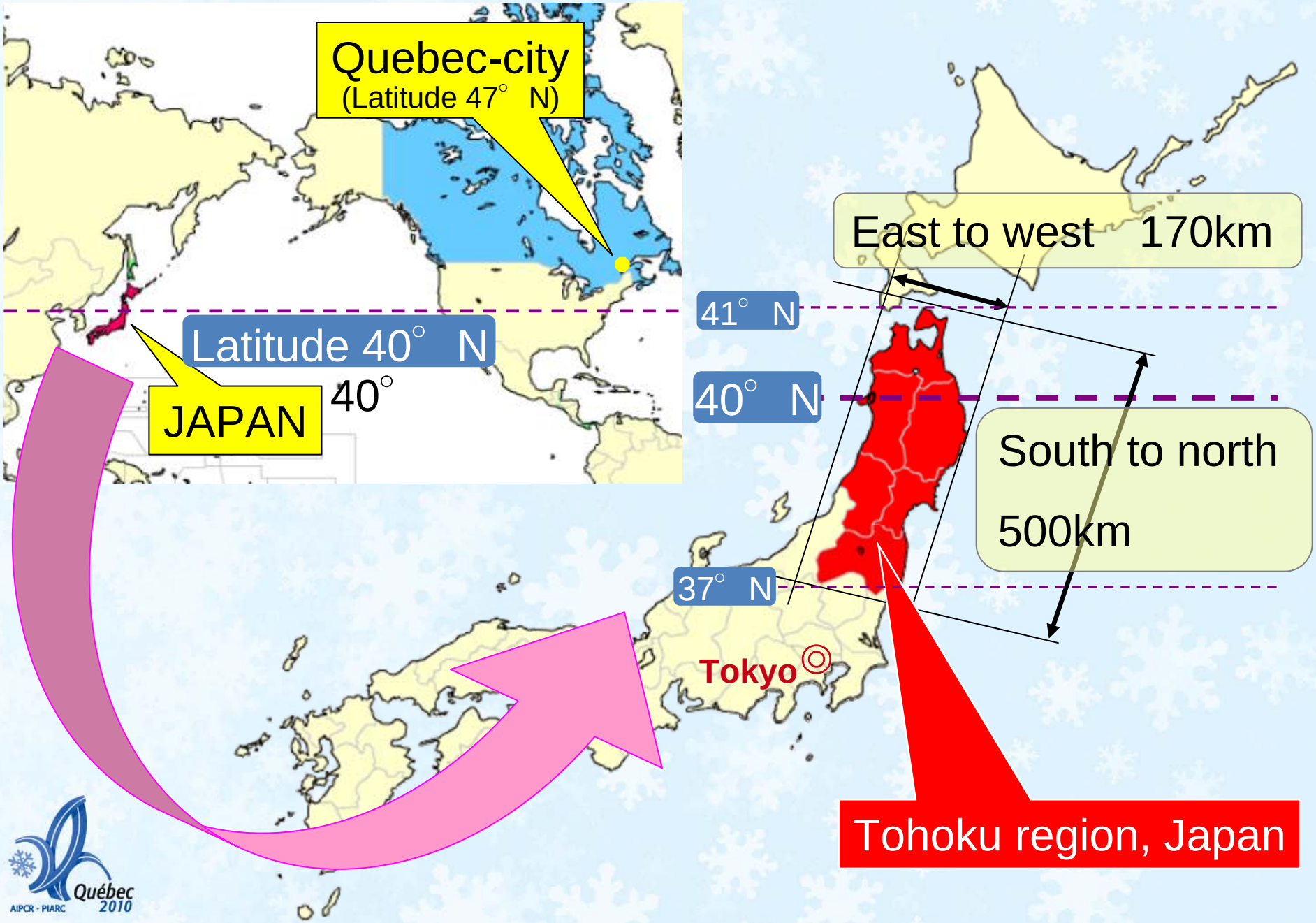
NEXCO 東日本グループ

SUMMARY OF PRESENTATION

- Japanese ‘ Tohoku region ’ is a one of heaviest snowfall areas in the world.
- In Expressways, the driver’s visual environment deteriorates due to snow storm, drifiting snow and heavy snowfall during the coldest period.

- I’d like to introduce ***3 solutions*** and ***these effects*** that we did for someone who drive in expressway during winter.

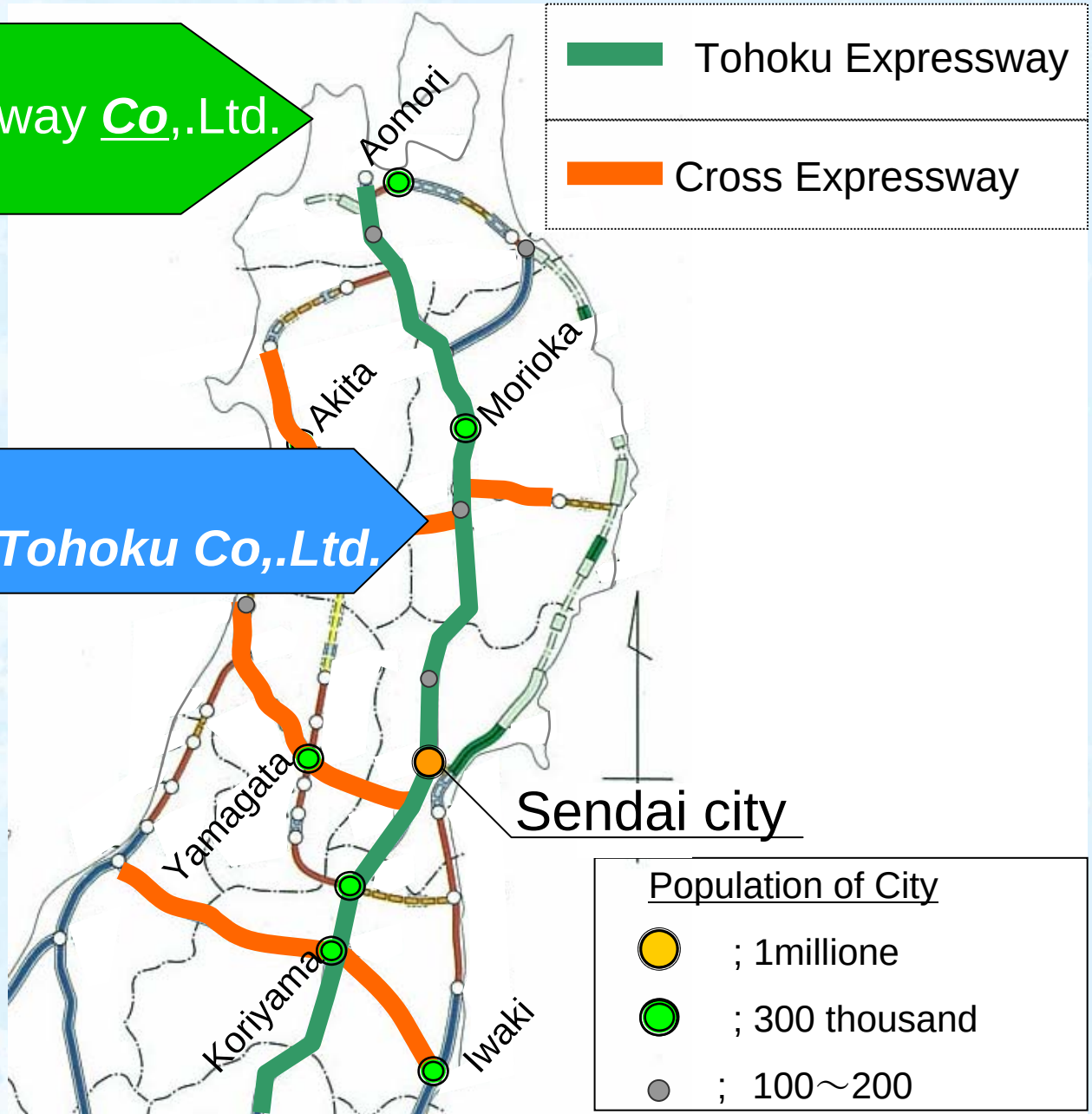
LOCATION OF JAPAN, TOHOKU REGION



EXPRESSWAY NETWORK IN TOHOKU REGION

Operation work
⇒east ***N***ippon ***Ex***pressway ***Co***,.Ltd.
= ***e-NEXCO***

Maintenance work
⇒***Nexco-Maintenance Tohoku Co,.Ltd.***



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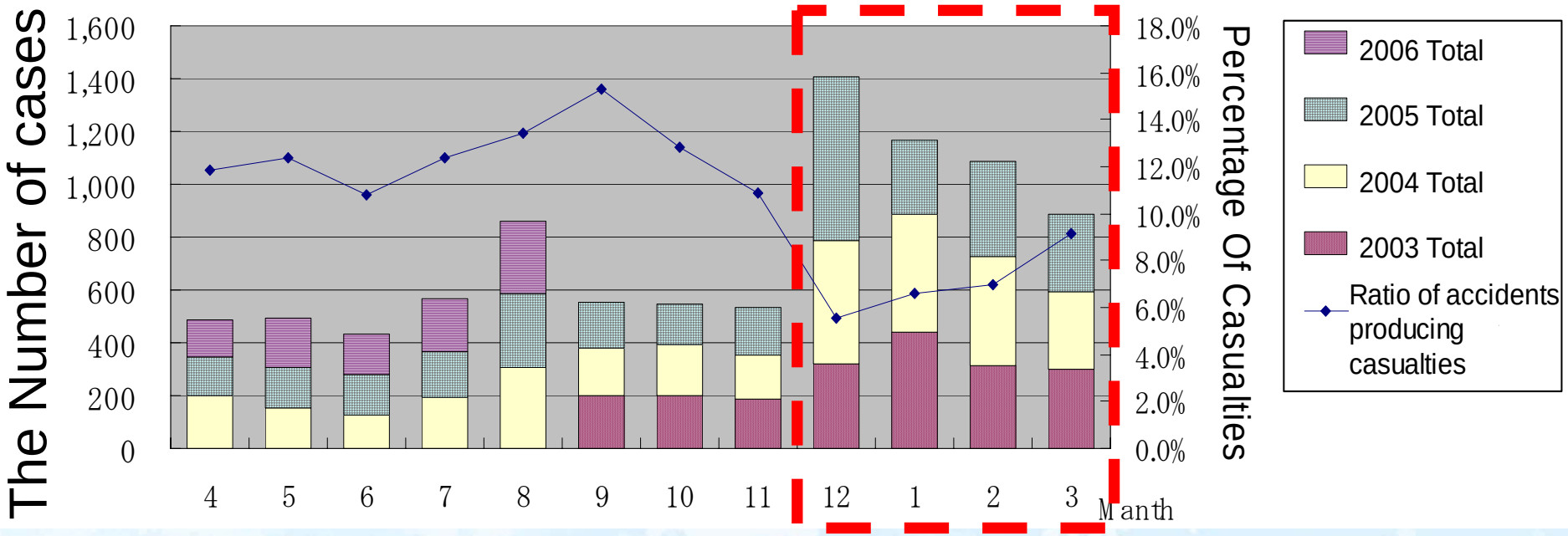
CHARACTERISTICS OF WINTER TRAFFIC

◆Total number of accidents over a three-year period, and yearly average number of accidents producing casualties.



- There are many accidents from Dec. to May.
- The expressways may be closed to prevent more traffic accidents.
- The causes of road closures : Poor visibly because of snowstorm(40%), and trafic Accidents(20%), Earthquake(5%)

THE MEASURES OF VISIBLY PROBLEM BECAUSE OF SNOW STORM

◆ Condition of visibly problem because of snow storm in limited place

blizzard @440KP, Kitakami-area, Tohoku expressway

◆Snowdrift prevention forest

◆Snow break fence

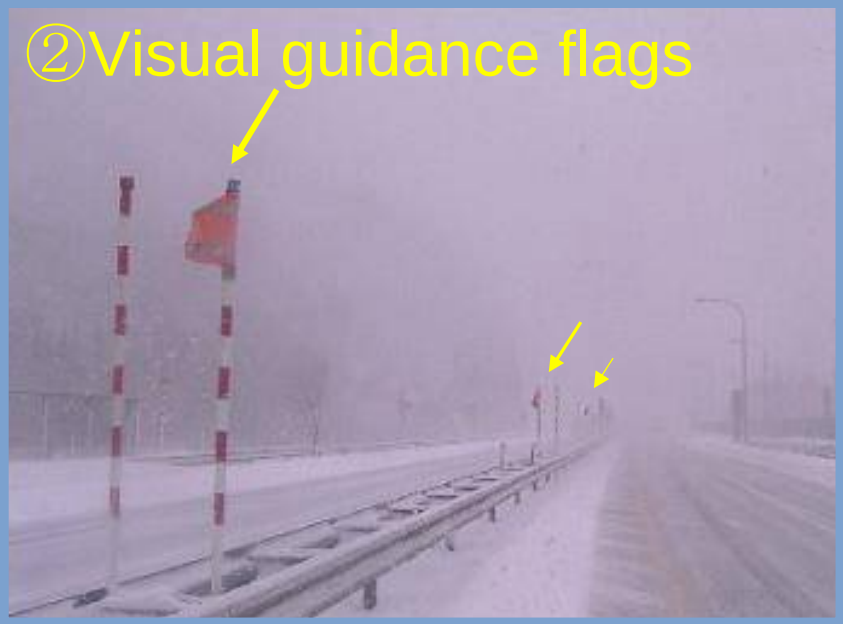
VISUAL GUIDANCE FACILITIES

①Self-luminous delineators

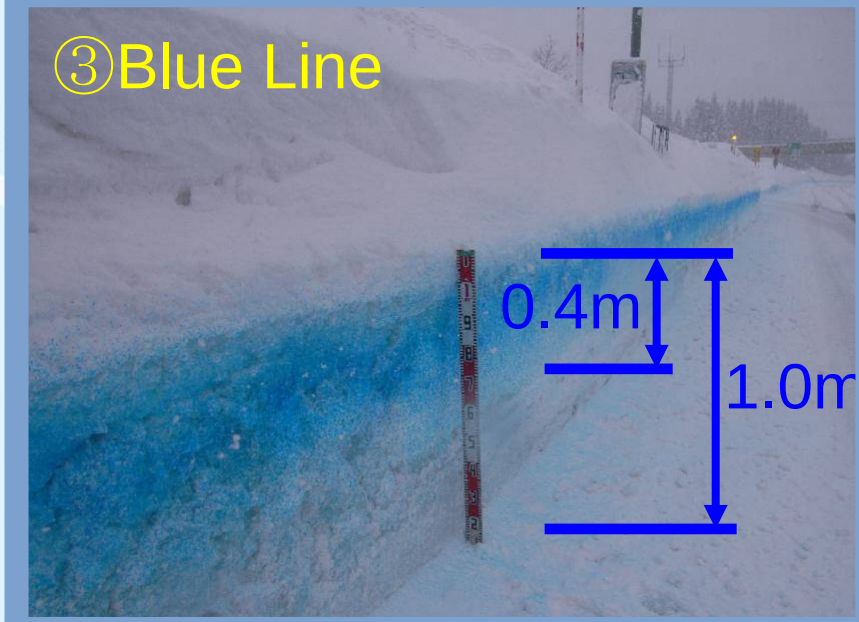
Power cable type

Solar-cell battery type

②Visual guidance flags



③Blue Line



SELF-LUMINOUS DELINEATORS (ELECTRICALLY-POWERED)

・Set up in the area where impaired visibility is a frequent occurrence

Height of delineators	Shoulder ：1.2m (from road surface) Median strip：1.6m (----- 〃 ----)
Distance between delineators	About less than 50m（depends on radius of curvature）

・ The cost is expensive, about $4,000 for 1 delineator.

SELF-LUMINOUS DELINEATORS (SOLAR CELL TYPE)

◆Installation situation

・ **Cost for 1 delineator**

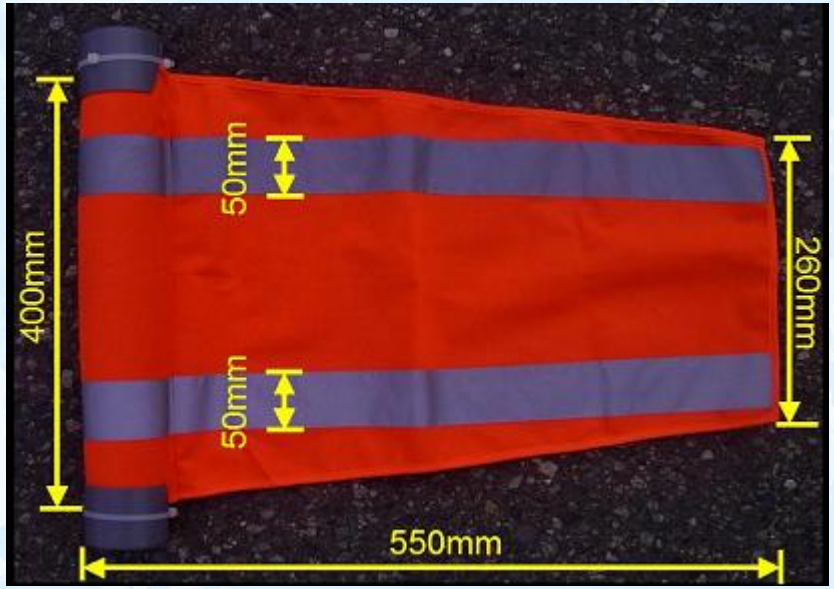
[electrically powered type : solar cell type = $4,000 : $90]

・It's possible to being fixed easily by a metal band(to existing snow poles.)

Height of Delineators	About 2.0m（from road surface)
Distance between Delineators	100m（as a test）

・ The brightness are inferior to electrically-powered lights

VISUAL GUIDANCE FLAGS

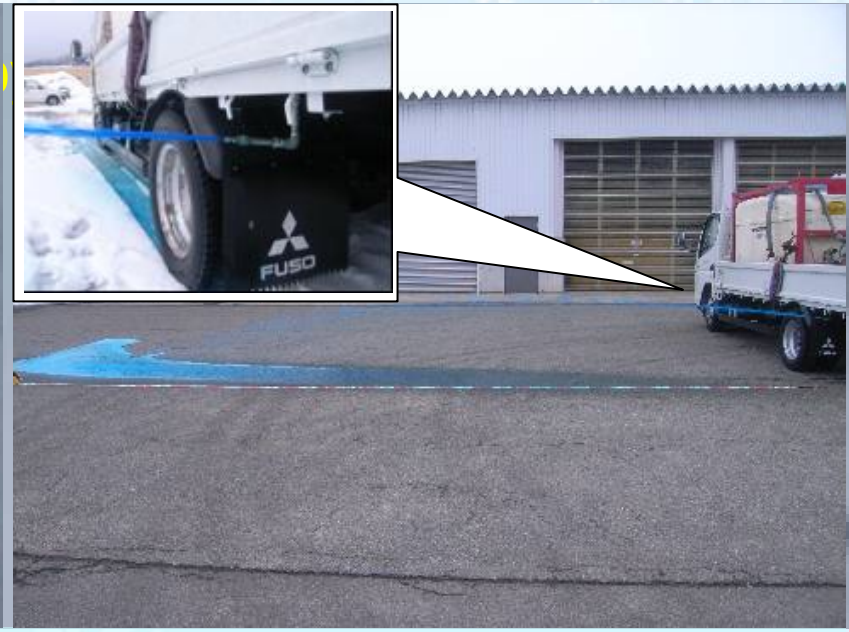


- The flag having reflector (it reflect the headlight)
- Fluttering provide visual guidance
- It can prevent snow sticking by fluttering.
- Set up on existing snow pole

Height of Flags	2.8m（from road surface)
Distance between flags	50m

THE BLUE - LINE

◆Spraying the Blue Line



The BLUE-LINE ＝ water ＋ pigment（ 1000 ： 1.5 ）

・Mixed liquid is harmless to living creatures and the environment.

Height of Blue Line （Top）	About 1.0m （from road surface ）
Width of Line	30cm ~ 40cm

・Driver assistant can control to spray in cabin.

・It needs enough snow bank to spray Blue Line.

・It’s possible to spray Blue Line at 20m/Liter.

MOVIE OF SPRAYING THE BLUE-LINE

Working at 60 km/h

Verificaition of effect to improve visual environment

- **How degree can driver recognize visual guidance facilities in poor visual environment?**

– (1) Questionnaires to frequent users
  - Self-luminous delineators
    (electricity-powered type, Solar cell type)
  - Visual guidance flags
  - Blue Line

– (2)Fixed-point observation by video camera
  - Self-luminous delineators
    (electricity-powered type : Incandescent lamps)

THE RESULT OF QUESTIONNAIRS [DELINEATORS]

- ***The electrically-powered*** delineators were given the highest evaluation
- The emitting light stimulate driver's visibility

  ⇒showing indication of the alignment of the road
- The regularly-spaced blinking remains as an afterimage

The worse visual environment become, the bigger effect of setting

- ***Solar cell-powered*** self-luminous delineators do not give off as strong a light as the electrically-powered ones
  - Increasing the brightness of the light (Improving function of solar cell-powerd type)
  - Placing them closer together (each 100m in present situation)

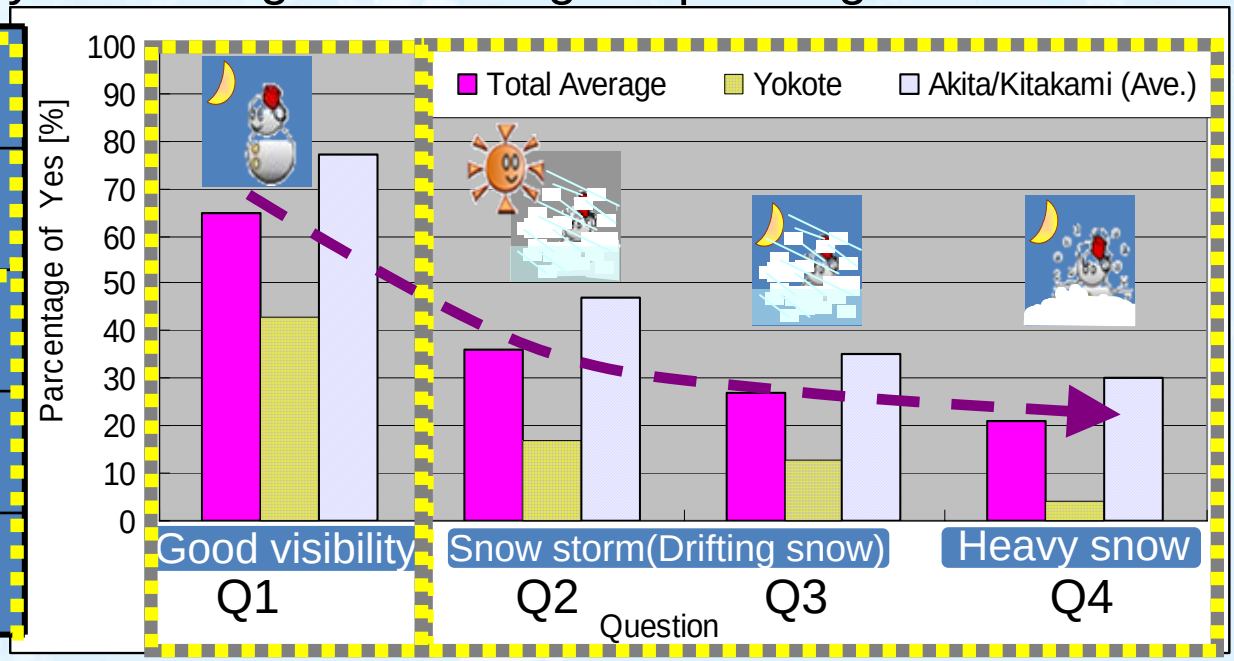
Furthermore, we need to improve the function and verify method to set up

When visibility is good, there is a case that driver **feel dazzle**.
So, we need to verify carefuly.

THE RESULT OF QUESTIONNAIRS [VISUAL GUIDANCE FLAGS]

◆Differences in the visibility of visual guidance flags depending on area

Is there effective visual guidance in the following situations?	
Q1	When night time visibility 'Good'.
Q2	When daytime visibility is 'Poor' due to snow storm.
Q3	When night time visibility is 'Poor' due to snow storm.
Q4	When night time visibility is 'Poor' due to heavy snow fall.



- Flag has good effect of visual guidance even when visual environment is bad
- As the visual environment deteriorated, the number

◆The image of haze phenomenon

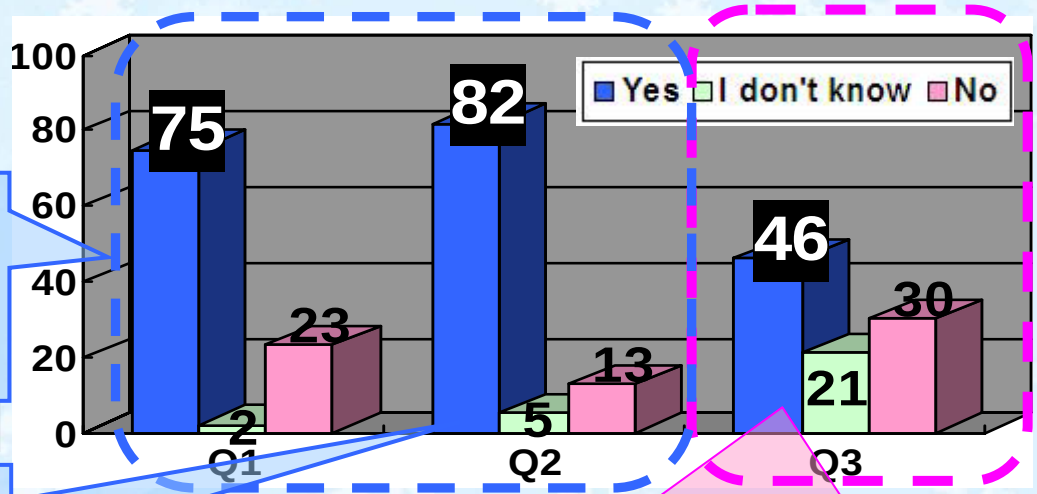
The height of setting up flag is ***too high***, 2.8m.

⇒Set up flags ***lower and continually***, in the area that they are *not buried* by snow bank growing

(from flash of camera)

THE RESULT OF QUESTIONNAIRS [THE BLUE-LINE]

Answer the following questions under a driving situation that is visibly problem due to snow storm and heavy snowfalls



Q1 The band of blue color on the snow bank can be seen even when the field of vision is poor

【***Yes　75%***, (43people/57people）】

Q2　The reason is that the shoulder can be seen by the Blue-line 【***Yes　82％***, （46people/56people）】

Q3Blue line can help driver at night time in poor visibly 【***Yes　46％*** 26/57people）】

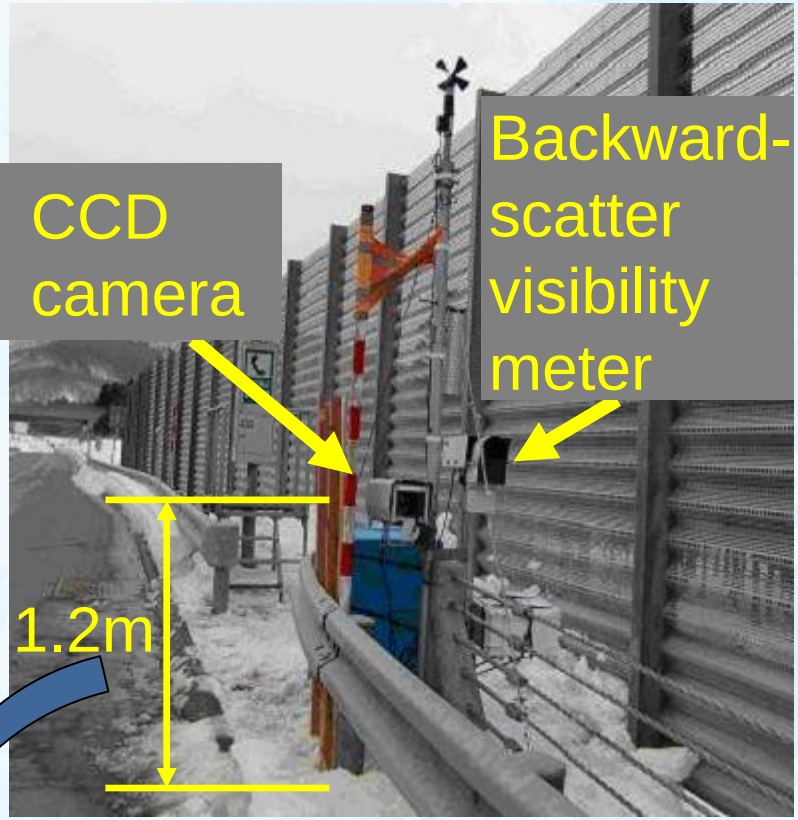
- Good height location ⇒【YES 91%　(50/55people)　】
- Good width ⇒【YES 83%　(45/54people), No　thin17%）】

The displaced snow covers onto the sprayed surface ,

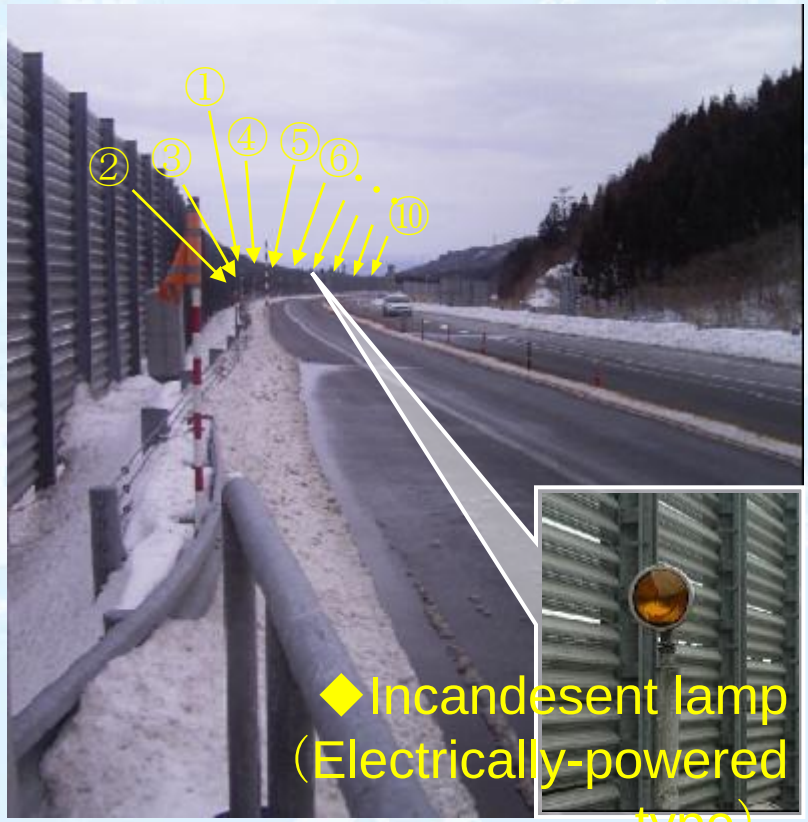
the Blue Line can no longer be seen.

Durability and visibly *at night time are problems*

INVESTIGATION OF HOW ARE SELF-LUMINOUS DELINEATORS SEEN



◆Observation equipment in position

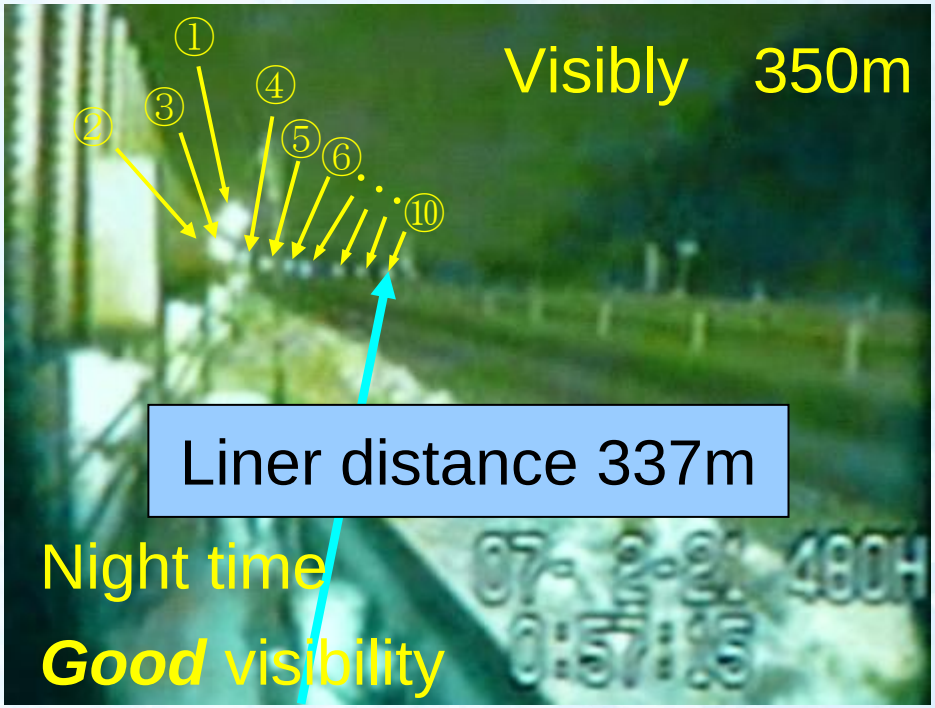


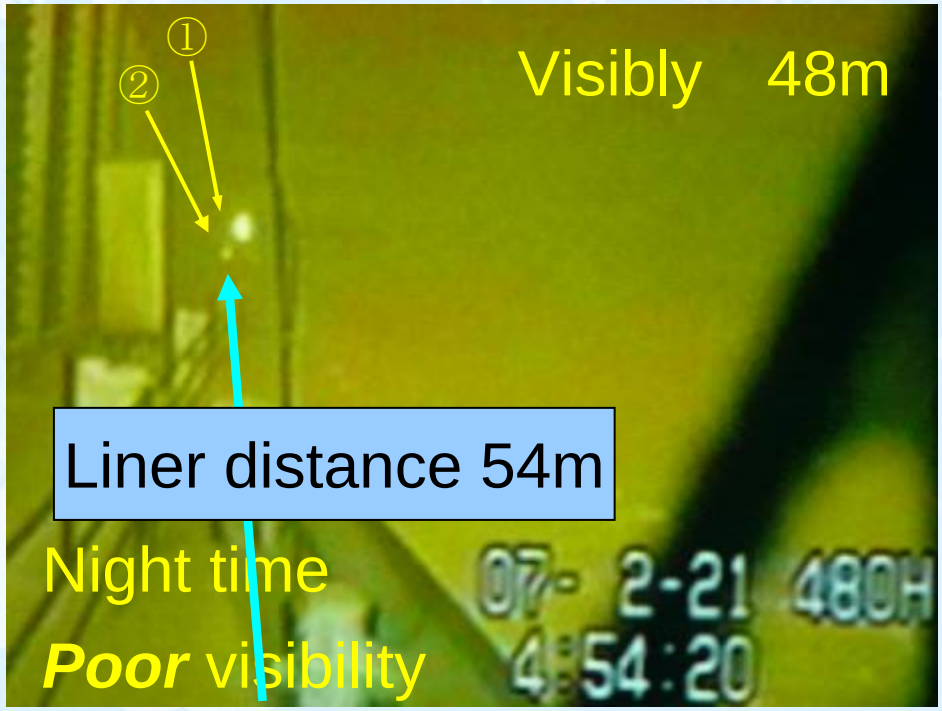
◆Viewpoint of Camera (by degital camera)
⇒There are 10 delineators.

1.2m was decided from viewpoint of ordinary motorcar

Investigation term : 1 month
（From Feb to March in 2008

INVESTIGATION OF HOW ARE SELF-LUMINOUS DELINEATORS SEEN





- When visibility is **good,** we can recognize **10** delineators.
  ⇒ (The liner distance to 10th delineator is 337m from camera)

- When visibility is **poor,** we can recognize **only 2** delineators
  ⇒ (The liner distance to 2nd delineator is 54m)

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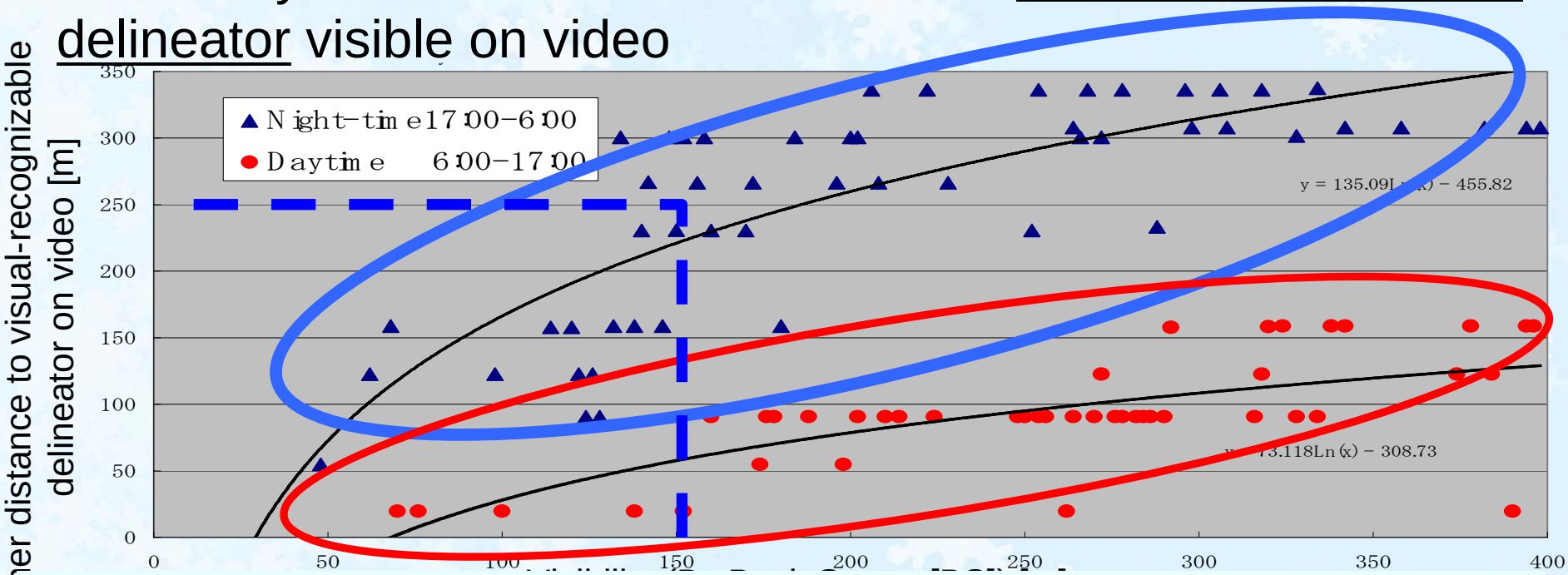
DELINEATORS WHICH CAN SEEN FROM CAMERA

◆Visibility and the linear distance to the farthest self-luminous delineator visible on video



•***During the daytime***, the distance of visible delineator reduce to half (due to the bright surroundings.)

⇒ Because of the greater contrast in light intensity between the lights and their surroundings.

– ***The delineator is able to support driving even when poor visibility such as snowstorms.***

CONCLUSION

◆Effect of visibly problem measures

Kind	Suitable place	Feature	Bad point
Self-luminous delineator (Electrically-powered)	•An area which has much visual problem •Heavy traffic & Importance of road	•Easy to remain as an impression	•Expensive for 1 delineator
Self-luminous delineator (Solar cell type)		•Low price •Set up easily	•Brightness is a little bit low
Visual guidance flag	•An area which has visual problem due to snowstorm	•Protect from sticking snow	•The color is getting worse after years
Blue-Line	• Heavy snowfalls area • An area where Whiteout occurrence	• Show the location of shoulder	•Durability •Visibility during night time

We need to ***choose the best measure which is suitable*** *for snowfalls, frequency of snowfall, wind,structure of road and size of snow bank.*

Thank you so much for listening my presentation.

◆Cost of visual guidande facilities.

- Self-luminous delineator (electrically-powered ; LED type)
  - •Construction extension : 2,700 m
  - •Number of installations : 67 ligts
  - •Construction cost : $ 26 million

  $ 9.7 million / km
  $ 390 thousand / light
  (Installation interval : 40m)

- Self-luminous delineator (sollar cell powered ; LED type)
  - •The cost of materials : $ 65 / light

  $ 1800 / km (Installation interval : 50m)
  $ 90 / light

- Visual guaidance flag
  - •The cost of materials : $ 46 / flag

  $ 920 / km
  (Installation interval : 50m)
  (only one side is set up)

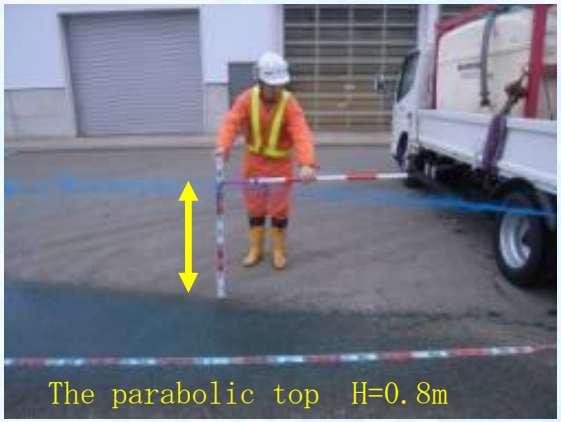
- Blue Line
  - The cost of coloring materials : $ 60 / 3Liter (= 2,000mixed liquid = 40km)
  - The cost of work(3 workers, etc.):$100/one time of work (= 40km/one time)

  $160 / one time = $40 / km

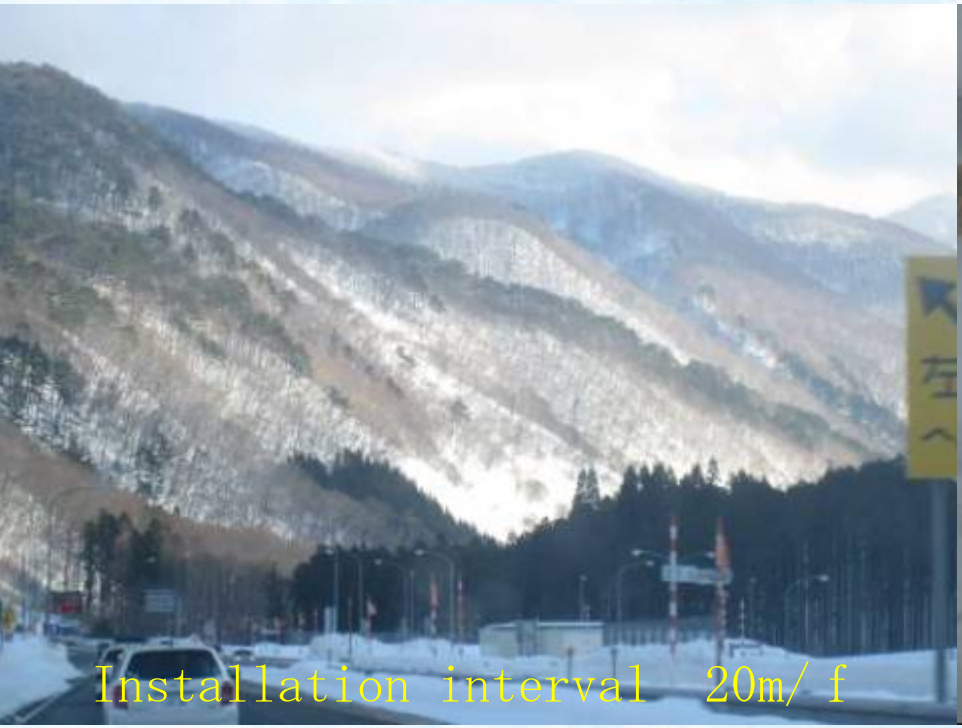
  - •The lease charge of work machine : $ 900 / 3months (2t truck + power sprayer) [Initial cost]

  [An initial cost is excluded.]

◆Work specification of blue line



◆Installation comparisons of visual guaidance flag



Whiteout

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