

CRACK SITUATION GRASP OF DIGITAL IMAGE METHOD

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ABSTRACT

Among a variety of damage phenomena, which the pavement road shows, the crack of the road is the most remarkable. The influence, which the crack exerts on the durability of the pavement road, is extremely large. It is necessary to understand the damage situation of the crack in the maintenance control of the pavement road. The device, which records the road image to understand the damage situation of the crack, is developed. The record device is divided into an analog method and a digital method. The technique of an analog method where the image of the road is recorded with 35mm roll film with a slit camera is typical. A digital method is a technique with a laser and an optical detection sensor. The grasp technique of the damage situation of the crack by a digital method is introduced.

1. INTRODUCTION

In the road extension of Japan, there are about 1,000,000km and 74% of the road extension is a pavement road (1997). Keeping the pavement of the road excellent becomes service to the user. It is important in the maintenance control of the pavement road to understand the damage situation on the surface of the pavement. The crack, the rut, and the roughness express the damage situation of the road. Especially, the influence of the crack on the durability of the pavement road is extremely large.

The road manager is confirming the damage situation by various means. The existence of the crack was confirmed by eyes 20 years or more ago. As for this means, long time and big cost are needed. It is general to confirm the damage situation with a special record device because it is solved now. It is about 20 years ago of the development of the device, which records the reflection of the road by an analog method in Japan. The slit camera and 35mm roll film were used at that time. The generation situation of the crack was confirmed from the film taken a picture. Digitalizing the measurement device develops another kind of device. The reflection record by a digital method uses the laser and the optical detection sensor. As for the device, taking a picture of equal is possible

though the measurement principle is different by an analog method and a digital method.

The road manager always has the concern in the damage situation of the road. And, the priority level of the repair is decided from the damage situation of the crack etc.

2. ROAD DAMAGE INVESTIGATION CAR

In Japan, there are about 10 cars to investigate the damage situation of the pavement road. The system which automatically investigates the damage situation is installed all of them. The item, which this car investigates, is a crack, a rut, and a roughness. The car equipped with the investigation system can run at a speed of about 40km per hour and acquire the damage situation of the road. All cars (system) cannot be investigated in daytime and it is necessary to execute the investigation at nighttime. Naturally, there is a big difference at the speed of the investigation when it is compared to execute the investigation as man walks and to execute the investigation by using the car. Because the investigation by the car does not need the traffic restriction, the road manager can reduce cost. Moreover, it need not be worried that the investigating person is rolled in the traffic accident. All cars are used to investigate an expressway and

a general road.

The means to measure the rut and roughness is a digital all method. The car that records the crack by a digital method is 1/3 of those. The record device of a digital method of the crack was developed with the Komatus Engineering Co., LTD. Figure 1 are a car equipped with the system which investigates the damage situation of the road.



(a) Car which investigates crack by digital method. The laser irradiation entrance is installed forward of the car.



(b) Car which investigates crack by analog method. The slit camera is installed forward of the car.

Fig.1 Road damage investigation car

3. IMAGE OF CRACK

There are two methods of means to acquire the image of the crack. One is an analog method and another is a digital method.

3.1 Analog Method

It is typical that an analog method uses the slit camera and 35mm roll film. The slit camera is

installed in the upper part of the car and the slit camera takes a picture of the road like seeing the right under. A special illumination device is installed in the car and the shadow of the crack is produced because of the light. 35mm roll film tunes to the speed of the car, is sent off, and the slit camera takes a picture of the shadow of the crack made from the illumination device. The crack up to about 1mm in width can be identified with the film. Figure 2 is an image of the film, which takes a picture of the crack.

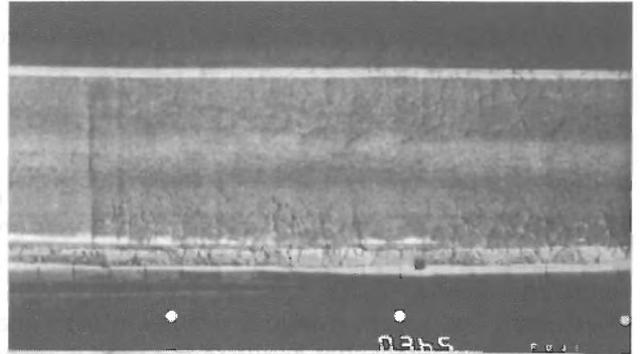


Fig.2 Crack image with film

3.2 Digital Method

It is typical that a digital method uses the laser and the optical detection sensor. The car has the irradiation device of the laser. The laser is irradiated from the upper part forward of the car by using the laser tube. The shape of the laser is a spot. A spot laser draws the tracks by using the mirror, which rotates at high speed in the direction where the road is crossed. The laser becomes as a result like the line. The rotation of the mirror is about 17,000 times per minute.

The laser drawn on the road is caught with the optical detection sensor. The optical detection sensor is installed under forward of the car. When the crack exists in the road, the laser enters the crack part and the laser projected to the road looks dark. The projected laser looks bright in the part, which does not crack.

Information acquired with the optical detection sensor is recorded on the W-VHS tape (high-definition television tape). Even the maximum at the recording time of the tape can be recorded regardless of the running speed of the car. The indoors special reproduction machine can see the image of the road recorded on the tape. The monitor as seen from 3m sky by eyes projects the image of the road. This digital image is not damaged and is not torn off (Differ from an analog film). Moreover, advancement, the retreat, and the

stop can be freely done with the remote control button of a video device.

Figure 3 shows the irradiation entrance of the laser. The mirror, which rotates at high speed in this, exists. Figure 4 shows the laser projected to the road. It is a spot laser where the line where the road is crossed rotates at high speed. The optical detection sensor is on a door lower forward of the car. Figure 5 shows the crack image of the vertical direction (direction of progress). Figure 6 shows a horizontal crack image. The crack can be identified in high accuracy with the laser and the optical detection sensor like this.



Fig.3. Laser irradiation entrance

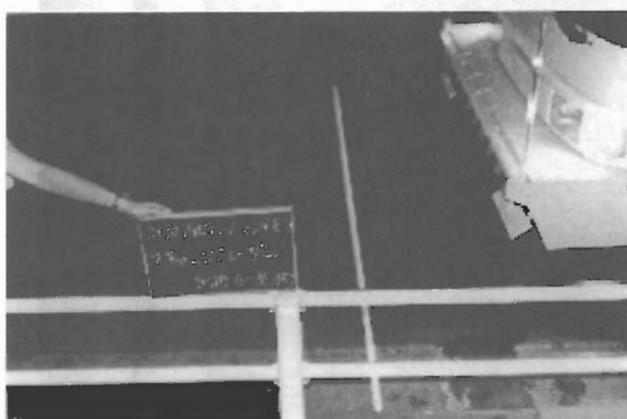


Fig.4. Irradiated laser (spot laser which rotates at high speed)

4. THEME IN THE FUTURE

There is one new possibility in the method of acquiring the crack in a digital image. It is a means

to make the crack identified automatically. The research is advanced in Komatsu Engineering CO.,LTD now. However, long time is needed for the automatic identification for the computer to analyze the existence of the crack similarly in the part where the crack does not exist and the part where the crack exists. The presence of the crack can be identified in one glance according to man's eyes.

It is a system, which can identify the width of the crack up to about 1mm. The road manager occasionally requests information on a high quality by the situation though it is enough in such accuracy now.

Moreover, if the system of the same quality is produced by the development of optical equipment in recent years, cost can be suppressed low.

The theme of the crack analysis by the future digital method is "Automatic identification", "High quality", and "Cheapness."

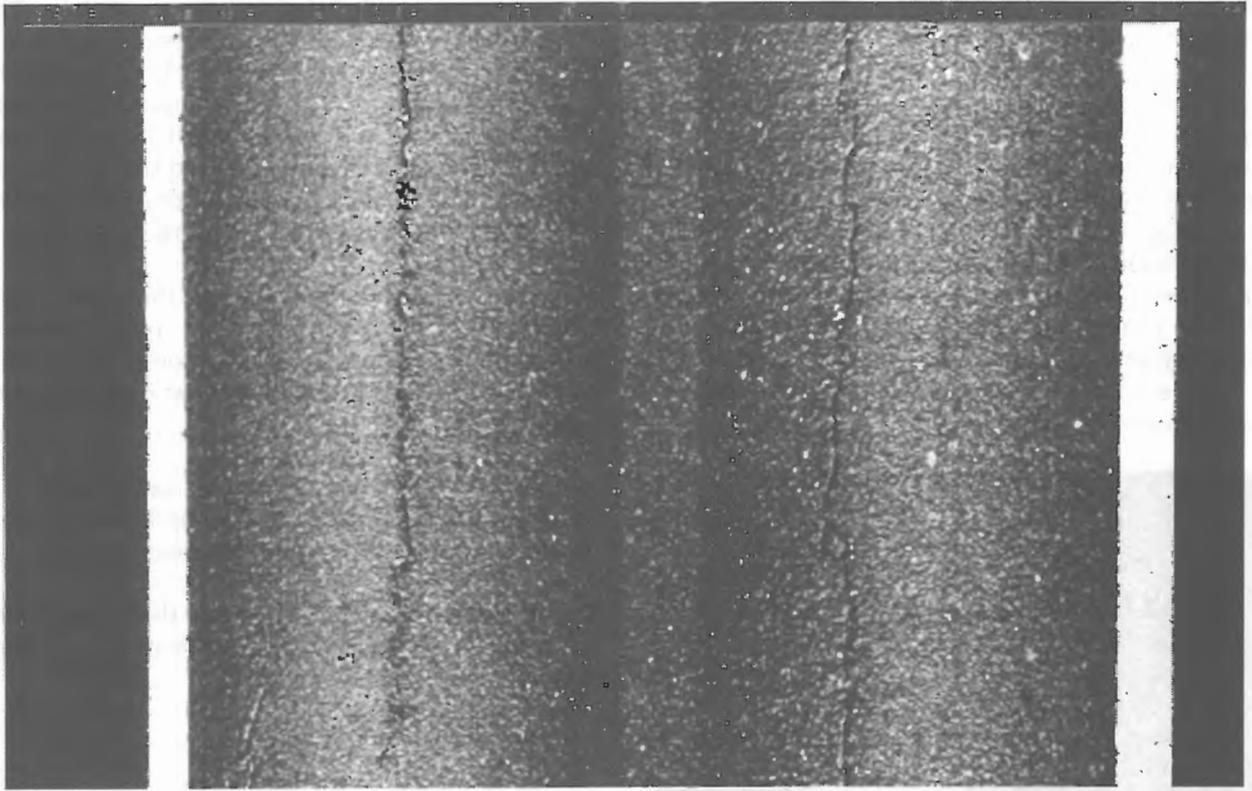


Fig.5. Crack image (Vertical direction)

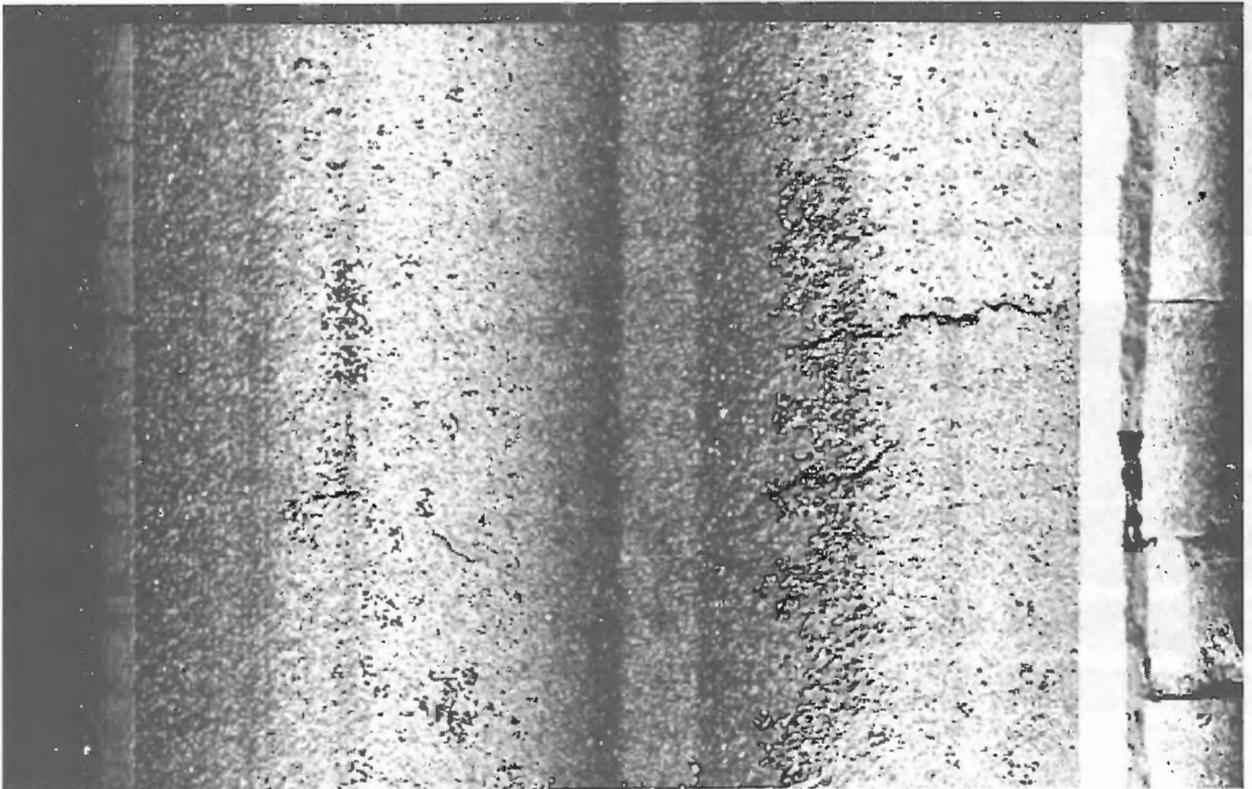


Fig.6. Crack image (Horizontal direction)