Emergency Repair of Runway after Cargo Plane Accident

K. Ookubo
NIPPO Corporation, Narita office, Chiba, Japan

S. Kakuta
Narita International Airport Corporation, Chiba, Japan

T. Inou
Airport Maintenance Service Corporation, Chiba, Japan

M. Ide
NIPPO Corporation, Narita office, Chiba, Japan

ABSTRACT: It is always desirable for engineers to complete construction projects on schedule. However, emergency repairs after accidents at transportation facilities such as airports and highways have also played an important role since the accidents significantly affect users in several ways. This paper summarizes the emergency runway repair as a management system (i.e. operators, machines and materials) from the early establishment of a construction party to completion of repair, based on the case study of a cargo plane accident at Narita International Airport. Three factors influencing the repair were examined through the case study: area, decision for section and repair methods; the following conclusions were drawn in this study. In terms of the decision for the repair area, field results indicate that although softening of the asphalt surface resulted from the fuel leakage from the cargo plane on the runway, no significant breakages were confirmed on the surface. Therefore, it was concluded that the softening did not have any significant effect on service, as the grooving of the runway remained effective after the accident. With regard to the repair depth, it was judged that 5 cm milling/overlay is enough to remove the damaged section because the softening was less than 5 mm in depth. With respect to the early establishment of the construction party, the repair plan was completed at an early stage. The reason for such early establishment was due to the applicability of the rehabilitation system to the emergency repair.

KEY WORDS: Airport pavement, management system, emergency repair.

1 INTRODUCTION

It is always desirable for engineers to complete construction projects on schedule. However, there is growing awareness that emergency repairs after accidents at transportation facilities such as airports and highways also play an important role, since such accidents significantly affect users in several ways. Nevertheless, management systems including repair work have still not been studied, especially in the field of asphalt pavements. Therefore, the establishment of emergency repair systems related to asphalt pavement construction is required in terms of risk management. This paper summarizes emergency runway repairs as a management system (i.e. operators, machines and materials) from the early establishment of a construction party to the completion of repairs, based on a case study of a cargo plane accident at Narita International Airport (NAA).

2 BACKGROUND

2.1 Details of the airport

Narita International Airport opened in 1978. Since then, the annual number of passengers and cargo has steadily increased, reaching 34,240,000 and 2,210,000 tons in 2007, respectively. In terms of world ranking, the airport is ranked 7th for passenger numbers and 3rd for cargo (Hayakawa et al. 2009). Details of aircraft usage are presented in Figure 1.

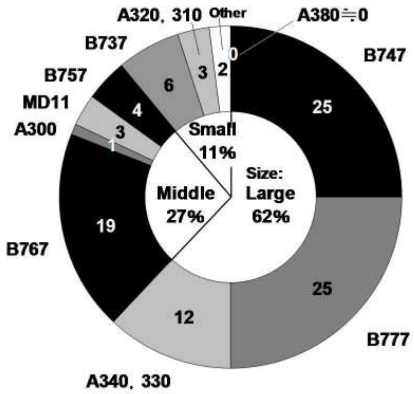


Figure 1: Details of aircraft that use Narita International Airport

2.2 Occurrence of accident

On March 2009, a cargo plane crashed upon landing on Runway A at Narita International Airport (see Figure 2). The cargo plane was destroyed in a fire that lasted for two hours, so the runway, which is paved with an asphalt surface, was also heavily damaged by the accident. Runway A was closed immediately after the accident; early recovery of the runway was desired since it was anticipated that the closure would significantly affect airport operations. Therefore, the establishment of a repair plan was required at a relatively early stage.

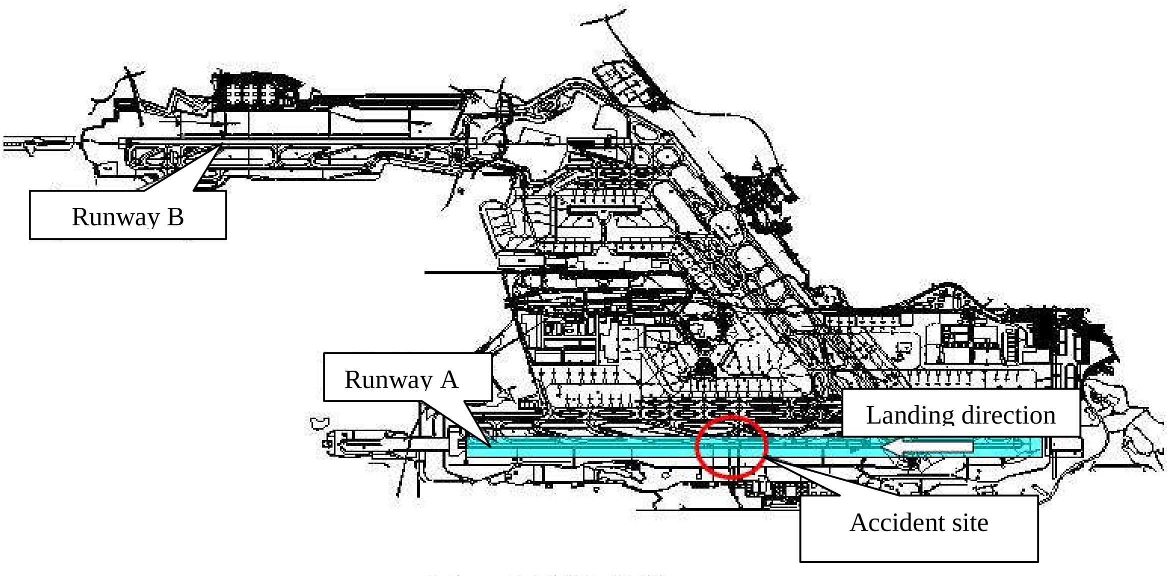


Figure 2: Narita International Airport

3 OUTLINE OF THE REPAIRS

After the accident, an emergency headquarters was established at NAA. Also, Airport Maintenance Service Corporation (AMCO) and NIPPO Corporation, which usually conduct maintenance at the airport, collaborated to establish an emergency repair plan based on NAA's risk management system. Table 1 shows an outline of the repairs from closing to re-opening of the runway.

Table 1: Outline of repairs

Date	Time	Detail
23rd	6:49 a.m.	A cargo plane crashed upon landing at Runway A.
	7:50 a.m.	Emergency headquarters set up in NAA[1].
	8:00 a.m.	AMCO[2] asked NIPPO[3] to establish an emergency repair system.
	8:30 a.m.	NIPPO agreed with AMCO to undertake the establishment.
	11:30 a.m.	NIPPO advised AMCO of the planned restoration system. ● Number of workers: 70 ● Number of milling machines: 4 ● Number of asphalt pavers: 3 ● Asphalt mixture required: 1,400 tons
	2:30 p.m.	NAA, AMCO and NIPPO confirmed the extent of the damage. ● More than 10,000 m^2 was damaged by fuel leakage. ● Cutback of the surface layer was also confirmed. (A detailed investigation including determination of the repair area was conducted after 16:00 due to the investigation of the accident by the government committee.)
	3:00 p.m.	NIPPO informed the construction party about the state of the runway and ordered planning to proceed for emergency repair work.
	4:00 p.m.	NAA ordered NIPPO to conduct emergency repairs via AMCO. ● AMCO and NIPPO conducted a field investigation and decided on the repair method at 17:00. ● The emergency repair system was established.
	10:00 p.m.	Emergency repair work started.
24th	7:00 a.m.	Repair of Runway A was finished.
	9:10 a.m.	Runway A was re-opened.

Notes:
1 NAA: Narita International Airport Corporation
2 AMCO: Airport Maintenance Service Corporation
3 NIPPO: NIPPO Corporation

4 INVESTIGATION FOR REPAIR WORK

4.1 Establishment of construction party

In the case of such an accident, a detailed investigation by government committee is normally needed before repairs can start. However, as closure of the runway has a significant effect in several ways, the early establishment of a construction party to determine the repair area was desired after confirmation that the surface was damaged. As a result of the visual inspection, it was estimated that the maximum repair area would be approximately 12,000 m^2. Based on this estimation, a construction party was established with 1,400 tons of asphalt mixture, 4 milling machines, 3 asphalt pavers and 70 workers.

4.2 Determination of repair area and method

After field investigation, the following factors were considered for the repairs.

- Width of the runway and asphalt pavers;
- Treatment of center ground light at the runway.

Figure 3 shows a plan of the repair area including the center ground lights. In the case of milling/overlay, normally, the removal and re-installation of the ground lights in the center of the runway is required before and after paving, respectively. However, since it was predicted that such repair work would take much time, priority was given to repairing the pavement; the re-installation of the lights would be considered after those repairs.

In terms of the depth of pavement damage, it was judged from on-site inspections that the depth of damage caused by the actual aircraft and the cutback of the asphalt surface by fuel leakage was minor and only affected the surface layer (see Figures 4 and 5). Thus, it was recognized that 5-cm milling/overlay would be enough to remove the damaged section because the softening was less than 5 mm deep.

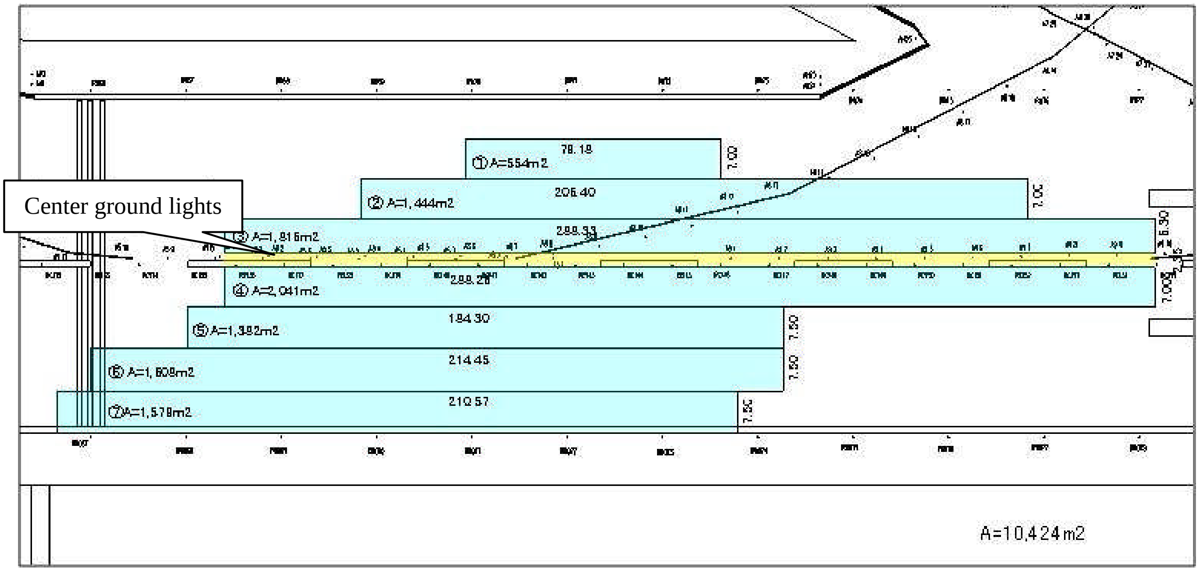


Figure 3: Plan of repair area


Figure 4: Damaged runway surface


Figure 5: Cutback of the asphalt surface caused by fuel leakage

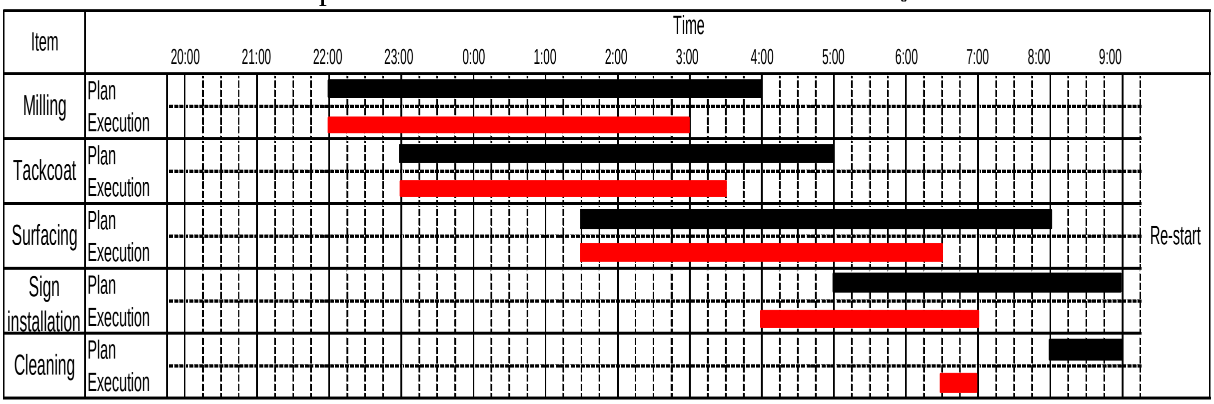
5 RESTORATION WORK

There was concern that prolonged closure of the runway due to repair work would result in the cancellation of flights. Therefore, the highest priority was to open the runway at the earliest stage. In order to achieve this, the repair work was conducted based on the following work plan.

5.1 Timetable

Table 2 shows the timetable for the repairs. The timetable was set up to conduct the repair work from 22:00 on 23rd to 09:00 on 24th November. Under this timetable, five factors were considered for completion of repairs: milling, tack coating, surfacing (laying), sign installation, and cleaning. Also, the legend for the plan and execution is depicted in the table. As can be seen in Table 2, all the work was finished ahead of schedule. Thus, it can be said that the repairs were successfully completed in terms of the following timetable.

Table 2: Timetable for repair work



5.2 Construction party for repair work

The repair method, timetable and construction party were established as shown in Table 3, based on the earlier determination of the repair area. As described in Section 5.1, the repair work was finished earlier than planned. Thus, it can be said that the arrangement and quantity of equipment, materials and workers were appropriate to complete the repairs on schedule.

Table 3: Equipment and materials used for the repair work

Item	Equipment	Quantity
Major equipment	Milling machines (Wirtgen: Width 2.0 m)	2
	Milling machines (SAKAI ER: Width 2.0 m)	2
	Milling machine (HANTA CRP: Width 1.0 m)	1
	Sweepers	2
	Asphalt pavers (VOGELE: Width 8.0 m)	2
	Tire rollers	2
	Vibrating rubber tire rollers	4
	Large dump trucks	12
Materials	Dense-graded asphalt mixture	1,306 tons
Arrangement of Workers	For Milling	9
	For Overlay	28

5.3 Restoration work

In order to conduct repair work in accordance with the timetable, the repair work was carefully carried out considering three factors: milling, tack coating, and laying.

5.3.1 Milling

Figure 6 shows the milling state for the repair work. In practice, it is important to complete the milling work and progress to the paving work as quickly as possible. To achieve this, 4 milling machines were prepared for the repair work. Segmentation of the construction area was also carried out for the paving work in parallel with the milling work.

Figure 6: Milling

5.3.2 Tack coating

In the case of laying, there was concern that blistering might occur due to a failure to break down the asphalt emulsion, as the repair work was conducted in winter. In addition, not only was blistering a concern, but it also affects the long-term performance of the runway. Therefore, high concentration emulsified asphalt was used in these repairs to prevent the surface layer from blistering and to enable an early start to the laying operation.

5.3.3 Laying

Figure 7 shows the laying during the repair work. In order to complete the restoration on schedule, the repair work was conducted by two parties. However, as approximately 1,300 tons of asphalt mixture had to be laid within 5 hours, the uninterrupted supply of the mixture was an issue. 450 tons per hour of asphalt mixture was, therefore, provided from two of their own asphalt plants and one backup plant. As a result, the supply of asphalt mixture and the laying operation were successfully finished. It can be said that this contributed to the early opening of the runway.

Figure 7: Laying

5.3.4 Execution management

In order to achieve early restoration, it was necessary to conduct milling, tack coating and laying continuously with minimal time lag. Since it is crucial to organize the timetable in each work, site engineers were stationed for the milling parties and laying parties, respectively so that the timetable was kept to. Through the execution, the following factors contributed to the adherence to the timetable and reduction in repair time:

- As paving machines were placed across a wider area, the operation was conducted by foremen guiding the machines; this led to the resolution of waiting times for dump trucks.
- Three leading vehicles were arranged for the mixture dump trucks. Consequently, the material was supplied appropriately by passing the delivery route.

As a result, the emergency repairs were completed by 7:00 a.m. – two hours ahead of schedule. 26 hours 21 minutes after the accident, and 11 hours 10 minutes after the restoration work began, Runway A was reopened for operation; the first flight since the accident landed successfully at 9:24 a.m.

6 CONCLUSIONS

To sum up, the repair of Runway A at Narita International Airport was completed based on the emergency system utilized for regular maintenance work. The reason for the early recovery of Runway A is that AMCO and NIPPO successfully collaborated to conduct the repairs under the supervision of the NAA. In particular, under such emergency circumstances, whether or not the established emergency system works appropriately is important. Therefore, through this accident, it was understood how control of the whole system (i.e. operators, equipment and materials) is critical for emergency repairs at transportation facilities. The main points learned from this case study are summarized below:

- In terms of workers, as runway maintenance is conducted regularly at the airport, the establishment of a system including construction party and material delivery could be achieved at an early stage. Therefore, utilization of the existing maintenance system (i.e. organizations and workers) is highly effective in the establishment of an emergency repair system.

- With regard to equipment, a system that gives consideration to emergency situations should be established by preparing larger pavers and spare machines near to transportation facilities.

- With respect to materials, the continuous supply of asphalt mixture was possible as two batching plants are sited within an hour of the airport. In addition, other batching plants are available as backup plants. Therefore, in case of an emergency, a stable transportation capability should be secured by making a contract with delivery companies.

REFERENCE

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