Development of Technical Standard through Vehicle Barrier Test

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1. Introduction

Almost every day there is a terrorist attack around the world. All member states have been striving to strengthen the security as terrorism becomes more diverse, intelligent, and complex. The international community is examining physical protection systems against terrorist and humanitarian accidents at nuclear facilities, and is making specific efforts to correct the response capability and performance standards.

In 2011, the IAEA completed the amendment of the Nuclear Security Recommendation for Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC / 225 / Rev.5) in accordance with the Amendment to CPPNM. The Nuclear Safety and Security Commission (hereinafter "NSSC") reflected the amended provisions to the Act on Physical Protection and Radiological Emergency (hereinafter "APPRE") in December 2013. In accordance with the revised APPRE, nuclear licensees are implementing strict physical protection and enhancing physical protection system.

On the other hand, the vehicle crash has been occurred at national important facilities such as the vehicle crash of Gimpo Police in November 2014, the 1-ton truck crash of Asan City Hall in Aug. 2014, the 1-ton truck crash of Sejong Government Office in Apr. 2014, the drunk driving of Wonju City Hall in Nov. 2012. So, it is urgent to establish measures to provide substantial protection to national important facilities against vehicle crash.

In this study, we conducted a field survey, selection of test objects and delayed performance tests for preparing practical countermeasures

2. Status and Issues of delayed equipment and issues installed at national important facility

A stone bollard, which is often seen around, is installed to separate between roads and roads or to mark the boundaries of facilities, but the original function is to block vehicle access. The stone (Granite) bollard is a representative vehicle delay equipment installed at all major airports nationwide including Incheon International Airport and Kimpo Airport, which are included in national important facilities in the country.

2.1 Purpose of Installation and Related Provisions for Vehicle Delay Equipment

The installation purpose of vehicle delay equipment is to prevent the entry of vehicles carrying explosives into national important facilities, thereby minimizing the damage to the lives and property of the people.

Related to these, the status and regulations of requirements for car delays are as follows:

○ Article 11 (Security of Airport Facilities, etc.)

① The airport operator shall take necessary measures for security of airport facilities and navigation safety facilities.

② In the case of constructing or maintaining or repairing an airport, the Minister of Land, Infrastructure, Transport decides the detailed standards for the protection of persons and facilities from illegal interference.

○ Presidential Decree No. 28 Guidance on Detailed Implementation of Integrated Defense
Article 18 (Protection of National Important Facilities)

① National important facilities are equipped with fences, guard posts, sights, watchtowers, other obstacles and modernized scientific equipment and facilities to protect their facilities from enemy infiltration.

○ Guidelines for the Management of National Security Facilities and Protective Equipment
Article 6 (Guards and Security Plan)

① For the protection of national important facilities, the facility owner shall establish and implement guards and security plan in accordance with its own conditions, including the following items. 3. Access control and security screening measures for people and vehicles. 6. Securing weapons and Operating counter-terrorism equipment operation status such as breaker.

② The guards and security plan shall be established in accordance with the following requirements. 1. Security personnel and scientific security equipment shall conform to the "National Important Facility Security Factor Securing Criteria (Attached Table 2)", only they may be added or subtracted depending on the location, topography, structure, etc.

2.2 Installation Status

As described above, despite the occurrence of vehicle crashes, there are no exact specifications and materials for the delay equipment in related regulations. So, stone bollards were installed at the national airports without appropriate criteria.

While there is no detailed guidance on stone bollard specifications as a vehicle delays for the protection of facilities, the height of the piles for restraining the entry of automobiles (commonly referred to as "bollards") is 80 ~ 100cm, the diameter is limited to 10 ~ 20cm, the interval is also within 1.5m. As a result, many stone bollards currently installed at airports across the country are being judged to be non-compliant.

2.3 Selection of vehicle delayed water test subject

As mentioned above, although the stone granite bollard is installed and operated at major airports nationwide, there is no clear standard for installation and it is treated as a non-compliant installation according to the relevant laws and regulations.

The stone bollard should not be interfered with the safety and convenient traffic of pedestrians according to the 'Enforcement Rule of the Traffic Utilization Promotion Act of Traffic Accident', and at the same time evaluate the performance of currently installed stone bollard. So, the most frequently installed stone (granite) bollard of 45cmx60cm (height x diameter) was selected as the test subject.

3. Results of Performance Test

In this test, the remote control unmanned vehicle was manufactured by itself and the test procedure is as follows.

① Prepare the unmanned vehicle at 40m distance from vehicle delay

② Accelerate to 40km/h by watching the instrument panel through real-time video using the unmanned vehicle regulator

③ When the car collides with the delayed water, the maximum braking

The adversary attempting to vehicle crash with real malice is more likely not to step on the brakes after the collision. However, we have to activate the engine stops and brakes after the collision due to the conditions of the test site which can't secure sufficient braking distance in this test and for safety reasons. Due to these test constraints, the speed graph only seems to have stopped faster in the order of steel bollard, steel barricade, and stone bollard. However, if the speed decreases immediately after the collision, it can be confirmed that the speed decreases in the order of stone bollard, steel barricade, and steel ballast.

The reason why the braking distance increased for each test is described below for each test. Figure 1 shows the speed of the vehicle at impact. Figure 2 is a graph showing the longitudinal acceleration of the vehicle. At the time of the collision at 0 second, the upper graph shows the results of the steel bollard impact test, the middle graph shows the steel barricade impact test, and the lower graph shows the stone bollard impact test results.

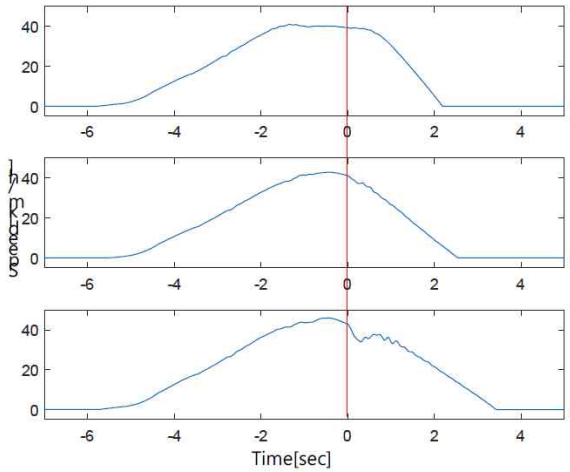

Figure 1. Vehicle Velocity ([1]Steel Bollard, [2]Steel Barricade, [3]Stone Bollard)

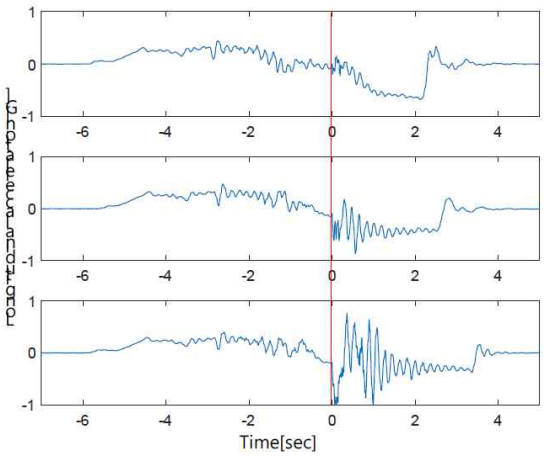

Figure 2. Longitudinal Acceleration ([1]Steel Bollard, [2]Steel Barricade, [3]Stone Bollard)

Table 1 shows the result of the calculation of the impact amount at the time of collision, and it is confirmed that the steel barricade and the stone bollard have impact force of 4 times and 10 times, respectively, as compared with the steel bollard.

Table 1. Impact due to Vehicle Barriers

Steel Bollard	Steel Barricade	Stone Bollard
2,943 kgm/s^2	12,360 kgm/s^2	29,430 kgm/s^2

3.1 Performance test - Steel Bollard

As a result of the test on the steel bollard, it was confirmed that the steel bollard was destroyed and collapsed at the same time as the collision with the naked eye, without any delay effect. After the collision, the vehicle was found to have only minor scratches and no functional problems at all. As a result of confirming the speed change before and after the collision, there was no change in the speed, and it was confirmed that

there was almost no effect as the vehicle delay equipment.

3.2 Performance test - Steel Barricade

It was confirmed that the speed decreased slightly after the vehicle hit the steel barricade, and the acceleration graph showed a shock of about 0.42G.

In the speed graph (Fig. 1), it can be seen that the speed is slower than that of steel bollard. This is because the flower bed set on the steel barricade is broken by the impact and the soil from the flower bed is sprayed on the road, it is judged as the cause. In the case of a steel barricade, the function as a vehicle retarding function is not sufficient. Especially, since it is not fixed on the ground, moving together with the vehicle after a collision is the most important cause of delay.

As a result of checking the degree of damage of the vehicle after collision, the front bumper and license plate of the vehicle were dented and the left headlight was slightly out, but there was no problem in function of the vehicle.

3.3 Performance test - Stone Bollard

A stone bollard is usually placed in a space of 5cm depth on the ground. However, this test was carried out with a pair of stone bollards on the ground when the grooves could not be caught in the asphalt of the accelerating zone due to the condition of the test site.

As a result of the test, it was confirmed that the speed decreased immediately after impact due to the weight of stone bollard (150-200kg). However, due to the limitations of the test conditions, there was no measure to fix the stone bollard to the ground. One bollard was turned upside down by 180 degrees after impact, resulting in a lump in contact with the floor of the vehicle. Also, the braking distance was increased due to the braking force being lost on the front wheel of the vehicle when the vehicle was raised above the stone bollard.

The vehicle was damaged by front bumper radiator grill left and right headlamp corner panel engine oil pan and other items, and even though only one stone bollard contributed to the collision, the vehicle was severely damaged and the vehicle was completely lost. As described above, it was judged that the absence of the base of the stone bollard had a great influence on the deterioration of the delay function.

Despite these testing constraints, however, some meaningful results were possible. The 1-ton truck ran up a 45cm stone bollard, and as a result, the stone bollard rotated 180 degrees from its original position. In order to utilize the stone bollard as a vehicle delay equipment, when considering the height from the ground to the undercarriage of the 1-ton truck selected as the test vehicle, the appropriate height of the stone bollard is higher than 45cm. If the stone bollard has a high height and a solid base, the vehicle will not be able to climb up the bollard, and the delay will be much improved due to the fixing force of the base and the weight of the stone bollard.

4. Summary

The results of the vehicle crash tests on three kinds of delay equipment such as steel bollard, steel barricade, and stone bollard showed that the delayed effect of delaying the vehicle is very limited. However, it can be concluded that the delay effect can be improved if the height of the stone bollard is higher than that of the stone bollard and the base (base) is installed to give a fixing effect to the stone bollard.

Experiences and data obtained from the collision tests learned through this project will be used for establishing delayed car installation and operation standards for vehicle delay equipment in physical protection of national important facilities. In this way, it is expected that the standardized security objective management guidelines that present specific standards for physical protection facilities will be provided to the operators, thereby deriving and improving the efficiency of the standards for each class and minimizing the burden on the operators implementing security guideline.

REFERENCES

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