Resistance of Glass to Typical Forced Entry In Japan

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Keywords
1 = laminated annealed glass 2 = resistance to forced entry
3 = manual attack test 4 = security glazing products

Abstract

Test methods for typical forced entry in Japan and resistant properties with various glass glazing products were investigated. Resistance time and the noise level were measured for evaluation. Monolithic annealed glass, film-coated glass, insulating glass, and laminated annealed glass were used as specimens. Laminated annealed glass, especially having 0.03 to 0.09 inch-interlayer, showed high resistance compared with the other glazing products.

Introduction

In the forced entry crimes in Japan, percentage of breaking glass is 55% for residences, and 36% for offices. [1] However, the standardized test method to determine the resistance of glass against forced entry does not exist in Japan. In Europe and USA there are some physical test methods for security glazing products that are more familiarly known as “anti-vandal” glazing products. [2][3] Unfortunately, precise physical attack test method that will cover a range of resistance against typical forced entry in Japan cannot be found in those test methods, because the threat level and/or the forced entry methods in these countries differ from those in Japan. This could be one of the reasons that laminated annealed glass, which is generally acknowledged as security glass glazing against forced entry, is not widely used in Japan compared to in Europe and USA.

Thereupon, forced entry methods in Japan for glass glazing were investigated in cooperation with Japan Urban Security Research Institute (JUSRI), in order to evaluate forced entry resistance properties of various glass glazing products. [4][5] At the time of forced entry crime, 57% of burglars carry some tools such as screwdriver (65%) or crowbar (30%). These are light, small, and easily transported in the pocket or a small bag. In addition, it is sufficient for residences and offices in Japan to make a small opening only permitting one’s wrist to be passed through to turn off a sash lock of the window or a door lock. On the other hand, in Europe and USA it may be required to make a large opening through which a human body passes, because the structure and lock systems of the door and/or the window are very strong compared to the Japanese ones.

Accordingly, typical methods covered about 75% forced entry crimes for residences and offices in Japan were categorized as follows:

- Inserts a screwdriver between the glass and the sash frame at the vertical edge of glass near the sash lock of a horizontal sliding window of a residence or an office and twisting it, breaks the glass with small breaking noise;
- Using small tools such as a small crowbar, breaks the glass near the sash lock of a horizontal sliding window of a residence or an office with some noise;
- Smashes the face of a fixed window of a building or a shop with relatively big noise.

Experimental procedure

According to the under-mentioned procedure, forced entry resistant properties of various glass glazing products were evaluated.

1 Classification of physical attack test

In order to make a definition of types of physical attack tests in Japan, three indices, that is, “the roughness of attack”, “the tools used for breaking”, and “the size of an opening” were categorized. “The roughness of attack” was identified into the following two sub-categories, a) glass breaking with twisting a screwdriver at the edge with small noise, and b) smashing glass with

some noise. “The tools used for breaking” were classified into the following three sub-categories, a) small tools, which can be carried in a pocket; such as a screwdriver, pliers, a cutter knife, and plate shears, b) medium size tools, which can be carried under a coat or in a small bag; such as a small crowbar, wrench pliers, and c) large tools, which is difficult to be carried simply; such as a large crowbar, a hammer. All of them are easily purchased in the market. “The size of an opening” was divided roughly into the following two sub-categories, a) the small opening permitting one’s wrist to be passed through to turn off a sash lock of the window or a door lock for residences and offices, and b) the large opening through which a human body passes for buildings and stores.

Therefore, with the combination of the three above-mentioned indices, physical attack test methods were set up like table 1.

Table 1 Classification of physical attack test methods

Classification	Roughness of attack	Tools	Size of an opening
Class A	with small noise	small	small
Class B	with some noise	small	small
Class C	with some noise	medium	small
Class D	with some noise	large	large

2 Specimens and support apparatus

Various glass glazing products such as monolithic annealed glass, film-coated glass, insulating glass, and laminated annealed glass were tested. In the case of insulating glass, which consisted of a laminated annealed glass and a monolithic annealed glass, the monolithic annealed glass was set as outer glass, that is, as the side exposed to attack. The specimens were about 800 mm long x 800 mm wide in class A, about 1200 mm long x 800 mm wide in class B and C, 1930 mm long x 864 mm wide in class C. The definitions of these classes are explained in Table 1.

About class A, B, and C, specimen was installed in a sash in order to reproduce an actual installation. Support rig, consisted of rigid wooden frame into which the sash was installed, had an unyielding connection to a solid base. About class D, shot bag impact test rig specified to JIS R 3205, which is almost the same rig specified to ANSI Z97.1, was used.

The attack height was controlled in order that the operator would work in a convenient position.

3 Test methods

In this test an attempt was made to create the accessible opening using the tools, as defined in table 1. Of course the test relies heavily on the competence and experience of the personnel in performing such a physical test. In this test, in order to make as close to real human attack as possible, a policeman who knew the actual human attack methods carried out the manual attack test.

From the start of each test the resistance time and the noise level were measured. The noise meter was installed at 1m away from the surface of the glass.

Results and Discussion

Test room temperature was in the range of 12-24 degrees C during whole test series.

1 Noise level

Noise is a dissuasive factor, which is related to environment. In Japan, as many urban areas are densely populated, it is essential not to be noticed by neighbors during attempts of forced entry. Therefore, the noise during the attack should be held in high regard among the burglars in Japan.

Seeing according to the classes, the maximum noise levels were less than 90dB(A) in class A, in the range of 93-97dB(A) in class B, in the range of 95-109dB(A) in class C, in the range of 98-108dB(A) in class D. It is obvious that the maximum noise level got higher corresponding with the roughness of attack. And all of them were in the category of “very noisy”, as shown in figure 1. [6] On the other hand, it didn’t depend on a kind of glass, i.e., the difference of the maximum noise level among monolithic annealed glass, film-coated glass, and laminated annealed glass didn’t seem to be significant.

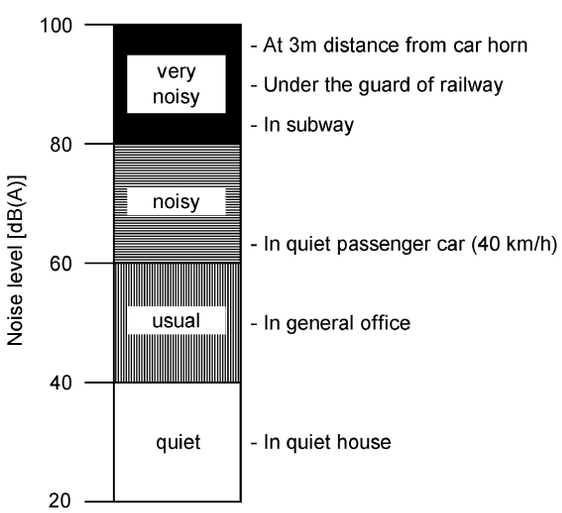

Figure 1 Examples of places with various noise levels

Moreover, the relationship between equivalent noise level and the number of impacts is shown in figure 2. The equivalent noise levels of monolithic annealed glasses and film-coated glasses showed considerable difference, which varied from 77 dB(A) to 90 dB(A) according to the roughness of

attack. On the other hand, those of laminated annealed glasses were in the range of 84–87 dB(A), and relatively independent of the roughness of attack. It can be considered that the forced entry resistance of laminated annealed glass is excellent in Japan because of its equivalent noise level, combined with the number of impacts.

Though noise has to be taken into account, the noise level might be dealt with as reference data, since it has secondary effects, such as making the suspicion of breaking fast or putting pressure mentally on burglars. Therefore, in order to categorize the performance of various glasses, the resistance time would be more appropriate.

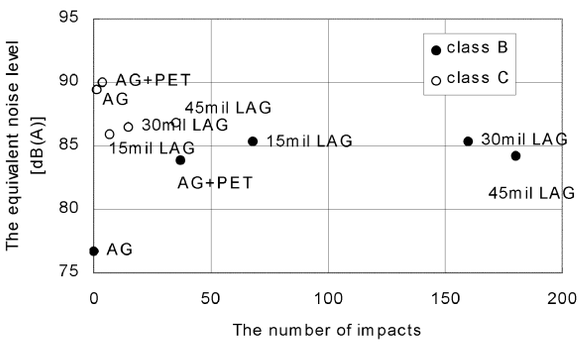

Figure 2 Relationship between the number of impacts and the equivalent noise level

2 Resistance time

The results of resistance time for all classes are shown in figures 3-6. It is quite obvious from these figures that laminated annealed glass, especially with from 0.03 to 0.09 inch-interlayer improved resistance as compared to monolithic annealed glass, film-coated glass and so on. In laminated annealed glass, thickening glass sheet, multiplying glass sheets, and thickening PVB interlayer improved the resistance. Multiplying glass sheets or thickening PVB interlayer was more effective than thickening glass sheet. Moreover, insulating glass, which consisted of a laminated annealed glass and a monolithic annealed glass, was also effective, since it was hard to break laminated annealed glass.

As a standard of resistance time, figure 7 shows the statistical results about the time of giving up breaking from habitual burglars. [1] There are some differences about the resistance time between in an actual crime and in this test. For instance, the operator in this test was sturdy and more familiar with the kind of glasses and physical attack methods than a burglar. And the operator had some advantages of steady footing, wearing perfect protectors, and no mental pressure. Figure 7 becomes one standard but should not be directly applied to the test results because of the above reason. So according to the views of the police inspectors, the standards of resistance time in this

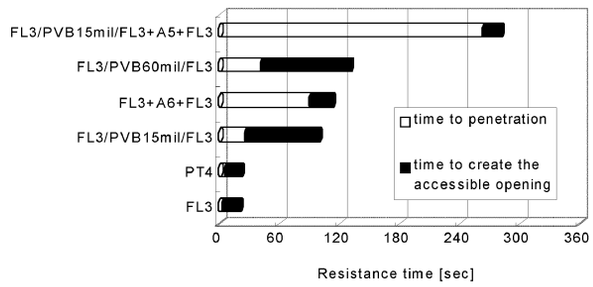

Figure 3 Results of resistance time for class A

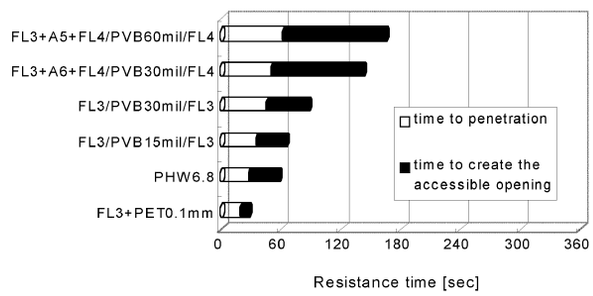

Figure 4 Results of resistance time for class B

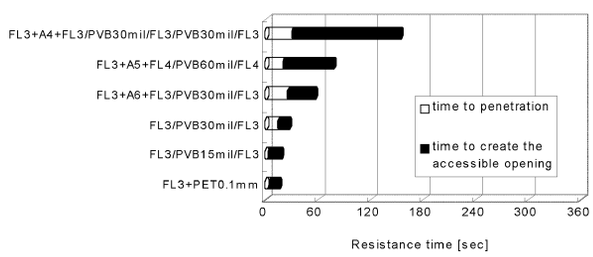

Figure 5 Results of resistance time for class C

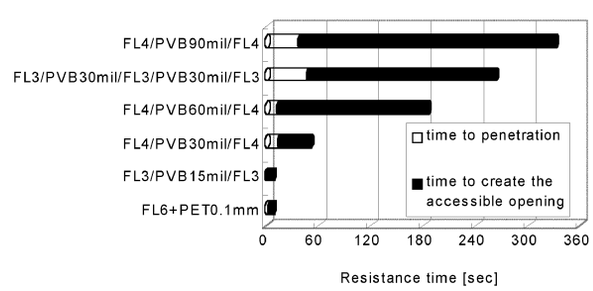

Figure 6 Results of resistance time for class D

test were defined as 5 minutes in class A and D, and 2 minutes in class B and C.

As a result, security glazing products that were appropriate in Japan were summarized in table 2.

Conclusions

Resistant properties of various glass glazing products to typical forced entry in Japan were evaluated. The ratings determined may not necessarily be reproducible and should therefore be considered as comparative rather than as absolute indications of the minimum time and/or maximum noise to breach the glass, but it was

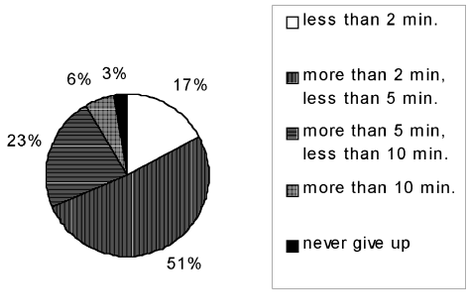

Figure 7 Statistical results about the time of giving up breaking

Table 2 Representative security glazing products that are appropriate in Japan

Classification	Number of sash locks	Representative security glazing products
Class A	3	FL3+A+FL3
	2	FL3+A+FL3/PVB15mil/FL3
	1	FL3+A+FL3/PVB30mil/FL3
Class B	3	FL3+A+FL3/PVB15mil/FL3
	2	FL3+A+FL3/PVB30mil/FL3
	1	FL3+A+FL4/PVB60mil/FL4
Class C	3	FL3+A+FL3/PVB30mil/FL3
	2	FL3+A+FL4/PVB60mil/FL4
	1	FL3+A+FL3/PVB30mil/FL3/PVB30mil/FL3
Class D	—	FL4/PVB90mil/FL4 FL3/PVB30mil/FL3/PVB30mil/FL3/PVB30mil/FL3

When the number of locks was plurals, the resistance time was multiplied by the number.

suggested that insulating glass or laminated annealed glass for breaking with small noise, and laminated annealed glass with from 0.03 to 0.09 inch-interlayer for breaking with some noise improved resistance effectively, and these were appropriate as security glazing products in Japan.

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