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ISO 13784-1과 ISO TS 17431(Model Box Test)에 적용을 통한 실대규모화재시편의 열방출율 분석

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Application to ISO 13784-1 and ISO TS 17431 as Real scale fire test methods for analyzing sandwich panel's Heat release rate

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ABSTRACT

ISO 13784-1 sandwich panel tests were conducted by FILK, KICT in Korea and SP in Sweden. Sandwich panels composed of steel sheets, EPS and glass wool supplied by FILK were tested. And in parallel, the same materials were tested using ISO TS17431 model box tests at GBRC and TUS in Japan.

1. Introduction

The present evaluation method for sandwich panels' fire risk in Korea is Cone-Calorimeter (KS F ISO 5660-1) which is a small scale test method and has some limitation compared to real scale fire tests. Recently in ISO standards, ISO 13784-1 [1] has been made as a real scale method of sandwich panels' fire risk. In Japan, the model box test [2] is one option for evaluating sandwich panels' fire risk. In the early 1970s, materials passing "surface test [3]" were classified as quasi-noncombustible materials. Sandwich panels were also included despite their inside combustion ignited by flames through surface joints in fire.

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A larger test method which could evaluate the joints' effects was desired, and then "model box test" was developed on the basis of the relevant study in Japan. In the middle of 1980's, it was used for the classification of quasi-noncombustible materials. The flame source was changed, and the revised method has been used for the classification since the new Building Standard Law was put in force in 2000. In this study, ISO 13784-1 as room fire test and supplemental trial using model box test for the same sandwich panels have been undertaken and the results were shown.

2. EXPERIMENTAL DESCRIPTION

ISO 13784-1 specifies a method of test for determining the reaction to fire behavior of sandwich panel building systems and the resulting flame spread on or within the sandwich panel building construction, when exposed to heat from a simulated internal fire with flames impinging directly on the internal corner of the sandwich panel building construction. Fire is started at the corner of a 3.6 m long, 2.4 m high, and 2.5 m wide room with a 0.8 m wide and 2.0 m high door way. The walls and ceiling with a total surface area of 32 ㎡ are covered with the specimen. The ignition source, located in the corner of the room, consists of a propane-fueled 0.17 ㎡ sandbox burner set to produce a heat release rate of 100 kW for the first 10 min. If the flashover does not occur, then the sandbox burner output is increased to produce a heat release rate of 300 kW for another 10 min. The test is ended after 20 min or as soon as the flashover is observed. A model box test evaluates heat release rate and so on of surface products set up in the small combustion chamber with an opening by a propane burner placed on the formed wall corner. The combustion chamber consists of two rectangular side walls, a rear wall, a floor and a ceiling. It shall have internal dimensions of 1 100 mm in width, 1 800 mm in length and 1 000 mm in height. Specimens cut from the product are attached to a steel frame using nails and so on. A steel sheet is applied to the back. A ceiling part, two side wall parts and a rear wall part thus formed and are combined and put inside the chamber. The internal dimensions are 840 mm wide, 1 680 mm long, 840 mm high. Before the commencement of the test, a front wall measuring 1 100 mm wide by 1 000 mm high with an opening measuring 300 mm wide by 670 mm high are attached to the chamber. The fire source

Figure 1 Test materials and Flashing

is a rectangular propane gas burner with a height of 145 mm and an upper surface of 170 mm by 170 mm made from a porous, non-catalytic substance such as sand. The test time is 10 min starting from propane gas supply to the burner. The burner is adjusted to provide the heat release rate equivalent to 40 kW. In the above two methods, 0.5 mm steel sheeted EPS + Glass wool were used (Figure 1).

3. RESULT AND DISCUSSION

The tests were conducted at FILK, KICT and SP (Figure 2). According to the results, there are a lot in common. No flashover occurred and each maximum HRR(including burner source heat) was 418.6, 425.0, 415.8 kW (Figure 3). These values show quite equal distributions of variations when analyzed by Grubbs test(ISO 5725-1's statistical method) where each HRR value would be proper when both of G_{min} and G_{max} is less than G(n=3, 0.05p) value (Table 1). Therefore, each lab. is supposed to have the same level of precision about the ISO 13784-1's result.

Table 1 HRR correlation of sandwich panel test results

	FILK	KICT	SP
Max HRR(0~2min)	113.6	111.7	137.6
Time(sec)	117	114	106
Max HRR(0~10min)	114.5	119.8	144.7
Time(sec)	121	261	366
Max HRR(0~12min)	394.3	340.2	386.5
Time(sec)	716	711	720
Max HRR(0~20min)	418.6	425.0	415.8
Time(sec)	790	810	886
Mim HRR	415.8		
Max HRR	425.0		
Average HRR	419.8		
Standard deviation	4.72		
Gmin	0.849		
Gmax	1.102		
G(n=3, 0.05 p)	1.155		
FIGRA(kW/s)	0.150	0.154	0.131

Figure 2 ISO 13784-1 test

Each correlation of HRR for ISO 13784-1 was also quite good (Table 2). FIGRA [4], maximum HRR divided by the very time, is 0.150, 0.154, 0.131 kW/s, and the material is classified as Class A, the safest class [4].

Table 2 HRR correlation of sandwich panel test results

		FILK *HRR*	KICT *HRR*	SP *HRR*
FILK *HRR*	Pearson Correlation Sig. (2-tailed)	1	**0.969**** 0.000	**0.975**** 0.000
KICT *HRR*	Pearson Correlation Sig. (2-tailed)	0.969** 0.000	1	**0.948**** 0.000
SP *HRR*	Pearson Correlation Sig. (2-tailed)	0.975** 0.000	0.948** 0.000	1

** Correlation is significant at the 0.01 level (2-tailed)

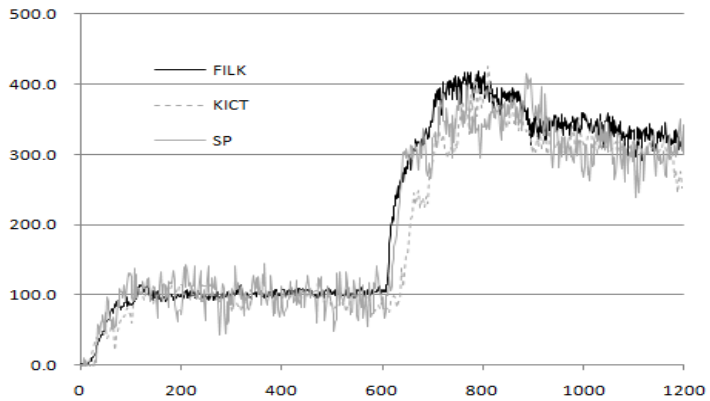

Figure 3 Heat Release Rate by ISO 13784-1
(X axis: Time sec, Y axis : HRR kW)

The model box tests were conducted at TUS and GBRC (Figure 4) using the same specimen as the above sandwich panel test provided by FILK. Flashover was observed after about 12 min, but judging from the results during 10 min, the material was sorted into quasi-noncombustible.

Figure 4 Model Box test

Mostly, the present evaluation method for sandwich panels' fire risk in Japan is Cone-Calorimeter (ISO 5660-1) or model box test. In the model box test, the test is done twice, and from experience, the 1st and the 2nd results are in good agreement. This time melting materials such as EPS were tested, and it was done without flashings which cover joints between two panels. Results of model box test have been under analysis on the point of fire engineering's view. The flashings should be also applied to the model box test especially to the bottom edge of the panels in order to prevent the melting EPS from spilling differently each time in future work.

4. SUMMARY

ISO 13784-1 sandwich panel test results between three laboratories show quite good identical tendency of heat release rate. According to the correlation analysis of ISO 13784-1 data, three labs have almost same level of precision. As for ISO TS 17431 model box test, it is possilby supposed to be a reliable test method for sandwich panels especially when end-use application of sandwich panel(ex. usage of flashing) is recommended under melting material being tested. Including this, different materials should be tested by the both methods for precise analysis.

ACKNOWLEGMENTS

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