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**

Analysis of Temperature Rise and Operation Time of Differential Spot Type Detector in Case of Mattress Fire in Multi-family House

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Abstract

This study developed a scenario to understand the reaction rate and operational time according to RTI value of rate of rise detector in each type in case of fire mattress. In the results of analyzing the reaction rate and operational time of detector in each scenario, in case when installing a single detector, the elevated temperature per minute was raised to 8 /min ~ 9 /min. In case when installing two detectors, it was raised to 9 /min ~ 10 /min. In case when installing three detectors, it was raised to 10 /min. The horizontal distance between detector and mattress was 1.8m~2.5m. Whenever the number of detectors was increased, the horizontal distance was decreased. The operational time of detector was within maximum 540 seconds and minimum 420 seconds. As the research tasks in the future, there should be the researches on the effects of reaction rate of detector on the evacuation in case of fire through the result value of RSET by setting up the latency until the detector operates, and the researches on the safety by understanding if the operational time of detector is suitable for the evaluation standard of performance-centered design.

Keywords : Rate of Temperature type Detector, Apartment, Fire Detector, Fire alarm system

1.

가 [2]
가
가 가 가
가 가 가
(2015)
[1] 가 UL(Underwriters Laboratories)

[3] (2017)

[4] (2018)
가 5

[5]

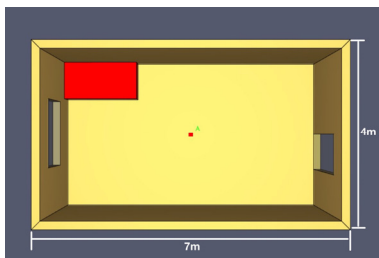
RTI

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2.

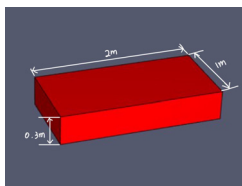
2.1

가 가 가
가 가 [Figure 1]
가 4m, 7m, 2.4m

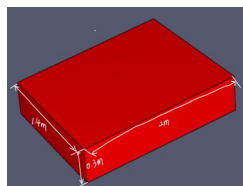


[Figure 1] Studio Structure of Multiple dwellings House

1m x 2m, x 0.3m,
1.4m x 2m, x 0.3m



(a) Single mattress



(b) Double mattress

[Figure 2] Experimental Model

2.2

가

2.4m 가

28m²

<Table 1>

1 2 1 [6]

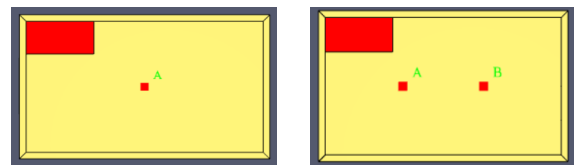
<Table 1> Number of installations of the detector

Detector Type	Calculation formula	Number of
Rate of Rise Spot - Type Detector (Termister)	$\frac{28m^2}{90m^2} = 0.31 \approx 1$	1
Rate of Rise Spot - Type Detector (Diaphram)	$\frac{28m^2}{70m^2} = 0.28 \approx 1$	1

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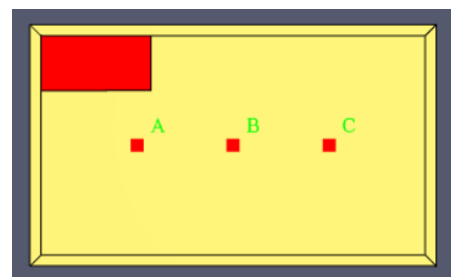
1~3
[Figure 3]

가



(a) Install 1

(b) Install 2



(c) Install 3

[Figure 3] Installation location of the Fire detector

2.3

가 가
가 4가 <Table 2>

1 1

<Table 2> Scenario Composition

Scenario	Composition	
	Mattress Size	Detector Type
Scenario 1	Single	Termister
Scenario 2	Double	Termister
Scenario 3	Single	Diaphram
Scenario 4	Double	Diaphram

2.4

Mesh, RTI, Polyurethane, Mesh, 0.250m x 0.275m x 0.25m, 20, 3.8m², 4.84m², RTI, 159√(m·s), 2, 122√(m·s), [7], 381.94kW/m², 100.51kW/m², [8]

<Table 3> Fire simulation Input Value

Division	Input Value	
Reaction	Polyethylene	
Mesh	0.250m x 0.275m x 0.250m	
Initial Temperature	20	
Fire surface area	Single mattress	3.8m ²
	Double mattress	4.84m ²
RTI	Rate of Rise Spot - Type Detector (Termister)	159√(m·s)
	Rate of Rise Spot - Type Detector (Diaphram)	122√(m·s)
Heat Release Rate	100.51 kW/m ²	

3.

3.1

가, <Table 4>, 가 1, 가 8 /min, 2.5m, 540, 가 2, 가 9 /min, 2.1m, 420, 가 3, 가 10 /min, 2.0m, 420

<Table 4> Scenario 1 Result Value

Sortation	Explanation		
	1	2	3
Number of detectors(each)	1	2	3
Rised Temperature Per Minute (/min)	8	9	10
Horizontal distance between detector and mattress(m)	2,5	2.1	2.0
Operation Time(s)	539.5	419.9	418.6

3.2

가, <Table 5>, 가 1, 가 9 /min, 2.4m, 420, 가 2, 가 10 /min, 1.9m, 540, 가 3, 가 10 /min, 1.8m, 420

<Table 5> Scenario 2 Result Value

Sortation	Explanation		
	1	2	3
Number of detectors(each)	1	2	3
Rised Temperature Per Minute (/min)	9	10	10
Horizontal distance between detector and mattress(m)	2,4	1.9	1.8
Operation Time(s)	419.9	539.5	419.9

3.3 3

<Table 8>

가 가 2
 가 <Table 6> 가 1
 가 8 /min,
 2.5m , 540
 가 2 가 9 /min,
 2.1m , 420
 가 3
 가 10 /min, 2.0m
 , 420

<Table 6> Scenario 3 Result Value

Sortation	Explanation		
	1	2	3
Number of detectors(each)	1	2	3
Rised Temperature Per Minute (/min)	8	9	10
Horizontal distance between detector and mattress(m)	2.5	2.1	1.8
Operation Time(s)	539.5	419.9	419.9

3.4 4

가 가 2
 가 <Table 7> 가 1
 가 9 /min,
 2.4m , 420
 가 2 가 10 /min,
 1.9m , 4280
 가 3
 가 10 /min,
 1.8m , 420

<Table 7> Scenario 4 Result Value

Sortation	Explanation		
	1	2	3
Number of detectors(each)	1	2	3
Rised Temperature Per Minute (/min)	9	10	10
Horizontal distance between detector and mattress(m)	2,4	1.9	1.8
Operation Time(s)	419.9	479.7	419.9

<Table 8> Compare Detector Operating Time for Each Scenario

Scenario	Nuber of detctors Division	1	2	3
		Scenario 1	Rised Temperature Per Minute (/min)	8
Horizontal distance between detector and mattress(m)	2.5		2.1	2.0
Operation Time(s)	539.9		419.9	418.6
Scenario 2	Rised Temperature Per Minute (/min)	9	10	10
	Horizontal distance between detector and mattress(m)	2,4	1.9	1.8
	Operation Time(s)	419.9	539.5	419.9
Scenario 3	Rised Temperature Per Minute (/min)	8	9	10
	Horizontal distance between detector and mattress(m)	2.5	2.1	1.8
	Operation Time(s)	539.5	419.9	419.9
Scenario 4	Rised Temperature Per Minute (/min)	9	10	10
	Horizontal distance between detector and mattress(m)	2,4	1.9	1.8
	Operation Time(s)	419.9	479.7	419.9

4.

RTI
 RTI
 (1) 1 1
 8 /min, 2.5m
 540 2
 9 /min,
 2.1m 420

3 10 /min, 가
 2.0m 420 가
 .
 (2) 2 1
 9 /min, 2.4m
 420 2
 10 /min,
 1.9m 540 .
 3 10 /min,
 1.8m 420
 .
 (3) 3 1
 8 /min, 2.5m
 540 2
 9 /min,
 2.1m 420 .
 3 10 /min,
 2.0m 420
 .
 (4) 4 1
 9 /min, 2.4m
 420 .
 1.9m 2
 10 /min, 480 .
 3 10 /min,
 1.8m 420
 .
 1 8 /min~ 9
 /min , 2 9 /min~ 1
 0 /min . 3 10
 /min .
 1.8m~2.5m , 가 가
 가
 540 , 420
 .
 가
 가 RSET
 가 가

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