

Evacuation Safety Performance Evaluation Manual

Article 1: Scope of Application

This manual applies to the following types of performance evaluations:

- (1) Performance evaluations pertaining to approvals under Article 129-2 Paragraph 1 of the Building Standard Law Enforcement Order
- (2) Performance evaluations pertaining to approvals under Article 129-2-2 Paragraph 1 of the Building Standard Law Enforcement Order

Article 2: Documents to be Submitted for Performance Evaluations

The documents to be submitted for performance evaluations are as below. Formats and other requirements are as stipulated in application procedures defined elsewhere.

- (1) Performance evaluation application
- (2) Documents providing an outline of the building plan
- (3) Documents providing an outline of the facility plan
- (4) Documents providing an outline of plans pertaining to evacuation safety performance
- (5) Building design documents (floor plans, elevations, cross-section drawings and detailed drawings of parts)
- (6) Calculation reports concerning evacuation safety performance

In principal, the following calculation reports must be provided:

- 1) Quantity of combustible materials in the room
- 2) Number of persons in the building and the room (occupants)
- 3) Predicted evacuation behavior
 - ① Evacuation start time
 - ② Time required moving from the remotest point to the (nearest) through stairs or to the ground
- 4) Predicted smoke movement

- ① Amount of smoke or gas, etc. (hereinafter referred to as “smoke, etc.”) produced per unit time
 - ② Effective smoke venting rate
 - ③ Time for smoke, etc., to descend to a height at which evacuation will be impeded
- (7) Documents containing other information required for evacuation safety performance evaluation

Article 3: Evaluation Method

(1) Implementation of evaluations

- 1) The evaluator(s) will use the documents stipulated in Article 2 to implement the evaluation items shown in (2) according to the evaluation criteria stated in (3).
- 2) If necessary for the purposes of the evaluation, the evaluator(s) may ask the applicant to explain the content of the documentation submitted for the performance evaluation, or to provide supplementary information.
- 3) If necessary for the purposes of the evaluation, the evaluator(s) may check the appropriateness of part, or all, of the methods described in the performance evaluation application, such as by attending tests.

(2) Evaluation items

The evaluator(s) will check, or investigate, to ensure that the following items in the applicant’s consideration procedures were carried out appropriately:

- 1) Selection and condition of fire rooms
 - ① All rooms, other than those in which the risk of fire is low, as stipulated in Ministry of Construction Notification No. 1440 of 2000, must be identified as fire rooms.
 - ② It must be confirmed that the quantities of stored and fixed combustible materials in the rooms are appropriate. In principle, these must be based on the figures shown in the table in Article 3 Paragraph 5 of Ministry of Construction Notification No. 1441 of 2000. Quantities for items not listed in the Notification must be determined as follows:

i) The quantities of combustibles stored inside a room

The calorific value of combustibles stored inside a room which could contribute to combustion must be a value obtained by means of tests or calculations that reproduced the arrangements and storage patterns of the items. If the types of combustible materials are known but it is not possible to calculate the calorific value that they would contribute to combustion according to their arrangements and storage patterns, the calorific value must be the product of the weight of each type of stored combustible material and the unit calorific value of that material (calorific value per unit of weight). In this case, the evaluator(s) will check the information against the design documents to ensure that the tests or calculations were based on reasonable evidence and are applicable to the spaces concerned.

ii) Fixed combustible materials

The values must be obtained through tests or calculations which reproduce the conditions stipulated in the design documents with regard to factors influencing the intensity, etc., of combustion, such as materials, arrangements and storage patterns. However, if it is not possible to calculate the calorific value that would be contributed to combustion according to arrangements and storage patterns, the calorific value must be the product of the weight of each constituent material and the unit calorific value of that material (calorific value per unit of weight). In this case, the evaluator(s) will check the information against the design documents to ensure that the tests or calculations were based on reasonable evidence and are applicable to the space concerned.

2) Parameters concerning occupants

It must be confirmed that the number of occupants are determined appropriately, taking into account such factors as the use and floor areas of the building or rooms concerned. In principle, the total must be based on the figures shown in the table in Article 3 Paragraph 4 of Ministry of Construction Notification No.

1441 of 2000. In the case of facilities that are not listed in the table, such as hospitals, clinics and child welfare facilities, the evaluator(s) must check to insure that proper allowance has been made for such factors as the number of beds, treatment categories, size of outpatient departments and care units, by referring to the results of tests that reproduced actual conditions, actual observations and documentation, etc.

3) Method used to predict evacuation behavior

The following items must be checked concerning predictions of evacuation behavior:

① Method used to set parameter for evacuation start time

The evacuation start time must be determined appropriately, taking into account factors that would trigger the start of evacuation, such as the descent of smoke or gas, etc., the activation of automatic fire alarms, and evacuation instructions given over public address systems. The time from the outbreak of fire until the fire is discovered and actual evacuation begins must be taken into account in accordance with a scenario covering the period from the outbreak of the fire until the start of evacuation.

② Method used to predict evacuation time from the remotest point to the (nearest) through stairs (or to the ground)

Flow rates and walking speeds must be defined appropriately according to evacuation routes based on the location of the fire, taking into account such factors as walking distances to through stairs, the widths and areas of each section of evacuation routes, the number of people passing through each section of evacuation routes, the difficulty of opening and closing doors, etc., and the mobility of users of the building. The relationship between occupancy density and walking speed, or the flow rate, must be defined according to crowd movement theory, such as the formulae concerning the relationship between crowd density and walking speed in the safety section of *Kenchiku Sekkei Shiryoshusei 10* [Building Design Resources 10] (Architectural Institute of Japan, 1983). If walking speed and the flow rate have been treated as constants, the figures must not

exceed those shown in the table in Article 2 Paragraph 2 of Ministry of Construction Notification No. 1441 of 2000 with regard to walking speeds, and in the table in Article 3 Paragraph 2 of Ministry of Construction Notification No. 1441 of 2000 with regard to flow rates. In this case, the evaluator(s) must check that the evacuation density of the remaining occupants does not exceed the actual time required for movement based on the speed or flow rate.

The predictions must be based on the methods shown in Ministry of Construction Notification No. 1441 or 1442 of 2000 or in Chapter 4 of *Kenchikubutsu no Sogo Boka Sekkeiho Daisankan* [Comprehensive Fire Safety Design for Buildings, Vol.3 (Evacuation Safety Design Methods) (Building Center of Japan, 1989), or on other recognized methods that are at least as reliable as these.

4) Methods used to predict smoke movements

The following items must be checked concerning predictions of smoke movements:

① Method used to predict amount of smoke, etc., produced in a fire room

The amount of smoke, etc., produced must be determined from the heat release rate (calorific value) over time and the continuous duration of the fire, taking into account such factors as the area and dimension of the fire room, the condition of openings, etc., the quantities and arrangement of stored combustible materials, and the materials and construction methods of interior finishing materials.

② Method used to predict smoke movements.

The following items must be reflected appropriately in the method used to predict smoke movements.

- i) The method used to predict smoke movement must be based on the laws of conservation of mass, conservation of momentum and conservation of energy. In principle, the methods used must be based on the methods shown in Chapter 4 of *Kenchikubutsu no Sogo Boka*

Sekkeiho Daisankan [Comprehensive Fire Safety Design for Buildings Vol.3 (Evacuation Safety Design Methods) (Building Center of Japan, 1989), or Chapter 7 of *Kenchiku Kasai Anzen Kogaku Nyumon* [An Introduction to Building Fire Safety Engineering] (Building Center of Japan, 1993), or other methods which allow prediction that is at least as reliably as these.

- ii) If the building is equipped with smoke exhaust equipment, the effective smoke venting rate must be defined appropriately.
- iii) The amount of smoke flowing from the fire room to other parts of the building must be determined by taking into account the construction methods of the walls of the fire room, the areas and construction methods of openings, the construction methods of smoke exhaust equipment, the effect of pressure differentials between rooms and other factors.

③ Construction method of smoke exhaust equipment

If smoke exhaust equipment consisting of smoke exhaust fans or air supply fans are to be installed, the evaluator(s) must check to insure that the construction method and starting device of the facilities, the capacity of smoke exhaust fans (air supply fan), pressure loss in ducts, and other factors have been appropriately reflected when determining the amount of smoke that can be removed, based on an analysis of these facilities.

(3) Evacuation safety performance evaluation criteria

- 1) The following criteria will be used to assess whether the required standard of safe floor evacuation performance is met:
 - ① Evaluations of floor evacuation safety performance will be based on confirmation that smoke, etc., capable of obstructing evacuation will not descend to a level that obstructs evacuation in any habitable room or any section of evacuation routes until evacuation from all areas to through stairs has been completed.

- ② “A level that obstructs evacuation” is defined as a level at which evacuees can move without assuming awkward stances. The standard is 1.8m from the floor of a habitable room.
- ③ “Smoke, etc., capable of obstructing evacuation” is defined as smoke, etc., with temperature and concentration at levels over which evacuation would not be impeded during the time in which occupants would be at risk of exposure to smoke, etc.

If the thermal effect of smoke on evacuees during the time of exposure to smoke meets the following criteria, the smoke, etc., is deemed to be capable of obstructing evacuation.

$$\int (\Delta T)^2 dt \geq 1.0 \times 10^4$$

Here, ΔT represents the rise in the temperature of smoke, etc., in the room concerned, compared with room temperature before the fire.

The representative indicator for concentration of the smoke etc., is the concentration of carbon dioxide. Smoke in which this exceeds 0.5% is deemed to be “smoke, etc., capable of obstructing evacuation.”

- 2) The following criteria will be used to assess whether the required standard of safe building evacuation performance is met:
 - ① Evaluations of evacuation safety performance for the entire building must be based on confirmation that smoke, etc., capable of obstructing evacuation will not descend to a level that obstructs evacuation in any habitable room or any section of evacuation routes until evacuation from all areas to the ground has been completed.
 - ② Definitions of “a level that obstructs evacuation” and “smoke, etc., capable of obstructing evacuation” are the same as those used for verification of safe floor evacuation performance.

Article 4: Performance Evaluation Report

The evaluation report will include the following items:

- (1) Evaluation number and evaluation completion date
- (2) Name of applicant(s) (company, representative, address)
- (3) Name of project
- (4) Scope of application
- (5) Summary of evaluation
- (6) Evaluation results
- (7) Other items identified during the evaluation process as necessary for inclusion in the report.