The reliability of fire protection system case study of Aceh Besar district regency office

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Abstract. The Regency Office is a building where the central government is administered in an administrative area at the district level. According to the Pd-T-11-2005-C regulation on building fire safety inspections, in order to ensure the safety and comfort of the building, the value of building safety system reliability (VBSSR) should not be less than 80%. This study aims to evaluate the value of the reliability of the office building safety system and propose recommendations on the reliability conditions of the Building of Aceh Besar District Regency Office. This study uses qualitative methods through observation. Evaluation of the reliability of building safety systems and recommendations on building reliability conditions is carried out based on technical guidelines of the Pd-T-11-2005-C regulations. The objects of the observations are the completeness of the site, rescue devices, active protection systems, and passive protection systems. For data analysis, the researcher used the scoring analysis (weighting). The results showed that the reliability value of the safety system of the Building of Aceh Besar District Regency Office was 74.97%, and the reliability was at a sufficient level.

1. Background of study

The Regency Office is a building that functions as the governmental center of an administrative area at the district level. In regulating the center of government, the Building of Aceh Besar District Regency Office is located on Prof. Dr. A. Ibrahim street, city of Jantho. This building is a new building having a 3-story. The Building of Aceh Besar District Regency Office must meet the building's reliability criteria for fire hazards to provide protection for building users so that the government can run as it should.

Fire, the unwanted event and sometimes cannot be controlled, is a result of burning material in the air and emitting heat and flame. Fire can cause death and can also cause a collapse of building structures. Fire control failures in buildings generally occur because they do not have a good value of building safety systems (VBSSR) and override applicable regulations. According to the Pd-T-11-2005-C [1] regulation on building fire safety inspections, VBSSR includes site completeness parameters, rescue facilities, active protection systems, and passive protection systems. To be able to guarantee the safety and comfort of buildings, the VBSS must not be less than 80%.

Based on preliminary observations, the Building of Aceh Besar District Regency Office does not have good reliability because it has not met the parameters in the VBSSR. First, the site has no yard hydrants. Second, the active protection system has no detection and alarm, siamese connection, building hydrants, overflow extinguishing systems, smoke controllers, smoke detection, smoke disposal, directions, and operating control rooms. Third, passive protection systems do not have good openings...
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protection. Therefore, the Aceh Besar District Regency Office Building's reliability of the building safety system needs to be evaluated so that the percentage value of the VBSSR is identified. The percentage of VBSSR can recommend appropriate forms of handling so that buildings can provide protection for users. This study aims to evaluate the value of the reliability of the safety system of the Building of Aceh Besar District Regency Office.

2. Research methods

2.1. Fire protection system

Minister of Public Works Regulation of Number 26/PRT/M/2008 [2] concerns the technical requirements of fire protection systems in buildings and environments. According to the regulation, the fire protection systems in buildings and the environment are systems consisting of tools, equipment, and facilities, all of which are used to protect buildings and their environment against fire hazards through active protection systems, passive protection systems, and internal management methods. Fire protection systems are used to detect and extinguish fires as early as possible with manually or automatically driven equipment.

2.2. Value of building safety system reliability (VBSSR)

According to Pd-T-11-2005 C [1] regarding building fire safety inspection, the VBSSR is the result of system performance measurement based on applicable building safety standards or the knowledge of the inspection team. The steps to evaluate the NKSKB are as follows:

1. Criteria for assessment

   The condition of each component or part of a building must be assessed or evaluated. The condition of the building's fire protection components is divided into three levels, which can be seen in table 1.

   | No. | Score | Compatibility | Reliability |
   |-----|-------|---------------|-------------|
   | 1   | > 80 – 100 | Qualified     | Good (G)    |
   | 2   | 60 – 80    | Installed but there are a small number of installations that do not meet the requirements | Fair (F) |
   | 3   | < 60       | Not suitable at all | Poor (P) |

2. Weighting

The weighting of each component must be done using the analytical hierarchy process (AHP) method. This method was chosen to reduce the element of subjectivity at weighting. AHP is a systematic method for comparing a list of observations or alternatives. Hierarchy is a special type of system based on the assumption that existing units, which have been identified, can be grouped into separate collections, in which units of a group influence the unit of another group that is also influenced by another group. Elements of each hierarchical group are assumed to be independent of each other. The weighting of the parameters of the building safety system component (BSSC) can be seen in table 2.

   | No. | BSSC parameters         | Quality of BSSC and Sub-BSSC |
   |-----|-------------------------|-----------------------------|
   | 1   | Site completeness       | 25%                         |
   | A   | Water sources           | 27%                         |
   | B   | Road environment        | 25%                         |
   | C   | Distance between buildings | 23%                      |
   | D   | Yard hydrant system     | 25%                         |
   | 2   | Rescue facilities       | 25%                         |
   | A   | Way out                 | 38%                         |
3. Interpretation
The safety reliability of a building can be judged to be good if the reliability of a building component or the reliability of a building safety system or NKSKB value is not less than the lower limit of good categories, as listed in Table 1. The required building safety and comfort rate is 80%.

4. Recommendations
Based on the results of the NKSKB examination that has been calculated, the recommendations can be submitted by the inspection team to improve the condition of less (K) or enough (C) to be good (B). Recommended steps include:
   a. periodic checks,
   b. periodic maintenance or maintenance,
   c. periodic maintenance and repairs,
   d. adjustment or repair of elements, and
   e. completion of the components that are lacking.

3. Result and discussion

3.1. Completeness of site
Completeness of site is the completeness of the place where a building is established. The completeness of the site includes water sources, road environment, the distance between buildings, and yard hydrants. The results of observations and assessments of the completeness parameters of the site in the Building of Aceh Besar District Regency Office can be described as follows:

1. Water source
The building has been equipped with water sources having capacities that meet the minimum requirements for the function of the building. Based on observation, the source of water condition can be considered as good.

2. Road environment
The building has been equipped with an environmental road having a width of 7.5 m, which passes the required road width of 6 m. The structure of the environmental road surface is rigid pavement. The width of the entrance is 7.5 m, where the required width is at least 4 m. Based on the observation, the environmental road condition can be assessed as good.
3. Distance between buildings
The distance between buildings, which have a height of more than 14 m, must be more than 8 m. The observed building has a height of 22.98 m. The building distances is 45.41 m. The Building of Aceh Besar District Regency Office is adjacent to the Aceh Besar District Financial Management Agency Office Building. Based on the observation, the distance between buildings condition can be assessed as good.

4. Hydrant yard
The building was not equipped with a yard hydrant. The hydrant yard or hydrant pillar is a fire prevention system that requires a water supply and is installed outside the building. Based on the observation, the yard hydrant condition was assessed as poor.

3.2. Rescue facilities
Rescue facilities are facilities that need to be prepared to save building users and property in the event of a fire in a building. Rescue facilities include an exit, construction of an exit, and a helipad. The rescue facilities in the Regent Office Building can be described as follows:

1. Exit
Based on the observation on the building, each floor has two exits. The exits of the first and second floors have a height of 4.35 m, while the third-floor exit has a height of 5.67 m. The required height of the exit is at least 2.5 m. Every exit is protected from fire because every corridor space has concrete walls, and there are no flammable objects. The maximum distance from the exit is 57.55 m, where the maximum distance required is 20 m. The minimum width of the exit is 2.87 m, where the minimum width required is 2 m. The distance from an exit to another exit is 5 m. The building is not provided with a smoke-free lobby. Exit on each floor is not blocked by walls or objects. The exit goes to a safe open space outside the building. Based on observations, the way out condition was assessed as good.

2. The structure of the exit
The structure of the exit must resist fire hazards at least for 2 hours. The way out is free from something that can hinder building users. The minimum width of the exit is 2.87 m, which passes the minimum required value of 2 m. The canal (exit release) road is protected from fire hazards. The interior walls of the building are not flammable, and the ceiling, which is made of gypsum and equipped with fire propagation resistance is not less than 60 m. At a certain level, building elements can maintain structural stability if there is fire. Buildings cannot prevent the spread of smoke from fires because they are not provided with smoke control equipment. Building users have enough time to carry out the evacuation process. Based on observations, the construction of the exit is assessed as good.

3. Helipad
The building is not equipped with a helipad because the building only has a height of 22.98 m, where the maximum height required is 60 m. The helicopter platform is useful for carrying out the evacuation process if there is a fire in the building. Based on observations, the helipad cannot be assessed.

3.3. Active protection system
The active protection system is a protection system to detect and reduce fires both manually and automatically with complete equipment. Active protection systems include detection and alarm, siamese connection, light fire extinguishers, building hydrants, sprinklers, overflow extinguishing systems, smoke controllers, smoke detection, smoke disposal, fire lifts, emergency lights, emergency electricity, and operating control rooms. The results of the observation and evaluation of the active protection system in the Building of Aceh Besar District Regency Office can be described as follows:

1. Detection and alarm
Based on the observation, the building is not equipped with a detection device and alarm, as required. Detection and alarm are useful for finding the location of the presence of fire hazards and providing emergency signals to building users so that they can immediately carry out the evacuation process. Based on observation, the detection system and alarm cannot be assessed.
2. Siames connection
As a result of the observation, the building was not equipped with convention siamese as required. Siames connection is useful for supporting water supply in buildings if the water in the reservoir is no longer sufficient. The water carried by fire engines will be channeled through this component for the water needs of the sprinkler and hydrant components. Based on observations, the siamese connection can be assessed as less.

3. Light fire extinguisher
The results of the observation show that the building has been equipped with a light fire extinguisher (LFE), which type is a chemical powder (dry chemical powder). The Regent's Office Building has a length of 60 m, which every floor has 1 LFE. The number of APAR is not in accordance with the length of the building. Based on observations, LFE can be assessed as less.

4. Building hydrants
As a result of the observation, the building was not equipped with a building fire hydrant. Hydrant building is useful as a storage place for equipment to extinguish fires such as fire hose, hydrant nozzle, and valve. Based on observations, the building hydrants cannot be assessed.

5. Sprinkler
The observation results show that the building is not equipped with a sprinkler because the building only has an area of 7,144 m, where the required area must be more than 18,000 m². The sprinkler is useful for extinguishing fires automatically by emitting a water discharge when a fire is detected. Based on observation, the sprinkler cannot be assessed.

6. Overflow extinguishing system
The building is not equipped with an overflow extinguishing system. Overflow extinguishing systems are useful for reducing fire propagation using gas, foam, or dry powder. Based on observations, the overflow extinguishing system can be assessed as less.

7. Smoke controller
The building is not equipped with smoke control. Smoke control is useful for blocking the flow of smoke into the way out, shelter, and others. Based on observations, the smoke controllers have not been able to be assessed.

8. Smoke detection
The observation results show that the building is not equipped with smoke detection. Smoke detection is useful for giving warnings to building users when fires occur through alarms so that they can immediately carry out the evacuation process. Based on observations, smoke detection can be assessed as less.

9. Disposal of smoke
The results of the observation show that the building is not equipped with the exhaust disposal system. Based on observations, the discharge of smoke can be assessed as less.

10. Fire escape elevator
The building is not equipped with a fire escape elevator. Based on observations, the fire escape elevator cannot be assessed.

11. Emergency directional lighting
The building has been equipped with emergency lights on each stair. Moreover, the stair handrail is made of iron, so it is protected against fire. The emergency light is useful to direct the building users in the evacuation process. However, the building is not equipped with directions or exits. Based on observations, emergency directional lighting in this building can be assessed as less.

12. Emergency electricity
The results of observation show that the building has been equipped with emergency electricity, which power supplied from the national electricity company and internal generators. The generator has a capacity of 250 KVA and can operate automatically if the electricity goes out with a 10 minute time delay. Temporary fire-resistant cables are used in the emergency electrical system; this cable is resistant for 60 minutes. Emergency electricity is useful to provide a supply of backup electricity while the fire is happening. As a result, the equipment can be activated to control the building during the evacuation process. Based on observation, emergency electricity in this building can be assessed as good.
13. Operation control room
The building was not equipped with an operating control room. The operating control room is used to monitor potential fire hazards. The Regent Office Building is only equipped with simple equipment, namely closed-circuit television (CCTV) to monitor the fire hazards. CCTV equipment is ready in all rooms on each floor of the building. For outside the building, the CCTV equipment is only installed on the front and rear sides of the building. Based on observations, the emergency operation control room can be assessed as sufficient.

3.4. Passive protection system
The passive protection system is a protection system to reduce fires that are directly built on buildings without using the equipment. Passive protection systems include the resistance of building structures to fire, compartmentalization, and protection of the openings. The results of observations of passive protection system in the Building of the Office of the District Head of Aceh Besar are as follows:

1. The building structures' resistance to fire
Based on observations, the building has been equipped with the fire resistance of type A of building structures. According to SNI 03-1736-2000, the fire resistance of type A of building structures are those whose construction elements are fireproof, capable of structurally resisting building loads, and preventing the fire from spreading on room or building. Based on observation, the fire resistance of building structures can be assessed as good.

2. Compartmentalization
Based on observations, the building has been equipped with compartments, in the form of walls and room partitions, with aluminum iron frames and glass as a separator between workspaces. Compartmentalisation limits the fires of a room and hampers the fire spreading to other rooms in a building. In addition, the width of the entrance of this building is 7.5 m and suitable for the requirement of 6 m. This entrance width can be passed by a fire engine. Based on observation, compartmentalization can be assessed as good.

3. Protection of openings
Based on the results of observations, the building has been equipped with the protection of the openings. The windows and doors are completed with the fire stoppers. The Regent's Office Building was completed with the fire suppressors using aluminum and glass iron material on windows and doors on each floor of the building. However, protection facilities for openings such as fire doors, fire windows, smoke barrier doors, and fire covers that comply with standards are not available. The door leaf can rotate on one side. The door has a 35 mm density. The wall on the exiting path is a concrete wall, so it is resistant to fire. The door on the exit can close automatically. Based on observations, the protection of openings can be considered as sufficient.

3.5. Assessment of VBSSR
VBSSR assessment includes site completeness parameters, rescue facilities, active protection systems, and passive protection systems. Each of these parameters has a number of individual conditions. VBSSR assessment is obtained by totalizing the total number of parameter values that exist. The VBSSR assessment of the Building of Aceh Besar District Regency Office is shown in table 3.

| No. | BSSR                   | Rating Result | Standard Value | Weight | Value of Condition |
|-----|------------------------|---------------|----------------|--------|--------------------|
| 1   | Water source           | Good          | 100            | 27%    | 6,75%              |
| 2   | Road environment       | Good          | 100            | 25%    | 6,25%              |
| 3   | Distance between buildings | Good       | 100            | 23%    | 5,75%              |
| 4   | Yard hydrant           | Poor          | 60             | 25%    | 3,75%              |
|     | Total value of site completeness condition |               |                |        | 22,50%             |
The research conducted by Trikomara [6], the Orthopedic Hospital Prof. Dr. R. Soeharso Surakarta has an average VBSSR of 92.77%. This means that the reliability of the building against fire hazards is good. In addition, the research conducted by Pratama [4] found that the VBSSR on the Eria Mother and Child Hospital of Pekanbaru City Pekanbaru is 57.24%. This means that the fire protection system in this building is classified as less reliable. Technical recommendations that should be performed are periodic maintenance and repair to each existing fire protection facility, the repair of damaged elements, and the addition of fire protection elements that are not yet available. Research conducted by Ruspianof [5] showed that the VBSSR at PT. PLN, at Riau Region and Riau Islands, was 86.47%. This means that the fire protection system in this building is classified as reliable. The research conducted by Trikomara [6] showed that the VBSSR was 79.07%. This finding showed the reliability of buildings in sufficient categories. This finding recommended that it is necessary to complete components that are not yet complete and to carry out inspections, repairs, and maintenance of components of the fire protection system periodically. The research conducted by Zulfiar and Gunawan [7] showed that the VBSSR on five floors UNY Hotel Buildings in Yogyakarta was 91.60%. This means that the condition of the building is included in the good category so that the building can be used optimally, and this building gets good protection from the dangers of building fires.
4. Conclusion and suggestion

4.1. Conclusion

The value of the reliability of the safety system of the Building of Aceh Besar District Regency Office is 74.97% with a sufficient level of reliability. The building has no guarantee of safety and comfort because the VBSSR is less than 80%. It is necessary that the lacking components in site completeness, rescue facilities, active protection systems, and passive protection systems of the Building of Aceh Besar District Regency Office to be completed.

4.2. Suggestion

It is recommended that the Aceh Besar District Government improve the reliability of the Building of Aceh Besar District Regency Office by completing components that are lacking in the completeness of the site, facilities for rescue, active protection systems, and passive protection systems. It is suggested to the next researcher to be able to evaluate the reliability of other buildings in the Aceh Province.

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