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Evaluation Road Planning and Assembly Point Determination for Disaster Response at Trunojoyo Class III Airport

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ABSTRACT

An airport is a designated area, either on land or water, equipped with buildings, installations, and equipment used fully or partially for the arrival and departure of aircraft. Trunojoyo Airport, located in Sumenep, Madura Island, began development in the 1970s during the leadership of Regent Soemar'oem. Initially established as a basic airstrip (Lapter), it became the first operational airport on Madura Island and has been serving pioneering flights since 2010. Currently, Trunojoyo Airport is classified as a Class III airport, with infrastructure that includes a 1,600-meter by 30-meter runway, two aprons (Apron A: 40 x 40 meters, Apron B: 160 x 70 meters), a terminal building of 3,600 m², and an operational building covering 480 m². Despite these developments, the airport terminal currently lacks essential safety features such as evacuation route signage and designated assembly points in case of emergencies or disasters. This condition poses potential risks to passenger and staff safety. Therefore, this study aims to evaluate and propose alternative evacuation routes and appropriate assembly points. In addition, it seeks to recommend the implementation of proper safety signage to enhance the airport's preparedness and ensure compliance with safety standards. The results of this study are expected to contribute to improving the emergency response infrastructure at Trunojoyo Airport, ensuring better safety for all airport users.

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INTRODUCTION

In life today, especially in Indonesia, transportation has a vital and valuable role In increasing affordability in every area. Every area naturally has differences, deeply related matters, regional characteristics, and habits in different locales. The role of airports, according to Directorate General Air transportation includes nodes in the network transportation air by Airport hierarchy, doors gate activity economy, place activity switch mode transportation, driving and supporting activity industry, trade and/ or tourism, opening isolation area, as well infrastructure strengthen outlook archipelago and state (Menteri Perhubungan, 2019).

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Transportation air has become the most appropriate choice, especially regarding efficiency. Besides, because of its geographical location, Indonesia is between two continents and two oceans. So, It can also impact it in various ways, such as water, social culture, agriculture, and natural disasters. One of The anticipated minimal natural disaster risks is with existing track evacuation and point gathering at each building. Evacuation Route Alone is a door emergency, and markings are essential for every user building.

Trunojoyo Airport Terminal needs to hold track evacuation and point gather (Assembly Point) to normalize circumstances and minimize injury and damaged assets, as well as hold material losses important for a country or area. According to Pemerintah Pusat (2021), that aspect of a safe environment is related to convenient access to extinguisher fire and access to evacuation on time in case of disaster.

Obligation procurement sign track evacuation is listed in Law No. 28 of 2002 concerning buildings and Regulations Government No. 36 of 2005 concerning buildings. " Every building, except House stay single and home row simple, should provide means of evacuation which includes system warning danger for user, door go out emergency, and path possible evacuation ensure convenience user building For do evacuation from in building in a way safe if happen disaster or circumstances emergency " (Pemerintah Pusat, 2005)

METHOD

Location is set in a way purposive or with on purpose that is because it is in the Trunojoyo Airport Terminal Building so far This No There is detrimental disaster or cause damage to buildings. With existing studies, this is expected to later become used For facing dangerous disasters with methods that give the track more evacuations good and optimal to guarantee the safety of every resident building. Later the data will be collected with the use of Method Observation. Method Observation is something observation of the object under study that is tracked evacuation later will use, measure distance with meter, and take picture existing condition.

Speed evacuation for every visitor to Trunojoyo Airport Terminal is known as Method Simulation. Method Simulation is an application process that builds a model from system real or proposed system and does experiments with that model To explain a behavior system, learn a performance system, or build a system new by desired performance. Method Simulation This is For known speed evacuation residents. The final result from the study This form recommendation design tracks optimal evacuation of protection against fire in the building.

Study This later will gather two Types of data, namely, primary data and secondary data. Primary data is data obtained or collected in a way directly from useful Trunojoyo Airport terminal building To get new data. To get primary data, then must do observation in a way directly to the location study

Technique used For collecting primary data including observation and measuring distance track evacuation, and secondary data is the data obtained or collected from various sources that have been there (researcher as hand second). secondary data can be obtained from various sources like theory already Yes, photo Photo terminal building, explanation data collection in tables following:

Table 1 Data Type

No	Type 1		Type 2	
	Primary	**Data collection technique**	**Secondary**	**Data collection technique**
1	Size and Distance	Observation and Measurement	Evacuation Route Theory and Standards	Applicable Literature
2	Condition Exiting Evacuation Route	Observation, Interview, Documentation Photo	Physical Data Building	Google And Documentation Photo Building
3	Speed Evacuate	Simulation	Floor plan Building	Observation

Primary data

Primary data collection uses method as following :

1. Research is carried out directly to find out the description of the research object by making observations.
2. The simulation is carried out using data that has been collected.

Secondary Data

The method that can used for secondary data collection is as follows:

1. Literature study means conducting a literature review using government standards, journals, related research, and applicable theories regarding evacuation routes.

Stages Study

There are two stages to be done in studying this, as follows:

Stage 1: Preparation

- Formulate the background, problems, and objectives of the research
- Collect comparisons that discuss theories related to research
- Plan the observation and field measurement stages to obtain primary data

Stage 2: Implementation

- Carrying out observations and research, to obtain existing data
- Carry out simulations and determine planning regarding evacuation routes and determining Assembly Points.
- Compile all the results of reports and discussions that have been obtained from data processing and then conclude to answer the problem thoroughly.

RESULTS AND DISCUSSION

Ladder Analysis Emergency

In evacuating visitors, a path ladder is one of the factors affecting the optimization of the evacuation process To ensure the safety of visitors buildings, so requires analysis performance physique building (Ramawangsa, 2019).

Is known that the variable is Not yet by specified standards. Because there is not yet is ladder emergency at the terminal building. So, for planning track evacuation temporary redirected through escalators and stairs existing access. Party from the building expecting victims to evacuate later To go out from the nearest entrance use the ladder evacuation that has been indicated with sign sign evacuation (Abrar, 2020).

Completeness Analysis Evacuation Path Support

With existing clear directions going to the door to go out emergency or point together, it provides a sense of security and comfort for workers moment evacuation (PP No. 36 Tahun 2005 Bangunan Gedung, 2005) Can is known that standard supporter track evacuation of the Trunojoyo Airport terminal building is Still Not yet in accordance. To create it track evacuation and point appropriate gathering with existing rules, it is mandatory To fulfill standard completeness supporter track evacuation moreover formerly (Irwan , Wakhid , & Nugroho, 2011).

Evacuation Route and Door Schemes Emergency

Following is the floor plan 2nd floor of the Trunojoyo Airport terminal building.

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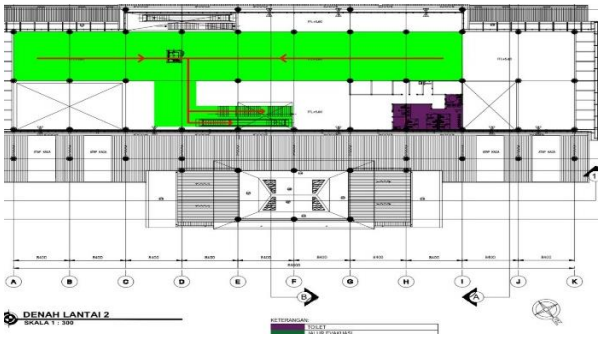


Figure 1 Schematic of 2nd Floor Evacuation Route

As can seen from the existing plan, there are 2 paths escalator in section front and back as access from 1st floor towards 2nd floor or on the contrary. Used as track evacuation later it will be suggested by researchers to go through the escalator part front. Because the escalator part behind is usually used for employee airport and direct going to airside.

Figure 2 Schematic of the 1st Floor Departure Evacuation Route

On the 1st floor of the departure area, there is 1 door access for employees airport and passengers who will do the flight. From the existing floor plan, the researcher recommends track evacuation to suit as depicted in the schematic. Researchers also suggest that parties airport add a door emergency (*exit*) in the symbolized part with a triangle red.

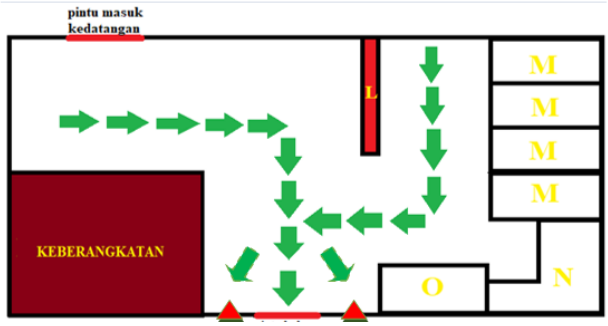


Figure 3 Schematic of 1st Floor Arrival Evacuation Route

In the arrival area only there is 1 access door to enter passengers from the airside and 1 access door to go out. From the existing floor plan, the researcher recommends track evacuation to suit as depicted in the schematic. Researchers also suggest that parties airport add a door emergency *(exit*) in the symbolized section with a triangle red.

Point Scheme Gather

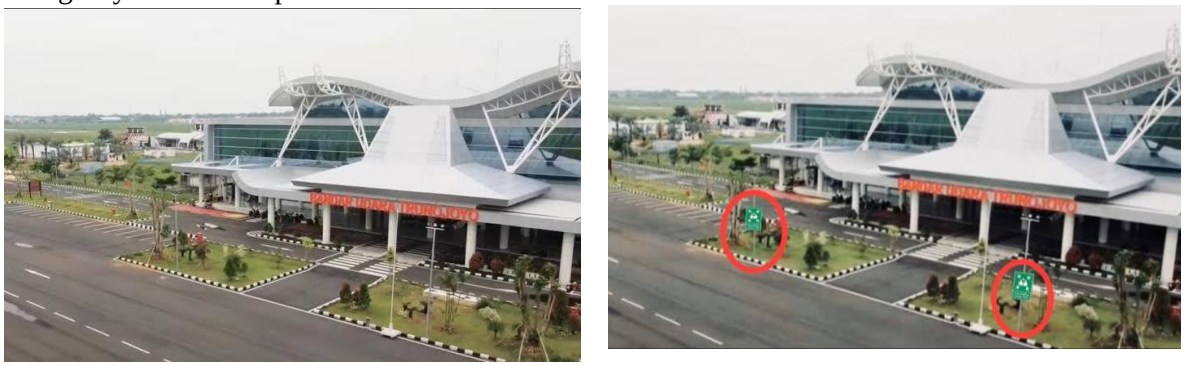
To determine the meeting point, the following indicators/prerequisites are met:

1. Availability of sufficient open area/space,
2. Easy access for victims and rescue workers.
3. Well protected from indirect direct or natural disaster hazards indirect.

4. Availability of shelter/temporary space for vulnerable groups, especially (elderly, babies, pregnant women, people with disabilities),
5. There is easy access for quick mobilization (moving to a safer place),
6. Availability of communication tools that are by the emergency organizational structure,
7. Availability of first aid kit (emergency kit),
8. Availability of adequate transportation access (mobilization transport) to take you to a safer place quickly and safely,
9. Availability of evacuation route plans that are easy to read and understand.

Figure 4 Assembly Point Scheme

From the indicators above, researchers suggest that the Assembly Point will be located at the front of the terminal building. The researchers also suggest placing two signs indicating the assembly point *on* the red triangle symbol on the plan above.



(a) (b)

Figure 5. Assembly Point Sign Location Scheme (a) Before there were Assembly Point Signs (b) Image after the assembly point signs have been installed

The picture above shows the placement of two signs indicating the assembly *point* suggested by the researcher.

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Installation Schemes Sign Evacuate In the Building

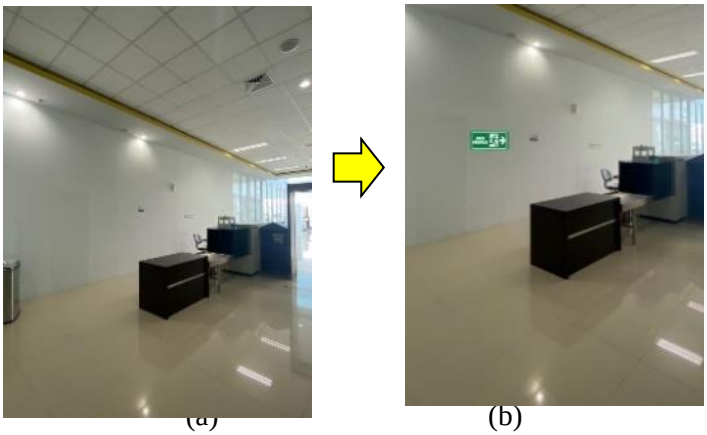
Figure 6. Scheme of Position of Evacuation Signs at Departure

From the picture above, researchers recommend adding evacuation signs to the red dots.

(a) (b)

Figure 7. Point 1 signs (a) Before There Are Evacuation Signs (b) Image after evacuation signs

The image above shows the position of the evacuation signs at point 1.



(a) (b)

Figure 8. Point 2 signs (a) Before There Are Evacuation Signs (b) Image after evacuation signs

The image above shows the position of the evacuation signs at point 2

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(a) (b)

Figure 9. Po ɡns

The image abo

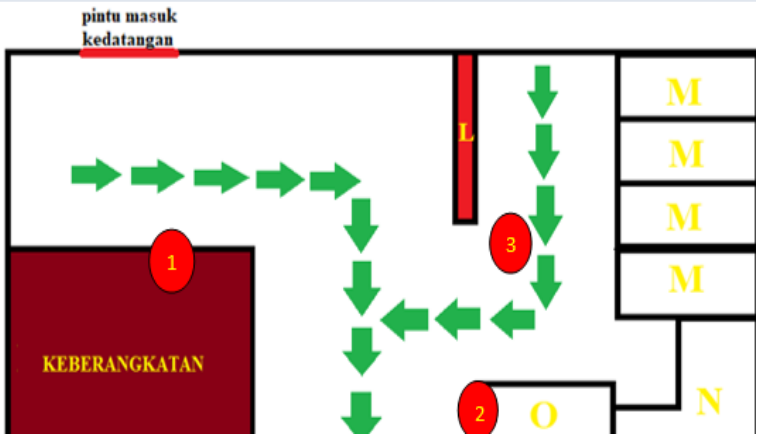

Figure 10 Signs Points 1, 2, and 3

The picture above shows the position of evacuation signs at points 1, 2, and 3.

Evacuation Time Passenger

For know time evacuation all over Visitors in the terminal building need time data per individual To save the self that will be totaled with the over average amount visitors. To know time per individual can use the formula existing density There is.

1. Average calculation on Floor 2
   Amount all over residents 2nd Floor

Standard Speed and level of People density can be seen in below.

2. Average calculation on Floor 1
   Amount all over residents 1st floor

Table 2Calculation of the speed at which people move on Floor 1

ESCALATOR / STAIRS	NUMBER OF PASSENGERS PER DAY (PERSON)	AVERAGE AREA OF CORRIDOR (m^2)	SPEED CALCULATION (p / average area m^2)	RESULTS (p/m^2)	PEOPLE'S SPEED (m/s)
EXITS 1 & 2	130	504	130: 504	0.2	0.2

Table 3Calculation of Minimum speed of people moving on Floor 1

ESCALATOR / STAIRS	MINIMUM MILEAGE (m)	SPEED OF PEOPLE MOVING IN THE CORRIDOR (m/s)	TIME CALCULATION (S/V) or (distance/speed)	RESULTS (p/m^2)	MINIMUM TRAVEL TIME (seconds)
FRONT	5	0.2	5/0.2	0.2	25

Table 4Calculation of Maximum speed of people moving on Floor 1

ESCALATOR / STAIRS	MAXIMUM MILEAGE (m)	SPEED OF PEOPLE MOVING IN THE CORRIDOR (m/s)	TIME CALCULATION (S/V) or (distance/speed)	RESULTS (p/m^2)	MAXIMUM TRAVEL TIME (seconds)
FRONT	71	0.2	71/0.2	0.2	335

Addition of Time For Find the time average fastest and longest
Fastest Time: 25 seconds
Longest Time: 335 seconds
So can the time fastest and longest until to each Exit is 24 seconds and time longest is 335 seconds

3. Route On Front Escalator

Calculations on Escalators 2nd Floor
To look for the minimum and maximum time people move on the stairs use the formula density, ie look for the density of passenger moment through the ladder, so will get the speed of the person moving on the stairs :
Time moves on the Stairs 2nd Floor
Assumption probability of having the fewest people on the stairs :

= number of people/volume of stairs
= 2 / (3.96 x 1.2 x 2)
= 0.2 p/m^2

So according to the table, the speed of people moving on the stairs is V = 1 m/s
Time on Stairs = Distance of Stairs / Speed of Person Moving on Stairs
= 7.92 / 0.3 = 26.4 seconds

So from the data above it can be obtained minimum and maximum time on the Stairs is a minimum of 7.92 seconds maximum of 26.4 seconds for every person, in general time each floor even with other buildings that have the same volume with ladder emergency already follow standard. In general, If The escalator is filled with a minimum of 1 to 10 people speed obtained is still 1 m/s with time travel per person of 7.92 seconds, and the same case If The stairs are filled with a minimum of 30 people so the speed at which people move up the stairs is 0.3 m/s with time travel per person 26.4 seconds.

Evacuation Route Modeling

Based on standards that have been determined government, a building must endure a maximum of 60 minutes. So To increase the effectiveness of time evacuation everyone there in the Trunojoyo Airport terminal building is to shorten the distance traveled on each track., the researcher recommends Adding a sign evacuation at some point and also adding several exits to shorten the distance travel to every exit.

According to (Departemen Permukiman dan Prasarana Wilayah, 2000) distance travel corridor in building class 9b allows a distance from an extra exit of 60 meters, and when researchers do a simulation which distance traveled to Each exit is already on average less than 40 meters, and it turns out the time required everyone for go out No exceed standard time evacuation visitors. So This proves that the regulation government allows passing buildings corridors and lobbies to have distance travel to exit each floor No more than 60 meters is an error in design safe architecture For reliability moment happen a disaster.

CONCLUSION

Based on results from research conducted researcher related to planning track evacuation and determination point gather (*Assembly Point*), the researcher takes several conclusions; It can be seen from the results and discussion above, it can be seen that there are still variables that are not by the specified standards, one of which is the absence of emergency stairs in the terminal building. So, for planning the temporary evacuation route, it was diverted via existing escalators and access stairs. The UPBU hopes that if there are evacuation victims, they will exit from the nearest *entrance* using the evacuation stairs which have been indicated by evacuation signs which will be placed at the points

recommended by researchers. Standards for supporting evacuation routes in the Trunojoyo Airport terminal building are still not appropriate. Because there is a 1st-floor departure area, there is only 1 entry and exit door for airport employees and passengers who will be flying. Based on the existing airport plan, the researcher suggests that the evacuation routes match those depicted in the scheme. The Assembly Point will be located at the front of the terminal building. The researchers also suggest placing two signs indicating the assembly point *on* the red triangle symbol.

Result of study This can be a comparison and reference For studying others and as material consideration For more deeper topic. Will do a study similar and want to deepen the topic This recommended; Added Emergency Stairs to the terminal building, and design evacuation routes to get better evacuation times.

Suggestions for UPBU, the Terminal Building is a place for many people to carry out various kinds of activities, of course, the architect must prioritize beauty and efficiency, but not forget to pay attention to the safety of visitors, in this case, such as taking into account the number of emergency stairs for all ends, the distance for visitors to travel. evacuation to *the exit*, and the final point (Assembly Point) at the end of the evacuation, which must be able to accommodate all evacuation victims.

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