Evacuation Analysis of 1200 GT Passenger Ship in Case of Fire using Agent-Based Modeling Approach

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***Abstract*— this study discusses about safety on board especially during fire condition. During fire, all passengers and crew had to beevacuated into safe place. The study observe at 1200 GT passenger ships, a typical ship which have small dimension vessel characteristic but able to carry passenger more than four hundred persons and also could containt cargo. When the ship was on fire at any circumstances that requires passengers need to be evacuated, it's obvious that there has been be a buildup of passengers when passing through stairs and corridors. The calculation use to estimate evacuation time required based on the IMO guidelines. Studies continued by creating evacuation simulation using Agent-Based Modeling, a simulation modeling that assume human being as an agent that has characteristics resemble to real state of motion. The comparation betiten the two methods, calculation and simulation are both using two scenarios, day and night conditions. Result show that the simulation generates evacuation time shorter than the calculation method. In the numerical calculation takes 689 seconds and 1595 seconds in day and night conditions, while in the simulation process takes 548 seconds and 1374 seconds in day and night conditions sequentially. This studies also folloitd by fire modeling study that aims to determine the spread of heat and smoke produced from fire. On the condition of fire, smokewords. production has been interfere passengers in the evacuation process. The evacuation time becomes longer and estimates the potential victims affected by fire.**

Keywords— evacuation, passenger vessels, agent-based modeling, fire, IMO, simulation.

I. INTRODUCTION

Evacuation in an emergency is vital the occurrence of an accident on the ship. Passenger ship is like an isolated island. In the event of an accident on the ship, it has been lead too much loss [1]. Many things need to be done in regard to preventing the occurrence ship accident, such as with create efficient route and systematic evacuation. Evacuation has been be efficient when the evacuation process can run as short as possible in order to avoid casualties. Data shows that 2/3 accidents were caused by a fire on board. The most fire from the engine room and it happen caused by a leaking fuel system on board. It is worth noting about anything affect fire occurrence. Such as material, hot work area and so on. Interpretation was done if there is a fire which areas worst hedge known so that the evacuation route planning avoid the area. Because it would endanger passengers when along the corridors which has high temperature because of fire [2].

From several parameters such as the characteristics of passengers, condition of the ship and fires then this may influence of each passenger in the process evacuation. Agent-Based Modeling System (ABMS) can model up to the level of behavior to which every individuals as itll as the adaptation process allows the changes in properties owned by individuals also helped in modeling modeling system that has been greatly similar to reality [3;4].

ABMS also be flexible, be able to describe evacuation phenomenon in detail, and provides information of the existing system such as the loss of life that may exist during the evacuation runs. Expected to apply The method of manufacturing process simulation can be more real so as to approach the real results, with so fires has been be the main parameters of this simulation because the decision of each agent has been be different because This emergency situation [3-5].

II. METHOD

Once a problem is already known, then The next is the study of literature. Which at this stage, searched and studied about the problems that exist, soclear what should be done in this thesis in order these problems can be solved. Studies literature can be done by reading the paper or journal dealing with problems to be solved. Of the steps that have been determined, it conducted mathematical calculations based on the reference of the IMO Interim Performance Guidance and has been be compared using a computerized evaluation of software-based Agent Based Modeling and eventually result in a long time evacuation of each method.

In this research after receiving a long time evacuation of passengers each distribution. Then do analysis of fire hazards that occur in some areas is assumed. With the help of evaluation of the software can be made in such fires that it can be observed against the effects during the evacuation process is underway.

III. RESULTS AND DISCUSSION

A. Calculation Long Evacuation

Evacuation scenarios was calculated by reference guide IMO MSC. Circ 1238. In reference referenced,

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time different evacuation of the condition of the day or night. Because in these conditions spread passengers has been be different. In daylight conditions would be more passengers in public space areas while at night conditions most of the passengers occupying the cabin room.

Distribution data of the number of passengers to space occupied indispensable to perform calculation of the length of time the evacuation of a troupe comes from a certain point up to the point of evacuation (Evacuation point). For the distribution of passengers assumed divided by day and night conditions, and some other conditions such as fires, so these evacuation has been vary according to the fire point been predetermined.

Table 1.
Distribution of Passengers and Crew At Morning

No.	Deck	Room	Amount
1.	Loitr Deck	Economy Pasengers	
		Space	85
		E/R	6
		ECR	3
2.	Main Deck	Economy pasengers	
		Space	70
		Pray room	10
		Cafeteria	8
		Information Office	2
		Hospital	2
		Mess Crew	4
		Meeting Room	4
		Galley	2
3.	Crew deck	SB 1st class	
		Passengers space	2
		PS 1st class	
		Passengers space	2
		SB 2st class	
		Passengers space	8
		PS 2st class	
		Passengers space	8
		Office Mess Room	5
		PS Gangway	46
		SB Gangway	50
		Poop Awning	65
4.	Bridge Deck	Wheel House	10
		Open Space A	25
		Open Space B	15

Table 2.
Distribution of Passengers and Crew at Night

No.	Deck	Room	Amount
1.	Deck	Economy Pasengers	
		Space	202
		E/R	6
		ECR	3
2.	Main Deck	Economy pasengers	
		Space	126
		Pray room	4
		Cafeteria	6
		Information Office	2
		Hospital	2
		Mess Crew	4
		Meeting Room	4
		Galley	2
3.	Crew deck	SB 1st class	
		Passengers space	2
		PS 1st class	
		Passengers space	2
		SB 1st class	
		Passengers space	2
		PS 1st class	
		Passengers space	2
		SB 2st class	
		Passengers space	8
		PS 2st class	
		Passengers space	8
		Office Mess Room	5
		PS Gangway	16
		SB Gangway	15
4.	Bridge Deck		
		Wheel House	10
		Open Space	5

Therefore in the first step, at every location of the distribution passengers who have mentioned earlier, made abbreviations to facilitate calculation and route selection evacuation.

Table 3.
Abbreviations on Each Deck

No	Abbreviation Deck	
1	L	Loitr Deck
2	M	Main Deck
3	K	Crew Deck

In the administration stands on the equipment to facilitate the calculation of the length of time the evacuation when down some of the facilities on board.

Table 4.
Abbreviations in the Facility

No	Abbreviations	Facility
1	C	Corridor
2	S	Stairs

3L-CL2-SL3-CM5-SM2-CC9-SC2-CB2-EP

These make it clear that the position of passengers originating from the point (3L), the point where the initial position of the crowd passengers on the lower deck to the lower deck two in the corridor (CL2), followed by the third down stairs located on the lower deck (SL3), after it throught with fifth down the corridor in the main deck (CM5). Furthermore, passengers proceed to the stairs in the main deck (SM2), followed by browsing corridor numbered nine crew were positioned on deck (CC9), and then using the stairs at deck crew (SC2) continued way open corridor in bridge decks (CB2) and finally to the evacuation point (EP).

B. Evacuation Modelling

Agent-Based Modeling is one method by the author to get the value of time duration of time evacuation in the vessel with similar as possible to the real situation. In daylight conditions signaling the evacuation time is shorter than by night. This occurs because the distribution of passengers during the day more in public places and on the condition night passengers and cabin crew

When did the simulation process, takes time for seventeen hours on each of the decks that have been specified scenario. It is common cause simulation the software uses parables almost close to the real circumstances and the many network created has been affect. The more detail and meeting the mesh network is made, the longer and complicated process simulation has been run.

In the event of fire on the main deck placed on areas prone to fire accidents, namely galley. HRR given property certainly has value smaller than that caused by fire in engine room because more properties in galley have been handled easily so that the fire can defelopment prevented by quickly. The fumes spreading the crowd on the second to 300 where 80% of the passengers had to the point of evacuation.

IV. CONCLUSION

Based on studies have been conducted, the results calculations using IMO Interim, followed by evacuation modeling uses Agent-Based approach Modeling. Have been varying results. Studies continued by modeling the fire to see the impact of smoke and flame to the evacuation process with reference Fire Dynamic Simulation. Here is the conclusion :

1. Long process of evacuation time on calculations recommended by the IMF, giving the time meet the IMO standards. Determination rallying point evacuation is on the highest deck of the ship that bridge deck.
2. The process of calculating the evacuation time is done with divide into two scenarios, day and night. The scenario has a characteristic distribution passengers are different according to the condition of the vessel.
3. In numerical calculations on a long time evacuation, need the time of 689 seconds and 1595 seconds on each day and night conditions. While in the simulation process, produce a time shorter for 548 seconds and 1374 seconds on each day and night conditions are sequentially.

In the fire simulation conducted on the third deck. In the scenario of a fire in the engine room are not disrupt the evacuation, while in scenario fire in the galley on the main deck to cause smoke formed and approached the crowd on the stairs the second to 300.

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