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LAY OUT ANALYSIS IN HANDLING DANGEROUS GOODS AT GREEN TERMINAL CONTAINER TELUK LAMONG SURABAYA IN 2023

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Abstract The objective of this paper is to analyze the layout of hazardous goods handling at the Green Terminal Container Teluk Lamong in Surabaya in the year 2023. The background of this research is the occurrence of accidents at container terminals in the international ports of Beirut and Tianjin. Additionally, the Logistics Performance Index for Indonesia in 2023 has dropped from ranking 42 to 64. In light of these events, the author and the team took the initiative to review the placement of hazardous goods that could affect safety at container terminals or ports, specifically focusing on the Green Terminal Container Teluk Lamong. The goal is to address deficiencies in operations and implement the National Regulation Ministerial Regulation number 16 of 2021 regarding the management of hazardous goods handling at ports and the International Maritime Dangerous Goods Code edition 41-22. The writing method used is descriptive-exploratory, utilizing data sources from the relevant container terminal or seaport and literature references. The collected data will be analyzed and processed using layout management methods. The results of this paper encourage stakeholders to adjust existing layouts when new and beneficial aspects are identified. The recommendations derived from this research can be implemented as a pilot project in container terminals and other ports across Indonesia. The conclusion of the study reveals that the layout still needs adjustments according to the separation table in the IMDG code, leading to significant changes in business processes in terms of time, resources, and environmental safety factors.

Keywords: Layout; Dangerous goods ; National Regulations; Terminal Container; Seaport

INTRODUCTION

Regarding the current problems of sea transportation and supporting infrastructure, namely first. Security and safety are the first priorities that need to be considered when handling the receipt, storage and distribution of cargo, especially those related to dangerous goods. (International Bank for Reconstruction and Development / The World Bank, 2023) regarding Indonesia's logistics report card has been reported as follows :

There are still deficiencies found in one of the chains, supply chain, either infrastructure or mode of transportation. The following is data on Indonesia's logistics costs for 2018 which are still being experienced today, which was also recently shown by the 2023 LPI.

Then the second problem, as (Purwanti, 2023) reported as follows :

several main ports have technical conditions and performance below the international average. So far, the factor that is considered to cause less efficiency at ports in Indonesia is waiting time at the port. Referring to the 2021 UNCTAD publication, the average waiting time for all ships at Indonesian ports is 1.29 days. This achievement is indeed much better than in previous years. However, it is still unable to compete with other countries, not even better than the world average.

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The third problem is about Human Resources Development (HRD), which is very fundamental issues that directly affect in many aspects. (Buchari & Basri, 2015) state as follows :

HRD in quality and quantity aspect has become the vision, listed in the Master Plan of National Ports. One of the most important things is the improvement of human resources of handling equipments, because the technical workers in ports play important roles in determining the productivity.

If this is not immediately followed up, it is feared that several indicators related to the latest major incidents or disasters related to the storage & transportation of dangerous goods in ports and seas at the end of 2022 could occur at ports in Indonesia. that occurred at ports, such as an explosion caused by chlorine at the Port of Aqaba, Jordan's Red Sea, on June 28 2022 which resulted in the deaths of 13 workers. And one container and its transport equipment were burnt down at Tanjung Perak Port, Surabaya, on August 26 2022.

One of the solution or method to solve those three problem above could be done by using the lay out analysis.

(Taner et al., 2014) define the effect of lay out as follows:

The effect of layout on terminal performance is analyzed using different simulation models. It also attempts to improve the performance of terminals by using different allocation strategies under the optimum dispatching rule. Total container handling amount per year in quay cranes is used as the major performance criterion.

(Kelvin & Herijanto, 2023) define the lay out terminal container as follows :

study to analyze the need for container yards at the seaport Terminal, the lay-out of the container yard and the performance of existing equipment so that it can serve the increasing flow of containers every year. By analyzing container flows, facilities, performance, container handling systems in the stacking yard layout, the size of the stacking yard in the seaport Terminal. So it can be used to calculate the area of the stacking yard, the layout of containers in the layout of the stacking yard and equipment requirements in the container yard now and 10 years later.

(Anumba & Bishop, 2011) states that : Site layout and organization are important management functions which influence all aspects of work on a construction site - from construction methods and sequence to health, safety, and productivity.

Main limitation of the previous researchers, that they did not observe the risk of stacking the dangerous goods container on the container terminal yard, while this matter is very important for safety work environment and green continuation. Therefore the researcher hope from the analysis lay out in Terminal container teluk lamong, some or all problem above can be solved by minimizing risk and also smooth the handling. So this main limitation become our research question , How to solve the the risk and effective handling of the dangerous goods on container terminal teluk lamong ?.

Finally the objective of the research is to analyze the layout of hazardous goods handling at the Green Terminal Container Teluk Lamong in Surabaya in the year 2023.

METHOD

On the Research Concept , The research process is carried out by collecting data, data preparation, calculation of field needs stacking, designing new layouts, handling simulations containers in a new layout and equipment utilization calculations in place

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Teluk Lamong Terminal. (Riopel & Langevin, 1991) Layout planning is an appropriate area to apply optimization models. A method is proposed for evaluating general layouts (block layouts) when interdepartmental handling is directed along the aisles. (Chiang et al., 2002) Although many authors have noted the importance of minimizing workflow interference in facility layout design, traditional layout research tends to focus on minimizing the distance-based transportation cost. While on the Research Data There are two data that will be used in the research from housing planning in the form of primary data and secondary data. Primary data was obtained from the results of a time survey handling containers coming in and out of the stacking yard and observing operations loading and unloading of containers at the dangerous goods Terminal stacking yard . Secondary data is in the form of required data in research such as total container flow, layout existing, number of tools, and tool working time . and for Data Analysis, From the data that has been collected, projections are calculated growth of container flows, analyzing needs, tool utilization, and container layout on growth container flows . Simulations carried out with using standard segregation reference of dangerous goods container inter classification of IMDG Code with Microsoft Excel. After the results are obtained, they are determined suggestions and conclusions.

RESULTS AND DISCUSSION

The finding was that the storage location for containers containing dangerous goods was still mixed with general goods. And the allocated area occupied is still quite large. This causes a waste of space for the storage area for dangerous goods which should be separated from general goods, and also other findings that there is no separation by providing signs or markings in the container storage area which of course can cause the mixing of dangerous goods that are incompatible with each other. with other dangerous goods in containers, which can later cause unexpected reaction incidents due to the mixing of hazards in these different materials. For example, if dangerous goods are mixed and do not follow the directions in Table section 7.2.4 in Volume 2 of the IMDG (International Maritime Dangerous Goods) Code. The general provisions for segregation between the various classes of dangerous goods are shown in the "segregation table" (IMO, 2022) given below.

Figure 1. segregation between the various classes of dangerous goods

CLASS		1.1 1.2 1.5	1.3 1.6	1.4	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	7	8	9
Explosives	1.1, 1.2, 1.5			*	4	2	2	4	4	4	4	4	4	2	4	2	4	X
Explosives	1.3, 1.6				4	2	2	4	3	3	4	4	4	2	4	2	2	X
Explosives	1.4	*			2	1	1	2	2	2	2	2	2	X	4	2	2	X
Flammable gases	2.1	4	4	2	X	X	X	2	1	2	2	2	2	X	4	2	1	X
Non-toxic, non-flammable gases	2.2	2	2	1	X	X	X	1	X	1	X	X	1	X	2	1	X	X
Toxic gases	2.3	2	2	1	X	X	X	2	X	2	X	X	2	X	2	1	X	X
Flammable liquids	3	4	4	2	2	1	2	X	X	2	2	2	2	X	3	2	X	X
Flammable solids, self-reactive substances, solid desensitized explosives and polymerizing substances	4.1	4	3	2	1	X	X	X	X	1	X	1	2	X	3	2	1	X
Substances liable to spontaneous combustion	4.2	4	3	2	2	1	2	2	1	X	1	2	2	1	3	2	1	X
Substances which, in contact with water, emit flammable gases	4.3	4	4	2	2	X	X	2	X	1	X	2	2	X	2	2	1	X
Oxidizing substances (agents)	5.1	4	4	2	2	X	X	2	1	2	2	X	2	1	3	1	2	X
Organic peroxides	5.2	4	4	2	2	1	2	2	2	2	2	2	X	1	3	2	2	X
Toxic substances	6.1	2	2	X	X	X	X	X	X	1	X	1	1	X	1	X	X	X
Infectious substances	6.2	4	4	4	4	2	2	3	3	3	2	3	3	1	X	3	3	X
Radioactive material	7	2	2	2	2	1	1	2	2	2	2	1	2	X	3	X	2	X
Corrosive substances	8	4	2	2	1	X	X	X	1	1	1	2	2	X	3	2	X	X
Miscellaneous dangerous substances and articles	9	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The numbers and symbols in the table have the following meanings:
1 – "away from"
2 – "separated from"
3 – "separated by a complete compartment or hold from"
4 – "separated longitudinally by an intervening complete compartment or hold from"
X – the Dangerous Goods List has to be consulted to verify whether there are specific segregation provisions
* – see 7.2.7.1 of this chapter for the segregation provisions between class 1 substances or articles

Source : (IMO, 2022)

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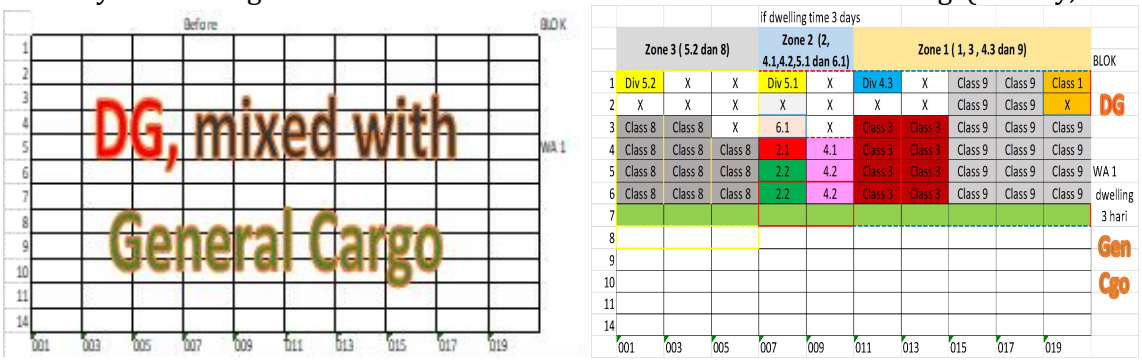
The segregation between various Dangerous Goods class also has been regulated by national regulation Part 5 chapter 15 about segregation dangerous goods of PM 16 Tahun 2022 related to Handling And Transportation Procedures Dangerous Goods At The Port (PM 16 Tahun 2021 Tentang Tata Cara Penanganan Dan Pengangkutan Barang Berbahaya Di Pelabuhan, 2021)

For code classs number 3 (separated by a full space) which applies to flammable liquid materials (Flammable liquid) class 3 and materials that infect (Infectious substances) division 6.2, because it is suspected that if a fire hazard incident occurs it could damage the packaging of goods in division 6.2 so that The next reaction is that it has an impact on spreading viruses from materials that easily infect the environment and worker who work around it, so this is quite dangerous if a safe distance is not applied when placing it.

The existing lay out before fixing and the lay out simulation after further analysis that should be fixed is shown on Figure 2.

Figure 2**:** Lay out of Dangerous Goods Terminal Container before and after fixing (Rizaldy, 2023)



(Raman et al., 2007) states that : Measuring effectiveness in an existing facilities layout is a prerequisite in order to initiate any action that will improve layout effectiveness.

What was previously Dangerous Goods (DG) lay out is found mixed with general cargo during observation in field. The previous areas occupies large with 63.16 m long x 63 m width = 3979.08m^2. So after being separated specifically for dangerous goods, it will only occupy an area of 22 m long x 62 m wide = 1364 m^2. So the difference in area is 2593.08m^2. So, in terms of time effectiveness and work efficiency, there is already quite a significant difference, where if 1 square meter of area requires approximately the following time after calculation. To calculate the time required for a truck to move within a 1 meter square area at a constant speed of 15 kilometers per hour (15 km/h), you need to convert the speed to meters per second and then determine the distance it needs to travel. 1 kilometer is equal to 1000 meters, and 1 hour is equal to 3600 seconds, so: 15 km/hour = (15,000 meters) / (3600 seconds) ≈ 4.167 meters/second Now, you want the truck to move within a 1 meter square area. The circumference of a 1 meter square is 4 meters (each side is 1 meter long), so if you want the truck to move along the entire circumference of the square at a constant speed of 15 km/h, you can use the following formula: Time (seconds) = Distance (meters) / Speed (meters/second) then Time = 4 meters / 4.167 meters/second ≈ 0.96 seconds So, it takes about 0.96 seconds for the truck to move along the entire circumference of a 1 meter square area at a speed of 15 kilometers per hour. Therefore in total the time difference before and after repositioning the area is approximately 0.96 seconds x 2593.08 m^2 = 2489.35 seconds then converted to minutes to become 41, 48

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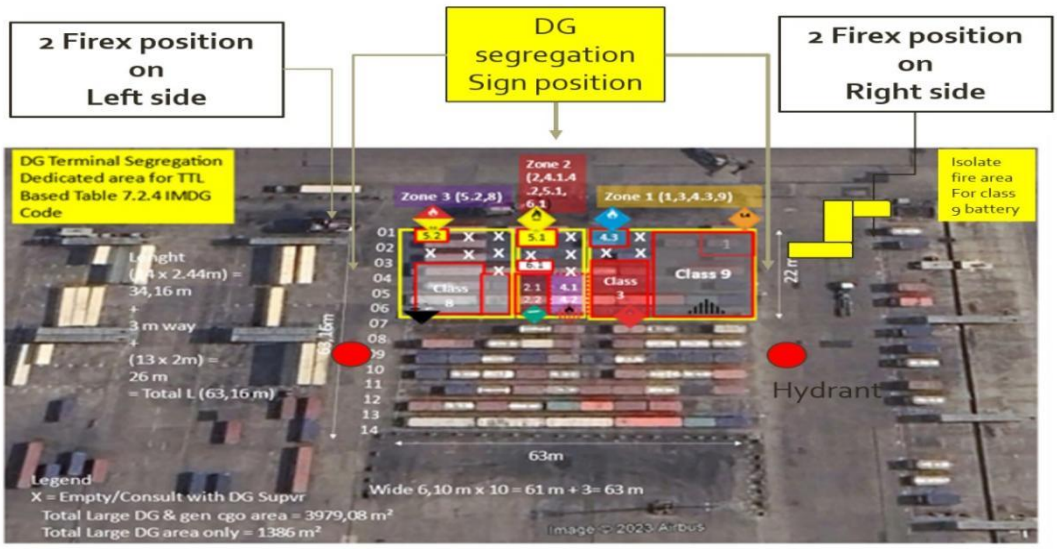
minutes. Per one search or item placement. Of course, this is very influential if more than 1 container is placed in a day. This has quite an impact on the time and fuel used when calculated cumulatively.

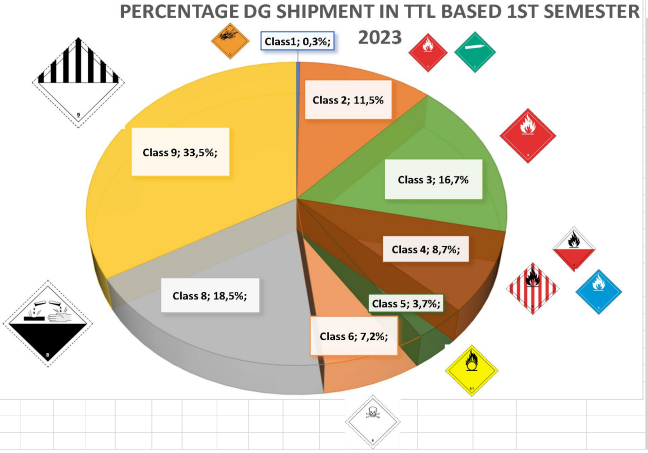
(Rizaldy et al., 2023) Change or improvements were made to the resource, placement position dangerous goods that were originally mixed with general cargo where the laying area is 3978.08 or 3979.08m^2 square meters has been changed to 1386 square meters or 1364m^2 Separate DG placement from general goods. The complete figure of Dangerous Goods Terminal Lay out as well as the calculation can be seen below on figure 3.

Figure 3 . Recommended Storage Area Dangerous Goods at Teluk Terminal Green Container Lamong (source: Researcher 2023)



Another finding after calculating the secondary data that the author obtained regarding the number of comparison ratios between classes of dangerous goods received by the container terminal, was the following data as shown on figure 4.

Figure 4 : % Ratio of Dangerous Goods Receipts based on 9 classes early semester 2023 Container terminals in Surabaya (Rizaldy, 2023)



Rank	
from	
Large qty	
Class 9	33,50%
Class 8	18,50%
Class 3	16,70%
Class 2	11,50%
Class 4	8,70%
Class 6	7,20%
Class 5	3,70%
Class 1	0,30%
	100%

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There are miscellaneous Class 9 hazards, followed by Class 8 corrosive hazards, and Class 3 flammable liquid hazards, ranked 1, 2 and 3, followed by Other hazard classes, this can help the container terminal to provide more area allocation for class 9 and beyond, as well as provide safety equipment related to the dangers posed by dangerous materials which are more incoming, this will help the party providing safety equipment in providing the equipment so that it is right on target and there is no waste. The average handling of containers containing dangerous goods is 29 containers/day with an average dwelling time calculation of 3 days. Additionally after fix the lay out of DG Terminal container. According to (Hafidh et al., 2021) state that:

The stacking DG cargo field, it is necessary to provide segregation signs in the DG cargo field according to its class as based on the guidelines of the IMDG Code chapter 7.2.4 section of the segregation table. As well as to minimize the risks that may arise later from DG, the condition of the stacking field needs to be provided with fire extinguishers that are in accordance with the DG class

So those analyze the layout of hazardous goods handling at the Green Terminal Container Teluk Lamong in Surabaya in the year 2023 has answered how to solve the the risk and and become effective handling of the dangerous goods on container terminal teluk lamong.

CONCLUSION

The finding of the lay out analysis is the modification some position of dangerous goods container, and the implication that there will be recommendation for terminal container to implement the lay out in the field, this solve the the risk and create the effective handling of the dangerous goods on container terminal Teluk Lamong. Suggestion for the future experiments the lay out can be done also in other terminal port to improve their work performance as well as their safety environment .

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