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論 文

Estimation of the CY Area Required for Each Container Handling System in Mokpo New Port

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목포 신항만의 터미널 운영시스템에 따른 CY 소요면적 산정에 관한 연구

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Key Words : Container Handling System(컨테이너 하역시스템), Mean Dwell Time(평균장치기간), Mean Stacking Height(평균적재단수), Peaking Factor(피크계수), Separation Factor(분리계수), TGS(Twenty-foot Ground Slot), Free Period(무료장치기간), Storage Demand(장치수요), CY(Container Yard)

Abstract

The CY can be said to function in various respects as a buffer zone between the maritime and overland inflow-outflow of container.

The amount of storage area needed requires a very critical appraisal at pre-operational stage. A container terminal should be designed to handle and store containers in the most efficient and economic way possible. In order to achieve this aim it is necessary to figure out or forecast numbers and types of containers to be handled, CY area required, and internal handling systems to be adopted.

This paper aims to calculate the CY area required for each container handling system in Mokpo New Port.

The CY area required are directly dependent on the equipment being used and the storage demand. And also the CY area required depends on the dwell time. Furthermore, containers need to be segregated by destination, weight, class, FCL(full container load), LCL(less than container load), direction of travel, and sometimes by type and often by shipping line or service. Thus the full use of a storage area is not always possible as major unbalances and fluctuations in these flow occuring all the time. The calculating CY area must therefore be taken into account in terms of these operational factors.

For solving such problem, all these factors have been applied to estimation of CY area in Mokpo New Port. The CY area required in Mokpo New Port was summarized in the conclusion section.

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1. Introduction

Since the beginning of the containerization, it has been rapidly spread over the world with realization of intermodalism, and our country has established container terminal at Pusan port in 1978 to meet worldwide trend of containerization.

Geographically Mokpo port has played a role as the major port of the South-West region in Korea. According to the rapid economic growth in the economic block of Yellow Sea, Mokpo port has a potential ability of growth as a connecting point of TCR.

Thus in recent years, new container terminal (30,000DWT × 2 berths) is under construction at Mokpo New Port which will be completed in 2001.

This paper aims to estimate the optimal container yard(expressed as CY) area required for each container handling system in Mokpo New Port.

A container terminal consists of the storage area and sorting area, which is situated between two demands, one associated with the arrival of the ships, the other associated with the arrival of land vehicles. The basic functions of the CY within the terminal are to keep cargo for certain formalities such as customs clearance and to accommodate cargo for varying period of the time, providing a flexible period for shippers to adjust to delivery requirements.

Lack of container storage space has been another serious constraint on operations. It is true that since the introduction of containerization on the major trade routes, there is a trend towards larger storage areas for container terminals. The optimal amount of storage area requires a very careful appraisal in terminal design.

The CY area to be capable of estimated average number of containers depends basically on the stacking height and the kind of mobile equipment to be used. To figure out this, the CY area should be calculated for each handling system. More space is obviously needed if containers are stored one high and if they are moved by tractors and trailers. Wide aisles must be left free for easy access to each unit. If enough land is available in the terminal, the one-high method of storing containers may be the most economical, in particular when nature of soil is poor. Pavement does not need to be very strong, as containers can be moved on trailers without using heavy lifting equipment, perhaps only a light gantry for placing on a low trailer container that have been stored direct on the ground. When space on land is scarce, containers must be stacked two or three high and special equipment must be used for stacking. Soil is to be resistant, with a strong pavement.

The major factors affecting the needed CY area of a terminal are the predicted throughput, dwell time, stacking height, separation factor, and peaking factor. The CY area is also affected by the method of operation.

For calculating the CY area required, this paper firstly analyze the characteristics of container handling systems in view of land utilization. Secondly, estimate the container traffic volumes, mean dwell time, peaking factor, separation factor, and mean stacking height. Finally, it is tried to calculate the required CY area for each handling system.

2. Characteristics of the Container Handling Systems

Both stacking height and layout of the stacking blocks are directly dependent on the equipment being used in the quay transfer and stacking operations. In fact, choice of equipment is such a significant factor in determining CY land area. Although a wide range of different types of equipment have been developed, the most commonly used types in operation are:

- tractor-trailer sets;
- fork-lift trucks;
- straddle carriers; and
- transfer cranes.

There can also be various combinations of these types of equipment at individual terminals. Many container handling systems have been developed, but there is no general agreement on the optimum system for each sets of circumstance.

In practice, specific terminal operations can be organized on the basis of using combinations of these equipment types, as some may be more suitable for some parts of the operation than others. It is more useful, therefore, to talk of container handling systems, rather than specific equipment types, and here we can conveniently distinguish five categories which are the most common container handling systems in operation today as follow:

1) The tractor-trailer system
2) The fork-lift truck system
3) The straddle carrier system
4) The transfer crane system
5) The combination system.

This paper will analyze these alternative handling systems focused on the factors influencing the stacking capacity and area needed for operating the equipment.

The essential features of each container handling systems are as follows.

1) Tractor-trailer system

The elements of this system are heavy- duty tractors and large numbers of trailers towed by them. The import containers discharged from a ship by crane are placed on a road trailer, which is towed to an assigned position in the storage area where it remains until collected by a road tractor. Trailers carrying containers for export are placed in the storage area by road tractors and towed to the ship by port equipment. The containers are thus of necessity stored one high, requiring a large transit storage area. With this system trailers are parked back-to-back in row with 12m or 18m wide access roadways between rows for 20ft or 40ft containers respectively.

This is a very efficient system because every container is immediately available for removal by a tractor unit, but in addition to requiring a large area it also requires large number of trailers, entailing considerable expense.

The major disadvantage of the tractor-trailer system is the land area needed for the container yard: stacking is to one container height only, and manoeuvring space has to be provided for the tractor- trailer sets, with their large turning circle. The row of containers have to be separated by transverse and longitudinal access roadways, while a perimeter roadways is usually provided, too. The result is excellent accessibility, but a high demand on land surface; on average, a tract-trailer terminal accommodates only about 180 TEUs per hectare. Another consequence is that transfer distances can be very long, slowing the quay transfer operation.

2) Fork-lift truck system

A completely different approach is to use heavy-duty lift trucks equipped with either a front-end or a side-lift spreader. A front-end spreader is capable of stacking fully loaded 40 foot containers two or three high, with the most common stacking height of two high. A side-lift spreader can be used for 20 foot containers, both full and empty, and 40 foot empties. Empty containers can be stacked up to four high. This system places heavy loading on the surface of the terminal and adequate soil improvement and surfacing must therefore be provided. Such trucks can transfer containers from ship's side to the stacking area, or tractor-trailer units can be used which will reduce the number of fork-lift trucks required.

The major attraction of front-end loadeds is their versatility; they can be used in many locations within the container terminal - lifting, stacking, transferring to and from the quayside, receiving from and delivering to road vehicles. However, it is difficult for a fork-lift truck to pick up a container from between the legs of a ship-to-shore gantry crane, and so in practice transfer of containers is often performed by tractor-trailer sets, with the fork-lift trucks working within the CY and between the CY and CFS.

The storage pattern allows lower density than straddle carriers, and wide access aisle are required between blocks. Typical aisle widths in the stacking area are 18 meters for 40 foot units and 12 meters for 20 foot units. Therefore, good selectivity is possible with wide access roads between rows but ground utilization is poor.

Export containers can stacked 3 high and import containers 1.5 high, so an overall average density of about 275 TEUs per hectare is possible in a 50 : 50 balance between imports and exports terminal.

3) Straddle carrier system

Straddles carriers are versatile equipments that can perform all terminal operations. They stack containers, transport them between quay cranes and storage area and service land transport. Good selectivity is also possible with reasonable ground utilization.

At the present time the straddle carrier system is the predominent one. Straddle carriers can stack containers two or three high, move them between ship-to-shore gantry crane and stacking area, and load or unload them to or from road transport. A variant of this system is the use of tractor-trailer units for the transfers between quayside and storage area, and the use of straddle carriers only within the storage area for stacking and selecting containers.

Good features of straddle carrier operations include operating flexibility and efficiency. Straddle carrier is a completely mobile unit, easily deployed to different activities in response to varying demands. It provides good utilization of the land area; even one high stacking, 220 TEUs per hectare are possible, and with mean stacking height 2 for exports and 1.5 for imports, and assuming a 50 : 50 balance between imports and exports, 385 TEUs per hectare are possible. Empty containers can be stacked up to three high.

Average stacking heights in the CY depend on container type and status. Export and empty containers are normally block-stacked two to three high, though straddle carriers stacking one over three are available. Import containers, where call-off or delivery times are not known, are seldom stacked more than one or two high, in alternate stacks for random access. For exports, then, the mean stacking height is 2.0 to 2.5, while for imports it is usually 1.5.

A major disadvantage of this system is the risk of damage to containers and equipment, caused by the relatively high travel speeds and the narrowness of the wheel spaces.

4) Transfer crane system

Transfer cranes or yard gantry cranes span several lines of containers. In this system, containers in the storage area are stacked by rail-mounted or rubber-tyred gantry crane. Their outstanding feature is the ability to stack containers up to five high. Although normally containers are stacked no more than four high, rail-mounted crane can stack containers up to five high. Rubber-tyred gantry cranes can normally stack containers two to four high. For a terminal operation, however, they require tractor-trailers to transfer containers between the qray cranes and the stacking area.

The major attraction of this system is its economical use of land area because of the high stacking, and is suitable for varying degrees of automation. One high stacking provides about 280 TEUs per hectare but, with average stacking heights of 2.5 for imports and 3.5 for exports, an overall 750 TEUs or more per hectare is possible for a 50 : 50 import/export split. Anothor attraction is that only the relatively narrow roadways for the transfer crane wheels need to be capable of high load-bearing.

Transfer crane system does, however, have some major drawbacks. The primary one is that it is not as flexible as a straddle carrier system. Although a transfer crane can be moved within the CY as required, it can not be used on the quayside or to transfer containers to a CFS, while a rail-mounted gantry crane can not even be moved from one stacking area to another.

In the long term, the need to economize in land is likely to be very important, and this favours the use of transfer crane. This system is especially useful where exports are a substantial proportion of the total traffic, but less than optimum where import containers consititute the major portion of the traffic.

5) Combination systems

Combination systems employ the best equipment for the particular operation. However, for such systems to be successful, a comprehensive information system and rigid operating policies are required, together with excellent management.

A number of terminals have adopted a container handling system which combines the particular advantages of several of the four types of equipment in an extensively hybrid system, with more than one type of stacking equipment in use at a time. For example, straddle carriers are used for extracting individual import containers and delivering them to the road vehicles, but transfer cranes are used in the container park for feeding exports to the ship where it is possible to work straight off an export stack. Another mixed system is one using straddle carriers for stacking full containers and fork-lift trucks for empty containers.

The objective of adopting the mixed system is to take the maximum advantage of all positive features of each type of equipment used in it and to minimize its drawbacks.

6) Effect of different operating systems on ground utilization

Ground slot utilization in terms of the mean number of TGSs that can be accomodated per hectare with such a system is presented in Table 1. Such a summary Table 1 helps considerably in the task of selecting the most appropriate type of equipment for a particular terminal, but it is also necessary to take into account the configuration and layout of terminal; this paper shall consider these aspects for calculating the CY area required of a terminal next.

Table 1 Ground slot utilization for each container handling system

Land utilization / System	TGSs/hectare	Mean Stacking Height		TEUs/hectare Export:Import(50:50)
		Export	Import	
Tractor-Trailer	180	1.0	1.0	180
Fork-Lift Truck	125	3.0	1.5	275
Straddle Carrier	220	2.0~2.5	1.5	385
Transfer Crane	250	3.5	2.5	750

* Source : UNCTAD, Operating and Maintenance Features of Container Handling System, 1988.

3. Determining Storage Demand

The needed CY land area for a container terminal requires a very critical appraisal at pre-operational stage. There are many interrelated factors involved here, but we can identify two major elements that start the process: estimating the expected storage demand, and then calculating the CY land area required to meet that demand. This paper deals with two steps in turn in the next sections.

1) Container throughput forecasts

This paper has estimated, on the basis of Construction Plan of Mokpo New Port, the annual numbers of TEUs/containers expected to pass through the terminal in the year of 2001 to 2016, by status: imports, export, empties. The estimated container traffic volumes in Mokpo New Port are presented in Table 2.

Table 2 Estimated container cargo volumes in Mokpo New Port

(unit : thousand TEU)

Year / Container Status	2001	2006	2011	2016
Export Full	16.7	45.7	78.7	87.9
Export Empty	2.3	6.3	10.8	12.1
Import Full	14.8	40.6	69.8	78.1
Import Empty	4.2	11.4	19.7	21.9
Total	38.0	104.0	179.0	200.0

* Source : MMAF, Construction Plan of Mokpo New Port, 1996.

For operational and administrative reasons, containers should not normally be transferred directly between the quayside and inland transport. Instead, a storage yard is provided at the terminal for in-transit storage of containers while all the administrative procedures involved in arranging delivery, collection or loading are gone through. The container yard is occupied the widest area in the terminal and the one most dependent on the storage demand.

The amount of space needed for storage is related to the number of containers passing through the terminal, but there is more to demand than just average throughput. To convert annual throughput in terms of the number of TEUs into storage demand, a series of other factors have to taken into account, the first of them being an allowance, the peaking factor, for variations in demand. This is the essential starting point to calculating the CY land area requirement.

2) Peaking factor

All container terminals experience peaks and troughs in the flow of containers over a period of time and an allowance is needed so that the peak is not excessively exceeded. To overcome this problem, this paper has estimated a peaking factor of 1.32 to cover these routine fluctuation in trade.

As Mokpo port has no existing container yard on which to base a peaking factor prediction, the relevant data used in this paper were derived from those of a container terminal in Pusan port and other foreign ports. However, much informations can be learned from terminals in similar types of environment and there is more commonality of problems in all terminal than there is difference.

3) Mean dwell time

The storage demand figures so derived do not directly indicate how many container slots are required each day, as they do not take into account the period each container stays in the CY, ie its dwell time.

The CY area required for storage demand takes status and equipment used into account but depends primarily on the dwell time of the containers on the terminal.

Just as significant is the time that a container can expect to remain in stacking area, we call this the dwell time. Clearly, the longer that containers, on average, are left in the CY, the more space is needed to accomodate a given throughput. Therefore, we need to consider the dwell time, as it is a very important factor influencing the land area requirement of the CY.

Dwell time is determined by subtracting the arrival date of the container from its departure date. The estimated mean dwell time of Mokpo New Port, by container status, is summarized in Table 3.

Table 3 Estimated mean dwell time in Mokpo New Port

(unit : days)

Port / Container Status	Mean Dwell Time				
	Pusan Port				Mokpo New Port (Estimated values)
	BCTOC	PECT	ODCY	Free Period	
Export	2.13	1.77	5.0~7.0	3	5.4
Import	2.85	3.01	7.0~10.0	4	6.3
Transshipment	3.29	2.99	-	7	7.5

* Source : BCTOC(Jan.~Sept., 1997), PECT(Jan.~Oct., 1997)

4) Separation factor

Finally, this study points out that applying a peaking factor and dwell times only ensures that the CY contains sufficient container slots to accommodate the expected flow if a relatively compact stacking pattern is assumed. However, there is still another allowance that needs to be built into our estimate, for our operational reasons.

In practice, containers need to be separated into groups in the container yard by size, by type, by weight, etc, to allow ease of access for in-terminal moves and operational flexibility. This extra space is allowed for by applying a separation factor.

The estimated separation factor in Mokpo New Port is presented in Table 4. This paper has been predicted a separation factor of 1.25 to 1.30. This factor has been applied to calculation of the CY area.

Table 4 Estimated separation factor in Mokpo New Port

Container Status	Separation Factor
Export	1.30
Import	1.25
Empty	1.25

5) Mean stacking height

Several factors determining CY area have been estimated: annual throughput, dwell times, peaking factor, and separation factor. To convert annual throughput in terms of TEUs into twenty foot ground slots, the height to which the containers can be stacked must be taken into consideration.

A variety of factors influence the number of containers in a stack. Stacking height depends on container status and on the handling system used. Therefore, a separate calculations are needed for each handling system. By taking all this factors into account, it is possible to calculate a mean stacking height for the CY. Table 5 shows the estimated mean stacking height for each status of container and for each container handling system.

Table 5 Estimated mean stacking height for each handling system

Handling System	Mean Stacking Height		
	Export	Import	Empty
Tractor-Trailer	1.0	1.0	1.0
Fork-Lift Truck	1.5	2.5	3.0
Straddle Carrier	2.0	2.5	3.0
Transfer Crane	2.5	3.0	3.5
Combination System	2.5	2.5	3.0

4. Estimation of the CY Area Required in Mokpo New Port

1) Calculating the required CY area

The major factors affecting the CY area of a terminal are the storage demand and equipment used. The stacking capacity in terms of TEUs is not directly translatable into land area as containers are not normally spread out one high. They are stacked on each other to varying heights, and the land area actually needed(expressed as TGSs) is calculated by dividing the stacking capacity by the stacking height.

In this study therefore, the following empirical formula has been used to calculate the CY land area. A period can be of any length, although a year is the one most frequently used. The required number of TGS N over a year is

$$N = \frac{C \times D \times P \times S}{H \times K}$$

Where:

N = number of ground slots;

C = estimated storage demand volumes(TEUs);

D = mean dwell time in CY;

P = peaking factor;

S = separation factor;

H = mean stacking height; and

K = number of days in CY(365 days)

N × H is the holding capacity of the container yard. The needed CY area A(m^2) can be computed as follow:

$$A = \frac{N \times a}{u}$$

Where:

A = total CY area(m^2)

u = utilization factor

a = projected area per 20 foot container(14.862 m^2)

The utilization factor relates to the physical use of the storage area as dictated by the nature of the equipment for container transfer. Table6 shows the estimated values of utilization factor for each handling system. These values are used to convert number of TGS into CY area(m^2).

Table 6 Estimated values of utilization factor

Container Handling System	Utilization Factor
Tractor-Trailer	0.28
Fork-Lift Truck	0.21
Straddle Carrier	0.39
Transfer Crane	0.37
Combination System	0.38

2) CY area required in Mokpo New Port

The estimated results of the CY land areas required for each handling system in Mokpo New Port are resulted as follows:

In the year of 2001, if the tractor-trailer system is adopted in Mokpo New Port, 1,021 TGSs(54,193m^2) are required. The fork-lift truck system is required 510 TGSs (36,089m^2). The straddle carrier system is required 440 TGSs(16,767m^2). The transfer crane system is required 361 TGSs(14,500m^2). In case of the combination system is needed 391 TGSs (15,292m^2)(see Table 7).

Table 7 Estimated TGSs and CY area in 2001

(unit : TGS)

Handling System	Export	Import	Empty	Total	CY Area(m^2)
Tractor-Trailer	424	421	176	1,021	54,193
Fork-Lift Truck	282	169	59	510	36,089
Straddle Carrier	212	169	59	440	16,767
Transfer Crane	170	141	50	361	14,500
Combination System	163	169	59	391	15,292

In the year of 2006, the CY areas required for each container handling system are as follows: 2,795 TGSs(148,355m^2) for the tractor-trailer system, 1,396 TGSs (98,796m^2) for the fork-lift truck system, 1,202 TGSs(45,805m^2) for the straddle carrier system, 986 TGSs (39,605m^2) for the transfer crane system, and 1,085 TGSs(42,435m^2) for the combination system. The shortages comparing with the CY area in the year of 2001 will be reached to 94,162m^2 for the tractor-trailer system, 62,707m^2 for the fork-lift truck system, 29,038m^2 for the straddle carrier system, 25,105m^2 for the transfer crane system, and 27,143m^2 for the combination system(see Table 8).

Table 8 Estimated TGSs and CY area in 2006

(unit : TGS)

Handling System	Export	Import	Empty	Total	CY Area(m^2)
Tractor-Trailer	1,160	1,156	479	2,795	148,355
Fork-Lift Truck	774	463	159	1,396	98,796
Straddle Carrier	580	463	159	1,202	45,805
Transfer Crane	464	385	137	986	39,605
Combination System	464	462	159	1,085	42,435

In the year of 2011, the CY areas required for each container handling system are as follows: 4,734 TGSs(251,274m^2) for the tractor-trailer system, 2,402 TGSs (169,992m^2) for the fork-lift truck system, 2,069 TGSs(78,845m^2) for the straddle carrier system, 1,697 TGSs (78,845m^2) for the transfer crane system, and 1,869 TGSs(73,098m^2) for the combination system. The shortages comparing with the CY area in the year of 2006 will be reached to 102,919m^2 for the tractor-trailer system, 71,196m^2 for the fork-lift truck system, 33,040m^2 for the straddle carrier system, 28,559m^2 for the transfer crane system, and 30,663m^2 for the combination system (see Table 9).

Table 9 Estimated TGSs and CY area in 2011

(unit : TGS)

Handling System	Export	Import	Empty	Total	CY Area(m^2)
Tractor-Trailer	1,921	1,988	825	4,734	251,274
Fork-Lift Truck	1,332	795	275	2,402	169,992
Straddle Carrier	999	795	275	2,069	78,845
Transfer Crane	799	663	235	1,697	68,164
Combination System	799	795	275	1,869	73,098

In the year of 2016, the CY areas required for each container handling system are as follows: 5,185 TGSs(275,212m^2) for the tractor-trailer system, 2,684 TGSs(189,950m^2) for the fork-lift truck system, 2,313 TGSs(88,143m^2) for the straddle carrier system, 1,896 TGSs (76,158m^2) for the transfer crane system, and 2,090 TGSs(81,741m^2) for the combination system. The shortages comparing with the CY area in the year of 2011 will be reached to 23,938m^2 for the tractor-trailer systam, 19,958m^2 for the fork-lift truck systam, 9,298m^2 for the straddle carrier system, 7,994m^2 for the transfer crane system, and 8,643m^2 for the combination system (see Table 10).

Table 10 Estimated TGSs and CY area in 2016

(unit : TGS)

Handling System	Export	Import	Empty	Total	CY Area(m^2)
Tractor-Trailer	2,232	2,313	640	5,185	275,212
Fork-Lift Truck	1,487	890	307	2,684	189,950
Straddle Carrier	1,116	890	307	2,313	88,143
Transfer Crane	893	741	262	1,896	76,158
Combination System	893	890	307	2,090	81,741

5. Conclusion

This paper has empirically calculated the required CY area from the time of opening the container terminal to 2016 year in Mokpo New Port. Based on these results, the following CY areas for each container handling system are obtained.

1) In the year of 2001, at the time of opening the Mokpo container terminal, the CY areas required are as follows: 54,193m^2 for the tractor-trailer system, 36,089m^2 for the fork-lift truck system, 16,767m^2 for the straddle carrier system, 14,500m^2 for the transfer crane system, and 15,292m^2 for the combination system.

2) In the year of 2006, the shortages comparing with the CY area in the year of 2001 will be reached to 94,162m^2 for the tractor-trailer system, 62,707m^2 for the fork-lift truck system, 29,038m^2 for the straddle carrier system, 25,105m^2 for the transfer crane system, and 27,143m^2 for the combination system.

3) In the year of 2011, the shortages comparing with the CY area in the year of 2006 will be reached to 102,919m^2 for the tractor-trailer system, 71,196m^2 for the fork-lift truck system, 33,040m^2 for the straddle carrier system, 28,559m^2 for the transfer crane system, and 30,663m^2 for the combination system.

4) In the year of 2016, the shortages comparing with the CY area in the year of 2011 will be reached to 23,938m^2 for the tractor-trailer system, 19,958m^2 for the fork-lift truck system, 9,298m^2 for the straddle carrier system, 7,994m^2 for the transfer crane system, and 8,643m^2 for the combination system.

The most efficient method in view of land utilization is the transfer crane system, because of its high stacking capability, also because it can span a number of container rows, avoiding the need for wide aisles.

요 약

우리나라 서남권역의 거점 항만으로서 역할을 해 온 목포항은 황해경제권의 중심에 위치하여 대중국 교역 및 TCR과의 연결에 유리한 지리적 이점을 갖고 있다. 또한 세계경제의 성장축이 환태평지역으로 이동할 것으로 예상되고, 황해경제권의 부상에 따라 이 지역의 역내교역 컨테이너 물동량의 증가가 예상되며, 주변 공단의 조성과 활성화가 가시화될 때 목포항의 역할과 기능이 크게 부각될 것으로 전망된다.

이러한 목포항 주변 환경의 변화에 따라 정부에서는 목포신외항 1단계 사업으로 2001년까지 30,000 DWT급 선박이 접안할 수 있는 컨테이너부두 1선석과 다목적부두 1선석을 건설하고 있다. 컨테이너 터미널 개장 초기에는 1선석만을 컨테이너 터미널로 사용하나 장기적으로는 2선석 모두 컨테이너 물동량을 처리할 예정이다.

본 연구는 2001년에 개장되는 목포신외항의 컨테이너 터미널 운영시스템에 따른 적정한 CY 소요면적을 산정하는 데 그 목적이 있다.

컨테이너 터미널의 계획 및 설계 단계에서 고려하여야 할 중요한 항목 중의 하나는 터미널 운영시스템의 선정에 따라서 터미널의 소요면적이 크게 달라진다는 점이다. 컨테이너 터미널의 CY 소요면적은 예상되는 컨테이너의 장치수요량과 장치기간에 의하여 크게 영향을 받게 되며, 또한 CY에서 사용되는 컨테이너 취급장비에 따라서 적재단수가 다르기 때문에 어떠한 운영시스템을 선정하는가에 따라서 CY 소요면적은 크게 다르게 된다.

따라서, 본 연구에서는 CY 소요면적 산정에 영향

을 미치는 주요한 요소들을 고려하여 2001년에 개장되는 목포신외항 컨테이너 터미널에 있어서 2001~2016년까지의 기간동안 각 컨테이너 터미널 운영시스템에 따른 CY 소요면적을 산정하였다. 그리고 목포신항만의 터미널 운영시스템별 CY 소요면적을 결론 부분에 요약하였다.

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