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Research paper

Analysis of Mobile Crane and Crawler Crane Lift Capacity In Steel Box Girder Type Bridge Construction

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ABSTRACT

Purpose: The causes of work accidents in the erection process are overloading of crane capacity, operational errors, equipment conditions, and planning problems. Operation of a crane that is not in accordance with its capacity has a high chance of causing work accidents. The purpose of this study is to analyze the lifting load, determining the type and capacity of a safe crane, and the bearing capacity of the soil in the crane pad area as an optimization of the box girder steel erection process to improve work safety.

Methods/Design: This research method uses a quantitative descriptive approach. Primary data collection is based on surveys. Secondary data is obtained from testing, project documents, and literature. The independent variables of this study are lifting load, lifting angle, and crane radius.

Findings: In the calculation, the crane lifting load is 126.12 tons divided into 2 tandems so that the load is 63.1 tons. From the analysis of the 250T crane, it is known that the length of the crane boom is 24.4 meters and the working radius is 12 meters with an angle of 65 °, so the lifting capacity of the 250 T crane is 90 tons, with a load capacity rating of 73% and a safety factor of 1.4. While the analysis of the 360T crane, the length of the crane boom is 31 meters and the working radius is 12 meters with an angle of 60 °, so the lifting capacity of the 360T crane is 87 tons, with a load capacity rating of 75% with a safety factor of 1.3. Thus, it has exceeded the ASME 30.5 safety factor standard of at least 1.3.

Practical implication: With the existence of mature calculations related to lifting study cranes, it is hoped that work safety and the success of bridge erection can be improved and construction activities can run efficiently and effectively.

INTRODUCTION

Work accidents during lifting activities during bridge erection using cranes are a serious problem in construction. Lifting crane is the process of using a crane to lift, move, or lower a load. Accidents that occur in this process can be fatal, harming crane operators, workers, and infrastructure. In addition, these accidents can cause major damage to heavy equipment and the load being lifted. According to BPJS Ketenagakerjaan data, work accidents were recorded at 110,285 cases in 2015, decreasing to 101,367 cases in 2016, but increasing significantly thereafter. In 2017, there were 123,040 cases, and in 2018 it jumped to 173,415 cases. In 2019, the number reached 182,835 cases. Since the pandemic in 2020 to 2022, the number of accidents has continued to increase, with 221,740 cases in 2020, 234,270 cases in 2021, and 265,334 cases until November 2022.

The erection process using crane service is high-risk because it involves lifting heavy loads. Erection cranes play a vital role in the assembly and installation of structural elements in construction projects, significantly impacting project timelines, costs, and safety. These cranes are essential for lifting and placing heavy components such as steel structures, precast concrete elements, and large mechanical equipment (Sadeghi et al, 2021). Accidents can occur due to crane overloading or inadequate ground support, such as the Steel Box Girder (SBG) erection project at the Teleng Bridge, which causes land subsidence and increases the risk of accidents. Operator errors, such as incorrect lifting angle settings or damaged equipment, also increase the risk of accidents. Poor planning, inappropriate crane selection, and external factors such as bad weather can worsen the situation, increasing the risk of work accidents.

Despite safety regulations, work accidents often occur due to lack of awareness and understanding of safety in the field. Workers who are not properly trained in K3 procedures can trigger accidents. Accidents can cause losses of material, time, and human resources, even fatalities. The risk increases due to the wide working radius of the crane and the potential for falling or rolling loads. In addition, workers near the crane are also exposed to danger, so protection and safe zones are very important.

Crane lifting operations are critical activities across various industries, including construction, manufacturing, logistics, and ports. The efficiency, safety, and reliability of crane operations directly impact project productivity, operational costs, and the potential for workplace accidents (Zhang & Pan, 2020). Crane lifting activities in erection projects are very crucial and involve heavy equipment and high costs. Selecting the appropriate crane type heavily depends on the characteristics of the load being lifted (weight, dimensions, shape), the conditions of the work site (workspace, ground conditions), and the required reach. Conducts a comparative analysis between various crane types such as crawler cranes, tower cranes, and mobile cranes in the context of high-rise construction projects, considering factors like cost, lifting capacity, and ease of mobilization (Hussein & Zayed, 2021)

Minister of Manpower Regulation No. 38 of 2016 and No. 9 of 2010 emphasize the importance of dividing responsibilities in the Occupational Health and Safety (K3) system, which involves operators, supervisors, and company management. K3 supervisors have an important role in ensuring that heavy equipment operations, such as cranes, comply with safety standards to prevent accidents. Careful and systematic planning is crucial in lifting crane operations, following regulations and technical standards such as the Association Society Mechanical Engineering (ASME) 30.5. In the Teleng Bridge erection project, a lifting study analysis is needed to determine the crane capacity, safe crane types, and the bearing capacity of the soil for the crane foundation, in order to ensure a safe and smooth erection process.

This final project aims to provide solutions to problems in the implementation of Steel Box Girder (SBG) erection on the Teleng Bridge, with a focus on the analysis of lifting loads, safe crane types and capacities, and soil bearing capacity. The goal is to optimize the erection process, prevent land subsidence on the crane pad, reduce the risk of accidents, and improve the smoothness of implementation. The methods used include lifting study analysis and back fill soil bearing capacity analysis.

METHODS/DESIGN

This study uses a quantitative descriptive approach to analyze problems and achieve research objectives by utilizing statistical data. Data is obtained through field observation and testing, then analyzed to produce figures that solve the problems faced, which are the focus of the study. This method was chosen because it is considered the most appropriate for obtaining solutions based on field data that can solve problems during project implementation.

This research was conducted at the Callender Hamilton (CH) Teleng Bridge Construction project, on Jalan Pacitan-Wonogiri, Sidoharjo, Pacitan, East Java. The time interval for implementing this research was carried out from January to July 2023. Data collection was carried out before the analysis to obtain existing data at the project location. This activity was carried out by visiting the CH Teleng Bridge replacement project, Pacitan, East Java.

The data collected is divided into primary data, which is obtained through visits, direct reviews, and testing at the project location. Primary data includes Dynamic Cone Penetration (DCP) and California Bearing Ratio (CBR) value data, Total Steel Box Girder (SBG) weight data. Secondary data includes SBG profile project drawings, embankment work methods, erection work methods, heavy equipment specification data, and Healthy Safety Engineer (HSE) data.

Data analysis is a research stage in the systematic and directed compilation and calculation of quantitative data that has been previously obtained from surveys, field testing, and interviews with related parties as well as sorting and selecting the data needed. Thus, in the end, the implementation and conclusions will be obtained which are expected to be solutions and alternatives for solving problems in the field. The following are research data analysis techniques: (1) Data collection; (2) Data cleaning; (3) Data exploration and organization; (4) Data analysis; (5) Interpretation of results; (6) Decision making; (7) Reporting results; (8) Analysis validation; (9) Reflection, improvement, conclusion.

In the implementation of research, it must be arranged systematically and directed with clear objectives and limitations in accordance with the research method. The following are the stages of implementing this research: (1) Planning includes the preparation of a research design, selection of research subjects, field observations, determination of research objects; (2) Implementation by collecting information through field testing and direct interviews with related parties in the project. This data collection focuses on the Teleng Bridge SBG erection process to optimize the methods used; (3) Data analysis includes justification of work methods, calculation of lifting loads, determination of tools and their capacities, analysis of soil bearing capacity, analysis of lifting studies, erection implementation plans, safety equipment and signs, operator, technician, and rigger checklists, and heavy equipment checklists; (4) Report writing. The erection method with a service crane is a stage of a project that has a relatively large value in the S-curve of work and project budget. With relatively large risks and opportunities for failure. The sanctions received if there is a failure and work accident during the erection process are very large. Therefore, this study was conducted to optimize the method and find alternative solutions related to problems during the SBG with a service crane. The implementation of this study is to optimize the erection method with a service crane so that it is more effective, efficient, and optimal. Thus, it will minimize construction failure and work accidents, especially in erection activities with a tandem service crane method.

FINDINGS

A. Lifting Load Analysis

The calculation of the lifting load from the crane is carried out before the process of determining the type and capacity of the crane. The lifting load consists of the SBG load, the rigging equipment load (sling) and the hook weight (schakle). The lifting procedure using a crane service is contained in the Regulation of the Minister of Manpower of the Republic of Indonesia Number 8 of 2020 concerning Occupational Safety and Health (K3) for Lifting Equipment and Transport Equipment, where the Permenaker standard has a minimum breaking load safety factor standard for the use of rigging. The calculation of the lifting load for the Teleng SBG erection work, Pacitan is in attachment 1. The following is a picture of the SBG Teleng Bridge spanning 60 meters.

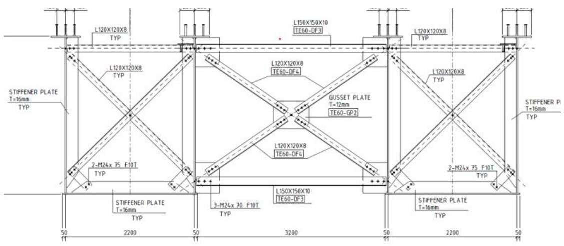

Figure 1. Transverse View of SBG
(Source: Bukaka Teknik Utama)

Based on the lifting load that has been calculated in attachment 1, the total weight on the SBG line 1 is 114.65 tons and the total weight on the SBG line 2 is 112.40 tons. This difference in total weight is due to the difference in the metal deck components installed on the SBG. With the addition of impact load of 10% of the total weight of SBG, the weight of SBG on line 1 becomes 126.12 tons and SBG on line 2 becomes 123.64 tons. Thus, the largest weight is taken for the calculation of crane capacity, which is 126.12 tons. The method used is the tandem method using 1 mobile crane, 1 crawler crane, and 1 set of head tractor with prime over multi axle. Then the weight is divided into 2 tandems so that the weight of each tandem/crane load is 63.1 tons.

Table 1. Additional Load Weight

Rigging	**Weight (ton)**	**Description**
Slings	0.300	4 pcs dia. 52 mm IWRC 6x36 *thimble eye*
Shackles	0.092	4 pcs @ 35 T Crosby (tipe g-213)
Master link		
Crane components	1.930	*Capasitas* 160 T *hook block*
Total weight	2.32	Additional burden

The sling on the crane used with the tandem method for both crane 1 and crane 2 is 4 pcs Ø52 mm IWRC 6x36 thimble eye weighing 0.3 tons. While the shackle used is 4 pcs. @ 35 T crosby (Type g-213) weighing 0.092 tons. For the hook block on each crane is installed with a capacity of 160 tons weighing 1.93 tons. Thus the total weight of the sling and shackle per crane is 2.32 tons.

B. Crane Type and Capacity Analysis

Minimum safety factor standards are usually determined based on crane load ratings regulated by standards such as ASME B30.5. This standard provides clear guidelines on the maximum lifting capacity of a crane under various operational conditions, including the weight lifted, distance, and speed of the crane movement. The importance of this calculation is to ensure that lifting operations are carried out safely and in accordance with applicable safety regulations. By complying with the minimum safety factor standards set, the risk of failure or accident during lifting can be significantly minimized.

Table 2. Type of Crane Mounting

Type of Crane Mounting	**Max. Load Ratings %**
Locomotive, without outrigger support:	
Booms 60 ft (18m) or less	85
Booms over 60 ft (18m)	85
Locomotive, using outriggers fully extended and set	80
Crawler, witout outrigger support	75
Crawler, using outriggers fully extended and set	85
Wheel mounted, without outrigger support	75
Wheel mounted, using outriggers fully extended and set, with tires off supporting surface	85
Wheel mounted, using outriggers beams partially extended and set, with tires off supporting surface	85
Commercial truck vehicle mounted, with outrigger extended and set	85
Commercial truck mounted, using outrigger partially extended and set	85

(Source: ASME. 30. 5)

Selection of the right equipment based on specifications Selection of appropriate equipment based on job specifications and functions will ensure that the work goes according to plan. A 75 T mobile crane is used for the assembly process between 5 box girders with a span of 12 meters into 1 line Steel Box Girder (SBG) with a span of 60 meters. This service crane is a type of crawler crane and does not use outrigger support in lifting activities. So it can be seen that the standard safety factor is 100% divided by 75%. For the results of the safety factor that has been calculated, it produces a safety factor of 1.3% so that the crane is in a safe position. The lifting capacity of the crane can be found using the liftcrane capacities table. Based on the analysis, it is known that the length of the crane boom is 18.3 meters and the working radius of the crane is 6 meters. From this data, the lifting capacity of the service crane is 33,550 tons.

Table 3. Mobile Crane Safety Factor Calculation

Spesification	Value	Description
Boom length	18.30	Meters
Working radius	6.00	Meters
Lifting capacity (d1)	33.50	Tons
Lifting calculation		
Weight of component (a)	24.20	Tons
Lifting point	1.00	Meter from SBG end
Lifting weight (a1)	24.00	Tons
Rigging		
Slings	0.021	4 pcs ø32 mm IWRC 6x36 thimble eye
Shackles	0.078	4 pcs @ 17 T Crosby (tipe g-213)
Master link		
Crane components	1.358	Capasity 50 T hook block
Total weight (b1)	1.46	Tons
Safety Factor Calculation		
Total lift weight (c1) = (a1) + (b1)	25.66	Meters
Lifting capacity (d1)	33.50	Meters
Load capacity rating (e1) = (c1/(d1)	77%	Meters
Safety factor (d1/c1)	1.3	ASME 30.5 min. 1.3 OK

Based on the calculation regarding the crane capacity, it has met the lifting capacity ratio of 77% with a safety factor of 1.3.

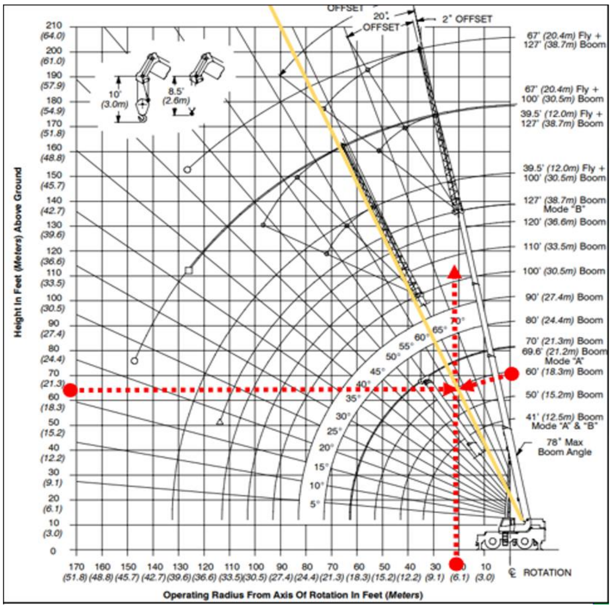

Figure 2. Boom Mobile Crane Service Area
(Source: Crane Market, 2023)

The crane service radius is 6 meters, the boom length is 18.3 meters, based on the graph it can be concluded that the crane service angle is 62.5 °.

The 250T crawler crane is in the abutment area 1. Lifting capacity can be found by looking at the lift crane capacities table as follows with a counterweight of 97.1 tons and a carbody weight of 20 tons. From the analysis of the 250T crane, it can be seen that the length of the crane boom is 24.4 meters and the working radius is 12 meters, so it can be seen that the lifting capacity for the 250 T crane is 90 tons.

According to the lifting plan calculation guidelines, there are two stages to obtain the lifting safety factor calculation, namely the crane safety factor calculation and the sling safety factor calculation. To calculate the crane safety factor, divide the lifting capacity by the total weight for lifting. Based on the calculation in point 1, it is known that the standard safety factor is 1.3% and for the 250T crawler crane, the safety factor is 1.4 so that the crane is in a safe position.

Table 4. Crawler Crane Safety Factor Calculation

Spesification	Value	Description
Boom length	24.40	Meters
Working radius	12.00	Meters
Lifting capacity (d1)	90.00	Tons
Lifting calculation		
Weight of component (a)	126.00	Tons
Lifting point	1.00	Meter from SBG end
Lifting weight (a1)	63.00	Tons
Rigging		
Slings	0.300	4 pcs ø32 mm IWRC 6x36 thimble eye
Shackles	0.092	4 pcs @ 17 T Crosby (tipe g-213)
Master link		
Crane components	1.930	Capasity 50 T hook block
Total weight (b1)	2.32	Tons
Safety Factor Calculation		
Total lift weight (c1) = (a1) + (b1)	65.32	Meters
Lifting capacity (d1)	90.00	Meters
Load capacity rating (e1) = (c1/(d1)	73%	Meters
Safety factor (d1/c1)	1.4	ASME 30.5 min. 1.3 OK

Based on the calculation regarding the crane capacity, it has met the lifting capacity ratio of 73% with a safety factor of 1.4. The following is the crawler crane boom area:

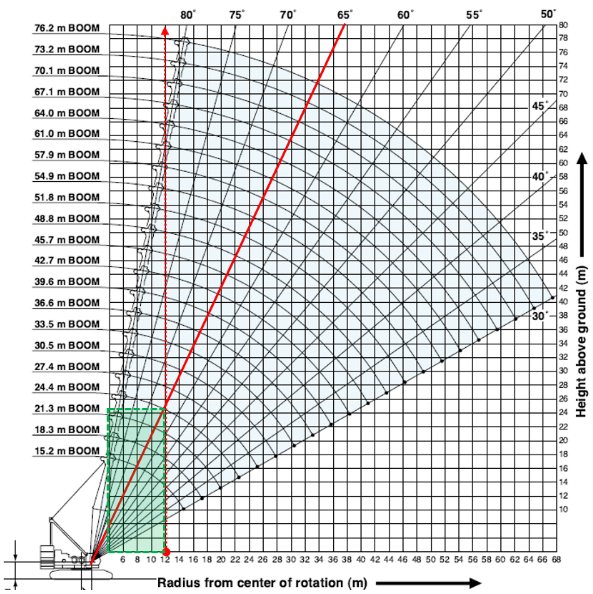

Figure 3. Crawler Crane Boom Area
(Source: Crane Market, 2023)

The radius of the 250 ton crane is 12 meters, the boom length is 24.4 meters, based on the graph it can be concluded that the angle of the 250T crane is 65 °.

The 360T crawler crane is in the A2 abutment area. Lifting capacity can be found by looking at the lift crane capacities table as follows. From the analysis of the 360 ton crane, it can be seen that the length of the crane boom is 31 meters and the working radius is 12 meters, so it can be seen that the lifting capacity is 87 tons.

Table 5. All-Terrain Mobile Crane Safety Factor Calculation

Spesification	**Value**	**Description**
Boom length	31.00	Meters
Working radius	12.00	Meters
Lifting capacity (d1)	87.00	Tons
<u>Lifting calculation</u>		
Weight of component (a)	126.00	Tons
Lifting point	1.00	Meter from SBG end
Lifting weight (a1)	63.00	Tons
<u>Rigging</u>		
Slings	0.300	4 pcs ø32 mm IWRC 6x36 thimble eye
Shackles	0.092	4 pcs @ 17 T Crosby (tipe g-213)
Master link		
Crane components	1.930	Capasity 50 T hook block
Total weight (b1)	2.32	Tons
<u>Safety Factor Calculation</u>		
Total lift weight (c1) = (a1) + (b1)	65.32	Meters
Lifting capacity (d1)	87.00	Meters
Load capacity rating (e1) = (c1/(d1)	75%	Meters
Safety factor (d1/c1)	1.3	ASME 30.5 min. 1.3 OK

Based on calculations regarding the crane capacity, it has met the lifting capacity ratio of 75% with a safety factor of 1.3. The following is the boom area of the all-terrain crane:

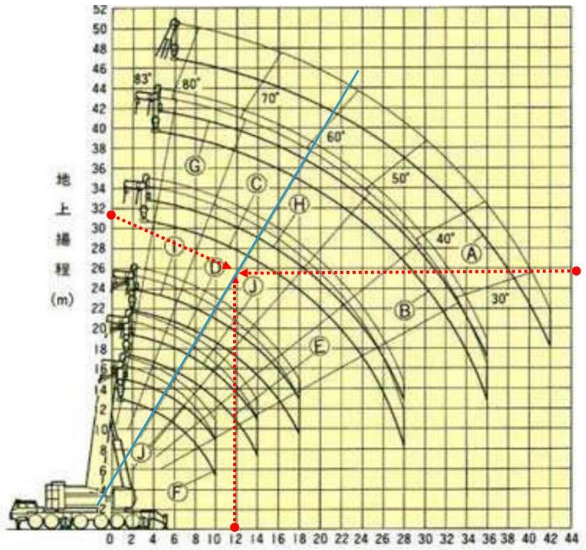

Figure 4. Boom Area of the All-Terrain Crane

C. Lifting Steel Box Girder

The safe capacity of mobile cranes, all terrain cranes and crawler cranes for lifting steel box girders based on the analysis of the lifting study that has been carried out with a total load received by the crane of 65.42 tons is a mobile crane with a capacity of 360 tons and a crawler crane with a capacity of 250 tons. According to the lifting plan calculation guidelines, there are two stages to obtain the lifting safety factor calculation, namely the crane safety factor calculation and the sling safety factor calculation.

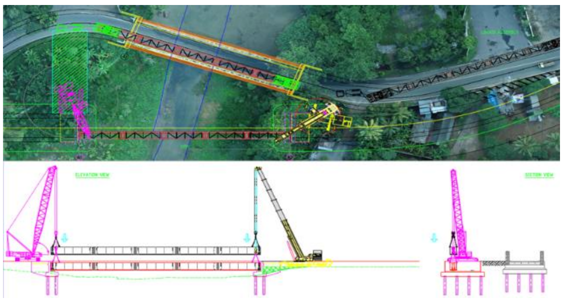

Figure 5. Tandem Method Erection Plan

Based on the calculation, it is known that the standard safety factor based on the maximum load ratings according to the type of crane mounting is 1.3. For a 250-ton crawler crane, it has a lifting capacity of 90 tons and a total load of 65.32 tons, so the lifting ratio is 73% and the safety factor is 1.4. A 360-ton mobile crane has a capacity of 87 tons and a total load received of 65.32 tons, so the lifting ratio is 75% and the safety factor is 1.3. Thus all cranes are in a safe position because they have exceeded the safety factor standard.

D. Analysis of Land Bearing Capacity

Before the equipment for the SBG erection process is mobilized to the location, crane land preparation must be carried out, namely through land filling and compaction. This filling and compaction are important things regarding the success and smoothness of the erection process. The procedure for making crane pads and multi axle pads in the back fill area with fill material for the Teleng Bridge SBG erection is to excavate the soil until a California Bearing Ratio (CBR) of 6% is obtained. Filling with 30 centimeter thick concrete blocks. Filling with 30 centimeter thick limestone compacted to a CBR of 40%.

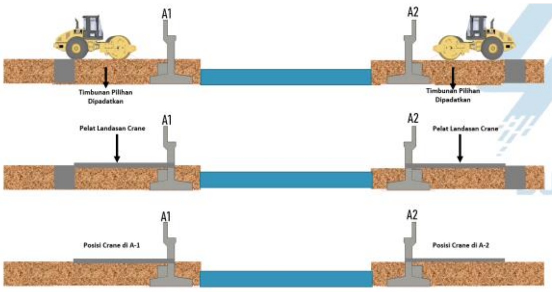

Figure 6. Visualization of Crane Land Preparation Stage

Based on the table of CBR A1 and CBR A2 test results, the CBR test results on land A1, the CBR value of the DCP test results is 45%. The soil density for A1 is 30 tons/m^2. Thus, the soil on land A1 has very good strength, with a CBR value of more than 40% and sufficient density to support the crane load. Then in A1, the CBR value of the DCP test results is 61.5%. The soil density on A2 exceeds 30 tons/m^2, approximately 40 tons/m^2. Thus, the soil on land A2 has good strength, with a CBR value meeting a minimum of 40% and sufficient density to support the use of the crane.

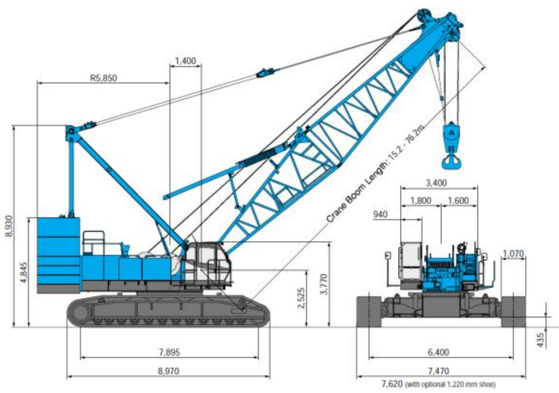

Figure 7. Detailed Specifications of the Kobelco 7250
(Source: Crane Market, 2023)

The crane weighs 211 tons with a lifted load of 63 tons, so the total weight is 274 tons. The runway area is 8.97x7.47, an area of 67.01 m2. The pressure received by the ground is 274 tons divided by an area of 67.01 m2, a value of 4.089 tons/m2. The minimum CBR allowable stress is 40% equivalent to 30 tons/m2 so that the soil supports.

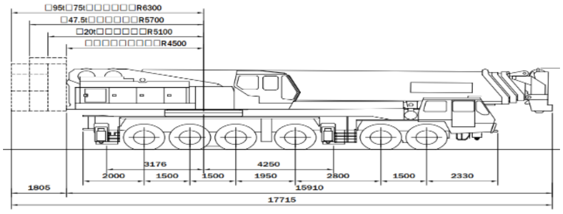

Figure 8. Kato NK3600 Specification Details
(Source: Crane Market, 2023)

The crane weighs 213 tons with a lifted load of 63 tons, so the total weight is 276 tons. The runway area is 11.25x9.2, an area of 104.07 m2. The pressure received by the ground is 276 tons divided by an area of 104.07 m2, a value of 2.652 tons/m2. The minimum CBR allowable stress is 40% equivalent to 30 tons/m2 so that the soil supports.

Table 5. CBR Values GBP Capacity

CBR (%)	**GBP *Capacity***		
100	80.74 Psi	551.54Kpa	55Ton/m^2
90	75.28 Psi	514.27Kpa	51Ton/m^2
80	69.62 Psi	475.59Kpa	47Ton/m^2
70	63.71 Psi	435.23Kpa	43Ton/m^2
60	57.51 Psi	392.89Kpa	39Ton/m^2
50	50.95 Psi	348.09Kpa	34Ton/m^2
40	43.94 Psi	300.15Kpa	30Ton/m^2
30	36.29 Psi	247.96Kpa	24Ton/m^2
20	27.73Psi	189.43Kpa	18Ton/m^2
10	17.50 Psi	119.55Kpa	11Ton/m^2

Based on the CBR GBP Cap table, the pressure value received by the soil at abutment 1 is 4.089 tons/m2 and at abutment 2 is 2.652 tons/m2 so it is less than 30 tons/m2 (permissible CBR soil stress) and has exceeded the DCP test value that has been carried out. Thus, the crane runway has met the technical specifications so that the erection process at abutment 1 and abutment can be carried out.

D. Discussion

1. Total weight on SBG line 1 114.65 tons and total weight on SBG line 2 112.40 tons, the difference in total weight is due to the difference in metal deck components installed on SBG. With the addition of impact load of 10% of the total weight of SBG, the weight of SBG on line 1 becomes 126.12 tons and SBG on line 2 becomes 123.64 tons. Thus, the largest weight is taken for the calculation of crane capacity, which is 126.12 tons. The method used is the tandem method using 1 mobile crane, 1 crawler crane, and 1 set of head tractor with prime over multiaxe. Then the weight is divided into 2 tandems so that the weight of each tandem/crane load is 63 tons. The sling on the crane used with the tandem method for both crane 1 and crane 2 is 4 pcs Ø52 mm IWRC 6x36 Thimble eye weighing 0.3 tons. While the shackle used is 4 pcs. @35 T Crosby (Type g-213) weighs 0.092 tons. For Hook block on each

crane is installed with a capacity of 160 tons with a weight of 1.93 tons. The total weight of the sling and shackle per crane is 2.32 tons. Thus the weight received on each crane is 63 tons plus the weight of the sling and shackle 2.32 tons so that the total load is 65.32 tons.

2. Determination of the type and capacity of the crane is influenced by factors, namely the load of the box girder steel and the weight of the sling and shackle of 65.42 tons. The method of SBG erection is influenced by the condition of the erection area where the tandem method is used so that it requires 1 mobile crane and 1 crawler crane. The type of crane installation also affects the crane capacity where the maximum load rating varies according to the type of crane installation. Where the crawler crane does not use outrigger support with a maximum load of 75% and the mobile crane also has a maximum load of 75%. The determination and determination of the boom and crane radius affect the angle taken by the crane and affect the lifting capacity according to the table on the lifting capacity of each crane. The crawler crane has a radius of 12 meters and a boom of 24.4 meters so that the angle is 65° and the lifting capacity is 90 tons. The mobile crane has a radius of 12 meters, a boom length of 31 meters so that the angle is 60° and the lifting capacity is 87 tons.
3. The safe capacity of the mobile crane and crawler crane to transport steel box girders with a total load received by the crane is 65.42 tons is a mobile crane with a capacity of 360 tons and a crawler crane with a capacity of 250 tons. According to the lifting plan calculation guidelines to obtain the lifting safety factor calculation, there are two stages, namely the calculation of the crane safety factor and the calculation of the sling safety factor. To calculate the crane safety factor is to divide the lifting capacity by the total weight lifted. Based on the calculation, it is known that the standard safety factor based on the maximum load rating according to the type of crane installation is 1.3. For a 250-ton crawler crane, it has a lifting capacity of 90 tons and a total load of 65.32 tons, so the lifting ratio is 73% and the safety factor is 1.4. The 360-ton mobile crane has a capacity of 87 tons and a total load of 65.32 tons, so the lifting ratio is 75% and the safety factor is 1.3. Thus, all cranes are in a safe position because they have exceeded the safety factor standard.
4. The amount of soil bearing capacity required for the crane runway is based on a minimum value of 40% or equivalent to 30 tons/m2. The results of the soil DCP test in the abutment 1 and abutment 2 areas respectively obtained values of 45% (32 tons/m2) and 61.5% (40 tons/m2), these values have exceeded the minimum DCP value of 30 tons/m2. The 250-ton crawler crane weighs 211 tons and a lifting load weight of 63 tons, so the total weight is 274 tons. The crawler runway area is 67.01 m2. The pressure received by the ground is 274 tons/67.01 m2 so that it is 4,089 tons/m2. For a mobile crane, it weighs 213 tons and the lifting load weight is 63 tons so that the total weight is 276 tons. The crawler runway area is 104.07 m2. The pressure received by the ground is 276 tons/104.07 m2 so that it is 2,652 tons/m2. Thus, the bearing capacity of the ground has been met.

PRACTICAL IMPLICATION

Based on the results of the research analysis on the analysis of the lifting capacity of mobile cranes and crawler cranes on the construction of steel box girder type bridges that have been carried out, it can be concluded:

1. Based on the calculation of the lifting load of Steel Box Girder (SBG) line 1 is 114.65 tons and the weight of Steel Box Girder (SBG) line 2 is 112.40 tons. The difference in weight occurs due to the difference in metal deck installed above the SBG. The method used is the tandem method using 1 mobile crane, 1 crawler crane, 1 all-terrain crane, 1 set of head tractors including prime over multi-axle. The lifting load per crane plus the weight of the sling and shackle becomes 65.42 tons.
2. Determination and determination of the boom and working radius of the crane affects the determination of the crane angle. The crawler crane has a radius of 12 meters and a boom of 24.4 meters so that the angle is 65o and the lifting capacity is 90 tons. All-terrain crane has a radius of 12 meters and a boom of 31 meters so that the angle is 60o and the lifting capacity is 87 tons.
3. The safety factor value of the crawler crane is 1.4 while the safety factor value of the all-terrain crane is 1.3. Thus all cranes are in a safe position because they exceed the ASME 30.5 safety factor standard with a value of 1.3.
4. The value of the soil bearing capacity on the foundation of the crawler crane and all-terrain crane based on the DCP test is 45% worth 32 tons/m2 and 61.5% worth 40 tons/m2. The value received by the soil due to the crane load and the weight of the crane on the crawler crane and all-terrain crane is 4,089 tons/m2 and 2,652 tons/m2. Thus the soil bearing capacity has been met and the erection process is safe to carry out.

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