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Beam of the overhead crane: Welding process in repair work

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Abstract
The crane is designed, manufactured in a box structure, balanced, sustainable. Materials used include steel sections, steel sheets commonly used. The link between the crane parts and details is the bolt or welded joint. Ensure that the welds are reliable, reliable and durable. Crane after manufacture, assembly finished are tested to meet the technical requirements set out. The main beam of the crane is designed in the form of a box and the letter I. It is the main force and the path of the electric palang. Depending on the lifting weights and the aperture of the crane, I match. Main girders in addition to the need to ensure durability also must ensure the hardness and elasticity, so the original beam was made available round the calculated. Rectangular box beams are made of 6-10mm thick steel plates. The two ends of the beam have a pivot linkage for mounting the crane spindle drive and are fitted with rubber elastic head to reduce the impact impulse when the crane moves to the end point of the runway. The connection between the main beam and the two side beams is achieved by means of high-strength angle weld. This article presents the structure of some types of crane and welding process for crane.

Keywords: beam, overhead crane, welding process

Introduction
On December 24, 2009, the Prime Minister issued Decision No.2190 on approval of "Planning on development of Vietnam's seaport system up to 2020 with orientation to 2030". Viet Nam attaches great importance to the development of ports capable of receiving up to 100,000 tons of sea-going ships or larger ships in the northern, central and southern regions. To build international gateway ports in Hai Phong, Ba Ria- Vung Tau and the central key economic region (when conditions permit) can receive ships of up to 100,000 tons (8,000 TEU container ships) or larger, capable to combine the container transshipment. These are seaports classified as IA in the decision approving the planning. The seaport system must ensure through the whole quantity of export and import goods and exchanges between regions and areas in the country by sea to meet the country's socio-economic development requirements according to the planning of seaport system at the planning time. In 2015, it is about 400-410 million tons per year, of which composite goods and containers are from 275 to 280 million tons per year. By 2020, the good increases from 640 to 680 million tons per year, of which composite goods, containers from 375 to 400 million tons per year. By the year 2030, the good increases from 1,040 to 1,160 million tons per year in which synthetic goods, containers from 630 to 715 million tons per year. By region, Vietnam seaport system increases up to 2020 with orientation to 2030 including six port groups. According to the Vietnam Maritime Administration, in 2014, cargo through Vietnam's seaport system was estimated at 370.3 million tons, up 14%, of which containerized cargo reached 10.24 million TEUs, up 20.1% over with 2013 and is the year to reach the highest output ever.
The northern seaport from Quang Ninh to Ninh Binh continued to grow steadily, reaching 120.3 million tons, up 13% (33% of the country). Group of seaport No.5 - The Southeastern seaport reached 162 million tons, up 14% (44%). According to the Vietnam Maritime Administration, container traffic in the area of Hai Phong reached 3.36 million TEUs, up by 20.3% in 2014; Ho Chi Minh City's area reached 4.98 million TEUs, an increase of 14.8%.

In Hai Phong port area, Dinh Vu is the biggest cargo port, followed by Hai Phong port (Hoang Dieu / Chua Ve) and other ports in Hai Phong. Meanwhile, in the city. Ho Chi Minh City, leading ports in terms of capacity, including Cat Lai, Vietnam International Container Terminal - VICT, Sai Gon Port, Phuoc Long ICD, Ben Nghe Port. Cai Mep - Thi Vai port terminal in the port of Ba Ria - Vung Tau in 2014 reached 59.3 million tons, up 20% compared to 2013, container goods alone reached 1.15 million TEUs. It is considered as a deep-water port with potential and favorable position, which can receive large vessels. However, the efficiency of port operation is low due to the connection between the port and the localities in the region, TP. Ho Chi Minh City is not synchronized. According to the master plan for the development of Vietnam's seaport system up to 2020 with a vision of 2030, by 2014 cargo throughput of Vietnamese seaports will reach 90.3% - 92.6%. out. According to the approved plan as mentioned above, the target of the industry by 2015, the cargo throughput of seaports will be about 400-410 million tons / year, of which composite goods and containers will be from 275 to 280 million tons per year. All the construction work, assembly and repairing cannot be carried away with the lifting machine. The shaft is an important device in the lifting equipment [1-3]. Especially in the warehouse, the crane plant becomes important and necessary equipment [4]. Overhead crane is widely used for loading and unloading of goods in warehouses in factory assembly and manufacturing factories [5,6]. The overhead crane is a box or platform girder, on which the car is placed with the lifting mechanism. The girders can be run on elevated rails along a car factory that can run along girders. Overhead crane is used mainly in workshops, warehouses for lifting and transporting goods in large quantities [7]. The overhead crane can be lifted and transported on demand at any point in the workshop space. There are many types of crane types as follows [8-10]:

- Overhead crane with general purpose and specialized crane
- One-beam overhead crane and two-beam crane
- Single beam overhead crane

This article discusses the method of designing the welding process for overhead crane to improve working and repairing capability at Vietnamese ports.

Beam of overhead crane

The I-beam is used in flat bending such as floor, bridge girder, and elevator beam. Asymmetrical U-shaped beams used in bending obliquely, such as beams, beams, and flat beams, are easy to connect with other details. U-shaped beams feature easy-to-make, simple bonding. The composite beams are composed of three steel plates assembled by angle welding, two horizontal plates - two beams, and straight - line - abdomen. Compared to riveted beams, less material and lighter, less costly to make, they are used more. The riveted beams consisted of a flat steel plate, a pair of beams, each of which consisted of two L-shaped steel angles, and one or two horizontal steel plates called the plates [1-4]. Because of the loss, they are costly to manufacture and use. They are used for heavy loads or dynamic loads. Composite beams feature large dimensions but save steel, costly workmanship. The main beam of the two-girder bridge is made in the form of a box or space-frame. The girder is slightly lighter than the box girder but difficult to fabricate and is usually used only for crane lifts with large load and aperture. The last beam of this crane is usually made in box form and it is associated with main beam by bushings. The bridge crane structure can be implemented in two ways: general mobility and mobility.

The method of driving the driving motor is located between the bridge girder and the transmission of motion to the active wheels on both sides of the rail by the transmission shaft, transmission axis can be slow rotation, fast rotation and rotation. Average [6]. The option to drive separately each wheel or wheel cluster is equipped a driving mechanism. The drive mechanism consists of two separate mechanisms for active wheels on each side of the rail, the power of each motor is usually 60% of the total power. The kind of overhead crane beam is shown in Figure 1, Figure 2.

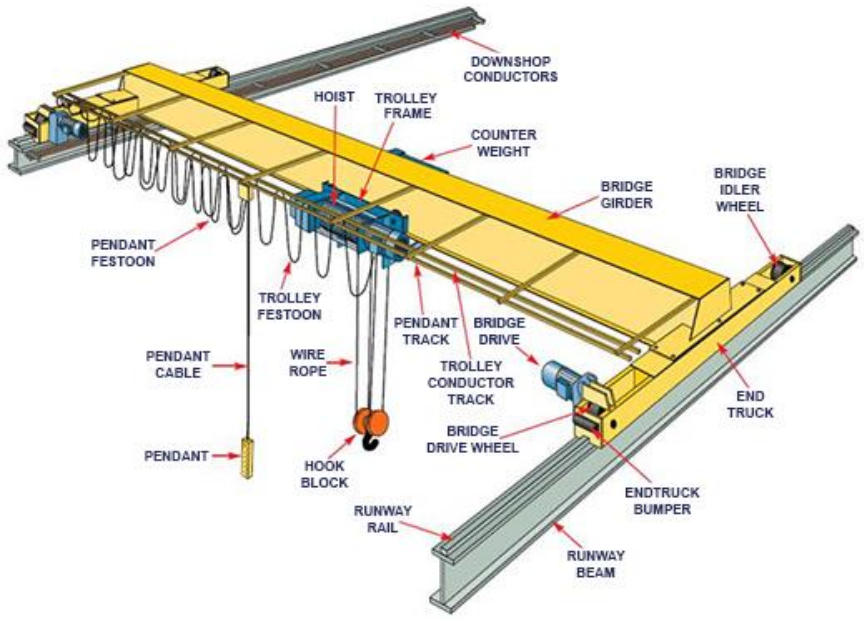

Fig. 1: Single-beam overhead crane

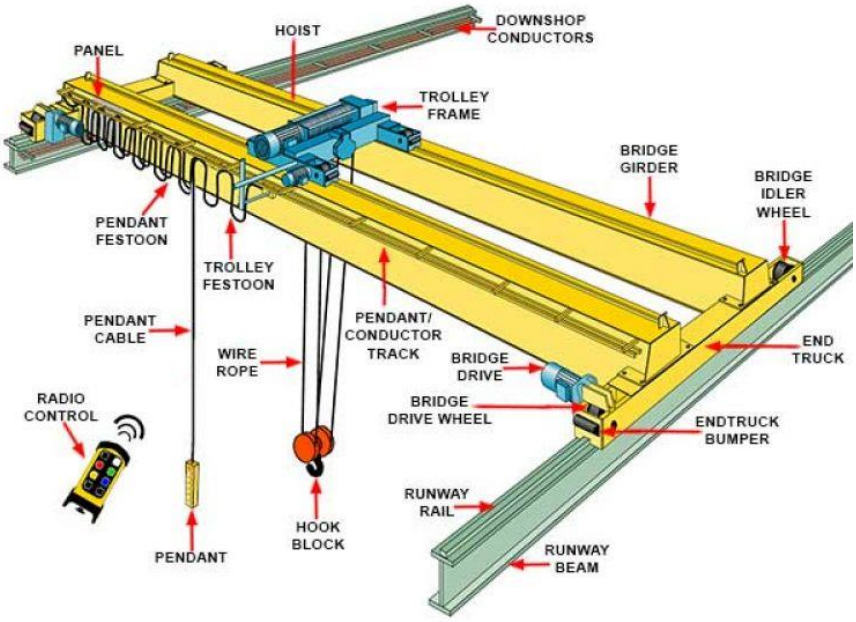

Fig. 2: Double-beam overhead crane

The welding structure is a combination of many parts in which each part has different functions and working conditions. Therefore, it is necessary to base on the technical requirements of each detail to select the basic materials to make the reasonable. The quality and cost of fabrication should be ensured. In other words, the material must ensure simultaneous economic and technical indicators. Although the details are different in size and shape, they are made of sheet steel material. Through mechanical processing to ensure the required size then put together by welding joints adjacent to the T-corner to create the structure. The size of the girder is relatively large, the work-piece is welded on many sides. The work beams are mainly subjected to the structural design of the beam, the structure of the sheet is made to ensure the mechanical indicators, high reliability as working. The load has no special requirements on the material selected for making steel beams CT 38 steel. Therefore, to ensure both durability and welding accuracy, the price is appropriate to choose the material is equal to CT38 steel. Because this type of material is commonly used in the market, it is both economical and meets the technical requirements of the structure when working. CT38 steel is a commonly quality carbon steel used in the manufacture of steel structures by welding technology. The steel is flexible, low hardness, high efficiency and low ram, so it calculates good welding. Welding need not use special technology before welding or heat treatment after welding, but the quality of welds still meets the technical requirements and welding properties are equivalent to basic welding. The chemical and mechanical composition of CT38 steel used for fabricating the overhead crane is given in Table 1 and Table 2.

Table 1: Chemical composition of CT38 steel

Steel grade	Chemical composition				
	C	Mn	Si	P	S
CT38	0,12÷0,23	0,4÷ 0,65	0,15÷0,3	< 0,045	< 0,045

Table 2: Mechanical properties of CT38 steel

Steel grade	Strength, σ_k (N/mm^2)	Tensile, σ_c (N/mm^2)
CT38	380÷ 490	240

In the production of steel billet size and the process of transporting billets is warping due to the large billet weight, transportation conditions are not favorable so need to have methods to fabricate embryos to ensure the requirements of the figure form, size required. Preparatory work for long embryos, rolls of round, banded or preformed shape before being cut into work, after half-heat treatment used in machining to reduce axial bending, resulting in uniform machining, thereby reducing the number of punches required to produce the work-piece. For bar steel rods that can be straightened in cold state by a variety of methods (hand hammers, screw presses, hydraulic presses). High diameter and large die forging blanks are usually straightened in the heated state on hammers. Accuracy and straightening productivity are dependent on the method employed. If straight on the specialized machine, the straightness is from 0.1 to 0.2 per meter in length, the productivity reached 0.8 to 1.6 meter per minute. Flat billet embryos for large size embryos can use specialized embossing machines to ensure uniform flatness.

Welding-beam process design

The durability structure depends on the durability of the welded joint. Choosing the type of welding, welding method, welding process technology will directly affect the life of the structure. Structural welding must be carried out in accordance with the approved technological process, which specifies: Welding method and welding mode; Welding equipment, tools and welding materials are allowed to be used; Sequence and fixing; The order of execution of welds in the structure; Inspection, supervision during manufacturing.

When performing beams welding and box beams, we choose welding method is automatic welding method under the class for the following reasons: This welding method ensures the welding size and chemical composition evenly throughout the course of beams. High concentrated arc temperature and high temperature allow for high speed welding. Welding quality, uniform metal welding of chemical composition is high; Welds have good shape, regular, less defects such as not drilling, gas holes, cracking and splashing; Reduced consumption of electrodes and

electricity is performed. Deformation of the bond after welding, good welding conditions, less toxic gas generation compared to manual arc welding, welding process automation may be carried out.

Structural fabrication materials are CCT38 steel, with manual arc welding process requires the use of low-hydrogen welding electrodes and welding rods must be thoroughly dried. Metal welds should ensure that the mechanical equivalent of the base metal and corrosive nature as the base metal, in addition to the same color with the base metal. According to AWS A5.1-1991, the type of welding rod used for welding low alloy structure with flat, vertical, ceiling, horizontal position. Some typical marks such as E7016 or E7018 are base welding electrodes. Low hydrogen content, supplemented with iron powder to increase fill coefficient, can be welded anywhere in any position welding by DC or alternating current. The chemical and mechanical composition of soldering stick used for welding the overhead crane is given in Table 3 and Table 4.

Table 3: Chemical composition of soldering stick E7018

Grade	Chemical composition				
	%C	%Mn	%Si	%P	%S
E7018	0,05-0,10	0,97 – 1,60	0,59 – 0,75	< 0,020	< 0,020

Table 4: Mechanical properties of soldering stick E7018

Grade	Mechanical properties			
	Minimum strength R_m(Mpa)	Minimum tensile $R_{p0,2}$	a_k(J/cm^2)	δ (%)
E7018	482	399	27	22

According to AWS standard A5.17EH14, EH14 welding wire has characteristics: EH-14 is a low carbon, low silicon manganese wires with high content of manganese, sulfur impurities and phosphorus. Good welding of metal substrates that can be combined with a variety of welding materials to produce high-specification welds. EH-14 is welded under the automatic arc-light technology under the protection layer to create stable welds, beautiful welding. Depending on the type of medicine that is typical medicine CM122 (F7A4). EH-14 is suitable for use in welding low carbon steel structures and medium manganese high impact resistant alloy. CM122 is metal oxide fluoride, in the welding process in addition to welding function, welding also has the function of defoliation of phosphorus, sulfur ... and various harmful impurities for welding. CM122 can weld DC or AC currents up to 1200A and allows high speed welding, good welding pattern, arc stability. CM122 solder is fired at a temperature of 850^{o}C, thus reducing the molten water to ensure that the weld is not porous. On the other hand, the amount of fluorine in the resin is very high, the residual capacity of the residual hydrogen in the weld is very strong, which makes the welds high resistance to impact, especially suitable for the structure working in the cold temperature. CM122 welding wires with EH 14 welding wire should be used to weld heavy duty steel structures. Welding mode is a synthesis of the basic properties of the welding process to ensure that the desired size is obtained. When calculating manual arc welding mode. We must know the basic parameters of manual arc welding. Welding mode includes the following parameters: Welding rod diameter (d_w), Welding current (I_w), Welding voltage (U_w), Welding velocity (V_w), Welding number (n), Welding number (q_w), welding depth (h), welding time (T_w). The calculation results are given in Table 5.

Table 6: The calculation results for welding process

Welding rod diameter, d_q(mm)	$d_q = \frac{S}{2} + 1$
Welding current, I_w(A)	$I_w=(\alpha+\beta.d_q).d_q$
Welding voltage, U_w(V)	$U_w=a+b.l_a$
Welding number, (n)	1
Welding velocity, V_w(cm/s)	$V_w = \frac{\alpha_d . I_w}{\gamma . F_d . 3600}$
Welding number, q_w(J/cm)	$q_d = \frac{q}{V_w} = \frac{3600 . \gamma . F_d . U_w \eta}{\alpha_d}$

Welding equipment including welding machines and welding fixtures is an important element that determines the quality of the structure and the yield of the welding process. When choosing the welding machine must be based on welding method, welding rod, the size of the parts to ensure the quality of the welding joint. Based on the above requirements, the casing speed of all the components is made of quality carbon steel. The welds are made in the PA, PB position so that the welding machine has a range of adjustable currents. wide welding. The selection of welding machines depends on the equipment of the workshop to reduce the cost of the product. Choosing the design of the fixture, attention should be paid to the elements such as fast and accurate assembly, the most suitable fitting sequence. Sufficient strength and rigidity to ensure accurate clamping of parts in the position required and limited distortion generated during welding is minimal, easy operation, easy inspection of parts when assembled and during welding, the number of welds is the least, and safety in the work process.

Conclusion

Overhead crane is a type of equipment that ensures the lifting and moving of goods in the workshop. It is very convenient and highly efficient in the loading and unloading of goods, with a lifting capacity of 1 to 500 tons, operated mainly by electric motors, which are widely used in industrial plants. In this article, material selection and welding process design for beam girder have been made. Here, the selection of the abdominal size, wing, weld size to ensure technical requirements, in addition to the choice must ensure both aesthetic. The results of this paper contribute to improving the efficiency of maintenance and repair work at Vietnamese ports, thereby enhancing the operation of port facilities.

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