International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 02 – Issue 10 || October 2017 || PP. 84-90

Design the welding process for beam of the overhead crane

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Abstract: Overhead cranes are used to aid in the building and repair of machines and materials, particularly within factories, and any well-outfitted fabrication shop will have them at their disposal. An overhead crane runs on rails attached to ceiling beams laid out as parallel runways. The moving section, known as the trolley, includes a hoist, which lifts objects. The trolley, which is carried by a bridge that is perpendicular to the rails, is attached to a wire rope hoist, which allows for easy load handling and safe operation. These machines are such a common site in fabrication shops today that it is difficult to imagine the industry without them. The paper present the overhead crane structure and welding methods for repair of overhead crane. The paper results will be used to improve the operation of port in Vietnam.
Keywords: overhead crane, welding, repair, beam

1. 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". Six seaports of Vietnam seaport system, with three seaports of type 1A and 11 seaports of type I. The port system was also invested, before 2007 the country had only 40 kilometers, and the cargo through port was 181 million. After 5 years of implementing the sea strategy, the whole country has added 5km of wharf, bringing the total length of the wharf to 45km and total cargo through the port of over 259 million tons. Currently investing in infrastructure of 3 ports of type A1 with total investment capital, including Van Phong international transit port, Vung Tau international gateway port and Lach Huyen international gateway port. The start-up phase and the investment project to build bridges and bridges connecting Tan Vu - Lach Huyen (Hai Phong) have been upgraded, expanded, and invested to develop in - depth equipment of general ports, specialized ports, focal point. In addition, it will develop a network of wharves in eleven areas. In addition, the construction of the Northern Shipbuilding Equipment Infrastructure System and the relocation of Ba Son Shipyard were completed. However, in general, our seaports are still weak. In ports, there are only three ports (Ho Chi Minh City, Da Nang, Hai Phong) in the list of 539 international seaports.

On the other hand, the repair and overhaul of old machines after a long time of use is accelerated. 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.

2. Overhead crane and beam of overhead crane

The I-beam is used in flat bending such as floor, bridge girder, 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 and 3.

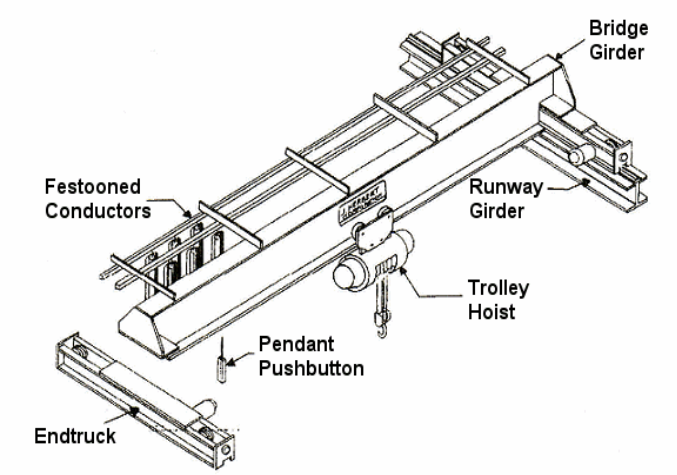

Figure 1. Single-beam overhead crane

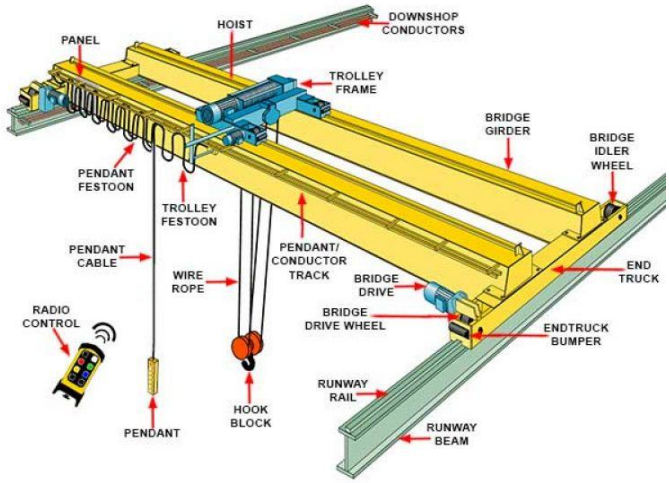

Figure 2. Double-beam overhead crane

Figure 3. Wall-relied-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.

3. 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. The structure for welding preparation of beam is shown in Figure 4.

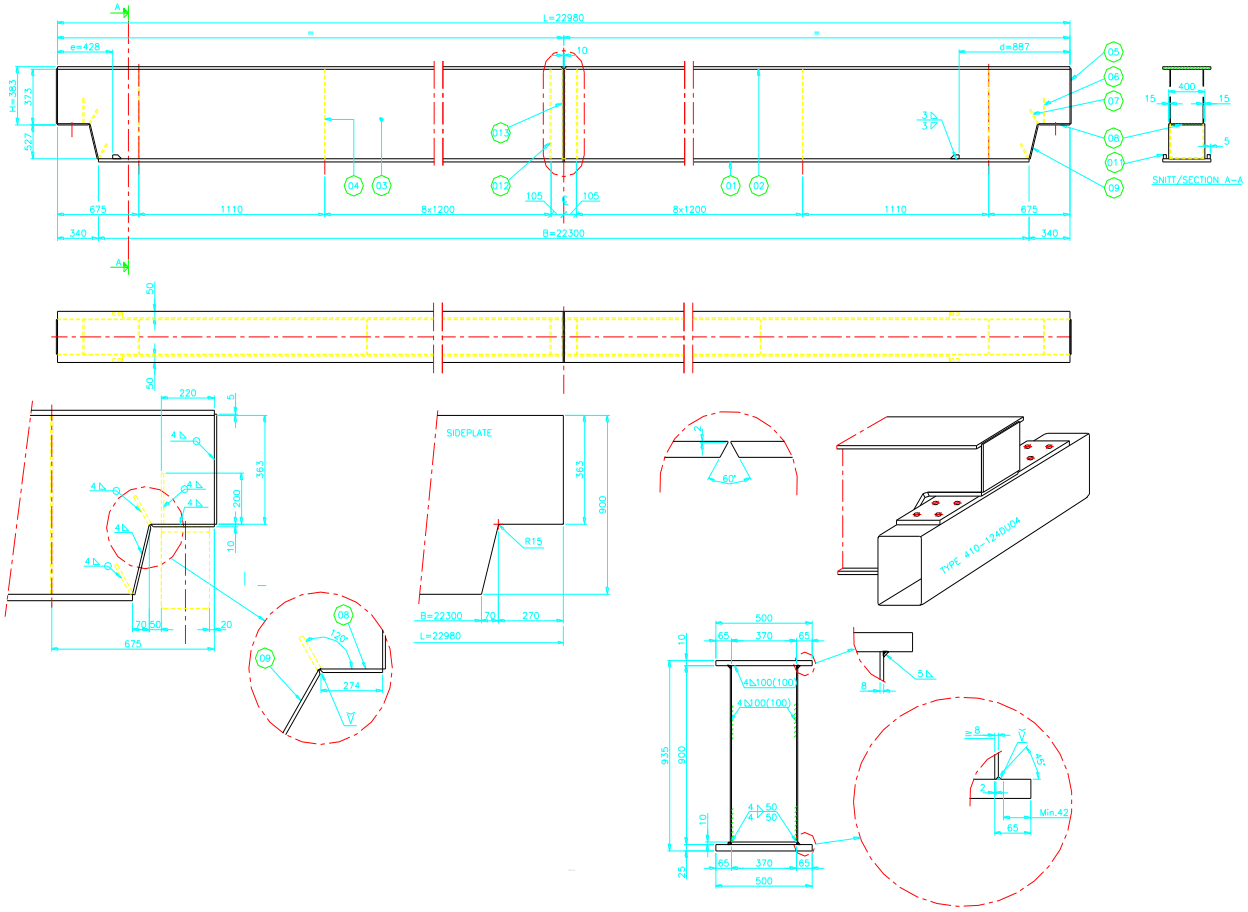

Figure 4. Beam structure for welding

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

Welding equipment (including welded wire and solder with automatic welded under the casing has a decisive effect on the metal properties of the weld.) The weld type significantly affects the chemical composition of the weld metal according to The degree of its involvement in metallurgical processes during welding Selects the welding equipment so that the weld metal has a composition similar to that of the base metal. The strength uniformity of the welded joint is guaranteed. Appropriate welding materials and welding welds, welding mode selection and welding.

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. The chemical composition of welding wire is given in Table 5.

Table 5. Chemical composition of welding wire

Grade	Chemical composition				
	%C	%Mn	%Si	%P	%S
H08A(EH14)	0,6	1,7	0,20	0,010	0,010

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 energy (q_w), welding depth (h), welding time (T_w). The calculation results are given in Table 6.

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 energy, 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.

The size check is a test of the entire width dimension and the total dimensions that the drawings require to be within the technical tolerances. All welds must be checked by observation that may use magnifier and the measurement to detect defects on the surface. Welding is acceptable if satisfy the requirements.

There are not any cracks. Ensure porosity between solder and base metal

Defects in the form of gas, slimy surface, foot burn, sagging too limited for

Permits must be repaired by wiping-repair

The surface of the angle weld may be flat, slightly convex (protrusion should not exceed 3mm and right has a comfortable transition from convex to base steel) or slightly concave

The frequency of pipe pitting on the surface of the angle weld not to exceed 1 defect over 100mm or 6 defects over 1200mm weld length and pore diameter no more than 2.4mm

For corner welds missing foot size compared to a specified size value less than 2mm, no repair if the missing weld length does not exceed 10% of the weld length. Welds welded to the abdomen do not allow the above size of weld to close. Suck the beams a little more than twice the wings

Surveys can be carried out immediately after welding to weld cool to ambient temperature.

Welding after examination by observation, is checked by ultrasound to detect

The defect lies inside the weld. Welds meet requirements without any cracks and other defect sizes do not exceed the specified value standard.

V or U groove along the crack with an angle of $60^o \div 70^o$ to type, completely removed cracks. The ends of the cracks crack or crack auk

Take a piece of about 50mm. Remove cracks by mechanical, grinding or lapping optical-pneumatic. If using arc-compressed air, the surface should be cleaned with air

The hand grinding to a depth of 1mm.Can be hand solder repair short, otherwise it must use the method of welding the weld. It must be completely cut and welded.

Welds are too protruding, need to remove the excess metal and grinding to ensure the smoothness from the weld transition to the base steel. Excess recesses such as: lack of size, fire near the weld, need to fix. Just grind it with a hand grinder.

Repair of welds should not exceed two times. After repairing, the quality of welds must be checked and re-evaluated using the same method and standard used on this welding line.

4. Conclusion

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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