A research on the stability of repair-welding for a great truss under the load

Myong Il Kim[1*], *Ju Chol Kwak*[1]

[1] *Pyongyang University of Architecture, Pyongyang, DPRK*

Abstract. In this paper, we developed the direct repair welding method without eliminating the load when the repair welding of the great steel truss is going. According to the information about the process and data systematized, working for eliminate defect of welding joint and analyzing used FEM on the stability of the process and result of welding-repair were scientific more than the last time at the great structure. When do this we did not eliminate defect from the part of joint and so it's not necessity to use any Jackie and turning back. The result of analysis and construction show that this method is very useful in the practice and by then the problem of stability solved clearly and perfectly and the time and efforts had consumed.

Keywords: bead, defect, load, repair, welding joint

Received 24 June 2022 | Revised 25 July 2022 | Accepted 25 August 2022

1 Introduction

It's very important for the establishment of new principle and technic of welding engineering in our construction science to convert in practical theory and design. Especially in the field of great construction repairing, welding method will be able to help a building with a life and quality, but also continue the stability indeed.

Generally, welding for repairing is going on the part of crack and the jointed under the physical method [1] [2]. But on the bead by welding, to eliminate defect completely and next dose it is to occur in other problems in that process during the groove working [2] [3].

The target to make reasonable work and condition for contributing effort and time are to prove new idea of repairing welding practically about great truss- structure instead of a thing completely is very useful way used arc heat by carbon electrode [4].

*Corresponding author at: Taedonggang Dong, Taedonggang District, Pyongyang, DPRK

E-mail address: shypinguo202108@163.com

ISSN: 2622-0008 e-ISSN: 2622-1640| DOI: 10.32734/ijau.v6i2.9697
Journal Homepage: https://talenta.usu.ac.id/ijau

Under the load, it is necessity to reduce the quantity compress by a supplement machine such as jack and clamping device [5]. So that, the state of stress will be relaxed, of course, on the basic the state of primary factors are considered. Therefore lots of labor, materials and days will go on line they want at this atmosphere [6].

This paper aim needed in practice of repair wedeling for great structure is to help the scientists and technical experts will be overcome to the standard level of working on new theory and method more easily. The key point is classified with considering the quantity of reducing load. For an analysis of the characteristic distribution of stress in bead, we consider the theory of material mechanics with force and stress [7]. Without any supplement, to solve this problem which is mentioned above is to analyze the internal force and stress in two cases that are on standard and others [8]. In the process of repair welding, eliminating defect is on first, after that, it is possible the remainder of bead will be countered the whole power [9]. The answer for this question is related with calculating the internal force and recognizing the characteristic distribution of stress [10].

2 Analysis and Discussion

Modeling the real-structure for calculation in the whole elements used by AutoCAD is useful in any case.

Under the figure 1 shows the result of modeling of the truss.

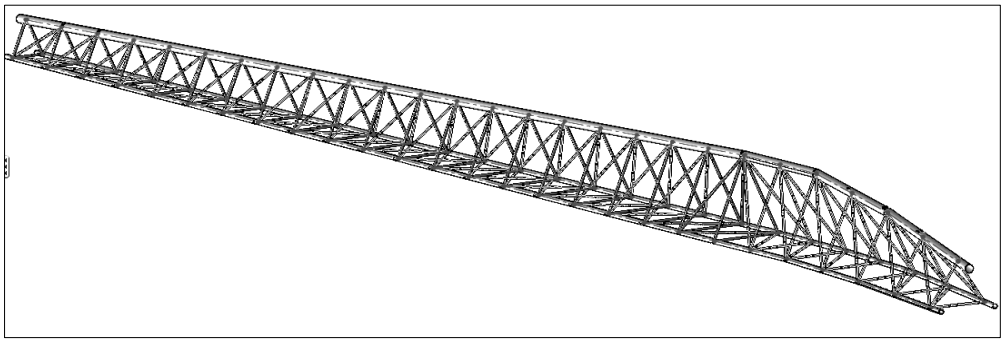

Figure 1 Model of truss

In this drawing, we set the real measurements and computed the forces used By SAP (Figure 2).

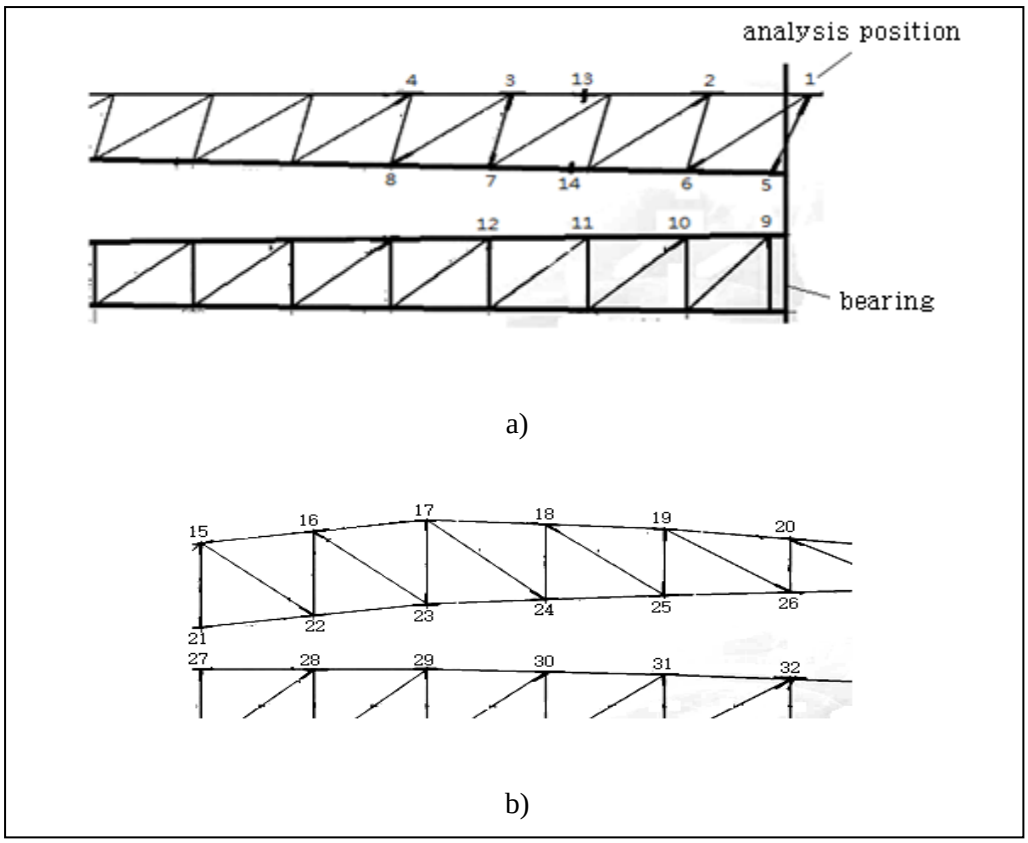

Figure 2 Analysis point of stress in weld zone of truss (a) inner truss of stadium, (b)outer truss of stadium

Above two results show the positions for analyzing of the internal force and the distribution of stress.

But in here the most important thing is state connected with stability more than relations.

In the process of analyzing, we consider fix-load and move one which including the vertical load by workers are real condition [11].

And the result of calculation of force reacted to the condition of external power for analyzing the stress at position.

The order of calculation arranged from the center point of the stadium to outside. Below diagram explain the conditions for analyzing stress (Table 1).

Table 1 Value of internal force and strss according to position of truss

no	D (mm)	T (mm)	force (N)	stress (MPa)	no	D (mm)	T (mm)	force (N)	stress (MPa)
1	108	5	-142008.61	-87.8168388	17	108	5	-105668.18	-65.3442
2	108	5	68634.82	42.44315132	18	89	4	75770.43	70.97268
3	108	5	-41639.95	-25.7497681	19	108	5	-48504.58	-29.9948

no	D (mm)	T (mm)	force (N)	stress (MPa)
4	108	5	50349.3	31.1355513
5	108	5	-142008.61	-87.8168388
6	108	5	59030.89	36.50416795
7	108	5	-41639.95	-25.7497681
8	108	5	58868.22	36.4035743
9	108	5	62873.11	38.88016202
10	108	5	4814.45	2.977212294
11	108	5	779.64	0.482122318
12	108	5	677.23	0.418792901
13	450	12	545768.49	33.06918208
14	340	6	-280645.37	-44.5995541
15	291	5	-87587.03	-19.5062648
16	108	5	74605.71	46.13549564

no	D (mm)	T (mm)	force (N)	stress (MPa)
20	89	4	80199.31	75.12112
21	291	5	-79825.78	-17.7778
22	108	5	69111.02	42.73763
23	108	5	-55408.22	-34.2639
24	89	4	66197.95	62.00632
25	108	5	-38624.11	-23.8848
26	76	4	65448.76	72.37345
27	156	5	9829.12	4.146083
28	108	5	18390.09	11.37227
29	108	5	3093.17	1.912788
30	89	4	13505.81	12.65063
31	108	5	4937.81	3.053497
32	76	4	0	0

The relation between stress and internal force is dealt with general constructive equilibrium equation. And we analyzed the state of stress by the program ANSYS (Table 2).

Table 2 Analysis result of stress of welding seam according to position

no	L	press,MPa
1	1	105.38
	1/2	338.27
2	1	50.93
	1/2	163.49
3	1	30.9
	1/2	99.19
4	1	37.36
	1/2	119.93
5	1	105.38
	1/2	338.27
6	1	43.81
	1/2	140.61
7	1	30.9
	1/2	99.19
8	1	43.68
	1/2	140.23
9	1	46.66
	1/2	149.77
10	1	3.57
	1/2	11.47
11	1	0.58
	1/2	1.86

no	L	press,MPa
17	1	78.41
	1/2	173.29
18	1	85.17
	1/2	188.22
19	1	35.99
	1/2	79.55
20	1	90.15
	1/2	199.22
21	1	21.33
	1/2	47.15
22	1	51.29
	1/2	113.34
23	1	41.11
	1/2	90.87
24	1	74.41
	1/2	164.44
25	1	28.66
	1/2	63.34
26	1	86.85
	1/2	191.93
27	1	4.96
	1/2	10.99

no	L	press,MPa
12	1	0.5
	1/2	1.61
13	1	39.68
	1/2	127.38
14	1	53.52
	1/2	171.8
15	1	23.41
	1/2	75.14
16	1	55.36
	1/2	177.71

no	L	press,MPa
28	1	13.65
	1/2	30.16
29	1	2.3
	1/2	5.07
30	1	15.18
	1/2	33.55
31	1	3.66
	1/2	8.1
32	1	0
	1/2	0

And the result of analyzed stress on the positions explain under the diagram (Figure 3).

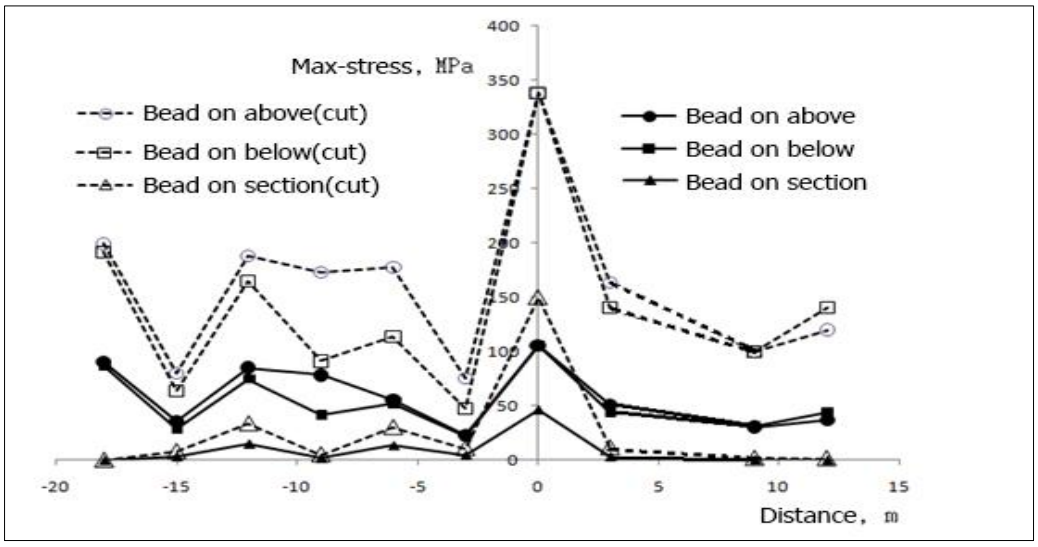

Figure 3 Maximum stress distribution of welding seam according to distance from point

We can recognize the maximum value of the stress and the whole state of distribution of stress every position [12]. As you can see, the value is expressed by absolute value and the distance of form the position to the next.

And the maximum value analyzed is lower than the value of yield limit.

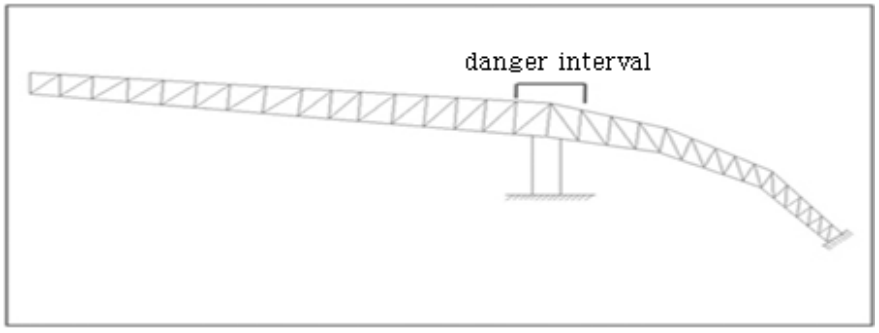

Figure 4 Danger interval of truss

In figure 4, shows the part projecting have to consider in the process of welding, having the support site.

3 Truss repair welding method

Repair welding method for the point place of truss. In the analysis for the stability of truss repair welding, it is identified to cut the welding joint directly in the rest places without the joint place [13]. In the point place, as the welding joint is loaded very big load, it cannot be cut and as this, in this paper the problem for repair method of the point place is considered. For the welding joint loaded the big force, the work condition of the joint is reduced generally and the fault part is cut [14]. Here are the work condition eliminating method, jack and clamping device using method and complementary steel pipe using method, etc. But this method needs a lot of materials and labor and it is difficult to provide the construction date.

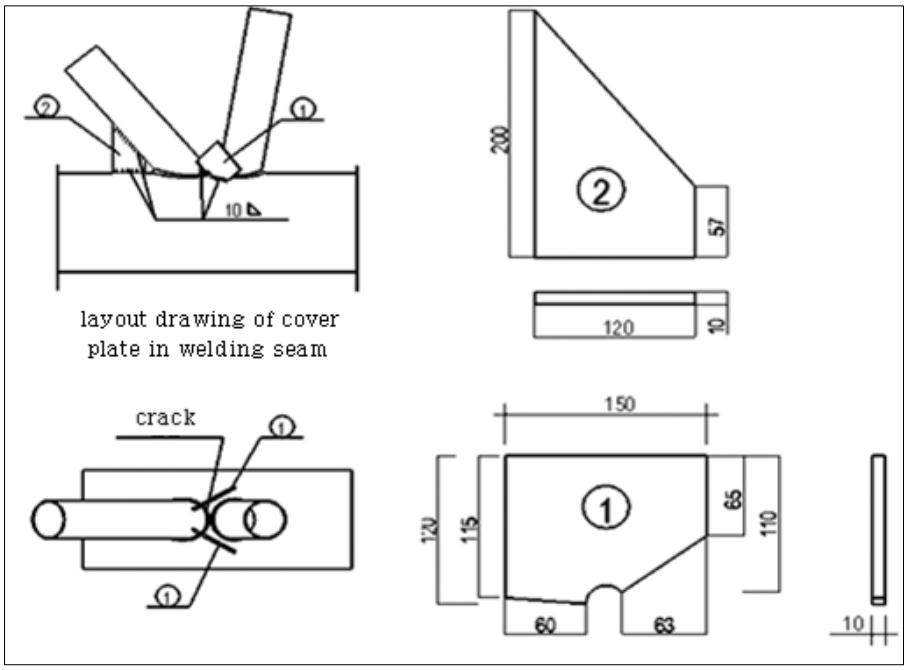

Figure 5 Cover plate erection in danger interval

Figure 5 showed the type, dimension, size, setting place of the reinforcing board in the point place of the truss.

The reinforcing board is determined for the type and size of each point and repair welding performs the welding of the reinforcing board at the first.

2) Repair welding method for the top brace

The top brace of the May Day Stadium' truss generally loads very big force and although not load it, as the deformation was arise to truss when cutting the joint, the joint in this place can't cut. In this case, the condition of the welding joint have to be eliminated.

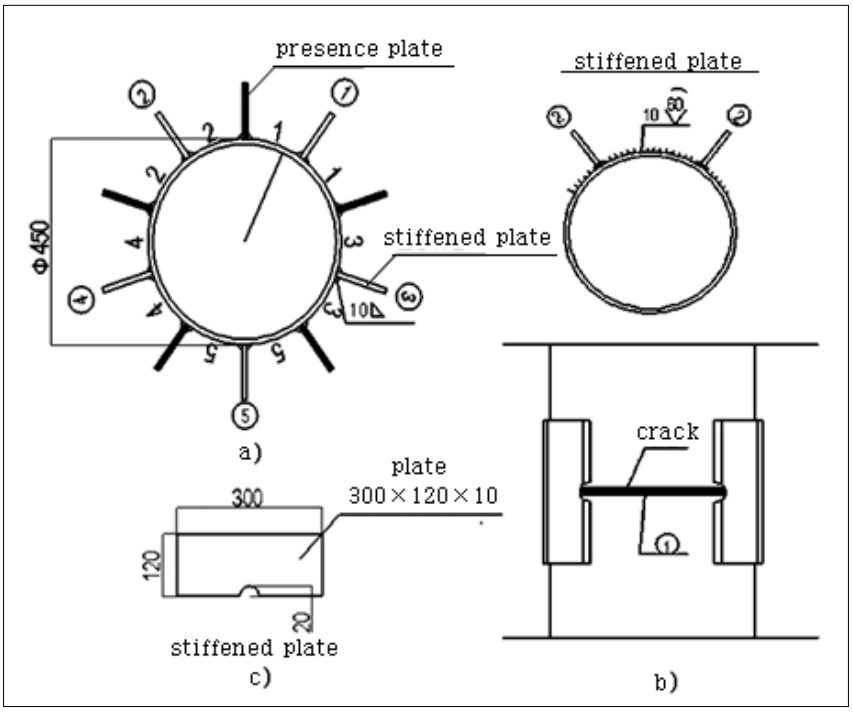

Figure6. erection form and dimension of cover plate in upper chord of truss

In this paper, the addition of the board has been used. In Figure 6, there is a welding method for repairing the truss weld joint and the type and size of the added board. Then, the figure also describes how to weld and repair welded joints if there is no add-on board and B) how to weld and repair welded joints if there is an add-on board. Next, C) explains that the Image is the type and size of the adder board.

In case that there is the adding board, at first the adding board is installed on joint according the order of ①, ②, ③, ④, ⑤ and after eliminating the fault, the repair welding is performed.

The repair welding is performed from the top to down of the steel pipe and according to the order of 1, 2, 3, 4, 5.

In case that there is the adding board, the adding board ② is installed firstly for the fault of joint as B) of Figure 6 and after eliminating the fault part, the repair welding is performed.

4 Conclusion

The author can prove that no error in the stability test can even reduce the load when the large frame is repaired by welding completely as a simulation solution. So there is no need to Jackie and turn so that only half the joint without removing the load.

REFERENCES

[1] Kang Wenjiang, Zhihua Chen, Heung-Fai Lam, and Chenran Zuo, "Analysis and design of the general and outmost-ring stiffened suspen-dome structures," *Engineering structures*,

vol. 25, no. 13, pp. 1685-1695, 2003.

[2] Baohua Chang, Yaowu Shib, and Liangqing Lu, "Studies on the stress distribution and fatigue behavior of weld-bonded lap shear joints," *Journal of Materials Processing Technology*, vol. 108, pp. 307-313, 2001.

[3] SNAME, "Guidelines for Site Specific Assessment of Mobile Jack-Up Units," 2002.

[4] Messler Jr RW, "oining composite materials and some thought-provoking possibilities," *ournal of Thermoplastic Composite Materials*, vol. 17, pp. 51-75, 2004.

[5] D. Koirala, "Repair, Inspection and Maintenance Methods of Steel Bridges," 2006.

[6] Messler Jr RW, *A practical guide to welding solutions: overcoming technical and material-specific issues*.: John Wiley & Sons.

[7] S. F. Edwards and D. V. Grinev, "Transmission of stress in granular materials as a problem of statistical mechanics," *Physica A: Statistical Mechanics and its Applications*, vol. 302, no. 1-4, pp. 162-186, 2001.

[8] A. R. Hadjesfandiari and G. F. Dargush, "Couple stress theory for solids," *International Journal of Solids and Structures*, vol. 48, no. 15, pp. 2496-2510, 2011.

[9] Sergio Saludes Rodil et al., "Laser welding defects detection in automotive industry based on radiation and spectroscopical measurements," *The International Journal of Advanced Manufacturing Technology*, vol. 49, no. 1, pp. 133-145, 2010.

[10] P. Dong and F. W. Brust, "Welding residual stresses and effects on fracture in pressure vessel and piping components: a millennium review and beyond," *J. Pressure Vessel Technol*, vol. 122, no. 3, pp. 329-338, 2000.

[11] G. Blight, *Assessing loads on silos and other bulk storage structures: Research applied to practice*.: CRC Press, 2005.

[12] Ruibin Gou, Yiliang Zhang, Xuedong Xu, Liang Sun, and Yong Yang, "Residual stress measurement of new and in-service X70 pipelines by X-ray diffraction method," *Ndt & E International*, vol. 44, no. 5, pp. 387-393, 2011.

[13] Hyun-Chan Park, Chin-Hyung Lee, and and Kyong-Ho Chang, "Strengthening a damaged steel girder bridge by the replacement repair welding," *KSCE Journal of Civil Engineering*, vol. 16, no. 7, pp. 1243-1249, 2012.

[14] Pedro Galvez et al., "Galvez, P., Quesada, A., Martinez, M. A., Abenojar, J., Boada, M. J. L., & Diaz, V. (2017). Study of the behaviour of adhesive joints of steel with CFRP for its application in bus structures," *Composites Part B: Engineering*, vol. 129, pp. 41-46, 2017.