

The Design of Optimum Bracing Connection welding to gusset plate by using finite element method

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Abstract: Welded connections have a significant importance in a steel structure. Many structures all over the world had failed because of weld defects despite the strong structural steel profile. The result of a wide research on buildings in Tehran, from design to inspection and operation steps showed that almost 90 percent of defects in steel structures relates to weak operation and non systematic welding operation. This fact shows the importance of research on failure mechanisms of welded connections to predict their behavior under loading. A research program was undertaken to present the welding layout in steel structures by prediction the behavior of welded connections against different loads. The finite element software ABAQUS is used in this research with regard to bearing capacity, operational and economical points. Present such layouts improves structure security and decreases hazards of destructive effects on structure.

Key word: Steel Structure, Welding, Gusset Plate, Numerical Analysis, Finite Element

Introduction

Assessment of vulnerability of existing structures is the subject that was introduced in recent 3 decades and has developed rapidly. Many existing structures have lots of values or due to different reasons we can't destroy them and built them again. Therefore after determining negative points of such structures, their retrofitting should be done. On the other hand by evaluating vulnerability of existing structures and determining their negative points we can choose proper strategy for designing and implementing new structures (Razaghi and Sedayi Sola, 2011). Regarding observations of earthquake in recent decades in the country and existence of many steel structures that preserved their stability against side loads by bracing and necessity of retrofitting them, regarding improper performance of their connections in previous earthquakes like Bam earthquake little research has been done a lack of such research is felt. Many studies in developed countries about behavior of connections in braced steel structures have been done but most of the studies was about screw type of connection. In most developed countries steel structures in many modes is done through bolt so getting direction of researches of researches about connection of braces was regarding their types. In our country most of these connections was welding and in usual and traditional constructions less structures are steel in which by using bolt, component of structure are connected to each other. For many reasons,

welding connection fashionable in the country has various problems as in recent earthquake in the country important performance of this type of connection has been observed. Therefore it seems that this type of connection regarding fashionable methods of its implementation in the country needs more comprehensive considerations (Razahi and sedayi sola, 2011).

Steel constructions constitute significant section of construction in Iran. One of the most important subjects in each steel construction especially regarding earthquake resistance is controlling its welding. Welding connections are counted as the most sensitive points in steel structures. There were many structures that although having strong structural profiles due to weakness in welding connections they have been ruptured. Studies of housing organization in constructions of Tehran city, since designing to the step of supervising and implementation have shown that about 90 percent of problems and existing deficiencies in metal structures turns back to weak implementation of operation of welding of connections. Regarding this important subject, the need for doing studies that can predict their performance after entering structural loads by modeling mechanism of rupture of welding.

Literature Review

The need for doing research design about enhancing quality of metal structures by welding and optimizing welding especially about sensitive

connection like brace is felt severely. Below some researches about this subject is pointed out.

In 2009 Krompen et al have done a comparative study between bolt and welding connections in order to determine the best type of connection in different conditions and situations. They concluded that in many places due to lack of skillful welder, tendency of designer engineers is toward bolt connections (Krupmen & carrato, 2009). Another research that was done by Feli et al in 2006 showed that calculation of tensions of waste in the form of two-dimensional axial symmetry can replace three-dimensional modeling that needs long time of implementation and high memory of computer (feli et al, 2006). Soleymani et al in 2009 predicted geometry of weld pool by using neurosis network. By considering the degree of parameters of the process in accuracy of predicting geometry of weld pool in this research it was distinguished that the power of laser has the highest effect. In the following by conformation of diverse model of neurosis network, parameters of the process of weld for achieving geometry of weld have been predicted (soleymani et al, 2009).

Heidari et al (2009) in another research for making exact mathematical relation between input parameters of welding MIG and output parameters (geometry of polen weld), developed mathematical models based on interpolation methods based on experimental data. These results showed that polynomial model by multiplying variables has adaptation with real process of MIG welding and suggestive model can be used as infrastructure of optimizing parameters of welding and also in predicting geometry of welding, for any set f input amount it is used (Heidari and Kolahan, 2009). In a research that was done by Akbarzadeh et al in 2008, some optimized models of mathematics for predicting depth of penetration of weld has been done through regression, neurosis network and SANN. The result of this research showed that suggestive models can predict depth of penetration of weld with acceptable precision. The result showed that among 5 presented models, the model of neurosis network predicted depth of penetration with higher precision. In continue by help of gradual algorithm Tebrid optimized amount of input parameters of the model that create favorable quality are estimated (Akbarzadeh and Sanaei moghadam, 2008).

In a research in 2001 done by Moncarz et al a situation was considered in which a deficient connection in thousands of modern metal structures has been used in earthquake regions. After earthquake in 1994 in North Rich, California, it was distinguished that these bending fusions can't tolerate changes of shapes resulted from earthquake and in fact they crack

in a level lower than expected limit. In this paper clarity of dark angels of the process of cooperation among universities, engineers, specialties and suppliers of primary material and tools have been done that lead to the cost of tens of billions of dollars for repairing or resisting modern constructions in earthquake regions (Moncarz et al, 2001).

Razaghi et al in 2011 tried for considering deficiencies resulted from incorrect implementation of connections of braced angels in traditional method, consider some existing deficiencies by using limited element software. Analysis was non-linear and after considering some deficiencies, suggestive methods of resisting are presented. The result of research showed that resisting connections distribution of tension in weld of connections of board of connection to the wing of shooting became uniform and also amount of tension decreased and behavior of connection has improved regarding existing deficiencies (Razaghi and sedayi sola, 2011).

Features of connections

Details of connections in modeling in current study have been mentioned in fig 1-4. With this difference that length and formation of weld in some models has changed. Also only above connection has become model.

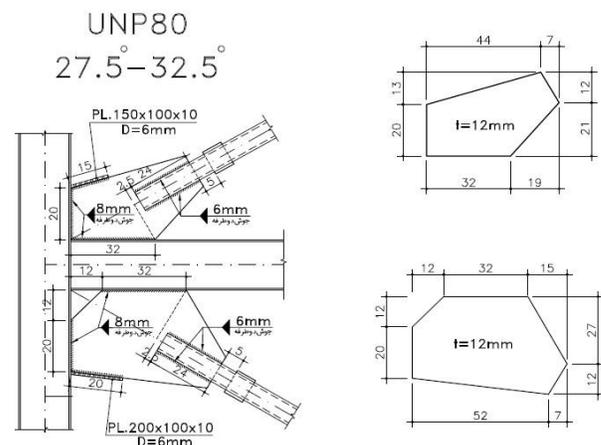


Figure 1. details of modeling connections (countries renovation organization, 2010).

Since concentration of this research is on connection of brace and its connection board to the system so for simplification two current profiles of IPE270 and IPE200 have been used as column and bar in modeling. For achieving reliable result, analysis was non-linear and regarding great change of forms and for accelerating the process of analysis implicit method has been used. It is necessary to mention that in implicit method the problem has been divided into

some smaller problems and each problem is solved simultaneously.

As it was shown in modeling shortening length of weld and adding hardening board like connection No 4 can improve performance of brace weld to plated gusset and concentration of tension in regions is decreased to acceptable limit. Fig 2 shows comparison of degree of existing tension in primitive points of weld of brace to connection screen in four considering models. As the results shows by making considered changes that was achieved in model 4, the degree of tension in mentioned point comparing to model 1 has decreased 50%. This problem can lead to decrease of change of form in considering point and decrease the probability of occurrence of rupture in this point.

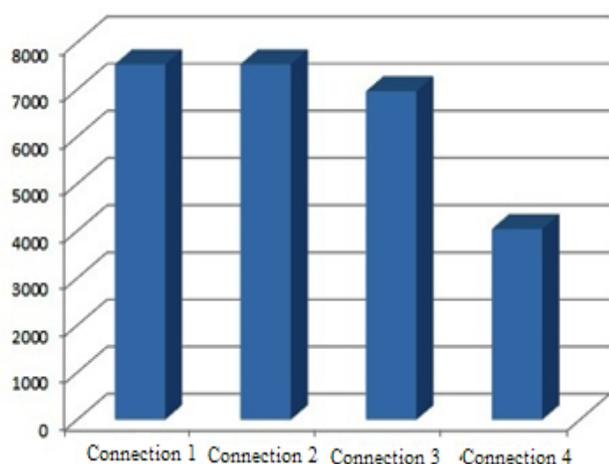


Figure 2. chart of changes of tension in primitive points of weld of brace connection to the screen of connection in models

Conclusion and suggestions

As it was shown in modeling the shortest length of weld and adding hardening board like connection No 4 can improve performance of bracing weld to plated gusset and concentration of tension in these regions decreased to acceptable limit. This decrease is 50% of model 1 that is a fashionable model.

In current study brace connection to its below connection board as one of the most sensitive point in steel structure was considered. It is suggested to do consideration on other usual connections in steel structures. Analysis in this thesis are linear and without regarding great changes. We can repeat

analysis by considering non-linear behavior of tools. Due to various reasons current weld connection in country has many problems as in recent earthquakes improper performance of this connection s has been observed. Therefore it seems that this type of connection regarding fashionable methods of implementing it in the country needs more considerations. Therefore considerations in current study can be repeated for dynamic loading of earthquake.

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