Modeling Of Double- Fillet Tee joint in solidwork simulation

Anahed Hussein Juber/ mechanical engineering/Applied/Al-Qadissiya university
Mail ,aaa56h@yahoo.com , anahed222@gmail.com

Abstract

The research aims to study and simulation weld joint type Double –Fillet Tee Joint ,It was studied stress concentration along the weld area and calculate the required weld size under effect variable loads (1,2,4)kN by using Finite Element Method through a program Solidwork Simulation 2013.

It has been identified weld size (4mm) as the value of fixed for all loads, this value is proposed from welding of scientists as the default value ranging (4-10)mm and used a feature (Edge Weld Check Plot) in solidwork program .

It has compared the theoretical results with the analytical results ,the ratio of error was less than (2%) .

It has simulation by draw 3D solid model and convert it to shell model with loads and fixture .

The results showed that the maximum value of the stress is (10)N / mm^2 under load (4)kN and less thickness necessary for the welding connection is 0.132mm under load (1)kN The more load on joint weld will increases weld size required without afailure.

The research supplies recommendations for precision of solidwork simulation to be used as design device calculate the joints.

Key words*: Fillet weld, Finite element method , Welded structure, Edge weld*

الخلاصة

يهدف البحث الى دراسة ومحاكاة وصلة لحام نوع الحام Double- Fillet Tee joint حيث تمت دراسة تركيز الاجهادات على طول منطقة اللحام وكذاك حساب السمك اللازم للحام weld size تحت تأثير احمال متغيرة (1,2,4)kN باستخدام طريقة العناصر المحددة (FEM) من خلال برنامج Solidwork Simulation 2013. تم تحديد قيمة السمك اللازم للحام(4mm) كقيمة ثابتة لكل حمل و هذه القيمة مقترحة من قبل علماء اللحام كقيمة افتراضية تتراوح بين (4-10)mm و باستخدام ميزة Edge Weld Check Plot الموجودة في البرنامج تم حساب القيمة الحقيقية اللازمة لسمك اللحام وتم مقارنتها مع النتائج النظرية حيث كانت نسبة الخطأ اقل من 2%. تمت المحاكاة برسم النموذج 3d solid ثم تحويله الى نموذج shell وتسليط الاحمال والتثبيت .بينت النتائج ان اقصى قيمة للاجهاد هو 10N/mm^2 تحت حمل 4KN واقل سمك لازم لوصلة اللحام هو 0.132mm تحت حمل 1KN وكلما زاد تحميل الوصلة يزداد سمك اللحام weld size المطلوب للوصلة بدون فشل. توجه هذه الدراسة بموثوقية استخدام البرنامج التحليلي SOLIDWORK في محاكاة وتصميم لحساب وصلات اللحام المطلوبة لسرعة النتائج ودقتها.

INTRODUCTION

Mostly welding contacts may be analyzed using oldish analysis or (FEM). Finite Element Method completely minutely determine download track which can be difficult to use the oldish analysis in the state of intricate structures. (FEM) group SolidWorks Simulation has been used to assess the strength of welding joints [1] .
If stresses on openness modeled welds can't be used for oracular objective, it is reasonable to ask why model welds in the general assembly. In fact, in most cases, leave the weld engineering out of recommended for domestic results won't provide good data and if they're there, a casual controller of your results may be tends to draw conclusions without the knowledge of these results are the debatable [2] .

1-Static Analysis of Welds and Weldments

Last distinguishes of FEA models of welds is that any result requires an initial valuation of the size of welding. stress near the welding will vary with welding the size of the selected as show in Fig.(1). This is inversion to the notion of predictive design analysis [3].

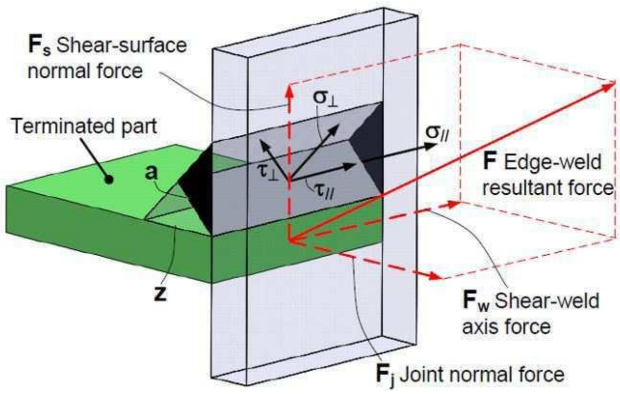


Figure 1: Stresses and forces in a fillet weld

2-Edge Weld Check Plot

edge welds are popular lineaments in engineering designs, but they can be difficult to analyze, Stresses welding in any program fees are uncertain in order to the values lean on each of engineering and mesh size. happily, the edge weld check plot it uses a simple accounts to supply a designer with a quick pass/fail answer to limit whether there was need for further refinement and welding analysis. the spot is key: edge weld check plots dependent on forces, not stresses. as mentioned earlier, the stress values stated in the seams are prone to error . this is why the seams are often "hot spots" in the fees on stresses alone models.
shear, and bending forces are checked at each node. the load at all node is thereafter studied through this shape:

$$f_w = \sqrt{(f_{normal} + f_{bending})^2 + (f_{shear})^2} \quad \text{.....................(1)}$$

At last, the "calculated weld thickness" required can be found by comparing with the maximum admissible electrode shear:

$$t_w = \frac{f_w}{F_a} \quad \text{.....................(2)}$$

this computation leads to a unit of length, which correspond correctly with units of t_w . if the present thickness at all node exceeds this minimum value, the software considers it "ok." if not, SolidWorks Simulation areas the weld in a "needs attention" folder. this means welding requires more realization. then, you can make multi-repeat change that primary value welding size to a value near the expense of welding size when determine the edge welding connector. When all the welding are named "ok" and colored green in subsequent check plots, analyst can rest confirm that the welds will safely bearing loads without fail. the account methodology aside, it is paramount to motion that the edge weld check plot is based on present tests, not just theory. the criterion used in the software go ahead the Structural Welding Code D1.1 of the American Welding community (AWS) [4].

3-Theoretical framework

Figure (2) shows the form and dimensions of the two pieces after assembly
It has been found weld thickness necessary of the link according to the following information.
Height (d)=20mm , width(b) =150mm
horizontal force =1000N , 2000N, 4000N
Use Code D1.1 of the American Welding community (AWS)
Weld strength P_w = 273 N/mm^2 (Electrode E60)
Safety factor S_F =3
Note that the welding be from both sides

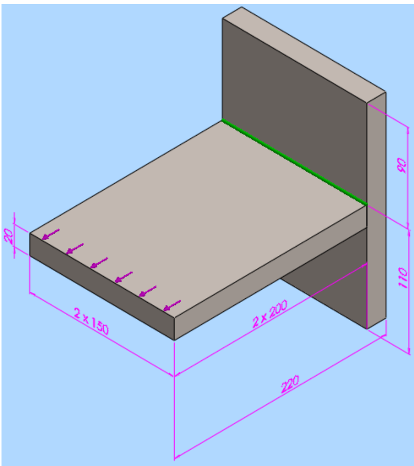


Figure (2)

Weld size (h)= $\frac{o.71p}{bts}$ …………(3)

The maximum shear stress allowable $(t_s) = \frac{0.4\,pw}{sf} = \frac{0.4*273}{3} = 36.4$ N/mm^2 …(4)
Whereas (0.4) depending on the quality edge weld it is factor value ranges (0.4 – 0.45) In books welding [5].

Weld size (h) = $\frac{0.71*1000}{150*36.4}$ =0.13mm

This is the least thickness ,but scientists welding say the weld size must be in the range (4mm -10mm), choose weld size (4mm)

4-Modeling simulation

As previously explained, there are three ways to simulate welded joint see Figure (3):
(1) all bodies to be solids as show in Fig.(3-a) .
(2) the fillet weld bead to be beam while other bodies solids as show in Fig.(3-b) .
(3) instead of bodies to use surfaces and Edge weld connection command as show in Fig.(3-a) .

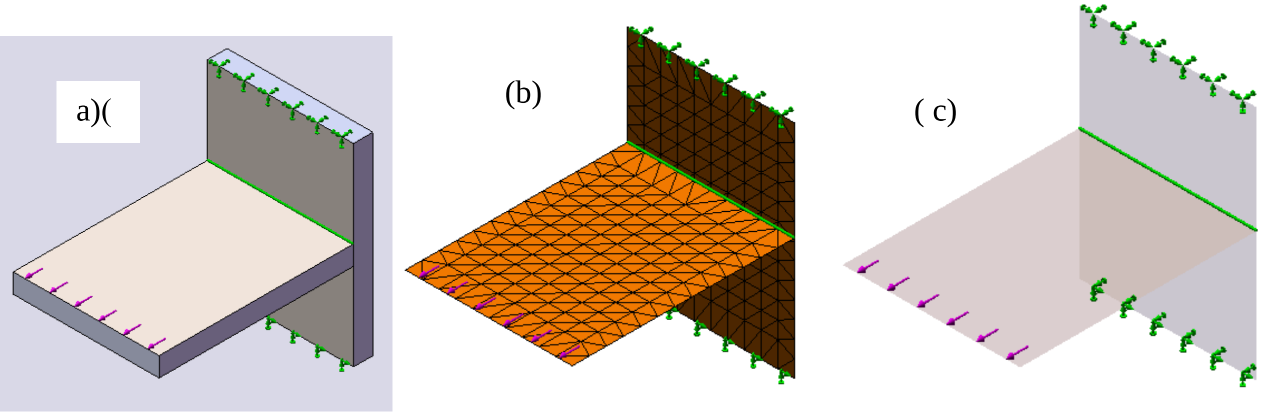


Figure 3: Double -fillet Tee joint

It depends welding Edge type (E60) according to specification Code D1.1 of the American Welding community (AWS) offer figure (4).

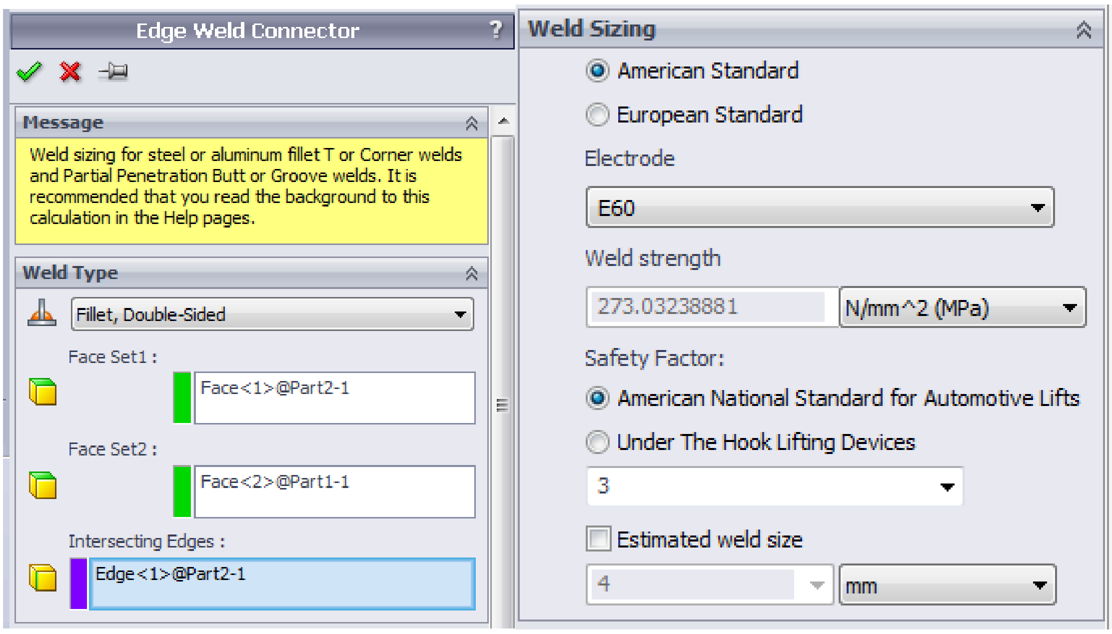


Figure 4: Specifications Edge weld

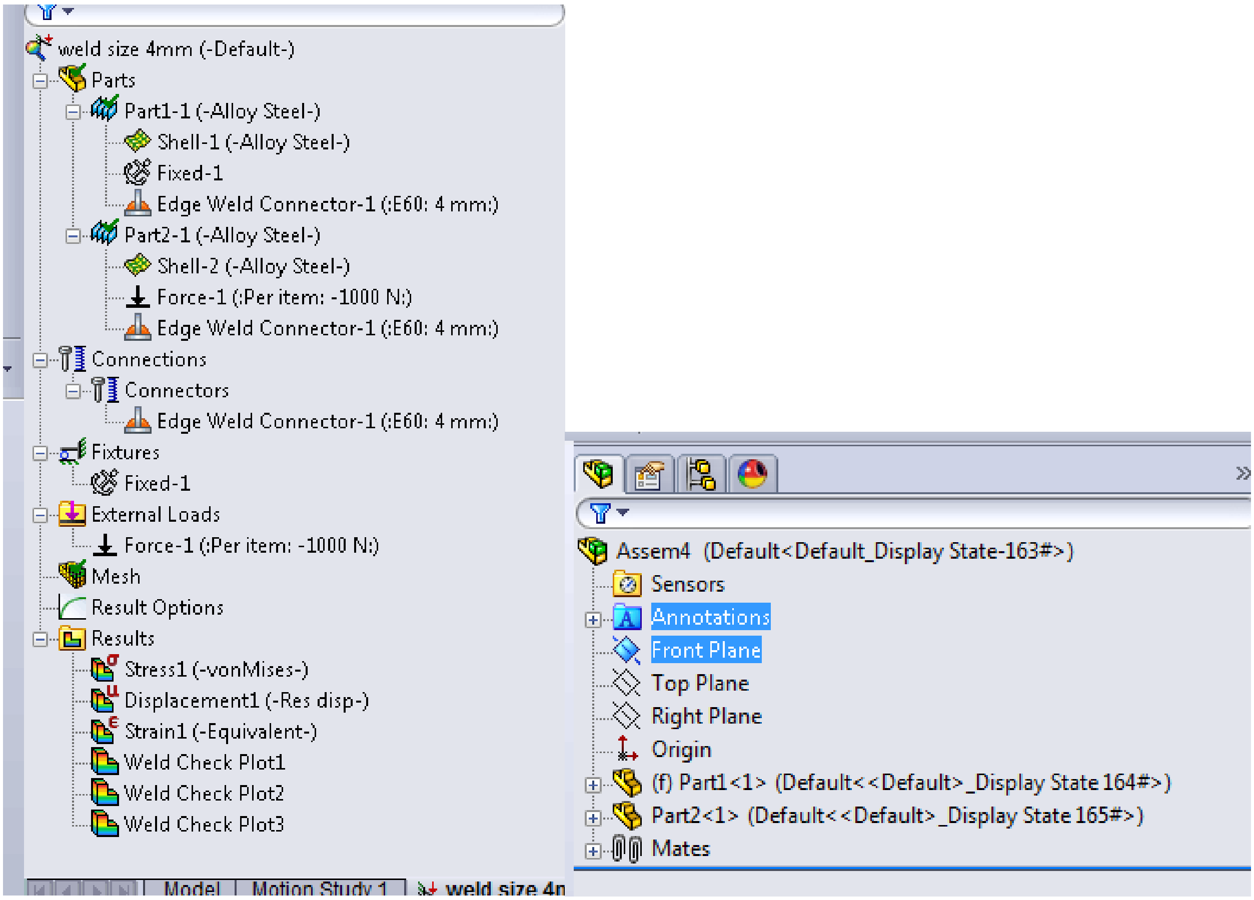
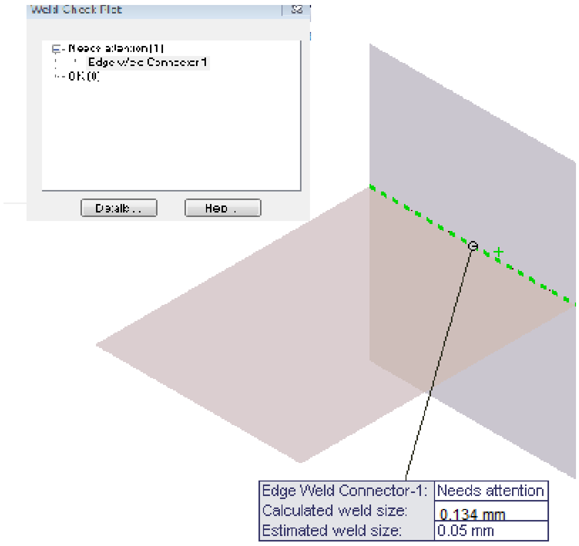


Figure 5 :Stages simulation model

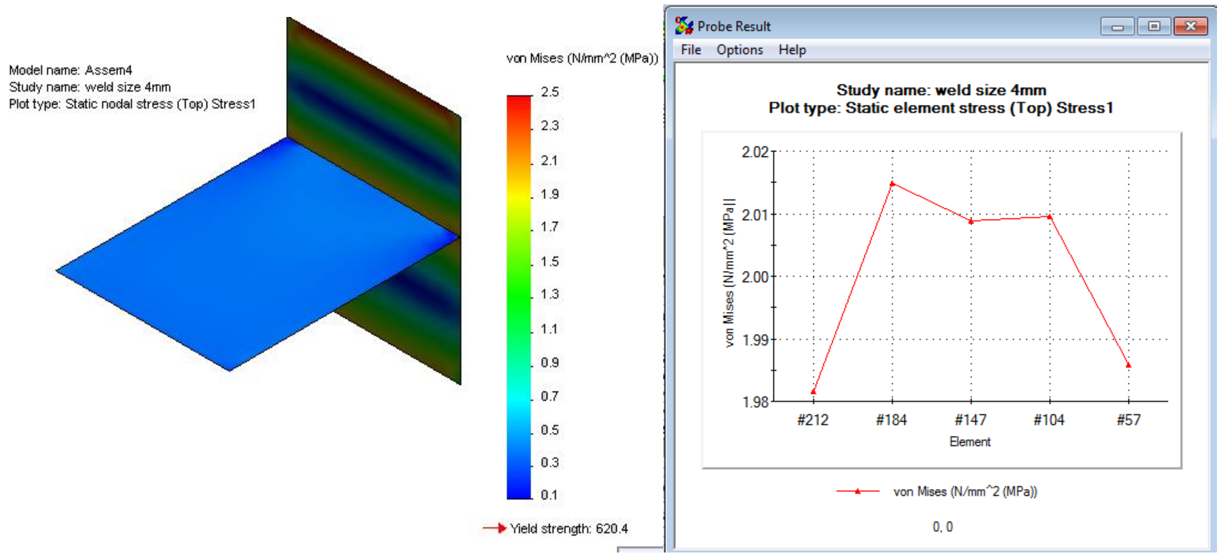
SIMULATION RESULTS

Initially choose weld size (0.1mm) the least from weld size the required (0.13mm) ,the program will be tested from weld check plot where they appear weld joint failed to make sure from the reliability of the program .show figure(6).



Figure(6):weld check plot failed

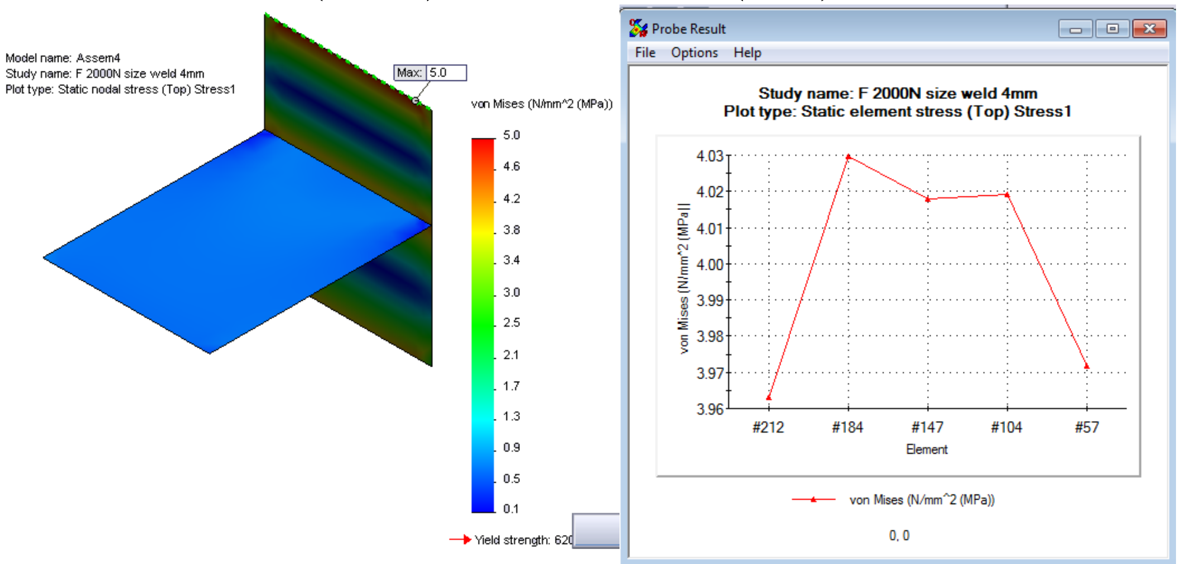
Note in figure(7-a) concentrated stresses in the welding area are the highest Von Mises (2.5 N/mm^2) and figure (7-b) represent the values of stresses along the weld area when horizontal load 1000 N and weld size 4mm



(a) (b)

Figure(7): Von Misses along welding area (load 1000N)

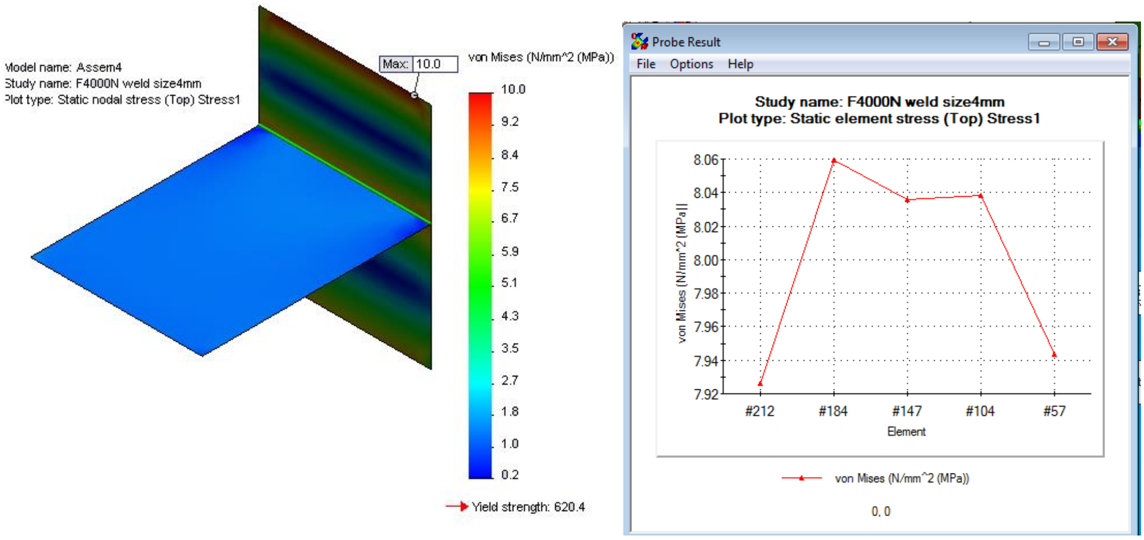
Note in figure(8-a) concentrated stresses in the welding area are the highest Von Misses (5 N/mm^2) and figure (8-b) it represent the values of stresses along the weld area when load (2000N) and weld size area (4mm)



(a) (b)

Figure(8): Von Misses along welding area (load 2000N)

Note in figure(9-a) concentrated stresses in the welding area are the highest Von Misses (10 N/mm^2) and figure (9-b) it represent the values of stresses along the weld area when load (4000N) and weld size area (4mm)



(a) (b)

Figure(9): Von Misses along welding area (load 4000N)

To validate these results used Weld Check Plot method in the program solidwork simulation which gives the weld size the required , As shown figure (9-a) and (9-b) where indicated that the weld size 4mm not need alteration under change loads,it is (OK) illustrated figure (10-a),(10-b) and(10-c).

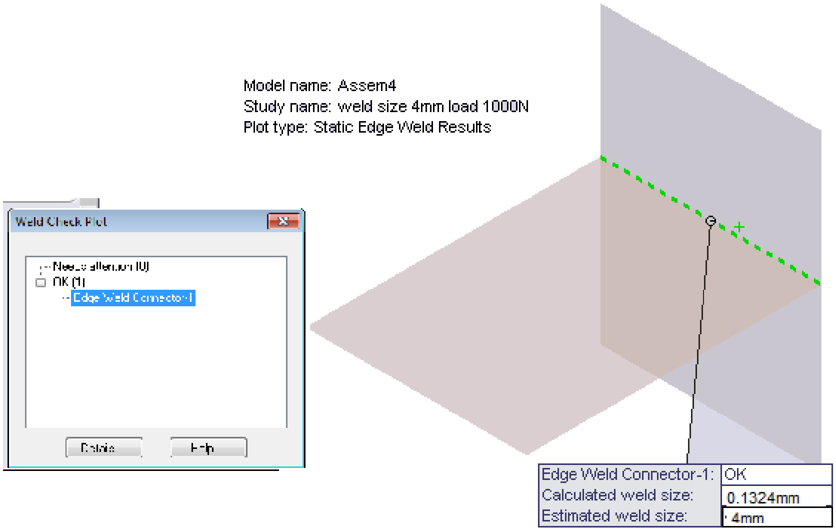


Figure (١٠-a) :load1000N

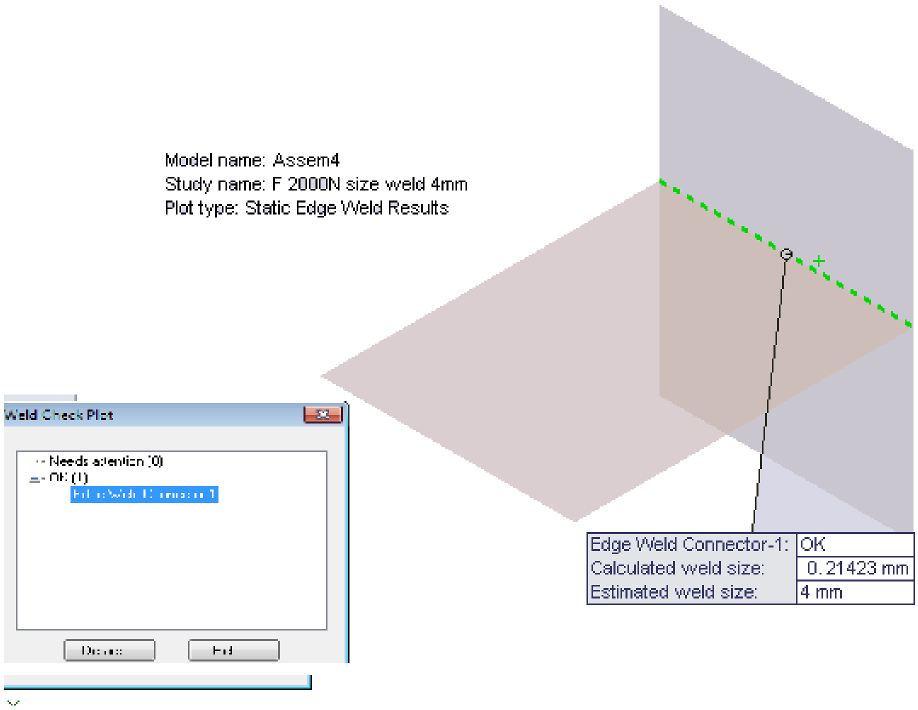


Figure (10-b):load 2000N

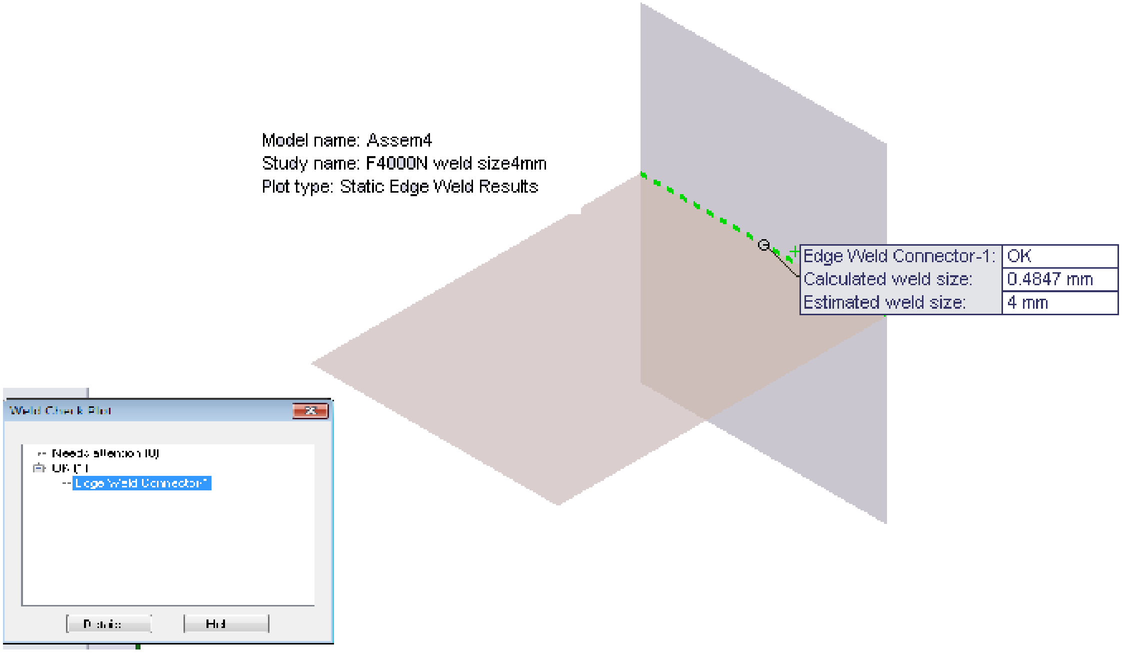


Figure (10-c):load4000N

When using Edge Weld check plot in figure(11-a) note that the largest thickness must be of aspects , figure (11-b) It shows a table that contains more detailed information such as the max and min to the weld size , value shear force and bending moment.

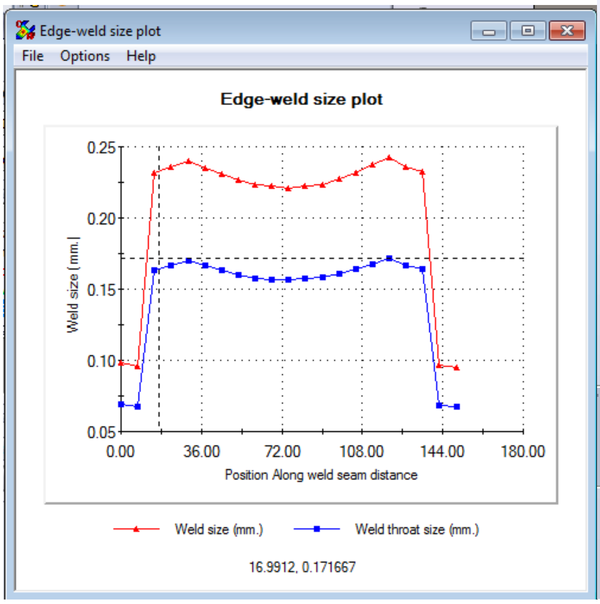


Figure (11-a) :estimated weld size When load 2000N

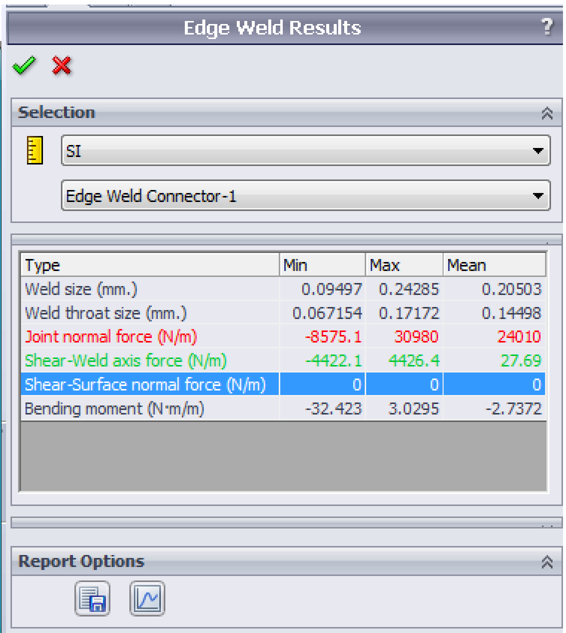


Figure (11-b): max and min to the weld size value shear force and bending moment.when load 2000N

The table (1) show the comparison between theoretical result and results of the analysis.The error rate dose not exceed 5%. Demonstrating the reliability of the result of the simulation in solidwork.

Load (N)	theoretical result weld size (h)mm	Analysis result Weld size (h)mm	Von Mises N/mm^2
1000	0.13	0.132	2.5
2000	0.26	0.2142	5
4000	0.52	0.4847	10

The table(1): show the comparison between theoretical result and results of the analysis

CONCLUSION

1. Use a feature (Edge Weld Check Plot) in solidwork program to calculate the required weld size
2. The use of program solidwork simulation one of the easiest tools for fast Calculation.
3. There are three method (3D solid , shell, element) representation modeled welded joint .
4. .Increasing the concentration of stress in the center of the welding area more than edges ,this explains the increased weld size in the center plate more than edges it.
5. Demonstrating the reliability of the result of the simulation in solidwork.

REFERENCES

1-Zoran Bojana., Modeling Of Single-Fillet Lap Joint In Solidworks Simulation, Original Scientific Paper number: Volume:14 ,Issue :1, Pa.no.21-27,2016

2-Paulius GR,"Modling of welded connections in solid work simulation" Conference paper ,Volume5,January 2011

3-The COSMOS Companion ,"Static Analysis of Welds and Weldments", volume116,p1-38.http:/www.cosmosm.com/pages/news/COSMOS_Companion .htmi.

4-Technical Paper,Www.Solidwork.Com, Check Plots: Find The Problem Fast, P 9-10.

5-EN 1993-1-8 (2005) : Eurocode 3: Design of steel structures - Part 1-8: Design of joints.