TENSILE STRENGTH ANALYSIS OF SIMILAR PLATE WITH F.E.A. WHEN LAP WELDED JOINT IS USED

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ABSTRACT

'Welding', the simple and excellent process joining of two similar and dissimilar metals of plates and other structure.50% of gross national product of the country is related to welding .Almost everything is made of metal is welded. Welding process includes arc welding, gas welding, and resistance welding (40 total process of welding exist).The most important factor of welding operation is tensile strength of welding joint under variable environmental and working conditions. .So by the experimental and analytical testing is done by the study of overlap length size and gap size are to be selected to evaluate the welded joint of tensile strength. The range of parameters is selected from the literature. For greater accuracy and test of specimen by making of holding device which will the specimen by UTM machine.The result is obtained by experimentation compare with result is evaluated by simulation. By the simulation and experimental observation to fix the length of overlap size is 25mm for 5mm thick plate recommended for minimum gap size. This will give maximum tensile strength.

KEYWORD: Tensile strength, Gap size, Overlap length

INTRODUCTION

During welding operation process, the work-pieces are to be joined are melted and usually a welding electrode (filler material) is added to make a fool of molten materials is that solid in form to become a very strong joint. At the inter molecular attraction in condition, brazing and soldering could not involve melting the working but a lower-melting-point material is melted in between the two work pieces to become them together. Types of welding are Arc welding (SMAW, GMAW, GTAW), Gas welding, Resistance welding, Energy beam welding, Solid-state welding.

LITERATURE REVIEW:

From the literature survey to conclude that worked on fount that tensile strength and fatigue strength of different welded joint by changing geometry of weld, welding opration, loading condition. Different defect checking techniques have observed by research in various papers. They are various types of welded machine component such as steel structure ,pressure vessels, axles, Heavy hydraulic turbine shaft, flanges weld to shafts, crank shafts, pulleys, Large gear, flywheels, machine frames, Gear housing. Mostly all type of welding in which electric arc welding most common is welding is widely used. Generally welding strength is depends on radius of curvature,

welding position, welding angle is common factors.
From the literature of survey is conclude that very less work have be done that checking strength of welding lap welded joint. Welding process parameter such as current and voltage, welding position and welding angle and tensile strength

POINTS TO BE AFFECTED TENSILE STRENGTH OF WELDING JOINT

The factor which are affected to tensile strength of welding joint are observed after doing literature survey. From the Fig .1 reason of effect diagram for welding joint

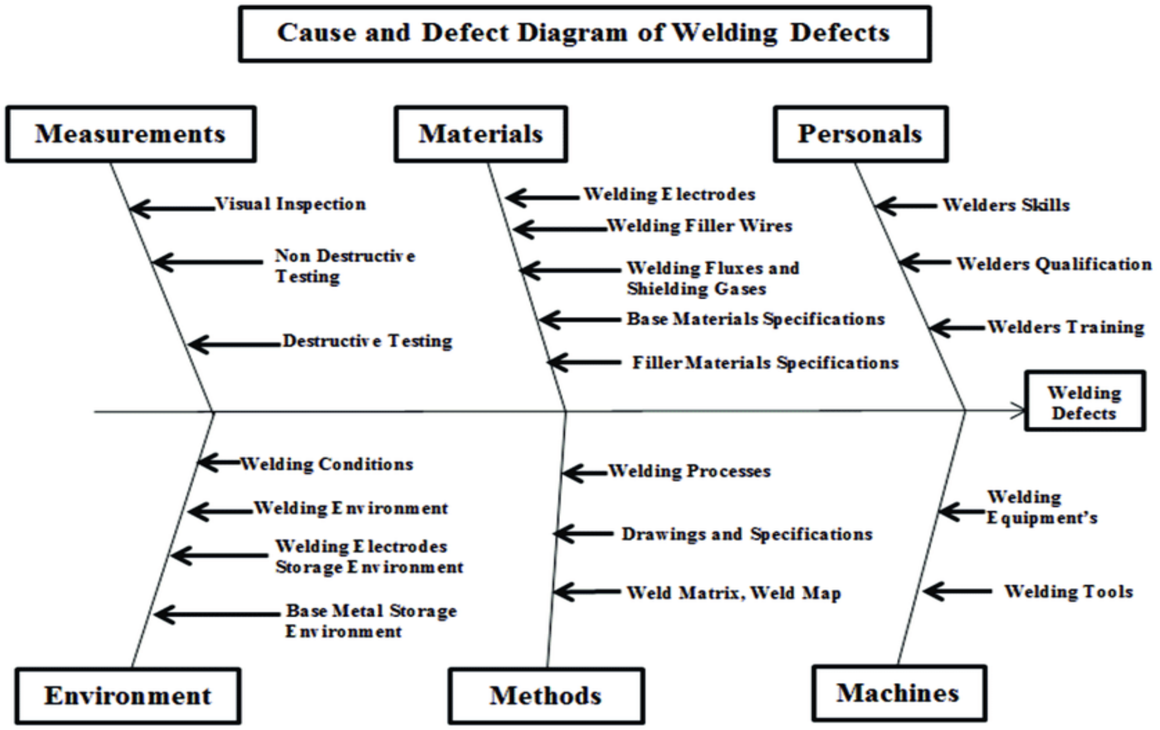


Fig.1 Cause effect diagram for welded joint

WELDING JOINTS OF PROCESS FACTORS

There are different factor which are affect on strength of welding. In which welding current, welding voltage, electrode size, welding speed. Basically by changing current of weld, welding material disposition is varying. Very high current of weld cause's microstructure become very smaller and increase in welding tensile strength and very low current because of base of metal plate not weld properly which lack strength of the joint. The voltage of welding is necessary for proper arc maintenance. For measurement of welding voltage, different techniques are used. These techniques depends on welding process used.
In SMAW and GMAW processes, the welding voltage take between the cable terminals on the welding machine. In GMAW and FCAW processes, the welding voltage take between the work lead at the work connection clamp. If practically is not possible the welding voltage take between terminals on the welding machine. For the SAW operation, the welding voltage take between the electrode lead connection at the torch and the work lead clamp.
If welding speed is too slow, there is result in piling of head. If welding speed is too fast, bead will be sparse and have poor fusion. If welding speed is inversely proportional to penetration.

JOINT GEOMETRY OF WELDING

By changing gap size fatigue life will be improved. By changing overlap length, stress variation of lap zone change. Maximum stress is inversely proportional to overlap length.

VARIOUS TYPES OF LOADING

There are various loading condition according to change in application. In structural application, the joints are subjected to static and fatigue loading. In this two the case of structural application the failure mode may be different due to change in loading condition. In automobile industry, to join different automobile components spot welding is used.

GEOMETRY OF WELDINGS:

Welding geometry affects the strength of the welding joint. In that, curvature radius is inversely proportional to stress. If welding process will have more penetrating power, results in lesser heat affected zone. Filler metal consumption will be also less.
If penetration of electrode will over, causes the melting of the base metal at the toe of weld due to cracking and porosity.

WELDING DEFFECTS:

The defects are produced due to not proper feeding speed of filler wire and distance between filler wire and heat resource. Welding defects means irregularities in welding surface, discontinuities, imperfections occurs in welding parts. Welding defects occurs due to improper weld design and unsuitable welding processes.

EFFECT OF ENVIRONMENTAL FACTOR:

Environmental factor is comes in consideration. During the welding process, Surrounding temperature mainly affect on the welding joint.
If welding process is carried out in hot region, residual stresses generates in welding joint. Humidity create defect in weld. If moisture content in air is more, bubbles in welding joint created, results in weaken the weld and decreases strength of the welded joint.

WORKPIECE PREPARATION:

Parameters which effects on strength of welded joint are process parameters, welding defects, environmental effects and loading conditions. Results are obtained with the help of ANSYS software.
By varying the gap size and overlap length size for same plate and same loading conditions gives different tensile strength. With the help of ANASYS software work is carried out
During the literature review, mild steel rolled sheet thickness varies from 2 mm to 10 mm are used for welded construction of ship, bridges and transport vehicles.
Weld strength is mostly depends on the welding overlap length, gap size and eliminates the stress concentration in overlapping area.

OVERLAP LENGTH SIZE

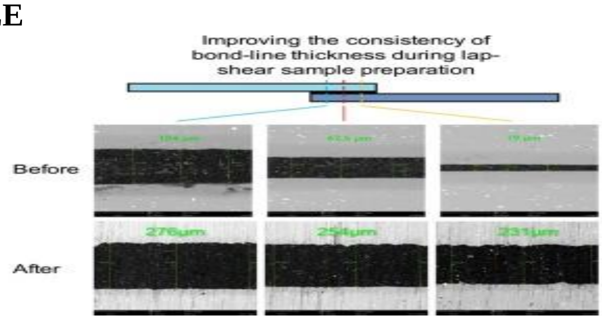


Fig.6 Cad model of overlap length specimen

Fig.6 Cad model of overlap length work-piece the overlap length size is marked on work-piece and correctly welding is done by holding device by the work-piece in C clamp so that accurate overlap length size can be calculated. Work-piece held in C clamp and measurement of length.
One metal plate is over another plate and in between two plates inserted filler gauge after that by C clamp hold the plates and welding the two plates and these filler gauge is removed.

Table.2 Specimen details (Overlap length)

Specimen number	Overlap length
1	21 mm
2	23 mm
3	25 mm
4	27 mm
5	29 mm

GAP SIZE

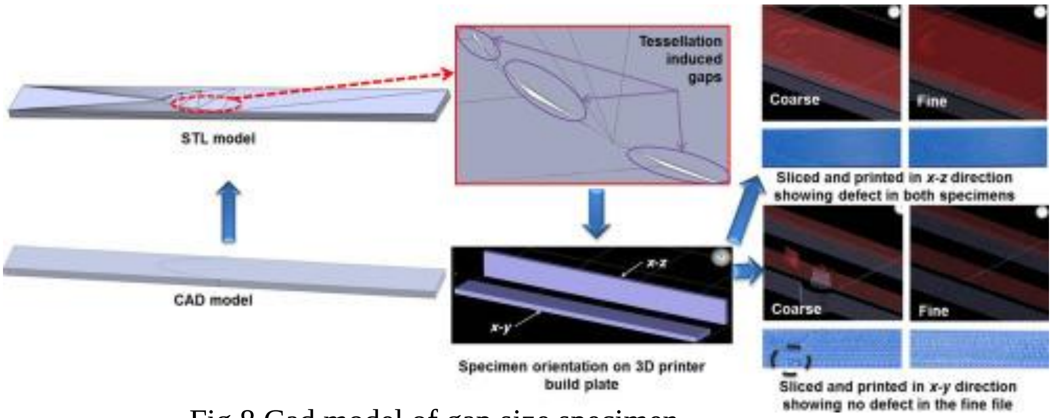


Fig.8 Cad model of gap size specimen

The gap size is maintained by filler gauge. One metal placed over other metal by sandwiching the filler gauge between plates and plates with filler gauge is held by clamp and welding is done then filler gauge is removed. This maintains gap between the plates equal to filler gauge failures

Table.3 Specimen details (Gap size)

Specimen number	Gap size
6	0.2 mm
7	0.4 mm
8	0.6 mm
9	0.8 mm
10	1 mm

EXPERIMENTATION

EXPERIMENTATION BY VARYING OVERLAP LENGTH

What happens if overlap length varied? Five specimens are prepared as per table and testing was carried out that are discussed below.

ISSN: 2394-3696 Website: ijiert.org
VOLUME 7, ISSUE 9, Sep.-2020

OBSEVATION OF WORK-PIECE 1:

Fig.10 Photo of workpiece 1

Fig. 10 work-piece 1. The work-piece with overlap length size 21 mm is tested.
Fig. 11 shows load and displacement graph

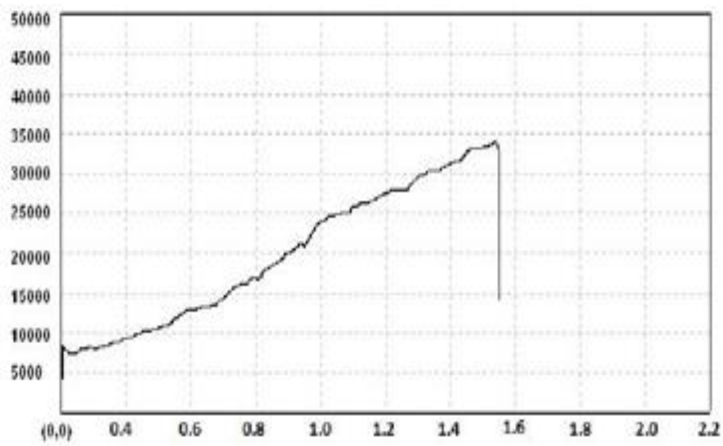


Fig.11 Graph of workpiece 1

Fig.11 work-piece 1 graph This fails at 34.5 KN and 1.57 mm elongation.
The same situation is simulated in ANSYS software and results are shown in fig.12

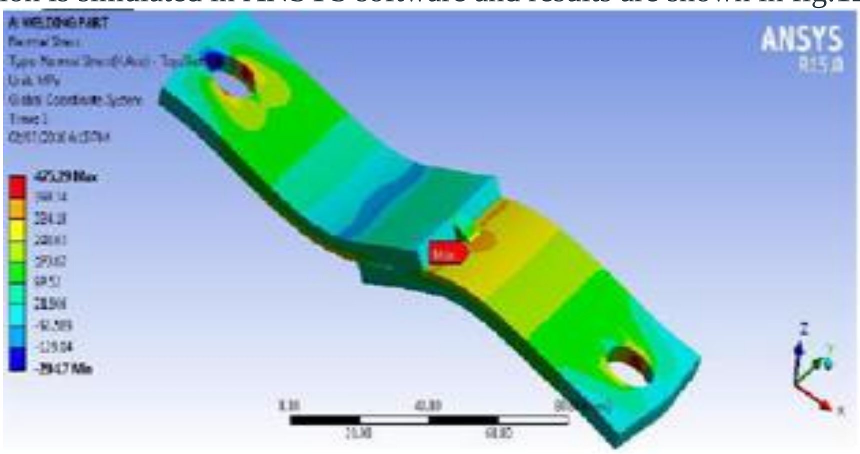


Fig.12 Simulation of workpiece 1

Sr. No	Tensile strength		% deviation
	Value evaluated by experimentally	Value evaluated by simulation	
1	34.5	32.41	6.05

OBSERVATION OF WORKPIECE 2:

Fig.13 Photo of workpiece 2

Fig.13 Photo of work-piece 2 overlap length size is 23 mm of work-piece 2 will be tested and Below fig. show that load and displacement graph diagram and results are shown in fig.14

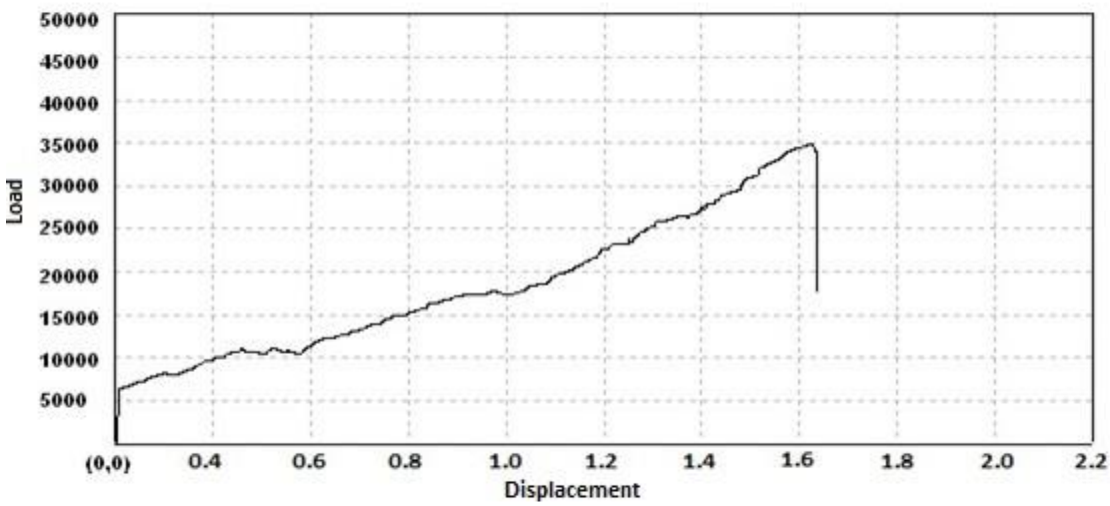


Fig.14 Graph of workpiece 2

Fig.14 Graph of work-piece 2 This work-piece breaks at 36 KN and 1.85 mm is increase of length. The same situation is simulated in ANSYS software as shown in fig.15

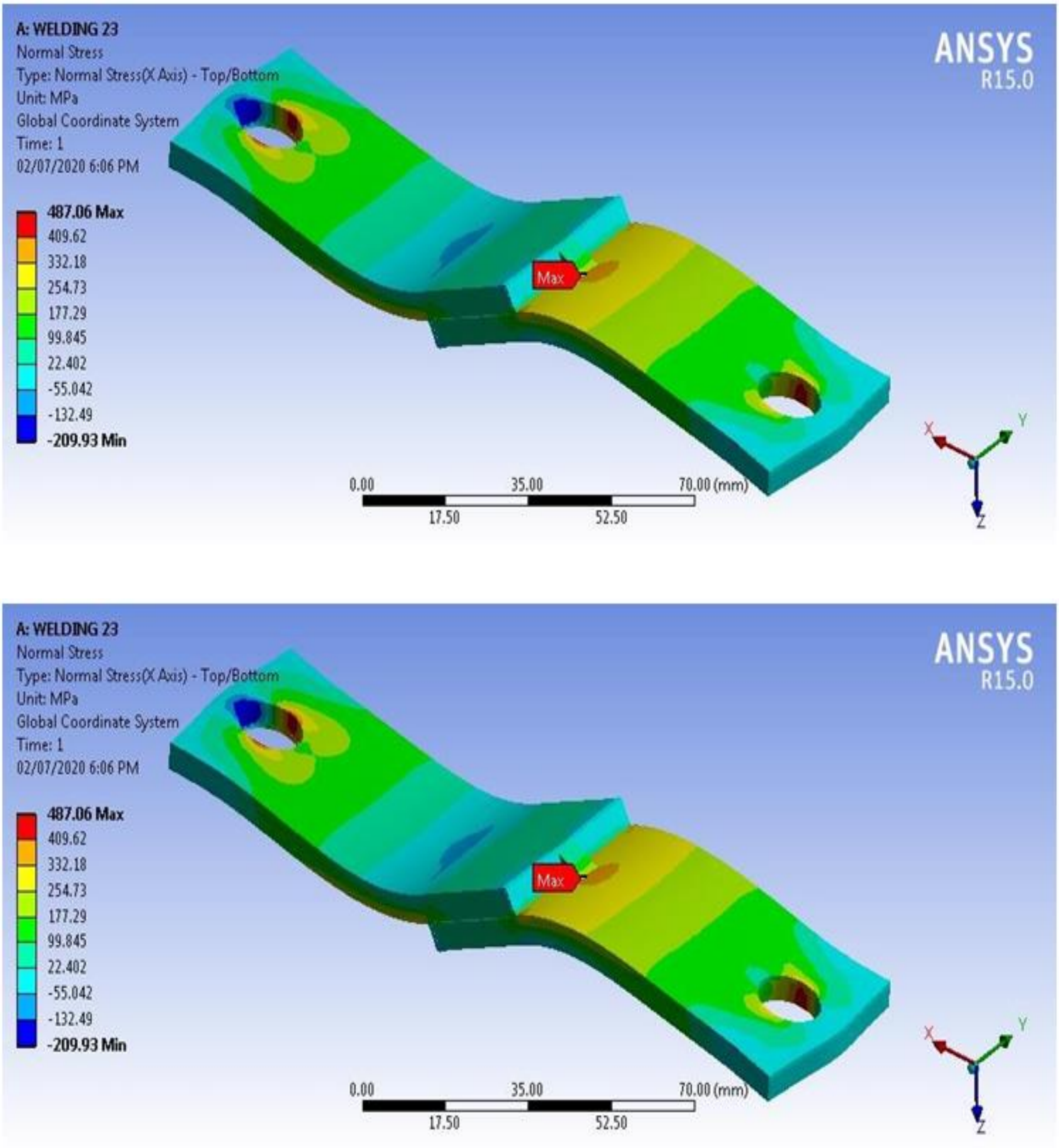


Fig.15 Simulation of workpiece 2

Sr. No	**Tensile strength**		**% deviation**
1	**Value evaluated by experimentally**	**Value evaluated by simulation**	
	36	33.22	5.12

OBSEVATION OF WORKPIECE 3:

Fig.16 Photo of workpiece 3

Fig.16 Photo of work-piece 3 overlap length size is 25 mm of work-piece 3 will be tested and below fig. shows that load and displacement graph diagram.

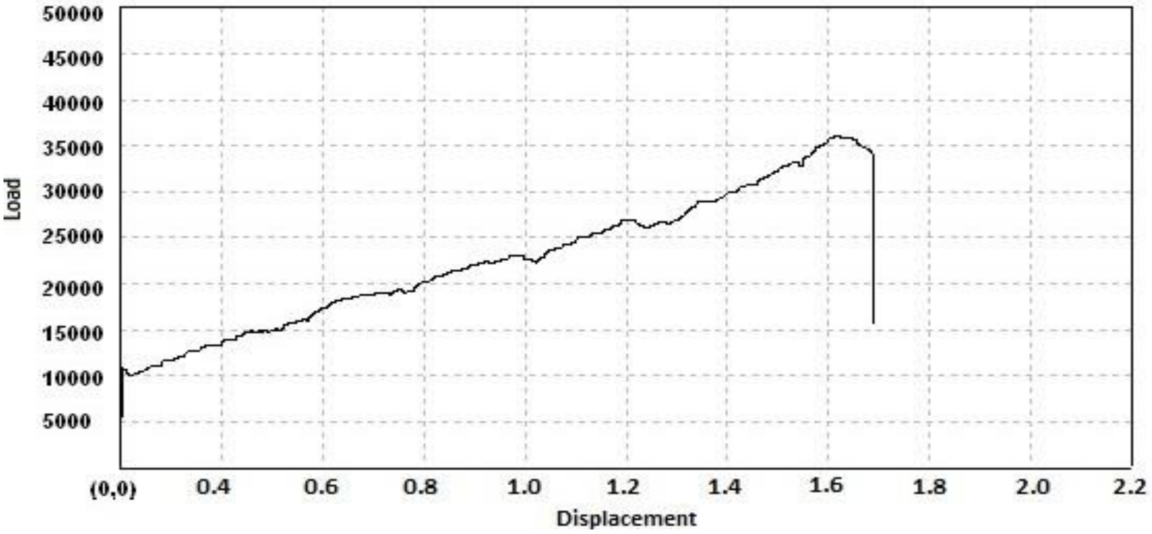
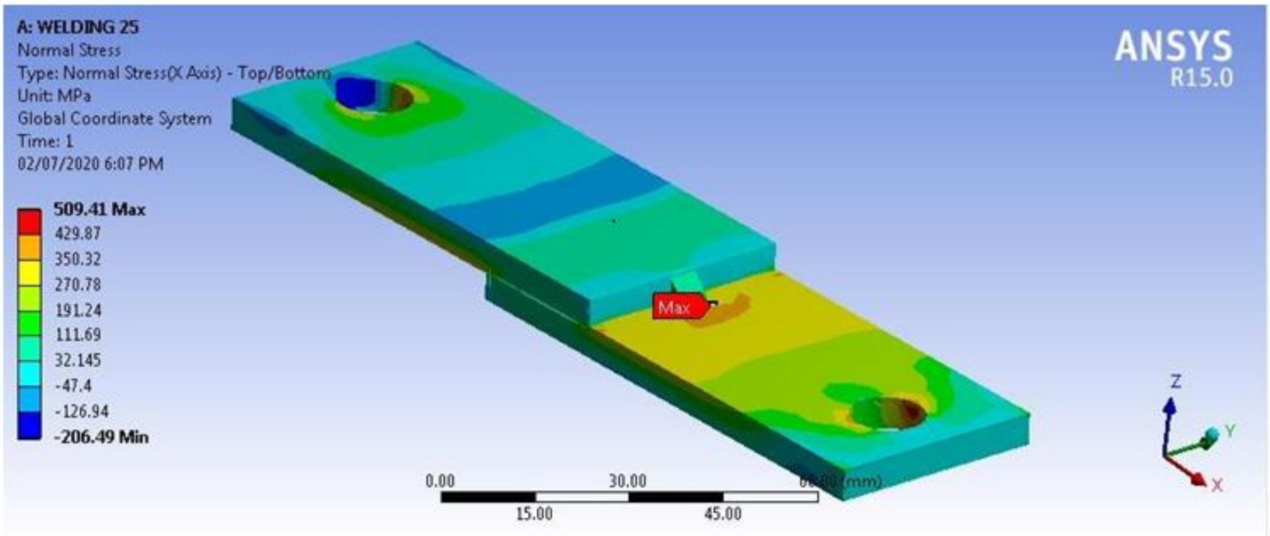


Fig.17 Graph of workpiece 3

This work-piece breaks at 36 KN and 1.69 mm is increase of length. The same situation is simulated in ANSYS software.



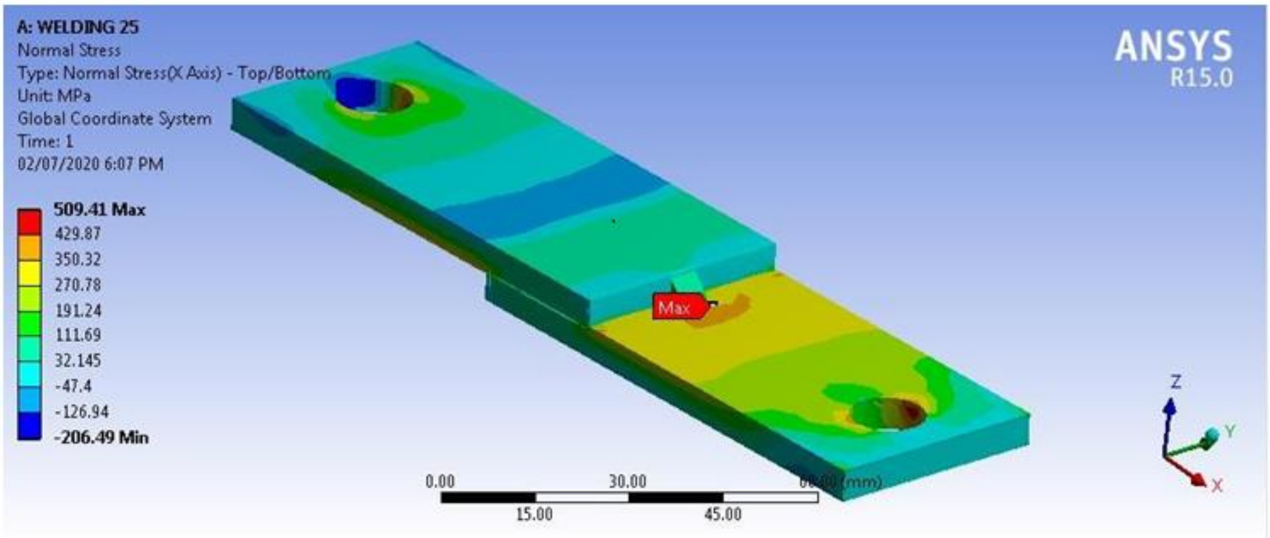


Fig.18 Simulation of workpiece 3

Sr. No	**Tensile strength**		**%deviation**
1	**Value evaluated by experimentally**	**Value evaluated by simulation**	
	36	35.03	2.69

OBSERVATION OF WORKPIECE 4

Fig.19 Photo of workpiece 4

Fig.19 Photo of work-piece 4 overlap length size is 27 mm of work-piece 4 will be tested and below fig. show that load and displacement graph diagram.

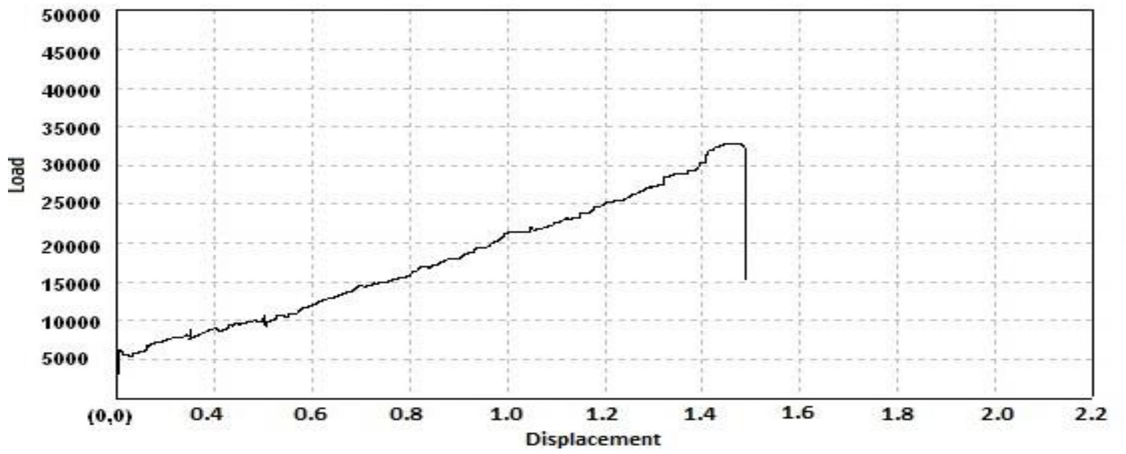
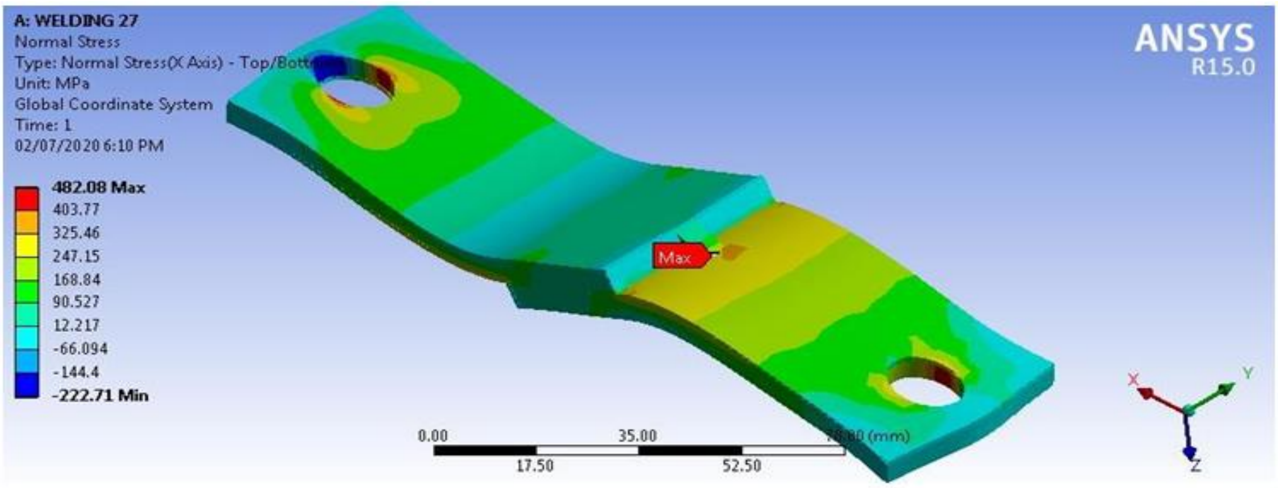


Fig.20 Graph of workpiece 4

This work-piece breaks at 34.2 KN and 1.51 mm is increase of length. The same situation is simulated in ANSYS software shown in fig. of simulation of work-piece.



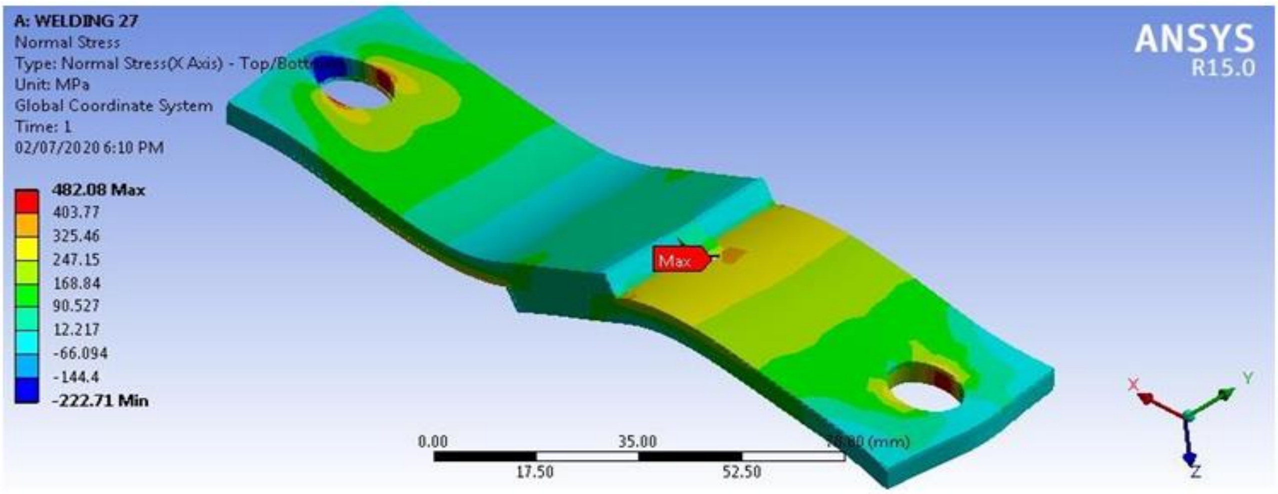


Fig.21 Simulation of workpiece 4

Sr. No	**Tensile strength**		**% deviation**
1	**Value evaluated by experimentally**	**Value evaluated by simulation**	
	34.2	32.55	4.58

OBSEVATION OF WORKPIECE 5

Fig.22 Photo of workpiece 5

Fig.22 Photo of work-piece 5 overlap length size is 29 mm of work-piece 5 will be tested. and below fig. shows that load and displacement graph diagram

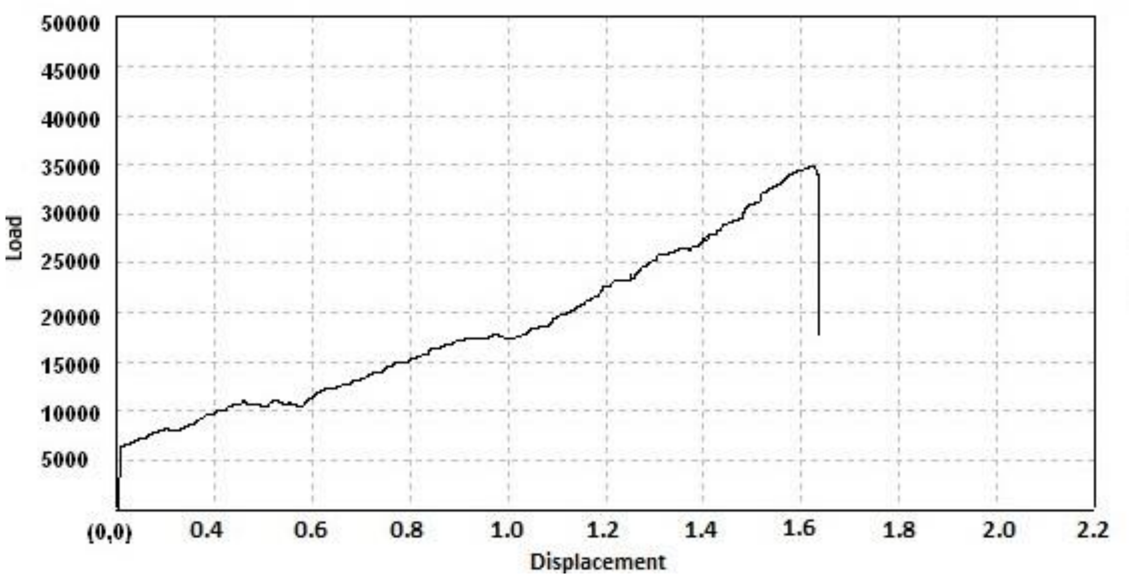


Fig.23 Graph of workpiece 5

Work-piece 5 this work-piece breaks at 35.2 and 1.65 mm is increase of length. The same situation is simulated in ANSYS software as shown fig. of simulation of work-piece.

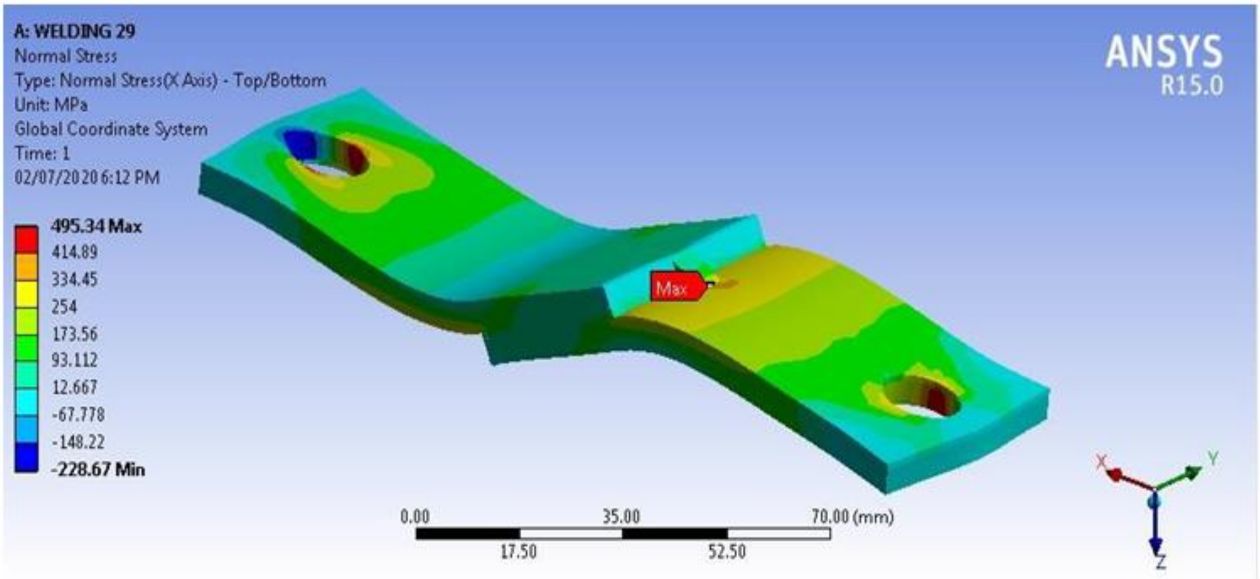


Fig.24 Simulation of work piece 5

Sr. No	Tensile strength		% deviation
1	Value evaluated by experimentally	Value evaluated by simulation	
	35.4	33.45	4.73

The maximum deviation obtain is 6.03. Hence we can say that results obtained by experimentally are validated successfully.

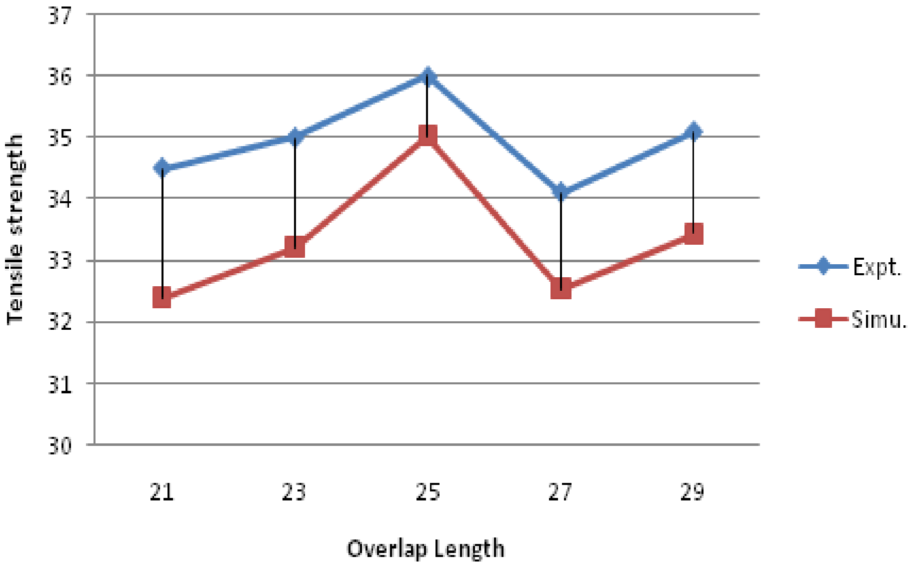


Fig.25 Difference between experimental and simulation results

Above fig shows that the joint gives max amount of tensile strength of 36 KN at 25 mm overlap length. Hence 25 mm overlap must be consider while using 5 mm plate welding of lap joint this overlap length will be considered for further experimentation.

OBSERVATION WITH VARIATION IN GAP SIZES
OBSERVATION OF WORKPIECE 6


Fig.26 Photo of workpiece 6

Fig.26 Photo of work-piece 6 the work-piece of gap size 0.2 mm is tested and belows fig.27 shows that graph of load and displacement diagram.

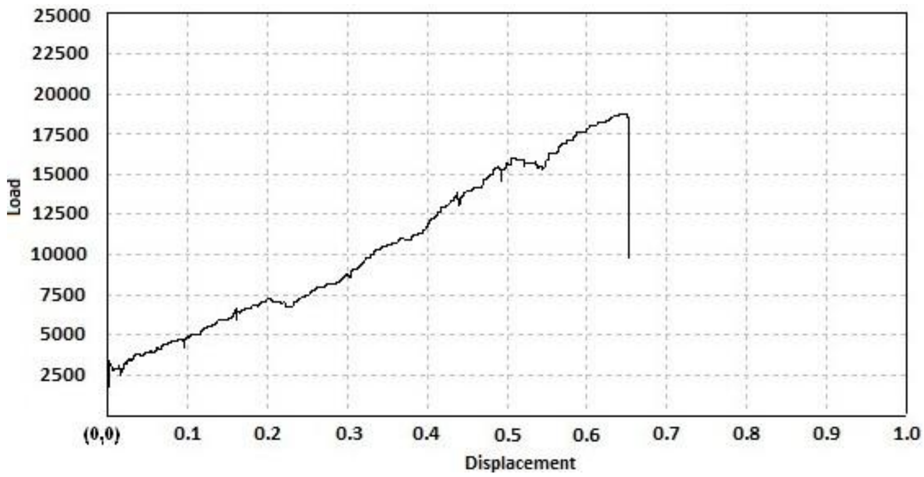


Fig.27 Graph of workpiece 6

This work-piece breaks at 18.220 KN at 0.66 mm elongation.

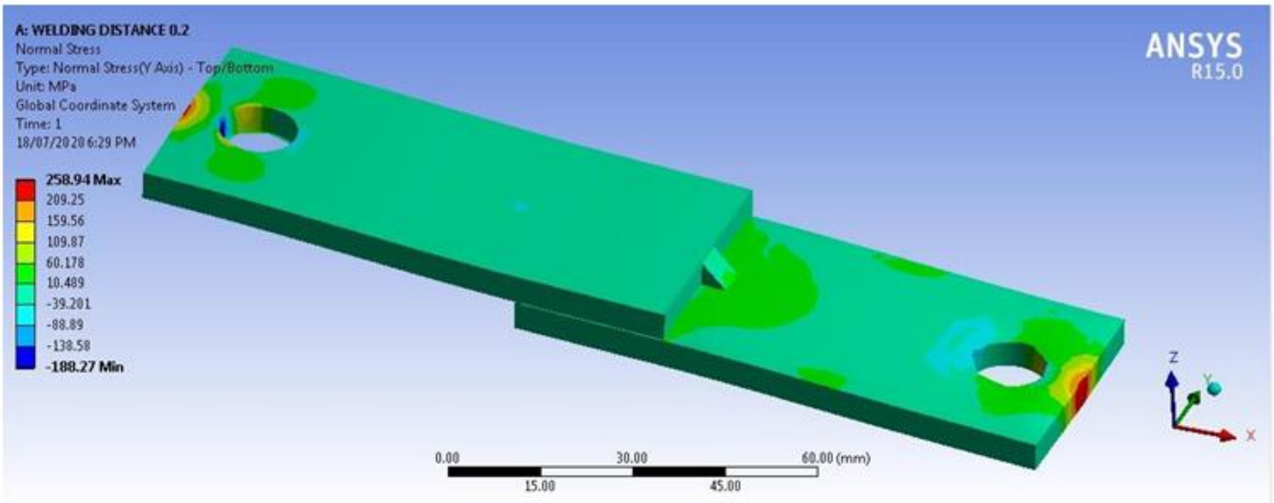


Fig.28 Simulation of workpiece 6

The same situation is in simulated in ANSYS software and results are shown in Fig.28

Sr. No	**Tensile strength**		**% deviation**
1	**Value evaluated by experimentally**	**Value evaluated by simulation**	
	18.220	15.957	12.40

OBSERVATION OF WORKPIECE 7

Fig.29 Photo of workpiece 7

Fig.29 Photo of workpiece 7 The work-piece of gap size 0.4 mm is tested and bellows fig.30 shows that graph of load and displacement diagram

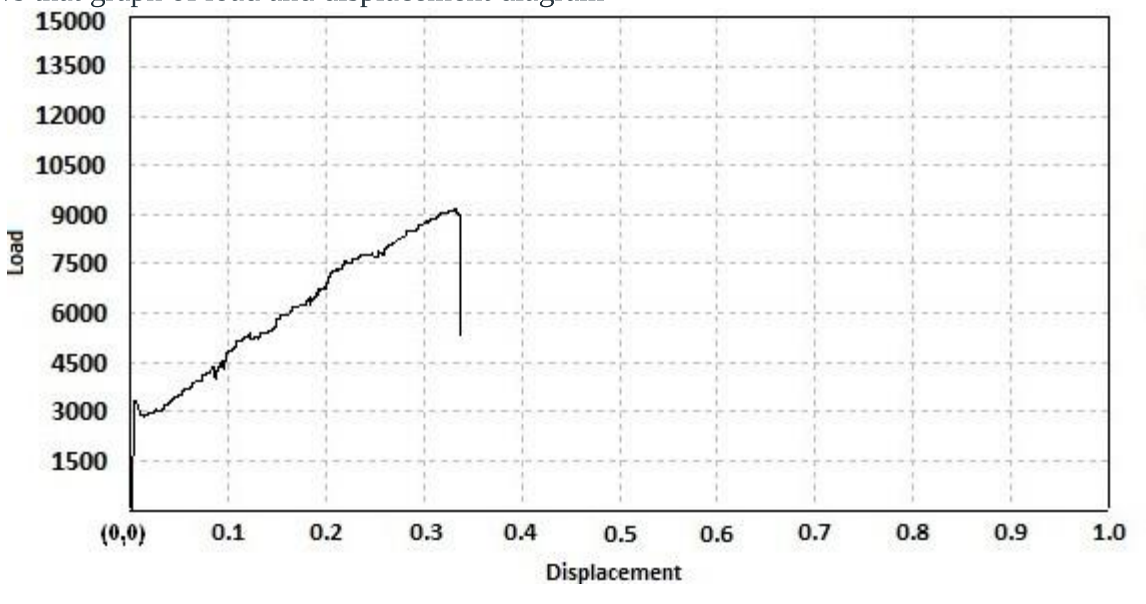


Fig.30 Graph of workpiece 7

This work-piece breaks at 9.105 KN at 0.35 mm elongation. The same situation is in simulated in ANSYS software and results are shown in Fig.31

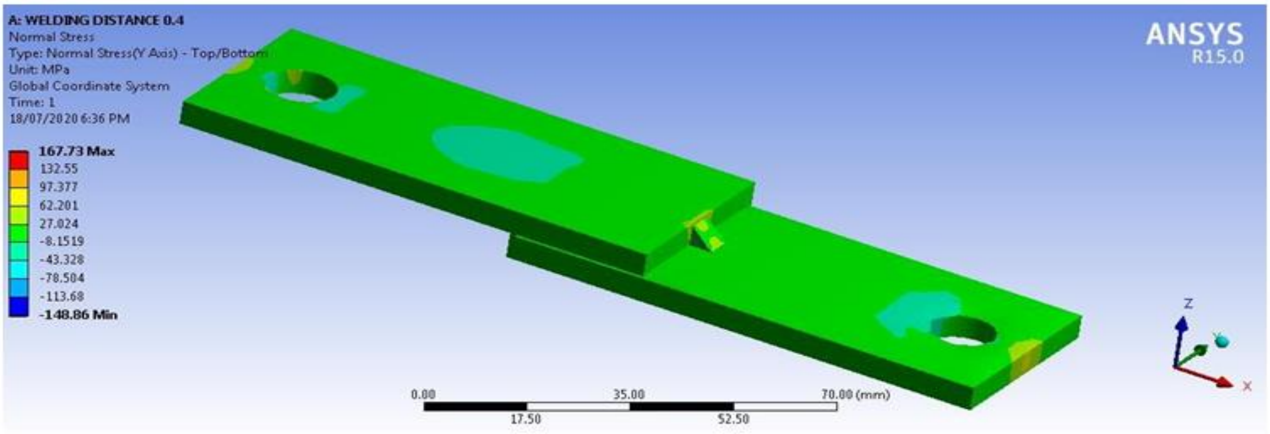


Fig.31 Simulation of workpiece 7

Sr. No	Tensile strength		% Deviation
	Value evaluated by experimentally	Value evaluated by simulation	
1	9.105	6.28	31.13

OBSERVATON OF WORKPIECE 8:

Fig.32 Photo of workpiece 8

Fig.32 Photo of work-piece 8 The work-piece of gap size 0.6 mm is tested and bellows fig.33 shows that graph of load and displacement diagram.

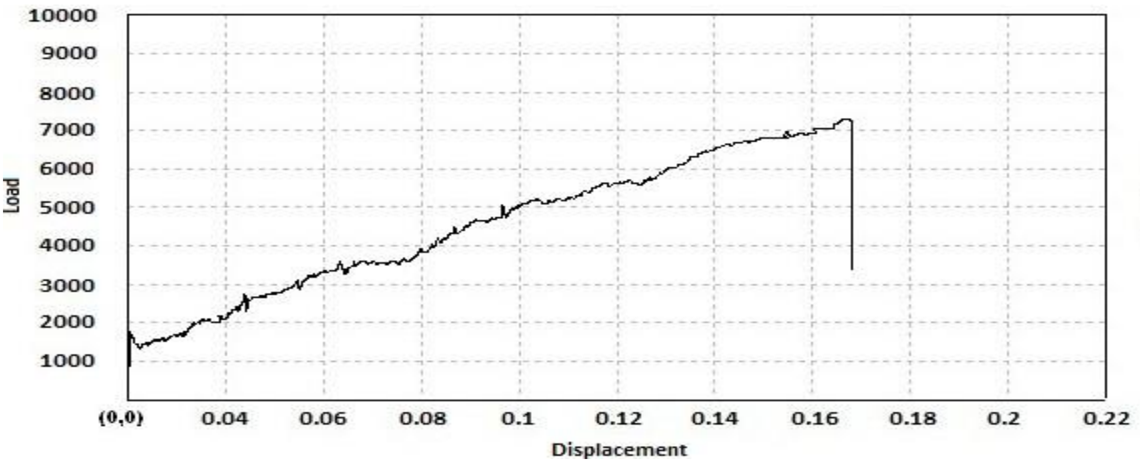


Fig.33 Graph of workpiece 8

This work-piece breaks at 7.253 KN at 0.167 mm elongation.
The same situation is in simulated in ANSYS software and results are shown in fig.34

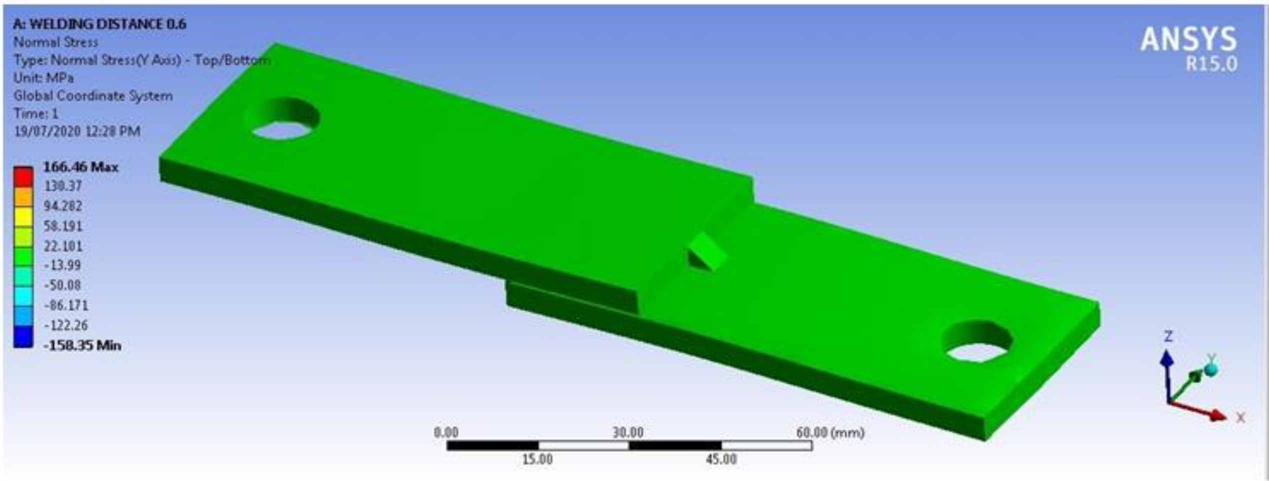


Fig.34 Simulation of workpiece 8

Sr. No	**Tensile strength**		**% Deviation**
1 .	**Value evaluated by experimentally**	**Value evaluated by simulation**	
	7.253	5.819	19.77

OBSERVATOIN OF WORKPIECE 9

Fig.35 Photo of workpiece 9

Fig.35 Photo of work-piece 9 The work-piece of gap size 0.8 mm is tested and bellows fig.36 shows that graph of load and displacement diagram.

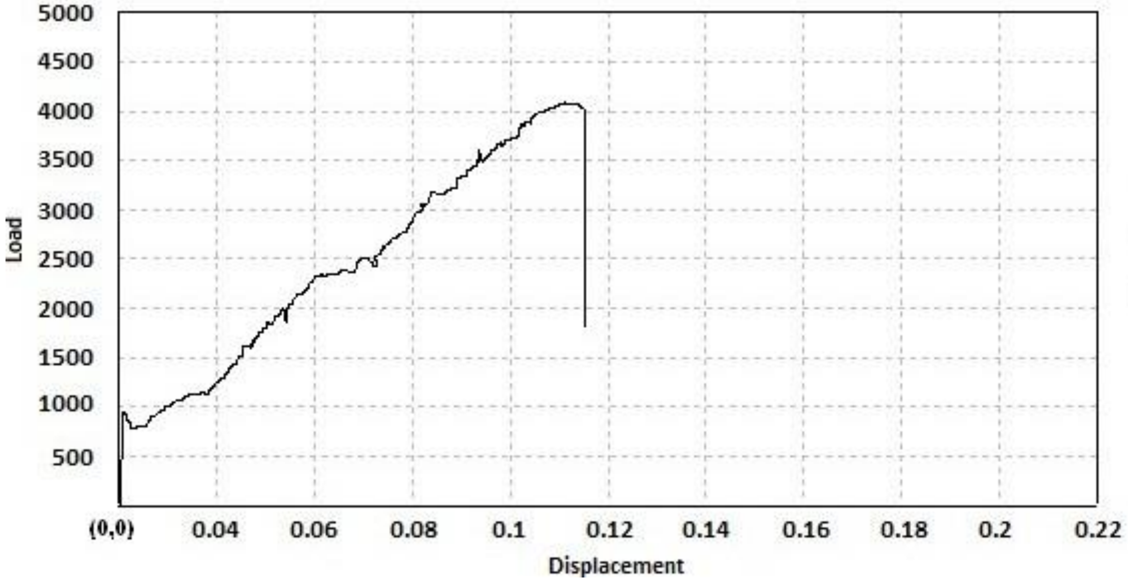


Fig.36 Graph of workpiece 9

This work-piece breaks at 4.468 KN at 0.119 mm elongation. The same situation is in simulated in ANSYS software and results are shown in fig.37

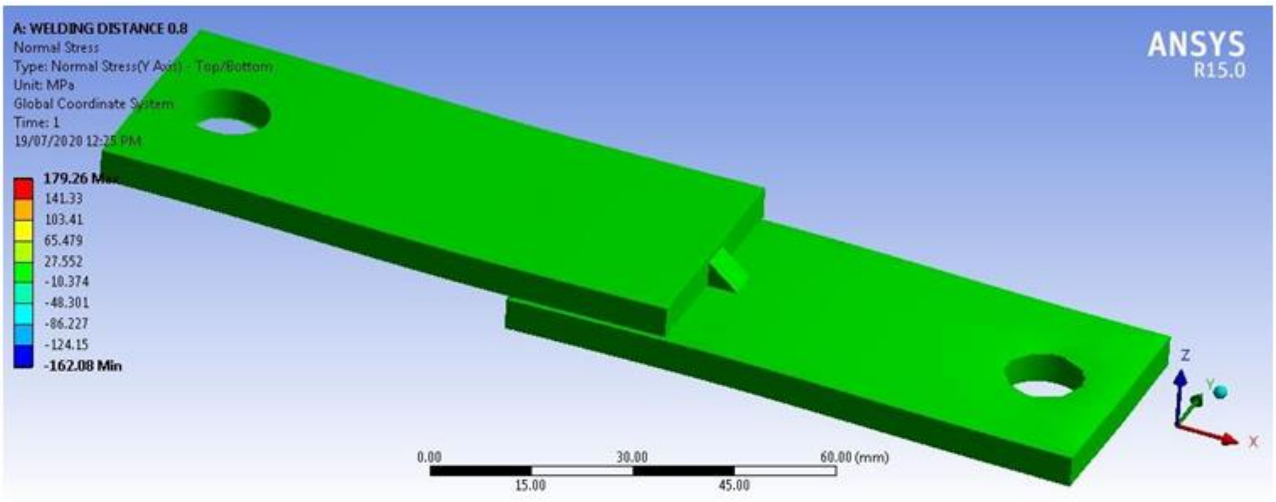


Fig.37 Simulation of workpiece 9

Sr. No	Tensile strength		% deviation
1	Value evaluated by experimentally	Value evaluated by simulation	
	4.468	2.756	38.326

OBSERVATION OF WORKPIECE 10

Fig.38 Photo of workpiece 10

Fig.38 Photo of work-piece 10. The work-piece of gap size 0.9mm is tested and bellow fig.39 shows that graph of load and displacement diagram.

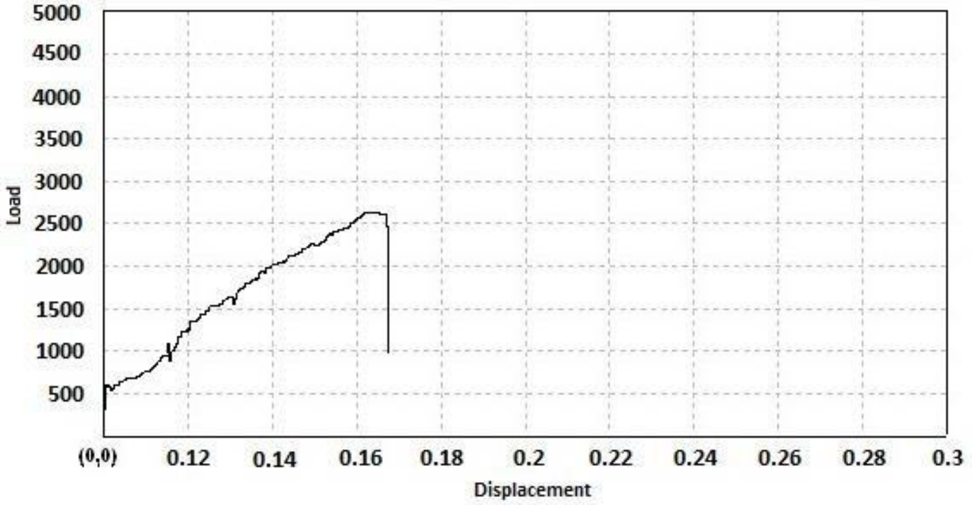


Fig.39 Graph of workpiece 10

Work-piece breaks at 2.632 KN at 0.168 mm elongation. The same situation is in simulated in ANSYS software and results are shown in fig.40

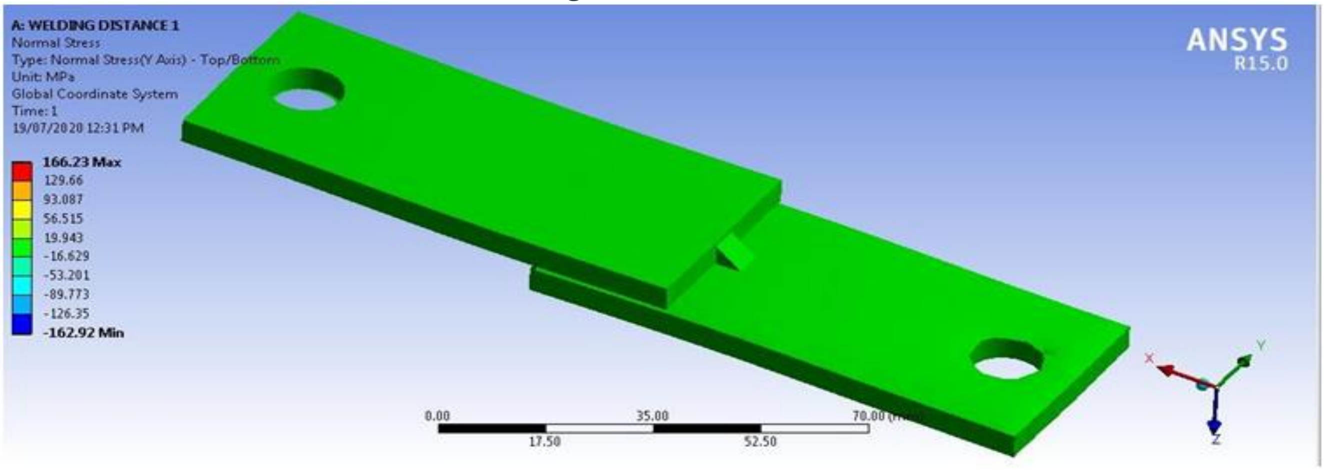


Fig.40 Simulations of workpiece 10

Sr. No	Tensile strength		% Deviation
	Value evaluated by experimentally	Value evaluated by simulation	
1	2.632	1.995	24.22

Max deviation is calculated is 38.325 KN. Hence we clear that values are calculated by using gap size on experimentally setup with validated with ANASYS software.

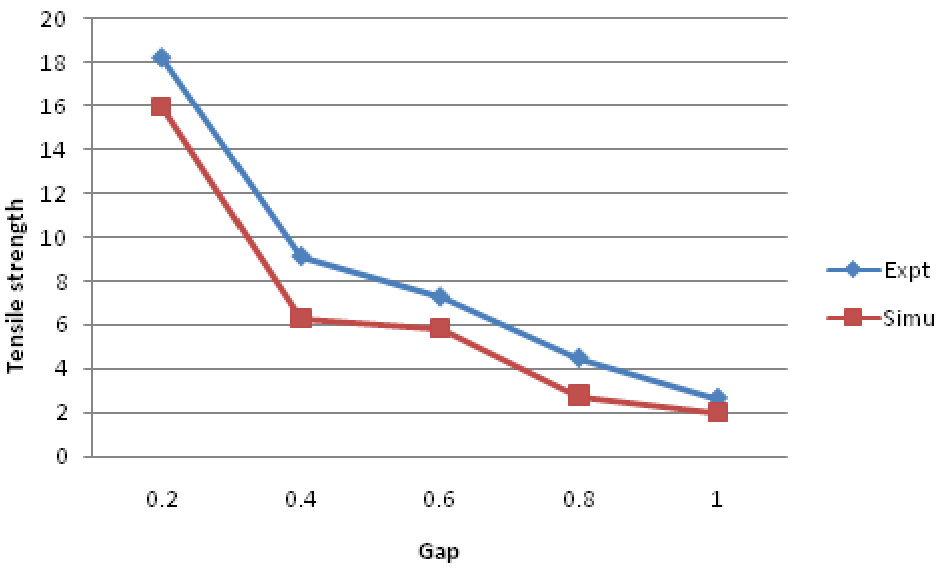


Fig.41 Difference between experimental and simulation result

The graph shows that increasing the gap size reduces the tensile strength.

CONCLUSION

Various types of design parameters are observed and effect of these parameters on lap welded joint strength is worked. Mathematically design procedure was considered for designing fixture to adjust the work piece.

The work piece dimensions were obtained and work piece were prepared by changing gap size and overlap length size. The stress values calculated from experimentation and values calculated by simulation are compared for validation of experimentation. a) The strength calculated by changing of overlap length size shows maximum strength of 36 KN with 25 mm overlaps length size. This refers that while using 5 mm thick plates for welded joint 25 mm overlap is refer. b) Increasing the overlap length size above 25 mm results in lack strength and decreasing overlap length size below 25 mm will also decrees tensile strength. c) Variation in between gap size shows maximum strength of 18.215 KN with 0.2 mm gap size. Increasing ahead the gap size decreases the tensile strength. So it is refer to that keep the gap size as min. as possible. d) With less in between gap size the chance of work piece rotation is also reduced. Because of reduction in gap size decrees eccentricity in loading.

FUTURE SCOPE OF WORK

Experimentation for welding lap joint by changing welding current, welding voltage and welding speed can be done. Mathematical model produced for presenting relation between thickness of plate and overlap length size for the purpose of standardization.

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