SIMULATION AND EXPERIMENTAL ANALYSIS OF ALLOY STEELS USING CO_2 GAS WELDING PROCESS

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***Abstract*—** The usage of various kinds of welding to join the materials by metal industrial in day to day .The maximum capacity of the accecible joining processes has been observed by assembling and outlining specialist.In this project,the comparision of Experimental & Simulation of carbon dioxide gas welding method with the material SM490A & SM520B steel as work piece that are adopted so as to seek out the following objectives by each through an experimentally and Analytically. The objectives are to assess the welding simulation capabilities of the commercial computer software package ANSYS. To evaluate three different plate lap-joint designs, undergoing welding. To compare Experimental & Simulated Analysis with regard to maximum welding durability. Evaluate the verification of experimental and Numerical results. A sample containing three items for carbon dioxide gas welding relying upon the worth for the weld time, current and also the voltage so as to outline the variability of the durability of the samples. The tensile testis carried out using uniformely varying load upto rupture strength . The experimentation is carried in three cases (490A+490A, 520B+520B and 490A+520B) for these three cases strength analysis were conducted. The finite part analysis is employed for the analysis of joints within the plane – stress condition, underneath static load. underneath finite part analysis we tend to used the static structural analysis. Modeling is completed in NX CAD and analysis is completed in ANSYS.

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Keywords: ***SM490A & SM520B structural steel***, CO_2 Gas Welding , Tension Testing Machine, NX CAD, ANSYS.

1.INTRODUCTION

In a welding method, the first task is to pick a combination of process variables that produces a suitable quality level for production. in a very range of printed studies, many strategies are planned to predict and perceive the consequences of the method variables on attachment performance. Generally, two major independent analysis areas are used to enhance welding performance. These areas include the empirical methodology supported studies of real welding things, and mathematical model- or simulated design- primarily based studies. during this project we tend to shows the welding simulation capabilities of the industrial computer code package ANSYS by comparison both Experimental & Simulated Analysis with regard to most welding durability. ANSYS is AN object-oriented programming setting that has the flexibility to totally access and manipulate the model. Static Structural Analysis is disbursed to the work piece.

2. MATERIAL & ITS PROPERTIES

SM 490A Alloy Steel

SM 490A Alloy steel has excellent weld ability and produces a uniform and harder case and it has good ductility, toughness and strength.

SM 520B Alloy Steel

SM 520B Alloy steel. It has high hardenable and it is very suitable for wear and corrosion resistance

ELELMENT	CONTENT	
	SM 490A	SM 520B
Carbon, C	≤ 0.20 %	≤ 0.25%
Iron, Fe	98.81 – 99.26 %	98.81 – 99.26 %
Manganese, Mn	≤ 1.6%	0.60 – 1.7 %
Phosphorous, P	≤ 0.035 %	≤ 0.040 %
Sulphur, S	≤ 0.035 %	≤ 0.050 %
Silicon,Si	≤ 0.55	0.02 – 0.61%

TABLE 2.0

CHEMICAL COMPOSITION OF SM 490A

SPECIMEN GEOMETRY : The geometry of single lap joint used for the analysis is taken as follows

Length: 125mm Width: 75mm Thickness: 6mm

SM 490A Alloy Steel

Young's Modulus: 205GPa Poisson's Ratio: 0.29

SM 520B Alloy Steel

Young's Modulus: 200GPa Poisson's Ratio: 0.295

3.EXPERIMENTAL PROCEDURE

WELDING PROCESS USED:

CO_2 Gas welding : it's a fussion welding process wherever change of joint takes place by an electrical arc sheilded by carbon dioxide gas and conductor is expendable. Gas metal arc welding (GMAW) , generally noted by its sub sorts metal element (MIG) welding or metal active gas (MAG) attachment , may be a semi-automatic or automatic arc welding method within which never-ending and expendable wire conductor and a shielding gas area unit fed through a welding gun.

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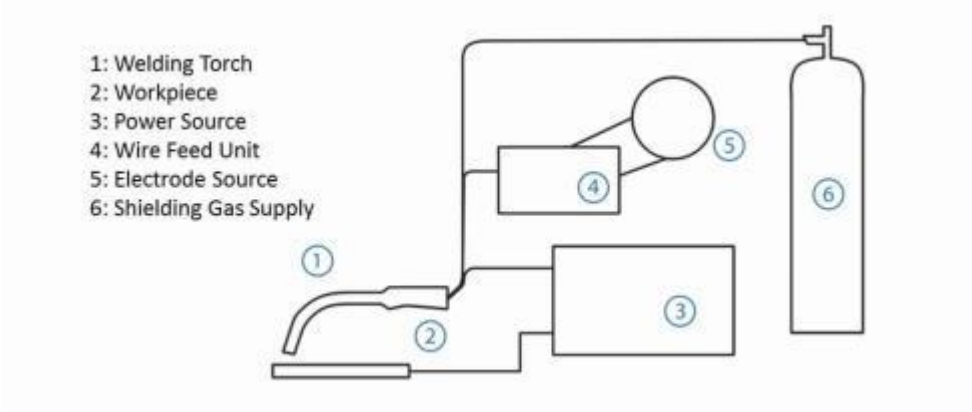

Fig 3.0: CO_2 Gas Welding

WELDING JOINT USED:

Double side Lap Weld Joint: The joint created by halving the thickness of every member at the joint and fitting them along. For change of combination of two totally different materials of varied thickness the splice is used. Dissimilar to a butt weld, the splice doesn't need that the plates to be parallel. For Double facet splice the welding is completed on the each side of plates.

Fig 3.1 : Test models of Weld lap joint

WELDING PROCESS PARAMETERS:

The thermal energy is supplied to the weld by three inputs current, voltage and weld time followed by each other, which are active for welding and their respective parameters are found in the Table.

MODELS	CURRENT (AMPERES)	VOLTAGE (VOLTS)	WELD TIME (INCH/SEC)
SM490A+SM490A	120	220	0.066
SM520B+SM520B	120	220	0.054
SM490A+SM520B	120	220	0.0495

Table 3.2 : Welding Process Parameters

METHOD OF MEASUREMENT

A sample containing three items for carbon dioxide Gas welding relying upon the worth for the weld time, current, voltage and gas flow rate so as to outline the variability of the durability of the samples. The tensile test at is disbursed mistreatment uniformly varied lade to rupture strength. The experimentation is split into three cases (490A+490A, 520B+520B and 490A+520B) for these three cases strength analysis were conducted.

Fig 3.3: A tension test machine

4.EXPERIMENTATION RESULTS AND DISCUSSION:

S.No	SM 490A+SM490A		SM 520B+SM 520B		SM 490A+SM 520B	
	FORCE (N)	STROKE (MM)	FORCE (N)	STROKE (MM)	FORCE (N)	STROKE (MM)
1	0	0	0	0	0	0
2	1500	7.2	1500	6.6	1500	12.54
3	5000	13.5	5000	12.9	5000	25.68
4	35000	20.41	35000	18.56	35000	39.15
5	150000	26.7	150000	25.32	150000	54.02
6	250000	33.85	250000	30.90	250000	67.11
7	180000	31.08	180000	32.64	180000	69.79

S.No	SM 490A+SM 490A		SM 520B+SM 520B		SM 490A +SM 520B	
	STRESS (N/MM^2)	STRAIN	STRESS (N/MM^2)	STRAIN	STRESS (N/MM^2)	STRAIN
1	0	0	0	0	0	0
2	2.1345	0.0001	1.52112	0.0001	1.1304	0.0001
3	3.4152	0.18186	5.5776	0.1972	3.3913	0.18194
4	4.2690	0.3637	35.4940	0.3944	9.0435	0.3638
5	21.3454	0.5456	190.1468	0.5916	22.6088	0.5458
6	258.2793	0.785	269.852	0.757	276.664	0.7277
7	64.036	0.7412	163.2727	0.82	203.4797	0.7894

Tables 4.1: Experimental Results

After doing range of iterations we tend to get totally different values of most stress corresponding deformations most load which will be sustain by the model. therefore totally different graphs area unit aforethought on the idea of the that knowledge.

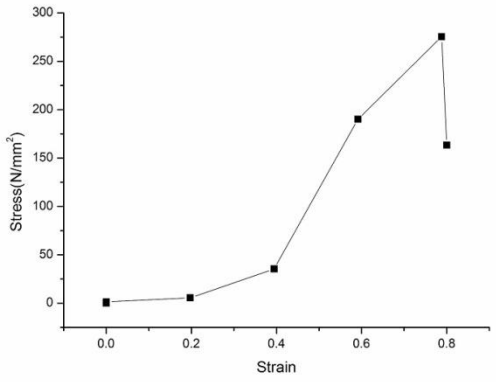

Fig 4.2: Stress-Strain Analysis for SM490A+SM490A alloy steel plates

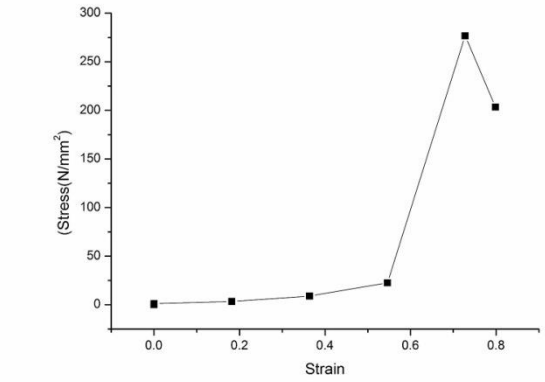

Fig 4.3: Stress-Strain Analysis for SM 520B + SM 520B

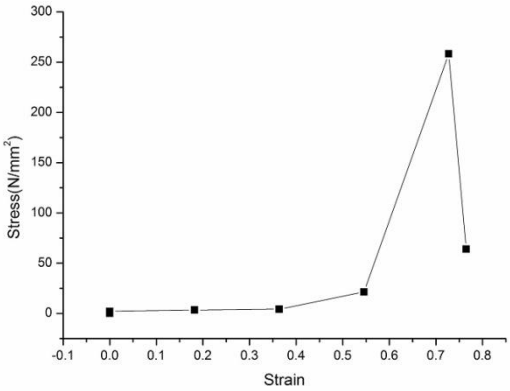

Fig 4.4: Stress-Strain Analysis for SM 490A+SM 520B

In initial case (i.e., SM 490A+SM490A) as there's increment in strength of weld joint. Quality of weld joint is increasing directly with increment operative. because the load is exaggerated the deformation when reaching final durability the equivalent strain is 0.78. the most force is 250 KN of durability 258.26 Mpa

In Second case (i.e., SM 490A+SM 520B) as there's increment in strength of weld joint. Quality of weld joint is increasing directly with increment operative. because the load is exaggerated the deformation when reaching final durability the equivalent strain is 0.72. the most force is 250K KN of durability 276.66Mpa.

In third case(i.e., SM 520B+SM 520B) as there's increment in strength of weld joint. Quality of weld joint is increasing directly with increment operative. because the load is exaggerated the deformation when reaching final durability the equivalent strain is 0.75. the most force is 250 KN of durability 269.852Mpa.

This impact is same for the deformation conjointly because of application of restraining force there's sure modification in deformation of weld joint however still it's not goodly.

Sample	Tensile strength (Mpa)	Fracture Location
SM490A+SM490A	269.85	Broken at weld
SM490A+SM520B	276.66	Broken Outside the weld
SM520B+SM520B	258.26	Broken at Outside the weld

Table 4.6:

Experimental test report of SM Steel Flat Plates

5. SIMULATION PROCEDURE

The Welding department of the corporate perpetually develops new and improved welding routines. to enhance this method the welding engineer at the welding department desires to own the chance to stimulate with FEA-program, the results can cut back the time and alter the welding developments.

The distribution of stress in several welded Joints is investigated with a pc modelling technique. Finite part methodology (FEM) may be a numerical technique wont to perform Finite part Analysis (FEA) of any physical phenomena like structural behaviour.The finite part analysis is employed for the analysis of joints within the plane – stress condition, underneath static load. underneath finite part analysis we tend to used the static structural analysis. Modelling is completed in NX CAD and analysis is completed in ANSYS

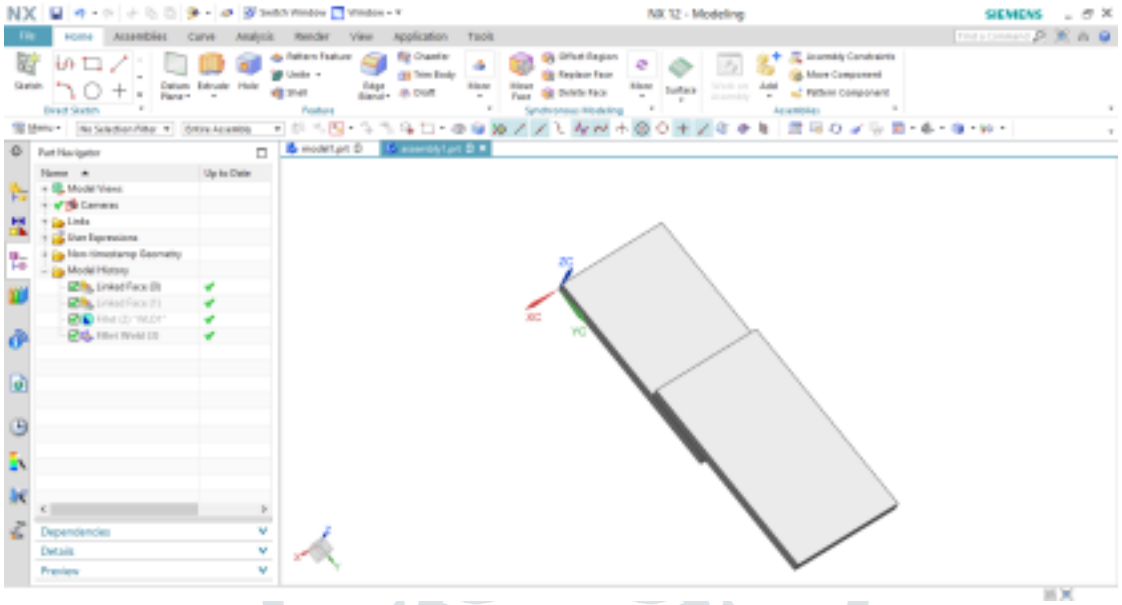

Fig 5.1: Design of Lap joint for SM490A & SM 520B In NX CAD

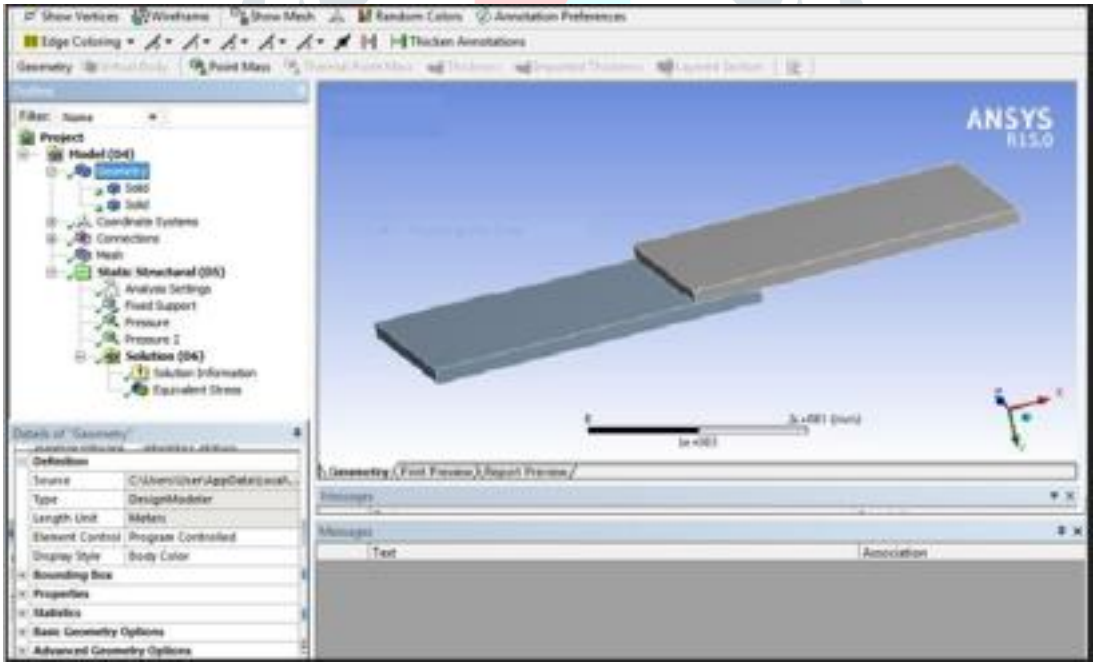

Fig 5.2: Imported model in ANSYS

PERFORMING STATIC STRUCTURAL ANALYSIS
MATERIAL: SM 490A +SM 520B

EQUIVALENT STRESS:

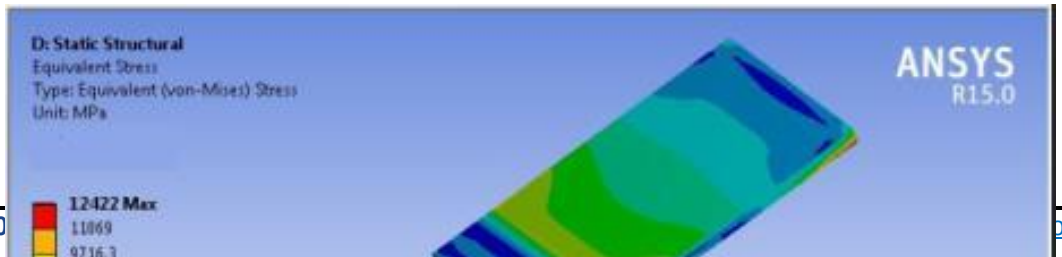

Fig 5.4: Stress for Weld Lap joint of SM 590A + SM 520B plates

EQUIVALENT STRAIN:

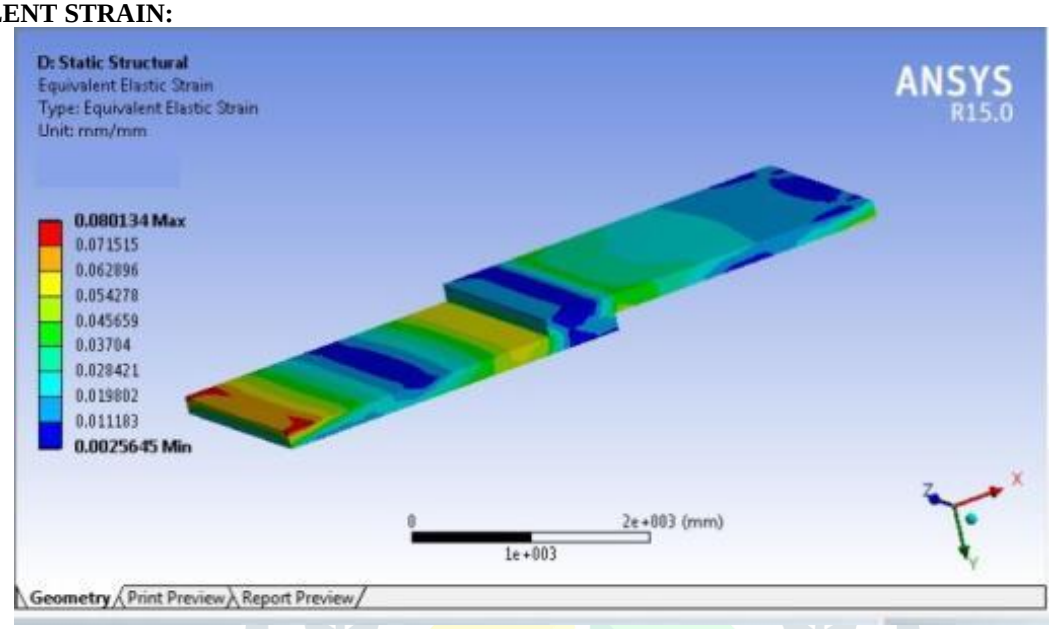

Fig 5.5: Strain for Weld Lap joint of SM 490A+ SM 520B plates

Fig. 5.4 and Fig. 5.5 shows Force and Stroke graphs plot for the Lap weld joint of SM 490A +SM five20B flat plates. during this case failure of weld joint happens at the association of plate and weld that's at assembly. once restraining force is applied on the free finish of single crosswise we tend told we get totally different stress pattern so equivalent stresses area unit discovered on weld additionally as plate (Fig. 5.4). once restraining force of 250 KN is applied on system minimum stresses are induced . It shows that at minimum stress we are able to increase the axial tensile force, final durability is 244.76 Mpa, that will increase load carrying capability of system.

MATERIAL:SM 490A+SM 490A
EQUIVALENT STRESS:

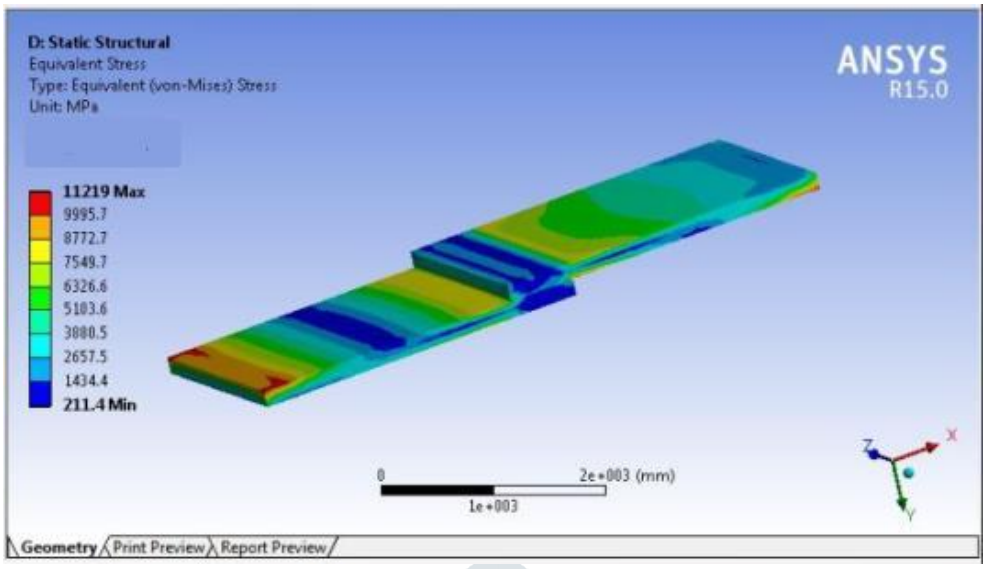

Fig 5.6: Stress for Weld Lap joint of SM 490A +SM 490A plates

EQUIVALENT STRAIN:

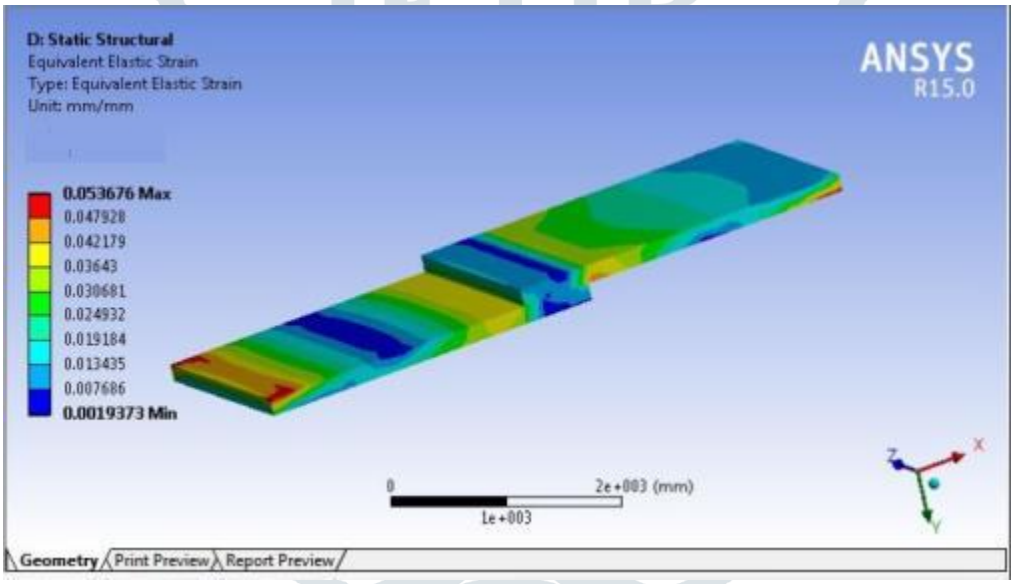

Fig 5.7: Strain for Weld Lap joint of SM 490A+SM 490A plates

Fig. 5.6 and Fig. 5.7 shows Force and Stroke graphs plot for the Lap weld joint of SM 490A + SM 490A flat plates. during this case failure of weld joint happens at the association of plate and weld that's at assembly. once restraining force is applied on the free finish of single crosswise we tend told we get totally different stress pattern so equivalent stresses are discovered on weld additionally as plate (Fig. 5.6). once restraining force of 250 KN is applied on system minimum stresses are induced . It shows that at minimum stress we are able to increase the axial tensile force, final durability is 241.98 Mpa, that will increase load carrying capability of system.

MATERIAL: SM 520B + SM 520B:

EQUIVALENT STRESS:

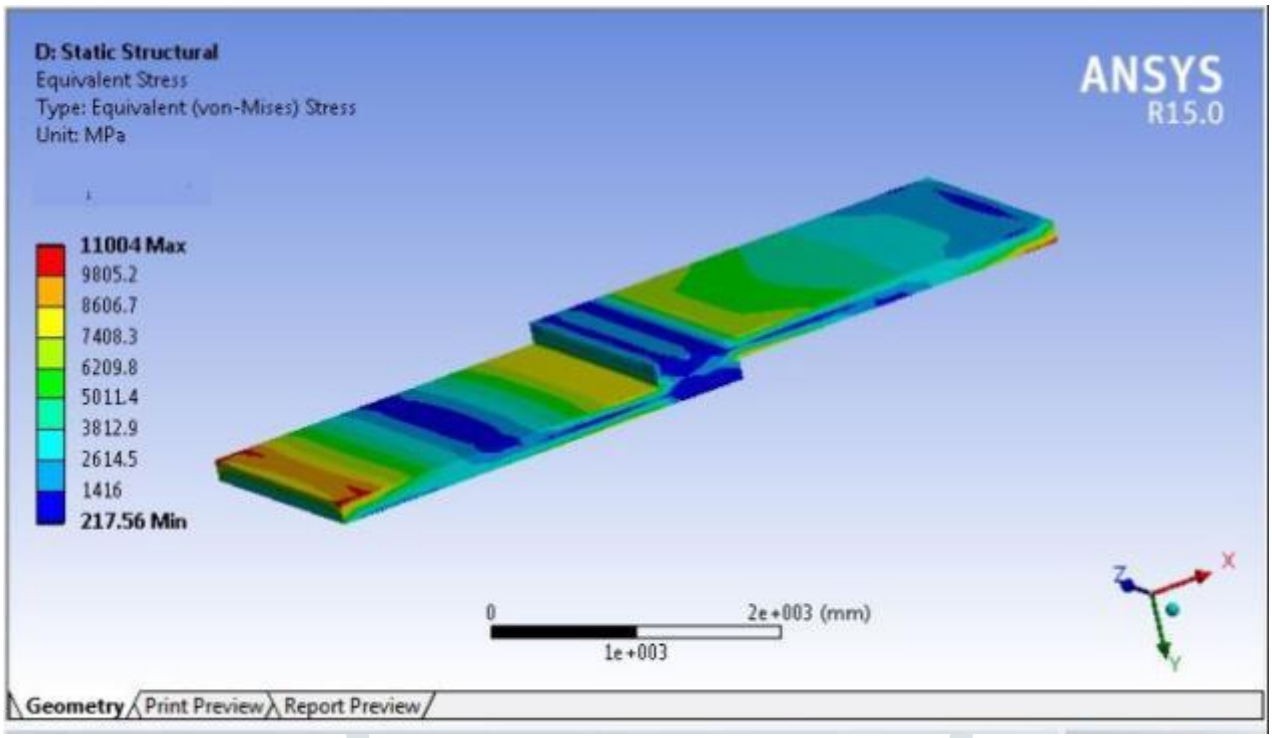

Fig 5.8: Stress for weld Lap joint of SM 520B +SM 520B plates

EQUIVALENT STRAIN:

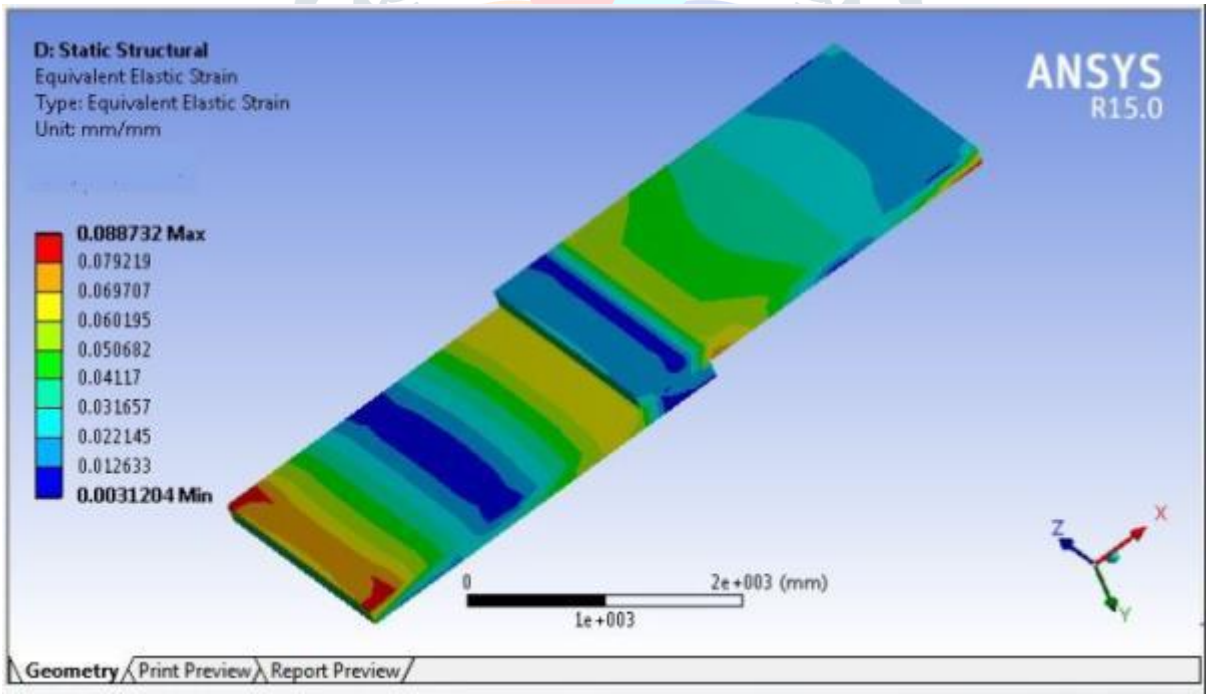

Fig 5.9: Strain for Weld Lap joint of SM 520B +SM 5200B plates

Fig. 5.8 and Fig. 5.9 shows Force and Stroke graphs plot for the Lap weld joint of SM 520B +SM 520B flat plates. during this case failure of weld joint happens at the association of plate and weld that's at assembly. once restraining force is applied on the free finish of single crosswise we tend told we get totally different stress pattern so equivalent stresses are discovered on weld additionally as plate (Fig. 5.8). once restraining force of 250 KN is applied on system minimum stresses area unit induced . It shows that at minimum stress we are able to increase the axial tensile force, final durability is 217.56 Mpa, that will increase load carrying capability of system.

From above table as value of force increases gradually slightly the Von Mises stress value increases and correspondingly deformation value is varying. It is observed during iterations the stress value is decreased after it crosses Ultimate strength value.

This work is also useful in the analysis of welded curved plate which are used in the boiler manufacturing, ship building. For producing complicated parts or welding of curved surfaces is done on workers experience, skill and knowledge. Sostill large scope available in this field.

Samples	Tensile strength (Mpa)	Equivalent Eastic Strain
SM 490A+SM 520B	244.76	0.0801
SM 490A+SM 490A	241.98	0.0536
SM 520B+SM 520B	217.56	0.0887

Table 5.1: Simulation Results of Flat Plates

6.CONCLUSIONS

Welds are normally a basic piece of creating structures. Due to Non linear themal process while doing welding Residual stresses are developed in the welded locales,. In some pertiular instances Weld joints may be blamed for the failure of large building structures, however it has to be observed that failures will be happened in bolted and riveted joints and in castings, forgings, hot moved plate and shapes, and also different sorts of development. Following conclusion have been observed from this experiment.

1 ultimate stress and deformations were noted and compared with simulations. A quite sensible results were obtained between experiment and simulations.

2. With the Static structural analysis results obtained with facilitate of ansys ,one will says that every one 3 joints are face up to for the applied hundreds

3. the most load wherever the fabric starts breaking i.e (250 KN,250 KN,250KN) on the materials,.it doesn't started at this hundreds in however It starts deforms within the case of study.

4. The analys within the ansys has some restrictions to point out the breaking of the fabric.

5. finally one will observe that, by applying correct boundary conditions the distinction between the styles and within the ends up in the ansys area unit terribly less. However, ansys has some restricions ans difficulties it will ready to simulate the attachment with sensible results.

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