

FABRICATION OF STAINLESS STEEL FOR ABC - SECTOR

PRESENTED BY

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CHENNAI**

WORKSHOP

ON

SUSTAINABLE STAINLESS STEEL FOR BUILDING & CONSTRUCTION

ON FRIDAY, THE 17TH June 2011 at PUNE.

IMPORT OF THIS WORKSHOP

- The most sought after material presently by the architects and builders in both interiors and exteriors applications.
- Well informed fabricators with trained supervisors and workforce to whom such projects could be entrusted are far less than the demand.
- To enlighten existing fabricators and fresh entrants on all the aspects of stainless steel fabrication for architecture.
- This presentation will discuss design, selection and fabrication of stainless steel with the quality of the end product in mind.
- Main considerations for use of stainless steel in building industry-
 - Functional and economic considerations.
 - Architectural applications
- Architecture and building industry finds extensive use of this metal.
- Transformation: MS fabricator **TO** SS Fabricator **TO** SS Sheet Metal Fabricator.
- Aware of pitfalls in
 - Handling
 - Storing
 - Fabrication
 - Finishing

THE ADVANTAGES OF STAINLESS STEEL

- Low-maintenance cost
- Long life span
- Appearance, Attractiveness and durability
- Ease of maintenance and cleaning.
- Hygiene Biological and organic neutrality
- Barrier against rust and other contaminates
- 100 % recyclable.
- Aesthetic qualities.

IMPORTANT CRITERIA

1. MATERIAL SELECTION – PROPER GRADE
2. DESIGN
3. MACHINERY
4. PROCESS
5. FINISHING
6. HANDLING , STORAGE & PACKAGING.

MATERIAL SELECTION

- Grade
- Finish
- Thickness

THE ABOVE HAS TO BE SELECTED BASED ON THE FOLLOWING FACTORS

- Aesthetic aspects
- Service environment
- Types of surface finish required
- Visual consistency of large areas.
- Optical flatness

GENERAL DESIGN CONSIDERATIONS

- **PRODUCT DESIGN**
- **PROCESS DESIGN**
- **DESIGN OF SUITABLE JIGS AND FIXTURES**

EXCLUSIVE TO STAINLESS STEEL

- **AVOID DESIGNS THAT RESTRICT FLOW OF WATER ON AN EXTERIOR**
- **MAKE PROVISIONS TO DRAIN THE DIRT.**
- **EVEN JOINTS SHOULD BE SO DESIGNED TO MINIMIZE DIRT ACCUMULATION.**
- **THE BENEFICIAL EFFECT OF RAIN SHOULD BE OPTIMIZED**
- **USE ONLY STAINLESS STEEL FOR ALL FASTENERS.**
- **AVOID INTRICATE DESIGNS**
- **CONCEAL ALL FASTENERS FOR AESTHETIC REASONS.**

IMPORTANT OBSERVATIONS

- Complex shapes can be easily formed
- Cold forming results in greater work hardening.
- Lighter gauges can be recommended.
- Hollow sections provide ample strength and stiffness
- Generally common fabrication methods are followed.
- **SIZES:** The mills normally supply in sheets of 1.25 X 2.5 Metres
- If sheets of higher lengths are required, the mills supply as coils.
- When using abrasive cutting, proper coolant should be used to avoid any possible heat damage to the stainless steel.

FACTORS ARE EXCLUSIVE TO STAINLESS STEEL

- Stainless steel is easily weldable
- Welding costs more
- Cost of welding rods high in case of stainless steel
- Cost of skilled labour high
- More controlled cleaning procedure required.
- Expert precautions required in handling, during welding, storage, packing and dispatch etc

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Factors are exclusive to stainless steel.(Continued)

- The electrodes and the filler rods must be stainless steel.
- Stainless and carbon steels can be welded together using filler metal suitable for the stainless steel.
- A wide range of fabrication techniques are available for shaping stainless steel for architecture
- The correct process is left to the skill and experience of the fabricator

REQUIREMENTS FOR GOOD FABRICATORS

- Close supervision
- Good working conditions
- Special equipments for various operations
- Aligning fixtures
- Properly designed clamps
- Accurate working surfaces

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Requirements for Good Fabricators (Continued)

- Fairly good knowledge of metallurgy of stainless steel.
- Ability to transfer most of field conditions & dimensions so that major fabrication could be carried out at the shop and minimizing site work.
- Skilled and dedicated work force-especially in areas where the fabricator is required to offer their own finishes and blending with mill finished material.
- A working knowledge as to the behavior of stainless steel when it is subjected to heating due to either welding or grinding.

MACHINERY AND PROCESS

SELECTION OF THE RIGHT MACHINERY / PROCESS

PARAMETERS THAT INFLUENCE MACHINERY SELECTION.

- END USE / APPLICATION OF PRODUCT
- QUALITY OF FINISH
- COST
- QUANTITY
- MARKET CONDITIONS – COMPETITIVE /SPEED.
- CUSTOMER AWARENESS
- TECHNOLOGY

FABRICATION PROCESS -& RELATED MACHINERY

FABRICATION PROCESS.

- CUTTING
- FORMING
- MACHINING
- WELDING
- FINISHING.



CUTTING

- **ABRASIVE CUT OFF**
- **SHEARING**
- **PUNCHING**
- **PLASMA**
- **LASER CUTTING**
- **WATERJET CUTTING**



CUTTING – NEW GENERATION

LASER CUTTING

“LIGHT AMPLIFICATION BY STIMULATED EMISSION OF RADIATION”

- Easier work holding
- Stainless Steel up to 10 mm thick can be cut.
- Can cut any profile with ease.
- Does not require any tooling
- Low heat affected zone, hence no distortion,
- More efficient on low thickness ferrous material
- Better material utilization through nesting.
- Reduced contamination of work piece
- Better precision, since the laser beam does not wear during the process.
- Reduced chance of warping of the material that is being cut.
- Precision. The operation dispenses with any type of special jigs and fixtures.
- Repeatability



TUBE LASERS

- PRODUCT RANGE
- REPEATABILITY
- FAST PRODUCTION
- VERSATILITY
- HIGH VOLUME MANUFACTURING



Cutting - Water Jet Cutting.

- Ability to cut material without interfering with the material's inherent structure as there is no "heat-affected zone".
- Capable of producing intricate cuts in material.
- The water jet saves material by creating very little Width of the cut, which can be as narrow as 0.02" (0.508 mm).
- Water jets are capable of attaining accuracy of 0.005" (0.13 mm), and repeatability of 0.001" (0.025 mm).
- Parts can be closely nested to maximize material use.
- This greatly improves the work environment and reduces problems arising from operator exposure.
- Suitable and Economical for Higher thickness of stainless steel.
- Will be uneconomical for lower thickness . Expensive and slow.
- Produces less than 1 Deg Taper.



Stainless Steel Pipe Bending.

- Look for deep scratches on the Pipe surface on receipt
- Correct specification
- Select suitable bending procedure
- Look for following defects in bending.
 - Damage to the pipe both on the inside curvature and on the outside as well.
 - The pipe at the point of the bend getting flattened out.
- Proper edge preparation at pipe joints is important before welding.
- For butt joints, Use SS inserts to avoid caving in of the metal due to heat.
- Polished pipes should be purchased with protective cover on each pipe
- Grinding the joints and matching the finish with the parent pipes is a skilled job, which can be achieved by practice.

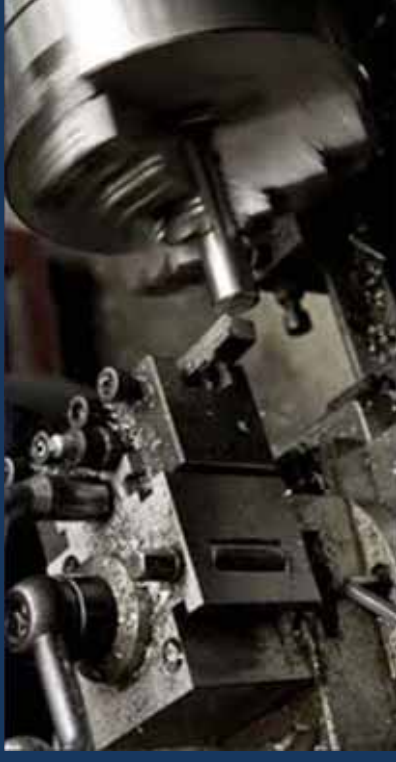
Types Of Pipe Bending.

- Rotary bending machines
- Hydraulic presses
- Mandrel bending machine
- Three-Roll Push bending

Machining Of Stainless Steel.

Due to several concerns, such as the possibility for chipping, machining stainless steel can be a complex process. Here are some suggestions that may help with machining this alloy:

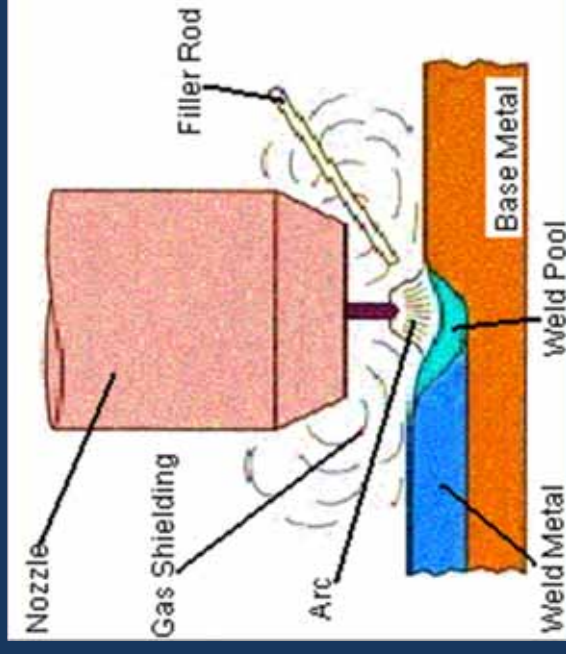
- Apply coolants or lubricants
- Use large tools to help dissipate heat
- Maintain light cuts and constant feeds
- Use chip breakers to deflect debris
- Select a machine tool that reduces vibration
- Keep The cutting Edge sharp at all times.



FABRICATION PROCESS –& RELATED MACHINERY

TIG WELDING

Gas Tungsten Arc Welding (GTAW) is frequently referred to as TIG welding. TIG welding is a commonly used high quality welding process. TIG welding has become a popular choice of welding processes when high quality, precision welding is required..



FABRICATION PROCESS –& RELATED MACHINERY

Common Gases Used for TIG.

- Argon
- Argon + Hydrogen
- Argon/Helium

•Helium is generally added to increase heat input (increase welding speed or weld penetration). Hydrogen will result in cleaner looking welds and also increase heat input, however, Hydrogen may promote porosity or hydrogen cracking



TIG Welding Benefits

- Superior quality welds
- Welds can be made with or without filler metal
- Precise control of welding variables (heat)
- Free of spatter
- Low distortion . Thin Gauge material can be welded easily.
- Most Suited for Architectural Applications. 23

FABRICATION PROCESS –& RELATED MACHINERY

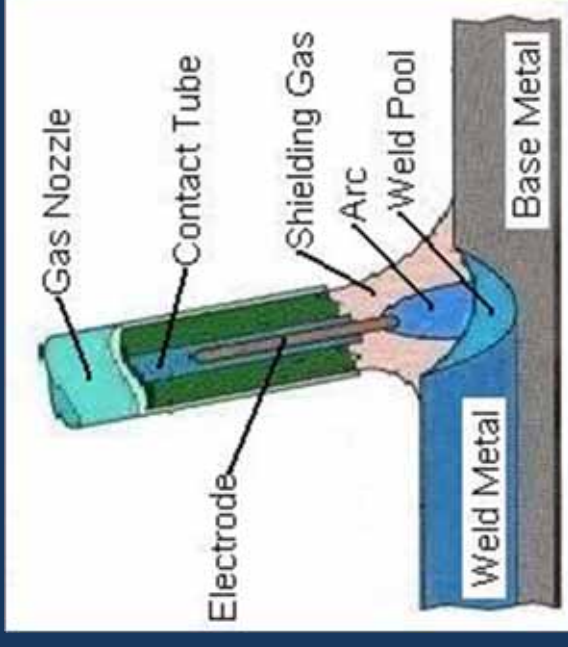
- TIG Welding ideally suited for complex profiles and ease of finishing
- Ease of Finishing . Can start from sanding
- No Contamination
- Better Penetration



FABRICATION PROCESS –& RELATED MACHINERY

MIG WELDING

Gas Metal Arc Welding (GMAW) is frequently referred to as MIG welding. MIG welding is a commonly used high deposition rate welding process. Wire is continuously fed from a spool. MIG welding is therefore referred to as a semiautomatic welding process.



FABRICATION PROCESS –& RELATED MACHINERY

Common Gases Used for MIG.

- C2 or 2% Carbon Dioxide and 98% Argon
- C25 or 25% Carbon Dioxide and 75% Argon
- 100% Carbon Dioxide
- 100% Argon



MIG Welding Benefits

- All position capability
- Higher deposition rates than SMAW
- Less operator skill required
- Long welds can be made without starts and stops
- Minimal post weld cleaning is required
- Not Suitable for Architectural applications.

FABRICATION PROCESS –& RELATED MACHINERY



LASER WELDING

- Laser welding provides high speed
- low heat input fusion welding for thermally sensitive or magnetic enclosed parts.
- laser allows us to provide weld penetration as low as .25mm up to 6mm depth.
- Since it is a fusion weld, neither fluxes, fillers, nor contaminates are introduced into the weld zone

SURFACE FINISHES AND APPLICATIONS

I HOT ROLLED FINISH No 1 finish

DULL AND SLIGHTLY ROUGH SURFACE. QUITE SUITABLE FOR STRUCTURAL APPLICATIONS IN BUILDING INDUSTRY. TO BE AVOIDED FOR EXTERNAL APPLICATIONS.

II COLD ROLLED FINISHES No 2B

ARCHITECTURAL AND BUILDING APPLICATIONS, WHICH INVOLVES WELDING. REQUIRED FINISHES TO BE GIVEN AFTER FABRICATION USING MECHANICAL OPERATIONS LIKE GRINDING, POLISHING AND BUFFING.

Surface Finishes And Applications (Contd)

III **MECHANICALLY POLISHED FINISHES**

1 No 4

This is unidirectional finish with restricted reflectivity. Recommended for applications in wall-panels, cladding of column , elevator door and interiors, escalator trim, control panels, furniture, luggage handling equipments, and similar areas.

2 No 8

Mirror polished. The most reflective finish and used selectively in architectural parts and reflectors.

3 Special rolled finishes

Moon-rock, chequered, striped, hammer tone, and many other finishes are offered by the manufactures for specific applications.

4 Coloured stainless steel

Yet to be manufactured in India..

FINISHING METHODS

SALIENT FEATURES ON FINISHING METHODS

- Surface finish is an important feature for SS application in ABC Sector.
- Also critical for maintaining the corrosion resistance of the parts.
- A smooth surface provides better corrosion resistance.
- Certain surface finishes also make stainless steel easier to clean.
- Variety of methods used for Dull, Bright and Mirror finishing.
- For grinding or polishing, grinding wheels or abrasive belts are normally used.
- Buffing uses cloth wheels in combination with cutting compounds.

Salient Features On Finishing Methods(contd)

OTHER FINISHING METHODS

- Other finishing methods include tumbling.
- Dry etching, wet etching and surface dulling are other processes in surface finishing.
- Manual and automated grinding and polishing machinery are available in India for polishing pipes of varies diameters and flat surfaces.
- Sheet metal blanks can be finished to specified mill grades or to the equivalent grit specifications before welding.
- Welds can be ground and polished to blend with the finish of the base material.

ADVANCED TRENDS IN FINISHES

Special finishes

- Etched,
- Embossed,
- Rolled,
- Colored,

These textured finishes offer more protection against scratches, dents and fingerprints. Are recommended in areas such as free-standing columns, doors, elevator panels etc.

QUALITY CONTROL

QUALITY CONTROL

- GENERAL
- STAINLESS STEEL CONTAMINATION
- PROTECTION DURING STORAGE AND PROCESSING
- TREATMENT OF WELD JOINTS.
- GALVANIC CORROSION
- IMPORTANT FACTOR THE FABRICATOR IS CAUTIONED AGAINST
- DISTORTION DUE TO HEAT.
- SCRATCHES ON THE FINISHED SURFACE
- PRECAUTIONS DURING HANDLING

QC -THE IMPORTANCE OF QUALITY CHECKS

- Must meet customer specifications including finish checks for material specification,
- Dimensional tolerance, welders' qualifications, structural stability
- Expectations of the architects are substantial
- The aesthetic importance and visual import
- In external applications, corrosion resistance will be the main task.
- Throughout the process from procurement, inward inspection, and storage, handling during work-in-progress, packing and dispatch. Handling at erection at site is no less important

QUALITY CONTROL - STAINLESS STEEL CONTAMINATION

- Stainless steel can become contaminated throughout the fabrication process.
- Iron dust can land on the stainless steel
- Water stains from resting water on the sheets
- Paint, oil, grease can introduce carbon into the material
- Scratches from carbon steel forklifts or carbon steel racks
- scratches from improper handling
- Embedded iron particles from tooling used on carbon steel and not properly cleaned

QC - PROTECTION DURING STORAGE AND PROCESSING

- A simple routine cleaning of stainless steel is required to remove fingerprints, stains, discoloration, grease and oil on stainless steel.
- The protective wrapping on the surface of the stainless steel should be kept intact until processing is complete.
- However many such adhesive wrapping, over a period, become extremely difficult to remove. Manufacturers should be contacted regarding information as to how long protective films or paper can be left in place

QC - PROTECTION DURING STORAGE AND PROCESSING

- Handle stainless steel with clean gloves or cloths to guard against stains or finger marks.
- Avoid the use of oily rags or greasy cloths when wiping the surface.
- Cleaning with chloride-containing detergents must be avoided.
- Even the finest cleaning powders can scratch a mill-rolled finish. On polished finishes, rubbing or wiping should be done in the direction of the polish lines, not across them.

QC - TREATMENT OF WELD JOINTS

POTENTIAL PITFALLS

- MIXING CARBON STEEL AND STAINLESS STEEL WELDING CONSUMABLES.
- GRINDING WELDS WITH EQUIPMENT PREVIOUSLY USED ON CARBON OR GALVANIZED STEEL
- IMPROPER CLEANING OF WELD AREA
- USING WIRE BRUSHES OF CARBON STEEL BRISTLES
- FINISHING ONLY THE FRONT SIDE OF THE WELD AND LEAVING THE BACK UNTREATED.

QC - GALVANIC CORROSION

Galvanic corrosion occurs under three conditions.

- Dissimilar metals
- Metal-to-metals contact
- Metals in the same conduction solution (moisture)

QC - FACTOR THE FABRICATOR IS CAUTIONED AGAINST

- Frequently Hydrochloric acid is used commonly in architectural applications for cleaning floors, tiles etc.
- Other agencies should be discouraged from using such acids on or near stainless steel.
- Even if the acid does not touch the stainless steel, the “fumes” in an enclosed space may cause surface corrosion of the stainless.

QC - DISTORTION DUE TO HEAT

- During the welding process Stainless steels experience more distortion than carbon steels especially in thin gauges. The experience and expertise are required to solve these complex problems.
- Reducing the no of welds will drastically bring down the distortion. With experience working with stainless steel, one may be able to assist with grade selection, recommend design changes, or suggest alternative fabrication methods.

QC - SCRATCHES ON THE FINISHED SURFACE

- Scratches are difficult to remove. Hence they should be avoided by better protection.
- The surface can be refinished using a non-metallic abrasive pad such as a Scotch Brite pad.

QC - PRECAUTIONS DURING HANDLING

- The shop should have a separate area where only stainless steel is fabricated. This will prevent the contamination of the stainless steel surface with “iron”
- If one has to use the same equipment to process both carbon and stainless steel, a thorough “cleaning” of the machinery is required before processing stainless.
- Carbon steel particles in the surface of the stainless steel will begin to rust over time which will appear that the stainless steel is “rusting”.
- Only nonmetallic (or stainless steel) material should be used in cleaning the surface.

QC - PRECAUTIONS DURING HANDLING (Continued)

- Mechanical damage like scratches can occur easily during handling if not guarded against. Such mechanical damage will also result in corrosion.
- Plates and sheets should be stored vertically in racks and not be dragged out of the racks or over one another. Racks should be protected to prevent iron contamination.
- Plates and sheets should be kept on wooden planks to prevent surface damage.
- Clean linen gloves should be worn when handling thin gauge cold rolled material with superior finish to avoid finger markings.
- Such marks can be removed by the use of warm detergent solution followed by rinsing with clean water.

THANK YOU