Stainless Steel has a wide range of applications and use.

It does a quiet job in industries, equipments, appliances invisibly.

Stainless Steel is MOST VISIBLE in Architecture

STAINLESS STEEL IN ARCHITECTURE
ISSDA seminar on Sustainable Stainless Steel for Buildings & Constrn.

June 2011
India has undoubtedly put its stamp of ingenuity and enterprise in the world of stainless steel
- in making stainless steel more contemporary,
- In making contemporary more Stainless Steel

No wonder, stainless Steel is today an integral part of Indian daily chore - there is a visible change now.
What is Stainless Steel

Stainless steel is not a metal, it is an alloy. (Essentially it is an alloy having a minimum of 10.5 percent chromium)

Stainless Steel has different grades.

Depending on the alloying elements included, SS grades have been classified variedly.

Each grade offers a set of properties and function. And grades are to be selected based on end use - environment, strength, anti-corrosion, aesthetics.
The Stainless steel family

Stainless Steel

Precipitation Hardening Grades
S17400 / S 17700 etc

Duplex grades
S 31200 / S 32900 etc

Martensitic grades
410 / 420 etc

Austenitic Grades
304 / 304L 316 / 316L 321 etc & 200 series

Ferritic grades
409 / 430 / 439 etc

S 31200 /
S 32900 etc
<table>
<thead>
<tr>
<th>Grades</th>
<th>Ni</th>
<th>Cr</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
<th>N</th>
<th>Oth</th>
</tr>
</thead>
<tbody>
<tr>
<td>304</td>
<td>8-10.5</td>
<td>18-20</td>
<td>0.08</td>
<td>0.75</td>
<td>2</td>
<td>0.045</td>
<td>0.03</td>
<td>0.10</td>
<td>-</td>
</tr>
<tr>
<td>316</td>
<td>10-14</td>
<td>16-18</td>
<td>0.08</td>
<td>0.75</td>
<td>2</td>
<td>0.045</td>
<td>0.03</td>
<td>0.10</td>
<td>2-3 Mo</td>
</tr>
<tr>
<td>430</td>
<td>0.75</td>
<td>16-18</td>
<td>0.12</td>
<td>1.00</td>
<td>1</td>
<td>0.04</td>
<td>0.03</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SSLN 4</td>
<td>3.8-4.7</td>
<td>14-17</td>
<td>0.10</td>
<td>0.75</td>
<td>8</td>
<td>0.07</td>
<td>0.03</td>
<td>0.15</td>
<td>2.2 Cu</td>
</tr>
<tr>
<td>SSLN 1</td>
<td>0.9-1.7</td>
<td>14-16</td>
<td>0.12</td>
<td>0.75</td>
<td>10</td>
<td>0.07</td>
<td>0.03</td>
<td>0.20</td>
<td>2.2 Cu</td>
</tr>
</tbody>
</table>
Versatility – the core of stainless steel

Stainless steel steals an edge over its contemporaries in terms of

- absolute corrosion resistance,
- virtually FIT and FORGET
- higher strength-to-weight ratio,
- excellent fabricability
- suitability for clean and hygienic environment.
Why is stainless steel different?

When exposed to atmosphere,

On stainless steel, an impervious layer of Chromium oxide is formed.

It resists corrosion

On carbon steel, a brittle layer of iron oxide is formed.

It corrodes and spreads like cancer.
Stainless steel - architect’s delight

* Superior aesthetics
* Tough & durable
* Weldable & easily formable
* Highly corrosion resistant
* Choice of colourful coatings
* Fire resistant
* Low maintenance
* High strength to weight ratio

Low life cycle cost

Intensive and innovative product and application development have brought in interesting finishes making stainless steel a designer’s delight.
<table>
<thead>
<tr>
<th>Grades</th>
<th>Usage profile</th>
<th>DUPLEX</th>
<th>316</th>
<th>304</th>
<th>430</th>
<th>Low Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel in building &amp; architecture</td>
<td>Corrosive / marine environments</td>
<td>Mostly exteriors where close to seaside / corrosive environment</td>
<td>Roofing, facia and cladding</td>
<td>Railings, cladding and aesthetic embellishments</td>
<td>Interior usages, false ceilings, trims and decorative furnishings</td>
<td>Interior usages, railings and other embellishments involving less draw in non corrosive environment</td>
</tr>
</tbody>
</table>
Aesthetic make-ups on stainless steel

<table>
<thead>
<tr>
<th>TRADITIONAL OPTIONS</th>
<th>2B/ NO. 4 / no.8 (mirror finish)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW AESTHETIC OPTIONS</td>
<td>moon rock</td>
</tr>
<tr>
<td></td>
<td>honeykom</td>
</tr>
<tr>
<td></td>
<td>quadra check</td>
</tr>
<tr>
<td></td>
<td>aqualine</td>
</tr>
<tr>
<td></td>
<td>linen</td>
</tr>
<tr>
<td></td>
<td>frondz</td>
</tr>
<tr>
<td></td>
<td>stripe</td>
</tr>
<tr>
<td></td>
<td>mystique</td>
</tr>
<tr>
<td></td>
<td>hammertone</td>
</tr>
</tbody>
</table>

Finishes that will be an embellishment on the sparkling Stainless steel
## Report Card of candidates

<table>
<thead>
<tr>
<th>Features / Grades</th>
<th>Duplex</th>
<th>316</th>
<th>304</th>
<th>430</th>
<th>Low Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetism</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Corrosion resistance</td>
<td>V Good</td>
<td>V Good</td>
<td>Good</td>
<td>Less</td>
<td>Less</td>
</tr>
<tr>
<td>Interior usage</td>
<td>V Good</td>
<td>V Good</td>
<td>Good</td>
<td>Usable</td>
<td>Usable</td>
</tr>
<tr>
<td>Exterior usage</td>
<td>V Good</td>
<td>V Good</td>
<td>Good</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Ductility</td>
<td>V Good</td>
<td>V Good</td>
<td>Good</td>
<td>Less</td>
<td>Less</td>
</tr>
<tr>
<td>Formability</td>
<td>V Good</td>
<td>V Good</td>
<td>Good</td>
<td>Less</td>
<td>Less</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td>1/3 of MS</td>
<td></td>
<td>1/2 of MS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal expansion</td>
<td>1.5 times MS</td>
<td></td>
<td>same as MS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USP</td>
<td>Fit n forget</td>
<td>Lustrous</td>
<td>Cost Effective</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: NR: Not Recommended
## Grades suitable for different site conditions

<table>
<thead>
<tr>
<th>Type of location</th>
<th>Grade of stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBURBAN</strong></td>
<td></td>
</tr>
<tr>
<td>Non industrial</td>
<td>430 grade - moderate staining *</td>
</tr>
<tr>
<td>Non coastal</td>
<td>Low ni / 304 grade – no attack</td>
</tr>
<tr>
<td>Low population density</td>
<td>316 grade – over specification *</td>
</tr>
<tr>
<td><strong>URBAN</strong></td>
<td></td>
</tr>
<tr>
<td>Residential/commercial</td>
<td>430 grade – can get heavily rusted</td>
</tr>
<tr>
<td>Moderate auto pollution</td>
<td>Low ni / 304 grade – slight discolouration *</td>
</tr>
<tr>
<td>Light industrial pollution</td>
<td>316 grade – performs well *</td>
</tr>
<tr>
<td><strong>INDUSTRIAL</strong></td>
<td></td>
</tr>
<tr>
<td>High Industrial pollution</td>
<td>Low ni / 430 grade – can get heavily rusted</td>
</tr>
<tr>
<td>SO₂ and NO₂ emission</td>
<td>304 grade – medium to heavy rust *</td>
</tr>
<tr>
<td>Light industrial pollution</td>
<td>316 grade – performs well *</td>
</tr>
<tr>
<td><strong>COASTAL</strong></td>
<td></td>
</tr>
<tr>
<td>Chloride and salt in air</td>
<td>Low ni /430 grade – unsuitable-will get rusted</td>
</tr>
<tr>
<td>High humidity</td>
<td>304 grade – can get pitted *</td>
</tr>
<tr>
<td>Hi-ambient temperature</td>
<td>316 grade – performs well *</td>
</tr>
</tbody>
</table>

*Note:* Smooth finish & periodic washing will improve performance
Breaking a myth

STAINLESS STEEL WILL NOT CORRODE

Even if there is no structural deterioration, Stainless steel will also get stained / corroded when

• right grade is not chosen
• Crevices are present to abet corrosion
• Bi-metallic contact - fostering corrosion
• Improper welding / finishing – passivation must
• Incorrect cleaning media is used
• no regular cleaning is undertaken
THE GOLDEN RULES TO FIGHT CORROSION

• Study the environment – the pollution level – suspended particulates
  
  Sulphur and Nitrogen oxides, flue gas soot, etc cause corrosive environment

  Salt in air coupled with humidity and high temperature can cause corrosive environment

• Study the wind pattern, direction – Hi velocity winds can blow out surface contaminants

• Study the rain pattern – intensive rains can wash out surface contaminants

• Opt for a smooth surface ( SR - Ra 5 microns and less )

• Opt for a vertical grain orientation – natural washing

• Avoid horizontal, crevice and sheltered surfaces
Extra word of caution!!

✓ Let us not assume that all that shines is stainless steel – ask for the right grade, know the chemistry

✓ A small cost saved by compromising in grade selection might end up in costly loss – loss of face, loss of outlay

✓ Even while opting for Low Nickel – please make sure that there is at least 16% chromium and around 4% nickel - and

✓ Make sure that a cleaning regime is in place
Spectrum of uses for stainless steel

* Roofing
* Cladding & panelling
  - column cladding
  - Interior panelling
  - curtain walling
* Doors frames & shutters
* Railings & balustrades
* Signages, street furniture & sculptures
* Waterlines
* Structurals
* Water tanks & building accessories
Stainless steel in roofing

The need: a zero-maintenance roofing option

The scoring points for ss

* High strength
* Ductility
* Choice of coatings
* Can use thinner gauge
* Durability
* Zero maintenance
* Lower Life Cycle Cost

The trade off: the higher initial outlay

But you save on repetitive annual maintenance headache – the most irritable and oft ignored aspect in public utility buildings.
FLUOROCARBON RESIN COATING - WORKING WELL SINCE 1993

... RIGHT AT THE SEA SIDE WITH 304 GRADE ROOFING WITH

TOKYO TATSUMI INTL. SWIMMING POOL

FEW ROOFING MASTERPIECES ACROSS THE GLOBE
Stainless Steel masterpieces - Ajuba

Khalsa heritage Centre – Anandpur Sahib

Over 40 MT of 304 grade texturised finish used for cladding
SALEM STEEL PLANT SUPPLIED OVER 400 TONNES FOF STAINLESS STEEL FOR THIS PRESTIGIOUS LANDMARK – THE PARLIAMENT LIBRARY PROJECT

ONE OF THE MANY LANDMARK PROJECTS CRAFTED BY CPWD
KOPARKHAIRANE
WITH COLOUR COATED
STAINLESS STEEL ROOFING

Grade : 304
Thk (mm) : 0.50
KOPARKHAIRANE – AERIAL VIEW

KOPARKHAIRANE STATION IN NAVI MUMBAI WITH COLOUR COATED SS ROOFING - OVER 50 YEARS LIFE WITH ZERO MAINTENANCE

220 metres Long. 10,000 s.q.m. metres in area. 70 tonnes of high quality stainless steel.
STAINLESS STEEL FOR CLADDING

The need :: rich aesthetics
durability
Zero maintenance

Where stainless steel scores -

* pristine & gleaming look
* Delicately reflective
* Strength & stiffness
* Water wash & that’s all
* Lasts for a lifetime
## PANELLING - A COST COMPARISON

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>STAINLESS STEEL</th>
<th>GRANITE / MARBLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (MM)</td>
<td>1.25/1.60</td>
<td>5.00/12.00</td>
</tr>
<tr>
<td>WEIGHT/SQ METRE (KG)</td>
<td>10/12.5</td>
<td>60 to 100</td>
</tr>
<tr>
<td>FIXING</td>
<td>Easy</td>
<td>Cumbersome</td>
</tr>
<tr>
<td>CHANCE OF BREAKAGE / CHIPPING</td>
<td>None</td>
<td>Quite Possible</td>
</tr>
<tr>
<td>LIFE</td>
<td>50 – 70 years</td>
<td>20 – 30 years</td>
</tr>
<tr>
<td>MAINTENANCE</td>
<td>Needs only occasional water wash. No weathering</td>
<td>Can weather &amp; crack over the years. Can fall off</td>
</tr>
<tr>
<td>COST PER SQ METRE (RS)</td>
<td>4500</td>
<td>2000 to 6000 depending on quality / colour</td>
</tr>
</tbody>
</table>
Stainless masterpieces

PETRONAS TOWERS – K L
Grade: 304 / 316

CHRYSLER TOWERS, USA
Grade: 302
Stainless masterpieces - Cloud Gate

168 panels – 2442 lr ft of Seamless welding
Weighs : 110 MT
Daily cleaning –1.8m
6 monthly TIDE wash 150 litres

designed by Anish Kapur at Chicago

10 mtr x 20 mtr x 13 mtr - Grade : SS 304
The 1600 metre Stonecutters bridge Hong Kong with two 290 metre Pole Towers is designed for a life of 120 years – using Duplex stainless steel plates and 304 grade stainless steel reinforcement bars.
Stainless Steel masterpieces – Burj Kalifa

The world’s tallest building
- 2717 feet tall

A sparkling testimony for stainless steel being the architect’s choice

Cladding using glass and textured stainless steel spandrel panels with vertical tubular fins

Architect: Adrian Smith
STAINLESS LANDMARKS – FAR AND NEAR

METRO RTA BLDG - TOKYO
Grade : SS 304

ASHOK LEYLAND-CHENNAI
Grade : SS 316
STAINLESS LANDMARKS – FAR AND NEAR

US AIR FORCE MEMORIAL
WASHINGTON DC - SS 316 Gr

HUDA PARK – HYDERABAD
Grade: SS 304
ARTISTIC RAILING & BALUSTRADES
COMMENORATIVE SCULPTURES

FORMS IN NATURE - SALEM

GARUDA - GURGAON
STAINLESS STEEL WATERLINES

- Water distribution lines have been in vogue in USA, Japan and Korea for over two decades.
  - New York - New Jersey water distribution tunnel has been installed with 100 years design life.
  - Widely used in related applications like water treatment and Sewage treatment

- And in India, Mettur makes the beginning.
# SS VERSUS MS WATERLINE PIPES - A TECHNICAL COMPARISON

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SS</th>
<th>MS</th>
</tr>
</thead>
<tbody>
<tr>
<td>YIELD STRENGTH</td>
<td>HIGH (1.5 TIMES)</td>
<td>LOW</td>
</tr>
<tr>
<td>% ELONGATION</td>
<td>40 %</td>
<td>25 %</td>
</tr>
<tr>
<td>CORROSION RESISTANCE</td>
<td>HIGH (0.002 MICRONS P.A)</td>
<td>LOW - (6 MICRONS P.A)</td>
</tr>
<tr>
<td>“C” VALUE</td>
<td>140 - 150</td>
<td>100</td>
</tr>
<tr>
<td>COATINGS</td>
<td>NOT REQD</td>
<td>REQUIRED</td>
</tr>
<tr>
<td>WT / METRE</td>
<td>LOW, since</td>
<td>HIGH, since</td>
</tr>
<tr>
<td></td>
<td>- no coatings</td>
<td>- in MS pipes higher thk. is required</td>
</tr>
<tr>
<td></td>
<td>- no corrosion allowance</td>
<td>for getting the reqd strength</td>
</tr>
<tr>
<td></td>
<td>- flexibility to opt for lower</td>
<td>- Concrete liner &amp; epoxy coat is a must</td>
</tr>
<tr>
<td></td>
<td>OD - THK configuration</td>
<td>- Allowance for corrosion loss to be</td>
</tr>
<tr>
<td></td>
<td></td>
<td>built up</td>
</tr>
<tr>
<td>INSTALLATION</td>
<td>EASY</td>
<td>DIFFICULT</td>
</tr>
<tr>
<td>LIFE</td>
<td>&gt; 100 YEARS</td>
<td>25 YEARS</td>
</tr>
</tbody>
</table>
WHERE SS WATERLINES SCORE

- Excellent corrosion resistance
- 100 years of leak & trouble free life
- Higher strength to weight ratio
- Flexibility to use a lower OD - lower Thickness configuration
- No need for corrosion allowance
- Overall weight reduction
- Lower friction loss - c value = 150
- Savings in pumping power
- Cleaner & hygienic option
- Lower life cycle cost
So, the crux of the issue lies in

- Deciding on the application for which stainless steel is being considered

- The environment – is it sea side / interior / industrial dusty and polluted / humidity and rain prone etc

- Choose the grade that suits the application

- Design the product suitably – make sure that
  - a right finish is chosen
  - right fabrication practices are adopted
  - there are no crevices,
  - suitable drainage is provided,
  - right slope is given,
  - right fasteners are used,
  - and a regime for cleaning is put in place
SALEM STEEL PLANT
INTERFACING THE FORCES
IN THE GOLDEN TRIANGLE

ARCHITECT

BUILDER

FABRICATOR
PLEASE FEEL TO CONTACT US AT

Shri Ranjit Sontakke, BRANCH MANAGER
STEEL AUTHORITY OF INDIA LIMITED
SALEM STEEL PLANT
VEER SAVARKAR UDYOG BHAVAN
NEAR RANG MANDIR
SHIVAJI NAGAR
PUNE 411 005

TEL : 2 55 33 967 / 940 4960 677
Email : sspppun@sail-steel.com