-Stainless Steel has vide 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 & Constn.

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

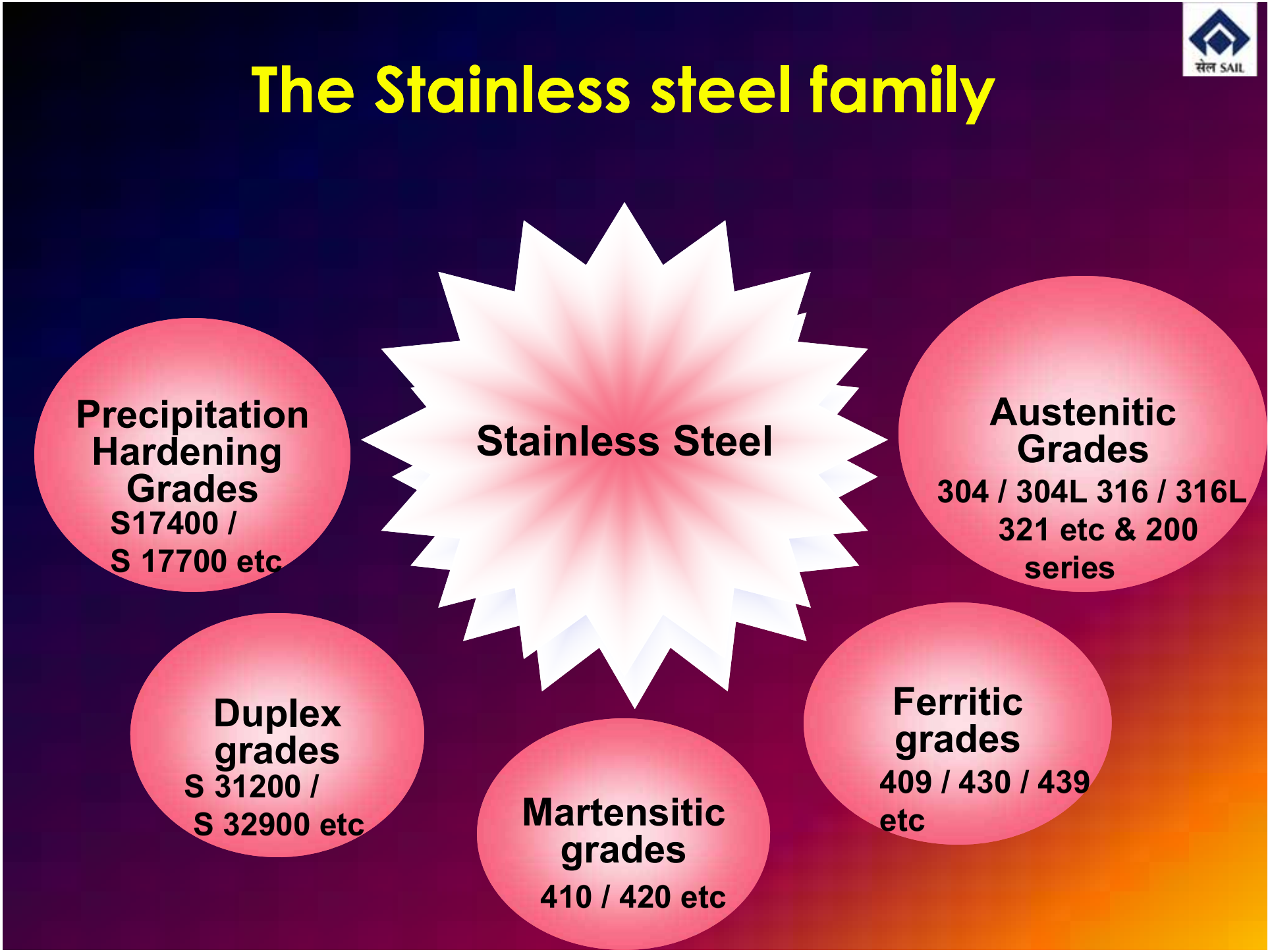
Stainless steel is not a metal, it is an alloy.
(Essentially it is an alloy having a minimum of 10.5 percent chromium)

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



Typical Chemistry – major grades (%)

Grades	Ni	Cr	C	Si	Mn	P	S	N	Oth
304	8-10.5	18-20	0.08	0.75	2	0.045	0.03	0.10	-
316	10-14	16-18	0.08	0.75	2	0.045	0.03	0.10	2- 3 Mo
430	0.75	16-18	0.12	1.00	1	0.04	0.03	-	-
SSLN 4	3.8-4.7	14-17	0.10	0.75	8	0.07	0.03	0.15	2.2 Cu
SSLN 1	0.9-1.7	14-16	0.12	0.75	10	0.07	0.03	0.20	2.2 Cu

Versatility – the core of stainless steel

Stainless steel steals an edge over its contemporaries in terms of

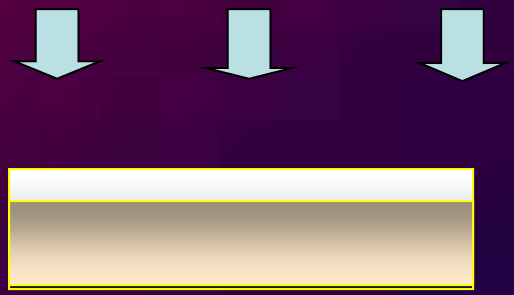
- absolute corrosion resistance,
- virtually FIT and FORGET
- higher strength-to-weight ratio,
- excellent fabricability
- suitability for clean and hygienic environment.

Why is stainless steel different?

When exposed to atmosphere,

On stainless steel , an impervious layer 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.

Stainless Steel in building & architecture

Grades	Usage profile
DUPLEX	Corrosive / marine environments
316	Mostly exteriors where close to seaside / corrosive environment roofing, facia and cladding
304	Interiors, Exteriors, Roofing, Railings, cladding and aesthetic embellishments
430	Interior usages, false ceilings, trims and decorative furnishings
Low Ni	Interior usages, railings and other embellishments involving less draw in non corrosive environment

Aesthetic make-ups on stainless steel

TRADITIONAL OPTIONS	2B/ NO. 4 / no.8 (mirror finish)
NEW AESTHETIC OPTIONS	moon rock honeykom quadra check aqualine linen frondz stripe mystique hammertone

Finishes that will be an embellishment on the sparkling Stainless steel

Report Card of candidates

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

Note : NR: Not Recommended

Grades suitable for different site conditions

Type of location	Grade of stainless steel
SUBURBAN Non industrial Non coastal Low population density	430 grade - moderate staining * Low ni / 304 grade – no attack 316 grade – over specification
URBAN Residential/commercial Moderate auto pollution Light industrial pollution	430 grade – can get heavily rusted Low ni / 304 grade – slight discolouration * 316 grade – performs well
INDUSTRIAL High Industrial pollution SO_2 and NO_2 emission Light industrial pollution	Low ni / 430 grade – can get heavily rusted 304 grade – medium to heavy rust * 316 grade – performs well *
COASTAL Chloride and salt in air High humidity Hi-ambient temperature	Low ni /430 grade – unsuitable-will get rusted 304 grade – can get pitted * 316 grade – performs well *

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

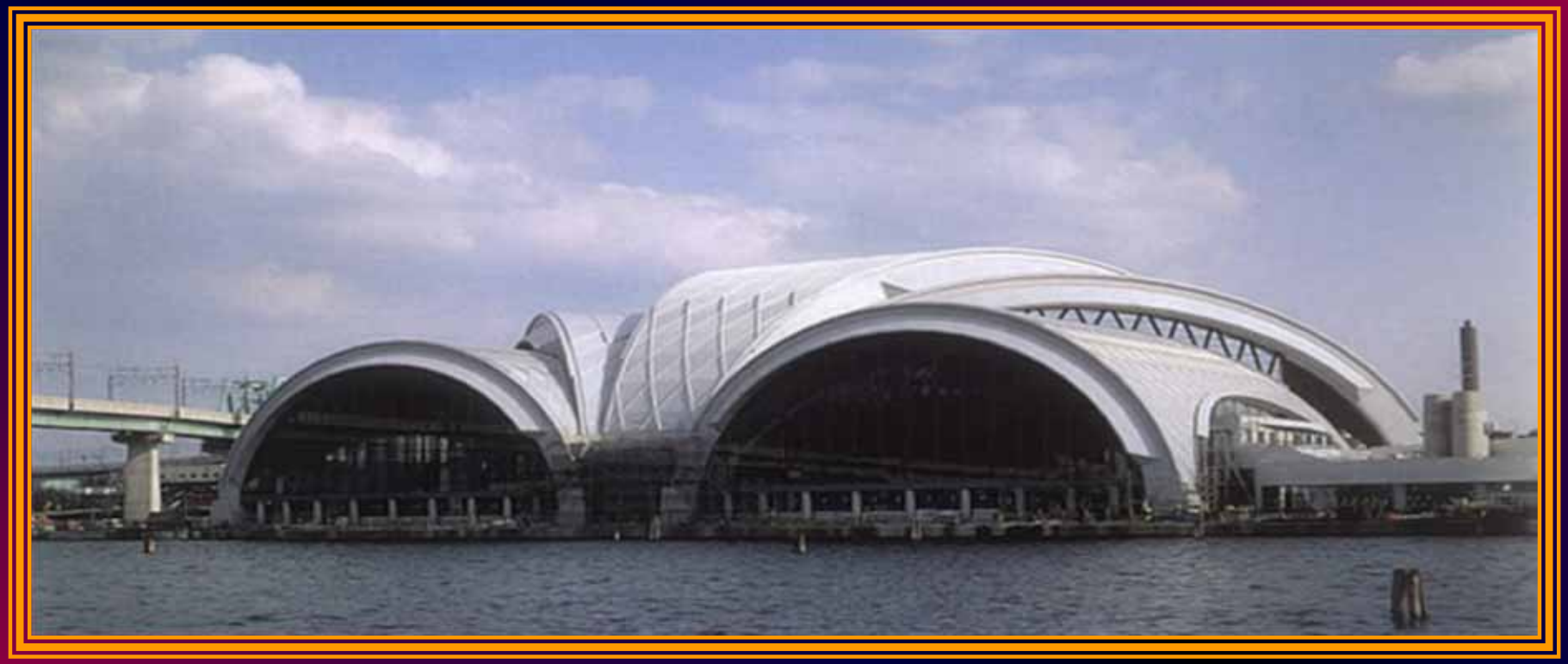
The scoring points for ss

* 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.

FEW ROOFING MASTERPIECES ACROSS THE GLOBE



TOKYO TATSUMI INTL., SWIMMING POOL

… right at the sea side with 304 grade roofing with flourocarbon resin coating - working well since 1993

Stainless Steel masterpieces - Ajuba

Khalsa heritage Centre – Anandpur Saheb
Over 40 MT of 304 grade texturised finish used for cladding

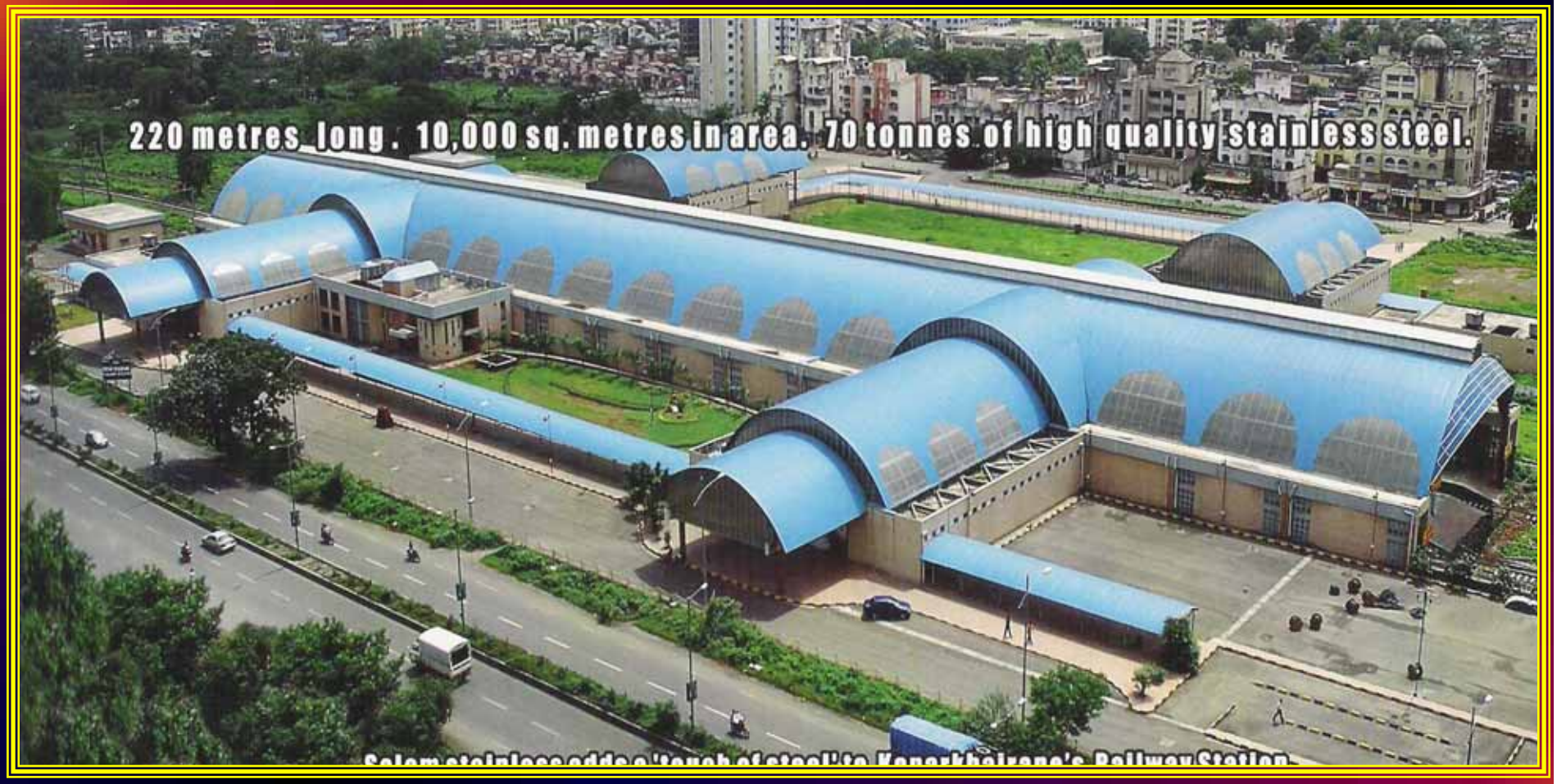
ONE OF THE MANY LANDMARK PROJECTS CRAFTED BY CPWD

SALEM STEEL PLANT SUPPLIED OVER 400 TONNES FOF STAINLESS STEEL FOR THIS PRESTIGIOUS LANDMARK – THE PARLIAMENT LIBRARY PROJECT

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

STAINLESS STEEL FOR CLADDING

The need :: rich aesthetics
durability
Zero maintenance

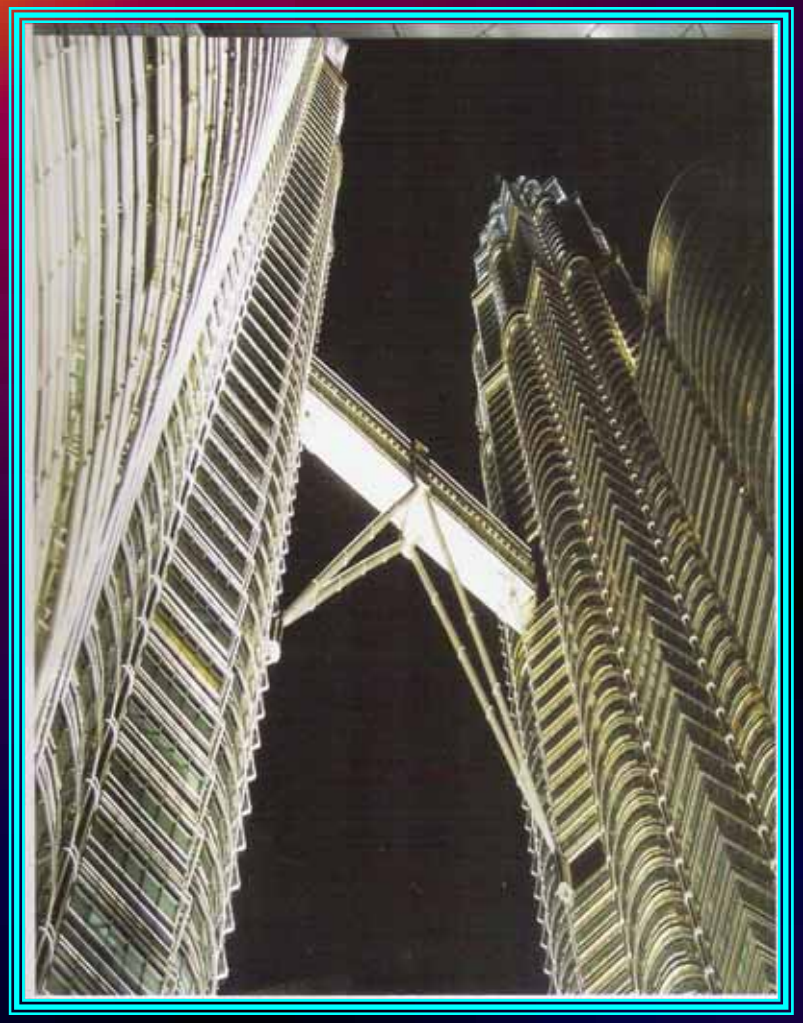
Where stainless steel scores -

* pristine & gleaming look
* Delicately reflective
* Strength & stiffness
* Water wash & that's all
* Lasts for a life time

PANELLING - A COST COMPARISON

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

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

Stainless masterpieces – Stonecutters bridge

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

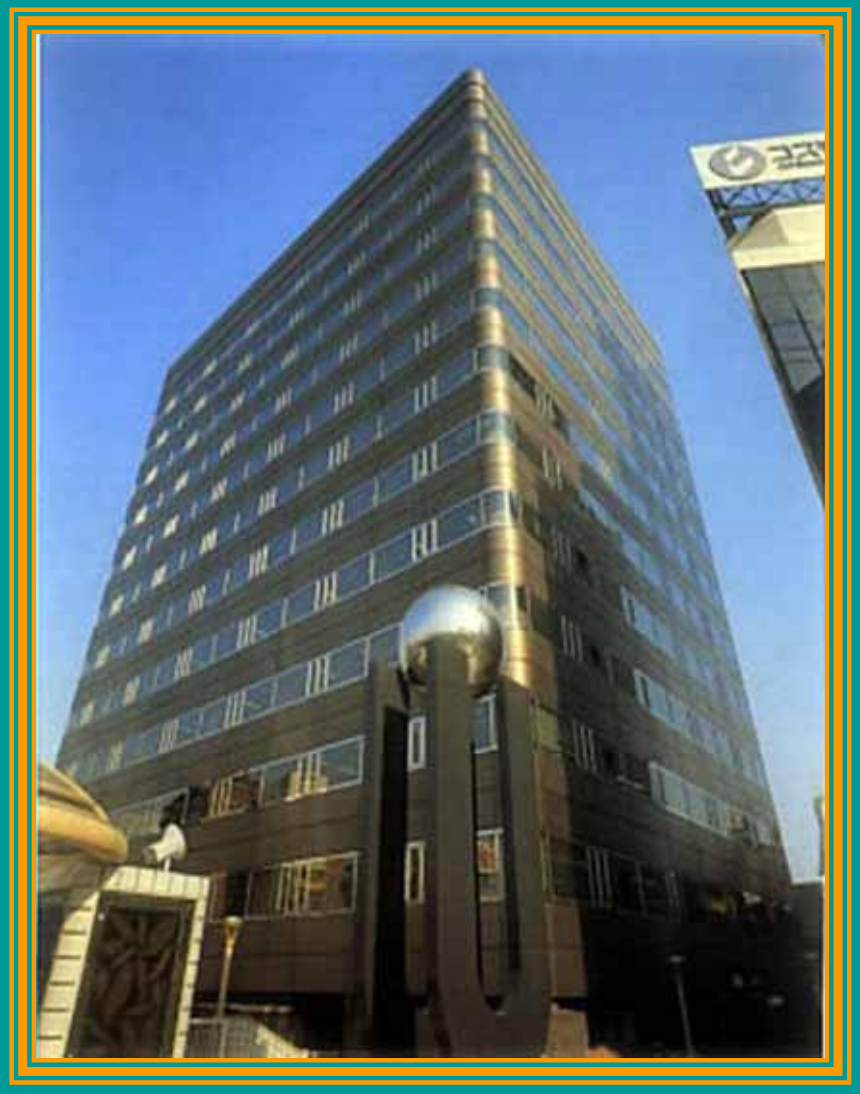
The world's tallest building -2717 feet tall

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

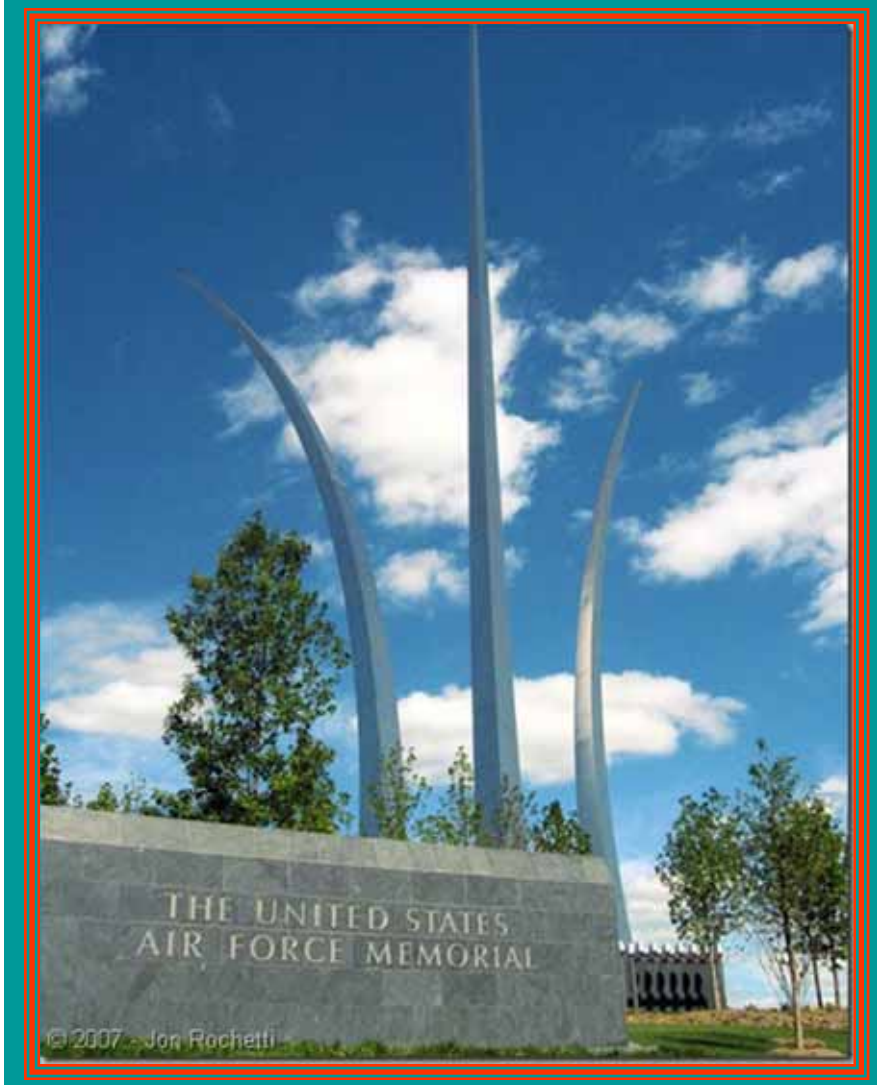
STAINLESS LANDMARKS – FAR AND NEAR



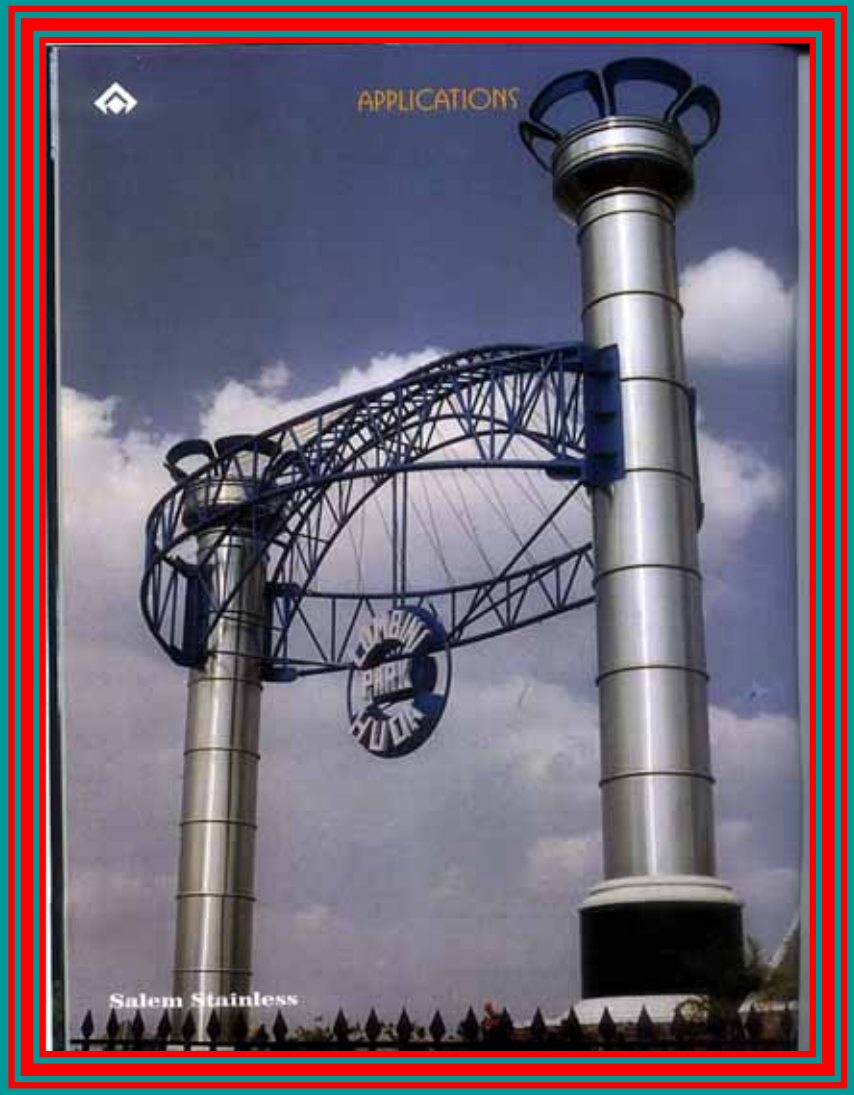
METRO RTA BLDG - TOKYO
Grade : SS 304

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

COMMEMORATIVE 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

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

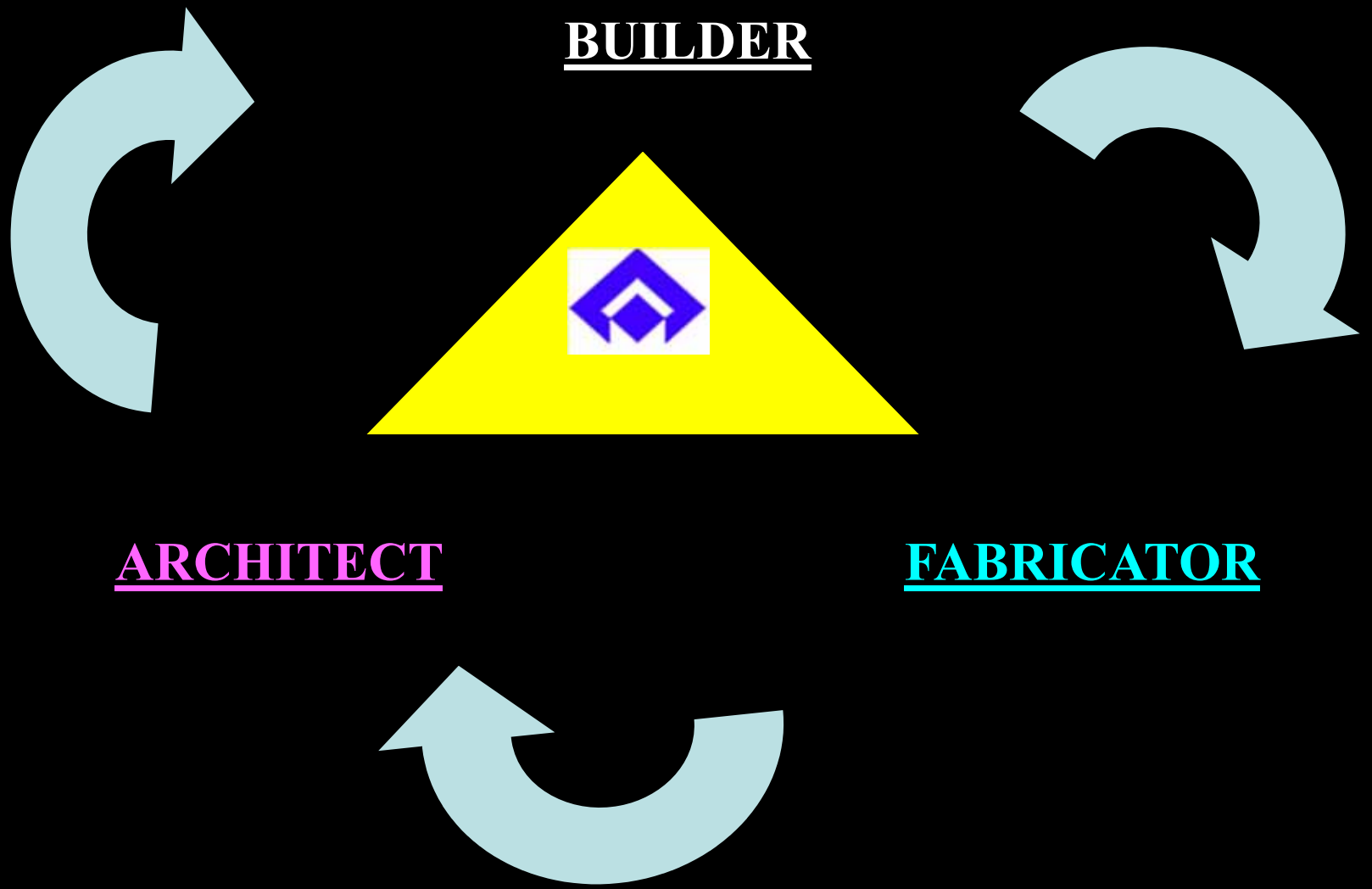
WHERE SS WATERLINES SCORE

- 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



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THANK YOU