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Three-Part Webinar Series: Structural Stainless Steel
Part 1: Applications and Specification
May 5, 2022

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Course Description – Submitted for AIA CE Credit

Structural Stainless Steel Applications and Specification
May 5, 2022

This presentation will introduce the new standard, AISC 370 *Specification for Structural Stainless Steel Buildings*, explaining why it is needed and how the specification and properties of stainless steel differ from those of carbon steel. An overview of structural alloys, applications and available product forms will be given, followed by guidance on how to assess the corrosiveness of the service environment, select an appropriate stainless steel family and alloy, and specify in accordance with ASTM and AISC 370 requirements.

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Learning Objectives – Submitted for AIA CE Credit

- Describe the chemical composition of stainless steels and how it differs from other steels.
- Explain why the design and construction of structural stainless steel has been codified.
- List applications for the use of structural stainless steel.
- Describe what structural stainless steel products are available and how to properly specify them using ASTM standards and AISC 370 *Specification for Structural Stainless Steel Buildings*.

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Structural Stainless Steel
Session 1: Applications and Specification

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Structural Stainless Steel Webinars

First in a three part series

- Applications and specification May 5
- Design May 12
- Connections and fabrication May 19

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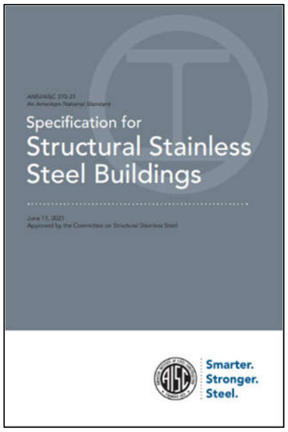
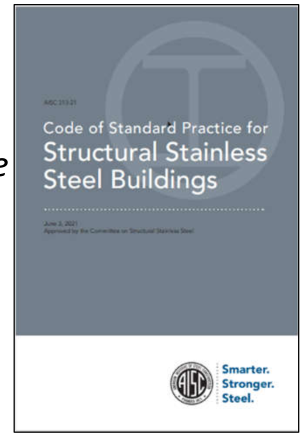
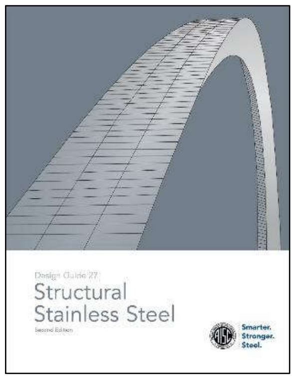
AISC's new stainless steel library!



AISC 370-21 *Specification for Structural Stainless Steel Buildings*

AISC 313-21 *Code of Standard Practice for Structural Stainless Steel Buildings*





AISC Design Guide 27, 2nd Ed.

Just published!

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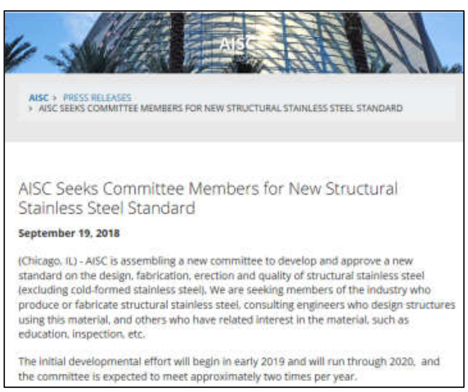


AISC > PRESS RELEASES > AISC SEEKS COMMITTEE MEMBERS FOR NEW STRUCTURAL STAINLESS STEEL STANDARD

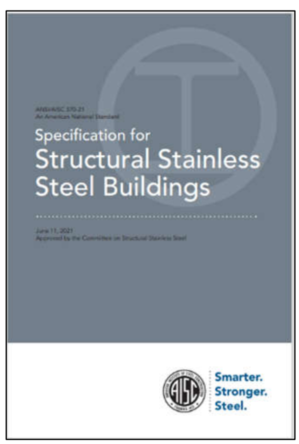
AISC Seeks Committee Members for New Structural Stainless Steel Standard

September 19, 2018

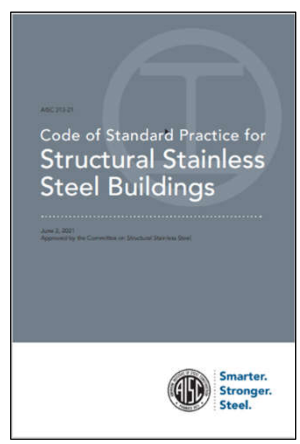
(Chicago, IL) - AISC is assembling a new committee to develop and approve a new standard on the design, fabrication, erection and quality of structural stainless steel (excluding cold-formed stainless steel). We are seeking members of the industry who produce or fabricate structural stainless steel, consulting engineers who design structures using this material, and others who have related interest in the material, such as education, inspection, etc.

The initial developmental effort will begin in early 2019 and will run through 2020, and the committee is expected to meet approximately two times per year.

Work started Sep 2018



AISC 370-21
Specification for Structural Stainless Steel Buildings



AISC 313-21
Code of Standard Practice for Structural Stainless Steel Buildings

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AISC Design Guide 27: Structural Stainless Steel

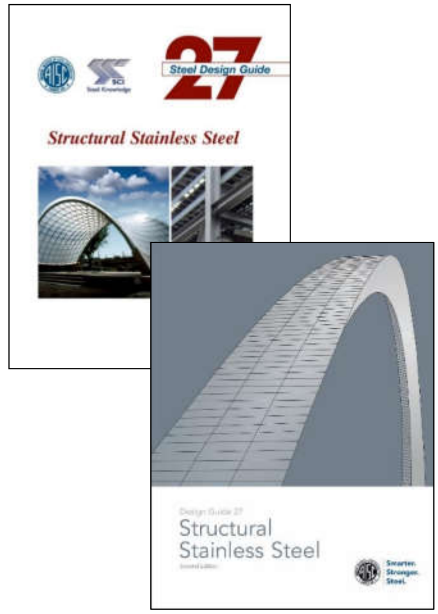
1st Edition, 2013

Hot rolled, welded & hollow sections

- Material properties, selection & durability
- Member and connection design rules
- Fabrication and erection
- Fire resistance
- Design examples

2nd Edition, May 2022

- Comparison of AISC 360 & AISC 370
- **More info:** Alloy durability and selection
- **New:** Design tables
- **More:** Design examples



An introduction to AISC 370 and AISC 313 …….

Jan 2022

A look at the new AISC 370 *Specification for Structural Stainless Steel*

Feb 2022

AISC's new *Code of Standard Practice for Structural Stainless Steel Buildings* smooths a path for the proper designation & design of structural stainless steel

Objectives of this session

We will answer the following questions:

- What is stainless steel and how do its properties and specification differ from other steels?
- Why is a design specification and code of standard practice needed for structural stainless steel?
- Where is structural steel used and how should appropriate stainless steels be selected?
- What product forms are available and how should it be specified using ASTM product standards and AISC 370?

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Selecting stainless family & alloy

1. Assess corrosion resistance requirements
    - Significant alloy family differences in some service environments
2. Mechanical properties
3. Physical properties
    - Manufacturing process can impact alloy family selection
4. Alloy and product form availability
5. Anticipated manufacturing processes

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A little history first….

Gateway Arch
World's first large stainless steel structural design (30 years)

Unisphere – 1964 World's Fair
Completed first
Used all structural product forms of stainless steel

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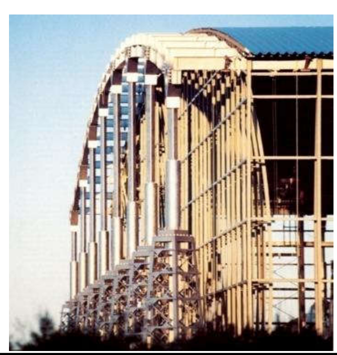
Canadian National Archives

- First large building framing application, 1995
- 500 year design life
- 2,800 tons types 304 and 316, designed to withstand earthquakes, tornadoes, and a corrosive environment



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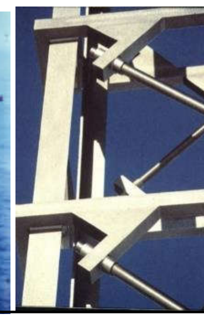
Comparison of steels

- What is stainless steel?
- How does it differ from other steels?
- How does its specification differ from other steels?







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Carbon vs. alloy vs. stainless steels

Carbon steel	Alloy steel	Stainless steel
ASTM A36, A500, A501	HSLA steels like weathering and dual-phase steels (ASTM A588, A847, A709)	Austenitic (304L, 316L, 904L up to 6% Mo) Duplex (2304, 2205 up to super duplex) Precipitation hardening (15-5 & 17-4)
Iron &carbon	Iron, carbon & other alloying elements	Iron, ≥10.5% chromium, low carbon (usually with other alloying elements)
	Corrosion resistance	
Low	Better	Best – Wide range of performance
	Ductility & energy absorption	
Low	Better	Best overall - Varies with alloy family
	Weldability	
Low	Good	Good – Varies with alloy family

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Fundamental differences

< 10.5% Chromium + higher carbon

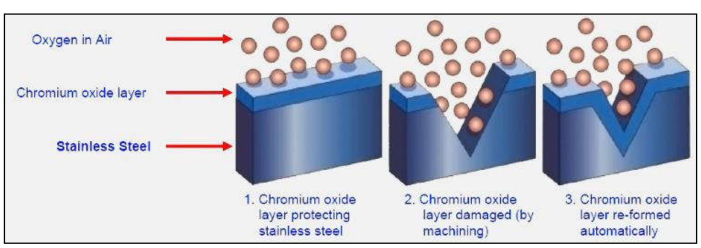
Uniform thickness loss without coating protection

≥ 10.5% Chromium + low carbon

Much lower corrosion rate in the form of small round pits = not coated

What makes it stain-less?

- Protective passive film forms **IF**
  - Alloy composition is corrosion resistant enough for the environment (10.5% Cr is not enough for most applications)
  - Surface is clean and exposed to oxygen (atmospheric or in fluids)



- More than 200 stainless steel alloys (custom made for different environments/ applications) - Only a few used in construction

Key things to know

- Stainless steels are grouped into “families” with different:
  - Microstructures
  - Mechanical and physical properties
  - Corrosion performance in different service environments
- Each family has different alloying element combinations
- Chromium, molybdenum and nitrogen are the primary alloying additions for increased corrosion resistance
- Nickel primarily improves formability and weldability

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Fundamental specification differences

- Terminology, Stainless Steel “Grade” = chemical composition
  - Alloy NOT strength (except for A1069 laser welded sections)
- Always use UNS number in stainless steel alloy specification
- Two ASTM standards typically required to specify a stainless steel product
- Stainless steel gauges are **not** defined in any standard
  - Specify thickness (minimum, maximum or range) – not gauge
    - Each stainless steel producer has their own gauge definitions
  - Stainless and carbon steel gauge thicknesses are different
- Stainless steel specifications list minimum required strength
  - Representative of very heavy plate not lighter sections

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Stainless steels families in AISC 370

- **Austenitic Fe-Cr-Ni (structural sections, tension bars, fasteners)**
  – Wide range of corrosion resistance
  – Strengthened by cold work, easier to to weld, higher formability
  – Nonmagnetic
- **Duplex Fe-Cr-Ni (Mo) (structural sections, tension bars, fasteners)**
  – Wide range of corrosion resistance
  – More resistant to chloride SCC and crevice corrosion
  – Higher strength & magnetic
- **Precipitation hardened FE-Cr-Ni (Mo-Al-Cu-Nb) (PH) (tension bars, fasteners)**
  – Highest strength, least corrosion resistant & magnetic
  – High strength/corrosion resistance nickel-based alloys are a better option if very high strength & corrosion resistance are required (see commentary)

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Chemistry & corrosion resistance

(Nominal Chemical Composition, Wt. Pct.)

- Higher Pitting Resistance Equivalent Numbers (PREn) indicate more corrosion resistance

	Cr	Ni	Mo	N	PREn
Precipitation Hardening 17-4PH	15	3	---	---	15
Austenitic 304/304L	18	9	---	0.06	18
Lean Duplex (2304 & 2101)	23	4.8	0.3	0.1	24.5
Austenitic 316/316L	17.5	11	2	0.06	25
Higher Alloy Duplex 2205	22	5	3	0.15	35
Higher Alloy Duplex 2507	25	7	4	0.28	43
Higher Alloy Austenitic 254 SMO	20	18	6.1	0.20	43

PREn (Pitting Resistance Equivalent number) = %Cr + 3.3(%Mo) + 16(%N)

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Selecting stainless family & alloy

1. Assess corrosion resistance requirements
   - Significant alloy family differences in some service environments
2. Mechanical properties
3. Alloy and product form availability
4. Anticipated manufacturing processes
5. Physical properties
   - Manufacturing process can impact alloy family selection

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Comparative atmospheric corrosion data for metals

Location	Pretoria-CSIR	Durban Bay	Cape Town Docks	Durban Bluff	Walvis Bay
Environment					
Location Type	rural, very low pollution	marine, moderate pollution	marine, moderate pollution	severe marine, moderate/low pollution	severe marine, low pollution
SO_2 Range μg/m^3	6 – 20	10-55	19 – 39	10 – 47	NA
Fog Days/year	NA	NA	NA	NA	113.2
Avg. rainfall, in/year (mm/year)	29.4 (746)	40 (1,018)	20 (508)	40 (1,018)	0.31 (8)
Relative Humidity Range %	26 - 76	54 - 84	52 - 90	54 - 84	69 - 96
Temp. range F (C)	43 – 79 (6 – 26)	61 – 80 (16 – 27)	48 – 77 (9 – 25)	61 – 80 (16 – 27)	50 – 68 (10 – 20)
Annual Corrosion Rate mm/year					
Type 316 SS	<0.0000025	<0.000025	0.0000025	0.000282	0.000044
Type 304 SS	<0.0000025	0.000062	0.00012	0.000418	0.000057
3Cr12 HR SS	0.00954	0.0135	0.0268	0.0454	0.0338
COR-TEN A®	0.0150	0.153	0.0753	0.781	0.88
Mild steel	0.0285	0.330	0.194	2.19	0.97

Stainless steel is pickled unless "HR" (hot rolled) is indicated
Source: Callaghan, B.G., *Atmospheric Corrosion Testing in Southern Africa: Results of a twenty year national exposure programme,* CSIR

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Design – A preview of May 12

Why is an AISC design specification and a code of standard practice needed for stainless steel?

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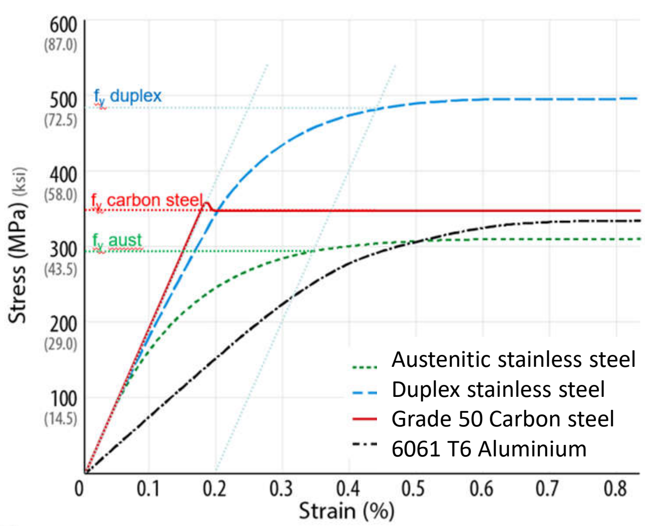
Stress-strain characteristics: low strains



Modulus of elasticity very similar to carbon steel, but form of stress-strain curve is fundamentally different.

Implications on design of structures

Yield strength = strength at 0.2% offset permanent strain

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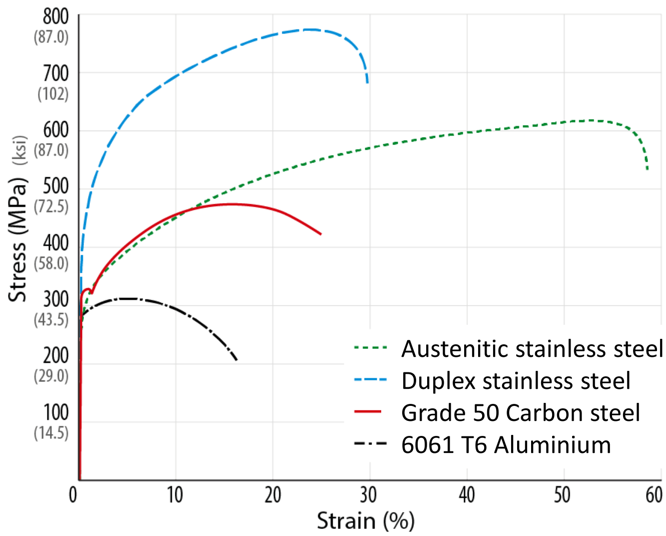
Stress-strain characteristics: high strains



Stainless steel has better intrinsic energy absorption properties than aluminium or carbon steel due to high rate of strain hardening & excellent ductility

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Mechanical properties

Material	Type	F_u	F_y	F_u/F_y	Min elong in 2 in.	Modulus of elasticity
		ksi	ksi		%	ksi
Carbon steel	Gr. 50	65	50	1.3	21	29,000
Austenitic stainless steel	304, 316	75	30	2.5	40	28,000
Duplex stainless steel	2101, 2205	95	65	1.5	25	29,000

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Physical properties

Material	Density		Thermal Conductivity at 68 °F (20 °C)		Thermal Expansion between 68 and 212 °F (20 and 100 °C)	
	lb/ft³	kg/m³	BTU/ hr.ft.°F	W/m.K	10^{-6}/°F	10^{-6}/°C
Carbon Steel	487	7800	30.8	53.3	6.5	11.7
Austenitic Stainless Steel	500	8000	8.7	15.0	8.9	16.0
Duplex Stainless Steel	485	7800	8.7	15.0	7.2	13.0

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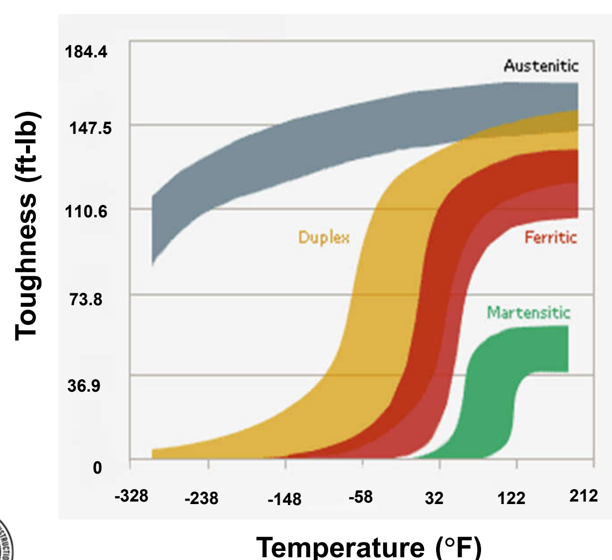
Low temperature toughness (welds)



Austenitics:

- no ductile to brittle transition
- ductile down to cryogenic temperatures

Duplexes:

- ductile to brittle transition like carbon steels,
- good toughness down to -40 °F

Liquified natural gas (LNG) tanks made from austenitic stainless steel

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Scope of AISC 370

Shapes

- Hot rolled, welded, extruded open structural sections
- Round and rectangular HSS
- Plate and bar

Exclusions – Under review / development for next version

- Seismic design
- Shapes: Angles in flexure, unequal angles, equal angles with slender cross-section
- Chapter I: Composite members
- Chapter K: HSS connections (limited scope)

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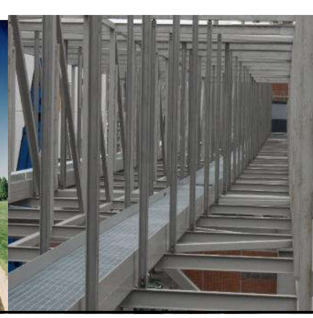
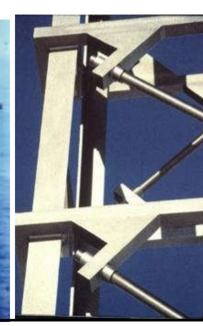
Applications & alloy selection

- Where is it used and how do you select the right alloy?

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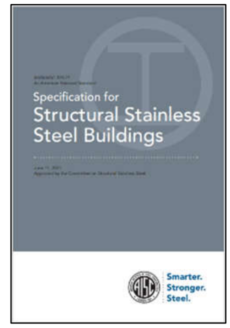
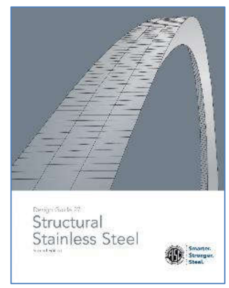
Where do I find selection information?

- AISC 370 design requirements & commentary
- DG27 provides more information
- Stainless steel producer and industry association literature and websites
- Books, papers, symposiums
  - Assoc. for Materials Protection and Performance - AMPP (formerly NACE)
  - ASM International
- Metallurgical engineers specializing in stainless corrosion - environment specific specialization





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Minimum assessment requirement

AISC 370 A4 specification <u>requirement</u>

- Assess the application for:
  - Galvanic Corrosion
  - Chloride Stress Corrosion Cracking
  - Crevice Corrosion
  - Microbiological Corrosion
  - Corrosion Caused by Immersion or Splashing by Liquids

Read the commentary and DG27 for more information

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Galvanic corrosion

Three things needed for galvanic corrosion to occur:

- Corrosion potential difference between dissimilar metals
  - Values vary with the environment
- Direct metal-to-metal contact
- Moisture regularly connects metals

- Failure - Galvanized bolts in stainless steel
- Bolts should **ALWAYS** be as corrosion resistant as the most corrosion resistant of the metals joined.

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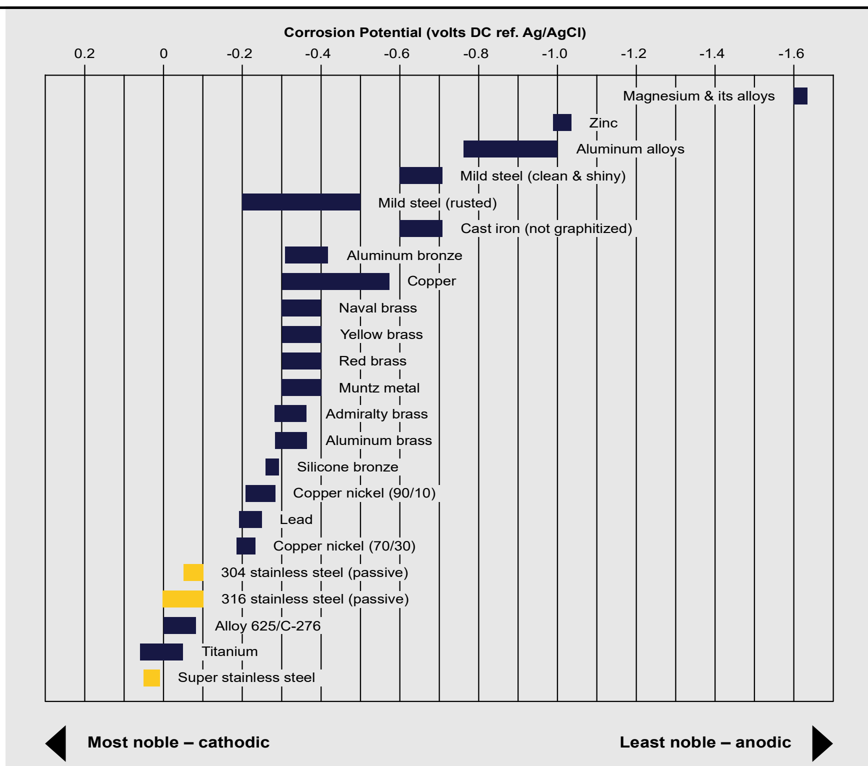

Galvanic series in seawater

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Galvanic corrosion

Solution = separate metals to avoid direct electrical contact

- Minimum required separation distance varies with service environment (electrochemical corrosion calculation)
- 3.937×10^{-6} to 0.0039 in. (0.1 – 100 μm)
- Burs & surface non-uniformity can connect the materials
- Abrasion / deterioration of barrier must be considered
- Any point of contact can negate the barrier

Do not use paint as a barrier between mechanically fastened surfaces!

Movement will abrade away the coating

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Galvanic corrosion

Separation options:

- Non-conducting barriers
  - Many types
  - Choice driven by service environment & application
- Paint welded connections
  - Paint the carbon or alloy steel + weld + ≥ 2 inches of stainless steel
  - Inspect it regularly & repair paint as needed to prevent moisture from reaching the weld
- Design to avoid problem

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Equivalent Surface Area Galvanic Couples

Corroding metal	Coupled metal						
	Aluminum	Anodized aluminium	Zinc	Carbon steel	Weathering steel	Copper	Stainless steel
Aluminum	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	Large increase in corrosion	Large increase in corrosion	Large increase in corrosion	Some increase in corrosion
Anodized aluminum	No data	No risk of galvanic corrosion	No data	Large increase in corrosion	No data	Large increase in corrosion	Some increase in corrosion
Zinc	No risk of galvanic corrosion	Some increase in corrosion	No risk of galvanic corrosion	Large increase in corrosion	No data	Large increase in corrosion	Some increase in corrosion
Carbon steel	No risk of galvanic corrosion	Some increase in corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	Some increase in corrosion	Some increase in corrosion
Weathering steel	No data	No data	No data	No data	No risk of galvanic corrosion	No data	Some increase in corrosion
Copper	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No data	No risk of galvanic corrosion	No risk of galvanic corrosion
Stainless steel	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion	No risk of galvanic corrosion

No risk of galvanic corrosion | Some increase in corrosion | Large increase in corrosion | No data

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Galvanic corrosion – relative surface area

- Relative exposed metal surface area ratio is critical to the assessment
- A larger noble (more corrosion resistant) metal surface area can dramatically increase the anodic metal corrosion rate
- The reverse is true if the anodic surface is large – unless there is a crevice

Stainless screws have no impact on weathering steel corrosion rate

Rapidly corroding galvanized steel bolts – no impact on stainless steel!

Rapidly corroding galvanized steel fasteners – no impact on stainless steel!

Photos courtesy Catherine Houska & ASSDA

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Statue of Liberty failure & restoration

- Completed 1886, Restored 1986
- Original galvanic barrier between iron & copper failed
- Iron corrosion damaged copper and threatened structural integrity
- New framing – duplex stainless steel and Type 316 armature bars

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Crevice corrosion

- Crevice corrosion resistance varies with alloy family and specific alloy, water chemistry, presence and type of surface deposits and presence of microbiological growths
- Appropriate design varies with service environment!!!
  - Water shedding atmospheric designs are easier
  - Immersed applications require help from a corrosion expert!

Bolt in Miami

MIC aquarium corrosion

Photos courtesy: Catherine Houska

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How do I assess a service environment?

- Start with AISC 370 commentary – Section A3.1a
- Table C-A3.1 lists common service environment characteristics
- Start by obtaining this data (and anything else that seems relevant)
- Some environments are simple – some are complex and require specialized engineering help
- Get as much data as possible **<u>before</u>** calling a metallurgical engineer who specializes in stainless steel corrosion in that specific service environment

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Atmospheric corrosion

- Any building or structure exposed to the outside air
  - Sheltered or fully exposed to precipitation
  - Sprayed or splashed with water but not immersed
  - Pollution and particulate exposure but not part of an industrial plant

Shady Grove
Photo: Chattanooga Boiler and Tank Co.

Security barrier, Geneva
© Nancy Baddoo

San Diego Pedestrian Bridge
© Catherine Houska

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Typical atmospheric environment data needed

Urban pollution exposure level
Industrial pollution exposure level and source
Particulate level and type (industrial, dust, etc.)
Rain acidity
Average multi-year total wet and dry chloride salt deposition level
Deicing exposure level and type of chloride salts used
Average monthly daytime and evening temperatures
Average monthly daytime and evening relative humidity
Frequency and quantity of total precipitation, heavy rain, fog, and snow
Expected manual cleaning frequency
Whether there is exposure to precipitation

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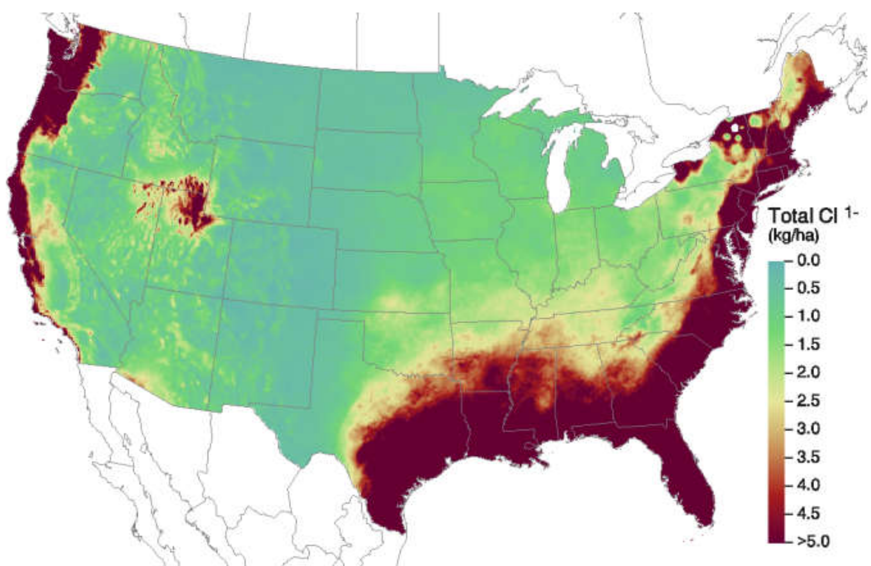
Total Chloride Salts Deposition (kg/ha) - 2018

US National Atmospheric Deposition Program data – pollution, salts, acid rain

Similar data available for other parts of world



Total chloride deposition 2018

Source: CASTNET/CMAQ/NADP

USEPA 10/21/19

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Railings Coastal Splash Zone

- New York City
- Painted carbon steel railings failure 8 – 10 yrs.
- Hudson River Park Type 316

- Canary Islands park
- Painted carbon steel railings failure 8 years
- Duplex 2205 after 30 years

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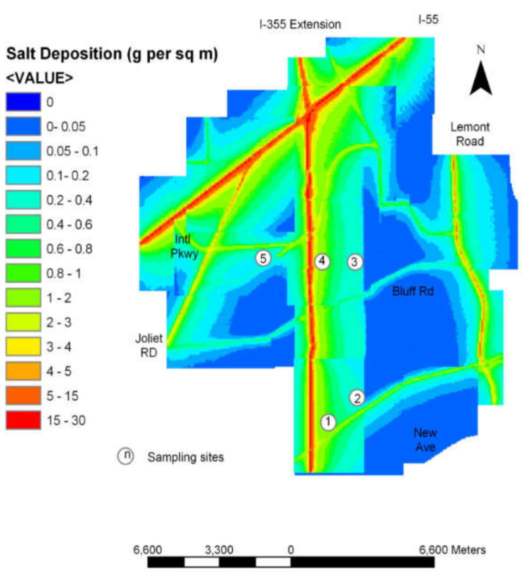
Deicing Salts (Chloride) Corrosion



- Multi-year study
  - IL DOT, NADP, Argonne National Lab
- High seasonal accumulation
- Large saltwater droplets
  - Splash zone (≤ 49 ft.)
- Dry particles
  - ≤ 1.2 miles from roads
  - ≤ 59 floors
  - Stays in the air for days

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Critical Temperature/Humidity Combinations

Coastal & Deicing Salts (chloride) Corrosion

Once a critical combination of temperature and humidity are reached, hygroscopic salts pull moisture from the air creating a concentrated corrosive salt solution on surfaces

Critical Temperature F (C)	**Critical Humidity Level, %** Sodium Chloride	Calcium Chloride	Magnesium Chloride
77 (25)	76	30	50
50 (10)	76	41	50
32 (0)	---	45	50

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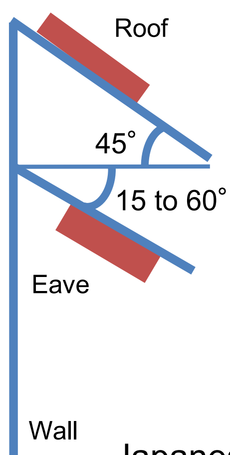
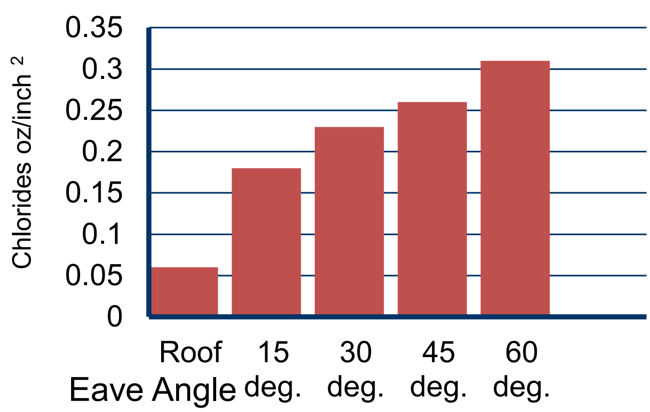
Typical Chloride Accumulation Sheltered Locations

- Sheltered locations are usually more corrosive with higher salts accumulation
- Exception: locations with very high particulate levels and minimal rain where exposed locations are more corrosive





Japanese coastal research, 17 locations, varying distances from coast

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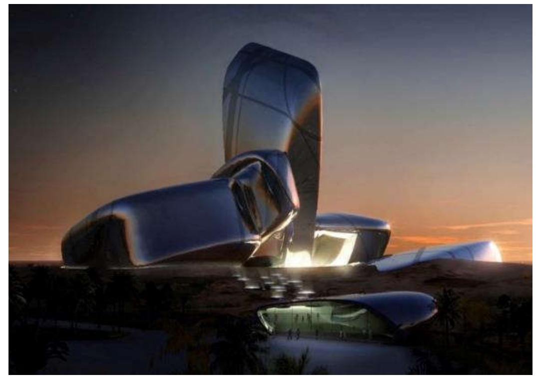
Dubai beach site corrosion rates
Standing Seam Roof Perforation Example

Metal	Corrosion Rate Dubai Coastal, in. (mm/year)
2205 Duplex	0 (0)
Galvanized steel*	0.02 (0.51)
Aluminum	0.002 (0.05)
Zinc	0.04 (0.89)
Copper	0.004 (0.10)

* A G140 coating (0.025 mm) was assumed to have delayed carbon steel corrosion by 1 year based on zinc corrosion rates, this may not be accurate.
Credit: Outokumpu corrosion test site data



King Abdulaziz Center for World Culture 2205 duplex stainless steel tube sunscreen

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Industrial

- Building framing, structures, platforms
- All structural components within the processing equipment or system
- Equipment supports

Pulp and paper plant
© Outokumpu

Energy & power
© Outokumpu

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Typical industrial environment data needed

Gas composition or atmospheric exposure
Operating temperature range
Presence and concentration of sulfides
Chemicals and their composition range
Salinity
Humidity/moisture exposure
Exposure to precipitation

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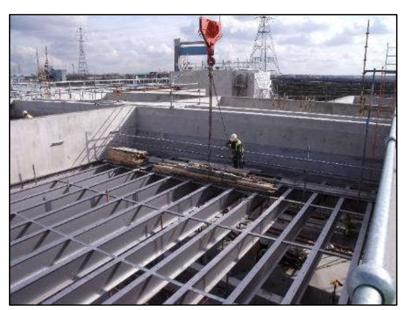
Continually or regularly immersed

- Any application with continual, cyclical or other regular immersion
- Potential for flood exposure
- Natural waters
- Industrial fluids
- Water processing
- Joints or other parts of the design where moisture accumulates


Lock & dam gates
© Outokumpu


Desalination, water and wastewater treatment plan
© Interserve

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Typical fluid environment data needed

Chemical composition range of liquid and atmosphere, if industrial
If not continuously immersed, frequency of immersion
pH range of liquid
Chlorine and/or bromine and chloride concentration, if used
Temperature range of liquid and atmosphere
Presence of microbiological organisms for natural water
Salinity of liquid and atmospheric environment

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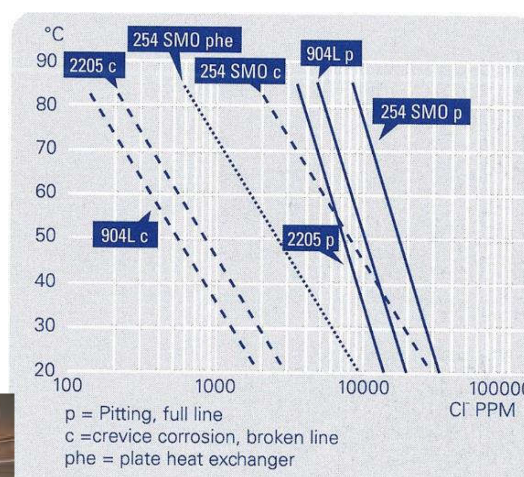
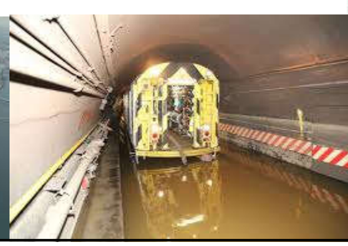
Immersion in sea & brackish water

- Do not use common stainless steels for long term immersion, spray or splashing!!
- Use seawater grade stainless steels
  - Type 316 is NOT a seawater stainless
  - Neither is 2205 duplex but it might be good enough for some applications
- Expert analysis required!





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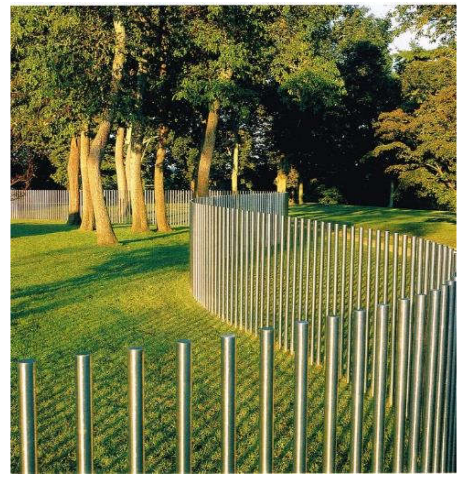
Soil and rock

- Applications embedded in or buried in soil
- Rock anchors and tunnel environments



Stainless steel fence post

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Soil and rock environments

- Most corrosive
  - Low pH, high chloride & sulfide levels, poor drainage
- Stray currents can accelerate corrosion
- Aluminum and carbon steel are not suitable
- Cast iron can provide reasonable life if there are low/no chlorides

Stainless Steels	Soil Environment
Austenitic 304, 316 Duplex 2304	Cl < 500 ppm, resistivity > 1,000 Ω-cm, pH > 4.5
Austenitic 316, duplex 2304, 2205	Cl < 1,500 ppm, resistivity > 1,000 Ω-cm, pH > 4.5
Austenitic 6% Mo alloys duplex 2507	Cl < 6,000 ppm, resistivity > 500 Ω-cm, pH > 4.5

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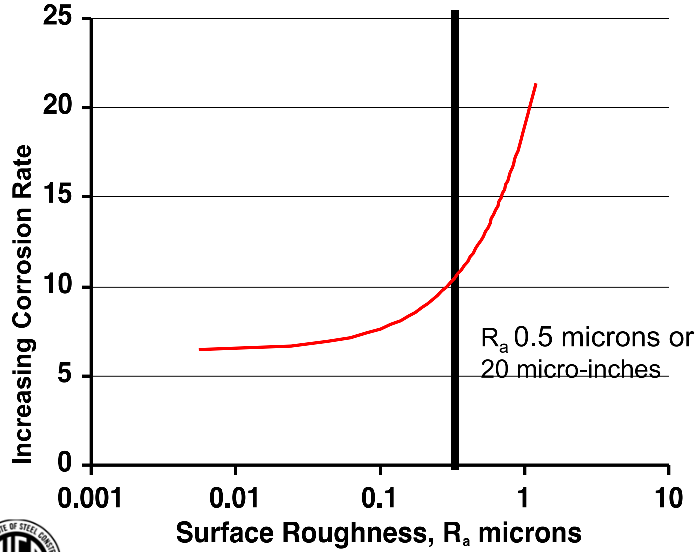
Surface finish critical to corrosion performance



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Stainless steel finish specification

- Standard finish for heavy sections
  - Abrasive blasted and pickled is most common
  - Very rough finish
- Grinding, polishing and electropolishing
  - More uniform appearance
  - Improved corrosion performance
  - Improved cleanability

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Product forms & specification

- What product forms are available
- How should it be specified using ASTM product standards and AISC 370?

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Basic specification considerations

- Higher alloy content = more corrosion resistant = higher cost
- Mill finishes do not add cost – smoother finishes add $$
- Common austenitics more available, better formability & weldability
- Duplex stainless steels are the most cost-effective choice if:
  - Better chloride stress corrosion cracking, crevice corrosion resistance is needed and often most cost-effective way to achieve higher corrosion resistance
  - Higher strength can be used
  - Less movement during welding
- If you need sharp precise corners, use laser or laser-hybrid welded shapes

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Product Range

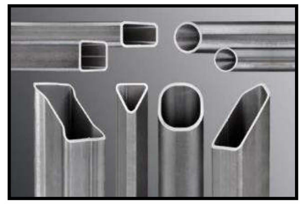
Structural shapes
- Hot & cold rolled
- Welded
- Extrusions

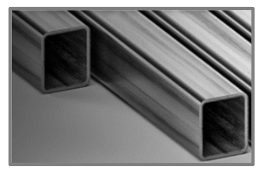
Hollow sections

Castings

Fasteners

Bar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Availability of Stainless Structural Shapes

- All of the common structural shapes are available in stainless steel
  - Stocked sizes are more limited than carbon steel
  - Generally only Types 304/304L and 316/316L are stocked, except for 2205 round tube and pipe
  - Custom fabrications & short runs readily available in all alloys
- Laser and laser-hybrid welded structural sections are commonly stocked up to 8-inch angle, 50-inch beams, and channels up to C15×33.9.
- Larger beams can be built-up from plate
- Hot rolled shapes up to 6 inch are common but larger sizes are inventoried like C8×18.75 (C203×476) channel
- Extruded shapes musts fall within an 8-inch diameter but maximum size varies with alloy
- 16-inch and larger hollow sections are available

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Specifying using ASTM product standards AISC 370 Table A3.1

- Two standards are required for most products
  - A standard for chemistry & mechanical properties
  - A standard for tolerances, finish, and everything else
- There are standards for everything except built-up shapes made by welding processes other than laser or laser-hybrid welding (ASTM A1069 covers laser welded shapes)
  - AWS D1.6 covers assemblies not cover production of structural shapes
  - ASTM standards and AWS requirements used to fill gap

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Other built-up shapes

Product Form	I-shapes, channels, angles, tees, box sections
Weld Filler Material Requirements	Weld strength and corrosion resistance
Dimensional Tolerance	Open Shapes • ASTM A6/A6M for member tolerances of built-up shapes • Specification of AWS D1.1/D1.1M, clause 7.22, member dimensional tolerances shall be a special ordering requirement, as applicable Box Sections • ASTM A554, or as specified in design documents

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Other built-up shapes

Profile and Welding Requirements	As shown in design documents
Alloy Chemical Requirements	UNS designation
Base Metal	Table A3.1 (a) and (e)
Weld Mechanical Properties	As shown in design documents
Welding and Inspection	AWS D1.6/D1.6M
Finish, Supplementary Requirements	ASTM A1069/A1069M or ASTM A484/A484M
Cleaning/Weld Restoration	ASTM A380/A380M

Additional requirements are in the notes

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Summary

- Stainless steels are corrosion resistant steel alloys used
    - in aggressive environments
    - where maintenance is difficult
    - for architectural reasons
- Different alloys are suitable for different environments
- Structural performance is similar to carbon steel but some modifications needed due to the non-linear stress-strain curve

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For those participating at their own connection…

- Reporting attendance is not necessary.
- Certificates will be issued based on AISC's attendance record.
- You will be receiving certificates via email from registration@aisc.org.

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CEU / PDH Certificates

For those participating at one connection with a group…

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    - Username: Same as AISC website username.
    - Password: Same as AISC website password.
- Once attendance has been reported, each group member will be receiving certificates via email from registration@aisc.org.

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