STAINLESS STEEL REBAR GUIDELINES FOR SHIPPING, HANDLING, FABRICATION AND PLACEMENT

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GENERAL APPLICATIONS

Stainless steel rebar has been used as concrete reinforcement in numerous applications including bridge decks, barrier walls, stanchions, parking garages, sidewalks, retaining walls and marine structures (sea walls, piers, jetties, moorings, etc.). Of paramount importance in the decision to use stainless steel is the required corrosion resistance in the application. The material has also found acceptance in areas where a low magnetic permeability material is required. These include deperming piers, magnetic resonance imaging (MRI) equipment, and electric motor foundations.

Alternative materials such as carbon steel and coated products in harsh environments, whether coastal or due to chloride corrosion from road salts, have inadequate corrosion resistance resulting in increased repair and rehabilitation costs. In these applications, where a long design life and minimum maintenance is required, stainless is an attractive alternative and cost justifiable. Stainless steel has excellent corrosion resistance to chlorides in concrete and numerous studies (both long term and accelerated short term tests) have validated this claim.

GUIDELINES FOR SHIPPING, HANDLING, FABRICATING & PLACEMENT OF STAINLESS STEEL REBAR

GENERAL COMMENTS

Stainless steel rebars are very rugged and durable.To maximize the corrosion-resistant properties of stainless steel, a certain amount of care is required during shipping, handling, fabrication and placement. For example, contact with carbon or low alloy steels can cause iron particles to become embedded in the stainless steel, which may result in surface staining.

Although stainless steels are much more resistant to corrosion than carbon steels, some alloys may suffer surface staining or localized corrosion in certain chloride-containing environments. Hence, stainless steel rebars should be protected from direct contact with chlorides (de-icing salt, calcium chloride, seawater, etc.) prior to embedment in concrete.

Although unlikely at the pH levels encountered in cured concrete, galvanic corrosion may occur on carbon steel when it is connected to stainless steel. To prevent galvanic corrosion from occurring under corrosive conditions, stainless steel rebars should not make metal-to-metal contact with carbon steel rebars or other carbon steel components in the structure. Simply keeping the two metals separated (plastic sleeves, etc.) will eliminate this potential problem.

NOTE: The Ontario Ministry of Transportation undertook a research project at Queen's University to investigate potential negative effects from contact between stainless steel and black steel reinforcement.

Results show that the corrosion rates between the galvanically coupled black steel and stainless steel are so small that distress of the structure is unlikely during the 75-year design life.

As a result of the report, the Ministry will no longer specify isolation between black and stainless steel reinforcement.

SHIPPING & HANDLING

- Prior to shipping, ensure that all chains and steel bands will not come into direct contact with the stainless steel rebars. Wood or other soft materials (thick cardboard) should be placed under the tie-downs. Alternatively, nylon or polypropylene straps should be used to secure the rebars.
- When bundles of carbon steel and stainless steel rebars must be shipped one on top of the other, the stainless steel rebars should be loaded on top. Use wooden spacers to separate the two materials.
- Outside storage of stainless steel rebars is acceptable. Consideration should be given to covering the stainless steel rebars with tarpaulins.
- Stainless steel rebars should be stored off the ground or shop floor on wooden supports. Stainless steel rebars should be stored separately from carbon steel rebars.
- Keep carbon steel tools, chains, slings, etc. off stainless steel rebars.
- Stainless steel rebars that require movement by fork-lift truck should be adequately protected so as not to scratch them or to contaminate the material by direct contact with the forks.
- Do not use carbon steel lifting devices. Use nylon or polypropylene slings.

FABRICATION

- Ensure that the stainless steel rebar is free of mill scale prior to fabrication. If mill scale is present, it should be removed by pickling or abrasive blasting (please consult the rebar supplier).
- If the rebar requires cleaning prior to the start of fabrication, it should be cleaned by a pressurized water spray. Do not use seawater or brackish water. Grime that cannot be removed by water washing should be removed with a non-chlorinated detergent, followed by a pressurized water wash.
- All hand tools should be stainless tools that have not been previously used on carbon steel. Mechanized tools and handling devices (such as shears, rollers, tooling, etc.) may be carbon steel provided they have a minimum hardness of Rockwell C35. Such steel tools and devices are to be wiped down with clean rags and cleaning agents prior to being used for stainless steel rebars.
- In order to avoid surface contamination with carbon steel particles or mill scale, it is recommended that stainless steel rebar should be processed on dedicated equipment.
- Do not use grinding tools or abrasive cut-off discs that have been previously used on carbon steel.
- Any iron pick-up/contamination should also be removed with pickling paste.
- Excessive thermal oxidation (or "blueing") caused by cutting with an abrasive cut-off disc should be removed with pickling paste. Using a cut-off wheel with ample water-cooling will usually avoid this potential problem.
- It will be necessary to apply more force in order to bend stainless steel rebars. Also, they tend to have more "spring" than carbon steel rebars and may need to be overbent, to compensate for this "spring-back."
- Stainless steel rebars must not be "hot" bent or "hot" straightened.
- Stainless steel rebars can be welded together using various welding techniques. Care should be taken to clean any dirt, grease and oil from the edges to be welded. Correct welding rods/electrodes and procedures must be used (please consult the rebar supplier or a knowledgeable welding supply house). After welding, all slag and oxidation should be removed by wire-brushing (with a clean stainless steel brush) or by the application of a proprietary pickling paste.
- To ensure good quality welds and proper post-weld clean-up, any tack-welding or joining of stainless steel rebar is best performed in the fabrication shop, rather than on site.
- Fabricated rebar is often shipped to the job site in "bundles", held together with wire. In the case of stainless steel rebar, the bundling wire should be plastic-coated or should be made of stainless steel. Do not use carbon steel ties.

PLACEMENT

- Stainless steel rebars should be supported and spaced using plastic "chairs" and spacers.
- Stainless steel couplers are available for connecting lengths of bar together longitudinally.
- Rebars must be held together with stainless steel tie-wire. Coils of stainless steel tie-wire (3.5 lb) are available to fit the standard, belt-mounted reels.
- To avoid possible galvanic corrosion problems, the tie-wire should have a level of corrosion resistance equivalent to that of the stainless steel rebars being used.
- Fully annealed (fully soft) Type 316 or 316L tie-wire (1.6mm/0.063in. diameter) is usually a good choice for this purpose and will facilitate twisting and cutting.
- At locations in the structure where the ingress of moisture, oxygen and chlorides will be absent, or judged to be extremely low, stainless steel and carbon steel may be connected together. However, to guard against any unforeseen changes in the future, consideration should be given to placing electrical insulation material between the dissimilar metal connections, whenever possible.

Corrosion Service Co., Canada

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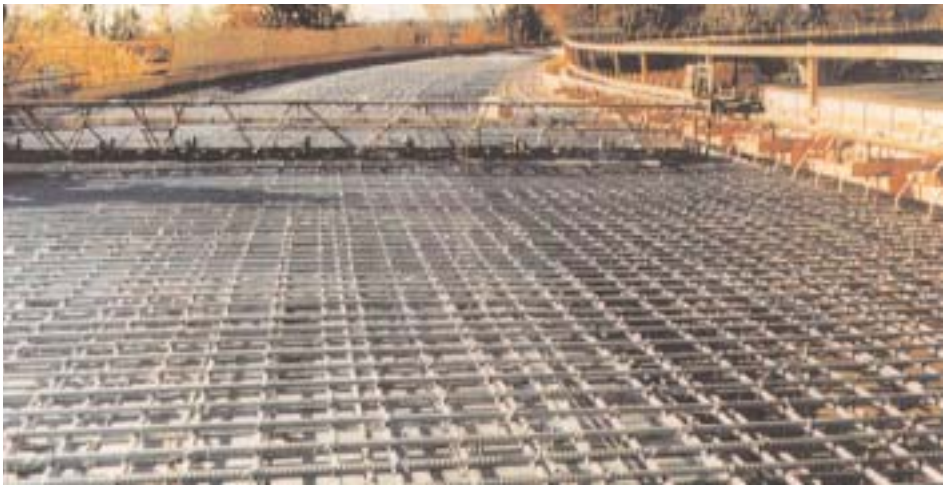

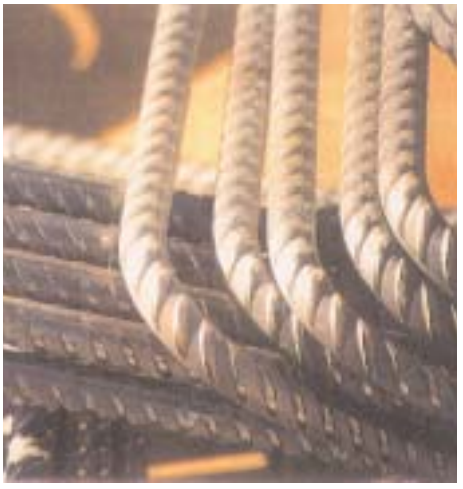

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CLEANING AND PICKLING

Stainless Steels, received in the pickled condition, can usually be easily cleaned with a mild soap and water. In some cases a degreaser may be needed. In cases where rusting, iron contamination or weld oxide must be removed, stainless steel brushes can be employed in localized areas. For more general cleaning, stainless steels are often cleaned with a commercial pickling paste.

GUIDELINES FOR ACCEPTABLE FINISH*

* Per Ontario Ministry of Transportation

NOTE: "B" can exhibit some light discoloration with no impact on service life.

"C" heavy rust

"D" pits and rolled-in-scale

SPECIFICATIONS-STAINLESS STEEL REBAR

ASTM A-955M and British Standard 6744

RELATED STAINLESS SPECIFICATION FOR BAR AND WIRE PRODUCTS

ASTM A-276 Specification for Stainless Steel Bars and Shapes

ASTM A-478 Stainless and Heat Resistant Weaving Wire

ASTM A-493 Stainless and Heat Resistant Wire for Cold Heading and Forging

ASTM A-555 Stainless Steel Wire and Rod — General Requirements

ASTM A-342 Test Methods for Permeability of Feebly Magnetic Materials

ASTM A-564 Specification for Hot Rolled and Cold Finished Stainless Steel Bars and Shapes

ASTM A-484 Specification for General Requirements of Stainless and Heat Resistant Shapes

LITERATURE/BIBLIOGRAPHY MATERIAL ON STAINLESS STEEL REBAR

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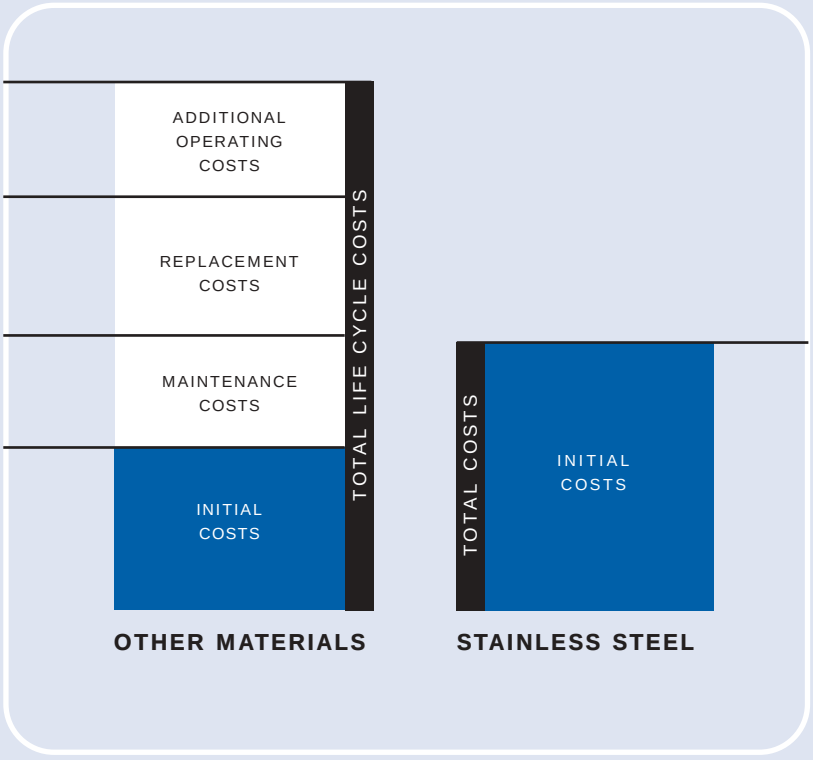
Ontario Ministry of Transportation	Research Agreement No. 9015-A-000045. Some Corrosion Aspects of Stainless Steel Reinforcement in Concrete

Stainless Steel Rebar and related construction products have been in use in the United States and Canada since 1996. Stainless steels have found increasing acceptance as the material of choice where a highly corrosion resistant material is needed to combat the ravages of corrosion from chlorides. The interested reader is advised to explore this publication for information relating to how stainless steel can insure longevity and minimum maintenance in even the harshest of environments. This will not only be cost justifiable, but accrue substantial savings to the owner through the benefits of Life Cycle Costing.



WHY STAINLESS STEELS

Upgrading to more corrosion resistant construction materials like stainless steel is one cost effective approach to the rust problem. Compared to other construction materials, stainless steels have many unique properties that are advantageous not only from a corrosion standpoint, but from a strength and safety viewpoint as well.

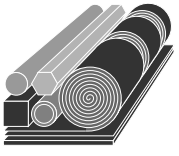
Stainless steels are fire and heat resistant, impact and shock loading resistant, can withstand deformation, and require little or no maintenance. Stainless steel's ease of fabrication, installation, weldability and ductility make it an ideal material for many construction applications.

LIFE CYCLE COSTING ADVANTAGES

Life cycle costing techniques and analysis allow the design engineer and materials specifier to consider the true cost of a project over its useful life. Using upgraded, more costly materials at the very start of a project oftentimes can be justified by pointing to the savings accrued over the project's life. Reduced maintenance, inspection and repair and replacement costs result from using upgraded material.

ACKNOWLEDGMENTS

Some of the information contained in this brochure was provided by F.N. Smith.



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