

Comparison of Steel and Aluminum in Footbridges

Prepared by

For decades, pedestrian and vehicular bridges had been designed and built the same way. Steel and concrete had been the dominant materials, with aluminum given little consideration, as it was thought to be too expensive. However, when the costs of using these traditional materials were compared to aluminum, often only the initial costs of construction and installation were taken into account.

Today's architects and contractors recognize that aluminum actually helps reduce the Total Cost of Ownership (TCO), since very little repair and maintenance are necessary. Aluminum is also the most easily recyclable material (and the most frequently recycled material), and it has the highest value when recycled.

For more details, see [the study](#) on our website.

8 Reasons to Choose Aluminum for Pedestrian and Vehicular Bridges

Aluminum has many advantageous characteristics that make it attractive for a variety of applications, including pedestrian and vehicular bridges.

1. Lightweight

Aluminum's high strength-to-weight ratio provides the advantage of light weight. This creates greater efficiency in terms of transportation, assembly and installation. For example, by reducing the dead load of a bridge deck, the live load can be increased.

2. Resilient

Aluminum is resilient. It flexes under loads and springs back from the shock of an impact.

3. Strong, even in cold weather

Aluminum is also great for cold weather: it does not lose its ductility when the temperature drops, unlike most other materials. Instead, aluminum actually becomes stronger as temperatures fall.

4. Complex integral shapes

Thanks to its high malleability, aluminum can be transformed into the perfect shape for every application, always offering excellent rigidity and energy absorption.

5. Easy to assemble

Aluminum is easily assembled with other materials. The proper methods just need to be followed to prevent galvanic corrosion.

6. Durable

Aluminum's durability is its most crucial advantage. Aluminum quickly generates an invisible protective oxide coating, making it highly resistant to atmospheric corrosion.

7. No painting required

In contrast to steel, aluminum does not require paint or any other protective finishing, except when an enhanced appearance is desired. And if it isn't painted, it will never need to be repainted!

8. Recyclable

Finally, aluminum can be recycled and reused infinitely, and it has high scrap value. These two important factors are often overlooked during investment decisions. For example, in May 2020, the scrap price for one pound of 6000 series aluminum (mill finish) was almost 4.5 times higher than that of hot-dip galvanized steel.



Verdun marina aluminum bridge

Aluminum: A More Eco-friendly Metal

People often claim that steel has a smaller carbon footprint than aluminum. Technically this is true, but only when aluminum is produced from raw materials. The majority of aluminum used in North America—and in most aluminum extrusions used in bridges—is made of recycled aluminum, which has a much smaller carbon footprint than steel.

Aluminum has a much lower melting point, and when it's recycled, it does not lose any of its quality or inherent properties. The cost of recycled aluminum is 30% to 45% that of aluminum produced from bauxite.

The Importance of Good Alloys

The first aluminum bridge structures built between the 1930s and 1960s were made of Al-Cu alloys (2000 series) that were strong but difficult to extrude into complex shapes. The introduction of Al-Si-Mg alloys (6000 series), which depend on Mg₂Si precipitation hardening, greatly facilitated the extrusion of beams with complex hollow cross-sections that were more resistant to corrosion. The higher strength 6063/6061/6082 alloys have established themselves as the standard alloys for most applications and are the best-performing alloys in the extrusion industry.

As design choices are often limited by stiffness and fatigue, most bridges today use standard 6063/6061/6082 alloys with T6 temper. At MAADI Group, these alloys are combined with the latest technology and design methods to produce GuarDECK[®], a patent-pending solution for lightweight aluminum bridge decking that's quick and easy to install without any welding.

Steel: An Expensive Look

Painting a steel structure involves a thorough cleaning and pretreatment process. Surface preparation can be carried out by chemical cleaning (e.g. chemical pickling, solvents) or by abrasive methods such as grinding and shot blasting. Depending on the paint or type of finish, a certain pretreatment procedure must be followed. Other factors such as ease of use and equipment availability may also influence the choice of pretreatment. For example, sandblasting and capturing the resulting exhaust may be difficult on a bridge structure over a busy street or waterway, or certain hazardous materials used in cleaning chemicals may not be allowed.

Aluminum, on the other hand, does not require any finish. It's naturally corrosion resistant—without any treatment—and withstands the elements without losing any visual appeal. It can be painted when an enhanced appearance is desired, without any costly pretreatment.

Looking Beyond Construction Costs

For the Marigot footbridge described on the next page, the total cost of repairs after 31 years in service (including preventive maintenance) is equal to about 63% of the cost of purchasing a similar aluminum pedestrian bridge. This comparative analysis of maintenance costs confirms that the Total Cost of Ownership (TCO) of hot-dip galvanized steel in an urban setting (with a 3% discount rate) exceeds that of aluminum after 33 years, as demonstrated in a 2010 Deloitte study (see table 8).

Decision makers should therefore look beyond the initial construction costs. A well-designed and well-constructed aluminum bridge has a lifespan of 100 years, which translates to a lower Total Cost of Ownership (TCO) for aluminum, as it resists the elements better than steel and requires no maintenance. The lowest initial purchase cost is not necessarily the best investment option, since aluminum's durability and corrosion resistance result in savings over the long term.

Comparing Real-World Examples

To illustrate the difference between steel and aluminum, we will compare two pedestrian bridges along the St. Lawrence River.

Verdun Marina Mill-Finish Aluminum Bridge



Figure 1. Year built: 2002



Figure 2. Condition 18 years later: no signs of wear (2020 photo)



Figure 3. Unlike steel, aluminum can be easily sanded or pressure washed to remove graffiti without damaging the protective coating.

Marigot Hot-Dip Galvanized Steel Footbridge



Figure 4. Year built: 1988



Figure 5. Condition 31 years later: repairs and maintenance work in 2014 and 2019 (2019 photo)



Figure 6. Corroded steel requires expensive maintenance and repairs that can be complex and harmful for the environment.

	Verdun Marina Bridge	Marigot Pedestrian Footbridge*
Year Built	2002	1988
Material	Aluminum and Cumaru wood deck	Hot-Dip galvanized steel and concrete deck
Location	Verdun, Quebec, near the St. Lawrence River (Canada)	Longueuil, Quebec, over Route 132 and Marie-Victorin Boulevard (Canada)
Dimensions	Length: 25 m (82 ft) Width: 3 m (10 ft)	Length (3 spans): 25.3 m, 25.4 m and 21.2 m (83 ft, 83.3 ft and 69.5 ft) Width: 3.86 m (12.7 ft)
Climate	Humid continental climate with large temperature range	Humid continental climate with large temperature range
Construction	Arched pony truss bridge with 6061-T6 mill-finish extruded aluminum profiles and Cumaru wood decking, built according to Canadian Highway Bridge Design Code CAN/CSA-S6-00	Single spans with Warren pony type steel trusses. Reinforced concrete slab deck, resting on steel girders arranged in three simple spans.
Live load	4.8 kPa	4.8 kPa
Treatment and finish	Structure: No finish or treatment Vertical pickets: Powder coating finish	Structure: Hot-Dip galvanized steel Bridge deck: Painted reinforced concrete
Maintenance and repair costs	CAD\$0 According to the City of Montreal, it has never required any repairs or maintenance in its 18 years of existence. Same condition as when it was built.	2014: Preventive maintenance, including prepping the steel surfaces, metal spraying the steel surfaces and taking environmental protection measures CAD\$302,000 2019: Preventive maintenance, including prepping the steel surfaces, metal spraying the steel surfaces and taking environmental protection measures > CAD\$322,000 Repairs: replacement of bearings, deck supports and guardrails > CAD\$190,000 Total: CAD\$814,000 <small>Note: Several hundred thousand dollars in costs were also incurred for organization, administration and traffic management on the construction sites for repairs in 2019, but these costs are excluded from the total.</small>

Table 1. Comparison of the two pedestrian bridges

* Financial data for the rehabilitation of the Marigot footbridge were obtained through a request under the *Access to Information Act* and through verifications with the cities of Longueuil and Montreal. For more information, please consult MAADI Group.

Conclusion

These examples speak for themselves: aluminum bridges offer great long-term value and aesthetically pleasing products that require little to no maintenance over their entire lifespan. They are suitable for harsh environments, including extremely cold and humid climates. They are easier to transport, easier to handle and quick to install, with minimal disruption to traffic.

MAADI Group Inc.

526, Guilbault St.
Mascouche (Quebec)
Canada J7L 3K9

T 450.449.0007

T 866.668.2587

www.maadigroup.com

info@maadigroup.com

