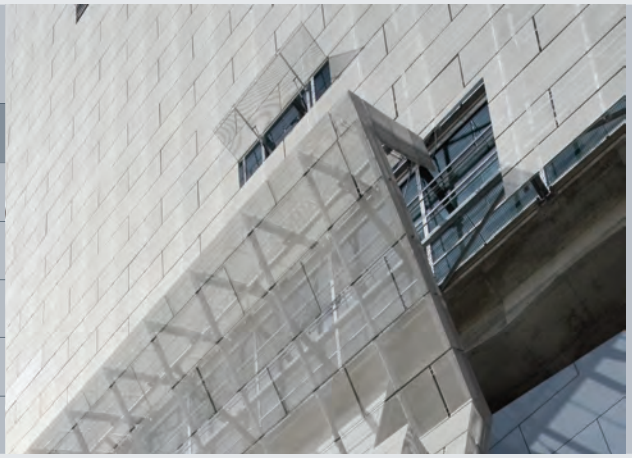
INTERNATIONAL MOLYBDENUM ASSOCIATION
THE VOICE OF THE MOLYBDENUM INDUSTRY

Molybdenum in Architecture, Building and Construction

Federal Building, San Francisco

Molybdenum's contribution to sustainable development in:

- **Stainless steels**
- Alloy steels
- Superalloys
- Cast iron
- Mo metal
- Chemicals



MoRE FOR LESS

www.imoa.info

Molybdenum makes an important contribution to sustainable development as a metal, as an alloying element, and as a constituent of chemical products. IMOA's 'MoRE FOR LESS' case studies explore, in more depth, how molybdenum is contributing to sustainable development, a pattern of growth in which resource use aims to meet human needs while preserving the environment.

In particular we will look at how a specific use or application is contributing to the three pillars of sustainability:

ECOLOGY Environmental performance, resource use, energy efficiency & production and recycling

ECONOMY Supply chain, lifecycle and materials performance

SOCIETY Health, safety and wellbeing

This case study explores the role of molybdenum in achieving energy savings and resource conservation in the design of San Francisco's award-winning Federal Building.

The Challenge

US federal agencies are required to address sustainable design comprehensively when specifying new buildings. These policies recognize that environmentally-sensitive green building design produces financial benefits, including reduced energy and water usage, waste disposal, emissions, operations and maintenance, and increased occupant productivity and health. Most US federal agencies also require Energy Star ratings, US Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED™) certification or designs that meet its requirements. Indeed, green building codes which address energy use and other environmental factors are an increasingly important element in new construction projects worldwide.

The US Government's General Service Administration (GSA) wanted the San Francisco Federal Building to exceed these requirements. Specifically, the building was required to provide over 100 years of service while dramatically reducing energy consumption compared to conventional commercial office buildings.

The Solution

Air conditioning accounts for the vast majority of energy consumption in many buildings. Sunscreens reflect solar heating and are proven to reduce or eliminate the need for air conditioning. Using moly-containing stainless steel guarantees corrosion resistance and decades of low-maintenance performance, particularly in coastal or pollution-prone urban areas.

Morphosis, an award-winning architecture firm known for their innovative use of cutting-edge technology, was selected to design the building. The US government has long funded sustainable building research and the design team worked with the Lawrence Berkeley National Laboratory to model the structure's thermal performance.

Completed in 2007, the 56,205 m^2 federal building is a slender 20 m (65 ft) wide rectangular tower rising 18 stories (73 m or 240 ft) along the northern edge of Mission and Seventh Streets. The building takes advantage of the city's temperate climate which ranges from 7 to 25 °C (44 to 78 °F). The first five levels have high concentrations of people and equipment and are air conditioned. Above the fifth floor, a sophisticated computer-controlled window and sunscreen system creates a 'living skin' allowing the building to 'breathe', using natural ventilation for cooling.

The perforated Type 316 sun screen panels can be individually rotated with changing sun position to vary the level of shading. © Iwan Baan

The tower is distinguished by its protective 'skin' of perforated Type 316 stainless steel sunscreen panels. They cover the entire southeast side of the glass window wall and extend over the roof. The roof is sheltered from the sun by fixed sunscreen panels. The panels over the wall rotate during the day to either provide shading or unobstructed views. On the naturally ventilated floors, the computer system opens and closes windows and vents, and moves exterior sunscreens in response to internal and external environmental conditions. The sunscreen can also serve as a jacket to buffer outside wind.

Nationally, the GSA strives to use no more than 55,000 Btu of energy per square foot per year in its buildings. The San Francisco Federal Building consumes less than half that and uses only 33% of the power typically consumed by a large Californian office building. This is equivalent to 6,900,000 kWh/yr, enough energy to power 600 homes. Approximately 85% of the workplace is illuminated with natural light and the moderately reflective sunscreens help to increase light levels while preventing glare. The GSA mandates that 75% of materials used during construction contain recycled content; this project achieved a recycling rate of 87%.

Although the San Francisco Federal Building was designed five years before the USGBC LEED Certification System was established, it is still considered to be a benchmark for sustainable building design. It retroactively received a USGBC LEED Silver designation and has won numerous design awards.

Sunscreens not only enhance the appearance of the US Federal building but also contributed to a 66% energy savings relative to similar California office buildings. © Iwan Baan

How molybdenum helped

As with all coastal cities, exposure to sea salts had to be considered when selecting exterior materials for this project. Second skins or sunscreens are at least partly sheltered from natural rain-washing, particularly the inner side facing the window wall – this increases the likelihood of corrosion because pollutants, salts and particulate accumulate. Both the exposed front and sheltered backs of the panels are visible, making corrosion unacceptable. In order to achieve the required 100-year design life and reduced maintenance requirements, a corrosion-resistant material was needed.

Morphosis specified perforated 1.5 mm (0.06 in) Type 316 stainless steel with a dull silver grey softly reflective finish. Molybdenum is added as an alloying element to some stainless steels to increase their resistance to corrosion from salt and pollution exposure. The 2–3% molybdenum content in Type 316 stainless steel makes it a common choice for long-term, low-maintenance applications in low to moderately corrosive coastal environments. There was no need to apply or maintain protective coatings in order to maintain desired surface reflectivity or corrosion resistance.

Additionally, the average international recycled content of stainless steel is 60%. The stainless steel used for this project was produced in the US where average recycled content rates are between 75 and 85%. Some 92% of the stainless steel used in buildings is diverted from landfills and recycled into new metal at the end of building life, therefore the stainless steel also contributed to the building's recycled content goals.

Key sustainability benefits

Benefit	Sustainability attribute		
Moly-containing stainless steel sunscreens contribute to a significant reduction in building energy requirements over the structure's 100-year design life	ECOLOGY	ECONOMY	SOCIETY
High recycled content and end-of-life recycling rates reduce raw material requirements and environmental impact	ECOLOGY	ECONOMY	
No replacement should be required over the 100-year design life, which reduces raw material requirements and environmental impact	ECOLOGY	ECONOMY	
Coatings are not necessary to maintain the corrosion resistance or softly reflective surface, which reduces fumes, improves occupant health, reduces maintenance costs, and reduces raw material requirements	ECOLOGY	ECONOMY	SOCIETY
Sunscreens contribute to light level control, making a high level of natural daylighting possible, saving energy and creating a more productive working environment	ECOLOGY	ECONOMY	SOCIETY
Sunscreens make a high level of natural ventilation possible, improving human health and productivity		ECONOMY	SOCIETY

Summary

Sunscreen technologies can contribute to substantial long-term energy savings while making increased natural ventilation and daylighting possible. Selection of appropriate molybdenum-containing stainless steels, like Type 316, can make a service life of 100 years or longer possible in environments with coastal, deicing salt, or pollution exposure. Molybdenum-containing stainless steel has both a high end-of-life recapture rate and a high recycled content, and with proper specification, should never need to be replaced over the lifetime of the structure.

International Molybdenum Association
info@imoa.info · www.imoa.info

IMOA/07/13