Melbourne Park Stadium

WORLD BEST TECHNOLOGY

STAIRNOSINGS
WITH LUMINESCENT STRIP

TECHNICAL SUBMISSION TO

MELBOURNE & OLYMPIC PARKS TRUST

PREPARED BY

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A SUMMARY

The proposed aluminium nosing and the luminous polypropylene insert have been chosen as the most suitable materials to be used in the stadium environment with either the roof open or closed.

The aluminium with a clear anodising finish of 25 micron thickness is long wearing, UV stable and is the recommended finish by Capral - the aluminium manufacturer.

The proposed method of adhering the nosing to the concrete and steel is using an adhesive recommended by Fuller, a chemical manufacturing company. This method of fixing is supported by the CSIRO who consider that any penetrations in either the aluminium and sub-base structure will only increase the potential for corrosion to occur. Also there is potential for the leading edge of the concrete nosing to be fractured when mechanical fixings are inserted.

The luminescent insert is hard wearing polypropylene containing the world's highest light output "LumiNova" pigment which is UV stable and therefore resists cracking and chipping. Please note that the LumiNova crystals are hand selected to provide the maximum performance in light output.

No other company can offer such a high performance product as it is extremely difficult to manufacture, with the polypropylene being extremely hard on tooling and production equipment.

We have recently accepted an order from Brisbane Airport where we are replacing a "resin based" luminescent strip with the product proposed for the stadium. The resin based material has deteriorated due to UV radiation and has to be regularly replaced. They see our alternative proposal as a long term solution.

Also, we have received the order for the Victorian Multi Purpose Venue for some 1700 lineal metres of the same material. This has been on trial for over 12 months on their site and they believe that it best meets their criteria for light out put and long term solution.

Both the airport and venue are using the luminescent stair nosing in exactly the same situation to replace electric methods of aisle lighting. The nosing will be chemically adhered in both applications, not mechanically fixed.

B Aluminium Nosing

Description:

The proposed aluminium extrusion is sized to be 80 x 34mm, as detailed on the A4 drawing at the end of this section. It has been specially designed to incorporate a 10mm polypropylene luminescent insert having the light out put required by the BCA and a ramp at the end of the strip to remove any potential as a tripping hazard.

Design Details:

The aluminium profile is to be manufactured by Capral to AS 1866 from Alloy 6060 with a temper T5 and a mass of 0.484 kg/m. All surfaces have been rounded to prevent any damage to the public or other surfaces. Also, the thickness of the profile has been chosen to allow slight movement to adapt to the existing concrete or steel sub-base.

Surface Finish:

The proposed finish is clear anodising to Class AA25 - 25 micron architectural finish. Referring to AS 1231 -1985, Aluminium and Aluminium alloys - Anodised Coatings for Architectural Applications - Page 5 extract attached - under Clause 7 details "Coatings for External Applications" - we have chosen Class AA25 which details an average anodising thickness of 25 microns for "External applications in severe environments subject to heavy industrial pollution where surfaces are cleaned less frequently than 4 times per year, eg. Monumental buildings, curtain walls." In the notes it refers to exposure to salt spray as a severe environment and we believe there is the potential for salt deposits to occur in the Stadium even though it is not in close proximity to the sea.

We have been asked to comment upon an alternative such as "powder coating" the aluminium and, in the time available, sought opinions from Capral (the aluminium manufacturer) and the CSIRO. We have received a letter of comment from Capral (which is attached for your review) and verbal advice from Mr Ivan Cole, the CSIRO Construction Principal Research Scientist. Their advice is summarised as follows:

Capral believe that anodising is superior to powder coating as, when aluminium is manufactured it naturally forms a protective film of oxide coating on its surface. The process of anodising, is where a hard non corroding oxide film is deposited on the aluminium alloy surface. The aluminium is made the anode in an electrolytic cell containing chromic or sulphuric acid. This in effect further enhances the natural process of oxidation by increasing the thickness of protection and hardens the surface to better withstand mechanical penetration.

The method of powder coating places a layer of paint over the oxide surface which is heated. If this layer of paint is broken or cracked, there is the potential, especially under high pressure water blasting treatment or under "Gerni" gun cleaning, for the paint layer surface to be further broken down, thereby exposing the surface.

For your information, Capral advised that 70% of their product is sold powder coated (aluminium windows and guttering), however, these were not being used in an environment of severe foot traffic conditions. Also, they had never been approached to provide a powder coated stair nosing and had never seen one installed.

Mr Ivan Cole of the CSIRO, also considered that the best available protection for aluminium being used as a stair nosing under the environmental and traffic conditions as described in the specification was anodising and he concurred with Capral's reasons.

It is for the above reasons that we recommend that a coating of 25 microns will best meet the environmental conditions prevailing at the Stadium and will provide the best corrosion protection to the aluminium nosing.

Fixing Method:

The proposed method of fixing is by using "81-84" contact adhesive recommended by Fullers, an adhesive manufacturer. This adhesive is suitable for adhering aluminium to both concrete and steel structures and Fullers have carried out their own "in-house" tests for over 6 months. These have been very successful. Also, this adhesive has been used for a 12 month trial period at the Multi-Purpose Venue to attach an aluminum stair nosing to a concrete platform as an in-situ demonstration. The results of this testing has formed the basis for Thiess to proceed with chemical adhesion only for fixing purposes.

Refer to the attached report regarding the adhesive.

They have also performed high pressure water hosing tests on the adhered aluminium profiles and there has been no separation of the profile from the sub-structure.

Mr Ivan Cole of the CSIRO also commented on the method of fixing the aluminium nosing to the structure. He considered that mechanical fixing of the nosing by drilling penetrations through the aluminium and into concrete steps could be the first cause of corrosion to the aluminium surface. He was concerned about the possibility of hydration, whereby water is present in the concrete sub-structure and comes to the surface below the aluminium nosing. If penetrations have been made in both surfaces, then this forms a perfect channel for the water to sit and corrosion commences.

The mechanical fixing also provides the opportunity for the anchor to penetrate through the protective layer, be it anodising or powder coating. If this occurs, corrosion could commence with no visible external sign.

Also, our installers are concerned about mechanically fixing within 30 – 40mm from the leading edge of the concrete stair tread. They believe that the front edge will fracture and generate additional problems of repair. The design of the aluminium nosing would have to be re-evaluated to overcome this problem.

Under the terms of the tender, we are contractually obliged to provide a 5 year warranty for the product and it is our recommendation after discussions with Capral , Fullers and the CSIRO that the nosing be chemically adhered to the sub-structure only. Mechanical fixing will only provide the potential starting point for corrosion.

Anti Slip Results:

The proposed aluminium profile complies with AS 3661.1 - 1993, Slip Resistance of Pedestrian surfaces. The test results are attached, however the summary of the tests indicates an average reading of 0.67, which exceeds the Australian Standard.

C Luminescent Strip

Description:

The proposed luminous strip is a 10mm extruded polypropylene insert that has a UV stabiliser additive. The insert has a luminance reading of 15mcd/m^2 (milli-candella per square metre) after 140 minutes (2 hours and 20 minutes). This has a luminance equivalence of 715 mcd/m^2 after excitation of 120 lux from a 100 watt coated metal halide lamp. Refer to the table below which summarises the results detailed in the technical report from Optical & Photometric Technology Pty Ltd that show the output to be 15mcd/m^2 after 140 minutes and the PSPA Press Release for the calculation of "Luminance Equivalent".

For the proposed insert:

Luminous Insert Proposed for the Melbourne Park Stadium			
Elapsed time in the dark (minutes)	**Luminance after 30 minute period of irradiation (mcd/m^2)**	**Calculation for Luminance Equivalence**	**Luminance Equivalence mcd/m^2**
5	270		
10	165	x 2 =	330
30	75	x 3 =	225
45	50		
60	40	x 4 =	160
75	30		
90	30		
105	25		
120	20		
140	**15**		
		Total	**715**

Design Details:

The insert has been specifically moulded to fit precisely into the aluminium profile and is adhered to the aluminium using an adhesive compound. The shape of both the aluminium and polypropylene profile means that the insert is physically retained and therefore cannot be easily removed by the public. However, this design allows replacement of the insert if it becomes damaged due to either physical abuse or movement of heavy equipment over the strip. This saves the additional cost of replacing both the strip and the aluminium nosing.

The selection of extruded polypropylene makes it extremely suitable to operate in both external and internal conditions and it can therefore withstand the external environmental conditions and the high volume of foot traffic anticipated at the stadium.

The life expectancy of this polypropylene insert is indefinite even under full UV exposure.

Phosphorescent Pigment Details:

The polypropylene insert has "LumiNova" phosphorescent pigment integrated through its molecular structure. This pigment is based on a metal oxide chemistry and is the best luminescent material that can be obtained in the world. This material absorbs the UV radiation either from the sun or internal lighting sources and after a short period of time saturates the pigment crystals. When the external light source is removed, this energy is then released in the form of light over a period of time.

The polypropylene design provides the mechanical structural protection that the pigment requires to withstand rain, high pressure hosing during the stadium wash down and cleaning operations and the anticipated high volume of foot traffic.

The drawing of the proposed insert is attached at the end of this section.

External Ambient Conditions:

The proposed polypropylene insert has been chosen because of its ability to withstand the most arduous external conditions and environment. It has been used for over two years as lures in the deep sea (long line) fishing fleets where it is used to attract the tuna. The lures are placed in UV chambers for a short period to fully charge the luminescent pigment and are placed on the fishing lines. These lures can go to depths of 3 to 4 km below the surface. After the charge is dissipated, they are brought to the surface and recharged and utilised again. The pressure is extreme and the temperature conditions vary from -40 to +40 ^{o}C. The original lures are still in use today and we are currently in discussions to supply other overseas fishing fleets.

With reference to the attached letter from Techcast the polypropylene insert has also been exposed to UV radiation in their laboratory for over 5000 hours without any breakdown of the material structure.

Important Design Criteria:

It should be noted that the aluminium nosing profile has been specifically designed so that the luminescent insert is flush with the surface of the aluminium. This is to ensure that the luminescent insert does not have any build up of external material eg mud, dirt, dust, etc. on its surface. Any build up of material upon the surface of the insert will prevent the UV radiation penetrating through to the pigment crystals. Consequently, the strip will fail to glow since it will not have absorbed the energy required to excite the pigment crystals.

We believe that this is a fundamental design issue at the stadium where there will be many thousands of people walking on the stair nosings during an event. If the luminescent material is designed to be below the surface of the aluminium profile, then as people pass over the nosings, they will gradually deposit material over the top of the luminescent surfaces. The consequence is that the luminescent pigment will fail to be charged and therefore cannot emit light when required. Unless the stadium nosings are to be cleaned after every event, there is the high possibility that the nosing luminescent strip will fail to meet the required light output. This means the nosing will not comply with the BCA requirements. This is not the case with our product as its surface is flush with the aluminium profile.

Maintenance Requirements:

The proposed aluminium nosing and the luminous polypropylene insert have been chosen as the most suitable materials to be used in the stadium environment. Consequently, the short term and long term maintenance requirements are not onerous and we would recommend the occasional wash down to minimise the material build up on the luminous insert. This will ensure that the light output from the insert always meets the BCA requirements.

We recommend a yearly check of the internal lights to verify the intensity of the light level onto the surface of the luminescent insert. Our documented tests show that if 120 lux is applied to the luminous insert, it will produce 15mcd/m^2 after 2 hours and twenty minutes.