The constructive design of the maritime station of Vilanova de Arousa (Pontevedra), first Spanish project with acetylated timber

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ABSTRACT

This paper describes the first Spanish project with acetylated timber, a timber cladding in a maritime station located in Vilanova de Arousa (Pontevedra), finished in June 2012. The paper analyses the decision making process between the architects studio (2C Architects) and the technical assistance given by a timber technological centre (CIS-Madera). The process involves the comparison between the advantages and disadvantages of employing iroko (the preliminary prescribed tropical timber) or a modified timber, as well as the evolution of the initial design of the timber cladding.
It also describes the process to define the coating applied to the acetylated timber as well as its quality control. As a result, it was given a written guarantee of 5 years (subject to periodic cleanings) regarding the durability of the coating exposed to maritime conditions. This written guarantee is an innovative process in Spain, which requires the cooperation between the different actors involved in the project, since it's strongly depends on the constructive design as well as in the application conditions of the coating.

INTRODUCTION

The project arises from the intention of the public company Galician Ports to promote maritime traffic routes in Galicia, Spain. Located in the urban edge of Vilanova de Arousa (Pontevedra), the Maritime Station consists of a small building intended primarily to provide various services to the users of these routes.
The building is located on the seafront and facing west. It is a fully glazed space under a dark concrete envelope and protected from the noise by a wooden box in which all services are collected.
The annual average temperature in Vilanova de Arousa is 14.9 °C with an average annual precipitation of 1525 mm.
The wooden envelope is originally designed with vertical slabs supported on horizontal boards and occupy a surface of 70 m^2, facing east. To maintain the appearance of the timber it is desired to apply a decorative coating.

Figure 1: General view of the projected maritime station

CIS-Madera was contracted to provide technical assistance during the project development.

RESULTS AND DISCUSSION

Review of the constructive design

As a first step, it was made a review of the preliminary design of the wooden envelope, made with vertical slats installed over horizontal tongue and grooved boards. As the tongue and grooved junctions will create a water trap, it was proposed an alternative design with vertical slats installed over vertical boards.
To connect the slats and the boards it was suggested to employ screws and intermediate plastic pieces in order to avoid a wood to wood contact and ensure a proper ventilation. Although this would be a better option from the point of view of the design, it was rejected because of its greater fragility and the risk derived than children could introduce their fingers in the space between the slabs and the boards.
For the above reasons, it was considered a direct contact between the boards and the slabs.
Figure 2 shows the evolution of the three design options being discussed.

Figure 2: Options discussed to connect the slabs and the boards

Choice of the species

Once agreed the general design it was considered the choice of the species.
Initially, the project considered employing iroko (*Milicia* spp) which is a moderately stable timber. The heartwood of iroko has a natural durability which allows its use in a timber cladding project without any preservative treatment.
Additionally, the constructive design of the project and mainly the use of boards with a thin section and a length of 3 m, will require a careful selection of the timber in order to employ boards with straight grain and, preferably, from quarter sawn sections.
An alternative option, it was to employ acetylated radiata pine (*Pinus radiata*) which has a greater stability and durability as well as a Forest Management Certification under the Forest Stewardship Council (FSC).
Table 1 shows the main properties of the two timbers. Data were obtained from CIRAD Forêt in the case of iroko (Paradis *et al*. 2011) and from technical data sheets in the case of the acetylated radiata pine (Accsys 2011). Durability class against fungi is based on the classification system given in EN 350-2.

***Table 1:** Properties of iroko and acetylated radiate pine*

Species	Density [kg/m^3]	Total tangential shrinkage [%]	Total radial shrinkage [%]	Durability class against fungi [EN350-2]
Iroko	640	5.4	3.5	1-2
Acetylated radiate pine	510	1.5	0.7	1

With regard to prices, for a proper comparison, it should be considered the increasing costs derived from the needed additional classification of the iroko timber (heartwood, straight grain, quarter sawn boards) as well as those being associated to certify that the wood has been provided under a sustainable forest management.
Considering the above, final prices between the two timber species will not differ in more than a 5%.
It was taken the decision to employ acetylated timber. After an analysis of the available commercial sizes it was proposed a slab section of 5 x 3 cm with a distance between the axis of 8 cm. The board section it was 7.5 x 1.5 cm. Both pieces have a length of 3 m.
Both pieces were joined with austenitic stainless steel screws to horizontal battens fixed to a corrugated metal sheet. The horizontal battens were made from preservative treated red pine (*Pinus sylvestris*), have a section of 5 x 5 cm and were spaced each 50 cm.
The solution was organised in modular panels which allowed that most of the work could be done in the carpentry, making easier the *in situ* installation. At the same time, no screws were visible from the wood surface, preventing possible points of moisture ingress.

Coating specification

From the aesthetic point of view, it was chosen a slightly colored coating that leaves the wood grain visible. Considering the design of the cladding, for improving the durability of the coating it was proposed a film forming product.
It was decided to apply a water borne translucent coating from Sikkens in a light oak tone. The detail of the products, as well as their application method in the small carpentry involved in the project, was proposed with technicians from Sikkens in order to produce a film thickness of 60-70 µ in the exposed faces (30 µ in the internal faces) that could last 5 years with a periodic maintenance.
The complete process consists of the steps shown in Table 2:

Table 2: Coating specification

Operation	*Product*	*Application*	*Faces*	*Wet film thickness*
Sanding (140-180 grit)	-	-	-	-
Primer	Cetol WF 771	Immersion	All faces	-
End grain protection	Kodrin WV 456	Brush	All ends	-
First coat	Cetol WF 748	Airless spray	All faces	100-120 µ
Sanding (220-240 grit)	-	-	-	-
Top coat	Cetol WF 748	Airless spray	Decorative faces	100-120 µ

Due to the lack of biocides in its composition, acetylated timber is susceptible to mould appearance which can be avoided employing a primer with a mouldicide. In this project, the mouldicide was not applied as it is expected that, in case of moulds occurrence, the annual cleaning of the wood surface will remove them.

Guarantee

Several companies extend guarantees regarding the durability of a coating (ultraviolet resistance, flaking, cracking, *etc*.), for applications as windows and, in a minor extent, for external timber claddings. In most cases, guarantees apply to industrial products, being designed under well known standardised best practices and finished with factory applied coatings.
In this project, it was discussed the possibility of extending a guarantee regarding the durability of the coating against ultraviolet radiation, taking into account both the proposed personalised design and that the product will be applied by a small carpentry.
After several meetings with the company providing the coating, a protocol was defined, intended also to be applied in future projects. It was agreed that a written guarantee for a 5 year period, it could be extended (subject to a periodic maintenance) if the following points were properly checked; a review of the constructive design considering the application of a film and a quality control of the application conditions of the coating in the carpentry.
Several publications give an overview of the best design practices in timber cladding projects (Davies and Wood 2010, Hislop and O'Leary 2012, Taylor *et al*. 2013).
In this project, the constructive design is made up of vertical elements from a very stable timber so rainwater will drain quickly and, at the same time, little movements are expected due to shrinkage and swelling. Nevertheless, several points should be checked considering that the coating will form a film:

- To have a uniform film thickness it is necessary to avoid any sharp edge, giving all the exposed edges a 3 mm radius.

- In addition to the application of a sealer, the upper and bottom ends of all the slabs and boards were chamfered at an angle of 30º and top ends were additionally protected with a metal capping. These measures will ensure that rainwater on the cladding surface will fall down towards the outside face, rather than running back and hanging on the underside of the elements.

- It was also discussed if the wood to wood contact areas between the slabs and boards should be protected with a joint sealant. As acetylated timber is very

stable and these joints are not directly exposed it was decided don´t apply the product and check this particular point during the first maintenance.

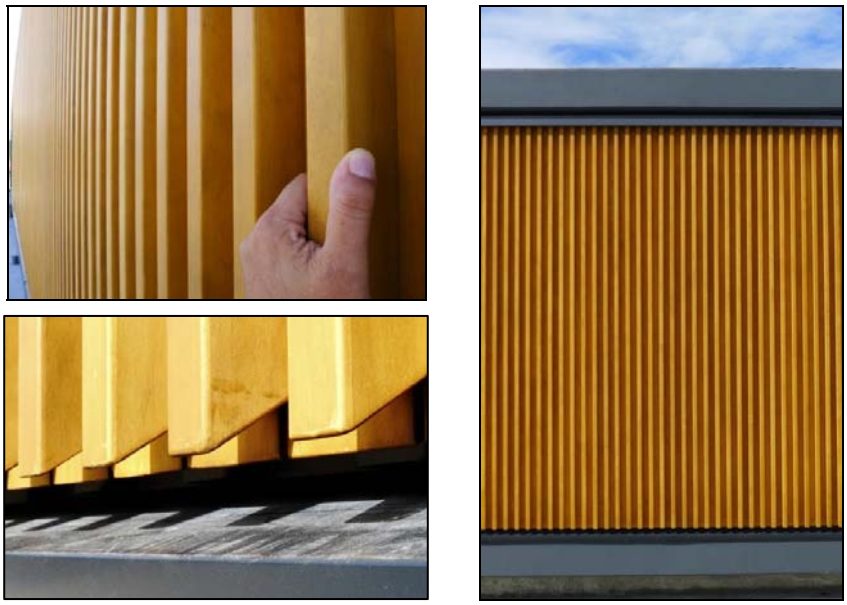

Figure 3: Details of the design. Exposed edges rounded to a 3 mm radius, top ends protected with a metal capping and bottom ends chamfered

Quality control

The quality control relied on the cooperation between the different actors involved in the project and it was focused on ensuring that the coating was applied following the instructions given by the manufacturer.
In doing that, it was checked, in a cost effective way, the quality of the timber machining, the range of temperature and humidity levels of the carpentry during the application of the coating and the film thickness in wet and dry conditions.
Wet film thickness was measured with a gauge that incorporates a series of notches cut into their sides. Dry film thickness was measured with a microscope.

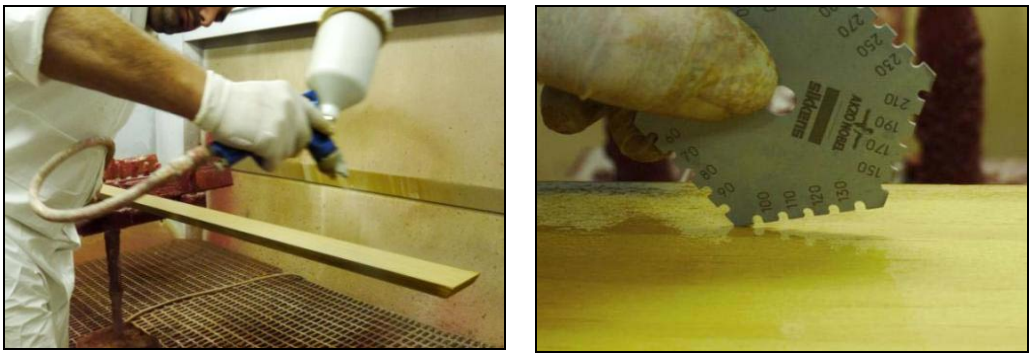

Figure 4: Detail of the wet thickness measurements with the notched gauge

Maintenance

To keep the guarantee over a 5 year period, it was prescribed an annual maintenance. Each maintenance consists in a cleaning of the wooden surface with a neutral detergent aimed to remove any pollutant from the film´s surface that could degrade the coating (as seagull droppings) and the posterior application of a maintenance product with a sponge.
The first maintenance was applied 17 months after the completion of the project by all the team involved in the project. At the same time two workers from Galician Ports received training to apply by themselves the posterior maintenances.

Figure 5: Maintenance of the timber cladding

At the moment of writing this article, 20 months after the completion of the project the maritime station has a very good aspect and any problem has been pointed out related to timber and/or to the decorative film coating.

Figure 6: General view of the maritime station

Probably, the maintenance period could be extended in time to an interval of 18 months. In that way, only three maintenances cycles should be needed for keeping the guarantee of the decorative coating during 5 years.

The cost of the needed products for each maintenance cycle did not exceed 50 Euros and two workers can complete the process in 2-3 hours.
The project has been recently recognised with a Grand Area Award 2013, granted by the Delegations of Vigo and Pontevedra, from the College of Architects of Galicia.

CONCLUSIONS

This paper details the decision making process in a timber cladding project with acetylated timber exposed to aggressive maritime conditions. It also describes the protocol followed to define the coating and to obtain a written guarantee regarding its durability.
A similar approach may be applied to future projects with modified and/or natural timber, contributing to the knowledge of how to ensure that best possible results are achieved under each specific situation.

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