



Contents lists available at ScienceDirect

# Construction and Building Materials

journal homepage: [www.elsevier.com/locate/conbuildmat](http://www.elsevier.com/locate/conbuildmat)

## Effects of geographical directions and climatological parameters on natural weathering of fir wood



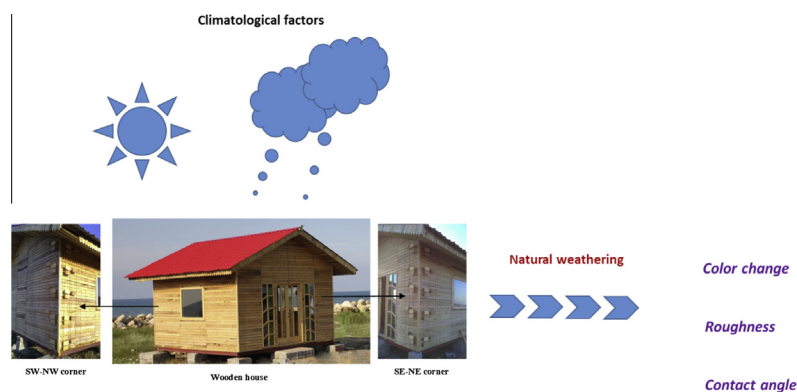
Behbood Mohebbi\*, Amir Mootab Saei

Dep. of Wood &amp; Paper Sciences, Faculty of Natural Resources, Tarbiat Modares University, P.O. Box 46414-356, Noor, Iran

### HIGHLIGHTS

- Surface properties of wood are affected due to variable climatic factors at the geographical directions.
- At southern side wood is more susceptible to checks and at northern side is susceptible to mold and fungi due less sunlight and more wet condition.
- Ambient temperature and relative humidity fluctuations provides checks in wood.

### GRAPHICAL ABSTRACT



### ARTICLE INFO

#### Article history:

Received 18 July 2013  
 Received in revised form 17 May 2015  
 Accepted 12 July 2015  
 Available online 18 July 2015

#### Keywords:

Natural weathering  
 Geographical directions  
 Climatological parameters  
 Discoloration  
 Roughness  
 Contact angle  
 Fir wood

### ABSTRACT

Discoloration, roughness and wettability of fir wood were studied during the natural weathering in different geographical directions with considering climatological factors. Climatological data such as sunlight, temperature and relative humidity were collected by a HOBO-Data Logger. Slats of fir wood in sizes of  $20 \times 10 \times 2$  cm were cut and hanged in right angles at different geographical directions (SE, SW, NE and NW). Samples were exposed to climatological factors for 120 days period. Color changes of the samples as well as contact angle and roughness were determined on samples' surfaces during the exposure period. Regarding the results, there were daily fluctuations for temperature and relative humidity as well as sunlight intensity. Results also revealed changes for the determined parameters in the slats. Samples exposed to SE direction showed major changes in color, roughness and hydrophobicity.

© 2015 Elsevier Ltd. All rights reserved.

## 1. Introduction

Weathering is a kind of the natural degradation of the wood when it is exposed to the sunlight (or ultraviolet). Water (as rain, dew and snow), fluctuations of the relative humidity as well the

temperature, aerosols (such as sands or any fine particles in the air) are all factors which can accelerate the natural weathering of the wood. Any kind of fungal decay should not be confused with the natural weathering. Because, the weathering occurs only on the wood surface and it can not affect severely its mechanical properties. Although, the microorganisms are able to colonize on the wood surface. However, they can not affect severely the wood properties by the colonization on the wood surface [1–7]. Wood is capable to absorb light due to chromophoric groups in its

\* Corresponding author.

E-mail addresses: [moebbyb@modares.ac.ir](mailto:moebbyb@modares.ac.ir) (B. Mohebbi), [a.mootab.saei@gmail.com](mailto:a.mootab.saei@gmail.com) (A.M. Saei).

structure; such as phenolic hydroxyl groups, aromatic skeletal and conjugated carbonyl groups. Light absorption by the wood promotes any photochemical reactions and causes color changes in the wood and resulting rough surface as well as appearing checks on the wood [8,9]. Photochemical degradation of the wood surface initiates immediately when it is exposed to the sunlight. The photodegradation occurs specially due to the ultraviolet light and initiates chemical alteration in lignin which results the color change of the wood. Wood color initially turns yellowish or brownish and then finally gray. All of the changes occur in 0.5–2.5 mm depth [4]. According to research reports, photodegradation of the wood occurs due to the visible light beside the ultraviolet [10]. Pandey [11] studied chemistry and color change of the wood surface under UV–visible light. He determined the color changes based on CIELAB as well as  $a^*$ ,  $b^*$ ,  $L^*$  and  $\Delta E^*$  and also he used FTIR and fluorescent microscopy to show alteration in wood surface chemistry. This report indicated that the UV–visible light cause physical and chemical changes of the wood surface as well as the color. He has expressed that the color change ( $\Delta E^*$ ) is related to the lignin degradation and increase in carbonyl groups.

In addition to the sunlight, fluctuations in the climatological factors; such as temperature as well as relative humidity, facilitate the natural weathering. Wood moisture provides the weathering reactions and it is affected by daily relative humidity fluctuations as well. The relative humidity is decreased due to the sunlight and the temperature raise. Besides that, rain, mist and also dew increase the air humidity. In coastal regions, the humidity is usually higher than other places. For this reason, [12] expressed that uncoated wood surface absorbs more moisture from the ambient atmospheres and it raises wood moisture. He believed that in addition to the chemical alteration and discoloration of the wood surface due to the sunlight, mechanical damage is also occurred because of the moisture fluctuation in wood. The wood moisture as well as the sunlight cause stresses in the wood surface due to swelling and shrinkages and it subsequently results micro cracks and checks. Variation in the moisture facilitates surfaces erosion; especially in the wood grains (early- and late-wood patterns) and

the wood surface becomes rough. Evans et al. [2] believe that the ambient temperature does not cause surface weathering itself or change the wood color because of higher melting point of the lignin (more than 150 °C) and temperature for carbohydrate degradation (more than 200 °C). Therefore, it should only ease the reactions involving in the weathering. Of course, wood surface becomes frozen and damaged physically due to any reduction in the temperature.

As noticed above, the sunlight and also other climatological factors affect the wood weathering. Therefore, there should be expected differences in wood color as well as other parameters when it is exposed to the sunlight with varying intensities in different geographical directions. This research work has hypothesized varying effects of the geographical directions on the natural weathering of wood.

2. Materials and methods

2.1. Sample preparation

Lumbers of fir wood (*Abies* sp.) were vacuum dried to achieve the moisture content of 12%. Afterwards, they were cut into sizes of 20 × 10 × 2 cm (length × width × thickness) to make sample slats. The slats were hanged parallel to the walls of a wooden house which was established and oriented in the geographical directions to simulate the situation of those walls. On each wall, there were hanged five slats from top to bottom in right angles (90°). All required measurements were carried out on the slats since the beginning till the end of exposure period. The wooden house was orientated in SE, SW, NE and NW directions.

2.2. Natural weathering

The wooden house, which the slats were hanged on its walls, was established in a southern coastal region of Caspian Sea at campus of Faculty of Natural Resources, Tarbiat Modares University, Iran (Fig. 1). This place is an interesting representative where influences of climatological factors on wood surface are accelerated in the country. The intensity of sunlight is quit high due to clean air and the humidity acceleration is rather more. Satellite map as well as sun path line were obtained from the Google Earth as shown in Fig. 1.

The slats were exposed to the climatological factors for a period of 120 days since November 2011 till March 2012. The exposure orientation of the sample was due to the sun path in northern hemisphere as noticed above.

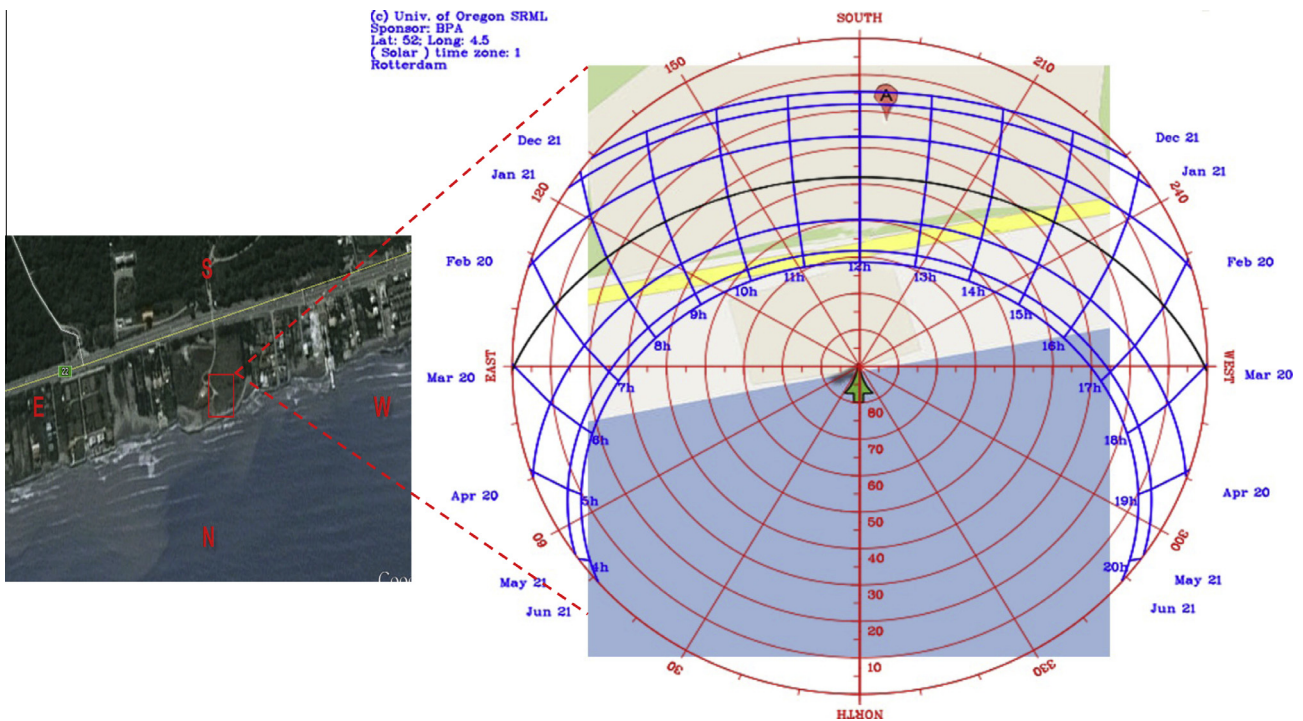


Fig. 1. Satellite view and map of the experiment's location with sun path line for different months of a year.

Download English Version:

<https://daneshyari.com/en/article/6720741>

Download Persian Version:

<https://daneshyari.com/article/6720741>

[Daneshyari.com](https://daneshyari.com)