IS 15890 (2010): Design, Installation and Testing of Solar Timber Seasoning Kiln - Guidelines [CED 9: Timber and Timber Stores]

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भारतीय मानक

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Indian Standard

DESIGN, INSTALLATION AND TESTING OF SOLAR TIMBER SEASONING KILN — GUIDELINES

ICS 27.160; 79.020

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Timber and Timber Stores Sectional Committee had been approved by the Civil Engineering Division Council.

Air seasoning and kiln seasoning are the traditional methods of seasoning timber. A large number of timber seasoning kilns have been installed in the country during the last five decades or so and many more are expected to be installed in the coming years with the rapidly increasing industrialization and the growing awareness of quality control in seasoned timber for various jobs. In the early years, kiln equipments manufacturing industry has got established on the basis of research work carried out at the Forest Research Institute, Dehra Dun.

The design of a timber-seasoning kiln has a direct bearing on the quality of seasoned timber produced with regards to seasoning degrade, uniformity of moisture content and freedom from stresses after drying. The kiln to be installed have varied widely in design features, such as, constructional material, nature of air circulation, mode of heating and humidification, venting system, baffling and several other minor but important details that affect performance.

For kiln seasoning, following three different designs of timber seasoning kilns are indigenously available and are most extensively used by timber industries in India at present:

a) Steam heated over-head internal fans reversible air circulation kilns.

b) De-humidification kilns.

c) Solar heated kiln.

IS 7315 : 1974 ‘Guidelines for design, installation and testing of timber seasoning kiln (compartment type with cross forced air circulation)’ has been published for the use of timber based industries. For such kilns the mode of heating is indirect in which heating by steam, furnace flue gases or electricity is generally adopted for heating the drying air. Conventional seasoning kiln using steam heat is appropriate only to large or medium scale operations, being prohibitively expensive to install and operate for small capacities. The steam-heated kilns, however, are versatile with minimum drying defects and being uniformly efficient regardless of the prevailing weather or climatic conditions. In recent years, the escalating cost of conventional fuels like coal, oil and wood waste required for generating steam has, however, considerably increased the seasoning costs in these kilns. Need has thus been felt to design and develop a kiln using non-conventional source of energy, with minimum infrastructure as well as seasoning costs.

The composition of the Committee responsible for the formulation of this standard is given in Annex A.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*).’ The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DESIGN, INSTALLATION AND TESTING OF SOLAR TIMBER SEASONING KILN — GUIDELINES

1 SCOPE

This standard lays the minimum performance requirements of solar seasoning kiln for seasoning of timber and recommends essential features of equipments, design and installation to attain the desired performance. It applies only to green house type solar kilns with double glazing. Procedure for testing kiln performance has also been outlined.

2 MINIMUM PERFORMACE REQUIREMENTS FOR SOLAR TIMBER SEASONING KILN

2.1 Efficient seasoning of timber with a minimum of drying defects requires that the minimum requirements with regard to air speed past the timber surfaces in the stack, relative humidity that can be maintained and the uniformity of drying conditions within the kiln be defined. Lack of an efficient humidifying arrangement exposes the timber to increased degrade through cracking and splitting and also make case-hardening relief impossible, particularly in thick and refractory timbers. Favourable air circulation speed and distribution are essential for uniform and efficient transfer throughout the stack and for maintaining uniform drying conditions within the stack.

2.2 The kiln should be capable of attaining the operating temperature from the ambient conditions within a reasonable short period, depending upon the place of its installation and weather conditions.

2.3 The kiln should be capable of attaining up to 90 percent relative humidity within a short period (say 1 h), with the timber charge near the desired final average moisture content and already heated up.

2.4 The circulation of air should be adequate and be uniformly distributed, not less than 0.6 m/s in any layer of the timber stack. It should be reversible in direction through the stack. Air speed measurement should be done with the stacking space of the kiln fully stacked in length and height, with 25 mm thick timber and using 20 mm thick crossers.

3 DESIGN, CONSTRUCTION AND EQUIPMENT

3.1 Site and Layout

The kiln should be installed at the site that provides maximum exposure to sun and should be installed on a concrete platform measuring not less than 8.5 m × 6.0 m and raised to at least 150 mm above the surrounding ground level.

3.2 Kiln Chamber

The kiln chamber should be of wood framed super structure, consisting of wall pillars and roof studs of any hard species (for example, Sal) of 150 mm × 50 mm size placed 0.95 m apart, center-to-center. The long axis of the chamber should be created in an East-West direction. The wall pillars should be erected on a wooden foundation of size 150 mm × 100 mm, having its 100 mm side half grounded into the concrete platform. The North wall should be sheathed with 9 mm thick shuttering grade plywood and all the other walls including roof should be covered with double layer of clear transparent glass of 5 mm thick on outside and 4 mm thick inside, separated by an air gap of about 37 mm by means of wooden spacer strips.

3.3 Roof of the Kiln Chamber

The roof of the kiln should be tilted towards the south at a suitable angle by adjusting the height of the North wall but keeping the height of the South wall fixed at 2.28 m. The tilt angle should be 0.9 times the latitude of the place where the kiln is to be erected, for maximum absorption of solar radiation for use all round the year.

3.3.1 Suitable rubber beading should be used, covered with shallow channels folded from 1.15 mm galvanized iron sheet for sealing purpose.

3.4 Kiln Door

3.4.1 The kiln chamber should be provided with double paneled glass sheet, wooden framed doors of size 2.06 m wide and 1.90 m high for charging of timber.

3.4.2 The kiln chamber should be provided with at least one inspection door of size 0.56 m wide and 1.90 m high for taking out kiln samples periodically for weighing.

3.4.3 The door should be located either in the Eastern or the Western wall of the kiln chamber and should be provided with suitable heat resistant gaskets and fastening arrangements to prevent heat losses.

3.4.4 In the North wall a 1.21 m × 0.6 m plywood door should be provided for facilitating lubrication of the fan bearing and adjustment of the baffles.

3.5 Corrugated Horizontal Galvanized Iron Solar Absorber

3.5.1 The glass of the kiln naturally possesses selective transmission properties for radiation. Thus radiated solar energy transmitted through the sheathing into the kiln is absorbed by a corrugated solar panel, which heats up and emits long wave heat energy. The incoming solar radiation is trapped as heat in the kiln and the temperature rises, depending upon the prevailing weather and sky condition, the moisture content, thickness and drying rate of timber, etc.

3.5.2 Inside the kiln chamber a v-corrugated galvanized iron solar absorber measuring 5.46 m long and 2.14 m wide should be installed horizontally along the entire length of the kiln at a height of 1.90 m above floor, leaving clear gaps of 0.61 m along both the North and South walls. This absorber should be painted with dull black paint.

3.6 Air Circulation System

3.6.1 Airflow serves to carry the heat from the overhead solar absorber to the timber surfaces within the stack and to return the spent, cold and humid air for re-heating over the absorber, in addition to carrying away the evaporated water vapour from the timber surfaces.

3.6.2 Inside the kiln chamber, a vertical partition of 9 mm thick plywood from floor to false ceiling and at a distance of 0.60 m from North wall shall be provided to the entire length of kiln. The plywood partition should bear two 100 mm diameter holes, their centre being at a distance of 1.36 m.

3.6.3 Two propeller fans of reversible type, 0.9 m diameter with 12 blades should be mounted in the fan housing with their shafts supplied cross wise of the length of stack horizontally. The fans should be supported on adequate number of ball bearing on pedestal, securely fixed in order to avoid vibration.

3.6.4 Two blackened, suitably curved baffles made of galvanized iron of size not less than 1 m wide should be mounted inside the kiln running along the length of the kiln roof, from the kiln roof to North wall and from kiln roof to South wall for smoothly guiding the air circulation.

3.6.5 Two 1.30 m high and 0.90 m wide openings with removable covers shall be provided directly at the back of the two fans in the North plywood wall. To convert the re-circulating air system into a single pass forced air drying system, the covers on the North wall openings behind the fans are removed and the 0.61 m wide North side plenum space is blocked all round these two openings by means of baffles described below, so that the fans exhaust the entire air leaving the stack through the opening in the plywood wall without it re-entering the stack, as in the re-circulating system. The baffles around each fan consist of two vertical 0.61 m high and one horizontal 1.26 m × 0.61 m framed galvanized iron sheet panels hinged to the vertical fan partitions. The two vertical panels are kept flush with the vertical fan partition and the horizontal panels flush with the false ceiling when the kiln is worked as re-circulating air system. When swung out into the North side plenum gap, the three panels block the plenum gap all round the North wall opening behind each fan and isolate the discharge of the air to the North side from the rest of the kiln, thus preventing re-circulation of the discharged air.

3.6.6 Eight vents of 300 mm × 600 mm size, four in the North wall and four in the South wall at the floor level, should be provided for fresh air intake as and when required.

3.7 Humidifier

A spinning disc humidifier capable of evaporating 37.85 litre of water/h, with a ¾ HP motor starter for 3-phase 440 V ac is installed in the North side plenum space, at the level of the solar absorbing false ceiling near the East or West end wall. A water supply connection is required to be made to the humidifier. A galvanized iron barrel attachment with a set of two strips-and-gaps type screens should be mounted on the humidifier casing to filter out and arrest coarse spray. A drain connection is required to be taken out from the barrel to remove water, that is, not converted into proper mist. The spray is worked manually by means of its starter, as and when kiln humidity needs to be raised.

NOTE — A de-humidifier unit may also be installed in the solar timber seasoning kiln in order to improve its drying efficiency.

3.8 Electric Motors

3.8.1 The kiln requires two electric motors, each of 2 HP, 14 440 rpm for 3-phase 440 V ac, complete with starters and reversing switches. In operation the actual power consumption for such fans does not exceed 1 kW, when fans of aluminium construction are used.

3.8.2 The fans inside the kiln as well as humidifier shall ordinarily be driven by electrical power. In locations where electric power is not available, a diesel engine may be used.

3.8.3 Any design of fan may be used provided that they are fully reversible and their capacity is adequate to fulfill the requirement with regards to speed laid down in **2.4**. They should preferably be made of aluminium or mild steel and painted with corrosion resistant paint.

4 CHAMBER DIMENSION, CHARGING OF KILN AND DRYING CAPACITY

4.1 The dimensions of the chamber depend upon the quality and maximum length of the timber to be seasoned and also the latitude of the place where solar kiln is to be installed. In general, the internal dimensions should be 5.5 m long and 3.35 m wide. Height of the North wall depends upon the latitude of the place.

4.2 Charging in the kiln is generally done manually.

4.3 Stacking capacity of a kiln shall be expressed in standard term as the maximum volume of 25 mm thick timber that can be stacked using 20 mm thick crossers.

4.3.1 Solar kilns of standard stacking capacity of 7.1 m^3/charge are available, which can be increased by repeating the standard unit length and adding more number of fans.

5 OPERATION ROOM

The concrete platform may be walled on the North side with galvanized iron or asbestos cement sheet in order to protect the motors, reversible switch starters, etc, from rain.

6 KILN INSTRUMENTS AND LABORATORY EQUIPMENTS

6.1 For weighing the samples and checking the moisture content of wood and for determination of rate of drying kiln charge, the following instruments/ equipment should be arranged.

6.1.1 Two sets of dry and wet bulb thermometers of mercury in glass type with range 20 to 100°C, one for North side and other for South side of the stack.

6.1.2 One digital weighing machine of capacity of 500 g and having an accuracy of 0.01 g.

6.1.3 One digital weighing machine to weigh up to 10 kg.

6.1.4 One electric drying oven with a digital temperature display and capable of maintaining a constant temperature of 100°C for drying small samples of wood.

6.1.5 One electrical moisture meter (useful for ready checking of the final moisture content attained).

7 KILN TESTING

7.1 A solar timber seasoning kiln may be tested for conformity to the minimum performance requirements laid down under **2.2** to **2.4** by tests described in **7.2**, **7.3** and **7.4**, which are functional in nature.

7.2 After closing the doors, vents and exhausts, fans should be started and it should be ensured that there is no leakage from anywhere. Suitable rubber beading or any other alternative arrangement shall be made to arrest leakage.

7.3 After closing the doors, vents and exhausts and after adjusting fan drive system to the prescribed rpm, the fans shall be started. The air speed between the stack layers shall be measured at different evenly distributed positions along the length and height, by inserting the probe of a suitable air speed measurement equipment (digital anemometer) up to the middle position and across the width of the stack. The air speed shall then be measured again in identical positions between the stack layers with the air circulation reversed. The result of the readings so obtained shall conform to the requirements given in **2.4**.

7.4 Humidity and temperature inside the kiln should be checked using dry and wet bulb thermometer and should conform to the requirements given in **2.2** and **2.3**. These tests should be carried out inside a fully stacked kiln.

ANNEX A

(*Foreword*)

COMMITTEE COMPOSITION

Timber and Timber Stores Sectional Committee, CED 9

Organization	*Representative(s)*
In personal capacity *(2989/D, 12th Main, HAL II Stage, Bangalore 560008*)	Shri Shyam Sunder (***Chairman***)
Bamboo Society of India, Bangalore	Shri A. C. Lakshmana Dr K. A. Kushalappa (*Alternate*)
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Ministry of Environment & Forests, New Delhi	Dr Bipin Behari
North-East Institute of Science and Technology, Jorhat	Director
Office of Development Commissioner (Handicrafts), New Delhi	Deputy Director
Rubber Research Institute of India, Kottayam	Director
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