



Your Full-Service  
Cooling Technologies Company  
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HOW PAHARPUR MAKES

# THE MOST DURABLE TIMBER COOLING TOWERS

**PAHARPUR LEADS**



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# PAHARPUR USES ONLY DOUGLAS FIR AS LOAD-BEARING MEMBER IN ITS TIMBER TOWERS



Paharpur has long been the go-to timber authority in the cooling tower industry. Our expertise in timber treatment and timber tower design has delivered real value to our customers for decades and comprises careful selection of timber, certification as per CTI standards and proper treatment. Our history of providing reliable timber cooling towers has also made us a member of the BIS technical committee on timber, CED 9.

Paharpur follows only CTI standards for timber treatment and timber tower design.

## TIMBER IN COOLING TOWERS

Timber has long been used as a structural member in cooling towers and as fill material when incoming hot water temperature is very high, making PVC unsuitable.

Low cost and compliance with industry standards makes timber ideal for use in cooling towers. However, not all timbers are suitable for use in cooling towers. Load-bearing

capacities, dimensional stability, natural durability and proper treatment are some major concerns when selecting timber.





**9-CELL CLASS 600  
CROSSFLOW TIMBER TOWER**  
AT BURUPP FERTILISER PROJECT  
KARRATHA, AUSTRALIA



*BIS classifies Douglas fir to be used as load bearing member in cooling towers*

#### WHY IS THE CHOICE OF TIMBER CRITICAL TO COOLING TOWER PERFORMANCE?

The wood structures and frames are the skeleton of the cooling tower, holding in place all parts and components. Therefore, the use of high quality wood is critical to ensuring the structural integrity of your cooling tower. For the following reasons, careful selection of timber is important:

#### Dimensional stability

Wood undergoes alternate cycles of swelling and shrinking due to wetting and drying. Expansion and contraction are exhibited in different directions; this develops a non-uniform stress in the support and necessitates the use of a species of wood with high dimensional stability, of which Douglas fir exhibits high values.

#### Durability

Cooling towers are not the kind of commodities which are replaced frequently. The same tower is used for decades. Hence, they require high durability and need to be immune to biological and chemical attack. Douglas fir is naturally highly durable, refractory and provides high resistance to decay.

#### Vibration during operation

The wood structure holds the tower and all its components in place and resists vibration during operation, thereby protecting the structural and functional integrity of the tower. Vibrations, if left unchecked, may cause great harm to the components of the cooling tower.

#### Sagging of support

If the wood support is not strong enough, it may cause the structure to sag. This can throw mechanical equipment out of line and even cause the tower to fall. Douglas fir has very high stress-bearing properties due to which sagging can be ruled out.



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## Quote from the Doc. no. CED 9 (8065) Revision of IS 2372:2004 Timber for Cooling Towers – Specification (Third Revision)

Botanical Name	Trade Name	Grade: Grade- I (N/mm <sup>2</sup> )
<i>Pseudotsuga menziesii</i>	douglas fir	9.1
<i>Pinus radiata</i>	radiata pine	6.8

NOTE: Minimum safe permissible stress is 8.5 N/mm<sup>2</sup> as per IS:883. Hence, those species which do not meet this requirement should be avoided from using in load bearing sections. They may be used in the fill areas after proper treatment as per IS 401.

# DOUGLAS FIR

## IS THE BEST MATERIAL FOR STRUCTURE & WOOD FILL

Douglas fir (*Pseudotsuga menziesii*) is an evergreen conifer species native to western North America. Its chemical and physical properties have been found to match perfectly with cooling tower structural and fill requirements.

Paharpur uses only Douglas fir in load-bearing members for its timber towers. Each member is individually strength graded at the West Coast Lumber Inspection Bureau, which only follows the highest CTI standards.

High stress durability of Douglas fir makes it the ideal timber for use in rough conditions as that of cooling towers.



PAHARPUR COOLING  
TOWERS IS A MEMBER  
OF THE BIS COMMITTEE  
ON TIMBER





For ISI Use Only

**5 GRADING OF TIMBER**

5.1 Cooling tower timbers shall be of three grades, namely, select grade, Grade I and Grade II depending on the defects permitted (see 5.3).

**Table 1 Timbers for Cooling Towers (Clause 4)**

Sl. No.	Botanical Name	Trade Name	Grade I (N/mm <sup>2</sup> ) Bending and tension along grain, Extreme fibre stress (inside location)
(1)	(2)	(3)	(4)
0	<i>Abies pinaster</i>	fir	8.7
1	<i>Cedrus deodara</i>	deodar	13.2
2	<i>Picea amabilis</i>	spruce	7.4
3	<i>Pinus kasya</i>	Musu pine	6.9
4	<i>Pinus roxburghii</i>	diu	6.5
5	<i>Pinus wallichiana</i>	kail	6.8
6	<i>Pseudotsuga murataevii</i>	Douglas fir	6.5
7	<i>Pinus radiata</i>	radiata pine	6.8
8	<i>Tectona grandis</i>	teak	15.5

NOTE 1: E-Value of all timbers in the table from "Mechanical properties of woods grown in the Indian States" by J.A. Neale and T.S.C. Wilson, United States Department of Agriculture Bulletin, 206, 47 p. (1917).

NOTE 2: E-Value of fir based on the data from "New Zealand Radiata pine: A technical manual of products, processes and uses" Ministry of Forestry Forest Research Institute Private Bag, Rotorua, New Zealand, 27 p. (1988).

NOTE 3: E-Value of late period radiata pine is 8.8 kN/m<sup>2</sup> as per IS 2002. Hence, these species should not meet the requirements should be avoided from using at load bearing sections. They may be used in the SS press after pre-treatment as per IS 401.

## PROPERTIES OF DOUGLAS FIR

The physical working properties, as well as the moderate durability of its heartwood and its excellent dimensional stability, are the principal reasons why Douglas fir is preferred over fast-grown plantation pine.

*Insufficiently strong structures will sag with time and put your entire tower at risk of collapse*

It is also tight-knotted and close-grained, adding to its structural capabilities. Regarding strength properties, Douglas fir has the highest ratings of any Western softwood for:

- Extreme fibre stress in bending ( $F_b$ )
- Tension parallel-to-grain ( $F_t$ )
- Horizontal shear ( $F_v$ )
- Compression perpendicular-to-grain ( $F_{c\perp}$ )
- Compression parallel-to-grain ( $F_{c\parallel}$ )



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The high dimensional stability of Douglas fir helps minimise vibration and preserve the structural integrity of your cooling tower during operation

Douglas fir exhibits more favorable physical properties than Australian or New Zealand Grade-A Pine in all categories.

### DOUGLAS FIR VS PINE

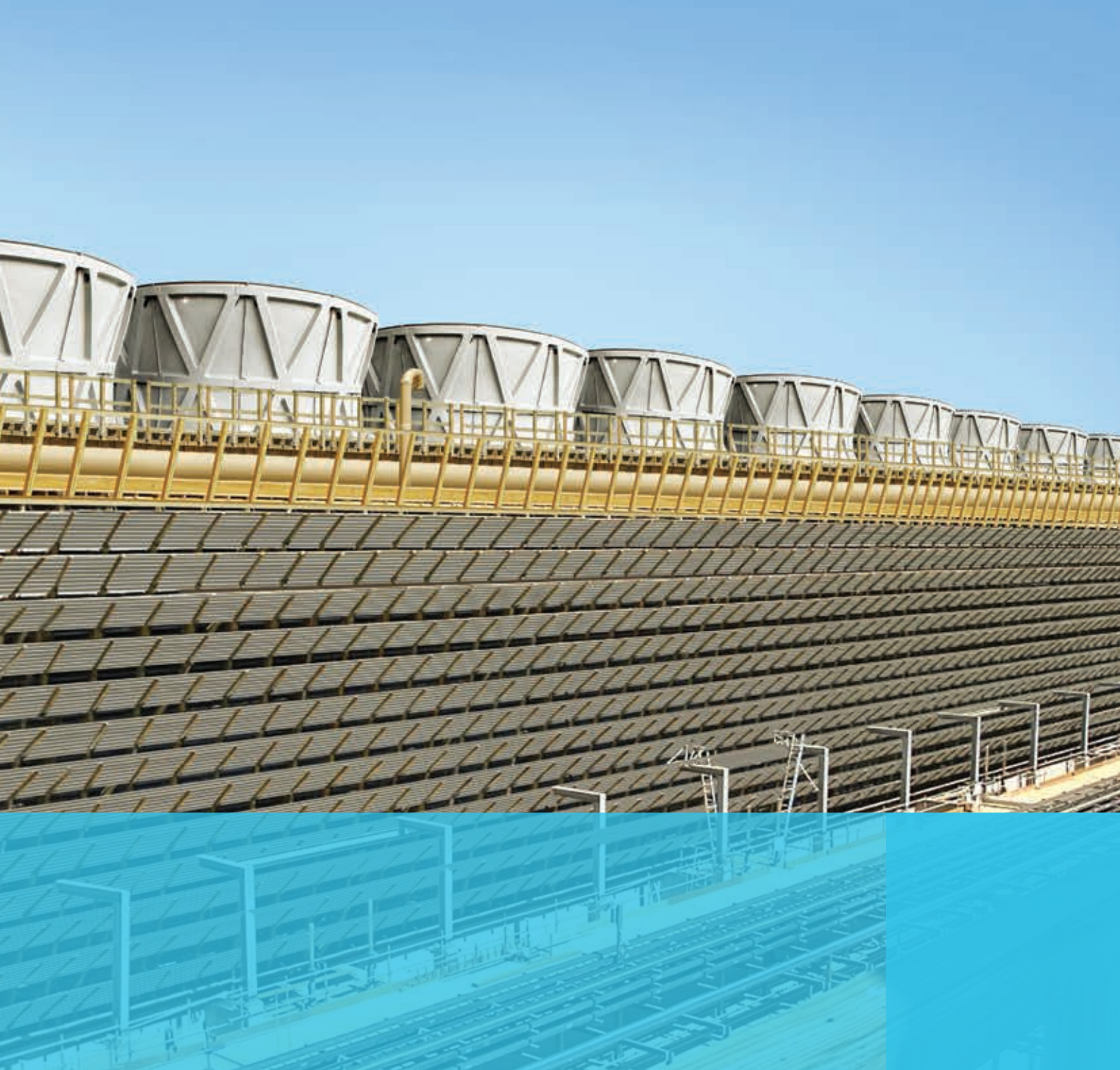
Properties	No. 2 Douglas fir	Australian / New Zealand Grade-A Pine
Maximum bending stress ( $F_b$ ) [MPa]	35	16 to 20
Maximum tension parallel to grain ( $F_t$ ) [MPa]	17	8.2 to 10
Maximum compression parallel to grain ( $F_c$ ) [MPa]	25	12 to 15
Modulus of Rupture [MPa]	86.8	79.2
Modulus of Elasticity [MPa]	12170	7900 to 10060
Strength-to-weight ratio	Superior	Low

In conclusion, Douglas fir is a better choice than Australian / New Zealand Pine for cooling tower applications since:

- It is more dimensionally stable and more durable.
- Douglas fir contains more heartwood.
- Moreover, it is very unusual to find a sawn length of Douglas fir that is primarily sapwood, as is common in radiata.

*Biological attack on timber has increased maintenance costs for cooling towers more than any other factor, this makes pressure treatment an absolute must*





## TYPES OF TIMBER DETERIORATION

Timber is a natural material and hence it is subjected to decay. The types of decay can be divided into the following categories:

### Chemical attack

Usually caused by oxidizing agents and alkaline materials. Occurs most frequently in the fill section and wetted portions of the tower where water contact is continuous. It also occurs where alternately wet and dry conditions develop.

### Internal decay

Generally restricted to the plenum area, cell partitions, access doors, drift eliminators, decks, fan housing and supports. Since decay is internal, it is difficult to detect in its early stages.

### Biological attack

Organisms attack cooling tower wood and use cellulose as their source of carbon for growth and development. Consequently degrading cellulose quality and quantity.



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Every individual piece of lumber tested by WCLIB is certified as per CTI standards only

The West Coast Lumber Inspection Bureau is a highly respected US-based certifying authority which strength grades every piece of lumber used in Paharpur's timber towers. Unlike other vendors,

Paharpur insists that every piece of lumber be strength graded and stamped with the prestigious seal that represents the highest quality standards.

# STRENGTH-GRADING AT WCLIB<sup>\*</sup>

IS YOUR GUARANTEE FOR  
THE STURDIEST TIMBER

CERTIFYING AUTHORITY  
(WEST COAST LUMBER  
INSPECTION BUREAU)

SPECIES IDENTIFICATION  
(DOUGLAS FIR)



POINT OF EXPORT  
(SOUTHPORT, USA)

LUMBER GRADE  
(GRADE 2)

SEASONING  
(KD-HT => 19% MAXIMUM  
MOISTURE CONTENT)

WEST COAST LUMBER INSPECTION BUREAU'S  
STRENGTH GRADING STAMP





Every piece of lumber used in our towers is strength graded only by the West Coast Lumber Inspection Bureau



Testing and grading procedures are strict and help us ensure strength and durability. The grading stamp (shown on page 6) provides details of the certifying authority, species of timber & its grade and seasoning of the specimen.

Every single piece of lumber shipped to Paharpur's facilities is individually strength graded. Even for jobs in the US or neighboring countries, the timber is shipped to Paharpur's facility for fabrication and treatment and then shipped back to the site.

We take great pains to ensure that our clients get long-lasting solutions that can deliver high performance in tough industrial operating conditions.

*The West Coast Lumber Inspection Bureau is the most sought after strength-grading agency in the industry*

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Chromated Copper Arsenate (CCA) treatment of timber provides high immunity to chemical and biological decay and improves resistance to weather

Pressure treatment with proper chemicals at proper concentration is key to ensuring a high quality structure, devoid of which, the tower may require major maintenance work soon after commissioning.

To ensure sturdy cooling tower structures, Paharpur treats its timber only as per CTI STD 112 and CTI STD 114.

The following preservatives are used for treatment of timber:

- Creosote, as defined by AWWA Standard P1/P13
- Water-Borne Preservatives as follows:
  - ACC (Acid Copper Chromate), as defined by AWWA Standard P5

- CCA (Chromated Copper Arsenate), as defined by AWWA Standard P5
- ACZA (Ammoniacal Copper Zinc Arsenate), as defined by AWWA Standard P5

# COMPLETE FABRICATION BEFORE TREATMENT

IS YOUR GUARANTEE FOR A LONG SERVICE LIFE

## PRE-TREATMENT FABRICATION

Pre-treatment fabrication of timber members is just one of the many unique things Paharpur does to ensure high quality cooling solutions for you. Fabrication of timber after treatment defeats the entire purpose of treatment-by exposing parts of the wood which have not been treated and thereby risking project

integrity. Paharpur conducts all treatment after fabrication of the members into their final shapes and sizes- the result of which is a fine, fully-treated, robust and strong support structure which gives you peace of mind and requires little to no maintenance throughout the life-cycle of your tower.

Paharpur treats its timber and designs its timber towers only as per CTI STD 112 and CTI STD 114.

*Paharpur has completely upgraded decades old towers with new equipment but has not had to refurbish the timber structures due to their excellent stability and immunity*



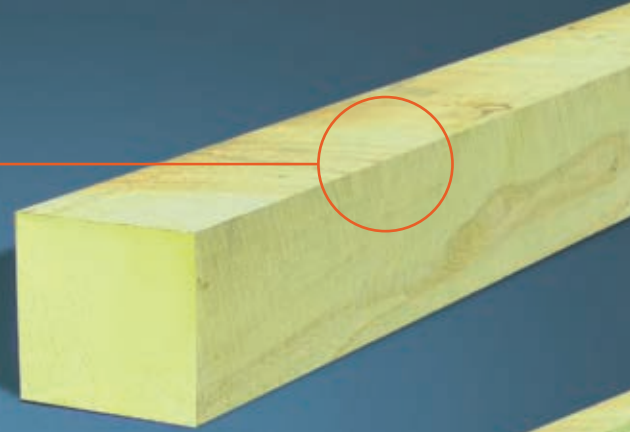


*Pressure treatment provides high immunity against all kinds of rot and results in a long-lasting tower structure*

*The advantage of post-fabrication treatment is that no exposed surface is left untreated*

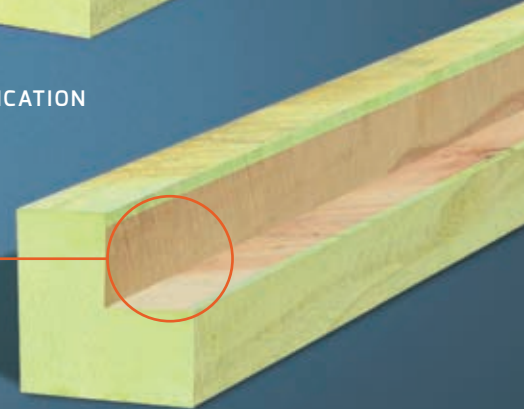
*When any surface is exposed due to fabrication, the entire CCA treatment process is compromised.*

**NO EXPOSED SURFACE**  
THIS MEMBER IS HIGHLY IMMUNE TO DECAY



**PAHARPUR - TREATMENT AFTER FABRICATION**

**EXPOSED SURFACE**  
THIS MEMBER WILL SOON DECAY, WHICH WILL SPREAD TO ALL OTHER MEMBERS



**OTHER MANUFACTURERS - FABRICATION AFTER TREATMENT**



#### SUGGESTED SPECIFICATION

1. Supply....using Douglas Fir timber, cut to size grade stamped 'Grade-II' or better as per CTI STD-114 by authorized inspectors from WCLIB (West Coast Lumber Inspection Bureau). Each length of timber should carry the grade stamping mark.
2. Douglas Fir Grade II or better conforming to CTI STD-114 for design and CTI STD-112 for chemical treatment (CCA treatment). Vendor shall submit **original test certificates** for verification lumbers and requisite records.
3. Vendor has to bring duly fabricated treated timber (cut to size) to site after treatment as per CTI-112 with relevant certificates from vendor's shop. CTI-112 does not permit fabrication/drilling of timber after treatment. Hence, No cutting/drilling is permitted at the site.



*Scan the QR code to find a digital copy of this text.*

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#### Disclaimer:

In the interest of technological progress, all products & specifications are subject to design and/or material change without notice.