NIRVANA
TECHNOLOGIES

Registered Office
B-501, Om Sarvoday CHS,
Rawalpada, Dahisar(E),
Mumbai-400068, India
Tel. No.: 91-22-28970207 / 65813793
Fax No.: 91-22-28970207

Factory Address
Unit No. A,B, Plot No. 4,
Poonam Industrial Estate,
Near Genesis,Padgha, Palghar(E),
Distinct. Thane Maharashtra, India

Website : www.nirvanatechnologies.co.in
Email : info@nirvanatechnologies.co.in

NIRVANA
TECHNOLOGIES

Cooling Solutions to
Industrial Needs

About Us

Nirvana Technologies was established in 2006 by professional engineers having vast knowledge in cooling tower field. Our head office located in Mumbai (Bombay) and manufacturing facility at Palghar, Maharashtra (70KM from Mumbai) with extended arms in all major indian cities and abroad to provide in time service to our valued clients. Our expertise lies in designing, manufacturing, supply, erection, testing and commissioning of any type of cooling towers. Selection and sourcing capability of best available components worldwide, put on edge over our competitors. We believe in innovation to save world by saving energy by using energy efficient components.

Our Mission and Core Values

Mission: Our purpose is to create value for our customers through design, manufacture & deliver quality products & superior services that meet unique need of each customer.

Core values: At **'Nirvana'** we strongly believe in our core values.

- **Integrity:** Continuously maintain the higher level of integrity with our customers, vendors and also among our self. We are honest, ethical & fair in all activities. We keep our word, deliver on our promises.
- **Quality:** we always maintain superior quality of the products & services we offer.
- **Innovation:** we always pursue newer & better processes, products & services. We believe in innovation to save world by saving energy by using energy efficient component.
- **Safety:** Safety is our important core value; we believe that all injuries are preventable. Adaptation of safety measures not only ensures safety of the life of the workers but also of their family dependent.
- **Strategic alliances:** we consider our clients as our partners & work with them to achieve their goals faster & in a cost effective manner.

Our Activites

- **Design & Engineering:**
  - Experienced team to work with you through design, budgeting, planning, installation, commissioning & testing.
  - High value, pre-engineered solution.
  - Custom design for any application.
  - Custom cell sizes to fit existing basin.
  - Fill selection to suit your application.
- **Supply, erection & commissioning of new cooling towers** (Type: Cross / Counter. MOC: RCC, FRP Package, Timber, Pultruted FRP, Steel, RCC cum Steel).
- **Own manufacturing facility at palghar 70 km from mumbai:**We manufacture fiber glass components (FRP/GRP)package cooling towers, aerodynamic fans (2ft upto 36 ft), fan stacks (upto 36ft dia), Fan(7 meter height)Panels, cladding sheets, walkway grating, doors.
  Structural Steel fabrications in MS galvanized, S304, SS316, 316 L, Duplex, super duplex material.
  Supply of hardware (nuts, bolts, screws, washers etc) in MSHDG, S304, SS316, 316 L, Duplex, super duplex, silicon bronze, aluminum bronze materials.
- **Performance / status testing** of cooling tower as per CTI ATC 105 procedures to establish cooling tower performance / capability.
- **Thermal, mechanical, structural audits** of cooling tower.
- **Up-gradation** beyond original design capacity.
- **Renovation and modernization (ANY TYPE, ANY MAKE)** of existing cooling towers: cross / counter / natural draft-hyperbolic towers, including civil / mechanical / structural / thermal part.
- **Retrofit and supply** of tower internals and mechanical parts, equipments.
- **Preparation and submission of reports** – includes prediction / comparison of present performance of cooling tower with respect to its original design conditions, root cause for deviation, probable remedies to improve performance, techno – commercial budgetary proposal to carry out proposed modifications.
- **Feasibility studies** for cooling tower.
- **Emergency repairs.**

Capabilities

- **Experienced team. International exposure** in cooling tower sector.
- **Own manufacturing facility** for FRP (fiberglass) components – such as **Energy Efficient FRP Fans**, FRP Package cooling towers, FRP fan stacks/cylinders, FRP aerodynamic doors for cooling towers, FRP walkway gratings, FRP cable trays, FRP field work such as lining, repair, modification etc. Also our factory is capable to take care of custom made steel fabrication.
- **Proven track record. Equipped with proper instrumentation** for carrying out cooling tower study.
- **Deliver guaranteed result.**

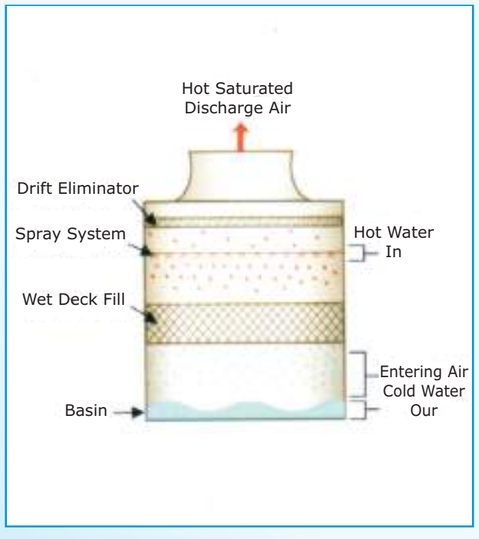
Industries We Cater

- Petrochemicals
- Refineries
- Chemicals
- Steel
- Cement
- Pulp & Paper
- Mines
- Process
- Central Utilities
- AC&R (Central Air Conditioning)
- District Cooling
- Power Plants
- Sugar Industries

And many more .....

Package Cooling Tower

Cooling Tower Principle of Operation



Cooling Towers come in many different shapes and sizes. They range from small 3 feet * 3 feet factory assembled models to large field erected cooling towers capable to rejecting thousands of BTU / Kcal of heat. Although the shapes and sizes can vary, the principle of operation remains the same.

Warm water from the heat source is pumped to the water distribution system at the top of the tower. The water is distributed over the wet deck fill by means of nozzles. Simultaneously, air is drawn through air inlet louvers and through the wet deck surface causing a small portion of the water to evaporate. The evaporative process removes heat from the water. The warm moist air is drawn out of the top of the tower by the fan and discharged to the atmosphere. The resulting cold water is then recirculated back through the heat source in a continuous cycle.

Wide Range of Capacity in Package CT

Starting from 10 TR capacity upto 500 TR in single cell and with FRP basin option and 8-10 cells in multi-cells in single row option are available. And without FRP basin option (i.e. with RCC basin, by others) upto 1000 TR in single cell and 8-10 cells in multi-cells in single row option are available to meet any type of cooling requirement in FRP package segment.

Structure

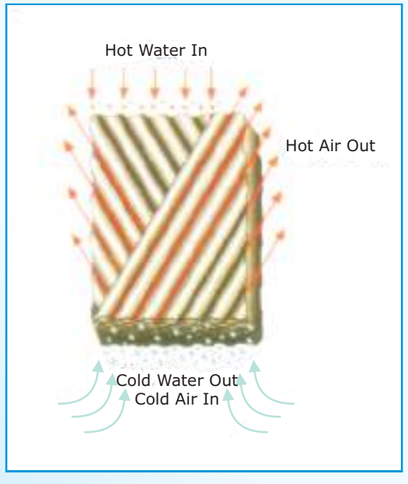
Standard **'Nirvana' cooling tower** structure shall be MS Hot Deep Galvanized and suitably design to withstand wind load, seismic load and extended life. For corrosive atmospheric condition, Zinc based epoxy cote provided to improve life further. As an option SS-304 or SS-316 or SS-316L structure could be supplied.

Casing & Fan Deck

The endwalls and sidewalls of the tower from air inlet elevation to the top of perimeter fan deck shall be cased with corrugated non-corrosive FRP panels attached to tower columns. Fan deck shall be of FRP.

PVC Film Fills

The principle of operation of cooling tower fill is to put as much water surface area in contact with as much air as possible, for the longest amount of time possible. Film fills allow the water to form thin flowing sheets to expose as much water surface area as possible to the interacting airflow.



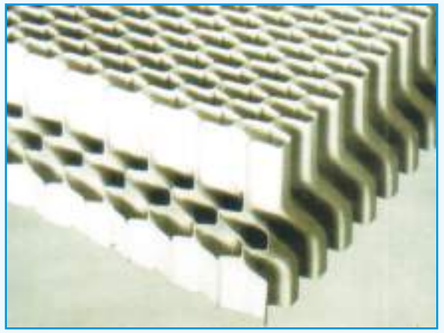
We use PVC cross-fluted film fills, which offer maximum heat exchange surface area, minimum pressure drop and higher water-air mixing time in result increase cooling tower thermal efficiency. Fills are double edge folded to provide additional strength, erosion resistance at edges and longer life. These PVC fill shall be resistant to rot, decay, or biological attack and non-brittle. The PVC fills have excellent fire resistant qualities, with a flame spread rating as per ASTM-E84.

Higher temperature fills are available for water temperatures exceeding 55 degree C. For dirty water quality package tower with Splash Fills can be supplied. Consult your **'Nirvana'** representative for further details.

PVC Drift Eliminators

"Drift" is the undesirable loss of liquid water to the environment via small droplets that become entrained in the leaving air stream. These water droplets carry with them chemicals and minerals thus impacting the surrounding environment.

'Nirvana' uses profile or cellular both type eliminator to ensure maximum removal of water droplets from air stream to limit the drift rate upto 0.005% of circulating water flow rate. With low drift rate, the **'Nirvana'** cooling tower saves valuable water and water treatment chemicals.



The drift eliminators are constructed of polyvinyl chloride (PVC) plastic material which effectively eliminates corrosion of these vital components. They are assembled in sections to facilitate easy removal for inspection and maintenance of the water distribution system and top of the fill area.

Fan & Motor

We offer widest range of fan and motor combinations to meet any type of cooling needs.

Stadel fans (www.stadelfans.com) shall be heavy duty axial type dynamically balanced and highly aerodynamic. They ensure minimal power consumption and trouble free operation. The fans constructed of FRP blades, installed in a closely fitted cowl with venturi air inlet. Fan screens shall be of GI mesh and frame, bolted to the fan cowl.

Fan Motors are totally enclosed fan-cooled, heavy duty, with 1.10 service factor and suitable for cooling tower & outdoor application. "Nirvana" offers many optional motors to meet your special needs.

Water Distribution System

The spray header and branches shall be constructed of Heavy duty, polyvinyl chloride pipe for corrosion resistance and shall have a steel flange connection to attach the external piping. The piping shall be removable for cleaning purposes. The water shall be distributed over the fill by precision molded **ABS / PP spray nozzles** with large orifice openings to eliminate clogging.

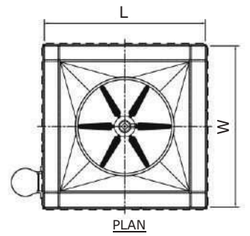
Louvers

The louvers shall be constructed from polyvinyl chloride (PVC) / FRP. The louvers shall be mounted in easily removable frames for access to the Basin for maintenance. The louvers shall be suitable angled and spaced to prevent splash out and block direct sunlight. They are aerodynamically designed to minimize pressure drop through it.

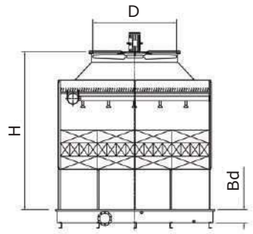
Inspection Window

An inspection window has been provided at the distribution level of casing panel. This window provide facility for inspection of distribution pattern, health of PVC fills & drift eliminator and carry out the maintenance work.

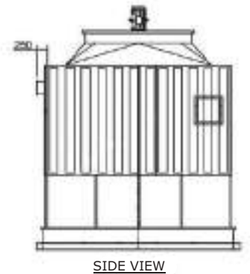
Selection Table



PLAN



SECTIONAL ELEVATION



SIDE VIEW

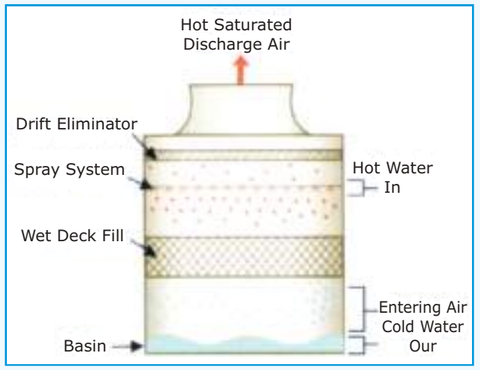
'NT' SERIES DETAILS

MODEL NO.	CAP. TR	DIMENSION			FAN DIA	BASIN DEPTH	PIPING DETAILS IN MM	
		L	W	H			IN	OUT
NT-012	15	850	850	2600	700	350	50	65
NT-024	20	850	850	2600	700	350	65	75
NT-036	30	1350	1350	2600	900	350	75	100
NT-048	35	1350	1350	2900	900	350	75	100
NT-060	40	1700	1350	2600	1000	350	75	100
NT-072	50	1700	1350	2900	1000	350	100	125
NT-084	60	1700	1700	3000	1450	350	100	125
NT-096	80	1700	1700	3300	1450	350	125	150
NT-108	100	2550	2030	3800	1600	450	125	150
NT-120	125	2550	2030	3950	1600	450	150	175
NT-132	150	2550	2550	3800	1830	450	150	175
NT-144	175	2550	2550	3950	1830	450	175	200
NT-156	200	2950	2950	3900	1830	450	175	200
NT-168	225	3400	2950	4050	1830	450	200	250
NT-180	250	3400	3400	4150	2440	600	200	250
NT-192	300	3400	3400	4450	2440	600	250	300
NT-204	350	4250	3400	4550	2440	600	250	300
NT-216	400	4250	4250	4600	3050	600	250	300
NT-228	500	4650	4250	4850	3050	600	300	350

Note : Dimensions are subject to change

Industrial Cooling Tower

Cooling Tower Principle of Operation



Cooling Towers come in many different shapes and sizes. They range from small 3 feet * 3 feet factory assembled models to large field erected cooling towers capable to rejecting thousands of BTU / Kcal of heat. Although the shapes and sizes can vary, the principle of operation remains the same.

Warm water from the heat source is pumped to the water distribution system at the top of the tower. The water is distributed over the wet deck fill by means of nozzles. Simultaneously, air is drawn through air inlet louvers and through the wet deck surface causing a small portion of the water to evaporate. The evaporative process removes heat from the water. The warm moist air is drawn out of the top of the tower by the fan and discharged to the atmosphere. The resulting cold water is then recirculated back through the heat source in a continuous cycle.

Wide Range of Capacity in Industrial CT

Available in 20 different models from one cell to twenty cells, both in Counter Flow & Cross Flow. **'Nirvana'** has a model for every application and capacity. If there is a special application, **'Nirvana'** will design a cooling tower that will fit your requirement. Contact with **'Nirvana'** head office or your local representative for alternate cooling tower solution.

Counter Flow Cooling Tower In
RCC Construction

Cross Flow Cooling Tower In
Timber Construction

Features

Structure

Depending on application, size and client's requirements, cooling tower structure shall be of the following type:

(a) As a standard, **'Nirvana'** cooling tower structure shall be MS Hot Deep Galvanized and suitably design to withstand wind load, seismic load and extended life. For corrosive atmospheric condition, Zinc based epoxy cote provided to improve life further. As an option SS-304 or SS-316 or SS-316L structure could be supplied.

(b) Chemically treated pine wood, conforming to IS-2372 and suitable for cooling tower application.

(c) Concrete (RCC) for longer life, steady and vibration free structure.

(d) Pultruded FRP with a flame spread of 25 or less, columns and diagonal braces are 3"x3" box section and for noncorrosive & lighter structure.

'Nirvana' cooling tower structural hardware can be supplied up to stainless steel **DUPLEX** grade, which is suitable for sea water application.

Casing & Fan Deck

The endwalls and sidewalls of the tower from air inlet elevation to the top of perimeter fan deck shall be cased with corrugated non-corrosive FRP panels attached to tower columns. Panels shall be lapped tool shed water inward to the tower. Corner rolls shall be provided to cover casing ends. Fan deck shall be of FRP. In case of RCC Tower casing and fan deck will be of RCC Construction.

Fills

The principle of operation of cooling tower fill is to put as much water surface area in contact with as much air as possible, for the longest amount of time possible. Depending on type of cooling tower, application and available circulating water quality the fill will be selected very carefully from below available fills:

(a) PVC Film Fills

Film fills allow the water to form thin flowing sheets to expose as much water surface area as possible to the interacting airflow. Fills are double edge folded to provide additional strength, erosion resistance at edges and longer life. These PVC fill shall be resistant to rot, decay, or biological attack and non-brittle. The PVC fills have excellent fire resistant qualities, with a flame spread rating as per ASTM-E84.

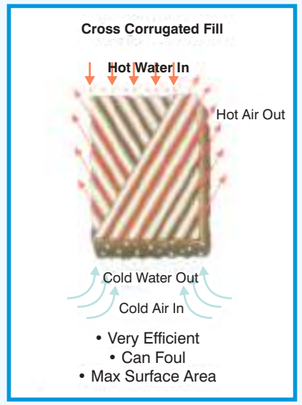
Higher temperature fills are available for water temperatures exceeding 55 degree C. Consult your **'Nirvana'** representative for further details.

We use below type of PVC fills:

(i) Cross-Fluted Film Fills: Cross fluted PVC film fills, which offers maximum heat exchange surface area, minimum pressure drop and higher water-air mixing time in result increase cooling tower thermal efficiency. Suitable for good water and industrial water quality.

(ii) Vertical Offset Fills: This fills has less fouling change, efficient and maximum surface area.

(iii) Vertical Fills: Good for dirty water, low fouling and low pressure drop.



PVC 'V'-Bar:

Opti-Grid:

TURBOsplashPAC

(b) Splash Fills

Splash fills are good for dirty water application and offer low pressure drop. Below available splash fills are used for **'Nirvana'** cooling towers:

(i) Wooden Splash Bar: Chemically treated wooden bars used for cross-flow cooling tower.

(ii) PVC 'V'-Bar: PVC 'V' Bars makes small droplets by splashing and shearing of water drops which produce better heat transfer efficiency. Used both for cross-flow and counter-flow cooling tower & suitable for turbid water application.

(iii) Opti-Grid: Opti-Grid is a direct replacement of splash fill for use in cross-flow and counter-flow towers where dirty water is concern. Opti-grid utilizes a floating hanger design that allows the fill layers to float for excellent fit in slanted cross-flow designs. This design offers reduced pressure drop, improved splash surface, non-fouling ability and maximum strength. Good for sea water and turbid water.

(iv) TURBO Splash PAC: Due to innovative design, there is no risk for the fills getting chocked, less resistance to the passage of air allows energy saving. Suitable both cross-flow and counter-flow cooling tower and any type of water quality including sea water.

PVC Drift Eliminators

"Drift" is the undesirable loss of liquid water to the environment via small droplets that become entrained in the leaving air stream. These water droplets carry with them chemicals and minerals thus impacting the surrounding environment.

'Nirvana' uses profile or cellular both type eliminator to ensure maximum removal of water droplets from air stream to limit the drift rate upto 0.005% of circulating water flow rate. With low drift rate, the **'Nirvana'** cooling tower saves valuable water and water treatment chemicals.

The drift eliminators are constructed of polyvinyl chloride (PVC) plastic material which effectively eliminates corrosion of these vital components. They are assembled in sections to facilitate easy removal for inspection and maintenance of the water distribution system and top of the fill area.

Fan & Motor

We offer widest range of fan and motor combinations to meet any type of cooling needs.

"Stadel" Fans (www.stadelfans.com) shall be heavy duty axial type dynamically balanced and highly aerodynamic. They ensure minimal power consumption and trouble free operation. The fans constructed of FRP blades, installed in a closely fitted cowl with venturi air inlet.

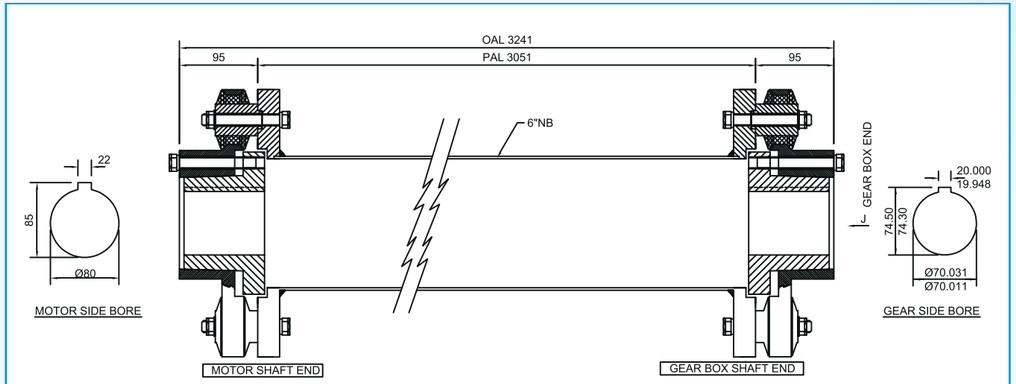
Fan Motors are totally enclosed fan-cooled, heavy duty, with 1.10 service factor and suitable for cooling tower & outdoor application. **'Nirvana'** offers many optional motors to meet your special needs.

Gear Reducers

The right angle, double-reduction, spiral-bevel gear reducers is designed in accordance with AGMA standards and CTI Bulletin STD-111. The speed reducers are sized with a minimum service factor (S.F.) of 2.0 based on the motor nameplate horsepower. The bearings are lubricated by a positive splash system. The fill, drain, and vent lines are GI / stainless steel and will extend outside of the fan stacks and have a sight glass. The sight glass will be marked to show normal lubricant level in the reducer when it is not operating.

Drive Shafts

Each drive shall include a HDG / SS, single piece drive shaft connected by flexible, self-aligning couplings to the motor and to the gear reducer. Each drive shaft and coupling set is sized for a minimum service factor of 2.0 based on the motor nameplate rating as per CTI standard. The coupling hubs will be keyed to the shafts, and the shaft assembly is dynamically balanced. Appropriate drive shaft arrestors and coupling guards are supplied as per OSHA requirements to protect equipments and operating personnel.



Water Distribution System

The spray header and branches shall be constructed of Heavy duty, polyvinyl chloride pipe / GI pipe for corrosion resistance and shall have a steel flange connection to attach the external piping. The piping shall be removable for cleaning purposes. The lateral pipes will be PVC material and connected to the main header with neoprene flexible couplings. The water shall be distributed over the fill by precision molded **ABS / PP spray nozzles** with large orifice openings to eliminate clogging. In case of RCC Counter Flow Cooling Tower, outside RCC channel will be provided with inside PVC lateral pipes and spray nozzles.

Vibration Limit Switches

Each drive will be provided with an electronic vibration monitoring switch equipped with a dual trip system.

FRP Fan Stacks

Engineered product with ribbed construction and aerodynamic inlet bell mouth to reduce frictional losses and velocity pressure. "Nirvana" FRP Fan stacks are available in different sizes and shapes ranging from 8 feet diameter up to 36 feet diameter and height from 1 meter up to 7.5 meter. These fan stacks are provided with inspection door to facilitate maintenance of mechanical items.

Customized Fabrication

Supply of hardware (nuts, bolts, screws, washers etc) in MSHDG, S304, SS316, 316 L, duplex, super duplex, silicon bronze, aluminum bronze materials.

We carry out custom made fabrication with below mentioned materials

A: MS Hot deep galvanized.

B: MS Hot deep galvanized + epoxy paint.

C: SS304, 316, 316L, DUPLEX, SUPER DUPLEX.

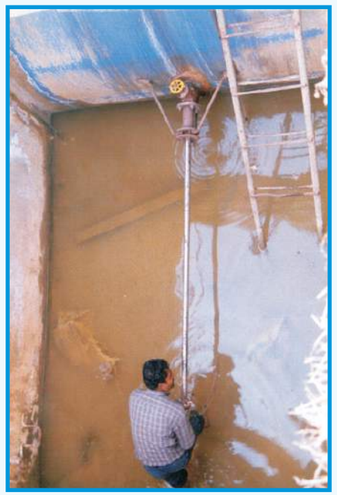
Retrofit / Upgradation Of Cooling Towers

Services Provided other than New CT

1. Performance / Status testing of cooling tower as per CTIATC 105 procedures to establish cooling tower performance / capability. Preparation and submission of reports - includes prediction comparison of present performance of cooling tower with respect to its original design conditions, root cause for deviation, probable remedies to improve performance, techno-commercial budgetary proposal to carry out proposal modifications.
2. Thermal, mechanical, structural audits of cooling tower.
3. Feasibility studies for cooling tower.
4. Up-gradation beyond original design capacity.
5. Retrofit and supply of tower internals and mechanical parts, equipments.
6. Thermal, mechanical, structural audits of cooling tower.
7. Renovations and modernization of existing cooling towers (cross, counter, natural draft-hyperbolic towers) including civil, mechanical, structural, thermal part.
8. Emergency repairs.

RCC Natural Draft Cooling Tower

Drift Loss Test



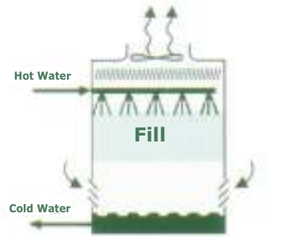
Water Flow Measurement Using Pitot Tube.

Technical Details

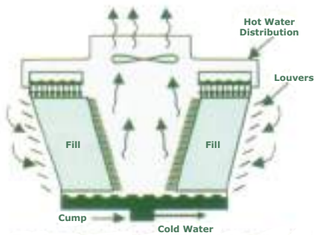
What Is Cooling Tower?

Cooling tower is an equipment used to cool the water, which is required for industrial and AC & R purpose.

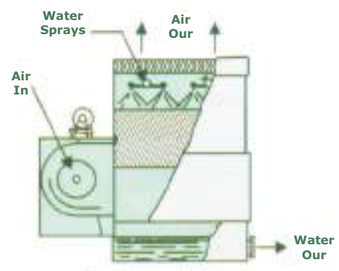
Principle of cooling is based on evaporation. Cooling tower maximize the water surface area, this water surface area comes in contact with air, top layer of water surface gets evaporate leaving behind inner surfaces of water cool.



Induced Draft Counterflow Tower With Fill



Induced Draft, Double-flow Crossflow Tower



Forced Draft Tower

Types of Cooling Tower.

Based on operation, basic types of cooling tower are,

1. Mechanical draft cooling tower.

In this cooling tower air draft is created by means of fan. There are two types of mechanical draft cooling tower.

a. Induced Draft

In this tower air draft is induced through the cooling tower. Fan comes on top of cooling tower, which sucks the air through cooling tower. Again there are two types of induced draft of cooling tower.

i. Counter flow cooling tower.

This tower is box type in which water flows down and air flows up causing counter current between air and water. These types of cooling tower are compact compare to cross flow cooling tower.

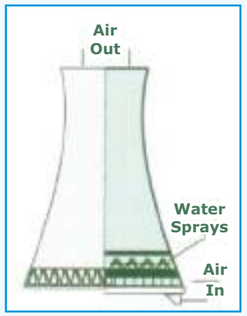
ii. Cross flow cooling tower.

This tower comes in inclined shape in which water flows down and air flows in 90 degree to water, causing cross current between air and water.

Again based on type of material used for cooling tower construction, these towers are divided in Steel, RCC, Timber, FRP, Pultruted FRP etc.

b. Forced draft

In this tower air draft is created by forcing the air in to cooling tower by means of fan. In this tower fan is installed at side bottom of cooling tower.



2. Natural Draft Cooling Tower.

In this cooling tower air draft is created naturally and there is no need of fan to create draft. Air draft is created because of venturi shape of tower and density differences of air at inlet and air at outlet. These towers are economical for large cooling water requirement, for example more that 40,000 CMH. For such large requirement these tower are advantageous because they needs less space, less maintenance, zero operational cost for fan power compare to induced draft. But capital cost of this tower is more comparing to induced one.

Nomenclature of Cooling Tower.

HWT : This is hot water temperature. This is the temperature of water going in to cooling tower.

CWT : This is cold water temperature. This is the temperature of water coming out of cooling tower.

WBT : This is wet bulb temperature of atmospheric air.

Approach : This is difference between CWT and WBT.

Range : This is difference between HWT and CWT.

L/G ratio : This is liquid to gas ratio, in cooling tower liquid is water and gas is air.

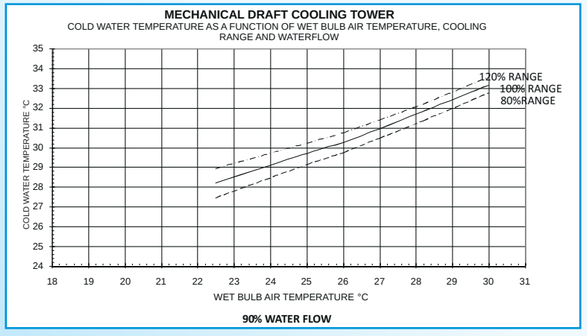
Evaporation Loss : During water cooling process of cooling tower some part of water get evaporate. This is called as evaporation loss, approximately it can be calculated as RANGE in deg C/6.11=evaporation loss in % of circulating water.

Drift Loss : This is purely a mechanical loss, some water droplets are get away through cooling tower fan and fall on cooling tower surrounding. This loss is called as drift loss, normally its value to be taken 0.005% of circulating water. In case of sea water cooling tower this loss can be calculated, designed and tested very accurately, since sea water can cause damages to surroundings.

Blow Down : During evaporation process, pure water gets evaporated leaving behind burden of total dissolved solids (TDS). This increased concentration of TDS gets accumulated at bottom of basin. To keep balance of TDS in circulating water it is required to take out some portion of water from basin bottom timely, called as blowdown. Approximate level of blow down can be calculated by following formula,

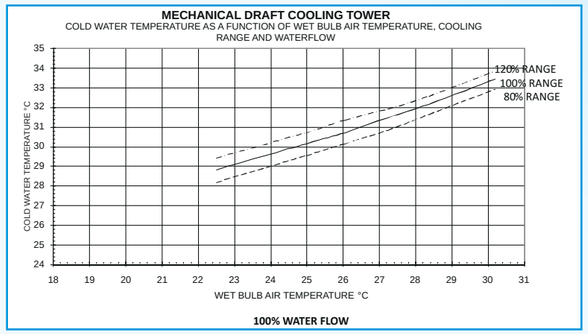
C=(E+D+B) / (D+B)

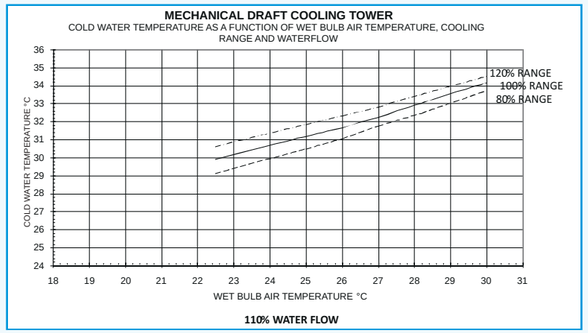
where E: Evaporation Loss, D: Drift Loss, B: Blow down, C: Cycles of concentration.



Performance Curves Of Cooling Tower.

Performance curves are prepared based on design condition of cooling tower, same will be submitted to client by cooling tower manufacture. These curves are made for +/_ 10 % water loading and +/- 20 % heat loading, compare to design one. These curves are helpful to cooling tower users in order to maintain track record of cooling tower Performance.





Types Of Fills

There are basically two types of fills, Film fill and splash fill. Film fill are more effective compare to splash one, but are more sensitive to choking & clogging. Hence proper selection of fill for particular operation is very much important for better cooling performance.

Some of the film fill are : Cross Fluted (C-10-12, C-10-19, C-10-27), Straight Flute, Straight Flute with holes etc.

Some of the splash fill are : Optigrid fill, PVC V bar fill, Concrete bars, Timber laths, TURBO Splash PAC etc.

Recirculation

Cooling tower is designed for inlet air wet bulb temperature. This inlet air wet bulb temperature will be at higher level compared to atmospheric wet bulb temperature, this happens because of recirculation. Fumes coming out of cooling tower get partially recirculated through cooling tower air inlet causing higher value of inlet wet bulb temperature. Recirculation depends on type of tower, size of tower, its location, wind direction and exit air velocity. Recirculation needs to be properly calculated and considered during tower designing.

Cooling tower fan selection.

Cooling tower fan will be selected based on air volume requirement to cool the water and static pressure across cooling tower.

Useful information on Fan Engineering.

ACFM : Actual Cubic Foot per Minute of air moved by fan.

Axial flow fan : Fan in which air/gas moves parallel to fan axis.

Beam Pass Frequency : Number of times per revolution that one fan blade passes over beam. This shows how structure interact with fan blade. Unit : cycles/sec (Hz)

Break Horsepower(HP) : This is the tower required for fan to perform desired/ designed work.

Blade Natural Frequency : Frequency at which blade freely vibrates. Unit: Cycles/Sec(Hz)

Blade Pass Frequency : Number of times per revolution that a fan tip passes a point on fan cylinder. This shows how fan cylinder interact with fan blade. Unit : cycles/se(Hz).

Chord : Straight line distance between leading and training edge.

Leading edge : Thicker portion of airfoil. This is a first part of blade to meet air.

Trailing edge : Thinner part of the airfoil opposite to leading edge.

Net free area : This is net area at fan plane minus area of Hub/Seal disc.

Static pressure : Sum of all the system resistance against which fan brake HP. Normally up to 60 %.

Static efficiency : This is a efficiency based on static pressure and fan brake HP. Normally upto 60%.

Tip clearance : Distance between blade tip and cylinder. Normally it is 0.005 * diameter of fan.

Velocity Pressure : Loss caused by work done to collect all the air in to the fan's inlet. Unit : Inches of water column.

Total Pressure : Static pressure + velocity pressure.

Total Efficiency : This is a fan efficiency based on total pressure and fan brake HP. **WR2 :** Moment of Inertia of fan.

Units / Conversions.

Air flow : 2118.64 * m3/sec = ft3/min (CFM)

Volume : 35.314 * m3 = ft3

Density : standard density : 0.075lb/ft3 , 16.018463 * lb/ft3 = kg/m3

Length : 25.4 * inch = mm , 3.281 * m = ft , 1000mm = micron.

Temperature : (°C * 1.8) + 32 = °F , (°F - 32) / 1.8 = °C

Power : 0.746 * HP = KW

Basic Equations.

Pressure (TP) : Static Pressure (SP) - Velocity Pressure (VP)

Fan BHP : (TP * ACFM) / (6356 * Efficiency Total)

Actual Velocity Pressure : $(V/4005)^2$ * (Á2/Á1) where, Á1 : Std. Air density : 0.075 lb/ft3 , Á2 : Density at the fan, V : Velocity (ft/min) : (ACFM (ft3/min) / NFA (ft3))

Maximum tip speed : 12000 ft/min. Tip speed = r * ÉWhere É = Radial velocity of fan . Unit : Radian/min, É = 2* À * N (N = Fan RPM).

When velocity recovery stack used VR : (Vp fan - Vp exit) * recovery efficiency Recovery efficiency is usually 0.6 to 0.8

Fan Laws : # CFM = fn(RPM) 1.Airflow varies in direct proportion to RPM. #SP or TP = fn(RPM) 2.Pressure capability varies with the square of a change in RPM. # HP = fn(RPM) 3.Power required varies with the cube of a change in RPM.

Tests of cooling tower.

a) THERMAL TEST : Thermal test on cooling tower can be carried as per CTI ATC-105. This test is carried out to prove cooling tower performance as per contractual agreement between cooling tower user and supplier. Also this test can be carried out in case of cooling tower up-gradation to check present status of cooling tower compare to its design values.

b) FAN TEST : In case of cooling tower up-gradation fan test can be carried out in order to check fan performance. This test gives the idea whether fine adjustment with existing fan can solve the purpose OR need to replace with higher efficiency fan.

c) DRIFT TEST : In case of sea water cooling tower drift loss is very critical, since it can make damages to surroundings. So to calculate, design and to test drift loss is very critical in case of sea water cooling tower. This test can be carried out as per CTIATC - 140. In case of normal water cooling tower drift test is necessary depending on tower location and application.

TECHNICAL DETAILS REQUIRMENT FOR **'NIRVANA'** COOLING TOWER OFFER :

Water flow ..... m^3/Hr.

HWT ..... °C

CWT ..... °C

WBT ..... °C

Location of site

Preferred tower design : Counter flow / Cross flow

Preferred MOC of tower structure : RCC / Timber / FRP / Steel

Water quality

Application

Site limitations (Length, Width, Height)

For Retrofit / up gradation of cooling tower our technical team will visit your site to collect the required data.