From : l&t construction <igrc@larsentoubro.com>
Subject : Re: Seeking permission for InPlant training – reg.
To : HOD CIVIL <hodcivil@peri.ac.in>

Thu, Jun 26, 2017 01:57 PM
1 attachment

Sir,

With reference to your request for Inplant training to Bangalore for 3 students of your institution, we are pleased to inform that the approval to the request may be preceded In a batch with 12 days date of visit to the plant.

Kindly revert to us at **igrc@larsentoubro.com** for any further clarifications over the same.

THE DIRECTOR
Larsen and Toubro House
Manapakkam, Chennai-
600125.

On Thu, Jun 26, 2017 at 10:49 AM HOD CIVIL <hodcivil@peri.ac.in> wrote: Respected Sir/Mam,

Sub:
We have 109 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
Bangalore plant to enhance their practical knowledge. So, We kindly request you to permit us to visit the plant in
last week of month 2017 and conform the date of site visit as soon as possible.
Awaiting for your favorable reply.

For further details kindly contact :

Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

proforma_field visit.doc
366 KB

From : HOD CIVIL <hodcivil@peri.ac.in>
Subject : Seeking permission for InPlant training – reg.
To : igrc@larsentoubro.com
Cc : principal@periit.com, "VICE PRINCIPAL" <viceprincipal@peri.ac.in>

Respected Sir/Mam,

Sub:

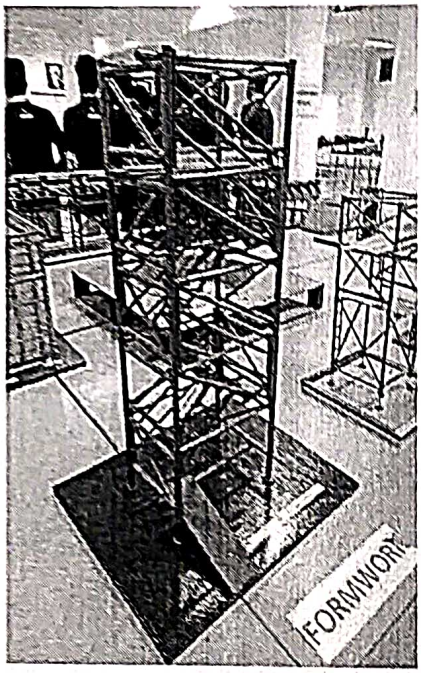
Thu, Jun 26, 2017 10:55 AM

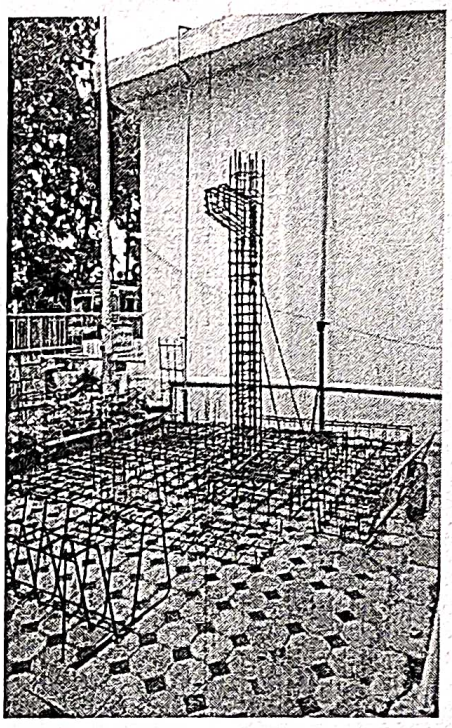
We have 109 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your Bangalore plant to enhance their practical knowledge. So, We kindly request you to permit us to visit the plant in last week of month 2017 and conform the date of site visit as soon as possible.

Awaiting for your favorable reply.

For further details kindly contact :
Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

OUR TWO STUDENTS


FORMWORK



From : PWD Buildings <ecibuildingspwd@gmail.com>
Subject : Re: Seeking permission for InPlant training – reg.
To : HOD CIVIL <hodcivil@peri.ac.in>

Thu, Jun 26, 2017 01:57 PM
1 attachment

Sir,

With reference to your request for Inplant training we are pleased to offer you an internship program with PWD Building and Maintanences, Chennai for a period of 10 days

Your students should note any information and data collected from you during the course of internship should be kept confidential at all times.

We appreciate the interest towards us..,

THE DIRECTOR
Larsen and Toubro House
Manapakkam, Chennai-
600125.

On Thu, Jun 26, 2017 at 10:49 AM HOD CIVIL <hodcivil@peri.ac.in> wrote: Respected Sir/Mam,

Sub:
We have 96 students in third year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
organization to enhance their practical knowledge. So, We kindly request you to permit us to visit the site in
last week of month 2017 and conform the date of site visit as soon as possible.
Awaiting for your favorable reply.

For further details kindly contact :

Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

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From : HOD CIVIL <hodcivil@peri.ac.in>
Subject : Seeking permission for InPlant training – reg.
To : ecibuildingspwd@gmail.com

Cc : principal@periit.com, "VICE PRINCIPAL" <viceprincipal@peri.ac.in>

Thu, Jun 26, 2017 10:55 AM

Respected Sir/Mam,

Sub:

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Awaiting for your favorable reply.

For further details kindly contact :
Mr. M. Hari Sathish Kumar,
Assistant Professor,
Department of Civil Engineering,
Contact No: 9894323214

GOVERNMENT OF TAMILNADU
PUBLIC WORKS DEPARTMENT
TAMILAGA ARASU BUILDING RESEARCH STATION, TARAMANI, CHENNAI - 600 113

CERTIFICATE

This is to certify that Sharan Prasad MS

B.E Third year Civil Engineering student of Peri Institute of Technology, Chennai, has undergone inplant training in Building Research Station, Taramani, Chennai from 15.06.2017 to 21.06.2017

21.06.2017

EXECUTIVE ENGINEER
TAMILAGA ARASU BUILDING RESEARCH STATION
TARAMANI, CHENNAI - 600 113

GOVERNMENT OF TAMILNADU
PUBLIC WORKS DEPARTMENT
TAMILAGA ARASU BUILDING RESEARCH STATION, TARAMANI, CHENNAI - 600 113

CERTIFICATE

This is to certify that *K. Balaji*

B.E Third year Civil Engineering student of Peri Institute of Technology, Chennai, has undergone inplant training in Building Research Station, Taramani, Chennai from 15.06.2018 to 21.06.2018

21.06.2018

EXECUTIVE ENGINEER
TAMILAGA ARASU BUILDING RESEARCH STATION
TARAMANI, CHENNAI - 600 113

From : PWD Buildings <ecibuildingspwd@gmail.com>
Subject : Re: Seeking permission for InPlant training – reg.
To : HOD CIVIL <hodcivil@peri.ac.in>

Thu, Sep 14, 2018 03:57 PM
1 attachment

Sir,

With reference to your request for Inplant training we are pleased to offer you an internship program with PWD Building and Maintanences, Chennai for a period of 6 days

Your students should note any information and data collected from you during the course of internship should be kept confidential at all times.

We appreciate the interest towards us..

THE DIRECTOR
Larsen and Toubro House
Manapakkam, Chennai-
600125.

On Thu, Sep 14, 2018 at 09:35 AM HOD CIVIL <hodcivil@peri.ac.in> wrote: Respected Sir/Mam,

Sub:
We have 96 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
organization to enhance their practical knowledge. So, We kindly request you to permit us to visit the site in
last week of month 2017 and conform the date of site visit as soon as possible.
Awaiting for your favorable reply.

For further details kindly contact :
Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

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366 KB

From : HOD CIVIL <hodcivil@peri.ac.in>
Subject : Seeking permission for InPlant training – reg.
To : ecibuildingspwd@gmail.com

Cc : principal@periit.com, "VICE PRINCIPAL" <viceprincipal@peri.ac.in>

Thu, Sep 14, 2018 09:35 AM

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Awaiting for your favorable reply.

For further details kindly contact :
Mr. M. Hari Sathish Kumar,
Assistant Professor,
Department of Civil Engineering,
Contact No: 9894323214

GOVERNMENT OF TAMILNADU
PUBLIC WORKS DEPARTMENT
BUILDING CENTRE AND CONSERVATION DIVISION, CHEPAUK, CHENNAI- 05

CERTIFICATE

This is to certify that R. Anirudhan B.E Final Year Civil Engineering student of Peri Institute of Technology, Chennai, has undergone In-plant training in Building Centre & Conservation Division, Chepauk, Chennai from 21.05.2018 to 31.05.2018

EXECUTIVE ENGINEER
BUILDING CENTRE & CONSERVATION DIVISION
CHEPAUK, CHENNAI – 600005

23.07.2018

SOUTHERN RAILWAY

Office of the Deputy Chief Engineer, Construction, Near My Lady's Garden, Chennai – 600 003

CERTIFICATE

This is to certify that Kharatmole Gayathrri , studying Fourth Year B.E (Civil Engineering) in PERI INSTITUTE OF TECHNOLOGY, Mannivakkam, Chennai, had undergone In-plant Training at Road Over Bridge in lieu of Level Crossing No.1 at Villivakkam Station and Road Under Bridge in lieu of Level Crossing No.4 at Korattur Station in Construction Unit on 04-06-2018 & 05-06-2018.

Place : Chennai.
Date : 05-06-2018

(M.PURANDHAR, M.E., I.R.S.E.,)
DEPUTY CHIEF ENGINEER/I,
Construction,
Southern Railway,
Chennai-600 003

From : l&t construction <igrc@larsentoubro.com>
Subject : Re: Seeking permission for InPlant training – reg.
To : HOD CIVIL <hodcivil@peri.ac.in>

Wed, Dec 26, 2018 03:23 PM
1 attachment

Sir,

With reference to your request for Inplant training to Chennal for 12 students of your institution, we are pleased to inform that the approval to the request may be preceded In a batch with 1 day date of visit to the plant.

Kindly revert to us at **igrc@larsentoubro.com** for any further clarifications over the same.

THE DIRECTOR
Larsen and Toubro House
Manapakkam, Chennai-
600125.

On Mon Dec 24, 2018 at 10:49 AM HOD CIVIL <hodcivil@peri.ac.in> wrote: Respected Sir/Mam,

Sub:
We have 109 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
Bangalore plant to enhance their practical knowledge. So, We kindly request you to permit us to visit the plant in
last week of month 2018 and conform the date of site visit as soon as possible.
Awaiting for your favorable reply.

For further details kindly contact :

Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

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From : HOD CIVIL <hodcivil@peri.ac.in>
Subject : Seeking permission for InPlant training – reg.
To : igrc@larsentoubro.com
Cc : principal@periit.com, "VICE PRINCIPAL" <viceprincipal@peri.ac.in>

Respected Sir/Mam,

Sub:

Mon, DEC 24, 2018 10:49 AM

We have 109 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
Bangalore plant to enhance their practical knowledge. So, We kindly request you to permit us to visit the plant in
last week of month 2018 and conform the date of site visit as soon as possible.

Awaiting for your favorable reply.

For further details kindly contact :
Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

L&T Construction
Transportation Infrastructure IC

Competency Development Centre

RAILWAY SBG

KANCHIPURAM

No CDC/Inplant Training/007

15.12.18

CERTIFICATE

This is to certify that the following students from the "PERI Institute of Technology" No 1, Near West Tambaram, Mannivakkam Chennai, Tamil Nadu, Pin-600048 has undergone the inplant training in our centre from 11-12-18 to 15-12-18

1. Balaji K
2. Ben Jachin S
3. Dilip Kumar T
4. Esther Metilda J
5. Gowtham B
6. Kaleel J
7. Sivaram M
8. Saranya J
9. Esther Metilda J

We wish them a bright future

M.Robert Rajasekaran

B.E (Civil); M.Tech (Transportation); M.B.A. (Computer Systems); Post.B.Sc.DCSA; P.hD ;
M.I.P.W.E(India);M.I.R.T (India);FIE; Charted Engineer (IE);FOV;
Sr.Dy.General Manager (Civil) & Principal,
Competency Development Centre,
L&T Construction, Transportation Infrastructure IC,
Kanchipuram.

LARSEN & TOUBRO LIMITED, COMPETENCY DEVELOPMENT CENTRE, RAILWAY SBG, L&T CONSTRUCTION
TRANSPORTATION IC, NEERVALLUR VILLAGE, ENATHUR (P.O), KANCHIPURAM-631 561. TEL PH NO 044 27291112
Email id: mm@lntecc.com

Zimbra

From : Port Chennai <chairman@chennaiport.gov.in>
Subject : Re: Seeking permission for InPlant training – reg.
To : HOD CIVIL <hodcivil@peri.ac.in>

Thur, Dec 28, 2018 01:23 PM
1 attachment

Sir,

With reference to your request for Inplant training to Chennai for 12 students of your institution, we are pleased to inform that the approval to the request may be preceded In a batch with 1 day date of visit to the plant.

Kindly revert to us at **chairman@chennaiport.gov.in** for any further clarifications over the same.

HR
No 1 Rajai Salai
Chennai- 600001.

On Mon Dec 24, 2018 at 10:54 AM HOD CIVIL <hodcivil@peri.ac.in> wrote: Respected Sir/Mam,

Sub:
We have 109 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
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For further details kindly contact :

Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

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proforma_field visit.doc
366 KB

From : HOD CIVIL <hodcivil@peri.ac.in>
Subject : Seeking permission for InPlant training – reg.
To : chairman@chennaiport.gov.in
Cc : principal@peri.ac.in, "VICE PRINCIPAL" <viceprincipal@peri.ac.in>

Respected Sir/Mam,

Sub:

Mon, DEC 24, 2018 10:54 AM

We have 109 students in final year in Department of Civil Engineering. They have Construction Practice as a part of the curriculum dealing with Site Practice. In this regard, they wish to do inplant training in your
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Awaiting for your favorable reply.

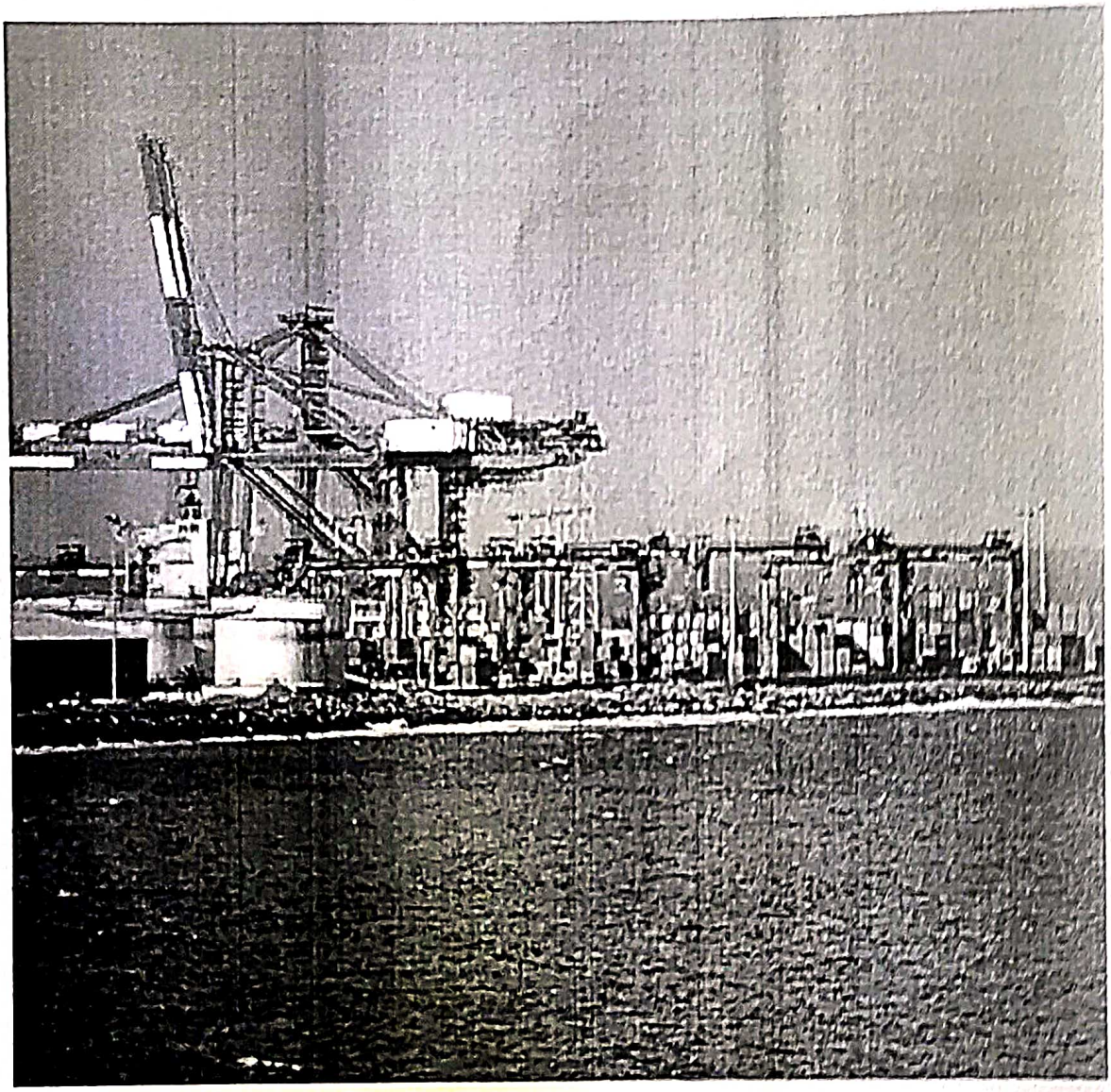
For further details kindly contact :
Mr. M. Hari Sathish Kumar,
Head of the Department,
Department of Civil Engineering,
Contact No: 9894323214

June 11,15 2018

In plant training Report Chennai Port Trust

One of the prime focuses of Department of Civil Engineering is enhancing the technical skill set of the students by Acquiring practical knowledge through industrial trainings and visit. We always thrive to accommodate the versatile functioning of Civil Engineering. As a part of these students have been encouraged to visit various functioning areas of Civil engineering such us Metro rail airport, harbors and other construction sites. One such visit has been arranged and six of our students were attending the training at the Chennai port Trust from June 11 th to June 15 th 2018.

Chennai port is situated on the Coromandel Coast in South-East India, the port of Chennai has more than 100 years of tradition. Strategically located and well connected with major parts of the world, it is today the hub port on the Indian subcontinent.

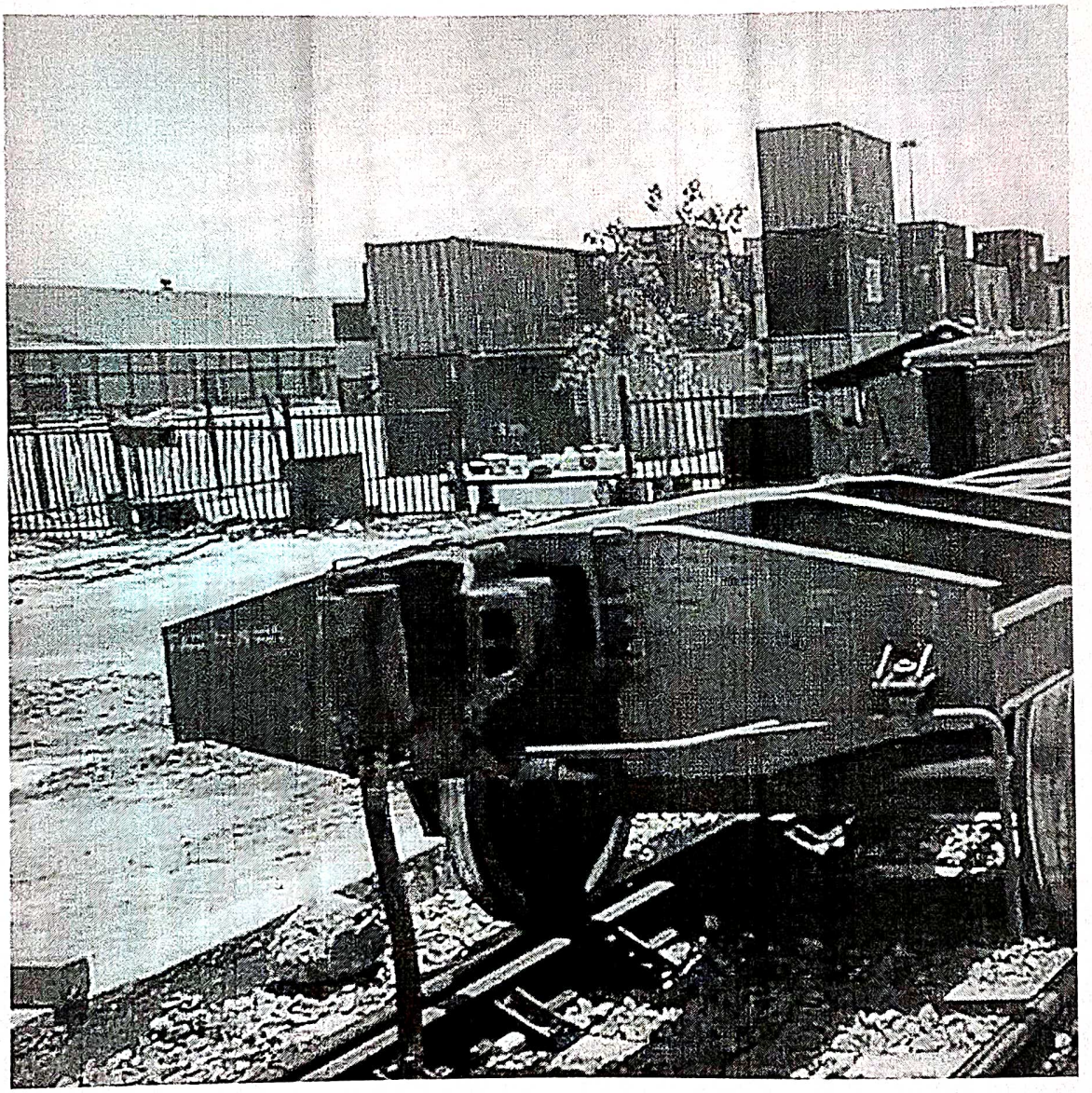


Day 1:

The Students were reported to project design office at 9.45 am and Mrs. Jayalakshmi (Assistant Executive Engineer) explained about the operations of project design. Also, she presented about the natural harbors like Goa, Mumbai, Visakhapatnam out of 12 major ports and the difference between them. She explained about docks, berth, fenders, breakwater, bollards, groynes, tetrapod's, rubbles and their functions.

DAY 2:

The Students were reported to Railway division at 7.30 am and Mr. George (Assistant Executive Engineer) explained the construction of rail tracks and other ongoing projects like expanding railway track network in yards and replacing the old rails and sleepers.



Day: 3

The Students were reported to the Environmental Cell of Chennai Port trust at 9.30 am and Mr. Saravanan (Assistant Executive Engineer) history, concepts and functions of

Environmental Cell. In Environmental Cell, they will monitor the ambient air quality, potable water quality, marine water quality, noise level, wind speed and temperature.

DAY 4:

The Students were reported to EX (C) P1 by 9.00 am and Mr. Sekar (Assistant Executive Engineer), who took us to the site inside the harbor and showed us the plan of costal berth construction and explained the concepts and work behind it.

The students were permitted to enter the Site observed the pile construction in sea water, reinforcement details of piles, the method of pile driving, auger boring, in-situ beams.

DAY: 5

The Students were reported to Northern division at 9.00 am and Mr.Gunasekaran (Assistant executive engineer), who took them to the site and explained about the oil docks and its transportation and how it is stored and collected by the owners.

As it is on the north side, it is named as northern division here the loading and unloading of oil and fuels are carried on.

STUDENT CORNER

This in-plant training gives us more practical knowledge about tender works, working with harbor departments, construction of berths, storage yards, railway lines and other civil engineering on-site encounters with practical difficulties.

We also obtained knowledge about the heavy equipment's used for construction, method of constructing piles in sea water.

We had an exposure to real time works and advanced methodologies and equipment's used for construction.

We had a good experience in Chennai port trust which was committed to efficiency through innovation, the four cornerstones of the port will see much growth in the years to come. Continuous modernization, efficient services at minimum cost, simple and integrated procedures, and user-friendly approach.

Thus, this training was very helpful for us to get practical knowledge & field experience and we sincerely thank Head of the Department of civil engineering -Peri institute of technology for giving permission to the training and for supporting us.

N. Boomiga, M. Dinesh, C. S. Jaya, S. Kamesh, R, Lokesh & R. Ramu

PERI INSTITUE OF TECHNOLOGY

Mannivakkam-48

Department of Electronics and Communication Engineering

COLLABRATION WITH JVS ELECTRONICS PVT LTD

JVS ELECTRONICS PVT LTD

PROTECTION • AUTOMATION • CONTROL

#121, Manchenahalli, Bangalore Mysore Highway, Bidadi, Ramanagara Dist. - 562 109, Karnataka, India

INTERNSHIP PROGRAMME CONFIRMATION

8th June, 2015

To

The Principal
PERI Institute of Technology,
Mannivakkam,
Chennai-600048.

Dear Sir,

Sub: Letter of offer for your Student Internship Programme.

We are pleased to offer you an internship programme of the students from PERI Institute of Technology, Chennai in the Department of Electrical and Electronics Engineering in our company, JVS ELECTRONICS PVT LTD, BANGALORE with effect from 4th July, 2015 for a period of one month.

We wish you good luck in your new assignment.

Regards,

JVS ELECTRONICS PVT LTD

M.S.AARYAA
Director

"Powering innvation"

JVS ELECTRONICS REPORT

JVS ELECTRONICS PVT LTD

PROTECTION + AUTOMATION + CONTROL

#121, Manchanayakanahalli, Bangalore Mysore Highway, Bidadi, Ramanagara District - 562 109, Karnataka, India

ABOUT JVS

Reliable, Safe & Proven products that are Engineered to perfection is what JVS Electronics offers. Having been in the Electrical Protection Industry for over two decades, JVS has developed and manufactured products that have realized customer delight over the years. With a strong and loyal customer base to boast about, JVS has designed and manufactured products that have been adding great value to businesses.

Started in the year 1991 in a small way, when acceptability of Small scale manufacturers to make high end products like relays was a challenge across the globe, JVS established itself by proving its excellence and commitment to inventing and producing products of great quality. JVS has since come a long way and is one of the leading relay manufacturers, supplying products in India and abroad. A highly energetic team of professionals, with a strong sense of customer focus has been working to take JVS to greater heights.

Conceptualizing new designs, developing new products, making products more customer friendly and adding value to customer's businesses is the daily mantra at JVS Owning many design and product patents, JVS has scaled heights thanks to virtues of patience and perseverance, they make sure that each product we manufacture are of the highest quality and we go about achieving the same at competitive prices. With the best delivery times in the Industry, JVS Electronics is the safest choice today. They strive to improve themselves in every aspect and hence for the valued customers who are already aware of JVS Quality, delivery and Service, there is more that you can expect. Team JVS assays to make each association, every transaction or even a conversation a memorable one.

INTERNSHIP

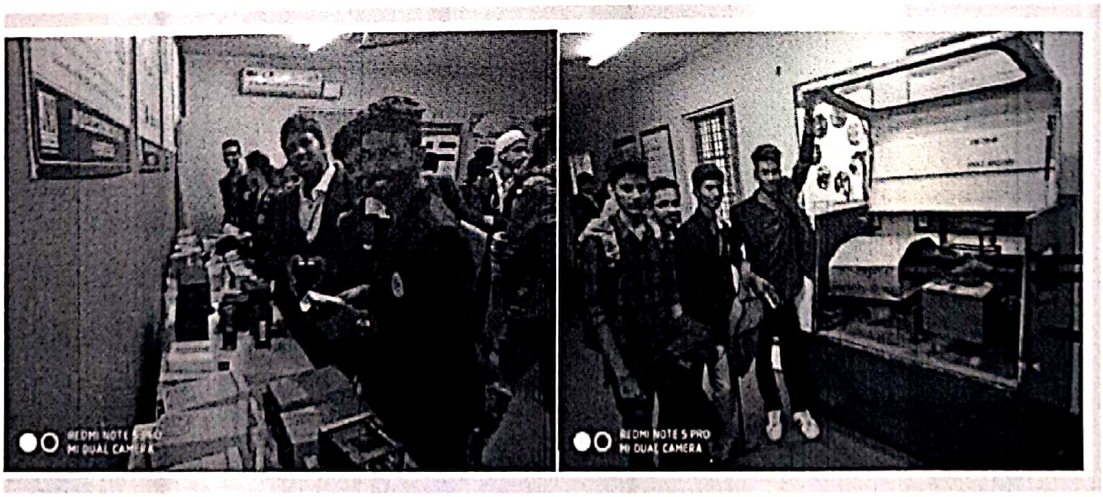
For about 10 students an Internship was provided by JVS Electronics ,Karnataka.for a period of one month from 4th July 2015.At this period they were able to gain knowledge in the manufacturing of

- Numerical Non-directional Inverse Time current Relays without communication
- Non-directional Inverse Time current Relays without /with communication
- Numerical directional /Non-directional, Non-communicable current Relay
- Numerical Transformer Differential Relay
- Numerical check synchronizing Relay
- Numerical over flux Relay
- Microprocessor based Instantaneous / Definite Time current Relays

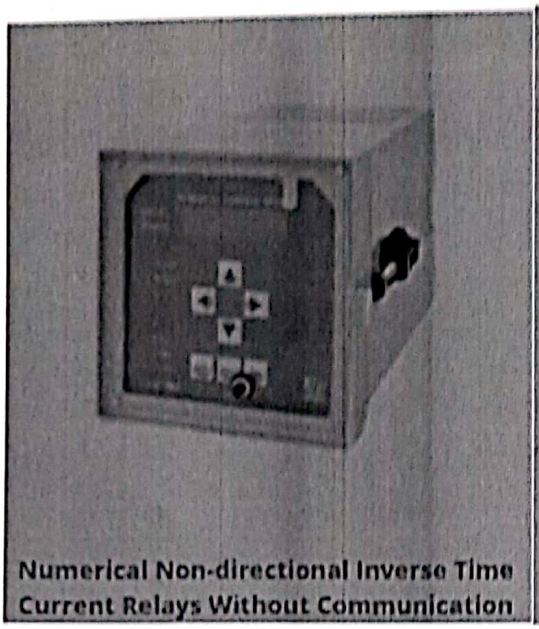
- Microprocessor based Inverse Time Non-directional ,Non-communicable current Relays
- Microprocessor based Inverse Time Directional/Non-directional ,Non-communicable current Relay
- Microprocessor based restricted E/F Relay
- Microprocessor based Instantaneous / Definite Time Battery E/F Relays
- Microprocessor based Instantaneous / Definite Time Ac Voltage Relays
- Microprocessor based Instantaneous / Definite Time Dc Voltage Relays
- Microprocessor based Neural Earth Resistor monitoring Relay
- Microprocessor based trip circuit supervision Relay
- Microprocessor based PT Fuse failure Relay
- Microprocessor based multi shot, auto reclose delay
- Two stage frequency Relay
- Time Delay Relay
- Earth leakage Relay
- Electromechanical Auxiliary& High speed Tripping Relays
- Panel Accessories
- Electronic Hooter
- Semaphore Indicator
- LED Semaphore Indicator
- Terminal Blocks & Plugs for testing
- LED Indicating Lamps
- Push buttons

NAMELIST OF STUDENTS

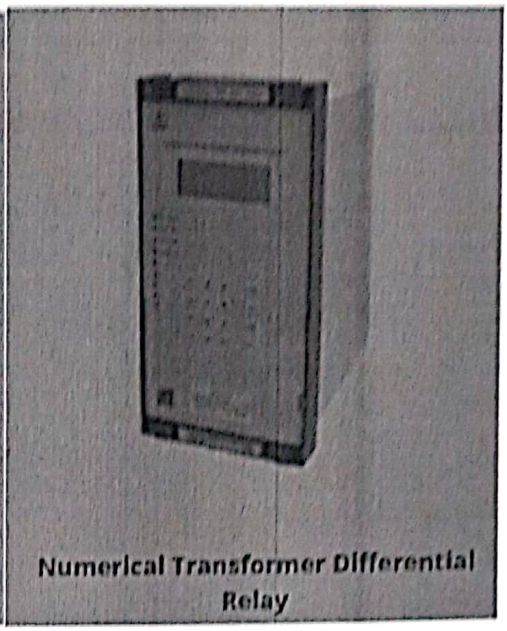
1	BALAJI M
2	BHUVANESWARI R
3	CHANDHINI J
4	CHITRA T H
5	JAGAN P
6	KHATHI JATHUL SAHANA M
7	LAVANYA S
8	RAKESH SELVAM T
9	RAMACHANDRAN C
10	SANTHA PRASAD K



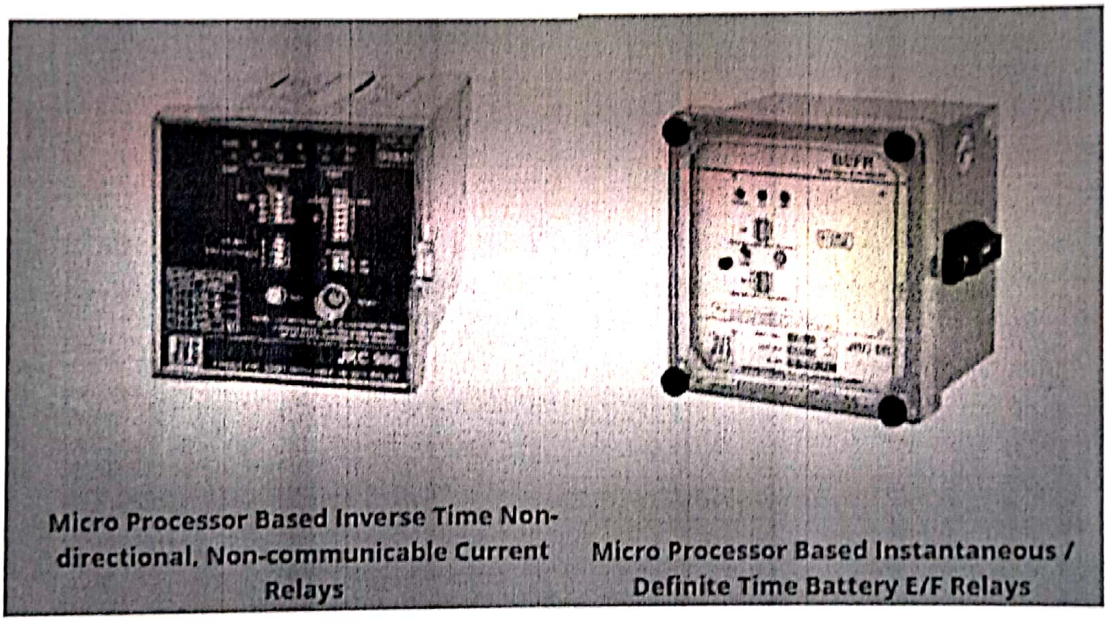
Students Image



Numerical Non-directional Inverse Time Current Relays Without Communication

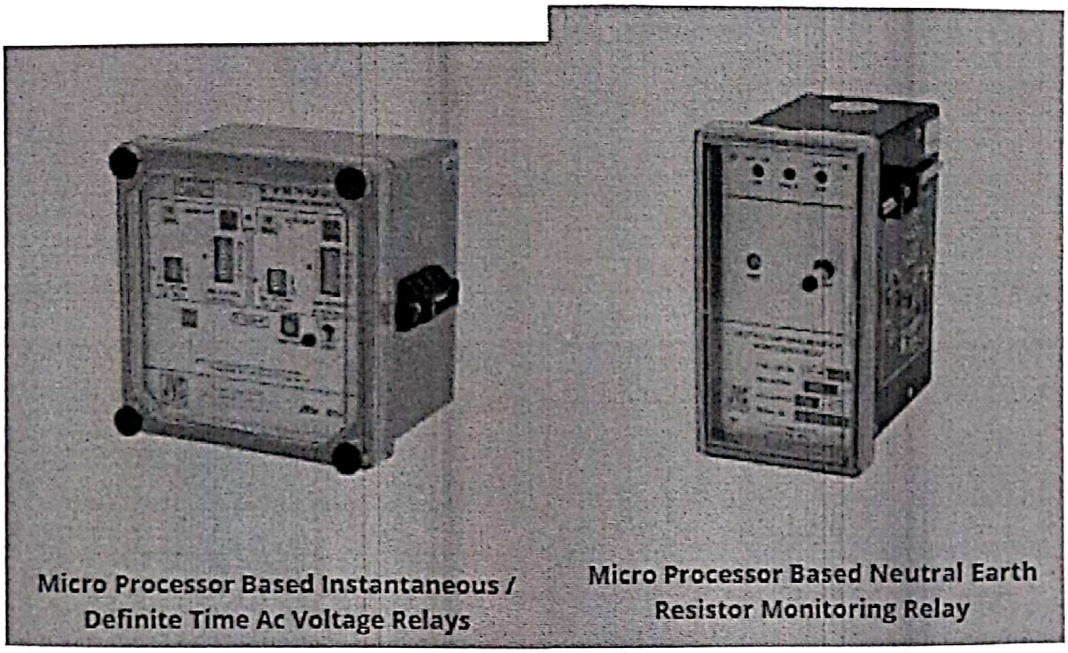


Numerical Transformer Differential Relay



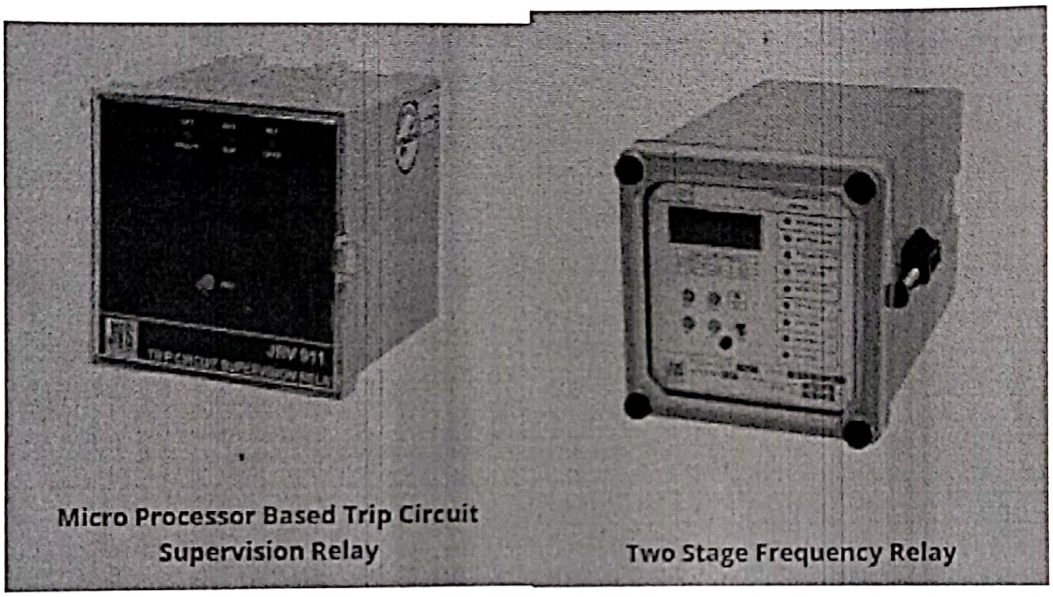
Micro Processor Based Inverse Time Non-directional, Non-communicable Current Relays

Micro Processor Based Instantaneous / Definite Time Battery E/F Relays



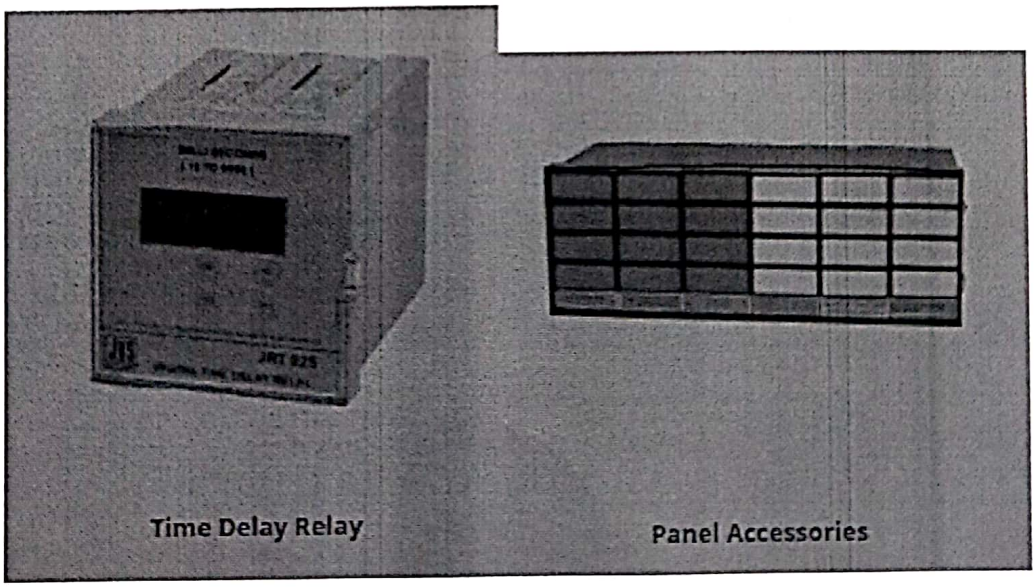
Micro Processor Based Instantaneous / Definite Time Ac Voltage Relays

Micro Processor Based Neutral Earth Resistor Monitoring Relay



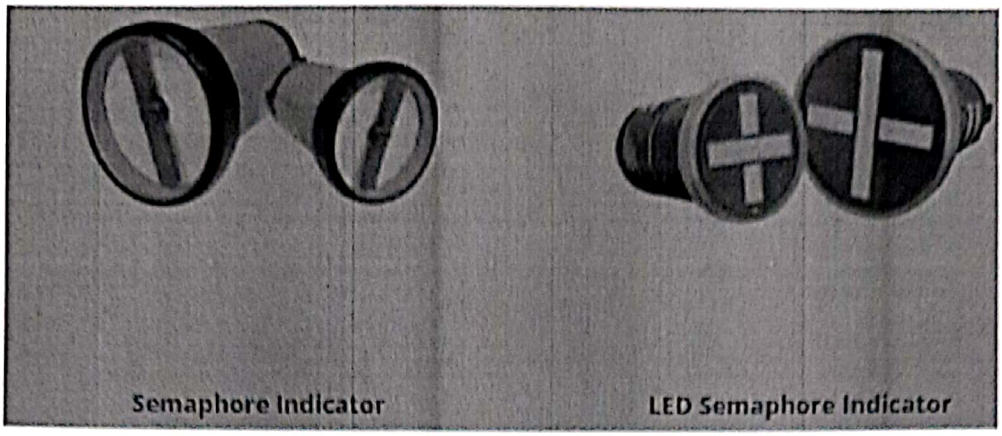
Micro Processor Based Trip Circuit Supervision Relay

Two Stage Frequency Relay



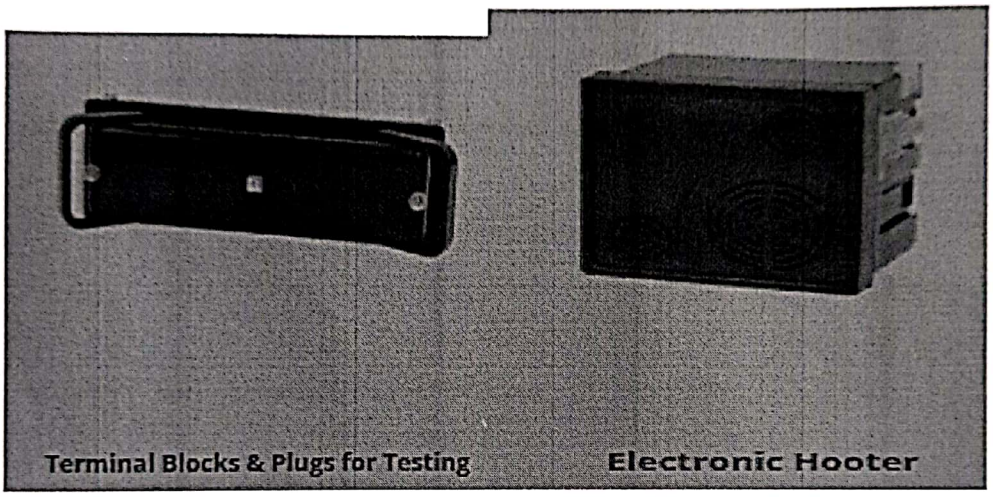
Time Delay Relay

Panel Accessories



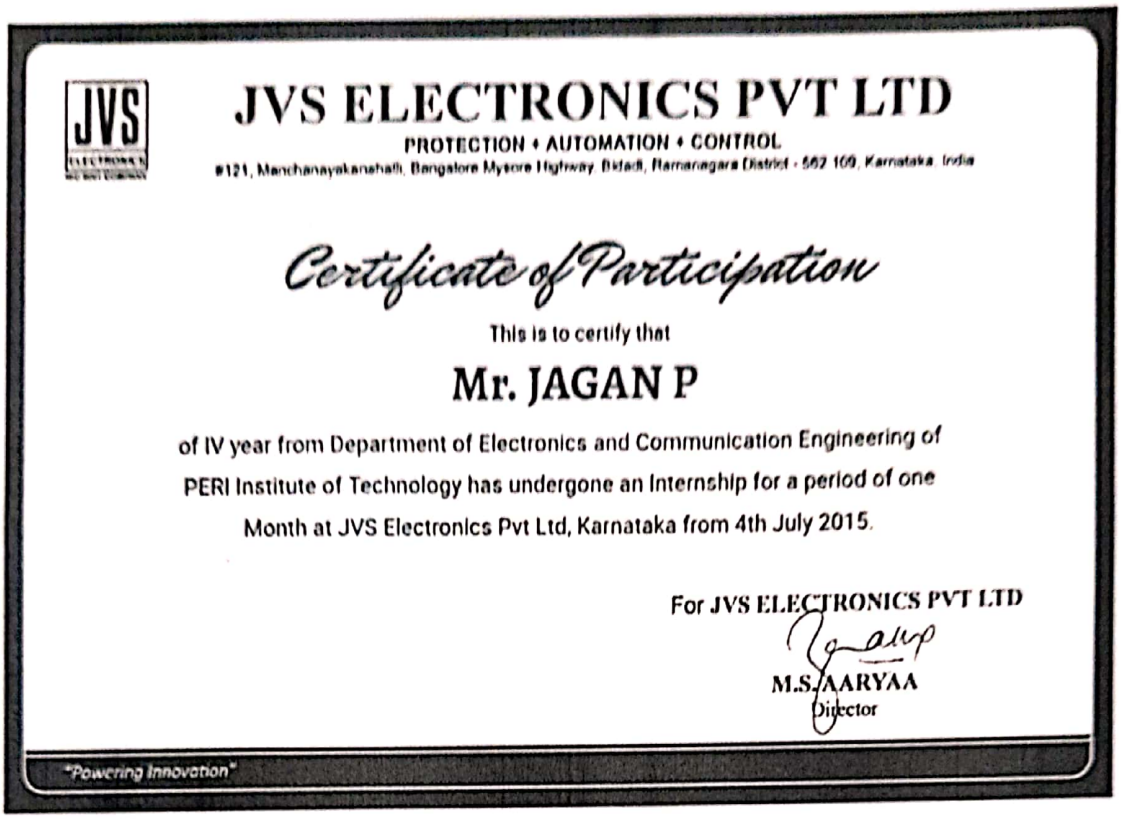
Semaphore Indicator

LED Semaphore Indicator



Terminal Blocks & Plugs for Testing

Electronic Hooter



JVS ELECTRONICS PVT LTD

PROTECTION + AUTOMATION + CONTROL

#121, Manchanayakanahalli, Bangalore Mysore Highway, Bidadi, Ramanagara District - 562 109, Karnataka, India

Certificate of Participation

This is to certify that

Mr. JAGAN P

of IV year from Department of Electronics and Communication Engineering of PERI Institute of Technology has undergone an Internship for a period of one Month at JVS Electronics Pvt Ltd, Karnataka from 4th July 2015.

For JVS ELECTRONICS PVT LTD

M.S. AARYAA
Director

"Powering Innovation"

HOD/ECE

PRINCIPAL

PERI INSTITUE OF TECHNOLOGY

Mannivakkam-48

Department of Electronics and Communication Engineering

COLLABRATION WITH KELTRON

KELTRON
(A Govt. of Kerala Undertaking)
KELTRON KNOWLEDGE CENTRE

April 16, 2018

Name: Ms. Jacklin Emilda. S

Sub: Appointed as an Internship Fellow

Dear Jacklin Emilda,

We are happy to inform you that you have been selected as an Internship fellow with KELTRON KNOWLDEGE CENTRE, (A Govt. of Kerala Undertaking).

The details of the trainings are as under:

Period of Training: May 01, 2018 to June 30, 2018.

Stipend: Rs. 5000/- per month.

Location of Training center: KELTRON KNOWLEDGE CENTRE (KKC), KARAKULAM

Address:

Keltron Group of Companies,

Keltron Knowledge Centre (KKC), Karakulam

Landmark: 14 kms away from Thiruvananthapuram Central.

Project: Enhancement of Electronics production values

You shall be reporting to Mr. Deepak Sharma for this project.

We wish you all the very best.

Regards,

K. Raghuvaran

General Manager

KELTRON REPORT

KELTRON
Kerala State Electronics Development Corporation Ltd.
(A Govt. of Kerala Undertaking)
KELTRON KNOWLEDGE CENTRE

ABOUT KELTRON

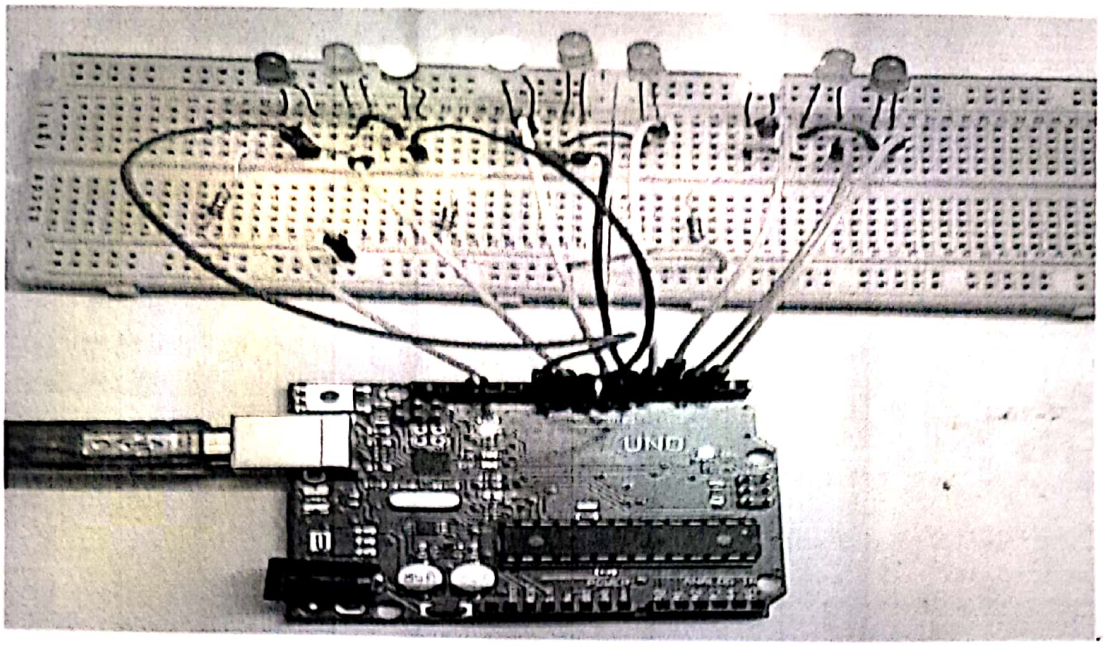
Keltron is a saga of innovation electronics .From being a pioneer in 1973 , to the role of a trends today, keltron has been the catalysis for the development of electronics industry in kerala.In five years since inception ,keltron set up several production centres and engaged more than 5000 people directly or indirectly for the manufacture of electronic goods.

INTERNSHIP

Ms. JACKLIN EMILDA,student of PERI Institute of Technolgy did an Internship with KELTRON ,Kerala from 1.05.2018 to 30.06.2018 for a period of 2months.They are providing internship on the production of components in these fields

- Strategic electronics
- Aerospace electronics
- Power electronics system
- Security & surveillance system
- Intelligent Traffic system
- Traffic Enforcement system
- Control & Instrumentation
- ID cards
- LED lighting

In this the student was enhanced with internship in "**EMS(Electronics Manufacturing services) and LED Lighting & Electronics Product Testing**"in which she gained experience in process, production, quality management and testingto show her excellence as a fellowship intern



Sahasra Sambhav
Skill Development Private Limited

KELTRON

Certificate Of Internship Partner

This is to certify that Ms. Jacklin Emilda. S from PERI Institute of Technology, Chennai undergone internship program at **KELTRON KNOWLEDGE CENTRE (KKC), KARAKULAM** in hands with **Sahasra Sambhav Skill Development Pvt, Ltd, A-4, Phase-II, NOIDA, Uttra Pradesh.**

For providing internship on **EMS (Electronics Manufacturing Services), LED Lighting & Electronics Product Testing. During Internship**, Candidate will be able to get Knowledge about Process Engineering, Production Process, Quality Management System & Testing of Final Products under guideless of Industry experts.

Date
22/06/2018

Skill India
कौशल भारत - कुशल भारत

www.sahasraelectronics.com

Auth. Signatory
Keltron Lighting Division

HOD/ECE

PRINCIPAL

PERI INSTITUE OF TECHNOLOGY

Mannivakkam-48

Department of Electronics and Communication Engineering

COLLABRATION WITH BSNL

BSNL भारत संचार निगम लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT SANCHAR NIGAM LIMITED
(A GOVT. of India Enterprise)

DTTC

District Telecom Training Centre
Telephone Exchange Compound, MES Road,
East Tambaram, Chennai-600 059
Email: dttcchennai@bsnl.co.in
Phone: 044-22790266, Fax: 044 22790286
(Landmark: Near Corley High School)

INTERNSHIP COLLABORATION CONFIRMATION

Date: 14.04.2014

On behalf of the DTTC, BSNL TAMBARAM, entered into a memorandum of understanding (MoU) with PERI INSTITUTE OF TECHNOLOGY, MANNIVAKKAM for promoting and exploring the areas of cooperation, joint collaborative work in project and internship and academic programmes. It is evident that Industrial exposure and training is an essential part and your company seems to be a perfect fit for the program and it would be great if you provide our students the internship. The internship program fees structure and course period is detail described in below.

Internship fees structure:

Duration: 2/3/4/5/6 Weeks
FEES FOR OUTSIDERS

TRAINING	FEES (RS.)	ST	TOTAL (RS.)
INTERNSHIP 2W	2400	12.36%	2697
INTERNSHIP 3W	3600	12.36%	4045
INTERNSHIP 4W	4800	12.36%	5393
INTERNSHIP 5W	6000	12.36%	6742
INTERNSHIP 6W	7200	12.36%	8090

Note: For BSNL wards (25%fess concession for BSNL employee's wards)

Please find attached the memorandum of understanding between DTTC, BSNL Tambaram and PERI Institute of technology, Chennai for the collaboration on internship program. Please carefully read the section that pertains to your roles and responsibilities for the collaboration. If you wish to edit any part of MOU, please do so and return it to us for review. Once a final revision is completed, we will send you two copies for signing.

If the revised MOU meets your approval, please sign both copies, keep one copy for yourself and return the other to the following address:

Mr. Magesh Adithya, Officer of DGM (Admn)
District Telecom Training Center BSNL,
No.9, M.E.S Road, East Tambaram,
Chennai-600059.

We look forward to working with you to make this collaboration successful.

Sincerely,

Officer of DGM (Admn)

BSNL REPORT

BSNL
(A Govt of India Enterprise)

District Telecom Training Centre
Telephone Exchange Compound, MLS Road,
East Tambaram, Chennai 600 059
Email: dttcchennai@bsnl.co.in
Phone: 044 22790266, Fax : 044 22790286
(Landmark: Near Corley High School)

BSNL DTTC LEARN TELECOM

ABOUT BSNL

BHARAT SANCHAR NIGAM LIMITED (BSNL) was formed by corporatization of the erstwhile Department of Telecom Services & came into being on 1st October 2000.

BSNL provides complete bouquet of telecom services that includes:

- Land line services
- Mobile Services including 2G, 3G & 4G (in limited areas) services
- Internet ,Broadband , Fiber to the Home (FTTH) services
- Wi-Fi services
- Data Center services
- Enterprise Data services such as Leased circuits, MPLS VPN etc
- National and International Long Distance services

BSNL is one of major service provider in its license area. The company offers wide ranging & most transparent tariff schemes designed to suit every customer. BSNL has **115.87 million** cellular as on 30.04.2019. 3G Facility has been given to all 2G connections of BSNL. In basic services, BSNL is miles ahead of its rivals, with **11.17 million wireline phone** subscribers i.e. 51.47% share of the wireline subscriber as as on 31.03.2019. BSNL telecom network therefore is part of modern global network, providing access to countries around the world for transporting information in the form of voice, data and video. The company has vast experience in planning, installation, network integration & maintenance of switches & transmission networks & also has a world class ISO 9000 certified Telecom Training Institute.

.

INTERNSHIP

The MoU was signed between Peri Institute of Technology and DTTC,BSNL Chennai.An Internship was conducted for 10 students for about 6 weeks from 21.4.20 and they were gaining the knowledge on these topics

- Mobile (GSM/CDMA,2G,3G equipments,GSM Antennas)
- Optic Fiber Systems

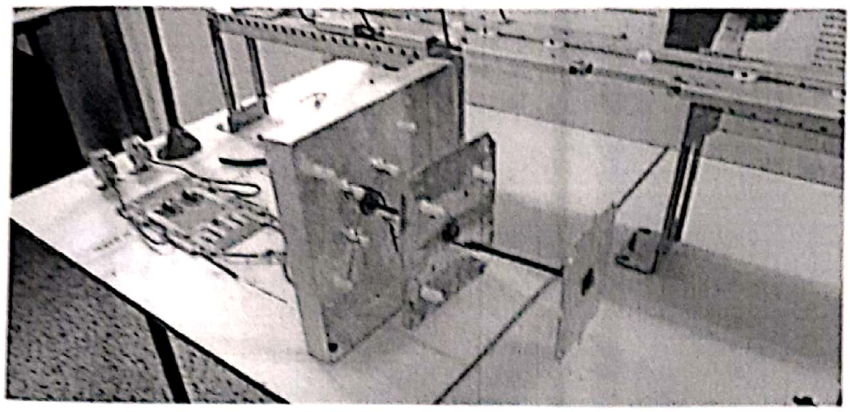
- Electronic Telephone Exchange Systems
- Digital Transmission Systems
- Telecom Infrastructure

At the end of 6 weeks Internship they were able to have a clear idea in all these topics in communication fieldsand its was more informative

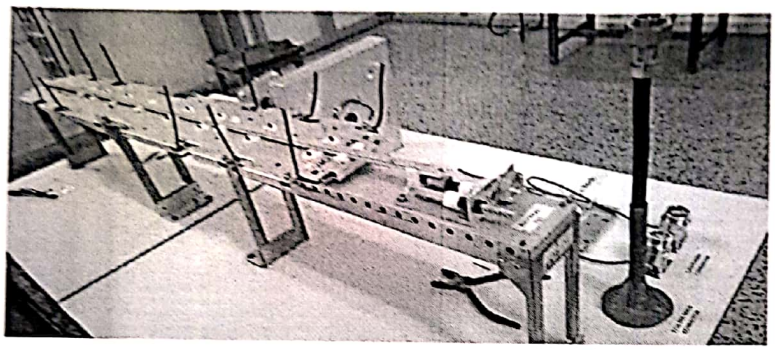
NAME LIST OF THE STUDENTS

1	ARUNKUMAR K
2	DIVYA BHARATHI G
3	JAYA MANIKANDAN R
4	KOKILA B
5	MOHAN C
6	MOHANAVALLI B
7	PRADEEP B
8	PREETHI L
9	SARAVANAN D
10	SHANMATHI G

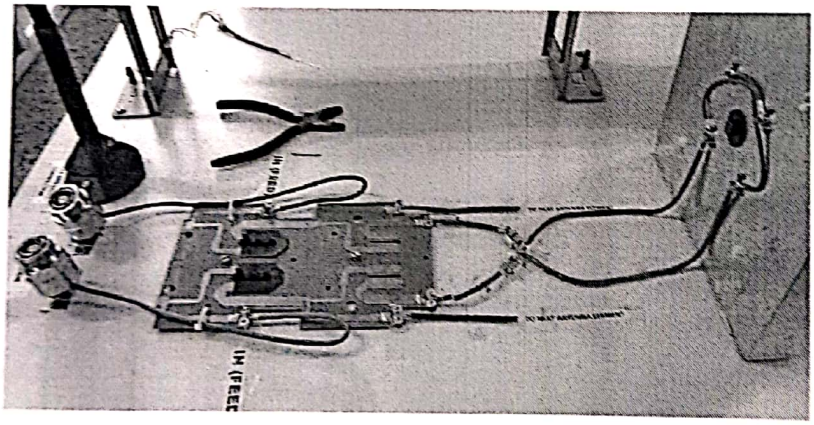
Student image



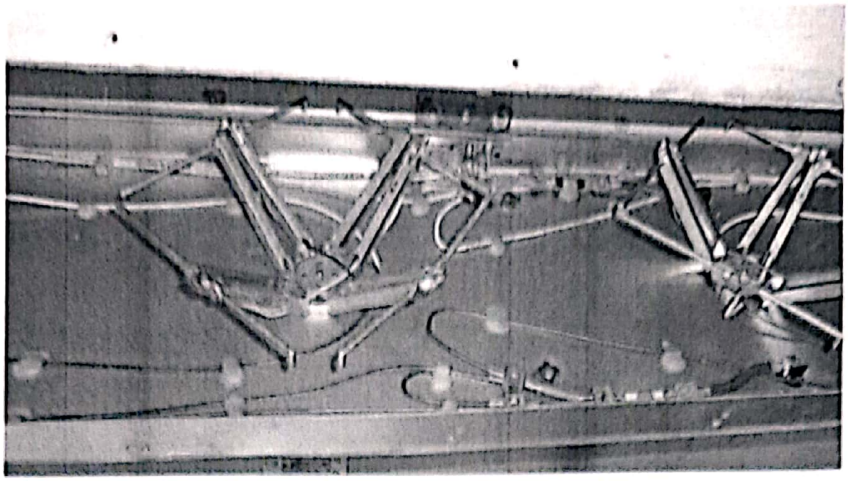
A single antenna element is removed from the patch panel antenna array and displayed. The components are removed and kept separated so that each part can be visible. This element basically has 3 parts.



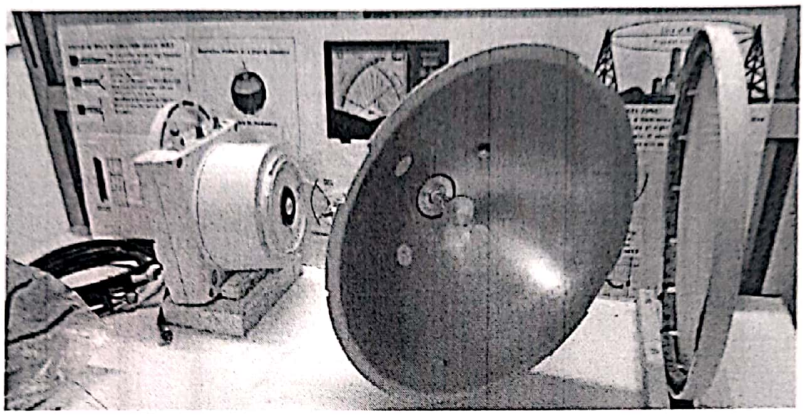
The electrical tilt portion of the gsm patch panel antenna



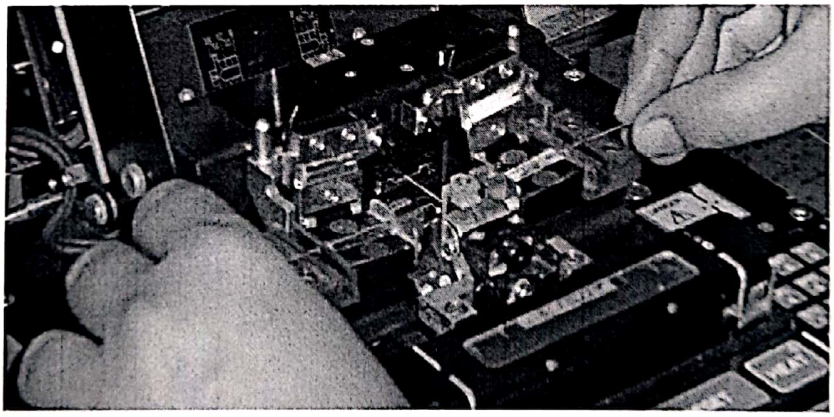
This is the electrical tilt closeup image. The cable distance between the input feed and the antenna element is varied by a slider. This slider can be moved by rotating the electrical tilt rotating wheel. This rotation can be controlled remotely also by using a motor.



This image shows the inside of the 2G GSM antenna 900Mhz.
it is a array of dipole element set at +45 and -45 degrees.

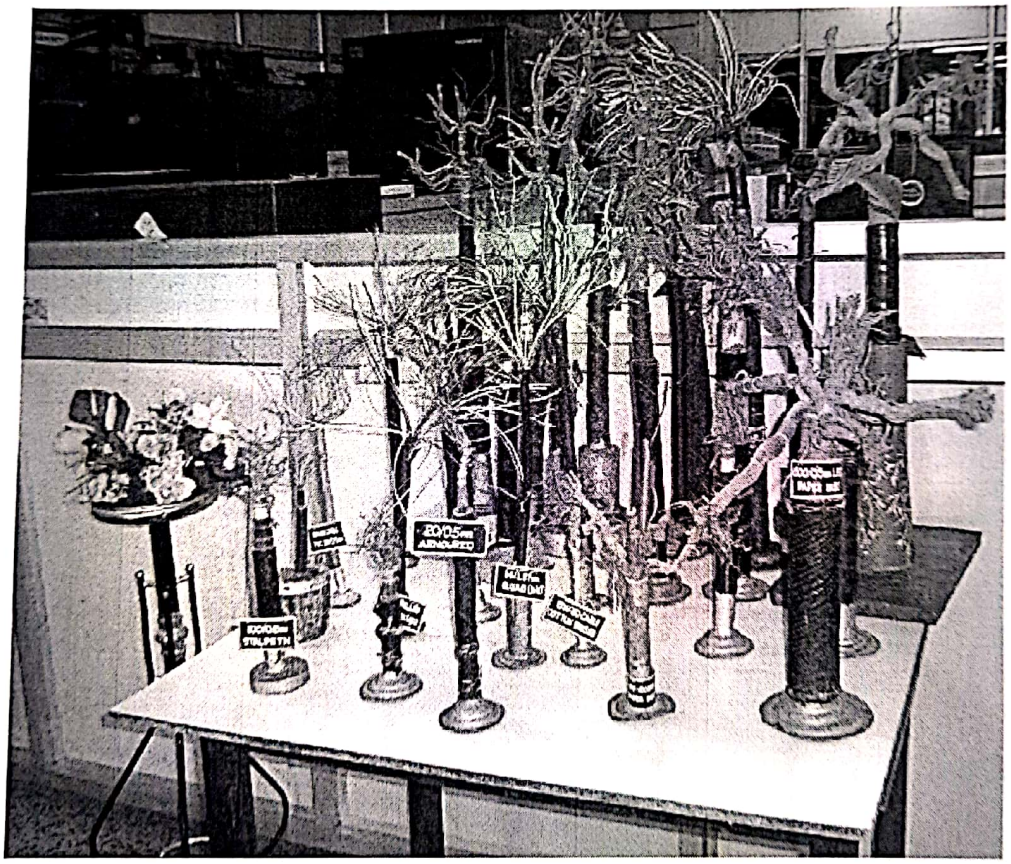


These are the parts of parabolic microwave antenna used in the backhaul between BTS and BSC.

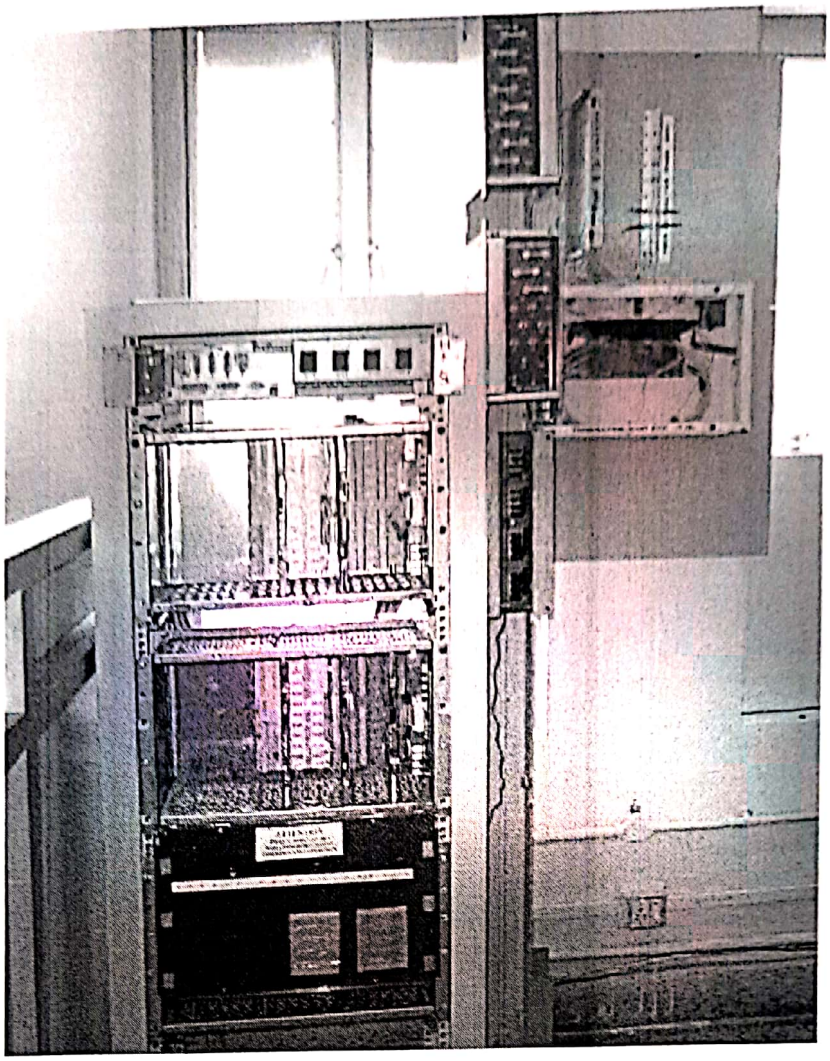


For joining two fibers, OPTIC FIBER SPLICING MACHINE is used.

How optic fiber enters into the Telecom Equipment Room. How it is jointed and How it is terminated to the PCBs.

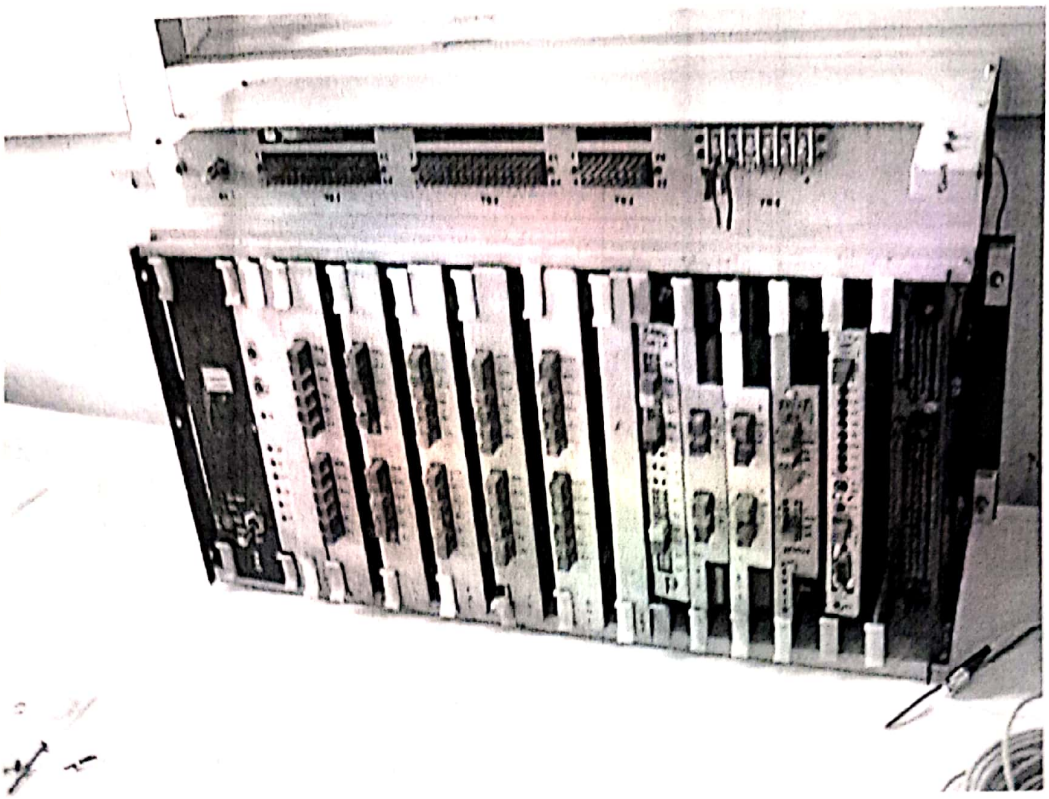


Various types of underground cables such as paper core cable, coaxial cable.



Transmission equipment systems (SDH)

This is underground-cable locator. One componenent (which is standing) generates Radio frequency.
This frequency is induced intothe cable lying under the ground. Using the Detctor (which is lying in the above image) is used to detect the cable. Just walk on the route carrying this detector, you will hear audible sound which cable is present.



30 channel Pulse code modulation equipment which works on Time Division Multiplexing.

भारत संचार निगम लिमिटेड

BHARAT SANCHAR NIGAM LIMITED

(भारत सरकार का उपक्रम)

(A Govt. of India Enterprise)

जिला दूरसंचार प्रशिक्षण केन्द्र

DISTRICT TELECOM TRAINING CENTRE

चेन्नै - ६०० ०५९.

Chennai - 600 059.

INTERNSHIP CERTICIFACTE

Certified that

KOKILA.B

B.E ECE IV YEAR

PERI INSTITUTE OF TECHNOLOGY

has undergone 6 weeks Internship

in BSNL,CHENNAI TELEPHONES

for four sessions from 21.04.2014 to 31.05 2014

The following topics were covered during the programme

- Mobile (GSM/CDMA,2G,3G, Antenna)
- Optic Fiber Systems
- Electronic Telephone Exchange Systems
- Digital Transmission Systems
- Telecom Infrastructure

DISTRICT TELECOM TRAINING CENTRE BSNL CHENNAI TELEPHONES

Date:31st May 2014
Place:Chennai-60059

P. Murugan
(P.MURUGAN)
PRINCIPAL

Registered & Corporate Office Bharat Sanchar [illegible] Lane Janpath New Delhi-110 001

R. Kokila 3/6/14

HOD/ECE

PRINCIPAL

PERI INSTITUE OF TECHNOLOGY

Mannivakkam-48

Department of Electronics and Communication Engineering

COLLABRATION WITH SLN TECHOLOGIES

SLN TECHNOLOGIES

Dear Students,

Greeting from SLN TECHNOLOGIES, Chennai

SLN Technologies has been at the forefront of research and development into the creation of model driven in Software development, embedded platforms, Android Apps, Digitalization and Network security that empower design teams to efficiently create the next generation of software and hardware systems through agile system development methods.

SLN has received recognition from various corporate (HP, HCL, IANT, Red Hat, SYZPRO), institutions and SMEs for innovative/delivery solutions. We have training & development facility in Chennai.

Over the years SLN has transformed the careers of thousands of IT Professionals into core fields.

We are glad to invite your students to share this legacy of excellence in the form of real time experience and become the IT Professional of tomorrow.

SLN Edges

- Towards on technology innovations
- Sharing the real time experience by the experts
- Multiple verticals and student get the opportunity on their interest
- More Focus on employability.
- All our programs towards on student centric

We hereby furnish our Internship details for your reference.

Event	:	Hands on Experience in current requirements
Program Duration	:	15 / 30 Days
Timings	:	As per students Timings.

Domain/Technology/Platform

- CYBER SECURITY & ETHICAL HACKING
- BIGDATA & DATA SCIENCE
- INTERNET OF THINGS
- EMBEDDED SYSTEMS
- ROBOTICS
- NETWORKING
- ADVANCE HARDWARE & NETWORKING
- LINUX
- PYTHON'
- JAVA
- ANDROID
- WEB DEVELOPMENT

Eligible streams : B.E/B.Tech, B.Sc, BCA, B.Com (CA), M.Sc, MCA(all years)

Certification : Individual Certification

Kindly confirm your date and time schedule to freeze our Technical support Team on the day.

To

The Principal
PERI Institute of Technology,
Mannivakkam,
Chennai-600048.

Thanking you,

Warm Regards,
Surendhar – 93808 10 879
Technical Lead
SLN Technologies, Chennai.
Email id: surendhar@slntechnologies.co.in

SLN TECHNOLOGIES REPORT

ABOUT SLN

Since its formation in the year 2006, SLN Technologies has been at the forefront of research and development into the creation of model driven in Embedded platforms, Software development, Android Apps and Network security that empower design teams to efficiently create the next generation of software and hardware systems through agile system development methods. SLN continues to work on next generation design languages and platforms that enable global system level optimization for complex solutions in the area of electronic embedded devices, software integration devices leading to lower cost thereby taking the benefits of technology to rural and value conscious urban markets.

INTERNSHIP

The following students attended the internship with SLN Technologies for one month period in various platforms

- Cyber Security & Ethical hacking
- Bigdata& Data science
- Internet of things
- Embedded systems
- Robotics
- Networking
- Advance Hardware & Networking
- Linux
- Python
- Java
- Android
- Web development

NAME LIST OF THE STUDENTS

1	Aruna T
2	Barathprasanna A
3	Deepa P
4	Govathy S
5	Harikumar K
6	Harish R
7	Jerinpunarviya p
8	Keerthana M
9	Rishi gopikrishnan
10	Vidhyalakshmi V
11	Manoarakhatun
12	Soumyaanand

SLN TECHNOLOGIES

(EMBEDDED SOLUTIONS)

INDUSTRIAL/IEEE/FINAL YEAR PROJECTS

EI/HTSS/GZB/2K14/1468

CERTIFICATE

OF PARTICIPATION

This is to certify that

Ms. DEEPA P

student of PERI Institute of Technology from Department of Electronics and Communication Engineering has successfully completed an Internship with SLN TECHNOLOGIES, Chennai from 1.05.2017 to 1.06.2017 for a period of one month on "Embedded Systems and Real Chip Design"

Co-ordinator

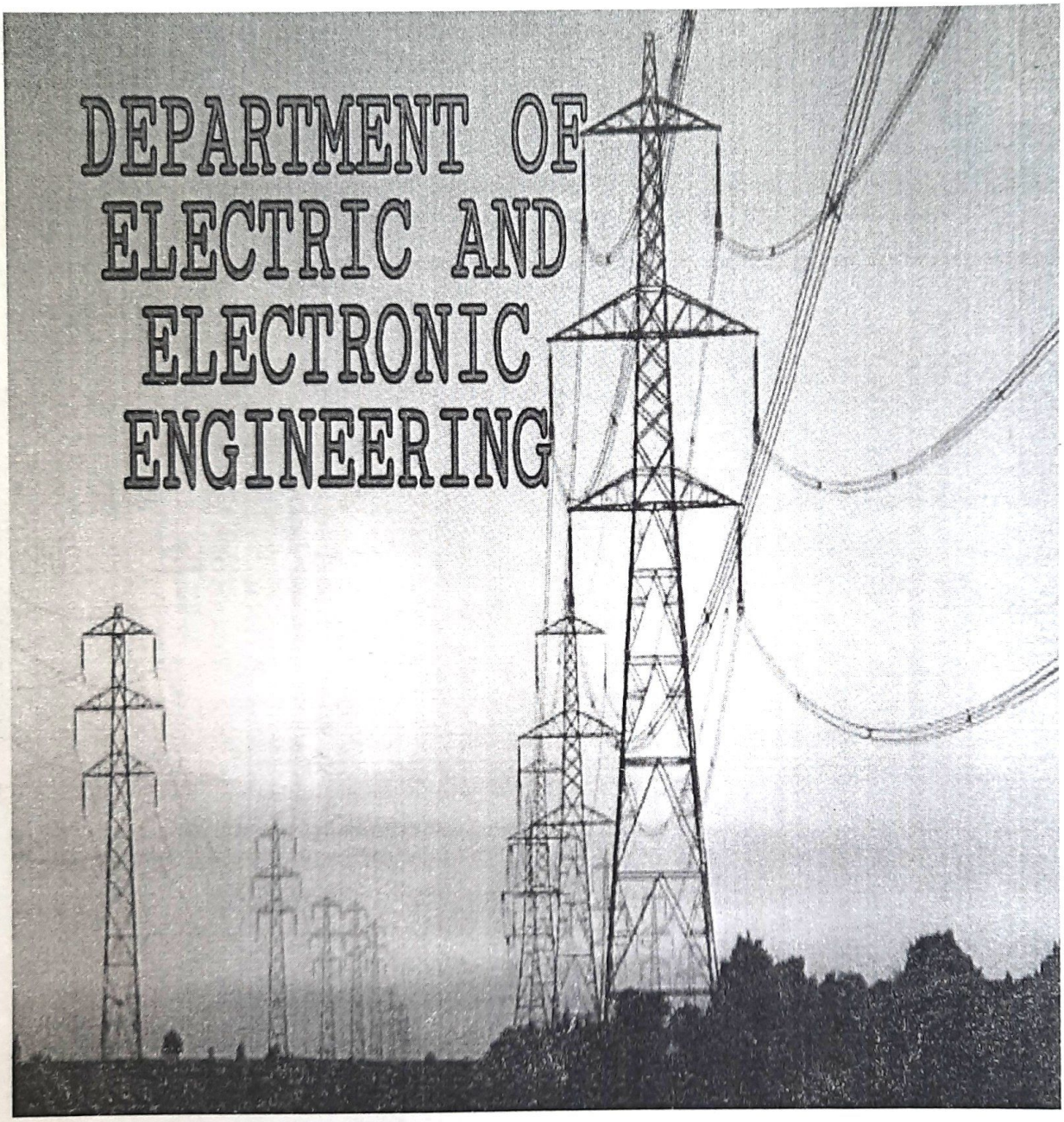
Regd. No U74120DL2008PTC174069

Director

HOD/ECE

PRINCIPAL

INDUSTRIAL VISIT-NLC



INDUSTRIAL VISIT REPORT -NLC

NLC Permission Letter

PERI
EDUCATION

PERI INSTITUTE OF TECHNOLOGY

(Approved by AICTE New Delhi and affiliated to Anna University)
(NO.1,Mannivakkam,West Tambaram,Chennai-600048)

From

Dr.R.Palson kennedy,
Principal,
Peri Institute of Technology,
Mannivakkam ,
Chennai

DATE: 28/08/2019

To

The Chief General Manager,
Public relation,
Public relation department,
NLC India Ltd,
Block-2,
Neyveli-1.

Dear Sir,

Sub: Requesting for Industrial visit for the B.E, "Electrical Engineering" students of PERI INSTITUTE OF TECHNOLOGY, Mannivakkam, Chennai

Greetings from Peri Institute of Technology,

With the subject to the above, On behalf of the management, I request you to kindly accord permission to our B.E **"Electrical Engineering"** students to do their Industrial Visit in your **"Thermal power station"** on 15/09/2019. So kindly do the needful.

Thanking you in advance for your time.

With Regards,

Dr.R.Palson kennedy,
Principal,
Peri Institute of Technology,
Mannivakkam ,
Chennai

Enclosures:-

1. Student Name List
2. Accompanying Faculty's

Date: 28.08.19

Dear Sir,

The Following students are the bonafide students of our college planning for industrial visit to Neyveli Lignite Corporation, Cuddalore, on 15/09/2019.

S.No	REG NO	NAME
1	411516105001	AARTHY S
2	411516105002	BALASUBRAMANI V
3	411516105003	CALEB W
4	411516105004	DHEVADHARSHINI V
5	411516105005	DURAI MURUGAN A
6	411516105006	GURU PRASAD R
7	411516105007	HARIKESH B
8	411516105008	HARISH
9	411516105011	SAM C
10	411516105012	SAMEERAN B
11	411516105013	VASANTH V
12	411516105014	VISHALI R
13	411516105301	JAGADESH N
14	411516105302	MAHADESHWAR S
15	411517105002	ANNEM CHAITANYA KUMAR REDDY
16	411517105003	ARAVIND G
17	411517105004	ARIVARASI A
18	411517105005	ARUN N
19	411517105006	CHANDRU S J
20	411517105007	DEEPAKKUMAR J
21	411517105008	DINESH KUMAR B
22	411517105009	DONALD SANTHURU S
23	411517105010	ESHWAR M
24	411517105011	GIRIDHARAN K
25	411517105012	GOLI SAI SUPRIYA
26	411517105013	ILAVARUNA KARTHIK P
27	411517105014	JAYASRI A
28	411517105015	JEEVITHA S
29	411517105016	KARAN RAJ S
30	411517105017	KEERTHIVASAN C

31	411517105018	MANOJ M
32	411517105019	MOHAMED RIZWAN R
33	411517105020	MONISHA M
34	411517105021	MUKESH S
35	411517105022	NAVEEN KUMAR M
36	411517105023	POOMANI R
37	411517105024	RAHMAN H
38	411517105025	RAJESH S
39	411517105026	RISHIKA P
40	411517105028	RUKMANI V
41	411517105031	SHARON DEVAKIRUBAI B
42	411517105032	SUGAN C
43	411517105033	SWETHA R
44	411517105034	SWETHA S
45	411517105036	VANI D
46	411517105037	VIGNESHWARAN R
47	411517105301	JAGAN
48	411517105302	JESHWANTH
49	411517105304	VIVEK

Faculty ESCORT:

1 S.L.SREEDEVI

2. R.TAMILAMUTHAN

3. A.N.ABHIRAMI

4. J.JOSELIN

NLC Industrial Visit Confirmation Letter

एनएलसी इंडिया लिमिटेड-NLC India Limited
('Navratna'- Government of India Enterprise)
CIN L93090TN1956GO1003507 Website :www.nlcindia.com

Public Relations Department
Block-2, Neyveli-607 801, Cuddalore District, Tamil Nadu
e-mail :pr.dept@nlcinda.com, pro.nlc57@gmail.com Tele Fax : 04142- 252257

Lr.No.264/Visit/PRD/2019 Date: 19/09/2019

To
The Principal,
Peri Institute of Technology,
Tambaram,Mannivakkam,
Chennai-48.

Sub: PRD – Visit to Industrial Units – Confirmation – Reg.

Ref: Lr. received dt. 04.09.2019.

We are in receipt of your letter dated: 04.09.2019The group of visitors from your Institution are permitted to visit **Mine-I &TPS-I Expn. only.** on **18/10/2019.** Please advise them to contact /the Public Relations Dept., (Near Nehru Square), Block-2, Neyveli /Township – 607 801 at 9.30 A.M.

The visitors/students are requested to bring their **Identity Card** along with TWO COPIES OF NAME LIST during their visit to Neyveli. **In case of foreign students please attach passport size photo's 2 No's and two copy of passport and registration certificate /Residential Permit [RC/RP],From 'A' [Rule 6]issued by BUREAU OF IMMIGRATION M.H.A Govt. of India,one week before.** Cell Phones with Cameras / Still Cameras / Video Cameras are strictly prohibited inside the Industrial Units.

We request you to arrange your own conveyance/accommodation during the visit.

Thanking you,

Yours faithfully,
for NLC India Ltd,

19/9/19
Chief General Manager/HR
General Manager / P.R
NLC Limited
Neyveli - 607 801

पंजीकृत कार्यालय : प्रथम तल नं.8, मेयर सत्यमूर्ति रोड, एफ.एस.डी, एग्मोर कांप्लेक्स, भारतीय खाद्य निगम, चेतपेट चेन्नै - 600 031.
REGD OFFICE 1st Floor, No.8, Mayor Sathyamurthy Road, FSD, Egmore Complex of Food Corporation of India, Chetpet, Chennai - 600 031
CORPORATE OFFICE: BLOCK-1, NEYVELI - 607 801, CUDDALORE DISTRICT, TAMILNADU.
निगमित कार्यालय: ब्लॉक -1 नेयवेली – 607801. कडलूर जिला, तमिलनाडु

PERI INSTITUTE OF TECHNOLOGY MANNIVAKKAM CHENNAI-48
PERI-IT FEE DEPT

Dr.N. FALSON KENNEDY, M.E.,
PRINCIPAL
PERI INSTITUTE OF TECHNOLOGY
Mannivakkam, Chennai-600 048.

ABOUT NLC

The department of Electronics and communication made its maiden industrial visit to NLC-Neyveli Lignite Corporation, a public sector which is into lignite mining and power production for the past half a century .Neyveli, located in the suburbs of Chennai is the heart of power which caters to the needs of power hungry southern states of India. The trip began in comfy buses of two at the crack of the dawn. It must be added with the deep thought that the visit was a runaway hit with the students as even the most complacent ones made it much to the astonishment of the lecturers. The mines-site of the lignite excavation was first shown to us through the visitors gallery, a spell bounding view spread over an area of roughly 16 sq km, It seemed to be a testimony to the still existing Indo-German tech ties. Its estimation annual production of 17 million tones is dug out using German excavation technology by means of excavators, conveyor belts, etc and of course with the workforce of whopping 8000-9000 miners. Not only did the mines supply the required load to the power plants but also to the several fertilizer and carbonization Plants .

The second to come was the Thermal power plants, old and new ones. An Indo-German obelisk greeted us at the entrance. The coal crushing and grinding units, the coolant units and ground water managing systems were quite impressive. Scaffolding like structure looking magnificent on the outside housed the power generating room. This plant put together with other newly commissioned plants has an aggregate capacity of 2070 MW. Inside the power generating room the surrounding temperature is a scorching 46 deg due to the high temperature steam that is used to rotate the huge shaft of turbines. This power station has seen many firsts-first lignite powered station in South East Asia, first largest thermal power in South India and so on. With that came the end of our first Industrial Visit. This trip how informative was it is another issue but it was exhilarating, rollicking fun for sure. Finally, the editorial board extends its thanks to the students, lecturers and the office bearers of the association for making this industrial visit possible.

NEYVELI LIGNITE CORPORATION

14.11.1956 Pt.Nehru launched a mining operations with his golden touch in May 1957. Even since, there has been no looking back. NLC has achieved the objectives it has set for itself. Fulfilling its corporate mission to be the leader in the industry. Computing of two open cast mines, two pit head Thermal Power Stations, Briquetting & Carbonisation plant and a Fertilizer Plant, NLC's growth is sustained and its contribution to India's social and economic development is significant.

MINES - I

Demarcated over an area of 16.90 Sq.km. with a reserve of about 287 million tones. Mine-I is situated on the Northern part of the field adjacent to the Neyveli Township. Its production (6.5 million tones of lignite per annum) feeds Thermal Power Station-I, Briquetting and Carbonisation Plant and the process Steam Plant.

MINES - II

Mine – II is located 5 Kms. South of Mine-I spread over an area of 26 sq.kms. With 398 million tones reserve. The lignite seam was first exposed in September 1984 and regular lignite mining commenced in March 1985. The maximum overburden is 103 m. and the lignite thickness varies from 8 to 22 m. Initially, the mine was started with a production capacity of 4.7 million tones and in February '83 the capacity was enhanced to 10.5 million tones per annum. The lignite production in this mine meets the fuel requirement of Thermal Power Station-II.

THERMAL POWER STATION - I

An opitome of India-Soviet collaboration, Neyveli-Thermal Power Station-I (TPS-I) was commissioned with one unit of 50 MM each and three units of 100 MM each.

The unique features of this power station.

First lignite-fired Thermal Power Station in South East Asia

First pit head Thermal Power station in India

First largest Thermal Power station in South India

Continuously achieving over 70% plant load factor, from 1982-83 to 1991.92 against the national average of around 50% and has continuously bagged the meritorious productivity award instituted by the Department of Power, Government of India.

The power generated from The Thermal Power Station is fed to the grid of Tamilnadu Electricity Board, the sole beneficiary.

THERMAL POWER STATION - II

Thermal Power Station-II (TPS-II) has been a major sources of power to all Southern states in India.

The first unit was synchronized in March 1986. The second Unit of this Power Station was formally commissioned by the then Prime Minister Shri. Rajiv Gandhi. This Power Station has been series of technological innovations such as

Largest Lignite-fired thermal power station in India.

First and tallest town type boiler in the country (92.7 m. height)

First software based burner management system

First Hydrogen/hydrogen cooled generator of this size

First boiler to be cleaned by hydrofluoric acid

Steel structures used for the power house building

124 Meters natural drought cooling towards.

FERTILIZER PLANT

This Plant with a production capacity of 1,29,200 tons of Urea per annum, was commissioned in 1966. This plant is the first of its kind in India to adopt solid fuel

gasification for synthesis gas production and in 1979 the plant replaced the fuel stock lignite with fuel oil.

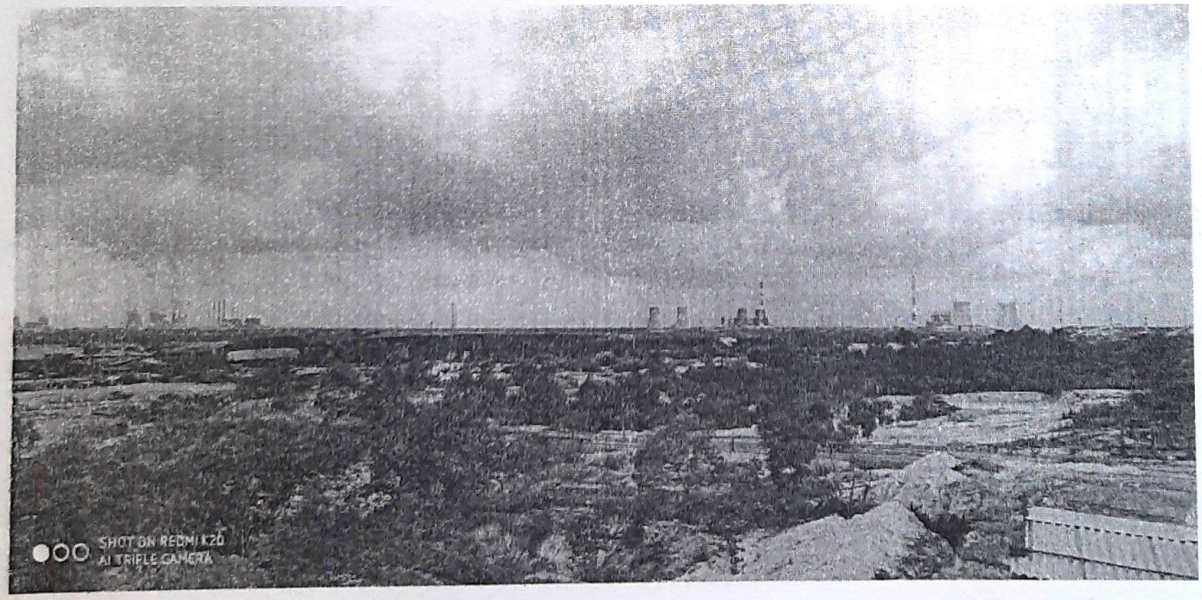
BRIQUETTING & CARBONISATION PLANT

The B & C plant with production capacity of 2,62,000 tones of coke was commissioned in 1966. The plant produces coke from lignite which is sold under the popular trade name 'LECO'. The coke produced in this plant is extensively used in the industrial sector because of its special properties.

Generally mining is of two types

- Open cast
- Under ground

If the soil is loss in nature so open cast method is used. It consist of 3 mining sector and all those 3 sector has two mines. 1th mining sector consume 230MW, 2nd mine consume 450MW, 3ed mine consume 1000MW. Thermal power station consume3240MW of energy. In mining process the Stacker machine is used to extract Lignite and the Splender machine is used to extract the sand. For this operation process almost 7k crore is required per year.



NLC IV REPORT

Report of the Industrial visit to "NLC India Ltd." at Neyveli On 18.10.2019 – Reg.

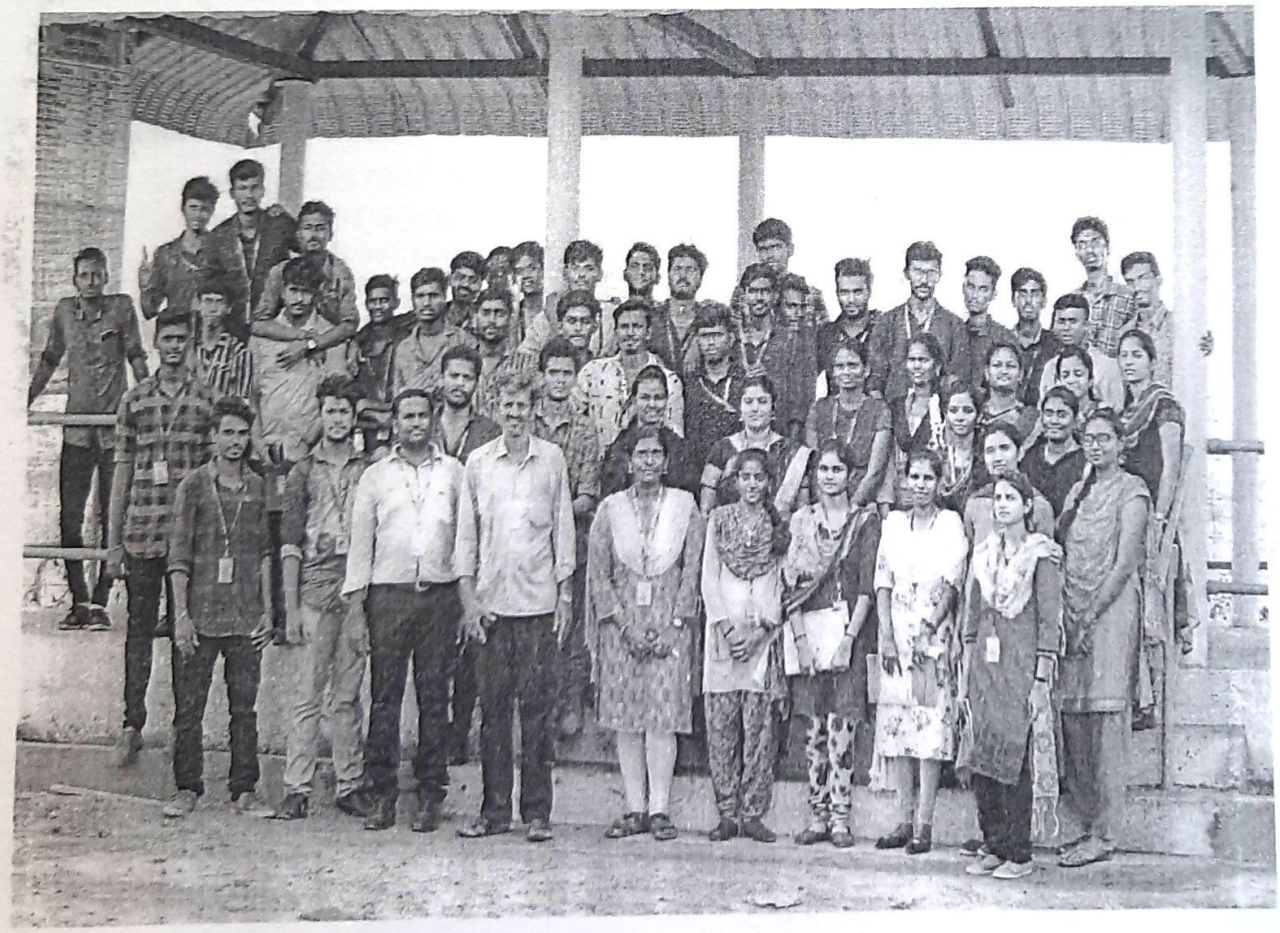
Permission was accorded for Third Year EEE and Final Year EEE Students to NLC India Ltd. at Neyveli On 18.10.2019, 49 students visited the industry.

Students got exposure towards,

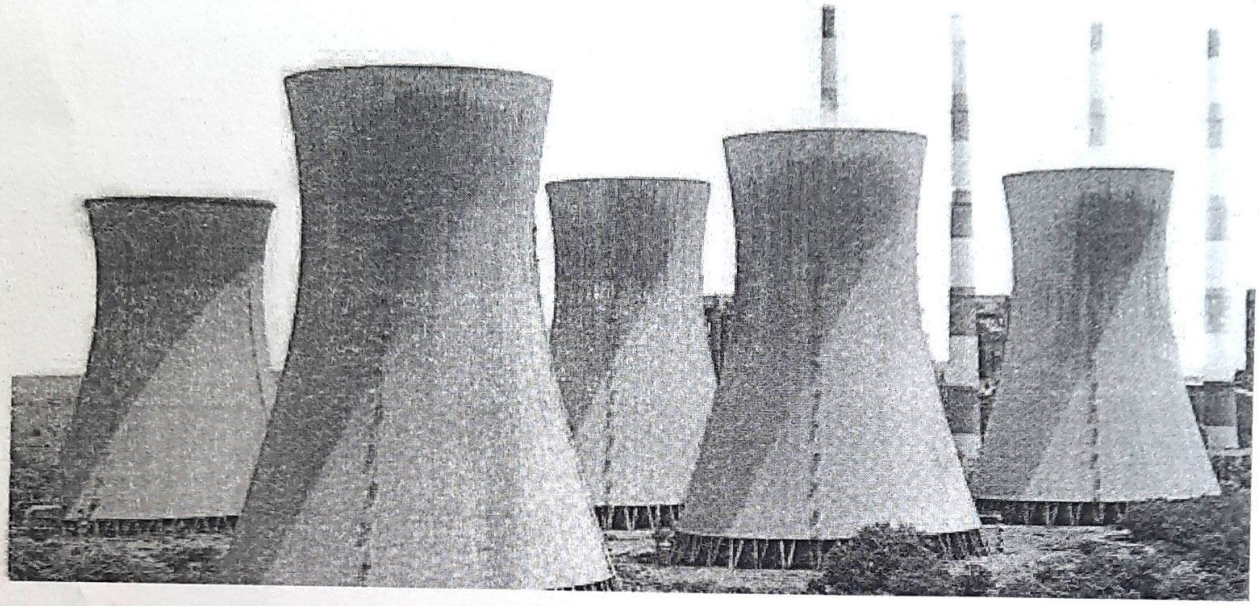
- Lignite Mining.
- Thermal Power Generation.
- Solar / Wind Energy Generation.
- Coal Mining.
- Organic/Bio Farming.
- Herbal Plantations/Gardens.

The following faculty accompanied the Students for the Industrial Visit,

- Mrs.S.L.Sreedevi, Assistant Professor -EEE
- Mr.Tamilamuthan, Assistant Professor - EEE
- Ms. Abirami. , Assistant Professor- EEE
- Mrs. Joshlin, Assistant Professor-EEE

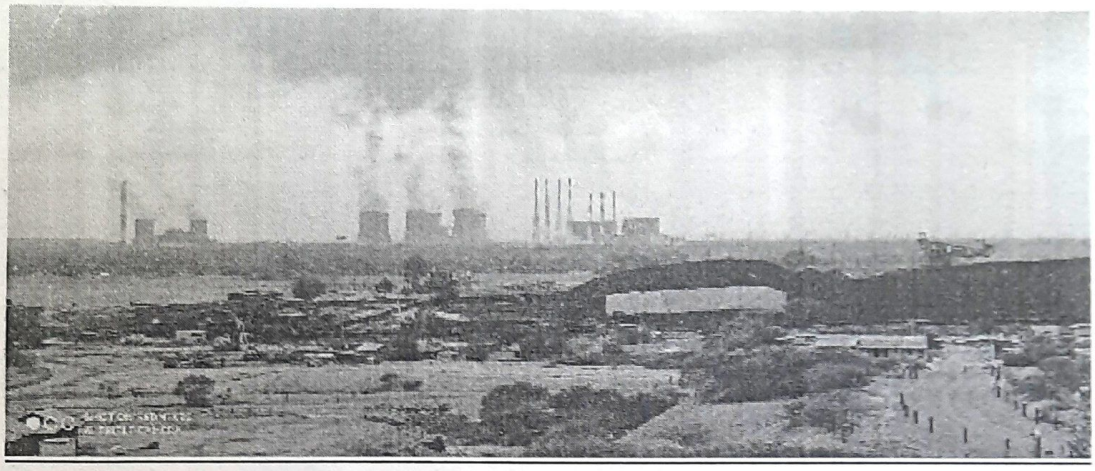


The industrial visit is associated by EEE staffs Mrs.S.L.Sreedevi , Mr.Tamilamuthan , Ms. Abirami and Mrs. Joshlin - of PERI IT. Junior Engineer Mr. Krishna gave a detailed explanation about the site and the on-going process in the plant.



The 1470 MW Second Thermal Power Station consists of 7 units of 210 MW each. In February 1978, Government of India sanctioned the Second Thermal Power Station of 630 MW capacity (3 X 210 MW) and in Feb.'83, Government of India sanctioned the Second Thermal Power Station Expansion from 630 MW to 1470 MW with addition of 4 units of 210 MW each. The first 210 MW unit was synchronised in March 1986 and the last unit (Unit-VII) was synchronized in June'93. The power generated from Second Thermal Power Station after meeting the needs of Second Mine is shared by the Southern States viz., Tamil Nadu, Kerala, Karnataka, Andhra Pradesh and Union Territory of Pondicherry.

NLC COOLER



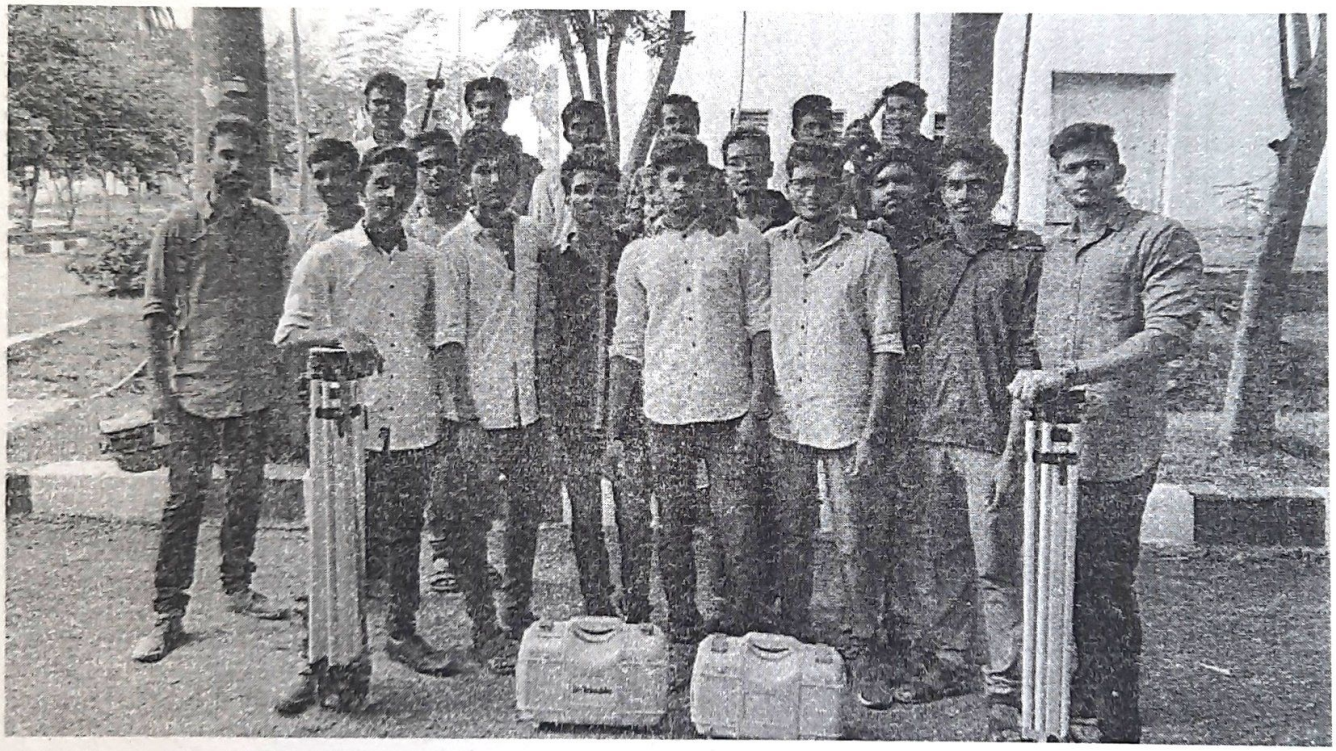
NLC PLANT VIEW

In NLC, the Junior Engineer Mr. Krishna gave a detailed explanation about the site and the on-going process in the plant. The installed plant capacity is 2,740 MW. The plant receives the coal from Mines 1 and Mines 2 in Neyveli. The coal used is lignite which has more amount of ash content. The coal is transported through belt conveyor before getting it to the boilers. Students had a look at the pre heating process and the types of fans used for the cooling process. The plant engineers also explained about ash handling and ash filtration processes. The exhaust gases and the fly ash are passed through a chimney constructed at a standard height of about 275 m. The super heated steam (540°C) is sent to the turbine of 3 types: high pressure turbine, medium pressure turbine and low pressure turbine. Turbo alternator is present on the same shaft where turbine is present. Turbo alternator runs at a rated speed of 3000 rpm. The overall process is monitored and controlled by PLC programs. The power produced is then connected to the power grid through switch yards. Switch yard is comprised of circuit breakers, isolators and step up transformers. Switching transformers are used during emergency times (plant shut down) to get power from the nearby power station. The communication is done using wave-traps in the power line.

October 18 2018

SURVEY CAMP

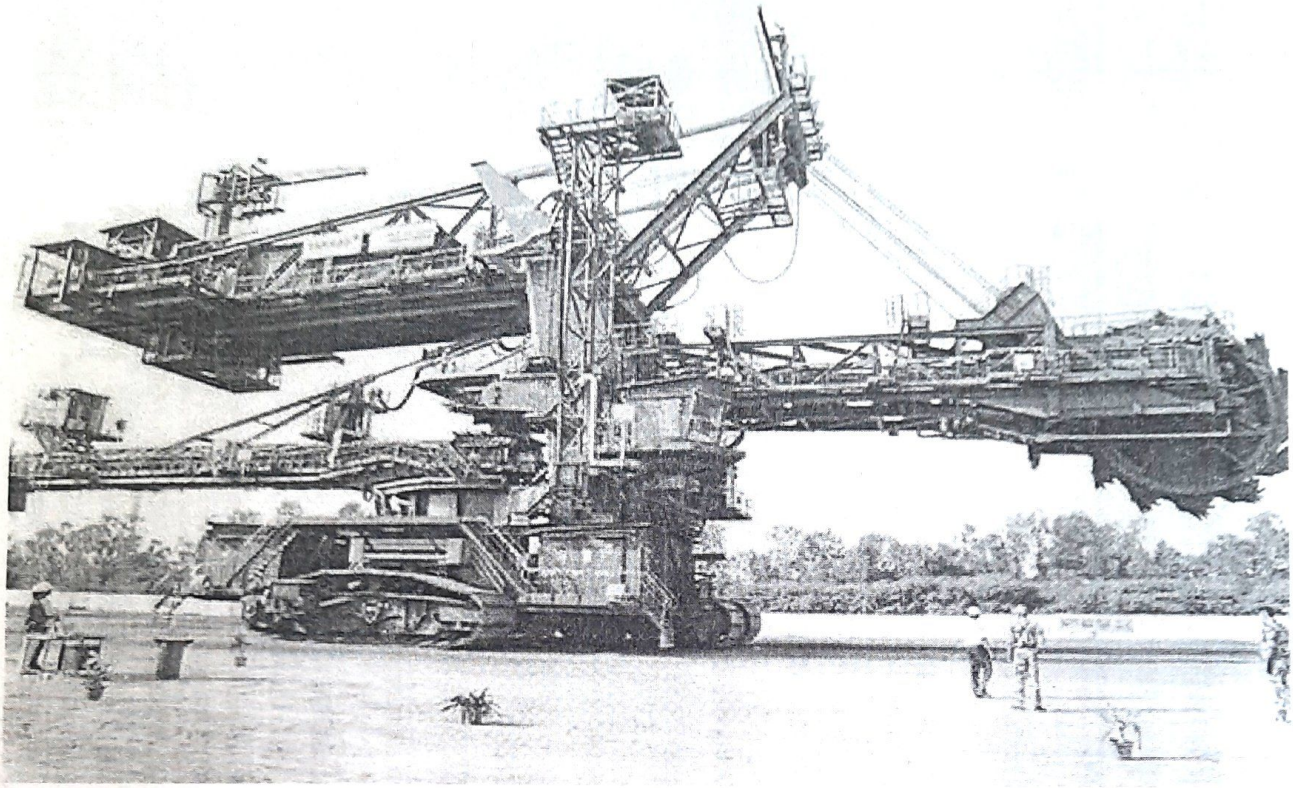
Survey camp was conducted for the students of III Year Civil Engineering students about a period of 3 days from 18.10.18 to 20.10.18. Various experiments were conducted pertaining to the syllabus as per Anna University Regulation 2013 and the students were benefitted by conducting experiments.



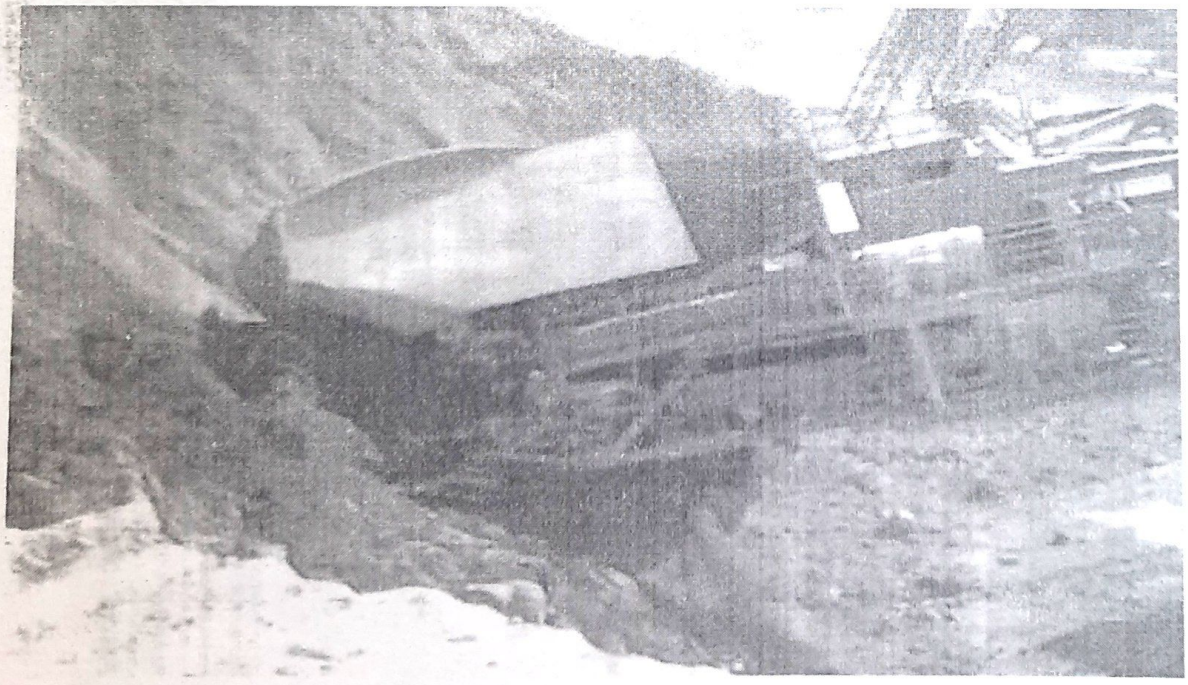
Implementation of the knowledge obtained through the curriculum by studying various topics were done by carrying out the experiments in real-time scenario.

The theoretical background, methods of carrying out the experiments and its practical applications in field using Total station was rendered and delivered to the students by trained professionals from ALG Institute of Technology who graciously accepted our request to teach our students in this regard.

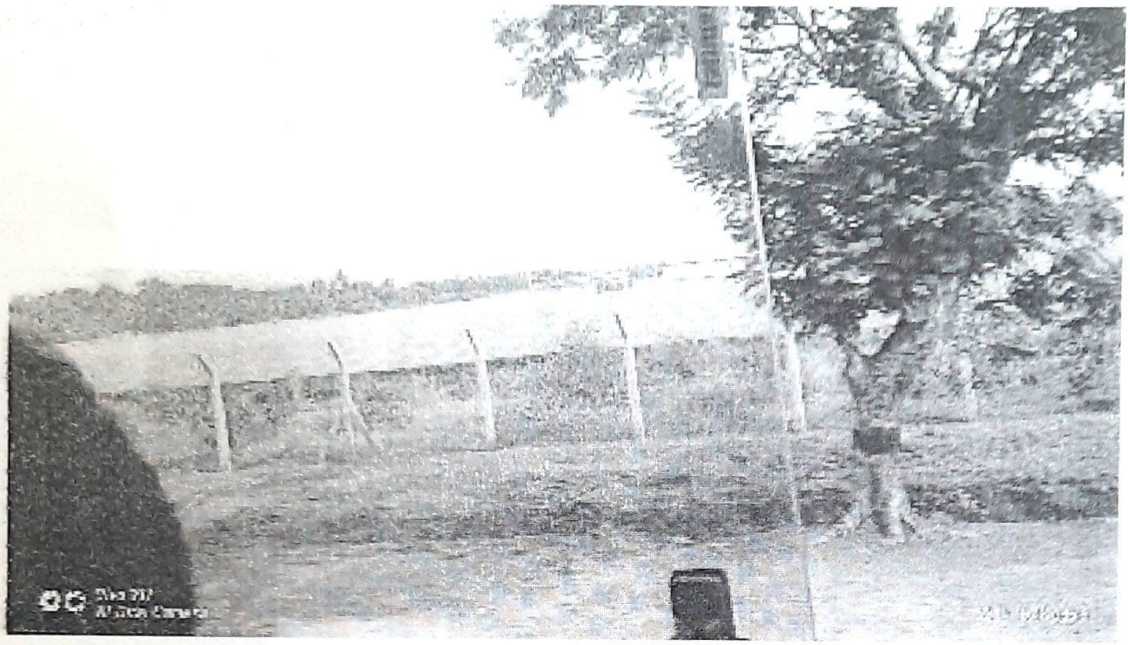
Day 1:



68 CRORE BUCKET- WHEEL EXCAVATOR



NEYVELI MINE CUTTER



NLC SOLAR PANEL

NLC MINE

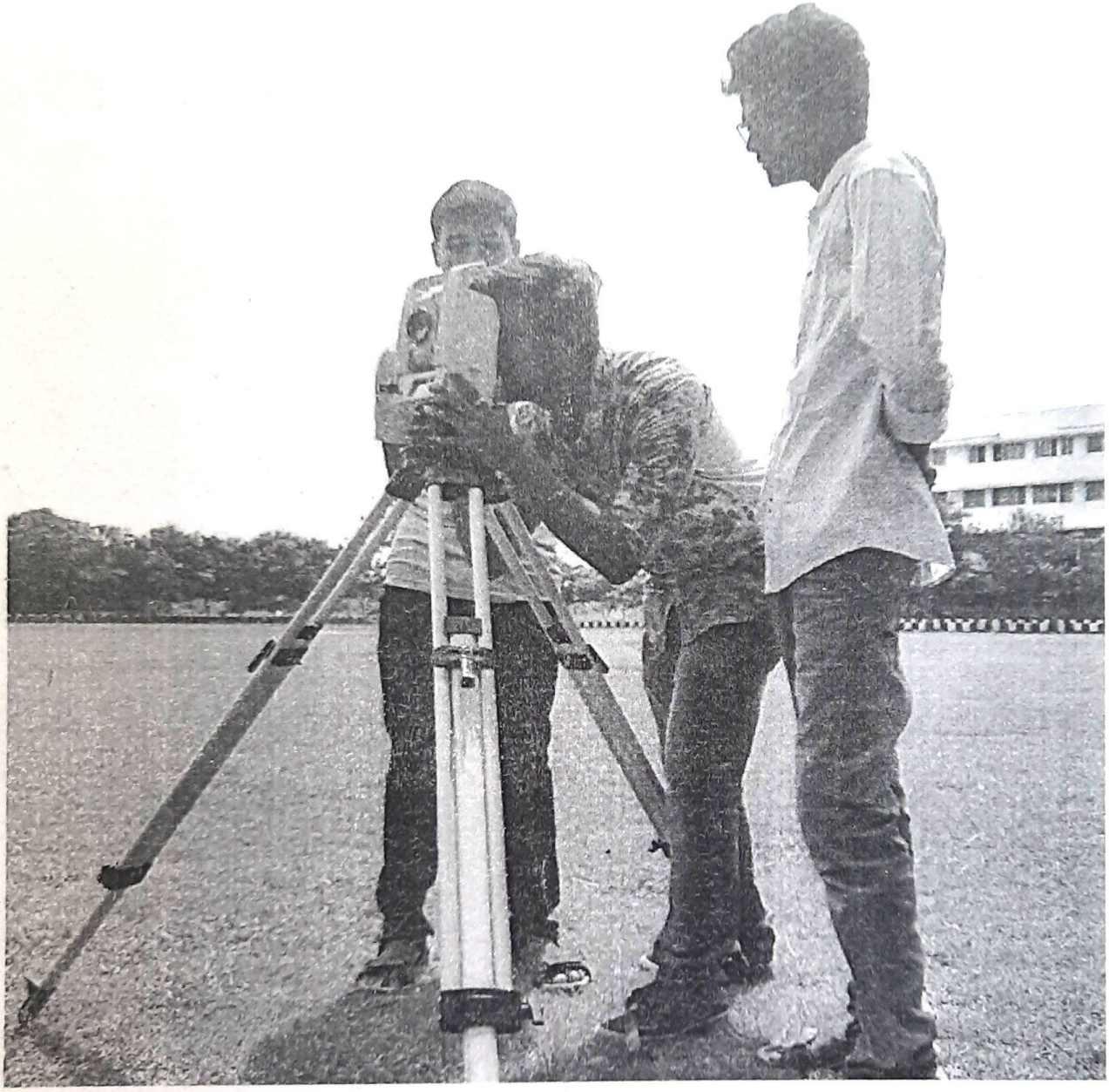
The introduction on ALG International Institute of technology and their services were briefly given to the students by Mr. G. Christyan and Mr. D. David Blessington. The session included paper presentation about Surveying and Equipments.

Prologue on Total station survey about its parts, functions and operations were dealt during the session which included details about Total station instrument setup and levelling, plotting the points on the surface by individual and team, capturing the prismatic level points these are the practices done on this day.

Day 2:

Crosssection and longitudinal section on ground surface were conducted.

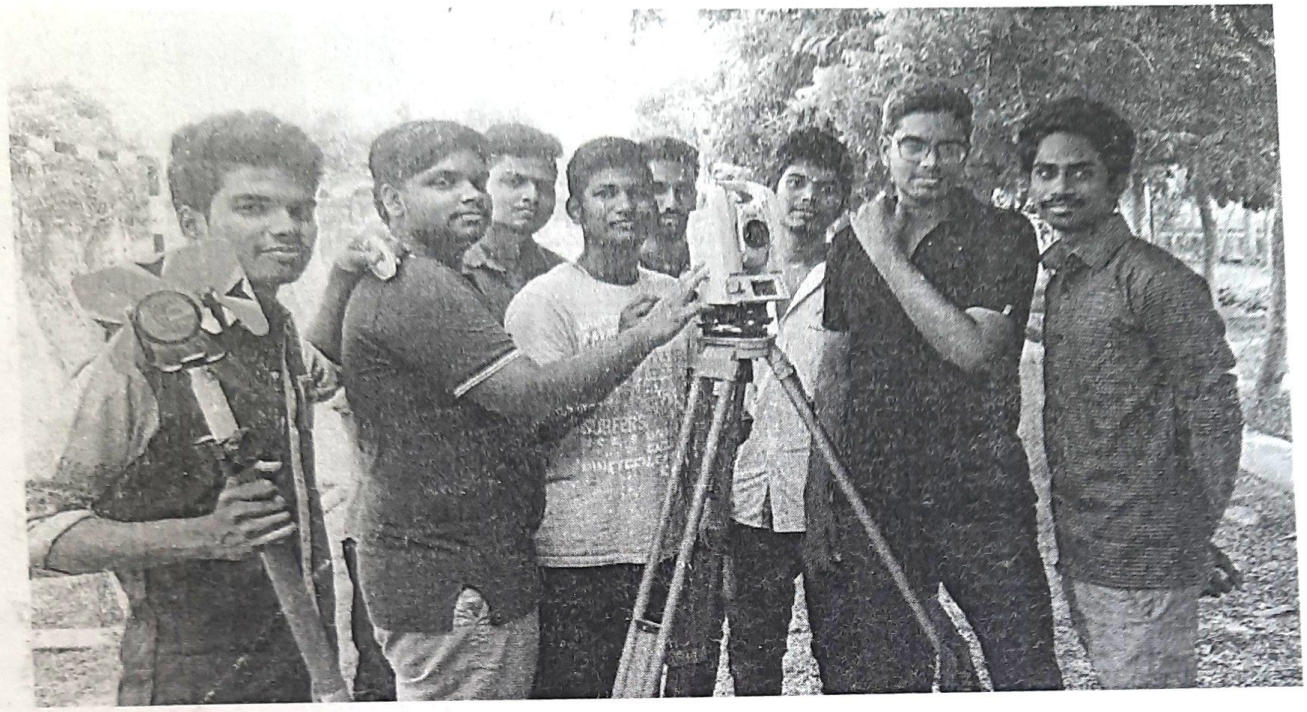
Calculation of area by triangulation method and find out the Stake out points in the field (missing points) were done.



Day 3:

Fly leveling and Grid countering session and importing and exporting the points from total station to computer software (AutoCAD) were discussed during third day of survey camp.

Calculating the height of the building and offset marking with basic column markings were the key points pondered through this experiment.



On behalf of the students and staff members of Civil Department, we hereby extend our sincere gratitude to the management, our COO, the Principal of our Institution for giving us the opportunity to conduct the survey camp in our college premises.

We extend our immense gratitude to our beloved Head of the Department, Mr. B. Magesh, for accepting our request and granting us the permission to conduct the camp during the requested period.

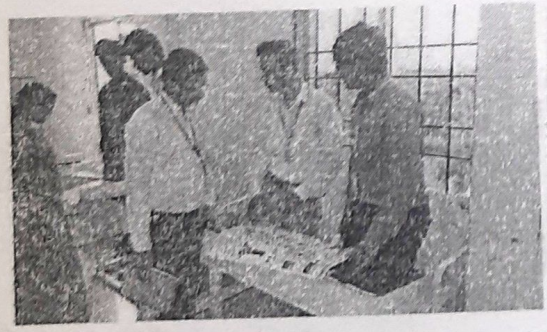
PERI INSTITUTE OF TECHNOLOGY
MANNIVAKKAM
CHENNAI-48

Dr.R. PALSON KENNEDY, M.E.,Ph.D.,
PRINCIPAL
PERI INSTITUTE OF TECHNOLOGY
Mannivakkam, Chennai-600 048

July 8, 2017

DEPARTMENT OF CIVIL ENGINEERING POSTER PRESENTATION

In our department Sustainable Development Society (SDS) was inaugurated to make the students to involve in developing Green India. Under SDS cell poster presentation event was organized on the topic of "Green Technology and Sustainable Development" for our students to enrich their knowledge and to expose their talent. The competition was conducted on **July 8th 2017.** Many students eagerly participated in the event and showed their interest towards the event. Around **14 teams (28 students)** were participated in the event. A panel of 3 members judged the event. Also Head of the Department from various departments joined the occasion and made the event more grandeur. Among the 14 teams, panel members selected 3 teams as winners. **1st prize** was awarded to **Subash and Sasi kumar of III 'A' sec** who did presentation in the title of **"Ground water Improvement". 2nd prize** was awarded to **Surya and Sharvesh of III A sec** who did presentation in the title of **"Sustainable Transportation"** and **3rd prize** goes to **Thangamuthu and M.Vignesh of Third year 'B' Sec** who did the presentation in the title of **"Green technology and Sustainable Development".**



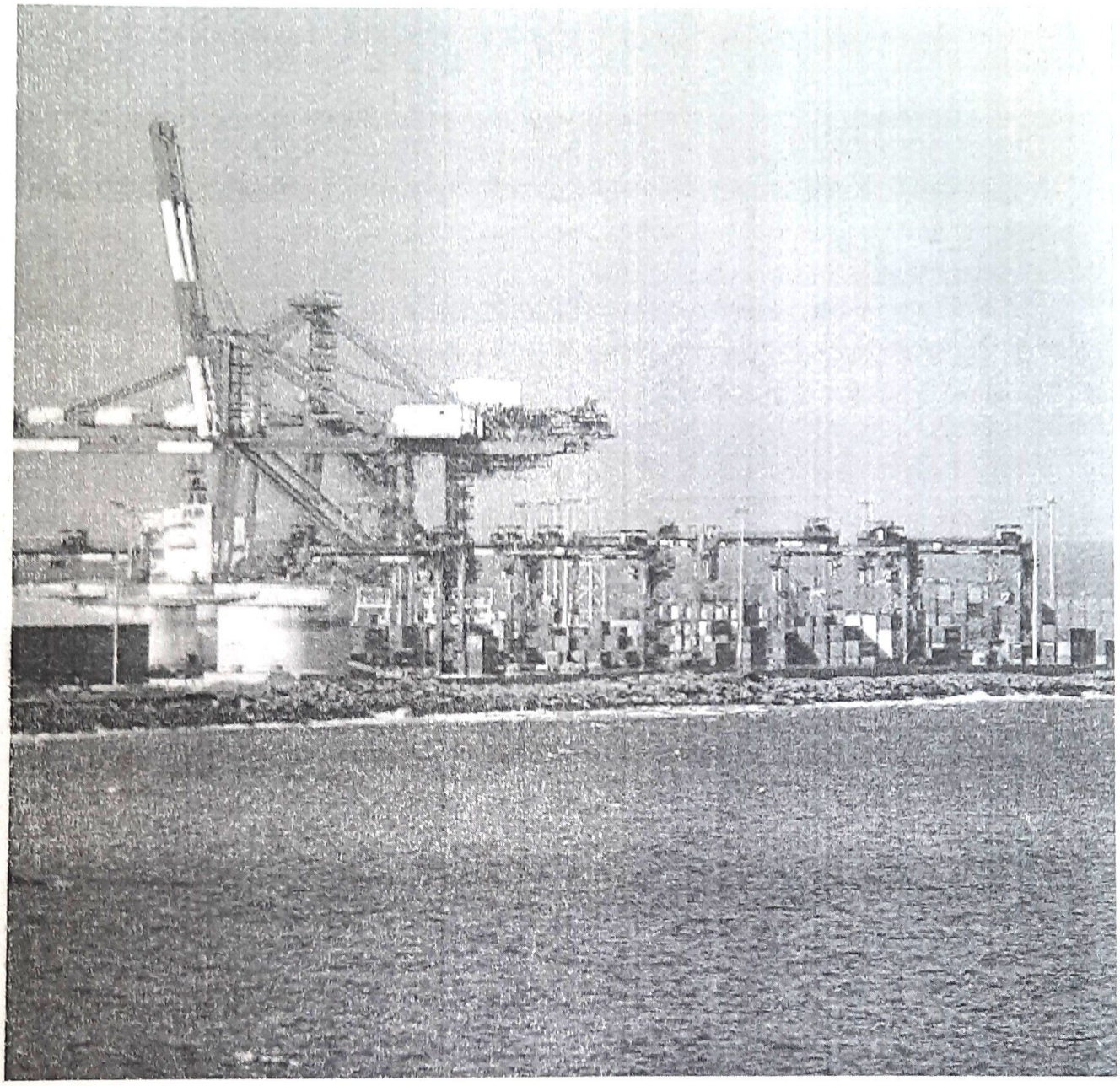
HOD's of Other Department are Visiting
our Civil Students Poster Presentation

June 11,15 2018

In plant training Report Chennai Port Trust

One of the prime focuses of Department of Civil Engineering is enhancing the technical skill set of the students by Acquiring practical knowledge through industrial trainings and visit. We always thrive to accommodate the versatile functioning of Civil Engineering. As a part of these students have been encouraged to visit various functioning areas of Civil engineering such us Metro rail airport, harbors and other construction sites. One such visit has been arranged and six of our students were attending the training at the Chennai port Trust from June 11 th to June 15 th 2018.

Chennai port is situated on the Coromandel Coast in South-East India, the port of Chennai has more than 100 years of tradition. Strategically located and well connected with major parts of the world, it is today the hub port on the Indian subcontinent.



Day 1:

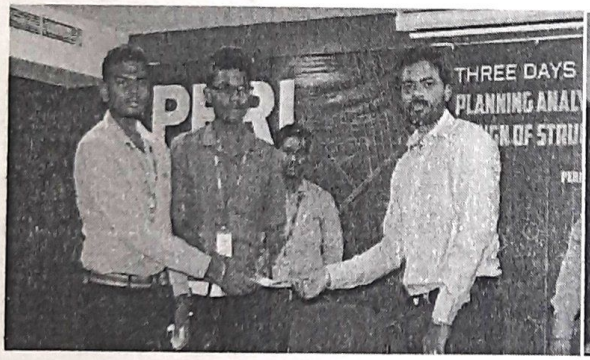
The Students were reported to project design office at 9.45 am and Mrs. Jayalakshmi (Assistant Executive Engineer) explained about the operations of project design. Also, she presented about the natural harbors like Goa, Mumbai, Visakhapatnam out of 12 major ports and the difference between them. She explained about docks, berth, fenders, breakwater, bollards, groynes, tetrapod's, rubbles and their functions.

DAY 2:

Panel Members Valid the Poster PresentationStudents Displaying the posters on SDS at Peri Delta

WINNERS

Our Chief guest Er. Gnansekaran, Our Principal Dr.R.Palson Kennedy and Head of the Department Mr.B.Magesh Presented Cash Rewards for the Winners



1st prize - Sasi Kumar and Subash (III year A sec)

2nd Prize - Surya and Sharvesh (III year A Sec)

3rd Prize - Thangamuthu and M.Vignesh (III year B Sec)

The Students were reported to Railway division at 7.30 am and Mr. George (Assistant Executive Engineer) explained the construction of rail tracks and other ongoing projects like expanding railway track network in yards and replacing the old rails and sleepers.

Day: 3

The Students were reported to the Environmental Cell of Chennai Port trust at 9.30 am and Mr. Saravanan (Assistant Executive Engineer) history, concepts and functions of

Environmental Cell. In Environmental Cell, they will monitor the ambient air quality, potable water quality, marine water quality, noise level, wind speed and temperature.

DAY 4:

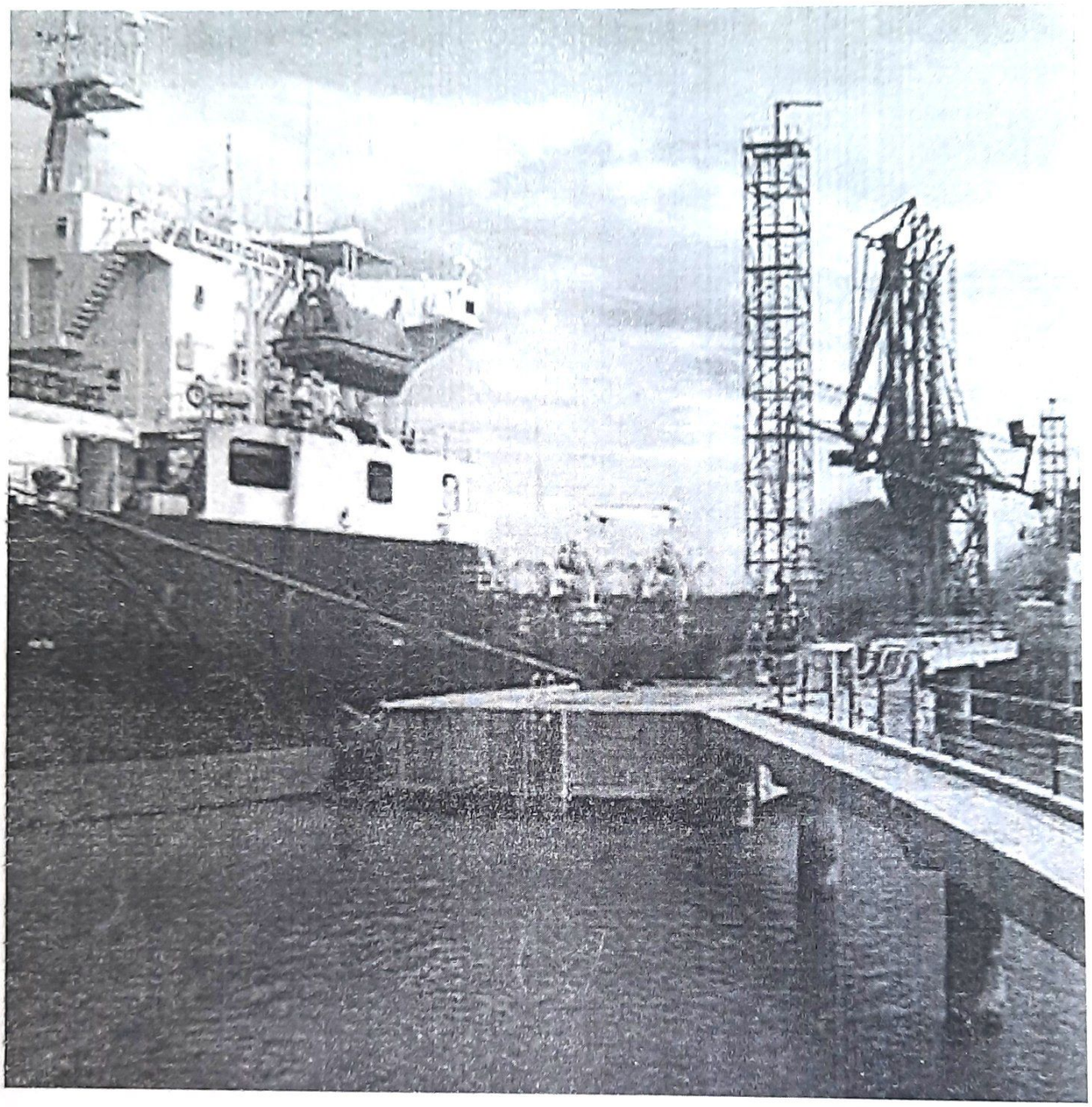
The Students were reported to EX (C) P1 by 9.00 am and Mr. Sekar (Assistant Executive Engineer), who took us to the site inside the harbor and showed us the plan of costal berth construction and explained the concepts and work behind it.

The students were permitted to enter the Site observed the pile construction in sea water, reinforcement details of piles, the method of pile driving, auger boring, in-situ beams.

DAY: 5

The Students were reported to Northern division at 9.00 am and Mr.Gunasekaran (Assistant executive engineer), who took them to the site and explained about the oil docks and its transportation and how it is stored and collected by the owners.

As it is on the north side, it is named as northern division here the loading and unloading of oil and fuels are carried on.



STUDENT CORNER

This in-plant training gives us more practical knowledge about tender works, working with harbor departments, construction of berths, storage yards, railway lines and other civil engineering on-site encounters with practical difficulties.

We also obtained knowledge about the heavy equipment's used for construction, method of constructing piles in sea water.

We had an exposure to real time works and advanced methodologies and equipment's used for construction.

We had a good experience in Chennai port trust which was committed to efficiency through innovation, the four cornerstones of the port will see much growth in the years to come. Continuous modernization, efficient services at minimum cost, simple and integrated procedures, and user-friendly approach.

Thus, this training was very helpful for us to get practical knowledge & field experience and we sincerely thank Head of the Department of civil engineering -Peri institute of technology for giving permission to the training and for supporting us.

N. Boomiga, M. Dinesh, C. S. Jaya, S. Kamesh, R, Lokesh & R. Ramu

REQUISITION LETTER

10.5.2017

To

The HR Manager –HR department,

NORTH CHENNAI THERMAL POWER STATION ,

Thiruvallur District,

Tamil Nadu 600120.

Respected Sir,

Sub: 4115- PERI Institute of Technology, Chennai - 48 – Permission Request for In plant training – Reg.

PERI Institute of Technology is affiliated to Anna University, Chennai and approved by AICTE, New Delhi. There are about 2000 students studying in Five UG courses and four PG courses.

As part of academic program the students have to visit industrial establishments concerned with the relevant branch of engineering to enhance their practical knowledge.

In this connection, IV year students of Electrical and Electronics Engineering are keenly interested to get a training from North Chennai Thermal Power Station to update their practical knowledge and exposure. So kindly let us know whether it would be convenient to plan an in plant training for our students to your organization during the second week of june 2017 according to your feasibility. We will be grateful to you, if you could kindly give us positive response on the same at the earliest convenience.

Please find below the details

1. Total No. of Students likely to visit your organization - 4

ACCEPTANCE LETTER

To

The Head of the Department,
EEE Department,
Peri Institute of Technology,
Mannivakkam,
Chennai 600048.

Subject: Confirmation of inplant training:

Respected Sir/Madam

Referring to your letter of inplant training in North Chennai Thermal Power Station (NCTPS) to your students, we are glad to accept the proposal of yours. Then I hereby confirmed that you can visit our campus on 12/6/2017 at about 9.00 a.m. Then this training will continue up to 16/6/2017.Totally five days of training will be given to the particularly selected students.

Looking forward to see you all.

Best Regards
Mr.V.Vasanthkumar
General manger

PERI
INSTITUTE OF TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Class : IV Year B.E. EEE

S. No.	Reg.No.	Name of the Student
1	411514105018	LAVANYA E
2	411514105031	RAJESH P
3	411514105004	BALAMBIGAI M
4	411514105024	MOHAN DASS C

INPLANT TRAINING REPORT

BALAMBIGAI M, LAVANYA E, MOHAN DASS C and RAJESH P of final year EEE students attended Inplant training during the period of 12.06.2017 to 16.06.2017 at NORTH CHENNAI THERMAL

POWER STATION (NCTPS).

They visited **Model Room And Demineralization Plant, Meter Relay Testing (MRT),Electrical Maintenance I, Internal Coal Handling System (ICHS) & External Coal Handling System (ECHS)** and learnt lots of information about Generation ,Transmission and Distribution of power supplies.

Students Opinion. It was a great experience to visit NCTPS - Chennai ,where we had learned so many new things in the field of

Electrical Engineering. They are successful enough to balance between Theoretical and Practical Subject.

INTERNSHIP PROGRAMME

DINESH KUMAR.M, MERCY PETRICIA M,YOGEETHAS and S. KEERTHANA of third year EEE students attended 5 days from 26-07-2017 to 30-07-2017 at UNIQ

technologies, Chennai.

During the training period ,they were knowledged on microprocessor and microcontrollers and designed some programs on 7-SEGMENTS,COM, ANODE and CATHODE using PIC 16F877A. They also assigned a mini project called SMART TRAFFIC SIGNAL using Peripheral Interface Circuit [PIC] in Embedded systems and HOME automation system.

Students Opinion:

It was a great experience, very interesting, informative and a grant successful training. Being Electrical Students, we gained a practical knowledge.

INDUSTRIAL VISIT- Neyveli Lignite

Corporation India Limited (NLCIL).....!!!

Third year EEE students ,went on an Industrial visit to NLCIL on On 11th August 2017. They were provided with visual knowledge on MINING processes and ELECTRIC POWER GENERATION in Lignite Based Thermal Power Stations.

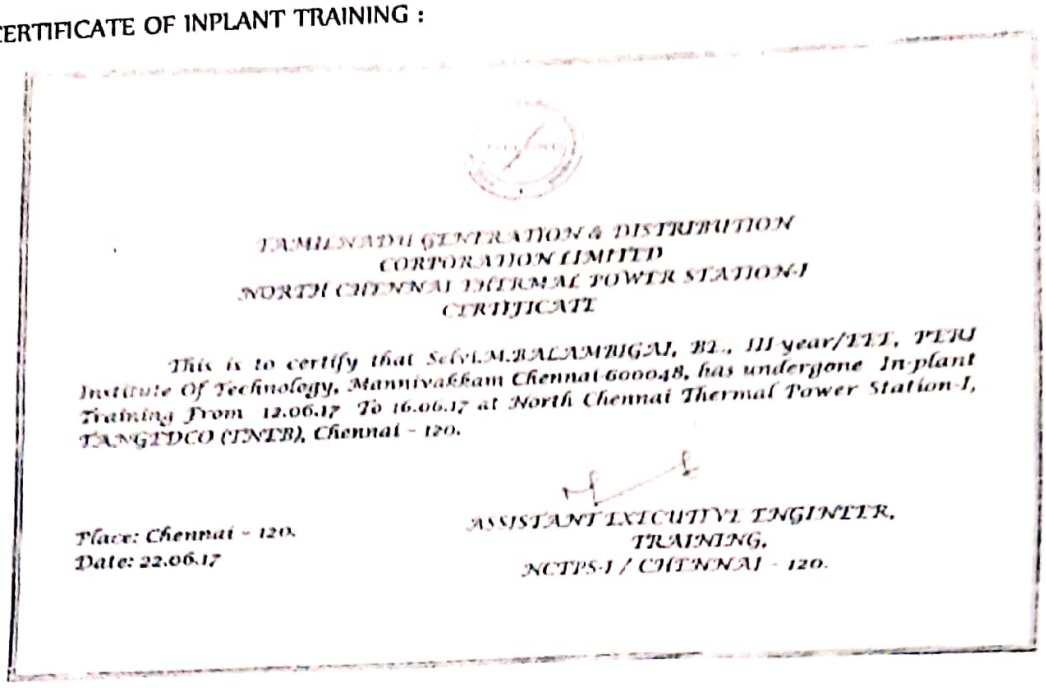
They visited the following places .;

- *MINE – I having capacity of 10.5 MTPA*
- *THERMAL POWER STATION-II (TS-II) - 1470 MW capacity*
- *POWER HOUSE including the boiler and turbine-generator arrangements.*
- *SWITCH-YARD arrangements for 230kV and 400kV units*
- *CONTROL ROOM*
- *COOLING TOWERS*
- *AFFORESTATION-I region*

Students Opinion ::

It was a great experience, very interesting and informative visiting the NLCIL. The interactive sessions made the visit lively. Being Electrical Students, we gained a lot of practical knowledge.

CERTIFICATE OF INPLANT TRAINING :



TAMILNADU GENERATION & DISTRIBUTION
CORPORATION LIMITED
NORTH CHENNAI THERMAL POWER STATION-I
CERTIFICATE

This is to certify that Selvi.M.BALAMRUGAI, B.E., III year/EEE, PERI Institute Of Technology, Manniyakkam Chennai 600048, has undergone In-plant Training From 12.06.17 To 16.06.17 at North Chennai Thermal Power Station-I, TANGEDCO (TNEB), Chennai - 120.

Place: Chennai - 120.
Date: 22.06.17

ASSISTANT EXECUTIVE ENGINEER,
TRAINING,
NCTPS-I / CHENNAI - 120.

HOD/EEE

PRINCIPAL

Indian Machine Tool Manufacturers' Association
108/Mo. Tumkur Road, Madavara Post., Bangalore – 562 123 (Karnataka), India
Tel: +91-80-66246600 Fax: +91-80-66246661, E-mail: imtma@imtma.in, Website: www.imtma.in

INTERNSHIP PROGRAMME CONFIRMATION

22.1.2015

To
The Principal,
PERI Institute of Technology,
Mannivakkam,
Chennai- 600048.

Dear Sir,

Sub: Letter of offer for your student internship programme.

We are pleased to offer you an internship programme of students from PERI Institute of Technology, Chennai in the Department of Mechanical Engineering in our company, with effect from 2nd February for a period of one month.

We wish you good luck in your new assignment.

Regards,

(M.Md. Zakiruddeen)
HR-Personnel

Indian Machine Tool Manufacturers Association
IMTMA
Bangalore

INTERNSHIP REPORT

PROPOSED HEAT VENTILATION AND AIRCONDITIONING WORK IN FOOD COURT

AT

MARCH 2018

Indian Machine Tool Manufacturer's Association

PROJECTS & MAINTENANCE DEPARTMENT

PROPOSED HEAT VENTILATION AND AIRCONDITIONING WORK IN FOOD COURT

DONE BY

REG. NO.	NAME OF THE STUDENT
411514114054	ELANGOVAN P
411514114319	PARTHIBAN N

DEPARTMENT OF MECHANICAL ENGINEERING,

PERI INSTITUTE OF TECHNOLOGY,

CHENNAI.

T ECHNICAL SPECIFICAT ION

SYSTEM DESCRIPTION

COMFORT AIR CONDITIONING.

The Air Conditioning system is designed considering the latest standards and codes like American Society of Heating, Air Conditioning and Refrigeration Engineers Standards, (ASHRAE) and Indian Society of Heating, Air Conditioning and Refrigeration Engineers Standards. (ISHRAE)

The Air-conditioning of the Food court shall be with chilled water AHU connected to an Air cooled chiller as described in the BOQ.

POWER SUPPLY:

Power shall be made available at 415 V 3 ph / 230 V single ph, 4 wire, 50 HZ earthed neutral system and all equipment shall be suitable for the above power supply with variation of + / -10 %. All equipment shall operate at this voltage and any equipment operating at other than this power supply shall be provided with necessary transformer.

CODES AND STANDARDS:

The installation shall conform in all respects to, the following broad certifying agency / standards apart from the specific equipment standards and specifications.

ASHRAE Standards

ASHRAE	:	62.1 – Ventilation for acceptable IAQ
ASHRAE	:	90.1 – Energy Standard for Buildings Except Low – Rise Residential Buildings
ASHRAE 52	:	Air Cleaning Devices Used in General Ventilation for Removing Particulate matter
ISHRAE	:	Weather Data
NFPA – 90 A	:	Installation of Air Conditioning and Ventilation Systems
ARI	:	Cooling Coil ratings
AMCA	:	Fans
SMACNA	:	Sheet Manufacturers and Contractors National Association.

In case of discrepancy among specifications, drawings and other documents, the specifications take precedence over all other documents. In case of discrepancy between specification, drawings etc and codes & Standards, the tenderer shall assume the more stringent of the two.

DRAWINGS, SPECIFICATIONS AND DEVIATIONS.

The drawings and specifications lay down minimum standards of equipment and workmanship. Should the tenderer wish to depart from the provisions of the specifications and drawings either on account of manufacturing practice or for any other reasons, he should clearly draw attention in his tender to the proposed points of departures and submit such complete

information, Drawings and specifications will enable the merits of the deviations to be fully appreciated. In the absence of any such deviation list, it will be deemed that the tenderer is fully satisfied with the intents of the specifications and the drawings and their compliance with the statutory provisions and local codes. All deviations or departures not brought out to the notice shall be disregarded.

TOOLS AND SPARE PARTS.

All the tools and tackles, scaffolding and staging required for erection and assembly of the installation covered by the contract shall be obtained by the contractor himself and shall meet the EHS requirement. All other material such as foundation bolts, nuts etc, required for the installation of the plant shall be supplied and included in the contract.
Tenderer shall include spares recommended by him for two years operation for each type of equipment covered by the specification.

SHOP DRAWING, INSPECTION AND TESTING

Working and construction drawings

The contractor shall prepare shop drawings and all work shall be according to approved working drawings. Shop drawings shall give all dimensions and shall incorporate the requirements of the Client. Approval of drawings does not relieve the contractor of his responsibility to meet the intents of the specifications. All such drawings for approval shall be submitted in 6 copies for Client. In addition, the contractor shall submit manufacturer's details and get them approved before ordering. This has to be done whether the materials / equipment are one of the approved makes or not.

Testing and Inspection

The contractor shall carry out tests on different equipment and system in total as specified in various sections of the tender in the presence of Client in order to enable them to determine whether the plant, equipment and installation in general comply with the specifications. All equipment shall be tested after carrying out the necessary adjustments and balancing to establish equipment ratings and all other design conditions. The test data shall be submitted in Acceptance Test Form.

Calibration of instruments and meters

The contractor for testing with initial requirements of all consumables shall furnish instruments required for testing. All the instruments, meters etc to be used at site and on the system shall have a valid calibration certificate issued by the competent authority. The contractor shall maintain and make available all such calibration certificates.

Handing over requirements

The plant shall be handed over after satisfactory testing along with following documents.

1. Detailed equipment data in the approved Performa.
2. Manufacturer's maintenance and operating instructions
3. Set of as built drawings, layouts, piping, ducting, cable routing, cable schedules etc
4. Approved test readings of all equipment and installations
5. Inspection certificates
6. Certificates of approval from statutory or Local Authorities for the operation and maintenance of the installations,

7. wherever such approval or certification is required. This shall include Application filed along with enclosures and receipts of fees paid and deposits made.

8. List of recommended spares

9. Certificate from the contractor that he has cleared the site of all debris and litter caused by him without violating the EHS norms during the construction. However, contractor has also to periodically clear the site from all the debris, which is generated from his part of scope.

10. Undertaking that all the materials supplied by him at site are fully tax paid and shall produce all documentation for satisfaction of Client or taxation authorities.

Submission of the above documentation shall form a precondition for final acceptance of the plant and installation and final payments.

Statutory approvals inspection

The contractor shall be fully responsible for meeting all the statutory obligations and local inspectorates wherever applicable to the works carried out by them. The contractor should prepare all working drawings and obtain approval of competent authorities and also have the equipment and installation inspected and got approved. All the original receipts of official fees paid and deposits made against the demand in writing from the appropriate authority shall be submitted to the Client.

SCOPE

The HVAC Contractor is expected to study the site conditions regarding ambient, seismic, geological & metrological data & ensure that the entire system supplied has been designed & manufactured to suit the same

SCOPE OF WORKS FOR HVAC SYSTEMS.

Major works.

1. Preparing shop drawing and working out the Actual final requirement of the system.
2. Procurement of Equipment as per the tender technical specifications and as per the schedule given by the Client.
3. Design of the sheet metal ducting based on the data furnished in the document.
4. Procurement of materials as per BOQ of the tender document.
5. Manufacturing as per standards & details furnished in the specifications
6. Assembly
7. Testing in Shop before delivery
8. Inspection
9. Insurance up to handing over
10. Packing & Forwarding
11. Transportation
12. Installation at Site as per the schedule given by Client/ Project Managers
13. Submission of method statements for execution
14. Testing, System balancing and Commissioning in the presence of specialized agency (manufacturer's representative)
15. Performance Guarantee run
16. Handing over

WORKS NOT INCLUDED FOR HVAC SYSTEMS

Associated civil works like drilling , punching holes and openings in concrete floors, slabs, chasing of brick walls, fabrication of supporting structures, drainage of water from cable trenches, cleaning and clearing of all debris.

Dismantling of existing fall ceiling

RCC / PCC Pedestals required for all air conditioning equipment like fresh air fan installation shall be executed by the Civil Contractor.

Coordination with other subcontractors with regard to installation of items not in Air Conditioning contractor's scope.

HVAC contractor should quantify & provide necessary details, detailed working drawings with dimensions, operating weight to the civil contractor for execution after obtaining the approval on the shop drawing from the consultants.

PREPARATION OF EXECUTION DRAWINGS AND AS BUILT-IN- DRAWINGS.

The contractor shall produce the Client, work drawings indicating all cut-outs to be left open, sleeves to be provided.

The extent of work services under the contract include all items shown on the drawings, indicated in companion with specifications, notwithstanding the fact that such items have been omitted from the BOQ. All equipment and services, which are required to complete the intent of the contract, shall also be deemed to be within the scope of the contract.

SCOPE OF SUPPLY

Supply of various equipment as per the relevant Specification & Drawings, unloading, receiving, inspection, storing, transportation to work site, handling, assembling, cleaning, mechanical erection, assisting main contractor in associated civil works which are required for HVAC system, Installation, alignment, testing and commissioning and handing over in working condition of all items covered below but not limited to it:

1. Air cooled scroll chiller with R-407C / R-410A refrigerant
2. Chilled water pumps.
3. Air handling units with chilled water cooling coil
4. Chilled water piping with necessary fittings, valves, and insulation etc.
5. Sheet metal ducts fabricated to meet SMACNA standards.
6. Volume control dampers, Fire dampers etc.,
7. Grilles & Diffusers.
8. Painting and finishing work as per the standard specification.
9. Thermal and Acoustic insulation as specified.
10. Associated HVAC Electrical Works.
11. Any other items required for successful functioning of the system whether specifically mentioned or not.

AIR COOLED CHILLER – WITH SCROLL COMPRESSORS

GENERAL

The scope of this section comprises the scope, design, supply, materials, installation, testing and commissioning of the Air Cooled Scroll chiller conforming to these specifications and in accordance with the requirements of Drawing and Schedule of Quantities.

SCOPE

The scope of the contractor not limited to but inclusive of Selection, Packing, Supply, installation, testing and commissioning of Air cooled chillers comprising multiple scroll type compressors, stepped capacity control, / DX type shell and tube cooler/ evaporator with closed cell elastomeric insulation, air cooled condensers, fans, Motors, Mounting frame, Gaskets, Spring type Vibration isolators, protection guard for condenser coils, necessary chilled water connection, Victaulic couplings, Hydronic kit, expansion tank, non return valve, 3-way flow control valve, Equipment electrical panel, water flow switches, Transporting, Lifting to the point of installation, installation, testing, commissioning etc., as per the Indian & International standards etc., The tender cost should be inclusive of all above requirements. If required to the client all the units should be provided with manufacturer test certificates. The supplier should arrange for the necessary factory inspection in case the project needs. The additional cost of the test & inspection if any shall be borne by the client.

CODES & STANDARDS.

The design, materials, manufacture, inspection, testing and performance of the Chiller shall comply with all currently applicable statutes, regulations, codes and standards in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. In particular, the Chiller shall conform to the latest edition of the following standards:

AHRI 550/590 Performance Rating for Air cooled-Chilling Packages using the vapour compression cycle
Eurovent Certification for Air cooled chilling package using the vapour compression cycle.
AHRI 575 Method of Measuring Machinery Sound within an Equipment Space
ASHRAE 15 Safety Code for Mechanical Refrigeration
ASHRAE 90.1 Energy Standards for Building except Low Rise Residential Buildings
ASME SEC 8 Boilers and Pressure Vessel Code
NEMA MG1 Motors and Generators
UL 1995 Safety of Cooling & Heating Equipments
NFPA 90 A Installation of Air-Conditioning and Ventilation Systems.
ECBC 2007 Table 5.1 – Minimum Equipment Efficiencies

QUALITY ASSURANCE.

Construct, test and rate chiller performance in accordance with AHRI 550/590-2011 with exceptions as noted in this specification. Construct, install and operate chillers in accordance with ANSI/ASHRAE 15- Safety Code for Mechanical Refrigeration and COMM 45 Wisconsin Mechanical Refrigeration Code. Construct and test chillers in accordance with ASME SEC 8. Construct and label chillers in accordance with UL1995.

DELIVERY STORAGE & HANDLING.

Unit shall be Shipped / Transported, in accordance with manufacturer's instructions. The equipment should be properly packed by the manufacturer before the shipment to protect against any possible physical damage, weather.

The unit shall be without any physical damage from the factory leaving to until the installation. (Wherever the chiller installation by the separate mechanical contractor, The Equipment manufacturer is responsible for coordinating with the mechanical contractor for proper unloading, storing, lifting, installation, testing & commissioning of the same.)

Unit shall be shipped with all refrigerant piping and control-wiring factory installed

Unit shall be shipped charged with oil and full charge of refrigerant. If the refrigerant charging is separate from the machine, then the refrigerant charging to be done by the manufacturer / HVAC contractor at the site.

The unit shall be handled & stored in accordance with the manufacturer's instructions.

The condenser coils shall be protected with PVC / ply wood sheets till the time of commissioning of the chiller.

GENERAL SELECTION CRITERIA.

The Chiller shall be factory fabricated & assembled with inbuilt Hydronic kit only.

All coils shall be rated, tested, and certified in accordance with AHRI standards.

The Chiller shall be selected for Actual cooling capacity as per the design condition & location given.

The chiller shall meet the requirements of AHRI standards and ASHRAE standard 90.1

The chiller shall meet the Efficiencies at 100% load and also at part load as prescribed in the BOQ.

The Chiller should be of Low noise & Low sound pressure level.

The Chiller foot print shall not exceed the dimensions captured in the tender drawings.

The Chiller shall be using refrigerant of Eco friendly and CFC free type.

The Chiller shall be with Energy Efficient compressor and motor only.

The Chiller shall be with high C.O.P only.

The Chiller shall be of less / minimum vibration type.

The Chiller shall be with necessary hardware & software suitable for the BMS operation with necessary provision for the two way communication.

SUBMITTALS.

General arrangement (GA) drawings of the Chiller equipments with parts details, static & operating weight & point load details.

The catalogue, operation & maintenance manual, wiring diagram etc.

Detailed technical data sheet of the Chiller.

Chiller Actual C.O.P & IKW/TR value at the maximum design load conditions.

Chiller performance details, Integrated Part Load Value (IPLV) in IKW/TR as per AHRI standards at the rated design flow and inlet and outlet water temperature including all accessories.

Equipment Sound power level in dbA and Sound pressure level in dbA @ 1.5m distance from the equipment at different octave band spectrum from 63 Hz to 8 kHz. etc.,

Water pressure drops in the cooler.

Air pressures drop in the condenser.

Type & details of Refrigerant used.

Details of Hydraulic kit.

Details of the Electrical characteristics.

Details of the power cabling requirements.

Chiller fan vibration balancing reports.

Factory performance test certificates.

CHILLER CONSTRUCTION DETAILS.

GENERAL:-

The chiller package shall consist of factory assembled liquid chiller shall comprise multiple scroll compressor, motor, lubrication system, insulated cooler, air cooled condenser, condenser fan and motors, Refrigerant pipe & fittings, Spring type vibration isolators, Necessary chilled water flange connection with Victaulic couplings, Refrigerant flow control devices (electronic expansion valves for DX type coolers), service valves, strainers, Antifreeze thermostat, liquid moisture indicators, First charge of refrigerant & oil, Hydronic kit, 2 way flow control valve, expansion tank, non return valve, Electrical Starter panel and microprocessor control system, and documentation required prior to start-up. The compressor motor starters can be mounted on the chiller, wired, and tested by the chiller manufacturer. The total Equipment body shall be painted with one coat of Epoxy primer and two coat of Epoxy paint. Unit shall be suitable for operating at coastal weather conditions.

Unit shall be with firmly attached name plates to the major components indicating the name of manufacturer, chiller type & model number, Compressor type & model number, Type of cooler & condenser, Type of refrigerant used, Weight of refrigerant to be charged for the operating conditions etc.,

All the components being mounted on robust constructed welded steel frame structure; the frame structure, structural profiles, base frame & panels made of galvanized sheet steel (GSS) shall be protected with primary coating & finished with acrylic paint. The machine shall be mounted on vibration isolators. The package shall be suitable for outdoor installation; in other words, no weather protection of any kind by way of wall or roof is contemplated.

The Chiller shall be with necessary hardware & software suitable for the BMS operation with necessary provision for the two way communication

POWER SUPPLY:-

The Chiller unit shall be suitable for the 415V-3phase, 50 Hz -4wire system. The unit should be suitable for operation through remote control BMS system. The Micro processor panel shall be mounted on the equipment.

REFRIGERANT:-

The unit shall be suitable for Eco-friendly, CFC free refrigerant likeR410 A/R 407 C The units should be first charged with refrigerant before shipping or shall be charged at site by the manufacturer. The equipment name plate shall be with type of refrigerant used, Weight of refrigerant to be charged for the operating conditions.

AIR COOLED CHILLER PERFORMANCE:-

Chiller should be selected for high COP value as per AHRI-550/590 standards as defined in ASHRAE 90.1 and as per ECBC Table 5 for minimum equipment efficiencies.

OPERATING SOUND PRESSURE LEVEL:-

The unit shall operate at full load and all part load conditions without exceeding 85 db A sound pressure level at 1.5m distance. Required necessary attenuation devices should be included in the cost of the chiller. The sound level shall be measured as per latest version of AHRI-575 standards. The sound pressure levels in all octave bands must be met as scheduled for full load and part load conditions.

COMPRESSOR:-

Multiple Scroll compressor of the high performance.

The compressor motor unit shall be accessible semi-hermetic direct drive, 3000 rpm at 50 Hz, rotary screw compressor suitable for use with refrigerant R134A/R 407C.

All sensors shall get quickly disconnected to allow replacement of the sensor without replacement of the entire sensor wire. Pressure transducers shall be capable of field calibration to ensure accurate readings and to avoid unnecessary transducer replacement. Transducers shall be serviceable without the need for refrigerant charge removal or isolation.

It shall be complete with suction and discharge shut-off valves, relief valve, suction filter, muffler, dual manual reset type pressure state, refrigerant suction and discharge pressure gauges, crank case heaters and relays, direct coupled motor. The compressor shall incorporate automatic capacity control feature.

The unit shall be provided with slide valve unloading for partial load operations. The compressors shall have reducing capacity down to minimum 25% of full load condition. Motor shall be suction gas-cooled, semi-hermetically sealed, two poles, squirrel cage induction type. Further, compressors should be in unloaded condition during starting.

COMPRSSOR MOTOR:-

Compressor motor shall be of the semi hermetic, squirrel cage, induction type suitable for voltage shown on the equipment schedule.

Motors shall be suitable for operation in a refrigerant atmosphere and shall be cooled by atomized refrigerant in contact with the motor windings.

Motor stator shall be arranged for service or removal with only minor compressor disassembly and without removing main refrigerant piping connections.

Full load operation of the motor shall not exceed nameplate rating.

One motor winding temperature sensor (and one spare) shall be provided.

Motor should be suitable for 415V, 50hz, 3phase power supply.

Motor shall have electronic overheating protection with manual reset facility.

COOLER:-

Cooler shall be having shell and tube, DX type construction.

Units shall be fabricated with high-performance tubing, minimum 6mm thick steel shell and tube sheets with fabricated steel water boxes.

Water box shall be nozzle-in-head Water box (150 psig).

Water box shall have standard Victaulic grooves.

Water boxes shall have vents, drains, and covers to permit tube cleaning within the space shown on the drawings. A thermistor type temperature sensor with quick connects shall be factory installed in each water nozzle.

Tubes shall be individually replaceable from either end of the heat exchanger without affecting the strength and durability of the tube sheet and without causing leakage in adjacent tubes.

Tubing shall be copper, high-efficiency type, with integral internal and external enhancement unless otherwise noted. Tubes shall be nominal 10mm. OD with minimum wall thickness of 0.64mm measured at the root of the fin at the enhanced areas and minimum wall thickness of 1.25mm where the tubes are in contact with the end tube sheets unless otherwise noted. Tubes shall be rolled into tube sheets and shall be individually replaceable. Tube sheet holes shall be double grooved for joint structural integrity.

Cooler shall be designed to prevent liquid refrigerant from entering the compressor. Devices that introduce pressure losses (such as mist eliminators) shall not be acceptable.

A reseating type pressure relief valve shall be installed on each heat exchanger. If a non-reseating type is used, a backup reseating type shall be installed in series.

Design, test & stamp the refrigerant side for minimum 400psig and the water side for 150psig working pressure.

AIR COOLED CONDENSER & CONDENSER FAN:-

The condenser coil shall be made out of seamless copper tube with aluminium fins. The coils shall be sized so as to optimize the performance with respect to airflow rate, pressure drop, condensing temperature, power consumption, etc. Thus the values furnished for the parameters of the coil in the Schedule of Equipment shall be regarded as suggested values rather than specified values.

The condenser coils shall include sub-cooling circuits.

The condenser coils shall be designed to limit the system charge to the minimum. However, if the condenser does not have adequate capacity to hold the entire charge in the system, receivers shall be provided. If receivers thus become inevitable, it must meet the following requirements:

Receivers shall be tested for the same pressure as the condenser.

The capacity of the receivers shall be adequate to hold the charge of the system when filled up to only 80% of its capacity. The condenser coils shall be tested for a minimum pressure of 30 kg/sqcm. In the field, they shall be tested to a pressure of not less than 21 kg/sqcm.

The condenser coils shall be provided with protective weld mesh to protect the fins from damage.

The air-cooled condenser shall incorporate necessary number of Low noise, direct drive, and aerofoil blades propeller fans of adequate size to obtain the required airflow rate under operating conditions. The fan shall be balanced both statically and dynamically. The fan motor shall be of TEFC squirrel cage construction and with IP-65 protection. Wherever condensers with discharge of hot air in the vertically upward direction are involved, special care must be taken to ensure that the fan motors are suitable for such service. The motor shall be suitable for outdoor installation and also for location in the stream of hot air leaving the condenser coil. The fan motor sets shall be complete with protecting guards. Condenser fan shall be individually replaceable.

REFRIGERANT FLOW CONTROLS:-

To improve part load efficiency, liquid refrigerant shall be metered from the condenser to the cooler using an electronic expansion valve to maintain the proper liquid level of refrigerant in the heat exchangers under both full and part load operating conditions

INSULATION:-

Insulation shall be done with not less than 19mm thick closed cell elastomeric class 'O' foam insulation of density more than 60kg/m^3, Thermal conductivity not more than 0.038W/m ^oC, The insulation shall be self extinguishing type and suitable for outdoor weather condition. It should have good chemical resistance and no fungal growth. The insulation shall be done for the Cooler shell & head, Refrigerant pipe suction line, Motor housing & cooling lines for hermetic compressors and all lines & items surface temperature is less than 65^oF or colder.

STARTER PANEL.

The Micro processor panel with fully operating micro processor controller in a lockable steel control panel suitable for outdoor application with minimum of IP65 class of protection. The panel shall incorporate main disconnect switches, for individual motors, contactors, over load relays, earth leakage relays, single phase preventers, phase loss protection, phase reversal protection, phase imbalance protection, under/ over voltage trip, required voltage transformers, on/off push buttons, auto manual switches to facilitate automatic operation or for manual operation. The disconnect switches provided shall be suitable for terminating copper cables.

INSTALLATION and START UP.

The chiller manufacturer shall provide a factory-trained representative, employed by the chiller manufacturer at the time of installation to do the installation or to monitor the installation and to perform the start-up procedures as outlined in the Start-up, Operation and Maintenance manual provided by the chiller manufacturer.

Manufacturer shall supply the following literature:

a. Start-up, operation and maintenance instructions.
b. Installation instructions.
c. Field wiring diagrams.
d. One complete set of certified drawings.

Functional Testing

Tests shall be in accordance with AHRI 550/590. NPLV method shall be used for nonstandard conditions.

The manufacturer's service technician shall provide initial startup of the chillers in client presence. Inspect all piping and electrical circuits. Provide and charge the machines with initial refrigerant and oil charges. Perform initial start-up of the chillers, measure and adjust water flows through the machine components for proper operation of the system, and complete other functions normally associated with startup. Perform operating checks on all operating and safety controls. Calibrate all integral controls, gauges, and thermometers, as well as all field-mounted controls furnished with the chiller. Provide required programming and setup of the required hardware / software assistance to the BMS vendor for software integration.Before starting the chiller, confirm that the remote starters have been field checked and certified in writing by an authorized factory service representative.

During initial run testing of the chillers, provide support for the starter-authorized factory service representative to re inspect the starters to ensure that the devices are operating correctly, all electrical connections are tight and secure, and that the ammeter is properly calibrated. In addition, check for proper loading and perform all calibrating procedures on the motor overload relays to match the cut-out points with the requirements of the chiller motor. Verify the equipment operates as designed, and rectify all deficiencies. Perform an oil analysis after 2000 hours of operation.

ENERGY EFFICIENCY REQUIREMENTS (General Guidelines).

The Manufacturers are requested to offer their high-energy efficient model Chillers for this project tendered. The energy efficiency of the chiller to be rated based on AHRI 550-590-98 standards or latest class of standards. The penalty clause shall be applicable as per the clause mentioned above if the chiller is not meeting the rating value confirmed by the manufacturer. AHRI STANDARD 550/590-98 – RATING METOHD (IPLV & NPLV) Standard for Water Chilling Packages using the Vapour Compression Cycle.

Evaporator Fouling Factor Allowance

Recently completed research work sponsored by ASHRAE shows that actual fouling of the waterside of closed circuit evaporators of water chillers is considerably less than the allowance currently contained in the Standards. The details of these studies are contained in two ASHRAE papers listed in the appendix (3) & (4). The results are further summarized in AHRI Guideline E-1997 (5). In the work associated with these studies, several experimental tests were run with various combinations of clean water, dirty water, different tube types, and 3 ft/sec. and 7 ft/sec. water velocities. The tests indicated that even in the worst case, the level of fouling after extended operation was less than 11.6% of the standard practice of using 0.00025 $h.ft^2.^oF/Btu$ of FF. This indicates that for closed circuit evaporators, the 0.00025 $h.ft^2.^oF/Btu$ of FF is overly conservative and is counter to the efforts to improve operating efficiency of chillers. An evaporator fouling factor allowance of 0.0001 $h.ft^2.^oF/Btu$ of FF is more appropriate for most closed loop circuits. As a result of these studies the standard fouling factor allowance on the waterside of closed circuit evaporators for centrifugal, screw, reciprocating and scroll compressor water chillers covered by AHRI Standard 550/590, and absorption chillers covered by AHRI Standard 560 are being changed to 0.0001 $h.ft^2.^oF/Btu$ of FF.

AIR COOLED SCROLL CHILLER REQUIREMENTS		
SL.NO	DESCRIPTION	**PROJECT DESIGN**
1	Type of Chiller	**Air Cooled**
2	Type of Compressor	**Scroll**
2	CAPACITY - TR	**80**
3	Refrigerant	**R-407C / R- 410A**
4	IKW/ TR - COP as per Site Conditions @100% load	**1.23 to 1.3**
5	Cooler Entering Water Temperature - deg F / deg C	**54 /12.22**
6	Cooler Leaving Water Temperature - deg F / deg C	**44 /6.66**
7	Cooler - Flow Rate - USGPM	**192**
8	Cooler - Minimum Flow Rate - USGPM	**80**
9	Cooler Fouling Factor - Hr FT2 ^{o}F / BTU	**0.0001**
10	Cooler Pressure drop –kPao f W.C. (Max)	**35**
11	Condenser Entering Air Temperature - deg F	**95**
13	Input Kw @ 100 % load as per site conditions (Including fans and Hydronic kit) (MAX.)	**105**
14	No. of Compressors	**2 or 3**

END SUCTION CENTRIFUGAL TYPE CHILLED WATER PUMPS

SCOPE

This specification covers the supply, installation, testing & commissioning of End suction close coupled back pullout or Frame mounted flexible coupled Pumps. Chilled water pumps shall be of Constant flow type. End suction long coupled base mounted pumps are also acceptable.

CODES AND STANDARDS

The design, materials, construction, manufacture, inspection and performance testing of centrifugal pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. Nothing in

this specification shall be construed to relieve the CONTRACTOR of this responsibility. The equipment supplied shall comply with the latest applicable Indian, American, British or equivalent standards.

DESIGN REQUIREMENTS

The total head capacity curve shall preferably be continuously rising towards the shut off. In case of unstable (drooping) characteristic the duty point shall be well away from the unstable region. The shut off head shall be at least 110% of the total head.

The required NPSH at duty point shall be at least 1.0 M less than the available NPSH.

Pumps shall run smooth without undue noise and vibration. The noise level shall be limited to 75 dBA at a distance of 1.8 M.

Vibration shall limited to class IIC of BS 4675 Part –I.

The Seismic capability of the pump shall allow it to withstand a horizontal load of 0.5g, excluding piping and/ or fasteners used to anchor the pump to mounting pads or to the floor, without adversely affecting the pump operation.

Motors shall be meet scheduled horse power, voltage, speed and enclosure design.

Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications and conform to the standards outlined in EPACT 92.

Pump shall be of maintainable design and for ease of maintenance should use machine fit parts and not press fit parts.

The pump vibration limits shall conform to Hydraulic Institute for recommend acceptable unfiltered field vibration limits for pumps with rolling contact bearings.

The power rating of the pump motor shall be the larger of the following:

a) The maximum power required by the pump from zero discharge to zero head.

b) 110% of the power required at the duty point.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division.

Components of identical pumps shall be interchangeable.

FEATURES OF CONSTRUCTION

CASING:

The casing shall be of heavy close grained Class 30 cast iron, to withstand high tensile strength with smooth waterways and fitted with bronze wear ring. Casing shall have tapped openings for priming, vent, drain and gauge connections.

IMPELLERS:

The impellers shall be of bronze and the bearing assembly shaft shall connect to impeller.

Impeller shall be hydraulically and dynamically balanced and keyed to the shaft and secured by a stainless steel locking cap screw or nut.

The impellers on end suction pumps shall be fully enclosed type carefully balanced for smooth operation. Balancing openings shall be provided near hub of the impeller to reduce pressure on the stuffing box to approximately suction pressure.

WEARING RINGS:

Wearing rings are provided to maintain close running clearance and to minimize pressure leakage between suction and discharge chambers of the casing. The casing bearing rings shall protect the casing against wear and shall be locked in pump casing to prevent rotation.

Pump shall be provided with renewable type casing ring. Pump having capacity 2,000 cu.m/hr and above shall be provided with impeller ring in addition to casing ring. The hardness of impeller ring shall be 50 BHN higher than that of casing ring.

SHAFT:

The shaft shall be of high strength steel with optimum diameter to provide maximum strength with minimum shaft deflection.

Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing box.

Stuffing box shall be of such design that it can be repacked without removing any part other than the gland and lantern ring.

SHAFT SEAL:

The pump shall have mechanical shaft seals of extra hard carbon ceramic type. Details of the Mechanical seal provided shall be submitted with the Tender.

BASE PLATE:

Base plate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends, with securely welded cross members and fully open grouting area. The minimum base plate stiffness shall conform to ANSI /HI 1.3.4 – 1997 for Horizontal base plate design standards.

BEARINGS:

The bearing assembly shall have solid SAE1144 steel shaft. A Non ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.

The bearing assembly shall support the shaft via two heavy duty regreaseable ball bearings. Bearing assembly shall be replaceable without disturbing the system piping and shall have foot support at the coupling end. Pump bearings shall be regreaseable without removal of bearings from the bearing assembly. Thermal expansion of the shaft toward the impeller shall be prevented via an inboard thrust bearing.

Labyrinth deflectors shall be provided to exclude dirt and moisture from the bearing housing. Grease reliefs shall be provided to prevent over-lubrication.

Bearings shall have a minimum life of 40,000 hours of working.

COUPLING:

The Coupling shall be flexible type, center drop out design coupler, capable of absorbing torsional vibration between pump and motor. Coupler shall allow removal of pump's wetted end without disturbing pump volute or movement of the pump's motor and electrical connections. On Variable speed applications the coupler sleeve should be constructed of an EPDM material to maximize performance life.

Coupler shall be shielded by a dual rated ANSI B15.1, section 8 and OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling.

All accessories required for proper and safe operation shall be furnished with pumps.

All incidental piping (including valves) required for sealing, lubrication and cooling for stuffing box packing and / or bearing of pump shall be furnished by the Contractor.

ALIGNMENT:

Pump and motors shall be factory aligned, and shall be realigned after installation by the manufacturer's representative. The pump manufacturer shall provide certification to the effect that the pump and motor coupling has been carried out by them and checked by them.

On completion of the installation, grouting and connection of all piping, the pump and motor shall be rechecked for alignment by means of accepted methods, by the pump manufacturer/sole agent.

TESTS AND INSPECTION

A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the maximum discharge head or twice the rated discharge head, whichever is higher. While arriving at the above pressure, the maximum suction head shall be taken into account.

The hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

Each pump shall be factory tested and name – plated before shipment.

PERFORMANCE TEST

Standard Running Test:

The pumps shall be tested as per IS 5120, at rated speed at SUB-Contractor's works to measure capacity, total head, efficiency and power. The negative tolerance on efficiency shall be limited to 2.5% (not 5 % as indicated in IS 5120. These tests shall form the basis for acceptance of pumps except for vibration and noise. The pumps shall be tested over the range covering from shut-off head to the maximum flow. The duration of the test shall be minimum one hour. Minimum five readings approximately equidistant shall be taken for plotting the performance curves.

NPSH Tests:

NPSH tests shall be conducted with water as the medium.

Mechanical Balancing

In addition to static balancing, impeller and balancing drum shall be balanced dynamically at or near the operating speed.

Field Testing

After installation, the pumps shall be subjected to testing at site also. If the field performance is found not to meet the requirements regarding vibration and noise as specified, the equipment shall be rectified or replaced by the CONTRACTOR, at no extra cost to the EMPLOYER.

TENDER DRAWINGS

The following documents/drawings shall be submitted by the CONTRACTOR along with their Bids:

Preliminary outline dimensional drawing of pump and motor. (Suction and discharge connections and foundation details shall also be indicated).

Performance curves (capacity vs total head, efficiency, NPSH and KW requirement) ranging from zero to maximum capacity.

Pump Catalogues.

PAINTING

All ferrous surfaces shall be painted with one coat of red oxide primer paint followed by finish paint. However the components of the pumps shall not be painted before inspection.

PUMP HEAD CALCULATION

It is very important that contractor shall submit actual pump head calculation based on site installation conditions taking into account pressure drop in installed (to be installed) chillers, piping and fitting. This actual pump head calculation shall be submitted for engineer's approval before ordering equipment and motor. Required pump motor capacity will be provided based on actual head calculation without any extra cost.

TECHNICAL REQUIREMENTS FOR CHILLED WATER PUMPS

DATA SHEET – A

1	**DESIGN FEATURES**		
1.1	Pump designation		Chilled Water Pumps
1.2	Design capacity	US GPM	192
1.3	Total head (Primary)	Ft	65
1.4	Location		Outdoor
1.5	Maximum rated speed (at 50 Hz.)	RPM	1450
1.6	Liquid handled		Water
1.7	Number required		2 (1Working + 1 Standby)
2.0	**FEATURES OF CONSTRUCTION**		
2.1	Type of pump		End suction back pullout
2.2	Impeller		Open/Enclosed/Non clog
2.3	Volute		Single
2.4	Shaft		Coupled
2.5	Drive Transmission		Direct
2.6	Seal		Mechanical seal
2.7	Coupling		Flexible
2.9	Prime Mover		AC Electric motor
3.0	**MATERIALS OF CONSTRUCTION**		
3.1	Impeller		Bronze *
3.2	Casing		Cast Iron GR FG 200*
3.3	Shaft		EN – 8 Steel *
3.4	Shaft Sleeve		EN-8 Steel *
3.5	Impeller Ring		SS 304 *

3.6	Casing Ring		Cast Iron GR FG 200*
3.7	Mechanical Seal		Ceramic seal seat and Carbon seal ring
3.8	Base Plate		Fabricated Steel / Cast Iron*
	Note : For components marked * material test certificates shall be furnished		
4.0	**ACCESSORIES**		
4.1	Companion Flanges		Yes
4.2	Foundation Bolts		Yes
4.3	Base Plate		Yes
5.0	**TESTING**		
5.1	Hydrostatic Test Casing Jackets / Cooling Passage		Witnessed
5.2	Performance Test Std. Running Test NPSH Test		Witnessed

DATA TO BE FURNISHED BY THE CONTRACTOR AFTER AWARD OF CONTRACT AND BEFORE' INSTALLATION

1. Quality Assurance Plan (QAP)
2. Detailed dimensioned general arrangement drawing of pump and driver.
3. Foundation drawing of pump and driver with static and dynamic loads, details of fixing, grouting and all relevant data required for design of foundation
4. Cross-section drawing of the pump with complete part list, materials of construction and relevant standards for each part
5. Pump performance curves flow rate Vs head, BKW, efficiency, NPSHR from zero flow to maximum flow and torque-speed curve
6. Scheme for pump sealing, lubrication and cooling
7. Driver dimensional drawing
8. Surface preparation and painting procedures
9. Catalogues, data sheets and drawings for instruments
10. Installation, operation and maintenance manual
11. Isolation pads and SS or Hot dip galvanised foundation bolts provided by the Contractor.
12. Cork -rubber make metallic bellows shall be provided at suction and discharge.
13. Pressure gauges with needle valve provided at suction and discharge lines.
14. All accessories provided to complete the pump installation.

DATA SHEET

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

No	Description	Unit	Time			Date			Remarks
			10.00	12.00	14.00	16.00	18.00	20.00	
1.	Suction pressure	Kg/cm^2							
2.	Discharge pressure	Kg/cm^2							
3.	Water flow rate	M^3/hr							
4.	Current	Amps							
5.	Bed plate levels and alignment checks								
6.	Hydraulic test for casing at 1.5 times design pressure								
7.	Noise level from pump	1.8m dB							
8.	Discharge Vs head	Mtr							
9.	Discharge Vs efficiency								
10.	Discharge Vs BkW								

Run Test shall be conducted on the Chilled Water Pumps.

INSPECTION:

Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipment. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified elsewhere in the specification.

Each pump set including motors, flexible connection at inlet and outlet, vibration isolators and accessories as specified in tender document shall be regarded as one unit for the purpose of measurement and payment.

DOUBLE SKIN AIR HANDLING UNITS (AHU)

SCOPE

This specification covers the general design, materials, and construction features, delivery at site, handling at site, installation, testing, commissioning and carrying out performance test at site of Double Air Handling Units - VAV type

CODES AND STANDARDS

The design, materials, manufacture, inspection, testing and performance of AHUs shall comply with all currently applicable statues, regulations, codes and standards in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the ACMV Contractor of this responsibility. In particular, the AHUs shall conform to the latest edition of following standards:

IS 7613	Methods of Testing Panel type Air Filters for Air Conditioning and Ventilation purposes.
ASHRAE 33	Methods of Testing – Forced Circulation Air Cooling and Air Heating Coils.
ARI 410	Forced circulation Air-Cooling and Air-Heating Coils.
ARI 430	Central-Station Air-Handling Units.
AMCA 210	Laboratory methods of Testing Fans for rating
FED STD 209E	Clean room and Work Station requirements, controlled environment.
NFPA 90A	Installation of Air-conditioning and ventilating systems.

CONSTRUCTION FEATURES

TYPE

The AHUs shall be draw through type Horizontal floor mounted as specified. The unit shall comprise of various sections such as Pre-filters, cooling coil, fan, etc

CASING

The Air handling units shall be constructed using double-skinned acoustic panels with minimum 0.7 mm thick pre-coated GSS sheet for outer skin and 0.7 mm plain GSS sheet for inner skin of the unit. All the panels shall incorporate 40 mm thick PUF insulation sandwiched in between inner & outer skin; The inner skins can be of perforated sheet in the case of Fan Sections to bring down the noise level. Entire inlet plenum should be acoustically lined with Mineral wool / fibreglass with perforated sheet.

The entire framework shall be mounted on a 100mm (minimum) aluminium alloy channel base. The panels shall be sealed to the framework by heavy-duty “O” ring neoprene gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots. Handles shall be made of hard nylon and be

operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on-site assembly match drilled, with bolts, nuts and continuous neoprene rubber gaskets. All fixing and gaskets shall be concealed. Floor and roof panels shall be single skin type and shall be of same construction as the wall panels.

AHUs shall have hinged quick-opening insulated access door on fan and filter sections. Access doors shall be double skin type and shall be of same construction as the wall panels.

Four (4) lifting lugs shall be bolted to each base section for lifting or placing the AHU in place.

All connecting fasteners and related hardware and its accessories shall be in stainless steel.

Sloping condensate drain pan shall be fabricated from 0.8mm (22g) stainless steel sheet and stainless steel nipple for drain connection. It shall be isolated from bottom floor panel through 25mm thick heavy duty Treated for Fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.

Casing shall be of air-tight construction and sufficiently rigid to exclude vibrations, throughout the working capacity range of the AHU.

COOLING COILS

The coil section of the AHU shall be of the cartridge-type, removable from the side of the casing and supported over the entire length of the coil. Chilled water coil shall be plate fin type with aluminium ripple corrugated fins and staggered cleanable tubes with not more than 5 Fins per centimetre. Fins shall have collars, belled and firmly bonded to the tubes by having the tubes mechanically expanded into the fins.

Coil face velocity shall not exceed as specified on the coil schedule. The number of fins provided should be the minimum needed to meet the performance requirements to minimize the pressure drop across the coil. Coil casing shall be 1.5mm thick galvanized, steel with drain holes in the bottom channels to insure condensate drainage. Coil tubes shall be copper mechanically expanded into aluminium plate fins. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing on non- corrosive aluminium slide rails to allow for easy removal when required. Coils shall be designed to utilize the full available unit cross section area.

Coils shall be rated to ARI standard. Coils shall have automatic air vents, the vent outlets beings piped to the drain pan with a copper pipe. Each coil shall be proof tested at 26 bar (375 psig) leak tested at 17 bar (250 psig)

Coil performance shall be rated in accordance with ARI standard 410.

FAN

The fan section of the air handling unit shall be of rigid construction, with the fan scroll and bearings mounted on a frame rigidly secured to a formed channel base. Fans shall be of the double – width, double – inlet centrifugal type with FORWARD CURVED blades. Bearings shall be self-aligning, pillow-block type selected for an average life of 200,000 hours at design operating conditions, and shall be provided with grease line extending to the outside of the AHU casing. Please see Equipment schedule for further details.

The fan wheels shall be keyed to the shaft and the complete wheel and shaft assembly shall be statically and dynamically balanced. Fan and shaft assembly shall be selected to operate at a speed of at least 25% below the first critical speed. Fan shall be designed for continuous operation at the maximum rated speed and capacity. Outlet velocity shall not exceed ASHRAE recommendations. Fan shall be driven by or internally unit-mounted motor connected to fan by V-belt drive. Access panel for easy belt change shall be provided for internally mounted motors. Belt connected motor capacity.

Motors shall be provided with adjustable bases for belt tensioning. The entire AHU fan -motor assembly shall be housed inside the AHU casing and mounted on a epoxy coated common steel base channel section with vibration isolation mounting. Fan should be provided with spring isolators.

Fan motor shall be of totally enclosed fan-cooled type and shall be suitable for 415V / 3 Ph / 50 Hz. Motor shall be sized to provide

the additional power requirements when the fan is operated to provide an additional 20% of the rated capacity.

Supply fan performance shall be rated in accordance with ARI standard 430. Fans shall have AMCA certification or it should have undergone testing in AMCA Certified Laboratory before getting dispatched to AHU Manufacturing Facility. The ratings which are to be submitted along with the proposal shall be based on the tests and procedures performed in accordance with AMCA publication 311 and comply with the requirements of AMCA certified ratings program.

DRAIN PAN

An insulated condensate drain pan shall be provided in each AHU which shall extend under the entire coil and fan section. The drain pan shall be of double-wall construction with 25 mm thick foam insulation cemented between the hot-dipped galvanised steel outer pan and inner pan. The inner pan shall be finished with a coating of water – proof and corrosion – resistant material. Drain connection shall be provided on both sides of the casing. The drain pan shall be sloped ¼ inch per ft and constructed to allow complete pan drainage.

Heavy duct flexible (Fire retardant) double layer canvas connection shall be provided at the outlet of AHU fan. Additional double layer canvas connection shall be provided between the GSS ducting and AHU. This canvas connection shall contain a provision (zip) for measuring the DBT and WBT of the cooled and dehumidified air.

The AHU shall be provided with the following accessories, bulk head lamp, inspection windows, limit switch, extended grease lines and belt and motor guard.

FILTER SECTION

Pre-Filter:

Each unit shall be provided with a factory assembled filter section containing 48mm thick washable synthetic type air filters having GSS frame. The media shall be supported with High Density polyethylene (HDPE) mesh on one side and aluminium on the other side. Filter banks shall be easily accessible and designed for easy withdrawal and replacement of filter cells. Filter bank framework shall be fully sealed and constructed from GSS. The efficiency of the filters shall be 90%down to particle size of 10 microns as per IS 7613, and ASHRAE 52.1.

Filters - Codes and Standards.

a.	ASHRAE 52.1	Gravimetric and Dust spot procedures for testing Air cleaning devices.
b.	IS 7613	Methods of testing panel type Air filters for HVAC
c.	FED – STD – 209	Clean room and work station requirements.

DAMPERS

Dampers shall be opposed blade type. Blades shall be made of double skin airfoil extruded aluminium sections with integral gasket and assembled within a rigid extruded aluminium or nylon, turning in Teflon bushes. In case of automatic dampers, sealed ball bearings shall be provided, in place of Teflon bushes. Manual dampers shall be provided with a bakelite knob for locking the damper blades in position. Linkages shall be extended for motorised operation if specified in data sheet A. Damper frames shall be sectionalised to minimise blade warping. Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.

AHU TOTAL (INTERNAL AND EXTERNAL) PRESSURE CALCULATION

Contractor shall submit calculations for the internal and external pressure of each AHU system based on the equipment to be selected and ducting system to be installed including pressure drops in coil, filter, ducts and fittings, VCD, FD, Diffusers etc. Contractor shall obtain approval from consultant on the SP Calculations before ordering AHU motor. Required motor HP based on actual Calculated SP shall be provided without extra cost.

NOISE LEVEL

The noise level inside the AHU room should be less than 65dBA.

TECHNICAL REQUIREMENTS

Sl. no.	Description	Requirements
1	**Numbers and Design capacity**	**2 nos. - 40 TR, 12000 CFM @ 2.0" TSP**
2	**Cooled and Dehumidified air flow rate –**	**12000 CFM**
3	**Cooling coil face area**	**Air velocity across cooling coil face area to be less than 2.5 m/s (500 FPM)**
4	**Number of rows for cooling coil**	**6 or 8 as per selection**
5	**Entering chilled water temperature – deg C**	**44 F**
6	**Leaving chilled water temperature – deg C**	**54 F**
7	**Chilled water flow rate – m^3/hr**	**Refer schedule**
8	**Drain connection on both sides of AHU**	**25 mm dia socket connection**
9	**Coil tube dia**	**13 mm**
10	**No. of Fins**	**Not more than 13 FPI**
11	**Type of fan motor**	**415 V, 3 PH, 50 Hz TEFC Sq. Cage energy efficient**
12	**Type of starter**	**Star-Delta / DOL**
13	**Pre-Filters (cleanable type)**	**Pre filters (panel type) of 90% efficiency down to 10 microns Class EU3 as per BS EN 779. Maximum face velocity 1.75 m/s**

DATA TO BE FURNISHED BY TENDERER

Sl. No.	DESCRIPTION	REQUIREMENT
	Air Handling Unit No.	
	Type	Floor Horizontal, Top discharge
	Model / Make	
	Air entering coil temperature (TE-DB deg C)	
	Air entering coil temperature (TE – WB deg C)	
	Air leaving coil temperature (TL – DB deg C)	
	Air leaving coil temperature (TL – WB deg C)	
	Maximum Air Face Velocity (m/sec) across coil	2.5
	Maximum Air side pressure drop across coil in inches	
	Total Fan Static Pressure in inches	
	External Static Pressure in inches	
	Chilled Water Entering Coil Temperature (deg C)	
	Chilled Water Leaving Coil Temperature (deg C)	
	Chilled Water Velocity – Maximum (m/sec)	
	Coil Rows	
	Coil Fins / Cm.	
	Chilled Water Flow Rate GPM	
	Maximum Chilled Water Pressure Drop (Feet) through coil	
	Type of Fan	FC / BC / Aerofoil
	Type of Fan Control	Variable Air Volume / Constant Air Volume.
	Maximum fan rpm	
	Maximum outlet velocity	M / sec
	Type of Filter (prefilter)	
	Maximum Air side pressure drop across filter (Pascals)	
	Type of Starter	

Sl. No.	DESCRIPTION	REQUIREMENT
	Motor Voltage	
	Type of Vibration isolator	
	Supply and return air noise treatment	
	Controls	
	Dimensions L x B x H	
	Operating weight kg	
	AHU motor kW rating	**BKW / KW**

DATA TO BE FURNISHED BY THE CONTRACTOR AFTER THE AWARD OF CONTRACT AND BEFORE INSTALLATION

1. Schedule of drawings and documents to be submitted for review, approval and information with submission dates.

2. Quality Assurance Plan (QAP).

3. Detailed P & I diagram showing clearly the scope of supply of equipment, piping with line sizes and material specifications, valves, specialities, instrumentation and control and all accessories. This drawing or documents mentioned under following clauses shall include all design data and information furnished in data sheets A and B. The makes of all major components and controls shall be indicated.

4. Dimensioned general arrangement drawing showing all equipment with accessories, mounting details, nozzle locations, etc.

5. Overall space and head room requirement with details of handling during erection, operation and maintenance.

6. Foundation drawing with static and dynamic loading data, pocket details, foundation outline, etc, for all items.

7. Cross-sectional drawings of all items with part list and materials of construction.

8. Performance curves and selection charts for fan, filters, etc. Selection charts and calculation for cooling coil and heating coil.

9. Operation and maintenance manual with lubrication schedule.

10. Catalogues furnishing detailed technical data for fan, coils, filters, etc.

11. CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION:

Data Sheet:

Sl. No.	Description	Unit	Remarks
1.	Entering Air temp DB (deg C)		
2.	Entering Air temp WB (deg C)		
3.	Leaving Air temp DB (deg C)		
4.	Leaving Air temp WB (deg C)		
5.	Entering Water temp (deg C)		
6.	Leaving Water temp (deg C)		
7.	Coil / Filter area (SFT)		
8.	Face Velocity (FPM)		
9.	Air Flow (CFM)		
10.	Fan Speed (RPM)		
11.	Voltage		
12.	Current (A) = R- Phase		
	= Y- Phase		
	= B- Phase		
13.	Over load relay range A		
14.	Over load relay setting A		
15.	Inlet Water pressure (Kg / cm^2)		
16.	Outlet water pressure (Kg / cm^2)		
17.	Noise level AHU room (dBA)		
18.	Vibration level (Microns) = X - axis		
	= Y - axis		
	= Z - axis		
19.	Fresh air velocity (FPM)		
20.	Fresh air filter area (SFT)		
21.	Fresh air flow (CFM)		
22.	Designed CFM		

INSPECTION:

Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipment. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified elsewhere in the specification.

Air handling unit :

Air handling unit of cabinet type along with flexible connection at fan outlet, flexible connection at chilled water pipe inlet and outlet of AHU, filter, fan, motor, outlet damper etc., as specified in tender document shall form one unit for the purpose of measurement and payment.

Supply air fan unit :

Supply air fan unit consisting of fan, fan motor, louvers, filters, vibration isolators, sound attenuators, outlet dampers, flexible connection at fan outlet, weather proof enclosure of GSS cabinet type construction and accessories will be regarded as one unit for the purpose of measurement and payment. This is applicable for measurement and payment of Fresh air supply units, kitchen supply air unit and lift lobby supply air units.

Pre-filters:

Pre-filters and fine filters complete with support, frame etc., shall be measured from the approved drawings I as built drawing on the basis of core area (excluding margin flanges) and paid per unit area. Pre filters and final filters in supply air fan units are part of fan units and no separate payment will be made for the same.

CHILLED WATER PIPING & VALVES

SCOPE

This section lays down the general requirements for Supply, Installation and testing of all Piping works like Chilled Water, Condensate drain piping and Refrigerant piping and related valves and accessories.

CODES AND STANDARDS

The material construction, manufacture, inspection, testing and commissioning of water piping shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in this specification shall construe to relieve the CONTRACTOR of his responsibility. The equipment supplied shall comply with the latest applicable Indian and / or British Standards. Other National Standards are acceptable, if they are established to be equal or superior.

SCOPE OF SUPPLY AND ERECTION

The CONTRACTOR shall supply all piping material like pipes, fittings, flanges and other items as required.

Scope of erection to be performed by the CONTRACTOR is outlined below:

1) The CONTRACTOR shall unload from carriers at plant site, handle, check, receive, transport, store, erect and test all materials furnished by him and others in accordance with this specification and General Conditions of Contract. The EMPLOYER shall be informed of any loss of damage within seven days of receipt of material.

2) The CONTRACTOR shall also install small accessory piping and any specialties furnished for equipment such as relief valves, built-in bypass and other equipment of this type.

3) The CONTRACTOR shall install primary elements for flow measurements, control valves and on-line metering equipment.

4) The CONTRACTOR shall hydrostatically test the entire piping system including valves and specialties.

5) All piping shall be internally cleaned and flushed by the CONTRACTOR before and after erection in a manner suited to the service as directed by the EMPLOYER.

6) For hydrostatic testing and water flushing, the CONTRACTOR shall furnish necessary pumps, equipment and instruments, piping etc. The EMPLOYER will provide water at available points of supply to which the CONTRACTOR's temporary piping will be connected.

7) The CONTRACTOR's scope under this includes the following:

a. Welding materials like welding electrodes, gas rods, oxygen, acetylene, propane and other consumable materials and backing rings etc., as required.

b. Jointing material as required for all screwed joints. Fasteners (bolts, nuts, studs washers etc.) and gaskets are required for all flanged joints.

c. Services of erection superintendents, erection superiors, fitters, riggers, other skilled and unskilled labour.

d. Erection tools, tackles and materials including welding machines.

MATERIAL SPECIFICATION

The material specification for piping, valves & specialities shall be as explained in later sections.

Colour code shall be used to identify pipe material. The CONTRACTOR shall be able to identify on request all random piping prior to any field fabrication.

The CONTRACTOR shall furnish six (6) copies of certificates for piping for –

a) Dimensions and

b) Hydrostatic test

FABRICATION

Wherever welded construction is specified, unless otherwise stated, welding directly on the main header provided the CONTRACTOR establishes the adequacy may make branch connection. Reinforcing plate shall be used for all branch connections to provide compensation for the material removed in the main line. Branch connection in galvanized piping shall be made by using suitable reducing tees.

Wherever space permits, the CONTRACTOR may use pipe bends (3D) for pipe sizes 50 mm nominal size and under. The CONTRACTOR shall ensure that undue thinning of pipe wall does not occur due to bending.

Welding ends for butt-welding shall be bevelled as per relevant standards.

For line joints, the CONTRACTOR shall employ welded construction for all black steel piping. All black steel pipes 65 mm and below shall have socket welded joints, unless otherwise specified.

CLEANING OF PIPING

All piping shall be wire brushed and purged with air blast to remove all rust and mill scale from inner surface. The method of cleaning shall be such that no material is left on the inner or outer surfaces, which will affect the serviceability of the pipe.

PROTECTION DURING TRANSIT

Effective precautions such as capping and sealing shall be taken to protect all pipe ends against ingress of dirt and damage during transit or storage. The outside of the carbon steel pipe (black) shall receive two coats of red lead paint.

SHOP AND FIELD HYDROSTRATIC TESTS

All pipes and fittings shall be tested hydrostatically at the ships where manufactured to test pressures which are given in the applicable codes mentioned. All piping systems shall be tested hydrostatically by the CONTRACTOR after erection.

The chilled water and condensate drain piping shall be suitably insulated as per specification.

Automatic air vents shall be installed at all high sections of piping as well as in the AHU room piping. The discharge from these air vents shall be piped via copper tubes of appropriate size to the nearest waste drain pipe.

GUARANTEE

The CONTRACTOR shall guarantee all material, fabrication and workmanship, erection, installation and proper functioning of all the piping and also tightness of all joints, for a period of one year from the date of commissioning.

The CONTRACTOR shall employ both in shop and field, qualified personnel and welders qualified recently to the satisfaction of the EMPLOYER.

If any shop fabrication part fails to meet the field tests in such a manner that the EMPLOYER's Inspection believes that the defect is minor, it will be remedied in the field by the CONTRACTOR at no cost to the EMPLOYER. In the event the EMPLOYER rejects defective part as not being capable of remedy in the field, the CONTRACTOR may at the EMPLOYER's discretion be required to transport new parts, from his shop at his own expense.

WATER PIPING

a) All chilled water and condensate drain piping up to 300 mm dia shall be of medium class black steel conforming to IS:1239. All pipe joints shall be welded while screwed joints shall be used for smaller sizes. Pipe flanges shall conform to IS:1536 whereas the threads shall conform to IS:554. Pipes above 300 mm but below 600 mm dia shall be fabricated using MS Plates of thickness 8 mm.

b) Whenever GI pipe is cut, it shall be painted with 2 coats of zinc paint both internally and externally over a coat of zinc chromate primer.

c) The ends of pipe lengths to be welded shall be cut square by a machine saw and the edges leveled to form a 'V' groove before welding. Under no circumstances, the edges shall be formed by gas cutting or welding.

d) Weld on flanges shall be as per IS:6392 and may be steel welding neck type or slip on type welded to the pipes. Flanges may be tack welded in position but all other welding shall be done with the joint dismantled. Gaskets of 3 mm thick 3 ply rubber shall be used with flanged joints.

e) The screwed flanges shall also conform to IS:6392 and shall be screwed to the pipes. Gasket of 3 mm thick 3 ply rubber shall be used.

PRESSURE GUAGES & THERMOMETERS

Bourdon type pressure gauges with aluminium casing with a minimum 100 mm dial and appropriate range complete with needle valves shall be provided at the inlet and outlets of heat exchangers, and pump sets.

Thermometers shall be of dial type mounted on a board with separable copper well. The case shall be of cast aluminium, weather & water proof type. Thermo well shall be provided at the inlet and outlet of all heat exchangers.

TESTING

a) All piping shall be tested to hydrostatic test pressure of atheist 1½ times the maximum operating pressure but not less than 7 KSC for a period of not less than 24 hours. All leaks and defects in joints and piping during the test shall be rectified and got approved. No pipe shall be welded with water inside the pipes. Piping repaired subsequent to the above pressure shall be retested in the same manner. Systems may be tested in sections and such sections shall be capped securely. Entire system shall then be retested. Noiseless circulation of water in the circuit should be achieved. If improper circulation due to air lock is found, it is the responsibility of the air- conditioning contractor to carry out all the rectification including opening and refinishing of floor, wall etc.,

Pressure gauges should be valved off during pressure testing. The air- conditioning contractor shall provide all materials, tools and instruments, services and labour required to perform the test and to remove the water resulting from cleaning and after testing.

b) The consultants shall be informed well in advance by the air- conditioning contractor of his intention to test a section or sections of piping and all such tests shall be witnessed by the consultants or their authorized representatives. Test certificates duly signed by the contractor and the consultant shall be submitted by the contractor after completing the tests.

c) No insulation shall be applied to pipes unless the pressure testing is completed to the satisfaction of the consultants/ client. Insulation shall be done as per the tender specifications.

d) After completion of the installation, the pipe lines are to be flushed thoroughly to blow out the entire dirt and muck. Commissioning strainers shall be used before all equipment.

The system then shall be balanced to deliver the water quantities as specified. Balancing report after certification shall be submitted with completion drawings and documents.

e) Pipelines shall be provided with one coat of primer and 2 coats of paint of color and quality as specified. Insulated piping and valves shall also be provided with painting in a similar manner. Direction of flow shall be marked on pipelines in bold markings.

f)) Provide automatic air vents at highest points. The body shall be of cast iron and the float and leverage shall be of stainless steel. The operating pressure shall be 150 psig. Air vents, purge and drain valves are considered to be a part of the piping and no extra cost will be paid for the same.

g) Provide expansion joints to prevent bending, bowing of pipes resulting in unusual stresses. The expansion joint shall be complete with anchor bases, inner liners, tie rods, outer jackets and flanges. The expansion joints shall be of stainless steel.

h) Provide flanged rubber bellows at pump, chiller inlets and outlets that are assumed to be a part of the equipment.

VALVES

a) GATE AND GLOBE VALVES

Gate and globe valves up to 50 mm size shall be gun metal construction. Valves above 50 mm dia shall have cast iron body and bronze/gun metal spindle valve seat. The valves shall have non rising spindle.

b) BUTTERFLY VALVES

The butterfly valve shall be supplied along with flow control lever. The valves shall be compact in size and shall conform to BS 5155,MSS SP 67 and API 609. The valves shall be light in weight and easy to install. The body shall of close grain cast iron conforming to IS:210 and the seating shall be of Resilient black, Nitrile rubber / EPDM moulded on to the body. The disk shall be of SG iron nylon coated, whereas the shaft shall be of stainless steel A ISI 431 treated permanently for lubrication. The shaft seals shall be of Nitrile 'O' rings and rubber seals. Valves shall be suitable for a working pressure of 150 psig. Care should be taken during installation to see that the disk is not damaged during installation due to the flanges being incorrectly spaced. Provide gear operated valves for sizes having 150 mm and above. For smaller sizes such as 40 mm and below diaphragm type valves are acceptable.

c) BALL VALVES

Ball Valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shal be of PTFE. The valve shall be complete with socket weld ends.

d) CHECK VALVES

Check valves for smaller sizes shall be of swing type of gun metal construction. Lift type check valves shall be used for horizontal lines. Wafer type plate check valves shall be used for bigger sizes as shown in the specifications. The check valves shall be suitable for 10.5 KSC test pressure.

e) STRAINERS

Strainers shall be preferably of approved 'Y' type or pot type as specified in the tender schedule with GI or fabricated steel bodies. Strainers up to 50 mm shall be of gun metal type. Strainers shall have a removable bronze screen with 3 mm perforations and permanent magnet. Strainers shall be provided with flanges. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of all screen without disconnection from the main pipe. Strainers shall be provided with isolating valves so that they may be cleaned without draining the entire system.

f) MANUAL CHILLED WATER FLOW BALANCING VALVES

Balancing valve shall be installed in branch pipe connecting cooling coils of AHU and wherever shown on drawing. These valves shall be factory calibrated. Each valve shal limit flow rates to within ±5% accuracy, regardless of system pressure fluctuations.

g) Sufficient number of flanges and unions shall be provided as required to facilities maintenance work once the piping is installed. Piping shall be properly supported on or suspended from stands, clamps, roller hangers, etc., as required. The contractor shall adequately design all brackets, saddles, clamps and hangers and shall be responsible for their structural integrity. Each support shall be
isolated from the support by means of anti- vibration springs or durable liner of neoprene rubber.
Pipe supports shall be of steel and shall be painted with rust preventive paint and finish coated with synthetic enamel paint of approved color. Only factory made supports with Galvanized fully threaded rods with bands are acceptable. The chilled water pipes shall be isolated from the bands by a rubber sheet. Pipe supports on the terrace exposed to weather shall be hot dip galvanized.

h) The spacing of pipe supports shall not be more than that as specified below:

NOMINAL PIPE SIZE IN M	SPACING IN M
Upto 25 mm	1.5 m
32 to 150 mm	2.5 m
above 150 mm	3.0 m

The GI support rods shall be 8 mm thick for pipes upto 50 mm dia, 10 mm for pipes from 65 mm to 125 mm dia and 12 mm for pipes 150 mm dia and above.

i)) Extra supports shall be provided at bends and heavy fittings like valves to avoid undue stresses on the pipes.

j)) Suitably designed blocks shall used for resting the pipe on the supports wherever required.

k) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe with a 12 mm thick rubber pad. Risers shall also have a suitable concrete pipe support at the lowest point.

l) Pipe sleeves of 50 mm larger diameter than the pipe shall be provided wherever pipes pass through the walls and the annular space filled with felt and finished with retaining rings. Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge sheet shall be provided between the insulation and clamps, saddle extending at least 10 mm on both sides of the clamps, saddles.

m) All welded bends shall be of 5 piece construction for pipe sizes 200 mm dia and for larger pipes atleast 7 piece construction shall be provided.

n) Where pipes are laid underground, the top of the insulated pipes shall not be less than 750 mm from the ground. Pipes shall be placed over RCC / PCC sleepers as shown in the drawing. Buried pipes shall be covered by river sand cushion for a height not less than 150 mm from the top of the pipe. After pipes have been laid and top sand cushion provided, the trench shall be refilled with

excavated soil and any extra soil shall be removed from the site of work by the contractor. RCC / PCC sleepers are in the scope of the air-conditioning contractor.

o) All piping work shall be carried out in a workman like manner causing minimum disturbance to the existing services. Piping installation shall be carried out with vibration elimination fittings wherever required. While installing the pipes, adequate clearance shall be provided for insulation wherever insulation is called for.

p) Drains shall be provided at all low points in the piping system and shall be of the following sizes:

MAIN LINE SIZE IN MM	DRAIN SIZE IN MM
Upto 300	25
Over 300	40

Drain shall be provided with gate valves of equal size but with rising spindle. Alternatively, ball valves shall be provided. Drain shall be piped through G. I medium class pipe to the nearest floor drain. Piping shall be pitched towards the drain points. Wherever specified, drain pipes for the ceiling suspended units and fan coil units shall be provided with water grade blue HDPE/ PVC pipe with screwed joints. The joints shall be proper so that no water leaks over the false ceiling. The pipes shall be tested for leaks to a minimum pressure of 1 KSC before the false ceiling sheets are fixed.

q) Air vents shall be provided at all high points in the piping system for venting. Air vents shall be of gun metal construction and of automatic type. Similarly drain valves shall be provided at all dirty legs. The size of the valves shall be 25 mm size for pipes upto 100 mm and 40 mm for sizes larger than 100 mm. Drain shall be closed with dummy caps to prevent accidental opening.

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

Sl. No.	**Description**	**Unit**	**Remarks**
3.	Hydrostatic pressure conducted as per specification		
4.	Any leaks		
5.	Any defects in joints		
6.	Tested after rectifying defects		
7.	Test witnessed and certified		
8.	Any noise in piping system		

Sl. No.	Description	Unit	Remarks
9.	Any water noise in coils		
0.	Any water noise in equipment		
1.	Proper flow achieved through AHU, FCU		
2.	Piping insulation checked		
3.	All valves open		
4.	All motorized valves close / open		
5.	Expansion joints provided and checked		
6.	Pipe work cleaned		
7.	Water condition after pipe cleaning checked		
8.	Expansion tank Ball valve functional		
9.	All strainers clean		
0.	Pressure gauges working		
1.	Thermometers working		
2.	Drain points provided at Low points		
3.	Air vents provided at High points		
4.	Pipe support and spacing checked		
5.	Pipe material checked		

INSPECTION:

Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipment. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified elsewhere in the specification.

Piping and Pipe insulation

All water pipes and other pipes be measured nett length and measured linear over all fittings such as bends junction etc., and given in running metres. The length shall be taken along -With centre lines of the pipes and fittings. The unit rate shall include fittings (Elbows, Tees, bends, Mitres, Reducers, flanges, Gaskets, Bolts, Nuts, CAPS, Blind flanges and end closures). The measurements will be based on the approved drawing I as built drawing and paid per unit running metre. Length of other fittings (valves and strainers), which are paid under appropriate item, shall not be re-measured under linear measurement. The bill of quantities specified does not include any wastages during fabrication and erection. These shall be included by the

tenderer in the unit rate. Also the unit rate quoted shall include piping insulation for chilled water piping and other pipes, no separate payment will be made for piping insulation.

Valves

Each Valve including accessories shall be regarded as one unit. The quantity of valves will be based on the approved drawing I as built drawing for the purpose of measurement and payment. Also the unit rate quoted shall include valve insulation for valves in chilled water piping, no separate payment will be made for valve insulation. The unit rate quoted for motorized valves shall include cost of actuators, no separate payment will be made for valve actuators.

Strainers

Each strainer including accessories shall be regarded as one unit. The quantity of strainer will be based on the approved drawing I as built drawing for the purpose of measurement and payment. Also the unit rate quoted shall include strainer insulation for strainers in chilled water piping, no separate payment will be made for strainer insulation.

SHEET METAL WORK

SCOPE

The scope of this section comprises supply fabrication, installation and testing of all sheet metal ducts.

Governing Standards

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA – 1995 Standards ("HVAC Duct Construction Standards – Metal and Flexible –Second Edition – 1995 "– SMACNA)

Raw Material

Ducting: All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certificates.
Galvanising shall be of 120 gms/ Sqmt. (Total coating on both sides)

In addition, if deemed necessary, samples of raw material, selected at random by client's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense.
G.I. raw material should be used in coil – form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.
Duct Connectors and Accessories: All transverse duct connectors (flanges /cleats) and accessories / related hardware are such as support system shall be zinc coated (galvanized).

FABRICATION STANDARDS

All ductwork including straight sections, tapers, elbows, branches, shoe pieces, collars, terminal diffuse boxes and other transformation pieces must be factory – fabricated

Coil line to ensure location of longitudinal seams at corners / folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.

All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.

All edges to be machine treated using lock formers, flangers and roller for turning up edges.

Sealant dispensing equipment for applying built – in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

SELECTION OF G.I. GAUGE AND TRANSVERSE CONNECTORS

Duct Construction shall be in compliance with 1 "(250 Pa) w.g Static norms as per SMACNA.

All transverse connectors shall be 4 bolt slip – on flange system with built-in sealant.

The specific class of transverse connector and duct gauge for a given duct dimension will be as per Table 1 below for 1" (250 Pa) pressure class.

Non – toxic, AC – applications grade P.E. or PVC Gaskets are required in between all mating flanged joints. Gasket sizes should conform to flange duct manufacturer's specification.

DUCT CONSTRUCTION

The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.

Dimensional Tolerances: All fabricated dimensions will be within +/- 1.0mm of specified dimension. To obtain required perpendicular, permissible diagonal tolerances shall be +/- 1.0 mm per metre.

Each and every duct pieces should be identified by colour coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge.

Ducts shall be straight and smooth on the inside. Longitudinal seams shall be Airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch as SMACNA practice, to ensure air tightness.

Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence.

Plenums shall be factory fabricated panel type and assembled at site. To be supplied along with Air Handling Units by AHU supplier only.

SUPPORT SYSTEM

A completely galvanized system consisting of fully threaded rods, double L bottom brackets (made out of 3.0 mm M.S. sheet) nuts, Washers and anchor bolts as supplied by Rolaster or approved equivalent or generally conforming to SMACNA standards should be used.

As an alternative, slotted galvanized brackets attached to the top two bolts of the system may also be used as appropriate for the site condition.

To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct supports and duct profiles in all supply air ducts not enclosed by return air plenums.

INSTALLATION

Tools and tackles for site work

The duct installation shall confirm to SMACNA norms. For duct assembly and Installation the use of suitable tools and tackles should be used to give the Required duct quality and speed of installation including (but not restricted to)

a) Electric Pittsburgh Seamer – used for closing Pittsburgh joints.

b) Electric Slitting shear – to make cut – outs.

c) Drilling machine with drill bits – for drilling holes in sheet metal work.

d) Hammer drill machine with drill bits – for drilling holes in building structures for anchors.

e) Hoisting system – for lifting the duct assembly upto mounting heights.

Installation Practice

All ducts shall be installed as per tender drawings and in strict accordance with approved shop drawing to be prepared by the Contractor.

The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specifications and drawings.The work shall meet with the approval of Consultant's and PMC's site representative in all its parts and details.

All necessary allowances and provision shall be made by the Contactor for beams, pipes, or other obstructions in the building whether or not the same are shown on the drawings. Where there is interference/ fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably as per actual site conditions.

Ducting over false ceiling shall be supported from the slab above, or from beams. In no case shall any duct be supported from false ceilings hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick appropriate insulation around the duct and totally covered with fire barrio mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, Air Handling Units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

DOCUMENTATION & MEASUREMENT OF DUCTING

All ducts fabricated and installed should be accompanied and supported by following documentation:

For each drawing, all supply of ductwork must be accompanied by computer generated detailed bill of materials indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct area by gauge and duct size range as applicable.

Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

TESTING

After duct installation, a part of duct section (approximately 5 % of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA – "HVAC Air Duct Leakage Test Manual" (First Edition)

DUCTWORK LEAKAGE TESTS

Type

All ductwork shall be pressure tested for leakage, smoke test is not acceptable.

The Sub-contractor shall provide the necessary test equipment and skilled labour to carry out the tests satisfactorily.
Tests shall be witnessed and certified by the Consultant or his representative. Prior to witness of final tests, the sub-contractor shall carry out preliminary tests to ensure the test results are within specified limits.
All ductwork shall be tested for leakage without duct insulation or duct enclosure at the joints.
Accuracy of the test apparatus shall be within:
±5% of the indicated flow rate or 0.4 I/s, whichever is greater, and
5% of the indicated static pressure in duct under test.
The test apparatus shall have a calibration certificate, chart or graph dated not earlier than one year before the test for which it is used.

DAMPERS

Fire Damper (FD)

The scope of the fire damper supply inclusive of Fire damper, Sleeves, Duct connecting GI Flanges, Wall retaining GI flanges, Actuator / Fusible links, Temperature sensor / smoke sensor, control panel, step down transformer, Fire sealant material, supports, bolts & nuts etc., The scope also inclusive of necessary installation, testing and commissioning of the same.

Fire damper control options

With Fusible Link and Spring Mechanism
The damper is held open by a replaceable fusible link rated at 74^{o}C (U.L.stamped). In the event of the increase in temperature the fusible link shall melt & the damper shall close shut with spring action.
actuates and releases the blades to shut off.

Aluminum Opposed Blade Collar Damper

The collar damper should be of robust construction for positive control of air at the supply air collar position, to be of multiple leaves oppose blade type made of high quality extruded aluminium extruded alloy. It should be provided with necessary linkage for smooth operation. These dampers should be with anodized matt black finish for durability and non visibility.. It shall be installed at the terminal supply air collar / neck of the grille / neck of the diffuser. These dampers are to be provided with key for the operation from the face of the grille or diffuser at the same time it should not projected out of the grille / diffuser.

GRILLES & DIFFUSERS

GENERAL

All air terminal devices mentioned in the tender documents / drawings shall be made out of extruded aluminium sections with very high quality finish. Grilles &
diffusers shall be of extruded aluminium from hard stock free from pits and spots joints shall be hairline. The colour of powder-coated finish shall be as per Client/Architect approval.
Grilles / Diffusers shall be sized / selected according to type of air flow like supply or exhaust, air throw distance within limits of sound pressure level NC-30 curve as a typical room having average room attenuation of 8 dB.
All supply and return air grilles and diffusers shall be as per the approved list furnished in the document. Consultants / Architect reserves right to choose the best. The grille shall be provided with powder-coated paint of approved colour. Further, the contractor shall submit a sample of grilles & diffusers for the approval.
The scope of the contractor with supply of material shall include but not limited to the following items.

a) Supply of materials.
b) Powder coated painting of the same.
c) Providing necessary materials like wooden frame / GI frame, fasteners, supporting arrangements.
d) Installation & air balancing of the same.
e) Measurement of grilles & diffuser shall be based on the neck size only.

CONSTRUCTION DETAILS.

All Diffuser / Grilles to be constructed with high quality aluminium alloy extrusions.
The supply air diffuser / grilles to be provided with damper. The square / rectangular damper shall be constructed with extruded aluminium of opposed blade type. And the circular damper shall be constructed with aluminium sheet and should be of 2flap or multi flap type.

The type of diffuser & Grilles the neck size, outer size, nos. of slots, deflection of blades of the grilles, throw direction and other details as per the BOQ and the tender drawing and specifications and as per the selection of manufacturers standards.

The grille should be with normal blade of thickness 3 to 5mm and the depth projected inside the false ceiling shall be of maximum 11mm. The grille blade pitch shall be 12.5mm shall be given with 0^o, 15^o, 30^o, 45^o as required as per drawing, specifications and selections.
Wherever the grilles & slot diffuser are continuous type, the total length should be divided equal of maximum possible length for supplying of material, No additional small piece is accepted. All the diffuser & grilles should have all around flanges.

BIRD SCREENS

Galvanised woven mesh or weld mesh bird screens in rigid galvanised iron frames shall be installed behind all external louvers and over all relief and exhaust air openings to the outside of the building.

INSULATION

SCOPE

The supply and return air ductwork shall be provided with insulating materials complying to the technical data specified herein.

Insulation deviating from the specification shall only be offered as an alternative.

Full technical data and specification in respect of the insulation offered shall be submitted with the tender.

EXTERNAL INSULATION OF CONCEALED DUCTS

All supply air ductwork located in false ceiling and other concealed areas shall be externally wrapped with 13 mm thick Closed cell nitrile rubber elastomeric/XLPE insulation with Aluminium foil.

The thermal conductivity shall not exceed 0.034 W/mk (0.235 BTU in/ft2/h/˚F).

The nitrile rubber elastomeric/XLPE insulation shall be classified as non-combustible by the Fire Authority and tested in accordance with BAS 476: Class O Standard.

The Aluminium foil shall have a flammability index of 2 and be tested in accordance with BS 476: Part 7: 1971, or Australian Standard 1530 Parts 2:3.

INTERNAL (ACOUSTIC) INSULATION DUCTS:

Acoustic insulation shall be provided for the following:

All supply air plenums.

Insulation material shall be Open cell cross linked polyolefin foam insulation/XLPE insulation of density 30 kg/ m3 and fire retardant in nature. The thermal conductivity (K) value shall not be more than 0.041 W/m K . Thickness shall be minimum 12 mm for Duct Acoustic Insulation. Manufacturer recommended adhesive shall be used to ensure adherence of duct insulation to surface of the ducts.

CHILLED WATER PIPING FOR AHU AND FCU

All chilled water piping, condensate drain piping shall be insulated as indicated herein. Prior to application of insulation, all pipe work shall be cleaned on the surface with wire brush to remove dirt and dust.

The insulation for chilled water piping shall be carried out from 50 mm Polyesterin/ 19mm XLPE insulation covered with 24 G Al. cladding having a minimum 'K' value of 0.032 W/m k at mean temperature of 200 C and a density of 25 Kg/cum.

Arrows indicating direction of flow shall be clearly marked.

SYSTEM STARTUP AND COMMISSIOINING

Work Included

This Section specifiesthe requirements for pre balance, start-up, and commissioning of mechanical systems, including, but not limited to:

i) General purpose and comfort air handling systems.

ii) General purpose and building exhaust systems.

ii) Chilled water systems

Requirements for the following are included:

i) HVAC systems pre balancing.

ii) HVAC systems manual run.

iii) HVAC systems balancing.

iv) HVAC control system testing.

v) HVAC systems, commissioning.

vi) HVAC systems 72 hour acceptance test.

Related Work

This Section shall be used in conjunction with the following other specifications and related Contract Documents to establish the total standard requirements for HVAC systems start-up and commissioning:

Provide services described in this section and in accordance with Builder Start-up Program see the Systems Start-up and Commissioning Appendix, at the end of this section. Contact Builder for a copy of this document

Quality Assurance

ASHRE Project Managers Guideline 1, the HVAC Commissioning Process.

Definitions

HVAC systems commissioning consists of the following:

Verify operation and functional performance of HVAC systems for compliance with design documents.

Document HVAC tests inspections.

Verify application of operation and maintenance manuals, as-built (record) documents, spare parts listing, special tools listing, another items as may be specified herein for support of HVAC systems and equipment.

Coordinate and direct training to personnel for operation and maintenance of HVAC equipment and systems.

Documentation

The Subcontractor shall prepare and have ready the following documents at the start of commissioning:

Project plans and specifications (Subcontract documents), authorized revisions, HVAC shop drawings and submittals (approved),test and balance reports, equipment start-up and certification reports, etc.

Records of required code authority inspections documentation signoff, etc.

Submittals

Submit the following for approval prior to starting the commissioning process:

i) Commissioning plan scheduling, sequence, documentation requirements, verification procedures, staffing requirements, etc).

ii) Training plan (scheduling, sequence of training personnel involved, etc.).

iii) Tool list.

After commissioning is complete, the Subcontractor shall submit all documentation obtained Products Instrumentation

The Subcontractor or agency performing prior tests shall provide instrumentation. Individual subcontractor shall operate instruments or agency as requested by Subcontractor.

Execution

General

Subcontractor personnel involved in commissioning (commissioning team) shall actively participate in construction phase of the project to ensure compliance with HVAC commissioning requirements.

Procedure

Commissioning team shall attend preconstruction meeting and establish requirements for HVAC commissioning authority process throughout construction phase.

Commissioning team shall prepare and submit to Contractor and Builder an HVAC commissioning outline which shall include:

Responsibility of each trade affected by HVAC commissioning, as required by appropriate paragraph of this Section.

Requirement for documentation of commissioning process.

Requirements for documentation of HVAC tests and inspections required by code authorities.

Format for training program for operation and maintenance personnel.

Commissioning team shall periodically attend construction and coordination meetings.

HVAC Systems Pre-balance

Subcontractor shall perform the following work for pre-balancing of all air hydraulic systems:

Prior to completion of the duct and piping systems, the mechanical subcontractor shall coordinate and fully cooperate with the balancing subcontractor. All drawings shall be checked and any dampers, balancing valves, or devices not shown on the Drawings, but necessary for proper balance as determined by the balancing subcontractor, shall be added or relocated at no additional cost. After completion of the duct and piping systems, the mechanical and balancing subcontractors shall both certify, in writing, to Contractor that the systems have been checked and that all devices are installed to facilitate the balancing work.

Complete all duct and piping pressure testing as specified.

Complete all punch list items which may affect balancing.

Remove all shipping and storage protection; remove shipping locks from vibration isolators and clean debris from under all isolated equipment.

Check all motors for rotation. Log RPM, voltage, and amps.

Check starter heater sizes for conformance with motor nameplate data.

Adjust and align all sheaves and belts; set all adjustable sheaves to provide specified RPM. Ensure all rotating components turn freely without interference or binding.

Install temporary construction filters or media as required.

Set all dampers, diffusers, grilles, extractors, inlet vanes, valves, and balance valves to the full open position.

The controls subcontractor shall, either via the control system or manually at each device, fully open all automatic control valve and dampers.

Drill all probe holes required for static pressure readings, pitot tube traverse readings, and temperature readings. Coordinate locations with balancing subcontractor. Install plastic plugs in all such holes.

Clean interior of all plenums, casings, and ducts, and install all specified filters.

Lubricate all equipment per manufacturer's recommendations and provide access to lubrication fittings as required.

Align all pumps and ensure that bases are grouted as required; check alignment of all flexible pump connectors. Flush clean all piping systems from debris. Treat piping systems with chemicals, if required.

Fill, bleed, and charge with chemicals all piping systems.

HVAC Systems Manual Run

Upon the completion of above and the submission of the documentation required for above Items, the Subcontractor shall perform the following:

a) Charge and start chillers, pumps, ceiling suspended units and all other major pieces of equipment Manufacturer's representatives shall perform the start-up of all major equipment. Setting of all operating and limit equipment controls shall also be by manufacturer's representative. Log all settings and furnish a start-up report for each piece of equipment.

b) Check all systems and equipment for excessive noise and vibration. Check and adjust all spring isolators

and replace any that are "bottomed out". Any problem area shall be reported to Contractor and Builder for corrective action.

c) Perform final vibration balance and testing for equipment requiring vibration balancing after installation as specified.

d) Operate all equipment manually (in the LOCAL or HAND mode) for a minimum of 5 (five) consecutive 8 hour days. All variable frequency drives shall be set to HAND or MANUAL (not BYPASS) with the output set at 100 percent. Repair or replace any piece of equipment, which fails during this period, and restart the test for that machine.

e) After such time as all systems have been successfully operated for the aforementioned 5 day period, the mechanical subcontractor shall so notify Contractor so that the balancing subcontractor may begin his work.

f) At the completion of the above test run, remove all start-up strainers. Clean all permanent strainers. Replace temporary filters and/or clean permanent filters. Generally make all systems ready for full-time operation.

HVAC Systems Balancing

a) Air and water balancing have been specified under separate paragraphs of this Section. The Subcontractor shall provide the following support during balancing:

b) Make available a qualified technician for 10 man hours to assist and instruct the balancing subcontractor. The Subcontractor shall document (via daily time vouchers signed by Contractor) any labour thus expended. At the completion of the projectthe Subcontractor shall credit to Contractor any unused labour at standard hourly rates per the Bid Form.

The mechanical subcontractor shall operate and maintain all equipment and systems for the use of the balancing and controls sub contractors from the time of initial startup until the successful completion of the final 72 hour test, Builder acceptance, and start of the warranty period.

It shall be the responsibility of the balancing subcontractor to determine and convey to the mechanical subcontractor the sizes of any required fan sheave changes. Any sheave replacements shall be the responsibility of the balancing subcontractor and will be treated as a change order for this project.

HVAC Control System Testing

a) The control system testing phase requires that the controls subcontractor, with assistance from the mechanical subcontractor as necessary, perform a complete checkout and verification of the proper operation and calibration of all system points, sequences, interlocks with associated systems (e.g., fire alarm and equipment switchover for backup), and loop functions. The purpose of this phase of work is to place the system into automatic operation in preparation for verification of themechanical and controls system operation by the 72 hour system acceptance test.

b)<u>The testing phase will consist of the following steps:</u>

a) Field testing and verification (loop checks).

b) Performance verification.

c) Test 1 is conducted by the controls subcontractor. This portion of the test verifies accurate wiring and pneumatic connections from control devices, i.e., sensors, valves, thermostats, damper actuators, switches, relays, and control panels.

d) All sequences of operation specified and identified in the Drawings and specifications shall be tested. Calibration of sensors, transmitters, controllers, and actuators to achieve set point tolerances for all control loops shall be accomplished during this test.

e) The controls subcontractor shall submit checklist forms to Contractor for approval at least

2 weeks prior to beginning Test 1. These forms shall identify all devices, sequences, set points, etc., which are to be tested as part of Test 1.

f) Project Managers and Builder may choose to observe any or all of the testing performed for Test 1.

g) Test 2 is the demonstration by the controls subcontractor to Contractor and Builder that all equipment is tested and ready for final system commissioning.

h) Test 2 will be started after three prerequisites are met:

a) Test 1 must be completed by the Subcontractor.

b) The completed Test 1 checklists have been submitted to and approved by Project Managers and Builder.

c) The controls subcontractor shall certify in writing that each wiring and pneumatic connection has been checked, the operation and calibration of each device has been verified, all sequences have been observed, and all have been found to be complete and operational.

HVAC Systems Commissioning

HVAC systems commissioning shall begin after the pre balance, manual run, air and water

balancing, and control system testing phases are completed.

b) Builder and Project Managers shall be included in the commissioning process.

c)Verify air and water balancing readings, such as supply and return air quantities, fan performance, hydraulic performances, branch duct readings, boiler performance, chiller performance, cooling tower performance, etc.

d) Verify calibration of temperature sensors, relative humidity sensors, dew point sensors, pressure transmitters, and related controls, such as damper settings, valve positions, VAV boxes, etc.

e) Verify readings of remote data and control systems, such as temperature, relative humidity, dew point, pressure, damper positions, variable frequency drive settings, etc.

f) Verify operation of system modes, such as humidification / dehumidification, smoke purge system operation, equipment failure and backup unit startup, etc.

g)Verify that total HVAC systems are performing to provide conditions outlined in design documents such as temperature control, humidity control, pressurization control, control system response, etc.

Mechanical and Electrical 72 Hour Systems Acceptance Test

The purpose of the 72 hour systems test is to demonstrate that the overall system will function

reliably and in accordance with the design documents.

Systems that are capable of producing trend logs for control points shall be utilized to produce these logs to record the status of temperature, pressure, humidity, etc., during the test. The points to be monitored will be determined by Contractor and Builder.

c) The 72 hour test is a prerequisite to obtaining a notice of Substantial Completion for the mechanical, electrical, and control systems. Equipment and systems warranties shall begin with Substantial Completion and acceptance by Builder.

d) Successful completion of the 72 hour test is a prerequisite to obtaining a notice of Substantial Completion for the mechanical, electrical, and control systems. Equipment and systems warranties shall begin with Substantial Completion and acceptance by Builder.

e) All HVAC systems and associated control and alarm interlocks shall be operated for a period of 72 consecutive hours. During the 72 hour period, all systems shall function in a completely automatic mode without any equipment shutdown of malfunction. All systems shall operate to maintain design sequences and conditions.

f)Any system shutdown, malfunction, or deviation from design sequences during the 72 hour test will be cause to discontinue the test and restart after faults are corrected. Builder will determine if a failure is severe enough to discontinue the test.

NOTES ON DRAWINGS:

1. The drawings furnished to the tenderer shall be interpreted by the use of given dimension and nomenclature only, they shall not be scaled under any circumstances. Drawings to a large scale have precedence over those to a smaller scale. These drawings are general in nature and cannot be regarded as working drawings.

2. Drawings have been prepared showing the areas to be air conditioned and the space allocated for plant room, equipment rooms, etc. The equipment offered shall be accommodated within the space provided as far as possible. If nevertheless additional space is required for the equipment offered the tenderer shall bring out this point clearly in the tender itself. He shall note in this context that claims for additional space, if made at a later date will not be entertained.

3. Space allocated for major air conditioning equipment shall be taken into consideration before ordering the equipment and they shall fit into the space provided with required clearance all round as per relevant I.S.S and I.E Rules.

4. Layout of equipment, duct routings, etc., as shown on the drawings, represent a feasible scheme. Apparatus may be re-arranged in the space allocated subject to the approval of the Consultants/Client.

5. Detailed Working Drawings

6. Prior to the execution of the work, the contractor shall check all drawings, specifications and shall within fifteen days report any errors, discrepancies and or omissions discovered therein to the Consultants/Clients and obtain appropriate orders on the same. Any adjustment made by the contractor without prior approval of the Consultants/Clients shall be at his own risk and cost.

7. The drawings attached to these specifications are general in nature and cannot be regarded as working drawings. The contractor shall prepare his own detailed working drawings and get them approved by Consultants/Clients before execution. For any further drawings or specification that may be required for the execution of the works or otherwise under the contract, the contractor shall give adequate notice in writing to the Consultants.

8. Prior to submission for approval, the contractor shall be responsible for thoroughly checking all drawings to ensure that they comply with the intent and the requirements of the contract specifications and that they fit in with the overall building layout.

9. The contractor shall obtain the approval in writing of the Consultants/Clients for his detailed working drawings before proceeding with the work. Any alterations proposed by the Consultants/Clients shall be incorporated in the drawings by the contractor and the corrected drawings shall be submitted once again in multiple sets to the Client.

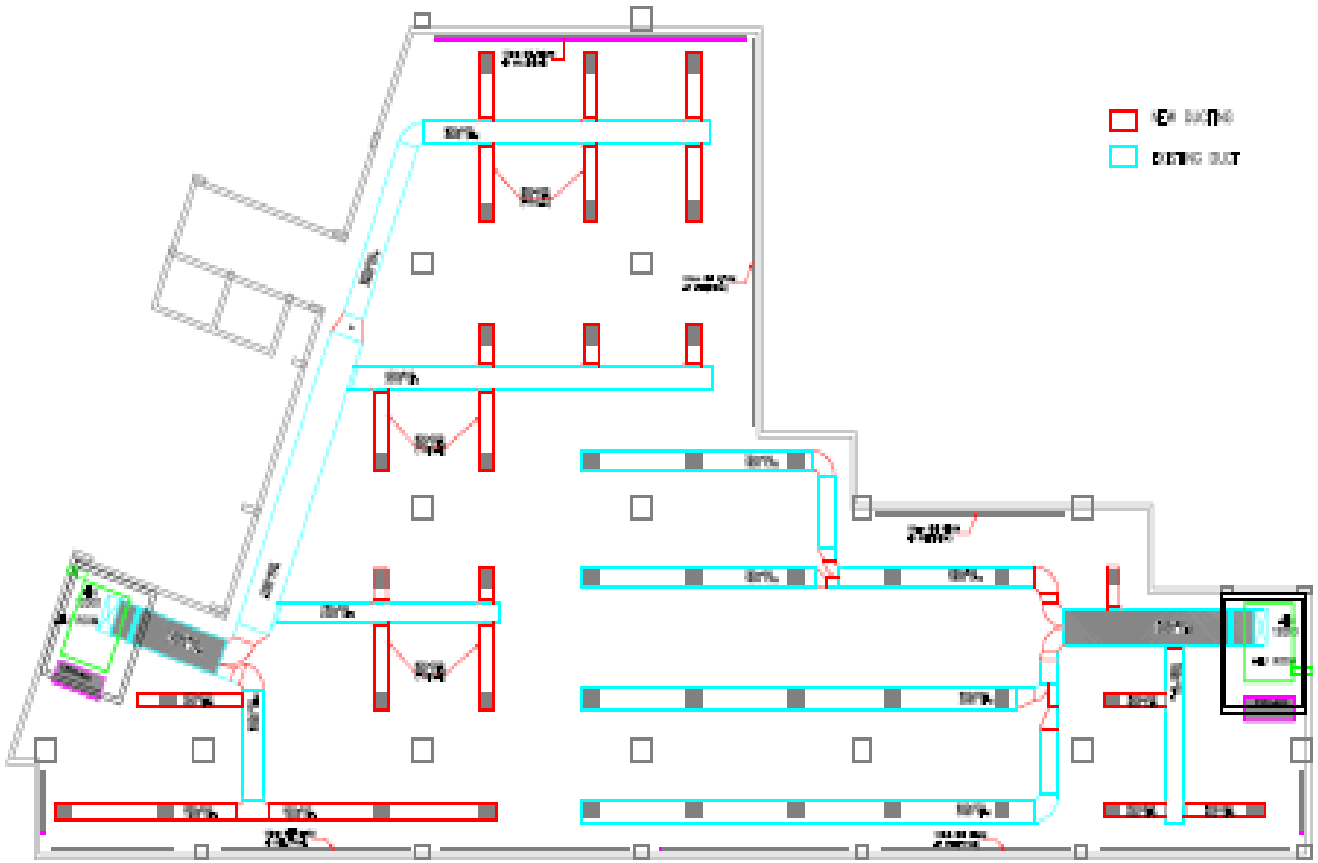
10. The working drawings to be submitted by the contractor shall comprise shall aspects of air distribution, refrigerant piping, plant room, air handling unit rooms, air cooled condenser layout, electrical work, controls, instruments, foundations, equipment layouts, routing of piping, ducts, cables, etc.

11. After installation is completed, multiple copies of "As built drawings" shall be prepared in full details and submitted to the Consultants/Clients within 3 weeks from the date of completion of installation.

VOLUME-3

CHILLED WATER SCHEMATIC DRAWING

FOR TENDER PURPOSE ONLY



PROPOSED HVAC LAYOUT

FOR TENDER PURPOSE ONLY

Project:- Proposed Heat Ventilation and Airconditioning work in food court at Bangalore International Exhibition centre on Tumkur road 10th Mile, Bangalore

Project consultant :- Manya associates

Client :- Indian Machine Tool Manufacturers Association

BILL OF QUANTITY

Sl.No	Description	Unit	Qty	Rate in Rs	Amount in Rs	Rate in Rs	Amount in Rs
1	**CHILLERS**			**Supply**		**Installation**	
	Supply,Installation, Testing and Commissioning of Air Cooled Scroll Chiller Package of actual capacity 80 TR (@ 96 deg F ambient DB temperature) with below mentioned operating conditions complete with Multiple scroll compressors, Motor, Compressor Starters, Sound Attenuator for compressors, Cooler, Condenser, throttling device, flow switch. The Air cooled chiller shall comprise minimum 2 equal sized scroll compressors or mutiple of equal size scroll compressors with slide valve control for stepless capacity control. The chiller system shall use eco-friendly refrigerant like R-407c. The chiller system shall comprise dedicated factory insulated cooler/ evaporator circuit to match number of compressors. An electronic expansion valve shall be provided for each dedicated circuit for DX type evaporators.	No	1				
	The unit mounted starter panel shall be complete with IP-55 protection consisting of power disconnecting switches, star-delta starters for compressor motors, under/over voltage trip, single phase preventers, communication card which can accept 4-20 mA or 2-10 Vdc analog signal.						
	All components shall be mounted on welded steel base frame, structural steel profiles/panels made out of galvanized sheet steel, protected with primary coat & finished with acrylic paint.						
	The chiller shall be mounted on the Anti vibration mounting as per the manufacturer's standard. The details should be furnished for approval. The quoted price should also be inclusive of PVC / ply wood sheet for protecting Condenser Fins from Factory.						
	The Chiller noise level shall not exceed 85dba measured at 1.5 m distance from the equipment in all directions.						
	Chiller Flow rate: 192 US GPM Chiller tubes to be designed for the above flow rate						

	Cooler						
	EWT :54 °F						
	LWT : 44 °F						
	Note: Victolic Coupling shall be provided for Air cooled chillers, 2 numbers per chiller.						
2	**CENTRIFUGAL PUMPS**						
	Chilled Water Circulation Pumps						
	Supply, installation, testing and commissioning of Centrifugal End suction back pull out Long coupled pumps (1 no Working + 1Standby) with electric motor for re circulation of water for the central air conditioning system. The pump motor shall be suitable for 415± 10% volts, 50 cycles, 3 phase AC power supply. **The pump shall be suitable for outdoor installation.**						
	Pump design parameters shall be designed as follows.						
	Flow rate: 192 US GPM & 65 ft Head with suitable motor. The pump shall be provided with mechanical seal.	Nos	2				
3	**ELECTRICA/CONTROL PANEL**						
	Supply, Installation, Testing and commissioning of Electrical control panel for power supply to the above chiller and pumps. Starters for chilled water pumps shall be included in this panel. Control of motorised on/off valves shall be possible through this control panel as per below mentioned scenario.						
	Scenario : When Chiller is switched on, the motorised on/off valve provided on the piping from existing chilled water system, which is normally open, shall close automatically and the motorised on/off valve provided on the piping from this proposed chilled water system, which is normally closed, shall open automatically.	No	1				
4	**AIR HANDLING UNITS**						
	Supply, Installation, Testing and commisioning of Double Skin AHU 40 mm Sandwitched PUF Insulation, **Forward Curved Fan** Section, Motor section , Cooling Coil section (6/8 Row deep based on Cooling Coil Selection) , Drive Package, Pre - Filter Section, Limit Switch, Emergency Light, Guard for Inspection Door,Vibration isolators, Fire retardant flexible connections. AHUs shall be supplied with SD starter. Cabling from Electrical Panel to the equipment Motor along with copper earthing for equipment shall also be included. Electrical feeder provision is the scope of Electrical contractor. Duct Type Temperature Sensors to actuate 3-way modulating valve with all wiring & duct mounting accessories shall be provided at the return air duct.						

a	40 TR, 12000 CFM @ 2.0" TSP	Nos	2				
	Supply and installation of following items						
5	Flexible connections for pumps & Chillers						
a	100 mm dia	Nos	6				
6	HDPE Expansion Tank of 100 liters capacity with float valve & MS Frame work for supporting the tank .	No	1				
7	PVC Condensate Drain pipe from Indoor Units to nearest floor drain.						
	40mm	RMT	30				
8	MS 'C' Class chilled water pipe with 50 mm Polyesterin/ 19mm XLPE insulation covered with 24 G Al. cladding. Rate shall be inclusive of all necessary fittings and pipe supports. **Pipe thickness** and necessary pipe supports to be provided as per the spec.						
a	100 mm dia	Rmt	40				
b	80 mm dia	Rmt	100				
9	**Butterfly Valve** with insulation & matching flanges						
a	100 mm dia	Nos	12				
b	80 mm dia	Nos	12				
10	**Manual Balancing Valve** with insulation & matching flanges.						
a	100 mm dia	Nos	1				
b	80 mm dia	Nos	2				
11	**Y Strainers** with insulation & matching flanges						
a	100 mm dia	Nos	2				
a	80 mm dia	Nos	2				
12	Dual Plate **Check Valve** with insulation & matching flanges						
a	100 mm dia	Nos	2				
13	100 mm dia dial type **pressure gauges** with ball / needle valve	Nos	10				
14	Dial type industrial type imported **thermometer**	Nos	6				
15	**Drain cock** 25 mm dia	Nos.	5				
16	Test point	Nos	8				
17	Purge valve	Nos	2				

18	Automatic **Air vent**	Nos.	4				
19	3 way modulating, temperature control valve plug type with electric actuator for modulating control of the valve of following USGPM:Sizes based on flow and pressure drop.						
a	96 US GPM (80mm dia)	Nos.	2				
20	Motorised ON/OFF Butterfly valve with position feedback.						
a	100 mm dia	Nos	2				
21	**AIR DISTRIBUTION SYSTEM**						
	Factory fabricated G.S.S. DUCTING complete with all accessories including necessary supports as per SMACNA standards.						
	24 G	Sqm	150				
	22 G	Sqm	30				
	20 G	Sqm	R/O				
22	Factory fabricated,18 G powder coated **plenum** with acoustic insulation of 25mm thick open cell nitrile rubber of 140-180Kg/Cum density. The Duct shall be provided with protective coating against vapour ingress and mechanical damage. The Duct shall be wrapped with 0.5mm thick Glass Fibre Fabric Woven cloth. Appropriate cutout to be made to connect the branch ducts with dampers as per approved shop drawings.	Sqm	10				
23	**16 G** G.I **Volume Control dampers** with matching flanges, sizes as per drawing.	Sqm	5				
24	Al.Extruded Collar Dampers	Sqm	15				
25	Extruded Al. powder coated continuous Return Air Grills of below mentioned sizes. .						
a	100 mm wide	RMT	100				

26	Extruded Al.Powder coated Grille for Supply air of below mentioned sizes						
a	600 x 600 mm	Nos	5				
27	Fire dampers with fusible link (For details refer spec).	Sqm	3				
28	**INSULATION**						
a	**Duct Thermal Insulation** applied outside of the duct work with 13 mm thk Closed cell nitrile rubber elastomeric/XLPE insulation with Aluminium foil.	Sqm	500				
b	**Duct Acoustic Insulation** applied inside of duct work with 13mm thick open cell nitrile rubber/XLPE insulation.	Sqm	100				
c	**AHU Room Acoustic Insulation** with 50 mm thk rigid Fibre glass, 48 Kg/Cum density on GI frame covered with RP tissue and finished with 22 G perforated Al. Sheet.	SQM	75				
d	Under deck Thermal insulation for the exposed roof using 15 mm thick Nitrile rubber/XLPE insulation.	SQM	1200				
29	Civil works such as opening and closing of walls to take the pipes and ducts, etc. and coordination with main civil contractor for equipment pedestals.	LOT	1				
30	Dismantling of existing duct work, and installation of the same wherever suitable.	LOT	1				
	Total for HVAC Works						
	Grand total						
Note:	1. This BOQ shall be read in conjunction with the technical specifications and drawings.						

Indian Machine Tool Manufacturers' Association
10thMile, Tumkur Road, Madavara Post, Bangalore – 562 123 (Karnataka), India
Tel: +91-80-66246600 Fax: +91-80-66246661, E-mail: imtma@imtma.in, Website: www.imtma.in

03.03.2018

SUB: INTERNSHIP COMPLETION LETTER

We are glad to inform you that **Mr.Elangovan.P & Mr.Parthiban.N** of PERI Institute of Technology, Chennai has completed their internship at IMTMA from **2nd Feb 2018 to 3rd March 2018.**

During their Internship, they were exposed to the various activities in **Automation Products & Services Division.**

We found them extremely inquisitive and hard working. They were very much interested to learn the functions of our core division and also willing to put their best efforts and get in to the depth of the subject to understand it better.

Their association with us was very fruitful and we wish them all the best in their future endeavors.

For IMTMA

Authorized Signatory

Manager- Production

MECHATRONICS
CONTROL EQUIPMENTS INDIA PRIVATE LIMITED

No: 232, 46th St,
TVS Colony, Padi,
Chennai, Tamil Nadu 600050
Ph: 044 2855 8485

Date: 11th Feb 2018

The Principal,
PERI IT,
Chennai- 600 048

Subject: Approval of Request regarding Internship Training program 2018 for Final Year Student.

Dear Sir/ Madam,

We are pleased to offer you an internship Training programme for your student Mr.Jones Daniel and Mr. Aravind.A from PERI Institute of Technology, Chennai in our company Mechatronics Control Equipments India Private Limited, with effect from 15.02.2018

With Best Regards,

K. Chithra

Chithra.K

For HR-Human Resources

MECHATRONICS
CONTROL EQUIPMENTS INDIA PRIVATE LIMITED

INTERNSHIP REPORT

COMMERCIAL DRONE

DONE BY

REG. NO.	NAME OF THE STUDENT
411514114081	JONES DANIEL M
411514114017	ARAVIND A

DEPARTMENT OF MECHANICAL ENGINEERING,

PERI INSTITUTE OF TECHNOLOGY,

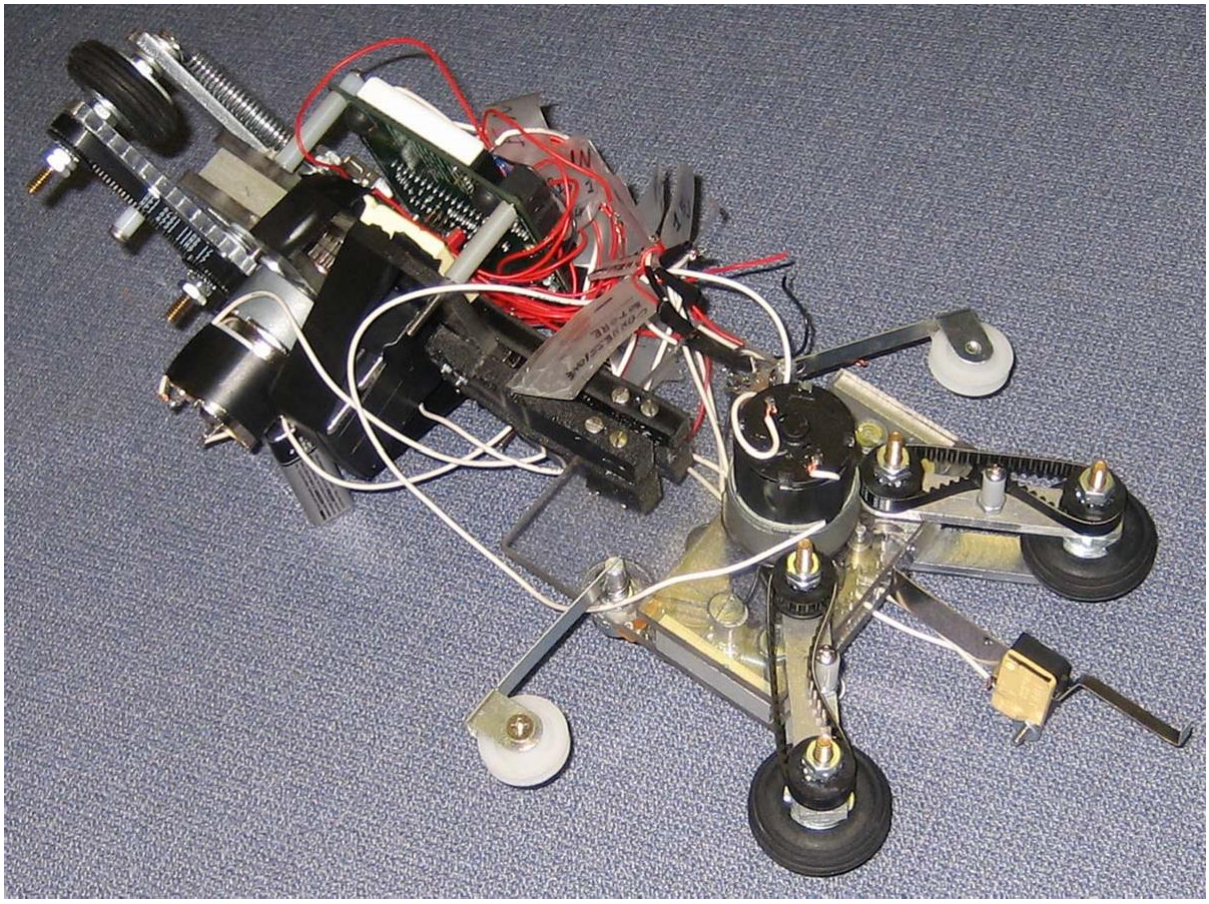
CHENNAI.

MARCH 2018

Project Report

Commercial Drone

13 March 2018



Abstract

During the Mechatronics Class course at Polytechnic University, New York a group of three people built a robot capable of moving inside pipes and detecting limestone clogs. This paper describes in detail how Cristonia, the robot, was ideated, designed, built and programmed.

Contents

1. Background

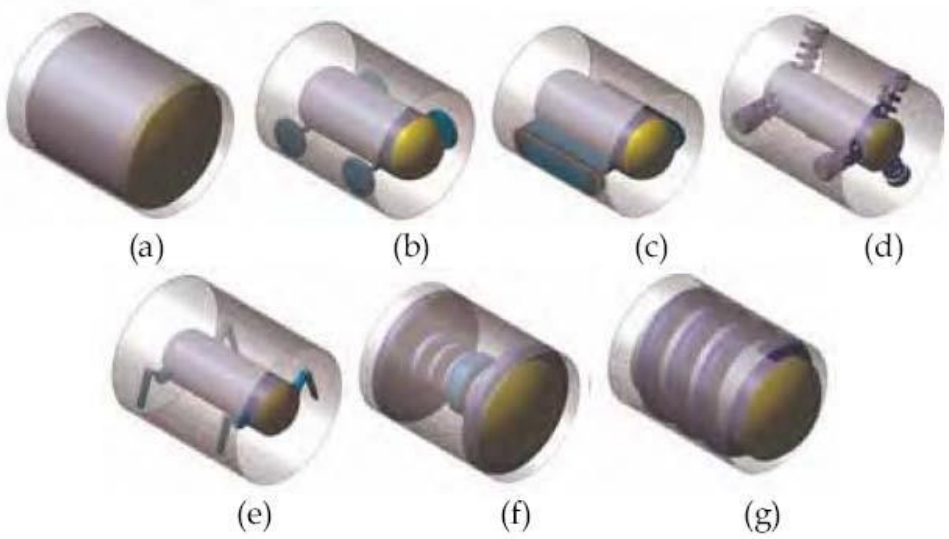
An important part of the *Mechatronics* course at *Polytechnic University* was designing and realizing a robot.

It had to been controlled by a Basic Stamp (BS2) and include sensors and actuators. It should be easily monitored and controlled by humans and safe.

We decided to build an in-pipe inspection robot, and we called it Gennaro.

1.2 Introduction

One of the main concern affecting all buildings and industries is the maintenance required. This implies wasting of time and money necessary to prevent from future damages and to fix those already happened. In particular great problems are associated with the maintenance of pipes conducts. Several approaches have been made in past works to build a vehicle for in-pipe inspection, as shown in the picture below: (a) Pig type. (b) Wheel type.
(c) Caterpillar type. (d) Wall-press. (e) Walking type. (f) Inchworm type. (g) Screw type



Numerous authors have studied the problem and several numbers of commercialized robot have been reported up to now for several applications, from gas industry to sewer pipes (Okada & Kanade, 1987; Hirose et al., 1999; Kolesnik, 2002; Suzumori et al., 1998; Kawaguchi et al., 1995; Suzumori, et al., 1999; Tsubouchi et AL.,2000; Scholl et al., 2000; Mhramatsu et al., 2000; Ong et al., 2001; Choi & Ryew, 2002; Ryew etal., 2000; Roh et al., 2001; Roh et al., 2002; Roh et al., 2005; Schempf & Vradis, 2005; SchempF,2002; Gamble & Wiesman, 1996).

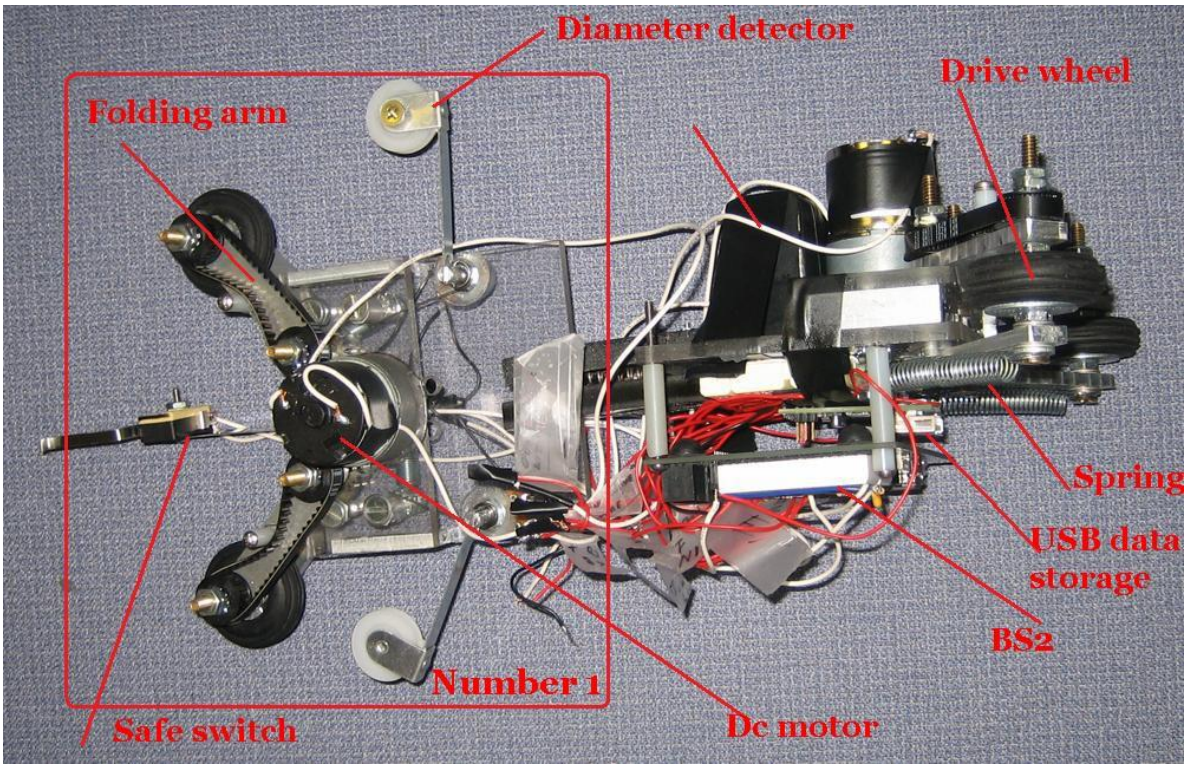
With this general problem in mind and background of previous studies, we focused our case to hot water pipes. One of the main issues regarding all the tubes that carries hot water is the limestone forming inside them. This can cause not only occlusions in the pipes but also loss of heat exchange and of pressure. For these reasons activities for their maintenance are required. To reduce the high budget needed for it, associated with the detection of the occlusions, the demolition of the pipes, and their substitution we decided to design a versatile robot for the inspection of pipe and detection of limestone inside. One of the future development will possibly be the capability for the robot of repairing the damages directly from inside, saving huge amount of time and money.

1.2 Constraints on the robot

Design of the inspection robot depends on two main critical factors: size and shape of the pipeline. It will weigh strongly on the manoeuvrability of robot and its dimensions. An ideal robot should:

1. drive through a pipe that can change its diameter along his pattern;
2. cope with elbows and branches, reducer, valves with unexpected mechanical damages that could change its mechanical configuration;
3. have sufficient traction to move and to carry out tasks as measurements or clogging detection in a slippery and not plane surface as a pipe
4. be robust and reliable

2. Mechanical design



Several constrains were taking into account in the first phase of the mechanical design. They were:

- minimal and maximal dimensions
- weight
- moving ability
- power request
- cost issues

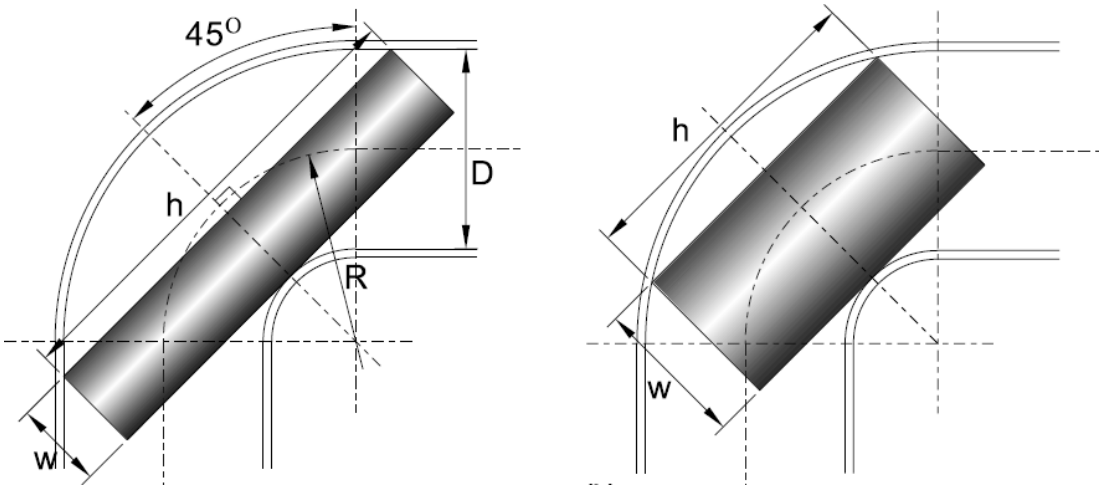
Any of the above influenced the others and was sometimes in contradiction. We wanted a light robot, with high power and torque to move easily and firmly, and it must work in the small space given by the 6 inch tube pipe. These were the main features for the robot we had in mind, but being realistic we knew from the beginning that we will have to arrive to a compromise between them to be successful.

2.1 minimal and maximal dimensions

The maximal dimension was given by the nominal pipe diameter we wanted to expect, of six inch. In addition, the robot was build to inspect pipes clogged by limestone, so we decided that it should be able to move in pipes of up to 5 inch of inner diameter. One

fundamental and critical aspect were corners. As shown in the picture below, the width (w) and high (h) of the robot influences each other, and the following formula[1] has been used to design the robot:

$$0 < w \leqslant \{(R + D/2)\sin 45° - (R - D/2)\},$$



The minimal acceptable dimension instead was given by the room necessary to equip the robot with a Basic Stamp, all the circuitery, the data acquisition devices, the sensors and motors and the power supplies needed.

2.2 Weight

Weight was another critical parameter. A light robot was desired in order to need less power to move, to be agile and to run in vertical pipes. However, this factor was influenced by the motor's choice and the batteries needed. Approximately 50% of the total weight was caused by the batteries and motor. However any other kind of propulsion or power supply we thought was discarded, and this seems to be the only possible way to have a compact and self propelled vehicle.

2.3 Moving ability

The moving ability was probably the greatest problem to deal with. The smooth surface of the pipes was something difficult to cope with and the round surface adds further difficulties. The robot was intended to move not only in horizontal but also in vertical pipes, so it has to hold onto the surfaces and have the necessary grip and power to climb them. All this requirements had to face with the reality of the chosen traction engine, the DC motors, and with our limited budget. We decided to use four rubber tyres of 1 inch of diameter, because they showed good grip, were light, cheap and compatible with the robot dimension. As will be better explained later we decided to have a robot made up of two

[1] H.R. Choi, S.M. Ryew. *Robotic system with active steering capability for internal inspection of urban gas pipelines.* Mechatronics 12 (2002) 713–736

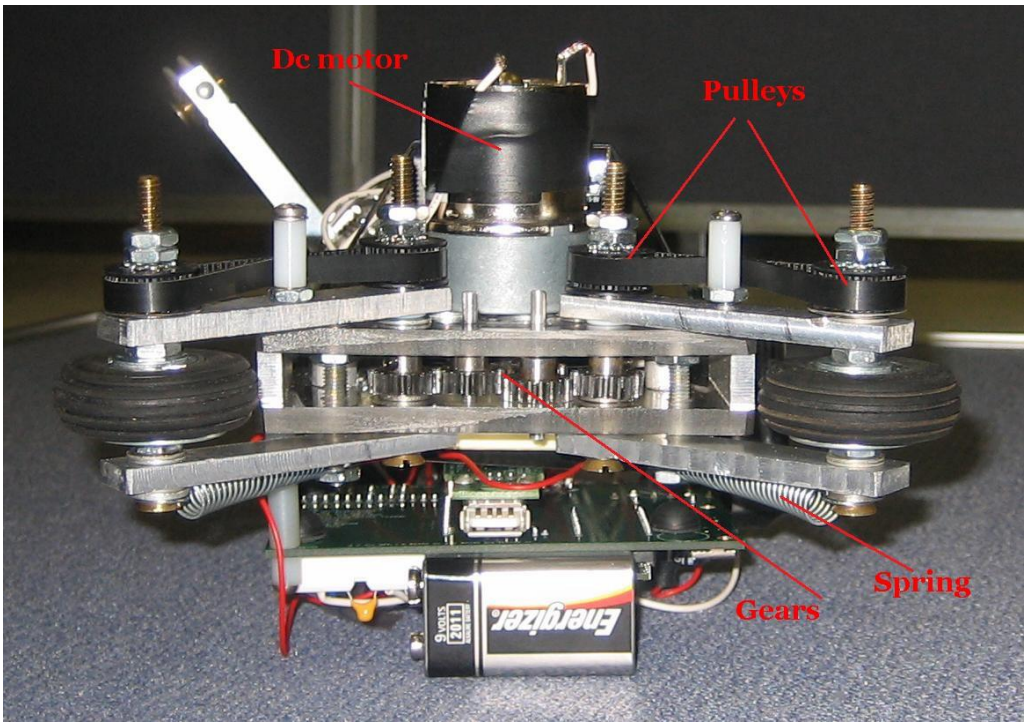
different autonomous parts. In order to link them, four strips of rubber with approximate dimensions of *5 cm* length *1 cm* width and *1 cm* height rubber were made, and fixed to the frame. The rubber was reinforced with a linear spring to obtain the desired flexibility and rigidity when approaching an elbow.

2.4 Power request

The motors used work with a 12 V dc current. They have a power request of approximately 1W. The Basic Stamp will be independent and equipped with a 9V battery. We decided to use 9V batteries in parallel also for the motors, in order to provide the sufficient current requested, but this added lot of weight to the robot. One future improvement will be to use more efficient power supply with rechargeable lithium batteries. However, the last period is good and the robot will be able to work for about 30 minutes before of batteries discharge.

2.5 Frame and transmission

The body of robot is designed to be compact and flexible and to have enough traction to climb vertical pipes. Mechanically the robot is made up of two autonomous and identical driving vehicle, connected by a flexible material. We will call them "*number 1"* and "*number 2"* . We chose to build a robot with only two vehicle, but this has been done only for budget and time issues. It is possible to link as many vehicle as you wish, and this is preferable if more room is needed. Indeed, the more vehicle are linked the best will be the dynamical behaviour of the robot.

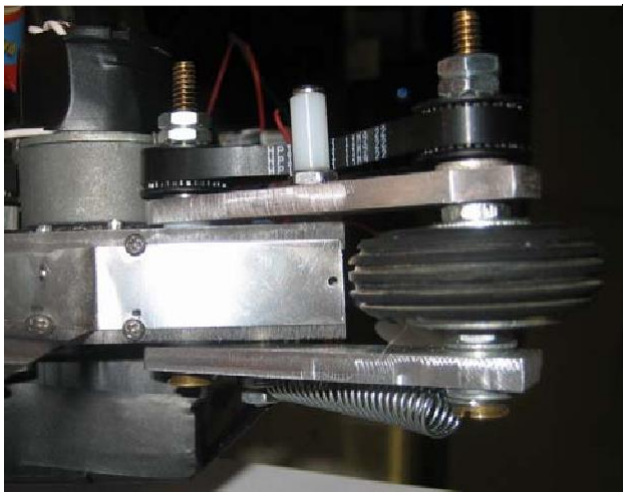


The robot has only four wheels in total that are in contact with the inner wall of the pipe, two in the first robot and two in the second. Each robot frame is made of a Plexiglass

square sheet of a quarter of inch of thickness that houses the dc motor, and to which are fixed the inner edge of two folding arms. On the other edges of the arms, made in aluminium, are mounted the wheels. The two frame are rotated of 90 degrees in order to have a wheel every 90 degree and we chose the Plexiglas to reduce weight and for its low price and easy machinery. For the same reasons we have chosen the aluminium when better mechanical performance were required.

The mechanical transmission drives the vehicle thanks to gears and flexible belts. Since the two wheels of each independent part have to turn in opposite directions (one clockwise, the other contraclockwise) to move the robot, we used four aluminium gears from the pinion gear of the dc motor. Dimensions of the aluminium gear are the same and therefore the gear ratio and torque is the same. The externals gears are mounted on a shaft that pass through the inner edge of the moving arms and the Plaxiglass frame, provided of ball bearings. The arms are free to move around their shaft and a spring is used to let them open and tightly fixed to the internal surface of the pipe. A pulley is fixed to the same axle, and through a rubber belt with trapezoidal teeth it moves another pulley at the other end of the arm and the wheel, fixed with this second pulley.

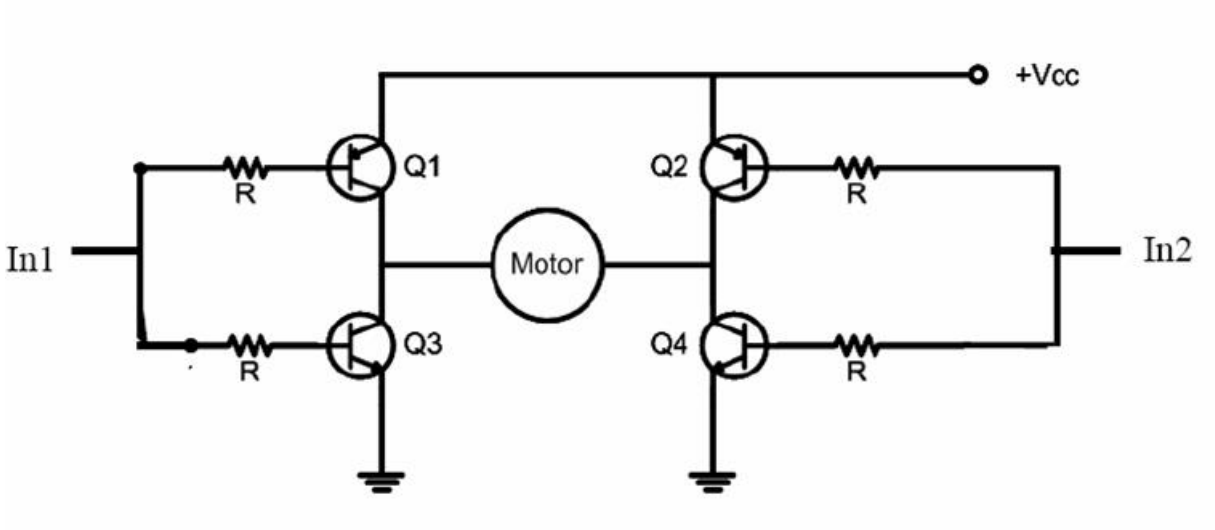
We decided to use this kind of transmission in order to have two wheels driven by the same motor and mounted on folding arms that can cope with different diameter of the pipes. We used bearings and grease to reduce the unavoidable mechanical loss.



2.6 Motors

The robot is equipped with two motors, one on *number 1* and one on *number 2*. Two identical motors were ordered from Jameco and since we didn't need high speed but high torque we chose two 12 V dc Reversible Gear Head Motors. They work at 12V and at approximately *60 rpm*. Unfortunately one of the motors didn't work well and we didn't have time to replace with an identical one. We replaced it with a similar but not same, that worked at different *rpm*. They exhibited good torque but needed lot of current and energy supply. To activate them, we will use two full bridge and pulse-width-modulation (PWM),

as shown in the scheme below. Each bridge has two inputs to control the base leads of the pair of transistors.



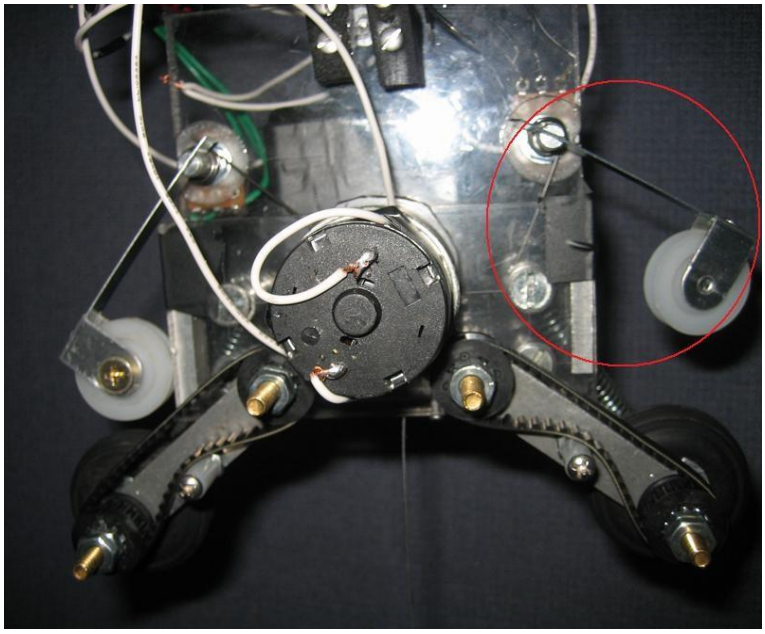
Unfortunately, due to the changing of the motor, the H-bridge chosen didn't work properly. To let them work at the same speed ratio then, and to have the same angular velocity for the wheels, we tried to use a potentiometer to adjust *number 2* at lower voltage, at approximately 9 V. This is only a partial solution that will be fixed in the future.

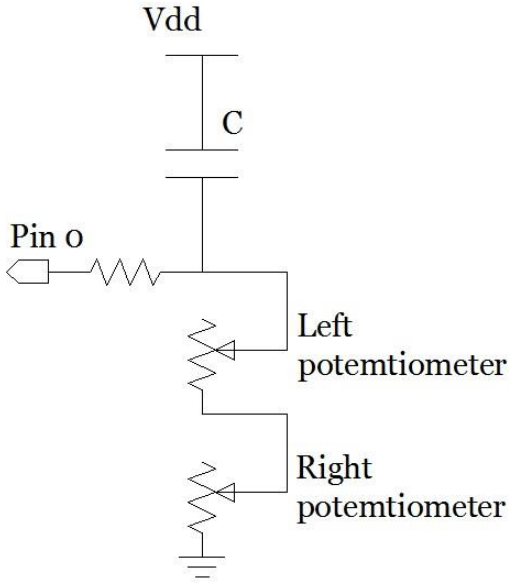
3. Sensors and robotics

The robot is provided with different sensors and robotics:

- two potentiometers
- one data acquisition device
- one relay
- two H-bridge to control the motors

We applied to *number 1* two angular potentiometers connected to two additional arms. They are pushed outward by two springs to stay always attached to the internal surface of the pipe. Using a RCTIME command on each arm, we are able to correlate the movement of the sensors to the measure of the diameter and therefore we can measure the inner diameter of the pipe.

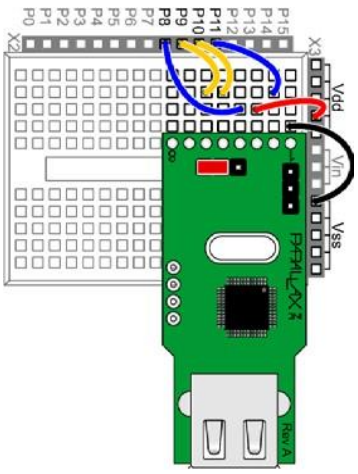


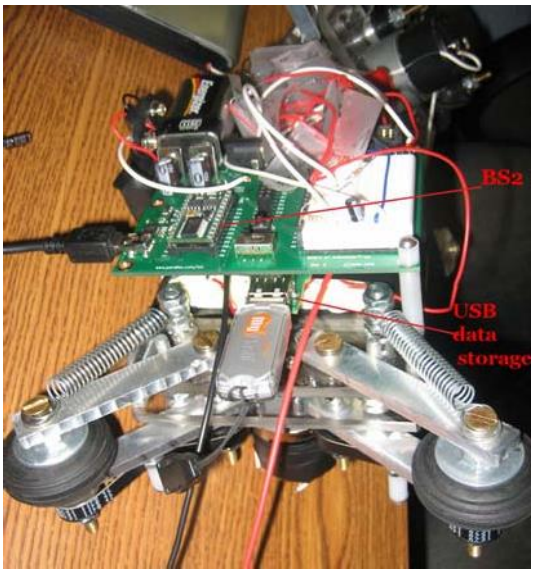


A common problem for inspection pipe robots is the communication with the external operator. One possible way is to use tether cables that unfortunately is not versatile for long and articulated pipelines. Another possible way is to use wireless signal, but it has the main problem in the reliability of the signal, especially with metal pipes. We decided to provide our robot with a third solution, a data logger system that can store data and make these available to the external operator when it goes out the pipelines. It is composed of a Memory Stick Datalogger (#27937). The Memory Stick Datalogger is a USB Host Bridge which allows you to connect a USB Mass Storage Device, such as a Thumb Drive, to your BASIC Stamp®, SX or Propeller Microcontroller. The Vinculum IC/Firmware on the

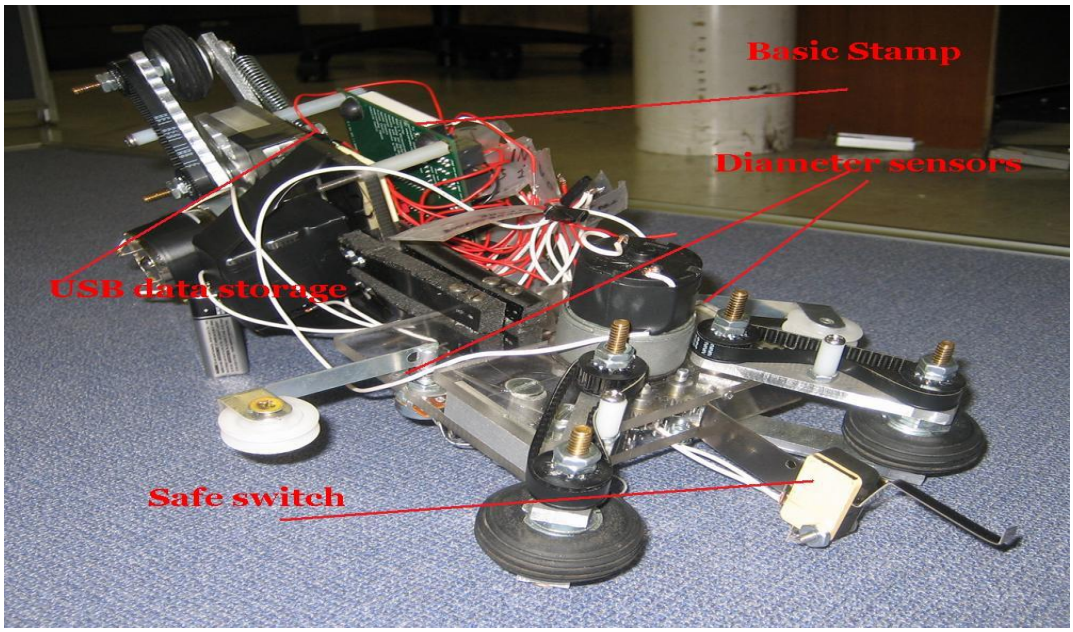
Datalogger Module handles the File System of the Memory Stick so that you can share the files with your PC. All of this control using simple Serial commands. Stored data can be

downloaded and elaborated with common software like Matlab or Excel to take decisions about the next maintenance period.





The switch is mounted to the top of the robot and is therefore pressed when it finds an obstacle on its way. It is intended as a safety equipment: if the robot fall into an obstacle such as a blocked pipe, the switch is pressed. The robot is programmed to stop, go reverse and try to go strait again. It repeats this procedure three times, after that it proceeds backward to the operator.



4. Cost analysis

The total cost of the robot was an important factor. We tried to reduce costs but the number of components and some parts as motors or data logger were absolutely necessary. However if a set of more than two vehicle is build, the unit price per vehicle will be lower, and will be possible to contain costs. Below are reported the description of the parts used, where do we bought them, their unit price and the total amount.

Description	*Company*	*Quntity*	*Price per Unit $*	*Total Price $*
Basic stamp	Parallax	1	59	59
Data logger usb	parallax	1	35	35
DC Motor Gear ReliaPro	Jameco	2	20	40
H-bridge	Jameco	2	3.5	7
Pinion gears	HPI Racing	10	3	30
Transmission Belt	HPI Racing	4	5	20
Plastic Pulley	HPI Racing	8	3	24
Linear Spring	Sid's Hardware	4	0.25	1
Rubber Wheels	HPI Racing	4	2	8
Bearing	HPI Racing	8	4	32
Potentiometer	Jameco	2	0.5	1
Mechanical Relay	Jameco	1	0.5	0.5
Plexiglass Sheet	Sid's Hardware	1	3	3
Screw	Sid's Hardware	30	0.3	9
Aluminum Sheet	Sid's Hardware	1	5	5
Linear Spring	Sid's Hardware	4	0.25	1
Batteries	Energize	10	2	20
Total		94		296.5

5. Construction, locomotion and future improvements

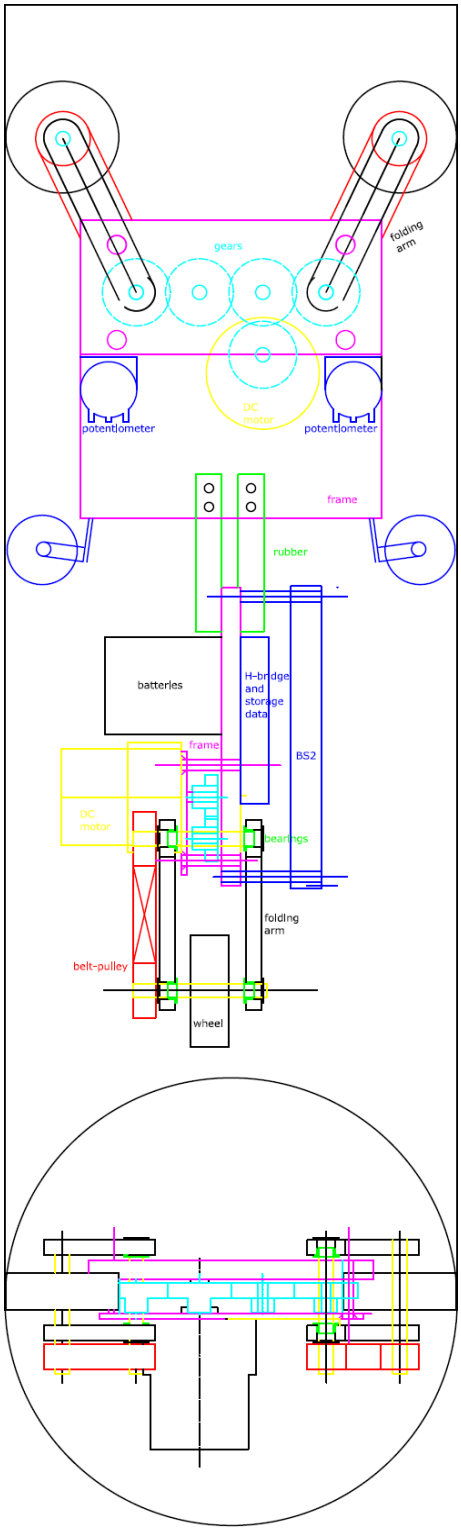
During the construction and assembly of the robot we found some critical parts that need to be explained in more detail. The first is about the folding arms. At first we decided to have only one cantilever beam per wheel, using a square aluminum sheet (dimensions 60mm x 2MM x 0.250 mm). The main problem was how to lock it firmly to the frame, since it had to sustain all the weight of the robot, and leave at the same time the freedom to bend. In addition it had to leave the shaft with the pulley free to spin inside it. As soon as we finished it we realized that it was not stiff enough to deal with the transmission and keep the robot tight to the pipes surface. Then we decided to use two aluminum cantilever for each wheel, one for each side of the wheel, and in this second version the robot behave much better and worked properly. However it probably remains the most critical part for the mechanical system, for their intrinsic complexity and for the small tolerance related with their dimension. Another possible enhancement for a new version in the future will be the spring system for the folding arms. We chose to use one linear spring for each arm because of the simplicity and easiness to assemble it. However the main problem is the bending moment resultant on each arm for the spring, in a complex and delicate component as the folding arms. Different solutions have been considered, as other ways to link them from the frame to the arms, or using torsion springs instead of linear one, but they have not been tried because too hard to been realized in short time.

About the locomotion, the power delivered by the motors seems enough for our needs, however as told before a better power supply is required for an enhanced version. The main problems are narrow elbows, because sometimes the robot collide the wall and blocks itself. This is due mainly to its shape full of corners. A necessary enhancement will be to build a smooth body to house the frame and the electrical components. This seems something necessary also considering the environment in which it will operate. The contact with liquids (water) and debris present in the pipes is something to avoid for the circuitery and the gear system, and a waterproof shell seems indispensable for the robot.

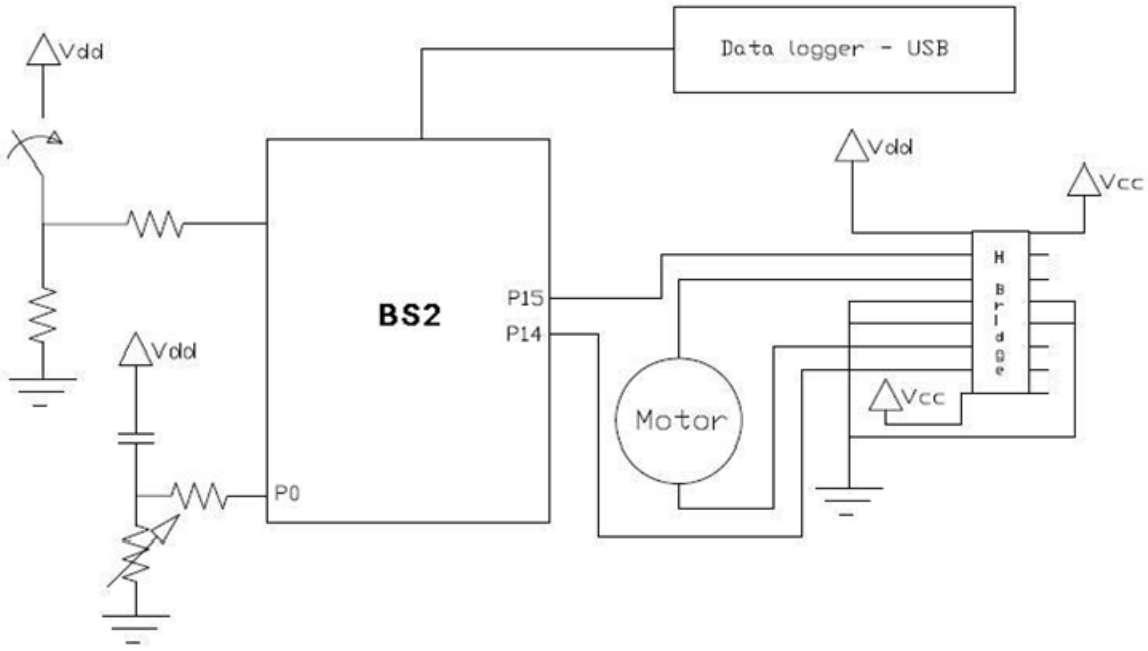
Several other improvements are possible for future works, from cameras and lights to see the interior of the pipes to wireless communication, and grinding machines to erode the limestone, and this project is only the first stone for a bigger figure.

6.Appendix

Autocad design



Circuitery



PBasic code

```
' {$STAMP BS2} '

{$PBASIC 2.5}

i VAR Byte rele

PIN 2

MOTORINPUT1 PIN 15

MOTORINPUT2 PIN 14

TIMEOBSTACLE VAR Byte

COUNTOBSTMAX CON 255

TIMEOBSTACLE=0

' -----[ I/O Definitions ]---------------------------------------------

  Sensor       PIN    0                    ' Light Sensor Or Thermistor

  TX           PIN    8                    ' Transmit Data   --> 27937.4 (RXD)

  RTS          PIN    9                    ' Request To Send --> 27937.6 (CTS)
```

```
RX              PIN     10                      ' Receive Data      <-- 27937.5 (TXD)
CTS             PIN     11                      ' Clear To Send   <-- 27937.2 (RTS) ' -----[
Constants ]----------------------------------------------------
Baud            CON     84                      ' Serial Baud Rate 9600 bps (BS2)
NumSamples      CON     10                      ' Number Of Samples To Log ' -----[
Variables ]----------------------------------------------------
  buffer        VAR     BYTE(15)                ' Input Buffer
  index         VAR     Byte                    ' Index Variable
  ioByte        VAR     Byte                    ' Input/Output Storage
  counter       VAR     Word                    ' Counter Variable
  result        VAR     Word                    ' Sensor RCTIME Result
  work          VAR     Word                    ' Work Variable
  flag          VAR     Bit                     ' Event Status Flag
' -----[ Initialization ]----------------------------------------------
counter=0
PAUSE 200                                       ' Allow Time To Settle
HIGH TX                                         ' Initialize Transmit Line
LOW RTS                                         ' Take Vinculum Out Of Reset
PAUSE 600                                       ' Allow Time To Settle DO
        SEROUT TX\CTS, Baud, ["E", CR]              ' Sync Command Character
        GOSUB Get_Data                              ' Get Response
        PAUSE 250
LOOP UNTIL ioByte= $0D                          ' Wait For Carriage Return DO
        SEROUT TX\CTS, Baud, ["e", CR]              ' Sync Command Character
        GOSUB Get_Data                              ' Get Response
```

```
        PAUSE 250
LOOP UNTIL ioByte= $0D                          ' Wait For Carriage Return SEROUT
TX\CTS, Baud, ["SCS", CR]                       ' Switch To Short Command Mode
GOSUB Get_Data                                  ' Purge Receive Buffer
SEROUT TX\CTS, Baud, [$07, $20, "datafile.txt", CR]
  GOSUB Get_Data                                ' Purge Receive Buffer '
                                                Then Create File
SEROUT TX\CTS, Baud, [$09, $20, "datafile.txt", CR]
GOSUB Get_Data                                  ' Purge Receive Buffer

DEBUG "Done", CR, "Switching to Short Command Mode..."
SEROUT TX\CTS, Baud, ["SCS", CR]                ' Switch To Short Command Mode
GOSUB Get_Data                                  ' Purge Receive Buffer
DEBUG "Done!", CR, "Waiting for Memory Stick..."
Check_Drive:
   DO
        SEROUT TX\CTS, Baud, [CR]                       ' Prompt Device For Status
        GOSUB Get_Data                                  ' Purge Receive Buffer
        IF buffer(0) =">" THEN                          ' Check For Ready Prompt
        EXIT                                            ' If Ready Then Exit Loop
        ELSEIF buffer(0) = "N" AND buFFER(1) = "D" THEN
        DEBUG "."                       ' Device Ready But No Memory Stick ELSEIF
        buffer(0) = "D" AND buFFER(1) = "D" AND flag = 0 THEN DEBUG "Connected!",
        CR, "Accessing..."
        flag = 1                                         ' Memory Stick Ready
        ELSE DEBUG "."
```

```
            ENDIF
            PAUSE 250                                   ' Command Retry Delay
LOOP

DEBUG "Ready!", CR
DEBUG "Opening Data File..."                            ' First Delete File
SEROUT TX\CTS, Baud, [$07, $20, "datafile.txt", CR]
  GOSUB Get_Data                                        ' Purge Receive Buffer '
                                                        Then Create File
SEROUT TX\CTS, Baud, [$09, $20, "datafile.txt", CR]
GOSUB Get_Data                                          ' Purge Receive Buffer
  acc:
PAUSE5000
FOR i = 50 TO 1
DEBUG "acc"
LOW  MOTORINPUT1 HIGH
MOTORINPUT2 PAUSE 10
LOW     MOTORINPUT1   LOW
MOTORINPUT2 PAUSE i
NEXT
  main:
IF RELE=1 THEN GOTO
obstacle ELSE
DEBUG "go"
LOW   MOTORINPUT1
```

```
HIGH  MOTORINPUT2 ENDIF
DEBUG "Open!", CR, CR, "Writing Data...", CR
counter = counter + 1                          ' Number Of Samples To Log
HIGH Sensor                                    ' Charge Capacitor
PAUSE 1                                        ' Wait 1 ms
RCTIME Sensor, 1, result                       ' Measure Discharge Time DEBUG
"Sample ", DEC5 counter, "  ", DEC5 result, CR ' Display Results SEROUT TX\CTS,
Baud, [$08, $20, $00, $00, $00, $0D, CR,
DEC5 counter, ",", DEC5 result, CR, LF, CR]
PAUSE 500                                       ' Write Results/Delay
GOSUB Get_Data                                 ' Purge Receive Buffer
'NEXT
GOTO main
```

obstacle:

```
TIMEOBSTACLE=TIMEOBSTACLE+2
DEBUG "obstacle!"
DEBUG HOME
LOW     MOTORINPUT1   LOW
MOTORINPUT2 PAUSE 2000
FOR i = 50 TO 1
DEBUG "go reverse"
DEBUG HOME
HIGH MOTORINPUT1
LOW  MOTORINPUT2
```

```
PAUSE 15
LOW     MOTORINPUT1   LOW
MOTORINPUT2 PAUSE i
NEXT
FOR i = 1 TO countobstmax DEBUG
"rwd"
DEBUG ? i DEBUG
HOME
HIGH    MOTORINPUT1    LOW
MOTORINPUT2 NEXT
PAUSE 2000
IF timeobstacle < 1 THEN FOR i =
50 TO 1
DEBUG "go!" DEBUG
HOME
HIGH MOTORINPUT2 LOW
MOTORINPUT1 PAUSE 15
LOW     MOTORINPUT2   LOW
MOTORINPUT1 PAUSE i
NEXT


FOR i= 1 TO countobstmax IF rele = 0
THEN
```

```
DEBUG "FRW"
DEBUG HOME
HIGH MOTORINPUT2 LOW
MOTORINPUT1 ELSE
GOTO obstacle
ENDIF
NEXT
GOTO main ELSE
GOTO gohome ENDIF
```

gohome:

```
DEBUG "Closing Data File..."                                    ' Close File (MUST CLOSE!)
SEROUT TX\CTS, Baud, [$0A, $20, "datafile.txt", CR]
GOSUB Get_Data                                                  ' Purge Receive Buffer


DEBUG "Done!", CR, CR, "Opening Data File..." SEROUT TX\CTS,
Baud, [$0E, $20, "datafile.txt", CR]
GOSUB Get_Data                                                  ' Purge Receive Buffer
                                                                ' Open Fil For Read Mode
DEBUG "Open!", CR, "Reading Data...", CR
FOR counter = 1 TO NumSamples                                   ' Number Of Samples To Read
SEROUT TX\CTS, Baud, [$0B, $20, $00, $00, $00, $0D, CR]
SERIN RX\RTS, Baud, [DEC5 work, ioByte, DEC5 result, ioByte, ioByte] 'GOSUB Get_Data
                                                                ' Purge Receive Buffer
DEBUG "Sample ", DEC5 counter, " of ", DEC5 NumSamples,
```

```
" --> ", DEC5result, CR                                    ' Display Results
PAUSE 500                                                  ' Delay
NEXT
DEBUG "Closing Data File...Program Complete!" SEROUT TX\CTS,
Baud, [$0A, $20, "datafile.txt", CR]
GOSUB Get_Data                                             ' Purge Receive Buffer
DO
DEBUG "HOME" HIGH
MOTORINPUT1 LOW
MOTORINPUT2 LOOP UNTIL
rele = 1 STOP
```

Get_Data:

```
index = 0                                                  ' Reset Index Pointer
DO                                                         ' Receive Data
SERIN RX\RTS, Baud, 100, Timeout, [ioByte]
buffer(index) = ioByte                                     ' Add Received Byte To Buffer
index = index + 1                                          ' Increment Index Pointer
IF index > 14 THEN Timeout                                 ' Check For Overflow
LOOP
```

Timeout:

```
 RETURN
```

MECHATRONICS
CONTROL EQUIPMENTS INDIA PRIVATE LIMITED

No: 232, 46th St,
TVS Colony, Padi,
Chennai, Tamil Nadu 600050
Ph: 044 2855 8485

Date: 15.03.2018

TO WHOMEVER IT MAY CONCERN

This is to certify that Mr.Jones Daniel, student of VIII Semester, BE in Mechanical Engineering, PERI Institute of Technology, Chennai is doing his project work in our company. He has worked on the project "Commercial Drone".

He has associated as an intern in the Internship program from 15.02.2018 to 14.03.2018. During this period, he has demonstrated dedication and hard work to meet the quality and commitments of the project.

We wish him all success.

For Mechatronics Control Equipments India Pvt. Ltd.

MECHATRONICS
CONTROL EQUIPMENTS INDIA PRIVATE LIMITED

No: 232, 46th St,
TVS Colony, Padi,
Chennai, Tamil Nadu 600050
Ph: 044 2855 8485

Date: 15.03.2018

TO WHOMEVER IT MAY CONCERN

This is to certify that Mr.Aravind.A, student of VIII Semester, BE in Mechanical Engineering, PERI Institute of Technology, Chennai is doing his project work in our company. He has worked on the project "Commercial Drone".

He has associated as an intern in the Internship program from 15.02.2018 to 14.03.2018. During this period, he has demonstrated dedication and hard work to meet the quality and commitments of the project.

We wish him all success.

For Mechatronics Control Equipments India Pvt. Ltd.

मुख्य महाप्रबंधक/परियोजना व व्यापार विकास का कार्यालय
OFFICE OF THE CHIEF GENERAL MANAGER
PROJECTS & BUSINESS DEVELOPMENT

NLC India Limited
('Navratna' - Government of India Enterprise)
CIN No.: L93090TN1956GOI003387
Website: www.nlcindia.com

निगमित कार्यालय
Corporate Office,
ब्लॉक-1, नेयवेली-607801
Block-1, Neyveli 607801

टेली/Tele : 04142 – 252286
कॉमन फैक्स/Common Fax : 04142 – 252645
ई-मेल/Email: cgmpbd@nlcindia.in

Lr.No: CGM/PBD/NTTPP/MoEF&CC/EC/137/2020

INTERNSHIP PROGRAMME CONFIRMATION

12.05.2018

To
The Principal,
PERI Institute of Technology,
Mannivakkam,
Chennai- 600048.

Dear Sir,

Sub: Letter of offer for your student internship programme.

We are pleased to offer you an internship programme of students from PERI Institute of Technology, Chennai in the Department of Mechanical Engineering in our company, with effect from 15th May 2018 for a period of one month.

We wish them good luck in their new assignment.

For NLC India Ltd.,

DPVL 7/5/2020

Deputy General Manager,
Projects and Business Development.

NLC India Limited

(formerly - Neyveli Lignite Corporation Ltd.,) "NAVRATNA" - Govt. of India Enterprise

LEARNING & DEVELOPMENT CENTRE

CERTIFICATE FOR INTERNSHIP TRAINING

This is to certify that Mr/Ms ..... Bhargava Narasimhan .....

PERI Institute of Technology, Chennai ..... has undergone

Internship Training in NLC India Limited, Neyveli between

15.05.2018 and 11.06.2018 ....

NLCIL wishes him / her Success in all future endeavours.

12 JUN 2018

HEAD / L&D
LEARNING & DEVELOPMENT CENTRE

"Training adding Value to Life"

NLC India Limited

(formerly - Neyveli Lignite Corporation Ltd.,) "NAVRATNA" - Govt. of India Enterprise

LEARNING & DEVELOPMENT CENTRE

CERTIFICATE FOR INTERNSHIP TRAINING

This is to certify that Mr/Ms ..... FIYAZAHAMED M .....

PERI Institute of Technology, Chennai ..... has undergone

Internship Training in NLC India Limited, Neyveli between

15.05.2018 and 11.06.2018 ....

NLCIL wishes him / her Success in all future endeavours.

12 JUN 2018

HEAD / L&D
LEARNING & DEVELOPMENT CENTRE

"Training adding Value to Life"

Zimbra

Internship Detail from CODE BIND Technologies , Chennai

From : Yuvaraj < info@codebindtechnologies.com > Wed, 6 Nov, 2016, 2:45 pm

Subject : Internship Detail from CODE BIND Technologies , Chennai

To : CSE HOD <hodcse@peri.ac.in>

Sir,

Greeting from CODE BIND Technologies, Chennai.

CodeBind Technologies is a certified (ISO 9001:2015), IAF, DAC, which is accredited in the software development, industrial seminars, technical training oriented programs. We are extending the relationship with our clients and make familiar in the world around your customers through the digital marketing sectors. Our support is also providing in the optimizing your website in popular search engines that we are certified by the "Google".

Internship @ CODE BIND Technologies

Internship Duration : 10 to 15 days (40 hrs)
Internship Fee : 3000 Per Student.

Domains / Technologies(any one for intern & all include for IPT):

- Internet of Things - Arduino ,Embedded C,WIFI,SMTP,HTTP
- Embedded - Robotics, Automation , Wireless
- Raspberry PI3 - Python , IOT,Web Services,Cloud Storage
- Android - Apps development

CODE BIND Scope for Internship Training:

- CodeBind Technologies is striving to fulfill your expectation than providing real time training to all engineering students.
- We are upgrading the latest technologies in a periodical manner and that are delivering to the students on weekly.
- Provides hands-on training by the experienced professionals from the reputed industries of MNC's like TCS, IBM, and HCL.
- Supporting the innovative ideas and publishing the real time projects in various emerging technologies.
- We are focusing only on technical terms, moreover we are providing ourselves to provide the placement training and career development training.

Benefit for the Students:

- Training from the Experts
- Certification from CODE BIND Technologies
- Materials for the Hardware Projects(Project Demo with Training)
- Placement Assistance

So please grab the opportunity as soon as possible which enhance your career with a brighter way.

Interested Student reply me following details

Students Name :
Mobile No :
College Name :
Department :
Duration :
Internship needed dates :

For further info & contact the undersigned

Warm Regards,

Yuvaraj
Team Lead
CODE BIND Technologies
Chennai

18/11/2016

Zimbra

sjenisin@gmail.com

Internship Detail from CODE BIND Technologies , Chennai

From : CSE HOD <hodcse@peri.ac.in> Mon, 18 Nov, 2016, 10:15 am

Subject : Request to do Internship

To : Yuvaraj < info@codebindtechnologies.com >

Dear Madam / Sir,

Greeting from PERI Institute of Technology

Greetings from PERI Institute of Technology, Chennai.

It gives us pleasure to introduce ourselves as a Premier Engineering College in Chennai. We are presently conducting a Four year full time BE programme affiliated to Anna University, Chennai and Approved by AICTE New Delhi.

As part of the programme, the students have to undertake Internship Training soon after 3rd,5th Semester for two weeks, and prepare report after internship with a reputed software company.

The objective of the internship is to explore the students to the working of an organization, thereby getting acquainted with da to day activities. This would help them to relate theoretical concepts to sound industry process.

We are confident the exposure and hands on training that the students gain in your organization will be of immense benefit to the students and aid in their acquiring the necessary expertise / skills.

For further details kindly contact :

Mrs. Revathi,
Head of the Department,
Department of Computer Science and Engineering,
Contact No: 9445279539

info@codebindtechnologies.com
+91 99 40 40 80 10

<codeb!nd/>
{Technologies}
Solution Without Compromise!

CERTIFICATE OF INTERNSHIP

CERTIFICATE NUMBER CBTTINTC282005191102

This certificate is awarded to **Mr./Ms D Kamesh** completion of **Internship** in **Web Development** at **CodeBind Technologies, Trichy** from **28th November 2016 to 04th December 2016**.

During the course of the internship **Mr./Ms. D Kamesh** exhibited an enthusiastic attitude for learning in addition to being quite industrious and dependable.

We are extremely satisfied with the candidate's performance and would like to wish them very success in their future endeavors.

Training Co-Ordinator

Issuing Authority

A-15, 1st Cross, Thillai Nagar, Trichy.
Near Thillai Nagar 1st Cross Bus Stop.

Zimbra

info@eyeopentechnologies.com

Industrial Visit from Eye Open Technologies , Chennai

From : CSE HOD <hodcse@peri.ac.in> Wed, 27 Aug, 2018, 12:30 pm

Subject : Request to do Industrial Visit

To : Praveen Kumar < info@eyeopentechnologies.com >

Dear Madam / Sir,

Greeting from PERI Institute of Technology

Greetings from PERI Institute of Technology, Chennai.

It gives us pleasure to introduce ourselves as a Premier Engineering College in Chennai. We are presently conducting a Four year full time BE programme affiliated to Anna University, Chennai and Approved by AICTE New Delhi.

As part of the programme, the students have to undertake Industrial Visit soon after 3rd,5th Semester for 2 days with a reputed software company.

The objective of the industrial Visit is to explore the students to the working of an organization, thereby getting acquainted with da to day activities. This would help them to relate theoretical concepts to sound industry process.

We are confident the exposure and hands on training that the students gain in your organization will be of immense benefit to the students and aid in their acquiring the necessary expertise / skills.

For further details kindly contact :

Mrs. Revathi,
Head of the Department,
Department of Computer Science and Engineering,
Contact No: 9445279539

Behavioural Training

- **Cross-functional Skills, Assertive skills, Business Etiquette, Communication Etiquette, Effective Interaction, Email Etiquette, Listening Power, Telephone Etiquette Branding Yourself, Resume Writing Training, appearing for Job Interview, Business Etiquette Training, Ergonomics, Stress Management, Time Management, Self-Awareness, Career Path Management, Branding Yourself, Self-Development for Success-Self Motivation, Conflict Management, Negotiation skills, Interpersonal Effectiveness,**

Certifications:

- **Oracle Certification, Microsoft, People cert ITIL Foundation, ISTQB LOGOS..**

Train the Trainer:

- **Moto of our team is to train the faculties for the next Gen Skills and to keep up to date on Technology. Digitize and exploring the many effective methods to come up with the best learning solutions.**

Seminars and Workshops:

- **We are preeminent in delivering the Seminars and Workshops on trending Technologies to keep audience on track with the requirements in the industry. We take audience level-headed on the subject.**

Internship:

- **In our Internship program students learn real time projects and experience the real work culture which helps to groom their career growth. we predominantly place the students in corporate internships**

Placement training and Job Assistance:

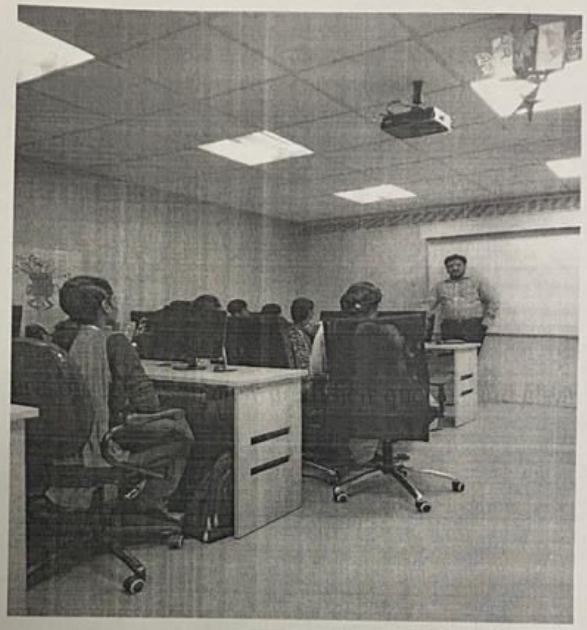
- **We groom the students with following skills like Aptitude, Soft Skills, Technical Interview, HR Assessment and conduct mock interview. Based on Client requirements we will provide Train to Hire the students and help them for Job Assistance. We also, share fresher job openings to conduct placement drive**

For further info & contact the undersigned.

Warm Regards,

Praveen Kumar
Eye Open Technologies
Chennai

enthusiastically and the resource person answered their queries and cleared their doubts.



The session was enriching, enthralling and energizing. They gained a clear view on employment opportunities in computer science especially in Government and IT Sectors.

10/10/18
HOD/CSE

PRINCIPAL
PERI INSTITUTE OF TECHNOLOGY,
Tambaram, Mannivakkam,
Chennai-600 048.

Zimbra

hodcse@peri.ac.in

Industrial Visit from Eye Open Technologies , Chennai

From : Praveen Kumar < info@eyeopentechnologies.com > Mon, 23 Jul, 2018, 10:10 am

Subject : Industrial Visit from Eye Open Technologies , Chennai

To : CSE HOD <hodcse@peri.ac.in>

Sir/ Madam,

Greeting from Eye Open Technologies, Chennai.

In year 2012 - Bootstrapped :

Eyeopen Technologies was born with 2 people onboard .

Public Training :

We offer career oriented software courses for Final year college students and freshgraduates to acquire key career oriented skills to get lucrative jobs .

Corporate Training :

Qualified staff on board for several High End and Cutting Edge Technologies.

Institute Training :

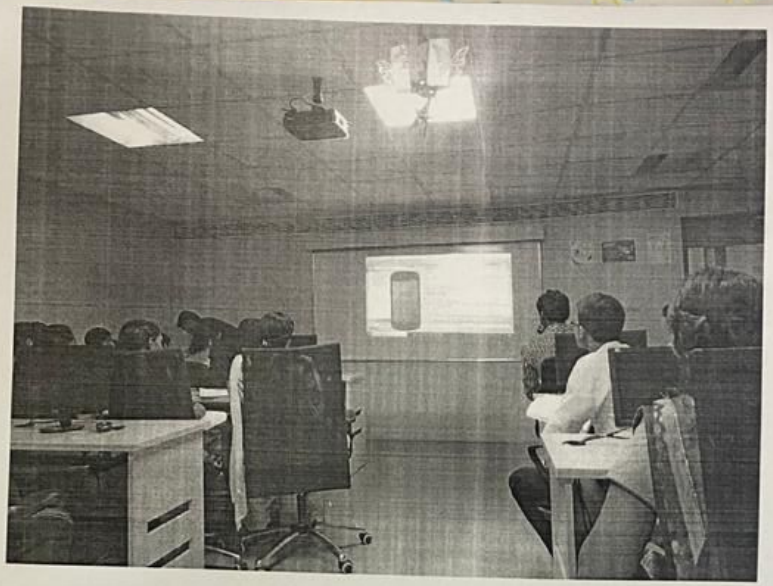
Employers are becoming extremely cautious in choosing the right talent required by them as more and more number of fresher is getting added in the employment market every day.

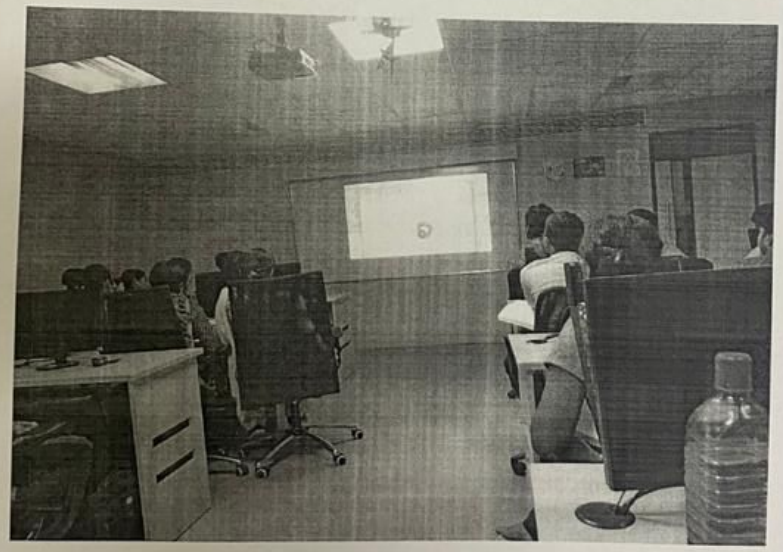
Development :

We have team of software developer's and they can assist you to automate your entire business process on a centralized CRM/ERP Application.

Value added courses:

- **Machine learning, Deep Learning, Python, R programming**
- **Sharepoint**
- **Bigdata**
- **Amazon Web Services, Microsoft Azure**
- **Photoshop, Corel draw, HTML, CSS, Javascript, Jquery**
- **Mean Stack (MongoDB, Express JS, AngularJS, and Node.js), React Js**
- **Manual and Automation Testing, Selenium, Load Runner, QTP, UFT**
- **Data warehousing**
- **PHP, Advance- MVC Architecture**
- **CoreJava, J2EE, Spring, Hibernate, Struts**
- **.NET, WCF, WPF, SQL server**
- **Android, IOS**
- **Embedded, IOT, Linux, Shell Scripting**
- **C, C++, Data Structures,**
- **Oracle 11g, Oracle 12 C, PLSQL, Mysql**





The presentation and interaction of the speaker was very effective, wherein he showed many related visuals and live presentation using various websites including their own personal websites and also spoke about mobile based application and its types . The students interacted enthusiastically and the resource person answered their queries and cleared their doubts.

was held with the intent of enlightening the students about their career opportunities, recent trends and emerging technologies in Mobile based application. He addressed about his carrier and growth also he took efforts to achieve success in life.

He enlightened and guided the students in various career aspects through which the students can aspire and initiate their career. A brief idea was given about the recent trends and emerging technologies in various types of applications like Web based, Desktop, Console, Mobile based etc.

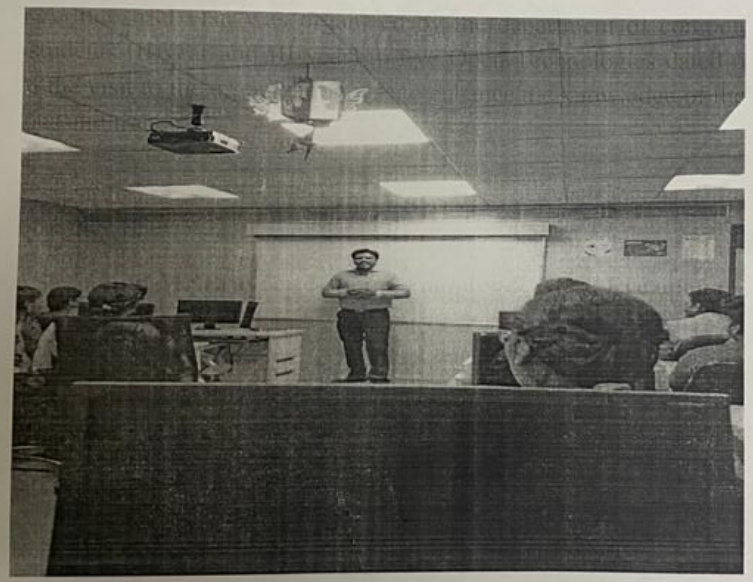
A demo session on "Android" was organized with the aim of introducing students to the career opportunities in the field of developing apps and gaming through android.

Industrial visit to Eye Open technologies

A Industrial visit was organized by the department of computer science for the higher semester students (II year and III year) to Eye Open Technologies dated on 8th October 2018. The purpose of the visit to the organization was to enhance the knowledge of the students in the emerging technologies and trends.

The students were accompanied with Ms.Renuka, Ms.Ranganayagi, Mr. Richard of computer science department and Ms.Tamizmozhi from S&H who actively participated in the visit.

Mr.Shan and Mr.Praveen Kumar, Founder & CEO, Eye open technologies, Chennai was the resource person for the day.



Day 1:

Mobile application development lab was scheduled for II year and III year computer science students for giving an overview of computer technologies in the field of Web based applications. For this purpose, Mr.shan, CEO from eye open technologies gave a presentation about their organisation and subsequently about web based applications like Note JS, Angular 2,Angular 4 ,MySQl, PHP, JSP, .NET , HTML(XHTML,HTML 5.0).

Day 2:

The students reported to IOT lab and Mr.praveen kumar explained about the key component of the emerging Mobile IoT ecosystem and its tools

The session

PERI INSTITUTE OF TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

BEST STUDENT PROJECT AWARD

By Dr.Kalam Educational Trust for Tribal

Report

The students M.Dinesh Kumar, J.John Betson and V.Karthik Raja studying prefinal year in the department of Computer Science and Engineering developed a model named as **HUMAN HEALTH MONITORING SYSTEM (VIBE).** The purpose of the project was to implement a prototype for human health monitoring system. The proposed model can be used to measure the physical parameters like body temperature, heart beat rate, and pulse with the help of pulse rate sensors in a continuous manner. The doctor would be alerted by a message if any abnormality is felt by the patient. Such a system would be supportive for the medical professionals to have an eye on their patients who need intensive care, even when the doctors are away.

The project was nominated for the National Level Award 2017 towards best student projects. It was a proud moment that the project was recognised as the best student project of the year 2017 by **Dr.Kalam Educational Trust for Tribal** and the team was awarded with a cash prize and appreciation certificates in the Awarding ceremony conducted at Dr.NGP Arts & Science College, Coimbatore on 12th May, 2018 (Saturday).

On behalf of the management, Principal, faculty members and students from this institution, the department of CSE congratulates the award winners M.Dinesh Kumar, J.John Betson and V.Karthik Raja for their achievement and adding laurels to themselves and the CSE department.

It is foreseeable that their effort and intuition towards knowing and developing innovative projects like this would create an inspiration and the urge to achieve something in the minds of few more students from the department and institution. This would be visionary achievement for the future innovators and developers from Peri Institute of Technology.

Invitation

Dr. Kalam Educational Trust for Tribal [Regd], Chennai
requests the honour of your presence at the

National level Award ceremony-2017

12th May 2018, Saturday 0900 to 1245 hrs
Dr. N.G.P. Arts & Science College,
Coimbatore

In presence of
Dr. Thavamani D. Palaniswami
Secretary, Dr. NGP Educational Institutions

Chief Guest
Dr. P. R. Vasudeva Rao
Vice Chancellor, Homi Bhabha National Institute , Mumbai

Guest of Honour
Dr. Kuppuswamy
Former Addl. Director, Dept. Of Public Health, Tamilnadu

Dr. S. Krishnakumar
Chairman / Selection committee
Dr. KET, Chennai

Agenda

Event	Time
Registration and Gathering	0900 – 0920
Prayer & Lighting of Kuthuvilakku	0920 – 0930

நேற்றைய கனவு இன்றைய நனவு நாளைய மாற்றம்

Dr. கலாம் பழங்குடியினர் கல்வி அறக்கட்டளை (Regd)
7 ஆதித்தனார் தெரு காந்தி நகர் ஆவடி சென்னை-54

Dr. Kalam Educational Trust for Tribal (Regd)

Office : 7, Athithanar St, Gandhi Nagar, Avadi, Chennai – 54
www.drket.com , Email : drkalamedutrust@gmail.com

To 15th Mar 2018

Mr.J. John Betson
PERI Inst of Tech, Chennai

Subject : National level Award – 2017

Dear Sir

Every year Dr.KET announces National level, non-monetary award to recognize the outstanding people and institutions who have made extraordinary contributions to students, society and environment that exemplify the highest standards. Award winners serve as inspirational role model to others and they embody the core values of serving the society.

The selection board is satisfied with your nomination for the award "Best Student Project-2017", credentials and performance during personal interaction.

It is our pleasure to announce that you've been selected for the award "Best Student Project-2017"

Note: This award is being conferred to you based on the credentials provided by you to the committee and at any circumstances if found guilty / false / adulterated on your claim, the award will be withdrawn without any warning/caution letter and necessary legal actions will be initiated against you.

President

பிரார்த்திக்கும் இதயத்தை விட கொடுத்துதவும் கரங்களே மேல்
Helping hands are more powerful then praying Hearts

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Dr. Kalam Educational Trust for Tribal (Regd)
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www.drket.com , Email : drkalamedutrust@gmail.com

15th Mar 2018

To

Mr.M. Dinesh Kumar
PERI Inst of Tech, Chennai

Subject : **National level Award – 2017**

Dear Sir

Every year Dr.KET announces National level, non-monetary award to recognize the outstanding people and institutions who have made extraordinary contributions to students, society and environment that exemplify the highest standards. Award winners serve as inspirational role model to others and they embody the core values of serving the society.

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President

Dr. Kalam Educational Trust for Tribal

Reg No.135/2015

www.drket.com

Certificate of Appreciation

BEST STUDENT PROJECT - 2017

Is awarded to

Mr. V. Karthik Raja

PERI Institute of Technology, Chennai

In recognition of excellence in the practice of engineering and technology

Date : 15 March 2018

Chairman

(Selection committee)

9:51 AM | 2.9KB/s

National level Award ceremony - Invitation

Inbox

dhanapal S 17/4/2018
to bcc: me

Dear Awardees

Greetings and congratulations from Dr.KET for your achievements.

The most awaited event "Awarding ceremony" is planned to conduct at Dr. NGP Arts & Science College, Coimbatore on 12th May 2018 (Saturday).

- Please make it convenient to attend the function and share your joy with us.
- If the awardee is unable to attend the said program, can nominate a suitable person (with authentication letter) to receive the same.
- **Dont forget to till the attached form (Declaration form) which should be submitted during the award. Failing which, certificate and memento will not be issued.**
- Please ensure proper & decent Dress-code.
- Only one guest will be allowed inside the hall along with the awardee to avoid crowding. Please co-operate
- Refreshments and Lunch will be provided. Which is sponsored by Dr. NGP Educational Institution.
- Few selected awardees will be invited to share their views.
- For any assistance
  - **regarding award...**
    - Dr. S Krishnakumar 9940316858 /

நேற்றைய கனவு இன்றைய நனவு நாளைய மாற்றம்

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Dr. Kalam Educational Trust for Tribal (Regd)
Office : 7, Athithanar St, Gandhi Nagar, Avadi, Chennai – 54
www.drket.com , Email : drkalamedutrust@gmail.com

15th Mar 2018

To

Mr.V. Karthik Raja
PERI Inst of Tech, Chennai

Subject : **National level Award – 2017**

Dear Sir

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Helping hands are more powerful then praying Hearts

Dr. R. PALSON KENNEDY, M.E., Ph.D.
PRINCIPAL
PERI INSTITUTE OF TECHNOLOGY
Mannivakkam, Chennai-600 [illegible]

Zimbra

hodcse@peri.ac.in

Internship/IPT Detail from SLN Technologies , Chennai

From : Jeni SLN <sjenisln@gmail.com> Sat, 6 Jan, 2018, 4:53 pm

Subject : Internship/IPT Detail from SLN Technologies , Chennai

To : CSE HOD <hodcse@peri.ac.in>

Dear Student,

Greeting from SLN Technologies, Velachery, Chennai.

Since its formation in the year 2006, SLN Technologies has been at the forefront of research and development into the creation of model driven in Embedded platforms, Software development, Android Apps and Network security that empower design teams to efficiently create the next generation of software and hardware systems through agile system development methods. SLN continues to work on next generation design languages and platforms that enable global system level optimization for complex solutions in the area of electronic embedded devices, software integration devices leading to lower cost thereby taking the benefits of technology to rural and value conscious urban markets.

Internship/IPT Training @ SLN Technologies

Internship Duration : 10 to 15 days (40 hrs)
IPT Duration : 3 to 5 Days (20 hrs)
IPT Fee : 1500 Per Student.
Internship Fee : 3000 Per Student.

Domains / Technologies(any one for intern & all include for IPT):

- Internet of Things - Arduino ,Embedded C,WIFI,SMTP,HTTP
- Embedded - Robotics, Automation , Wireless
- Raspberry Pi3 - Python , IOT,Web Services,Cloud Storage
- Android - Apps development
- Bigdata - Data science , data analysis
- Android
- JAVA/J2EE
- Dotnet
- Networking

SLN Scope for Internship Training:

We provide placement/internship training for students to enhance their knowledge in process of interview and face competence at ease. We also give them exposure in real time industry knowledge. Trainers are delivering, a relevant and guided learning experience that combines lecture and practice to deliver what you need to know on interview techniques and placement training.The Objective of the training is to enrich the student knowledge in placement process with communication and interview skill sets.

Benefit for the Students:

- Training from the Experts
- Certification from SLN Technologies
- Materials for the Hardware Projects(Project Demo with Training)
- Placement Assistance

...cribe which enhance your career with a brighter way

Interested Student reply me following details

Students Name :
Mobile No :
College Name :
Department :
Duration :
Internship/IPT needed dates :

For further info & contact the undersigned.

Warm Regards,

S.Jenifer - 9364407007
Team Lead.
SLN Technologies
Velachery, Chennai-42.

P

SLN
TECHNOLOGIES

Hewlett Packard Enterprise
Delivery Partner
Certificate of Competency Program

INTERNSHIP CERTIFICATE

This is to certify that **Mr.Dinesh Kumar.M (Reg.No:411515104021)**, Third year **B.E (CSE)** student of **Peri Institute of Technology,** completed his internship in our organization. He did his internship training using **Networking** under the guidance of our technical team, in the month of **January 2018(15 Days)**.

During the above period, his performance was good. We wish great success in all his future endeavors.

Date: 06.02.2018

Place: Chennai

HPE CoC Delivery Partner
SLN Velachery

Technical Lead

No.52, Sree Ponniamman Complex, Velachery Main Road, Velachery, Chennai - 600 042. Ph: +91 44 4303 6263