Guidelines for Vahiny Design

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If you come across any problems, you can contact us at info@vahiny.in

Happy Transporting!!

About This File

This document is created for the benefit of all Vahiny users, developers, dealers, testers and all interested people who wants to use Vahiny - Pneumatic Tube System for any kind of task automation. It is also helpful for propspect investors, stack holders, channel partners and investors to draw the guidelines as well as future plan of vahiny.

Vahiny - Pneumatic Tube System is product of Homebrew Automation Solution. Content in this file is proprietary of Homebrew Automation Solution. All the information and drawings are for the reference and real dimention may vary at the time of installation without prior information. This variation will be for the betterment and improvement of the product. We are commited to make all vahiny components energy efficient and environment friendly and reduce the carbon foot print.

Vahiny, which is pronounced "Vaa-hee-nee" is an internal logistic system. Pneumatic Tube System (PTS) is widely known as Chute System or Pneumatic Transport System or Pneumatic Tube Transport System. On a bigger scale we can call consider it as a type of Automatic Material Transport System(AMTS). System uses pressure difference to transfer material from one point to other point. Sending and receiving points (called smart stations) are connected by tubes. It is a very user friendly system that involves three simple steps. 1. Put material in a bottle shaped carrier, 2. Place that carrier inside the smart station, 3. Select destination code on the touch screen. System software will automatically route the carrier to the selected destination.

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Introduction

1.1 Why?

Vahiny is the most effective solution for Healthcare and Industry when movement of small materials within premises is critical and frequent. Vahiny is your go- to solution partner for intra-logistics solutions. Efficient, fast, accurate and more importantly it is capable of saving substantial amounts money from Day 1. Vahiny is ideal for hospitals, pharmaceutical and chemical industry, diamond, Food and Dairy Industry, Foundry and manufacturing plants and similar operations.

For hospitals sending samples from various type of wards to the laboratory or medicines from the pharmacy to the nurse station is a very essential requirement. Paramedical personnel continuously rush to and from spending time, energy and creating needless hustle and bustle. Obviously, the activity is a waste of highly trained human resources, waste of time and waste of power for the elevators etc.

In other industries like Pharmaceutical and Chemical industry, Diamond, Food and Dairy Industry also needs to transport samples and documents from various departments(production line/raw material/finished goods) to lab for quality check. Vahiny plays crucial role to make make things faster and safer. So that staff can focus on other critical operations. It will improve your staff efficiency, productivity as well as helps to maintain hygeine standards.

Vahiny is never designed to take care of all types of intra logistics movements of the industry. Despite system, some critical and big size items, laundry material, waste will not be transported via vahiny. However, careful design, planning and consideration of vahiny can reduce 70-80% of intra-logistics challanges. Recently, better quality healthcare, Covid-19, healthcare awareness, high patient load and increased healthcare professional cost has driven the demand of vahiny in Indian Healthcare Market. Most upcomming hospitals above 100 beds would have considered of planned vahiny from architect and project department.

1.2 What?

Vahiny can transport carrier at 4-6 meter per second speed. This speed will vary and depends on infrastructure and configuration of the system on site. Movement against gravity and with gravity will also play crucial role to delivery time. Vahiny come with two major type. This types is defined based on outer diameter of the pipe. Smaller version is with OD110mm and bigger version is with OD160mm. OD110 can work for small multispecialty hospital where blood bank is not inside the building. It can carry upto 1 Kg material. It can not carry blood pouch because of small volume. OD160 is the good enough to carry more weight and volume. It can accomodate blood pouches as well. Generally, OD160 can take upto 2Kg weight. If hospital beds count is more than 250, they should consider OD160 diameter system for the project.

Note : Weight carring capacity and speed vary and it depends on configuration, installation quality, design and many other aspects.

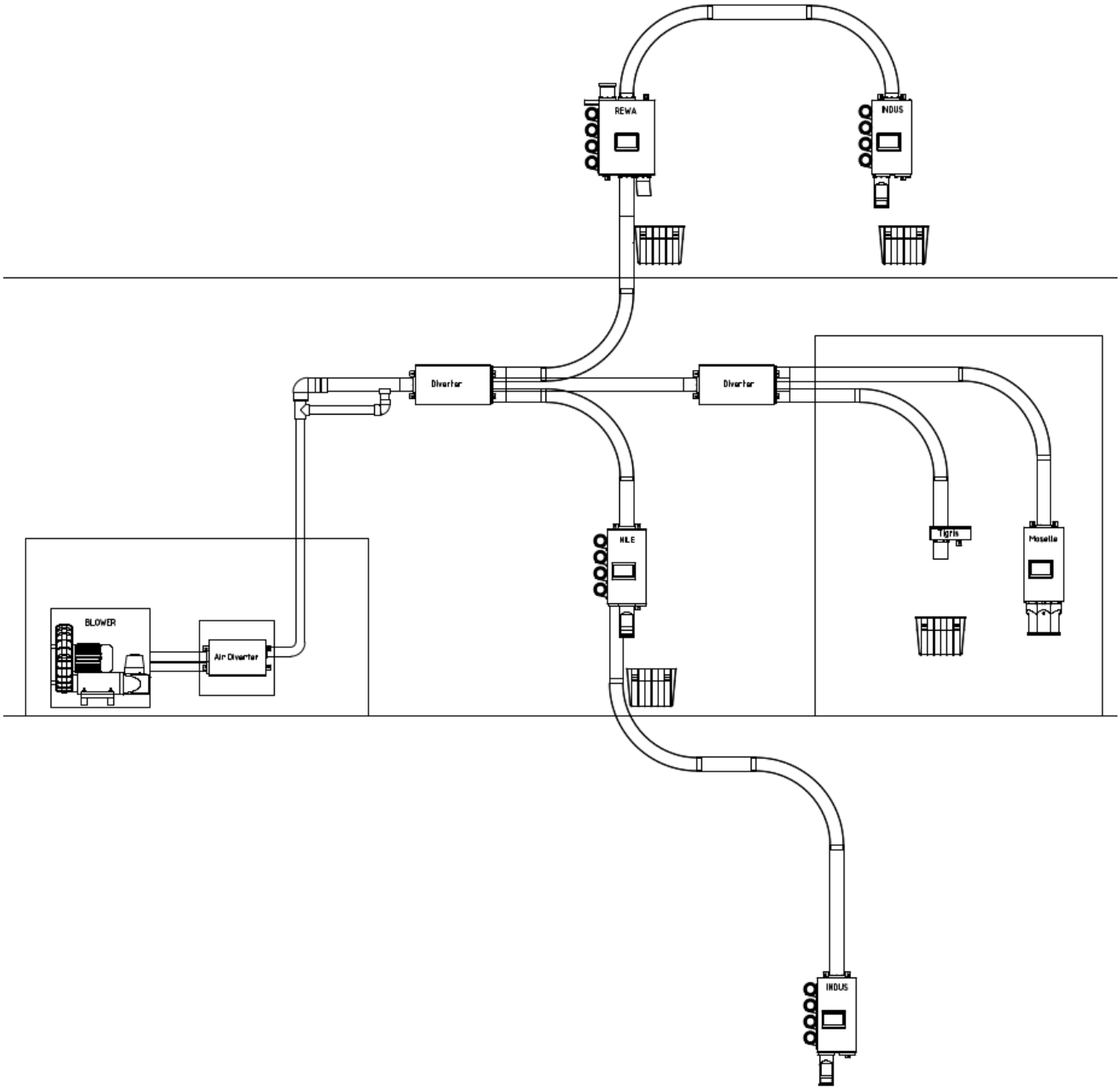

Figure 1.1: Sample of Schematic Diagram

1.3 How?

Blower in Blower/Control room will create the partial vaccum or pressure to move the carrier from one point to another point inside the pipe. It uses suction and pressure both mode of operations depending on the destination location. While receiving at station, air cusion will be created to slow down the speed and eject the carrier gently.

Blower will be rotating unidirection. But there will be air flow switching component attached with blower. This is also called air-diverter or air-valve. This component will change the air flow and helps to crease suction or pressure as per the carrier direction of movement. Hence, it will generate suction to pressure and vice-versa very instantly during the carrier movement.

2

Vahiny Components

2.1 Tubing

Depending upon the application (hospital/ infra/ bank etc.,) Vahiny tubing can made up transparent or opaque U-PVC tubes. Transparant pipe of PVC or PC material can be also used to some area near reception or corridor to keep up with aesthetic look of the building. Tubing work includes but not limited to straight pipe, bends, sleeve, rubberline clamp. metal clamp. stud bolt, nuts, adhasive, etc. Any kind of hot and cold pipes must not be installed near Vahiny pipes. This will avoid the condensation and formation of water droplets inside vahiny pipe. Any kind of hot and cold pipes must be insulated with proper wrapping.

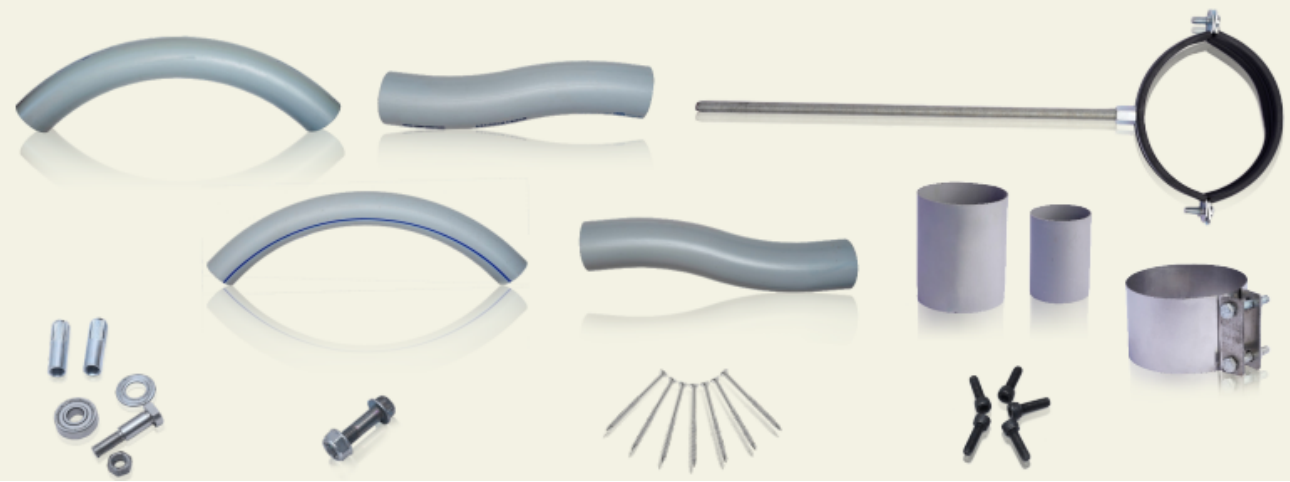

Figure 2.1: Tubing Accessories

2.1.1 Tube Bend

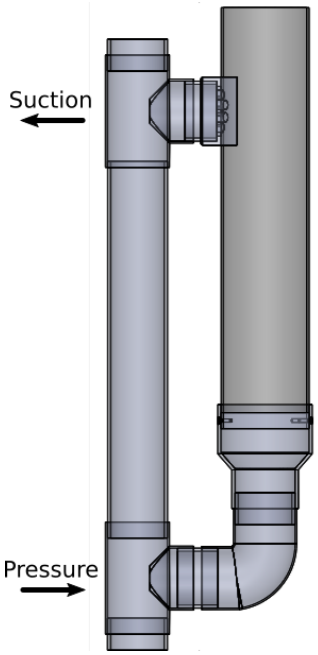

Figure 2.2: Bypass

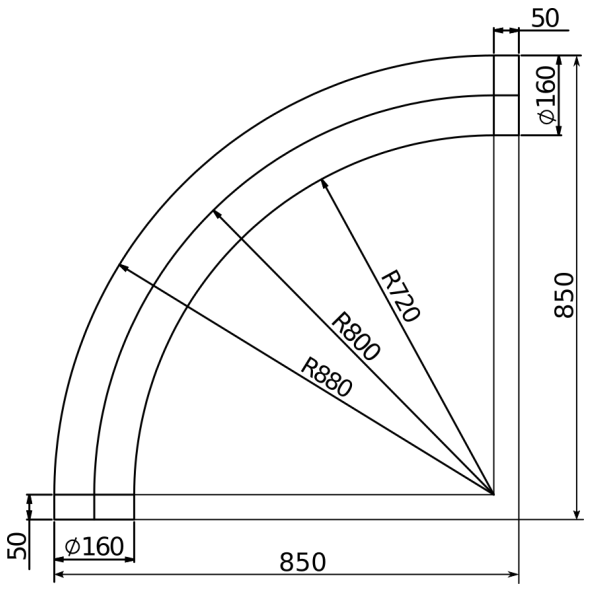

Figure 2.3: Bend OD160

Large radius bends will be used to change the direction of carrier smoothly. 650mm radius for OD110 and 800mm radius for OD160mm is the standard radius. Core cut required for tube installation is 50mm more than the pipe outer diameter. Bends must be smoothly crafted from factory and should contain straight pipe at the both end to make pipe joining easy with sleeve socket.

Figure 2.4: Bend

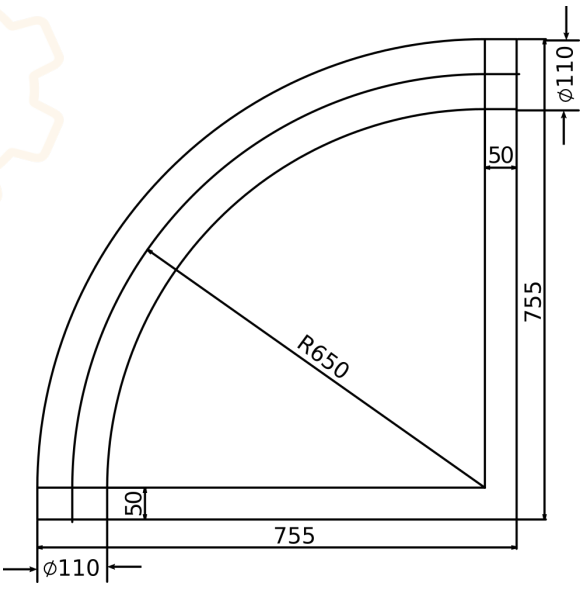

Figure 2.5: Bend OD110

2.2 Carriers

Figure 2.6: Carrier

Carrier will be travelling inside pipe. This will carry the material from one point to another point. It contains black color gliding velcro rings. This rings will be the only point of contact between pipe and carrier. Hence these rings will gets wear and tear over certain usage. Hence, it must be replaced as and when required. There are carrier with RFID tag. This tag will keep track of carrier usage and system will generate the warning after threshold has been reached. Carriers with swivel cap and side flip are suitable for most application.

Figure 2.7: Carriers

It contains spring loaded side flip cap. Hence, it reduce the chances to get it open during transaction. Proper maintenance and check of carrier must be planned by service person for the carrier. Also every end user must be trained to identify the defect in the carrier. In case defect is found, they should report to service person and not to place that carrier into the system.

Vahiny carrier are allowed to transport following items via system :

- Urine and Stool Specimens (120 ml or less plastic container)
- Blood/Body Fluids - Vacutainer Tubes
- Culture Specimens (Culturettes, sterile containers less than 150 ml)
- Blood Culture Bottles
- Documents and medicine prescription
- Blood Bags containing Whole Blood or Blood products
- Pharmacy Products
- Chemotherapy Drugs
- Frozen Sections
- Intravenous Medications
- Vaccines
- Controlled Pharmacy substances must be sent using the secure send function
- Temp controlled - (refrigerated/iced) Tissue biopsy
- Tissues formalin preserved
- Total parenteral nutrition
- Blood Gas Specimens
- Items For PTTS Transportation in Emergency situations
- The transport of ABG samples will be allowed only on an emergency basis from the ICUs, LDR Rooms, Emergency Triage Room to the Blood Gas Labs. Every effort must be made to ensure that protocols for the elimination of air from arterial blood specimens, prior to transport, are implemented.
- A combination of a leakproof vial must contain the syringe along with a Ziplock bag or a Zip N Fold bag and a red zippered pouch (labelled as biohazard).

Following items must be avoided for transportation via Vahiny :

- 24-hour Urine Samples (containers larger than urine cup)
- Formalin and/or alcohol preserved specimens
- Empty Blood Bags

- Blood Bags, IV Sets, IV Solutions that have been implicated in a possible transfusion reaction
- Drinks or food items
- Contaminated Supplies
- Sharps
- Non-leak tight containers containing liquids
- Samples for doing Blood Gases
- Flammable Liquids
- Hazardous Chemicals
- Specimens in Syringes
- Specimens from patients with dangerous, communicable diseases
- Hazardous Drugs (Chemotherapy agents)
- Body fluids in large containers (i.e., paracentesis, peritoneal, pleural, thoracentesis)
- Platelet Function study specimens (TEG)
- Dry Ice packaged specimens

Note : Above list is based on prior experience and inputs from industry experts. It vary based on site, installation and design configuration. System validation must be performed before taking it into the usage.

2.3 Diverter

Figure 2.8: Diverter

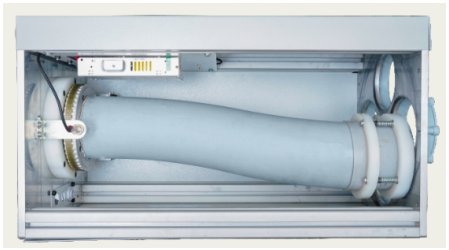

Figure 2.9: Diverter

As the name implies, diverters take care of diverting the material by changing lanes/tracks. There are 2 types of diverter. 3-way and 4-way diverter. Diverters will be installed below beam and above false ceiling area. There must be trap door planned for serviceablity of the diverter. Normally, 4-way diverters will need more space and hence not feasible to install hence 3-way diverters are used. 4-way diverters can be used in control room. As it has plenty of space for installation.

Vahiny diverter works on LAN and de-centralized power. Hence single phase switch and socket as well as LAN port with minimum 100 MBPS speed must be planned near by every diverter location.

2.4 Stations

Stations are crucial component of system. It is wall mounted component that end user will interact with. It must be installed on rigid wall. Furniture or partition wall must be avoided. All required accessories must be installed properly. It includes but not limited to carrier rack, carrier receiving basket with upholstery, etc. Vahiny stations works on LAN and de-centralized power. Vahiny is fully IP based modular system. Hence, single phase(110-250V, 2Amp) switch and socket as well as LAN port with minimum 100 MBPS speed must be planned near by every station location. Station must be planned at following departments. Item movements from and to this department will be the major human movement and frequently.

- Phlebotomy or Lab Collection
- Emergency Nurse Station
- Pathology/Biochemistry/Micro
- Pharmacy
- Pre-Op Nurse Station(OT)
- Nurse Station of Ward/ICU/CCU
- Reception
- Mediclaim/Account/Billing/Admin Department
- Blood Bank

2.4.1 End Type

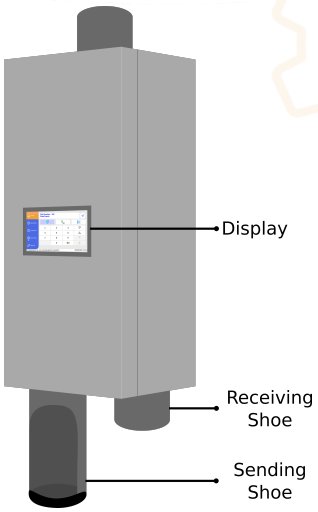

Figure 2.10: End Station

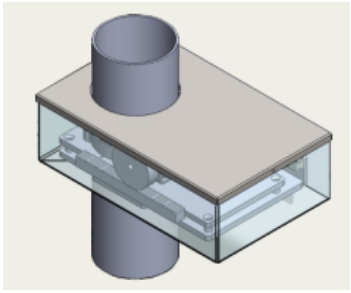

Figure 2.11: End Station Bottom Loading

This type station can send and receive carriers. It is a duplex type station. It can store one carrier for the operation. Hence, if one carrier is under operation, It can hold another carrier in station and it will process the carrier once previous operation is over. It will be equipped with carrier rack and receiving basket. It can get only pipe connection from top. Bottom plate of the station must be at 1.0 meter from finished floor for ergonomically easy access for end user.

2.4.2 Pass-Through Type

This tyoe station has 2 pipe connections one from top of the station and another from bottom of the station. Hence, it provide easy connection with top or bottom floor stations via slab core-cut. There are major 2 types based on carrier loading operation.

- Top Loading Pass-Through
- Bottom Loading Pass-Through

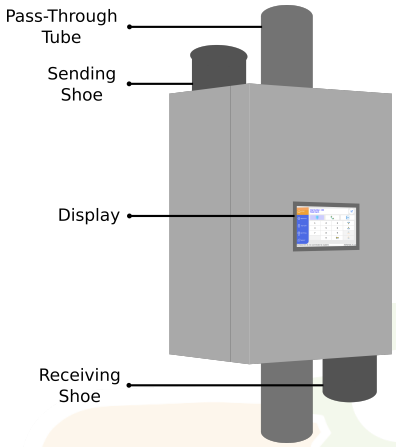

Figure 2.12: Pass-Through Top Loading Station

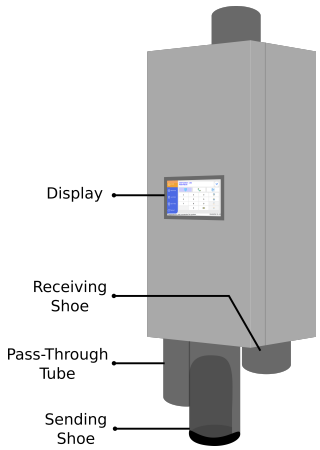

Figure 2.13: Pass-Through Bottom Loading Station

2.4.3 Multi-Send

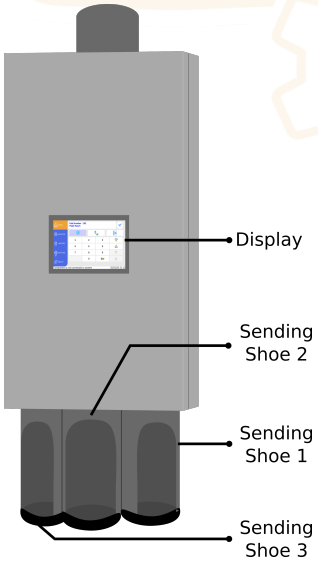

Figure 2.14: Multi-Send Station

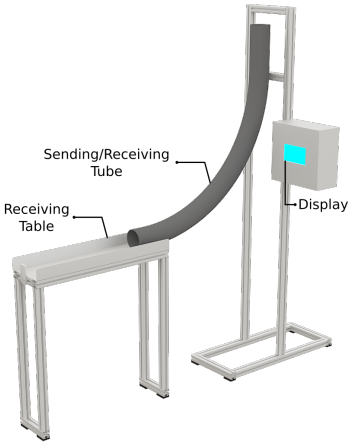

Figure 2.15: Lab Station

Multi Send station is generally paired with Lab station and used in pharmacies or labs to manage high loads.
It has 3 sending shoes with the option of RFID detection module. Hence, it detects the home or fix destination of carrier and process the empty carrier.

2.4.4 Multi-Receive/Lab Station

Combined with multi send or other types of stations, Multi Receive/Lab Station is deployed at the destination points to receive multiple number of carriers at a time. It can manage high load of Lab. This station will be installed with dedicated blower from control room.

2.5 Blower

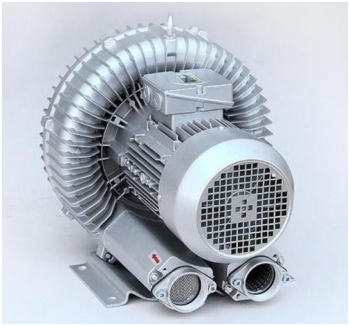

Figure 2.16: Blower

Blower is the "driver" of PTS. It generates the necessary pneumatic pressure which speeds the carriers along the tubing and delivers the carrier at the destination station. It is essential to plan and choose the number, power and type of blowers based on the loads to be transported. Number of blower can be calculated based on station count. Generally, 10-12 stations are placed under one blower.

2.6 Zone Exchange Unit

Given that one blower manages one carrier at a time, the system is to be designed with zone containing of 10 to 12 stations in a single zone. In bigger project where station count is more, deisgn team need to consider multiple zone. Zone exchanger unit is designed to provide effective and fast handover and takeover of carrier from send zone to receiver zone. It can be done multiple ways. Here, We will explain on of the simple and modular design approach to make zone exchanger unit. Normally this exchanged mechanism is placed in Blower Control room. Hence, whenever their is a carrier dispatch from one zone to another zone, It will come to blower control room and it will be routed to destination from that place.

2.6.1 Diverters based Zone Exchange

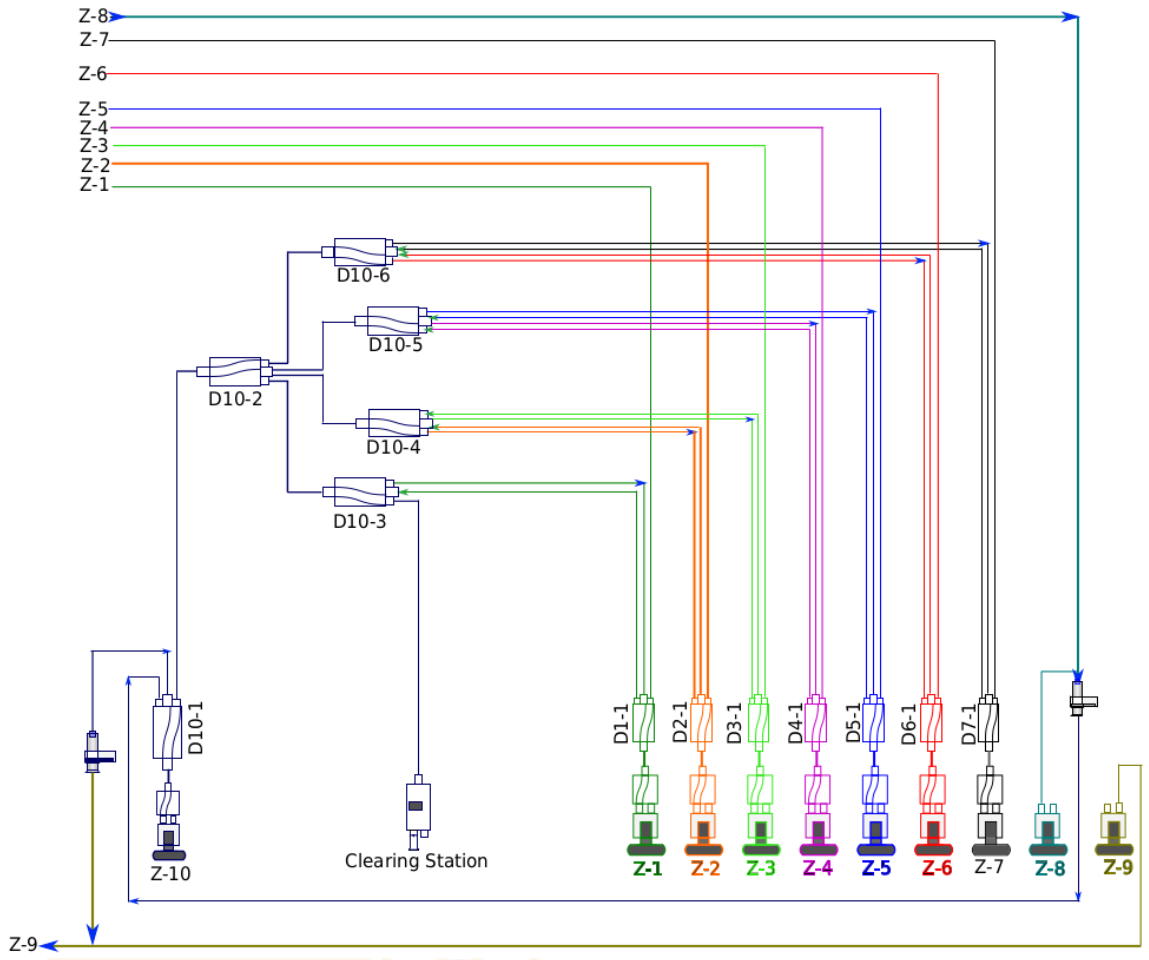

Figure 2.17: Diverters as Zone Transfer

Here, diagram shows how zone exchange can be achieved by set of diverters and an extra blower into the system. Here all left side 4 zones are the main zone that will have stations connected to hospital building and right-side zone will take the carrier from sender zone and hands it over to the receiving zone. Main 4 zone can be divided in a way to cater the civil blocks like block-A,B,C,D.

This kind of zone exchanger design will provide flexibility and modularity. In case of fault in any one diverter of part only that much part of the zone will be affected. Keeping all other zone of the system live. Also it will provide flexibility incase of extension of hospital. Simply adding an additional diverter will make us enable to increase the zone of the system.

Multi-send and Multi-receive stations are normally linked with dedicated blower. This will make their operations independent from the all other zone. This will help to increase through-put drastically. Mostly this mechanism is used in pair for Lab and Pharmacy. It can reduce wait time for Lab and Pharmacy carriers and increase turn around time and increase productivity.

3

Planning & Design

3.1 Understanding Requirement

Most hospital planners knows about vahiny and keep important aspects in mind while designing mustispeciality or general hospital. Whereas, many old and running hospital buildings are also raising requirement to have facility for internal logistics.
Indian private healthcare with capacity morethan 100 beds can be clasified in 3 major segments:

- Corporate Hospitals
- Trust and NGO based Hospitals
- Family, Friends or Partner Operated Multi-Speciality and Super-Speciality Hospitals

Government Healthcare with more than 100 beds can be classified as following :

- AIIMS and PGI type institute (mostly 1 in every state)
- State/Center operated Hospitals and Medical College
- PHC and CHC Center

Before we start planning, customer must know the expected load carring capacity and required volume for the system. Mainly OD110 and OD160 has been widely used in healthcare sector. OD110 has volume of around 500ml IV Bottle or an A4 size paper folded from landscape. However, it can not take blood bag bigger than 300ml. If your requirement is to get more volume, Please choose to go with OD160mm. OD110 system is good enough to carry blood samples, small surgical items and medicines.
Purpose of vahiny in hospital is to collect few samples and send it to lab for processing as soon as possible. This will increase the productivity of lab and reduce the turn around time(TaT) of the sample. This system is designed to take care of 70-80% of intra-logistic problems and reduce the human movement. However,

there will be some items and heavy load material that need to be transported by other means.
If we carefully observe the human movement inside the hospital. We can find that more human movement is for the items mentioned in above topic of Carriers.
Movement of hospital staff for above items will be to/from the departments listed in above stations section.
Vahiny is recommended to use for the above items and departments. However, this must be validated by end user and authorized person. Validation must be performed by relevant department for relevant items before placed into the vahiny system.
For optimizing Vahiny design and return on investment purpose following aspects needs to be keep in mind :

- Predict the volume of Vahiny carrier traffic on each zone of the proposed vahiny network during different periods of day and night, especially during periods of peak activity.
- The Vahiny usage policy should be periodically reviewed based on statistics and occupancy of the hospital. If frequent error or alarm are reported from any department than training for the staff need to be scheduled as soon as possible.
- Determine the speed at which the Vahiny carriers should be moved.
- Determine the highest weight and size of specimen that will be shipped via Vahiny.
- If extremely high through-put is required between 2 departments then point to point zone can be considered. In this, a dedicated blower should be assigned to the 2 stations.
- Configure the type and layout of PTS stations in line with the number and type of transactions.
- Design a single zone with stations stacked over each other on floors.
- Provide maximum of 10 to 14 stations in one Zone.
- Determine the requirement and type of Zone Interchange Unit based on requirement.
- It is preferable to locate Clearing Station in plant room.
- Determine the requirement of color-coded carrier. This might ease the task of end users and helps them to identify the purpose of carrier. For ex., red can be assigned only for Lab related operation, Yellow can be for Pharmacy related operation and Orange can be assigned for all other purposes.
- It is essential to ensure that the contents placed in Carriers are properly and securely packed. Since hazardous products such as laboratory Samples may be transported by Vahiny, proper packaging of the material, e.g., blood sample tube is mandatory before placing it inside the Carrier.

3.2 Type of Projects

3.2.1 Green Field Project

Green field projects are the projects that are going to be planned on empty land. Healthcare Architect or Consultant must do all required and mandatory checkup to decide as per client requirement and scope of work needs to be defined and written. Below are some of the recommendations that can be helpful to make vahiny friendly hospital planning. Number of basements and total floor counts must be decided keeping all the facility in mind. Normally, Reception, Emergency, Billing, OPDs, Phlebotomy and Pharmacy needs to be planned on Ground floor. Keeping OPDs on ground floor will reduce the human movements to higher

floor, reduce elevator usage. If hosptial has planned morethan G+7 floors, they should consider to keep one floor or half floor area as sevice floor typically located on the middle floor. This space can be utilized to place all services related department offices and noisy machines, Maintenance office, etc. Vahiny control room can be also planned in this space. If floor are lesser or equal to G+7, all the services can be planned in upper basement area. Hence, Vahiny control room can also be planned on same level. Above numbers are not the strict rules and it vary from case to case bases. It also depends on floor heights, customer's requirements, availability of space and many more aspects.

To start with Vahiny planning one needs to fix the floor layouts and departments location on each floor. Location of blower control room must be decided and provided by responsibile agency. Typically, Blower room needs to placed near by center of the floor. This will help to cater entire hospital area with most efficient and faster way with minimal energy usage. Based on above details, stations locations and Single Line Diagram(SLD) can be made by vahiny design team. This location and SLD must be approved by concern agencies and authorized person from end user. Any changes in floor departments and locations will affect the SLD and Vahiny planning. Hence, replanning and design will be required to make it efficient.

3.2.2 Brown Field Project

Brown fields vahiny projects are the one that required vahiny in running hosptials. In this kind of project, it is hard to estimate the cost and timelines. As complexity and hidden tube path can bring lot of surprises during installation. Recent multi-speciality hosptials with HVAC, Fire-Fighting, MGPS and multiple other services makes pipe path and planning very difficult. For this kind of project, We need to gather as much as documents and design of floor related services. These drawings may not provide exact idea of planning but it does help to locate departments on floor and finalize the station locations. However, tubing path and feasibility must be examined by physical verification on site. Most cases drawings will have lot of deviation from real situation on site. To avoid surprices during installation, maximum time needs to be spend for analysis and detailing of tube path and core cutting locations.

3.2.3 Extension or Renovation Project

Vahiny system is pretty modular and can be extended very easily with new building or departments or floor as per requirement. However, blower room and its capacity for the same need to evaluated. If required second control room can be planned with separate blower. Internally both system can be connected for transactions. Compatibility of the software and system versions need to be checked and verified before finalizing the project. While planning the extention Vahiny for other part; control room, distance, underground trench or overhead bridge, load analysis of departments in new area need to be taken into consideration.

3.3 Planning

Following are some of formulas to determine the number of required stations in Hospital :

$$\text{Number Of Station} = \text{Number Of Beds} / (12\text{-}18)$$
$$\text{Number Of Blower} = \text{Number Of Station} / (10\text{-}15)$$
$$\text{Required Blower Space(in Sq. Meter)} = \text{Number of Blower} * 10$$

Above formulas are general thumb rule and actual requirement can vary based on architect/floor/block shape and size. However, Blower location of required space must be defined based on above mentioned formula.

Suppose, we wants to plan a vahiny project for upcomming green field hospital located in Kolkata. Estimated

bed count for the hospital will be around 250. Let's determine the number of stations and Blower space requirement based on above mentioned formulas.

Number Of Station = 250 / 15 (Choosing 15 as reference between 12-18) = 16.66
Station count will be around 16. Number Of Blower = 16 / 12 = 1.33
Required Blower count will be 1. Required Blower Space(in Sq. Meter) = 1 * 10 = 10 Sq. Meter

To prepare SLD one must make station list of the project. Here, we made a sample station list of our project. This listing contains floorwise and blockwise/wingwise list of the stations. Once this list has been approved by client, project management consultant, architect and respective stack holders, we can proceed with the schematic diagram.

ABC Hospital, XYZ Road, Kolkata				
Floor	**Block A**	**Block B**	**Block C**	**Count**
LG	Sample Collection		Sample Collection	2
UG	Emergency	Blood Bank		4
	Pharmacy			
	Ward			
1st	OT Store	Nurse Station	Sample Collection/Store	3
2nd	ICU	OT Store(in future)	Lab	4
	Passage End Area			
3rd	Passage End Area			3
	General Ward			
	CSSD			
Terrace		Control Room		0
Total	10	3	3	16

Figure 3.1: Station List Reference

Single Line Diagram(SLD) must be prepared based on decided station location and blower room. SLD will help to decide the type of station and quantity of diverter and other required items. It will show the proposed tube path and core-cut locations. SLD must be approved by project management team and end customer to go ahead. Otherwise feedback and necessary changes must be integragated in SLD. This will be an iterative process to get approved and include necessory feedback. Once SLD is finalized, BoQ can be prepared. This will help draw the estimation of very much realistics project costing and items required. Based on SLD co-ordinated CAD design and BIM design can be made. This will help to identify the collision with other services. Co-ordinated drawings are highly recommended for the project to avoid the unnecessary surprices. This design must include furniture layout along with stations layout. Below you can find a simple reference SLD of our example 250 beded hospital. For bigger hospital, this diagram can be more complex.

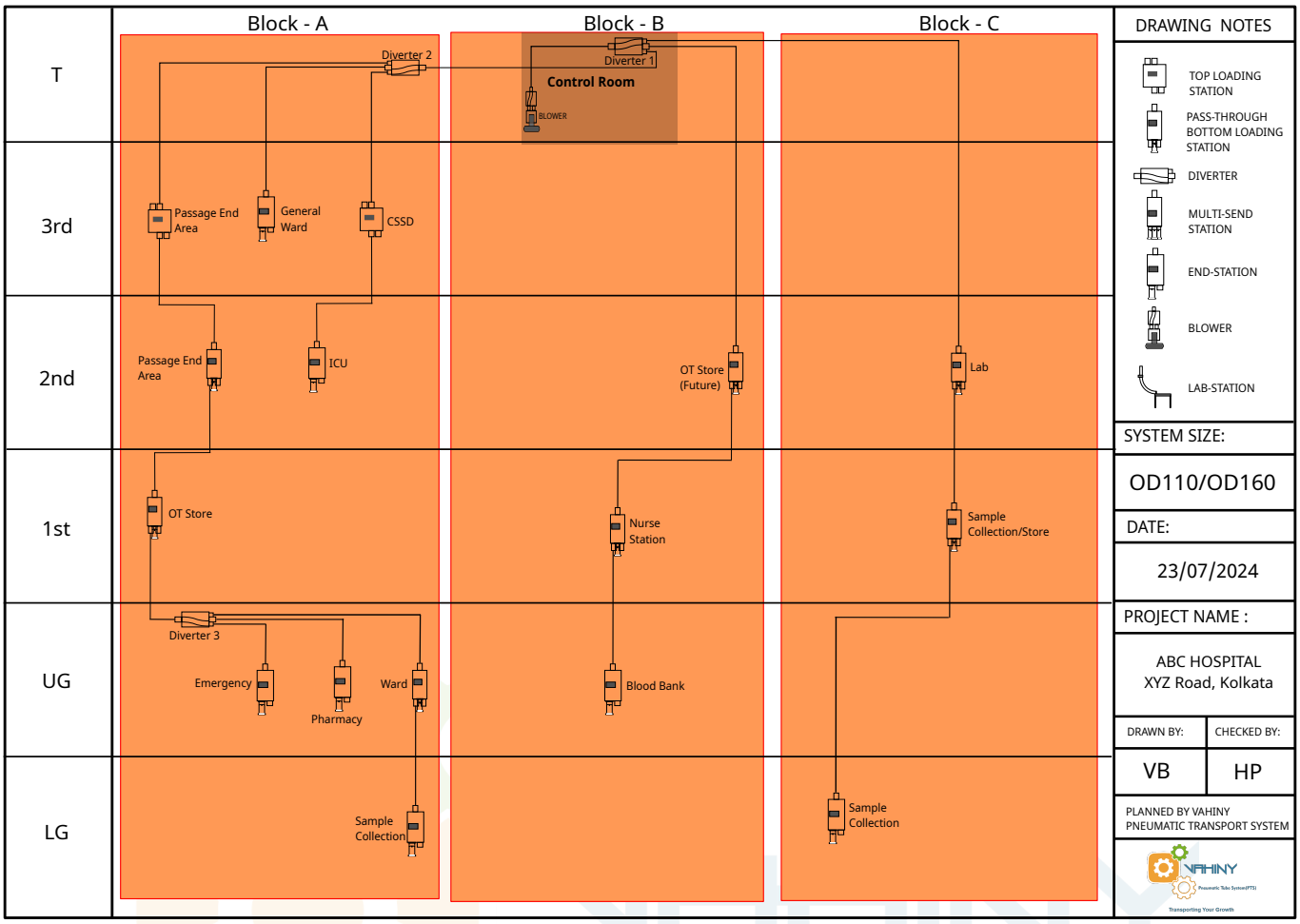

Figure 3.2: SLD Reference

3.4 Co-Ordinated Drawings And Execution

Requirement of infrastructure services has been increased over the time. Strict Government regulations of firefighting, basic need of HVAC, Electrical(Raw power and UPS power), Elevators, Medical gas, Various types of drainage pipes and many more services will be very important part of design. This all services will be placed below the beam and above the false ceiling area. It demands very much detailed planning and MEPF design to avoid the surpises on site. Vahiny pipes also need to be planned along with all other infrastructure services. Here collosion with other services can be figured out and resolved. This preventive actions will help to reduce installation time, and derive exact BoQ. There must be project management consultancy, who can ensure the installation and execution of services as designed by architect and MEPF drawings. Vahiny engineer can join MEPF designer team and will help to avoid collision and decide the tube route as per schematic design. Execution as per drawings will help to keep project in budget and avoid cost escalation as well as change in BoQ.

4

Topology

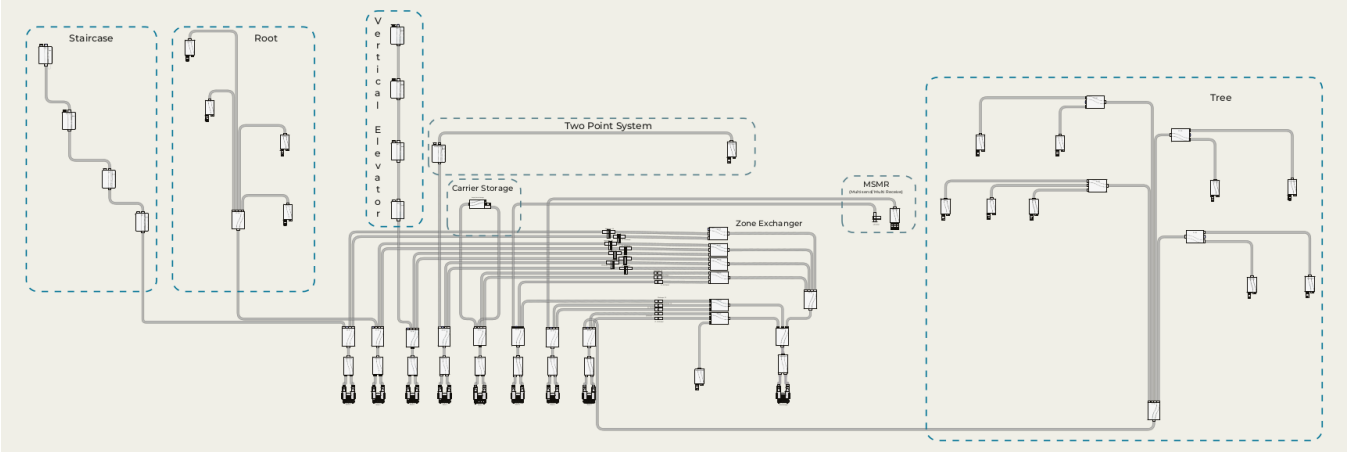

Figure 4.1: Design Topology

Above diagram shows various type of design approach for the vahiny system in the hospital building. Most cases multiple approach are mixed in project to cater the building requirement.

4.1 Vertical Elevator

This is most energy efficent and simple design of vahiny. Mostly, IPD wards are typical design of same type. This approach is very much practically possible in these departments. As all nurse stations can be located on same location on all the floors. This will reduce the chances of collision with other services and reduce pipe length, installation cost and operation cost as well. Most cases pass-through type stations are used in this kind of topology.

4.2 Stair Case

This is little complex than vertical elevator aspects. This way of design is applicable where floor design is not typical but required station count on floor is same as above or bottom floor. In this approach core-cut will be created just below the station and that will be linked to station of below floor. Here little horizontal tubing will be required. Path for this tube installation must be clear and avoid the collision with other services. This approach is very much practical and possible without many complexity.

4.3 Root Topology

This approach is applicable building that are created by PT slab. In this kind of building core-cutting is not allowed. Hence dedicated shaft from the center of building must be used. Here all pipes will go to particular floor and provide the connectivity with station location. Typically, End type station is used in this design approach.

4.4 Tree Topology

This is little bigger version of root topology. This is used when more stations are required on any floor. Here diverter will be installed in the ceiling of particular floor. This will allow to create multiple branches. In this kind of design, location of diverter must be choosen very carefully. Trap door and servicibility must be kept in mind. This diverter will be closed in false ceiling and hanged below the beam. Here, collision with other services (like fire fighting, HVAC, etc) must be resolved very well by respective agencies.

4.5 Dedicated Line

Dedicated Line approach us used with Multi-send, Multi-receive stations. Here station will be connected to dedicated blower via tube. This approach is used to handle high load of pharmacy or lab. This design approach will help to make faster delivery and reduce wait time for lab and pharmacy.

4.6 Control Room/Blower Room/Plant Room

Following are some important thumb rules for the design criteria of cost effective vahiny design.

- Number of Station = Bed Count / 12-18 – Generally 12-18 beds per station
- Blower Count = Number of Station / 12 – Generally 10-14 station per blower
- Space Required For Blower Room = Blower Count * 10 sq meter

All the blowers required for the project will be located in control room. Zone exchanger unit will also be placed inside control room along with one clearing station for the system. Control room must be enclosed area with solid wall and no false ceiling. It must have lockable door and table, chair and cupboard to store vahiny spares. Vahiny server CPU will be placed here. Operation and Maintenance engineer can observe the entire system from vahiny server. Required firewall setting must be done Blowers will be operate on 3ph power supply. Hence required powersupply with proper earthing must be provided in control room. It must have proper air ventilation. Blower will start only when the carrier movement is required. During transaction blower will make noise upto 80db at 1 meter distance from blower. Hence control room must be sound proof to avoid disturbance in near by departments. It can be located in service area where most other equipment control rooms are located. If hospital building heights is lessthan 6 floors, control room can

be placed in upper basement or on top floor or terrace. If basement has parking allocated than one need to make sure the polluted smoke of car does not go into blower room. As blower will be blowing air into the pipe system. Car smoke will increase chances to block the photoelectric sensors and it will need frequent cleaning of sensors.

If hopsital building has more than 6 floors, Vahiny recommend to keep control room in central floor or service floor. This will reduce the power consumption of the system and make it more reliable and efficient. Blower room must be enclosed, isolated and dedicated place built with rigid wall. This wall will be used for blower mounting. Door for blower room must be as wide as possible. Normally, Blower room can be used as storage room for Vahiny when installation is under progress. False ceiling must be avoided in blower room. It must have atleast 1m of clear opening doors.

5 Installation

5.1 Tube Installation

Space required for straigh pipe installation is 50mm more than the pipe outer diameter. As it should avoid direct or close contact with other services. However, cold and hot pipe passing near by Vahiny pipe must be insulated properly. Otherwise it can create condensation in vahiny pipe. Condensation will lead to water droplets inside pipe and it can contaminate the carrier and sample. Near by every blower, there will be bypass mechanism of pipe as shown in below image. It will store the carrier during transfer from suction to pressure whenever necessory. Pipe must get a proper straight cut. Sleeve is used to make pipe joint. It can slide smoothly over a pipe yet in a tight tolerance. Vahiny pipe can be installed at fix height without any kind of slope. Pipe will be hanged at appropriate height below the beam and above the false ceiling area. There must be enough space and clear path for the vahiny pipe installation. It should avoid the collision with other services. Vahiny pipe must be isolated from cold and hot pipe. Co-ordinated drawings must be approved by respective agencies for the piping work to commence. Rubberline clamps must be used to provide proper grip to pipe. This will avoid sliding or movement of pipe when carrier is passing with speed. Stud support must be provided after almost every 2m. Before installation of straight pipe. Installer must take care of cleaning it from inside with proper technique.

5.2 Station Installation

Station must be on rigid wall. Bottom loading stations must be installed at 1.0 meter height of bottom plate from finished floor. Whereas top loading stations must be installed at 1.5meter height from finished floor. This installation practice will provide ergonomical access by end user. Carrier rack and Baskets must be installed properly. Capacitive touch screen will provide the phone directory. All possible destinations must be synced with station directory from main server. All station will required to have its own single phase power supply. Hence 110-240V,5A switch and socket must be provided near station location. Vahiny

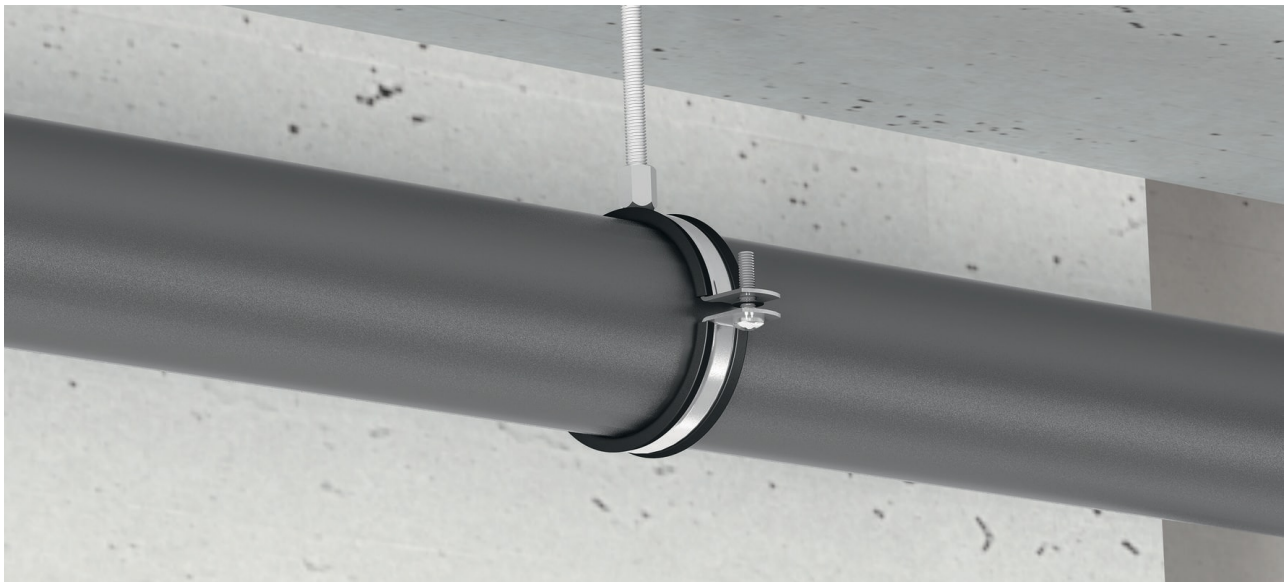

Figure 5.1: Tubing

is the most advanced type system and it works on IP with your existing IT network infrastructure. This makes vahiny's integration with other system like HMIS or BMS very easy. Hence make sure to provide around 100 MBPS speed port near by station. Vahiny station will be plug-in from single phase socket and connected to LAN port. It will use TCP/IP protocol for faster, safer communication with a vahiny server CPU. Normally, Vahiny server will be placed in plant room.
Avoid installation of station in corridor area. As passing of stretcher or transporting patient from one place to another place may hit the station. Station must be located near by hospital staff person. Enough space must be allocated for servicability and maintenance and opening the station door. If required, station can be equipped with light base beeper and buzzer. This will blink and create beeping sound on arrival of carrier for certain fix duration.

5.3 Diverter Installation

Diverters will be installed on rigid wall or hanged from ceiling. When diverter is hanged, all pipe connected to diverters will be staying below the beam and above the false-ceiling space. Hence proper location and enough space must be planned for diverter. Here trap door must be planned for servicablity.
Also diverters will be installed in control room. Based on required space and design, it needs to be planned and installed. Vahiny Diverters are all IP operated and works on de-centralized power supply. Hence, LAN port and single phase power switch and socket(110V-240V, 5A) needs to be placed.

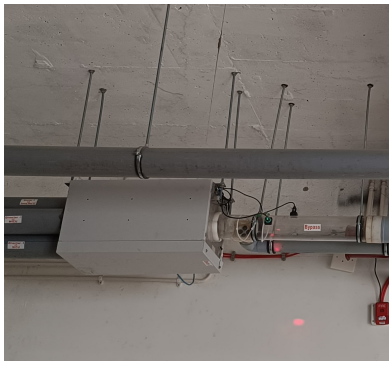

Figure 5.2: Diverter Installed

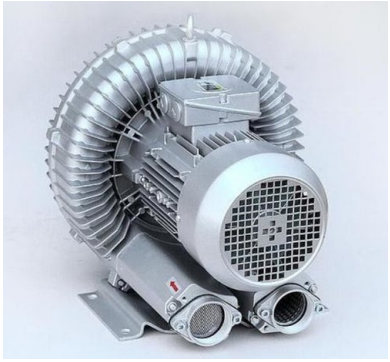

Figure 5.3: Blower Installed

5.4 Blower and Zone-Exchanger Installation

All the blowers must be placed in control room. If distance to travel is higher than 500m in any direction from control room, there must be second control room planned in that direction. All blowers should be equipped with VFD. This will help to reduce or increase the speed of blower as per requirement. This speed can be configured at the time of testing and commissioning.

5

References

[1] Nous Healthcare, Dr. K. B. Sood, Delhi link

[2] European Compliances Regulation, link