Distribution Centres for Fruits & Vegetables

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Except air, all other resources required for leading our lives require distribution. Water, food, clothing, fuel, construction materials, money are some of the key requirements of daily life which need distribution.

Each product by virtue of its characteristics, has its own demands on the distribution pattern and system required. This demand or speciality for a particular product is based on the requirements for sustaining the product's journey from the place of production to the point of consumption . On this journey from production to consumption , there are points of aggregation, storage, treatment, and distribution. These points are broadly called "Distribution Centres" (DC) and this article gives an overview of such centres for fruits and vegetables.

Most of us have read that India is the second largest producer of fruits and vegetables. However a large part of this (almost 25-30%) gets damaged and unfit for consumption due to improper or non-existent facilities for treatment post harvest , storage and distribution from places of plenty to places of demand.

Thanks to the retail trade revolution which is currently storming the country we now see an opportunity to have this big loss being encashed by a proper supply and distribution chain management of fruits & vegetables (F&V). This will result in a good nation-wide distribution system for such products although it is safe to assume that most distribution centres will operate on a city and region basis.

A distribution centre is metaphorically located between the farm (centre of production) and the city (centre of consumption). *Figure 1* shows a schematic representation of the location of a DC. The system operates and looks like a "hub and spoke" system. *Figure 2* shows a typical internal layout of a DC.

A modern F&V city distribution centre (for a metro city) will cover an area of approx 7000 to 10000 sq.m.

It will generally have the following contents:

1. Precoolers
2. Process Halls
3. Cold Stores

About the Author

M. S. Manjunath is an electrical engineer with 18 years experience in project marketing of cold storage systems, food refrigeration and clean room constructions for food and pharma industries, in India and abroad.

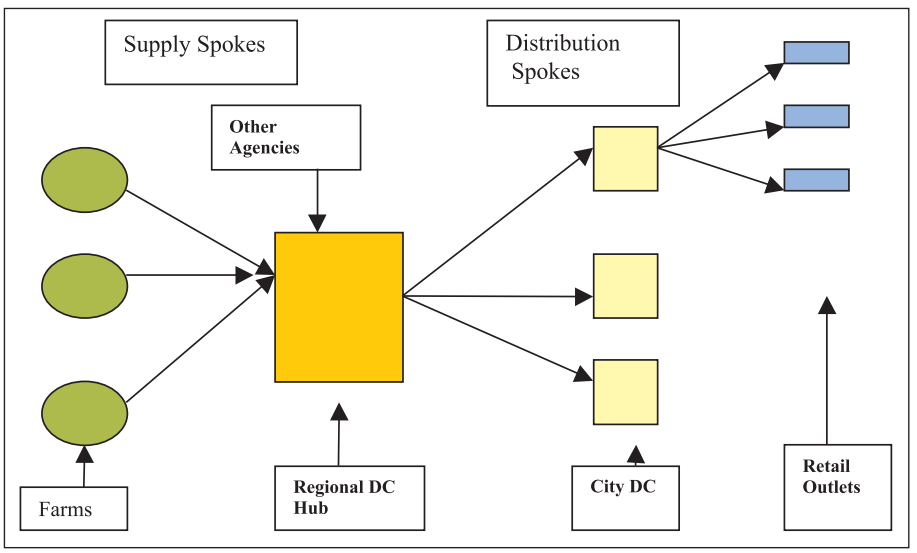

Figure 1: A schematic representation of a DC

4. Frozen Stores
5. Ripening Chambers
6. AnteRooms for Cold and Frozen stores
7. Refrigeration Systems
8. Humidification Systems
9. Automation
10. Material Handling and Storage Systems
11. Packing Systems
12. Dry Warehousing
13. UPS, Server, Office rooms
14. Change rooms, Restrooms and utilities
15. Machine rooms/Technical corridors

Futuristically, if business promoters opt to process certain F&V into cubes and frozen products then the DC may also contain an IQF or blast freezer.

Design Engineering of a DC

The modern day DC handles raw F&V and certain processed packed dairy items also.

The DC forms a part of the investment in a retail chain. Hence the following issues need to be carefully addressed during design:

1. Hygiene
2. Power consumption
3. Quick unloading and loading
4. Access to main roads and highways
5. Quick construction and commissioning
6. Security and risk management
7. Water resources
8. Waste disposal and sanitation
9. Pest protection
10. Material and man movement controls

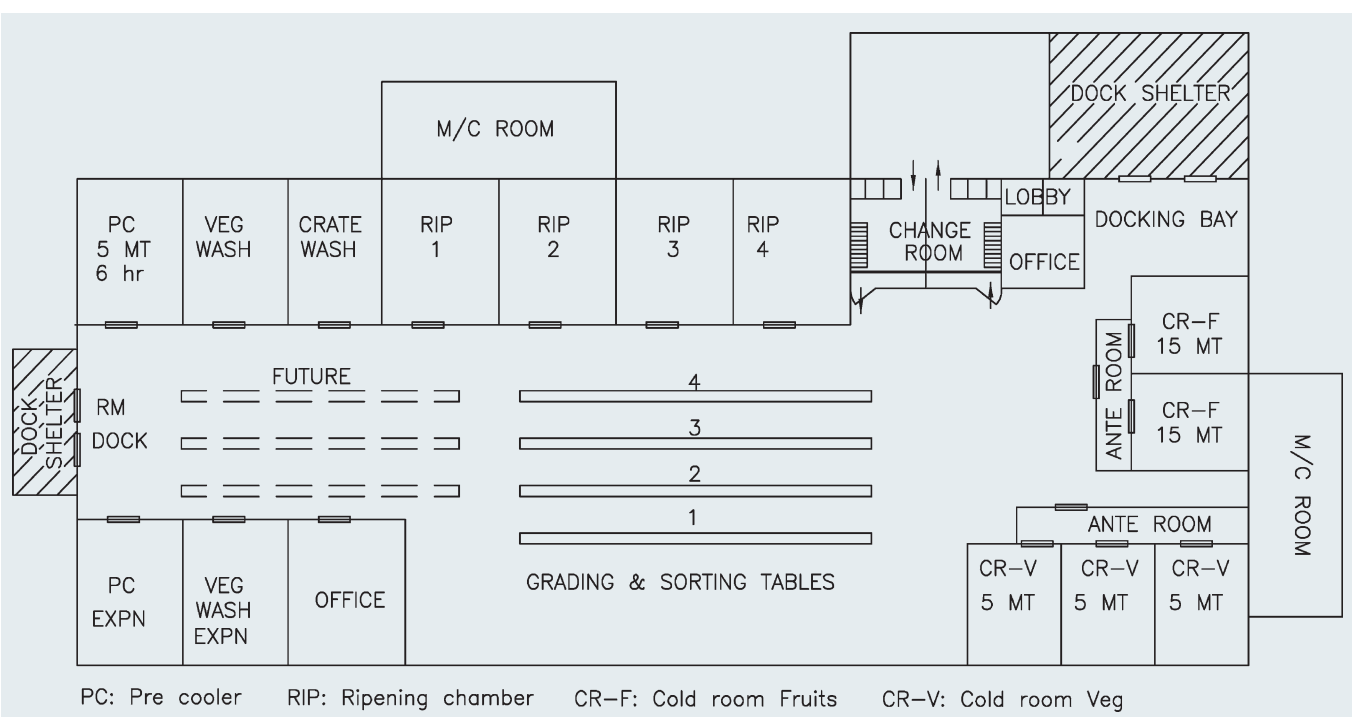

Figure 2 : Typical layout of a DC

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11. Door systems , docks and seals

Construction of a DC

Plinth:

The plinth should be designed to take care of :

1. Static load of the superstructure, the storage system and the payload
2. Dynamic load of material and man movement
3. Drainage and cleanability of drains
4. Height to accept container docking
5. Proper pest protection.

Superstructure:

The superstructure is a combination of preengineered steel building and prefabricated metal clad insulated panel system. The pre engineered building is first erected over which the perimeter walls and ceiling are then erected using prefab panels.

Advantages of such a design are:

1. Preengineered steel structurals with bolted design offer quick construction and larger spans not requiring intermediate column supports.
2. Prefabricated insulated metal (prepainted) panels offer excellent insulation value thereby reducing power consumption and equipment size.
3. Panel construction offers the best hygienic surfaces which lend easily to cleanability and disinfection thereby ideal for certification and approvals.
4. Close to 95% salvage value, these constructions can be re-erected at another location .
5. The entire construction can be accomplished at less than 15% of the time taken for conventional construction finishes.
6. Preengineered and prefabricated panels offer excellent value added benefits and reduce site work immensely.
7. Flexibility is the hallmark of such constructions. It is very easy to partition and create various rooms which requires very little time at site although good planning is essential.
8. Uniform aesthetics: all cold stores, process halls, ripening chambers and perimeter walls have the same finish and look. Doors and viewglasses offered are state-of art systems completely integrated into the wall systems.
9. Roofing panels (optional and where applicable) are prefabricated and insulated can be mounted exposed-to-sky and do not need any additional roofing sheet .
10. Life cycle costs are attractive and definitely cost

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Table of contents and specifications of a typical DC

Room	Item	Specification
Overall DC	Size of the DC Process Thro'put Storage capacity	50M X 25M X 3.5M 10 MTPD 50 MT
Precooler	Capacity---------- Temp---------- Relative Humidity--------- No. of precoolers per DC Type of precooler Air Distribution	5MT per batch of 6 hrs Plus 2 Deg C 95-98% 1 HFA Type Plenum Injected
Cold Stores	Capacity Temp Relative Humidity No. of coldrooms per DC	5 to 15 MT Plus 2 to Plus 8 Deg C 85 to 95 % 4 to 10 Nos
Process Halls	Size of the hall Temp Relative Humidity No. of Process Halls per DC Thro'put per day	25M X 15M X 3M 18 to 20 Deg C 85% 1 10 MT
Ripening Chambers	Capacity No. of rooms Temp Range Relative Humidity range Ethylene controls Cycle	10 MT 4 nos 14 Deg to 16 Deg C 95% Injection & Extraction reqd. 4 Day Cycle
Frozen Stores	Product Temp Docking Bay Temp Relative Humidity	Dairy Products Minus 20 Deg C Width 4 M 16 to 18 Deg C 85%
Refrigeration Systems	Freon System R22 / R 404a OR Ammonia System Factory assembled and tested	Air Cooled Skid mounted Systems
Humidification Systems	Refrigeration Generated Steam Humidification	Upto 85% 85 to 95 %
Automation	BMS Data Mining	Dixell / Sauter Controls Possible for Traceability
Material Handling	Fork Lifts Hand Palletiser	To suitable requirements
Material Storage	Racks with Crates OR Only Crates stacked	
Door Systems and Loading Accessories	Coldrooms Precoolers Ripening Rooms Dock Seals Dock levellers Internal doors	Sliding Doors Sliding doors Sliding Doors Bellow type Required Swing single leaf

saving as compared to conventional construction systems. These panel systems are virtually maintenance free through their life.

A general table of contents and specifications is offered to understand the contents of a DC.

DC Refrigeration

A refrigeration system for a DC can be either Ammonia based or Freon based. The choice is dictated by parameters such as:

a. Overall capacity of the refrigeration system

b. Capacity utilization of the cold rooms and other equipment.

c. CAPEX and OPEX evaluation of both systems where either are suitable technically.

d. Environmental compatibility

e. Availability of trained manpower.

DC Automation

DC automation is based on what parameters need control, recording and annunciation. Investment in automation is driven by statutory needs, power savings in the long run and reduced human intervention. Benefits arising out of a good automation can be reliable functioning, data mining, traceability, power saving, optimum operation of various plants and drives etc.

DC Humidification

A F&V DC is essentially a high humidity area since it handles fruits and vegetables , whose basic requirement is high humidity for staying fresh. To a large extent (upto 75-80% RH) humidification can be achieved by fine tuning the refrigeration system.

Thereafter, to raise the humidity levels upto 95%RH it is advisible to opt for a steam type humidification system. Other water based systems are also used but are likely to have the issue of moisture carryover resulting in suspended moisture particles in the air which is not advisable in handling and storage of F & V. It is also advisable to have a dedicated steam humidifier in each room hooked to a humidistat control.

Humidification systems require excellent quality soft water. It will be ideal to have water hardness maintained at 50ppm, but in an extreme case, not more than 150 ppm.

Conclusion

Modern day distribution centres are just emerging in the country and to that extent the technology, the format, layout and interfaces are still gaining maturity.

There will definitely be many changes and upgradations in the systems mentioned in this article.

Hence it is expected that designs will undergo many revisions in a year or two. ❖