TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
PULCHOWK CAMPUS

A PROJECT REPORT

ON

DESIGN AND SELECTION OF EQUIPMENT FOR COLD STORE

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1. INTRODUCTION

1.1 Background

1.1.1 Cold storage

Cold storage industry is popularly known as agricultural service oriented industry which serves as a vital link between the production and consumption of agricultural produce. Cold storage industry is popularly known as agricultural service oriented industry which serves as a vital link between the production and consumption of agricultural produce. Storage implies preserving. It is the process of carrying surplus production for future consumption. It includes all types of storage, like traditional method or scientific methods of storage, or the storages maintained by the private or public agencies.

The overall growth of the agricultural sector and its output has a close relationship with the level of investment made in agricultural infrastructure. In fact empirical research has shown that there is a strong positive correlation between the level of infrastructure and the economic development. Investments made in the infrastructure results in a comparative advantage for the region, which results in a higher agricultural output and productivity. Availability and efficient use of the cold chain is much more evident in developed countries than developing countries. Unreliability of the power supply, lack of proper maintenance and inefficiency of utilization of cold storage and refrigerated transport facilities are among the reasons for failure of the cold chain in the developing countries.

A cold storage is a commercial facility for storing perishable products such as fruits, vegetables, meat, fish etc. under controlled conditions for longer periods. It is a critical component in the food supply chain. Without rapid cooling and appropriate storage conditions, produce deteriorates rapidly. Nutritional temperature is critical, as otherwise it will cause chilling injury to the produce. Also, relative humidity of the storeroom should be kept as high as 80-90% for most of the perishables, below (or) above which his detrimental effect on the keeping quality of the produce. (Kumar, 2002)

Most fruits and vegetables have a very limited life after harvest if held at normal harvesting temperatures. Postharvest cooling rapidly removes field heat, allowing longer storage periods. Proper postharvest cooling can:

- Reduce respiratory activity and degradation by enzymes;
- Reduce internal water loss and wilting;
- Slow or inhibit the growth of decay-producing microorganisms;
- Reduce the production of the natural ripening agent, ethylene.

Figure 1: Cold store

Based on the purpose the modern cold stores are classified into following groups:

- Bulk cold stores: Generally, for storage of a single commodity which mostly operates on a seasonal basis E.g.: stores for potatoes, chilies, apples etc.
- Multi-purpose cold stores: It is designed for storage of variety of commodities, which operate practically, throughout the year.
- Small cold stores: It is designed with pre cooling facilities. For fresh fruits and vegetables, mainly for export oriented items like grapes etc.
- Frozen food stores: It is designed for with (or) without processing and freezing facilities for fish, meat, poultry, dairy products and processed fruits and vegetables.
- Mini units /walk in cold stores: It is located at distribution center etc.
- Controlled atmosphere (CA) stores: It is mainly designed for certain fruits and vegetables. (Rao, 2015)

1.1.2 Potato and its storage

Potatoes are perishable food item and require specific storage conditions to maintain their quality and extend their shelf life. Several factors contribute to the spoilage of potatoes during storage. Sprouting is a common issue, especially when potatoes are exposed to higher temperatures or prolonged storage periods. Sprouting not only affects the appearance of potatoes but also alters their texture and flavour. Additionally, potatoes are susceptible to rot caused by fungal and bacterial pathogens, particularly in humid and poorly ventilated storage conditions. Mechanical damage during handling and storage can also accelerate spoilage by providing entry points for pathogens and accelerating decay processes.

To minimize spoilage and maintain potato quality during storage, it's essential to store them in a cool, dark, and well-ventilated environment with controlled temperature and humidity levels. The optimal storage temperature for potatoes typically ranges between 4 to 10 degrees Celsius. At temperatures lower than 4 degrees Celsius, potatoes can suffer from chilling injury, while temperatures above 10 degrees Celsius can promote sprouting and encourage the growth of spoilage microorganisms. Humidity levels are also crucial for potato storage. Ideally, potatoes should be stored in an environment with high humidity, typically around 90 to 95 percent relative humidity. Adequate humidity helps prevent moisture loss from the potatoes, which can lead to shrinkage and dehydration.

1.1.3 Load Calculations

For positive temperature cold storages, the major heat load contributors are:

• Heat gain through walls, roof and flooring

• Product load comprising of load due to the difference in product loading temperature and storage temperature

• Respiration load, as the product continues to breathe during storage for a considerable period

• Outside air load due to ventilation requirements and infiltration

• Equipment load such as air cooler fan heat gain and forklifts

• Loads contributed by human beings operating inside the room

• Lighting load

We shall now consider each factor for this typical NHB presented data on page 40, and how the values have been arrived at.

i) Transmission Load:

This type of load arises from the heat transfer through the walls, roof, floor, and doors of the cold store due to the temperature difference between the inside and outside environments. The transmission load is given by:

$$Q = U*A*T_D$$

Where 'U' is overall heat transfer coefficient in W/m2
K = K/x, 'K' is thermal conductivity of insulation used in W/m.K
'x' is insulation thickness in m,
'A' is the external area of each room in
'T_D' is the temperature difference between ambient condition and cold room temperature in K.

ii) Product Load:

Product load is the heat gain from the stored items, such as potatoes in this case, due to their initial temperature, respiration, and any exothermic reactions occurring within the products.

The product load due to their initial temperature, also known as product exchange load is given by:

$$Q = \frac{m * C_p * (T_f - T_i)}{t}$$

Where 'm' is mass in kg
'C_p' is specific heat capacity of product in KJ/Kg.^oC
'T_f' is final temperature of product in ^oC ,
'T_i' is initial temperature of product in ^oC ,
't' is required time to reach final temperature in day.

iii) Internal Load:

Internal load refers to the heat generated by people, lighting, and other sources within the cold store, contributing to the overall cooling load. The various internal loads can be calculated as,

Occupancy Load = No. of people * working hours * heat released per person

Lighting load = No. of lamps * wattage * lighting hours

iv) Air Infiltration Load:

This type of load results from the infiltration of warm air into the cold store through openings like doors and windows, which must be compensated for by the cooling system.

Infiltration load = ACH * V * E * (T_a - T_d)

v) Equipment Load:

Equipment load is the heat generated by refrigeration equipment, fans, and other machinery operating within the cold store, which needs to be removed to maintain the desired temperature.

Fan Load = no. of fans * wattage * hours of use

1.2 Objective

1.2.1 Main Objective

- To design a cold store for the storage of seed potato.

1.2.2 Specific Objectives

- To determine the size of a cold store room
- To calculate the various components of cooling load
- To select an appropriate refrigeration equipment for the cold store

2. DESIGN OF A COLD STORAGE

2.1 Location

Lele is a village development committee in Lalitpur District in the Bagmati Zone of central Nepal, at an elevation of 4,344 feet (1,324 metres) above sea level. Lele is 14 km from Lagankhel, Patan, the main city of Lalitpur. It is located in a small valley within the Kathmandu Valley. The river is the main source for irrigation for the farmland.

Coordinate: 27.5753120, 85.3505281

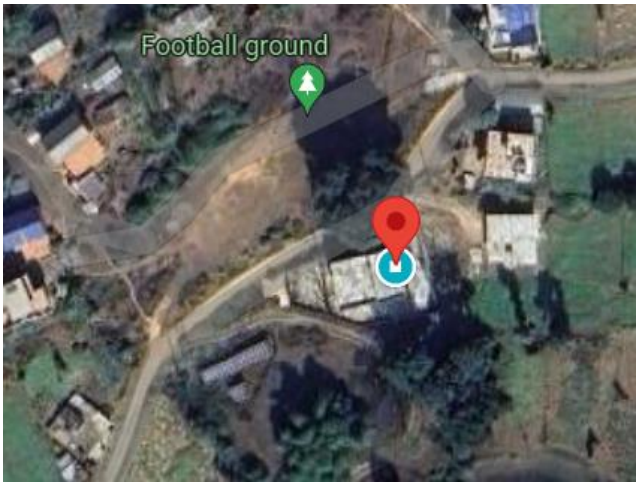

Figure 2: Location

2.2 Design Conditions

The maximum temperature was in May which was 33.18 ˚C temperature and Relative humidity for May was 56.42%. This condition was taken as an outdoor design condition for the total product load calculation.

The required indoor conditions for cold storage is shown in below.

Conditions		
Cold storage	DBT (° C)	4
	RH (%)	90
Ambient	DBT (° C)	30
	RH (%)	70

Table 1: Design conditions

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Oct	Dec	Year
Record high °C (°F)	21.12 (70.02)	25.14 (77.25)	30.16 (86.29)	33.18 (91.72)	33.18 (91.72)	32.18 (89.92)	30.16 (86.29)	30.16 (86.29)	29.16 (84.49)	28.15 (82.67)	25.14 (77.25)	22.12 (71.82)	33.18 (91.72)
Average high °C (°F)	14.7 (58.46)	17.63 (63.73)	22.57 (72.63)	26.02 (78.84)	27.36 (81.25)	27.65 (81.77)	25.62 (78.12)	26.03 (78.85)	24.87 (76.77)	23.09 (73.56)	19.12 (66.42)	16.35 (61.43)	22.58 (72.64)
Daily mean °C (°F)	10.44 (50.79)	13.54 (56.37)	18.73 (65.71)	22.63 (72.73)	24.08 (75.34)	24.8 (76.64)	23.15 (73.67)	23.18 (73.72)	21.8 (71.24)	19.02 (66.24)	15.05 (59.09)	12.05 (53.69)	19.04 (66.27)
Average low °C (°F)	3.48 (38.26)	5.38 (41.68)	9.38 (48.88)	12.69 (54.84)	15.01 (59.02)	17.26 (63.07)	17.45 (63.41)	16.39 (61.5)	15.04 (59.07)	11.5 (52.7)	7.9 (46.22)	5.14 (41.25)	11.38 (52.48)
Record low °C (°F)	-5.03 (22.95)	-1.01 (30.18)	2.01 (35.62)	7.04 (44.67)	10.05 (50.09)	13.07 (55.53)	14.08 (57.34)	13.07 (55.53)	11.06 (51.91)	5.03 (41.05)	1.01 (33.82)	-2.01 (28.38)	-5.03 (22.95)
Average precipitation mm (inches)	29.71 (1.17)	63.59 (2.5)	80.68 (3.18)	237.68 (9.36)	420.44 (16.55)	653.24 (25.72)	1022.66 (40.26)	896.64 (35.3)	539.95 (21.26)	192.76 (7.59)	29.22 (1.15)	15.38 (0.61)	348.5 (13.72)
Average precipitation days (≥ 1.0 mm)	4.76	6.86	8.41	17.27	24.78	28.8	30.9	30.44	28.06	18.46	5.39	2.84	17.24
Average relative humidity (%)	48.07	46.07	39.76	42.76	56.42	72.69	86.96	86.54	84.31	70.46	65.4	56.54	62.99
Mean monthly sunshine hours	8.49	9.0	11.54	12.78	13.22	13.31	12.4	12.4	11.76	9.35	8.61	8.59	10.95

Table 2: Temperature and humidity of year

2.3 Storing Method

Among many options to place a product like sack, wooden palette box, plastic crate etc. We have chosen sack which can store 50kg of potato. This type of sack is easily available at reasonable price which every farmers can afford. The sack also consists of many passages for air flow which makes the air distribution effective and also reduce its overall mass thus reducing cooling load required to cool the sack. Its size is also suitable for a single labour to carry effectively so fork lift truck is not needed.

Figure 3: Storing sack

The specifications of sack is given below:

Parameters	Specifications
Material	Polypropylene Plastic Bag
Size	1.5’x3’1’
Capacity	50 kg

Table 3: sack specifications

2.4 Dimensions and general specifications

General Specification			
Product	Potato		
Sack Dimension (2a,2b,L) (in cm)	47	32	94
Weight of potato per sack (kg)	50		
Volume of potato per sack (cm3)	111036.4507		
No. of sacks(single layer)	50		
Number of layers of sacks in each pallet	6		
No. of sacks	300		
Capacity of cold store (MT)	15		
Volume of each pallet (m3)	6.786048		
(Chamber 1) Room dimension (L,B,H) (in m)	14.0208	4.23672	3.048
Total Volume of room (m3)	181.0579171		
Store room dimension (L,B,H)(ft)	39.234	10.234	8.2
Storage Volume(ft3)	3292.470199		
(Chamber 2) Room dimension (L,B,H) (in m)	9.1186	5.5626	3.048
Total Volume of room (m3)	154.604083		
Store room dimension (L,B,H)(ft)	23.401	15.9895	8.2
Storage Volume(ft3)	3068.196374		

Table 4: Chamber specifications

2.5 Cooling load Calculation of Chamber 1

Condition	Temperature (oC)	Humidity (%)
Ambient	30	70
Inside Storage	4	90

Table 5: Design conditions of chamber

2.5.1 Transmission Load

Wall	Polyurethane Insulation Panel
U- Value (W/m2.K) (Wall 80mm)	0.275
U- Value (W/m2.K) (Floor 50mm)	0.43

Table 6: conductivity of insulation panel

Surface	Area (m2)	Temperature (oC)	Cooling Load (KWh/day)
North Wall	42.7353984	30	7.333394365
West Wall	12.91352256	30	2.215960471
East Wall	12.91352256	33	2.471648218
South Wall	42.7353984	31	7.615447995
Ceiling	59.40220378	41	14.50601816
Floor	59.40220378	15	6.743338173
Total transmission load (KWh/day)			**40.88580738**

Table 7: Transmission load from wall

2.5.2 Product Load

Product Load	
Specific Heat Capacity of potato (KJ/Kg.oC)	3.39
Respiration heat (KJ/Kg per day)	3.6
Mass of potato (kg)	15000
Time taken to cool the product (days)	7
Product exchange load (KWh/day)	52.46428571
Product respiration load (KWh/day)	15

Total Product Load (KWh/day)	**67.46428571**

Table 8: Product load

2.5.3 Internal Load

Internal Load	
People	
No. of people working inside per day	2
Hours of working per day	6
Heat released by a person (W/hr)	270
People load (Kwh/day)	3.24
Light	
No. of lamps	3
Wattage of each lamp	35
Hours of use per day	12
Lighting load (KWh/day)	1.26
Total Internal Load (KWh/day)	**4.5**

Table 9: Internal load

2.5.4 Air Infiltration Load

Air Infiltration Load	
Air changes per day	6
Volume of cold store (ft3)	3292.470199
Total air change (cfm)	13.71862583
HRV(cfm)	62
Power consumption (W)	89
Running hour(h) HRV	5.310435805
Enthalpy load(KWh/kg)	0.012922
Efficiency of HRV	60
mass flow rate (kg/h)	123.32544

heat load without HRV(Kw)	1.593611336
Total infiltration load(KWh/day)	**3.385108279**

Table 10: Air infiltration load

2.5.5 Equipment Load

Equipment Load	
Fans	
No. of fans	3
Wattage of each fan	185
Hours of use per day	16
Fan Load (KWh/day)	8.88
Total Equipment Load (KWh/day)	**8.88**

Table 11: Equipment load

2.5.6 Total Load

Total Cooling Load (KWh/day)	**123.3237044**
Safety Factor (%)	10
Final Cooling Load (KWh/day)	135.6560749
Refrigeration system run hours per day	16
Refrigeration Cooling Capacity(KW)	**8.47850468**
Refrigeration Cooling Capacity(Tons)	**2.410720694**
Number of evaporators	1
Capacity of each evaporator (KW)	**8.47850468**
Required Air throw (m)	**11.96158537**

Table 12: Total load

2.6 Cooling load Calculation of Chamber 2

Condition	Temperature (oC)	Humidity (%)
Ambient	30	70
Inside Storage	4	90

Table 13: design condition of chamber 2

2.6.1 Transmission Load

Wall	Polyurethane Insulation Panel
U- Value (W/m2.K) (Wall 80mm)	0.275
U- Value (W/m2.K) (Floor 50mm)	0.43

Table 14: conductivity of insulation panel

Surface	Area (m2)	Temperature (oC)	Cooling Load (KWh/day)
North Wall	27.7934928	25	3.852178102
West Wall	16.9548048	25	2.349935945
East Wall	16.9548048	28	2.68564108
South Wall	27.7934928	26	4.035615155
Ceiling	50.72312436	20	5.356361932
Floor	50.72312436	10	3.14077586
Total transmission load (KWh/day)			**21.42050808**

Table 15: transmission load of chamber 2

2.6.2 Product Load

Product Load	
Specific Heat Capacity of potato (KJ/Kg.oC)	3.39
Respiration heat (KJ/Kg per day)	3.6
Mass of potato (kg)	17400
Time taken to cool the product (days)	7
Product exchange load (KWh/day)	49.155

Product respiration load (KWh/day)	15
Total Product Load (KWh/day)	**66.555**

Table 16: product load of chamber 2

2.6.3 Internal Load

Internal Load	
People	
No. of people working inside per day	2
Hours of working per day	6
Heat released by a person (W/hr)	270
People load (Kwh/day)	3.24
Light	
No. of lamps	2
Wattage of each lamp	45
Hours of use per day	12
Lighting load (KWh/day)	1.08
Total Internal Load (KWh/day)	**4.32**

Table 17: internal load of chamber 2

2.6.4 Air Infiltration Load

Air Infiltration Load	
Air changes per day	6
Volume of cold store (ft3)	3068.196374
Total air change (cfm)	12.78415156
HRV(cfm)	62
Power consumption (W)	89
Running hour(h) HRV	4.948703829
Enthalpy load(KWh/kg)	0.012922
Efficiency of HRV	60
mass flow rate (kg/h)	123.32544
heat load without HRV(Kw)	1.593611336

Total infiltration load(KWh/day)	**3.154524207**

Table 18: air infiltration load chamber 2

2.6.5 Equipment Load

Equipment Load	
Fans	
No. of fans	3
Wattage of each fan	135
Hours of use per day	16
Fan Load (KWh/day)	6.48
Total Equipment Load (KWh/day)	**6.48**

Table 19: equipment load of chamber 2

2.6.6 Total Load

Total Cooling Load (KWh/day)	**101.9300323**
Safety Factor (%)	10
Final Cooling Load (KWh/day)	112.1230355
Refrigeration system run hours per day	16
Refrigeration Cooling Capacity(KW)	**7.007689719**
Refrigeration Cooling Capacity(Tons)	**1.992519113**
Number of evaporators	1
Capacity of each evaporator (KW)	**7.007689719**
Required Air throw (m)	**7.13445122**

Table 20: Total load of chamber 2

2.7 Bill of Quantity:

Detail Estimate of Cold Store Item

Project Name: kishan kendra cold store

Site: Lele, Lalitpur

A. COLD ROOM PANELS & ACCESSORIES:					
S.N.	**DESCRIPTION**	**QTY**	**UNIT**	**UNIT RATE**	**AMOUNT**
	COLD ROOM PANELS & ACCESSORIES:				
Modular Wall Panels / Ceiling Panels :					
1	**Supply, installation, transportation, testing and commissioning of 80mm** Polyurethane prefabricated sandwiched panels with pressure injected polyurethane foam insulation of density 42 kg/cu. M and cladded with 0.5mm thick white Lacquered galvanised steel sheet 1122 SM panels as room insulation complete with aluminium supports.The panels should be suplied with all accessories to support all the four walls and roof in an open space Single Piece of any suitable size 1.0/1.1 m width x 3.76 m length for wall panels single length and 1.0m x 4 m	120	Sq.M		
2	Supply of 50mm Thick PUF Slab, PUF density 40kg±2/m3. For Cold room along with Floor insulation material (bitumen and 2 layer of 2.5 mm thick Tar Felt sheet wo layer of bitumin of 1.5 kg / sq.m**.**	55	Sq.M		
3	Supply of 80mm Thick PUF " L" corner300 mm width from outer side, inner side 0.5mm and 0.5mm outer RAL 9002 PPGI sheet, PUF density 40kg±2/m3. single length (without joint). Joint tounge and groove clading with cam lock and complete cealing material or silicon glue.	17	RM		

4	Supply of sliding door, 80mm Thick PUF Insulation,0.6mm poweder coated Finish (For Positive temperature +1degree) (Density 45kg/m3) wall fixing frame with Door Opener & Closure, Pad Lock, door sliding mechanism, Door Size - (opening width min 900 mm, Height min 2000mm),	2	Nos.		
5	Supply and installation of material (Flushing, Silicon, Pop Revit's, for partition joints for panels in corner. (wall to wall corner as well as ceiling to wall joint. Joining detail to be provided by PUF panel manufacturer with cost including.		Rm		
6	U channel and fixing accessories 0.5 mm sheet width 105 mm and height 40 mm (Screw fastner with rawl plug pop rivets) Joining detail to be provided by PUF panel manufacturer with cost including.	40	Rm		
			Total cost for panel		-
B. Air Cooled Scroll/ Receprocating Refrigeration Unit					
SR.NO.	**DESCRIPTION**	**QTY**	**UNIT**	**UNIT RATE**	**AMOUNT**
Air Cooled Scroll/Receprocating Refrigeration Unit					
7	**Supply, Installtion, Testing & Commissioning of Condensing unit and cooling unit Condensing unit** include Scroll hermetic compressor, air cooled condenser with condenser fan, liquid accumulator, oil separator, liquid receiver, integrated HP/LP/OLR and Drives, eco-friendly refrigerant R404A/134a controls gauges, Starter, control Panel, anti-vibration pads etc. Compressors Motor shall be suitable for 415±10% 50 cycles. 3 phase AC supply and motor cable terminal box shall be suitable to connect Copper				

	Cabling. **Cooling unit** include cooling coil, two evaporator fan, Thermostatic expansion valve, Solenoid coil, Thermostat, Electrical Defrost heater, Drain pan, drain pipe, electrical terminal box with water shield. fan motor shall be 220/1phase/50 Hz cost involve with foundation work with metalic frame.				
	Design Ambient:30°C& 70%RH,				
	Inside temp: 4°C,				
	SST: -3.05±1°C				
	Capacities: kW output at design condition.				
8	Heat Load min. 9 kW output at design condition. Compressor power: approx.5.5 kW Single compressor 440±10%/3ph/50Hz Condenser fan: 1 ph Singlefan220±/1ph/50Hz10% Number of condenser fan 2 Electric Power: = approx.500 W Air cooled condenser consisting of coppertube with hydrophilic coated aluminum Fins Evaporator capacity: 8.5kW Evaporator Fan:1 PH 220V/50 Hz Number of evaporator fan : 2nos. Evaporator Fan power approx. 0.33 HP Air through 12 m	2	Set		
9	Heat Load min. 8 kW output at design condition. Compressor power: approx.5.5 kW Single compressor 440±10%/3ph/50Hz Condenser fan: 1 ph Singlefan220±/1ph/50Hz10% Number of condenser fan 2 Electric Power: = approx.500 W Air cooled condenser consisting of coppertube with hydrophilic coated aluminum Fins Evaporator capacity: 7 kW Evaporator Fan:1 PH 220V/50 Hz	2	Set		

	Number of evaporator fan : 2nos. Evaporator Fan power approx. 0.33 HP Air through 7 m				
10	Supply installation testing and commissioning of PLC base indoor temperature, humidity, defrost control with difrost timer unit	2	set		
11	Supply installation of Condensate water drain pipe with necessary accessories		Rm		
12	Supply, Installtion, Testing & Commissioning of Aultrasonic Humidifier with all control accessories for humidity control for humidification(min 30 Ltr/24 hr)	2	Nos.		
13	Supply, Installtion, Testing & Commissioning ofHeat recovery Ventilation units (HRVs) for Long storage room. Capacity: 100CFM	2	Nos.		
14	Supply of Refrigerant R404a/R134a for complete units each Cylinder with 11.5kg net weight or as required by condensers provided.	1	cylinder @13.6 kg		
15	4Ft Low Noise level type Centrifugal Air curtain over the main Cold room entrance door including control system for operation only door open time.	2	Nos.		
C. Electrical Accessories					
SR.NO.	**DESCRIPTION**	**QTY**	**UNIT**	**UNIT RATE**	**AMOUNT**
Electrical Accessories					
16	**Supply, installation, transportation, testing of Power Socket including wiring,** 16amp 3*3 power socket inside coldroom	4	Nos.		

17	**Supply, installation, transportation, testing of Light including switch and wiring** LED round panel light of 35W inside chamer 1	3	Nos.		
18	**Supply, installation, transportation, testing of Light including switch and wiring** LED round panel light of 45W inside chamer 2	2	Nos.		
19	**Supply, installation, transportation, testing of circuit breaker with wall mount box.** 32amp MCB for 4 condenser unit including suitale gauge wire, 16amp MCB for 2 chamber for power socket and lighting inside coldroom	6	Nos.		
			Total Machine cost		-
	Total amount without VAT				-
	Total amount with VAT				-

Table 21: Bill Of Quantity

3. RESULTS AND DISCUSSION

Cooling Loads	Chamber 1 (KW)	Chamber 2 (KW)
Transmission load	2.55	1.39
Product load	4.21	4.16
Internal load	0.28	0.27
Air infiltration load	0.21	0.2
Equipment load	0.55	0.4
Total	7.8	6.42
Safety factor (%)	10	10
Final cooling load	**8.47**	**7.062**

Table 22: Cooling load calculation result

The layout plan of the cold store was thoughtfully crafted to ensure optimal space utilization while accommodating the storage requirements and refrigeration system. As illustrated in the accompanying picture, this arrangement facilitates efficient organization and storage of the produce within the cold store.

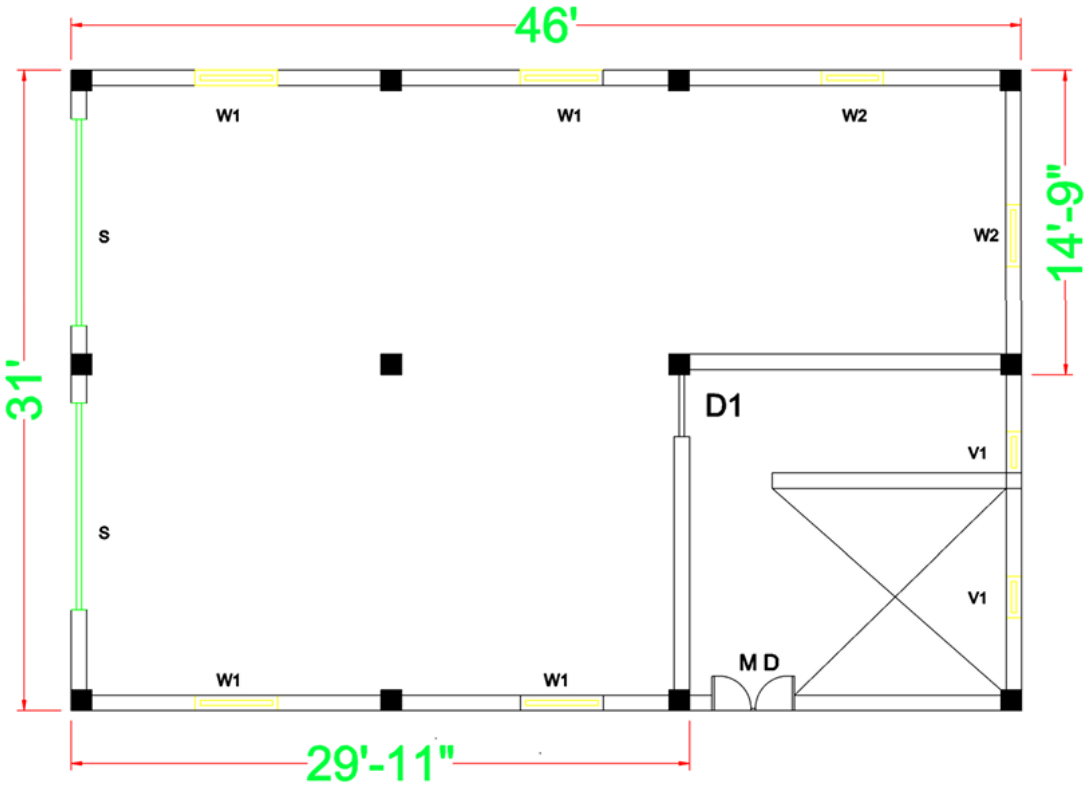

Figure 4: Room layout for cold room

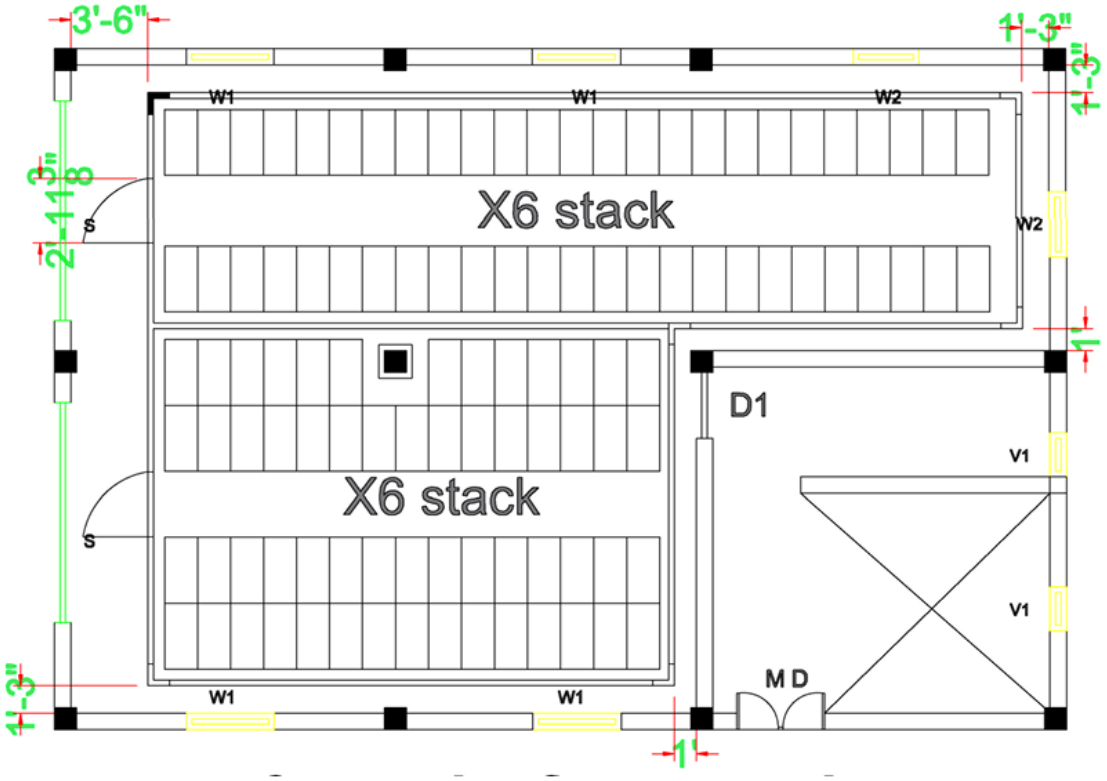

Figure 5: Cold-room layout

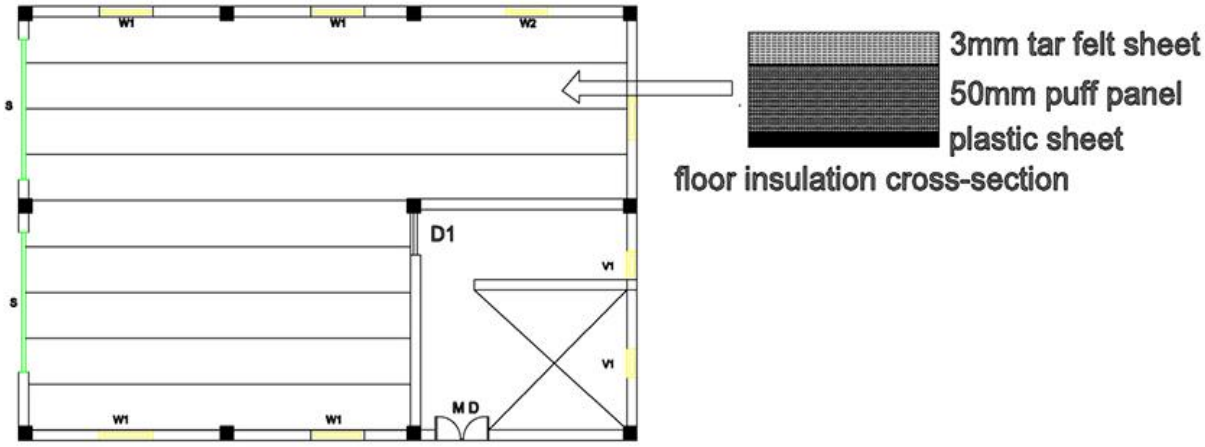

Figure 6: floor insulation plan view

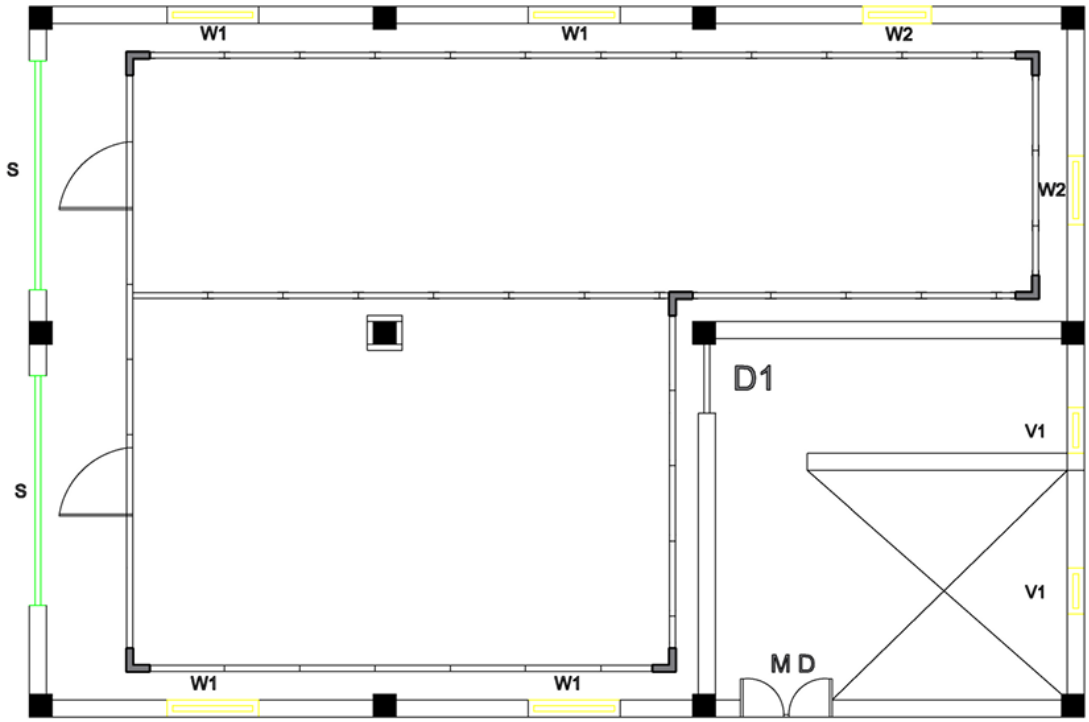

Figure 7: L corner and panel placement plan view

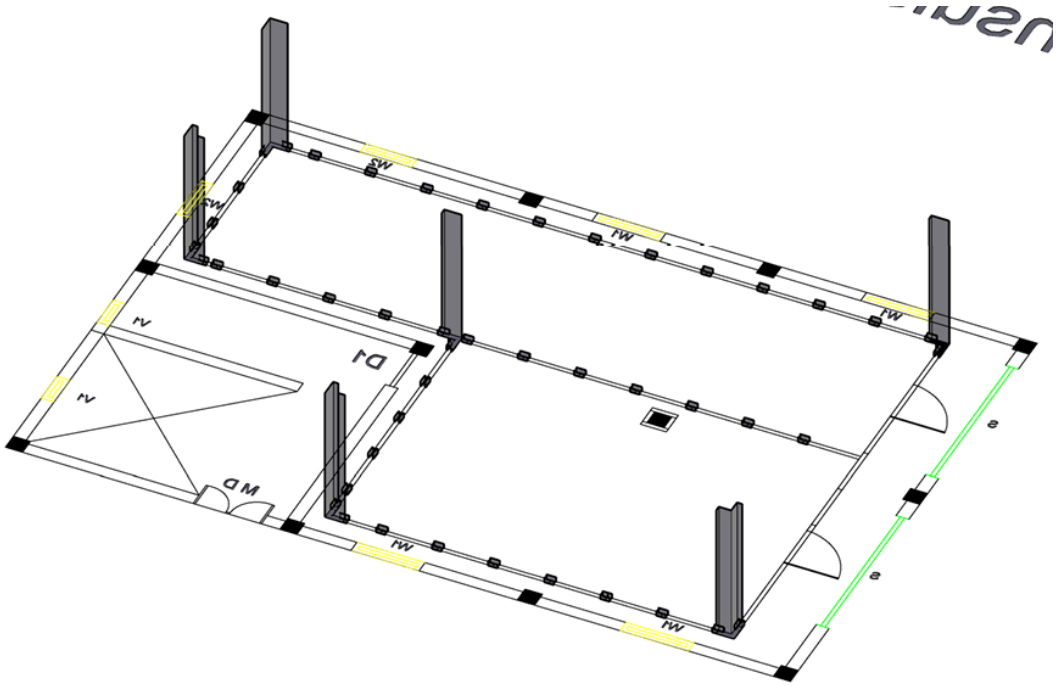

Figure 8: L corner placement isometric view

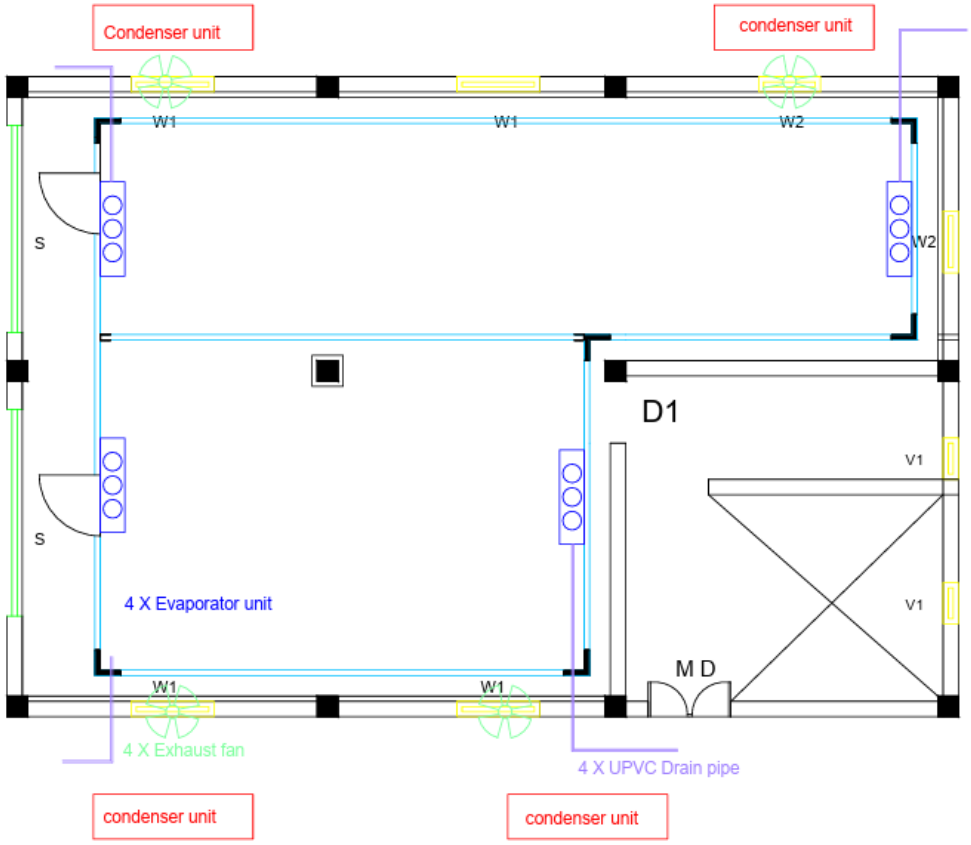

Figure 9: Evaporator placement plan view

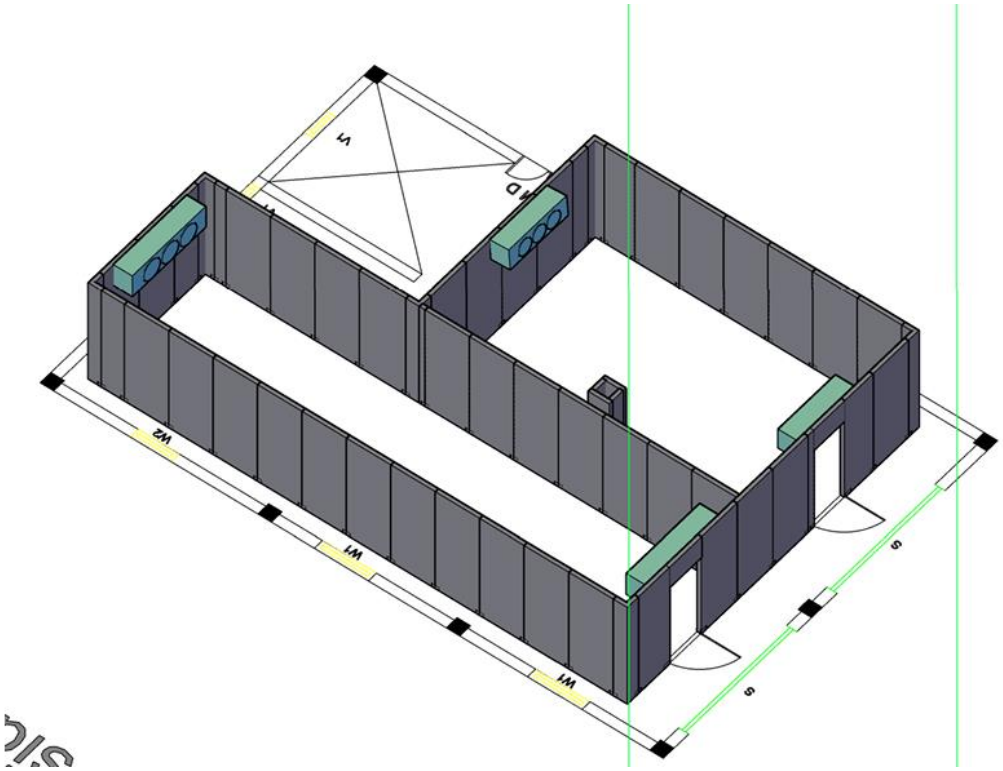

Figure 10: Side panel and evaporator placement isometric view

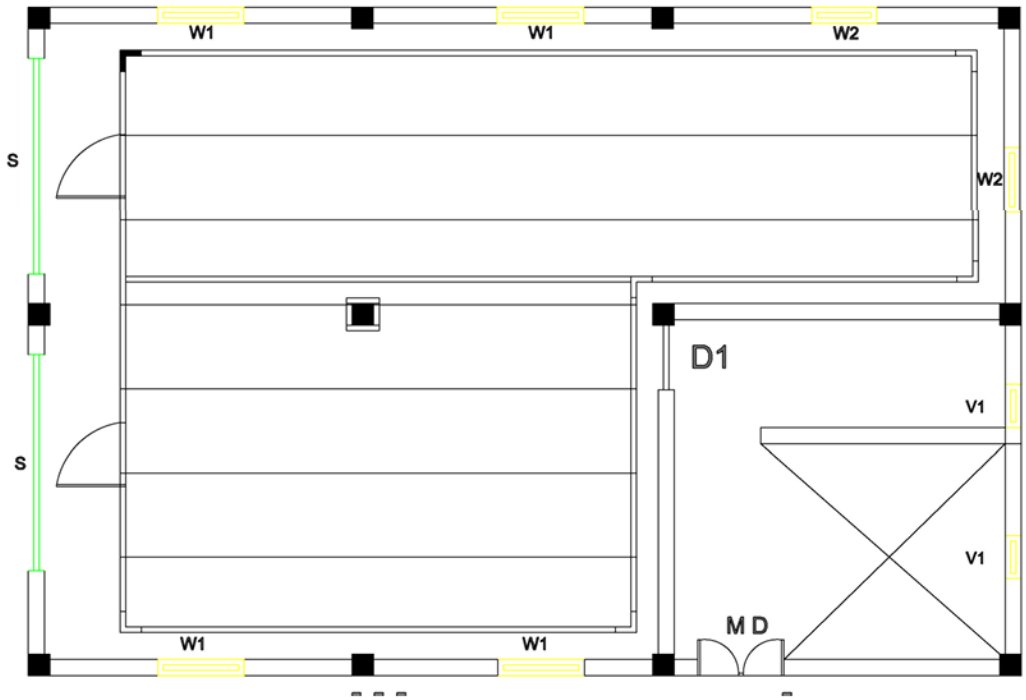

Figure 11: celling insulation placement plan view

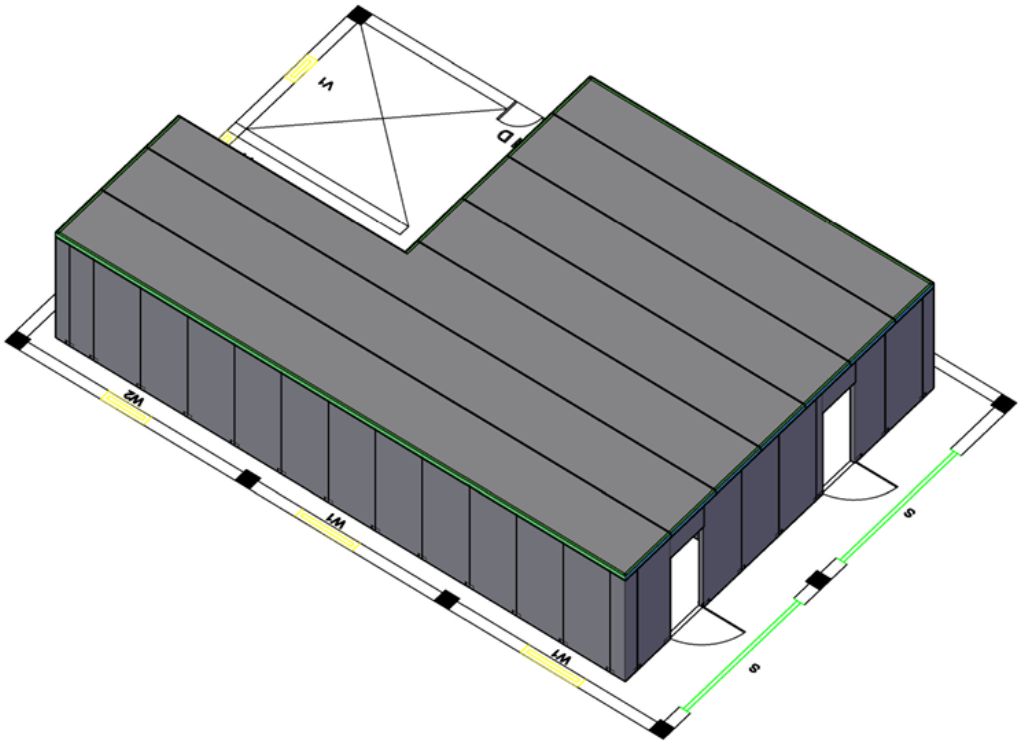

Figure 12*: celling insulation placement isometric view*

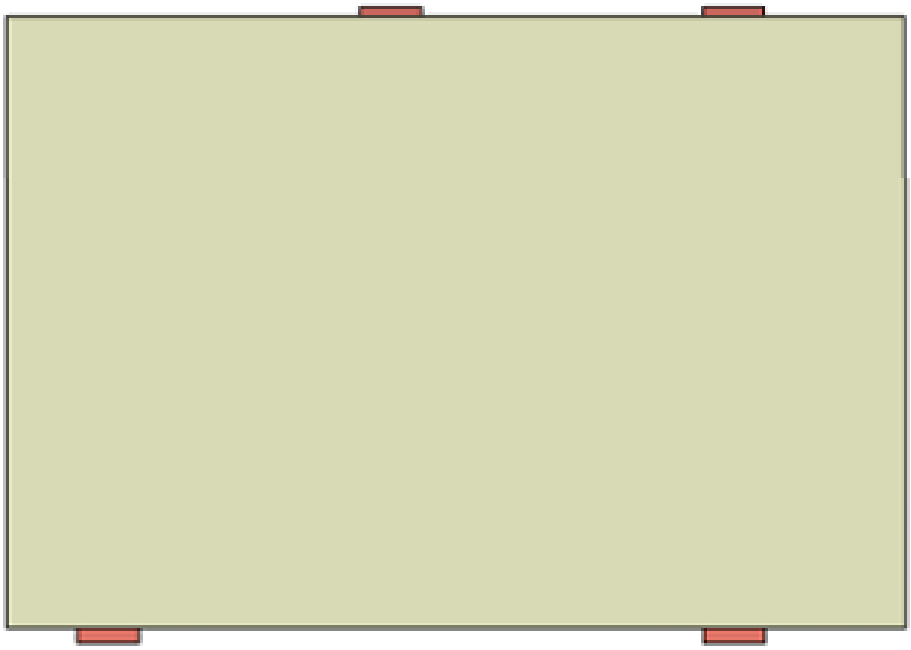

Figure 13: top view

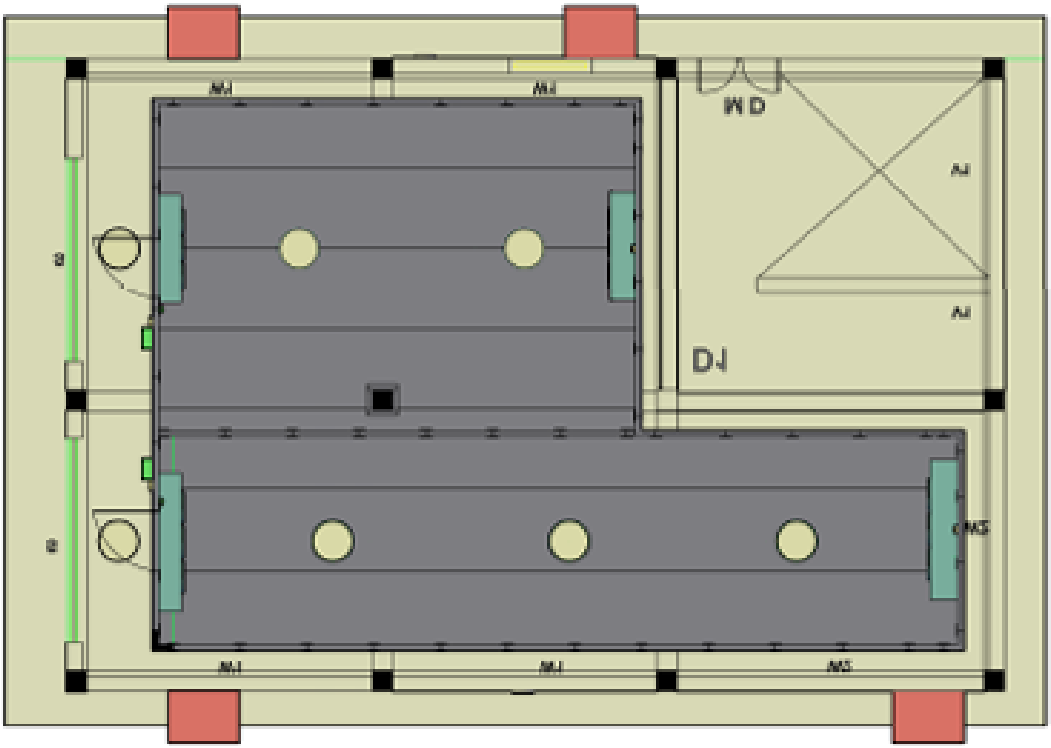

Figure 14: top sectional view

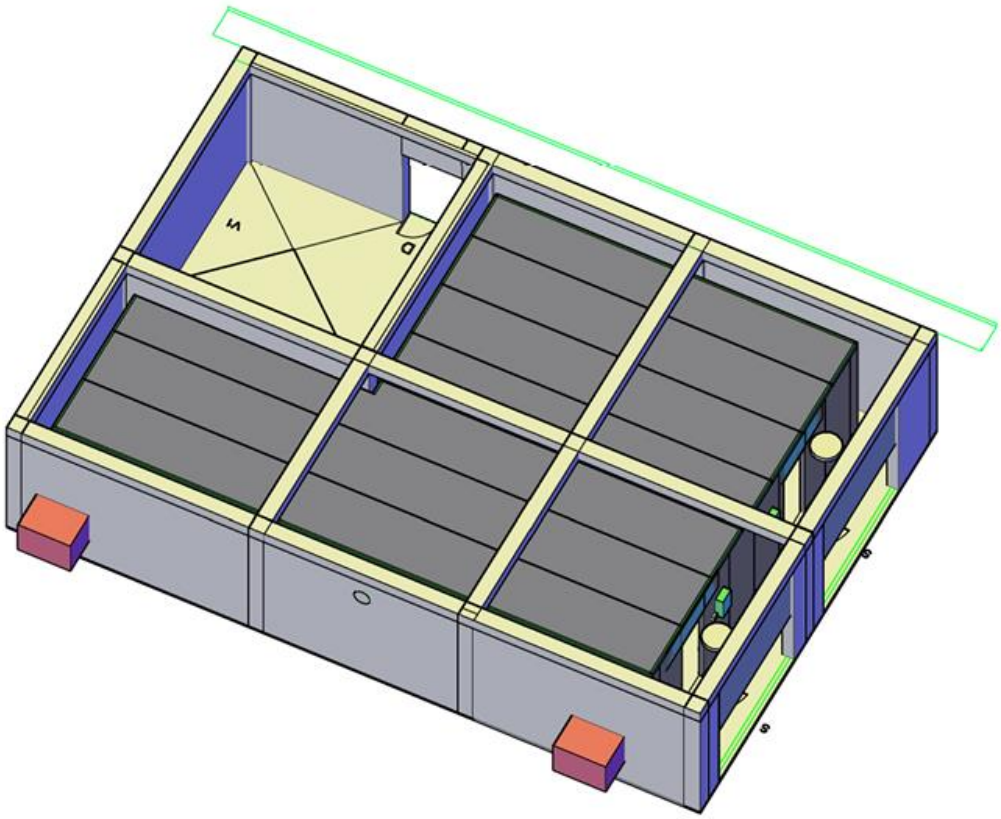

Figure 15: top sectional view (isometric)

Figure 16: western view

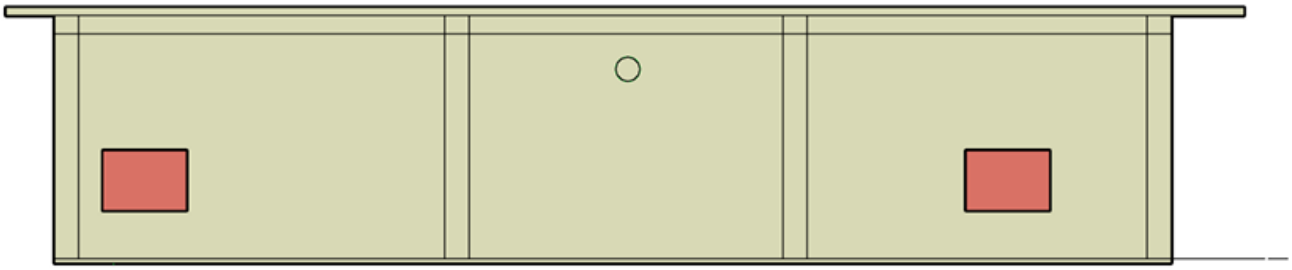

Figure 17: northern view

Figure 18: eastern view

4. CONCLUSION

In conclusion, the design of a cold store room tailored for potato storage presents a comprehensive solution to address the challenges faced by the potato industry in Nepal. Through detailed calculations and analysis, key aspects such as cooling load, storage requirements, and equipment selection were carefully considered to ensure optimal performance and efficiency of the cold storage facility. The results of the cooling load calculations highlighted the significant contribution of various factors such as transmission load, product exchange load, and internal load to the overall cooling demand. By understanding and addressing these factors, the designed cold storage facility can effectively maintain the desired temperature and humidity levels critical for preserving potato quality and extending shelf life.

5. REFERENCES

https://www.youtube.com/watch?v=0gv2tJf7nwo
ASHRAE Handbook of Fundamentals, American Society of Heating