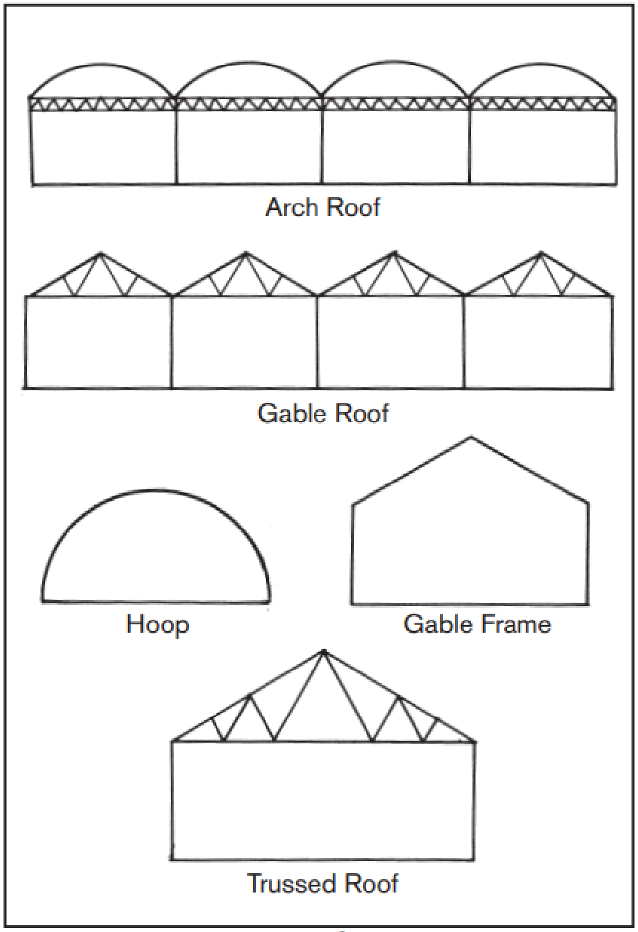


Figure 2–4. Some typical greenhouse frames.

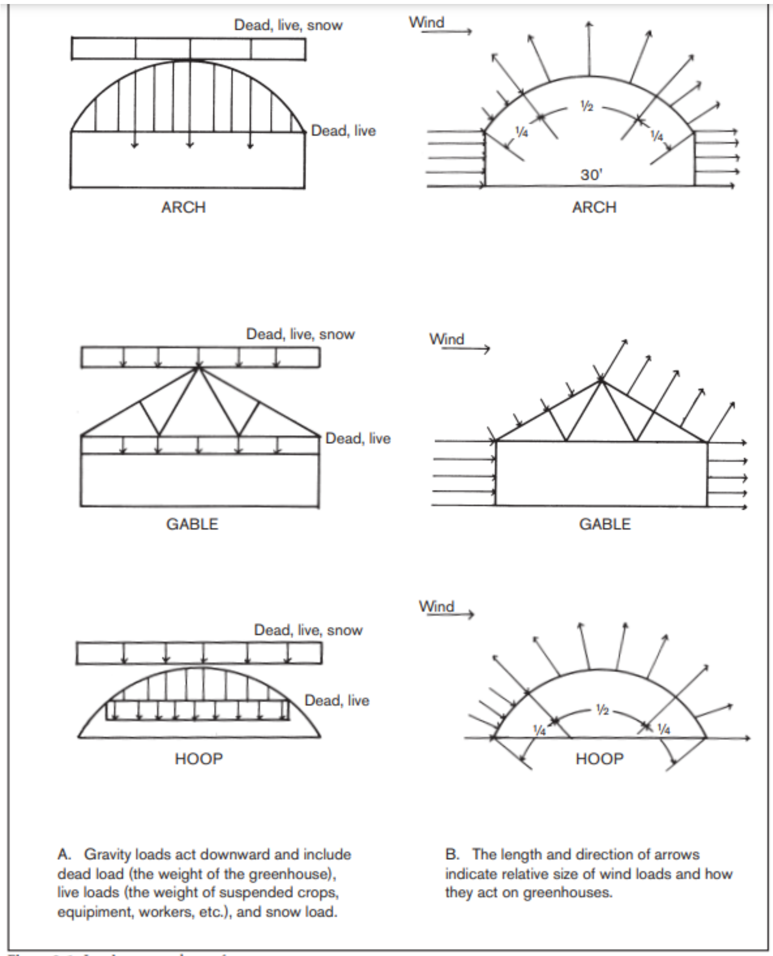
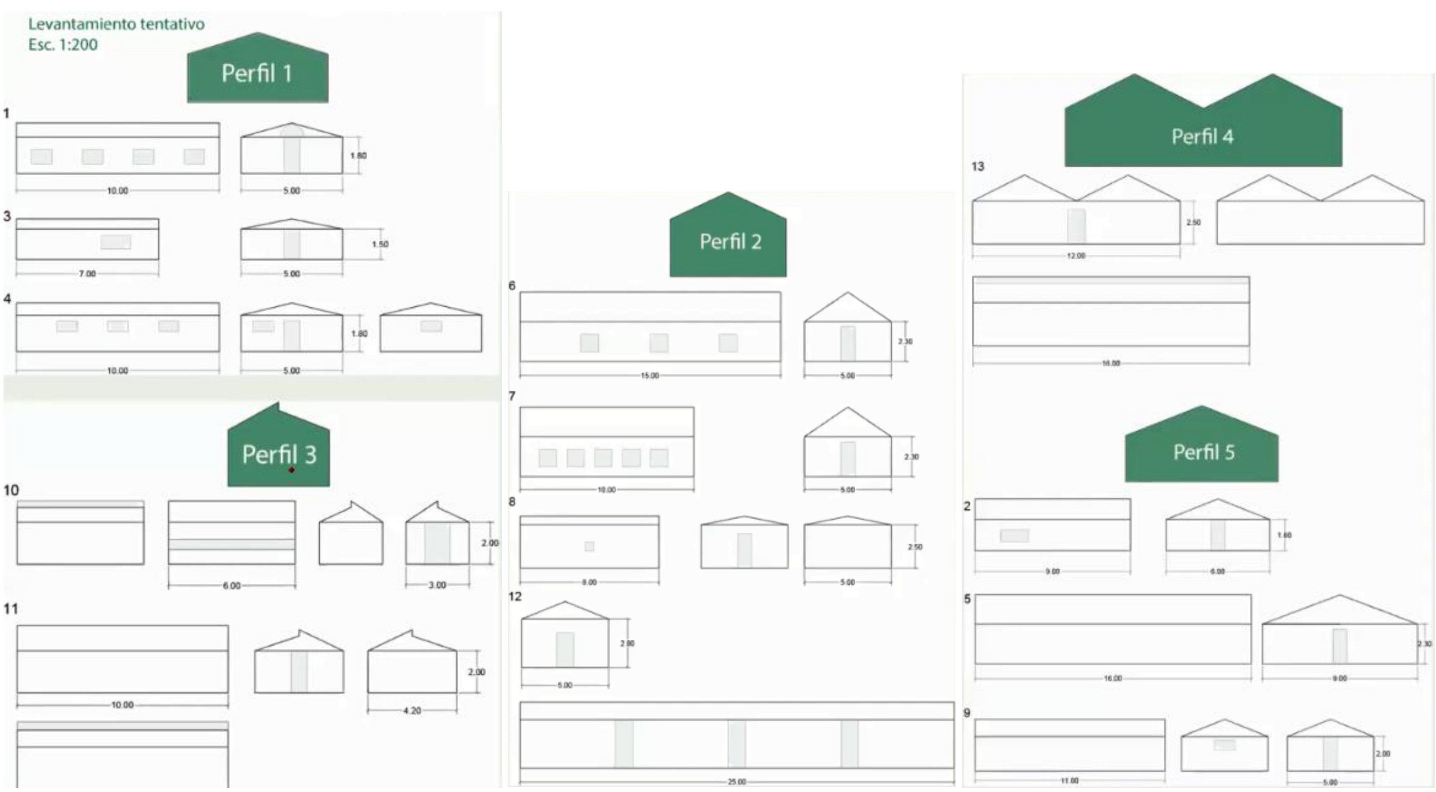


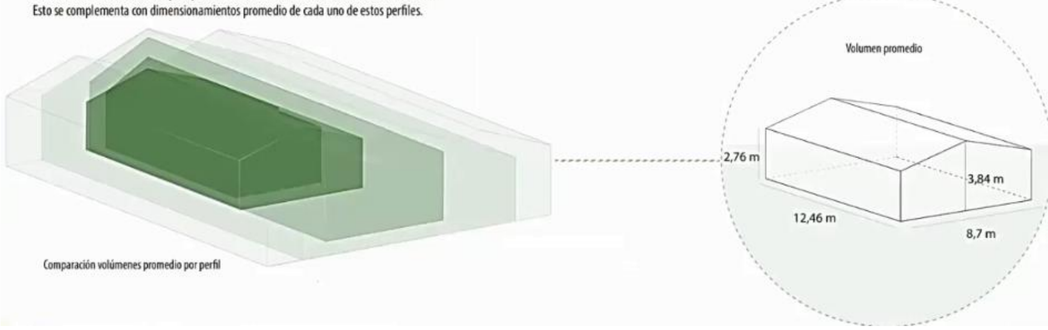
Figure 2–1. Loads on greenhouse frames.

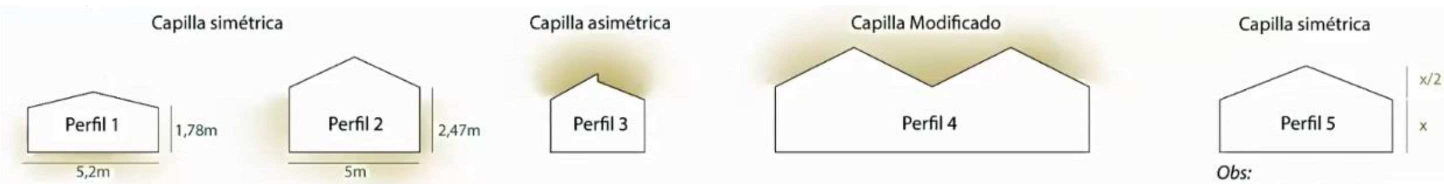


1 PERFILES

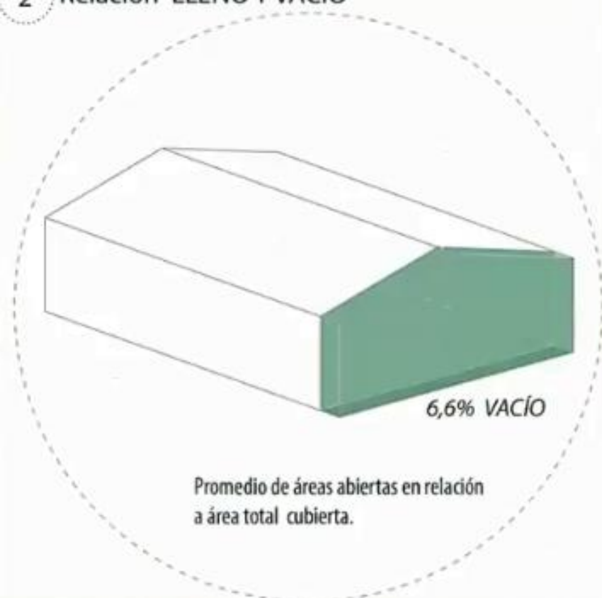
Se han identificado "Perfiles tipo" que caracterizan al universo estudiado de invernaderos.
Esto se complementa con dimensionamientos promedio de cada uno de estos perfiles.

2.- Experienci



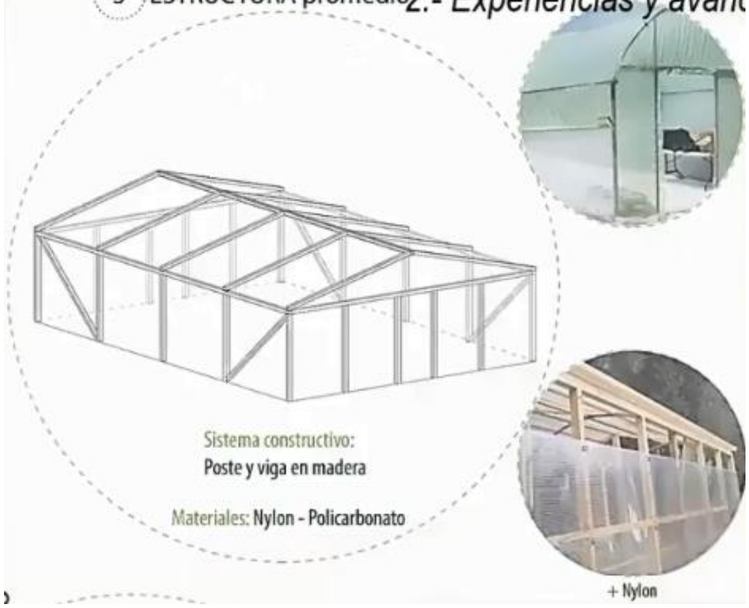


2 Relación LLENO Y VACÍO

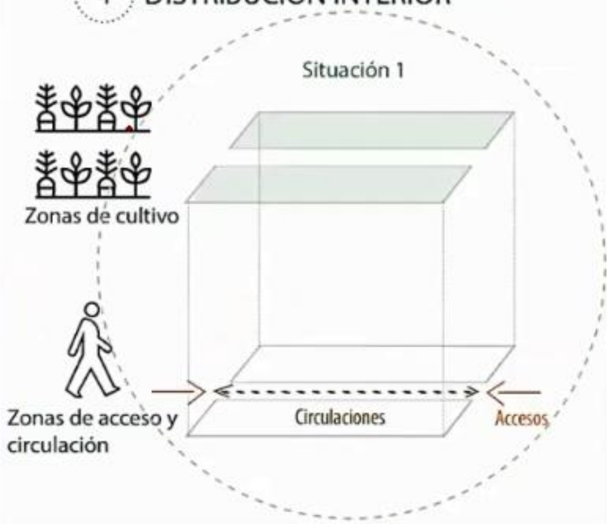


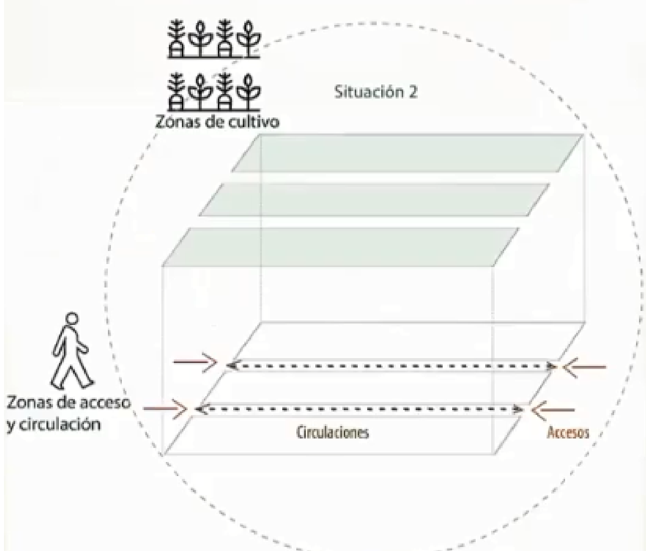
3 ESTRUCTURA promedio

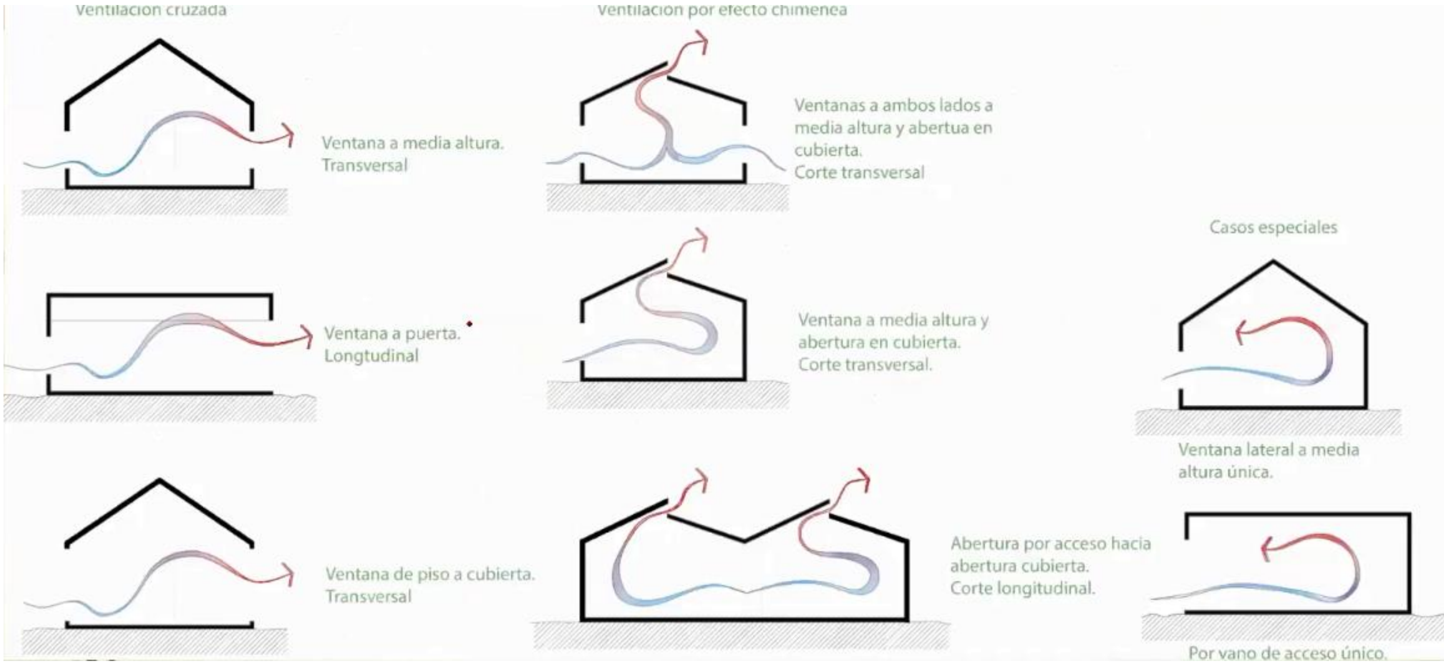
2.- Experiencias y avanc

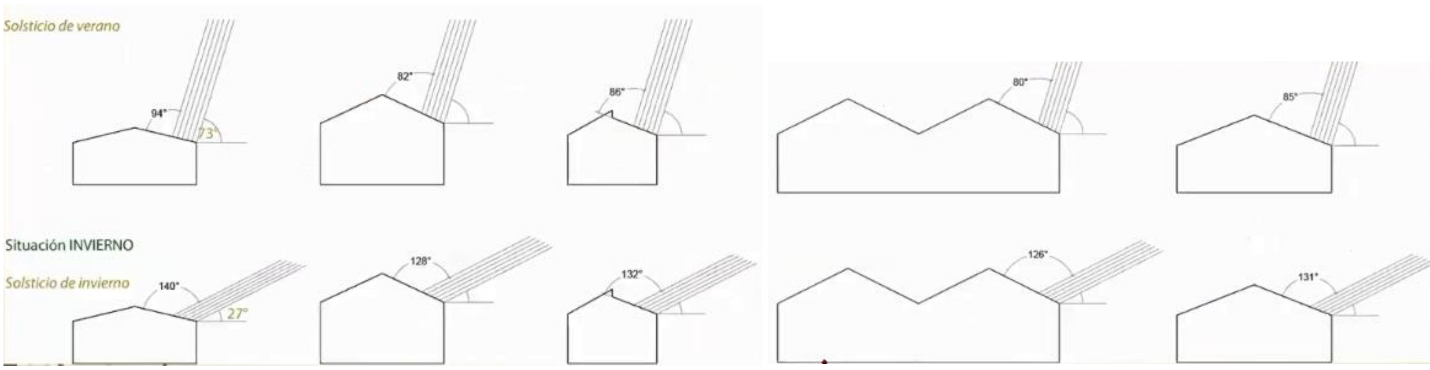


4 DISTRIBUCIÓN INTERIOR

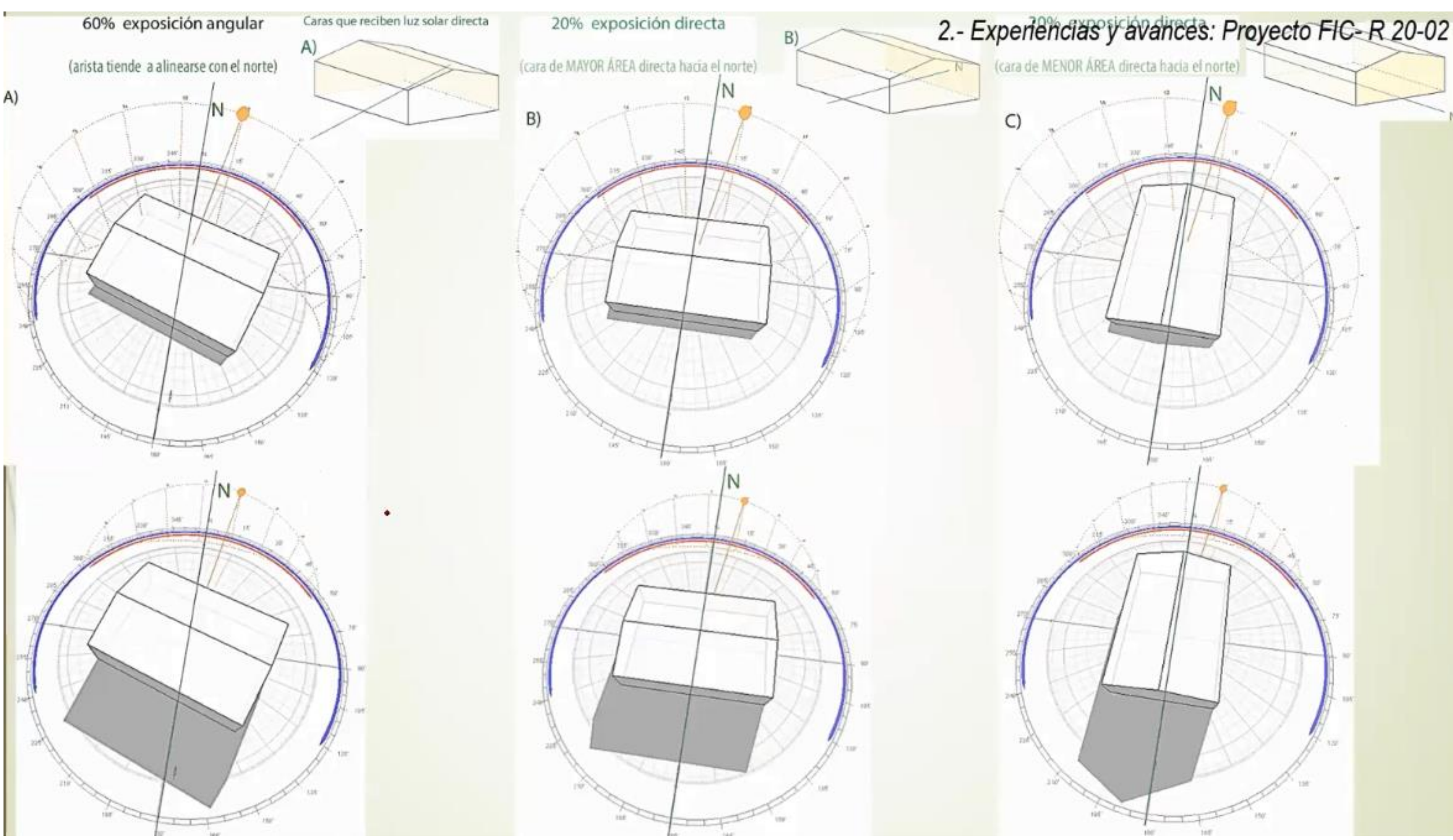


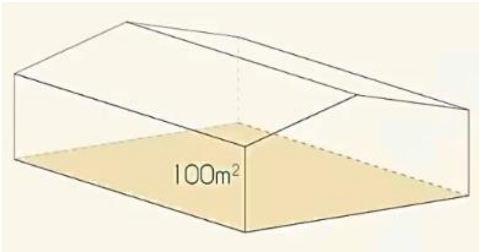


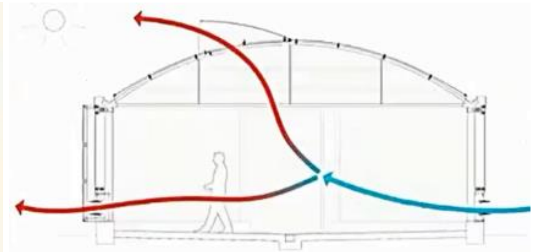




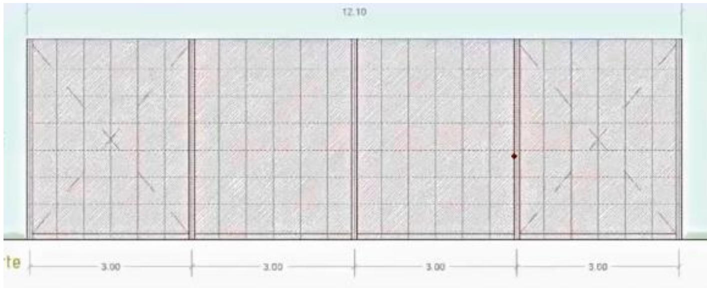
2.- Experiencias y avances: Proyecto FIC- R 20-02

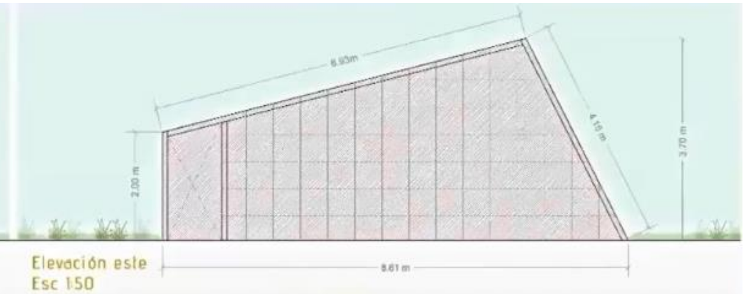


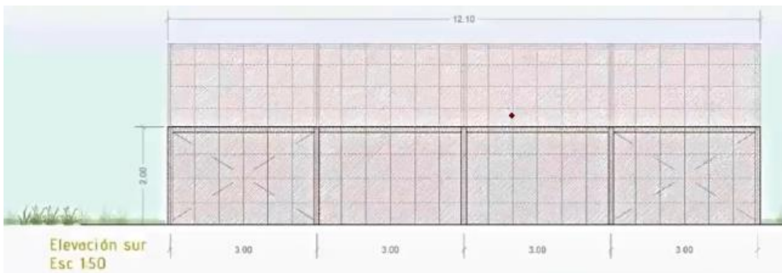

100m2

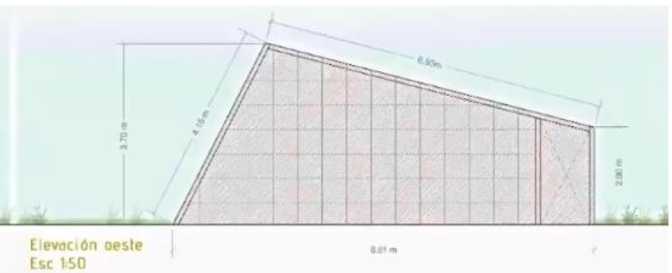


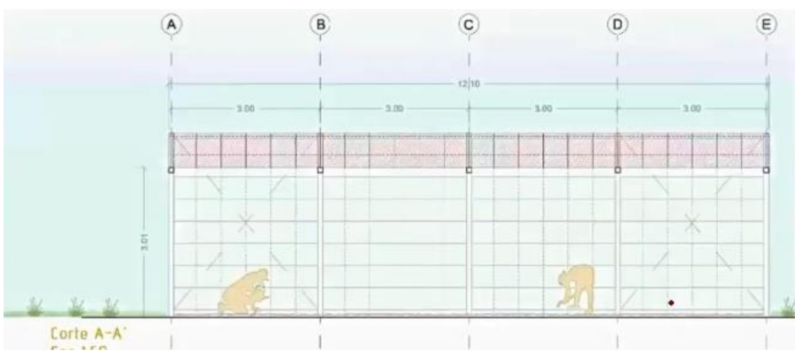

α

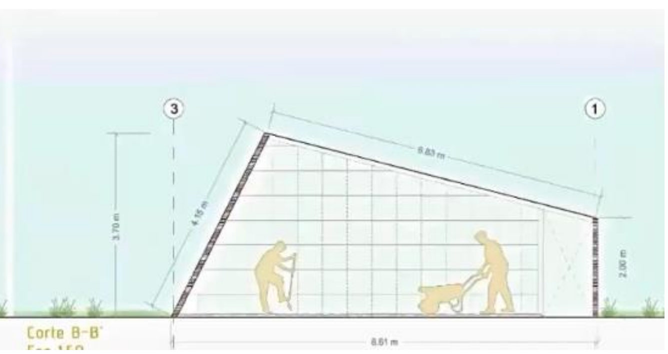

12.10
3.00
3.00
3.00
3.00

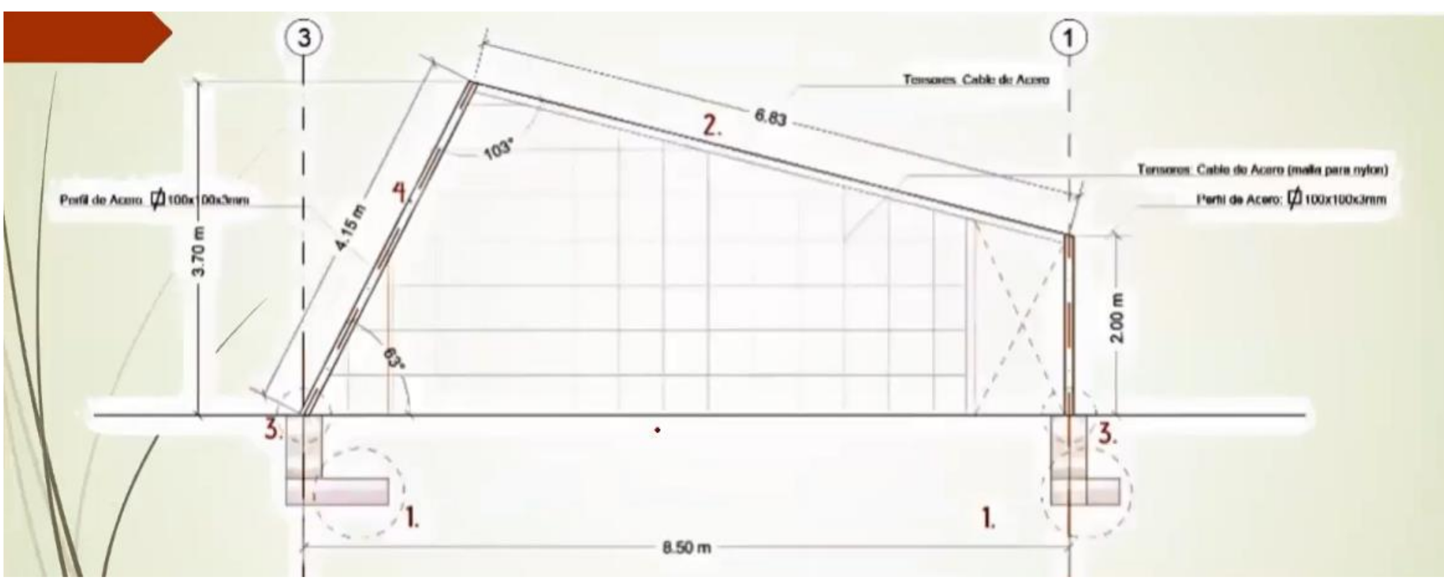

6.93m
4.15 m
3.70 m
2.00 m
8.61 m
Elevación este
Esc 1:50

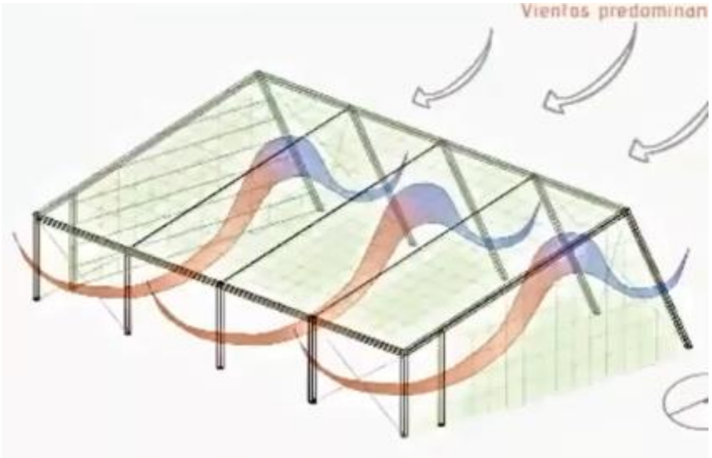

12.10
2.00
3.00
3.00
3.00
3.00
Elevación sur
Esc 1:50

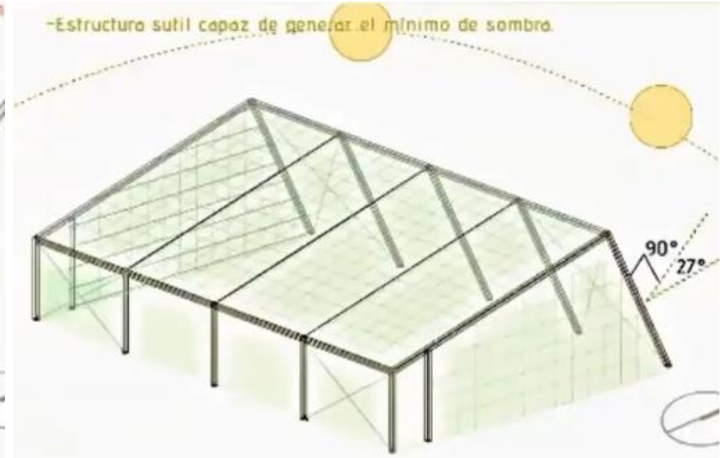

6.93m
4.15 m
3.70 m
2.00 m
8.61 m
Elevación oeste
Esc 1:50

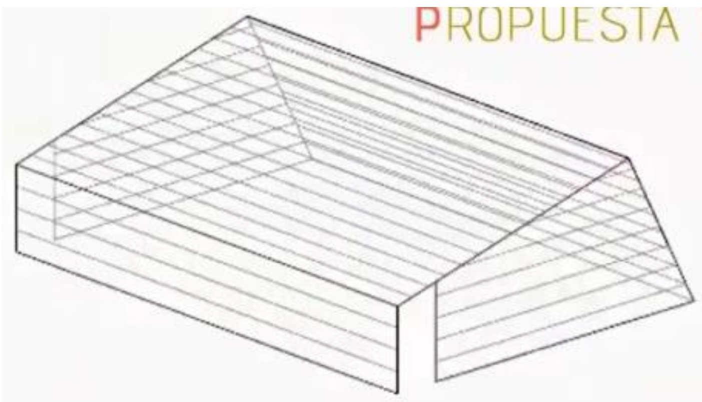

A
B
C
D
E
12.10
3.00
3.00
3.00
3.00
3.01
Corte A-A'

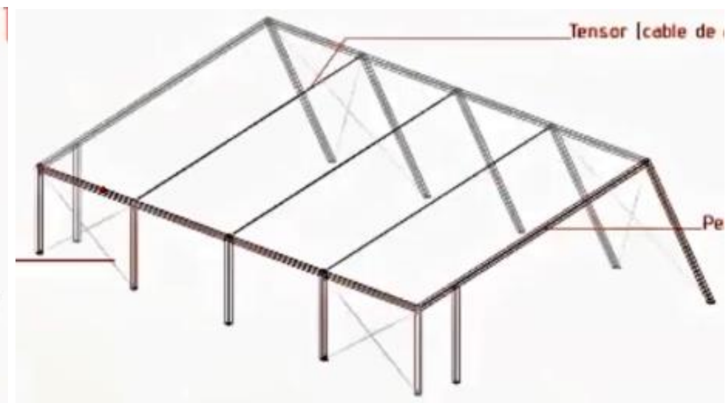

3
1
6.83 m
4.15 m
3.70 m
2.00 m
8.61 m
Corte B-B'

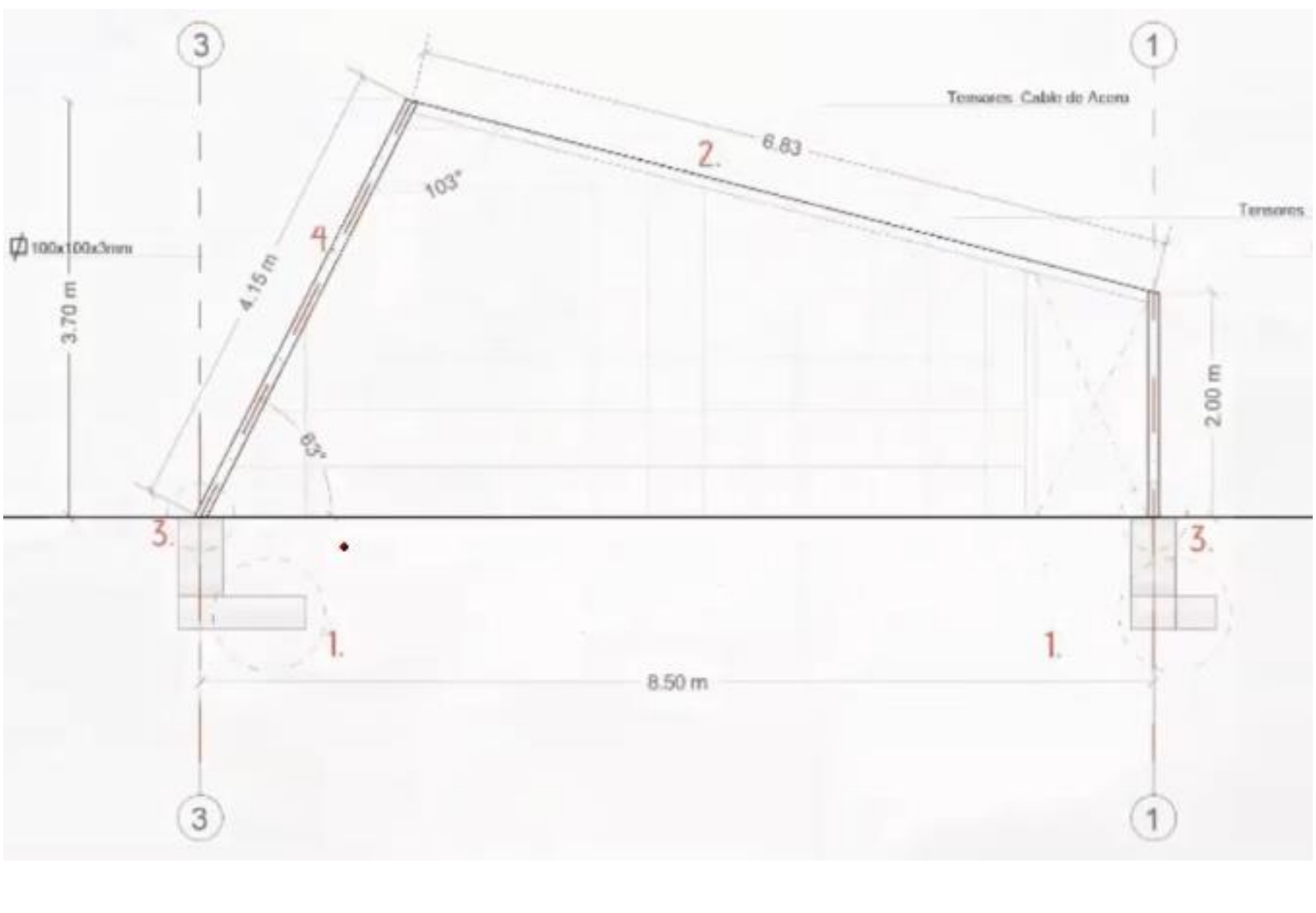

3
1
Tensores: Cable de Acero
6.83
2.
103°
4
4.15 m
Perfil de Acero: ∅100x100x3mm
Tensores: Cable de Acero (malla para nylon)
Perfil de Acero: ∅100x100x3mm
3.70 m
2.00 m
63°
3.
3.
1.
1.
8.50 m


Vientos predominan

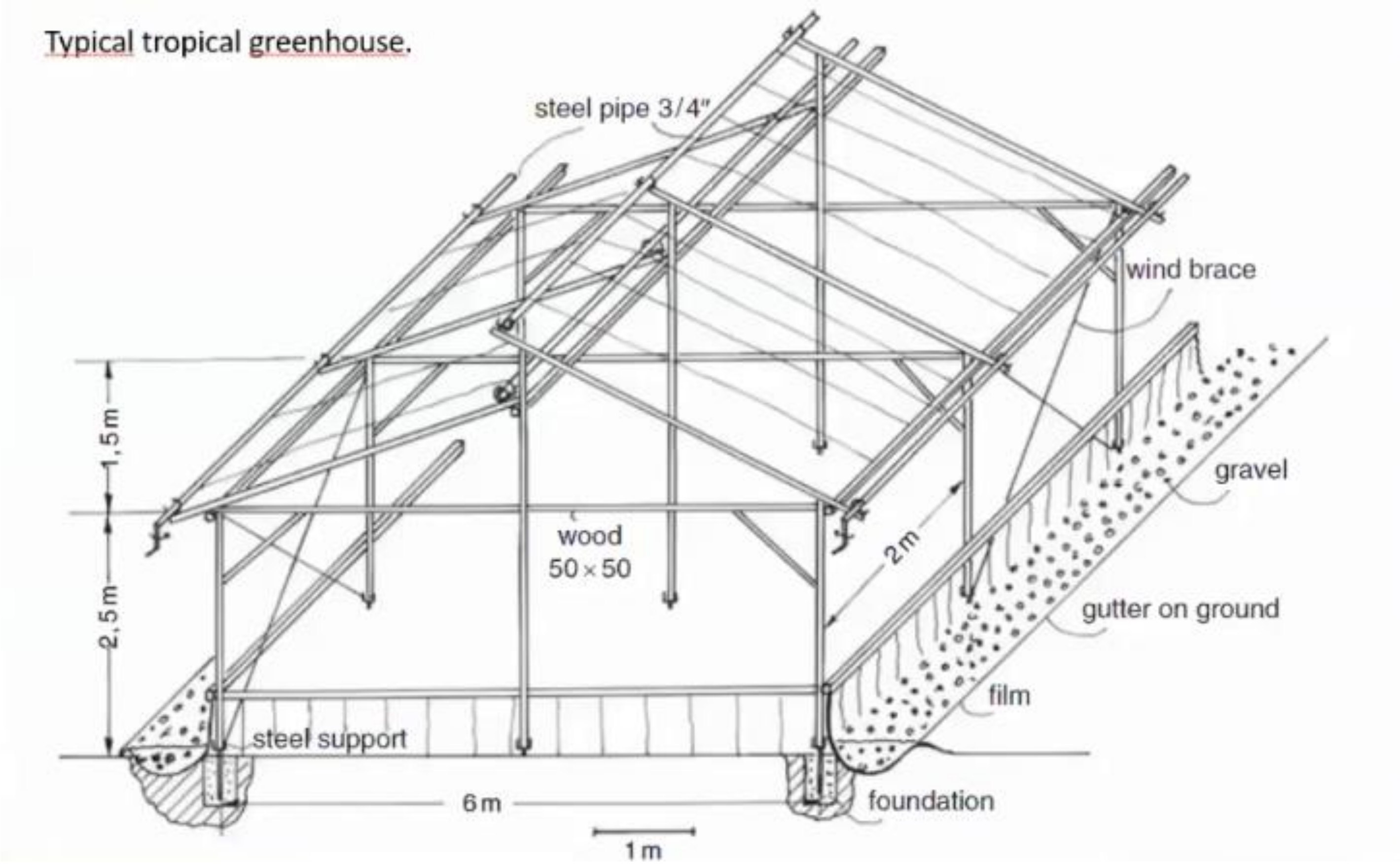

-Estructura sutil capaz de generar el mínimo de sombra.
90°
27°

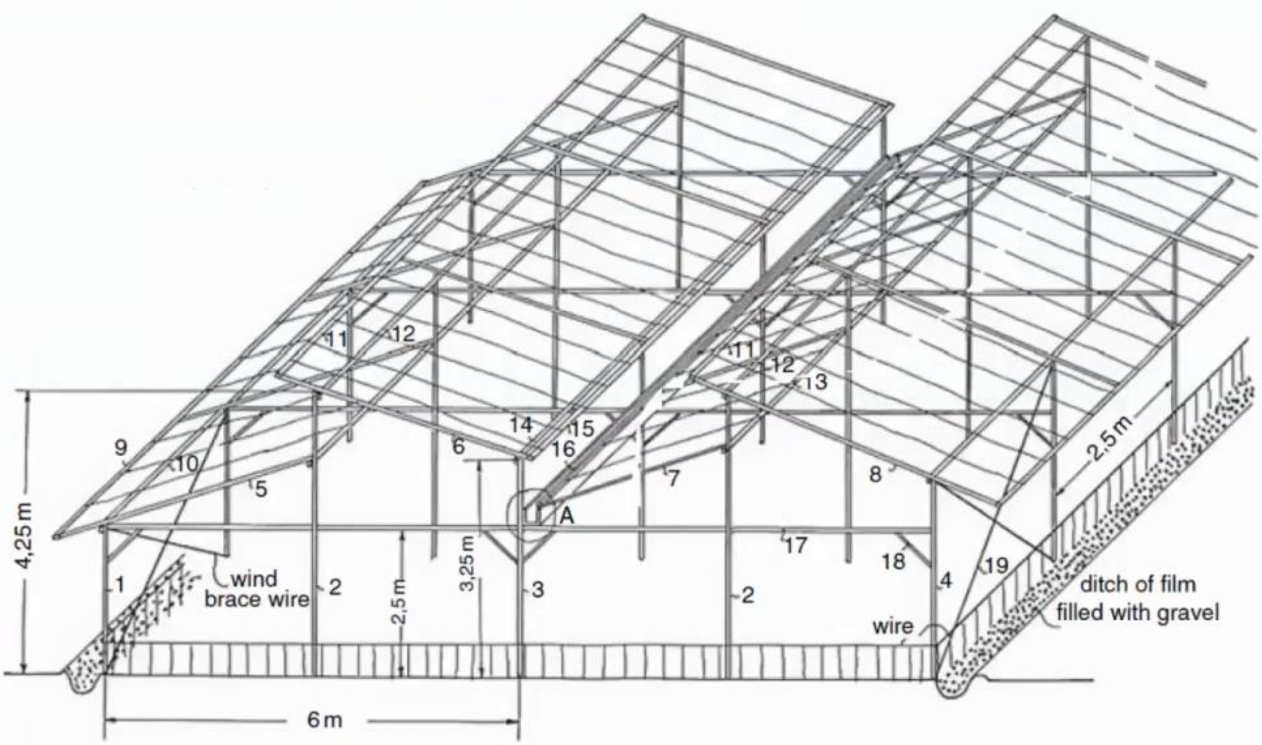

PROPUESTA


Tensor (cable de
Pe


3
1
Tensores Cable de Acero
6.83
2.
103°
Tensores
∅100x100x3mm
4.
4.15 m
3.70 m
2.00 m
63°
3.
3.
1.
1.
8.50 m
3
1

Typical tropical greenhouse.





2.- Experiencias y avances: Proyecto FIC- R 20-02
Propuesta invernadero
Perfil de Acero: 100x100x3mm
3.70 m
4.15 m
103°
6.83
2.00 m
8.50 m

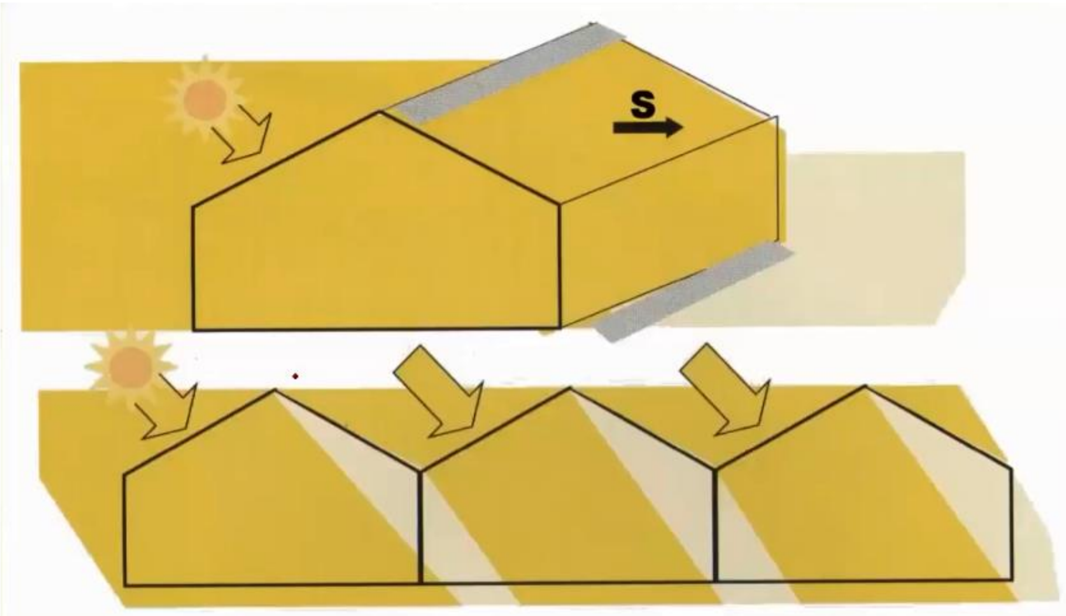
2.- Experiencias y avances: Proyecto FIC- R 20-02

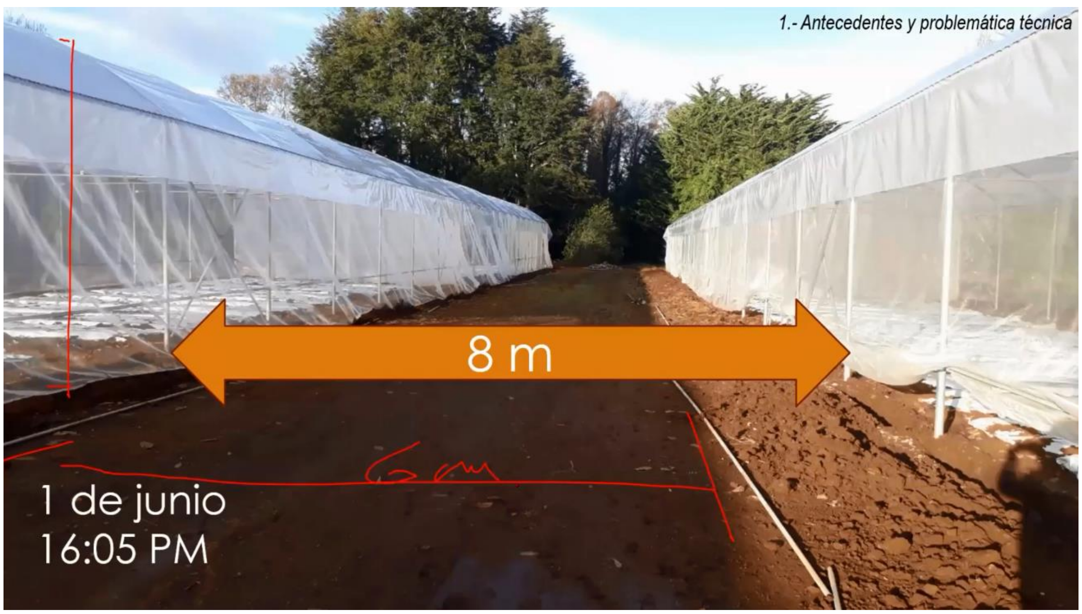

2.- Experiencias y avances: Proyecto FIC- R 20-02

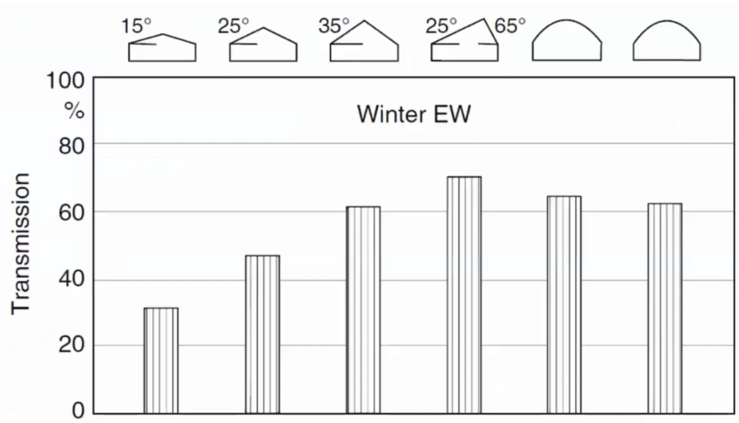

2.- Experiencias y avances: Proyecto FIC- R 20-02


2.- Experiencias y avances: Proyecto FIC- R 20-02

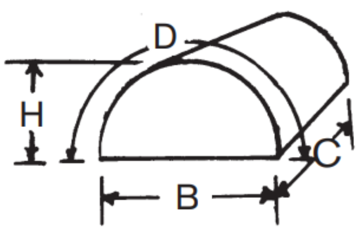

2.- Experiencias y avances: Proyecto FIC- R 20-02

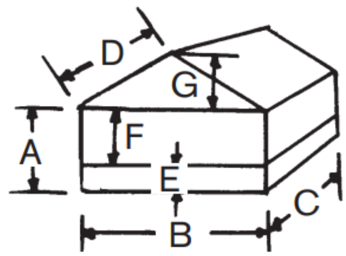


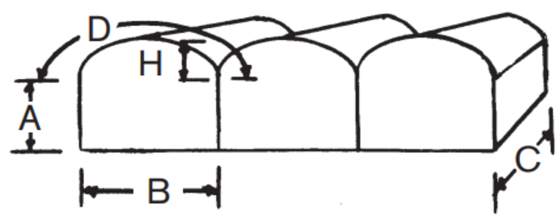




Comprehensive description of the transmittance for EW orientation in winter (Nisen 1969)

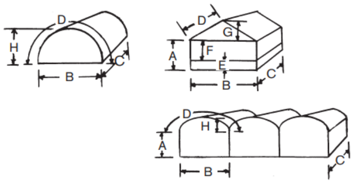






WORKSHEET NO. 4—GREENHOUSE HEAT LOSS CALCULATIONS

The dimensions defined in the diagrams are used throughout the Heat Loss Calculations:



Step 1. List greenhouse dimensions in feet:

Wall height,	A	=
House width,	B	=
House length,	C	=
Rafter length,	D	=
Lower wall height,	E	=
Upper wall height	F	=
Gable height,	G or H	=

Step 2. Calculate the appropriate surface areas and perimeter. N is the number of individual house sections forming each greenhouse range.
N = 1 for a single house

Lower wall area:
2N(E x B) + (E x 2C) =

Upper wall area:
2N(F x B) + (F x 2C) =

Single material wall:
2N(A x B) + (A x 2C) =

Gable area:
N x B x G =

Curved end area:
1.3N x B x H =

Gable roof area:
2N x D x C =

Curved roof area:
N x D x C =

Perimeter:
2 [(N x B) + C] =

Step 3. List construction materials and U factors for each surface.

Location	Construction Material	U Factor
Lower wall		U_1 =
Upper wall		U_2 =
Single material wall		U_3 =
End area		U_4 =
Roof		U_5 =
Perimeter		U_6 =

Step 4. Calculate appropriate conduction heat loss, h_c.

h_c = Area x U x ΔT

T = Inside night temperature – minimum outside temperature

Lower wall area x U_1 x ΔT =
Upper wall area x U_2 x ΔT =
Single wall area x U_3 x ΔT =
Gable or curved end area x
U_4 x ΔT =
Roof area x U_5 x ΔT =
Perimeter length x U_6 x ΔT =

Total = Q_C =

Step 5. Calculate greenhouse volume.

Gable house volume:
N [(A x B x C) + (B x G x C/2)] =

Single curved roof house volume:
2H x B x C/3 =

Multiple curved roof volume:
N [(A x B x C) + (2H x B x C/3)] =

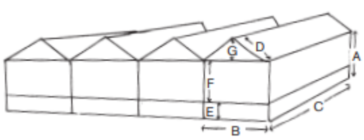
Step 6. Calculate air infiltration losses, h_{inf}.

h_{inf} = 0.02 x ΔT x Volume x Air changes/hour (Table 4–5, page 66)
=

Step 7. Calculate total heat loss, h_t.

h_t = h_C + hinf =

WORKSHEET NO. 4—EXAMPLE



N = 4
ΔT = 60°F

Step 1. List greenhouse dimensions in feet:

Wall height,	A	= 8
House width,	B	= 24
House length,	C	= 192
Rafter length,	D	= 13.4
Lower wall height,	E	= 1.5
Upper wall height	F	= 6.5
Gable height,	G or H	= 6

Step 2. Calculate the appropriate surface areas and perimeter. N is the number of individual house sections forming each greenhouse range.
N = 1 for a single house

Lower wall area:
2N(E x B) + (E x 2C) = (2)(4) [(1.5)(24) + (1.5)(2)(192)]
= 864 ft.^{2}

Upper wall area:
2N(F x B) + (F x 2C) = (2)(4) [(6.5)(24) + (6.5)(2)(192)]
= 3,744 ft.^{2}

Single material wall:
2N(A x B) + (A x 2C) =

Gable area:
N x B x G = (4)(24)(6) = 576 ft.^{2}

Curved end area:
1.3N x B x H =

Gable roof area:
2N x D x C = (2)(4)(13.4)(192) = 20,582 ft.^{2}

Curved roof area:
N x D x C =

Perimeter:
2 [(N x B) + C] = 2 [(4)(24) + 192] = 576 ft.

Step 3. List construction materials and U factors for each surface.

Location	Construction Material	U Factor
Lower wall		U_1 = 0.75
Upper wall		U_2 = 1.1
Single material wall		U_3 =
End area		U_4 = 1.1
Roof		U_5 = 1.1
Perimeter		U_6 = 0.8

Step 4. Calculate appropriate conduction heat loss, h_c.

h_c = Area x U x ΔT

ΔT = Inside night temperature – minimum outside temperature

Lower wall area x U_1 x ΔT = 864(0.75)(60) = 38,880
Upper wall area x U_2 x ΔT = 3,744(1.1)(60) = 247,104
Single wall area x U_3 x ΔT =
Gable or curved end area x
U_4 x ΔT = 576(1.1)(60) = 38,016
Roof area x U_5 x ΔT = 20,582(1.1)(60) = 1,358,412
Perimeter length x U_6 x ΔT = 576(0.8)(60) = 27,648

Total h_C = 1,710,060 Btu/hr.

Step 5. Calculate greenhouse volume.

Gable house volume:
N [(A x B x C) + (B x G x C/2)] =
4 [(8)(24)(192) + 24(6)(192)(½)] = 202,752 cu.ft.

Single curved roof house volume:
2H x B x C/3 =

Multiple curved roof volume:
N [(A x B x C) + (2H x B x C/3)] =

Step 6. Calculate air infiltration losses, h_{inf}.

h_{inf} = 0.02 x ΔT x Volume x Air changes/hour (Table 4–5, page 66)
= 0.02(60)(202,752)(1) = 243,300 Btu/hr.

Step 7. Calculate total heat loss, h_t.

h_t = h_C + hinf = 1,710,060 + 243,300
= 1,953,360 Btu/hr.

SAMPLE WORKSHEET NO. 5—GREENHOUSE COOLING CALCULATIONS

Step 1. List greenhouse dimensions in feet:

House width A = 96 ft.
House length B = 192 ft.

Step 2. Calculate ground area for each house:

A x B = 18,432 ft.^{2}

Step 3. Calculate air flow required for each house:
(Use 8 cfm/ft.^{2} of ground area)

A x B x 8 cfm/ft.^{2} = 147,456 cfm of installed capacity

Step 4. Select fans from manufacturer's catalog to provide a minimum of three stages of ventilation (provide 2 cfm/ft.^{2} for first stage).

				Manufacturer Model No.
1)	2	fan(s) at	18,900 cfm	
2)	2	fan(s) at	18,900 cfm	
3)	4	fan(s) at	18,900 cfm	
		Total =	151,200 cfm	

Step 5. Size inlet louvers to be at least 10% larger than exhaust fan areas. If continuous wall vents are used, size to air speed ≈ 250 fpm through vents.

SAMPLE WORKSHEET NO. 6—EVAPORATIVE (PAD) COOLING CALCULATIONS

Step 1. Calculate face area of pad:
Installed cfm divided by 250 for cellulose pads,
or divided by 150 for aspen shavings pads.

__151,200__ cfm/250 = __605__ ft.^{2}
______ cfm/150 = ______ ft.^{2}

Step 2. Calculate pad height to extend full length of one wall:

__605__ ft.^{2}/ __192__ ft. = __3.2__ ft. of pad height
(use 3.0 ft.)

Step 3. Calculate water flow rate and pump size:

__192__ ft. x 0.5 gpm/linear ft. of pad = __96__ gpm

Step 4. Calculate pump size:

__576__ ft.^{2} of pad x 0.75 gal./ft.^{2} = __432__ gal.

For a system in which pad-to-fan distance is less than 100 ft., increase installed fan capacity by the factor $F = \frac{10}{\sqrt{D}}$, where D is the pad-to-fan distance.

[Useful Conversions continued]

Type of Measurement	To convert:	Into:	Multiply by:
Liquid Volume	ounces	milliliters (cubic centimeters)	29.59
	pints	liters	0.4732
	quarts	liters	0.9463
	gallons	liters	3.785
	milliliters (cubic centimeters)	ounces	0.0338
	liters	pints	2.113
	liters	quarts	1.057
	liters	gallons	0.2642

Parts Per Million

1 oz./gal. = 7,490 ppm
1oz./100 gal. = 75 ppm

To determine parts per million (ppm) of an element in a fertilizer, simply multiply the percent of that element by 75. The answer will be the ppm of the element per ounce of the fertilizer in 100 gallons of water.

As an example, ammonium sulfate contains approximately 20% nitrogen. Multiply 20% (.20) by 75, which equals 15, the ppm of nitrogen in 1 oz. of ammonium sulfate/100 gal. of water.

Temperature Conversions

To convert Fahrenheit to Celcius (Centigrade): Subtract 32 and multiply by .55 (= 5/9), thus:
(68°F – 32) x .55 = 20°C.

To convert Celcius to Fahrenheit: Multiply by 1.8 (= 9/5) and add 32, thus:
(60°C x 1.8) + 32 = 140°F.

Formulas: (°F – 32) x (5/9) = °C
(°C x (9/5)) + 32 = °F

APPENDIX XIII
USEFUL CONVERSIONS

Type of Measurement	To convert:	Into:	Multiply by:
Length	feet	inches	12
	yards	inches	36
	rods	feet	16.5
	miles	feet	5,280
	miles	yards	1,760
	millimeters	inches	0.04
	microns	millimeters	0.001
Area	square feet	square inches	144
	square feet	square yards	0.111
	square yards	square inches	1,296
	square yards	square feet	9
	acres	square feet	43,560
	acres	square yards	4,840
	sections	acres	640
Mass Weight	ounces	grams	28.3495
	pounds	kilograms	0.4539
	short tons	megagrams (metric tons)	0.9078
	grams	ounces	0.3527
	kilograms	pounds	2.205
	megagrams (metric tons)	short tons	1.1016
Volume	cubic feet	cubic inches	1,728
	cubic feet	cubic yards	0.037
	cubic feet	bushels	0.804
	cubic feet	gallons	7.48
	cubic yards	cubic feet	27
	cubic yards	cubic inches	46,656
	cubic yards	bushels	21.71
	barrels (dry)	bushels	3.281
	barrels (dry)	quarts	105
	barrels (dry)	cubic inches	7,056
	bushels	cubic yards	21.7
	bushels	cubic feet	1.24
	bushels	cubic inches	2,150.4
	gallons (dry)	cubic inches	269
	gallons (liquid)	cubic inches	231
	gallons (liquid)	quarts	4
	quarts (dry)	cubic inches	67.2
	quarts (liquid)	cubic inches	57.7
	pints (liquid)	cubic inches	28.87
	ounces (liquid)	cubic inches	1.805
	ounces (liquid)	tablespoons	2
	ounces (liquid)	teaspoons	6
	ounces (liquid)	milliliters	29.57

SAMPLE WORKSHEET NO. 1—GREENHOUSE FACILITY PLANNING

General specifications

Cropping System:
- **Bedding plants** __X__
- **Pot plants** ____
- **Cut flowers** ____
- **Woody ornamentals** ____
- **Vegetables** ____
- **Other** ____

Growing Period:
- **All year** ____
- **Part year** __X__

Growing System
- **Floor** __X__
- **Fixed benches** ____
- **Moving benches** ____
- **Other** ____

Production Unit:
- **Pots** ____
- **Flats** __X__
- **Blooms** ____
- **Other** ____

Annual Production:
- **Pots** ____
- **Flats** __40,000__
- **Blooms** ____
- **Other** ____

Growing Media:
- **Soil, site mixed** __X__
- **Soil, purchased** ____
- **Hydroponic** ____

Marketing System:
- **Wholesale only** ____
- **Wholesale/retail** __X__
- **Retail only** ____

Marketing Period:
- **All year** ____
- **Seasonal** ____ **From** ____ **to** ____ .

Activity

Media Preparation:
- **Mixed on site** __X__ **As needed** ____ **For season** ____
- **Purchased** ____ **As needed** ____ **For season** ____

Volume Required:
yds.^{3}/day __6__ **yds.^{3}/season** __360__

Components:	#1 __soil__	#2 __peat__	#3 __perlite__
Vol. req./day	____	____	____
Vol. req./season	__132 yd.^{3}__	__132 yd.^{3}__	__132 yd.^{3}__

Seeding/Germination:

Yes	X	**No**		**Flat size**	11.5" x 21.25"
No. of flats:		**per day**	60	**per week**	300
Max. no. of seed flats germinating at one time:			380		

Transplanting:

Yes	X	**No**	

Transplanting from:

Seed flats	X
Plugs	
Cuttings	
Other	

Growing container:	Type	Size	No./day	No./week
	6 pack flat	11.5" x 21.25"	740	3,700

Max. no. of growing containers in use at one time: 27,890

Marketing–Order Assembly:

Marketing Unit:	flat	**Size**	11.5" x 21.25"
No./shipping container			70
No. containers/carrier			14
Maximum No. of shipping containers/day			14
Maximum No. of carriers at any one time			1

Production Areas:

Seeding:	ft^2	200	**Conditioning:**	ft^2	1,860
Germinating:	ft^2	700	**Growing:**	ft^2	52,700
Transplanting:	ft^2	600	**Total Production Area:**	ft^2	56,060 *

* allow for walkway, etc.

Ancillary Areas

	Area (ft^2)
Dry storage (flats, market packs, pots, labels, etc.)	360
Office	160
Employee (toilet, eating, etc.)	1,000
Chemicals (pesticides, fertilizers, etc.)	120
Central heating, mechanical service, fuel storage	180
Refrigeration (cold storage)	—
Parking: Employee	2,400
Public (receiving, shipping, visitors)	2,400
Total Antillary Areas:	**6,620**

SAMPLE WORKSHEET NO. 2—STORAGE & MECHANIZATION REQUIREMENTS

Sample for a Nursery Operation

Must can 500,000 gallon cans during a 50-day production season. Average production hours equal 7 hr./day. Tractors pulling two trailers holding 200 cans each move plants to fields, requiring 20 minutes for each trip.

A. No. of containers to be filled/season	500,000 (1 gal. cans)	containers/season
B. Length of production season	50	days/season
C. Work hours/day	7	hours/day
D. Daily output required = A ÷ B (500,000 ÷ 50)	10,000 cans	containers/day
E. Hourly output required = D ÷ C (10,000 ÷ 7)	1,429	containers/hours
F. Volume of media required = A ÷ containers filled/cu. yd. (500,000 ÷ 252) (see Appendix V, 252 one gal cans/yd.^{3})	1,985	yd.^{3}
G. Storage floor area required for media = (F x 27) ÷ depth of media (ft.) (1,985 x 27) ÷ 6 [assume media depth is 6ft.]	8,932	ft.^{2}
H. Volume of media required/day = F ÷ B (1,985 ÷ 50)	40	yd.^{3}/day
I. Labor hours required to fill containers = A ÷ containers/labor hour (500,000 ÷ 1,429)	350	hours
J. Hours per day filling containers = I ÷ B (350 ÷ 50)	7	hours/day
K. Volume of media handled/hour = H ÷ J (40 ÷ 7)	5.7	yd.^{3}/hour
L. No. of tractor-trailer units required	2	

Equipment Required[1]	Work Crew[2]
Front end loader	Front end loader – 1
Mixer	Pot filling – 2
Feeder bin	Moving plants to growing beds – 4
Pot filler	
Belt conveyor	
2 tractors	
4 trailers	

[1] Does not include seeders, transplanters, waterers.
[2] Work crew to operate equipment listed.

SAMPLE WORKSHEET NO. 2—STORAGE & MECHANIZATION REQUIREMENTS

Sample for a Bedding Plant Operation

A. No. of containers to be filled/season	10,000 (flats)	containers/season
B. Length of production season	40	days/season
C. Work hours/day	7	hours/day
D. Daily output required = A ÷ B (10,000 ÷ 40)	250 flats/day	containers/day
E. Hourly output required = D ÷ C (25 ÷ 7)	36 flats/hr	containers/hours
F. Volume of media required = A ÷ containers filled/cu. yd. (10,000 ÷ 95) (see Appendix V and VI, 13" x 15" flat, 95 filled/yd.^{3})	105	yd.^{3}
G. Storage floor area required for media = (F x 27) ÷ depth of media (ft.) (105 x 27) ÷ 6 [assume media depth is 6ft.]	473	ft.^{2}
H. Volume of media required/day = F ÷ B (105 ÷ 40)	2.6	yd.^{3}/day
I. Labor hours required to fill containers = A ÷ containers/labor hour (10,000 ÷ 60) (see Appendix VI, hand filling ≈ 60 flats/hour)	167	hours
J. Hours per day filling containers = I ÷ B (167 ÷ 40)	4.2	hours/day
K. Volume of media handled/hour = H ÷ J (2.6 ÷ 4.2)	0.62	yd.^{3}/hour
L. No. of tractor-trailer units required	none	

Equipment Required[1]	Work Crew[2]
Mixer	1 person to load and unload mixer, deliver and remove flats

[1] Does not include seeders, transplanters, waterers.
[2] Work crew to operate equipment listed.

SAMPLE WORKSHEET NO. 3—CALCULATING MACHINERY COSTS

Machine: Flat/pot filling machine w/ supply hopper and belt conveyor. A bucket loader is already owned.

Original cost: $12,000

Estimated useful life: 10 years

Estimated hours of use per year: 15 flats/minute x 60 minutes/hour = 900 flats/hour

Yearly Production	Hours of use
25,000 flats	28
50,000	56
75,000	84
100,000	112

Salvage or trade-in value (if any): $2,000

Fixed Cost		**Annual Cost**
Depreciation	$\frac{12{,}000 - 2{,}000}{10}$	$ 1000.00
Interest on Investment	$\frac{12{,}000 + 2{,}000}{2} \times .08$	$ 560.00
Taxes	12,000 x 0.03	$ 360.00
Insurance		$ 30.00
Shelter		$ 20.00
	Total Fixed Cost	$ **1,970.00**

Variable Cost		**Annual Cost**
Electricity	3.5 KW ($0.10) x 28 hours	$ 10.00
Repair cost (parts & labor)	5.5% of 12,000	$ 660.00
Labor	3 people ($5.00/hour) (28 hours use + 7 hours waiting and service time)	$ 525.00
	Total Variable Cost	$ **1,195.00**

Total Annual Cost = $1,970.00 + 1,195.00 = $3,165.00

Total Cost/Hour = $3,165 ÷ 28 hours = $113

Total Cost/Flat = $3,165 ÷ 25,000 flats = 13¢/flat

SUMMARY AND COMPARISON—WORKSHEET NO. 3 CONTINUED

	Yearly Production—flats			
	25,000	50,000	75,000	100,000
Fixed Costs				
Depreciation	$1,000	$1,000	$1,000	$1,000
Interest on Invesment	560	560	560	560
Taxes	360	360	360	360
Insurance	30	30	30	30
Shelter	20	20	20	20
Total Fixed Costs	**$1,970**	**$1,970**	**$1,970**	**$1,970**
Variable Costs				
Electricity	$10	$20	$30	$40
Repairs	660	660	700	750
Labor	525	1050	1575	2100
Total Variable Costs	**$1,195**	**$1,730**	**$2,305**	**$2,890**
Total Annual Costs	**$3,165**	**$3,700**	**$4,275**	**$4,860**
Total Cost/Hour	**$113**	**$66**	**$51**	**$43**
Cost/Flat	**$0.13**	**$0.07**	**$0.06**	**$0.05**

Appendix V
CONTAINER CAPACITIES

Table 1. Number of containers filled per unit of rooting media.

Container Size	Containers per bushel	Containers per yd.³	Container Size	Containers per bushel	Containers per yd.³
Pot, STD Round			*Pot, Hanging Basket*		
2.25″	320	6,900	6″	25	540
2.50″	260	5,600	8″	10	215
3.00″	150	3,240	10″	6	135
3.50″	100	2,160	12″	5	110
4.00″	60	1,300			
4.50″	50	1,080			
5.00″	35	750	*Gallon Container*		
5.50″	25	540	1 gal.	11.7	252
6.00″	20	430	2 gal.	5.8	126
7.00″	12	270	3 gal.	3.9	84
8.00″	7	160	4 gal.	2.9	63
10.00″	4	80	5 gal.	2.3	50
Pot, Round Azalea			*2.5″ Deep Flats*		
4.0″	70	1,500	11″ x 22″	3.5	77
4.5″	55	1,180	12″ x 24″	3.1	67
5.0″	35	750	13″ x 15″	4.4	95
5.5″	30	650	14″ x 16″	3.8	83
6.0″	22	480	14″ x 18″	3.4	74
6.5″	20	430	15″ x 20″	2.8	62
7.0″	15	325	16″ x 16″	3.3	72
7.5″	12	270	16″ x 21″	2.5	55
8.0″	9	190	16″ x 24″	2.2	48
10.0″	5	110			
Pot, Square					
2.25″	444	9,600			
3.00″	160	3,450			
4.00″	70	1,510			

Note: Pot numbers are approximate and may vary with soil type, fill level, and manufacturer.

Appendix VI
LABOR OUTPUT AND MACHINE CAPACITIES

Table 1. Labor requirements for typical growing tasks.

Growing Task	Labor Required
Soil Mixing	
Mortar mixer	1-1/2–2 yd.³/worker/hour
Transit mixer	3–5 "
Shredder-tractor w/bucket loader	15–20 "
Drum mixer—feeder bins	15–20 "
Flat Filling	
Hand	60–100 flats/worker/hr.
Machine	150–300"
Transplanting—bedding plants	
Hand	8–15 flats/worker/hr.
Cell transplants, production line conveyor	30–50 "
Canning—1 gallon	
Assembly of materials, hand filling & planting, moving to field by trailer	120–150 cans/worker /hr.
Assembly of materials, machine canning, moving to field by trailer	160–400"
Canning—5 gallon	
Assembly of materials, hand filling & planting, moving to field by trailer	25–35 cans/worker/hr.
Assembly of materials, machine canning, moving to field by trailer	30–60 "
Potting—1 gallon nursery stock	
On ground—in place	400–500 plants/worker/day
In trailer	400–500"
On assembly conveyor	600–800"

Table 2. Typical equipment capacities and output.

MACHINE	CAPACITY	OUTPUT
Mixers		
Batch	1 yd. bin with spiral agitator	6–8 yd.³/hr.
Batch	2 yd. bin with spiral agitator	10–12 "
Continuous	Feeder bins with drum mixer	≤ 50 "
Flat/Pot Fillers		
Carousel	Semi-automatic 1–4 operators, pots/tubs	400–2,500/hr.
Potting Machine	Pot dispenser/dibble—1–2 operators, pots/cans	≤ 3,000 "
Belt	Pots held in template	9,000 "
Belt	Flats	900–1200 "
Pot Separator	5-1/2–13-in. dia.	≤ 5000/hr.
Plug Extractor	Removes plugs from tray	≤ 20,000/hr.
Precision Seeders		4–8 flats/hr.
Soil Bagger	4 yd. hopper	500–1,000 bags/hr.
Nursery Stock Balling Machine	8–15-in. dia. balls	800–1,200/day
Bare Root Bagger	3 operators	4,000/day
Shredder	3 HP engine	8 yd.³/hr.
	5 HP	12 "
	24 HP	40 "

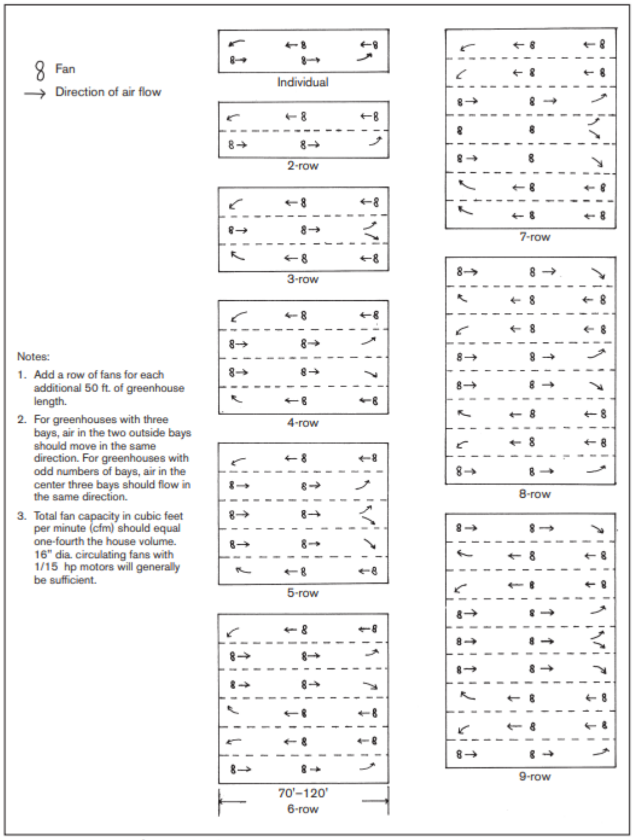


Figure 5–8. Fan layout for horizontal air flow systems to provide uniform temperature distribution.

Separate Variable Costs from Fixed Costs on the Chart of Accounts

Table 3 shows the chart of accounts after the Variable Costs (Cost of Goods Sold) have been separated from the Fixed Costs (Overhead Costs) in the Cornell Greenhouse Business Analysis program.

Table 3. Chart of Accounts after Separating Variable and Fixed Costs

CHART OF ACCOUNTS: GREENHOUSE	
Income	
Wholesale Sales	
Retail Sales	
Other Income	
Variable Costs	
Hired Labor	
Seeds & Plants	
Fertilizer and Spray	
Potting Soil	
Packaging Material (including tags)	
Hard Goods	
Advertising	-- Vary with production volume
Heating Fuel	
Gas/Diesel	
Electricity	
Water/Sewage	
Telephone	
Trucking/Shipping	
Sales Tax	
Fixed Costs	
Interest	
Depreciation	
Insurance	
Repairs, Equipment/Vehicle	
Repairs, Building	-- Do not vary with production volume
Property Taxes	
Lease/Rental	
Land Rent	
Office Supplies	
Professional Services	
Miscellaneous	