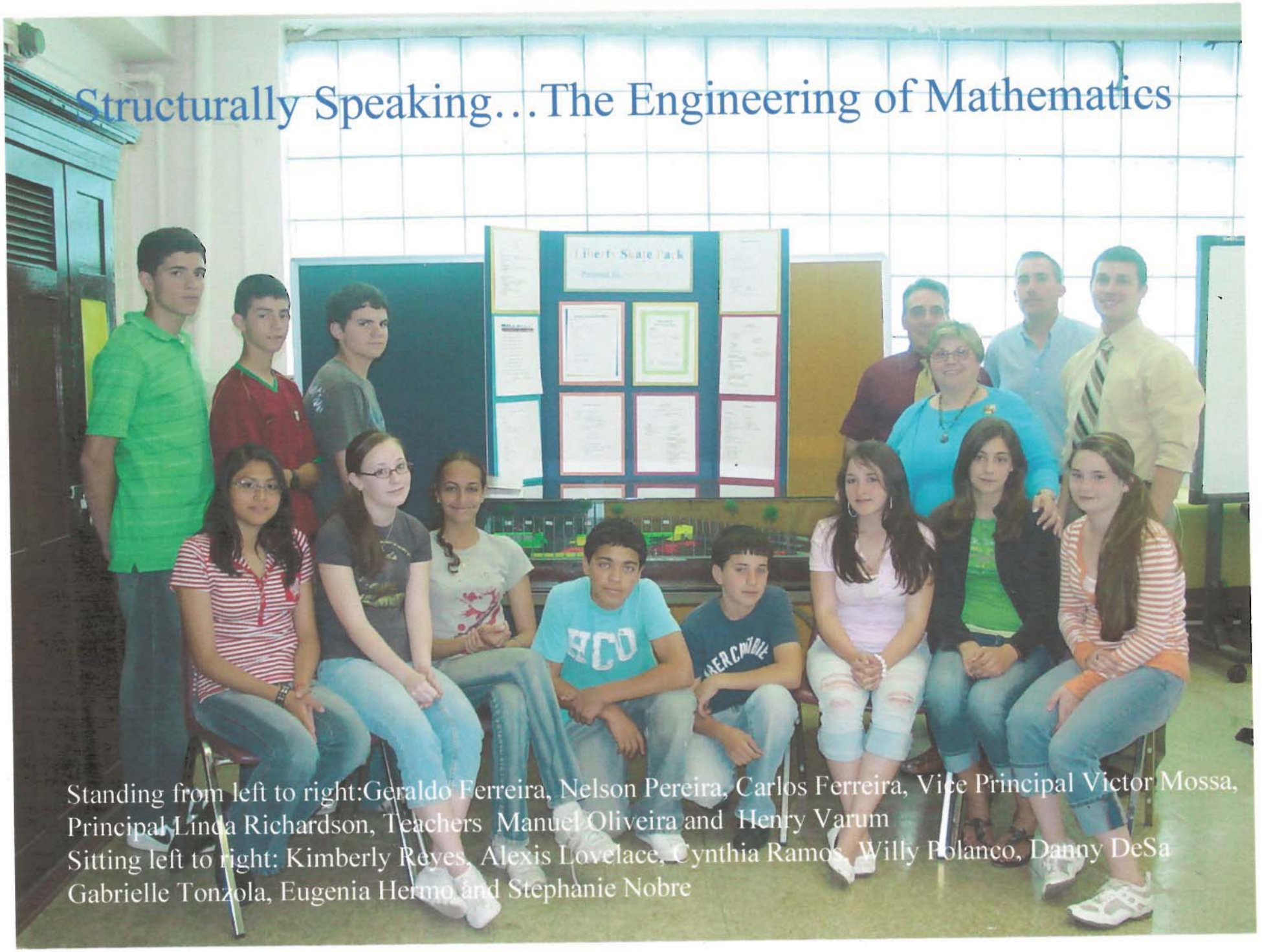
Structurally Speaking…The Engineering of Mathematics



Standing from left to right:Geraldo Ferreira, Nelson Pereira, Carlos Ferreira, Vice Principal Victor Mossa, Principal Linda Richardson, Teachers Manuel Oliveira and Henry Varum
Sitting left to right: Kimberly Reyes, Alexis Lovelace, Cynthia Ramos, Willy Polanco, Danny DeSa Gabrielle Tonzola, Eugenia Hermo and Stephanie Nobre

Structurally Speaking… The Engineering of Mathematics
Liberty Skate Park

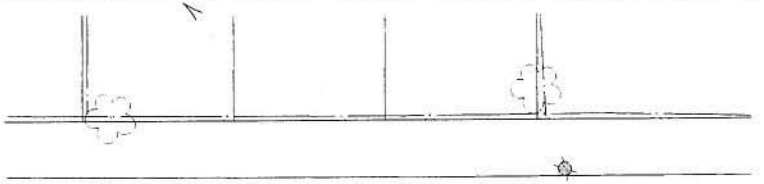
One day in March during Algebra class, our teacher Mr. Varum, presented the main idea for this year's Math Fair theme; Structurally Speaking... The Engineering of Mathematics. Our minds flooded with ideas as we pondered through our imaginations. Suddenly we came up with the perfect design. There is an area located on the corner of Hennessey St. and Chestnut St called Liberty Park. What used to be a wonderful play area became run-down and filthy, so now there is no use of it what so ever. We decided to create a skate park in place of it.

First, Mr. Varum gave us exact scale blueprints of the park. Next we began to study the different kinds of ramps all skate parks had to offer. After that we created our own ramps on graph paper, where we had to incorporate many algebra concepts to find all the side lengths and area. Using sine, cosine, and tangent ratios we learned how to find missing side lengths for each of our ramps. Also assimilating our knowledge of formulas, arc length, and sectors, we learned how to find the length of a curved side of a half-pipe.

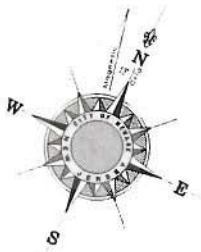
After checking our math and making any needed corrections, we began to construct our ramps. Using x-acto knives, hard poster board, and the great help of our science teacher (Mr. Oliveria), we were able to create

exact scale models of our original ramps. The scale for our skate park is: 1 inch on the model ramp is equal to 5.614 feet on the actual ramp. After constructing all of our model ramps we then spray-painted them bright neon colors. Finally the edifice of our very own skate park was completed.

AREA MAP
HENNESSY STREET PARK



HENNESSY STREET



139.85

239.85 (TOTAL)

100

BLOCK
993

LOT 1

LOT 7

123.62

95.50

95.50

CHESTNUT STREET

61.36

161.36 (TOTAL)

100

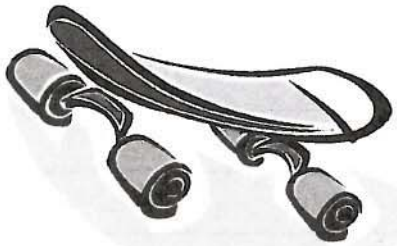
LOT 24.02

LOT 24.01

GRAPHIC SCALE
SCALE IN FEET
50 25 0 25 50 100

1/100 0 1/100 1/50
SCALE IN MILES

PREPARED BY: CITY OF NEWARK–DEPARTMENT OF ENGINEERING
PREPARED FOR: ANN STREET SCHOOL 8TH GRADE CLASS
APRIL 18, 2007
SCALE: 1' = 10'



Model I

The Pool

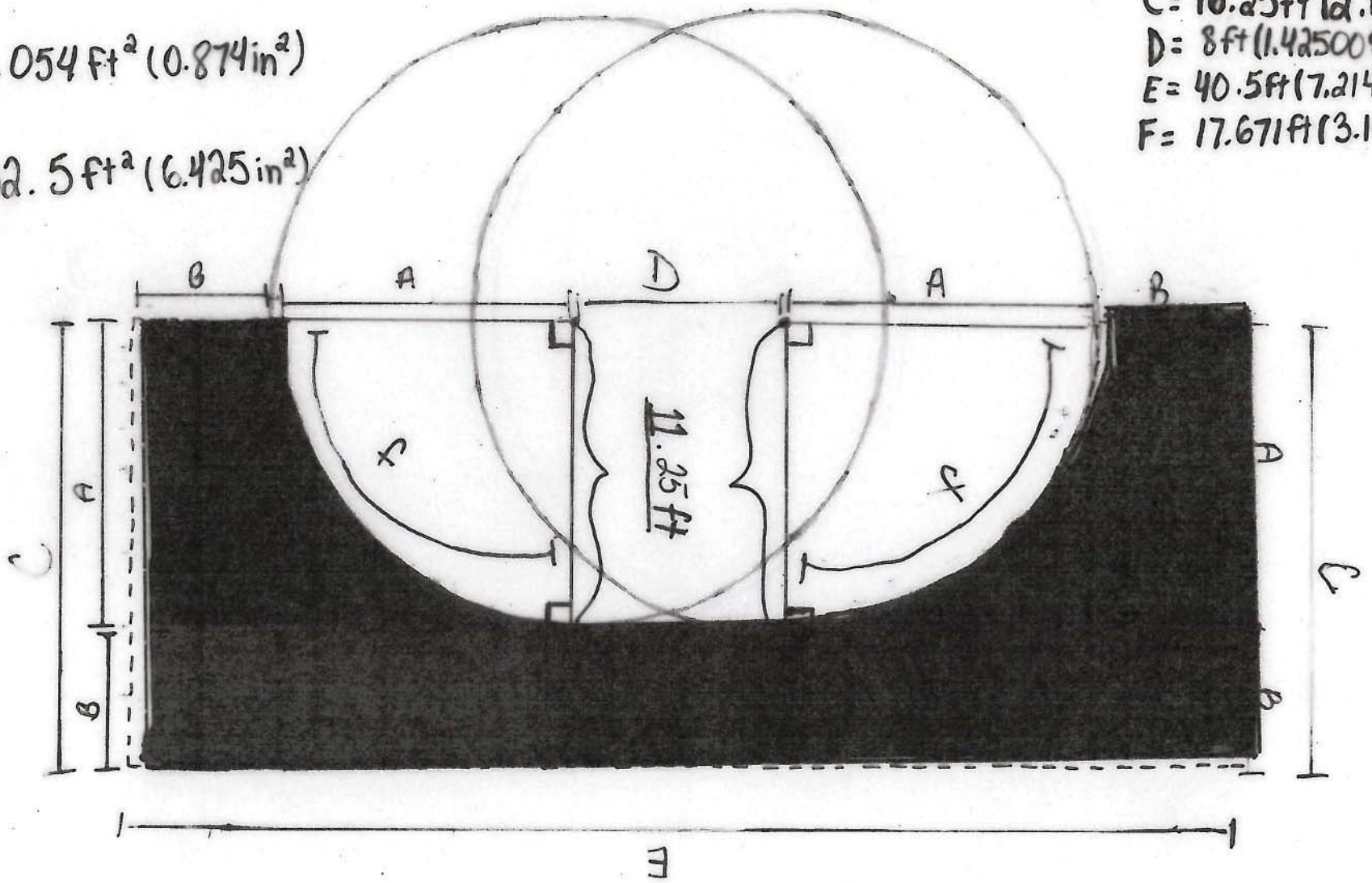
TOP VIEW OF SIDE OF POOL

1 = 56.25 ft² (1.785 in²)

2 = 27.054 ft² (0.874 in²)

3 = 202.5 ft² (6.425 in²)

A = 11.25 ft (2.0039 in)
B = 5 ft (0.89063 in)
C = 16.25 ft (2.8945 in)
D = 8 ft (1.4250089 in)
E = 40.5 ft (7.2141 in)
F = 17.671 ft (3.148 in)



Top View of the Pool
Outer Area

A. 11.25 ft. 11.25 ft ÷ 5.614ft= 2.003918774 in.

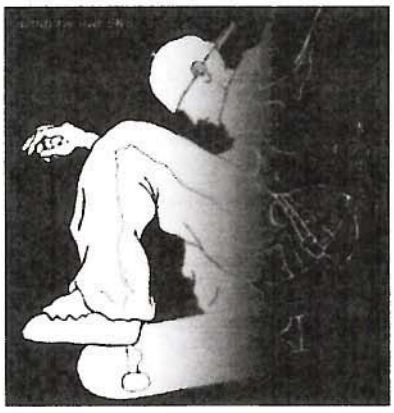
B. 5 ft 5 ft ÷ 5.614ft= 0.8906305664 in.

C. 11.25 ft + 5 ft = 16.25 ft
16.25 ft ÷ 5.614 ft= 2.896613191 in.

D. 8 ft 8ft ÷ 5.614ft= 1.425008906 in.

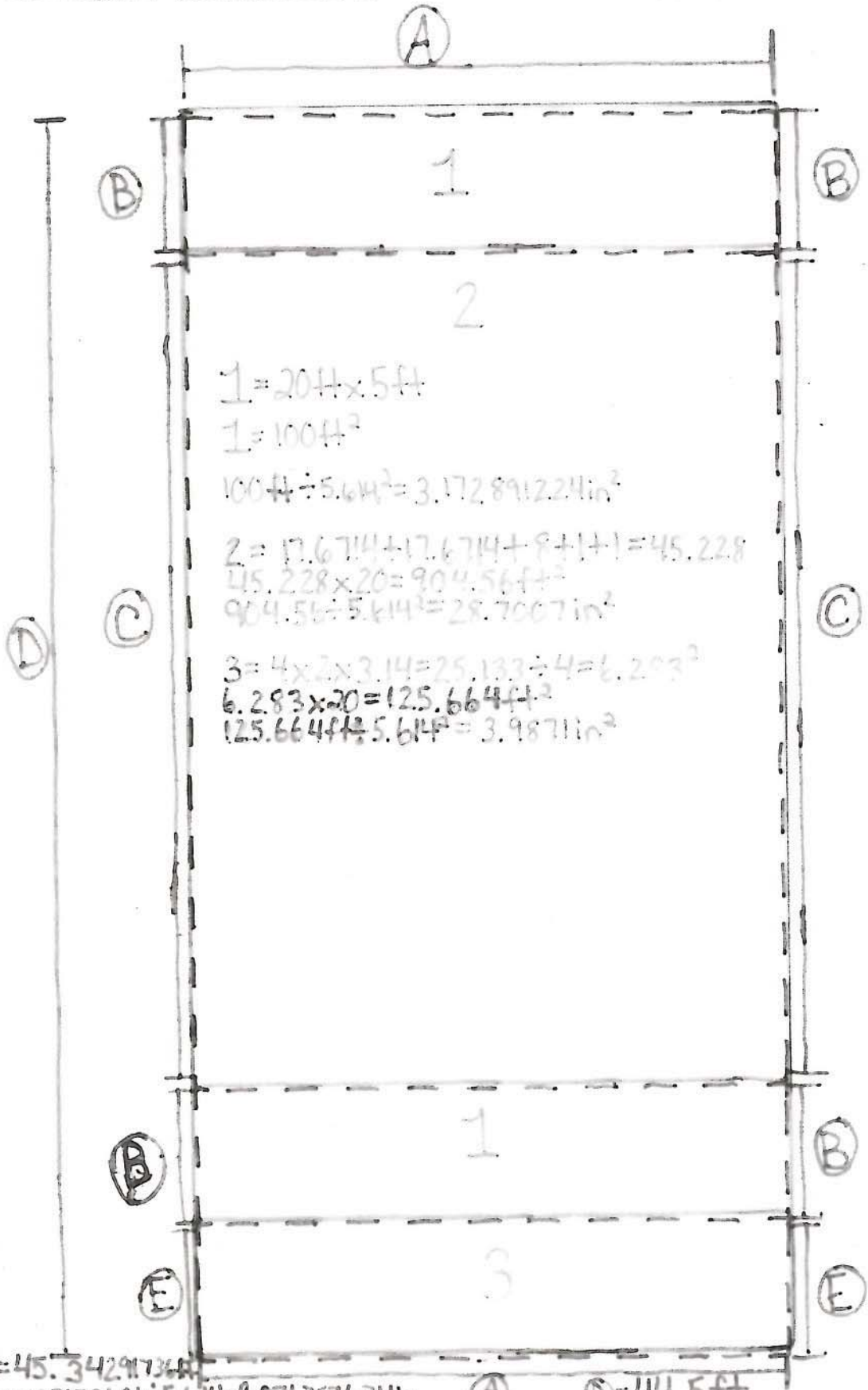
E. 40.5 ft 40.5 ft ÷ 5.614ft= 7.214107588 in.

F. π22.5= 70.68583471 ft
70.68583471 ft ÷ 4= 17.67145868 ft
17.67145868 ft ÷ 5.614ft= 3.14774825 in.



Ⓐ=20ft
20ft÷5.614=3.562532266in

Ⓑ=5ft
5ft÷5.614=.8906305664in



1=20ft×5ft
1=100ft²
100ft÷5.614²=3.172891224in²

2=17.671ft+17.671ft+8ft+1ft+1=45.228
45.228×20=904.56ft²
904.56÷5.614²=28.7007in²

3=4×2×3.14=25.133÷4=6.283²
6.283×20=125.664ft²
125.664ft²÷5.614²=3.9871in²

Ⓒ=45.34291736ft
45.34291736ft÷5.614=8.076757634in
Ⓒ=curved section*

Ⓓ=44.5ft
44.5ft÷5.614=7.926612.04in

Ⓔ=6.283185307ft
6.283185307ft÷5.614=
1.119199378in
Ⓔ=curved section*

Half Pipe

Top View

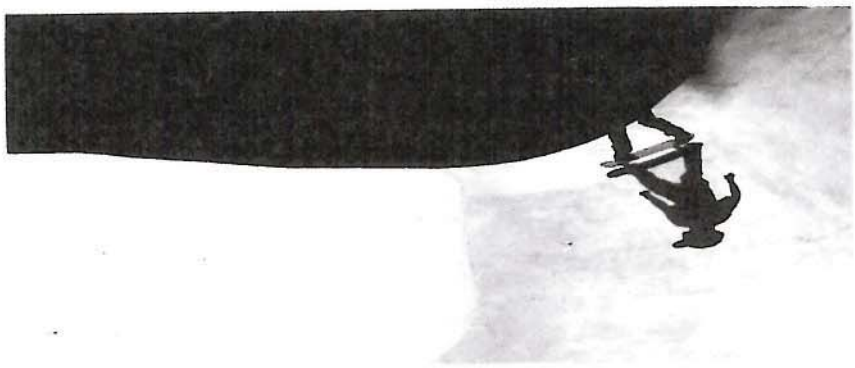
A. = 20 ft
20 ft ÷ 5.614 = 3.562522266 in.

B. = 5 ft
5 ft ÷ 5.614 = .8906305664 in.

C. = 45.34291736 ft (curved section) (2)17.67145868+8+8+1+1
45.34291736 ft ÷ 5.614 = 8.076757634 in.

D. = 44.5 ft
44.5 ft ÷ 5.614 = 7.92661204 in.

E. = 6.283185307 ft (curved section)
6.283185307 ft ÷ 5.614 = 1.119199378 in.



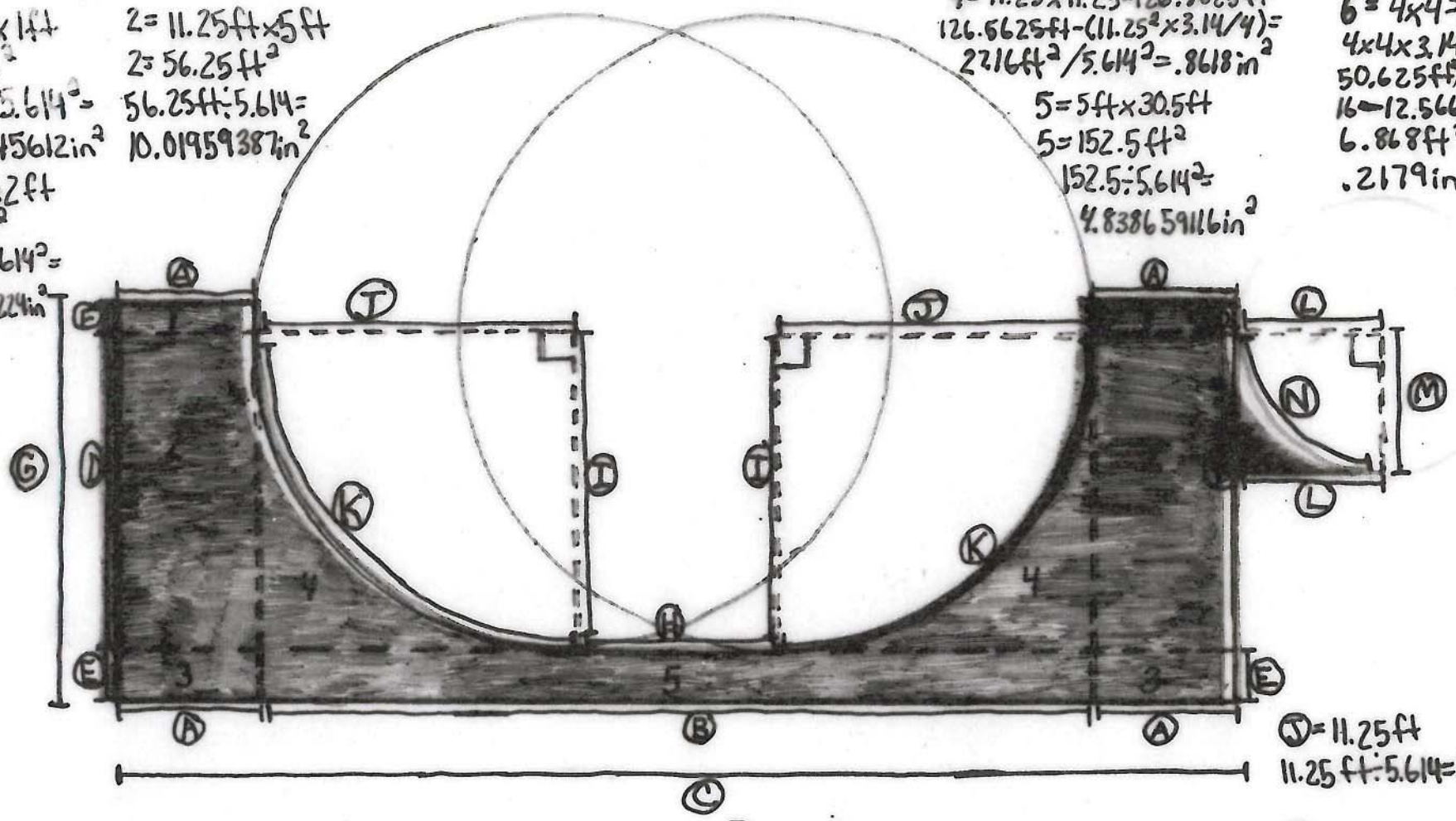
: 5ft x 1ft
= 5ft²
ft ÷ 5.614² =
58644562in²
=5ft x 2ft
=10ft²
ft ÷ 5.614² =
31728911224in²

2= 11.25ft x 5ft
2= 56.25ft²
56.25ft ÷ 5.614 =
10.01959387in²

4= 11.25 x 11.25 = 126.5625ft²
126.6625ft - (11.25² x 3.14/4) =
2216ft² / 5.614² = .8618in²

5= 5ft x 30.5ft
5= 152.5ft²
152.5 ÷ 5.614² =
4.838659116in²

6 = 4x4 = 16ft
4x4x3.14 = 50.625ft²
50.625ft²/4 = 12.566ft²
16 − 12.566 = 3.434x2 =
6.868ft² ÷ 5.614² =
.2179in²



J = 11.25ft
11.25 ft ÷ 5.614 = 2.003918774

)=5ft
ft ÷ 5.614 = .8906305664in

D=30.5ft
0.5ft ÷ 5.614 = 5.432846455in

)=40.5ft
0.5ft ÷ 5.614 = 7.214107588in

N=11.25ft
11.25ft ÷ 5.614 = 2.003918774in

E=2ft
2ft ÷ 5.614 = .3562522266in

F=1ft
1ft ÷ 5.614 = .178126133in

G=14.25ft
14.25ft ÷ 5.614 = 2.538297114in

H=8ft
8ft ÷ 5.614 = 1.425008906in

I=11.25ft
11.25ft ÷ 5.614 = 2.003918774in

K=17.6714ft
17.6714ft ÷ 5.614 = 2.00391877

L=4ft
4ft ÷ 5.614 = .712504532 i

M=4ft
4ft ÷ 5.614 = .712504532in

N=6.283185307ft
6.283185307ft ÷ 5.614 = 1.125044532 i

Half Pipe

Side View

A. = 5 ft

5 ft ÷ 5.614 = .8906305664 in.

B. = 30.5 ft

30.5 ft ÷ 5.614 = 5.432846455 in.

C. = 40.5 ft

40.5 ft ÷ 5.614 = 7.214107588 in.

D. = 11.25 ft

11.25 ft ÷ 5.614 = 2.003918774 in.

E. = 2 ft

2 ft ÷ 5.614 = .3562522266 in.

F. = 1 ft

1 ft ÷ 5.614 = .178126133 in.

G. = 14.25 ft

14.25 ft ÷ 5.614 = 2.538297114 in.

H. = 8 ft

8 ft ÷ 5.614 = 1.425008906 in.

I. = 11.25 ft

11.25 ft ÷ 5.614 = 2.003918774 in.

J. = 11.25 ft

11.25 ft ÷ 5.614 = 2.003918774 in.

K. = 17.6714 ft 2(11.25) (Π) ÷ 4= 17.67145868

17.6714 ft ÷ 5.614 = 3.14774825 in.

L. = 4 ft

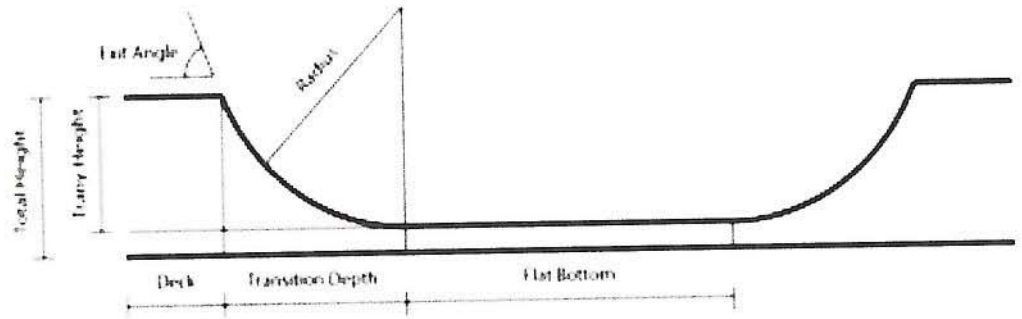
4 ft ÷ 5.614 = .7125044532 in.

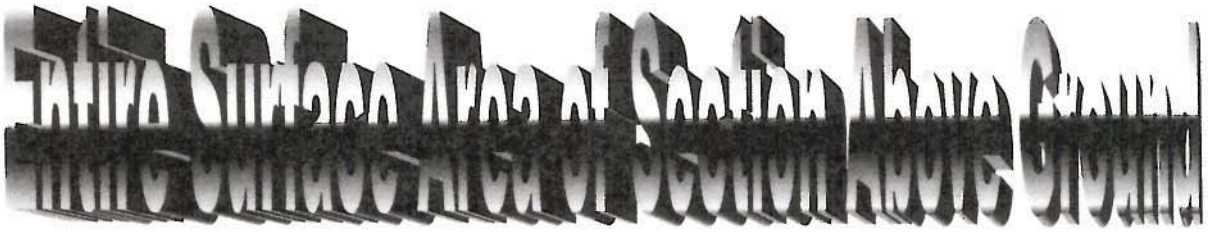
M. = 4 ft

4 ft ÷ 5.614 = .7125044532 in.

N. = 6.283185307 ft 4(2) Π÷4=6.283185307

6.283185307 ft ÷ 5.614 = 1.119199378 in.





A = 202.5 x 2 = 405ft² / 5.614² = 12.85in²

B = 81.25 x 4 = 325ft² / 5.614² = 10.31in²

C = 202.5 x 2 = 405ft² / 5.614² = 12.85in²

D = 56.25 x 4 = 225ft² / 5.614² = 7.14in²

E = 27.16 x 4 = 108.64ft² / 5.614² = 3.45in²

F = 904.56ft² / 5.614² = 28.7in²

G = 100 x 2 = 200ft² / 5.614² = 6.35in²

H = 125.664ft² / 5.614² = 3.99in²

I = 3.434 x 2 = 6.868ft² / 5.614² = .22in²

J = 5 x 20 = 100ft² / 5.614² = 3.17in²

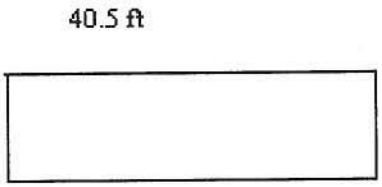
K= 141.3712 x 2 = 282.7424ft² / 5.614² = 8.97in²

L = 198.8039 x 4 = + 795.2156ft² / 5.614² = +25.23in²

3883.69ft²	123.23in²
Surface Area in ft	Surface Area in Inches

Scale used: 1in = 5.614ft

A



$5 \times 40.5 = 202.5\ ft^2$

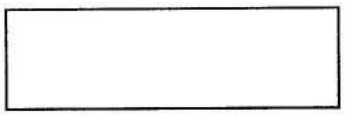
$202.5/5.614^2 = 6.4251 in^2$

B

$5 \times 16.25 = 81.25 ft^2$

$81.25/5.614^2 = 2.578 in^2$

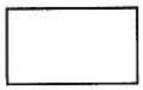
C



$40.5 \times 5 = 202.5\ ft^2$

$202.5/5.614^2 = 6.4251 in^2$

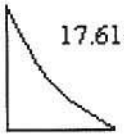
D



$11.25 \times 5 = 56.25\ ft^2$

$56.25/5.614^2 = 1.7848 in^2$

E

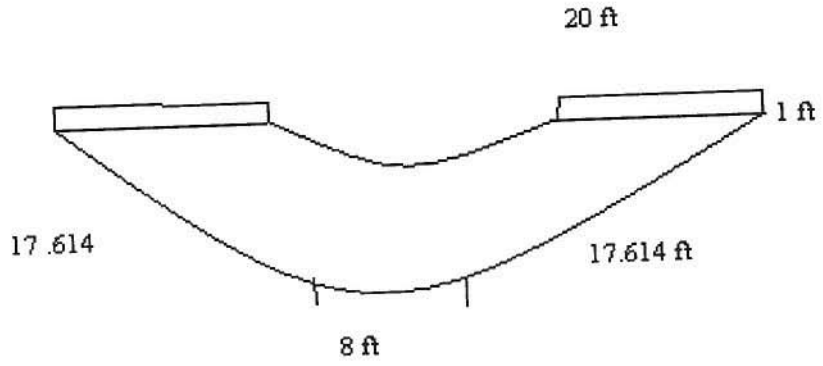


$11.25^2 = 126.5625 ft^2$

$126.5625 - (11.25^2 \times 3.14/4) = 27.16 ft^2$

$27.16/5.614 ft^2 = .8618 in^2$

F

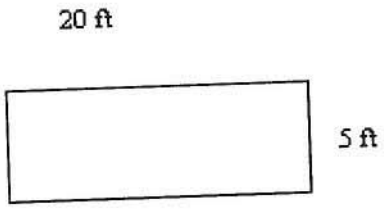


$8 + 17.614 + 17.614 + 1 + 1 = 45.228\text{ft}$

$45.228 \times 20 = 904.56\ \text{ft}^2$

$904.56/5.614^2 = 28.7007\text{in}^2$

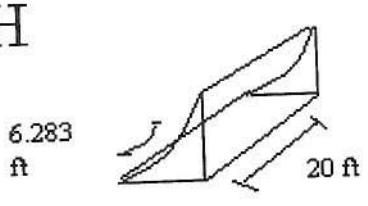
G



$20 \times 5 = 100\ \text{ft}^2$

$100/5.614^2 = 3.1729\text{in}^2$

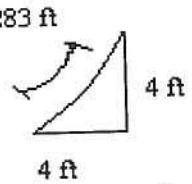
H



$4 \times 2 \times 3.14 = 25133/4 = 6.283\text{ft}^2$

$6.283 \times 20 = 125.664\text{ft}^2$ $125.664/5.614^2 = 3.9871\text{in}^2$

I



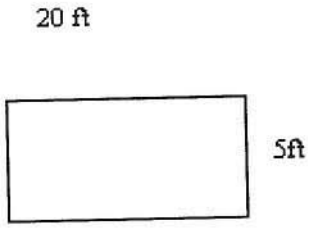
$4x4 = 16\ ft^2$

$4x4x3.14 = 50.265ft^2$ $\quad 50.265/4 = 12.566ft^2$

$16-12.566 = 3.434x2 = 6.868ft^2$

$6.868/5.614^2 = .2179in^2$

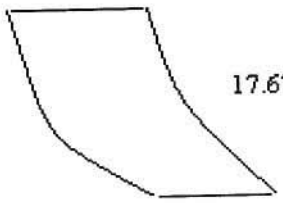
J



$5 \times 20 = 100\ ft^2$

$100/5.614^2 = .2179in^2$

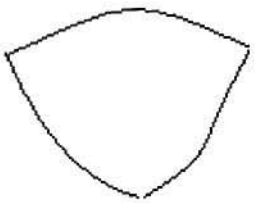
K



$8 \times 17.6714 = 141.3712\ ft^2$

$141.3712/5.614^2 = 4.486in^2$

L



$4x3.14x11.25x11.25=1590.431281/2=795.2156ft^2$

$795.2156/4=198.8039ft^2$

$198.8039/5.614^2=6.3078in^2$

Underground Section of Pool

A= 9.25 x 40.5 = 374.625 x 2 = 749.25 ft^2
749.25/5.614²=23.773in^2

B= 9.25 x 16.25 = 150.3125 x 4 = 601.25 ft^2
601.25/5.614²=19.077in^2

J= 9.25 x 20 = 185 x 2 =370 ft^2
370/5.614²=11.7397in^2

Base= 16.25 + 16.25 + 20 =52.5 x 40.5 = 2126.25 ft^2
2126.25/5.614²=67.4636in^2

Volume of pool section of ramp

$4/3\ \pi\ 11.25^3 = 5964.12ft^3/2 = 2982.06ft^3$ Half Sphere

$\pi\ 11.25^2 \times 20 = 7952.16ft^3/2 = 3976.08ft^3$ Half Cylinder

$\pi\ 11.25^2 \times 8 = 3180.86ft^3/2 = 1590.43ft^3$ Half Cylinder

$8 \times 20 \times 11.25 = 1800ft^3$ Rectangular Prism

$\pi 11.25^2 \times 1 = 397.608ft^3$ Cylinder

$20 \times 30.5 \times 1 = 610ft^3$ Rectangular Prism

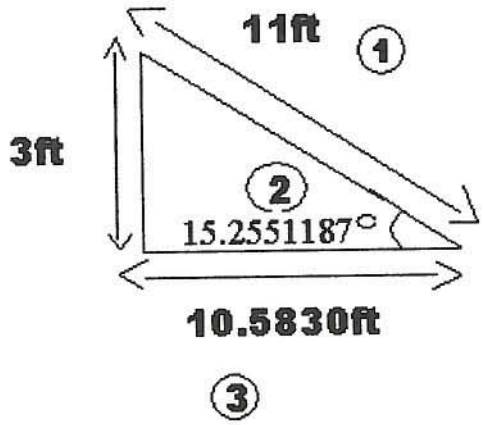
$11.25 \times 8 \times 1 \times 2 = 180ft^3$ 2 Rectangular Prisms

$180+610+397.608+1800+1590.43+3976.08+2982.06 = 11536.178ft^3$=Volume of Pool

MODEL II

FUNBOX 1

Fun Box 1



1. $\sin 15° = \frac{3}{x}$

$(x).2588 = \frac{3}{x}(x)$

$.2588x = 3$

$\approx 11.59\text{ft}$

$11.59\text{ft} \div 5.614 = .367738092\text{in.}$

2. $\tan^{-1} x = \frac{3}{11}$

$= 15.2551187°$

3. $a^2 + b^2 = c^2$

$3^2 + b^2 = 11^2$

$9 + b^2 = 121$

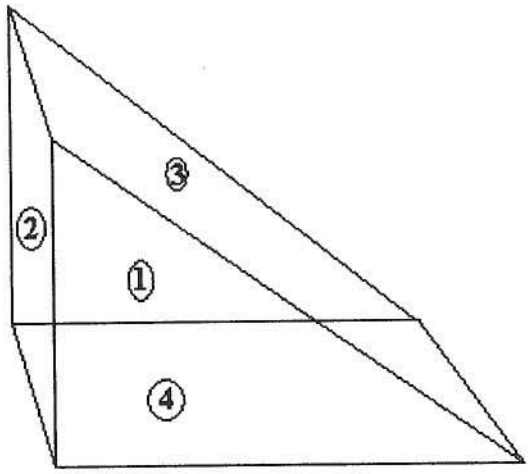
$121 - 9 = 112$

$\sqrt{112}$

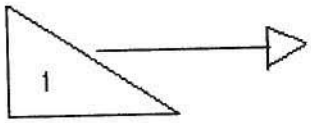
$= 10.5830\text{ft}$

$10.5830\text{ft} \div 5.614\text{in} = 1.885\text{in}$

3D view of Triangular Prism-



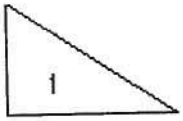
Surface Area for Triangular Prism-



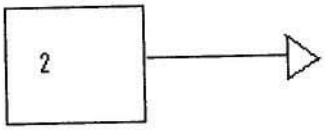
$A=\frac{1}{2}bh$

$A = ½ \times 10.58ft \times 3$

$A=15.87ft^2$



$15.87ft^2 \div 5.614in^2 = .50354in^2$

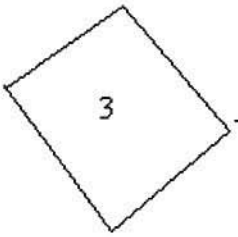


$A=l \times w$

$A=3ft \times 7ft$

$A=21ft$

$21ft^2 \div 5.614in^2 = .6663in^2$

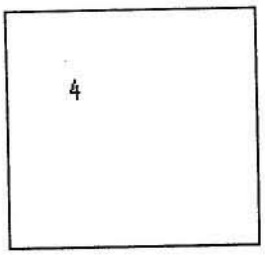


$A=l \times w$

$A= 11ft \times 7ft$

$A=77ft^2$

$77ft^2 \div 5.614in^2 = 2.4431in^2$



$A=l \times w$

$A=7ft \times 10.58ft$

$A=74.06ft^2$

$74.06ft^2 \div 5.614in^2 = 2.35in^2$

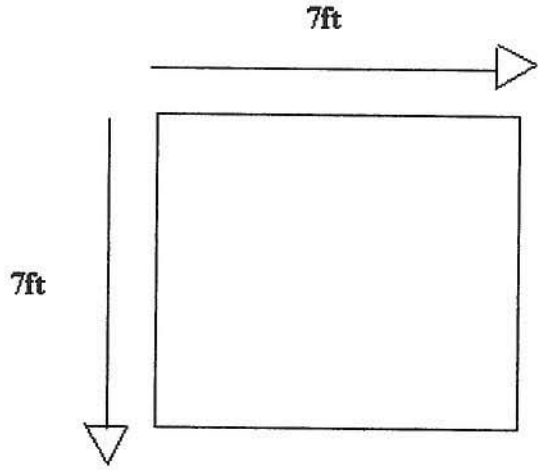
Total Surface Area for Triangular Prisms-

$15.87ft^2 + 15.87ft^2 + 21ft^2 + 77ft^2 + 74.06ft^2 = 203.8ft^2$

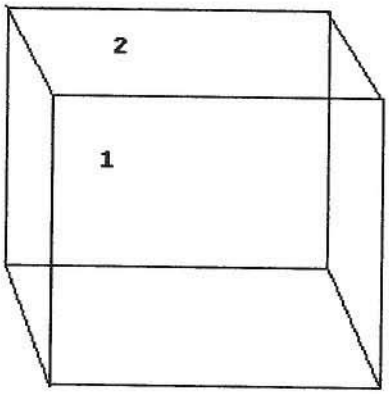
$203.8ft^2 \div 5.614in^2 = 7.1326in^2$

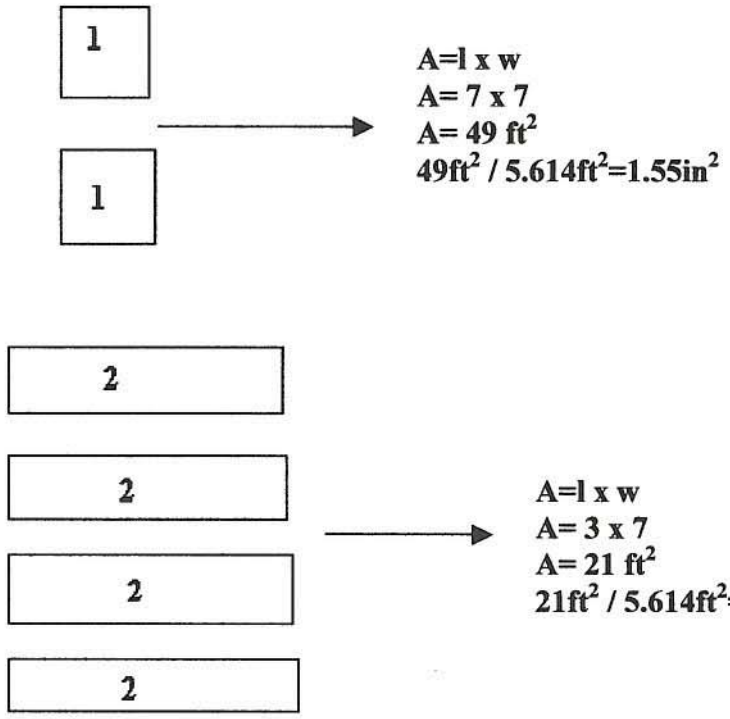
$$\begin{array}{r} 203.8\ ft^2 \\ \times \quad 4 \\ \hline 815.2\ ft^2 \end{array}$$

Surface area for Rectangular Prism



3D view of Rectangular Prism-





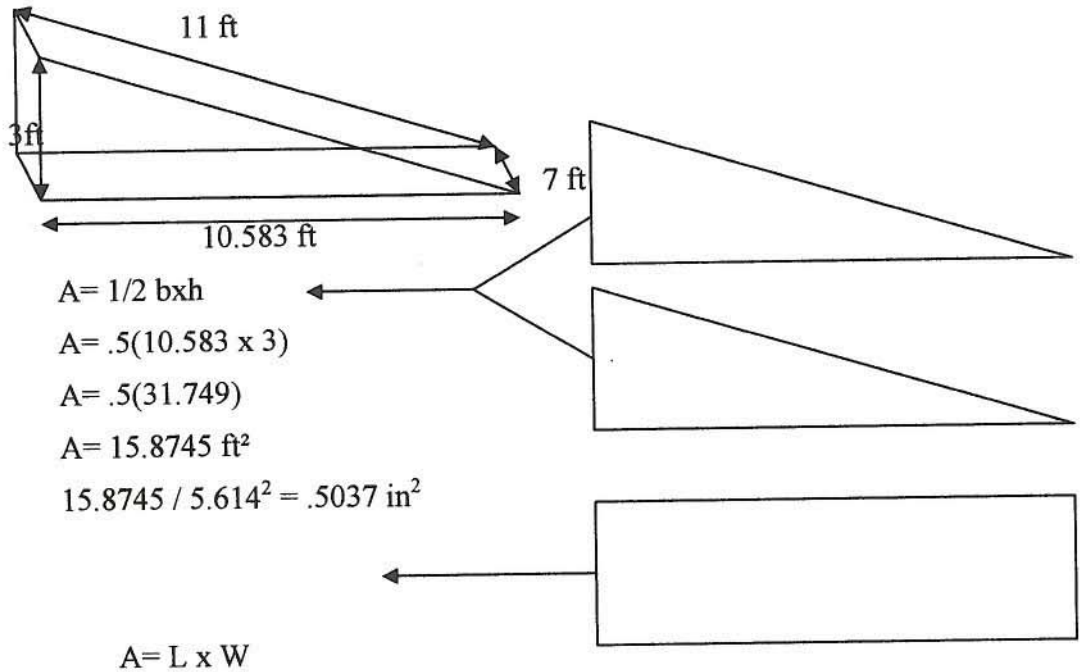
Total Surface Area of Rectangular Prism-

$49ft^2+49ft^2+21ft^2+21ft^2+21ft^2+21ft^2=182ft^2$

$182ft^2 \div 5.614in^2=5.77in^2$

Surface Area for Fun-Box 1

Scale: 1 in = 5.614 ft



A= 1/2 bxh

A= .5(10.583 x 3)

A= .5(31.749)

A= 15.8745 ft²

$15.8745 / 5.614^2 = .5037$ in²

A= L x W

A= 7 x 11

A= 77 ft²

$77 / 5.614^2 = 2.4431$ in²

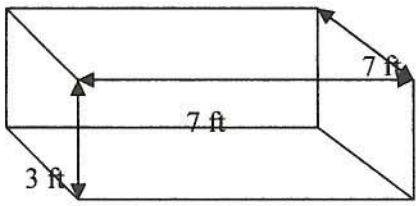
77 ft² 15.8745 ft² + 15.8745ft² = 108.749ft²

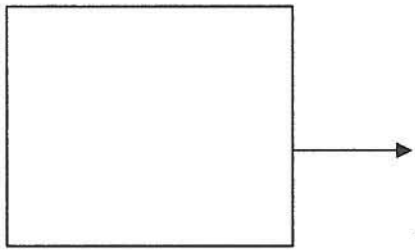
$108.749 / 5.614^2 = 3.4505$ in²

108.749 ft² x 4 = **434.996 ft²**

$434.996 / 5.614^2$ = **13.8019 in²**

Box Surface Area...





A= L x W

A= 7 x 7

A= 49 ft²

Surface Area for Actual Ramp= 49 ft²

Surface Area for Model Ramp= 1.55 in²² 49 ft/ 5.614²= 1.55 in²

Total Surface Area for Actual Fun Box= 483.9965 ft²

434.996

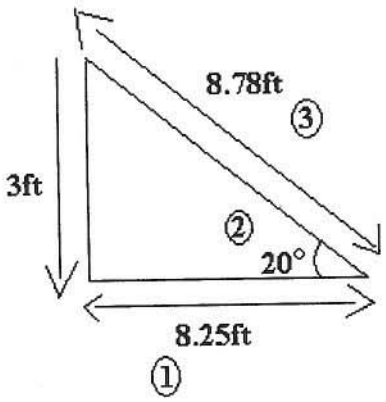
+ 49

483.9965 ft²

Total Surface Area for Scale Model of Fun Box= 15.36 in²

483.9965/ 5.614²

Fun Box 2



1. $\tan 20^\circ = \frac{3ft}{x}$

$(x).3639702343 = \frac{3ft(x)}{x}$

$.3639702343 = 3ft$

$= 8.2424ft$

$= 8.25ft$

$8.25ft \div 5.614 = 1.4695in$

2. $\tan^{-1} x = \frac{3ft}{8.25ft}$

$= 19.98^\circ$

$= 20^\circ$

3.

$a^2 + b^2 = c^2$

$3ft^2 + b^2 = 8.25ft$

$9ft^2 + b^2 = 68.0625ft$

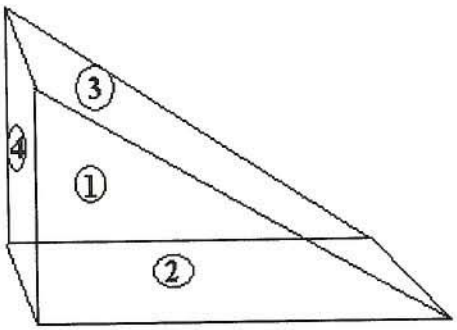
$68.0625ft^2 + 9ft$

$\sqrt{77.0625ft}$

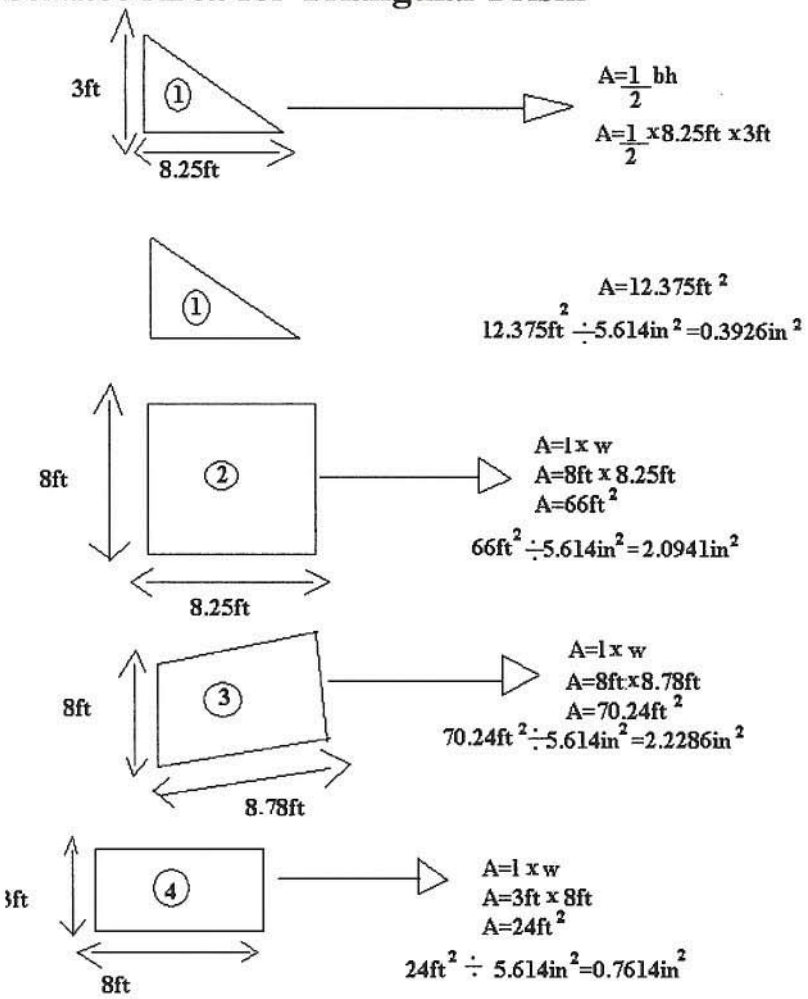
$= 8.78ft$

$8.78ft \div 5.614in = 1.5639in$

3D View of Triangular Prism-



Surface Area for Triangular Prism-



Total Surface Area for Triangular Prism-

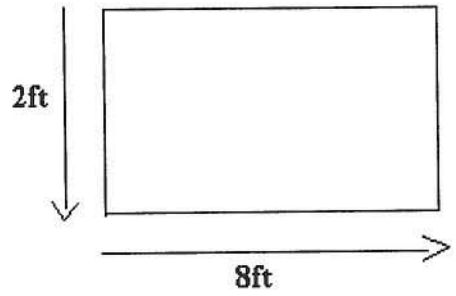
Total Surface Area-12.375ft² +12.375ft² + 66ft² +70.24ft² +24ft² =184.99ft²

184.99ft² ÷ 5.614in² =5.8695in²

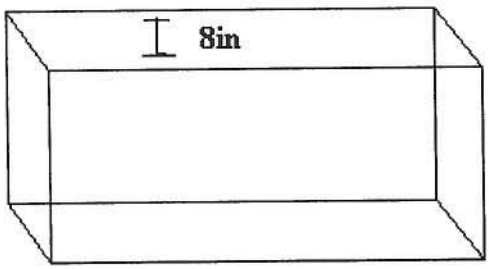
$$\begin{array}{r} 184.99\text{ft} \\ \times \quad\quad 3 \\ \hline 554.97\text{ft}^2 \end{array}$$

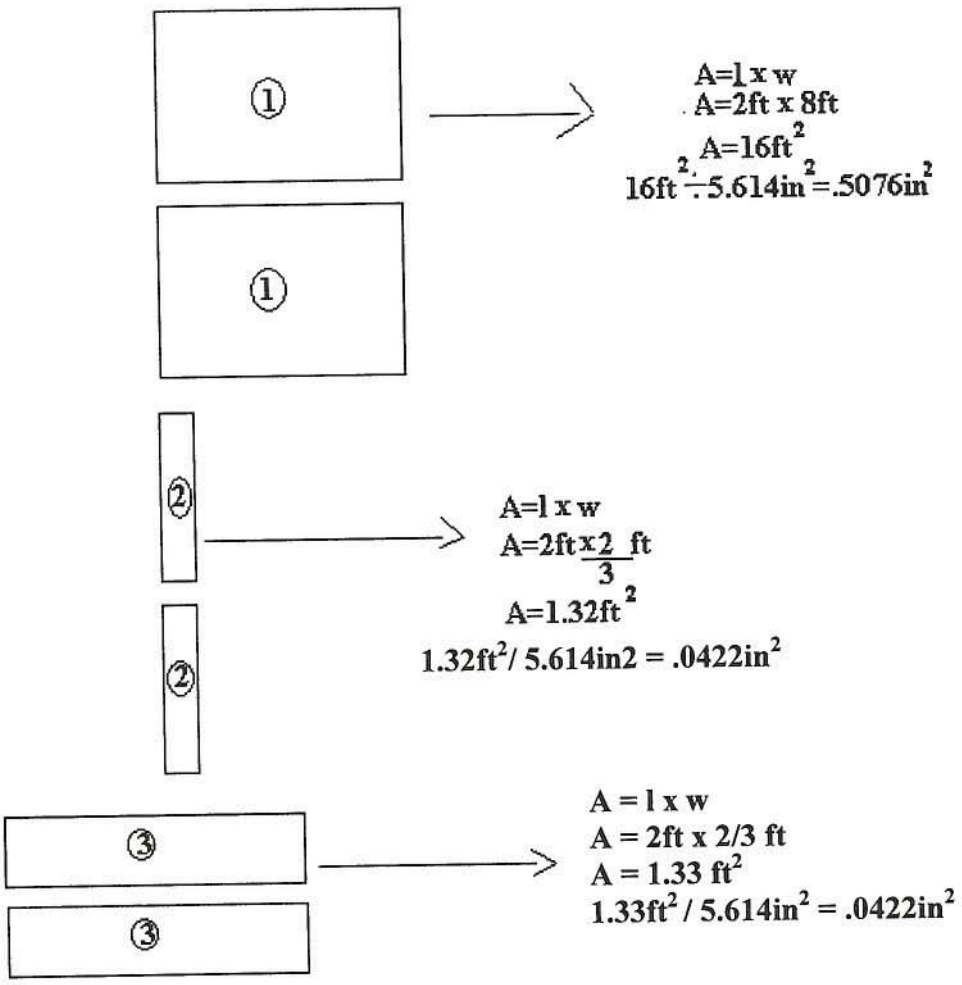
554.97ft² ÷ 5.614in² =17.6085in²

Surface area for Vert Wall (Rectangular Prism)



3D View of Rectangular Prism-



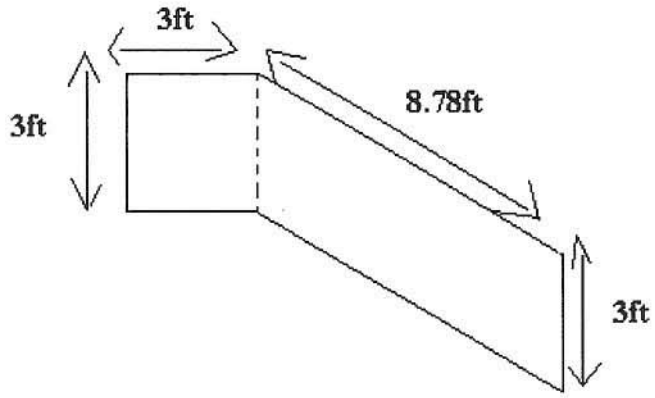


Total Surface Area for Vert Wall (Rectangular Prism)-

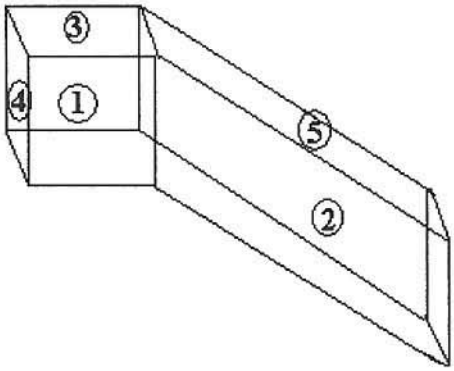
$16ft^2 + 16ft^2 + 1.33ft^2 + 1.33ft^2 + 5.33ft^2 + 5.33ft^2 = 45.32ft^2$

$45.32ft^2 / 5.614\ in^2 = 1.4380\ in^2$

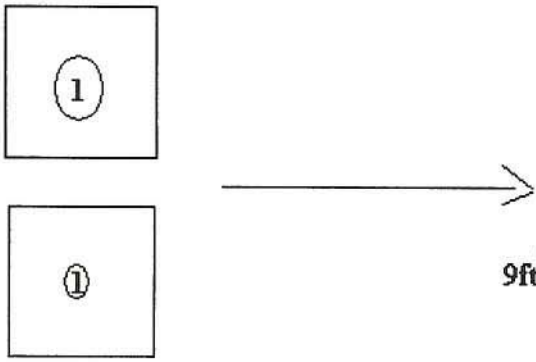
Railing D



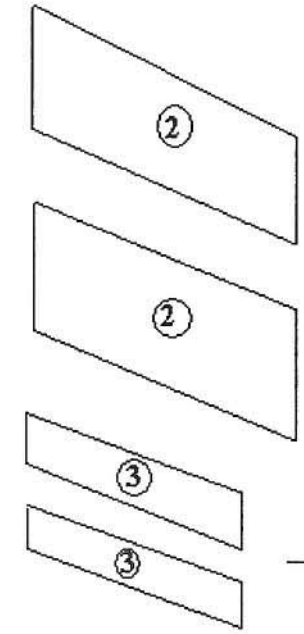
3D View of Railing D-



Surface Area of Railing D-



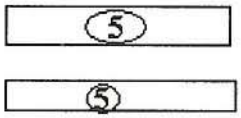
A=l x w
A=3ft x 3ft
A=9ft^2
9ft^2 ÷ 5.614in^2=.2855in^2



A = l x w
A = 3ft x 8.78ft
A = 26.34ft^2
26.34ft^2 / 5.614in^2 = .8357 in^2

A= l x w
A= 8.78 ft x 2/3 ft
A = 5.85ft^2
5.85ft^2 / 5.614in^2 =
.1856in^2

A= l x w
A= 3 ft x 2/3 ft
A = 2ft^2
2ft^2 / 5.614in^2 = .0635in^2



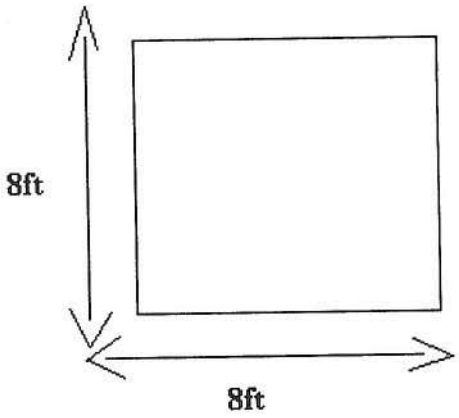
A=l x w
A=3ft x $\frac{2}{3}$ ft
A=2ft^2
2ft^2 ÷ 5.614in^2=.0634in^2

Total Surface Area of Railing D-

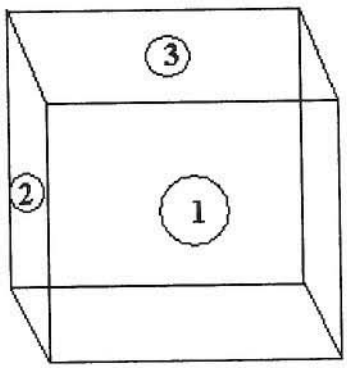
$9ft^2 + 9ft^2 + 26.34ft^2 + 26.34ft^2 + 5.85ft^2 + 5.85ft^2 + 2ft^2 + 2ft^2 + 2ft^2 + 2ft^2 = 90.38ft^2$

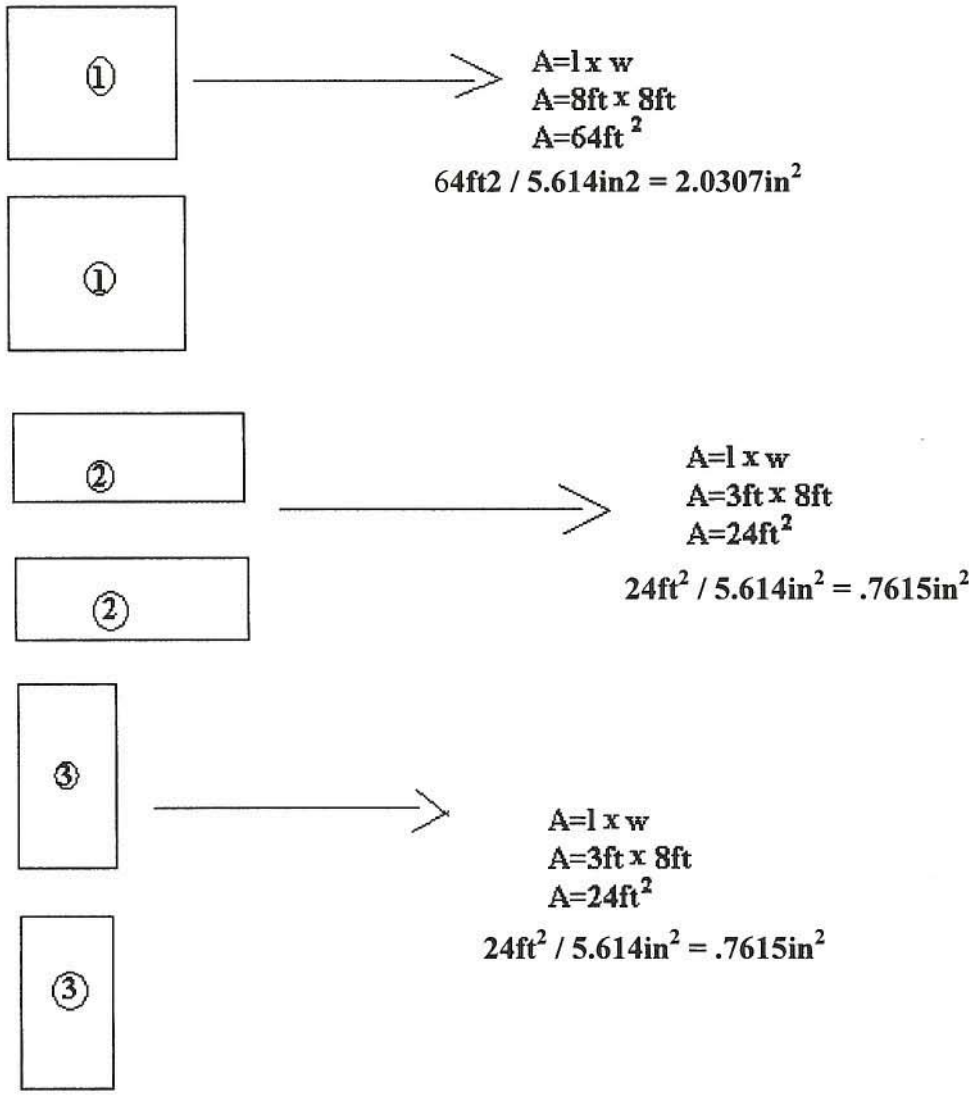
$90.38ft^2 / 5.614\ in^2 = 2.8677in^2$

Surface area for middle section of the Fun Box (Rectangular Prism)



3D View of Rectanglular Prism-





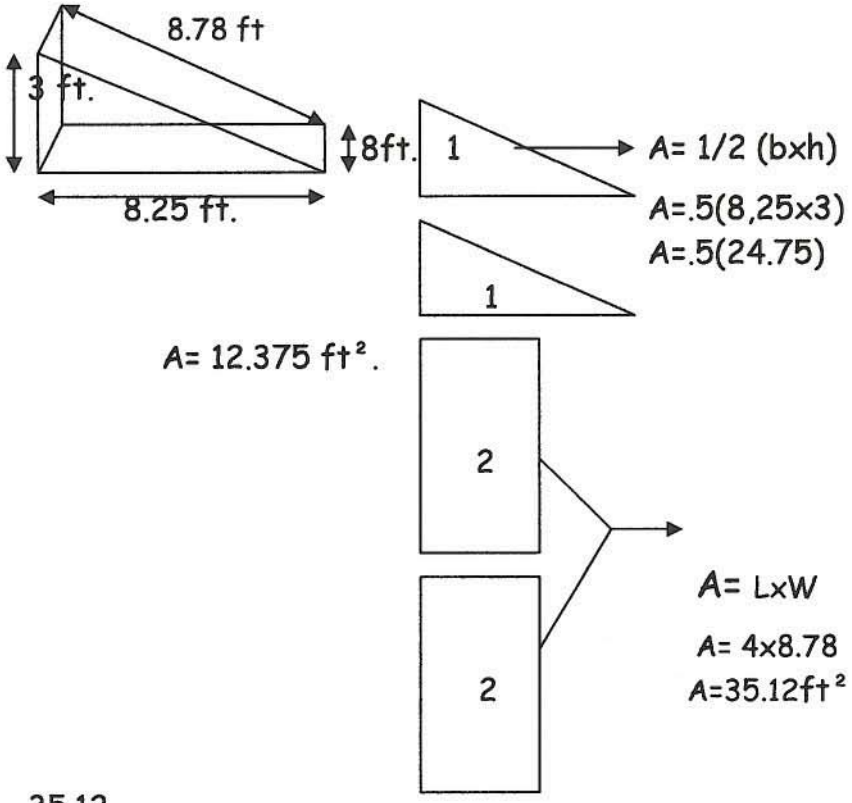
Total Surface Area for rectangular prism-

$$64ft^2 + 64ft^2 + 24ft^2 + 24ft^2 + 24ft^2 + 24ft^2 = 224ft^2$$

$$224ft^2 \div 5.614in^2 = 7.1072in^2$$

Surface Areas For Actual and Scale Models

Ramp A



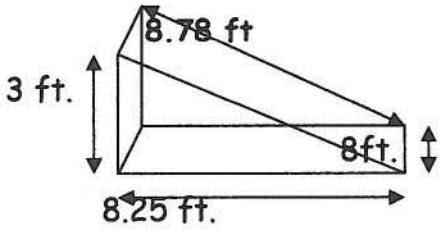
35.12
35.12
12.375
+12.375

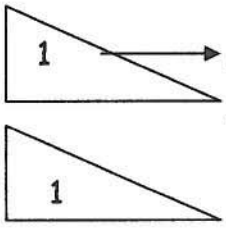
Surface Area= 94.99 ft².

Surface area of Scale Model= 3.01 in².

Surface Areas For Actual and Scale Models

Ramp B





A= 1/2 (bxh)

A=.5(8.25x3)

A= 12.375 ft^2

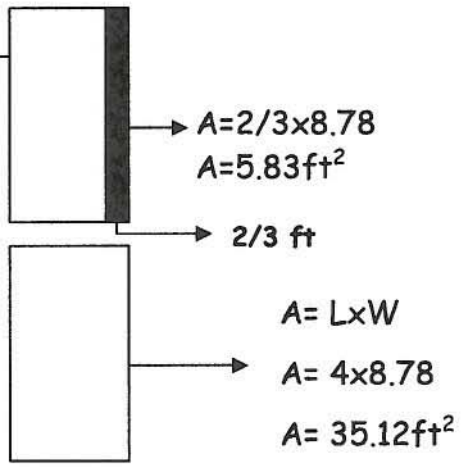
A= LxW

A= 4x8.78

A= 35.12ft^2

A= 35.12-5.83

A= 29.29 ft^2



A=2/3x8.78

A=5.83ft^2

2/3 ft

A= LxW

A= 4x8.78

A= 35.12ft^2

35.12ft^2

29.29ft^2

12.375ft^2

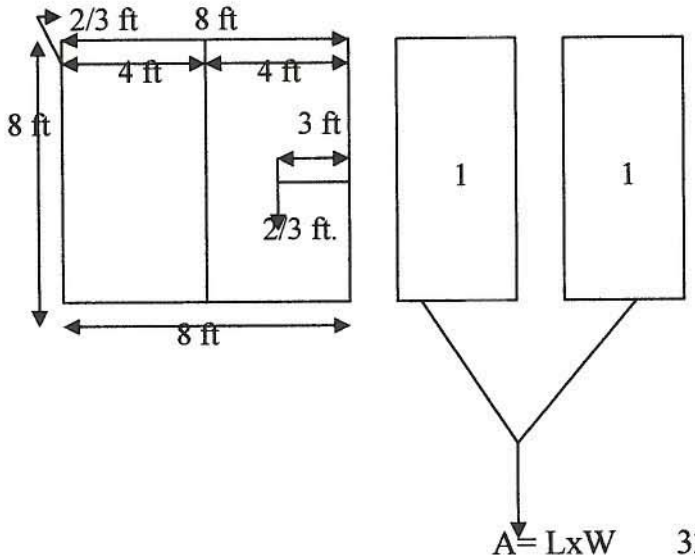
+12.375ft^2

89.16ft^2

Surface Area=89.16ft^2

Surface Area of Model= 89.16/5.614^2= 2.829in^2

Base Box (sides B and C)



A= LxW 32

A= 8x4 + 32

A= 32 ft² 64 ft²

3x 2/3= 2 ft²

8x 2/3= 5.33 ft²

5.33 64 56.67/5.614=1.79 in²

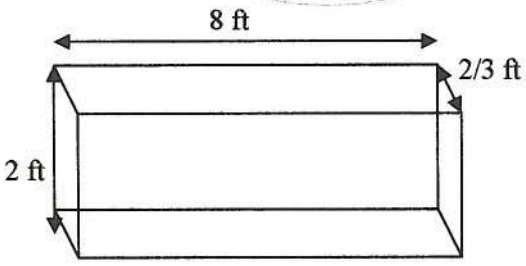
+ 2 - 7.33

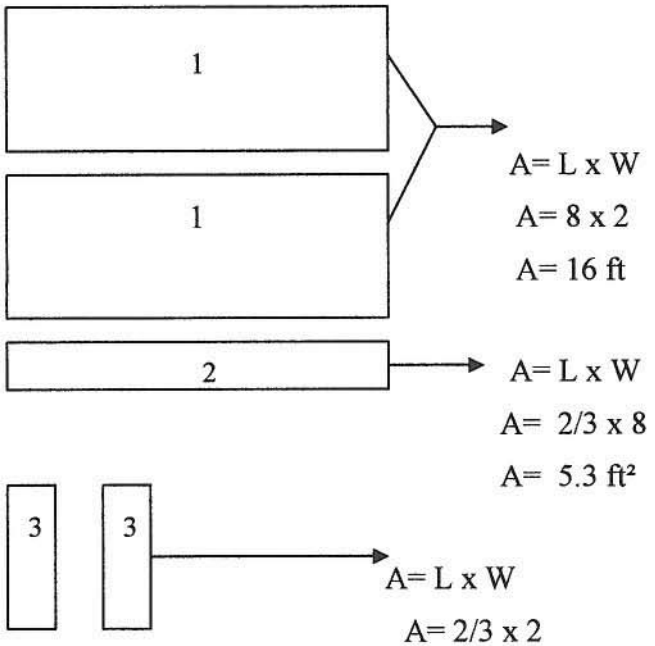
7.33 56.67

Actual Surface Area= 56. 67 ft²

Scale Model Surface Area= 1.79 in²

WALL E





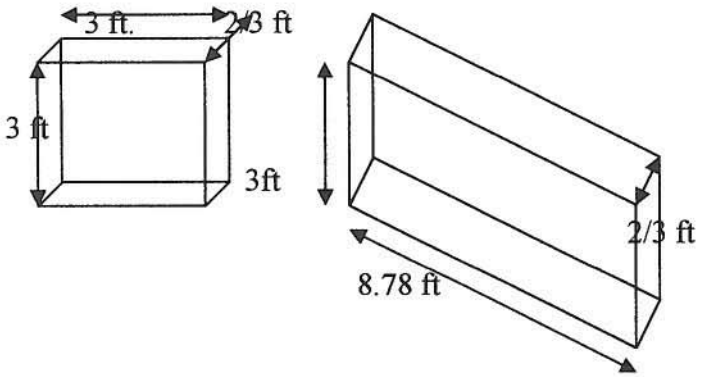
16
16
1.3
1.3
+ 5.3
39.9 ft²

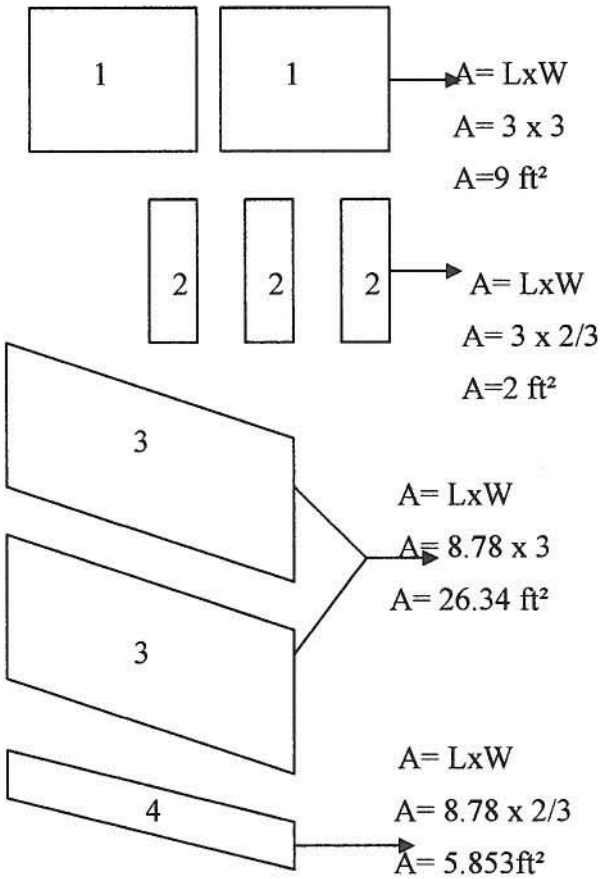
Actual Surface Area= 39.9 ft²

39.9/ 5.614²

Scale Model Surface Area= 1.27 in²

RAIL D





			52.68 ft
9	2	26.34	18 ft
x 2	x 3	x 2	6ft
18 ft²	6 ft²	52.68 ft²	+ 5.8355ft
			82.533 ft²

Actual Surface Area= 85.533 ft²

Surface Area for Scale Model= 2.71in²

82.533/ 5..614²= 2.71 in²

Curved Ramp F

1. Radius 2 in x 5.614= 11.228ft²

2. Area of Trapezoid

½ (b1 x b2) (h)

5 (11.228+3)(7.368375 ft)

5(14.288)(7.368375)

5(104.8423616)

Area of Trapezoid= 52.42 ft²

3. Area of Circle

A= л r²

A= л(11.288²)

A= л(126.067909)

A= 396.0540198

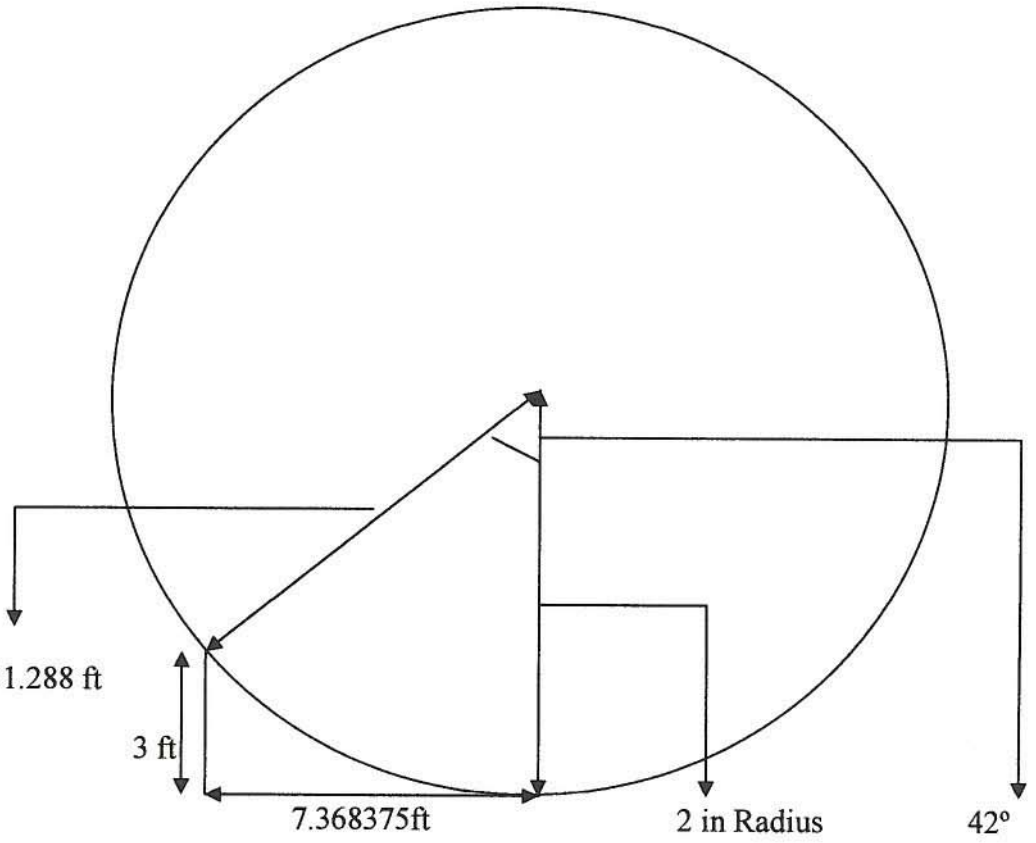
4. Area of a Sector

396.0540168

x 42

16,634.2687

5,634.2687÷ 360=46.20



Curved Section	6. Circumference	7. Arc Length	Total surface area= 78.59 ft²
2.42118079	c= л d	42° = x	Surface Area for Scale Model= 2.49 in²
6.2063096	c= л 22.576	360° 70.92	78.59 / 5.614²= 2.49 in²
6.214878834 ft²	c= 70.92ft	x= 8.27 ft	8. Ramp Area 8 x 8.78= 66.16 ft

The Outcome...

Total Surface Area for the Outside of the Actual Model = 539.83 ft²

$94.99ft^2 \times 2 = 189.89ft^2$

$89.16ft^2$

$56.67ft^2$

$39.9ft^2$

$78.59ft^2$

$+85.53ft^2$

$539.83ft^2$

Total Surface Area for the Scale Model of Fun-box= 17.109 in²

$3.01\ in^2 \times 2 = 6.02in^2$

$2.829\ in^2$

$1.79\ in^2$

$1.27\ in^2$

$2.49\ in^2$

$+2.71\ in^2$

$17.109\ in^2$

Model IV

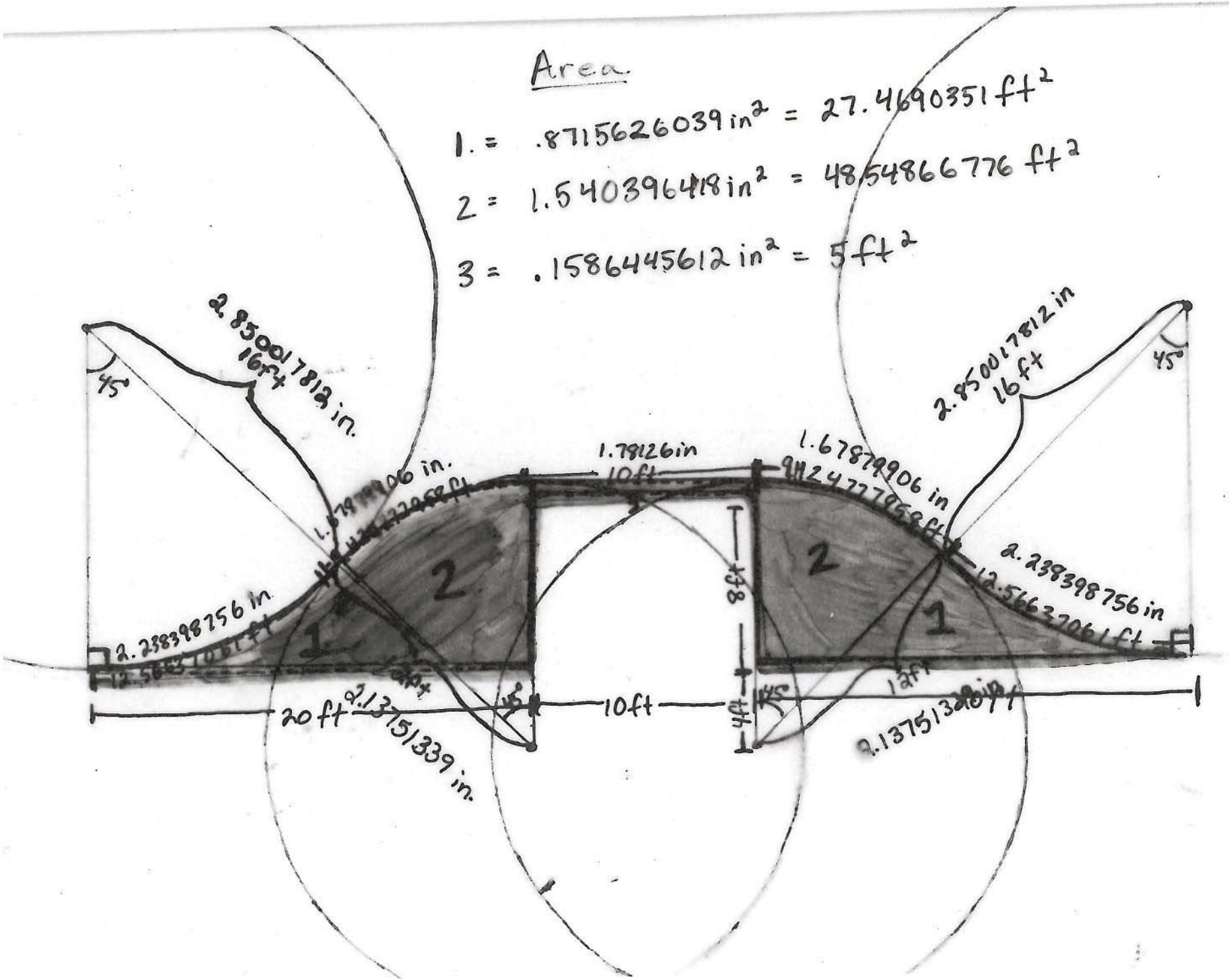
The Bridge

Area

1. = .8715626039 in^2 = 27.4690351 ft^2

2 = 1.540396418 in^2 = 48.54866776 ft^2

3 = .1586445612 in^2 = 5 ft^2



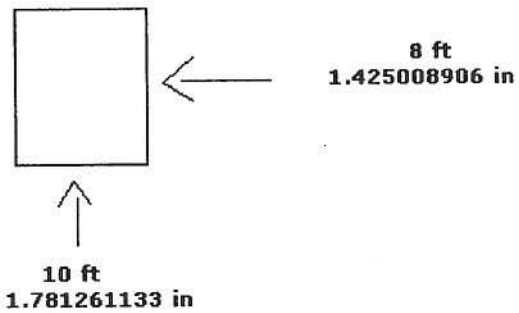
Surface Area for the Curved Bridge

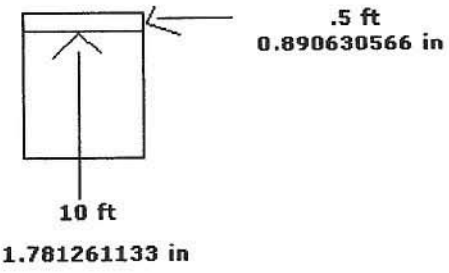
Step 1

Area of strip

.5ft x 10ft = 5ft² (actual)

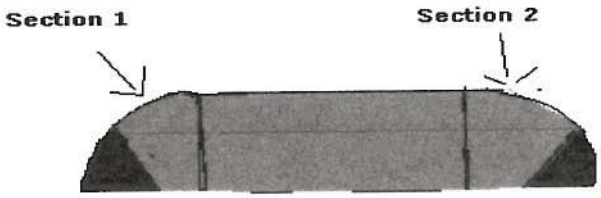
5ft²/5.614² = .1586445612in² (model)





Step 2

Area Of Section 1+2



I created a circle using the radius of 12ft which is equal to 2.137513359in. I found the area of the sector then subtracted the area of the small triangle to find the area of section 1 & 2.

Area Of Circle

$12ft^2 \times 3.14 = 452.3893421ft^2$ (actual)

$452.3893421ft^2/5.614^2 = 14.35382173in^2$ (model)

Area of Sector

$452.3893421/360 = x/45$ $452.3893421 \times 45/360 = 56.54866776ft^2$ (actual)

$56.54866776ft^2/5.614^2 = 1.794227716in^2$ (model)

Area of Triangle

$\text{Tan } 45^\circ = x/4$

$1 = x/4$ $\frac{1}{2}(4 \times 4) = 8ft^2$ (actual)

$8ft^2/5.614^2 = .2538312979in^2$ (model)

Area of Sections 1 + 2

$56.54866776ft^2 - 8ft^2 = 48.54866776ft^2$ (actual)

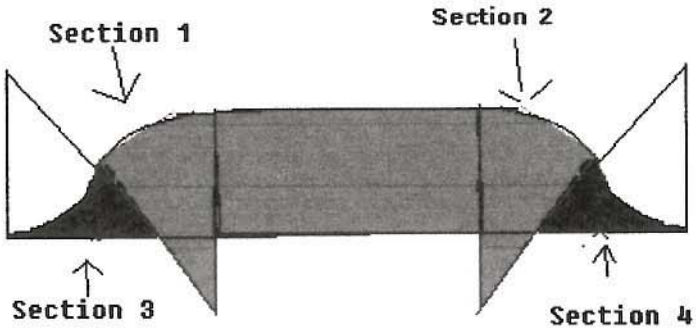
$1.794227716in^2-.2538312979in^2 = 1.540396418in^2$ (model)

$48.54866776ft^2 \times 2 = 97.09733552ft^2$ (actual)

$97.09733552ft^2/5.614^2 = 3.080792837in^2$ (model)

Step 3

Area of Sections 3 & 4



I found the area of the sector and the large triangle, the subtracted the sector from the triangle to find the area for section 3 and 4.

Area of Sector

$A=3.14r^2$

$A = 3.14(2.850017812^2)$

$A=25.51790529in^2$ (model)

$25.51790529in \times 5.614^2=804.247719ft^2$ (actual)

$25.51790529in^2/360° = x/45°$

$1148.305738/360 = 3.189738161\ in^2$ (model)

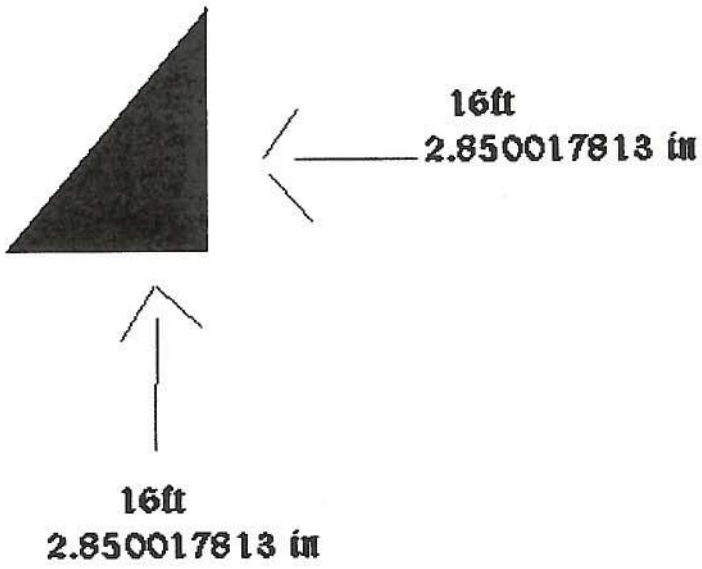
$3.189738161 \times 5.614^2 = 100.5309649\ ft^2$ (actual)

Area of triangle

Tan 45° = 16/x

1=16/x

X=16ft² (actual)



A=½b (h)

A=½ 16×16

A=128ft² (actual)

A=128/5.614²

A= 4.061300766in² (model)

Area Of Section 3 & 4

A= triangle – sector

A = 128ft² - 100.5309649ft²

A=27.4690351in² (actual)

$27.4690351 \times 2 = 54.9380702 ft^2$

$54.9380702/5.614^2 = 1.743125208 in^2$ (model)

Area of the side

A=strip + section 1&2 + section 3&4

$A=.1586445612 + 3.080792837 in^2 + 1.743125208 in^2$

$A = 4.9825602606 in^2$ (model)

$4.982562599 \times 5.614^2 = 157.0354055 ft^2$

Arc Lengths

C=d (3.14)

C=32ft×3.14

C=100.5309649ft

12.5663706/5.614 = 2.238398756in

Arc Length = x/100.5309649ft = 45/360

Arc Length = 4523.893421/360

Arc length = 12.56637061ft

C = d (3.14)

C = 24 (3.14)

C = 75.36ft

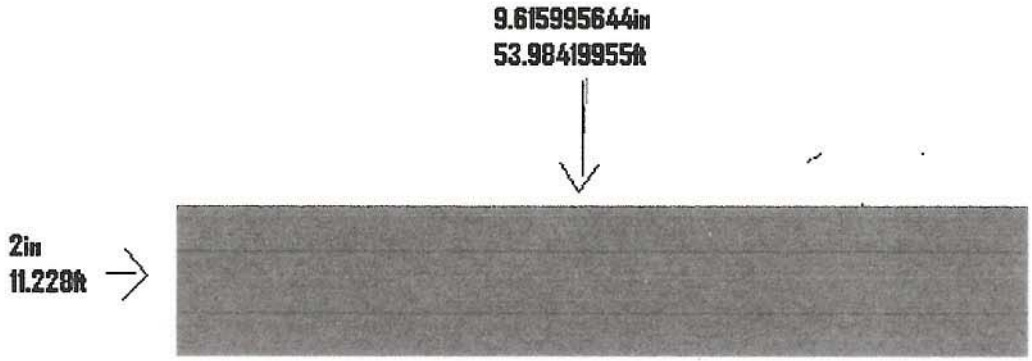
9.42/5.614 = 1.678799066in

Arc Length = x/75.36 = 45/360

Arc Length = 3391.2/360

Arc Length = 9.424777958ft

Area of Top ramp



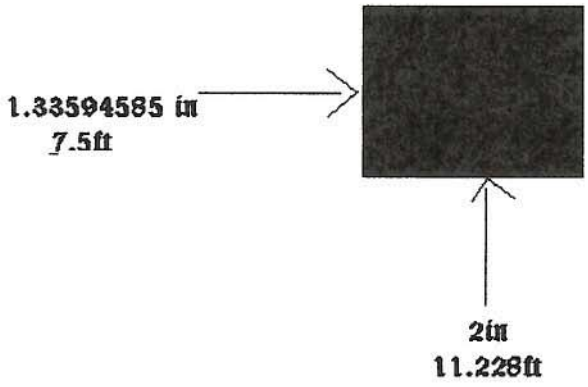
A= l ×w

A=9.615995644in×2in

A=19.23199129in²

19.23199129×5.614²= 606.1345925ft²

Area Of Inside Walls

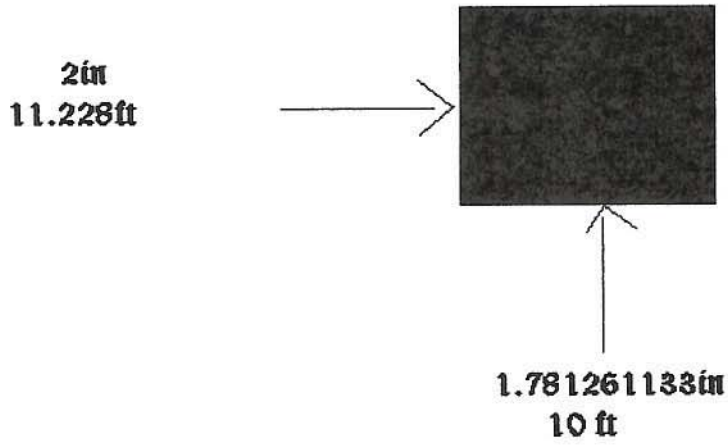


A=l × w

A= 2 × 1.33594585 = 2.671891699in² (model)

2.671891699 × 5.614^2 = 84.21ft² (actual)

Area of wall beneath strip (ceiling)



A=l ×w

A = 1.781261133×2

A= 3.562522266in² (model)

$3.562522266 \times 5.614^2 = 112.28ft^2$ (actual)

Total Surface Area

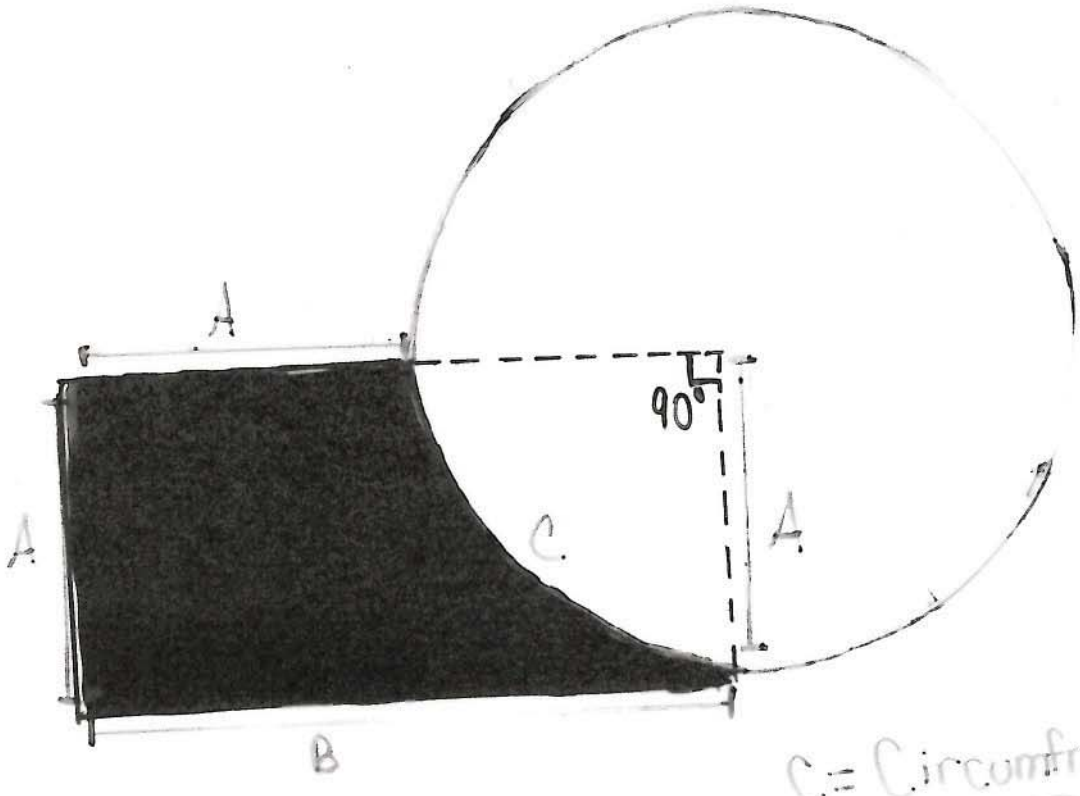
A = side1+side2+top+wall1+wall 2 + under strip wall

A= 4.982562599+4.982562599 + 19.23199129 + 2.671891699

+2.671891699+3.562522266

A=38.10342215in²

$38.10342215 \times 5.614^2 = 1200.905404ft^2$



C = Circumfrence

$C = \pi d$

$C = \pi 20$ → 62.8ft ÷ 5.61
$C = 62.8\text{ft}$ = 11.191in

Arc Length

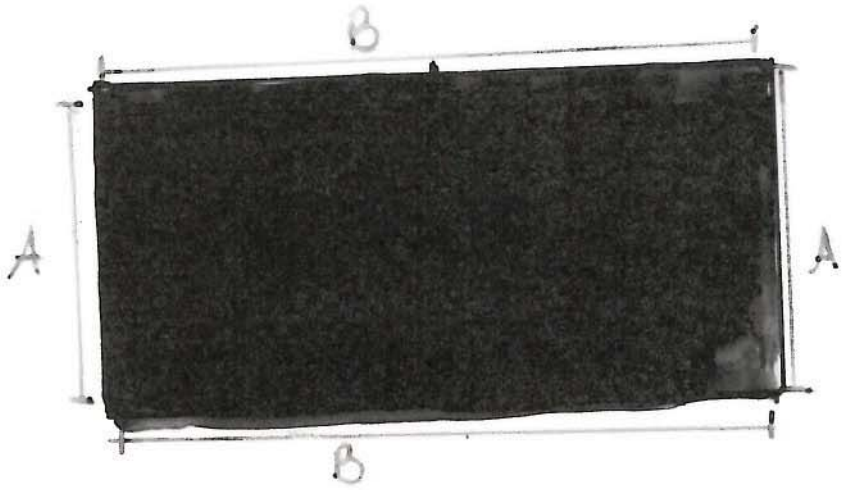
$\frac{x}{62.8\text{in}} = \frac{90°}{360°}$ → 15.7ft ÷ 5.
$x = 15.7\text{ft}$ = 2.796

A = 10ft

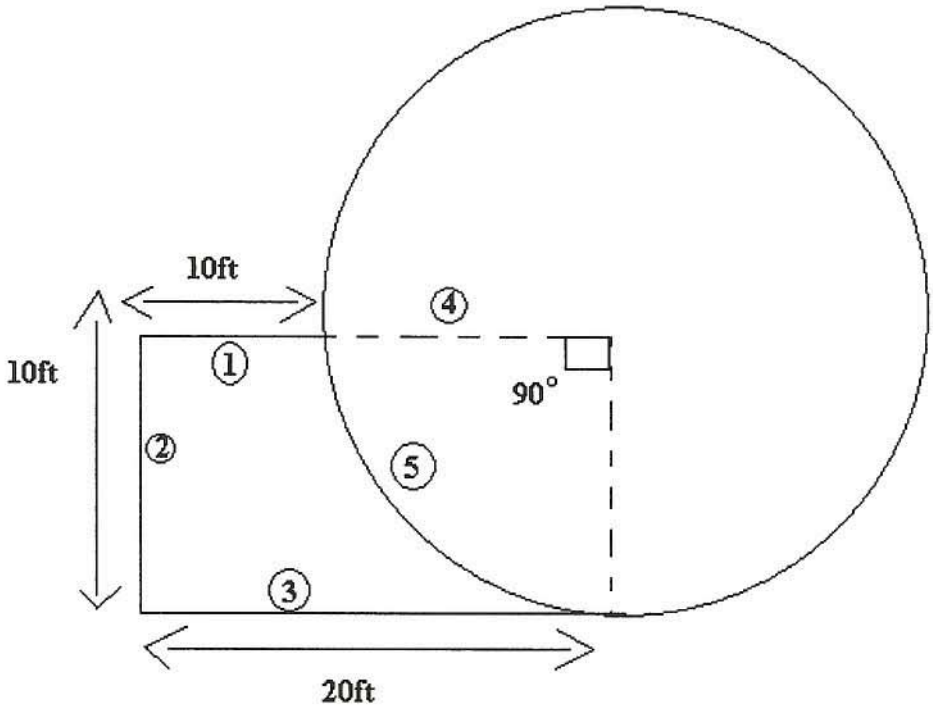
10ft ÷ 5.614in = 1.781 2.in

B = 20ft

20ft ÷ 5.614in = 3.5625in



Quarter Pipe Drop-In Ramp



1. 10ft ÷ 5.614in = 1.78in
2. 10ft ÷ 5.614in = 1.78in
3. 20ft ÷ 5.614in = 3.56in
4. radius-10ft ÷ 5.614in = 1.78in
5. Circumference

   C=πD

   C=π × 20FT

   C=62.8ft

   62.8ft ÷ 5.614in = 11.1919in

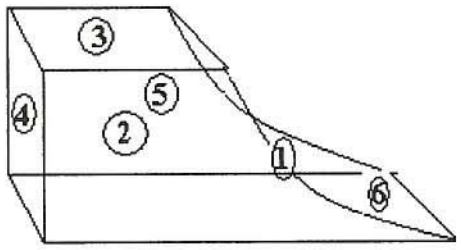
Arc Length

$\frac{x}{62.8in} = \frac{90}{360}$

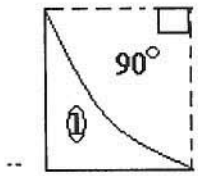
x=15.7ft (actual)

$15.7ft^2 \div 5.614in^2 = 11.1919in^2$ (model)

3D View of Ramp-



Surface Area of Ramp-



Area of square

$A=l \times w$

$10ft \quad 10ft=100ft^2$

$100ft^2 \div 5.614in^2=3.17in^2$

Area of circle

πr^2

$3.14 \times 10ft = 314ft^2$

$314ft^2 \div 5.614in^2=9.96in^2$

Area of sector

$$\frac{90^\circ}{360^\circ}=\frac{x}{314ft^2}$$

$x=78.5ft$

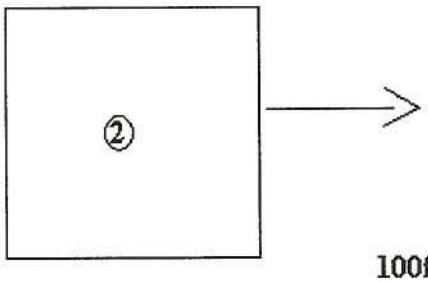
$78.5ft^2 \div 5.614in^2=2.49in^2$

$100ft^2$

$- \ 78.5ft^2$

$21.5ft^2$ (actual)

$21.5ft^2 \div 5.614in^2=.68in^2$ (model)

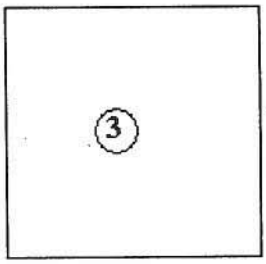


$A=l \times w$

$A=10ft \times 10ft$

$A=100ft^2$

$100ft^2 \div 5.614in^2=3.17in^2$

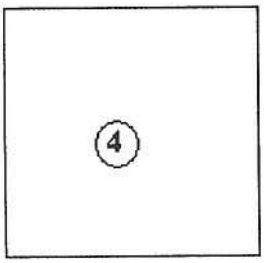


$A=l \times w$

$A=10ft \times 10ft$

$A=100ft^2$

$100ft^2 \div 5.614in^2 = 3.17in^2$

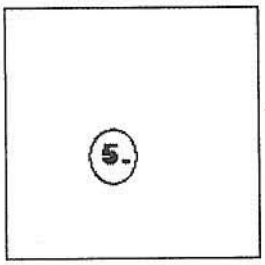


$A=l \times w$

$A=10ft \times 10ft$

$A=100ft^2$

$100ft^2 \div 5.614in^2 = 3.17in^2$

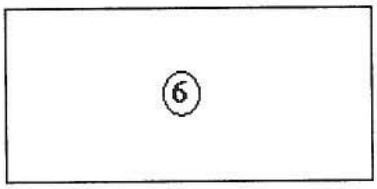


$A=l \times w$

$A=10ft \times 10ft$

$A=100ft^2$

$100ft^2 \div 5.614in^2 = 3.17in^2$



$A=l \times w$

$A=10ft \times 15.7ft$

$A=157ft^2$

$157ft\ ft^2 \div 5.614in^2 = 4.98\ in^2$

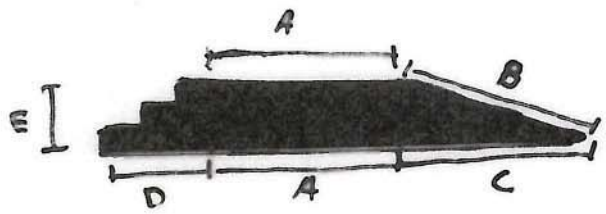
Total Surface Area-

$21.5ft^2+21.5ft^2+100ft^2+100ft^2+100ft^2+100ft^2+157ft^2=600ft^2$

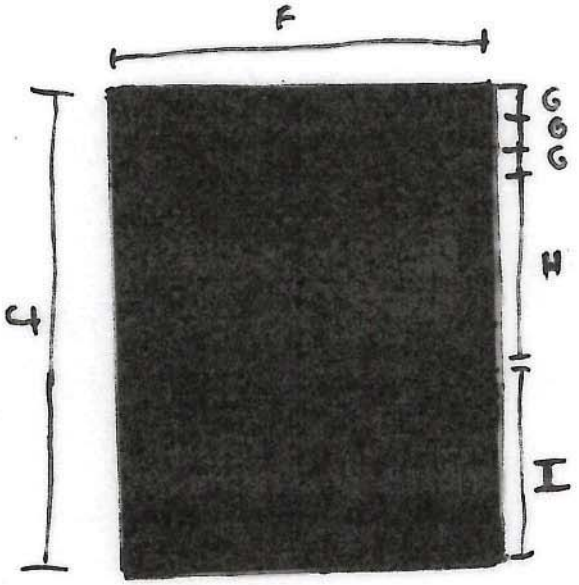
$580ft^2 \div 5.614in^2=19.04^2$

Model VI

The Stair Ramp

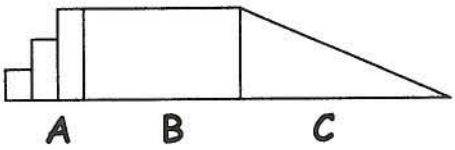


A=5.614 ft= 1 in
B=5.8476088 ft= 1.041611828 in
C=5.494954839 ft=.978794448 i
D=6.079729248 ft= 37.5 in
E=4.275026719 ft= 24 in
F= 11.228 ft= 2 in
G= 1.041666667 ft=.185548034
H=5.614 ft= 1 in
I = 5.8476088 ft= 1.041611828 in
J= 14.58660088 ft= 2.598255933
K= .667 ft=.118750742 2 in



A= 4.166666667 ft²= .132203801
B= 11.228 ft²= .356252266
C= 5.494954839 ft²= .174389
D= 35.08750002 ft²=1.113288
E= 63.033992 ft²= 2 in²
F=65.96102726 ft²=2.093223
G=7.485333334 ft²= .237501484

Stair Ramp
Side View Lengths



A. c-1.041611828in
c-5.8476088ft
x-.9787949482in
x-5.494954839ft

Height Of Ramp
2ft-Actual
.3562522266in-Model

Find X
Tan=Opposite / Adjacent
Tan 20=2/X
(x).3639702343=2(x)/X
.3639702343x=2
.3639702343 =.3639702343
X=5.494954839
5.494954839ft=.9787949482in
5.614ft
5.494954839ft-Actual
.9787949482in-Model

1in-5.614ft

B. .3562522266in-2ft
1in X .3562522266in-Model
5.614ft X 2ft-Actual

Find C
$a^2+b^2=c^2$

$2ft^2+5.494954839ft^2=34.19452868ft^2$
$\sqrt{34.19452868}=5.8476088ft$
5.8476088ft=1.041611828in
5.614

1.041611828in=Hypotenuse-Model
5.8476088ft=Hypotenuse-Actual

12.5in-11.8750422in

C.  8in-.185548037in

School Steps-Rise=7in

Run=11in

7 = 8

11 X

11x8=88 =12.57142857in=12.5in

7

Our Steps Rise=8in=.185548037in

Run=12.5in=.1187507422in

8x3=24in

24in=Total Rise of our steps

12.5x3=37.5in

37.5in=Total Run of our steps

12.5/12=1.04166ft-Actual

1.04166ft=.1855480347in

5.614ft

.1855480347in-Model

8=2/3ft-Actual

12

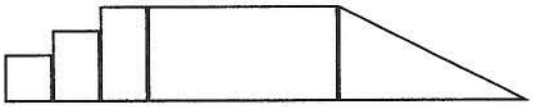
2/3ft=.1187507422in

5.614ft

.1187507422in-Model

Surface Area

Side View



A - Area = 1/2bh
.5 x .9787949482 x .3562522266 = .1743489398 in^2 (model)
.5 x 5.494954839 x 2 = 5.494954839 ft^2 (actual)

B- 1 x .3562522266 = .3562522266 in^2 (model)
5.614 x 2 = 11.228 ft^2 (actual)

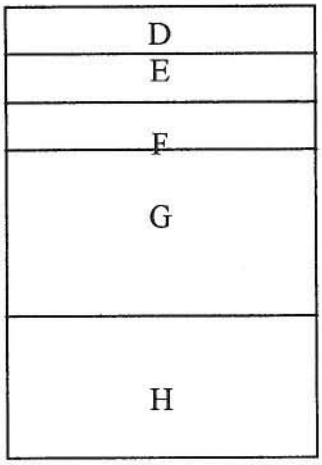
C - .3562522266 x .1855480347 = .0661019005
.2375014844 x .1855480347 = .0440679337
.1187507422 x .1855480347 = .0220339668
.132203801 in^2 (model)
.132203801 x 5.614^2 = 4.1666667 ft^2 (actual)

Total Surface Area

.1743489398 in^2	5.494954839 ft^2
.3562522266 in^2	11.228 ft^2
+ .132203801 in^2	+ .4.1666667 ft^2
.6628049674in^2	20.88962154 ft^2
x 2	x 2
1.325609935 in^2	41.77924308 ft^2
2.083223655 in^2	65.65695161 ft^2
2 in^2	63.033992 ft^2
1.113288208 in^2	35.08750002 ft^2
+ .2375014844	+ 7.485333334 ft^2
6.759623282 in^2	213.04302 ft^2

Surface Area

Top View



D- .1855480347 x 2 = .3710960694 in^2
1.041666667 x 11.228 = 11.69583334 ft^2

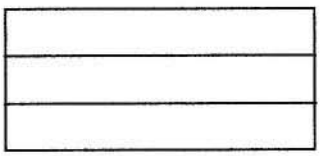
E- .1855480347 x 2 = .3710960694 in^2
1.041666667 x 11.228 = 11.69583334 ft^2

F- .1855480347 x 2 = .3710960694 in^2
.041666667 x 11.228 = 11.69583334 ft^2

G- 2 x 1 = 2in^2
11.228 x 5.614 = 63. 033992 ft^2

H- 1.041611828 x 2 = 2.083223655 in^2
5.8476088 x 11.228 = 65.65695161 ft^2

Front Stair View



Each step– 2 x .1187507422 in = .2375014844 in^2
11.228 x .667 = 7.485333334 ft^2

Model VII

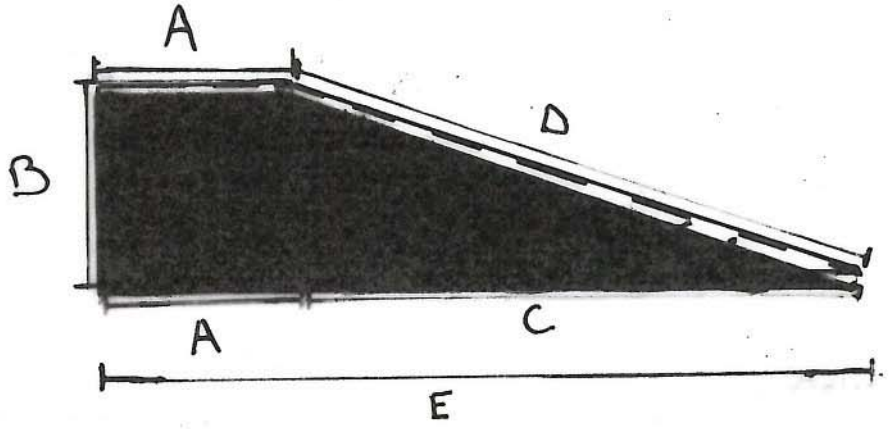
The Drop-In

Areas

1. $1.068756668 in^2 = 33.684 ft^2$
2. $4.587859776 in^2 = 144.5955583 ft^2$

Lengths

A: $1 in = 5.614 ft$
B: $1.068756668 in = 6 ft$
C: $2.936848441 in = 16.48486452 ft$
D: $3.124835483 in = 17.5428264 ft$
E: $3.936848441 in = 22.09886452 ft$

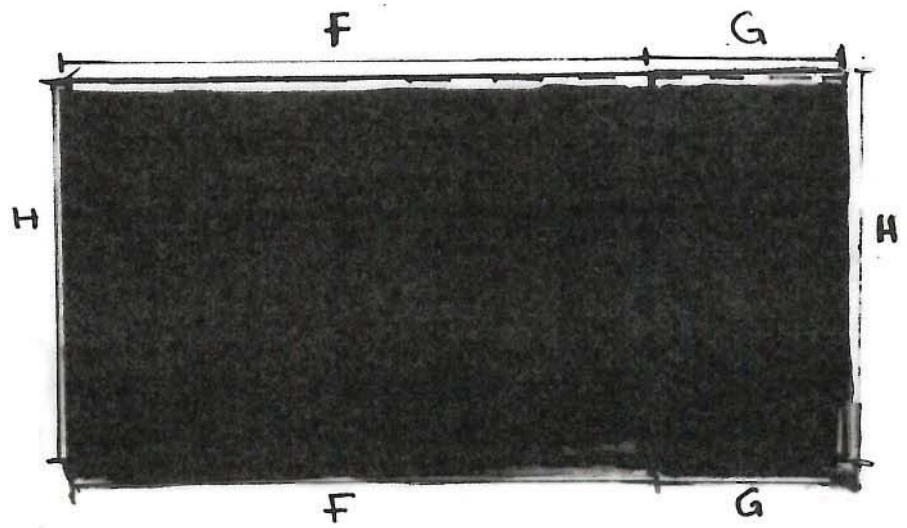


Areas

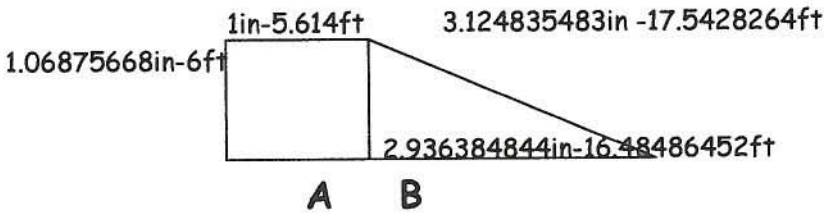
3. $0.2567096 6 in^2 = 196.9708548 ft^2$
4. $2 in^2 = 63.033992 ft^2$

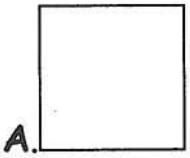
Lengths

F: $3.124835483 in = 17.5428264 ft$
G: $1 in = 5.614 ft$
H: $2 in = 11.228 ft$



Drop In Ramp
Side View Lengths





Length

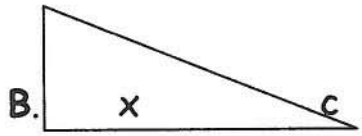
1in-Model

5.614ft-Actual

Height

1.06875668in-Model

6ft-Actual



Find x

Tan=Opposite / Adjacent

$\tan 20° = \frac{6}{x}$

$(x).3639702343 = \frac{6}{x}(x)$

$.3639702343x = 6$

$\frac{3639702343}{3639702343} = \frac{.3639702343}{X}$

X=16.48486452ft

16.48486452ft=2.936384844in

2.936384844in-Model

16.48486452ft-Actual

Find C

$a^2+b^2=c^2$

$16.48486452^2+6^2=307.7507582^2$

$\sqrt{c} = \sqrt{307.7507582}$

C = 17.5428264ft

17.542826ft=3.124835483in

5.614ft

3.1248354in-Model

17.5428264ft-Actual

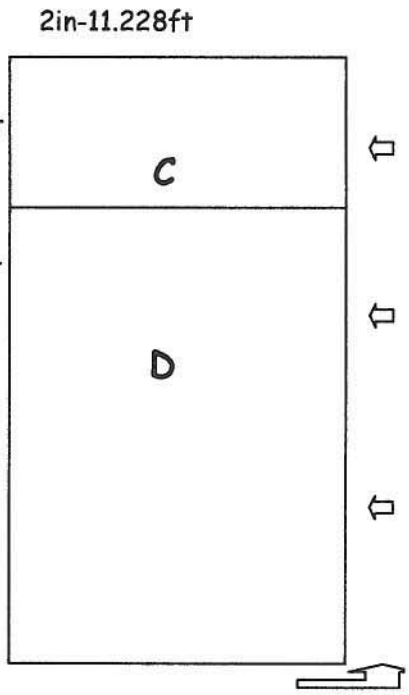
Surface Area

Side View

A. 1 X 1.06875668=1.06875668 in^2

5.614X 6=33.684ft^2

Check:1.06875668 X 5.614^2=33.684



B. 1/2bh

.5 X 2.936384844 X 1.06875668=1.569140459in^2

.5 X 16.48486452 X 6=49.45459357ft^2

Check: 1.569140459in^2X 5.614^2=49.45459357ft^2

Top View

C. 1 X 2=2in^2

5.614 X 11.228=63.033992ft^2

Check:2 X 5.614^2=63.033992ft^2

D. 2 X 3.124835483=6.249670966in^2

11.228 X 17.5428264=196.9708548ft^2

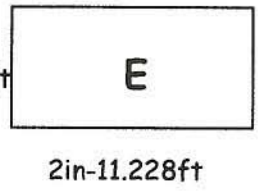
Check:6.25670966 X 5.614^2=196.9708548ft^2

Back

E. 2 X 1.06875668=2.13751336in^2

11.228 X 6=67.368ft^2

Check:2.13751336 X 5.614^2=67.368ft^2



Total Surface Area

$1.06875668in^2$
$+1.569140459in^2$
$2.656616456in^2$
$\times 2$
$5.275794278in^2$
$+2$
$7.275794278in^2$
$+6.249670966in^2$
$13.52546524in^2$
$+2.13751336in^2$
$15.6629786in^2$

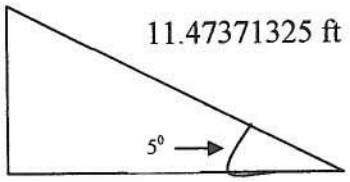
$33.684ft^2$
$+49.45459356ft^2$
$83.1385935ft^2$
$\times 2$
$166.2771871ft^2$
$+63.033992ft^2$
$229.3111791ft^2$
$+196.9708548ft^2$
$426.2820339ft^2$
$+67.368$
$493.6500339ft^2$

Check: $15.6629786in^2 \times 5.614^2 = 493.6500339ft^2$

Model VIII

The Starter Ramp

Beginner's Section



$$\sin(5) = \frac{1}{X}$$

$$\frac{.0871557427x}{.0871557427} = \frac{1}{.0871557427}$$

$$X = 11.47371325 \text{ ft}$$

$$\frac{11.47371325}{5.614} = 2.043767945 \text{ in.}$$

$$a^2+b^2=c^2$$

$$1^2+b^2=11.47371325^2$$

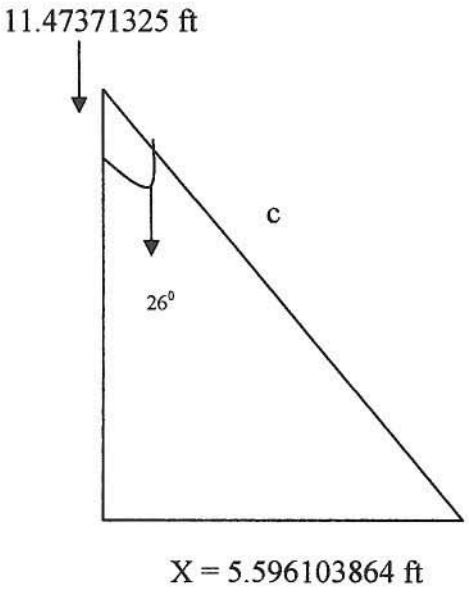
$$1+b^2= 131.6460957$$

$$-1 \qquad -1$$

$$b^2= 130.6460957$$

$$\sqrt{b}= \sqrt{130.6460957} = 11.43005231 \text{ ft}$$

$$\frac{11.43005231}{5.614} = 2.035990792 \text{ in.}$$



Find X

$$\text{Tan} = \frac{\text{opposite}}{\text{adjacent}}$$

$$\text{Tan } 26 = \frac{x}{11.47371325}$$

$$(11.47371325)\ 0.4877325886 = x \qquad \frac{(11.47371325)}{11.47371325}$$

$5.596103864 \text{ ft} = x$

$5.596103864 / 5.614\text{ft}^2 = 0.9968122308\text{in}^2$

Find C

$a^2+b^2=c^2$

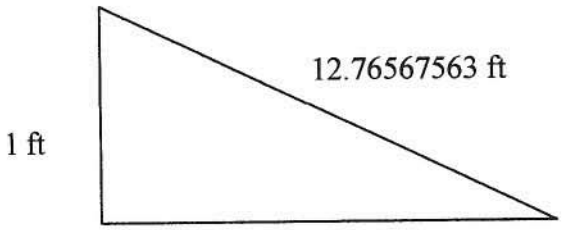
$11.47371325^2+5.596103864^2= c^2$

$162.9624742 = c^2$

$\sqrt{c} = \sqrt{162.9624742}$

$C= 12.76567563$ ft

$$\frac{12.76567563}{5.614} = 2.273900183 \text{ in.}$$



$a^2+b^2=c^2$

$1^2+b^2= 12.76567563^2$

$1+b^2= 162.9624743$

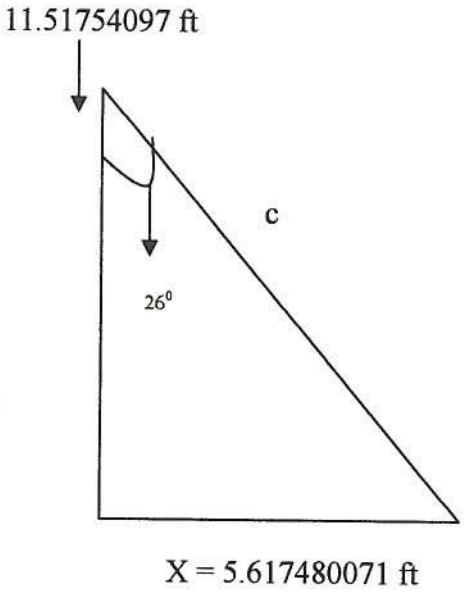
$-1 \qquad -1$

$b^2= 161.962474$

$\sqrt{b^2}= \sqrt{161.962474}$

$b= 12.72644783$ ft

$\frac{12.89108519}{5.614} = 2.296238901$ in.



Find X

$$\text{Tan} = \frac{\text{opposite}}{\text{adjacent}}$$

$$\text{Tan } 26 = \frac{x}{11.51754097}$$

$$(11.51754097)\ 0.4877325886 = \frac{x}{11.51754097}\ (11.51754097)$$

$5.617480072 \text{ ft} = x$

$5.617480072 / 5.614 = 1.000619892 \text{in}^2$

Find C

$a^2+b^2=c^2$

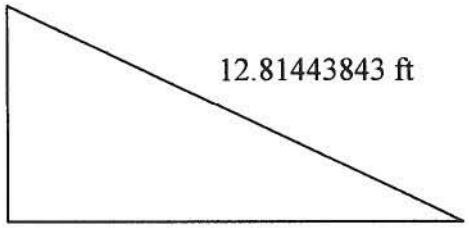
$11.51754097^2+5.617480072^2= c^2$

$164.2098324= c^2$

$\sqrt{c} = \sqrt{164.2098324}$

$C= 12.81443843 \text{ ft}$

$$\frac{12.81443843}{5.614} = 2.282586112 \text{in.}$$



$a^2+b^2=c^2$

$2^2+b^2= 12.81443843^2$

$4+b^2= 164.2098328$

$-4 \qquad -4$

$b^2= 160.2098328$

$\sqrt{b^2}= \sqrt{160.2098328}$

$b= 12.65740227$ ft

$\frac{12.65740227}{5.614}= 2.25461387$ in.

Surface Area for Beginner's Ramp

Surface area forTriangle that separates the different sloped ramps.

2 ft × 11.34256364 ft x 1/2 = 11.34256364 ft^2
11.34256364/5.614^2 = 0.35993 in^2

1 ft x 11.43005231 ft x 1/2 = 5.715026155 ft^2
5.715026155/5.614ft^2 = .1813315633in^2

(Find the Difference to Find Inside Section)
11.34256364 ft – 5.715026155 ft = **5.627537485 ft^2**
5.627537485/5.614^2 = **0.178555643 in^2**

Surface area for sloped triangle of the 2ft ramp
11.47371325 ft × 5.596103864 ft x 1/2 = **32.10404553 ft^2**
32.1040/5.614^2= **1.018626443 in^2**

Surface area for sloped triangle of the 1 ft ramp
11.51754097 ft x5.617489971 ft x1/2=**32.34977843ft^2**
32.34977843/5.614^2 = **1.026423281in^2**

Surface area for side triangle of the 2 ft ramp
2 ft x 12.65740227 ft x 1/2 = **12.65740227ft^2**
12.657/5.614^2 = **0.4016056057in^2**

Surface area for side triangle of the 1 ft ramp
1 ft × 12.72644783 ft x 1/2 = **6.363223915 ft^2**
6.363223915/5.614^2 = **0.2018981731 in^2**

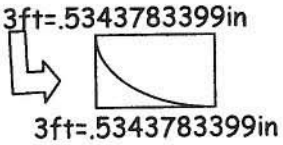
Entire surface area in feet
5.627537485 ft^2 + 32.10404553 ft^2 + 32.34977843 ft^2 +
12.65740227ft^2 + 6.363223915 ft^2 = **89.10198763 ft^2**

Entire surface area in inches
0.178555643 in^2 + 1.018626443 in^2 + 1.026423281in^2 +
0.4016056057in^2 + 0.2018981731 in^2 = **2.827109146 in^2**

Model IX

Perimeter 1/4 Pipe

u r e Pp R m



Area

πr^2

$\pi 3^2$

28.27433388-Area of Full Circle

90° =x

360°=28.27433388

$\frac{90 \times 28.27433388}{360°} = 7.0685583471 ft^2$

3 X 3=9ft²

9 ft²

-7.068583471 ft²

1.931416529ft²=Area of Side of Ramp -Actual

1.9314165529=

5.614ft²

Area of Curved Section

14in+14in=

28 X 5.614=157.192ft-Length of Actual Ramp

157.192ft X 4.71238898ft=740.7498485ft²-Actual

740.7498485ft²=

5.614ft²

Area of Back of Ramp

157.192ft X 3ft=471.576ft²-Actual

471.576ft²=

5.614ft²

Total Surface Area

$7.068583471 \times 4 = 28.27433388 ft^2$

$28.27433388 ft^2$

$+740.7498485 ft^2$

$+471.576 ft^2$

$1240.600182 ft^2$ - Actual

1240.600182=

5.614ft²

Perimeter

πd

$\pi 6$

18.84955592ft-Perimeter of Total Circle

$\frac{90°}{360°} = \frac{x}{18.84955592ft}$ $\quad \frac{90 \times 18.84955592}{360°} = 4.71238898$

4.71238898ft=Arc Length-Actual

4.71238898ft=

5.614ft

Total Perimeter

3ft+3ft+4.71238898ft=10.77238898ft-Actual

10.77238898ft=

5.614ft

Model X

Seating Area

Sitting Area

Top Part

Section 1

$A = l \times w$
$A = 2ft \times 20ft$
$A = .356in \times 3.562in$
$A = 40ft^2$
$40/5.614^2 = 1.269156489in^2$

Section 2

$A = l \times w$
$A = 16ft \times 2ft$
$A = 2.850in \times .356in.$
$A = 32ft^2$
$32/5.614^2 = 1.015325192in^2$

Section 3

$A = l \times w$
$A = 2ft \times 20ft$
$A = .356in \times 3.562in$
$A = 40ft^2$
$40/5.6414^2 = 7.125044532in^2$

Total Area of Top Part

$A = section1 + section2 + section3$
$A = 40\ ft^2 + 32\ ft^2 + 40\ ft^2$
$A = 1.269in^2 + 1.015in^2$
$A = 112ft^2$
$112/5.614^2 = 3.55363817in^2$

Inner Walls

Wall 1

$A = l \times w$
$A = 18ft \times 2ft$
$A = 3.206in \times .356in$
$A = 36ft^2$
$36/5.614^2 = 1.14224084in^2$

Wall 2

$A = l \times w$
$A = 16ft \times 2ft$
$A = 2.850in \times .356in.$
$A = 32ft^2$
$32/5.614^2 = 1.015325192in^2$

Wall 3

$A = l \times w$
$A = 18ft \times 2ft$
$A = 3.206in \times .356in$
$A = 36ft^2$
$36/5.614^2 = 1.14224084in^2$

Total

$A = wall\ 1 + wall\ 2 + wall\ 3$
$A = 36+32+36$
$A = 1.142in^2 + 1.015in^2 + 1.142in^2$
$A = 104ft^2$
$104/5.614^2 = 3.299806872in^2$

Outer Walls

Wall 1

$A = l \times w$
$A = 20ft \times 2ft$
$A = 3.563in \times .356in$
$A = 40ft^2$
$40/5.6414^2 = 1.269156489in^2$

Wall 2

$A = l \times w$
$A = 20ft \times 2ft$
$A = 3.563in \times .356in$
$A = 40ft^2$
$A = 40/5.6414^2 = 1.269156489in^2$

Wall 3

$A = l \times w$
$A = 20ft \times 2ft$
$A = 3.563in \times .356in$
$A = 40ft^2$
$40/5.614^2 = 1.269156489in^2$

Wall 4

$A = l \times w$
$A = 2ft \times 2ft$
$A = .356in \times .356in$
$A = 4ft^2$
$4/5.614^2 = .1269156489in^2$

Wall 5

$A = l \times w$
$A = 2ft \times 2ft$
$A = .356in \times .356in$
$A = 4ft^2$
$4/5.614^2 = .1269156489in^2$

Total

$A = \text{wall } 1 + \text{wall } 2 + \text{wall } 3 + \text{wall } 4 + \text{wall } 5$
$A = 40ft^2 + 40ft^2 + 40ft^2 + 4ft^2 + 4ft^2$
$A = 1.269in^2 + 1.269in2 + 1.269in^2 + .127in^2$
$A = 128ft^2$
$128/5.614^2 = 4.061300766in^2$

Total Surface Area

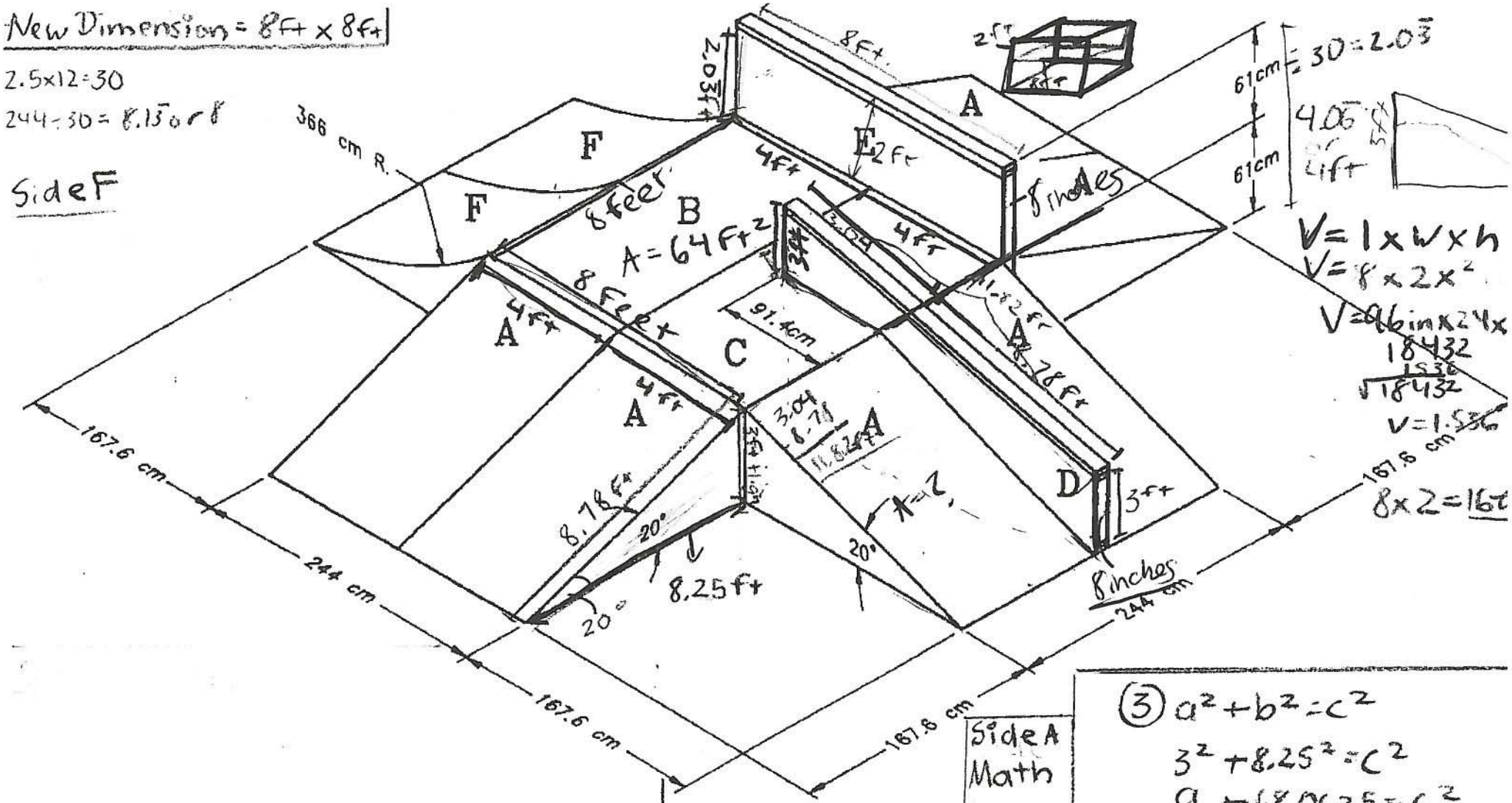
$A = \text{top area} + \text{outer walls} + \text{inner walls}$
$A = 112 + 104 + 128$
$A = 3.55363817in^2 + 3.299806872in^2 + 4.061300766in^2$
$A = 344ft^2$
$344/5.614^2 = 10.91474581in^2$

New Dimension = 8Ft x 8Ft

2.5×12=30

244÷30 = 8.13 or 8

Side F



Side A Math

① $\tan 20° = \frac{3}{x}$

$(x)\ .3639702343 = \frac{3}{x}(x)$

$.3639702343x = 3$

$\frac{.3639702343}{.3639702343}$

$X = 8.2424$ $x = 8.25$

② $\tan x = \frac{3}{8.25}$

$\tan^{-1} = \frac{3}{8.25}$

$\tan^{-1} = 19.98310652$

Angle Measure = 20°

③ $a^2 + b^2 = c^2$

$3^2 + 8.25^2 = c^2$

$9 + 68.0625 = c^2$

$77.0625 = c^2$

$\sqrt{77.0625} = c$

FUN BOX $c = 8.778524943$

$c = 8.78$

SHEET 1 OF 7 SIZE A

SCALE: 1/4"=1'

DO NOT SCALE DRAWING!

8.78Ft