STATE OF FLORIDA
DEPARTMENT OF COMMUNITY AFFAIRS

EMERGENCY MANAGEMENT • HOUSING AND COMMUNITY DEVELOPMENT • RESOURCE PLANNING AND MANAGEMENT

LAWTON CHILES
Governor

JAMES F. MURLEY
Secretary

May 23, 1997

Mr. Jose Fernandez
Cellucrete Corp.
11905 NW 99th Avenue
Hialeah Gardens, FL 33016

Dear Mr. Fernandez:

This letter is in response to your request for a clarification on how the thermal properties of building properties are determined in Florida's Energy Efficiency Code For Building Construction (the Code).

Commercial applications primarily use U-values, which are determined according to the criteria of section 1.1 of Appendix B of the Code. Section 1.1 specifies either use of the ASHRAE Handbook of Fundamentals, data from manufacturer's information or laboratory or field test measurements. Laboratory or field test measurements are obtained by use of specific ASTM standards that utilize a guarded hot plate or hot box, a heat flow meter, or a calibrated hot box.

Residential applications typically consider only the R-value of added insulation products in accordance with the criteria of section 1.2 of Appendix C of the Code. The thermal properties of typical building materials are included in the multipliers provided on Form 600A-93. Any new or emerging technologies for which multipliers are not provided would have to have a methodology established for it by the Department of Community Affairs.

Should you or others have further questions on this issue or others, I can be reached at 904/487-1824.

Sincerely,

Ann L. Stanton
Energy Analyst

2555 SHUMARD OAK BOULEVARD • TALLAHASSEE, FLORIDA 32399-2100

FLORIDA KEYS AREA OF CRITICAL STATE CONCERN
FIELD OFFICE
2796 Overseas Highway, Suite 212
Marathon, Florida 33050-2227

SOUTH FLORIDA RECOVERY OFFICE
P.O. Box 4022
8600 N.W. 36th Street
Miami, Florida 33159-4022

GREEN SWAMP AREA OF CRITICAL STATE CONCERN
FIELD OFFICE
155 East Summerlin
Bartow, Florida 33830-4641

1998 REVISIONS

TO THE 1997 Edition of the

FLORIDA ENERGY EFFICIENCY CODE FOR BUILDING CONSTRUCTION

State of Florida
Department of Community Affairs
Building Codes and Standards
2555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100
(850) 487-1824

James F. Murley, Secretary

124-1991, the EF used shall be the effective water heating efficiency (CA_{ef}) listed for the appliance by the Gas Appliance Manufacturer's Association (GAMA).

From APPENDIX B, Supplemental Information for Chapter 4, the following sections are revised to read:

1.1 General. Information on thermal properties, performance of building envelope sections, and components and heat transfer shall be obtained from the 1997 ASHRAE Handbook of Fundamentals. When the information is not available from this source, the data may be obtained from manufacturer's information based on laboratory or field test measurements.

If laboratory or field test measurements are used for envelope heat transmission, they shall be obtained using one of the following test methods:

1. Guarded Hot Plate: ASTM C-177-97
2. Heat Flow Meter: ASTM C-518-91
3. Guarded Hot Box: ASTM C-236-89
4. Calibrated Hot Box: ASTM C-976-90

From Appendix C, Supplemental Information for Chapter 6, the following sections are revised to read:

2.1 **Glass Multipliers.** Three basic underlying assumptions were used in development of the Fla/Res window load correlation coefficients:

1. Frame area equals 25% of the total window area.
2. Frame U-value equals glass U-value equals overall U-value
3. Interior shading factor equals 0.70 in summer and 0.9 in winter.

The general equation for determining the window point multipliers is as follows:

$$PM = A_1 \cdot SC_o + A_2 \cdot U_o + A_3 \cdot (SC_o \cdot U_o) + A_4 \cdot SC_o^2 + A_5 \cdot U_o^2 \qquad \textbf{Equation 6-1a}$$

Where:

PM= "Point multipliers" (load coefficient in kBtu/ft^2 of window)

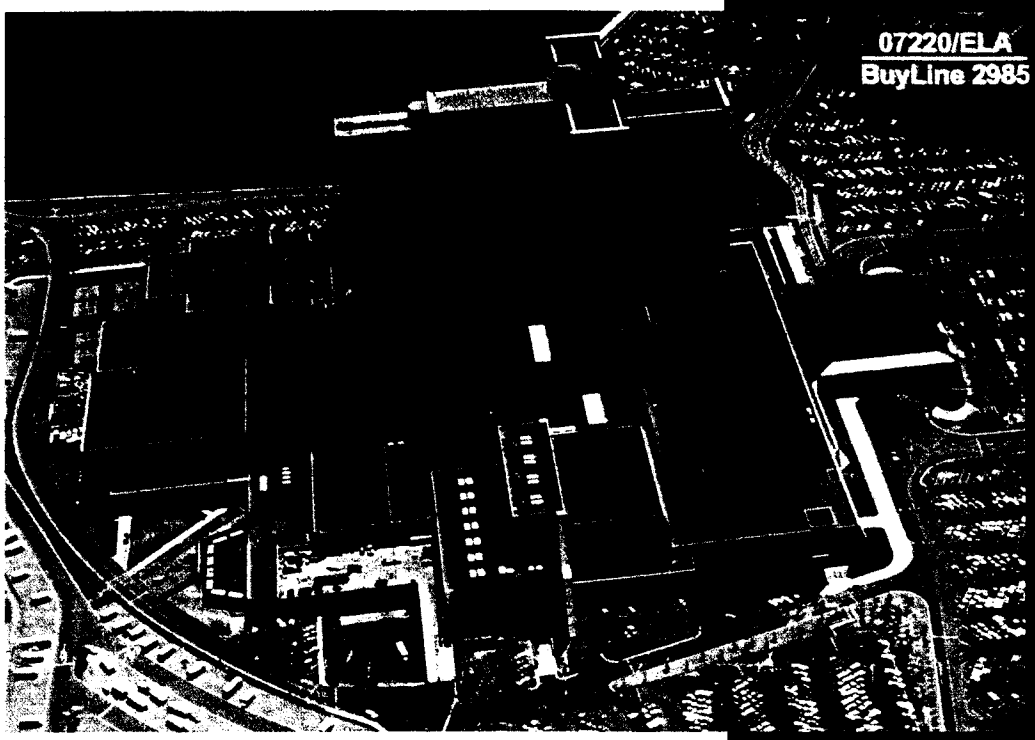
SC_o= Overall shading coefficient of entire installed system including glass, frame and sash and interior treatments

U_o = Overall U-value of entire installed window system, including glass, frame and sash

A_i = Regression coefficients

Coefficients A_1 through A_5 vary by season of the year (2), by climate zone (3), and by glass orientation (8 + horizontal = 9), such that there are 54 sets of A-coefficients needed to fully describe the window "point multipliers" (load correlation coefficients in Florida's Energy Code).

07220/ELA
BuyLine 2985



QUALITY ROOF DECKS FOR NEW CONSTRUCTION AND REROOFING APPLICATIONS

- Slope-to-Drain
- Lightweight
- High R-Value
- Superior to Insulation Board
- Low Cost

ELASTIZELL

COMPOSITE INSULATING ROOF DECK SYSTEMS

PHYSICAL PROPERTIES

	Air Dry Density (pcf)	Oven Dry Density (pcf)	Cast Density (pcf)	28-Day Minimum Compressive Strength (psi)	R-value (per inch)
RANGE IA	21-27	16-20	26-34	40	1.80
RANGE IB		20-24		80	1.58
RANGE IIA	27-32	24-28	34-42	160	1.34
RANGE IIB		28-32		200	1.20
RANGE IIIA	32-40	32-38	42-50	250	1.00
RANGE IIIB		38-44		300	0.86

NOTE: Thermal conductivity is based on the minimum dry density measured at a mean temperature of 75 degrees F.

R-VALUES FOR VARIOUS MATERIALS

Consult specific manufacturer's literature

1/2" plywood	0.62	1" fiberboard	2.78
3/4" plywood	0.93	3/4" plaster	0.15
1/2" gypsum board	0.45	1" poured perlited gypsum	0.87
5/8" gypsum board	0.56	1" perlite board	2.78
1/2" acoustical tile	1.25		
3/4" acoustical tile	1.89	air space (heat flow up-winter)	0.94
		air space-winter-reflective surface	1.90
2" polystyrene board	8.33	air space (heat flow down-summer)	1.23
1-1/2" polystyrene board	6.25	air space-summer-reflective surface	3.74
1" polystyrene board	4.17	1" Foamglass insulation	2.63
1" urethane - sprayed on, 3 pcf	7.14	15/16" Fiberglas® Roof insulation	3.70
		1-5/16" Fiberglas® Roof insulation	5.26

Sources: ASHRAE Handbook of Fundamentals and manufacturer's values.

SEISMIC DATA

Elastizell and steel decking meet Seismic Zone 4 requirements.

These seismic shear values are based on:

1. Steel deck need not be web slotted.
2. Deck welding pattern of 3-3 in each corrugation.
3. When required, Keydeck Mesh Style 2160-2-1619.
4. Minimum 2" thick, 200 psi Elastizell.
5. EPS with six-3" diameter holes per 2' by 4' board.

Diaphragm Shear Values (lbs./lin. ft.)

For 2" ELASTIZELL Insulating Concrete Over High Tensile Corrugated Steel Deck And From 1" to 4" of EPS Insulation Board

Base Metal Thickness and (Deck Gauge)	Allowable Diaphragm Shear		
	Mesh	No Mesh	F
.018" (26 ga)	570	---	4.5
.020" (26 ga)	630	---	4.5
.024" (24 ga)	750	460	4.5
.030" (22 ga)	930	640	4.5
.036" (20 ga)	1030	790	4.5

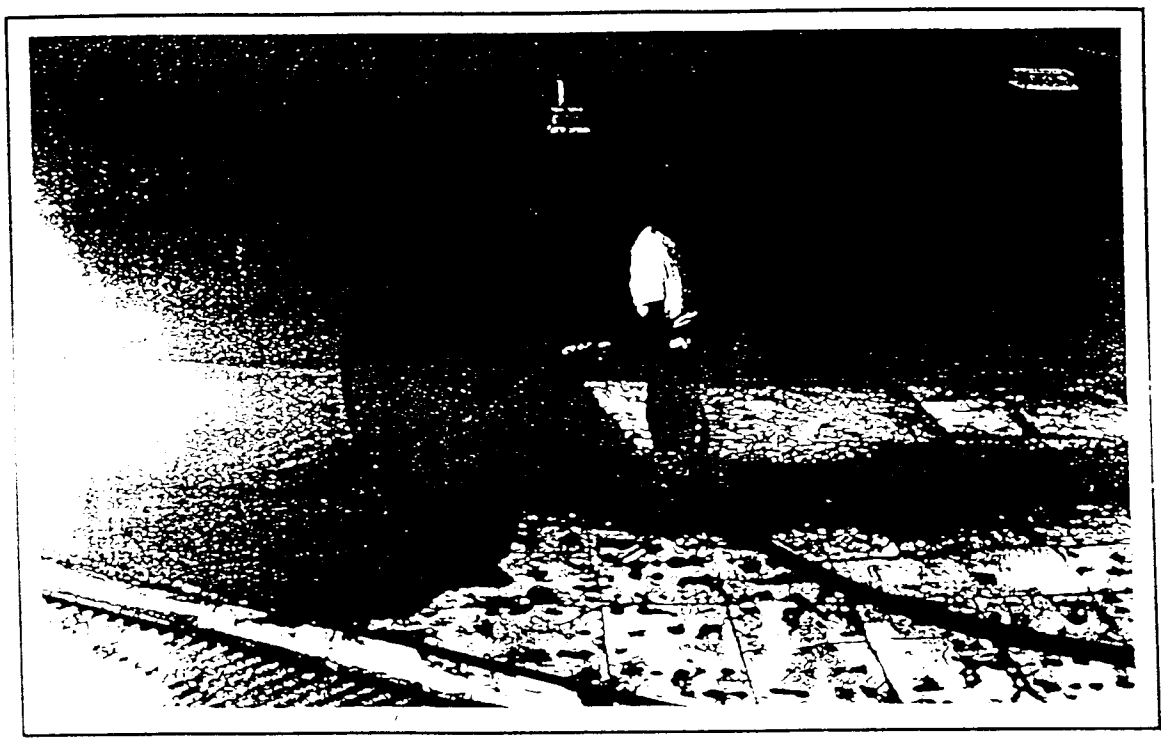
GUIDES and APPROVALS

Underwriters Laboratories:
Wind Uplift Class 90 - Construction Nos. 155 & 480
Fire Ratings - Multiple listings (see previous page)
Factory Mutual Approval Guide
Non-combustible & Class I Roof Deck Construction
ICBO
Report Nos. 1381 and 3081
Federal Construction Guide Specification
Section 03501 - May, 1975, Insulating Concrete Roof Decks
Corps of Engineers Guide Specification
CEGS-03501 - June, 1988

Southern Building Code Congress,
SBCC Report No. 8254
California State Fire Marshall
Listing 1060-510:2
City and County of San Francisco
General Approval 121 E2.4
City of Los Angeles
Research Report No. 23982
Army Corps of Engineers
September, 1970, CE 204 - Class F
Dade County (Florida)
Approval No: 97-0611.03

MEARLCRETE®
CELLULAR CONCRETE ROOF DECKS

Lightweight Insulated Cast-In-Place Concrete Roof Deck Systems
On
Galvanized Corrugated Steel Decks Or Concrete Substrates



Over 35 Years of Successful Worldwide Roofing Projects Used In Both New Roof Deck Systems Installations & Re-Roofing Projects with BUR & Single Ply Roofing Membranes

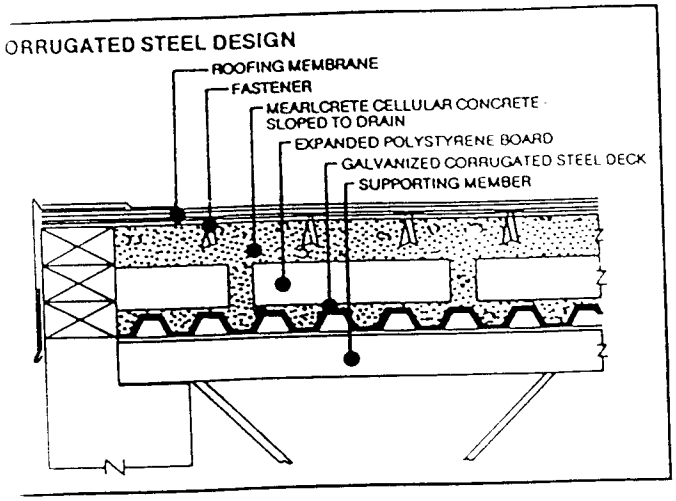
TECHNICAL BULLETIN R411F

ENGELHARD

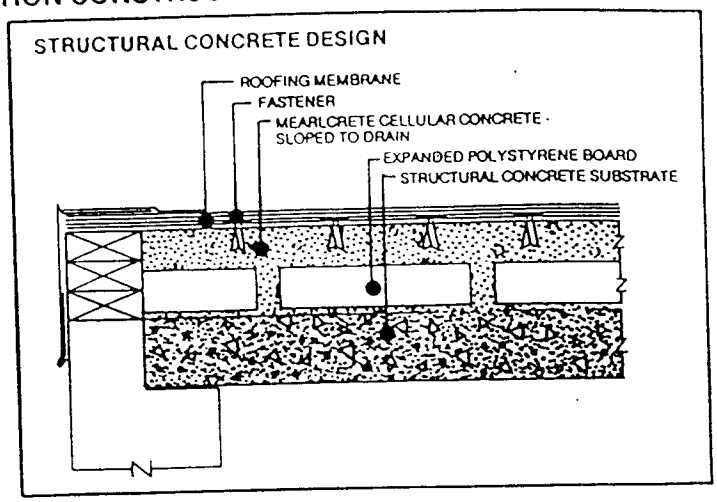
change the nature of things

TYPICAL ROOF INSULATION CONSTRUCTION

ORRUGATED STEEL DESIGN



STRUCTURAL CONCRETE DESIGN



MEARLCRETE Roof Deck - Physical Properties

Wet Density lbs/ft³ (1)	Dry Density lbs/ft³	Compressive Strength lbs/in² (2)	R-Factor °F/(BTU/hr./sq.ft.) per In. Thick
30	25	140	1.49
35	29	210	1.32
40	34	330	1.15
45	38	450	1.02

ater/Cement Ratio = 0.50
ethod of ASTM C-495

Actual properties will depend on cement use ... ing conditions and other variables as dictated by job conditions

pprovals & Guides:
w York City Board of Standard/Appeals (Docket 680-58-SM)
de County, Florida - #96-0919.01
s Army Corps of Engineers - CEGS-03510
Roof Decking, Cast-In-Place Low Density Concrete

Technichal Staff Membership Representation:
American Concrete Institute
American Society for Testing and Materials
National Roof Deck Contractors Association
South Florida Roof Deck Association
Roof Consultants Institute

TYPICAL CORRUGATED STEEL DECK LOADS/SPAN TABLE

THREE SPAN CONDITION - ALLOWABLE UNIFORM ROOF LOADS IN POUNDS PER SQUARE FOOT

Gauge	Depth of Corrugation	lbs. per Sq. Ft.	Moment of Inertia in⁴/ft	Section Modulus in³/ft	3'-0"	3'-6"	4'-0"	4'-6"	5'-0"	5'-6"	6'-0"	6'-6"	7'-0"	7'-6"	8'-0"	8'-6"	9'-0"
28	9/16" to 19/32"	0.76 to 0.95	0.010 to 0.013	0.032 to 0.039	99-131	75-96	58-73	47-58	38-47	35	—	—	—	—	—	—	—
26	9/16" to 1-5/16"	1.0 to 1.18	0.013 to 0.084	0.046 to 0.118	140-279	100-209	80-221	61-175	50-142	41-117	34-98	34-84	38-72	48-63	42-55	27-44	
24	15/16" to 1-3/8"	1.37 to 1.50	0.083 to 0.136	0.105 to 0.146	—	—	204-273	161 216	131-175	108-144	91-121	77-101	67-89	59-78	52-68	41-59	36-53
22	1-5/16" to 1-3/8"	1.68 to 1.90	0.100 to 0.183	0.143 to 0.209	—	—	226-343	206-271	167-220	138-181	116-153	101-130	85-112	74-98	65-86	47-67	42-66
20	1-5/16" to 1-3/8"	2.0 to 2.11	0.122 to 0.164	0.170 to 0.217	—	—	300-422	238-333	193-270	160-223	134-180	121-160	98-138	86-120	75-105	80-90	60-77

Note: Loads Shown Are For Steel Decks Only

RRUGATED STEEL DECK MANUFACTURERS
rman Metal Deck Division, Cyclops Corp. Marlyn Steel Products Inc. United Steel Decks, Inc

Siplast Roof Insulation
THERMAL VALUES

siplast

Roof insulations must perform the basic function of helping to control fluctuations in building interior temperature relative to changing exterior temperatures. By reducing interior temperature fluctuations, the comfort of building habitants is improved and the air conditioning or heating costs can be controlled. Several factors affect the selection of design thermal values for insulation materials. The performance of roof insulation is also affected by additional factors relative to application of the system.

Roof Insulation Thermal Values

The thermal values of insulation materials are determined by ASTM standard test methods. ASTM standards C 518 and/or C 177 define specific conditions known as steady-state for determination of a material's thermal properties. In summary, these steady-state conditions for determination of K-factors are:

1. The material must be homogeneous through its thickness.
2. The insulation mean temperature must remain constant during the thermal property measuring process (steady-state condition).
3. The insulation must maintain constant mass during the measuring process.

The result of these measurements is the thermal conductivity or K-factor for the material at the specific mean temperature during measurement. The typical mean temperature used by insulation manufacturers is either 40°F or 75°F. Other mean temperatures may be used but may not be representative of roof temperature conditions in the U.S. The R-value or thermal resistance value is determined from the above test measurements using the formula:

$$R = \frac{1}{K\ factor}$$

The R-value is expressed as R per inch for design purposes. Table 1 shows R-values for Siplast Roof Insulation materials and other insulation materials.

Roof Insulation Design

Generally when a designer specifies an insulation, he or she may request that the roof insulation provide a minimum R-value or, when a sloped system is installed that the insulation meet an average R-value. To assist the designer, manufacturers publish tables of insulation values for various thicknesses or combination of materials used in roof insulation.

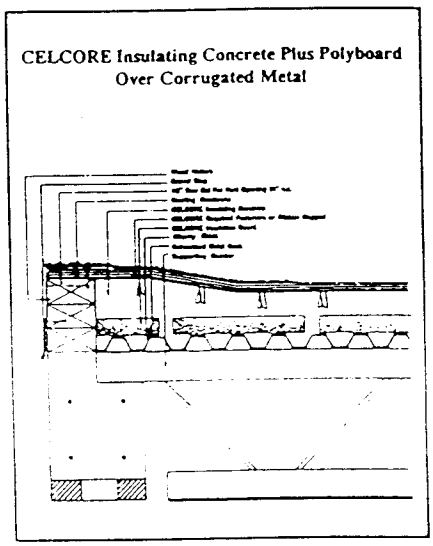
Table 1

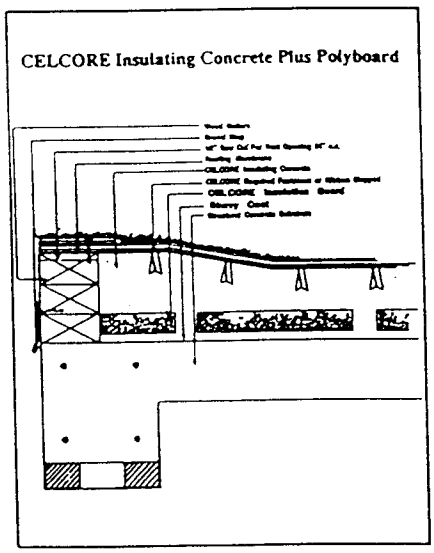
R-Values of Roof Deck Components	R/Inch	Definitions
Zonolite Insulating Concrete 1:6 Mix, 1"	1.49	Thermal Conductivity (k) - the thermal transmission, by conductance only, through a one-inch thickness of homogeneous material. Express as BTU-in./hr. sq. ft. °F.
NVS Concrete, 1"	0.90	
Insulcel Concrete, 1"	1.30	
Zonocel Concrete, 1"	1.10	Thermal Conductance (C) - similar to thermal conductivity but broader. It applies to any thickness of homogeneous and heterogeneous material. Expressed as BTU/hr. sq. ft. °F.
Insulperm Insulating Board, 1"	4.00	
Steel Decking	0.00	
Structural Concrete (140 pcf), 1"	0.08	Thermal Resistance (R) - the reciprocal of thermal conductance (C). Expressed as °F hr. sq. ft./BTU.
Medium Weight Concrete (100 pcf), 1"	0.28	
Glass Fiber Board, 1"	3.70	Thermal Transmittance (U) - also known as overall heat transfer coefficient. The transmission of heat through a construction air to air. Expressed as BTU/hr sq ft. °F
Expanded Perlite Board, Organic Bonded, 1"	2.78	
Gypsum Formboard, ½"	0.45	
Outside Air Film (heat flow up - winter) 15 mph	0.17	
Outside Air Film (heat flow down - summer) 7½" mph	0.25	
Inside Air Film (heat flow up - winter)	0.61	
Inside Air Film (heat flow down - summer)	0.92	
Built-Up Roofing	0.33	
Polyisocyanurate: Fiberglass Faced, 1"	5.60	
Poured Gypsum (12.5% wood chips), 1"	0.60	
Extruded Polystyrene (1.8 - 3.5 pcf), 1"	5.00	

Authority for Values: ASHRAE Handbook of Fundamentals, 1981, Independent Laboratories, Manufacturer's Literature.
NRCA Roofing and Waterproofing Manual, Third Edition

Celcore Roof Insulation

CELCORE INCORPORATED
775 US Hwy 70 West
Black Mountain, N.C. 28711
(704) 669-4875
(704) 669-4874 Fax
Web Site: www.celcoreinc.com
Fax on Demand: (704) 669-4874





THE PRODUCT

Basic Use: Celcore Foam Concentrate is mixed with water and generated into a preformed foam for addition to a cement/water slurry mixture to create a closed cell cellular concrete of a specific density. Typical air dry densities are in the range of 28 - 39 pcf. Oven dry densities are in the range of 24 - 36 pcf. Typical usages for Celcore Cellular Concrete are poured-in-place insulating applications and geotechnical fills.

Celcore Cellular Insulating Concrete is a key component of a Celcore Cellular Insulating Roof Deck System. Celcore Cellular Insulating Concrete may be used in conjunction with expanded polystyrene board to produce a thermally efficient, fire rated, Underwriter's Laboratories Approved, Factory Mutual Approved, South Florida Approved insulation assembly.

Celcore Cellular Concrete can be poured over some existing roof membranes in reroofing applications, galvanized steel deck form, precast concrete, or poured-in-place structural concrete. Celcore monolithic insulating concrete roof deck fills placed over metal deck form can be designed into structures as shear diaphragms. These composite systems provide good resistance to shear forces which may result from wind or seismic activity. Shear diaphragms provide bracing to the structures they cover acting to transfer and distribute an acting load force through-out the structure.

Composition and Materials: Celcore Foam Concentrate contains no synthetic surfactants. It is comprised of natural saponified rosins and is protein stabilized. Celcore Foam Concentrate is non-corrosive, non-hazardous and readily biodegradable. It is packaged in (5) gallon pails and displays the UL and FMRC mark on the product label.

CELCORE'S TECHNICAL INFORMATION is available through print and electronic media. You have two options for obtaining the following information electronically. Celcore's Web Site - www.celcoreinc.com or via Celcore's Fax on Demand System by calling (704) 669-4874 and following the menu instructions. The information that is available is as follows:

(1) CSI formatted specification for Celcore's Roof Insulation -
(2) Roof over existing roof specifications
(3) Celcore PVA curing compound specifications
(4) Thin Patch patching material specifications
(5) Diaphragm design information and tables
(6) Product Data Sheets
(7) Celcore Quality Control Guidelines
(8) Factory Mutual Product Approval Listings
(9) South Florida Product Approval Listings
(10) Material Safety Data Sheets
(11) Geo Technical specifications
(12) Polystyrene board configuration & installation

THE ENVIRONMENT

Celcore Roof Insulation is a superb product to use in meeting the World's environmental concerns. The foundation for Celcore's Foam Concentrate does not contain man made chemicals. Celcore Foam Concentrate is non-corrosive, non-hazardous, and biodegradable.

NO "CFC'S" • NO "FIBER GLASS" • NO "ASBESTOS" • NO "VERMICULITE"

Celcore Roof Insulation

CELCORE CELLULAR CONCRETE TECHNICAL DATA

Cast (wet) Density	-	36 to 49 pounds per cubic foot (Pcf)
Air Dry Density	-	27 to 39 Pcf
Compressive Strength	-	175 pounds per square inch (Psi),
Drying Shrinkage	-	0.20 to 0.40
Thermal Expansion	-	5.0 to 7.0 x 10^-6 /°F
Thermal Resistance	-	"R" = 2.22 per inch thick (average for temp. range 18° - 190°F)

TYPICAL CELCORE MIX DESIGNS

Cast Density	36 pcf	38 pcf	40 pcf	42 pcf	45 pcf
Type I Cement	663 lbs.	703 lbs.	742 lbs.	782 lbs.	850 lbs.
Mix Water	29 gals.	31 gals.	32 gals.	34 gals.	37 gals.
Celcore Foam	19.80 cu. ft.	19.32 cu. ft.	18.94 cu. ft.	18.51 cu. ft.	17.75 cu. ft.
Concrete Yield	1 cu. yard	1 cu. yard	1 cu. yard	1 cu. yd.	1 cu. yard
Theroretical Psi	175 psi	225 psi	250 psi	300 psi	350 (+) psi

"U" FACTOR TABLES FOR CELCORE INSULATING FILL OVER CORRUGATED METAL DECKS & STRUCTURAL CONCRETE SUBSTRATES

Thickness of CELCORE concrete over top of deck corrugations, structural concrete or EPS Insulation	Thickness of EPS in inches R/In.=3.85 Nominal density @ 1 pcf	26 Gauge metal deck 15/16" Corrugation depth			24 Gauge metal deck 1 1/2" Corrugation depth			22 Gauge metal deck 1 1/2" Corrugation depth			Structural Concrete Substrate Thickness 5 1/2" Density 142 pcf		
		Weight of the Deck Composite in lbs./sq. ft.	"U" FACTOR No ceiling HEAT FLOW		Weight of the Deck Composite in lbs./sq. ft.	"U" FACTOR No ceiling HEAT FLOW		Weight of the Deck Composite in lbs./sq. ft.	"U" FACTOR No ceiling HEAT FLOW		Weight of CELCORE Insulating Deck in lbs./sq. ft.	"U" FACTOR No ceiling HEAT FLOW	
			UP	DOWN		UP	DOWN		UP	DOWN		UP	DOWN
2"	0	6.08	.139	.132	6.91	.128	.123	7.20	.128	.123	4.00	.140	.113
	1	6.68	.090	.087	7.49	.086	.083	7.78	.086	.083	5.08	.091	.088
	1 1/2	6.73	.077	.075	7.54	.074	.072	7.83	.074	.072	5.13	.078	.075
	2	6.77	.067	.065	7.58	.065	.063	7.87	.065	.063	5.17	.067	.066
	2 1/2	6.81	.059	.058	7.62	.057	.056	7.91	.057	.056	5.21	.060	.058
	3	6.85	.053	.052	7.66	.052	.051	7.95	.052	.051	5.25	.054	.051
	3 1/2	6.89	.048	.047	7.70	.047	.046	7.99	.047	.046	5.29	.049	.048
	4	6.93	.044	.043	7.74	.043	.042	8.03	.043	.042	5.33	.044	.044
2 1/2"	0	7.08	.123	.117	7.91	.114	.110	8.20	.114	.100	5.00	.124	.118
	1	7.68	.083	.080	8.49	.079	.077	8.78	.079	.077	6.08	.084	.081
	1 1/2	7.73	.072	.070	8.54	.069	.067	8.83	.069	.067	6.13	.072	.069
	2	7.77	.060	.061	8.58	.061	.059	8.87	.061	.059	6.17	.063	.062
	2 1/2	7.81	.056	.055	8.62	.054	.053	8.91	.054	.053	6.21	.057	.055
	3	7.85	.051	.050	8.66	.049	.049	8.95	.049	.049	6.25	.051	.049
	3 1/2	7.89	.046	.045	8.70	.045	.044	8.99	.045	.044	6.29	.047	.046
	4	7.93	.042	.042	8.74	.041	.041	9.03	.041	.041	6.33	.042	.042
3"	0	8.08	.106	.102	8.91	.100	.096	9.20	.100	.096	6.00	.107	.103
	1	8.68	.075	.073	9.49	.072	.070	9.78	.072	.070	7.08	.076	.074
	1 1/2	8.73	.066	.064	9.54	.063	.062	9.83	.063	.062	7.13	.066	.063
	2	8.77	.058	.057	9.58	.057	.055	9.87	.057	.055	7.17	.059	.057
	2 1/2	8.81	.052	.051	9.62	.051	.050	9.91	.051	.050	7.21	.053	.052
	3	8.85	.048	.047	9.66	.046	.046	9.95	.046	.046	7.25	.048	.047
	3 1/2	8.89	.044	.043	9.70	.043	.042	9.99	.043	.042	7.29	.044	.043
	4	8.93	.040	.040	9.74	.039	.039	10.03	.039	.039	7.33	.040	.040

The above values include proper allowance for Winter and Summer conditions and the RUR
The "U" Factor is based on 36 pcf wet density Celcore Cellular Insulating Concrete

(CRI 1/97)

Center For Applied Engineering, Inc.
SM Materials Testing Services

April 7, 1997

Mr. Jose E. Fernandez
Cellucrete Corp.
11905 N.W. 99th Ave.
Hialeah Gardens, FL 33018

Dear Mr. Fernandez:

I have perused the Westinghouse report titled "Lightweight Concrete Materials and Structural Systems for Water Tanks for Thermal Storage" (C00-4703-26) and dated December 1980. The test method used in this report does not conform to any ASTM consensus industry accepted thermal test method. The four (4) methods generally accepted are ASTM C177 (guarded hot plate), C518 (heat flow meter), C236 (guarded hot box) and C976 (calibrated hot box).

If you have any questions, please contact me at (813) 578-4351.

Sincerely,

R. G. Miller, PhD, P.E.
Manager
Materials Testing Services

RGM:dds

CELCORE "R" VALUE
TESTING PROCEDURE

COO-4703-26

Advanced Energy Systems Division

LIGHTWEIGHT CONCRETE MATERIALS AND STRUCTURAL SYSTEMS FOR WATER TANKS FOR THERMAL STORAGE

FINAL REPORT

Prepared by
R.W. Buckman, Jr.
G.G. Elia
Y. Ichikawa

DECEMBER 1980

Prepared for
The United States Department of Energy
Under Contract EM78 C 02 4703 A000

Westinghouse Electric Corporation
Advanced Energy Systems Division
P.O. Box 10864
Pittsburgh, Pennsylvania 15236