Workshop on Cool Roofs and Pavements
Global Superior Energy Performance Partnership (GSEP)

Cool Roofs in México

Dr. Ignacio R. Martín-Domínguez
Dr. Gabriela del Socorro Alvarez-Garcia
Ing. Francisco Rubín-Zacarías
Advanced Materials Research Center (**CIMAV**)
Research and Industrial Development Research Center (**CENIDET**)
Mexican Association of Paints and Inks Manufacturers (**ANAFAPyT**)

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México


U.S.A.
Tijuana
Cuidad Juárez
Guaymas/
San Carlos
Chihuahua
Loreto
La Paz
Cabo San Lucas
Monterrey
Gulf of Mexico
Mazatlán
Isla
Mujeres
Cancun
Mérida
Playa del Carmen
Cozumel
Puerto Vallarta
Guadalajara
México City
Veracruz
Manzanillo
Cuernavaca
Ixtapa/
Zihuatanejo
Acapulco
Oaxaca
Huatulco
North Pacific Ocean
Mapas de Mexico

Current State of Cool Roofs Mexican Legislation

NOM = Mexican Compulsory Norm (standard)
NMX = Mexican Voluntary Norm (standard)
PROY = Norm project (in development stage)

- NOM-008-ENER-2009
- NOM-020-ENER-2011
- NMX-C-460-ONNCCE-2009
- PROY-NMX-AA-164-2012 (Cool roofs included)

Government and Industry Sectors Involved

- National Energy Efficiency Comission (CONUEE)
- Thermal insulation (AEAEE)
- Coatings manufacturers (ANAFAPyT)
- Other roofing material manufacturers (Tile, metal sheet, acrylic sheet)(not yet involved)

Recent Actions and Events

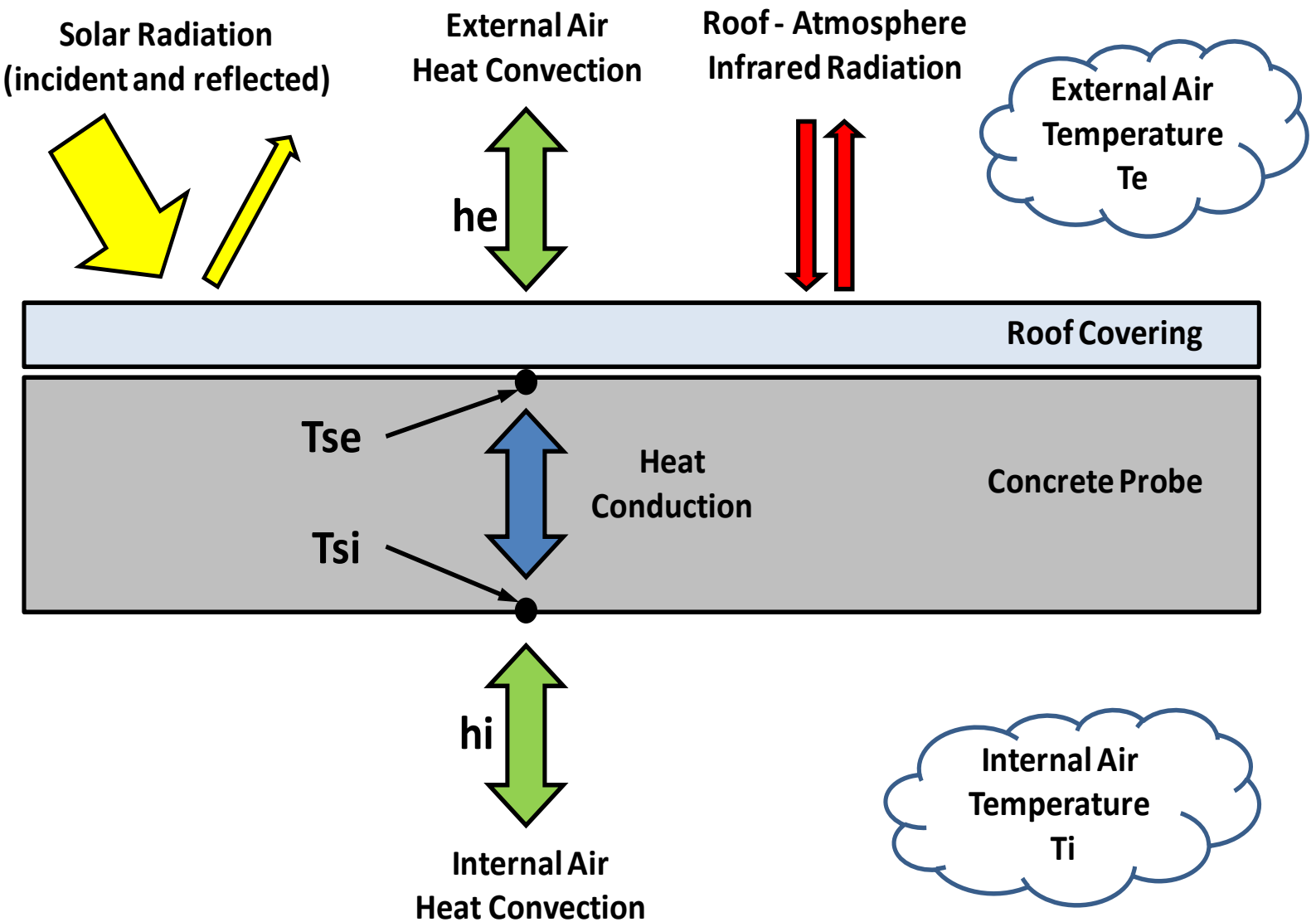
- International Solar Buildings Workshop, Nov 2011, Mexico–Spain, Cuernavaca, México
- Cool Roofs Workshop, Feb 2012, Mex–USA, Mexico City
- Industrial and Commercial Roofs Energy Efficiency, Mex–USA, Sep 2012, Mexico City

Experimental Work

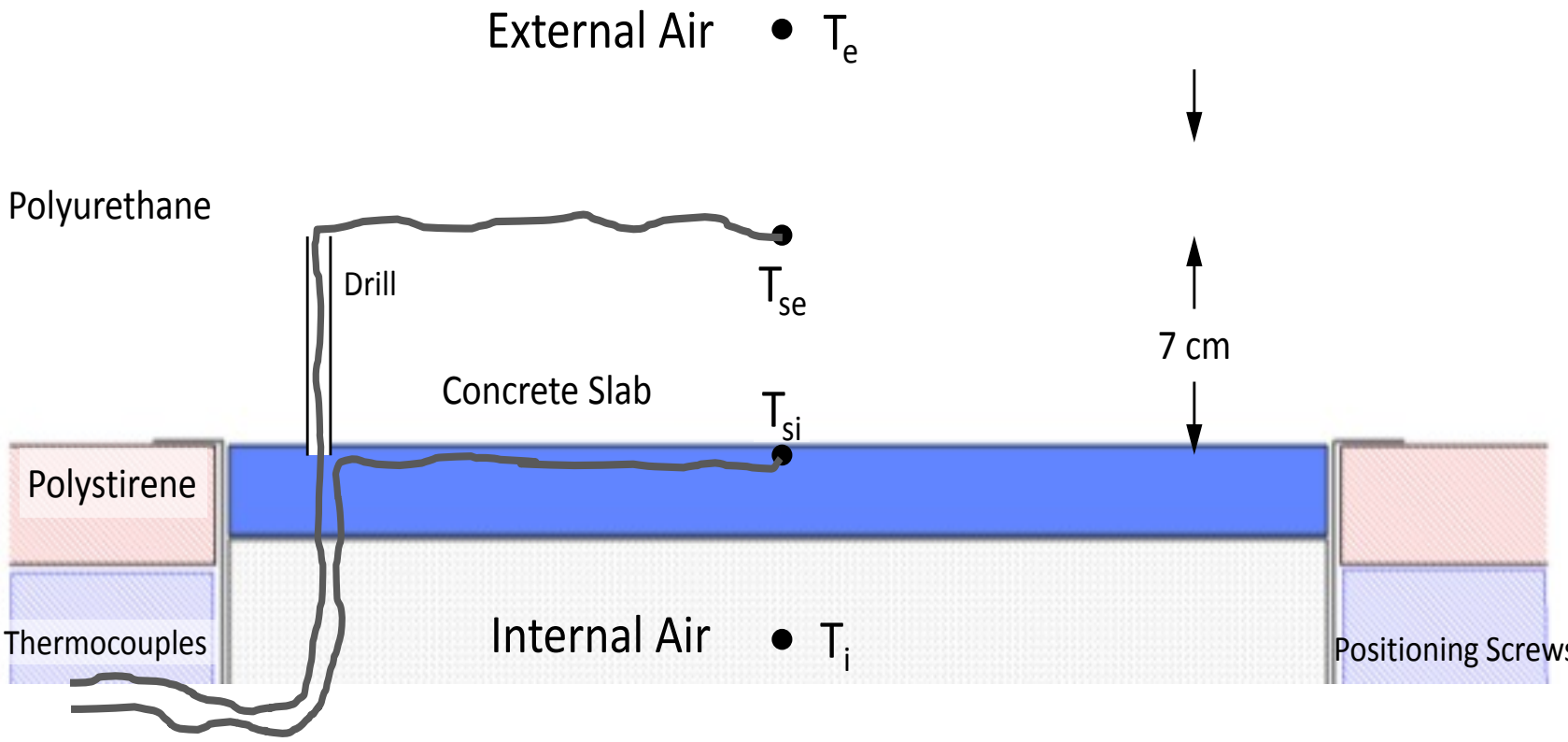
Experimental comparison of heat flow through concrete roofing flagstones with different coatings

- Compares heat flow trough concrete slabs whith different roofing systems
- Sponsored by ANAFAPyT
- Executed by CIMAV
- Results presented at ISES Solar World Congress 2011. Kassel, Germany

Energy balance for a low sloped roof

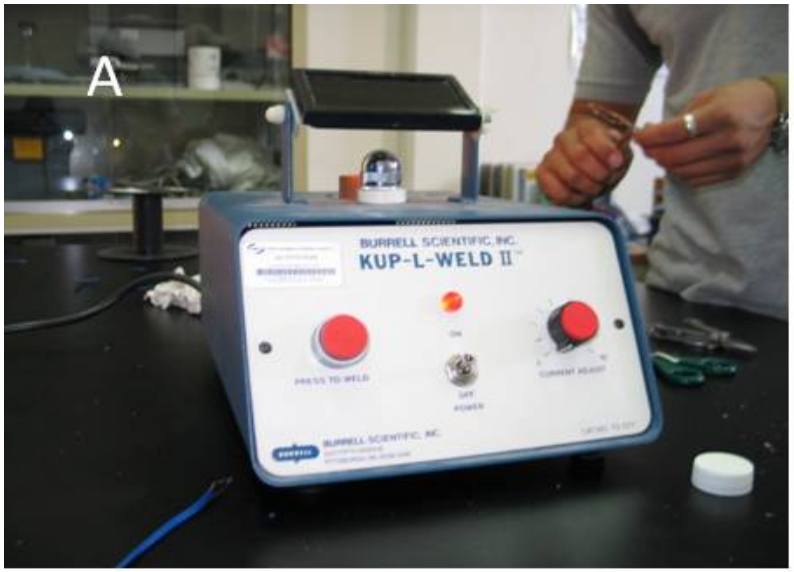


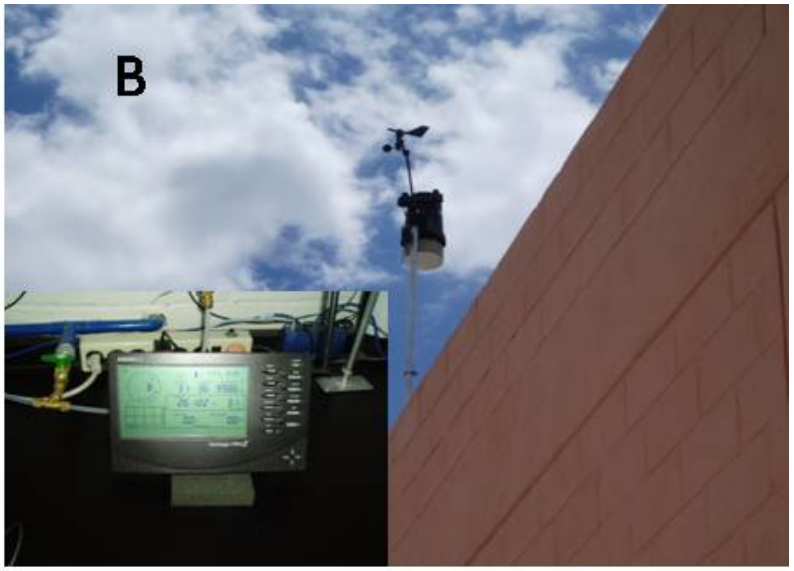
Experimental Setup



Controled Inner Conditions Testing Room

Instrumentation



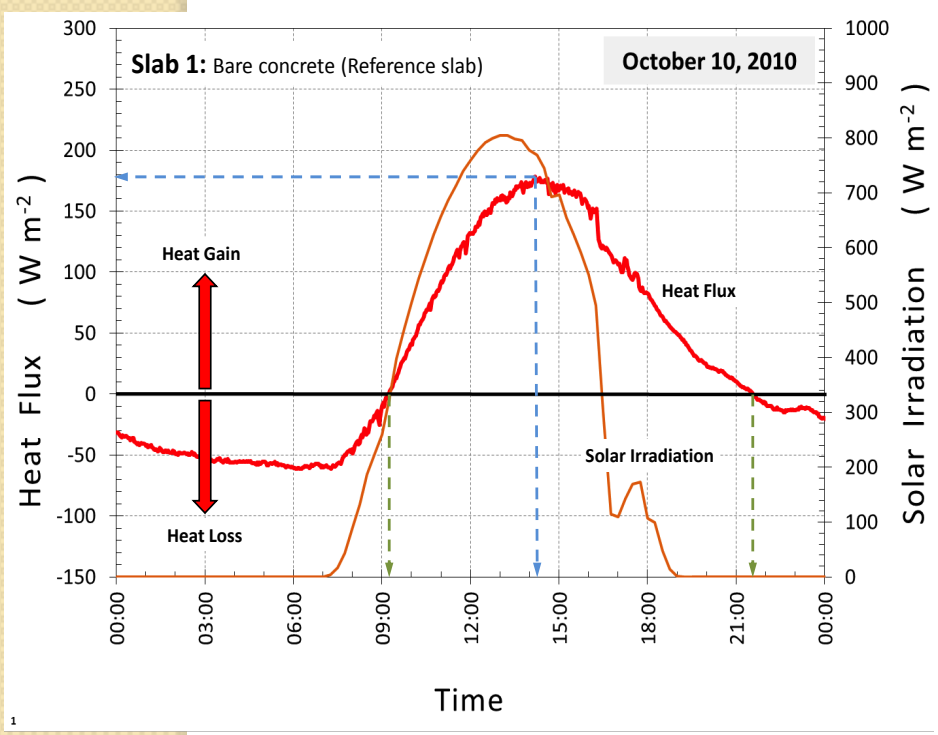


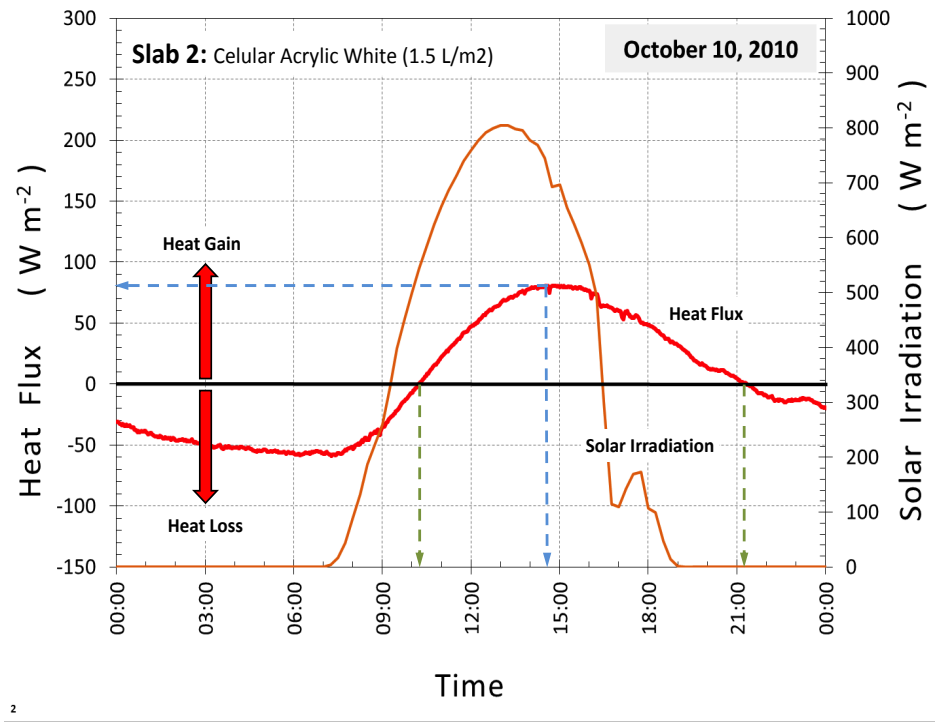
Comparison of heat flux, October 10, 2010:

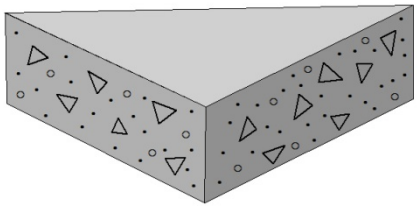
Bare concrete

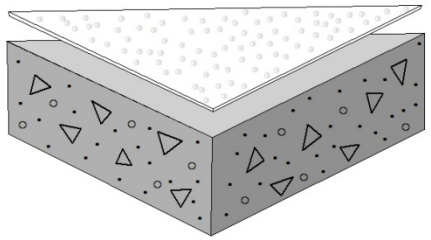
— versus —

White Cellular Reflective Coating







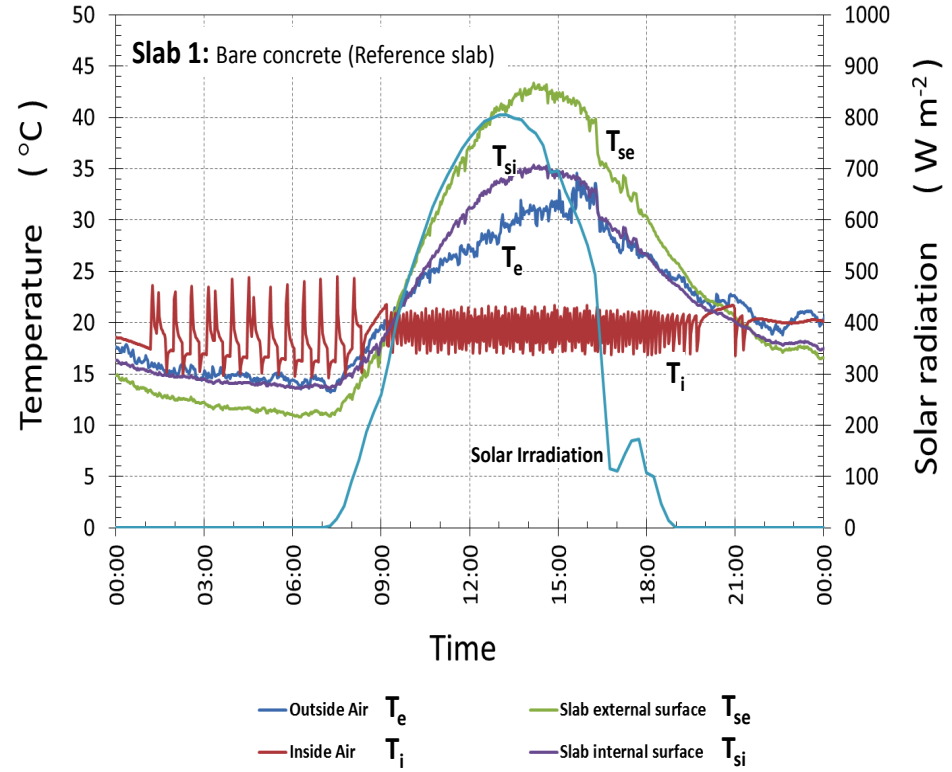


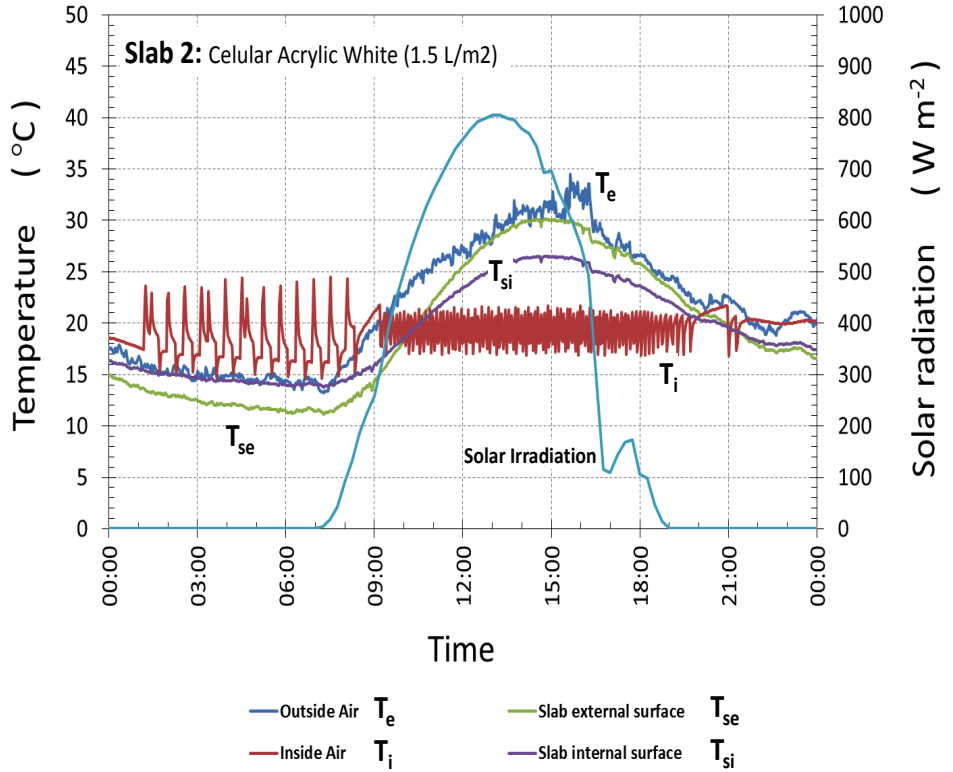
Comparison of surface temperatures, October 10, 2010:

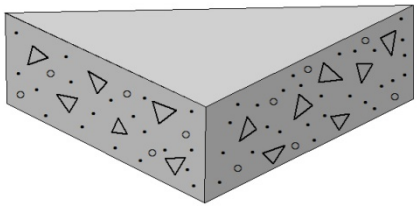
Bare concrete

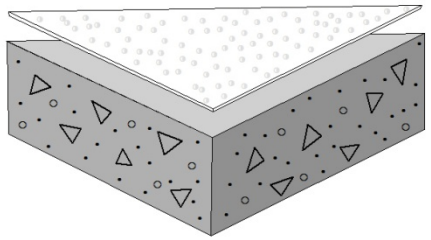
— versus —

White Cellular Reflective Coating

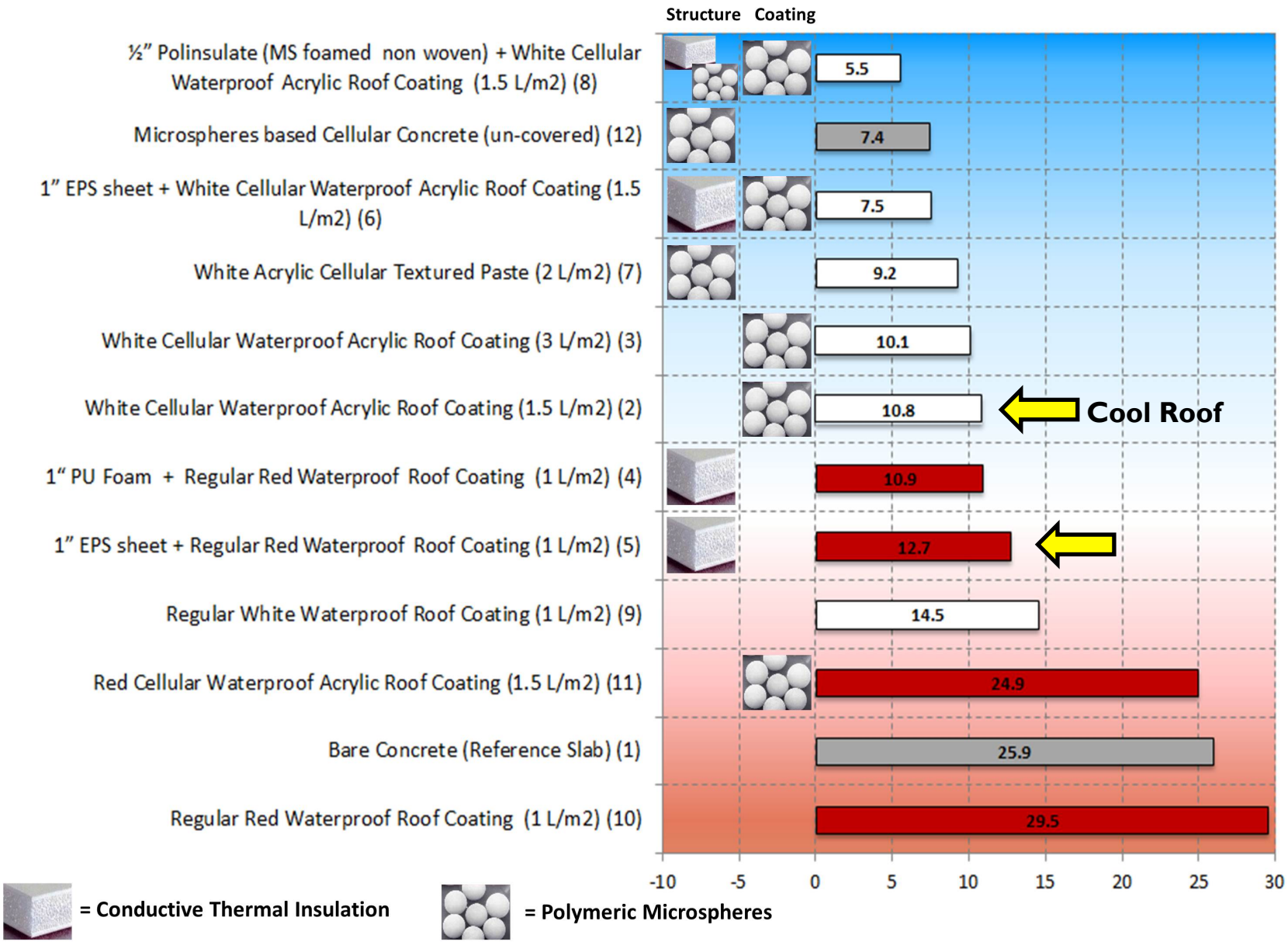








Diurnal Heat Gain (MJ/m² · week)



Actions Needed

Modification of NOM-020-ENER-2011

Current State

- NOM-020 gives sol-air temperatures for roofs and walls of different cities in Mexico.
- With those data and R values given, the heat flow of a same size/shape reference building is calculated.
- Design heat flow must be less or equal than the calculated for the reference building, in order to comply.
- The norm uses the sol-air temperature method to determine reference heat flux

Modification of NOM-020-ENER-2011

From ASHRAE Handbook Fundamentals 2009 (Pag 30.22) Sol-Air Temperature is defined as:

$$t_e = t_o + \frac{\alpha E_t}{h_o} - \frac{\varepsilon \Delta R}{h_o}$$

α = absorptance of surface for solar radiation
E_t = total solar radiation incident on surface, W/m^2
h_o = coefficient of heat transfer by long-wave radiation and convection at outer surface, W/(m^2·K)
t_o = outdoor air temperature, °C
t_s = surface temperature, °C
ε = hemispherical emittance of surface
ΔR = difference between long-wave radiation incident on surface from sky and surroundings and radiation emitted by blackbody at outdoor air temperature, W/m^2

Modification of NOM-020 ENER-2011

- The norm fails to report the surface reflectance value used for the Sol-Air temperature calculation
- Heat flux stated in NOM-020 is only true for one solar reflectance value
- When questioned, CONUEE claimed that solar reflectance used in the Norm was: 0.71

Improvements Proposed

- The Norm must specify that solar reflectance of roof coverings must be 0.71 or higher, in order to comply.
- Solar Reflectance considered must be the aged value
- Some insulation penalty should be stated in case solar reflectance value is not met.

Cool Roofs Impact in Mexico Estimation

Winbuild-CENIDET-CIMAV

- Mexican authorities are not yet aware of Cool Roofs advantages
- The impact of Cool Roofs on energy efficiency, economy and health/comfort should be estimated
- Dimensioning the effect of Cool Roofs should make authorities and population more likely to accept and use the technology

IMPACT OF COOL ROOF SURFACES ON ENERGY SAVINGS IN BUILDINGS IN MEXICO

Winbuild-CENIDET-CIMAV

Project Scope:

- Investigate and gather information of solar radiation to elaborate solar radiation maps of Mexico.
- Effect of using cool roofs on the energy saving will be evaluated by using the database of climate variables and degree days of 700 cities.
- Estimate the area of different color of roofs in 5 typical cities of different climate zones in Mexico by using a digital process by satellite image identification in order to know the percentage of areas of roof different to cool roofs in cities of Mexico.

Project Goals:

- Elaborate monthly average solar radiation, temperature, humidity maps, and maximum and minimum climatic variables maps.
- Identify the different climatic zones in Mexico.
- Elaborate monthly heating and cooling degree day maps in Mexico.
- Determine the energy savings by the use of cool roofs in Mexico.
- Estimate the percentage areas of different colors of roofs of 5 cities representative of different climates.

Fortcomming Projects

- COMEX Group (the largest paint and coatings manufacturer in Latinamerica) wants to build a heat flux measuring facility, similar to the one developed by CIMAV. (COMEX-CIMAV-Nat. Research Council – Spain)
- Simulation study to estimate the effect of cool roofs on energy use and human comfort in low income housing with and without air conditioning, in different climatic zones of Mexico (CIMAV)

Most Important Work Ahead

- NOM-020 and 008 should explicitly include solar reflectance values
- A new NMX for Cool Roofs should be developed, including criteria for surface optical properties and its measuring methods
- Products certification laboratories and weathering farms should be established

Gracias!

ignacio.martin@cimav.edu.mx