Rezumat scurt

Aceasta teza de doctorat se compune din 5 capitole, intr-o buna masura independente.
In Capitolul 1 sunt calculate intr-o maniera personala, cele 2 unghiuri sferice care definesc directia radiatiei solare directe in reperul cartezian al unei suprafete plane receptoare (precum o fereastra sau un colector solar), plasate pe Pamant intr-o pozitie oarecare in emisfera nordica, intre Cercul Tropicelui si Cercul Arctic. La fel, este calculata si formula iradiantei solare difuze a unei suprafete plane de orientare oarecare, in ipoteza ca primeste radiatie izotropa de la bolta semisferica pe care ea "o vede" .
In Capitolul 2, este prezentata baza geometrica pentru o extindere originala a renumitului algoritm de geometrie computationala dat de Greiner si Hormann (1998), la situatii noi, neabordabile de catre original; situatii de mare interes practic in analiza inginereasca, cum este de exemplu problema calculului pentru o suprafata receptoare plana, a umbririi ei de catre multiple obstacole (pentru radiatia solara directa), de forma si amplasament generale.
In Capitolul 3 sunt efectuate de catre autor, calcule ale unui parametru de performanta energetica a vitrajelor important (transmitanta termica), in situatii cu si fara accesorii (precum tocul sau oblonul exterior, izolat termic consistent). Este de asemenea facut, pentru jumatatea rece a anului, bilantul energetic lunar al unei ferestre din Bucuresti, prevazute cu un astfel de oblon, orientata spre Sud. Rezultatele arata posibilitatea de pierderi energetice nete zero chiar si in cele mai nefavorabile luni ale anului pentru o astfel de fereastra, daca ea nu este umbrita si este montata in perete astfel incat puntea termica de montaj sa fie redusa.
Capitolul 4 se ocupa de efectul unor dispozitive exterioare de umbrire foarte simple: copertina si jaluzeaua exterioara nelamelara (din material continuu). Este prezentata aici o simulare energetica orara a necesarului de racire al unei cladiri din Bucuresti (cu si fara jaluzele exterioare), ce arata clar eficienta energetica a unui astfel de dispozitiv de umbrire.
Capitolul 5 este partea experimentala a lucrarii. Este evaluata aici, cu o instalatie artizanala construita de catre noi de la zero, influenta unui oblon exterior din izolatie (EPS gros de 3 cm) asupra pierderilor de caldura din interior spre exterior, pentru un vitraj dublu performant (cu o foaie low_e si cu amestec Argon 90% & Aer 10% in cavitatea sigilata). O reducere de cel putin 30% este estimata.

Abstract

This Ph.D thesis mainly consists of 5 chapters, that can be read as separate modules.
In Chapter 1, an original way to calculate the 2 spheric angles defining the direct solar rays in the specific cartesian frame of a planar receiving surface (like a window or a solar collector) is presented. The surface location is in the northern hemisphere, anywhere between the Tropical Circle and the Arctic Circle. Also, the diffuse solar irradiance of a planar surface arbitrarily oriented is calculated in a personal manner, under the assumption the radiation received from the "seen" hemisphere is isotropic.
In Chapter 2, we provide the complete geometric fundamentals for an original extension of the computational geometry algorithm given by Greiner & Hormann in 1998. The extension makes possible tackling important engineering problems like computing the resultant shadow on a planar receiving surface for solar radiation obstructions of general shape and location; something the original cannot do.
In Chapter 3, we calculate the thermal transmittance (that is a measure of the heat loss through the glazed element) for some cases of interest : center of the insulated glazing unit (IGU), framed glazing (that is a window) and window with a consistently insulated shutter. We also do the monthly energy balance for a South window in Bucharest during the cold half of the year. The results suggest the possibility of having zero net energy losses even in the most unfavorable months (december and january) for the chosen green window (double pane glazing with low_e and Argon 90% & Air 10% gas mixture and an efficient frame), if it has complete solar access and is carefully mounted in the wall such that its installation thermal bridge effect is decreased.
Chapter 4 deals with two simple exterior shading devices : awning and shade. The cooling load resulted from an hourly simulation for a mid-rise building in Bucharest (with and without exterior shades) is presented. The energy efficiency of the shades is very obvious.
Chapter 5 is the experimental part of this work. Not having a more professional installation, the improvement in the thermal transmittance of a good double glazing (low_e and Argon & Air mixture) is conservatively assessed by using a "differential" two box approach (one equiped with the plain glazing, the other with the glazing and a shutter consistently insulated). The shutter (EPS 3 cm thick) lowers the heat loss through the glazing by at least 30%.