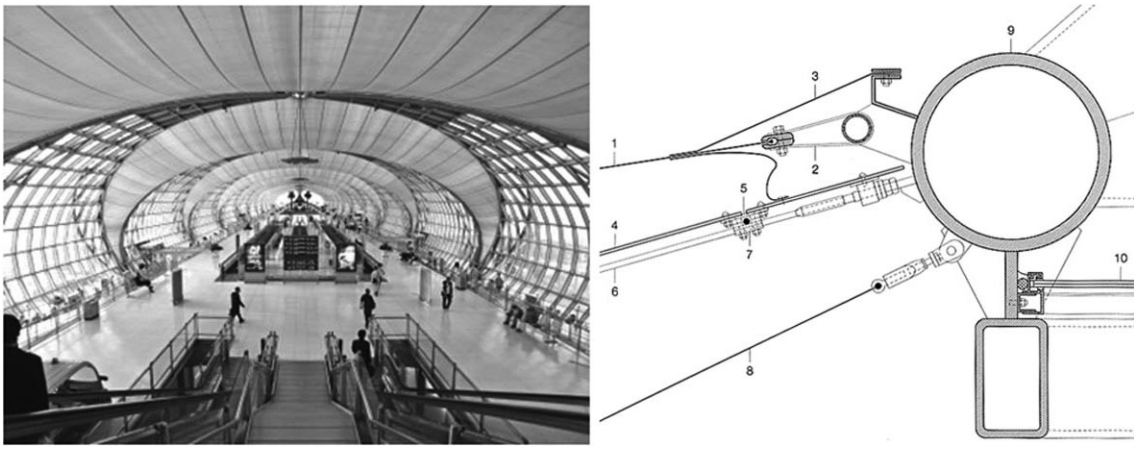
ENVIRONMENTAL CONTRIBUTIONS OF STRUCTURAL MEMBRANES.

The environmental characteristics of structural membranes suffer from their low mass and lack of acoustic and thermal insulation. Nevertheless, remarkable progress is taking place introducing translucent insulating materials such as aerogels, printing capabilities which increase solar absorption and reduce solar transmission, low emissivity coatings, and multi-layer, sandwiched and composite membranes, including inflated cushions, analogous to double glazing, to improve thermal, acoustic and energy performances.

The three-layered roof of the Suvarnabhumi Airport, Bangkok 2006 (figs.1,2), is an example: three layers maximize the comfort. From top (outside) to bottom: PTFE-coated fibre glass for weather protection, transparent polycarbonate sheet for noise protection attached to a steel cable mesh and inner low-e coated open wave acoustic membrane .



Figures 1,2: Suvarnabhumi Airport, Bangkok 2006. 1 Outer membrane weather protection: glass fibre PTFE-coated 1,2 kp/cm^2. 2 Tensioning mechanism on Ø 40 mm aluminum tube. 3 Edge strip glass fibre PTFE-coated attached following tensioning of membrane. 4 Middle membrane noise protection (1000/1000/6 mm, 7,2 kp/m^2 transparent PC sheet R'$_w$ = 35 dB, fire-rating B1). 5 Acoustic joint sealing section-strips EPDM. 6 Substructure Ø 12 mm steel-cable mesh. 7 Stainless steel cable clamp. 8 Inner acoustic membrane (glass fibre with low e-coating aluminium open pores, 0,320 kp/m^2, fire-rating A2). 9 Three-chord truss Ø 419 x 36 mm CHS. 10 15,5 mm laminated safety glass with low e-coating sun protection: frit, coverage level progressing from 20% (lowest point) to 80% (highest point). 11 Grating, 150 x 250 x 16 mm RHS (DETAIL 7/8-2006)

Figures 3,4: Canobbio Textile Engineering, 2016: Air hall for the Helsingin Jalgapalloklub football team field, Helsinki

The air hall for the Helsingin Jalgapalloklub football team (figures 3,4) is double-layered with two membranes completely detached to avoid thermal bridges along the perimeter and

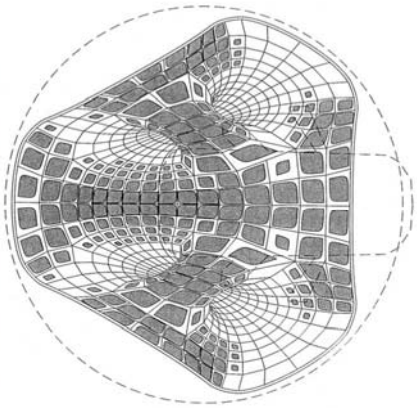
condensation, achieving energy savings of 49% compared with single membrane solutions at the same climatic conditions. Another peculiarity of this project was the use of different fabric bands with different translucency percentages so as to allow the light to filter and going to save further on the lighting system.

Energy harvesting

In addition, new environmentally friendly applications such as environment protection and energy harvesting have emerged.

Figures 5,6: Ackermann und Partner with Taiyo Europe GmbH, 2011: "Truck depot. Office for Waste Management", Munich.

The canopy of the waste-management-vehicle maintenance facility was replaced by steel columns carrying three-chord trussed girders, transverse steel arches with tension rods, inverted flying pyramids and ETFE 11 x 3,3 m cushions with solar cells embedded in the middle layer (figures 5,6). Part of the energy is fed into the public grid, the rest operates three ventilation units that provide the air pressure required to keep the cushions inflated. The ductwork and drainage pipes are concealed within the trussed girders.



The "PURE Tension" Volvo Pavilion, a collaborative effort between Synthesis Design + Architecture, Buro Happold, and Fabric Images, is a lightweight, rapidly deployable, free-standing tensioned membrane structure and portable charging station commissioned by Volvo Car Italia to showcase the new Volvo V60 Hybrid Electric Diesel car (figures 7,8).

More information at: *https://www.arch2o.com/sda-to-design-pure-tension-pavilion/*