

COWIfeature

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Researcher:

White concrete can replace grey

**Protection against
flooding**

**Audiences to heat
new Playhouse**



Construction of Copenhagen's new Playhouse, to be located opposite the new Opera House, commenced in the beginning of October. Model photo courtesy of architects Boje Lundgaard and Lene Tranberg



Audiences to help heat new Playhouse

Water from Copenhagen Harbour and surplus heat from the auditorium of the Royal Theatre's new Playhouse will heat and cool the building by means of an original concept. The method will mean substantial savings on operating costs—to the benefit of the arts

By Christina Tækker

Seawater and surplus heat from the auditorium of the Royal Theatre's new Playhouse will heat and cool parts of the building on completion four years hence—saving substantial amounts of energy.

As one of the first Danish projects involving thermo-active concrete constructions, the Playhouse has been able to draw on practical experience gained from a pioneering research project at the Technical University of Denmark. Thermo-active concrete constructions, or climate belts, are joint heating and cooling systems that utilise plastic tubes moulded into concrete floors and ceilings. The Playhouse dressing rooms, offices and foyer will be heated by utilising the heat given off by projector lights at ceiling level—and body heat from the previous evening's audience. This is done by extracting the heat from the auditorium, converting it to liquid and reusing it as floor heating the following day.

Similarly, the location of the Playhouse partially over the water will allow a heat pump to be employed that will alternately cool and heat water taken from Copenhagen Harbour. Using this method, the Playhouse will reduce energy consumption for cooling the building by an estimated 75-80 per cent—simply by using seawater and a heat pump.

Savings on operating costs achieved

"Reusing and exploiting energy in this way is an interesting concept," comments the Royal Theatre's technical director Nikolai Jensen. "Given our proximity to the water, it's an obvious solution. This concept means that, in environmental terms, we are in the forefront. And it will give us substantial savings on operating costs—to the benefit of the arts."

As part of a major EU sponsored project called ECO Culture, coordinated by COWI, the company has received a grant of DKK five

Heating and cooling using the same heat pump:

In summer the water from Copenhagen Harbour will be used to provide cooling via the ceiling of the Royal Theatre's Playhouse. In winter the water will be used to help warm the building.

The concept works with the help of a heat pump which operates on the same principles as a refrigerator. The heat pump produces cold on one side and heat on the other. Just as a refrigerator takes energy from the refrigeration unit and emits it into the room, so the pump takes energy from the seawater—despite the coldness of the water—and emits it into the building.

About the Playhouse:

COWI is consultant for the Playhouse, to be located on the Copenhagen Harbour waterfront. The assignment involves traditional engineering disciplines such as construction and civil engineering, performance-based fire safety design and risk management. In addition, COWI will demonstrate new and alternative sustainable energy-saving solutions. The Playhouse, designed by architects Boje Lundgaard and Lene Tranberg, is due for completion in 2008.

million to test, demonstrate and try out the energy concepts in the Playhouse. As part of the project, Norwegian consultants Eriksen & Horgen are contributing energy solutions from the new Norwegian Opera House in Oslo, while Dutch company Ecofys and Amsterdam City Council are trying out sustainable energy systems in Amsterdam's new central library.

One aim of the project is to inspire other construction projects to utilise sustainable energy concepts rather than traditional methods of heating and cooling with compressors and radiators. The experience gained from this project will therefore be made available on the Internet, through workshops and visits to the worksite.

Easy to replicate

"The energy concepts are easy to replicate," explains COWI project manager Jens Ole Hansen. "You do not necessarily have to use seawater to heat and cool buildings. Groundwater would serve just as well."

The energy concepts utilised in the Playhouse are not new, but as Jens Ole Hansen points out they function very well together. The climate belts moulded into the floors and ceilings heat an entire room via a large surface area compared to a radiator, which must heat an entire room with only a small surface area. Consequently less energy is required, and seawater and surplus heat can easily be utilised. For instance, in the summer it will often be possible to use seawater directly, as the water in the cooling tubes needs only to be a couple of degrees below the desired room temperature.

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