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CONCEIVING NEW LOW-ENERGY REPETITIVE DISTRIBUTION STATIONS FOR THE NEXT CENTURY.

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INTRODUCTION

Art & Build Architects & Engineers is in charge of designing new stations for DHL. As part of the EC 2000 plus programme, the aim of the project is to both improve the environmental performance of DHL existing building stock and to ensure that future developments are designed and constructed with due regard to the 'total' environmental performance over the life of the building and to occupiers comfort, health and safety.
This model station has been conceived to be set up in the first stage in four different locations in Europe before being constructed all across the continent.

METHODOLOGY

The project team consists of an architect (Art & Build Architects & Engineers), an environmental and services engineering consultant (Roger Preston & Partners), a structural engineer, an environmental specialist to advise on embodied energy (ECD), and an IT consultant. The rapid procurement of new stations preludes the project specific research and development of energy efficient and sustainable engineering methods required for the most appropriate design for each site.

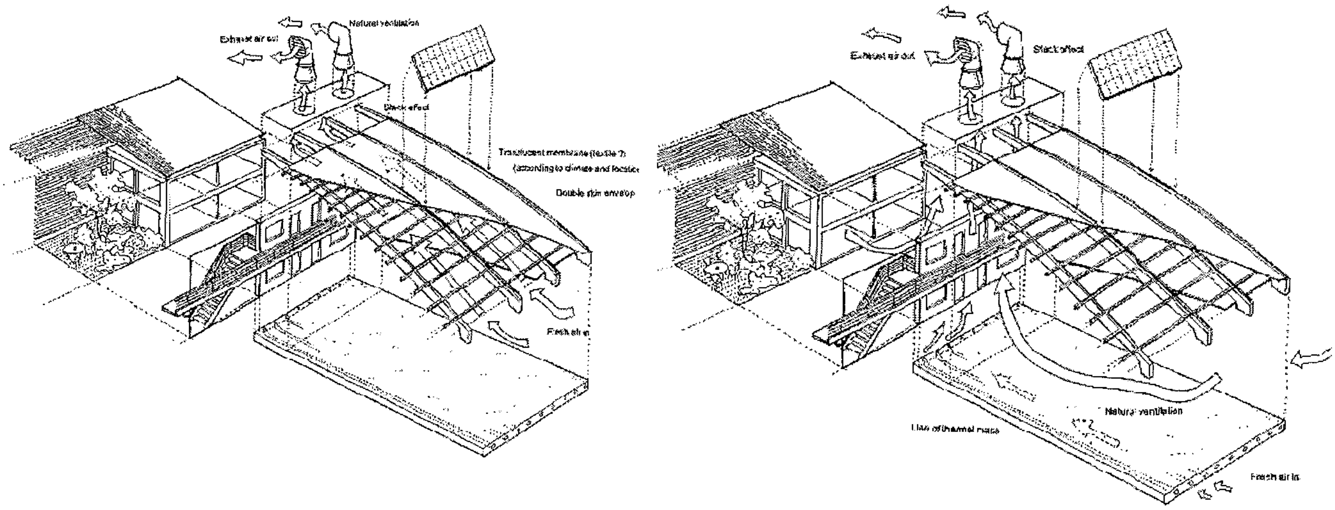

Figure 1 :Ventilation principles

The project team therefore plans to develop a modelling technique which will allow a generic building design to be produced to evaluate environmental performance. This will enable the development of a ‘kit of parts’ with known performance characteristics which can be readily adapted to suit the site specific climate and geography anywhere in Europe.

This project will look at whether energy technologies such as Photovoltaic (PV) cells (in association with Shell Solar), wind turbines, natural ventilation (Figures 1& 2), ground coupling, grey water recycling and rainwater harvesting are appropriate to small mixed use office and industrial buildings.

Moreover, although not currently included, this project has the potential to be extended, with research into transport and electric vehicles and the use of integrated design project models. In energy terms alone the benefit to the environment could be a reduction in energy use equivalent to the output of a small power station.

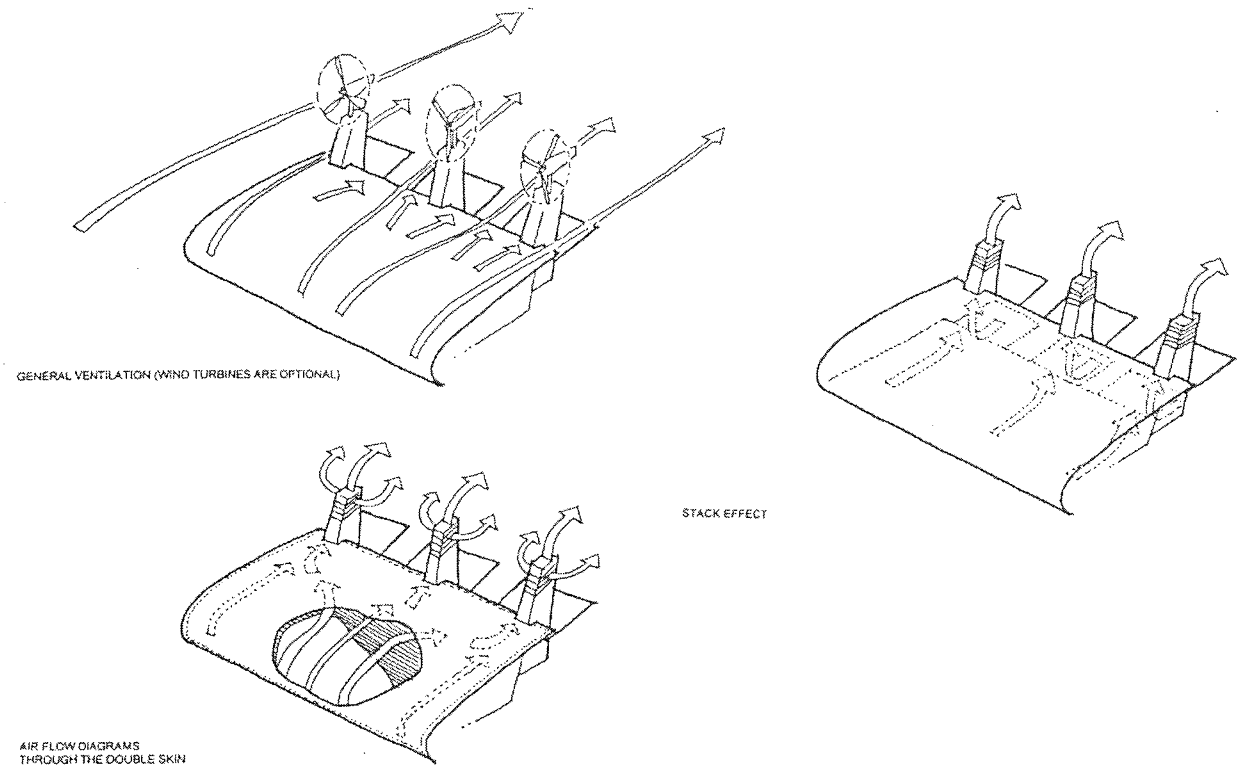

Figure 2 : Ventilations principles.

OBJECTIVES

The objectives of the project are to:

- Create an interactive design tool to enable the total environmental impact of a new building to be assessed and optimised, taking into account the local geographical and climatic variations that exist throughout the European Continent.

- Test the model's predictions with real on site buildings constructed within different European climatic zones.
  The model will integrate specific measures relating to, for example, the local climate, disposition of the site, building form, embodied energy on construction materials, energy use and water efficiency.

Inherent to the main objectives are a number of key stages:

- Complete environmental surveys of a number of the client's existing buildings to benchmark current performance.

- Develop the generic concept model.

- Apply the generic model to the concept design of four real and distinct prototype buildings in Europe.

- Monitor the construction and development of the four buildings.

Agree parameters for the assessment of the model and the four buildings and provide feedback to DHL and relevant bodies.

DESIGN STRATEGIES

The proposed generic concept model for DHL new stations must include as many low energy strategies as possible in order to enable the choice of the most appropriate measures related to the location of each building.

Over and above the measures needed to provide comfort in an energy efficient manner are those affecting energy consumption in construction generally. These measures apply regardless of climatic zone and they include embodied energy, renewable energy generation and the efficient and responsive management of energy systems.

The contribution of 'passive' comfort measures, that is those that exploit natural forces without recourse to mechanical and electrical systems, can make a considerable contribution if orchestrated effectively. Once a strategy for passive measures has been outlined, 'active' measures can be called upon to augment and enhance them so that reasonable comfort can be established throughout the year and during the day and night. The active measures include fans to assist natural air currents, cooling to lower temperatures when passive systems are inadequate, heating in the reverse situation, and artificial lighting.

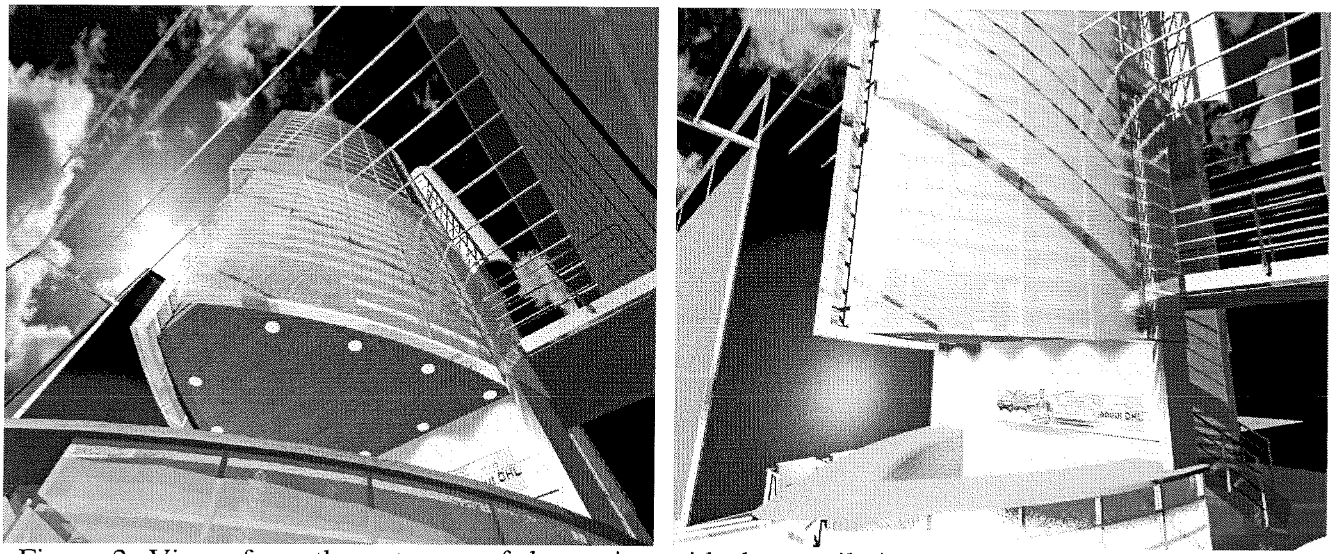

Figure 2: Views from the entrance of the station with the ventilation tower containing PV cells and a wind turbine.

Innovation for this project will also be provided with the station design and development taking into account the interactions and dependencies illustrated in the table 1. The figure identifies clearly the crucial topics of exterior space, technical installations, building fabric and transport, together with the respective sub-topics.

The project aims to establish a design approach for small buildings (2000m^2) that takes into account both energy embodied into the construction of the buildings and energy consumed in operation. Many buildings throughout Europe fall into the above category, both small mixed use office and industrial units. Generally these are basic low cost units where it is currently both uneconomic and unfashionable to spend more than the very minimum on their design.

Despite the perceived lack of 'glamour' associated with these buildings, the potential environmental improvement is far higher here than in single, high profile, headquarters buildings. Based upon the initial investigations of the project team it is believed that it may be possible to reduce the energy consumption of one of DHL typical 2000m^2 buildings by around 50%.

A. External environment.

- A.1. Air
  - Noise
  - Free air
    - Natural ventilation
    - Wind force
    - Energy content
  - Stack effect
    - Solar energy, diffuse radiation
    - Solar energy, direct radiation
- A.2. Soil
  - Aquifer
    - Heat storage
    - Cold storage
  - Groundwater
    - Cold energy
    - Heat energy
  - Earth/rock
    - Geothermal cooling
    - Heat energy
- A.3. Water surfaces
  - Lake
    - Pump water or grey water
    - Heat energy
    - Cold energy
  - River
    - Pump water or grey water
    - Heat energy
    - Cold energy
- A.4. Natural light/solar rays
  - Orientation
    - Light reflection
    - Avoid glare
    - Avoid overheating
  - Blinds/solar protection
    - Shading devices
    - Avoid glare
    - Avoid overheating
  - Lightshelves

B. Technical installations.

- B.1. Heat Energy
  - Direct
    - District heating
    - Boiler (gas, oil, biogas, coal...)
    - Electrode boiler (with storage)
  - Indirect
    - Active solar technology
    - Combined heat and power plant (CHP)
    - Heat pump (absorber, solar bore holes)
    - Flue heat exchanger
- B.2. Cooling energy
  - Direct
    - Electrically driven chiller
    - Absorption chiller
    - Gas-motor driven chiller
    - Cooling towers (free cooling)
    - Tandem systems
  - Indirect
    - Cold storage in building
    - Cold storage in terrain
    - Bore holes
- B.3. Electrical energy
  - Mains supply
    - Commercial power supply utilities
  - Selfsupply
    - Combined heat and power plant (micro CHP)
    - Emergency generator
    - Photovoltaic
    - Tandem system
    - Wind generator
- B.4. Water
  - Pure water
  - Public supply (drinking, cooling, flushing)
  - Greywater
    - Waste water (condenser water, flushing)
  - Rainwater
    - Flushing, cleaning, cooling
- B.5. Building management system (BMS)
  - Comfort
    - Lighting
    - Temperature
    - Fresh air
    - Movement detectors
  - Energy consumption
    - Maintenance
    - Heating
    - Water

C. Building fabric.

- C.1. Façade and roof
  - Thermal transmission
  - Insulating material
  - Photovoltaic
  - Absorber surface
  - Storage masses
  - Planted surfaces
  - Rainwater
  - Daylight elements
  - Collectors
  - Condensation control
- C.2. Construction
  - Storage masses
  - Passive solar absorber
  - Heat exchanger elements
  - Night cooling by outside air
- C.3. Atria
  - Green zones
  - Evaporative cooling
  - Passive solar energy
  - Heat buffer
  - Thermal chimney
  - Minimise heat losses
  - Transitional space
- C.4. Maintenance
  - Space and structure polyvalence
  - Easy to repair and replace
  - Easy to clean
- C.5. Materials
  - Local sources
  - Non-toxic materials
  - Recycled
  - Re-used
  - Timbers from managed sou
  - Life cycle
  - Embodied energy
  - Compatibility

D. Transport

- Materials
- Electrical vehicles
- Public transport
- Relevance of location

Table 1: List of potential strategies interacting in the design process

The benefit obtained by DHL alone developing and adopting the proposed approach could be a saving of around 30 million kWhrs of electrical energy and 50kWhrs of gas per year, with an associated reduction in CO_2 of 30 million kg per year.

Effective publicity of the anticipated success and achievements of the project should, it is believed by the team, vastly increase the awareness of European society of the failings and limitations of current strategies. Beyond this it is hoped that the team will to contribute to the available body of knowledge relating to this type of building.

Assessment of energy consumption will be made under the main headings of:-

- Space heating
- Ventilation energy
- Cooling
- Hot water service
- Internal lighting
- External lighting
- Small power
- Miscellaneous (lifts, catering, drainage pumps etc).

Where appropriate a zero value would be entered, and where perhaps an energy saving feature is incorporated into the design the predicted benefit would be calculated and recorded. The design concept will also take into account the embodied energy in the design options.

Energy consumption will be broken down into the various fuels, such as electricity, oil and gas.

Actual Performance

It is intended that each of the four prototype buildings will be monitored for a period of two years, and fuel consumption together with the performance of energy saving equipment monitored.
In order to give an indication of potential energy savings, figures are given below based on information from four of the client's (participant's) existing buildings in the UK.

Given the projected increase to 357 stations throughout Europe by 2004, if the team can achieve a 50% saving in electricity and gas the projected savings would be:

Gas saving	30 million kWhr/year
Electricity saving	50 million kWhr/year
Water saving	70,000 m^3/year

CONCLUSION

Art & Build, Roger Preston & Partners and ECD are going to conceive new stations for DHL. Solutions have to be found to create low-energy station all across Europe in relation to the local climate conditions.

The aim of the project team is to combine DHL's corporate image with minimum impact on the environment and at the same time maintaining confort conditions. Considerable research and input is needed to gather relevant data and knowledge, and to develop a design technique that is appropriate, a good predictor of environmental impact, applicable throughout the EU, and quickly and efficiently applied to projects. It is anticipated that the payback will be achieved in 7 to 10 years.