

CFC	- Continuous Function Chart
DALI	- Digitally Addressable Light Interface
FBD	- Function Block Diagram
HVAC	- Heating, Ventilation and Air-Conditioning
IL	- Instruction List
LD	- Ladder Diagram
SFC	- Sequential Function Chart
ST	- Structured Text

Abbreviations

Building automation in Fairland office development

By H du Preez, SAM

Proactive and innovative thinking has always kept one ahead of competitors. This is the approach First National Bank (FNB) used when deciding to conserve energy, by using a building management system in their Fairland building. With South Africa being in an energy crisis and considering the current economic situation, it is imperative to find ways to save electricity – and this involves a properly designed control and automation system.

The development of a building to house WesBank and certain FNB consumer divisions, comprising two levels of 64 000 m², a 1 600-car super basement; two separate office buildings of three floors, each totalling 63 000 m²; a shared facilities building; and related external and site works - is no mean feat. The building is an example of best-of-breed, environmentally friendly development. The project is described in *Table 1*.

The environmental commitment began with the digging of the foundations of the project. It took a year to dig the foundations but soil was not moved from the site. Instead it was dispersed around the site and used in some of the landscaping. An on-site concrete batching plant meant that trucks were making shorter trips and therefore using less fuel.

Several measures have been taken to ensure that, once completed, the building is super-energy efficient. The lighting management is completely automated using building automation products. The parties involved were: Claassen Auret Incorporated the consulting engineers on this project; A to Z Electrical the main electrical

- 90% of the electrical energy consumed in a building is for HVAC and lighting.
- Proper energy management requires thorough control and automation strategies.
- Building management systems offer significant opportunities for intelligent management of energy usage.

Take note



contractor; Systems Automation & Management (SAM) as the system integrator for the lighting control in this particular project.

Control architecture

As the building is diamond shaped, it was decided to divide each floor into quadrants and a shared facilities area. The controllers were distributed into the twenty five areas where DALI buses radiate from the controller into the areas. Light fittings and sensors were placed into position and plugged into the nearest DALI bus connection.

Twenty five CX9000 Embedded PCs managing the entire DALI Bus (Digitally Addressable Light Interface) through a hundred and fifty

KL6811 DALI master terminals. With eight hundred SmartSpot sensors acquiring information such as light intensity and occupancy, every SmartSpot sensor controls approximately four lights which surround the sensor. This lighting solution is used to control approximately four thousand dimmable fluorescent lights in an area consisting of seventy meeting rooms and twenty three open office areas.

Meeting and presentation rooms

Throughout the building, meeting and presentation rooms are controlled via EnOcean switching technology. The KL6023 terminal receives the wireless switch signals, to control the selected lighting



scene in each meeting or presentation room. The KL6023 can receive signals from the wireless, battery-less switches from up to 30 m away. The KL6023 can be situated up to 300 m away from the controller.

The presentation rooms also allow for integration with the Audio/Video solutions, so that the lights would automatically adapt according to the selected AV mode. In the shared facilities area, large function venues can be split into separately controlled lighting zones,

or simply joined into one large zone. In the joined mode, all the EnOcean switches can operate the system in parallel. In separate zone mode, the switches only operate their allocated areas.

Comfort lighting

The SmartSpot sensors not only detect motion control but also light intensity. We have used this feature to control the light intensity. If the surrounding light intensity changes, the intensity at desk level is kept constant. The intensity of lights is carefully controlled to ensure that the occupant does not notice the change.

Software

Writing software that was flexible enough to suit the installation and possible future alterations to the building, was undeniably an advantage. In some cases none of the five devices, four lights and one sensor, was on the same DALI bus. Alterations to the system can be made with very little or almost no change to the hardware. An open office area can be transformed into a meeting room or boardroom by simply reconfiguring the system.

The TwinCat PLC software provides various options of programming languages like IL (Instruction List), LD (Ladder Diagram), FBD/CFC (Function Block Diagram/ Continuous Function Chart), SFC (Sequential Function Chart) and ST (Structured Text). It was decided to use structured text as very little bitwise programming, and lots of movement of data and data structures were used. The higher level languages enabled easy data collection from sensors and switches, saving it into well defined selections and using it as needed.

Commissioning

Commissioning of four thousand plus devices, no matter how simple, is a gigantic undertaking. With a very effective cabling and DALI wiring structure implemented by A to Z Electrical, an auto-addressing TwinCAT programme was developed to speed up commissioning. This handled the DALI addressing of the system, thus very little configuration remained to be done.

The visualisation feature of the TwinCat software provides a quick and easy way to interface with a PLC program. Visualisations were used with the auto-addressing programme in the commissioning phase.

The KS2000 software provides features for commissioning and managing installations. This includes running queries like lamp failures, groups, add to group, assign address, scenes, system failure level, and light status, fade time, fade rate, etc.

Emergency lighting

At night, in conditions of low visibility or in case of an emergency, there are lights that are powered from a UPS. These lights function as normal but when the lights switch off, these stay on and remain on even during a power outage.

Energy saving

Two thirds of all energy consumed in an average office building is electricity. HVAC and lighting account for 90% of this.

It was proposed that the system integrates with the HVAC building management system. The occupancy detection can be passed onto the HVAC controller, so that only occupied rooms and areas can be air-conditioned or heated. This can substantially save energy and ensure a green building.

The dimming of the Osram lights will not have any effect on the life of the fluorescent lamp. When used in conjunction with a light management system the devices offer a potential energy saving of

Table 1: Fairland fast facts.

Contract investment	R800 M.
Number of employees	5 000.
Number of floors	Three office levels, two basement levels.
Total space	150 000 m ² .
Size of WesBank office space	Large enough to house the Ellis Park Stadium.
Size of FNB office space	Large enough to house the Wanderers Stadium.
Corporate kitchen	Largest corporate kitchen in Southern Africa.
Daily catering	Three sittings a day – feeding over 1 500 employees per lunch sitting.
Use of colour	Based on concept of the four seasons so that the building blends into the surrounding environment.
Glass	Over 1 ha of glass has been used throughout the entire building.
Concrete	To maintain the building programme, concrete was poured at a rate almost double the South African standard.
Cranes	During peak building operations, more than eight tower cranes were based on site, the highest number ever used on a commercial development. However, this has since been eclipsed by stadium construction in South Africa.
Sunscreen	1,4 ha.
Data cabling	20 km of data cabling runs through the building.
Circumference	2km around the perimeter of the building.
Length of building	Almost 500 metres.
Bricklaying milestones	At the peak of the building operation, over 50 000 bricks were laid a day.
Generators	Six generators on site.

up to 70% for daylight-dependent lighting applications with presence mode. In the open office areas, light management is implemented purely on time and occupancy information, no switches are used. When the specific time has elapsed the lights will dim down before switching off. This is to alert any occupant that the switching off of lights is imminent. If the sensor still detects no activity, the lights will switch off. During the on mode the lights will dim and control the light intensity at desk level.

Conclusion

The completion of the project both in time and budget convinced many that the approach taken was a correct. FNB has a building management system which not only creates pride in the working environment but contributes to the maintaining of a greener planet.

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Hercu du Preez started at SAM in 2006. He worked on software development and commissioning of Beckhoff PLCs to control the lighting at the Fairland building. He



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About the author