Greening Infrastructure Programmes in South Africa

Case Study 2: Health Care Infrastructure

DBSA 2011 Knowledge Week
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CSIR Built Environment : Building Science and Technology
Health system

OBJECTIVES

- Responsive
- Fair

SYSTEM PLATFORM

- Health wellbeing
- Service delivery (at appropriate level, in/ outside fixed service platform)
- Resources (people, buildings, equipment, drugs, supplies)
- Stewardship (oversight, managing resources, powers, expectations)
- Financing (raising, pooling, allocating revenues)

Public sector health estate
- ±3 900 PHC facilities
- ±500 hospitals
- ±100 000 beds
- ±R200bn current replacement value
InKosi Albert Luthuli Hospital, Durban, KwaZulu-Natal
Architects: FGG
Tomorrow’s healthcare environment

- Healthcare infrastructure in South Africa
  - Legacy estate – poor condition, location (?), functionality
  - Incremental replacement/ growth
  - Refurbishment requirement

- Drivers for change
  - Health service transformation – policy, NHI, PHC reengineering...
  - Population – growth, distribution, migration...
  - Disease profile – SA’s triple burden of disease, HIV/ TB...
  - Technology – medical, IT, communications, engineering systems...
  - Environmental – climate change, sustainability
  - Efficiency – people, funding...

- Health system / facilities
  - Complex, many interacting and interrelated variables
  - Function paramount
“It may seem a strange principal to enunciate as the very first requirement of a hospital, is that it should do the sick no harm.”

“In attempting to arrive at the truth, I have applied everywhere for information but scarcely in an instance have I been able to obtain hospital records fit for any purpose of comparison”

Florence Nightingale. Notes on Hospitals, 1863

“First we shape our buildings, then they shape us”

Winston Churchill, 1943
IUSS project
National Department of Health – 2010 to …

NDoH Infrastructure Unit
Dr M Shaker

CSIR
Health facility norms and standards, guidelines, area modeling

CSIR
Cost modeling

DBSA
Rapid project contract assessment

NDoH
Project management information system

DBSA
Projects monitoring and oversight unit
IUSS Project: Focus Area 1 - Health Care Facility Norms & Standards

First draft documents to end March 2012

**Work Package Progress Dashboard**

**Work completed**
- Whole hospital
- Hospital departments
- Cross cutting
- Primary health care
- Area norms
- Cost norms
- Strategic planning
- Briefing
- Maintenance and upgrading
- Tomorrows healthcare environments
- Process support

**Notes**
1. Progress shown for work package is weighted percentage progress of all work packets in each package set
2. Percentage of total work shows the proportion of work for 2011/12 for each package set of total work commitment
3. Contribution to progress shows the proportion of total work contributed by progress for each package set
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<tr>
<th>Category</th>
<th>Departments</th>
<th>Manual Details</th>
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<tr>
<td>Health service context / policy framework / NHI</td>
<td>Department 1</td>
<td>Policy &amp; service context manual</td>
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<td>General (whole hospital) design principles</td>
<td>Department 1</td>
<td>Planning &amp; design manual</td>
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<td>Department 2</td>
<td>Planning &amp; design manual</td>
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<td></td>
<td>Department 4</td>
<td>Planning &amp; design manual</td>
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<tr>
<td>Room data, layouts</td>
<td>Department 1</td>
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<td>Cross cutting – Infection prevention and control</td>
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<td>Cross cutting – Engineering services</td>
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<td>Cross cutting – Environment and sustainability</td>
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<td>Cross cutting – Fire / other regulations</td>
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<td>Health care facilities futures study</td>
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IUSS norms and standards

Environment and sustainability

- IUSS task group – public and private sector, health & technical
- South African / international best practice for sustainable healthcare facilities planning, design and operation
- Performance measurement and benchmarking
- Lifecycle guidelines
  - Strategic planning
  - Project planning and briefing
    - Performance targets
  - Design
  - Construction
  - Operational management
  - Retrofitting and refurbishment
  - Disposal
- Case studies
• Environmental impact of NHS health estate
  • 893 000 tonnes of carbon emissions per year – just under one third of total emissions of public buildings
  • 125 MWh of energy, half of which is electricity
  • £563 million per year
  
  Better building design could save 25% of energy costs
  
  South African health estate equivalent?

• Directives
  • The Climate Change Act 2008 focuses on reducing carbon emissions by 80% between 1990 and 2050
  • UK budget statement from 2008 requires all public buildings to aim to be zero carbon by 2018. All new buildings to achieve this from 2019 onwards
South Africa

Estimate of current energy cost and potential savings

- Total SA beds (public and private, 2010): 126,000
- Assume occupancy: 80%
- Total occupied beds: 101,000
- Assume energy consumption / bed day: 95 kWh
- Estimated energy consumption / year: 3,495,400 mWh
- Estimated energy cost / year: R2.4 bn
- Potential operational cost saving with 25% energy saving (increasing with tariff increases): R600 m/year

* Based on R0.68/kWh; excludes peak load and administration charges
Case study – environmentally conscious design
Khoo Teck Puat hospital, Singapore
Offering a comprehensive range of medical and healthcare services, Khoo Teck Puat Hospital is a 550-bed hospital with integrated approaches to environmental sustainability, climate control, patient care, disease and disaster management.
Distinct Blocks for Different Functions
a. Specialist Outpatient Clinics
b. Podium (Diagnostic & Treatment)
c. Private Ward Tower
d. Subsidised Ward Tower
TOTAL BUILDING PERFORMANCE

Passive and Active Systems

Form & Orientation responsive to sun-path

Shaded Internal Courtyard & Multiple Landscaped Decks reduced heat island effect

Permeable Form enhanced natural airflow and daylight access

Self-Shading Geometry reduced façade solar gains
TOTAL BUILDING PERFORMANCE

Passive Design – Form and Geometry

SOLAR EXPOSURE OF FACADES
ETTV: Envelope Thermal Transfer Value

It is the measure of thermal transfer from the facade into the building interior. Baseline ETTV is 50 W/m².K

KTPH ETTV: 38.2 W/m².K

23.6% less heat gain through facades over current standard.

1. Critically designed external sunshades on the critical east and west facade.
2. High performance glazing

PASSIVE STRATEGIES
KHOO TECK PUAT HOSPITAL @ YISHUN
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HIGH RISE GREENING FOR A HEALING ENVIRONMENT

*Planter boxes* for green respite in every subsidized ward

Bringing a garden right outside the window

PASSIVE STRATEGIES

*KHOO TECK PUAT HOSPITAL @ YISHUN*
TOTAL BUILDING PERFORMANCE

Passive Design – Airflow and Natural Ventilation

Impact on Ward Design and Patient Comfort

Case 1: Floor to 1800mm high solid partitions

Case 2: 1800mm high solid partitions with 300mm gap from floor

Case 3: Floor to ceiling vertical slat-type partitions with 50% free area

Case 4: 1800mm high open-louvred partitions with 300mm gap from floor
Energy efficiency

Reduction from 3.26 MWh/month-bed to New AH@Yishun 1.63 MWh/month-bed

Achieve target yet presenting a high comfort, high performance, aesthetic hospital building

- Enhanced daylight design, reduced gloominess.
- Enhanced thermal comfort with personal control.
- Enhanced air quality through ventilation and materials usage.
- Enhanced aural comfort by suitable noise control design.
- Enhanced spatial quality through visual design.
Khoo Teck Puat Hospital  
*Total building performance*

**Energy efficiency**

1. **Lighting:** Integrated daylight design  
   - Energy efficient lamps  
   - Lighting design  
   - **Save 40%**  
   - **Total Save 11%**

2. **Air-con:** Absorption chillers with CHP  
   - VSD and efficient components  
   - Cleaning and maintenance features  
   - High performance facades  
   - Desiccant cooling  
   - **Save 59%**  
   - **Total Save 38%**

3. **Others:** Heat recovery for hot water  
   - Energy efficient transportation  
   - Solar PV (optional)  
   - **Save 28%**  
   - **Total Save 3%**

**Global Saving 52%**
Deventer – Deventer ziekenhuis
Architects, Engineers, Contractors: de Jong, Gortemaker, Algra
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Architects, Engineers, Contractors: de Jong, Gortemaker, Algra
Deventer ziekenhuis

- 380 bed teaching hospital - 55,000m², 145m²/bed
- Completed 2007
- EU Hospitals project demonstration facility
- Energy efficiency focus
  - Emissions (CO₂, SOₓ, NOₓ) 69% below average Dutch hospital
  - Annual energy cost savings – payback 13.4 years (8.7 with EU incentives)
  - Heating 73% below average; cooling 50% below average
  - Electricity 16% below average
  - ‘Green’ planted roof over 13,300m² out-patient – view from overlooking blocks
- Patient care focus
  - Single, double, triple patient rooms – away from high traffic areas, daylight, views, operable windows
The hospital has a compact structure which allows for good orientation and short walking routes. The teardrop form also has certain technical advantages such as reduced wind influence, improved direct sunlight and improved energy yield.
Safer hospitals – airborne infection control

*Incidence of TB in high-burden TB countries: 2008*

- Burden of disease impacting on infrastructure design
  - *South Africa has the highest incidence rate of TB in the world*
  - 10,5m (2010) HIV prevalence in SA
  - HIV / TB co-infection rate of over 70%
  - 406 000 notified TB cases in SA (2009)
Global Fund DR-TB Infrastructure Project
Reducing airborne cross infection

Global Fund Project statistics

- 9 sites (of 22 MDR facilities in SA)
- 400 new long term care beds

Project deliverables

- Safer facilities for patients and staff
- Guidelines for natural ventilation for airborne IPC
- Sustainable solution
- Capacity development
Modimolle XDR-TB unit

Future 100 beds

Staff residential zone

Existing hospital – new post intensive phase

New 62 bed intensive phase

Out-patients, visitors and clinical support

Modimolle XDR-TB unit
Regulations and targets

- **SANS 10400-XA**
  - Part X – Environmental sustainability
  - Part XA – Energy in buildings

- Building should be designed to reduce energy usage
  - *All buildings shall obtain at least 50% of water heating from sources other than electrical resistance heating*
  - *Design orientation, floors, walls, fenestration, roof assembly*
  - *Design to meet set energy consumption values for occupancy types - health buildings excluded; however need to comply with deemed to satisfy design principles or rational design*
IUSS way forward

*Greening health infrastructure in SA*

- Significant MTEF public sector investment in new and upgrade health capital projects
  - Equitable share – about R4bn/annum
  - Total: Over R10bn/year over MTEF
- Private health sector making it core business
  - New and retrofit projects
- IUSS N&S guidelines, including environment and sustainability
  - Input into process welcomed
  - Benchmarking website being developed
  - Case studies
  - Design targets should be included in all new health project briefing
  - Retrofit project guidelines
Thank you

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